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EUROPEAN ORGANIZATION FOR EXPERIMENTAL PHOTOGRAMMETRIC RESEARCH

TEST ON ORTHOPHOTO AND STEREO-ORTHOPHOTO ACCURACY

Report by Guy Ducher

Official Publication N° 25

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Test on Orthophoto and Stereo-Orthophoto Accuracy

(with 16 Figures and 44 Tables)

Report by Guy Ducher

Table of Contents

page

Abstract, Résumé, Zusammenfassung 15

1 Introduction 30

2 Objectives 31

3 Project description 32

3.1 Preparation of the test 32

3.1.1 Test area 32

3.1.2 Aerial surveys 32

3.1.3 Preparation of control 34

3.1.4 Preparation of contours 35

3.2 Distribution of tasks 36

3.2.1 Operative and assessing centers 36

3.2.2 Combination of instruments 38

3.2.3 Pointing precision 39

3.3 Products obtained 45

3.3.1 Tables of orthophotos and stereo-orthophotos 45

3.3.2 Measurements 46

4 Planimetric assessment 53

4.1 Plane transformations 53

4.1.1 Four assessing methods 53

4.1.2 Similarity on two points 53

4.1.3 Similarity on the whole GCPs 56

4.1.4 Affinity on GCPs 59

4.1.5 Similarity on the whole points 60

4.1.6 Comparison of assessing methods 66

4.1.7 Gaussian distribution of residuals 73

page

4.2 Impact of the type of points 78
4.2.1 Targetted points 78
4.2.2 Targetted control points 78
4.2.3 Points from aerial surveys at 1 : 7000 80
4.2.4 Points from aerial surveys at 1 : 30 000 80
4.3 Impact of the location of points 80
4.3.1 Near-nadir points 80
4.3.2 Targetted near-nadir points 85
4.3.3 Points near to the corners 85
4.3.4 Nadir half of a pair 87
4.3.5 Neighbouring points 87
4.3.6 Near-nadir neighbouring points 90
4.3.7 Type of relief 90
5 Altimetric assessment 93
5.1 Setting up stereo-orthophoto-pairs 93
5.1.1 Two assessing methods 93
5.1.2 Comparison of methods 94
5.2 Impact of the type of points 96
5.2.1 Targetted points 96
5.2.2 Points from aerial survey at 1 : 7000 98
5.2.3 Points from aerial survey at 1 : 30 000 98
5.3 Impact of the location of points 100
5.3.1 Near-nadir points 100
5.3.2 Targetted near-nadir points 100
5.3.3 Points near to the corners 100
5.3.4 Nadir half of a pair 104
5.3.5 Neighbouring points 104
5.3.6 Near-nadir neighbouring points 106
5.3.7 Type of relief 106

page

6 Arrangements of orthophotos and stereomates 106
7 Assessment of D.T.M. 109
7.1 Parallaxes between orthophotos 109
7.2 Comparison with the heighting and x accuracies 111
8 General results 114
8.1 Absolute results 114
8.2 Relative results 116
8.3 Practical formulae 121
8.3.1 A formula for planimetric accuracy 121
8.3.2 Comments and examples of application of the planimetric formula 122
8.3.3 Formulae for height accuracy 127
8.3.4 Comments and examples of application of the altimetric formula 129
9 Conclusions 133
10 Appendices 137
10.1 References 137
10.2 Information on control and check points 139
10.3 Information on the test area 140
10.4 List of orthophotos and stereo-orthophotos 140
10.5 Individual forms from each orthophotograph 151
10.6 List of co-ordinate residuals 183
10.6.1 List of planimetric residuals 183
10.6.2 List of altimetric residuals 204
10.7 List of the orthophoto working group 221
10.7.1 List of operative centers 221
10.7.2 List of members and associate members 222
10.8 List of abbreviations and acronyms 224
10.9 Acknowledgements 226

A B S T R A C T

A test has been conducted by OEEPE which aimed at obtaining information on the impact of five main parameters on the metrical accuracy of typical orthophotos and stereo-orthophotographs. These parameters consist of the scale of the aerial survey to rectify, that of the survey from which the D.T.M is derived, that of the orthophoto, the slit width and the scanning direction.

Three scales were considered for aerial surveys and D.T.Ms(1:60 K, 1:30 K and 1:16 K-scale) and two for output products (1:25 K and 1:5 K-scale).

The test area covered a full frame at 1:30 K-scale and had a wide range of relief and slopes. It was fitted with as many as 271 fixed points, including 170 natural features and 101 signalised points, suited to 1:16 K and 1:30 K-scale surveys. Seven producing centers delivered a total number of 90 products,out of which 59 were assessed, analyzed and retained for their results, comprising 29 orthophotos and 30 stereomates. Four assessing centers,using six different instruments, carried out a total of 5657 pointings, delivering 2243 average measurements, out of which 230 were rejected through seven iterative cycles, due to excessive residuals, higher than 2.58 times the value of the related r.m.s.e. As a result 2013 measurements were kept.

After assessing the pointing precision, the planimetric and heighting accuracies were considered.

Regarding planimetry, four plane transformations were compared that converted orthophoto co-ordinates of each product into ground co-ordinates and comprised three similarities and one affinity. Similarities were respectively based on two remote points, on the GCPs used in the rectifying stage (six on the average), and on the whole fixed points available (GCPs and check points).

When using a two-point base, extrapolation outside this base should not take place. Better results are obviously obtained when many more points are used : the improvement reaches 10 % by adjusting the transformation on 7 GCPs, 15 % by using 10 to 12 known points and 20 % with 20 points.

The accuracy at GCPs used in orthophoto production is better, by 20 % to 50 %.

Regarding altimetry, two assessing methods were used; the first one, based on two points displaying the largest elevation difference, the second one, based on the whole fixed points available in each stereo-orthophoto pair (GCPs and check points).

The second one delivers better results by 21 % on the average.

Targetted points were found to have an improved accuracy by up to 35 % in planimetry and 40 % in altimetry. Emphasis has thus to be laid on the importance of point identification, interpretability of detail, easiness of pointing, all the more as some examples show that identification errors can sometimes overpass the pointing errors by many times.

Near-nadir points benefit from improvements in accuracy of 21 % in planimetry and 31 % in height, while points near to corners are conversely degraded, but only by 5 %; as a result the nadir-half of a pair is 8 % better than the other one, so that it should be recommended to rectify the whole nadir area of each photograph, especially when blocks of several strips have to be rectified.

Neighbouring points display great improvements as regards their relative accuracy, reaching 27 % in planimetric differences and 44 % in elevation differences. Such a high homogeneity makes stereo-orthophotos best suited to map revision and civil engineering projects.

The whole improvements have a cumulative effect at points which own several properties and benefit from an addition of improvements, such as e-g targetted GCPs, near-nadir targetted points, or near-nadir neighbouring points.

The value of the D.T.M actually used in the rectification stage has been approached by assessing orthophoto-pairs from both frames of an aerial pair. The heighting accuracy achievable from stereo-orthophotos is generaly better than that of the original D.T.M, by a factor ranging from 0.8 to 3.4 times, and amounts to 3.7 x H/10 000 on the average (H being the altitude of the rectified survey).

Some absolute results show that high levels of accuracy can be reached, such as those displaying at natural points a r.m.s.e of 50 microns, resultant vector in x,y at photo scale,or of 1.3 x H/10 000 in height. It was demonstrated that off-line differential rectification of an aerial pair at 1:16 K-scale into a stereo-orthophoto pair at 1:5 K-scale, using a D.T.M derived from aerial surveys at 1:60 K-scale could ultimately provide as good an accuracy as 0.60 m (r.m.s.e) in height at targetted points (i.e 2.5 x H/10 000), 0.90 m (r.m.s.e) for x,y resultant vector, also at targetted points (i.e 56 microns at photo scale).
But large discrepancies are noted between absolute results, as a function of the input parameters, since many products resulted from an off-limit use of small-scale data, as the test was also specially designed to get a better acquaintance with the impact of scale parameters, over a wide range.

Discrepancies resulted also from the assessing method, showing variations of up to 30 % in results. Discrepancies were finally noted between similar products from the same center, showing that it is not so easy a task to reach the top level permitted by the data quality, probably requiring very stringent quality control at each stage.

However general formulae have been established, involving only scales of input, DTM and output data, disregarding the slit width which did not appear very significant in this test.

They apply to the whole products carried out in this test with an average precision of ± 20 % in planimetry and ± 35 % in height. (1). Though approximate, they can be used as guidelines to choose the most efficient and cost-saving scales complying with a required accuracy for the orthophoto.

They are expressed as follows :

$$e_{xy}^2 = 0.75 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.20 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

$$e_{z_x}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.10 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

$$e_{z_y}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.50 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

in which :

e_{xy} = r.m.s.e in planimetry (resultant vector) in meters, on the ground, on natural points (including some targetted points), of the resulting orthophoto, off-line scanned in whatever x or y direction .

e_{z_x} , e_{z_y} = r.m.s.e in height, in meters, on the ground, on natural points (including some targetted points) of stereo-orthophoto-pairs off-line scanned resp. in the x and y directions.

(1) This term "average precision" means that two-thirds of the orthophotos carried out using similar parameters, have a r.m.s.e error differing from the e value computed by these formulae, by less than ± 20 % in planimetry and ± 35 % in height. Therefore two-thirds of measured r.m.s.e in planimetry are ranging from 0.8 e_{xy} to 1.2 e_{xy}.

PHOTO = 1 : scale of the aerial survey (ranging from 16 K to 60 K) to be rectified.

DTM = 1 : scale of the DTM, i-e of the survey which was plotted into contours and gave rise to the DTM, (ranging from 16 K to 60 K).

ORTHO = 1 : scale of the orthophoto and stereo-orthophoto (ranging from 5 K to 25 K).

The scale ranges within which these formulae are applicable, can be somewhat extended towards both larger and smaller scales, as shown by some examples. As a result, when deriving the D.T.M from the same survey as that to be orthophotoprinted, enlargements of up to 4.5 or 5.0 times are allowed for the orthophoto, while complying with well established map accuracy standards.

Conversely, each time a D.T.M from a scale smaller than that of the survey to rectify is available, it is strongly recommended to use this one, since it could be more cost-saving. Examples are given showing that a D.T.M derived from a scale smaller than that of the survey to rectify by a factor of 2, 3 or 4 times, allows enlargements of as much as resp. 3.5 times, 3.0 or 2.3 times for the orthophoto.

Existing height databases and/or D.T.M derived from space surveys should therefore be taken into account whenever possible, when off-line differentially rectifying a given survey.

Fully digital processing methods, which should still improve the end-product quality, will be an incentive for further developing the stereo-orthophoto technique. Appropriate tests at scales smaller and larger than those used in the present OEEPE test, could be conducted later on, in order to assess the actual possibilities evolving from CCD cameras and digital rectification.

R E S U M E

L'OEEPE a effectué un essai visant à étudier l'influence de cinq facteurs essentiels sur la précision métrique des orthophotos et stéréo- orthophotographies.

Il s'agit de l'échelle du levé aérien à orthophotographier, de celle du levé dont on a tiré le M.N.T, de l'échelle de l'orthophoto, de la longueur de la fente et du sens de balayage.

On a pris en compte trois échelles pour les levés aériens et les M.N.T (1 : 60 K et 1 : 30 K et 1 : 16 K) et deux échelles pour les produits en sortie (1 : 25 K et 1 : 5 K).

Le polygone d'essai concernait un cliché entier à l'échelle de 1 : 30 K, et comportait une gamme étendue de reliefs et de pentes. Il était équipé d'un nombre élevé de points de coordonnées connues, 271 en tout, répartis en 170 points naturels et 101 points prébalisés qui avaient été établis en vue des levés aériens au 1 : 16 K et au 1 : 30 K. On a obtenu au total 90 produits, fournis par sept centres de production, et dont on a pu évaluer, analyser et conserver 59 d'entre eux, répartis en 29 orthophotos et 30 stéréo-associés. L'évaluation a été faite par quatre centres utilisant six appareils de mesures différents; au total 5657 pointés ont été effectués, fournissant 2243 mesures moyennées, dont on a dû éliminer 230 d'entre elles au cours de sept itérations, pour résidus excessifs, supérieurs à 2,58 fois la valeur de l'e.m.q. résultante. Finalement on a conservé 2013 mesures.

Une fois estimée la précision de pointé, on a étudié les précisions plani et altimétriques.

En ce qui concerne la planimétrie, on a utilisé comparativement quatre transformations planes pour convertir les coordonnées-orthophoto de chaque produit en coordonnées-terrain.

Parmi elles, figuraient trois similitudes et une affinité. Le calcul des similitudes a été effectué en utilisant successivement deux points éloignés, puis l'ensemble des points d'appui ayant servi à produire l'orthophoto (six en moyenne) et enfin l'ensemble des points connus (points d'appui et points de vérification).

Lorsque l'on se base sur deux points seulement, il faut éviter toute mesure en extrapolation sur ces points. On obtient naturellement de meilleurs résultats en se basant sur un plus grand nombre de points destinés à établir la similitude; c'est ainsi que l'amélioration atteint 10 % lorsque la similitude est compensée sur 7 points d'appui, 15 % en faisant la compensation sur 10 ou 12 points connus, et 20 % avec 20 points.

On constate que la précision aux points ayant servi d'appui pour produire l'orthophoto est de 20 % à 50 % meilleure.

En ce qui concerne l'altimétrie, on a utilisé deux méthodes d'évaluation; la première étant basée sur les deux points présentant la dénivelée maximale, la seconde sur l'ensemble des points connus disponibles dans chaque couple stéréo-orthophoto (points d'appui et points de vérification). Les résultats obtenus par la seconde méthode sont de 21 % meilleurs en moyenne.

On a constaté que les points pré-balisés présentaient de meilleures précisions, l'amélioration allant jusqu'à 35 % en planimétrie et 40 % en altimétrie. Aussi faut-il mettre l'accent sur l'importance de la photo-identification d'un point, sur celle de la facilité de pointé et d'interprétation des détails, d'autant que certains exemples montrent que les erreurs d'identification peuvent quelquefois dépasser de plusieurs fois les erreurs de pointé.

Les points situés au voisinage du nadir ont une précision meilleure de 21% en planimétrie et 31% en altimétrie, tandis que les points situés dans les coins sont dégradés, mais de 5 % seulement. Il en résulte que la moitié nadirale d'un couple présente une amélioration de 8 % sur l'autre, ce qui incite à recommander de redresser en orthophoto l'ensemble de la zone entourant le nadir de chaque cliché successif, notamment lorsqu'il s'agit de redresser des blocs contenant plusieurs bandes de clichés.

On constate que la précision relative de deux points voisins est considérablement accrue : l'amélioration atteint 27 % sur la position planimétrique relative et 44 % sur la dénivelée. Cette forte homogénéité rend les stéréo-orthophotos tout à fait appropriées à la révision des cartes et aux projets de génie civil.

Toutes ces améliorations peuvent se cumuler. Les points qui possèdent plusieurs propriétés bénéficient ainsi de la somme des améliorations; c'est le cas par exemple de points d'appui pré-balisés, de points proches du nadir et pré-balisés ou de points voisins situés près du nadir.

On a pu obtenir une idée de la valeur du M.N.T. effectivement utilisé dans la phase de redressement, en évaluant les couples constitués des orthophotos des deux clichés d'un couple aérien. L'exactitude altimétrique accessible à partir de stéréo-orthophotos est généralement meilleure que celle du M.N.T. original, d'un facteur allant de 0,8 à 3,4 fois, et se situe en moyenne à 3,7 x H/10 000 (H étant la hauteur de vol des clichés à orthophotographier).

Quelques exemples montrent que l'on peut atteindre un haut niveau d'exactitude absolue. Il en est ainsi de ceux qui font état d'une e.m.q. (sur points naturels) de 50 microns pour le vecteur résultant x, y en coordonnées-cliché ou de 1,3 x H/10 000 en altimétrie. Il est établi que le redressement différentiel en

différé d'un couple aérien au 1 : 16 K en stéréo-orthophoto au 1 : 5 K, à l'aide d'un M.N.T. issu de levés aériens au 1 : 60 K peut finalement fournir une exactitude caractérisée par une e.m.q aussi bonne que 0,60 m en altimétrie en des points pré-balisés (soit 2,5 x H/10 000) ou 0,90 m sur le vecteur résultant x, y également en des points pré-balisés (soit 56 microns sur le cliché aérien). Mais on a pu remarquer d'importantes discordances dans les résultats absolus, en fonction de la valeur des paramètres introduits. Cela provient aussi de ce que l'on a réalisé de nombreux produits en dépassant les limites généralement admises de manière à faire jouer justement les paramètres d'échelle sur une plus grande amplitude et mieux en déterminer l'influence.

Les discordances résultent également de la méthode d'évaluation, faisant apparaître des variations allant jusqu'à 30 % sur les résultats. Mais on a pu aussi relever des discordances pour des produits similaires, réalisés par le même centre, mettant ainsi en évidence qu'il n'est pas si simple d'atteindre le plus haut niveau autorisé par la qualité des données et qu'il faut pour cela recourir à un strict contrôle de qualité à chaque phase.

On a toutefois pu établir des formules générales faisant seulement intervenir les échelles d'entrée, de sortie et celle du M.N.T., en négligeant la longueur de la fente dont l'influence n'est pas apparue très significative dans cet essai. La précision avec laquelle ces formules s'appliquent aux différents produits réalisés pour cet essai est de ± 20 % en moyenne en planimétrie et ± 35 % en moyenne en altimétrie(1). Quoiqu'approchées, ces formules peuvent donc servir de référence dans le choix des échelles les plus économiques et les mieux adaptées à des conditions de précision demandées sur l'orthophoto.

Ces formules sont les suivantes :

$$e_{xy}^2 = 0.75 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.20 \times \left(\frac{\text{MNT}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

$$e_{z_x}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.10 \times \left(\frac{\text{MNT}}{15\ 000}\right)^2 + 0.25 \times \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

$$e_{z_y}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.50 \times \left(\frac{\text{MNT}}{15\ 000}\right)^2 + 0.25 \times \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

où :

e_{xy} = e.m.q. planimétrique (vecteur résultant), en mètres sur le terrain, en des points naturels (comportant quelques points pré-balisés) d'une orthophoto réalisée en différé, par balayage dans un sens quelconque, x ou y.

(1) Le terme de "précision moyenne" signifie que les deux-tiers d'orthophotos réalisées avec des paramètres identiques ont une e.m.q. qui diffère de la valeur e, calculée d'après ces formules, de moins de ± 20 % en plani et ± 35 % en altimétrie. Par conséquent, les 2/3 des e.m.q. mesurées en plani sont comprises entre 0.8 e_{xy} et 1.2 e_{xy}.

e_{z_x}, e_{z_y} = e.m.q. altimétrique, en mètres sur le terrain, en des points naturels (comportant quelques points pré-balisés) d'une stéréo-orthophotographie, réalisée en différé par balayage respectivement en x et en y.

PHOTO = inverse de l'échelle du levé aérien à redresser (située en principe dans la gamme de 1 : 16 K à 1 : 60 K)

M.N.T. = inverse de l'échelle du M.N.T, c'est-à-dire de celle du levé qui a été restitué en courbes de niveau pour générer le M.N.T.(situé en principe dans la gamme de 1 : 16 K à 1 : 60 K).

ORTHO = inverse de l'échelle de l'ortho et de la stéréo-photo (située en principe dans la gamme de 1 : 5 K à 1 : 25 K).

Les gammes d'échelles à l'intérieur desquelles ces formules s'appliquent peuvent être quelque peu étendues vers les grandes échelles comme vers les petites, ainsi que l'ont montré quelques exemples. Il en résulte que par exemple, si le M.N.T. est extrait du même levé aérien à orthophotographier, on peut réaliser des orthophotos avec des agrandissements allant jusqu'à 4,5 à 5,0 fois, tout en restant dans les normes courantes de précision cartographique .

En revanche, chaque fois qu'un M.N.T issu d'une échelle inférieure à celle du levé à redresser est disponible, il est vivement recommandé de s'en servir, car il peut permettre de réduire les coûts. Les exemples fournis montrent qu'avec un M.N.T provenant d'une échelle deux, trois ou quatre fois plus petite que celle du levé à redresser, on peut encore aller jusqu'à des agrandissements respectivement de 3.5, 3.0 ou 2.3 fois pour l'orthophoto.

Il y a donc lieu de tenir compte de l'existence des bases de données altimétriques et/ou de la possibilité d'extraire le M.N.T de levés spatiaux, chaque fois que cela s'avère possible pour réaliser les orthophotos d'une prise de vue donnée.

Les méthodes entièrement numériques de traitement qui ne feront qu'améliorer la qualité du produit final, constitueront un stimulant pour un développement ultérieur de la technique stéréo-orthophotographique.

Il pourrait s'avérer intéressant de mener des essais dirigés vers des échelles supérieures et inférieures à celles de l'essai OEEPE actuel, pour évaluer les possibilités réelles résultant des méthodes numériques de traitement et des chambres de prises de vues à CCD.

ZUSAMMENFASSUNG

Die OEEPE führte einen Versuch durch mit dem Ziel, den Einfluß von fünf wesentlichen Parametern auf die metrische Genauigkeit von typischen Orthophotos und Stereoorthophotos zu untersuchen. Es handelt sich bei diesen Parametern um den Maßstab der Aufnahme, von welcher das entsprechende DGM abgeleitet wurde, den Maßstab des Orthophotos sowie um die Einflußgrößen Spaltlänge und Abtastrichtung.

Es wurden drei Maßstäbe für Luftaufnahmen und DGM (1:60 000, 1:30 000 sowie 1:16 000) und jeweils zwei Maßstäbe für Ausgabeprodukte (1:25 000 und 1:5 000) bei der Untersuchung berücksichtigt.

Das Versuchsfeld umfaßte ein volles Bildformat im Maßstab 1:30 000 und beinhaltete unterschiedliches Relief und Hangneigungen. Darüber hinaus war es mit 271 Festpunkten versehen, davon 170 natürliche Punkte und 101 signalisierte Punkte, die auf 1:16 000 und 1:30 000 Aufnahmemaßstäbe abgestimmt waren. Sieben beteiligte Stellen lieferten insgesamt 90 Ausgabeprodukte, von welchen 59 bewertet, analysiert und deren Ergebnisse gespeichert wurden, wobei es sich um 29 Orthophotos und 30 Stereopaare handelte. Von vier Auswertestellen wurden mit sechs verschiedenen Instrumenten insgesamt 5657 Punktmessungen durchgeführt, welche 2243 gemittelte Beobachtungen ergaben, von denen 230 im Verlauf von sieben Iterationen aufgrund zu großer Restfehler eliminiert werden mußten, die über den 2,58fachen Wert des dazugehörigen mittleren quadratischen Fehlers hinausgingen. Schließlich wurden 2013 Messungen beibehalten.

Nach erfolgter Bewertung der Einstellgenauigkeit wurden die Lage- und Höhengenauigkeiten untersucht.

Zur Beurteilung der Lagegenauigkeit wurden vier ebene Transformationen verglichen, wobei die Orthophoto-Koordinaten eines jeden Ausgabeproduktes in Geländekoordinaten umgewandelt wurden. Diese Umwandlungen beinhalteten drei Ähnlichkeitstransformationen und eine Affintransformation.

Die Ähnlichkeitstransformationen wurden jeweils auf der Grundlage zweier weit voneinander entfernten Punkte, der Gesamtheit der für die Herstellung des Orthophotos verwendeten Punkte (durchschnittlich 6 Punkte) sowie schließlich unter Verwendung aller verfügbaren Festpunkte (Paßpunkte und Kontrollpunkte) realisiert.

Bei Verwendung einer 2-Punkte Basis sollte eine Extrapolierung außerhalb dieser Basis nicht stattfinden. Bessere Ergebnisse lassen sich offensichtlich erzielen, wenn eine bedeutend größere Anzahl von Punkten benützt wird: das Ergebnis verbessert sich um 10 %, wenn sich die Transformation auf sieben Paßpunkte stützt, um 15 % auf der Basis von 10 bis 12 bekannten Punkten und um 20 % bei 20 Punkten.

Bei den in der Orthophotoproduktion verwendeten Paßpunkten ist die erzielte Genauigkeit größer, und zwar um 20 % bis 50 %.

Bei der Beurteilung der Höhenmessung gelangten zwei Verfahren zum Einsatz; bei dem einen Verfahren wurde die größte Höhendifferenz benützt, beim zweiten die Gesamtheit der in jedem Stereoorthophoto verfügbaren Festpunkte (Paßpunkte und Kontrollpunkte).
Das zweite lieferte um durchschnittlich 21 % bessere Ergebnisse.

Bei den signalisierten Punkten konnte eine um bis zu 35 % bessere Lagegenauigkeit und eine um bis zu 40 % bessere Höhengenauigkeit ermittelt werden. Besondere Beachtung muß deshalb der Bedeutung der Punktidentifizierung, der Detailinterpretierbarkeit und der Meßbarkeit der Punkte gewidmet werden, da einige Beispiele deutlich zeigen, daß Identifizierungsfehler manchmal die Einstellfehler um ein Vielfaches übertreffen.

Nadirnahe Punkte profitieren von einer Genauigkeitsverbesserung um 21 % in der Lage und um 31 % in der Höhe, wohingegen für die in den Eckenbereichen liegenden Punkte Genauigkeitsverluste hingenommen werden müssen, allerdings lediglich in einer Größenordnung von 5 %. Somit ist die Nadir-Hälfte eines Bildpaares um 8 % besser als der restliche Modellbereich, so daß eine Entzerrung des gesamten Nadirbereichs eines jeden Photos zu empfehlen ist, insbesondere dann, wenn Blöcke von mehreren Streifen zu entzerren sind.

Benachbarte Punkte zeigen große Verbesserungen in bezug auf ihre relative Genauigkeit, welche eine Größenordnung von 27 % bei den Lage- und von 44 % bei den Höhengenauigkeiten erreichen. Aufgrund dieser hohen Homogenität eignen sich Stereoorthophotos bestens für die Kartenfortführung und Ingenieuranwendungen.

All diese Verbesserungen haben kumulative Wirkungen an solchen Punkten, die mehrere der erwähnten Eigenschaften besitzen und zudem noch von weiteren Verbesserungen profitieren, wie z.B. signalisierte Paßpunkte, nadirnahe signalisierte Punkte oder nadirnahe benachbarte Punkte.

Die Werte des tatsächlich zur Entzerrung genutzten DGM wurden aus Orthophotopaaren der jeweiligen Luftbilder abgeleitet. Die aus Stereoorthophotos erzielbare Höhenmeßgenauigkeit ist im allgemeinen größer als die des Original - DGM, und zwar um einen Faktor zwischen 0,8 und 3,4; sie erreicht im Mittel den Wert 3,7 x H/10 000 (wobei H die Flughöhe der zu entzerrenden Luftbilder darstellt).

Einige absolute Ergebnisse zeigen, daß ein hohes Genauigkeitsniveau erzielbar ist, wie z.B. im Falle der natürlichen Punkte, die einen mittleren quadratischen Fehler von 50 µm als vektoriellen Lagefehler im Bildmaßstab oder von 1,3 x H/10 000 in der Höhe aufweisen. Es konnte gezeigt werden, daß bei der off-line Differentialentzerrung eines

Luftbildpaares vom Maßstab 1 : 16 000 in ein Stereoorthophotopaar vom Maßstab 1:5 000 - unter Verwendung eines aus Luftaufnahmen im Maßstab 1:60 000 abgeleiteten DGM - letztlich eine Höhengenauigkeit in der Größenordnung von 0.60 m (mittlerer Fehler) bei signalisierten Punkten, (d.h. 2,5 x H/10 000) und von 0.90 m (mittlerer qu. Fehler) für den vektoriellen Lagefehler, ebenfalls bei signalisierten Punkten (d.h. 56 µm im Bildmaßstab) erreichbar ist.
Demgegenüber konnten große Widersprüche zwischen verschiedenen absoluten Ergebnissen festgestellt werden, die von der Größe der Eingabeparameter abhingen. Das rührt daher, daß bei diesem Versuch die Grenzen der üblichen Parameterwahl weit überschritten wurden, um deren Einfluß besser bestimmen zu können.

Die Widersprüche ergaben sich auch aus der jeweils eingesetzten Auswertemethode, wobei sich Schwankungen von bis zu 30 % in den Ergebnissen zeigten. Schließlich wurden Schwankungen innerhalb ähnlicher Produkte ein und derselben Auswertestelle festgestellt, woraus man erkennen konnte, wie schwierig es ist, bei gleicher vorgegebener Datenqualität gleiche Spitzenqualität der Auswerteergebnisse zu erhalten. Möglicherweise erfordert dies strenge Qualitätskontrollen in jedem Bearbeitungsstadium.

Ungeachtet dessen wurden allgemeine Formeln aufgestellt, die ausschließlich den Maßstab der Eingabe des DGM's und der Ausgabe beinhalten, wobei die Spaltlänge aufgrund ihrer bei diesen Verfahren geringen Signifikanz außer acht gelassen wird.

Diese Formeln gelten für alle bei diesem Versuch erzeugten Produkte bei einer mittleren Genauigkeit von ± 20 % in der Lage und von ± 35 % in der Höhe. Der Ausdruck "mittlere Genauigkeit" bedeutet, daß 2/3 der mit gleichen Parametern gefertigten Orthophotos einen mittleren Fehler haben, der weniger als ± 20 % in der Lage und weniger als 35 % in der

Höhe von den e-Werten der nachfolgenden Formeln abweicht. Folglich liegen 2/3 der gemessenen mittleren Lagefehler zwischen 0,8 exy und 1,2 exy. Wenngleich es sich nur um Näherungswerte handelt, so können sie doch für die Auswahl der kostengünstigsten Maßstäbe dienen, die den geforderten Genauigkeitsansprüchen für das Orthophoto genügen.

Die Formeln sehen wie folgt aus:

$$e_{xy}^2 = 0.75 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.20 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2.$$

$$e_{z_x}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.10 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

$$e_{z_y}^2 = 0.30 \times \left(\frac{\text{PHOTO}}{15\ 000}\right)^2 + 0.50 \times \left(\frac{\text{DTM}}{15\ 000}\right)^2 + 0.25 \left(\frac{\text{ORTHO}}{5\ 000}\right)^2$$

wobei:

e_{xy} = mittlerer quadratischer Fehler in der Lage (Vektor) in Metern in der Natur, an natürlichen Punkten (einschließlich einiger signalisierter Punkte) des erzeugten Orthophotos, off-line abgetastet in x- oder y-Richtung.

e_{z_x} , e_{z_y} = mittlerer quadratischer Fehler in der Höhe, in Metern in der Natur, an natürlichen Punkten (einschließlich einiger signalisierter Punkte) bei Stereoorthopaaren, off-line abgetastet in x- resp. in y-Richtung.

PHOTO = 1 : Maßstab der zu entzerrenden Luftaufnahme (im Bereich von 16 000 bis 60 000).

DTM = 1 : Maßstab des DGM, d.h. der Aufnahmen, aus denen das DGM generiert wurde (im Bereich von 16 000 bis 60 000)

ORTHO = 1 : Maßstab des Orthophotos und Stereoorthophotos (im Bereich von 5 000 bis 25 000).

Aus einigen aufgeführten Beispielen ist ersichtlich, daß die für die angeführten Gleichungen relevanten Maßstabsgrenzen in gewissem Umfang sowohl auf kleinere als auch auf größere Maßstäbe ausgedehnt werden können. Wird somit das DGM von derselben Aufnahme abgeleitet, die auch für den Orthophotodruck vorgesehen ist, so sind Vergrößerungen vom 4,5 - 5,0fachen für das Orthophoto unter Einhaltung gewohnter Genauigkeitsstandards zulässig.

Demgegenüber wird dringend empfohlen, bei Verfügbarkeit eines aus einem kleineren als dem zu entzerrenden Maßstab hergeleiteten DGM auf letzteres zurückzugreifen, da sich auf diese Weise eventuell eine Kosteneinsparung erzielen läßt. Weitere Beispiele zeigen, daß die Orthophotoherstellung noch möglich ist mit einem DGM, dessen Ursprung 2, 3 oder 4mal kleiner ist als die zu entzerrenden Aufnahmen. Diese Aufnahmen können dann noch um den Faktor 35, 30 oder 23 vergrößert werden.

Bei der off-line-Differentialentzerrung sollte deshalb - wenn irgend möglich - stets auf vorhandene Höhendatenbanken und/oder aus Weltraumaufnahmen abgeleitete DGM zurückgegriffen werden.

Vollständig digital ablaufende Arbeitsmethoden, welche eine weitere Verbesserung der Endprodukte bewirken sollen, werden somit auch in Zukunft einen Anreiz für Weiterentwicklungen im Bereich des Stereoorthophoto-Verfahrens darstellen.
Mit neuen Versuchsreihen in größeren und kleineren als bei den gegenwärtigen OEEPE-Tests verwendeten Maßstäben könnten die Möglichkeiten der Nutzung von CCD-Kameras und der digitalen Entzerrung ausgeschöpft werden.

1 - INTRODUCTION

Further to the Steering Committee decisions taken in 1982, to re-activate OEEPE in the realm of orthophotography, an inquiry was conducted by a new orthophoto Working group and circular letters sent in 1983 as a preliminary step for establishing a test on the accuracy of ortho- and stereo-orthophotography.

As soon as enough positive answers were received, a meeting of the Group was held in June 1984 at the IGN (F) and a working schedule distributed to the participants.

The test consisted of three main stages :

- i - data collection (control and DTM)
- ii - production of the ortho and stereo-orthophoto products
- iii - assessment and analysis of results

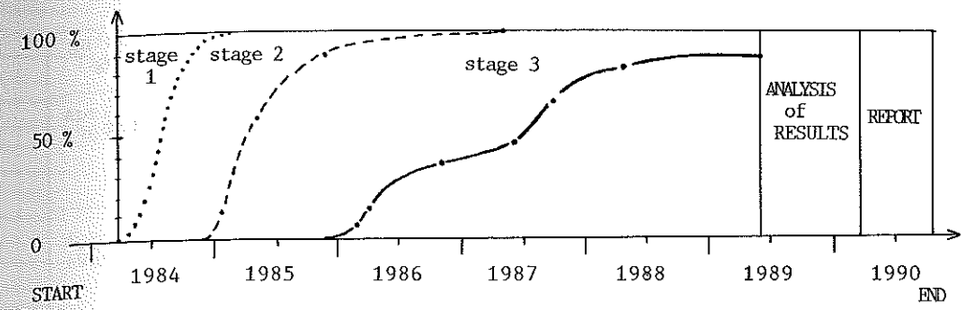
If the first two stages were easily carried out well within the anticipated deadline (about 1 ½ year), the third one was longer than expected (3 ½ years) because of a very scarcity of operative centers capable of measuring large format stereo-orthophotos pairs quickly and of a lack of people at the IGN (F) ready to assess the results in due time, after they were eventually received.

Anyway six years for managing a full test involving 13 centers and 90 products should not be considered as abnormal and it is a task which only few organisations could achieve thoroughly, but in which OEEPE succeeded in obtaining some results reported in parts 4 to 8.

Twelve intermediate reports were regularly presented to keep the Steering Committe aware of the status of the test, from 1983 to 1990, and for approval.

The progress of the three stages is represented in fig. 1, while a full description of the test and of the results are presented in this report.

As can be seen, stage 3 started before stage 2 was fully achieved while some 13 % of the products available have not yet been assessed, partly due to some redundancy but for not more delaying this report; the test can now be considered as completed significantly.



Progress of the test : Stage 1 : data collection ....
Stage 2 : stereo-ortho production---
Stage 3 : assessment of products____

FIG 1

2 - OBJECTIVES

Taking into account previous international tests on orthophoto-printing, such as those undertaken by ISPRS Commission IV, the OEEPE test was especially devoted to the use of D.T.M. in off-line ortho and stereo-orthophoto-printing.

Through a large amount of products, differing from each other in only one parameter, sometimes two parameters, it should be possible to obtain more information on the impact of each separate parameter into the final metrical accuracy of a typical ortho and stereo-orthophotograph. The five main parameters which were considered are the scale of the aerial survey, that of survey from which the D.T.M. was derived, that of the orthophoto, the slit width and the scanning direction. Moreover some redundancy being obtained by aiming at rectifying both frames of most of the stereopairs into orthophotos and stereomates, some information should be drawn on the best arrangement for producing both the orthophoto and its stereomate.

Laying the stress on the use of 3 scales of D.T.M., this test should bring a better knowledge of the enlargements allowable between input and output products, especially as regards input data at a scale of 1 : 30 K, and promote the establishment

and use of altimetric databases for off-line orthophoto-printing at larger scale, whether the products be carried out by analog or digital procedures.

The formulae derived in Part 8 and their extension to smaller scale space surveys, constitute a positive answer to these expectations.

3 - PROJECT DESCRIPTION

3.1 PREPARATION OF THE TEST

In order to reduce the cost and length of the test, the area was chosen among existing data,taking into account the availability of aerial surveysand control at several scales.

3.1.1 TEST AREA

The test area is located in France, in the Massif Central area, around the small town of Lacapelle Marival (Lot "département") consisting of 1200 people.

It has a wide range of relief from 350 m up to 628 m above datum, including valleys as deep as 150 m near its sides and slopes ranging from moderate (some 30 % slopes in the middle) to steep (many 50 % to 60 % slopes on the hillsides).
The terrain is gently rolling in the middle of the area.

Due to the neighbourhood of the "Causse de Gramat" the forest is not very thick, while many natural features are disseminated over the entire test area, which is portrayed on the basic map at 1 : 25 K-scale with a 10 m contour interval (appendix 10.3).

3.1.2 AERIAL SURVEYS

The main interest of this test area lies in the availability of four standard photogrammetric aerial surveys, taken by IGN (F) as follows :

Time	1:Scale	Camera	Flying Height above ground	Reference
April 1969	7 k	f = 302.82 mm (on glass plates) SOM-OR THOR EO3 19 x 19 cm	2 100 m	- Gorses FR-69-1692-70 - for cadastral purposes
April 1969	16 k	f = 152.56 mm WILD 15 UAG 290 24 x 24 cm	2 400 m	- Gorses FR-69-1692-160 - for cadastral purposes
Sept. 1969	30 k	f = 153.00 mm WILD 15 AG 97 24 x 24 cm	4 500 m	- Lacapelle-Marival FR-69-2237/300 - for standard base map series
Aug. 1981	60 k	f = 153.19 mm WILD 15 UAG 3 100 24 x 24 cm	9 200 m	- FR-81/60-7 045 - special coverage at small scale over France

Few changes having occurred in this area, the photographs taken at 1 : 60 K-scale twelve years later were quite similar to the previous ones.

The testarea consists of the entire area of the full frame n° 32, at 1 : 30 K-scale (appendix 10.3).

The larger scale has not been used into the orthophoto rectification but only for delivering additional photogrammetric control in the built-up area of Lacapelle Marival. The three smaller scales have been rectified as follows :

- Over the entire test area (37 km^2), regarding frames n° 31, 32 and 33 at 1 : 30 K-scale and over the southern part, regarding frames n° 64 and 65 at 1 : 60 K-scale.
- over two small parts of the area (8.5 km^2) located near the S-W (Lacapelle) and N-E corners of the area (a steep area), regarding frames n° 3, 5, 14 and 16,at 1 : 16 K-scale, in order to reduce the amount of work to do.

3.1.3 PREPARATION OF CONTROL

The accuracy of the orthophoto products being determined by measuring co-ordinates of well-defined points onto them, it was of paramount importance to establish first a set of fixed points, evenly distributed over the entire test area, consisting of features capable of being identified at different photo scales, with co-ordinates known in x, y and z and tied to the Lambert national grid system, without requiring additional field survey.

Mr. NAUDIN, from IGN (F), was successfully charged with preparation of control for the whole scales. After reviewing the existing control, previously established at the IGN (F) for stereoplotting these surveys, he identified additional sharp natural distinctive features,clearly visible onto two surveys at least, chosen among fences, field boundaries and road junctions; their co-ordinates were determined by five operative centers participating in the test (GID(DK), IGM (I),IGN (F), IPUS (D) and ITPT (I)), mainly from the survey at 1 : 16 K scale, some co-ordinates being checked by two independant measurements.

A general catalog, briefly describing each GCP and check point, including good witness diagrams showing the location of the features, was established by Mr. NAUDIN, and delivered to each operative center without masking the co-ordinates of each point for an easier search of these points which should be used either for producing orthophotos or assessing the products (appendix, 10.2).

The accuracy of these points can be inferred from the origin of their determination and from some redundancy in their measurements.

As a result, GCPs and checked points gathered in this inventory consisted of the six following classes :

- IGN-S : 25 points determined from previous field surveys, carried out by IGN (F) in 1969. Their accuracy is about 20 cm. One point was signalised.
- PHS-7 K : 22 points, located in the Lacapelle built up area, plotted from photographs at 1 : 7 K-scale.
- NP-16 K : 30 points, of which 27 are targetted, determined from measurements onto a stereocomparator, followed by model adjustment in an IBM computer, established at the IGN (F) in 1970. Photographs used at 1 : 16 K scale allowed a 30 cm accuracy.
- A-16 K : 54 points, of which 50 are targetted, obtained from a block aerial triangulation at 1 : 16 K-scale carried out at the IGN (F) in 1970. Their accuracy is of about 35 cm.

- PHS-16 K : 118 points, of which only 24 are targetted, stereoplotted from 1 : 16 K-scale photography, as a part of stage 1 of the test, by five centers which provided resp. 67 points (GID (DK), from pair n° 3-5), 44 points (IPUS (D) from pair n° 14-16), 100 points (IGM (I) and ITPT(I) from pairs n° 3-5 and 14-16).
  Extra checking was performed by IGN (F) and the expected accuracy was 40 cm (on each coordinate).
- PHS-30 K : 22 additional points were eventually determined at the IGN (F), especially suited to check orthophotos from 1 : 60 K-scale survey.

Finally, the network of fixed points comprised 271 points, of which 170 were natural features (63 %) and 101 (37 %) targets easy to identify without any sketch, at 1 : 16 K-scale and more often at 1 : 30 K-scale, but never at 1 : 60 K-scale.

Their distribution was evenly ensured throughout the test area, with a higher density in both opposite corners, that of Lacapelle Marival and that of the steepest terrain of the area (appendix 10.2).

3.1.4 PREPARATION OF CONTOURS

Considering the present trend in the national mapping agencies to establish heighting databases at medium scale by digitising contours of base map series at 1 : 25 K-scale or by stereoplotting pairs at 1 : 30 K-scale and storing the related data in a vector format, it was decided to deliver to each producing center the required altimetric data in a format consisting of contours stored on magnetic tape directly.

Each operative center was responsible for computing the profiles required for rectifying aerial photographs into the ortho and stereo-orthophotos it has agreed to do, using its own algorithms to interpolate the relevant data from the contours.(1)

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(1) In this way, NLS (S) reported that interpolation was achieved by using its own KURVA and ORTO programs, NBS (SF) by Dr. S. HALJALA's interpolation method of finite elements, ITC (NL) by the SORA-OPS Version 16-A with a logarithmic law for parallaxes, IFAG (D) by the HIFI-S program and IGN (F) by different modified versions implemented onto a minicomputer Eclipse from Data General.

Contours from aerial surveys at 1 : 30 K and 1 : 60 K-scale were stereoplotted and digitised by the IGN (F) at a vertical interval of 10 m, while those from surveys at 1 : 16 K-scale were stereo-plotted by IGM (I) and ITPT (I) and automatically digitised with both time and space interval, at a vertical interval of 5 m.

Residuals on GCPs were within the 20-35 cm range. Spot heights were added to these plots.

In addition, a pair at 1 : 60 K-scale was scanned by IGN (F) along profiles in the y direction, at 125 m step interval, for a comparison with contours.

3.2 DISTRIBUTION OF TASKS

Stage 1 (data collection) started as soon as a large majority of the products listed in stages 2 (production) and 3 (assessment) was secured. Waiting till the whole products be engaged would have delayed the test for many years !

Data collection was achieved within one year (1984, fig 1) Production of ortho and stereo-orphotos involved seven centers and consisted of twenty three classes of products, out of which twenty-one were actually realised and assessed, (§ 3.3.1), the missing ones being not of primary importance for the results of the test.

3.2.1 OPERATIVE AND ASSESSING CENTERS

The test was conducted by IGN (F) acting as pilot center (but also as operative and assessing center).

Seven centers carried out a total of ninety products, out of which fifty nine were actually assessed by four assessing centers and eventually analysed at the IGN (F), which represents about the two thirds of the data available.

The distribution is as follows :

Acronyms of the centers	Number of products produced by the (producing) centers	produced, assessed and analysed	Number of Products measured by the (assessing) centers and (analysed)		
			orthos	stereo-orthos	Total
IFAG (D)	21	19			
IGN (F)	23	10	9	10	19
IPTU (A)	-	-	14	16	30
ITC (NL)	27	16	-	-	-
NBS (SF)	6	6	-	-	-
NLS (S)	5	5	-	-	-
NRC (CDN)	2	-	3	3	6
UCL (GB)	-	-	3	1	4
WH (CH)	6	3	-	-	-
TOTAL	90	59	29	30	59

Those fifty nine products were measured either separately and/or arranged into orthophoto-pairs and stereo-orthophoto pairs according to the following distribution :

Assessing centers	Number of arrangements measured as Single orthophoto pair	orthophoto pair	stereophoto pair	Total of N° of arrang. measured
IGN (F)	5	2	10	17
IPTU (A)	-	1	16	17
NRC(CDN)	1	1	4	6
UCL (GB)	1	1	1	3
TOTAL	7	5	31	43

The missing data are related to products which no center has assessed, or which have not been analysed due to their too poor quality (generally insufficient number of check points easily stereoviewed onto products derived from 1 : 60 K-scale photography).

3.2.2 COMBINATION OF INSTRUMENTS

In order to obtain more reliable results, an attempt was made to involve a wide range of instruments.

Five centers produced ortho and stereo-orthophotographs using a WILD-OR 1 (IGN (F), ITC (NL), NB S (SF), NLS (S) and WH (CH)) and a sixth center used a Zeiss- Z 2 (IFAG (D)).
With such well known off-line orthoprojectors, scale correction is achieved by differentially adjusting the optical magnification and direction correction is achieved by image rotation.

Products from the seventh center, carried out on-line with a GPM, were not measured.
Six instruments were used for measurements onto the products delivered to the four assessing centers, as follows :

- i) IGN (F) used the ORTOSTER, a home made prototype, fitted with encoders,storing data on tapes. This ORTOSTER accepts a large format of size 330 x 570 mm, and has resolutions of 2 cmm in x, y and 1 cmm in px, free hand motion, and fine-adjustement track-ball devices.

- ii) IPTU (A) used a STEREOGRAPH, from R and A.ROST C^y(Wien,(A)) fitted with Diadur glass scale of 1 cmm resolution,storing data on tapes. The STEREOGRAPH accepts a very large format of size up to 550 x 750 mm, has a free hand motion and fine adjustment screws.

- iii) NRC (CDN) used its STEREOCOMPILER, built in its laboratories, which was specifically designed to accomodate stereo-orthophotos and had been in use for about twelve years for research purposes.
  This instrument accepts a very large format of size up to 400 x 720 mm, has resolutions of 1 cmm but did not store data on tape,while delivering x, y and px listings; it has a free hand motion device with air bearings and a px micrometer.

- iiii) UCL (GB) used three types of instruments :

  - a CP1 stereoplotter modified to plot from stereo-orthophotos, which accepts small formats of size 250 x 250 mm; it has a free hand motion device and a px measurement by footwheel.
  - a KERN DSR1 analytical stereoplotter accepting a small format of 250 x 250 mm and storing very accurate data on a floppy disc.

  - a ROSS stereo-orthophoto plotter developped by ROSS Instruments Ltd., and commissioned by the OS (GB). The prototype was made available to UCL (GB). It accepts a large format of size 400 x 400 mm and has a free hand motion device, a tracker ball and a joystick for px removal.

Eight combinations of stereo-orthophoto printers and compilers were thus obtained, each combination being involved in measuring the following number of arrangements, among the forty three arrangements listed above (§ 3.2.1) :

MEASURING INSTRUMENTS \ ORTHO-PROJECTORS	WILD OR1	ZEISS-Z2	TOTAL N° of arrangements measured
IGN (F) : ORTOSTER	14	3	17
IPTU (A) : STEREOGRAPH	9	8	17
NRC (CDN) : STEREOCOMPILER	6	0	6
UCL (GB) : CP1 UCL (GB)-OS (GB):ROSS	0	1	1 (same arrang^t measured on both instruments)
UCL (GB) : KERN DSR1	2	0	2
TOTAL	31	12	43

3.2.3. POINTING PRECISION

The four assessing centers have been requested to achieve ten successive rounds of measurements onto a set of twelve points at least, for the purpose of determining a value of the pointing precision.

The standard deviation from the average of these separate ten measurements provides an order of magnitude of both the quality of the instrument and the reliability of pointing a given point by the operator.

It is quite different from the absolute pointing accuracy because small discrepancies do not mean that the identification and pointing are not wrong, but that the error is the same for each pointing.

However the pointing precision is a part of the pointing accuracy, a prerequisite for obtaining good results.
The results from each center are as follows :

- i) IGN (F)/ORTOSTER :

Stage	Stereo ortho N°	1 : Scale of photo	ortho	Number of points	Number of rounds	Pointing standard deviation at ortho-scale (microns), in x	y	Vector (x,y)
2.1.1	19-21	30 K	25 K	24	10	51	53	73
2.2.3	40-42	30 K	25 K	27	10	69	67	96
Weighted Average						60	60	85

These figures could seem rather high; it is the reason why the IGN (F) operators have always carried out two and often three rounds of measurements at each of the GCPs and check points onto each product to assess.

So that the final pointing standard deviation was reduced resp. to 60 and 50 microns (85 : $\sqrt{2}$ and 85 : $\sqrt{3}$), for the resultant vector, after two and three rounds. Considering the smallest value obtained for the planimetric r.m.s.e at ortho-scale, which is about 150 microns (appendix 10.5), the pointing precision appears to be involved for may be 7 % in this result, which is quite acceptable.

Moreover other values of the pointing precision, actually obtained from these three rounds of measurements are better, whatever the pointings be done,mono or stereoscopically, as shown in the following table :

Mono/ Stereo	Stage	ortho N°	1 : scale photo	ortho	Number of points	Number of rounds	Pointing standard deviation at ortho-scale (microns),in x	y	Vector (x,y)
Mono	2.25	16	30 K	5 K	28	3	37	34	50
Mono	2.2.2	13	30 K	25 K	48	3	45	37	58
Stereo	2.25	15	30 K	5 K	59	3	34	44	56
Stereo	2.25	16	30 K	5 K	61	3	37	47	59
Stereo	2.2.2	13	30 K	25 K	48	3	42	40	57
Weighted Average							39	41	57

Such values lead to a pointing precision of 33 microns (57 : $\sqrt{3}$), for the resultant vector and the average of three pointings, which is fully negligible with regard to 150 microns.

ii) IPTU (A)/ STEREOGRAPH

Stage	Stereo ortho N°	1 : Scale of photo	ortho	Number of points	Number of rounds	Pointing standard deviation at ortho-scale (microns), in x	y	Vector (x,y)
2.1.2	72-76	30 K	5 k	12	10	37	56	67
2.2.7	90-91	30 K	5 K	13	10	37	52	65
Weighted Average						37	54	66

The results are of the same order of magnitude as in i) (IGN (F)) and the same comments are valid. Two rounds of measurements having been done at each point, the pointing precision on the average is therefore 47 microns, (66 : $\sqrt{2}$), which is fully negligible with regard to the smallest value of the planimetric r.m.s.e of 194 microns.

iii) NRC (CDN) / STEREOCOMPILER

Stage	Stereo ortho N°	1 : Scale of photo	ortho	Number of points	Number of rounds	Pointing standard deviation at ortho-scale (microns), in x	y	Vector (x,y)
3.2.1	26-29	16 K	5 K	4	2	44	53	69
3.2.2	27-25	16 K	5 K	1	3	23	25	34
3.2.1	26-28	16 K	5 K	1	7	26	36	44
Weighted Average						33	42	54

The same comments as above in i) and ii) can be applied here.

iiii) UCL (GB)

As regards the CP1 and ROSS instruments, no such rounds have been performed, but they are reported to being capable of producing an accuracy which appears quite similar to that of the previous instruments (appendix 10.1, [1]), resulting in negligible pointing errors.

As regards the DSR1, the requested rounds having been performed, the results are as follows :

Mono/ Stereo	Stage	ortho N°	1 : scale of photo	1 : scale of ortho	Number of points	Number of rounds	Pointing standard deviation at ortho-scale (microns), in x	y	Vector (x,y)
Mono	1.1.2	81	60 K	25 K	11	10	15	15	21
Stereo	1.1.2	81	60 K	25 K	11	10	18	22	28
Stereo	1.1.2	81	60 K	25 K	2	5	12	18	22
Stereo	1.1.1	84	60 K	25 K	11	10	18	23	29
Stereo	1.1.1	84	60 K	25 K	2	5	12	32	35
		Weighted Average					17	20	26

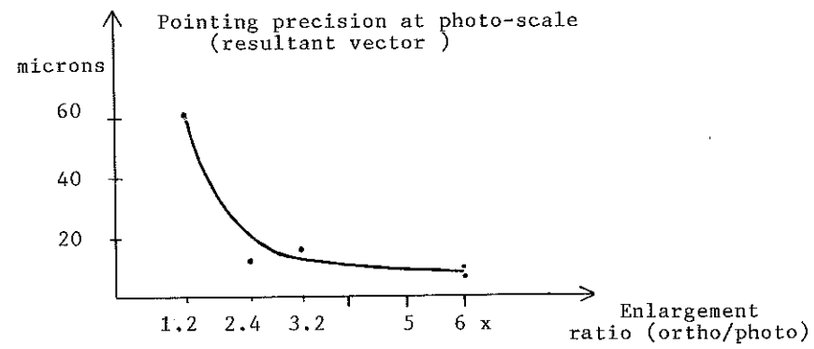
These results appear to be the best ones at orthophoto scale. They show that using a first order analytical plotter, with a format of smaller size than that of the other instruments and a much larger viewing magnification (range 5 x - 20 x in the DSR1 instead of 1 x - 3 x in the other ones), improves the quality of measurements to a large extent.

Can it be concluded that the main part of the relative pointing error in the three other assessing centers is attributable to the quality and magnification of the instrument available and that the repetitivity of an operator pointing to a well-defined feature is within a standard deviation of 25 microns, resulting vector, at orthophoto-scale ?

However, it can be of interest to examine the related pointing error at the original photo-scale as shown in the following table :

Center	Viewing Instrument	Ortho N°	1 : scale of photo	1 : scale of ortho	Total Number of measurements	Pointing standard deviation at photo-scale (microns) in x	y	Vector (x,y)
IGN (F)	ORTOSTER	19-40-13	30 K	25 K	798	45	44	63
IGN (F)	ORTOSTER	15-16	30 K	5 K	444	6	7	9
IPTU (A)	STEREOGRAPH	72-90	30 K	5 K	250	6	9	11
NRC (CDN)	STEREOCOMPIL.	26-27	16 K	5 K	18	10	13	17
UCL (GB)	DSR1	81-84	60 K	25 K	350	7	8	11

Pointing precision appears to be rather sensitive to the enlargement ratio between the original photograph and the orthophoto product, whatever the viewing instrument used, as shown on the following curve:



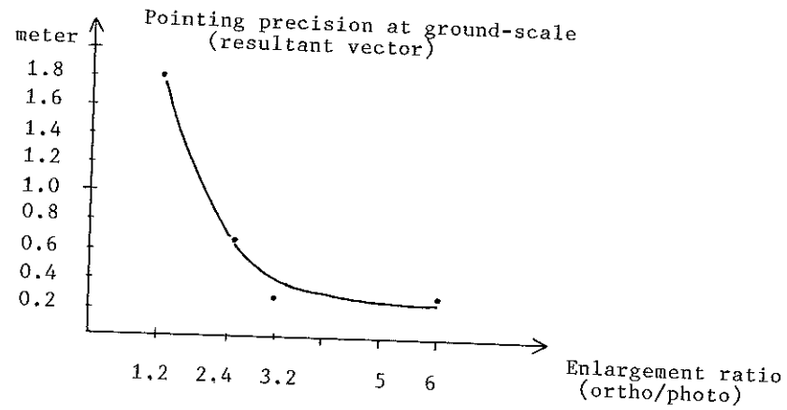
The correlation coefficient with an hyperbolic law such as $y = 42/(x - 0.5)$ being 0.7, the agreement can be considered as good, hence inciting to use an enlargement of at least 2.5 x when orthophotoprinting, in order to draw full benefit from the original photograph content.

In general, the pointing precision in x is slightly better than in y, which is probably a result generally encountered in stereoscopic measurements.

The corresponding errors in meter at ground scale, are shown in the following table :

1 : Photo-scale	1 : ortho-scale	Pointing precision (resultant vector)
60 K	25 K	0.66 m
30 K	25 K	1.80 m
30 K	5 K	0.30 m
16 K	5 K	0.27 m

Emphasis is again easy to lay on the interest to enlarge at least 2.5 x the photo into orthophotos, as shown on the following curve :



3.3 PRODUCTS OBTAINED

3.3.1 TABLES OF ORTHOPHOTOS AND STEREO-ORTHOPHOTOS

The fifty nine products which have been delivered, measured and analysed, comprising twenty nine orthophotos and thirty stereomates, are distributed as a function of the five parameters involved in the test, as indicated in tables 1 and 2.

Scale of	1 : 60 K	1 : 30 K	1 : 16 K	Total
Aerial photo	4	39	16	59
D.T.M	22	30	7	59

Number of products from different photo and DTM - scales

TABLE 1

	Scale of the output product		Scanning direction		Slit width	
	1: 25 K	1:5 K	x	y	4 and 5 mm	8 mm
Number of products	19	40	33	26	39	20
Total	59		59		59	

TABLE 2

The use of medium scale aerial surveys (1:30 K) and medium to small scale DTM (1:30 K and 1:60 K) have therefore been emphasized as anticipated. However, the remaining number of products derived from aerial surveys at 1:60 K-scale is smaller than expected. In fact that scale did not deliver so good results and some products could not be included in the analysis, because of a relative scarcity of check points stereoviewed onto the resulting orthophotos and of difficulties in identifying and accurately pointing to them, all the more as no targetted points were visible on these products.

As a result, two classes of products are vacant out of the expected twenty three. The fifty nine products available are distributed amongst the remaining twenty one classes as indicated in table 3, while their distribution amongst the operative centers are listed in table 4 as regards the orthophotos and table 5 as regards the stereo-orthophotos.

Three classes of format can be noted (table 3) consisting of products the size and number of which are as follows :

- class 1, small format : products at an output scale of 1:25 K of size either 22 x 26 cm (full frame) or 12 x 26 cm (stereopair) amounting to nineteen products (n° 10 to 14, 19 to 23, 32, 33, 36, 40 to 43, 81, 84).
- class 2, medium format : products at an output scale of 1:5 K, coming from photographs at 1:16 K-scale, of size about 30-35 cm by about 50-65 cm, amounting to sixteen products (n° 24 to 29, 50 to 53, 62 to 67).
- class 3, large format : products at an output scale of 1:5 K, issuing from photographs at 1:30 K-scale, of size about 55-65 cm by 75-90 cm, amounting to twenty four products (n° 15 to 18, 37 to 39, 44 to 49, 72 to 79, 90 to 92)

3.3.2 MEASUREMENTS

Each product or arrangement of products has been measured by two rounds, sometimes three rounds, each of them including closure measurements on GCPs. Some products have been assessed by dividing them into smaller parts and measuring them successively.
As a result 2243 measurements have been performed from the 59 products combined in the 43 arrangements analyzed, each measurement comprising the average of the x, y, px values of pointings issued from the relevant two or three rounds. The actual number of pointings which have been carried out is as follows :

IGN (F)	:	3120
IPTU (A)	:	1752
NRC (CDN)	:	276
UCL (GB)	:	509
Total number of pointings		5657

This total number includes pointings carried out for determining the pointing precision, and is thereby more that twice as much as the number of averaged measurements (2243), used as inputs in the further computations for assessing planimetric and altimetric accuracies (chapter 4 and 5).

TABLE 3

DISTRIBUTION OF THE 59 PRODUCTS AMONGST THE DIFFERENT CLASSES.

CLASS (i-e production phase)	Aerial Photo	1:Scale of D.T.M.	Ortho	Slit Width	Scan Direct.	*Format -,class n°	Product n°	Number of products
1.1.1	60 K	60 K (PEB 8) (profile)	25 K	5 mm	y	1	-84-	1
1.1.2	60 K	60 K	25 K	5 mm	y	1	-81-	1
1.1.3	60 K	60 K	25 K	4 mm	y	1	-33-36-	2
2.1.1	30 K	60 K	25 K	5 mm	y	1	-19-20-21-22-23-	5
2.1.2	30 K	60 K	5 K	5 mm	x	3	-72-74-76-78-	4
2.1.3	30 K	60 K	5 K	8 mm	x	3	-73-75-77-79-	4
2.1.4	30 K	60 K	5 K	8 mm	y	3	-37-38-39-	3
2.2.2	30 K	30 K	25 K	5 mm	x	1	-10-11-12-13-14-	5
2.2.3	30 K	30 K	25 K	4 mm	y	1	-40-41-42-43-	4
2.2.4	30 K	30 K	5 K	4 mm	y	3	-44-45-46-47-	4
2.2.5	30 K	30 K	5 K	5 mm	x	3	-15-16-17-18-	4
2.2.6	30 K	30 K	5 K	8 mm	y	3	-48-49-	2
2.2.7	30 K	30 K	5 K	8 mm	x	3	-90-91-92-	3
2.3.1	30 K	16 K	30 K	5 mm	x	1	-32-	1
3.1.2	16 K	60 K	5 K	8 mm	x	2	-66-67-	2
3.2.1	16 K	30 K	5 K	5 mm	x	2	-24-26-28-29-	4
3.2.2	16 K	30 K	5 K	8 mm	x	2	-25-27-	2
3.2.3	16 K	30 K	5 K	8 mm	y	2	-50-51-	2
3.3.1	16 K	16 K	5 K	4 mm	y	2	-52-53-	2
3.3.2	16 K	16 K	5 K	5 mm	x	2	-62-64-	2
3.3.3	16 K	16 K	5 K	8 mm	x	2	-63-65-	2
21 classes	TOTAL							59

* Format : class
class 1: size 12 x 26 cm or 22 x 26 cm
class 2: size about 30-35 cm by about 50-65 cm
class 3: size about 55-65 cm by about 75-90 cm

TABLE 4

DISTRIBUTION OF THE 29 ORTHOPHOTOS AMONGST THE OPERATIVE CENTERS

(List arranged in ascending order of their number).

Ortho n°	class (stage)	Aerial photo n°	Operative center and instrument for production	assessment
10 13 15 16	2.2.2 2.2.2 2.2.5 2.2.5	33 32 32 33	IGN(F)-OR1	IGN(F)-ORTOSTER
19 21	2.1.1 2.1.1	31 32	NLS(S)-OR1	IGN(F)-ORTOSTER
26 27 29	3.2.1 3.2.2 3.2.1	14 3 16	NBS(SF)-OR1	NRC(CDN)-STEREO-COMPILER
32	2.3.1	32	IGN(F)-OR1	IGN(F)-ORTOSTER
33	1.1.3	64	IFAG(D)-Z2	UCL(GB)-CP1-ROSS
37	2.1.4	32	IFAG(D)-Z2	IPTU(A)-STEREOGRAPH
40 42	2.2.3 2.2.3	32 33	IFAG(D)-Z2	IGN(F)-ORTOSTER
44 46 48 50 52	2.2.4 2.2.4 2.2.6 3.2.3 3.3.1	32 33 32 3 3	IFAG(D)-Z2	IPTU(A)-STEREOGRAPH
62 63 66 72 73 74 75	3.3.2 3.3.3 3.1.2 2.1.2 2.1.3 2.1.2 2.1.3	3 3 3 32(S) 32(S) 32(N-E) 32(N-E)	ITC(NL)-OR1	IPTU(A)-STEREOGRAPH
81 84	1.1.2 1.1.1	64 64	ITC(NL)-OR1	UCL(GB)-DSR1
90	2.2.7	32	WH(CH)-OR1	IPTU(A)-STEREOGRAPH
TOTAL: 29				

TABLE 5

DISTRIBUTION OF THE 30 STEREO-ORTHOPHOTOS AMONGST THE OPERATIVE CENTERS

(List arranged in ascending order of their number).

Stereo-ortho n°	Class (stage)	(1) Law for parallax	Aerial photo n°	Operative center and instrument for production	assessment
11 12 14 17 18	2.2.2 2.2.2 2.2.2 2.2.5 2.2.5	lin. lin. lin. lin. lin.	33 31 32 32 33	IGN(F)-OR1	IGN(F)-ORTOSTER
20 22 23	2.1.1 2.1.1 2.1.1	lin. lin. lin.	31 32 33	NLS(S)-OR1	IGN(F)-ORTOSTER
24 25 28	3.2.1 3.2.2 3.2.1	lin. lin. lin.	16 5 14	NBS(SF)-OR1	NRC(CDN)-STEREO-COMPILER
36	1.1.3	lin.	64	IFAG(D)-Z2	UCL(GB)-CP1-ROSS
38 39	2.1.4 2.1.4	lin. lin.	31 33	IFAG(D)-Z2	IPTU(A)-STEREOGRAPH
41 43	2.2.3 2.2.3	lin. lin.	32 33	IFAG(D)-Z2	IGN(F)-ORTOSTER
45 47 49 51 53	2.2.4 2.2.4 2.2.6 3.2.3 3.3.1	lin. lin. lin. lin. lin.	32 33 33 5 5	IFAG(D)-Z2	IPTU(A)-STEREOGRAPH
64 65 67 76 77 78 79	3.3.2 3.3.3 3.1.2 2.1.2 2.1.3 2.1.2 2.1.3	Log. Log. Log. Log. Log. Log. Log.	5 5 5 31 31 33 33	ITC(NL)-OR1	IPTU(A)-STEREOGRAPH
91 92	2.2.7 2.2.7	lin. Log.	33 33	WH(CH)-OR1	IPTU(A)-STEREOGRAPH
TOTAL: 30					

(1) lin = linear law
Log = logarithmic law

As described hereafter, in chapter 4.1.1, different plane transformations have been computed and applied to those measurements, achieving a conversion of the orthophotos co-ordinates and enabling a comparison with those from the general catalog, established in the IGN (F) Lambert grid system.

Once these transformations performed, some residuals appeared excessive, requiring a cancelling procedure for eliminating such measurements to be considered as gross errors. It was decided to eliminate those measurements exceeding 2.58 times the value of the r.m.s.e. in any residual, which corresponds to the maximum error with a 1 % confidence level to be reached. Seven iterative cycles were necessary for stabilizing the procedure, no extra measurement having to be rejected after this last computation.

In fact, the first cycle was the most efficient one, resulting in 60 % of these large gross errors being detected and two thirds of the rounds cleared from errors. After the second cycle, 80 % of these wrong measurements were deleted and 84 % of the rounds cleared.

The following table shows the progress of this procedure and fig. 2 the relevant curve which is very smooth :

Iterative cycle N°	Number of measurements cancelled by the cycle	Number of measurements cancelled after the cycle	
		Total	Percentage
1	137	137	59.6 %
2	46	183	79.6 %
3	26	209	90.9 %
4	14	223	97.0 %
5	4	227	98.7 %
6	3	230	100.0 %
7	0	230	100.0 %

The impact of these eliminations on the value of the r.m.s.e. computed at each cycle is very impressive in the first cycle, reducing this value by a factor from two to four times, which confirms that these errors were often large gross blunders.

In the following cycles, the reduction decreases slowly and fig. 3 depicts some typical curves related to ten orthophotos. It could be discussed whether these cycles were stopped too late or not. In fact, if the procedure had stopped at the fourth cycle, seven additional measurements should have been kept as a whole, which would have changed the resulting r.m.s.e. by only a few percents, maybe 10 % as a maximum for one product, which is not very significant out of the whole orthophotos.

The number of cancels was limited to a few measurements in each round, from two to five, seldom more, reaching a total of 230, mainly 10 %, as indicated in the following table :

Type of point	Number of measurements achieved	Number and % of cancels		Number of measurements used
Targetted	738	68	9.2 %	670
Natural	1505	162	10.8 %	1343
TOTAL	2243	230	10.3 %	2013

This table shows that targetted points are slightly less eliminated than natural features, because of an easier identification; moreover, it shows that the number of measurements carried out onto targets is relatively inferior to their proportion in the general catalogue (33.3 % versus 37.3%), because such points were lacking on products issued from 1:60 K-scale photographs.

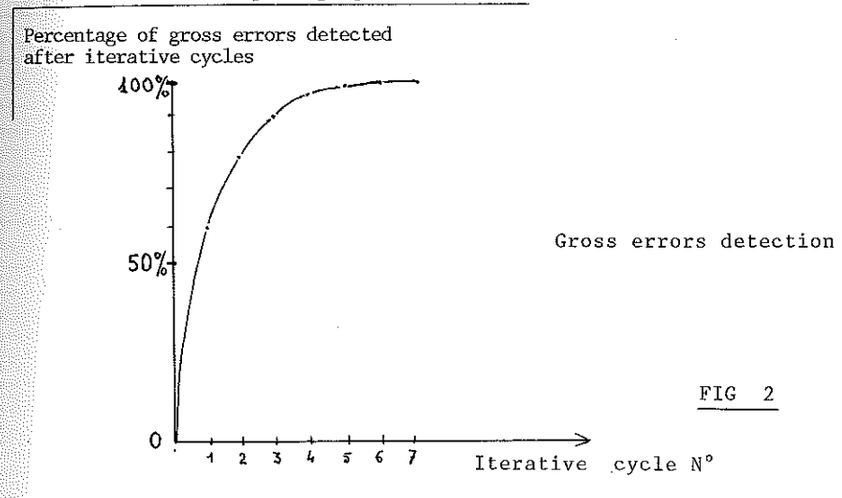


FIG 2

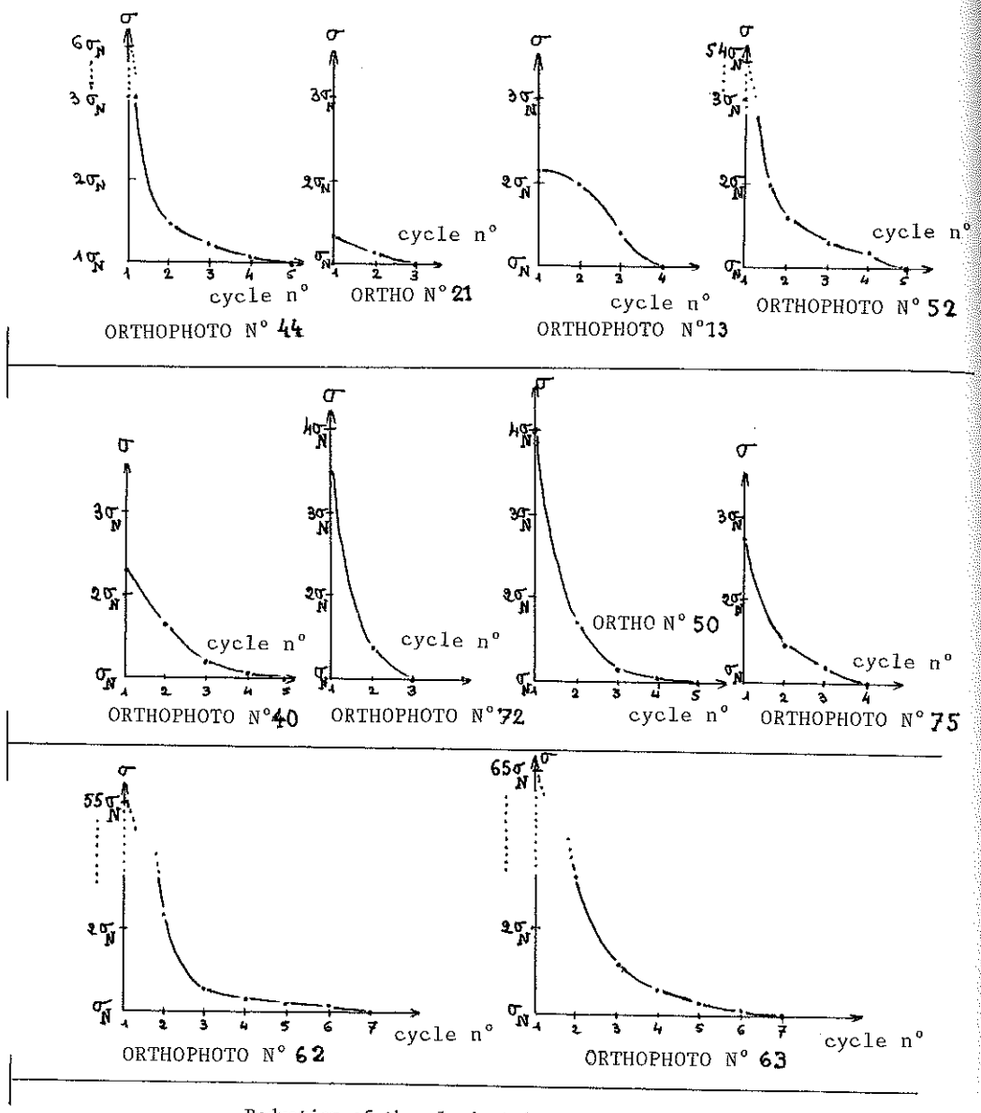


FIG 3 Reduction of the planimetric r.m.s.e (resultant vector) σ , after gross errors elimination in successive cycles of computations, down to σ_N , value from the last cycle.

4 - PLANIMETRIC ASSESSMENT

4.1 PLANE TRANSFORMATIONS

4.1.1 FOUR ASSESSING METHODS

As indicated in 3.3.2 several transformations have been computed and applied to the measurements of each separate round, in order to convert the orthophoto co-ordinates into ground co-ordinates and enable a comparison with true co-ordinates listed in the general catalogue and established in the IGN (F) Lambert grid system.

For that purpose, four methods have been set up, comparatively used and applied to most of the orthophotographs. They consisted of three similarities and one affinity, the effects of which were therefore those of translations, rotations and scaling either similar along x and y or different. Hence they permitted it to evaluate the accuracy of the different products by computing residuals, standard deviations and r.m.s.e, on GCPs and check points as well, first for each round then for each orthophoto as an average of the related rounds, weighted according to the number of points in the round. Complete lists of residuals in x and y are given in appendix 10.6, relatively to the whole sets of measurements and assessing methods.

4.1.2 SIMILARITY ON TWO POINTS

4.1.2 - a) Considering that a user willing to draw full benefit from the metric qualities of an orthophoto and to perform measurements onto it, will be eager to check the scale of his product by using a minimum of two known points, at least to correct for possible shrinkage, a first similarity has been computed by using only two remote known points. These base points were chosen by a computer program as being those displaying the largest distance between them in the round, in a similar way as a user should have operated. They were either GCPs or check points.

By computing both centres of gravity related to these two points (in fact, their mid-point), one from the measurements, in orthophoto co-ordinates, the other from the general catalogue, in given ground co-ordinates and superimposing them, the two parameters of the plane transformation were expressed as follows :

$$\begin{vmatrix} X - X_o \\ Y - Y_o \end{vmatrix} = \begin{vmatrix} a & -b \\ b & a \end{vmatrix} \cdot \begin{vmatrix} x - x_o \\ y - y_o \end{vmatrix} \qquad (1)$$

where :

- X, Y are ground co-ordinates of a point
- X_o, Y_o are the ground co-ordinates of the centre of gravity
- x, y are orthophoto co-ordinates of the image-point
- x_o, y_o are the orthophoto co-ordinates of the centre of gravity
- a, b are the two similarity parameters.

Applying formula (1) to either of these distant points previously chosen, provides the value of a and b directly and that of the orthophoto scale ($\sqrt{a^2 + b^2}$).

Then applying formula (1) to the whole other points converts their orthophoto-coordinates into ground co-ordinates and provides the expected residuals by difference between computed coordinates and known co-ordinates. These residuals are denoted DX_1, DY_1 in the list of appendix 10.6. Of course, for both base points, residuals are exactly 0.00 m.

This very simple method, which is well within the possibility of any user, has been efficiently applied to the whole orthophotos.

Comments on the results printed onto each separate form of appendix 10.5, are given in 4.1.6.

4.1.2 - b) Impact of the base length

A test has been made outlining the impact of a reduction of the base length on the results of the similarity computed using the two points at both ends of the base. Ten orthophotos were involved in this test and the results are indicated in table 6 and fig.4.

They comply well enough with an anticipated hyperbolic relationship such as that expressed by formula (2) :

$y = 0.6 / x + 0.4$, (2) and drawn on curve (C) (fig. 4)

where :

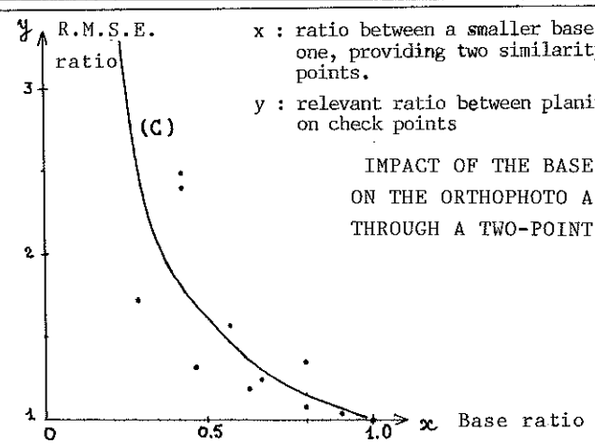
y = ratio between both values of the r.m.s.e. obtained for the resultant vector (x, y) on the same check points, using a similarity computed on a smaller base length and a longer one.

x = ratio between the two related base lengths.

ORTHOPHOTO N°	RATIO BETWEEN SMALL TO LONG BASE LENGTH	RELEVANT RATIO BETWEEN R.M.S.E (x,y) AT CHECK POINTS
21	0.80	1.35
21	0.91	1.03
44	0.42	2.49
46	0.46	1.31
48	0.42	2.40
72	0.63	1.18
73	0.29	1.72
74	0.66	1.23
75	0.57	1.57
90	0.80	1.07

VARIATIONS OF PLANIMETRIC R.M.S.E
AS A FUNCTION OF THE
BASE LENGTH USED FOR A
SIMILARITY TRANSFORMATION OF
COORDINATES (SCALING ON TWO POINTS)

TABLE 6



x : ratio between a smaller base and a longer one, providing two similarity control points.

y : relevant ratio between planimetric r.m.s.e on check points

IMPACT OF THE BASE LENGTH
ON THE ORTHOPHOTO ASSESSMENT
THROUGH A TWO-POINT SIMILARITY

FIG 4

It can be stated once more that extrapolation outside a base acting as a control point line, should not take place, which every user should be aware of, when scaling his orthophoto.

4.1.3 SIMILARITY ON THE WHOLE GCPs

4.1.3 - a) The second approach which was practised to convert orthophoto coordinates into ground coordinates is a well-known one and consists of a similarity based upon the whole GCPs, namely points used as GCPs when producing the orthophotos.

The same formula (1) as in 4.1.2 is used but centres of gravity are determined as those of the whole GCPs and parameters a and b are obtained by solving the set of equations (1) related to each GCP, by a least-squares adjustment. Hence applying formula (1) to the whole GCPs and check points converts the orthophoto coordinates and provides the expected residuals (denoted DX_2, DY_2 in the list of appendix 10.6), standard deviations and r.m.s.e. as well.

Comments on the results printed onto each form of appendix 10.5 are given in 4.1.6 and here after as regards the impact of GCPs quality.

4.1.3 - b) Impact of the number of GCPs, on check points

Through the different rounds of measurements, different arrangements are available in which the number of GCPs actually used is ranging from 2 to 15.

When only two GCPs are used, no least-squares adjustment is feasible and the conditions are in fact those of 4.1.2.a, differing in that the distance between GCPs is generally shorter than that used in 4.1.2, where the two points chosen for controlling the similarity displayed the largest possible distance in the orthophoto. Hence an opportunity was given to compare both results as a function of the base length, which provided the comparison carried out in 4.1.2.b.

For a number of GCPs greater than two, table 7 indicates the results by comparing both r.m.s.e. (resultant vector x, y) on the same check points, between the first plane-transformation (similarity on two points) and this second one (similarity on whole GCPs). Only rounds in which the number of check points was exceeding ten were considered, while some discrepancies can be noted.

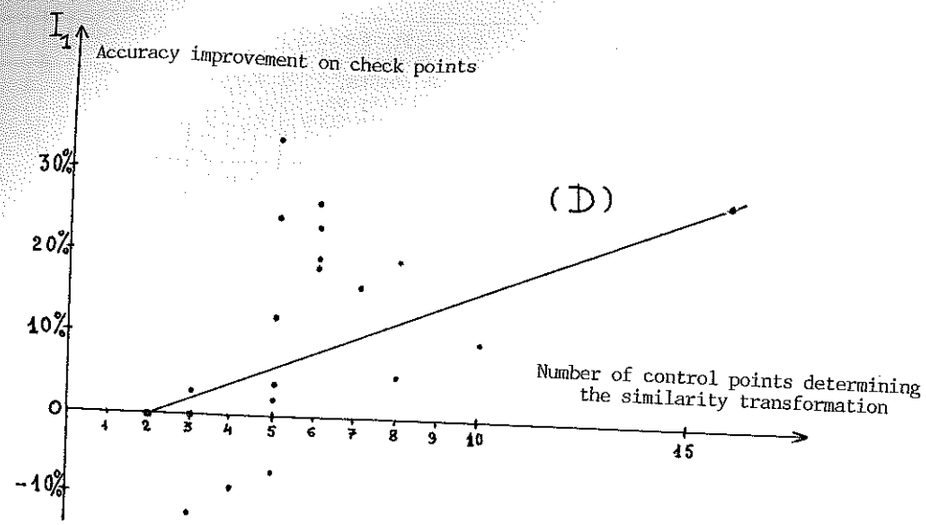
It can be inferred from the variations of the ratio between both r.m.s.e. as a function of the number of GCPs involved, that the improvement in the results can be approximated by a linear function of this number, expressed by :

$I_1 = 0.02\ N_b - 0.04$ (3), (running as straight line (D) in fig.5) with a correlation factor of 0.64

ORTHOPHOTO N°	Number of GCPs	Number of check points	R.m.s.e (result. vector) (x,y) in meter at check points, after similarity on 2 points r1	whole GCPs r2	Ratio r2/r1	Improvement $I_1 = 1 - \frac{r2}{r1}$
any	2	-	any	any	1.00	0%
13 (4 rounds)	3	10	4.21	4.08	0.97	3%
19 (1 round)	3	13	3.20	3.59	1.12	-12%
90 (1 round)	3	21	2.03	2.03	1.00	0%
13 (1 round)	4	12	7.23	7.94	1.09	-9%
13 (2 rounds)	5	12	8.97	5.88	0.66	34%
19 (3 rounds)	5	11	7.01	6.18	0.88	12%
40 (2 rounds)	5	26	3.33	3.21	0.96	4%
42 (1 round)	5	11	4.16	3.16	0.76	24%
62 (1 round)	5	47	1.22	1.31	1.07	-7%
63 (1 round)	5	43	1.20	1.18	0.98	2%
40 (1 round)	6	12	5.36	4.32	0.81	19%
42 (2 rounds)	6	13	6.25	4.67	0.74	26%
50 (1 round)	6	50	2.26	1.73	0.77	23%
66 (1 round)	6	49	2.11	1.73	0.82	18%
13 (1 round)	7	10	4.16	3.50	0.84	16%
13 (1 round)	8	10	3.56	3.38	0.95	5%
16 (1 round)	8	10	3.11	2.55	0.82	18%
10 (2 rounds)	10	15	5.27	4.83	0.91	9%
13 (9 rounds)	15	15	5.74	4.19	0.73	27%
					average	11%

RELATIVE PLANIMETRIC IMPROVEMENTS ($I_1 = 1 - r2/r1$) obtained at check points by increasing beyond two the number of control points for determining a similarity which transforms orthophoto coordinates into ground coordinates

TABLE 7 (see FIG 5)



IMPROVEMENT OF PLANIMETRIC ACCURACY I_1 obtained on check points by increasing beyond 2 the number of control points which determine a similarity converting ortho-photo coordinates into ground coordinates (see table 7).

This improvement is related to check points, relatively to their r.m.s.e in the 1st transformation using a similarity based on two points.

FIG 5

where I_1 = improvement (%) of the r.m.s.e on check points by using a similarity based on N_b GCPs.

Nb = number of GCPs (Nb $\geqslant$2) actually used for similarity determination.

This improvement is obviously due to a better adjustment of the plane transformation when increasing the number of points which it is based on, through a reduction of the resulting error. Though relatively slow, this improvement can reach at least 10 % with six or seven control points, which is worth-while and not out of reach of a demanding user.

4.1.3 - c) Impact of the type of points : control versus check points.

For a number of control greater than five points (six to eight points) used to determine the similarity transformation, it can be meaningful to compare the accuracy on these control points with that on check points. The improvement I_2 noted on control points, ranges from 13 % to 73 %, with a value of 40 % on average, as shown in table 8.

4.1.4 AFFINITY ON GCPs

4.1.4 - a) In the next step, the question of whether scale variations could not occur between the x and y directions of the orthophotos, was considered. Hence an affinity based on GCPs replaced the above mentionned similarity.

This transformation may be outlined as follows :

$$\begin{vmatrix} X - X_o \\ Y - Y_o \end{vmatrix} = \begin{vmatrix} a & b \\ c & d \end{vmatrix} \cdot \begin{vmatrix} x - x_o \\ y - y_o \end{vmatrix} \qquad (4)$$

where :

X, Y	are ground co-ordinates of a point
X_o Y_o	are ground co-ordinates of GCPs centre of gravity
x, y	are orthophoto co-ordinates of the image-point
x_o y_o	are orthophoto co-ordinates of GCPs centre of gravity
a,b,c,d	are the four affinity parameters

Applying formula (4) to the whole GCPs, the number of which should exceed three, provides the value of the four parameters, a,b,c,d, using a least-squares adjustment method. Hence applying formula (4) to the whole GCPs and check points converts the orthophoto coordinates into ground coordinates and provides

the expected residuals,(denoted DX 3, DY 3 in the list of appendix 10.6), standard deviations and r.m.s.e. as well.

Comments on the results printed onto each form of appendix 10.5, are given in 4.1.6 and hereafter regarding the impact of the type of points and scale variations.

4.1.4 - b) Impact ot the type of points : control versus check points

For a number of control greater than five points determining the affine transformation (six to eight points), it can be meaningful to compare the accuracy on those control points with that on check points. The improvement noted on the same orthophotos as that of table 8 (in 4.1.3.c) ranges from 13 % to 77 %, with an average of 49 %, as shown in table 9.

4.1.4 - c) Scale variations in X/Y :

By computing the scales $1:S_x$ and $1 : S_y$, resp. in the x and y directions, from the value of the four parameters of the affine transformation, using the following formulae :

$$\left| \begin{array}{l} S_x = \sqrt{a^2 + c^2} \\ S_y = \sqrt{b^2 + d^2} \end{array} \right. \qquad (5)$$

small variations appear mainly as regards the smaller scale products, the scale S_x being larger than S_y by a factor of 10^{-3} on average (table 10).

The maximum error,either absolute or relative,which could result for an orthophoto of size 22 x 25 cm reaches 0,25 mm, and can therefore be considered as negligible.

Scaling the orthophoto onto the orthophotoprinter was therefore quite satisfactory for practical uses.

4.1.5 - SIMILARITY ON THE WHOLE POINTS

4.1.5 - a) In the fourth and last step, the similarity was computed by using the whole points available, both control and check points. A least-squares adjustment permitted it to determine the value of both a, b parameters of the plane transformation from the set of equations (1) obtained by applying formula (1) to each point, either GCP or check point, the barycenter being that of the whole points.

Then applying formula (1) to each point converts its orthophoto co-ordinates and provides the expected residuals,(denoted DX 4, DY 4 in the list of appendix 10.6), standard deviations and r.m.s.e as well.

ORTHOPHOTO N°	After similarity on whole GCPs, R.M.S.E (resultant vector) in meter		I_2 Improvement of accuracy at GCPs over check points
	at GCPs	at check points	
10	3.73	4.28	13 %
13	3.06	4.74	35 %
15	2.45	3.16	22 %
16	1.73	3.17	45 %
21	3.96	5.65	30 %
40	2.05	3.65	43 %
42	3.31	4.01	17 %
50	0.66	1.73	62 %
52	0.35	1.29	73 %
66	0.62	1.73	64 %
TOTAL : 10 ORTHOS			AVERAGE 40 %

IMPROVEMENT I_2 OF PLANIMETRIC ACCURACY AT GCPs (in number from six to eight) versus check points, for a similarity transformation adjusted on GCPs.

TABLE 8

ORTHOPHOTO N°	After affinity on GCPs, R.M.S.E (resultant vector) in meter		Improvement of accuracy at GCPs over check points
	at GCPs	at check points	
10	3.47	3.97	13 %
13	2.39	4.59	48 %
15	1.81	3.35	46 %
16	1.63	3.13	48 %
21	3.18	5.71	44 %
40	1.21	3.27	63 %
42	2.58	3.79	32 %
50	0.67	1.75	62 %
52	0.29	1.26	77 %
66	0.70	1.80	61 %
TOTAL : 10 ORTHOS			AVERAGE 49 %

IMPROVEMENT OF PLANIMETRIC ACCURACY at GCPs (in number from six to eight), versus check points, for an affine transformation adjusted on GCPs.

TABLE 9

ORTHOPHOTO N°	1 : SCALES, from affine transformation in x Sx	in y Sy	Average (Sx + Sy)/2	RELATIVE 1 : SCALE VARIATION
10	25 000	24 974	24 987	13
13	24 996	24 998	24 997	1
19	25 074	25 090	25 082	8
21	24 990	25 048	25 019	29
40	24 971	25 001	24 986	15
42	24 936	25 003	24 969	33
Average	24 994	25 019	25 007	13 i-e 0.5×10^{-3}
15	4 985	5 000	4 992	7
16	4 983	5 008	4 995	12
37	5 000	4 998	4 999	1
50	4 998	4 996	4 997	1
52	4 999	4 998	4 998	1
62	4 995	4 997	4 996	1
63	4 995	4 997	4 996	1
66	4 997	4 991	4 994	3
72	5 019	4 996	5 007	12
74	4 998	5 000	4 999	1
90	4 997	4 997	4 997	0
Average	4 997	4 998	4 998	1 i-e 0.2×10^{-3}

SCALE VARIATIONS IN X AND Y
from affinity transformation

TABLE 10

No distinction can be made between GCPs and check point and as there is no bias, the average of residuals is zero, in x and y and as the number of points is high enough, standard deviations and r.m.s.e are very near to each other ($\sum V^2/n \cong \sum V^2/n-1$).

Comments on the results printed onto each form of appendix 10.5 are given in 4.1.6.

4.1.5 - b) Impact of the number of control points of the transformation, on control points

Having achieved the four transformations above mentioned, which involve very different numbers of control points used for determining the parameters of the similarity, it is now possible to review the impact of the number of these control points on themselves, or more exactly, to study the improvement in accuracy for points which were simple check points and turn to be control points of the similarity.

It is not exactly what was done in 4.1.3 c, 4.1.4 b, tables 8 and 9, in which the accuracy on GCPs was compared to that on check points, for a number of six to eight GCPs. Now the range is increased up to 56 control points and the accuracy is studied on these actual points, as they are turning from a check point position into a control point position for the similarity.

Two ways are used for that purpose. First, by comparing the r.m.s.e on control points in the second transformation (4.1.3, similarity on the whole GCPs) relatively to the r.m.s.e on these same points, in the first transformation (4.1.2, on two points), in which they were check points merely. The relevant number of control points is ranging from 6 to 10. Second, by comparing the r.m.s.e on the whole points, which are control points of the fourth transformation (4.1.5, similarity on the whole points of each set) to the r.m.s.e they had before, in the first transformation (4.1.2, on two points) in which they were check points. The relevant number of control points is ranging from 11 to 56.

Results are indicated in table 11 and fig.6 in which curve(C) represents an hyperbolic law expressed by :

$$I_3 = 0.14 + 1.56/N_b \quad (6)$$

with a correlation factor of 0.97

where I_3 = accuracy improvement obtained on N_b points, by turning them into control points for similarity transformation.

N_b = number of related points

Of course, for a very small number of such points, the increase of accuracy is very high; for two points, it should tend to infinity as residuals on the two points which determine the similarity are zero.

ORTHOPHOTO N°	NUMBER OF CONTROL POINTS FOR THE SIMILARITY	IMPROVEMENT OF ACCURACY AT CHECK POINTS WHEN TURNING INTO A CONTROL POINT POSITION, IN		AVERAGE IMPROVEMENT I3 FOR EACH CLASS OF NUMBER OF POINTS
		2nd TRANSFORMATION RELATIVELY TO 1st ONE	4th TRANSFORMATION RELATIVELY TO 1st ONE	
40	6	76%		Class 1: 6 pts
42	6	30%		
42 (other round)	6	55%		51%
50	6	48%		
52	6	38%		
66	6	61%		
13	7	43%		Class 2: 7 pts 43%
13	8	27%		Class 3: 8 pts
16	8	31%		29%
10	10	15%		Class 4: 10-13 pts
10 (other round)	10	20%		
81	11		17%	19%
73	12		21%	
72	13		19%	
16	13		19%	
37	14		11%	Class 5: 14-18 pts
13	15		29%	
42	16		32%	23%
19	17		20%	
21	18		19%	
75	18		25%	
40	20		21%	Class 6: 20-24 pts
74	20		32%	
10	21		16%	22%
44	21		16%	
46	21		39%	
48	22		7%	
90	24		23%	
63	48		17%	Class 7: 48-56 pts
52	52		7%	
62	52		5%	17%
66	55		22%	
50	56		32%	

I3: IMPROVEMENT OF PLANIMETRIC ACCURACY AT POINTS, FIRST BEING CHECK POINTS IN A TWO-POINT SIMILARITY THEN TURNING INTO CONTROL POINTS FOR DETERMINATION OF 2nd AND 4th TRANSFORMATION OF SIMILARITY

TABLE 11

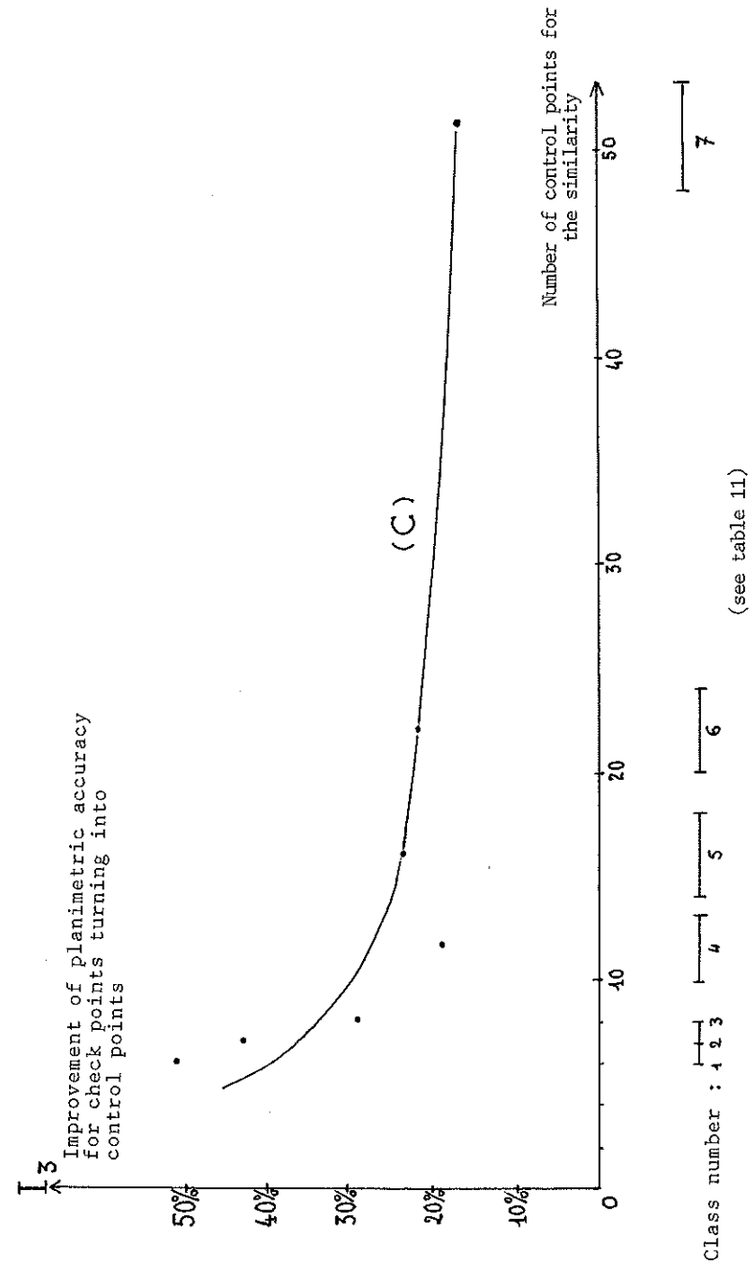


FIG 6

For 6 to 8 points, the improvement is about 35 % to 40 %, value which is of course near to that obtained in 4.1.3.c and 4.1.4.b. Then the improvement of accuracy decreases and is stabilized beyond 15 to 20 points at a value of about 20 %.

These results are coherent with those derived from formula (3), (4.1.3, b; fig. 5) and table 8 (4.1.3.c), obtained for 6 to 8 control points; the following relationship between the improvements I_1, I_2 and I_3 : $(1 - I_3) = (1 - I_2) . (1 - I_1)$ is well satisfied. Indeed for Nb = 6, I_1 = 20 % (table 7) I_2 = 40 %, I_3 = 50 % (table 11), expressing that the improvement of accuracy on points turning into a control position $(1 - I_3)$, is the product of improvements on check points when increasing the number of GCPs $(1 - I_1)$ by the improvement of accuracy of GCPs relatively to check points $(1 - I_2)$.

These results permit it to determine the extent to which a better accuracy can be obtained for both GCPs and check points when using a given orthophoto, by an increase of the number of points used as control points for the plane-transformation of coordinates. It could be recommended to use up to twelve or fifteen such control points, which provides an improvement of 20 % to 25 % on both GCPs and check points.

4.1.5 - c) Impact of the type of points :

This fourth transformation offers the opportunity to outline the improvement of accuracy related to GCPs, namely to points which were used as control points for the orthophoto production, since those GCPs take the same part as the other points in the determination of the parameters of the transformation. Hence the ratio of the r.m.s.e computed from those only GCPs to the r.m.s.e on the whole points provides the expected value as indicated in table 12 for 12 orthophotos, amounting to 58 rounds of measurements.

A general improvement can be noted, ranging from 3 % to 57 %, with a value of 22 %, on the average. This improvement is primarily due to a better geometric positioning of those GCPs on the orthophotograph, evolving from the special part taken in rectifying the aerial photograph, and, for a smaller part (2 %), to a slight reduction of the resulting pointing error at GCPs, due to three rounds of measurements instead of two at the other points.

4.1.6 COMPARISON OF ASSESSING METHODS

4.1.6 - a) Having achieved the planimetric assessment through four plane transformation methods for the majority of the products, it is possible to compare these methods as regards variations of accuracy on GCPs, check points, and on the whole points as well.

ORTHO-PHOTO N°	NUMBER OF ROUNDS	NUMBER OF GCPs FOR ORTHOPHOTO PRODUCTION	IMPROVEMENT OF R.M.S.E. (resultant vector) AT GCPs RELATIVELY TO THE OTHER POINTS
13	19	4 to 8	23 %
15	1	5	65 %
16	5	5 to 8	35 %
19	5	4 to 6	3 %
21	8	4 to 7	5 %
40	11	5 or 6	25 %
42	4	5 or 6	15 %
50	1	6	40 %
52	1	6	23 %
62	1	5	41 %
63	1	5	32 %
66	1	6	57 %
TOTAL 12 ORTHOS	58 ROUNDS	WEIGHTED AVERAGE :	22 %

IMPROVEMENT OF PLANIMETRIC ACCURACY

AT POINTS USED AS GCPs FOR THE ORTHOPHOTO PRODUCTION

TABLE 12

In fig.7 the value of r.m.s.e on check points is put equal to 1.0, for the first transformation, while it is equal to zero on control points used for setting up the similarity, because they are only two base points, which is the strict minimum, causing residuals to be zeros at these points.

Table 7 indicates the improvement of accuracy of the second transformation (based on the whole GCPs used for the orthophoto production) over the first one ; this improvement reaches 11 % on average on check points.

It is therefore efficient to use more than two points, for example five or six, in the determination of the similarity, as said already in 4.1.3 - b and 4.1.5 -b .

Table 13 shows the variations of r.m.s.e on control points of the similarity, between the second and third transformation and their value, relatively to that of r.m.s.e on check points in the first transformation, which is about half this one. The accuracy is improved on control points in the third transformation, relatively to the second one, because the affine transformation provides better adjustments on control points and smaller residuals, as four parameters are involved instead of two. Only orthophotos in which control point number is over four were considered in table 13.

Table 14 provides the ratio between r.m.s.e on check points, from the third and second transformations. From 14 orthophotos, it may be seen that this ratio shows little variations around the average value of 0.99 so that applying an affine transformation instead of a similarity does not appear worthwile.

Table 11 indicates results related to the fourth transformation, in the fourth column. In this transformation, the whole points are used as control points for the similarity, which are check points all the same, so that the r.m.s.e on check points is the same as that on control points. The average improvement over 22 orthophotos, relatively to the first transformation, reaches 21 %.

Hence , it may be seen that this fourth assessing method produces superior results to any previous method, increasing by 21 % the accuracy obtained; however, it requires much more control points for the similarity.

In fig.7 the overall comparisons may be seen.

4.1.6 - b) Scale Variations

Table 15 indicates more completely than table 10 does, the scales resulting from the fourth assessing methods for 22 orthophotos. Small to very small deviations from the theoretical value can be noted for a large number of products, especially for those at a scale of 1 : 5000.
The maximum relative deviations are - 2.5 x 10^{-3} and + 3.3x10^{-3} which would result in variations of -0.63 mm and 0.83 mm at orthophoto scale for a line of 250 mm long.

ORTHOPHOTO N°	NUMBER OF ROUNDS	RESULTING NUMBER OF CONTROL POINTS	RATIO r_2/r_1	RATIO r_3/r_1
10	4	34	0.76	0.71
13	19	132	0.55	0.43
15	5	21	0.76	0.66
16	5	35	0.54	0.51
19	5	26	0.72	0.48
21	8	45	0.70	0.57
37	1	6	0.82	0.98
40	11	57	0.56	0.33
42	4	22	0.59	0.46
50	1	6	0.29	0.30
52	1	6	0.27	0.22
62	1	5	0.28	0.24
63	1	5	0.35	0.25
66	1	6	0.29	0.33
TOTAL : 14 ORTHOS	WEIGHTED AVERAGE		0.59	0.47

where r_1 = r.m.s.e on check points in the 1st transformation
r_2 = r.m.s.e on control points in the 2nd transformation
r_3 = r.m.s.e on control points in the 3rd transformation

REDUCTION OF PLANIMETRIC R.M.S.E ON CONTROL POINTS IN A SIMILARITY AND AFFINE TRANSFORMATION BASED ON THESE POINTS RELATIVELY TO R.M.S.E ON CHECK POINTS IN A SIMILARITY ON TWO POINTS

TABLE 13

ORTHOPHOTO N°	NUMBER OF MEASUREMENTS	RATIO r_3/r_2
10	84	0.93
13	354	0.97
16	78	0.99
19	83	1.18
21	142	1.01
37	28	1.07
40	212	0.90
42	67	0.94
50	56	1.01
52	52	0.98
62	52	1.02
63	48	1.03
66	55	1.04
90	48	1.06
WEIGHTED AVERAGE		0.99

where r_2, r_3 = r.m.s.e (resultant vector x, y) on check points resp. in the 2nd and 3rd transformation (affinity)

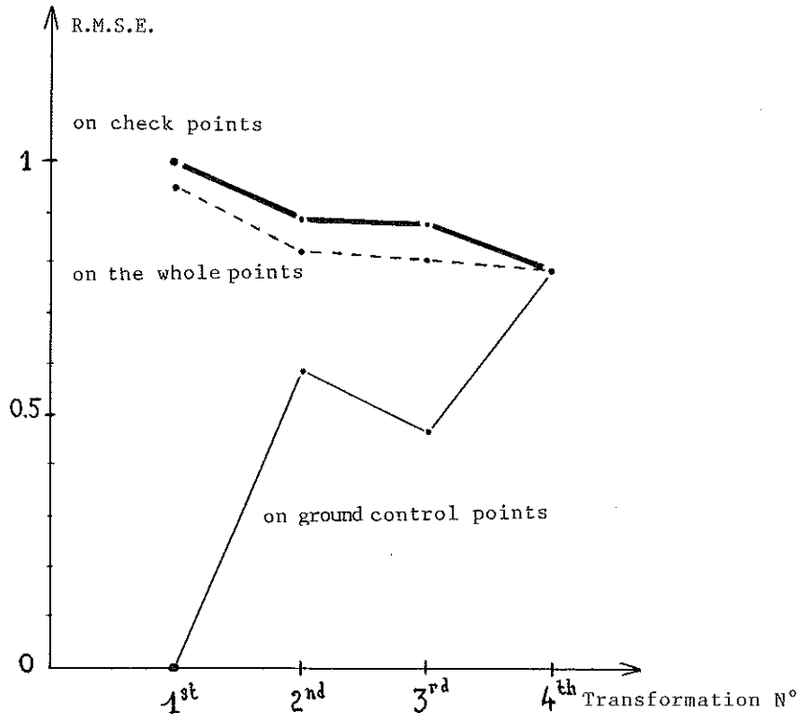
COMPARISON OF PLANIMETRIC R.M.S.E BETWEEN AFFINITY AND SIMILARITY BASED ON WHOLE GCPs

TABLE 14

ORTHOPHOTO N°	1 : SCALE AVERAGES FROM TRANSFORMATIONS N° 1	N° 2	N° 3	N° 4	GENERAL AVERAGE
10	24 937	24 953	24 987	24 960	24 959
13	24 985	24 986	24 997	24 989	24 989
19	25 019	25 063	25 082	25 017	25 045
21	24 986	25 015	25 019	24 979	24 999
40	24 992	24 991	24 986	24 996	24 991
42	24 981	24 974	24 970	24 978	24 976
15	5 001	5 004	4 992	5 000	4 999
16	5 000	4 999	4 995	5 000	4 998
37	5 001	4 999	4 999	5 000	5 000
44	5 000	4 998	N.A.	5 000	4 999
46	4 998	4 999	N.A.	4 999	4 999
48	5 000	4 996	N.A.	5 001	4 999
50	4 994	4 998	4 997	4 997	4 996
52	4 996	4 997	4 998	4 998	4 997
62	4 997	4 996	4 996	4 997	4 997
63	4 996	4 995	4 996	4 996	4 996
66	4 999	4 996	4 994	4 996	4 996
72	4 999	4 995	5 007	4 999	5 000
73	4 998	5 007	N.A.	4 998	5 001
74	5 003	4 997	4 999	5 004	5 001
75	4 998	4 996	N.A.	5 005	5 000
90	4 998	4 997	4 997	5 000	4 998
TOTAL : 22 ORTHOS					

SCALE VARIATIONS AS A FUNCTION OF THE ASSESSING TRANSFORMATION

TABLE 15



COMPARISON OF PLANIMETRIC R.M.S.E ON { CHECK POINTS ····· : ▬▬▬ ; GCPs ····· : ——— ; WHOLE (CHECK Pts + GCPs) ····· : - - - - }

RESULTING FROM FOUR ASSESSING TRANSFORMATIONS

(1st, 2nd, 4th : similarity, resp. on 2 points, GCPs, whole points)

(3rd : affinity on GCPs.)

FIG 7

As a conclusion, scaling the orthophoto onto the orthophotoprinter was generally quite satisfactory, though it is recommended to check the actual scale of the product when accurate improvements are required, at least by using two distant control points for clearing any possible film shrinkage.

4.1.7 GAUSSIAN DISTRIBUTION OF RESIDUALS

4.1.7 - a) Histogram in X

Table 16 indicates the distribution of |D X 4| = R residuals, resulting from the 4th transformation, arranged in 7 classes. Large variations can be noticed across the 18 orthophotos and 25 rounds involved, due to the very small number of points in each class for each round, since a round consists of 17 to 25 points on average. But the general average complies with a quite gaussian law, as shown off in fig. 8, proving a good agreement of the results with the normal distribution of accidental errors.

4.1.7 - b) Histogram in Y

Table 17 indicates in a similar way as above the distribution of R = |D Y 4| residuals, resulting from the 4th transformation. The same comments as in X can be made as regards variations across the 25 rounds and the fairly good general agreement with a normal distribution of accidental errors (in fig.9)

4.1.7. - c) Comparison of r.m.s.e in X and Y

Table 18 indicates the ratio obtained between the values of r.m.s.e in y and x, as can be partly deduced from tables 16 and 17, second column. This ratio is ranging from 0.63 to 1.77, with an average of 1.13; out of 22 orthophotos, 14 have a ratio greater than 1.0.

This result can be explained by the format of the orthophotos which is rather rectangular, of sizes 22 x 26 cm, 30 x 50 cm, 55 x 85 cm, 65 x 75 cm..., giving rise to a ratio of 1.2 to 1.7 between y and x sides, and to corresponding larger errors in the y direction, near the smaller side, the errors being more or less oriented in a radial direction, as they are primarily caused by heighting errors.

Anyway, the values which have been kept in each form of appendix 10.5 are the resultant vector x,y which is the most appropriate indicator of the metrical accuracy of a product.

ORTHOPHOTO N°	R.M.S.E IN X AT THE 4th TRANSFORMATION R_o (in meter)	RELATIVE NUMBER OF POINTS IN EACH CLASS OF R = |DX4| RESIDUALS						
		1	2	3	4	5	6	7
		$R \leq \frac{R_o}{3}$	$\frac{R_o}{3} \leq R < \frac{2}{3} R_o$	$\frac{2}{3} R_o \leq R < R_o$	$R_o \leq R < \frac{4}{3} R_o$	$\frac{4}{3} R_o \leq R < \frac{5}{3} R_o$	$\frac{5}{3} R_o \leq R < 2 R_o$	$R \geq 2 R_o$
		%	%	%	%	%	%	%
10	3.81	36	20	24	0	4	4	12
	1.27	41	18	18	12	0	0	11
13	1.48	12	24	24	17	0	12	11
	3.53	40	20	15	10	0	10	5
16	1.53	17	28	28	6	11	10	0
19	3.15	17	11	22	39	11	0	0
21	2.73	5	40	10	35	5	0	5
	2.18	26	11	26	21	11	0	5
40	1.81	19	30	22	8	10	8	3
	1.87	23	31	8	15	12	11	0
	2.08	33	33	12	11	0	0	11
	2.07	33	22	17	12	0	11	5
42	3.56	37	21	26	0	5	0	11
	1.98	39	17	17	6	5	11	5
44	1.16	19	19	19	24	14	5	0
46	1.33	43	14	14	10	10	0	9
48	1.35	36	18	18	5	9	9	5
50	0.94	29	28	18	7	7	4	7
52	0.75	37	15	19	12	6	7	4
62	0.58	27	33	8	17	4	7	4
63	0.50	21	38	13	6	10	8	4
66	0.80	29	22	16	15	6	7	5
74	1.74	25	25	10	15	20	5	0
75	1.45	39	11	6	22	17	5	0
90	1.13	38	17	17	8	8	12	0
GENERAL AVERAGE 18 ORTHO-PHOTOS / 25 ROUNDS		28.6 %	23.9 %	16.5 %	12.5 %	7.4 %	6.3 %	4.9 %
			69 %					

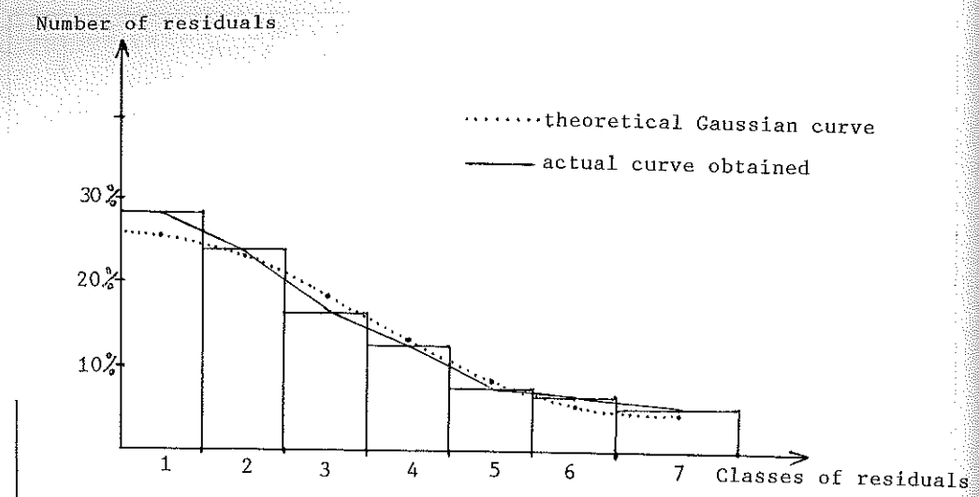
DISTRIBUTION OF RESIDUALS IN X
IN THE 4th TRANSFORMATION

TABLE 16

ORTHOPHOTO N°	R.M.S.E IN Y AT THE 4th TRANSFORMATION R_o (in meter)	RELATIVE NUMBER OF POINTS IN EACH CLASS OF |DY4| = R RESIDUAL						
		1	2	3	4	5	6	7
		$R \leq \frac{R_o}{3}$	$\frac{R_o}{3} \leq R < \frac{2 R_o}{3}$	$\frac{2 R_o}{3} \leq R < R_o$	$R_o \leq R < \frac{4}{3} R_o$	$\frac{4}{3} R_o \leq R < \frac{5}{3} R_o$	$\frac{5}{3} R_o \leq R < 2 R_o$	$R \geq 2 R_o$
		%	%	%	%	%	%	%
10	2.59	24	36	12	12	4	8	4
	2.08	24	12	24	17	23	0	0
13	1.48	18	29	18	12	12	11	0
	5.00	20	40	10	20	0	0	10
16	1.65	28	6	44	6	5	11	0
19	3.41	17	33	17	22	0	6	5
21	3.80	30	20	15	20	5	5	5
	3.30	26	26	11	16	5	16	0
40	1.73	30	22	22	5	11	8	2
	2.15	27	19	23	19	4	0	8
	2.43	44	22	11	0	6	11	6
	2.58	33	33	0	17	11	0	6
42	3.05	11	26	42	11	0	5	5
	3.28	39	17	17	11	0	11	5
44	0.88	33	19	14	10	19	5	0
46	0.84	29	10	29	24	4	0	4
48	1.59	36	23	18	9	5	0	9
50	1.22	32	25	9	20	5	2	7
52	0.91	29	37	10	6	4	5	9
62	0.99	29	33	11	13	2	2	10
63	0.84	31	25	19	7	4	6	8
66	1.41	25	29	13	13	13	4	3
74	1.69	35	25	10	10	5	15	0
75	1.68	33	17	22	11	0	11	6
90	0.97	25	29	17	8	8	13	0
GENERAL AVERAGE 18 ORTHO-PHOTOS / 25 ROUNDS		28.6 %	25.8 %	16.2 %	12.3 %	6.2 %	5.6 %	5.3 %
			70.6 %					

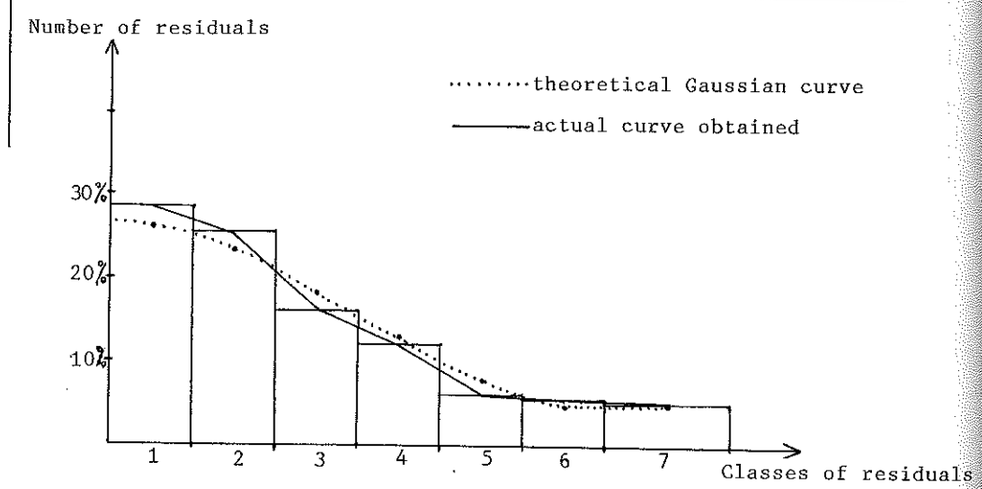
DISTRIBUTION OF RESIDUALS IN Y
IN THE 4th TRANSFORMATION

TABLE 17



HISTOGRAM IN X

FIG 8



HISTOGRAM IN Y

FIG 9

ORTHOPHOTO N°	RATIO BETWEEN R.M.S.E IN Y AND X
13	1.06
10	0.80
15	0.97
16	1.19
19	1.08
21	1.23
37	1.04
40	1.11
42	1.04
44	0.82
46	0.63
63	1.69
66	1.77
72	0.70
73	0.69
48	1.17
50	1.30
52	1.22
62	1.72
74	0.97
75	1.16
90	0.90
WEIGHTED AVERAGE	1.13

RATIO BETWEEN R.M.S.E IN Y AND X
FROM THE 4th TRANSFORMATION

TABLE 18

4.2 IMPACT OF THE TYPE OF POINTS

4.2.1 TARGETTED POINTS

One third of the measurements were carried out on targetted points easy to stereoview on products at 1 : 5 K-scale, derived from photographs at 1 : 16 K and 1 : 30 K-scale, and to a less extent, on orthophotos at 1 : 25 K-scale. It is possible to outline the improvement of accuracy obtained at targetted points, considering three classes of products, as a function of the input and output scales. Table 19 indicates improvements on targetted points, relatively to natural features, related to 20 orthophotos and to the 4th assessing tranformation. These improvements are ranging from 3 % to 50 %, with values in each class as follows, on the average (fig.11):

class N°	1 : scale of aerial survey		orthophoto	Improvement at targets in planimetric
1	30 K	→	25 K	16 %
2	30 K	→	5 K	25 %
3	16 K	→	5 K	40 %

The signalised points were established for cadastral purposes at 1 : 7 K-scale and 1 : 16 K-scale, so that the results are in agreement with the goal aimed at.

Hence it is highly recommended to use some targetted points to obtain a better overall accuracy of the product, at least among points used as GCPs.

These results highlight once more the proper account which should be taken of the identification of details, and of the availability of well-defined points belonging to distinctive features, with unarguable ease of identification, for the purpose of control or measurements as well.

4.2.2 TARGETTED CONTROL POINTS

It can be of interest to determine whether targetted control points benefit from both improvements or not, as control points and as signalised points.

Referring to the 2nd transformation, in which control points are the same for both orthophoto production and assessment, it should be noted that GCPs comprise the same proportion of targets as check points do (33 %), so that the improvement of accuracy on GCPs and targetted GCPs, over check points, cannot be attributable to a biased distribution of targets in GCPs.

CLASS OF PRODUCT	ORTHO-PHOTO N°	NUMBER OF MEASUREMENTS ON TARGETTED POINTS	NUMBER OF MEASUREMENTS ON NATURAL POINTS	TOTAL NUMBER OF MEAS^ts	R.M.S.E. (result. vector) in meter, on TARGETTED POINTS	NATURAL POINTS	WHOLE POINTS	RELATIVE PLANIMETRIC IMPROVEMENT AT TARGETS OVER NATURAL POINTS
N° 1 (30 K→25 K)	10	26	58	84	2.68	4.39	3.94	39 %
	13	82	272	354	3.10	3.86	3.70	21 %
	19	30	53	83	4.38	4.61	4.53	5 %
	21	45	97	142	4.19	4.35	4.30	4 %
	40	77	135	212	2.46	2.85	2.72	14 %
	42	25	42	67	3.06	3.82	3.56	20 %
	TOTAL: 6 ORTHOS				WEIGHTED AVERAGE			16 %
N° 2 (30 K→5 K)	15	22	21	43	2.60	3.57	3.11	27 %
	16	26	52	78	1.73	2.64	2.38	35 %
	37	18	10	28	2.15	2.23	2.18	4 %
	44	27	15	42	1.26	1.78	1.47	30 %
	46	14	7	21	1.36	1.84	1.54	26 %
	48	16	6	22	2.02	2.09	2.04	3 %
	74	14	6	20	2.13	2.85	2.37	25 %
	75	13	5	18	1.99	2.55	2.16	22 %
	90	32	16	48	1.18	1.97	1.49	40 %
	TOTAL: 9 ORTHOS				WEIGHTED AVERAGE			25 %
N° 3 (16 K→5 K)	50	17	39	56	1.02	1.68	1.51	40 %
	52	19	33	52	0.69	1.37	1.17	50 %
	62	18	34	52	0.78	1.28	1.13	39 %
	63	17	31	48	0.74	1.07	0.97	31 %
	66	19	36	55	1.10	1.82	1.61	40 %
	TOTAL: 5 ORTHOS				WEIGHTED AVERAGE			40 %
	GENERAL TOTAL: 20 ORTHOS							

IMPROVEMENT OF PLANIMETRIC ACCURACY
AT TARGETTED POINTS
(USING THE 4th TRANSFORMATION)

TABLE 19

Table 20 indicates the results among those orthophotos mentionned in the previous table 19, which have a significant number of GPCs and targetted GPCs. Consequently, the whole products of class 3 have been removed along with a large part of those of class 2 which reduces the statistical value of the results. However, the average improvement of planimetric accuracy at targetted GCPs over non-targetted GCPs appears of the same order of magnitude as at ordinary points, 19 % for class 1 versus 16 % and 39 % for class 2 versus 25 %.

It can therefore be stated that improvements have a cumulative effect at points which own both related properties.

4.2.3 POINTS FROM AERIAL SURVEYS AT 1 : 7000

Some orthophotos located around La Capelle-Marival for a large part of their area, comprise several points which have been determined by plotting stereopairs at 1 : 7000. Though their number is rather small, an improvement of accuracy of 7 % may be shown in table 21, relatively to the other points, probably due to a better accuracy of their co-ordinates and to an easier identification of the feature.

4.2.4 POINTS FROM AERIAL SURVEYS AT 1 : 30 000

Conversely it can be of interest to assess whether check points determined by plotting stereopairs at 1 : 30 000 have a degraded accuracy or not. Table 22 indicates the results from 9 orthophotos. The improvement of accuracy of 3 % obtained is not very significant, whence it can be asserted that these points have about the same accuracy as the other points, on the average.

4.3 IMPACT OF THE LOCATION OF POINTS

4.3.1 NEAR-NADIR POINTS

Let us denote Near-Nadir points, those which are located inside an arbitrary area determined by a circle surrounding the nadir point, corresponding to points viewed at an angle equal to 15° with the principal axis. The radial distance of those so-called near-nadir points is smaller than or equal to 4 cm, at photo scale, and this nadir area is about 11.5 % of the area of a stereopair (fig. 10). About 191 measurements can be identified as at near-nadir points, out of a total of 1860 measurements in a set of 20 orthophotos listed in table 23, which corresponds fairly well to the relative surface of the nadir area (191 : 1860 = 10.3 % instead of 11.5 %).

CLASS OF PRODUCT	ORTHO-PHOTO N°	NUMBER OF MEASUREMENTS ON TARGETTED GCPS	NUMBER OF MEASUREMENTS ON NATURAL GCPs	TOTAL NUMBER of MEASts ON GCPs	R.M.S.E (result.vector) in meter, on TARGETTED GCPs	R.M.S.E (result.vector) in meter, on NATURAL POINTS	R.M.S.E (result.vector) in meter, on WHOLE GCPs	RELATIVE IMPROVEMENT AT TARGET GCPs OVER NATURAL GCPs
1 (30K→25K)	10	16	18	34	2.04	4.77	3.73	57 %
	13	19	113	132	2.98	3.07	3.06	3 %
	19	6	20	26	4.96	4.18	4.37	−18 %
	21	16	29	45	3.48	4.20	3.96	17 %
	40	22	35	57	1.42	2.36	2.05	40 %
	42	11	11	22	1.83	4.31	3.31	58 %
					WEIGHTED AVERAGE			19 %
2 (30K→5K)	15	11	10	21	1.49	4.82	3.50	69 %
	16	20	15	35	1.52	1.98	1.73	23 %
					WEIGHTED AVERAGE			39 %

IMPROVEMENT OF PLANIMETRIC ACCURACY
AT TARGETTED GCPs
(USING THE 2nd TRANSFORMATION)

TABLE 20

ORTHOPHOTO N°	NUMBER OF POINTS FROM 1 : 7 K	R.M.S.E (resultant vector) in meter AT POINTS FROM 1 : 7 K	AT OTHER POINTS	RELATIVE IMPROVEMENT AT POINTS FROM 1 : 7 K
13	7	2.76	2.83	3 %
19	5	6.83	8.22	17 %
21	5	3.77	5.16	27 %
66	3	2.21	1.62	-36 %
TOTAL 4 Orthophotos, 20 points		WEIGHTED AVERAGE		7 %

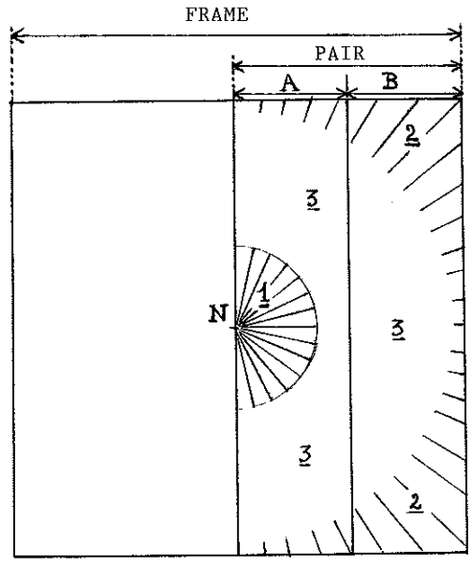
IMPROVEMENT OF PLANIMETRIC ACCURACY
AT POINTS PLOTTED FROM 1 : 7K-SCALE SURVEY
OVER OTHER POINTS (USING 4 th TRANSFORMATION)

TABLE 21

ORTHOPHOTO N°	NUMBER OF MEASUREMENTS AT POINTS PLOTTED FROM 1 : 30 K	R.M.S.E (resultant vector) in meter AT POINTS FROM 1 : 30K R_{30}	AT OTHER POINTS R_o	RATIO $\frac{R_{30}}{R_o}$
13	34	3.04	3.19	0.97
21	15	4.54	4.38	1.04
37	3	2.06	2.64	0.78
40	16	1.94	2.59	0.75
42	8	2.48	3.40	0.73
44	8	1.96	1.56	1.26
48	4	1.77	2.09	0.85
74	4	2.42	2.43	1.00
90	10	1.92	1.51	1.27
TOTAL 9 Orthophotos	102 points	WEIGHTED AVERAGE		0.97

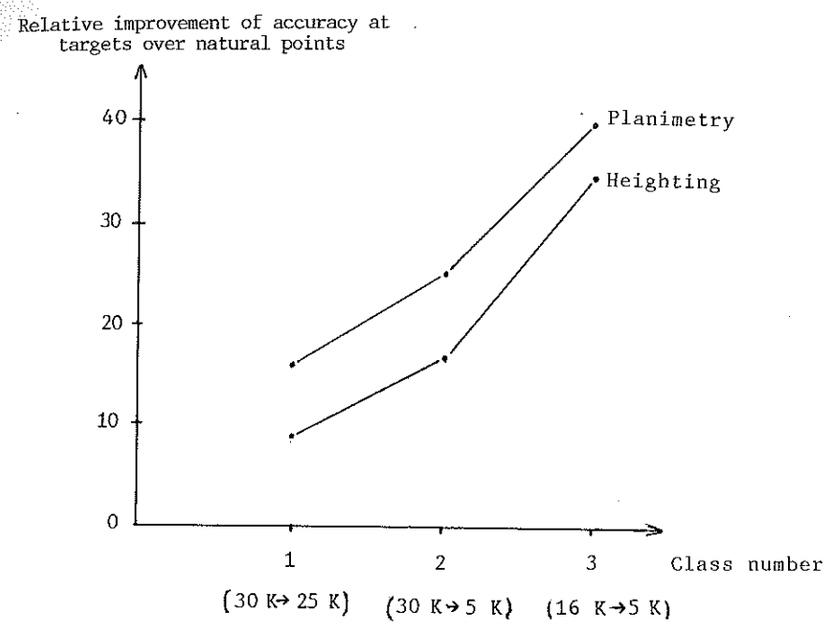
COMPARISON OF PLANIMETRIC ACCURACY
BETWEEN POINTS PLOTTED FROM 1 : 30 K-SCALE AERIAL SURVEY
AND OTHER POINTS (USING 4 th TRANSFORMATION)

TABLE 22



Parts of a pair	Relative Area	Relative r.m.s.e. Plani	Height
1 : Nadir area	11.5 %	0.81	0.71
2 : Corner area	21.0 %	1.03	1.03
3 : Intermediate area	67.5 %	1.02	1.03
Total, on a pair	100.0 %	1.00	1.00
A : Nadir half	50 %	0.96	0.94
B : Corner half	50 %	1.04	1.06
Total, on a pair	100 %	1.00	1.00

FIG 10



(see tables 19 and 28)

IMPROVED ACCURACY AT TARGETTED POINTS

FIG 11

An improvement of 21 % on the average is reached at near-nadir points, over other points located in the other parts, which is significant of the better quality obtained in the nadir area of an orthophoto, due to a much smaller impact of possible errors in the D.T.M interpolated from contours in this area. It is a most important result which leads to recommend that the whole nadir area be always used when rectifying an aerial photograph, instead of processing by stereopairs, involving only half this nadir area (see chapter 6).

4.3.2 TARGETTED NEAR-NADIR POINTS

In a similar way as in 4.2.2, regarding the cumulative effect at points having two separate properties, it is possible to check the improvement at targetted near-nadir points. Only two orthophotos have a significant number of such points as follows :

Orthophoto n°	Number of targetted Near-Nadir points	Improvement at targetted Near-Nadir points, in planimetry
13	13	37 %
40	7	34 %
	WEIGHTED AVERAGE :	36 %

Considering that, from table 19, the improvements due to the property of being targetted were 21 % and 14 % resp. for orthophoto n° 13 and 40, and that the improvement due to the property of being a near-nadir point was respt. 15 % and 11 % (see 4.3.1), the resulting improvements I should be as follows :

ORTHO N° 13 : (1 - I) = (1-21 %) x (1 - 15 %)
ORTHO N° 40 : (1 - I) = (1-14 %) x (1 - 11 %)

whence resp. I = 32 % and 24 % values which are not that far from the observed ones of 37 % and 34 %.

It can once more be stated that improvements have a cumulative effect at points which own two distinct properties.

4.3.3 POINTS NEAR TO THE CORNERS

Points are arbitrary said to be located in the corners of the aerial photograph, when the viewing angle shown with the vertical axes is beyond 35° so that their radial distance is over 10.5 cm, at photo scale (area n° 2, fig. 10). This area is about 21 % of that of a stereopair and about 468 measurements

ORTHOPHOTO N°	NUMBER OF MEASUREMENTS AT NEAR-NADIR POINTS	IMPROVEMENT OF PLANIMETRIC ACCURACY AT NEAR-NADIR POINTS
13	44	15 %
15	12	50 %
16	9	21 %
19	11	68 %
21	10	30 %
26	18	72 %
29	3	38 %
37	9	- 2 %
40	16	11 %
42	9	19 %
44	10	- 12 %
48	5	21 %
50	3	28 %
52	3	17 %
62	3	13 %
63	3	6 %
66	3	9 %
72	3	- 24 %
73	3	- 43 %
90	14	- 3 %
TOTAL : 20 ORTHOPHOTOS	191 measurements	WEIGHTED AVERAGE 21 %

IMPROVEMENT OF THE PLANIMETRIC ACCURACY AT NEAR-NADIR POINTS OVER OTHER POINTS (USING THE 4 th TRANSFORMATION)

TABLE 23

have been identified as related to such points out of 1833, which is a little more than the relative surface of this corner area (468 : 1863 = 25.5 % instead of 21 %) because some more check points have been established in Lacapelle-Marival (S-W corner) and in the more rugged N-E corner. A list of 21 orthophotos is given in table 24 resulting in a slight degrading of the accuracy at points near the corner of 3 % relatively to the whole points, which is 5 % relatively to the points which do not belong to the corner area. It is perhaps less than it could be expected, all the more as one third of the orthophoto does not show similar degrading in the corners. Perhaps this area is too large and could have been restricted or the DTM was good enough relatively to other sources of errors.

4.3.4 NADIR HALF OF A PAIR

The nadir half of a pair is the narrow rectangular strip in fig. 10, having a longer side through the nadir point and the other one dividing the stereopair into two equal parts. Table 25 indicates the results for 18 orthophotos and 424 measurements at points located in this area, out of a total of 837 measurements corresponding to the rounds involved, which is in good agreement with the relative surface of this area (424 : 837 = 50.7 % instead of 50.0 %), which results from an even distribution of check points all over the test area.

As a result, an improvement of 4 % can be noted for the planimetric accuracy in the nadir half relatively to the whole pair, which represents an improvement of 8 % between this nadir half and the other one.

Referring to fig. 10, the nadir half denoted A, consists mainly of parts 1 (nadir area, relative surface 23 % of A, r.m.s.e 0.81) and 3 (intermediate area, relative surface 77 % of A, r.m.s.e 1.02) which yields an approximate value of its r.m.s.e equal to $\sqrt{0.23 \times (0.81)^2 + 0.77 \times (1.02)^2} = 0.976$, quite near to the value obtained (0.96).

4.3.5 NEIGHBOURING POINTS

As many photogrammetric products, orthophotos are primarily used as tools for interpolating points near to each other, either for map up-dating or for civil engineering projects.

It can be of interest to assess the homogeneity of an orthophoto and to outline the improvement of accuracy in the relative positioning of two neighbouring points, located at a distance of e.g. less than 3 % of the size of the orthophoto from each other (from 40 m to about 200 m).

ORTHOPHOTO N°	NUMBER OF MEASUREMENTS NEAR CORNERS	RATIO BETWEEN PLANIMETRIC R.M.S.E AT CORNERS AND R.M.S.E AT WHOLE POINTS
10	30	0.94
13	117	0.92
15	6	0.80
16	31	1.16
19	29	0.93
21	35	1.01
26	31	1.24
27	10	0.69
29	10	1.27
40	43	1.09
42	20	0.90
44	6	0.97
48	3	1.11
50	12	1.21
52	11	1.18
62	23	1.10
63	21	0.97
66	12	1.25
74	8	1.06
75	4	1.13
90	6	1.29
TOTAL : 21 ORTHOPHOTOS	468 MEASUREMENTS	WEIGHTED AVERAGE 1.03

PLANIMETRIC ACCURACY
NEAR CORNERS
(USING THE 4 th TRANSFORMATION)

TABLE 24

ORTHOPHOTO N°	NUMBER OF MEASUREMENTS IN NADIR HALF	NUMBER OF MEASUREMENTS IN THE PAIR	RATIO BETWEEN PLANIMETRIC R.M.S.E. AT POINTS IN NADIR HALF AND R.M.S.E ON WHOLE POINTS
10	8	17	0.97
15	28	43	0.85
16	22	48	0.83
19	36	83	1.09
21	37	68	0.96
26	58	92	0.95
27	8	32	1.13
29	14	38	0.93
37	18	28	1.07
40	43	65	0.92
48	15	22	0.93
50	26	56	1.04
52	23	52	0.95
62	15	52	1.04
66	26	55	0.98
74	9	20	0.93
75	10	18	0.98
90	28	48	0.95
TOTAL 18 ORTHOS	424 Measur^{t}	837 Measur^{t}	WEIGHTED AVERAGE 0.96

PLANIMETRIC ACCURACY
IN THE NADIR HALF
OF A PAIR
(USING THE 4 th TRANSFORMATION)

TABLE 25

Table 26 indicates the results regarding the relative planimetric error between 25 pairs of neighbouring points, measured through a total number of 82 rounds. Large improvements can be noted for the majority of the pairs, while the average improvement obtained reaches 27 %. Thus it may be asserted that orthophotos have better homogeneity at short distances which makes them very suited to many users who need a better relative accuracy in smaller areas.

4.3.6 NEAR-NADIR NEIGHBOURING POINTS

Considering in the previous table 26 that 4 pairs of neighbouring points are located in near-nadir areas (pairs marked with N in columns), it is possible to verify once more the cumulative improvement on these pairs, resulting from the fact they are near-nadir points (improvement 21 %) and neighbouring points (improvement 27 %).

Indeed, the average observed improvement I at these four pairs of points is 38 % while it should be about :

$1 - I = (1-21\%) \times (1-27\ \%)$ whence $I = 42\ \%$, near to the actual value of 38 %.

4.3.7 TYPE OF RELIEF

Four categories of relief have been considered as function of both the maximum in height differences and elevation standard deviations around the average value, as follows :

Class of relief	$H_{max} - H_{min}$	Elevation standard deviation
1	55 to 100 m	20 m
2	100 to 180 m	40 m
3	160 to 220 m	60 m
4	210 to 240 m	75 m

Some orthophotos having similar parameters as regards the scales of aerial photograph, DTM and orthophoto, but belonging to different classes of relief, a review of the impact of the type of relief can be approached.

PAIR OF POINTS N°	DISTANCE	NUMBER OF ROUNDS	AVERAGE RATIO (IN THE ROUNDS) BETWEEN THEIR RELATIVE PLANIMETRIC ERROR AND R.M.S.E. BETWEEN TWO POINTS ($\sqrt{2}$ x R.M.S.E. OF THE ROUNDS)		RELATIVE HEIGHTING ERROR AND R.M.S.E. BETWEEN TWO POINTS ($\sqrt{2}$ x R.M.S.E. OF THE ROUNDS)	
603-3301	70 m	5	0.62		0.48	
604 - 607	135 m	5	1.26		0.47	
604 - 763	75 m	5	0.88		0.66	
613 - 616	155 m	1	0.27		0.43	
614 - 619	120 m	1	1.25		0.12	
701-2806	100 m	1	0.62		0.59	
702 - 772	235 m	1	0.17		0.16	
704-5705	150 m	2	0.85		0.13	
714-5703	200 m	1	0.49		0.55	
729-2101	80 m	3	0.76		0.95	
733-2007	100 m	6	0.80		0.54	
733-2702	125 m	1	0.62		0.23	
739 - 740	165 m	4	0.30		0.61	
739 - 741	20 m	1	0.88		N.A.	
745-6203	180 m	3	0.40		1.17	
746-6203	190 m	4	0.68		0.75	
748-6102N	145 m	5	0.71	N	0.50	N
749-6101	75 m	3	0.70		1.58	
754 - 758	190 m	9	0.55		0.54	
756 - 757	40 m	2	1.41		1.08	
778 - 780N	225 m	2	0.45	N	0.28	N
783-1084N	70 m	1	0.40	N	0.69	N
812-2906N	180 m	8	0.63	N	0.30	N
821-5908	85 m	3	1.44		0.35	
1070-1700	70 m	5	0.82		0.20	
TOTAL: 25 pairs		82 rounds	WEIGHTED AVERAGES	0.73	0.56	

RELATIVE PLANIMETRIC
AND HEIGHT ACCURACIES BETWEEN
TWO NEIGHBOURING POINTS
(USING THE LAST TRANSFORMATION)

(N = near nadir points)

TABLE 26

Two comparisons between the r.m.s.e (resultant vector) obtained, can be carried out as follows :

ORTHOPHOTO N°	CLASS OF RELIEF II	III	IV	IMPROVEMENT II/III or/IV
72		2.01 m		
73	2.02 m			
74		2.37		
75		2.16		
37		2.18		
Average	2.02 m	2.18 m		7.3 %
10	3.94			
13			3.70	
40	2.72			
42	3.56			
Average	3.41		3.70	7.8 %

A small improvement of 7 % to 8 % seems resulting from a smoother relief, but it is difficult to be more affirmative as other parameters have changed (operative center, slit width).

5 - ALTIMETRIC ASSESSMENT

5.1 SETTING UP STEREO-ORTHOPHOTO-PAIRS

5.1.1 TWO ASSESSING METHODS

In order to eliminate systematic errors such as those resulting from a wrong value used for the ratio of the air base to the flying height, from film shrinkage or from small unwanted rotations between the orthophoto and its stereomate when measuring the Px parallax, the formula parameters giving elevations as function of parallaxes were always determined from the measurements themselves.

Two methods aimed at computing these parameters were used, both requiring height control points, and described hereafter in 5.1.1-a and 5.1.1-b.

Then applying these formulae at each point allows to convert the observed parallax into height above datum, to compare the computed values to the known values listed in the general catalogue and to obtain the standard deviation and r.m.s.e.

5.1.1-a) Adjustment on two points.

In a way similar to that which a user would follow when checking the formula delivered to him together with the stereo-ortho-pair, parameters are determined hereat two points having the largest height difference of the pair.

When a linear interpolation is used, the method is quite simple, referring to the following formula :

$$Px = k.(z-z_0) \quad (7)$$

where Px = observed parallax at a point between orthophoto and stereomate image points.

k = constant, near to the ratio of the air base B to the flying height H_0.

z = elevation of the point

z_0 = datum constant.

Two points are required to determine k and z_0 in formula (7), and the software obviously chooses those at which z is maximum and minimum.

Once k and z_o known , z is derived from p_x applying (7) at each point.

When a logarithmic interpolation is used, a first iteration with formula (7) gives similarly an approximate value for $k = B/H_o$, (H_o being fixed equal to the given flying height) and z_o. Applying then the logarithmic formula (8) :

$$p_x = - B. \log (H_o - z + z_o) / H_o \quad (8)$$ with the above values of B, H_o and z_o, gives rise to residuals dp_x at the two previous base points.

Differentiating (8) in p_x, B and z_o permits it to determine the small variations dB and dz_o to be brought to B and z_o to remove residuals dp_x at both base points :

$$dp_x = -dB. \log (H_o - z + z_o)/H_o - B\, dz_o/(H_o - z + z_o) \quad (9)$$

In general one round of iteration is enough.

5.1.1-b) Adjustment on the whole points

In a way similar to that of the method used in the fourth plane-transformation of co-ordinates in the planimetric assessment, parameters are determined here at the whole points available in the stereopair, used as height control points, whatever they were for producing the orthophoto, control points or not.

When a linear interpolation is used, the method refers to formula (7) which is applied to the whole points, using for k and z_o the values previously computed at the two base points. Then a least-squares solution is resorted to and the small required variations dK and dz_o yielded.

When a logarithmic interpolation is used, referring to (8) and applying it to the whole points using the values previously obtained in 5.1.1-a) for B and z_o, gives rise to residuals dp_x which are solved by formula (9) and a least-squares adjustment.

5.1.2 COMPARISON OF METHODS

A large number of stereo-orthophoto-pairs having been assessed by both above methods, it is possible to determine to what extent the second one provides better results.

Table 27 provides a list of 19 orthophotos, involving 22 stereomates, which have thus been assessed twice. An improvement reaching up to 41 % can be noted, while the average improvement in heighting accuracy is 21 %.

ORTHOPHOTO N°	STEREO-ORTHO-PHOTO N°	R.M.S.E. IN HEIGHT (in meter) BY COMPUTING INTERPOLATION PARAMETERS ON		RESULTING IMPROVEMENT USING WHOLE POINTS
		TWO POINTS	THE WHOLE POINTS	
10	14	3.04 m	1.90 m	37 %
13	11 and 12	2.99	2.80	6 %
15	18	1.54	1.04	32 %
16	17	0.87	0.59	32 %
19	22	1.75	1.39	21 %
21	20 and 23	1.89	1.38	27 %
37	38 and 39	4.85	3.92	19 %
44	47	1.94	1.89	3 %
46	45	1.68	1.59	5 %
48	49	2.68	2.31	14 %
50	51	1.21	0.86	29 %
52	53	1.12	0.77	31 %
66	67	1.27	0.87	31 %
72	76	1.31	1.35	-3 %
73	77	2.21	1.54	30 %
74	78	1.30	1.27	2 %
75	79	1.01	0.91	10 %
90	91	2.80	1.65	41 %
90	92	2.53	1.78	30 %
TOTAL 19 ORTHOS	22 STEREOMATES		AVERAGE	21 %

COMPARISON OF ALTIMETRIC ASSESSING METHODS AND RESULTS

TABLE 27

It is interesting to point out that it is exactly the same improvement as that obtained for the planimetric assessment when using a plane transformation based similarly on the whole points instead of two only.

Hence it may be stated that using some more than two height control points should be recommended when deriving elevations above datum from stereo-orthophoto-pairs, the altimetric accuracy being improved in proportion up to 21 % on the average.

This improvement comes not only from a reduction of the resulting error when using an average on several points, but from removing by a least-squares adjustment a possible rotation between the stereomate and the orthophoto when setting up the pair onto the carriages of the measurement device. Indeed removing y parallaxes from the pair can sometimes reveal difficulties due to non-error free D.T.M, which involves radial distorsions including unwanted y parallaxes in the orthophoto production stage.

For example, when calibrating formula (7) using points n° 717 and 2704 as height control for stereopair n° 26-24, at 1 : 5 K-scale, the results gave rise to large residuals and systematic errors indicated by the following values :

altimetric standard deviation	:	3.84 m
average residual	:	3.51 m
r.m.s.e. in height	:	5.17 m

Inspecting the distribution of residuals DZ over the pair showed clearly the impact of an unwanted K rotation in the inner orientation of the pair, represented by a linear relationship such as DZ = -64 + 0.027 x Y with a correlation factor of 0.85. After correcting for such a rotation, the results were dramatically improved as follows :

altimetric standard deviation	:	1.73 m
average residual	:	0.88 m
r.m.s.e. in height	:	1.92 m

5.2 IMPACT OF THE TYPE OF POINTS

5.2.1 TARGETTED POINTS

Similarly to the analysis carried out in 4.2.1 regarding the impact of targetted points on planimetric accuracy, three classes of products can be considered as a function of the input and output scales. Table 28 indicates improvements on targetted points, relatively to natural features, computed from 19 stereo-ortho-photo-pairs, using the second adjusting method (5.1.1-b). These improvements are ranging from - 33 % to + 81 % showing

CLASS OF PRODUCT	STEREO ORTHO-PHOTO PAIR N°	NUMBER OF MEASUREMENTS ON TARGETTED POINTS	NUMBER OF MEASUREMENTS ON NATURAL POINTS	TOTAL NUMBER OF MEASts	R.M.S.E IN HEIGHT in meter, on TARGETTED POINTS	R.M.S.E IN HEIGHT in meter, on NATURAL POINTS	R.M.S.E IN HEIGHT in meter, on WHOLE POINTS	RELATIVE ALTIMETRIC IMPROVEMENT AT TARGETS OVER NATURAL POINTS
N° 1 (30 K→25 K)	10 - 14	15	34	49	1.69	1.98	1.90	15 %
	13 - 11	44	79	123	2.10	3.12	2.80	33 %
	19 - 22	17	53	70	1.57	1.32	1.39	- 17 %
	21 - 20	19	127	146	1.75	1.32	1.38	- 33 %
	40 - 43	25	35	60	3.61	4.26	4.00	15 %
	42 - 41	27	36	63	3.89	4.08	4.00	5 %
	TOTAL : 6 PAIRS				WEIGHTED AVERAGE			+ 9 %
N° 2 (30 K→5 K)	15 - 18	18	19	37	0.82	1.21	1.04	32 %
	16 - 17	15	33	48	0.40	0.66	0.59	39 %
	37 - 38 / 37 - 39	16	10	26	3.92	3.92	3.92	0 %
	44 - 47	12	9	21	1.97	1.78	1.89	- 11 %
	46 - 45	14	7	21	1.61	1.54	1.59	- 3 %
	74 - 78	14	6	20	1.07	1.64	1.27	35 %
	75 - 79	13	5	18	0.45	1.57	0.91	81 %
	90 - 91	34	14	48	1.75	1.64	1.72	- 7 %
	TOTAL : 9 PAIRS				WEIGHTED AVERAGE			+ 17 %
N° 3 (16 K→5 K)	50 - 51	19	34	53	0.57	0.98	0.86	42 %
	52 - 53	19	30	49	0.59	0.86	0.77	32 %
	63 - 65	7	38	45	0.74	0.89	0.87	17 %
	66 - 67	19	33	52	0.61	0.99	0.87	38 %
	TOTAL : 4 PAIRS				WEIGHTED AVERAGE			+ 35 %
	GENERAL TOTAL : 19 PAIRS							

IMPROVEMENT OF HEIGHTING ACCURACY
AT TARGETTED POINTS
(USING THE 2nd ASSESSING METHOD)

TABLE 28

large discrepancies, with average values in each class as follows :

Class	1 : scale of aerial survey	1 : scale of orthophoto	Improvement at targets, in height
1	30 K	25 K	9 %
2	30 K	5 K	17 %
3	16 K	5 K	35 %

These results are quite similar to those obtained in planimetry (table 19), though the improvements be slightly inferior to them (fig. 11), probably because a difficulty in identifying the exact planimetric position of a natural point involves a smaller error in height, the slope of the terrain being inferior to 1.

They confirm the impact of feature detectability and interpretability of detail in the pointing accuracy, these targets being designed for aerial surveys at 1 : 7 K and 1 : 16 K-scale.

5.2.2 POINTS FROM AERIAL SURVEY AT 1:7 000

Though in a relatively small number, points from aerial survey at 1 : 7 K can be considered as providing an improvement of heighting accuracy of 19 % as indicated in table 29, to be compared with table 21, related to planimetry.

This improvement probably results from a higher accuracy of their elevation and from an easier identification of the feature.

5.2.3 POINTS FROM AERIAL SURVEY AT 1 : 30 000

Table 30 indicates that check points determined by plotting stereo-pairs at a scale of 1 : 30 000, have exactly the same heighting accuracy as the other points, without any degrading effect which could have resulted from a smaller scale survey origin. This result is similar to that of table 22 in § 4.2.4 related to the planimetric accuracy.

STEREO-ORTHOPHOTO PAIR N°	NUMBER OF POINTS FROM 1:7 K	R.M.S.E. IN HEIGHT in meter AT POINTS FROM 1:7 K	R.M.S.E. IN HEIGHT in meter AT OTHER POINTS	RELATIVE IMPROVEMENT AT POINTS FROM 1:7 K
13 - 12	7	2.19	2.55	14 %
19 - 22	5	1.02	1.43	29 %
21 - 20	5	0.66	0.95	31 %
66 - 67	3	1.38	1.27	- 9 %
TOTAL: 4 PAIRS	20 POINTS	WEIGHTED AVERAGE	=	19 %

IMPROVEMENT OF HEIGHTING ACCURACY
AT POINTS PLOTTED FROM 1:7 K - SCALE SURVEY
OVER OTHER POINTS (using 2nd
assessing method)

TABLE 29

STEREO-ORTHOPHOTO PAIR N°	NUMBER OF MEASUREMENTS AT POINTS FROM 1:30 K	R.M.S.E. IN HEIGHT in meter AT POINTS FROM 1:30 K R_{30}	R.M.S.E. IN HEIGHT in meter AT OTHER POINTS R_o	RATIO $\frac{R_{30}}{R_o}$
13 - 12	11	2.38	2.40	0.99
21 - 20	6	1.18	1.64	0.72
40 - 43	5	2.87	2.78	1.03
42 - 41	8	4.36	3.70	1.18
44 - 47	8	2.10	1.74	1.21
48 - 49	4	1.11	2.31	0.48
74 - 78	4	1.58	1.27	1.24
90 - 91	5	1.72	1.65	1.04
90 - 92	5	1.55	1.78	0.87
TOTAL: 9 pairs	56 points	WEIGHTED AVERAGE	=	1.00

COMPARISON OF HEIGHTING ACCURACY
BETWEEN POINTS PLOTTED FROM 1:30 K - SCALE
SURVEY AND OTHER POINTS (using 2nd
assessing method)

TABLE 30

5.3 IMPACT OF THE LOCATION OF POINTS

5.3.1 NEAR-NADIR POINTS

Using the same definition for near-nadir points as that given in 4.3.1 (Fig. 10), about 119 measurements have been performed on such points, out of a total of 991 measurements related to 21 stereo-orthophoto-pairs, which, corresponding to a proportion of 12 %, is exactly the relative surface of the nadir area (11.5 %).

The improvement of heighting accuracy at those points over other points shows wide discrepancies around the average value of 31 %,as indicated in table 31. This improvement is higher than in planimetry and is significant of the better quality obtained in the nadir area of an orthophoto.

It is an additional incentive to rectify the whole nadir area of an aerial photograph into orthophotograph, even when the stereomate is required, instead of processing by stereopairs, which involves only half the nadir area (see chapter 6).

5.3.2 TARGETTED NEAR-NADIR POINTS

In a similar way as in planimetry, regarding the cumulative effect at points having two separate properties, table 32 shows that the improvement obtained at targetted near-nadir points, results from both advantages. Indeed an improvement of 26 % can be noted when a targetted point turns into the position of being a targetted near-nadir point, which is not far from the value of 31 % related to any point becoming a near-nadir point (see 5.3.1).

5.3.3 POINTS NEAR TO THE CORNERS

Using the same definition for corner areas of aerial photographs rectified into orthophotos, as that given in 4.3.3 (fig.10), about 291 measurements may be reviewed on such areas, out of 1042 measurements carried out on 21 stereo-orthophoto-pairs listed in table 33, which gives a ratio of 291 : 1042 = 28 %, a little greater than the relative surface of corner areas (21 %), but in the same proportion and for the same reason as in planimetry (see 4.3.3).

The accuracy at points near to the corners as indicated in table 33, is fairly similar to the accuracy on the whole orthophoto, so that no degradation appears in the corner in the heighting accuracy, conversely to the planimetric accuracy which was 5 % worse. A good compensation can therefore be pointed out over the entire area of the aerial photograph,

STEREO-ORTHOPHOTO PAIR N°	NUMBER OF MEASUREMENTS AT NEAR-NADIR POINTS	IMPROVEMENT OF HEIGHTING ACCURACY AT NEAR-NADIR POINTS OVER OTHER POINTS
13 - 11	13	50 %
15 - 18	12	71 %
16 - 17	9	36 %
19 - 22	5	31 %
21 - 20 / 21 - 23	10	30 %
37 - 38 / 37 - 39	9	24 %
40 - 43	5	36 %
42 - 41	9	-44 %
44 - 46 / 44 - 47	10	36 %
48 - 49	5	46 %
50 - 51	3	21 %
52 - 53	3	53 %
62 - 64	3	20 %
63 - 65	3	50 %
66 - 67	3	69 %
73 - 77	3	55 %
90 - 91 / 90 - 92	14	4 %
TOTAL 21 pairs	119 measurements	WEIGHTED AVERAGE 31 %

IMPROVEMENT OF HEIGHTING ACCURACY
AT NEAR-NADIR POINTS OF THE ORTHOPHOTO
OVER OTHER POINTS
(USING THE 2nd ASSESSING METHOD)

TABLE 31

STEREO-ORTHOPHOTO PAIR N°	NUMBER OF TARGETTED NEAR-NADIR POINTS	IMPROVEMENT OF HEIGHTING ACCURACY AT TARGETTED NEAR-NADIR POINTS OVER OTHER TARGETTED POINTS
13 - 11	11	24 %
15 - 18	5	71 %
16 - 17	2	10 %
21 - 20	5	35 %
37 - 38 / 37 - 39	7	11 %
40 - 43	3	13 %
42 - 41	3	72 %
44 - 47	4	4 %
73 - 77	4	51 %
74 - 78	1	43 %
75 - 79	1	56 %
90 - 91 / 90 - 92	10	− 2 %
TOTAL : 14 pairs	56 points	WEIGHTED AVERAGE : 26 %

IMPROVEMENT OF HEIGHTING
ACCURACY AT TARGETTED NEAR-NADIR POINTS OF THE
ORTHOPHOTO (USING THE 2nd ASSESSING METHOD)

TABLE 32

STEREO-ORTHOPHOTO N°	NUMBER OF MEASUREMENTS NEAR TO CORNERS	RATIO BETWEEN R.M.S.E IN HEIGHT AT CORNERS AND R.M.S.E AT WHOLE POINTS
10 - 14	21	1.04
13 - 11	50	0.91
15 - 18	6	0.44
16 - 17	18	1.36
19 - 22	26	1.19
21 - 20 / 21 - 23	35	1.06
40 - 43	11	1.22
42 - 41	20	1.16
44 - 46 / 44 - 47	6	0.99
48 - 49	3	0.98
50 - 51	12	0.74
52 - 53	11	1.04
62 - 64	21	0.87
63 - 65	21	0.82
66 - 67	12	1.11
74 - 78	8	0.86
75 - 79	4	1.19
90 - 91 / 90 - 92	6	0.83
TOTAL 21 pairs	291 measurements	WEIGHTED AVERAGE 1.01

HEIGHTING ACCURACY
NEAR TO CORNERS OF THE ORTHOPHOTO
(USING THE 2nd ASSESSING METHOD)

TABLE 33

relatively to errors in the D.T.M used, confirming the interest of deriving stereomates from the same D.T.M. as that used for the orthophoto.

5.3.4 NADIR HALF OF A PAIR

Referring to fig. 10, it has been possible to review 305 measurements achieved at points located in the nadir half of a pair, namely the part which includes the nadir point of the aerial photograph rectified into an orthophoto.

These measurements were related to 15 stereo-orthophoto-pairs comprising a total of 606 measurements, in good agreement with the relative surface of this area :

305 : 606 = 50.3 % instead of 50.0 %.

Table 34 shows that an improvement of 6 % can be noted for the heighting accuracy in the nadir half relatively to the whole pair, which represents an improvement of 12 % between this nadir half and the other one, of the same order of magnitude as that obtained in planimetry (4.3.4).

Referring again to fig. 10, the nadir half A consists of two parts :

- part 1, nadir area with a relative surface of 23 % of A and r.m.s.e of 0.71
- part 2, intermediate area with a relative surface of 77 % and r.m.s.e of 1.03

which yields an approximate value of its r.m.s.e equal to $\sqrt{0.23 \times (0.71)^2 + 0.77 \times (1.03)^2} = 0.966$, near enough to the actual value of 0.94.

5.3.5 NEIGHBOURING POINTS

The same neighbouring points as those mentionned in 4.3.5, for planimetric assessment, have been used for evaluating the improvement of relative heighting accuracy between points very near to each other (less than 200 m). Table 26 indicates the results regarding the relative height errors between 25 pairs of neighbouring points, measured through 82 rounds. Very large improvements can be noted for the majority of the pairs, while the average improvement obtained reaches 44 %. Thus it may be asserted that stereo-orthophotos have better homogeneity at short distances in both components, the orthophoto and the stereomate as well, which makes them very suited to many users who need a better relative accuracy for determining elevation differences more accurately in smaller areas.

STEREO-ORTHOPHOTO PAIR N°	NUMBER OF MEASUREMENTS IN THE NADIR HALF	NUMBER OF MEASUREMENTS IN THE PAIR	RATIO BETWEEN R.M.S.E IN HEIGHT AT POINTS IN NADIR HALF AND R.M.S.E ON WHOLE POINTS
15 - 18	22	43	1.15
16 - 17	22	48	0.86
19 - 22	30	83	0.80
21 - 20	37	68	0.77
37 - 38 / 37 - 39	18	28	1.05
40 - 43	39	65	1.01
48 - 49	15	22	0.98
50 - 51	26	56	0.85
52 - 53	23	52	1.09
66 - 67	26	55	0.95
74 - 78	9	20	1.16
75 - 79	10	18	1.01
90 - 91 / 90 - 92	28	48	0.92
TOTAL 15 pairs	305 measurements	606	WEIGHTED AVERAGE 0.94

HEIGHTING ACCURACY
IN THE NADIR HALF
OF A PAIR
(USING THE 2nd ASSESSING METHOD)

TABLE 34

5.3.6 NEAR-NADIR NEIGHBOURING POINTS

Considering the same 4 pairs of neighbouring points located in near-nadir areas as those reviewed in 4.3.6, for planimetric assessment, it is once more easy to point out the cumulative improvement obtained at points which own two advantages. Drawing benefit from being near to each other, their accuracy should be improved by 44 %, and as near-nadir points, it should be improved by an additional 31 %, whence a total improvement I, given by 1-I=(1-44%)(1 - 31%) which yields I = 61.4 %.

Table 26 gives for these 4 pairs of points an average value of 61.6 %, which is exactly the assumed value.

5.3.7 TYPE OF RELIEF

Using the same four classes of relief as in 4.3.7, for planimetric assessment, three comparisons between r.m.s.e in height can be made, involving products which have similar parameters regarding the scales of aerial photograph, DTM and orthophoto.

Results are indicated in table 35; they confirm the same trend as in planimetry, towards a general improvement of accuracy with a smoother relief,providing figures better from 17 % to 56 %. The heighting accuracy is much more sensitive to the ruggedness of the terrain than is the planimetric accuracy.

6 - ARRANGEMENTS OF ORTHOPHOTOS AND STEREOMATES

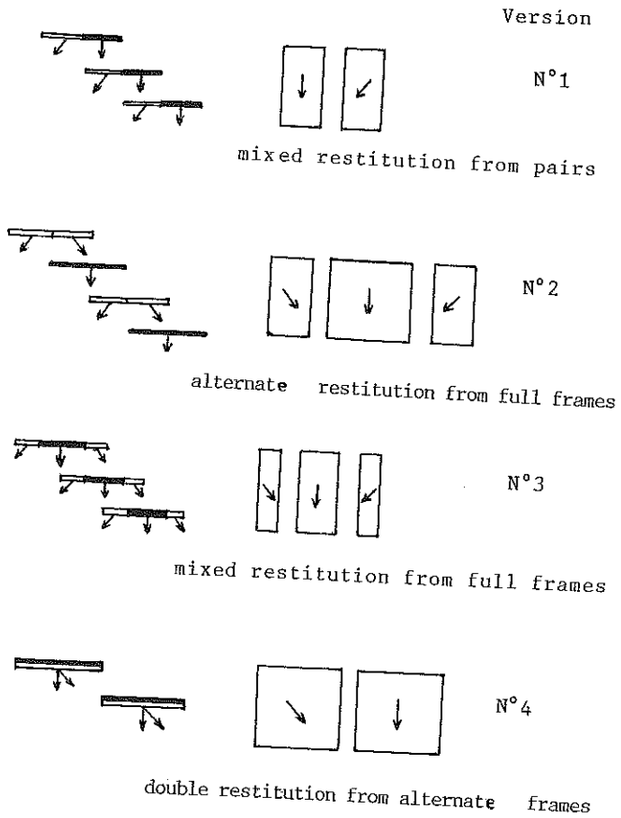
Various arrangements of orthophotos and stereomates can be used as shown in fig. 12, which were reviewed by DUCHER [2], [3] and KRAUS [4] ; each of them has its own advantages and drawbacks. Version n° 2, resorting to alternate restitution from full frames, is the most often used in practice because it is easier, delivers larger format orthophotos and can be carried out in two phases, starting with orthophotos first, then, when required, printing out the stereomates. However rectification into orthophotos is made in this version up to the edges of photograph, including the corners, while in version 3, applying a mixed restitution from full frames, rectification into orthophotos is limited to a smaller size area around the center in order to avoid the increased geometric distortion typically found at the edges and corners of photographs, and to reduce the importance of lean-over or hidden features.

As a result from the above planimetric and altimetric assessments summed up in fig. 10, versions 1,2 and 4 should deliver the same metrical accuracy; conversely version 3, in which

STEREO-ORTHOPHOTO PAIR N°	R.M.S.E. IN HEIGHT in meter CLASS OF RELIEF II	III	IV	IMPROVEMENT II / III or/IV
37 - 38 }		3.92		
37 - 39 }		1.35		
72 - 76	1.54			
73 - 77		1.27		
74 - 78		0.91		
75 - 79				
AVERAGE	1.54	1.86		17 %
10 - 14	1.90		2.80	
13 - 11				
AVERAGE	1.90		2.80	32 %
15 - 18	1.04			
16 - 17	0.59			
44 - 47		1.89		
46 - 45		1.59		
48 - 49		2.31		
90 - 91		1.65		
90 - 92		1.78		
AVERAGE	0.81	1.84		56 %

HEIGHTING ACCURACY
AS A FUNCTION OF RELIEF
(USING 2nd ASSESSING METHOD)

TABLE 35



Arrangements of orthophotos and stereomates

FIG 12

each nadir area is fully rectified into orthophoto, provides higher image resolution and draws benefit from 20 % to 30 % improvements of accuracy over this area; version 3 is confirmed as delivering slightly better results, both in planimetry and height of about 4 % to 6 %.

In fact, this improvement is probably higher, because, as was pointed out in 4.3.3, some more check points, especially from 1 : 16 K-scale survey, have been established nearer to the edges than to the nadir point, so that the value of the r.m.s.e on the nadir half of a pair is relatively higher than it should be by a few percents. In addition, when rectifying aerial surveys consisting of several strips of photographs with 15 % overlap, for orthophotomapping over wide areas, on a regular basis, aimed for example at map revision or at base map series, the length of the nadir half will be reduced by the same ratio of 15 %. As a result the accuracy of the nadir half should be improved by a few extra percents, more than the whole frame itself, reaching an eventual value of 10 %.

Version 3 should therefore be recommended, especially when large areas,involving many strips and photographs in each strip, are required for orthophotoprinting, although the resulting metrical improvement is not perhaps so high as expected.

7 - ASSESSMENT OF D.T.M.

It is possible to approach the value of the D.T.M. actually used for generating orthophotos and stereomates, by measuring parallaxes between both orthophotos from both frames of a pair of aerial photographs. Then by comparison with the heighting accuracy, it may be interesting to outline the improvement obtained relatively to the D.T.M and to the x accuracy.

7.1 PARALLAXES BETWEEN ORTHOPHOTOS

D.T.Ms from aerial surveys at 1 : 30 K and 1 : 60 K-scale have been used to rectify both frames of a pair into orthophotos, so that by measuring parallaxes between these orthophotos, it has been possible to obtain an order of magnitude of the quality of the DTMs.

The problem is first to establish an approximate relationship between these parallaxes dp_x and the source error dz in the DTM.

Two approaches can be used :

-i) Assuming that the error dz in the DTM actually used for generating profiles onto the orthophotoprojector is exactly the same for both orthophotos of the pair, the relationship is given by the well-known following formula :

$$dp_x = \frac{B}{H} \cdot dz \quad (10)$$

- ii) Assuming now that this error is not exactly the same for both orthophotos and denoting them by dz_1 and dz_2, they give rise to separate x-errors dp_1 and dp_2.

The parallax measured from the pair is :

$$dp = dp_1 - dp_2$$

with $dp_1 = \frac{x}{H}.dz_1$ and $dp_2 = -\frac{B-x}{H}.dz_2$ (fig. 13)

Assuming that a large number n of orthophotos be carried out with errors $dz_{11} \dots dz_{2n} \dots$ at each time and that the r.m.s.e. e_{DTM} is the same for each point of the pair and for each time at a point, the r.m.s.e ep_x on $dp_{11} \dots dp_{2n}$ is, with x varying from 0 to B :

$$ep_x^2 = \frac{1}{B} \cdot \int_0^B \left[\sum \left(\frac{x}{H}.dz_1\right)^2 + \sum \left(\frac{B-x}{H}.dz_2\right)^2 \right] \cdot \frac{1}{n}.dx$$

whence $ep_x = \frac{B}{H} \cdot \sqrt{\frac{2}{3}} \cdot e_{DTM}$ (11)

Formula (11) can be obtained similarly from :

$dp_1 = \frac{x}{H}.dz_1$ giving rise to the r.m.s.e $ep_1^2 = \frac{1}{n}.\sum(dp_i)^2$

$ep_1^2 = \frac{1}{n} \cdot \frac{1}{H^2}.\sum(x_i dz_i)^2$ and x varying from 0 to B :

$$ep_1^2 = \frac{1}{H^2} \cdot e^2_{DTM} \cdot \frac{1}{B} \int_0^B x^2 dx \quad \text{whence } ep_1 = \frac{B}{H} \cdot \frac{e_{DTM}}{\sqrt{3}} \quad (12)$$

and (11) is derived from (12) as being the r.m.s.e of $dp_1 - dp_2$ where dp_1 and dp_2 are assumed to have the same r.m.s.e ep_x.

Considering both formulae (10) and (11), it may therefore be stated that approximately :

$$\frac{H}{B} \cdot ep_x \leqslant e_{DTM} \leqslant 1.22 . \frac{H}{B} \cdot ep_x \quad (13)$$

The r.m.s.e ep_x is computed from the measurements dp_x directly and the values obtained from the related orthophotos-pairs are listed in table 36.

The limits for e_{DTM} are then derived from (13) and listed in table 36, column 8, delivering the required order of magnitude of the accuracy of the D.T.M actually interpolated and used when producing the orthophotos.

Some discrepancies can be noted for this accuracy which should be considered together with the slit width : the high value obtained for e_{DTM} from orthophoto-pairs n° 19-21 and 40-42 can be explained by a relatively large step interval of 100 to 125 m; so that comparing the value of e_{DTM}, of about 4 m, with that of the slit width of 100 m at ground scale, is not a bad result taking into account the steep slopes encountered in the test area. The better accuracy obtained for e_{DTM} from orthophoto-pair n° 44-46 is connected to a reduction of the slit width by five at ground-scale. These results do not apply so well to the pair n° 26-29.

7.2 COMPARISON WITH THE HEIGHTING AND X ACCURACIES

7.2 - a) It is interesting to compare the order of magnitude of the r.m.s.e e_{DTM} of a D.T.M, with the r.m.s.e in height obtained when measuring elevations from a stereo-orthophoto-pair carried out using the same D.T.M or a similar one.

If some discrepancies can be noted, probably due to other sources of errors, five stereo-orthophoto-pairs (n° 21-20, 21-23, 19-22, 26-24, and 29-28) created by the same D.T.M as pairs n° 19-21 and 26-29, show a heighting accuracy e_z of 2.5 to 3.4 x times better than that of the D.T.M used in creating them (table 36).

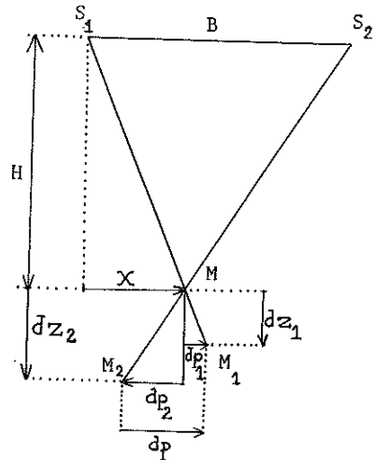
Such a result fully confirms those previously noted by KRAUS [4], and is one of the most interesting features of this method aimed at stereo-plotting elevation data automatically through stereo-orthophoto-pairs.

7.2 - b) As regards the x accuracy, the value of the r.m.s.e ep_x obtained from the parallaxes between both orthophotos of a pair is systematically inferior to the r.m.s.e which could be expected from the planimetric accuracy between points located onto two similar orthophotos.

Hence it may be stated that other sources of error are involved when pointing separately to points on orthophotos, consisting of the pointing precision of the assessing instrument and of errors in identification of the detail and in pointing it to the right place, all errors which are cancelled when pointing simultaneously to both orthophotos for measuring parallax between them.

ORTHOPHOTO PAIR N°	1 : SCALE OF AERIAL PHOTO	DTM	ORTHO	SLIT WIDTH (ground scale)	R.M.S.E. (in meter) MEASURED on PARALLAX e_{p_x}	IN X on TWO POINTS	DERIVED for D.T.M. e_{DTM}	IN Z at A POINT, e_z	RATIO e_{DTM}/e_z
19 - 21	30 K	60 K	25 K	125 m	2.33	4.30	4.0 to 4.7	1.38	2.9 x to 3.4 x
26 - 29	16 K	30 K	5 K	25 m	2.80	3.06	4.7 to 5.7	1.92	2.5 x to 3.0 x
40 - 42	30 K	30 K	25 K	100 m	1.89	3.56	3.2 to 3.8	3.95	0.8 to 1.0 x
44 - 46	30 K	30 K	5 K	20 m	0.76	1.50	1.3 to 1.5	1.59	0.8 to 0.9 x

ASSESSMENT OF D.T.M
BY MEASURING PARALLAXES
AT IMAGE POINTS OF BOTH ORTHOPHOTOS
OF A PAIR
TABLE 36



S_1, S_2 : perspective centers

M : exact location on a map

M_1, M_2 : shifted locations on both orthophotos of a pair, due to DTM errors d_{z1}, d_{z2}

FIG 13

Combining these errors in a formula such as follows :

$$(\sqrt{2}\, e_x)^2 = e_{p_x}^{\ 2} + (\sqrt{2} \cdot e_{pp})^2 + (\sqrt{2} \cdot e_{Id})^2 \qquad (13\text{bis})$$

where e_x = r.m.s.e in x at a point of the orthophoto

e_{p_x} = r.m.s.e of parallaxes at corresponding points of the orthophoto-pair.

e_{pp} = pointing precision, defined in 3.2.3

e_{Id} = r.m.s.e in x in identification of a feature.

yields an order of magnitude of e_{Id} for the relevant orthophotos as follows :

Orthophoto N°	e_{Id} : r.m.s.e in identification in x in meter (ground scale)	in microns (at photo-scale)	in microns (at ortho-scale)
19 and 21	1.80	60	70
26 and 29	0.83	52	160
40 and 42	1.14	38	40
44 and 46	0.90	30	170

As shown in this table, the identifying accuracy is ranging from 30 to 60 microns at photo-scale, which represents an important part of the resulting planimetric accuracy and emphasizes once more the need to take proper account of the ease of identification and interpretability of detail, all the more as an orthophoto is a sophisticated enlargement with a rather degraded image quality.

7.2 - c) Orthophotoprinting both frames of a pair has often been considered as a method well suited to checking the quality of a D.T.M, including the interpolation algorithm and for removing gross errors. Indeed formula(13bis) shows that parallax measurement at corresponding image points onto such an orthophoto-pair contains smaller errors than absolute measurements at points of each separate orthophoto, because errors in identifying a point and pointing errors in the x and y co-ordinates are there totally removed.

However, formula (13) shows that the impact of errors in the D.T.M creating an orthophoto,on the accuracy of the orthophoto itself is - fortunately for the orthophoto method itself - not very acute,so that these errors are reproduced with a reduction of may be 2 times in size. Moreover an error in measuring the dp_x parallax, or any other positioning error of a point on the orthophoto, at the production stage, due to mechanical backlashes, distortions or improper slope corrections, will involve an error twice as much on the assessment of the D.T.M, impeding it to be very accurate.

It does not mean that this method cannot be used,but that it is recommended to be careful when interpreting the results on D.T.M quality. This method is primarily adequate to D.T.M gross errors removal.

8 - GENERAL RESULTS

8.1 ABSOLUTE RESULTS

As previously noted, somewhat large discrepancies occurred between results related to products of the same type or production stage and even between different rounds of measurements of a given product, as a function of the area assessed, of the operator, of the GCPs and check points involved in the round. Hence results from each separate product should not be considered for their absolute value without paying further attention to its specific characteristics or to the average results of the type of product which it belongs to.

However, taking into account the large number of ortho and stereo-orthophotos produced, of measurements carried out, of instruments and laboratories involved in the test and the number of cases studied, it can be stated that these results have a significant statistical value, fully validated by the large number of samples involved, by their quality and a Gaussian distribution of the residuals.

Another remark would consist in observing that it is not so easy to reach the top level permitted by the data available each time an orthophoto is produced and that large variations can be noticed, even from a given laboratory, so that quality control is a prerequisite which should be paid more attention to, from both users and producers.

Hence detailed specifications should be resorted to for a common definition of the metrical quality of an orthophoto, as large variations exist in the way of producing an orthophoto and assessing its quality according to the input and output scale, the scale and spacing of D.T.M used during the rectification process, the number and type of GCPs used, the availability of targetted points used as GCPs or check points, the quality of the features permitting a proper identification, the type of

relief and its location in the original picture, the arrangement used for orthophotoprinting, the location of the area studied in the orthophoto, the type of tranformation used for assessing the product, especially the length of the base used in case when two points are used for scaling or the number of points used as control for the transformation.

The only assessing stage can provide wide variations in the metrical accuracy of a product, reaching up to ± 20 %, if not ± 30 % of the average value of this accuracy. It is therefore necessary to be very careful when carrying out the various stages of a test and not to rely on an isolated result on the accuracy of a single orthophoto for extending conclusions to the accuracy attainable by any orthophoto of the same type.

These general remarks being given, it is interesting to refer to appendix 10.5 comprising the absolute results for each orthophotograph of the test. Let us point out for example some very good results as those obtained in stages n° 3.12 or 3.33 and other stages n° 3 as well. It is stated that an absolute heighting accuracy of up to 0.90 m on undistinctive points and 0.60 m on targetted points (2.5 x H/10,000) can be reached from an aerial stereopair at 1 : 16 K-scale rectified into a stereo-orthophoto-pair at 1 : 5 K-scale, using a D.T.M derived from aerial surveys at a scale of 1 : 60 K.

Similarly a r.m.s.e for planimetric resultant vectors of 0.90 m can be reached on targetted points; moreover replacing the previous D.T.M by another one interpolated between contours stereoplotted from surveys at 1 : 16 K-scale, the same scale as the original photo being rectified, provides a planimetric accuracy of 0.60 m on targetted points (40 microns at photo-scale). Of course, such results have not been obtained for each product and they can be considered as a limit which is however attainable, probably when an optimum control of the various error sources is kept throughout the whole orthophotoprinting process.

Unfortunately results from smaller scale photographs were not so good, due to obvious difficulties in identification of ground control and check points.

An histogram indicates in fig. 14 the distribution of the planimetric accuracy (r.m.s.e resultant vector) at photo-scale, which is quite regularly shaped, showing an average value of 108 microns with 72 % of the orthophotos having a r.m.s.e inferior to this value.

Conversely the histogram drawn in fig. 15 regarding the same distribution at orthophoto-scale appears as a two domes-shaped curve, with a general average of 340 microns and only 60 % of the orthophotos which can be considered as within the American NMAS (90 % within 0.5 mm or r.m.s.e inferior to 310 microns) but 70 % being within 0.43 mm.

In fact, three classes of products should be considered, two of which being beyond the N.M.A.S., namely : products resulting from small-scale DTM and aerial photograph, far beyond limits, and products resulting from 1 : 30 K-scale aerial photograph rectified into orthophotos at 1 : 5 K-scale, using D.T.M from surveys at 1 : 60 K and 1 : 30 K-scale, corresponding to somewhat too great enlargements (see table 40, ex n° 7 and 9). Besides such results were basically expected, because this test was also designed in such a way as to carry out products generally considered as off-limits, in order to have a better knowledge of the actual impact of each parameter, over a wider range. If we exclude the former class of 2 off-limits products, the latter, which consists of 11 products, provides an average of 413 microns, which is well related to the run of the second dome, while the third class , comprising 12 products, has an average of 190 microns, well related to the run of the first dome.

So that the general run of curve in fig.15 is quite well explained: compared to fig.14, it can be said that Gaussian distributions of planimetric accuracies are fairly well obtained , at photo-scale and at orthophoto-scale, related to the 25 products considered,provided they be classed as said before.

As regards the heighting accuracy, fig. 16 shows a distribution characterized by a single-dome curve, with an average value of 3.7 x H/10,000 for the r.m.s.e. in height, with 68 % inferior to this average, the smallest value being 1.3 x H/10,000 and the highest one 8.7 x H/10,000.

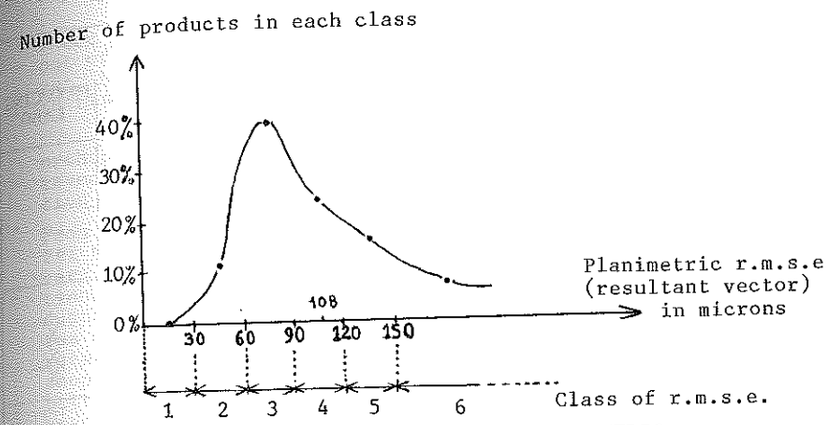
8.2 RELATIVE RESULTS

However interesting may be the absolute quality of each separate product, it is mostly the relative value which has been studied, providing many valuable results even from products which were much worse than the general average of their class.

8.2 - a) Planimetric comparisons

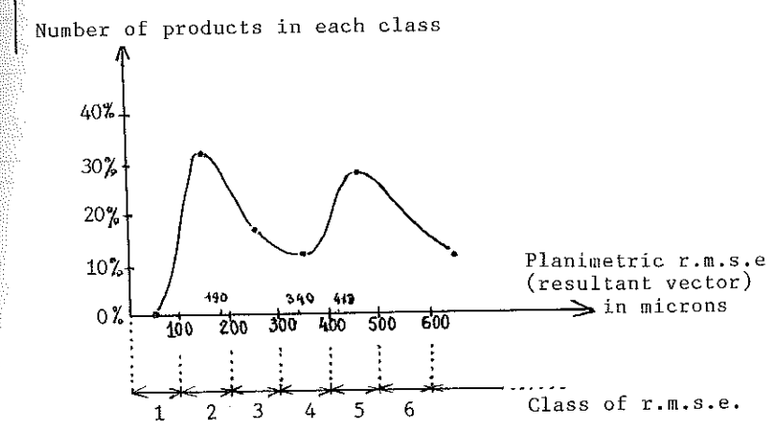
A total of 47 comparisons has been studied consisting of (see table 37):

- 10 comparisons of products which differ in the variation of only one parameter (scale of the aerial survey, DTM or ortho-photo or slit width).
- 8 comparisons with changes in 2 parameters (scan direction and operative center in addition to the 4 previous ones)
- 21 comparisons with changes in 3 parameters
- 7 " " " 4 "
- 1 " " " 5 "



HISTOGRAM OF THE PLANIMETRIC ACCURACY AT PHOTO-SCALE

FIG 14



HISTOGRAM OF THE PLANIMETRIC ACCURACY AT ORTHO-PHOTO-SCALE

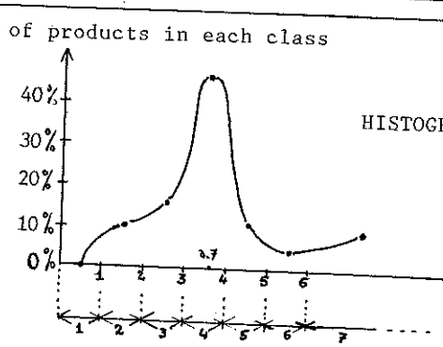
FIG 15

NUMBER OF COMPARISONS WITH CHANGES IN PARAMETERS		NUMBER OF CHANGING PARAMETERS	CHANGING PARAMETERS : 1 : SCALE OF AERIAL SURVEY	D.T.M	ORTHO-PHOTO	SLIT WIDTH	SCAN DIRECTon	PRODUCING LABO
TOTAL NUMBER								
10	2	1	X					
	3			X				
	2				X			
	3					X		
8	3	2	X	X				X
	2			X				X
	1					X		
	2						X	X
21	4	3	X	X				X
	1		X			X		X
	1		X		X	X		
	1			X	X			X
	2			X		X		X
	3			X			X	X
	5					X	X	X
	3				X	X		X
	1				X		X	X
7	4	4	X	X	X			X
	1			X	X		X	X
	1			X	X	X		X
	1			X		X	X	X
1	1	5	X		X	X	X	X

TOTAL = 22 combinations / 47 comparisons

ARRANGEMENT OF COMPARISONS OF PRODUCTS WITH CHANGING PARAMETERS

TABLE 37



HISTOGRAM OF THE HEIGHTING ACCURACY

FIG 16

These comparisons involved a total of 22 combinations of changes, out of the 63 combinations which it would have been possible to get, by changing the 6 parameters studied, from one by one up to five by five ($\sum_{i=1}^{i=6} C_6^i = 2^6 - 1 = 63$), if three times more orthophotos had been produced to comply with such a thorough research which would have required somemore years for completion !

From these comparisons it has been possible to derive the general formulae given in 8.3, noting that the results were not very sensitive to the length of the slit nor to the scan direction (except for the height accuracy). The accuracy of some products are ranking in the right order of the slit width (orthophotos n° 44 and 46 compared with n° 48) but for others it is the reverse : for example, despite the use of 8 mm slit in the orthophoto n° 73, planimetric accuracy appears to be slightly better than in the orthophoto n° 74 in which a 5 mm slit was used. A similar inversion can be noted for orthophotos n° 62 and 63.

8.2 - b) Planimetric vs altimetric accuracy

A comparison between the heighting accuracy and the planimetric accuracy has been carried out for 28 stereo-orthophoto-pairs. As indicated in table 38, a general improvement appears in the heighting accuracy, all the more important as the scanning direction used for printing out the orthophoto and its stereo-partner is the x direction . This improvement, sometimes negative as regards the y direction, amounts to 35 % in the x direction and 11 % in y,on the average.

This result is entirely coherent with the estimates of the accuracy of a D.T.M., given in chapter 7. Indeed, the heighting accuracy ez was assessed as being about three times better than that of the DTM used (see 7.2), e_{DTM} , so that $ez \approx \frac{1}{3} . e_{DTM}$.

From formula (12) in 7.1 , the r.m.s.e, resultant vector, related to that e_{DTM} of the DTM is :

$$e_{xy} = \sqrt{2} . e_{p_1} \cong \sqrt{2} \cdot \frac{B}{H} \cdot \frac{e_{DTM}}{\sqrt{3}} \cong 0.5 \cdot e_{DTM}$$

hence $e_{xy} \cong 0.5 \cdot 3 . ez = 1.5 \cdot ez$

and the resulting improvement should be : $\frac{exy - ez}{exy} = 33\ \%$

value which is quite similar to that obtained above from the whole stereo-orthophotos.

STEREO-ORTHOPHOTO PAIR N°	R.M.S.E. (in meter) IN HEIGHT	IN PLANIMETRY (resultant vector)	IMPROVEMENT OF ACCURACY IN HEIGHT VS PLANIMETRY WHEN SCANNING IN X DIRECTION	Y DIRECTION
33 - 36	4.80	5.80		+ 17 %
19 - 22	1.39	4.53		+ 69 %
21 - 20 } 21 - 23 }	1.38	4.30		+ 70 %
72 - 76	1.35	2.01	+ 33 %	
74 - 78	1.27	2.37	+ 46 %	
73 - 77	1.54	2.02	+ 24 %	
75 - 79	0.91	2.16	+ 58 %	
37 - 38 } 37 - 39 }	3.92	2.18		- 80 %
13 - 11	2.80	3.70	+ 24 %	
10 - 14	1.90	3.94	+ 52 %	
44 - 47	1.89	1.47		- 29 %
46 - 45	1.59	1.54		- 3 %
15 - 18	1.04	3.11	+ 67 %	
16 - 17	0.59	2.38	+ 75 %	
48 - 49	2.31	2.04		- 13 %
90 - 91	1.65	1.49	- 11 %	
90 - 92	1.78	1.49	- 19 %	
66 - 67	0.87	1.61	+ 46 %	
26 - 24	1.73	3.44	+ 50 %	
29 - 28	2.09	2.68	+ 22 %	
50 - 51	0.86	1.51		+ 43 %
52 - 53	0.77	1.17		+ 34 %
62 - 64	0.90	1.17	+ 23 %	
63 - 65	0.87	1.17	+ 26 %	
40 - 43	3.91	3.46		- 13 %
42 - 41	3.99	5.23		+ 23 %
TOTAL: 28 STEREO-ORTHOPHOTO PAIRS		AVERAGE :	+ 35 %	+ 11 %

COMPARISON OF ACCURACIES :
PLANIMETRIC VS ALTIMETRIC

TABLE 38

Such an improvement confirms the interest of the stereo-orthophoto process for getting spot heights or contours. This improvement can also be explained by the fact that the x-parallax between an image-point on the orthophoto and the corresponding point on the stereo-partner has a higher accuracy than that of the location of the image-point itself, as it has already been noted [1].

Profiling in x provides better heighting results because differences between the profiles actually used for creating the orthophoto and the stereomate are larger when profiling in the y direction, causing worse altimetric parallaxes, as expected and noted in [2] and [4].

8.3 PRATICAL FORMULAE

8.3.1 A FORMULA FOR PLANIMETRIC ACCURACY

Reviewing the r.m.s.e, resultant vector (x,y), computed by the fourth assessing method, namely using a plane transformation established on the whole points available (GCPs and check points), through 24 orthophotographs classed in 9 categories depending on the scales of the input, DTM and output products, permitted a general practical relationship to be set up, as said in 8.2.a.

The following formula was established :

$$e_{xy}^2 = 0.75 \times \left(\frac{PHOTO}{15\,000}\right)^2 + 0.20 \times \left(\frac{DTM}{15\,000}\right)^2 + 0.25 \times \left(\frac{ORTHO}{5\,000}\right)^2 \quad (14)$$

in which

e_{xy} = r.m.s.e. in planimetry (resultant vector) in meters, on the ground, on natural points (including some targetted points), of the resulting orthophoto.

PHOTO = 1 : scale of the aerial survey (ranging from 16 K to 60 K) rectified into orthophoto.

DTM = 1 : scale of the D.T.M., i-e of the survey which was plotted into contours and gave rise to the D.T.M. (ranging from 16 K to 60 K)

ORTHO = 1 : scale of the orthophoto (ranging from 5 K to 25 K)

It should be emphasized that this formula is an approximate one, which can be applied in the conditions of the test, to obtain an order of magnitude of the accuracy attainable for an orthophoto produced and assessed in those conditions.

Among those conditions are :

- similar classes of relief (from 100 m to 240 m as maximum elevation differences and 40 m to 75 m for the elevation standard deviation).
- similar scale-ranges as those used in the test
- regular distributions of GCPs and check points over the entire area of the orthophoto which covers the full original frame
- good proportions of well-defined features, with accurately fixed co-ordinates, used as GCPs and check points as well. Using signalised points is highly recommended (their proportion in the test was 33 %).
- an assessing method based on a similarity using a least-squares adjustment on at least seven points, and preferably twelve or fifteen points.
- a stereo-compiler allowing a pointing standard deviation of 60 microns, resultant vector and two-round measurements.

The scanning direction can be either x or y, and a slit width of 4 mm or 5 mm is recommended,but a 8 mm slit can also provides similar results.

The B/H ratio is assumed to be about 0.6,but it should be noted that formula (14) can be applied when using longer focal length for both D.T.M. and orthophoto. Indeed in such a case, the B/H ratio is much smaller and the D.T.M less accurate but the displacements of images due to relief are similarly smaller,so that they can comply with proportionally less accurate corrections.

Formula (14) is right at about ± 20 % for two thirds of the 24 orthophotos considered, as shown in table 39.(see also foot-note (1),p.6).

8.3.2 COMMENTS AND EXAMPLES OF APPLICATION OF THE PLANIMETRIC FORMULA

8.3.2 - a) Comments

Formula (14) (see 8.3.1) indicates the total effect of three main components into the accuracy which can be obtained in planimetry in orthophotoprinting; the following comments can be given :

-i) The scale of the photograph to be rectified is the driving factor. The accuracy of the results is improved nearly proportionally to the increase of this scale and much more than if the scale of DTM and/or that of the orthophoto were increased.

-ii) The scale of the DTM, namely that of the aerial photograph from which the D.T.M. is derived, has the least impact on the results. Examples listed hereafter in 8.3.2 - b) confirm that smaller scale DTM can be efficiently used and that there is little to be gained when stereoplotting D.T.M

ORTHOPHOTO N°	1 : SCALE OF AERIAL SURVEY	D.T.M.	ORTHO-PHOTO	VARIATION BETWEEN R.M.S.E. (result. vector x,y) MEASURED AND COMPUTED BY FORMULA (14) in meter	in %	AVERAGE VARIATION OF EACH CLASS
33	60 K	60 K	25 K	+ 1.15	+ 25 %	+ 25 %
19 21	30 K	60 K	25 K	+ 1.00 + 0.75	+ 28 % + 21 %	+ 24 %
72 74 73 75 37	30 K	60 K	5 K	- 0.55 - 0.18 - 0.53 - 0.39 - 0.37	- 21 % - 7 % - 21 % - 15 % - 14 %	- 16 %
10 13 40 42	30 K	30 K	25 K	+ 0.77 + 0.53 - 0.45 + 0.39	+ 24 % + 17 % - 14 % + 12 %	+ 10 %
44 46 15 16 48 90	30 K	30 K	5 K	- 0.54 - 0.47 + 1.10 + 0.37 + 0.03 - 0.52	- 26 % - 23 % + 54 % + 18 % + 1 % - 25 %	- 17 %
32	30 K	16 K	30 K	- 0.55	- 15 %	- 15 %
66	16 K	60 K	5 K	- 0.44	- 21 %	- 21 %
50	16 K	30 K	5 K	+ 0.16	+ 12 %	+ 12 %
52 62 63	16 K	16 K	5 K	+ 0.07 + 0.03 - 0.13	+ 6 % + 3 % - 12 %	- 1 %
24 ORTHOPHOTOS		9 CLASSES		GENERAL AVERAGE		- 4 %

VARIATIONS OF ACTUAL PLANIMETRIC ACCURACY OF ORTHOPHOTOS IN THE TEST (FROM THE FOURTH TRANSFORMATION) AROUND COMPUTED VALUES GIVEN BY PRACTICAL FORMULA (14)

TABLE 39

from the same survey as that to rectify.

-iii) A conclusion drawn by this formula is that the output scale has not a very strong impact on the result at ground-scale. However orthophotoprinting should always be considered as an enlargement of the original survey. If the output scale is very near to that of the input product, a loss of accuracy appears at ground scale which is caused by problems of feature detectability and lack of ease of identification. Meanwhile considering that D.T.M. used for creating an orthophoto are often stereo-plotted from the actual survey to rectify, formula (14) can yield the maximum enlargement to be used to comply with mapping accuracy requirements at orthophoto-scale, such as for example the U.S. N.M.A.S which set a limit of 0.50 mm (resultant vector) for 90 % of points, corresponding to a r.m.s.e. of 0.31 mm.

The maximum value obtained is an enlargement of 4.51 x, which is not enough practised and should be recommended for a better cost/benefit ratio, instead of smaller enlargements of 2.5 x to 3 x, more often used.

8.3.2 - b) Examples

A set of applications of formula (14) is given in tables 40, 41 and 42; they provide examples related respectively to medium scale products, ranging within scale-limits of the test, to larger scale products and to smaller scale products derived, for the latter, from high altitude photography or space imagery as well, by an off-limit application of formula (14).

Most of examples display a r.m.s.e better or equal to that corresponding to U.S. N.M.A.S based on a value of 0.50 mm (resultant vector at orthophoto-scale) at a 90 % level of confidence (i-e 0.31 mm at a r.m.s.e level of confidence of 68 %).

-i) Table 40 shows a wide variety of combinations which could be used for an efficient off-line production of orthophotos at medium scales, using D.T.M derived from altimetric data bases which are currently established by stereoplotting aerial surveys at 1 : 30 K or 1 : 60 K, aimed at a regular digital coverage of entire areas of countries. Some examples indicate a very good agreement with the results from other previous tests (examples n° 11 and 17), others show that there is little to be gained using D.T.M at the same scale as the aerial photograph to rectify (examples n° 6 vs 8, n° 9 vs 15).

-ii) Table 41 shows that formula (14) can be extended to larger scales than those involved in this test and examples n°4, 5 and 9 display a good agreement between accuracy computed from formula (14) and that obtained in different other previous tests.

EXAMPLE N°	1 : SCALE OF THE AERIAL SURVEY (INPUT)	D.T.M.	ORTHO-PHOTO (OUTPUT)	COMPUTED PLANIMETRIC R.M.S.E. (resultant vector) AT GROUND SCALE (in meter)	AT ORTHO-PHOTO SCALE (in mm)	WITHIN U.S. N.M.A.S. (90 % <0.5 mm)	COMMENTS
1	60 K	60 K	25 K	4.6 m	0.18 mm	yes	- max. enlargement poss.
2	60 K	60 K	12.5 K	4.1 m	0.32 mm	yes	
3	45 K	45 K	10 K	3.1 m	0.31 mm	yes	- max. enlargement poss.
4	40 K	50 K	25 K	3.7 m	0.15 mm	yes	- very good for 25 K map revision; used by GID (DK)
5	40 K	40 K	12 K	2.9 m	0.24 mm	yes	- USGS digital test
6	30 K	60 K	25 K	3.5 m	0.14 mm	yes	- very good for 25 K map revision
7	30 K	60 K	5 K	2.5 m	0.50 mm	no	
8	30 K	30 K	25 K	3.2 m	0.13 mm	yes	- compare with ex. n° 6
9	30 K	30 K	5 K	2.0 m	0.40 mm	no	
10	30 K	16 K	30 K	3.5 m	0.12 mm	yes	- not very efficient
11	25 K	25 K	25 K	3.0 m	0.12 mm	yes	- see [5], test for map revision, using a GPM; r.m.s.e. obtained is ranging from 0.10-0.17 mm
12	22.5 K	22.5 K	5 K	1.5 m	0.31 mm	yes	- max. enlargement poss.
13	22 K	40 K	12 K	2.1 m	0.18 mm	yes	USGS digital test, see [6]
14	22 K	22 K	12 K	1.9 m	0.16 mm	yes	
15	20 K	60 K	5 K	2.2 m	0.40 mm	no	- more efficient than ex. n° 9
16	20 K	30 K	5 K	1.5 m	0.31 mm	yes	- very efficient for 5 K
17	16 K	16 K	6.5 K	1.2 m	0.18 mm	yes	- see [7], SUDBURY CDN test, r.m.s.e. obtained 0.17 mm
18	15 K	60 K	5 K	2.0 m	0.40 mm	no	possible use of alti-data base at 1:30 K
19	15 K	50 K	5 K	1.8 m	0.35 mm	no	
20	15 K	30 K	5 K	1.3 m	0.26 mm	yes	
21	15 K	30 K	4 K	1.3 m	0.32 mm	yes	
22	15 K	15 K	5 K	1.1 m	0.22 mm	yes	

EXAMPLES OF APPLICATION
OF PRACTICAL FORMULA (14)
RANGING WITHIN LIMITS OF THE OEEPE TEST
(AT MEDIUM SCALE) :
COMPUTED (AND EXPECTED) PLANIMETRIC ACCURACY
OF ORTHOPHOTOS

TABLE 40

EXAMPLE N°	1 : SCALE OF THE AERIAL SURVEY (INPUT)	D.T.M.	ORTHO-PHOTO (OUTPUT)	COMPUTED PLANIMETRIC R.M.S.E. (resultant vector) AT GROUND SCALE (in meter)	AT ORTHO-PHOTO SCALE (in mm)	WITHIN U.S. N.M.A.S. (90 % <0.5 mm)	COMMENTS
1	13 K	13 K	5 K	1.0 m	0.20 mm	yes	- used in FRG
2	12 K	34 K	5 K	1.3 m	0.26 mm	yes	- used in Rhineland-Palatinate (FRG) see [8]
3	12 K	12 K	2 K	0.80 m	0.40 mm	no	- used in french local communities - prod. IGN (F)
4	10 K	10 K	4 K	0.75 m	0.19 mm	yes	- see [7], RIPON CDN test, r.m.s.e. obtained 0.19 mm
5	10 K	10 K	2.5 K	0.70 m	0.28 mm	yes	- see [9], Intern-test-r.m.s.e range obtained 0.12-0.28 mm (using marked GCPs)
6	8 K	30 K	2.5 K	1.0 m	0.40 mm	no	- possible use of alti data base at 1:30 K
7	8 K	15 K	2 K	0.67 m	0.34 mm	no	- possible use of alti data base at 1:15 K
8	8 K	8 K	2 K	0.56 m	0.28 mm	yes	- compare with example n° 3
9	4 K	4 K	1.25 K	0.29 m	0.23 mm	yes	-see [10], FRG's test giving a r.m.s.e. range 0.20-0.46 mm

EXAMPLES OF EXTENDED
APPLICATION OF FORMULA (14)
TO LARGER SCALE :
COMPUTED (AND EXPECTED) PLANIMETRIC
ACCURACY OF ORTHOPHOTOS

TABLE 41

-iii) Table 42 shows in a similar way that formula (14) can be extended to much smaller scales than those used in this test and good agreements result from examples N° 1, 4 and 5 with other previous tests. Some examples illustrate the possibility of efficiently merging data from space and aerial surveys (see examples n° 11, 12 and 13), to obtain orthophotos at medium to large scale (1 : 10 K to 1 : 25 K), using aerial photographs at 1 : 30 K and 1 : 60 K-scale and D.T.M derived from SPOT data and/or, in the future, from new space projects at 5 m. pixel size, currently being developed by NASA, ESA or CNES, expected to deliver stereo-viewing through fore and aft-looking sensors with a B/H ratio of 0.75.

8.3.3 FORMULAE FOR HEIGHT ACCURACY

Reviewing the r.m.s.e in Z computed by the second assessing method, using a calibration on the whole points, through 25 stereo-orthophoto-pairs classed in 12 categories, depending on the scales of the input, DTM, output products and scanning direction, permitted two general practical relationships to be established, as follows :

$$e^2_{Z_x} = 0.30 \times \left(\frac{PHOTO}{15\ 000}\right)^2 + 0.10 \times \left(\frac{DTM}{15\ 000}\right)^2 + 0.25 \times \left(\frac{ORTHO}{5\ 000}\right)^2 \quad (15)$$

$$e^2_{Z_y} = 0.30 \times \left(\frac{PHOTO}{15\ 000}\right)^2 + 0.50 \times \left(\frac{DTM}{15\ 000}\right)^2 + 0.25 \times \left(\frac{ORTHO}{5\ 000}\right)^2 \quad (16)$$

in which

e_{Z_X} , e_{Z_Y} = r.m.s.e in height, in meters, on the ground, on natural points, (including some targetted points) of stereo-orthophotopairs scanned resp. in the X and Y directions.

PHOTO = 1 : scale of the aerial survey (ranging from 16 K to 60 K) to be rectified

DTM = 1 : scale of the DTM, i-e of the survey which was plotted into contours and gave rise to the DTM, (ranging from 16 K to 60 K)

ORTHO = 1 : scale of the orthophoto and stereo-orthophoto (ranging from 5 K to 25 K).

EXAMPLE N°	1:SCALE OF THE AERIAL OR SPACE SURVEY (INPUT)	D.T.M.	ORTHO-PHOTO (OUTPUT)	COMPUTED PLANIMETRIC R.M.S.E. (resultant vector) AT GROUND SCALE (in meters)	AT ORTHO-PHOTO SCALE (in mm)	WITHIN US N.M.A.S. (90% <0.5 mm)	COMMENTS
1	1000 K (SOYUZ KATE--200)	200 K (?) 50 K (?)	200 K 1000 K	68 m 115 m	0.33 mm 0.12 mm	no yes	- Hungarian test reporting accuracy of 0.25 mm, see [11] - digital hungarian test, see [11] r.m.s.e. obtained 0.1 mm
2	820 K SPACELAB-MC	820 K	100 K	54 m	0.54 mm	no	- see [13] ESA test: accuracy 0.25 mm over 1/20 of a photo
3	730 K US-LFC	730 K	100 K	48 m	0.48 mm	no	
4	300 K SPOT	150 K (B/H=1)	50 K	185 m	0.37 mm	no	- see [14] r.m.s.e range obtained 0.25-0.38 mm in stereoplotting.
5	220 K SOYUZ-KFA-1000	220 K 50 K	50 K 50 K	15 m 13 m	0.30 mm 0.25 mm	yes yes	- see [12] Hungarian test reporting accuracy of 0.2 mm
6	175 K STEREO-MOMS	150 K 150 K	50 K 25 K	12 m 11 m	0.24 mm 0.45 mm	yes no	
7	175 K NEW SPACE PROJECT AT 5 m PIXEL SIZE	100 K 100 K (B/H=1)	50 K 35 K	12 m 11 m	0.23 mm 0.32 mm	yes yes	- would be very efficient
8	150 K AERIAL PHOTO	150 K 150 K 30 K	100 K 50 K 50 K	14 m 11 m 10 m	0.14 mm 0.22 mm 0.20 mm	yes yes yes	- used in Groënland (DK) - would be efficient - used in Sweden
9	120 K AERIAL PHOTO	120 K	64 K	10 m	0.15 mm	yes	- used in Alaska (USGS) (NHAP)
10	80 K AERIAL PHOTO	80 K	24 K	5.7 m	0.24 mm	yes	- used by USGS (NHAP)
11	60 K AERIAL PHOTO	150 K SPOT (B/H=1) 100 K (SPACE)	25 K 20 K	6.2 m 5.0 m	0.25 mm 0.25 mm	yes yes	- would be very efficient - would be very efficient using D.T.M. from ex. n° 7
12	50 K AERIAL PHOTO	150 K SPOT (B/H=1) 100 K (SPACE)	20 K 15 K	5.7m 4.4 m	0.28 mm 0.29 mm	yes yes	- would be very efficient. - would be very efficient using D.T.M. from ex. n° 7
13	30 K AERIAL PHOTO	100 K (SPACE)	10 K	3.6 m	0.36 mm	no	- would be a very efficient product using D.T.M. from ex. n° 7

EXAMPLES OF EXTENDED APPLICATION OF FORMULA (14)
TO SMALLER SCALE:
COMPUTED (AND EXPECTED) PLANIMETRIC ACCURACY OF ORTHOPHOTOS

TABLE 42

It should be emphasized that these formulae are still much more approximate than formula (14) in planimetry, due to wider discrepancies and twice less orthophotos in each class which separates the x and y scanning directions.

They can provide an order of magnitude of the accuracy attainable from stereo-orthophotopairs produced and assessed in the same conditions of the test , listed in 8.3.1.

The B/H ratio is assumed to be 0.6 and the slit width about 4 mm or 5 mm, but no significant differences should appear using a 8 mm slit.

No significant differences have been noted between linear and logarithmic laws for the x-parallaxes introduced into the stereomate, probably due to a lack of measurements at overhead features.

Formulae (15) and (16) are right at about ± 35 % for two thirds of the 25 stereo-orthophotopairs, as it can be seen in table 43 (instead of ± 20 % for formula (14) in planimetry).
(see also foot-note (1), p.6).

8.3.4 COMMENTS AND EXAMPLES OF APPLICATION OF THE ALTIMETRIC FORMULA

8.3.4 - a) Comments

-i) Comparing formulae (15) and (16) to (14) emphasizes a statement given in 8.2 - b) and table 38, according to which the absolute r.m.s.e in height is lower than the planimetric one (from 11 % to 35 %), strengthening the interest of stereo-orthophoto printing.

-ii) When scanning in x, the scale of the photograph to be rectified remains the driving factor while when scanning in y, the scale of the D.T.M overpasses the impact of that of the photograph. Anyway the impact of the input is smaller than in planimetry.

-iii) The impact of the orthophoto scale is the same as in planimetry, confirming that stereo-orthophoto printing should be considered as enlargements of the original survey.

-iv) The results are better when profiling in x than in the y direction from 20 % to 45 %, because differences between the profiles actually used for off-line creating the orthophoto and its partner are larger in y than in the x direction, introducing extra errors in the x-parallax.

-v) The results are inferior to those which would be obtained directly by plotting the original stereopair.

STEREO-ORTHOPHOTO PAIR N°	1 : SCALE OF AERIAL SURVEY	D.T.M.	ORTHO-PHOTO	VARIATION BETWEEN R.M.S.E. IN Z MEASURED AND COMPUTED BY FORMULAE (15) OR (16) in meter	in %	AVERAGE VARIATION OF EACH CLASS	SCAN DIRECTION
33 - 36	60 K	60 K	25 K	+ 0.44	+ 9 %	+ 9 %	y
19 - 22 21 - 20 21 - 23	30 K	60 K	25 K	- 2.54 - 2.53	- 64 % - 64 %	- 64 %	y
37 - 38 37 - 39	30 K	60 K	5 K	+ 0.83	+ 27 %	+ 27 %	y
44 - 47 46 - 45 48 - 49	30 K	30 K	5 K	+ 0.03 - 0.27 + 0.45	+ 2 % - 15 % + 24 %	+ 4 %	y
50 - 51	16 K	30 K	5 K	- 0.73	- 45 %	- 45 %	y
52 - 53	16 K	16 K	5 K	- 0.26	- 25 %	- 25 %	y
72 - 76 74 - 78 73 - 77 75 - 79	30 K	60 K	5 K	- 0.40 - 0.48 - 0.21 - 0.84	- 23 % - 27 % - 12 % - 48 %	- 27 %	x
13 - 11 10 - 14	30 K	30 K	25 K	0.0 - 0.90	0 % - 32 %	- 16 %	x
15 - 18 16 - 17 90 - 91 90 - 92	30 K	30 K	5 K	- 0.32 - 0.77 + 0.29 + 0.42	- 23 % - 56 % + 22 % + 31 %	- 6 %	x
66 - 67	16 K	60 K	5 K	- 0.59	- 40 %	- 40 %	x
26 - 24	16 K	30 K	5 K	+ 0.95	+ 97 %	+ 97 %	x
62 - 64 63 - 65	16 K	16 K	5 K	+ 0.39 + 0.07	+ 48 % + 8 %	+ 28 %	x
25 STEREO-ORTHOPHOTO PAIRS	2 x 6 CLASSES						

VARIATIONS OF ACTUAL
HEIGHT ACCURACY OF STEREO-ORTHOPHOTOS
IN THE TEST AROUND COMPUTED VALUES
GIVEN BY FORMULAE (15) AND (16)

TABLE 43

8.3.4 - b) Examples

Some examples of application of the altimetric formula (15) are given in table 44, consisting of scales ranging within the conditions of the test and of scales extended towards smaller and larger values. A wide variety of combinations which could be used for stereo-orthophoto printing, is displayed.

It can be seen that some examples fully agree to the results of other previous practical tests (see examples n°1, 2, 7, 9, 10 and 11) either from space data or larger scale aerial photographs, which brings an additional validation of this formula. Conversely results obtained in previous tests using a G.P.M indicate that this instrument delivered a heighting accuracy twice better than that of other analog stereo-ortho projectors. The reason probably lies in an on-line rectification of both frames of the pair, using exactly the same D.T.M. established by the GPM, for creating both orthophoto and its partner.

It is once more stated that stereo-orthophoto printing requirements are difficult to cope with, using analog printers. Digital photogrammetry should bring improvements in a near future which could foster its production.

EXAMPLE N°	1 : SCALE OF THE AERIAL/ SPACE SURVEY (INPUT)	D.T.M.	ORTHO-PHOTO (OUTPUT)	COMPUTED ALTIMETRIC R.M.S.E. AT GROUND SCALE (in meter) FROM STEREO-ORTHO SCAN IN X	COMMENTS
1	820 K SPACE-LAB-MC	820 K	100 K	36 m	- values of 20 m to 30 m have been obtained by stereo-plotting pairs directly.
2	300 K SPOT	150 K (B/H=1)	50 K	12 m	- see [14], r.m.s.e. range obtained is 4 m - 10 m
3	30 K	100 K (NEW SPACE PROJECT)	10 K	2.6 m	
4	30 K	30 K	10 K	1.6 m	- a value of 0.6 - 0.9 m is generally obtained by directly stereoplotting pairs
5 6	25 K 25 K	25 K 25 K	25 K 10 K	2.7 m 1.4 m	- see [5], a value of 0.97 m has been obtained, using a GPM
7	16 K	16 K	6.5 K	0.85 m	- see [7] SUDBURY test: r.m.s.e. obtained 0.71 m
8	10 K	10 K	10 K	1.1 m	- see [9], a value of 0.44 m has been obtained, using a GPM
9	10 K	10 K	4 K	0.58 m	- see [7], RIPON test: r.m.s.e. obtained: 0.40 m
10	10 K	10 K	2.5 K	0.50 m	- see [9], analog stereo-ortho-printers gave a r.m.s.e. range of 0.4 - 1.7 m
11	4 K	4 K	1.25 K	0.21 m	- see [10], FRG'test giving a r.m.s.e. of 0.22 - 0.24 m

EXAMPLES OF APPLICATION OF
FORMULA (15) OVER A FULL RANGE
OF SCALES: COMPUTED (AND EXPECTED) HEIGHTING ACCURACY
OF STEREO-ORTHOPHOTO PAIRS

TABLE 44

9 CONCLUSIONS

This OEEPE test on orthophotos and stereo-orthophotos gives more insight into accuracy of different categories of products and assessing methods.

Three parameters are of paramount importance : the scale of input and output products and DTM source. The results did not appear very sensitive to the scan direction, except for the height accuracy, nor to the slit width, within standard limits.

Most products were carried out using 6 GCPs on the average, mainly from 5 to 7, which is a standard number, but the impact of a large variation of GCPs number on the accuracy has not been studied.

However the impact of the number of control points used for establishing the transformation of orthophoto co-ordinates into ground co-ordinates was studied in a very detailed way. At least two remote fixed points should be used for scaling, and extrapolation outside these points, acting as control, should not take place.

It should be recommended to use a similarity adjusted on the whole fixed points available, keeping perhaps inactive two or three fixed points, if their number allows for such a further check. When using 7 GCPs for ajusting the plane-transformation, the improvement reaches 10 % relatively to a mere scaling on two points; this improvement is of 15 % by using 10 or 12 known points for this transformation and could be of 20 % with 20 points.

It should be recommended to use some targetted points, at least as GCPs, the improvement over natural points reaching up to 35 % or 40 % regarding the plani and height accuracy at targets, when their size is very appropriate to the scale. This emphasizes the importance of point identification and interpretability of detail. Measurements should be carried out at well-defined points,on distinctive features, easy to point to. The value of the r.m.s.e in identifying a point can be assessed as ranging within 30 and 60 microns at photo-scale,and as reaching up to 4.3 times the value of the pointing error, caused by the assessing instruments.

It should be recommended to use a mixed restitution from full frame, which allows to rectify the whole nadir area of each successive photograph, area in which the accuracy is improved by 21 % over other areas, on the average. This method delivers an improvement of 6 % for the final result, and probably more when a large block involving several strips has to be rectified, as off-nadir fringes, of poorer results, can be reduced by sharing the side overlaps between adjoining strips.

Orthophotos and stereomates benefit from a better local homogeneity, marked by an improvement of 27 % and 44 %, as regards the relative accuracy improvement resp.in planimetric and elevation differences between two neighbouring points. This important result makes both products best suited to many purposes, such as map revision and civil engineering projects, in which accurate measurements are required in smaller areas, using close-range interpolation inside well known features.

All these improvements have been noted as being exactly additive, resulting in a cumulative effect at points which own several properties such as near-nadir targetted points or near-nadir neighbouring points.

Somewhat large discrepancies have been noted between products and in their assessments, which would require more stringent quality control rules at each separate stage in order to reach a high, if not the top level permitted by the data quality, which is not an easy task. Otherwise, accuracy and reliability can nosedive without notice.

However general formulae have been set up, outlining some useful guidelines as to determine the best way of producing stereo-orthophotos by using appropriate scales for the original survey, DTM and orthophotos. Output products should be considered as an enlargement of the input survey by at least 2.5 times, for drawing full benefit from the original photographic content. Substantial cost savings can be obtained by a clear awareness of the proper data required. Some examples show cost-effective manners to choose which scales to use.

When no heighting data base or no smaller scale photographs are available, the DTM, which is derived from the original survey to rectify, allows an enlargement of up to 4.5 or 5.0 times for the orthophoto. So that the scale of this survey derives from that of the orthophoto, which derives itself from the accuracy required on the ground and the need to comply with the related map accuracy standards. As a result, it could be sometimes cheaper to commission a special aerial photographic survey, especially over wide areas, whenever the surveys available have a scale too different from its most appropriate value.

When a DTM derived from a smaller scale survey is available, there is a great interest in using it. The scale from which this DTM is derived can be at leat 2 times, 3 or even 4 times smaller than that of the survey to rectify, giving rise to allowable enlargements of as much as resp. 3.5 times, 3 or 2.3 times for the orthophoto. So wide ranges are seldom used which correspond to a ratio of 7 to 9 between the scales of the orthophotos and the D.T.M. which produced them.

In urban areas, where a planimetric accuracy of about 0.5-0.7 m is required by many users, orthophotos could be carried out at 1:2 K-scale, using aerial photographs at a scale of 1:8 K and a D.T.M derived from 1: 15 K-scale surveys.

In rural areas, where an accuracy of 2 m to 10 m is needed for the preliminary design phase of civil engineering projects (see [15]), orthophotos could be achieved at 1: 10 K or 1: 20 K using aerial photographs resp. at 1: 30 K or 1: 50 K and a D.T.M obtained from space surveys at 1: 100 K-scale.

In any case the heighting accuracy, though inferior to that of a regular stereoplotting product, would be approximately of 3.7 x H/10 000, allowing contours to be superimposed with an interval twice as much as that of the related regular line map; they could be issued either from the D.T.M used in orthophoto production or from the stereo-orthophoto-pair, eventually delivering a quite complete and interesting orthophotomap.

Many other examples of application are or could be reported, showing that there is little to be gained in accuracy by using a much better D.T.M and more money to be lost by doing so.

In the prospect of fully digital photogrammetry and orthophography, which are already under successful development, the stereo-orthophoto technique should no longer be hampered by cost-effectiveness problems. Its value as supplements or alternatives to standard mapping and the great potential it offers through computer-aided cartography (see [6]) and G.I.S., could then be fully recognized. It should eventually be an efficient by-product of the basic altimetric data bases which are now being available or being established in an increasing number of countries, and/or of DTM derived from stereoscopic space surveys.

Orthophotos and space geocoded data are ready for integration into G.I.S and are applicable across a broad spectrum of interest.

Stereo-orthophotos are easy to produce, as they largely rely on automatic formation of a D.T.M and other computer-assisted stages; they are simple to use and need no setting procedure by comparison with a conventional stereoplotter (see [1] and [9]).

The results obtained in this OEEPE test apply to whatever kind of data is used in input, in analog or digital format, either from field, aerial or space survey; these results are independant of the technology used in production, whatever type of off-line orthophoto-printer is used,optical or digital, and can be but improved in the future, using CCD cameras for example and digital color image processes.

Digital orthophotoprinting shows great promise as an important tool in automated mapping, either from scanned aerial photographs or CCD sensors.

Further developments should be expected around the year 2000, using a new generation of space sensors such as those studied by CNES, for the post SPOT-4 era, or by ESA and NASA for a polar platform. All these instruments are scheduled for delivering a better ground resolution and fore and aft stereoscopy.

Should there not be room for further tests that OEEPE could consider later on ?

Taking into account the availability of digital input data and digital processing methods, two ways could be approached in a more specific test :

- large-scale stereo-orthophotomapping, using existing DTM and color digital data, checking the maximum enlargement which can be obtained in output products versus the scale of DTM and aerial surveys.

- small-scale stereo-orthophotomapping, using a DTM from 5 m or smaller pixel size space data, checking the maximum enlargement allowable in output for either aerial or space images to rectify.

Fully digital processing should improve the heighting accuracy attainable from stereo-orthophotopairs,since, unlike now in most orthophoto-projectors, except GPM, each pixel from both images of a stereopair would be rectified into an orthophoto or its stereomate using exactly the same DTM. No instrumental backlash or deviating value due to differences of interpolation in the DTM between the orthophoto and its stereomate, should then take place.

As regards specifications of equipments for using the stereo-orthophotos, they mainly depend on the goal aimed at. At present 5 or 6 instruments can be considered as available (see 3.2.2), though most of them are still prototypes. They differ in size, magnification, number of carriages for holding 1 or both stereomates, compiling or revising a map, superimposition possibility, digital recording systems... A planimetric accuracy of 2 to 3 cmm and a parallax accuracy of 1 cmm is quite sufficient and should not raise any problem.

Considering that the loss of relative heighting accuracy as compared with that of the original survey, which can reach 80 % between points far from each other, is quite null at neighbouring points, this difficulty should no longer be a major drawback for many users.

Improvements should be brought when producing the stereo-orthophotopair : both orthophoto and stereomate should be printed onto the same film, together with proper register ticks, in order to set up the stereo-orthophotopair more easily, to clear any unwanted rotation, and to provide the user with an immediate way to check the scale and the heighting formula.

The cost will still remain the major restraint on a wider use of stereo-orthophotographs. But the development of digital photogrammetry, delivering better products and increased accuracy at always reducing costs, together with that of geocoded images, G.I.S. and heighting data bases, should largely remove such restrictions and foster the production and dissemination of these products.

Stereo-orthophoto technique will remain the simplest automated stereoplotting method, which requires very little specialised training of the user and can be used by non-photogrammetrists as well (see ALI and DOWMAN, [1]).

10 APPENDICES

10.1 REFERENCES

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10.2 INFORMATION ON CONTROL AND CHECK POINTS

Seven location maps show hereafter the distribution of fixed points, used as GCPs or check points as well.

This distribution appears quite uniform as a whole.

Three pages issued from the "General Catalogue" of fixed points, show some examples of points derived from aerial surveys at 1 : 7 K, 1 : 16 K and 1 : 30 K-scale, together with sketches. This catalogue contained 29 pages.

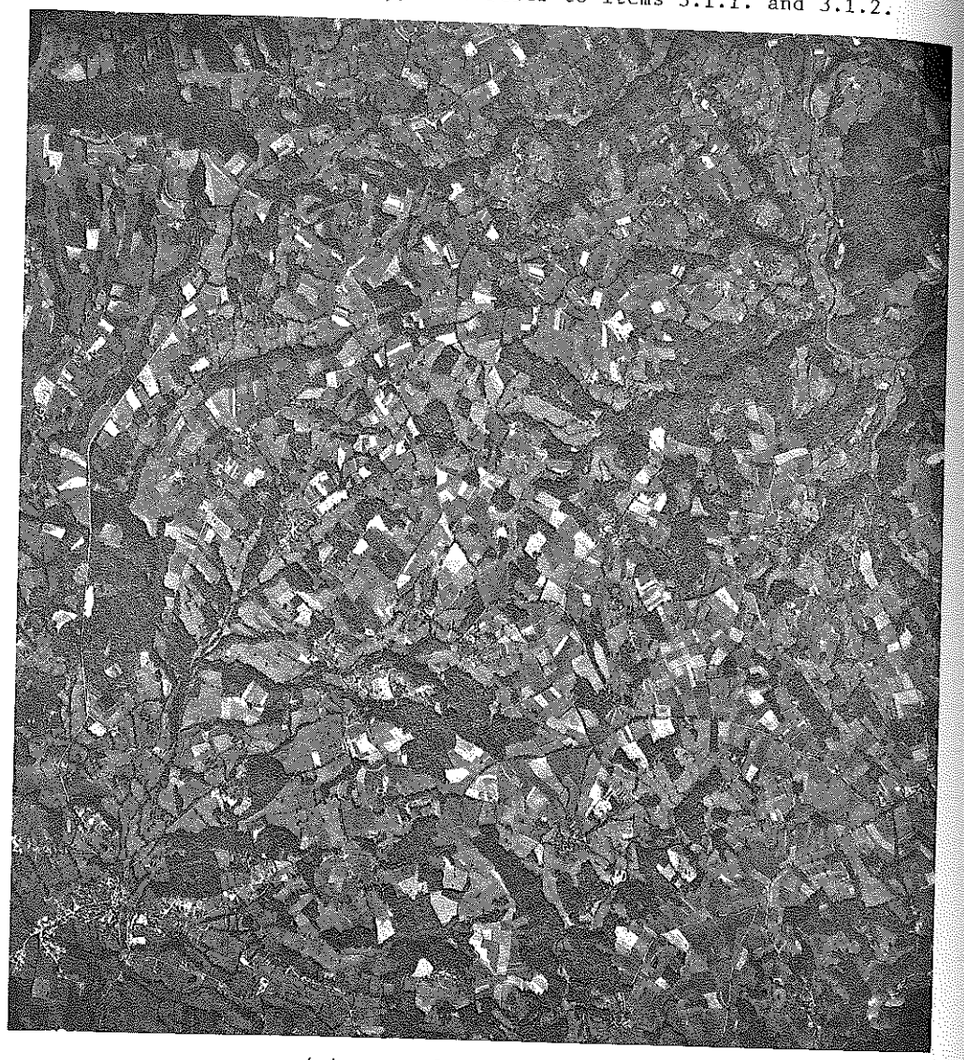
For more information, please refer to item 3.1.3.

10.3 INFORMATION ON THE TEST AREA

An aerial photograph at 1 :30 K-scale shows the type of land-use land-cover encountered in the test area which covers the whole frame.

As regards the relief, please refer to any location map in 10.2, where contours are displayed at a 10 m elevation interval.

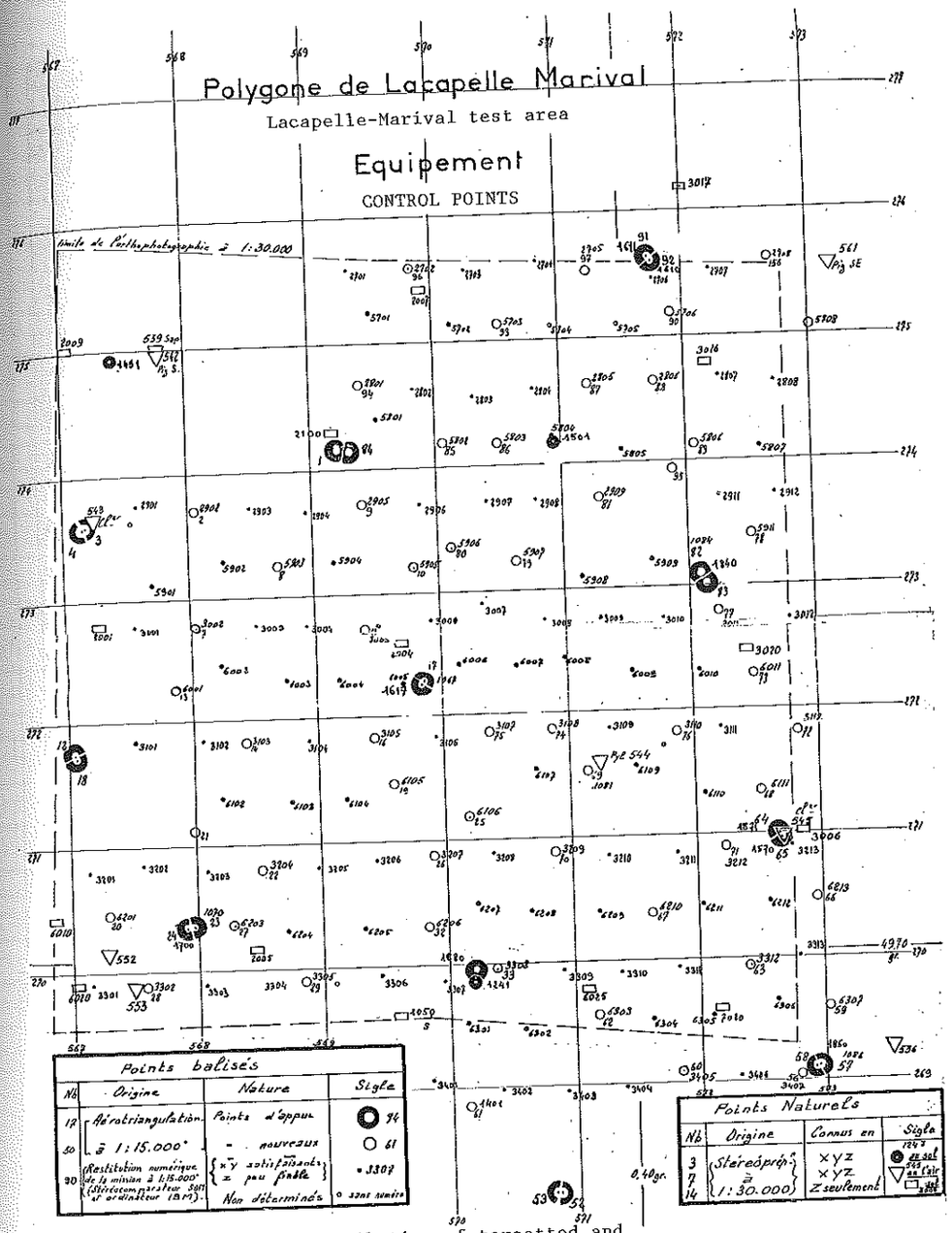
For more information,please refer to items 3.1.1. and 3.1.2.



(image reduced in scale)

10.4 LIST OF ORTHOPHOTOS AND STEREO-ORTHOPHOTOS

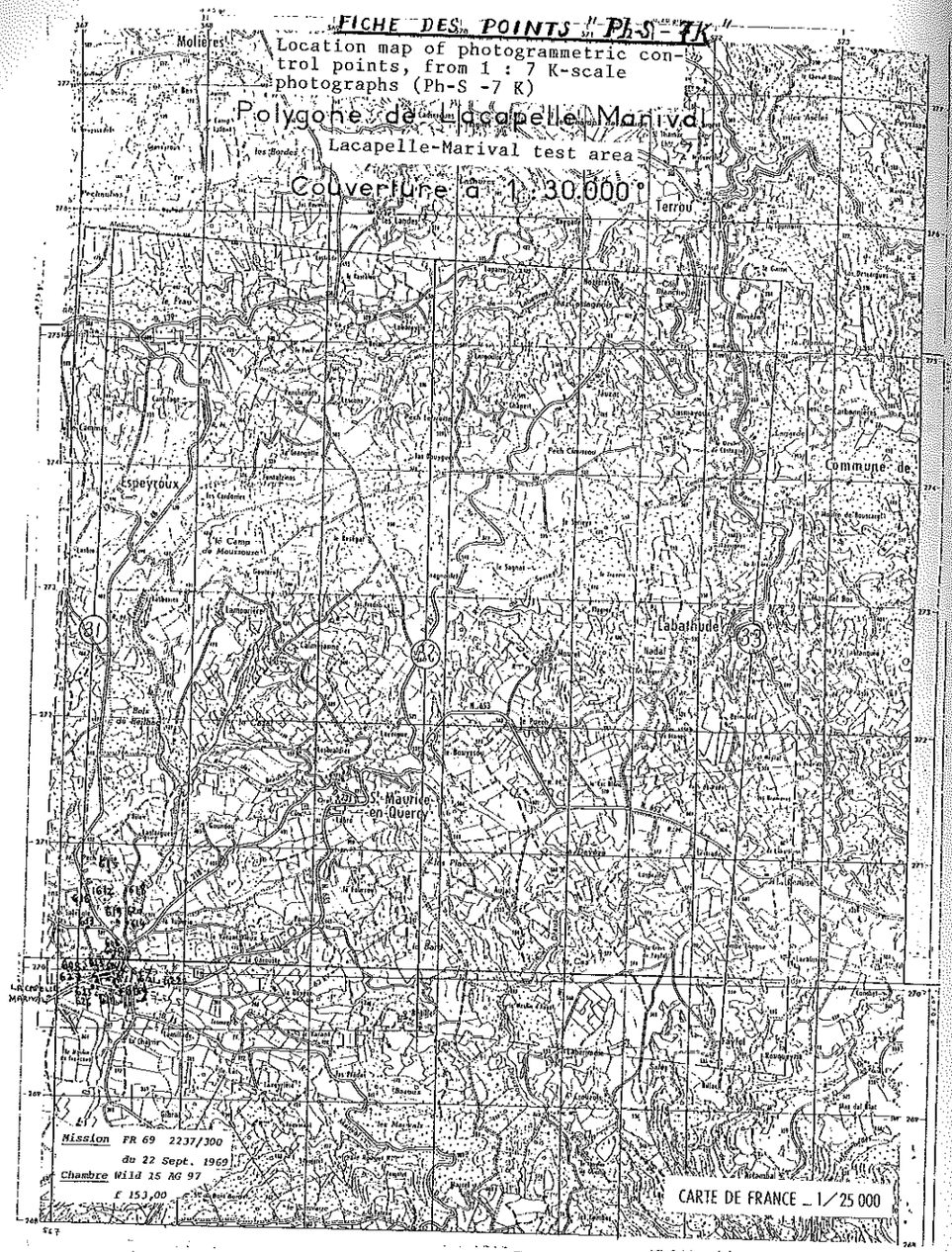
See item 3.3 and tables n° 3, 4 and 5.



Distribution of targetted and natural fixed points

FICHE DES POINTS "Ph-S - 7K"

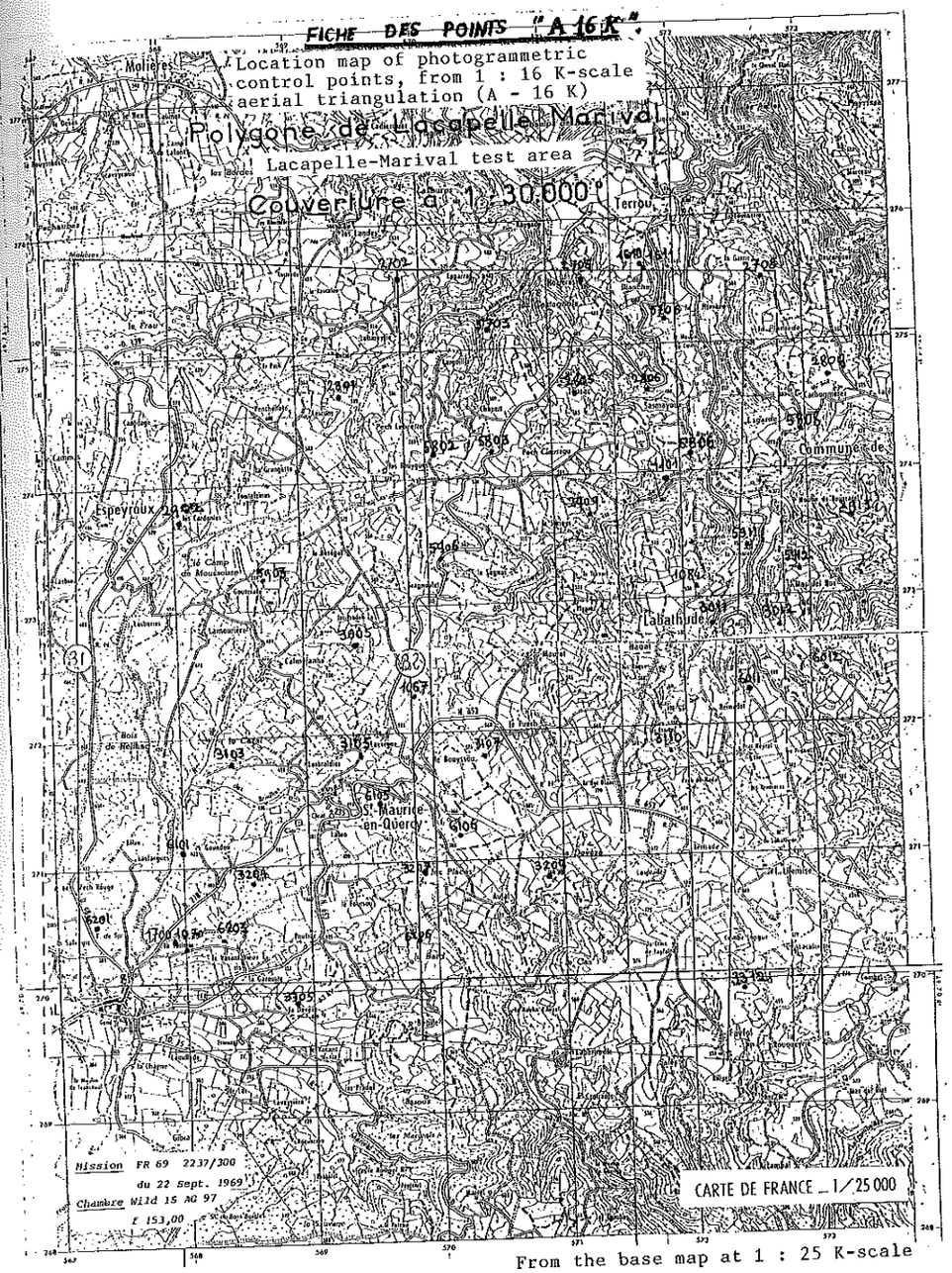
Location map of photogrammetric control points, from 1 : 7 K-scale photographs (Ph-S -7 K)



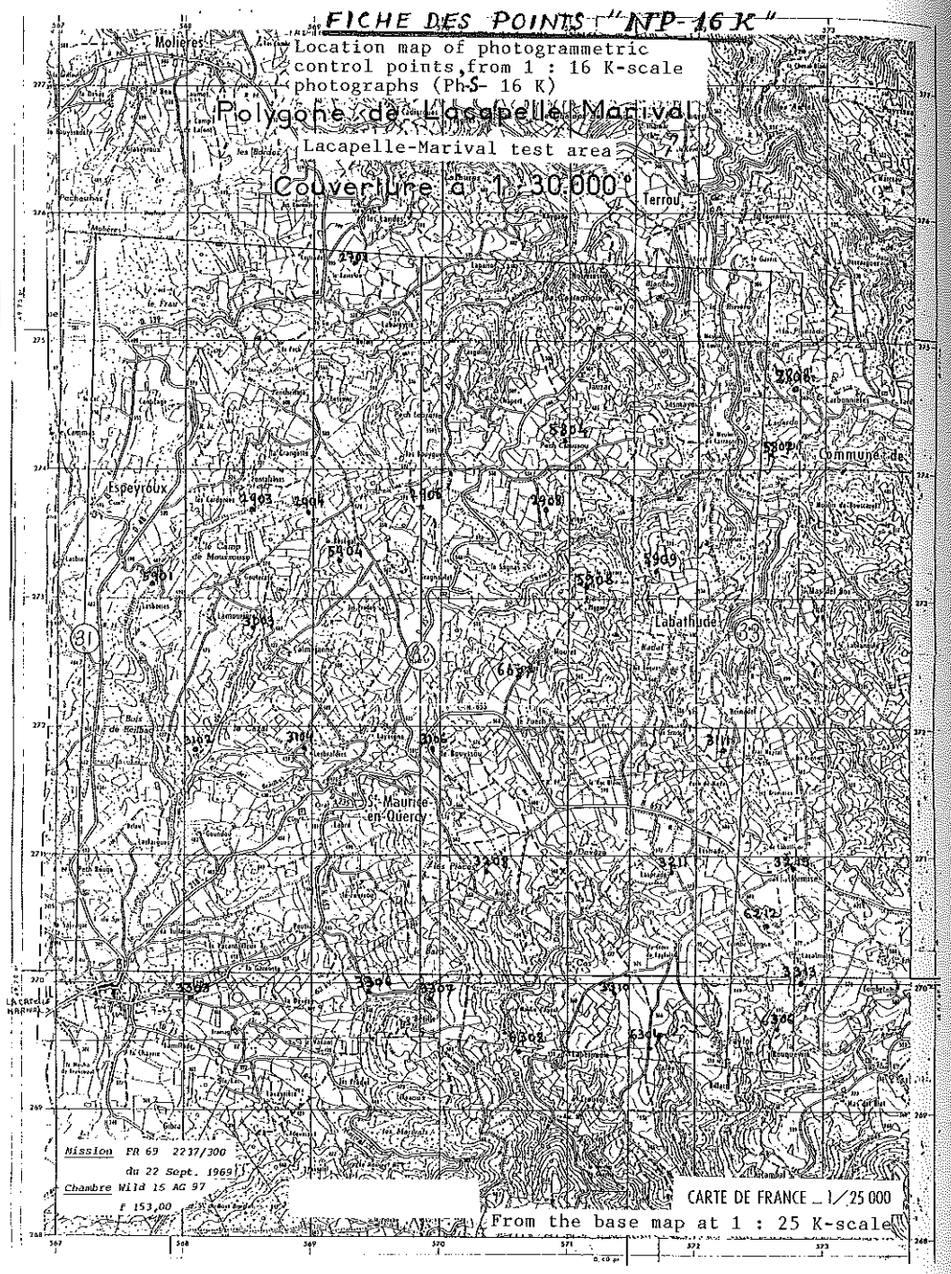
From the base map at 1 : 25 K-scale

FICHE DES POINTS "A 16 K"

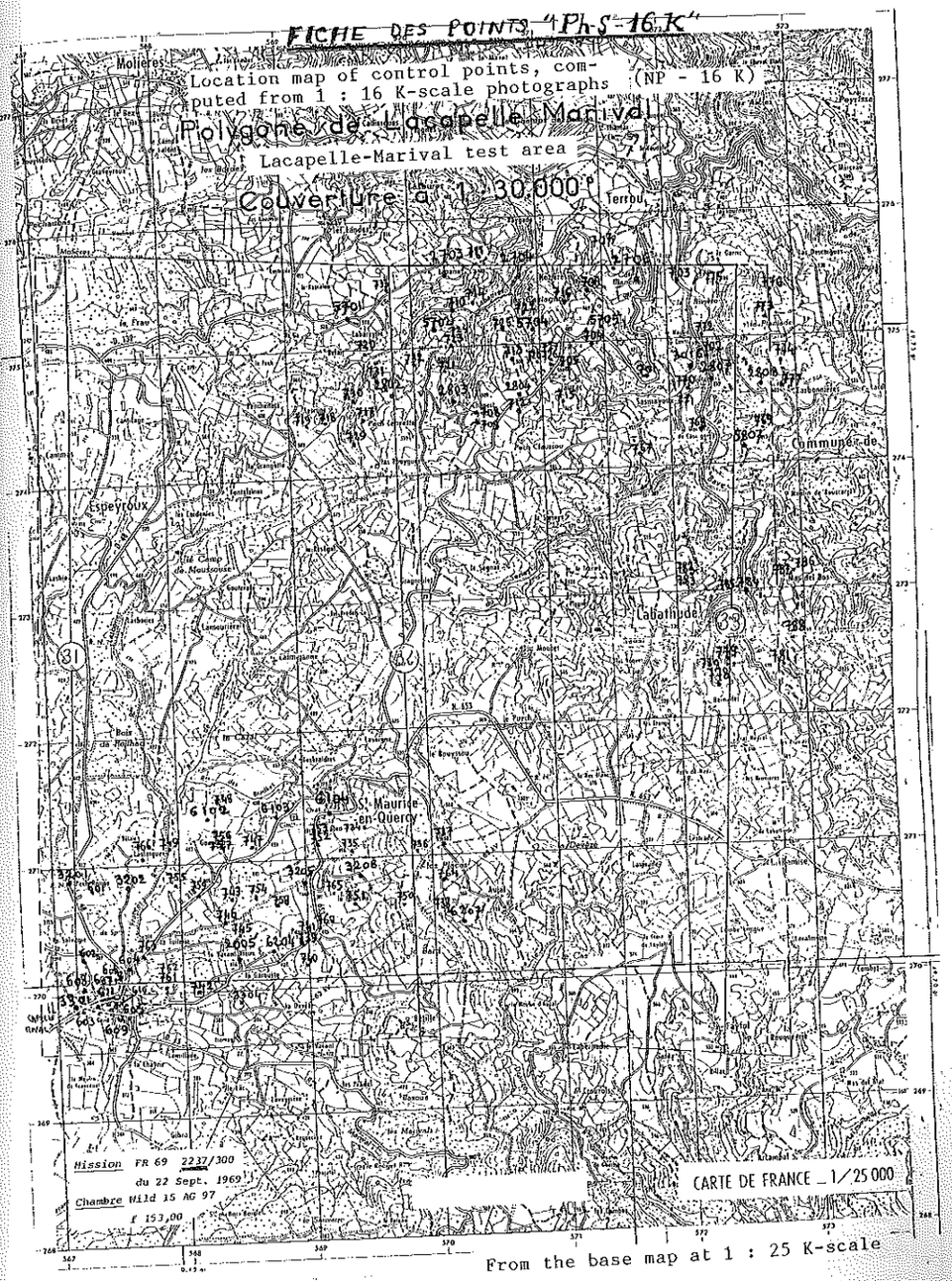
Location map of photogrammetric control points, from 1 : 16 K-scale aerial triangulation (A - 16 K)



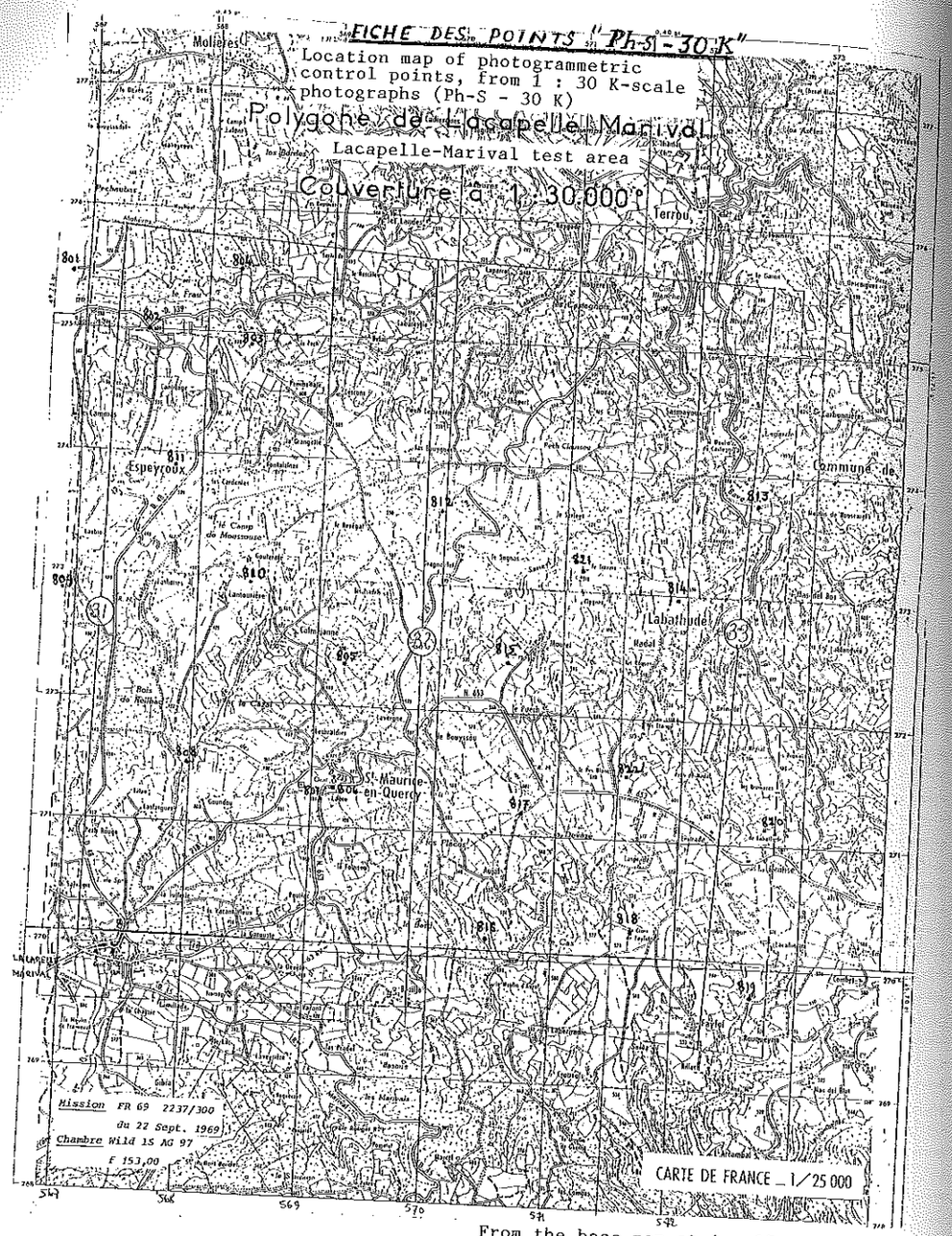
From the base map at 1 : 25 K-scale



From the base map at 1 : 25 K-scale

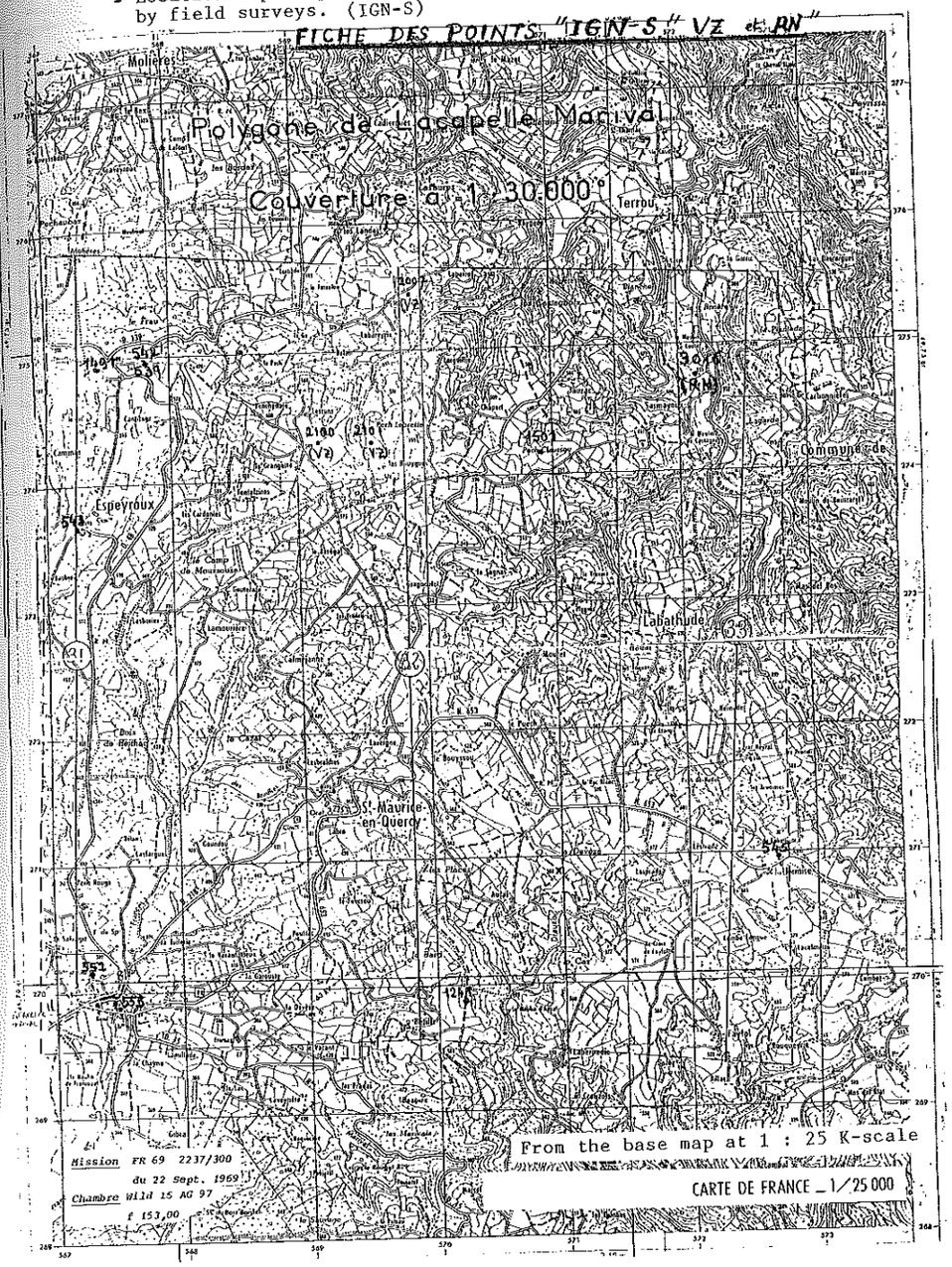


From the base map at 1 : 25 K-scale



- Location map of photogrammetric control points, from 1 : 30 K-scale photographs (Ph-S - 30 K)

From the base map at 1 : 25 K-scale



- Location map of points determined by field surveys. (IGN-S)

From the base map at 1 : 25 K-scale

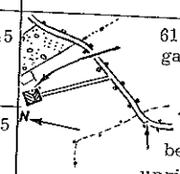
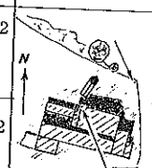
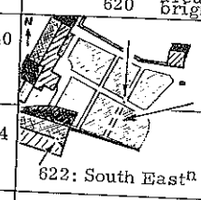
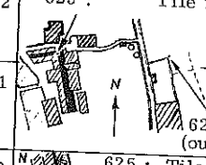
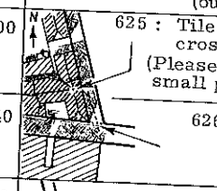
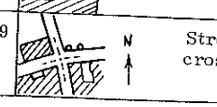
page issued from the "General Catalogue" of fixed points

OEEPE/WG/G IGN-GRED/PN	Lacapelle Marival stereo orthophoto test Area Stereopair 184 - 187 (1: 7 k)

- ~~Targetted~~
- Natural

- ~~Ground control points~~
- Check points (To be determined on stereo orthophoto prints)

Scales concerned :
60 k 30 k 16 k 7 k

Origin (1)	N°	X	Y	Z	Sketch , comments...
Ph. S 1 : 7 k	617	567 525, 44	270 091, 91 ?	396, 45	 617 : Northern gable end
-	618	567 519, 22	270 643, 23	381, 55	618 : Road bend, lane axis upright a bush
-	619	567 493, 06	270 381, 71	386, 72	 619 : Fence angle (inner side)
-	620	567 474, 41	270 375, 39	392, 32	Roof inferior edge between two adjoining areas dark and bright 620
-	621	567 560, 68	269 999, 27	371, 40	 Paths crossing in a garden (one more on 60k)
-	622	567 540, 94	269 987, 70	381, 84	622: South East^{n} gable end
-	623	567 299, 62	270 048, 34	399, 62	623 : Tile ridge angle
-	624	567 366, 12	270 053, 53	391, 41	 Fence angle 624 (outer side)
-	625	567 329, 88	269 897, 93	389, 00	 625 : Tile ridges crossing (Please ignore the small pinnacle)
-	626	567 339, 20	269 885, 39	377, 40	626 : streets crossing
-	627	567 307, 49	269 974, 55	381, 69	 Streets crossing

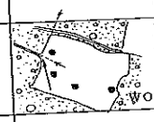
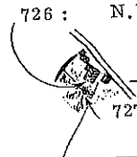
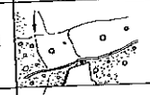
page issued from the "General Catalogue" of fixed points

OEEPE/WG/G IGN-GRED/PN	Lacapelle Marival stereo orthophoto test Area Stereo pair 14 - 16 (1 : 16 k)

- ~~Targetted~~
- Natural

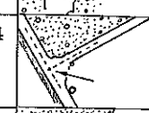
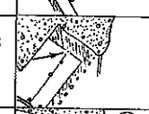
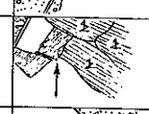
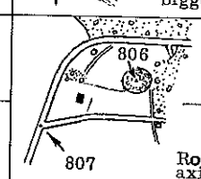
- ~~Ground control points~~
- Check points (To be determined on stereo orthophoto prints)

Scales concerned :
60 k 30 k 16 k 7 k

Origin (1)	N°	X	Y	Z	Sketch , comments...
Ph. S. 1:16 k	723	570 293, 62	275 009, 75	501, 55	N 723 : Eastern house corner
"	724	570 290, 69	275 012, 23	509, 21	724 : Northern gable end
"	725	570 716, 69	275 120, 73	492, 67	 Indentation of the wood skirt (Track in line wood skirt in line)
"	726	571 091, 05	274 838, 49	507, 82	726 : N. Western gable end
"	727	571 080, 99	274 842, 33	496, 11	 727 : White spot (axis)
"	728	570 979, 57	274 852, 49	471, 97	728 : Boundaries' crossing in a thalweg
"	729	569 514, 19	274 264, 31	548, 10	Hedge corner (inner side)
"	730	569 531, 59	274 588, 02	525, 18	Bend of a narrow white track
"	731	569 723, 02	274 751, 49	529, 51	 Wood corner
"	732	570 017, 50	274 881, 50	499, 94	Boundaries' corner
"	733	569 816, 58	275 458, 59	502, 30	Pasture entrance axis

page issued from the "General Catalogue" of fixed points

OEEPE/WG/G IGN-GRED/PN	Lacapelle Marival stereo orthophoto test Area stereo pair 31-32 (1: 30 k)	
- ~~Targetted~~ - Natural	- ~~Ground control points~~ - Check points (To be determined on stereo orthophoto prints)	Scales concerned : 60 k 30 k 16 k 7 k

Origin (1)	N°	X	Y	Z	Sketch , comments...
Ph. S 1:30 k	801	566 892, 2	275 455, 4	478, 7	Road axis upright a tree
-	802	567 514, 1	275 008, 7	609, 4	 Roads' crossing axis
-	803	568 365, 8	274 902, 4	619, 3	 Boundaries' crossing
-	804	568 241, 6	275 519, 3	495, 4	Traks'crossing axis on the skirt of a wood
-	805	569 223, 4	272 359, 4	511, 2	 Small white spot at a culture corner (Much bigger on 60 k)
-	806	569 181, 6	271 330, 0	522, 2	 Upper part of a huge tree
-	807	569 071, 4	271 244, 7	482, 0	Roads crossing axis
-	808	567 995, 0	271 489, 9	390, 8	Near a confluent wood skirt, house in line
-	809	566 900, 9	272 852, 3	440, 5	At dam corner : track axis , dam side in line
-	810	568 440, 0	272 995, 7	501, 5	Culture corner (outer side)
-	811	567 783, 9	273 879, 2	517, 7	Boundaries' crossing

10.5 INDIVIDUAL FORMS FROM EACH ORTHOPHOTOGRAPH

Each of the 29 orthophotographs which have been assessed, gave rise to a form comprising the main results obtained, as regards both heighting and planimetric accuracies. They result from the different plane-transformations used for assessing the measurements, consisting of two methods in altimetry and four in planimetry.

When the computations were not carried out, for different reasons, the abbreviation N.A. (not available) is printed. The values given for the precision (standard deviation) and accuracy (root mean square error, r.m.s.e.) were computed on the whole fixed points available in the pair (GCPs and check points), and are referred to three reference systems (on the ground, at photo and orthophoto scale).

A global overview of the differences in results at GCPs and check points is given in item n° 4.1.6 a and fig. 7, while the values at targetted points is indicated in the recapitulation form, heading this appendice 10.5.Differences between the values of standard deviations and r.m.s errors, resulting from the first plane-transformation (on 2 points), and which can sometimes appear rather big, evolve from bias when using only 2 points. These differences are reduced till zero when using the three other plane-transformations involving more points. The best quality indicator emerging from these forms is the r.m.s.e. from the last plane-transformation, set up on the whole points.

RECAPITULATION						RESULTS FROM AERIAL PHOTOS AT 1 : 60 k 30 k 16 k (in meters)							
	STAGE	1: Scale of Aerial Photo	D. T. M	Ortho	Slit Width Scan dir.	HEIGHT ACCURACY transf. set up on 2 points st^d dev		whole pts, r.m.s.e on whole points	targets only	PLANI ACCURACY transf. set up on 2 points st^d dev		whole pts, r.m.s.e on whole points	targets only
ITC	1.1.1	60 K	60K/PEB8	25 K	5 mm y					N.A		26.4	N.A
	1.1.2	60 K	60 K	25 K	y					17.2		15.0	N.A
IFAG	1.1.3	60 K	60 K	25 K	4 mm y			4.8				5.8	N.A
NLS	2.1.1	30 K	60 K	25 K	5 mm y	1.6		1.4	1.7	4.8		4.4	4.2
ITC	2.1.2	30 K	60 K	5 K	5 mm x	1.3		1.3	1.3	2.3		2.2	2.0
ITC	2.1.3	30 K	60 K	5 K	8 mm x	1.2		1.2	1.2	2.7		2.1	1.9
IFAG	2.1.4	30 K	60 K	5 K	8 mm y	4.0		3.9	3.9	2.5		2.2	2.1
IGN	2.2.2	30 K	30 K	25 K	5 mm x	2.4		2.5	2.0	4.4		3.7	3.0
IFAG	2.2.3	30 K	30 K	25 K	4 mm y	4.0			N.A	3.2		2.9	2.6
IFAG	2.2.4	30 K	30 K	5 K	4 mm y	1.8		1.7	1.8	1.6		1.5	1.3
IGN	2.2.5	30 K	30 K	5 K	5 mm x	0.8		0.8	0.7	3.0		2.6	1.7
IFAG	2.2.6	30 K	30 K	5 K	8 mm y	2.5		2.3	2.7	2.3		2.0	2.0
WH	2.2.7	30 K	30 K	5 K	8 mm x	1.8		1.8	1.8	1.8		1.5	1.2
IGN	2.3.1	30 K	16 K	30 K	5 mm x	N.A		N.A	N.A	2.7		2.9	-
ITC	3.1.2	16 K	60 K	5 K	8 mm x	0.8		0.9	0.6	1.7		1.6	0.9
NBS	3.2.1	16 K	30 K	5 K	5 mm x	1.9		N.A	N.A	3.2		N.A	N.A
NBS	3.2.2	16 K	30 K	5 K	8 mm x	3.3		N.A	N.A	2.2		N.A	N.A
IFAG	3.2.3	16 K	30 K	5 K	8 mm y	0.9		0.9	0.6	1.8		1.5	0.9
IFAG	3.3.1	16 K	16 K	5 K	4 mm y	0.8		0.8	0.5	1.3		1.2	0.7
ITC	3.3.2	16 K	16 K	5 K	5 mm x	0.9		N.A	N.A	1.2		1.1	0.7
ITC	3.3.3	16 K	16 K	5 K	8 mm x	0.7		N.A	N.A	1.0		1.0	0.6

STAGE 1.1.1		ORTHOPHOTO N° 84			Relief : class	
Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 84	n° 64	60 K	PEB 8 y-scanning 60 K (profiles)	25 K	5 mm 125 m	y	ITC (NL) - OR1 -	UCL (GB) -DSR1 -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
	2 points			
	The whole points (least sq. adjust.)			

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 84 - 81	3	-	9	10	30	90

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole GCPs (similarity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least sq. adjust.)	23.2 m	26.4 m	387	440	928	1056

STAGE 1.12	ORTHOPHOTO N° 81	Relief : class

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 81	n° 64	60 K	60 K	25 K	5 mm 125 m	y	ITC (NL) - OR1 -	UCL (GB) - DSR1 -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
	2 points			
	The whole points (least sq. adjust.)			

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 81 single n° 81 - 84	0	-	11	10	0	110

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	17.2	18.0	287	300	688	720
- The whole GCPs (similarity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	15.0	15,0	250	250	600	600

STAGE 1.13	ORTHOPHOTO N° 33	Relief : class

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 33	n°64	60 K	60 K	25 K	4 mm 100 m	y	IFAG (D) - Z2 -	UCL (GB) CP1-ROSS-STEREO-ORTHO

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
		1		16

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 33 - 36	2 points		CP1 : 4.8.... ROSS : 5.8....	4.8 x H/10000 6.1 x H/10000
	The whole points (least sq. adjust.)			

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 33 - 36			13	1		13

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)						
- The whole GCPs (similarity by least sq. adjust.)		5.8		97		232
- The whole GCPs (affinity by least sq. adjust.)						
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)						

STAGE 2.11	ORTHOPHOTO N° 19	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 19	n° 31	30 K	60 K	25 K	5 mm 125 m	y	NLS (s) - OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0	16 to 19	4	0	70

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 19 - 22	2 points	1.57	1.75	3.9 x H/10000
	The whole points (least sq. adjust.)	1.40	1.39	3.1 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 19 - 21	0 to 2	4 to 6	16 to 18	5	5	83

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	4.62	5.64	154	188	185	226
- The whole GCPs (similarity by least sq. adjust.)	5.01	5.36	167	179	200	214
- The whole GCPs (affinity by least sq. adjust.)	5.70	5.88	190	196	228	235
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	4.53	4.53	151	151	181	181

STAGE 2.11	ORTHOPHOTO N° 21	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 21	n° 32	30 K	60 K	25 K	5 mm 125 m	y	NLS (S) -OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0 to 4	16 to 22	8	9	146

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 21 - 20	2 points	1.58	1.89	4.2 x H/10000
21 - 23	The whole points (least sq. adjust.)	1.34	1.38	3.1 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 21 - 20 21 - 23	0 to 4	4 to 7	16 to 20	8	9	142

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	4.89	5.29	163	176	196	212
- The whole GCPs (similarity by least sq. adjust.)	4.54	5.17	151	172	182	207
- The whole GCPs (affinity by least sq. adjust.)	4.36	5.04	145	168	174	202
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	4.30	4.30	143	143	172	172

STAGE 2.12	ORTHOPHOTO N° 72	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 72	n° 32 (S)	30 K	60 K	5 K	5 mm 25 m	x	ITC (NL) - OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
4	13	1	4	13

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 72 - 76	2 points	1.36	1.31	2.9 x H/10000
	The whole points (least sq. adjust.)	1.36	1.35	3.0 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 72 - 76	2	3	13	1	2	13

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.19	2.49	73	83	438	498
- The whole GCPs (similarity by least sq. adjust.)	2.30	2.90	77	97	460	580
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.09	2.01	70	67	418	402

STAGE 2.12	ORTHOPHOTO N° 74	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 74	n° 32 (N-E)	30 K	60 K	5 K	5 mm 25 m	x	ITC (NL) -OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
5	20	1	5	20

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 74 - 78	2 points	1.28	1.30	2.9 x H/10000
	The whole points (least sq. adjust.)	1.24	1.27	2.8 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 74 - 78	4	3	20	1	4	20

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.40	3.46	80	115	480	692
- The whole GCPs (similarity by least sq. adjust.)	2.62	4.08	87	136	524	816
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.43	2.37	81	79	486	474

STAGE 2.13	ORTHOPHOTO N° 73	Relief : class II LACAPELLE

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 73	N° 32 (S)	30 K	60 K	5 K	8 mm 40 m	x	ITC(NL) -OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
4	12	1	4	12

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 73 - 77	2 points	1.62	2.21	4.9 x H/10000
	The whole points (least sq. adjust.)	1.57	1.54	3.4 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 73 - 77	2	2	12	1	2	12

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.33	2.56	78	85	466	512
- The whole GCPs (similarity by least sq. adjust.)	2.92	4.39	97	146	584	878
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.12	2.02	71	67	424	404

STAGE 2.13	ORTHOPHOTO N° 75	Relief : class III N-E

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 75	n° 32 (N-E)	30 K	60 K	5 K	8 mm 40 m	x	ITC (NL) - OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
3	18	1	3	18

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 75 - 79	2 points	0.89	1.01	2.2 x H/10000
	The whole points (least sq. adjust.)	0.85	0.91	2.0 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 75 - 79	3	2	18	1	3	18

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.96	2.88	99	96	592	576
- The whole GCPs (similarity by least sq. adjust.)	3.14	4.53	105	151	628	906
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.22	2.16	74	72	444	432

STAGE 2.14	ORTHOPHOTO N° 37	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 37	n° 32	30 K	60 K	5 K	8 mm 40 m	y	IFAG (D) -Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
3	13	2	6	26

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 37 - 38	2 points	3.96	4.85	10.8 x H/10000
37 - 39	The whole points (least sq. adjust.)	3.96	3.92	8.7 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 37 - 38 37 - 39	1	2 or 4	14	2	2	28

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	2.49	2.45	83	82	498	490
- The whole GCPs (similarity by least sq. adjust.)	2.25	2.68	75	89	450	536
- The whole GCPs (affinity by least sq. adjust.)	2.57	2.90	86	97	514	580
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.18	2.18	73	73	436	436

STAGE 2.22	ORTHOPHOTO N° 10	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 10	n° 33	30 K	30 K	25 K	5 mm 125 m	x	IGN (F) - OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
1 or 3	24 or 25	2	4	49

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 10 - 14	2 points	1.97	3.04	6.7 x H/10000
	The whole points (least sq. adjust.)	1.92	1.90	4.2 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 10 single 10 - 14	1 to 3	7 or 10	17 or 25	4	5	84

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	4.30	4.66	143	155	172	186
- The whole GCPs (similarity by least sq. adjust.)	3.96	4.07	132	136	158	163
- The whole GCPs (affinity by least sq. adjust.)	3.73	3.77	124	126	149	151
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	3.94	3.94	131	131	158	158

STAGE 2.22	ORTHOPHOTO N° 13	Relief : class IV

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 13	n° 32	30 K	30 K	25 K	5 mm 125 m	x	IGN (F) -OR1 -	IGN (F) - ORTOSTER-

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0 to 3	11 to 16	12	19	175

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 13 - 11 13 - 12	2 points	2.48	2.99	6.6 x H/10000
n° 13 - 11 only	The whole points (least sq. adjust.)	2.78	2.80	6.2 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 13 single 13 - 11 13 - 12	0 to 4	4 to 8	11 to 20	23	29	354

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	4.38	5.21	146	174	175	208
- The whole GCPs (similarity by least sq. adjust.)	3.94	4.20	131	140	158	168
- The whole GCPs (affinity by least sq. adjust.)	3.60	3.92	120	131	144	157
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	3.70	3.70	123	123	148	148

STAGE 2.23	ORTHOPHOTO N° 40	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 40	n° 32	30 K	30 K	25 K	4 mm 100 m	y	IFAG (D) -Z2 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
1 to 2	12 to 17	4	7	60

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 40 - 43	2 points	3.92	3.91	8.7 x H/10000
	The whole points (least sq. adjust.)	N.A	N.A	N.A

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 40 - 42 40 - 43	0 to 9	5 or 6	14 to 37	11	27	212

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.97	3.46	99	115	119	138
- The whole GCPs (similarity by least sq. adjust.)	2.81	3.27	94	109	112	131
- The whole GCPs (affinity by least sq. adjust.)	2.65	2.86	88	95	106	114
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.72	2.72	91	91	109	109

STAGE 2.23	ORTHOPHOTO N° 42	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 42	n° 33	30 K	30 K	25 K	4 mm 100 m	y	IFAG (D) - Z2 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0 to 3	13 to 19	4	6	63

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 42 - 41	2 points	4.11	3.99	8.9 x H/10000
	The whole points (least sq. adjust.)	N.A	N.A	N.A

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 42 - 41	0 or 1	5 or 6	14 to 19	4	2	67

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	3.90	5.23	130	174	156	209
- The whole GCPs (similarity by least sq. adjust.)	3.68	3.80	123	127	147	152
- The whole GCPs (affinity by least sq. adjust.)	3.24	3.44	108	115	130	138
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	3.56	3.56	119	119	142	142

STAGE 2.24	ORTHOPHOTO N° 44	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 44	n° 32	30 K	30 K	5 K	4 mm 20 m	y	IFAG (D) - Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
5	21	1	5	21

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 44 - 47	2 points	1.95	1.94	4.3 x H/10000
	The whole points (least sq. adjust.)	1.94	1.89	4.2 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 44 - 46 44 - 47	4	2	21	2	8	42

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	1.58	1.75	53	58	316	350
- The whole GCPs (similarity by least sq. adjust.)	3.59	4.36	120	145	718	872
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.47	1.47	49	49	294	294

STAGE 2.24	ORTHOPHOTO N° 46	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 46	n° 33	30 K	30 K	5 K	4 mm 20 m	y	IFAG (D) - Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
4	21	1	4	21

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 46 - 45	2 points	1.71	1.68	3.7 x H/10000
	The whole points (least sq. adjust.)	1.62	1.59	3.5 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 46 - 45	3	2	21	1	3	21

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	1.58	2.51	53	84	316	502
- The whole GCPs (similarity by least sq. adjust.)	2.94	3.28	98	109	580	656
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.57	1.54	52	51	314	308

STAGE 2.25	ORTHOPHOTO N° 15	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 15	n° 32	30 K	30 K	5 K	5 mm 25 m	x	IGN (F) -OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0 to 2	6 to 13	4	2	37

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 15 - 18	2 points	1.14	1.54	3.4 x H/10000
	The whole points (least sq. adjust.)	1.06	1.04	2.3 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 15 single 15 - 18	0 to 2	3 to 6	6 to 13	5	2	43

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	3.36	4.02	112	134	672	804
- The whole GCPs (similarity by least sq. adjust.)	3.23	3.36	108	112	646	672
- The whole GCPs (affinity by least sq. adjust.)	4.00	5.24	133	175	800	1048
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	3.11	3.11	104	104	622	622

STAGE 2.25	ORTHOPHOTO N° 16	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 16	n° 33	30 K	30 K	5 K	5 mm 25 m	x	IGN (F) -OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
0 to 2	9 or 15	4	4	48

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 16 - 17	2 points	0.63	0.87	1.9 x H/10000
	The whole points (least sq. adjust.)	0.59	0.59	1.3 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 16 single 16 - 17	0 to 2	5 to 8	9 to 18	6	7	78

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	2.74	2.93	91	98	548	586
- The whole GCPs (similarity by least sq. adjust)	2.40	2.62	80	87	480	524
- The whole GCPs (affinity by least sq. adjust)	2.32	2.57	77	86	464	514
- The whole points (GCPs + check pts) (similarity by least (sq. adjust)	2.38	2.38	79	79	476	476

STAGE 2.26	ORTHOPHOTO N° 48	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 48	n° 32	30 K	30 K	5 K	8 mm 40 m	y	IFAG (D) - Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
4	21	1	4	21

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 48 - 49	2 points	2.53	2.68	5.9 x H/10000
	The whole points (least sq. adjust.)	2.34	2.31	5.1 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 48 - 49	2	2	22	1	2	22

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	2.31	2.18	77	73	462	436
- The whole GCPs (similarity by least sq. adjust)	4.20	5.23	140	174	840	1046
- The whole GCPs (affinity by least sq. adjust)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust)	2.08	2.04	69	68	416	408

STAGE 2.27	ORTHOPHOTO N° 90	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 90	n° 32	30 K	30 K	5 K	8 mm 40 m	x	WH (CH) -OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY linear parallax

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
7	24	1	7	24

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 90 - 91	2 points	1.69	2.80	6.2 x H/10000
	The whole points (least sq. adjust.)	1.68	1.65	3.7 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 90 - 91 90 - 92	5	3	24	2	10	48

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.84	1.94	61	65	368	388
- The whole GCPs (similarity by least sq. adjust)	1.76	1.93	59	64	352	386
- The whole GCPs (affinity by least sq. adjust)	2.09	2.04	70	68	418	408
- The whole points (GCPs + check pts) (similarity by least (sq. adjust)	1.49	1.49	50	50	298	298

STAGE 2.27	ORTHOPHOTO N° 90	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 90	n° 32	30 K	30 K	5 K	8 mm 40 m	x	WH (CH) - OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY **logarithmic parallax**

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
7	24	1	7	24

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 90 - 92	2 points	1.85	2.53	5.6 x H/10000
	The whole points (least sq. adjust.)	1.81	1.78	3.9 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)						
- The whole GCPs (similarity by least sq. adjust)						
- The whole GCPs (affinity by least sq. adjust)						
- The whole points (GCPs + check pts) (similarity by least (sq. adjust)						

STAGE 2.31		ORTHOPHOTO N° 32					Relief : class II	
Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 32	n° 32	30 K	16 K	30 K	5 mm 125 m	x	IGN (F) - OR1 -	IGN (F) - ORTOSTER -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
	2 points			
	The whole points (least sq. adjust.)			

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 32 single	0	-	11	1	0	11

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	N.A.	N.A	N.A	N.A	N.A	N.A
- The whole GCPs (similarity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole GCPs (affinity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	2.69	2.94	84	92	108	118

STAGE 3.1.2		ORTHOPHOTO N° 66					Relief : class III	
Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 66	n° 3	16 K	60 K	5 K	8 mm 40 m	x	ITC (NL) - OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
13	52	1	13	52

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 66 -67	2 points	0.80	1.27	5.3 x H/10000
	The whole points (least sq. adjust.)	0.80	0.87	3.6 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 66 - 67	10	6	55	1	10	55

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.73	2.07	108	129	346	414
- The whole GCPs (similarity by least sq. adjust.)	1.64	1.64	102	102	328	328
- The whole GCPs (affinity by least sq. adjust.)	1.76	1.71	110	107	352	342
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.62	1.61	101	101	324	322

STAGE 3.21	ORTHOPHOTO N° 26	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 26	n° 14	16 K	30 K	5 K	5 mm 25 m	x	NBS (SF) - OR1 -	NRC (CDN) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
2	34	1	2	34

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 26 - 24	2 points	1.73	1.92	8.0 x H/10000
	The whole points (least sq. adjust.)	N.A	N.A	N.A.

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 26 single 26 - 24 26 - 28 26 - 29	1 to 5		34 to 45	4	13	169

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	3.44	N.A	215	N.A	688	N.A.
- The whole GCPs (similarity by least sq. adjust.)	N.A	N.A	N.A	N.A	N.A	N.A.
- The whole GCPs (affinity by least sq. adjust.)	N.A.	N.A	N.A	N.A	N.A	N.A.
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

STAGE 3.21	ORTHOPHOTO N° 29	Relief : class II

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 29	n° 16	16 K	30 K	5 K	5 mm 25 m	x	NBS (SF) - OR1 -	NRC (CDN) -STEREOCOMPILER-

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
2	38	1	2	38

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 29 - 28	2 points	2.12	2.09	8.7 x H/10000
	The whole points (least sq. adjust.)	N.A.	N.A.	N.A.

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 29 - 28	2		38	1	2	38

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat. precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat. precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat. precision	r. m. s. e. accuracy
- 2 points (similarity)	2.42	2.68	151	167	484	536
- The whole GCPs (similarity by least sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
- The whole GCPs (affinity by least sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

STAGE 3.22	ORTHOPHOTO N° 27	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 27	n° 3	16 K	30 K	5 K	8 mm 40 m	x	NBS (SF) - OR1 -	NRC (CDN) -STEREOCOMPILER-

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
4	29	1	4	29

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 27 - 25	2 points	3.30	3.25	13.5 x H/10000
	The whole points (least sq. adjust.)	N.A.	N.A.	N.A.

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 27 - 25	3		32	1	3	32

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	2.16	2.32	135	145	432	464
- The whole GCPs (similarity by least sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
- The whole GCPs (affinity by least sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

STAGE 3.23	ORTHOPHOTO N° 50	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 50	n° 3	16 K	30 K	5 K	8 mm 40 m	y	IFAG (D) - Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
12	53	1	12	53

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 50 - 51	2 points	0.87	1.21	5.0 x H/10000
	The whole points (least sq. adjust.)	0.86	0.86	3.6 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 50 - 51	9	6	56	1	9	56

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.76	2.22	110	139	352	444
- The whole GCPs (similarity by least sq. adjust.)	1.62	1.64	101	102	324	328
- The whole GCPs (affinity by least sq. adjust.)	1.63	1.67	102	104	326	334
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.54	1.51	96	94	308	302

STAGE 3.31	ORTHOPHOTO N° 52	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 52	n° 3	16 K	16 K	5 K	4 mm 20 m	y	IFAG (D) - Z2 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
16	49	1	16	49

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 52 - 53	2 points	0.77	1.12	4.7 x H/10000
	The whole points (least sq. adjust.)	0.77	0.77	3.2 x H/10000

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 52 - 53	13	6	52	1	13	52

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.30	1.26	81	79	260	252
- The whole GCPs (similarity by least sq. adjust.)	1.22	1.22	76	76	244	244
- The whole GCPs (affinity by least sq. adjust.)	1.19	1.19	74	74	238	238
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.18	1.17	74	73	236	234

STAGE 3.32	ORTHOPHOTO N° 62	Relief : class III

Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 62	n° 3	16 K	16 K	5 K	5 mm 25 m	x	ITC (NL) - OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
15	49	1	15	49

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 62 - 64	2 points	0.90	1.19	4.9 x H/10000
	The whole points (least sq. adjust.)	N.A.	N.A.	N.A.

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 62 - 64	12	5	52	1	12	52

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.17	1.19	73	74	234	238
- The whole GCPs (similarity by least sq. adjust.)	1.22	1.26	76	79	244	252
- The whole GCPs (affinity by least sq. adjust.)	1.25	1.28	78	80	250	256
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	1.15	1.13	72	71	230	226

STAGE 3.33			ORTHOPHOTO N° 63				Relief : class III	
Ortho Product	Aerial Photo	1: SCALE OF Aerial Survey	D. T. M	Ortho	Slit Width	Scan dir.	Operative Center and Instrument for ortho Production	Assessment
n° 63	n° 3	16 K	16 K	5 K	8 mm 40 m	x	ITC (NL) -OR1 -	IPTU (A) - STEREOGRAPH -

HEIGHT ACCURACY

In a round, number of points cancelled	measured & used	Number of rounds	Total number of cancels	measurements used
20	45	1	20	45

Stereopair	Altimetric transform. set up on :	standard deviation (meter)	r. m. s. e. accuracy (meter)	(in Z) flying height H
n° 63-65	2 points	0.72	0.87	3.6 x H/10000
	The whole points (least sq. adjust.)	N.A.	N.A.	N.A.

PLANIMETRIC ACCURACY

Stereopair	In a round, number of points cancelled	GCPs	measured and used	Number of rounds	total number of cancels	measurements used
n° 63 - 65	16	5	48	1	16	48

Planimetric transformation set up on :	Resultant vector in (x , y) on the ground (meter) st^d deviat precision	r. m. s. e. accuracy	at photo scale (microns) st^d deviat precision	r. m. s. e. accuracy	at ortho scale (microns) st^d deviat precision	r. m. s. e. accuracy
- 2 points (similarity)	1.02	1.17	64	73	204	234
- The whole GCPs (similarity by least sq. adjust.)	1.10	1.13	69	71	220	226
- The whole GCPs (affinity by least sq. adjust.)	1.13	1.15	71	72	226	230
- The whole points (GCPs + check pts) (similarity by least (sq. adjust.)	0.98	0.97	61	61	196	194

10.6 LIST OF CO-ORDINATE RESIDUALS

10.6.1 LIST OF PLANIMETRIC RESIDUALS

A full list of planimetric residuals is given hereafter. They derive from the whole sets of measurements and four assessing methods.

The abbreviations denote the following expressions :

DD : number of the rectified product(orthophoto), (n° du document droit).

SERIE : number of the round of measurements (each measurement being an average of two or three pointings to each point in the round).

NUMP : number of the point which is measured and given in the general catalogue of fixed points.

V-A : type of the point in the rectification stage. It can be either "app" (appui) i-e a ground control point, or "ver" (vérification), i-e a fixed point kept aside while setting up the pair in the rectification stage, and considered as a check point in the 2nd and 3 rd assessing methods (similarities based only on GCPs really used in the production stage).

DX_i DY_i: with i = 1 to 4, residuals in x and y resulting from the plane-transformation of co-ordinates n° i (see items n° 4.1.2, 4.1.3, 4.1.4 and 4.1.5). in meters.

LIST OF PLANIMETRIC RESIDUALS

(in meter)

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
10	20	1241	app	.00	.00	.56	1.44	-.38	1.44	.38	1.59
	20	6105	app	-9.25	4.66	-8.69	6.00	-6.75	5.00	-8.56	6.28
	20	815	app	-.81	-1.63	-.38	-.34	-2.06	.34	-.06	-.19
	20	817	app	1.94	-1.25	2.44	.13	-.25	1.03	2.56	.22
	20	2906	app	-1.31	-3.25	-.81	-2.06	.69	-2.56	-.25	-1.75
	20	2007	app	.00	.00	.38	1.06	2.19	.72	1.31	1.44
	20	5703	app	.19	-3.06	.56	-1.94	-.31	-1.25	1.44	-1.72
	20	5803	app	.75	-.31	1.13	.84	.19	1.50	1.81	1.09
	20	6206	app	5.63	-5.56	6.19	-4.16	6.88	-4.75	6.13	-3.94
	20	1067	app	-1.88	-2.25	-1.38	-.97	-.19	-1.50	-1.06	-.69
	20	708	ver	-4.44	3.56	-4.00	4.72	-4.94	5.34	-3.31	4.94
	20	717	ver	1.06	-5.88	1.50	-4.75	4.25	-5.66	2.19	-4.34
	20	714	ver	2.31	-1.34	2.63	-.25	2.00	.41	3.56	.00
	20	729	ver	-1.00	-2.66	-.56	-1.53	2.56	-2.59	.13	-1.13
	20	723	ver	-1.19	-2.81	-.81	-1.69	-.69	-1.38	.06	-1.41
	20	721	ver	-1.88	-1.44	-1.50	-.31	-1.19	-.13	-.69	.00
	20	720	ver	-10.88	1.84	-10.44	2.94	-7.63	2.06	-9.63	3.34
	20	6207	ver	-.13	-.06	.44	1.34	-.44	1.44	.38	1.50
	20	2802	ver	-4.44	-1.97	-4.06	-.84	-2.19	-1.34	-3.31	-.47
	20	2803	ver	2.19	-3.97	2.63	-2.81	2.50	-2.50	3.38	-2.56
	20	5702	ver	-.50	-2.75	-.13	-1.66	.56	-1.59	.75	-1.34
	20	725	ver	6.63	-3.16	7.00	-2.03	5.38	-1.00	7.88	-1.84
	20	732	ver	-5.00	-.53	-4.56	.56	-3.38	.41	-3.75	.91
	20	731	ver	-1.69	-4.78	-1.25	-3.66	1.13	-4.34	-.50	-3.28
	20	730	ver	-2.00	1.72	-1.56	2.84	1.56	1.81	-.81	3.25
10	21	1241	app	.00	.00	.38	1.91	-.56	2.00	1.13	1.03
	21	1067	app	-.13	-3.59	-1.19	-1.41	-.06	-2.06	-.44	-1.91
	21	2906	app	1.38	-3.34	-.44	-.91	1.00	-1.53	.25	-1.19
	21	6206	app	6.56	-6.47	6.63	-4.69	7.19	-5.34	7.31	-5.50
	21	6105	app	-8.25	4.25	-8.88	6.13	-7.96	4.97	-8.19	5.50
	21	2007	app	3.31	-1.47	.50	1.34	2.25	.81	1.25	1.31
	21	5703	app	2.81	-5.09	.31	-2.00	-.44	-1.22	1.19	-2.06
	21	5803	app	3.00	-3.00	1.06	-.09	.13	.63	1.88	-.31
	21	815	app	1.00	-2.50	.00	.09	-1.63	.94	.81	-.41
	21	817	app	1.88	-2.78	1.63	-.34	-.94	.81	2.44	-1.03
	21	3107	ver	.69	-2.91	-.06	-.53	-1.13	-.06	.75	-1.09
	21	5906	ver	-3.81	-.91	-5.38	1.59	-5.00	1.50	-4.63	1.28
	21	5802	ver	3.06	-2.13	1.00	.53	1.75	.38	1.75	.34
	21	2802	ver	-1.19	-3.13	-3.50	-.50	-1.69	-1.19	-2.81	-.63
	21	764	ver	-9.94	-1.69	-10.06	.31	-10.25	.16	-9.38	-.41
	21	812	ver	.31	-4.38	-1.44	-1.88	-.44	-2.25	-.69	-2.19
	21	5702	ver	3.25	-5.78	.69	-2.91	1.38	-2.91	1.44	-2.97
	21	3208	ver	2.31	-1.00	2.13	1.19	.81	1.66	2.94	.47
	21	2803	ver	5.31	-5.16	3.06	-2.28	3.00	-1.97	3.88	-2.44
	21	733	ver	.00	.00	-2.81	2.75	-.69	2.06	-2.06	2.75
	21	734	ver	-8.44	-3.72	-8.94	-1.94	-6.69	-3.31	-8.31	-2.59
	21	736	ver	2.63	4.66	2.31	6.59	3.00	5.97	3.00	5.91
	21	737	ver	1.13	1.00	.75	3.06	.63	2.94	1.50	2.38
	21	738	ver	3.75	.88	3.69	2.91	3.25	2.84	4.44	2.13
	21	750	ver	-.13	.53	-.25	2.34	.81	1.50	.44	1.59
10	1024	5702	app	.69	-5.03	-.19	-1.59	-.56	-1.41	1.25	-2.03
	1024	5705	app	.06	.38	1.19	2.78	1.31	2.66	1.19	3.06
	1024	2706	app	-1.94	-4.34	-.13	-1.59	-1.13	-2.84	-.56	-1.56
	1024	3016	app	-4.25	-2.22	-2.31	-.81	-.88	-.25	-2.81	.16
	1024	2007	app	2.25	-2.13	1.25	1.91	-.19	1.38	2.75	1.06
	1024	5706	app	.00	.00	1.81	2.22	1.81	1.72	1.38	2.63
	1024	2802	app	.06	-5.81	-1.63	-2.91	-.44	-1.25	.38	-2.97
	1024	731	ver	-.69	-5.63	-2.50	-2.44	-1.75	-1.06	-.44	-2.69
	1024	730	ver	.00	.00	-2.19	3.06	-.94	4.97	.13	2.91
	1024	733	ver	-1.19	-.34	-2.31	3.84	-3.38	3.22	-.75	2.91
	1024	720	ver	-.63	-3.06	-2.44	.50	-2.84	1.31	-.38	-.03
	1024	716	ver	-.94	-4.50	-.06	-1.56	-.75	-2.22	.13	-1.66
	1024	715	ver	-.75	-2.50	-.56	-.72	1.94	.84	.13	.00
	1024	712	ver	-2.25	-4.97	-2.63	-3.00	-.63	-1.19	-1.56	-2.41
	1024	713	ver	-.44	-3.47	-.56	-.91	.19	-.16	.31	-.72
	1024	721	ver	-.56	-3.31	-1.56	-.41	-.81	.66	-.06	-.44
	1024	732	ver	-1.69	-1.16	-2.94	2.00	-2.50	2.94	-1.25	1.78
	1025	2007	app	1.88	-.97	1.75	2.09	.56	2.06	2.38	1.91
	1025	5706	app	2.56	2.91	.81	1.41	.88	1.25	.94	2.03
	1025	2706	app	1.06	-.78	.00	-2.09	-.63	-2.41	.06	-1.59
	1025	5705	app	2.44	3.31	.69	2.84	.81	2.78	.94	3.34
	1025	3016	app	.00	.00	-2.88	-1.91	-1.69	-1.84	-2.69	-1.03
	1025	2802	app	1.25	-4.53	-.75	-.88	.06	-.44	.19	-.88
	1025	5702	app	1.31	-4.16	.31	-1.50	.00	-1.41	1.00	-1.53
	1025	720	ver	-.50	-2.41	-1.56	1.59	-1.69	1.84	-.69	1.41
	1025	715	ver	1.31	-2.00	-1.69	-1.41	-.19	-1.06	-1.06	-.84
	1025	716	ver	1.56	-1.91	.44	-1.84	.00	-2.00	.75	-1.50
	1025	713	ver	-.13	-2.03	-2.06	-.75	-1.56	-.56	-1.50	-.44
	1025	717	ver	-1.31	-10.88	-3.56	-6.59	-2.44	-6.00	-2.50	-6.63
	1025	730	ver	2.06	-.69	.13	3.72	.94	4.22	1.19	3.63
	1025	731	ver	2.13	-7.81	.50	-3.97	.94	-3.56	1.44	-4.03

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
10	1025	732	ver	-.13	-.28	-1.63	2.81	-1.44	3.09	-.88	2.81
	1025	721	ver	.81	-2.50	-.94	.16	-.94	.47	-.19	.28
	1025	733	ver	.00	.00	.00	3.28	-1.31	3.22	.63	3.03
13	4	2001	app	2.56	1.66	-.75	-.34	-.50	.09	-1.19	1.09
	4	2007	app	.00	.00	.13	.53	-.31	.03	-2.75	1.13
	4	1491	app	3.63	-1.31	.81	-.88	.94	-.16	-.38	-.75
	4	2005	app	2.31	5.97	-.19	.72	-.13	.03	-.50	4.16
	4	720	ver	.06	1.06	-.19	1.13	-.56	.72	-2.75	1.94
	4	2802	ver	.25	.38	.13	.00	-.25	-.56	-2.50	1.09
	4	729	ver	4.88	-1.69	4.38	-2.41	4.00	-2.88	2.06	-1.19
	4	719	ver	6.50	1.28	5.56	.78	5.31	.53	3.44	1.78
	4	607	ver	3.88	5.34	.25	.22	.56	.06	.50	3.38
	4	610	ver	.00	.00	-3.75	-5.44	-3.38	-5.63	-3.31	-2.09
	4	717	ver	2.75	-8.50	2.38	-9.03	2.00	-9.50	-.06	-7.91
	4	604	ver	6.06	-3.81	2.56	-8.84	2.88	-9.06	2.75	-5.72
	4	733	ver	3.19	.84	3.25	1.44	2.81	1.00	.38	2.00
	4	731	ver	4.56	-5.06	4.38	-5.28	3.94	-5.78	1.75	-4.31
	4	730	ver	5.44	4.72	5.00	4.34	4.69	3.91	2.56	5.38
13	6	2001	app	-4.50	-3.19	-2.13	-1.06	-.75	-.44	-1.88	-.88
	6	2005	app	-.38	-1.50	.81	1.78	-.19	-.09	1.00	1.66
	6	1491	app	-3.00	-1.78	-.25	-.84	1.38	.81	.06	-.47
	6	2007	app	.00	.00	1.50	.16	-.44	-.25	2.13	.44
	6	742	ver	.00	.00	1.38	3.44	.81	1.81	1.50	3.34
	6	741	ver	2.00	5.50	2.94	8.56	1.25	6.34	3.19	8.47
	6	735	ver	-2.31	-11.00	-1.38	-8.38	-3.50	-10.59	-1.06	-8.47
	6	736	ver	.44	.50	1.06	3.00	-1.81	.31	1.44	2.91
	6	740	ver	.38	.31	1.31	3.47	-.44	1.16	1.50	3.34
	6	739	ver	.69	-1.13	1.63	1.94	-.06	-.28	1.88	1.84
	6	746	ver	-8.44	-8.44	-7.13	-5.38	-7.88	-6.94	-6.94	-5.41
	6	747	ver	-.81	-2.56	.50	.19	-.38	-1.25	.75	.16
	6	745	ver	-5.00	-10.00	-3.75	-6.88	-4.69	-8.59	-3.56	-6.94
	7	2001	app	-2.13	-3.59	-2.13	-1.06	-.75	-.44	-2.50	-1.47
	7	2005	app	3.00	-.31	.81	1.78	-.19	-.09	.88	1.06
	7	2007	app	.00	.00	1.50	.16	-.34	-.25	1.31	.41
	7	1491	app	-1.81	-2.91	-.25	-.84	1.38	.81	-.81	-.91
	7	760	ver	3.38	3.00	1.38	4.59	-.56	2.31	1.50	4.00
	7	759	ver	-1.06	-2.44	-2.69	-.22	-3.13	-1.50	-2.75	-.88
	7	758	ver	.19	1.25	-1.63	3.00	-3.00	1.13	-1.56	2.41
	7	748	ver	1.75	.28	.56	2.25	.00	1.13	.50	1.72
	7	750	ver	-.19	-.53	-2.19	.53	-5.00	-2.31	-1.94	.03
	7	754	ver	2.81	.06	1.06	1.97	.00	.28	1.13	1.38
	7	755	ver	.00	.00	-1.56	2.34	-1.69	1.31	-1.63	1.72
	7	757	ver	5.94	-5.34	4.50	-3.31	3.88	-4.56	4.44	-3.88
	7	752	ver	3.63	-6.66	2.13	-5.19	.38	-7.13	2.19	-5.69
	7	751	ver	1.06	-.69	-.88	.63	-3.13	-1.84	-.75	.09
13	8	2001	app	-2.81	-3.75	-1.38	-1.16	-.44	-.28	-2.44	-.38
	8	2005	app	.13	-1.53	.19	1.75	-.13	-.06	.19	1.16
	8	2007	app	.00	.00	1.25	.72	-.25	-.16	1.31	3.34
	8	1491	app	-2.13	-3.03	-.06	-1.31	.81	.47	-1.38	.69
	8	804	ver	-.63	-6.00	1.31	-4.78	1.44	-3.66	.44	-2.34
	8	803	ver	-.50	-3.91	1.19	-2.50	1.19	-1.81	.44	-.38
	8	811	ver	-1.75	-6.31	-.19	-4.31	.31	-3.47	-1.13	-2.84
	8	626	ver	.00	.00	.50	3.75	1.25	3.13	-.19	2.88
	8	627	ver	-1.81	-3.53	-1.25	.19	-.50	-.38	-1.94	-.66
	8	802	ver	-1.06	-4.41	1.00	-2.75	1.81	-1.03	-.25	-.69
	8	808	ver	2.38	-3.84	3.13	-.97	3.31	-1.53	2.63	-.84
	8	810	ver	1.88	-2.97	2.94	-.81	2.75	-1.16	2.50	.22
	8	805	ver	-.88	-3.09	-.38	-.94	-1.31	-2.53	-.25	-.16
	9	2001	app	-1.88	-.88	-1.75	-.34	-.44	.06	-1.13	-.22
	9	2007	app	.00	.00	1.56	.16	-.25	.03	2.19	-1.00
	9	2005	app	1.56	1.94	1.00	1.56	-.13	.00	.69	1.97
	9	1491	app	-1.69	-2.28	-.81	-1.38	.81	-.09	.25	-1.78
	9	614	ver	-2.06	-1.13	-2.75	-1.09	-2.31	-1.91	-2.88	-.44
	9	613	ver	-2.00	-3.34	-2.69	-3.25	-2.00	-3.91	-2.69	-2.56
	9	762	ver	3.44	-1.53	2.75	-1.72	2.44	-2.91	2.50	-1.09
	9	616	ver	-1.13	-2.81	-1.75	-2.72	-1.06	-3.34	-1.75	-2.06
	9	621	ver	.00	.00	-.75	-.09	-.63	-1.13	-.94	.59
	9	763	ver	2.56	2.19	1.94	2.09	1.54	1.13	1.75	2.69
	9	765	ver	2.94	3.91	2.75	3.41	.69	1.63	2.38	3.50
	9	619	ver	2.88	-1.38	2.19	-1.38	2.56	-2.19	2.13	-.75
	9	618	ver	-.63	2.66	-1.19	2.69	-.81	1.97	-1.19	3.25
	9	615	ver	-.75	-2.75	-1.25	-2.63	-.63	-3.19	-1.25	-2.06
13	10	2001	app.	-2.50	-2.91	-1.38	-1.22	-.38	-.31	-2.88	-.72
	10	2007	app	.00	.00	1.38	.66	-.25	-.19	1.31	1.44
	10	1491	app	-1.94	-2.59	-.31	-1.25	.69	.59	-1.31	-.09
	10	2005	app	.00	.00	.31	1.81	-.06	-.06	-1.44	1.16
	10	2802	ver	-1.50	-2.59	-.31	-1.81	-1.88	-2.97	-.56	-1.28
	10	2904	ver	1.06	-.41	2.19	.78	1.50	.13	1.44	1.19
	10	6101	ver	5.19	.97	5.81	2.72	6.00	1.91	4.13	2.50
	10	2701	ver	-3.13	-1.53	-1.63	-.75	-2.63	-.81	-1.81	.22
	10	1067	ver	2.13	-1.78	2.75	-.66	1.06	-3.06	2.00	-.91
	10	2100	ver	-.88	-5.78	.38	-4.75	-.50	-5.31	-.19	-4.19
	10	2101	ver	.75	-2.88	1.88	-1.94	.56	-3.03	1.44	-1.47
	10	3103	ver	-1.19	-2.38	-.44	-.81	-.69	-1.78	-1.81	-.91
	10	3003	ver	2.19	-4.38	3.13	-3.00	2.81	-3.56	2.00	-2.78
	10	2903	ver	-2.56	4.03	-1.44	5.28	-1.63	5.22	-2.31	5.81

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
13	11	2001	app	-4.25	-1.06	-2.44	-.81	-.81	-.22	-2.44	-.66
	11	1491	app	-2.56	-1.53	-.63	-1.34	1.44	.41	-.25	-1.31
	11	2007	app	.00	.00	1.88	.16	-.14	-.13	2.25	-.31
	11	2005	app	-.56	1.75	1.19	2.00	-.19	-.03	.63	2.06
	11	3102	ver	-2.69	.09	-.88	.34	-.94	-.38	-1.06	.41
	11	6104	ver	-1.13	-.78	.63	-.53	-1.69	-2.56	.31	-.66
	11	3104	ver	-2.81	2.31	-1.06	2.53	-2.69	1.03	-1.31	2.44
	11	3304	ver	.00	.00	1.75	.28	.31	-1.94	1.19	.34
	11	5901	ver	-5.50	-.59	-3.69	-.38	-2.75	.00	-3.63	-.31
	11	2906	ver	-.81	-2.00	1.00	-1.81	-1.81	-3.06	1.06	-2.19
	11	5904	ver	1.31	.22	3.19	.41	1.44	-.47	3.19	.19
13	12	3111	app	3.13	.22	1.00	.22	-.06	.38	.94	.53
	12	1241	app	.00	.00	-3.75	1.44	-2.88	.69	-4.44	2.28
	12	1501	app	-1.75	-2.03	-2.19	-.97	-2.31	-.69	-1.56	-.22
	12	2007	app	-.38	-1.84	.06	.03	.75	.31	1.00	1.16
	12	1067	app	3.63	-2.31	1.75	-.50	2.69	-.88	1.75	.50
	12	818	app	6.13	-1.00	2.81	-.59	2.38	-.91	2.25	-.16
	12	5706	app	.00	.00	.38	.38	-.93	1.09	1.31	.88
	12	701	ver	1.88	-.03	1.88	.38	1.00	1.00	2.69	.91
	12	2804	ver	.19	-2.66	.06	-1.44	.06	-1.13	.75	-.63
	12	2807	ver	2.31	1.94	2.31	2.03	1.00	2.75	3.06	2.41
	12	5702	ver	-1.00	-6.09	-.75	-4.38	-.25	-4.13	.06	-3.34
	12	5705	ver	-.50	.63	-.19	1.34	-.81	1.94	.69	1.97
	12	812	ver	-1.50	-6.66	-2.44	-4.91	-1.63	-4.97	-2.00	-3.88
	12	2802	ver	-3.00	-5.34	-3.13	-3.44	-2.31	-3.34	-2.44	-2.34
	12	2706	ver	-2.88	-2.38	-2.25	-1.88	-3.19	-1.16	-1.25	-1.34
	12	2704	ver	-2.13	1.50	-1.56	2.69	-1.69	3.19	-.56	3.53
	12	702	ver	-3.13	-2.84	-3.00	-2.66	-4.19	-1.94	-2.19	-2.22
13	13	3111	app	2.38	-1.31	2.44	-.13	2.13	-.44	1.75	1.00
	13	3016	app	-2.13	-2.19	-2.44	-1.69	-2.88	-1.81	-2.13	-.88
	13	1067	app	1.69	-1.03	2.19	-.25	2.63	.00	1.94	1.59
	13	818	app	.00	.00	.31	1.44	.31	1.16	-.75	2.94
	13	1241	app	-2.88	-1.38	-2.19	.00	-1.75	.00	-3.25	2.00
	13	1501	app	-.31	-.72	-.25	-.19	-.25	-.09	.00	1.06
	13	5706	app	.13	.28	-.13	.69	-.50	.66	.31	1.53
	13	2007	app	.00	.00	.13	.13	.38	.53	.88	1.56
	13	2802	ver	-2.75	-4.13	-2.56	-3.84	-2.19	-3.44	-2.00	-2.28
	13	817	ver	-.38	-3.44	.06	-2.31	.25	-2.31	-.63	-.59
	13	814	ver	-.50	-5.13	-.50	-4.25	-.75	-4.44	-.75	-3.16
	13	813	ver	2.19	-.97	1.94	-.19	1.44	-.47	1.88	.63
	13	815	ver	-.19	-4.53	.13	-3.69	.38	-3.59	-.13	-2.09
	13	821	ver	-1.00	-3.44	-.94	-2.69	-.94	-2.66	-1.00	-1.34
	13	822	ver	-.31	-5.50	-.13	-4.34	-.19	-4.53	-.75	-2.97
	13	820	ver	4.06	-2.69	4.06	-1.28	3.63	-1.78	3.13	-.25
	13	816	ver	1.94	-2.75	2.50	-1.41	2.88	-1.44	1.56	.50
	13	3107	ver	.00	-1.97	.38	-1.03	.69	-.91	.00	.72
13	14	3111	app	5.31	.16	1.88	.53	1.06	.16	2.50	.06
	14	3016	app	-1.69	-2.38	-4.19	-2.06	-5.13	-1.97	-2.75	-2.19
	14	5706	app	2.81	.34	.50	.69	-.25	.91	2.00	.72
	14	1501	app	1.75	-1.44	-.88	-.75	-.81	-.53	.25	-.56
	14	1067	app	4.88	-1.56	1.69	-.44	2.75	-.31	2.13	-.16
	14	1241	app	.00	.00	-4.00	1.06	-3.13	.75	-4.19	.97
	14	818	app	7.81	.22	3.94	.81	3.63	.31	4.00	.34
	14	2007	app	3.19	-.88	1.06	.13	1.94	.72	2.38	.75
	14	703	ver	.00	.00	-2.25	.28	-3.19	.50	-.63	.28
	14	716	ver	-.25	-4.66	-2.50	-4.06	-2.69	-3.72	-1.00	-3.84
	14	708	ver	-.50	1.06	-3.00	1.91	-2.56	2.25	-1.88	2.25
	14	705	ver	.69	-2.56	-1.75	-1.97	-1.98	-1.69	-.44	-1.78
	14	713	ver	.25	1.00	-2.19	1.75	-2.00	2.09	-.88	2.03
	14	715	ver	1.38	2.03	-1.13	2.66	-1.25	2.88	.13	2.78
	14	712	ver	-1.19	-.28	-3.69	.47	-3.50	.75	-2.50	.72
	14	704	ver	1.81	-3.03	-.56	-2.50	-.88	-2.25	.88	-2.38
13	15	3111	app	3.19	.03	2.19	.47	2.19	.00	2.94	.09
	15	3016	app	-3.44	-3.53	-3.50	-2.50	-3.75	-2.91	-2.13	-1.88
	15	5706	app	.00	.00	.00	1.19	-.31	.91	1.38	2.00
	15	1067	app	3.81	-2.38	2.44	-1.16	2.63	-.66	2.50	-.84
	15	2007	app	.94	-1.50	.56	.34	.50	.88	1.31	1.69
	15	1241	app	.00	.00	-2.00	.63	-1.63	.94	-2.38	.06
	15	818	app	1.88	.66	.31	.94	.50	.69	.50	.19
	15	1501	app	.50	-1.22	-.06	.06	-.13	.16	.81	.75
	15	723	ver	-3.31	-5.88	-3.75	-4.22	-3.81	-3.88	-2.94	-3.13
	15	733	ver	-1.88	-.66	-2.25	1.22	-2.31	1.78	-1.56	2.59
	15	737	ver	3.69	-2.19	2.06	-1.28	2.31	-.91	1.88	-1.41
	15	736	ver	1.31	1.41	-.44	2.38	-.13	2.84	-.63	2.28
	15	722	ver	-3.50	-5.63	-3.75	-4.13	-3.88	-3.97	-2.69	-3.06
	15	721	ver	-1.38	-1.72	-1.88	-.09	-1.94	.28	-1.13	.97
	15	732	ver	-1.69	-.03	-2.19	1.69	-2.25	2.16	-1.50	2.81
	15	725	ver	3.00	-5.72	2.69	-4.19	2.56	-4.00	3.69	-3.13
	16	3111	app	4.75	-.06	2.00	-.09	1.88	-.50	1.38	-.59
	16	1067	app	3.44	-1.53	2.00	-1.59	2.25	-1.16	1.56	-1.00
	16	2007	app	1.63	2.16	.38	.38	.44	.88	1.50	.97
	16	818	app	3.00	.00	.44	.88	.56	.63	-.88	.63
	16	1241	app	.00	.00	-1.81	1.22	-1.50	1.47	-3.38	1.66
	16	1501	app	2.50	.84	.63	-.31	.56	-.25	1.13	-.25
	16	5706	app	2.13	3.41	-.19	1.59	-.44	1.38	.75	1.25
	16	3016	app	-.94	-.47	-3.44	-2.06	-3.59	-2.41	-2.63	-2.56

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
13	16	3209	ver	3.13	-1.59	1.00	-1.00	1.19	-.97	-.06	-.88
	16	3110	ver	3.69	1.25	1.13	1.25	1.96	.97	.50	.91
	16	738	ver	3.81	-1.19	2.13	-.34	2.44	-.06	.88	.13
	16	764	ver	6.31	-2.94	4.69	-2.22	5.00	-1.88	3.56	-1.72
	16	2704	ver	-1.19	3.84	-2.88	1.97	-3.00	2.13	-1.75	2.09
	16	2706	ver	.00	.00	-2.25	-1.94	-2.50	-2.13	-1.13	-2.22
	16	5803	ver	1.00	.94	-.63	-.19	-.63	.06	-.13	.09
	16	5906	ver	-1.31	2.72	-2.81	2.06	-2.69	2.41	-2.75	2.53
	16	5802	ver	2.25	-.44	.81	-1.53	.88	-1.16	1.31	-1.03
	17	3111	app	3.81	-.72	2.56	.13	2.56	-.28	1.81	.09
	17	3016	app	-2.75	-4.00	-3.25	-2.72	-3.44	-3.06	-3.50	-2.91
	17	2007	app	2.00	-.59	1.31	1.38	1.19	1.78	1.38	1.56
	17	1501	app	.06	-2.22	-.81	-.69	-.88	-.66	-1.06	-.63
	17	818	app	2.19	.72	.44	1.44	.63	1.25	-.56	1.63
	17	1067	app	3.81	-3.47	2.31	-1.97	2.44	-1.56	1.81	-1.59
	17	1241	app	.00	.00	-2.06	1.03	-1.88	1.31	-3.06	1.50
	17	5706	app	.00	.00	-.44	1.41	-.63	1.16	-.56	1.25
	17	3211	ver	4.88	-3.41	3.25	-2.63	3.38	-2.88	2.38	-2.53
	17	5908	ver	1.13	.09	.00	1.38	.00	1.38	-.44	1.47
	17	3208	ver	2.94	-.72	1.13	.44	1.31	.69	.31	.81
	17	2908	ver	-.13	.13	-1.13	1.59	-1.19	1.69	-1.50	1.72
	17	2807	ver	3.44	1.22	2.88	2.47	2.75	2.09	2.63	2.28
	17	2906	ver	2.00	-3.97	.88	-2.25	.88	-1.84	.63	-1.97
	17	5807	ver	1.81	-3.16	1.19	-2.09	1.06	-2.59	.88	-2.31
	17	5705	ver	.81	.22	.31	1.72	.13	1.59	.19	1.66
	17	5702	ver	-.44	-4.06	-1.19	-2.19	-1.31	-1.88	-1.19	-2.03
13	18	3111	app	4.94	.13	2.69	.09	2.63	.09	3.19	.38
	18	3016	app	-1.13	-1.09	-3.63	-2.31	-3.69	-2.28	-3.31	-1.09
	18	1501	app	1.44	.22	-.50	-.84	-.44	-.84	-.50	.13
	18	5706	app	1.88	1.88	-.56	.47	-.63	.50	-.31	1.84
	18	1241	app	.00	.00	-1.25	.56	-1.19	.53	-1.31	.13
	18	1067	app	3.06	-.56	1.69	-1.00	1.81	-1.03	1.44	-.69
	18	818	app	2.19	.78	.31	1.31	.25	1.28	.69	1.06
	18	2007	app	2.81	3.41	1.19	1.75	1.25	1.75	.75	3.06
	18	5909	ver	3.44	2.34	1.31	1.69	1.25	1.69	1.56	2.41
	18	772	ver	2.38	-1.97	-.13	-3.28	-.19	-3.25	.19	-1.97
	18	767	ver	-1.31	-1.81	-3.56	-2.78	-3.56	-2.75	-3.31	-1.78
	18	769	ver	2.50	.78	-.13	-.19	-.25	-.16	.38	.91
	18	768	ver	6.25	-4.03	3.75	-5.06	3.69	-5.03	4.13	-3.97
	18	5807	ver	2.94	-1.16	.38	-2.09	.25	-2.06	.88	-1.03
	18	774	ver	.00	.00	-2.75	-1.16	-2.88	-1.13	-2.19	.13
	18	5804	ver	-.38	.59	-2.31	-.50	-2.31	-.50	-2.31	.50
	19	3111	app	4.13	2.09	2.81	-.56	2.44	-.56	2.88	-.81
	19	1501	app	-3.25	3.09	-1.13	-.41	-1.06	-.38	-1.31	.34
	19	2007	app	-3.81	5.31	.56	1.72	.94	1.81	.06	3.06
	19	3016	app	-4.88	3.16	-3.19	-2.16	-3.50	-2.03	-2.88	-1.25
	19	1241	app	.00	.00	-1.56	1.19	-1.31	1.00	-2.38	.31
	19	1067	app	.75	-1.16	2.00	-1.81	2.38	-1.91	1.25	-1.72
	19	818	app	2.75	2.31	.31	1.66	.19	1.53	.13	.84
	19	5706	app	-2.19	5.81	.13	.41	-.06	.56	.38	1.50
	19	786	ver	.88	5.09	.19	.50	-.31	.59	.69	.72
	19	783	ver	-2.81	5.09	-2.81	1.31	-3.06	1.38	-2.56	1.59
	19	780	ver	3.50	2.88	2.63	-.53	2.25	-.50	2.88	-.56
	19	775	ver	.00	.00	2.13	-6.19	1.75	-6.00	2.63	-5.03
	19	777	ver	-3.94	5.66	-3.13	-.22	-3.63	-.03	-2.50	.59
	19	778	ver	5.25	1.63	4.19	-1.50	3.88	-1.47	4.38	-1.59
	19	785	ver	-3.50	5.91	-3.94	1.81	-4.31	1.88	-3.63	2.00
	100	804	app	-.06	-6.44	-.38	-2.19	-.06	-1.13	1.50	-4.28
	100	810	app	.50	-.44	-.88	.47	-.63	.91	.75	.63
	100	1070	app	3.13	1.63	-.25	-.63	.50	.13	1.75	1.88
	100	3005	app	.81	.13	.56	.19	.00	-.75	1.31	.56
	100	2005	app	1.94	1.63	-.88	-1.13	-.56	-1.13	.69	1.53
13	100	2007	app	.00	.00	1.81	3.25	.75	1.97	2.13	1.22
	100	607	ver	.00	.00	-4.13	-2.25	-3.00	-.84	-1.69	.44
	100	750	ver	-1.13	.06	-2.06	-2.78	-2.81	-4.53	-1.69	-.56
	100	811	ver	-4.38	-6.34	-6.13	-3.94	-5.38	-2.47	-3.94	-4.59
	100	802	ver	-2.44	-3.94	-3.94	.03	-3.00	2.06	-1.50	-1.59
	100	803	ver	.06	-3.22	-.38	.19	-.19	1.00	1.31	-1.34
	100	805	ver	4.25	-.16	3.56	-.47	3.19	-1.22	4.44	.22
	100	729	ver	.69	-2.25	1.38	-.28	.69	-1.16	2.06	-1.28
	100	733	ver	-2.13	3.56	-.44	6.91	-1.44	5.75	.00	4.84
	100	808	ver	-2.38	-.19	-5.13	-.97	-4.50	-.13	-3.19	.50
	100	5901	ver	-5.50	-.75	-7.69	.69	-6.88	2.16	-5.44	.75
	100	739	ver	2.50	1.31	.38	-1.44	.31	-2.13	1.50	1.03
	1013	2101	app	-1.69	-8.34	-1.00	-1.28	1.56	-.47	.31	-2.16
	1013	2007	app	3.50	-1.75	.25	2.28	.31	-.25	2.63	4.16
	1013	1491	app	.00	.00	6.44	-.66	.25	.22	2.44	.63
	1013	2100	app	-4.06	-7.16	-2.00	-1.22	-.81	-.06	-1.75	-1.94
	1013	2802	app	-2.63	-5.63	-3.63	.88	-1.38	.56	-1.63	.81
	1013	2701	ver	1.13	-2.09	-.63	-.13	-2.88	-2.63	.38	2.34
	1013	803	ver	2.81	-4.28	6.13	-2.47	2.94	-2.31	4.50	-1.47
	1013	731	ver	.38	-7.03	-.56	-1.22	1.00	-1.78	1.19	-.97
	1013	733	ver	.00	.00	-3.06	3.69	-3.38	1.13	-.88	5.69

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
	1013	802	ver	-1.81	-.25	4.06	-.97	-2.06	-.41	.38	.50
	1013	804	ver	1.94	-4.59	4.06	-5.19	-1.38	-6.66	2.31	-2.63
	1013	720	ver	-5.56	-2.31	-6.75	2.53	-6.13	1.50	-5.13	3.34
	1013	729	ver	-7.25	-11.63	-6.25	-4.69	-3.88	-3.75	-5.19	-5.59
	1013	717	ver	-4.00	-12.25	-3.81	-5.72	-1.69	-5.34	-2.38	-6.19
	1013	730	ver	1.56	-2.31	1.69	3.59	3.13	3.66	2.88	3.47
13	1014	2001	app	1.88	-4.16	1.56	-.28	.63	1.16	3.56	-1.00
	1014	808	app	.25	-9.91	-2.31	-6.03	-1.63	-3.34	-.69	-6.09
	1014	1491	app	.00	.00	2.38	2.19	.25	.59	4.31	.41
	1014	3005	app	.94	.34	-1.00	1.47	.56	1.38	-.13	.81
	1014	2101	app	-.63	2.88	-.63	2.66	.19	.22	.13	1.19
	1014	2904	ver	-1.13	1.88	-1.50	2.94	-1.00	1.88	-.38	1.78
	1014	810	ver	3.38	-2.03	2.50	.19	2.75	.47	3.88	-.63
	1014	1067	ver	.00	.00	-2.81	.84	-.44	1.00	-2.13	.41
	1014	3103	ver	-2.56	-7.19	-5.00	-4.13	-4.00	-2.25	-3.63	-4.38
	1014	3104	ver	-1.50	-2.59	-4.31	-.19	-2.69	1.34	-3.13	-.41
	1014	2903	ver	-3.38	3.47	-3.31	5.09	-3.44	4.31	-2.00	3.91
	1014	2906	ver	-1.75	4.34	-2.69	4.16	-1.19	2.31	-2.00	3.00
	1014	3102	ver	1.56	-4.25	-.56	-.72	.00	1.44	1.00	-.94
	1014	811	ver	.69	-2.25	1.44	.19	.38	-.25	3.19	-1.06
	1014	5904	ver	-.69	1.63	-1.75	2.63	-.75	1.88	-.69	1.66
	1014	5901	ver	-2.88	-.91	-3.06	2.16	-3.69	2.81	-1.31	1.28
13	1015	6105	app	-13.50	9.16	-4.31	3.75	-1.25	2.31	-8.50	3.31
	1015	765	app	-2.94	11.03	.06	3.63	-.50	4.56	.31	4.94
	1015	808	app	.00	.00	.19	3.28	.31	.66	3.00	-3.09
	1015	3204	app	-.13	5.94	-.56	2.50	-2.19	2.75	2.38	1.06
	1015	6206	app	.00	.00	4.63	-13.16	3.69	-10.28	3.38	-7.69
	1015	740	ver	-3.69	7.59	-4.75	-1.75	-7.88	1.03	-1.63	1.19
	1015	747	ver	.75	4.19	2.13	2.41	1.81	1.53	3.81	-.31
	1015	752	ver	-4.63	5.25	-.19	.63	.56	.09	-.88	-.16
	1015	750	ver	-8.38	6.38	-2.69	-4.59	-2.56	-2.88	-4.56	-.78
	1015	758	ver	-7.13	4.94	-6.69	-.66	-8.25	.22	-4.50	-.56
	1015	754	ver	-5.50	1.81	-5.69	-2.38	-7.31	-1.91	-3.00	-3.25
	1015	760	ver	-3.75	5.41	-2.56	-2.88	-4.25	-1.09	-1.00	-.84
	1015	739	ver	-2.56	5.91	-2.81	-2.41	-5.25	-.28	-.25	-.28
	1015	748	ver	-.69	4.75	1.13	5.63	1.63	3.53	2.63	.94
	1015	734	ver	2.94	9.53	10.19	3.50	12.06	2.81	7.38	3.63
	1015	736	ver	-3.19	8.69	5.31	-.41	7.25	-.16	1.44	1.91
13	1018	1491	app	.00	.00	.63	-.72	-.56	.03	2.81	.03
	1018	2101	app	-3.75	-9.75	.50	-3.06	.69	-.13	-.25	-3.53
	1018	2100	app	-4.44	-8.50	-.56	-3.31	-.63	.13	-.81	-3.41
	1018	2802	app	-5.44	-7.34	-2.38	.44	-1.94	.16	-3.06	-.63
	1018	2007	app	1.50	-1.81	1.81	6.66	2.44	-.16	1.75	4.72
	1018	733	ver	.00	.00	.19	8.16	.69	1.19	.19	6.28
	1018	731	ver	-4.06	-8.47	-1.50	-1.03	-1.13	-2.13	-1.94	-2.09
	1018	717	ver	-3.88	-10.97	-.31	-4.13	-.06	-2.59	-.88	-4.78
	1018	729	ver	-8.00	-10.94	-3.81	-4.53	-3.63	-1.34	-4.50	-4.91
	1018	2701	ver	.19	-3.50	-.44	2.97	-.19	-4.44	.25	1.38
	1018	720	ver	-6.13	-1.75	-4.31	5.44	-3.94	2.78	-4.50	4.25
	1018	730	ver	.75	-2.53	3.88	4.09	4.06	4.69	3.44	3.41
	1018	802	ver	-.56	1.91	-.13	1.56	-1.25	1.50	2.00	2.16
	1018	803	ver	.19	-2.75	1.50	-.09	.94	-.50	2.63	-.16
	1018	804	ver	2.06	-4.69	1.06	-2.13	.56	-7.47	2.88	-2.72
13	1019	2101	app	3.06	3.84	.88	4.34	-.63	-.72	.75	2.75
	1019	2001	app	2.31	-9.75	.75	-4.22	.44	-.44	2.38	-1.81
	1019	6105	app	.00	.00	-6.25	3.81	-3.69	3.22	-8.88	5.97
	1019	808	app	4.88	-14.91	.63	-8.84	2.44	-5.00	.13	-5.34
	1019	1491	app	.00	.00	1.31	2.84	-1.94	2.88	4.63	2.31
	1019	3005	app	6.81	-.53	2.69	2.06	3.31	.03	1.44	2.72
	1019	749	ver	-1.88	-23.00	-6.56	-16.38	-4.25	-11.75	-7.25	-12.31
	1019	3003	ver	.63	-15.53	-2.38	-11.75	-2.19	-11.44	-2.44	-10.41
	1019	810	ver	8.44	-5.16	5.81	-1.50	5.69	-1.25	6.06	-.34
	1019	5901	ver	.25	-6.84	-1.38	-2.34	-2.00	-.31	-.06	-.75
	1019	811	ver	1.00	-7.00	.44	-3.47	-1.25	-2.78	2.38	-2.91
	1019	2902	ver	3.88	-2.16	2.75	1.25	1.34	1.47	4.13	1.78
	1019	2903	ver	-.69	3.47	-2.38	6.22	-3.50	5.13	-1.56	6.34
	1019	2904	ver	2.50	2.28	.25	4.38	-.63	2.09	.38	4.19
	1019	2906	ver	2.69	6.09	-.63	6.88	-1.13	1.97	-1.63	5.81
	1019	5904	ver	5.13	.53	2.00	2.75	1.75	.41	1.50	2.84
	1019	3102	ver	4.56	-8.88	.69	-3.31	2.06	-.22	.44	-.34
	1019	3103	ver	3.94	-11.06	-.31	-6.03	1.19	-3.91	-1.06	-3.34
	1019	3104	ver	5.50	-4.78	.63	-.41	2.38	.31	-.75	1.84
	1019	1067	ver	7.00	-2.38	1.69	.09	3.13	-2.50	-.56	.94
13	1020	765	app	3.44	4.41	.44	-1.50	.06	-.44	.06	2.56
	1020	808	app	.00	.00	.25	.69	.06	-.34	2.25	-.69
	1020	3204	app	3.75	2.47	.75	.06	-.19	.94	2.56	2.31
	1020	6105	app	-2.31	8.38	-1.38	.78	.50	-.16	-4.88	3.31
	1020	748	ver	2.56	4.47	2.56	3.25	2.63	2.47	3.50	3.03
	1020	747	ver	3.56	1.44	2.13	-.94	1.81	-.91	3.13	.31

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
	1020	736	ver	7.13	6.13	6.13	-3.03	7.00	-2.81	2.69	1.53
	1020	807	ver	-10.50	1.53	-10.88	-3.50	-10.38	-3.84	-12.06	-1.47
	1020	758	ver	-2.13	-2.50	-5.63	-6.38	-6.44	-5.16	-4.44	-3.06
	1020	740	ver	2.19	-2.03	-3.69	-7.16	-5.19	-4.59	-2.06	-1.72
	1020	739	ver	3.38	-1.66	-1.69	-6.63	-2.94	-4.56	-.38	-1.81
	1020	760	ver	4.31	.06	.06	-5.50	-.81	-3.75	.56	-.81
	1020	750	ver	.00	.00	-3.19	-8.91	-3.13	-7.56	-5.31	-3.13
	1020	754	ver	2.44	-3.50	-.81	-6.41	-1.69	-5.41	.81	-3.78
	1020	752	ver	5.00	.69	4.00	-4.44	4.25	-4.44	3.06	-1.97
	1020	734	ver	13.38	9.38	13.06	2.31	13.94	2.03	10.56	5.34
13	1021	604	ver	5.38	-2.66	7.94	-5.47	7.81	-5.44	5.75	-5.41
	1021	627	ver	.00	.00	2.94	-1.56	2.49	-1.53	.31	-2.63
	1021	757	ver	.00	.00	1.75	-7.06	1.88	-7.41	.63	-3.25
	1021	746	vér	-5.19	-.03	-4.56	-5.44	-4.13	-4.69	-4.75	-3.19
	1021	3304	ver	.06	4.59	-.88	1.03	.06	3.16	.19	1.47
	1021	2005	ver	.25	5.00	-.19	.66	.56	2.28	.50	1.84
	1021	610	app	-1.56	-2.56	.75	-4.00	.69	-3.50	-1.31	-5.25
	1021	6201	app	-8.56	11.91	-4.69	8.81	-5.19	7.91	-8.00	9.22
	1021	1070	app	1.06	4.72	2.56	.66	2.75	1.09	1.44	1.75
	1021	3204	app	-1.63	4.47	-1.06	-2.03	-.56	-1.53	-1.13	1.22
	1021	755	app	-.06	2.16	2.44	-3.44	2.31	-3.97	.56	-.88
	1021	742	ver	.94	5.81	1.31	2.66	1.31	4.00	1.13	2.84
	1021	618	ver	1.56	4.31	5.06	.19	4.63	-.72	2.13	1.50
	1021	763	ver	2.13	3.59	4.44	.31	4.38	.41	2.56	.75
15	22	2906	app	.00	.00	.50	.03	.00	.00	.56	.00
	22	1067	app	1.13	-1.78	.69	-.47	.00	.00	1.06	-1.03
	22	815	app	-.25	-.28	-1.19	.44	.00	.00	-.63	.09
	22	812	ver	1.69	.34	2.00	.44	1.75	.31	2.13	.38
	22	6007	ver	.00	.00	-1.00	.72	.31	.22	-.38	.34
	22	5906	ver	-3.00	.16	-2.94	.38	-2.88	.16	-2.75	.25
	102	2906	app	.00	.00	.31	-.03	.00	.00	.50	.00
	102	1067	app	.31	-1.72	.38	-.38	.00	.00	.63	-.84
	102	815	app	-.19	-.75	-.69	.38	.00	.00	-.25	.00
	102	812	ver	1.63	.28	1.81	.38	1.63	.31	2.00	.34
	102	6007	ver	.00	.00	-.63	1.16	.19	.72	-.13	.75
	102	5906	ver	-3.13	-.47	-3.06	-.16	-3.06	-.31	-2.81	-.25
	1001	5911	app	2.38	1.44	.50	-3.34	-1.00	-1.13	-.69	-.81
	1001	780	app	10.50	-.31	3.38	-1.53	1.81	2.03	4.81	-1.94
	1001	6011	app	.00	.00	-8.50	-1.50	-5.69	-6.41	-6.19	-1.91
	1001	785	app	8.56	10.19	4.63	6.38	4.88	5.50	4.56	7.97
	1001	813	ver	.00	.00	.19	-6.13	-1.31	-4.38	-2.06	-2.53
	1001	781	ver	5.44	2.13	-3.31	-1.72	9.19	-26.31	-.50	-.78
15	1004	2805	app	8.31	-.47	7.06	-1.22	5.94	-1.09	6.81	-1.69
	1004	2705	app	3.06	2.91	1.56	2.50	-.81	1.09	.81	2.16
	1004	2706	app	.00	.00	-1.25	-.28	-.63	-1.38	-1.88	-.31
	1004	1501	app	.00	.00	-1.19	-1.03	-3.00	-.19	-1.19	-1.69
	1004	701	ver	1.38	2.41	.38	1.88	2.34	2.09	.19	1.75
	1004	705	ver	1.81	-1.75	.50	-2.47	-1.96	-2.59	.19	-2.94
	1004	715	ver	4.06	.22	2.88	-.59	1.69	-.28	2.69	-1.09
	1004	5804	ver	-.13	2.38	-1.31	1.38	-3.25	2.09	-1.38	.69
	1004	716	ver	4.50	2.41	3.06	1.91	.94	.84	2.50	1.53
	1004	5705	ver	1.13	3.13	-.19	2.63	-.50	2.03	-.63	2.38
	1004	704	ver	-.44	.47	-1.75	-.09	-2.25	-.47	-2.13	-.41
	1004	2806	app	-1.06	1.28	-2.13	.69	-.25	1.00	-2.25	.53
	1004	767	app	-3.19	.16	-4.00	-.66	-1.25	.59	-3.88	-.91
15	1005	5802	app	2.06	-.75	-.13	.25	.25	.50	.88	-.19
	1005	5803	app	.00	.00	-1.44	-.31	.00	-1.06	-.19	.09
	1005	5702	app	.63	-2.50	1.44	-.06	.56	.16	.63	.19
	1005	2802	app	1.69	-3.34	.44	-.84	-.44	.06	.44	-1.50
	1005	5703	app	-1.81	-.31	-.31	.97	-.31	.34	-.94	1.97
	1005	731	ver	3.06	-5.28	2.00	-2.22	.63	-1.03	1.69	-3.03
	1005	714	ver	-2.06	-8.16	.00	-6.38	-.44	-6.91	-1.00	-5.34
	1005	708	ver	-.31	-1.06	-.88	-.84	.06	-1.53	-.19	-.31
	1005	2803	ver	-.44	-2.72	-1.06	-1.78	-.69	-2.03	-.63	-1.53
	1005	721	ver	.63	-1.00	.56	.63	.38	.66	.44	.84
	1005	732	ver	-.19	2.72	-.38	5.13	-1.19	5.63	-.75	4.97
	1005	733	ver	.00	.00	1.25	4.03	-1.00	5.13	-.38	3.81
16	1007	6011	app	-4.19	-1.25	-1.31	-.97	-.88	-.50	-2.94	-.47
	1007	1084	app	1.75	-1.75	1.56	-.69	-.38	-.56	1.56	-.44
	1007	780	app	-.81	-1.34	1.38	-1.00	1.06	-.56	.06	-.50
	1007	5911	app	-.69	-3.97	-.75	-1.13	-.06	-1.47	-.69	-1.81
	1007	813	app	.00	.00	-.88	3.75	.19	3.09	-.31	2.63
	1007	783	ver	1.06	-2.81	.88	-1.50	-.75	-1.47	.88	-1.38
	1007	785	ver	-1.13	.38	-.19	2.47	.56	2.34	-.69	2.13
	1007	814	ver	1.38	-1.75	1.13	-1.34	-1.88	-1.03	1.13	-.72
	1007	778	ver	.00	.00	2.56	-.31	1.81	.34	1.06	.53

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
16	1008	704	ver	.25	-1.69	-.63	-2.50	-.06	-3.00	-.31	-2.00
	1008	716	ver	-1.56	.59	-2.19	-.13	-2.25	-.25	-2.25	.69
	1008	722	ver	-3.13	-2.41	-3.88	-2.94	-4.31	-2.63	-4.25	-2.41
	1008	1501	app	.00	.00	-1.31	-.59	-.88	-.66	-1.13	-1.22
	1008	2704	app	.88	.84	.38	.34	-.38	.81	-.25	1.22
	1008	2804	app	2.31	.50	1.25	.00	1.13	.31	1.00	-.19
	1008	2705	app	.00	.00	-.50	-.72	-.69	-.84	-.63	.38
	1008	5705	app	1.00	1.81	.25	.94	.75	.38	.56	1.66
	1008	715	ver	3.19	-1.00	2.06	-1.69	2.56	-1.97	2.31	-1.84
	1008	713	ver	1.88	2.63	.94	2.13	.63	2.50	.63	2.22
	1008	727	ver	1.31	-.88	.44	-1.53	.56	-1.59	.44	-1.31
	1008	705	ver	-1.88	.28	-2.88	-.41	-2.50	-.63	-2.69	-.22
	1008	725	ver	6.81	1.53	6.00	1.09	5.38	1.63	5.50	1.47
	1008	5804	ver	1.81	2.03	.56	1.44	.94	1.41	.69	.88
	1008	712	ver	1.63	1.53	.50	1.03	.50	1.25	.38	.69
	1009	5706	app	1.94	-2.06	1.75	-.44	.13	1.38	1.75	-1.00
	1009	775	app	-.81	-2.25	-1.19	-.97	.50	-5.47	-.88	-1.47
	1009	768	app	1.31	-5.75	.63	-3.75	-.13	-1.16	.69	-4.88
	1009	5807	app	.00	.00	-.94	1.97	.96	2.00	-.75	.69
	1009	3016	app	.81	-1.19	.38	.59	-.31	1.78	.38	-.25
	1009	772	app	-.25	1.06	-.63	2.63	-.31	1.44	-.50	1.94
	1009	702	ver	.44	1.19	.00	2.91	-.69	4.00	.06	2.13
	1009	2807	ver	-.25	1.03	-.81	2.81	-.94	3.44	-.69	1.91
	1009	703	ver	.00	.00	-.13	1.41	-.31	.06	-.06	.97
16	1010	730	ver	.75	3.13	.13	2.69	-.94	2.34	1.38	2.44
	1010	731	ver	.13	-.22	-.50	-.84	-1.13	-1.19	.56	-1.44
	1010	717	ver	.13	-1.97	-.56	-2.41	-1.94	-2.47	.44	-2.50
	1010	2803	app	.88	-.03	-.06	-.88	.51	-.28	.00	-1.47
	1010	2101	app	2.50	.34	1.69	.03	.58	.16	2.75	.19
	1010	2802	app	.38	.16	-.38	-.47	-.69	-.53	.44	-.94
	1010	5802	app	.00	.00	-1.06	-.56	-.63	.28	-.81	-.50
	1010	5702	app	.50	1.72	-.06	.72	.25	.31	.50	-.66
	1010	2007	app	.13	2.16	-.19	1.16	-.56	.06	.88	-.53
	1010	729	ver	-1.00	-2.06	-1.75	-2.34	-2.81	-2.28	-.69	-2.13
	1010	5701	ver	.00	.00	-.25	-.69	-1.63	-2.03	1.38	-1.91
	1010	733	ver	-4.25	7.72	-4.50	6.75	-5.13	5.50	-3.31	5.06
	1010	732	ver	1.25	2.53	.63	1.72	.63	1.53	1.25	.78
	1010	721	ver	-1.31	2.47	-2.06	1.56	-1.50	1.72	-1.75	.63
	1010	720	ver	-3.94	4.50	-4.38	3.88	-5.31	3.09	-3.06	3.00
	1011	2705	app	2.31	-.38	-.13	-.47	-.38	-1.59	.00	.13
	1011	5706	app	.75	-1.50	-1.19	-.66	-.44	-.72	-1.19	-.31
	1011	2704	app	3.19	2.44	.81	1.81	-.13	.59	.94	2.56
	1011	2806	app	.44	-2.59	-.81	-1.91	-.56	-.72	-1.00	-1.50
	1011	2706	app	.94	-.88	-1.38	-.25	-.75	-1.03	-1.31	.16
	1011	5705	app	3.44	2.41	1.63	2.69	1.56	2.69	1.56	3.19
	1011	2804	app	2.06	-1.53	1.00	-2.13	-.50	-1.16	.75	-1.38
	1011	3016	app	1.56	-.34	.13	.91	1.19	1.91	.00	1.13
	1011	703	ver	.00	.00	-2.38	1.09	-1.13	.44	-2.25	1.34
	1011	705	ver	1.81	-1.94	.44	-2.06	-.25	-1.38	.31	-1.44
	1011	716	ver	5.00	2.53	2.88	2.41	2.50	1.81	2.94	3.03
	1011	727	ver	.13	-1.53	-1.31	-1.75	-2.19	-1.25	-1.44	-1.09
	1011	715	ver	1.94	-1.78	.88	-1.88	.00	-.56	.63	-1.25
	1011	712	ver	.00	.00	-.94	-.59	-2.34	.72	-1.19	.19
	1011	701	ver	3.56	-1.13	2.25	-.38	2.63	.69	2.06	.00
	1011	704	ver	3.06	-2.81	1.44	-2.63	1.19	-2.31	1.31	-2.06
	1011	702	ver	-1.13	-3.00	-2.69	-1.81	-1.69	-1.00	-2.81	-1.56
	1011	713	ver	2.13	-1.25	.69	-1.88	-.69	-1.53	.56	-1.13
16	1012	721	ver	.38	2.28	-.38	2.03	.19	2.16	-.56	.75
	1012	733	ver	-1.00	5.63	-1.13	5.09	-1.38	4.09	-.38	3.56
	1012	5701	ver	.00	.00	.00	-.22	-.88	-.84	.88	-1.31
	1012	720	ver	-2.00	4.84	-2.25	4.75	-2.88	4.66	-1.75	3.81
	1012	732	ver	-.63	5.00	-1.19	4.81	-1.00	4.81	-1.13	3.63
	1012	731	ver	1.94	-1.25	1.50	-1.22	1.13	-.97	1.75	-2.06
	1012	2007	app	-.06	1.84	-.31	1.25	-.38	.31	.31	-.28
	1012	2801	app	1.25	-.34	1.06	-.06	.06	.38	1.50	-.59
	1012	5702	app	1.31	.00	.75	-.44	1.19	-.91	.94	-1.97
	1012	2802	app	-.06	-.75	-.56	-.66	-.75	-.22	-.50	-1.50
	1012	2803	app	.00	.00	-.94	-.09	-.13	.44	-1.38	-1.25
	1012	717	ver	.63	-2.69	.19	-2.34	-.44	-1.53	.25	-2.84
19	1026	3005	app	-2.06	-1.00	-.56	-1.47	-.56	-1.13	.63	-2.94
	1026	2007	app	.00	.00	-3.81	4.66	-3.63	5.19	.56	1.94
	1026	1491	app	6.31	1.50	-.06	-.19	.19	-.47	4.31	.25
	1026	2001	app	5.06	2.47	3.31	-2.66	3.38	-2.97	5.13	-1.53
	1026	3204	app	-.44	2.94	4.13	-2.38	3.94	-2.31	3.19	-2.28
	1026	6201	app	-6.63	10.59	-3.13	2.03	-3.31	1.69	-4.19	3.72
	1026	2701	ver	-3.38	5.81	-8.38	9.41	-8.19	9.75	-3.69	7.38
	1026	3003	ver	.63	2.91	.75	.56	.75	.63	2.19	.16
	1026	5901	ver	1.06	5.41	-.81	1.78	-.75	1.59	1.31	2.28
	1026	5904	ver	-3.38	-.28	-3.38	-.34	-3.38	-.06	-1.50	-1.72
	1026	2904	ver	-4.19	1.84	-5.44	1.78	-5.38	2.00	-3.00	.66
	1026	2906	ver	-5.56	-3.59	-5.56	-1.53	-5.50	-1.03	-3.31	-3.78
	1026	3102	ver	-1.00	6.31	.63	1.56	.50	1.47	1.00	1.94

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
	1026	1067	ver	-6.94	-1.94	-3.75	-2.03	-3.81	-1.53	-3.19	-3.94
	1026	763	ver	.00	.00	4.50	-7.94	4.25	-8.13	3.06	-6.69
	1026	3304	ver	-.81	5.19	5.69	-1.56	5.44	-1.50	3.63	-1.19
	1026	3104	ver	-5.63	4.91	-2.75	2.03	-2.81	2.25	-2.56	1.38
	1026	2903	ver	-4.19	5.97	-6.19	4.91	-6.13	5.00	-3.63	4.34
19	1027	2100	app	-4.75	-5.38	-1.81	-1.25	-1.06	-.34	-3.38	-3.75
	1027	1491	app	.00	.00	7.56	-.66	1.06	.34	2.38	.00
	1027	2802	app	-3.13	-4.34	-2.88	-.22	-.56	-.22	-2.56	-2.53
	1027	2007	app	.88	-.25	-.31	1.47	.63	.28	.94	.97
	1027	717	ver	-2.63	-8.38	-1.31	-4.03	.63	-3.63	-1.69	-6.59
	1027	730	ver	1.31	3.22	2.63	7.00	4.00	7.28	2.19	4.84
	1027	802	ver	2.88	2.06	10.00	1.28	3.63	2.09	5.13	2.03
	1027	803	ver	-.06	-1.22	4.56	-.28	1.25	.19	1.56	-.59
	1027	804	ver	2.31	-2.94	6.31	-4.19	1.38	-4.59	3.69	-2.88
	1027	2701	ver	-2.44	5.06	-2.06	5.31	-3.44	4.22	-2.06	5.75
	1027	733	ver	-1.56	2.03	-2.56	3.50	-2.00	2.28	-1.50	3.16
	1027	720	ver	-3.69	4.06	-3.25	6.81	-2.31	6.47	-3.13	5.47
	1027	731	ver	-.75	-3.41	-.25	.16	1.44	.06	-.13	-1.78
	1027	729	ver	-.63	-3.63	1.25	1.16	3.19	1.91	.44	-1.75
	1027	2101	app	-2.94	-5.25	-1.38	-.41	.81	.28	-1.94	-3.34
	1027	2702	app	.00	.00	-1.19	1.06	-.88	-.31	.00	1.03
19	1028	3103	ver	-1.56	-3.59	-3.88	-4.50	-3.69	-.47	-1.31	-3.84
	1028	5904	ver	1.13	.78	.38	1.25	.81	2.31	.56	1.59
	1028	3104	ver	-1.25	1.06	-3.00	-.09	-2.31	4.56	-.88	1.16
	1028	3003	ver	1.63	1.38	-.19	1.53	-.25	3.13	1.19	1.50
	1028	2001	app	5.06	-.47	1.75	.22	.38	.22	4.13	-1.25
	1028	3005	app	.13	-2.41	-.63	-2.66	.25	.16	.00	-1.63
	1028	2100	app	-.81	-.75	-1.19	.94	-1.19	-.75	-2.19	.41
	1028	2101	app	.00	.00	.06	1.50	.56	.38	-1.19	1.47
	1028	3102	ver	.00	.00	-2.75	-.75	-2.34	2.81	.13	-.50
	1028	5901	ver	.63	1.34	-1.94	2.25	-3.00	1.91	-.31	1.00
	1028	2906	ver	-1.31	-2.59	-1.13	-1.91	-.13	-1.16	-2.00	-1.13
	1028	2903	ver	-1.25	4.41	-2.69	5.69	-3.13	4.75	-2.38	4.84
	1028	811	ver	1.50	-.19	-.69	1.59	-2.00	-.72	.00	-.22
	1028	2902	ver	5.25	1.09	3.25	2.53	2.31	1.06	3.94	1.19
	1028	2904	ver	-.06	-.25	-1.00	.78	-.94	.50	-1.06	.53
	1028	810	ver	2.81	-1.66	.94	-1.19	.69	-.31	2.13	-1.50
	1028	1067	ver	-1.13	-4.66	-1.56	-5.63	.00	-1.06	-.75	-3.69
	1029	3204	app	3.00	6.09	4.63	1.97	-.25	1.25	2.69	1.69
	1029	808	app	.00	.00	1.31	-2.78	.88	-3.91	-.69	-1.72
	1029	765	app	-2.13	8.41	.44	3.69	-1.13	3.81	-.69	2.75
	1029	6206	app	.00	.00	3.25	-5.75	1.19	-4.94	2.56	-7.78
	1029	6105	app	-13.25	6.81	-9.63	2.88	-.75	3.78	-9.63	2.53
	1029	740	ver	-1.13	6.03	.81	.69	-7.94	.34	-1.13	-.75
	1029	736	ver	-5.56	7.34	-1.75	2.63	4.19	3.69	-1.81	1.50
	1029	734	ver	4.06	9.94	7.38	5.75	12.34	6.41	7.06	5.19
	1029	748	ver	3.06	5.31	4.88	2.16	5.69	1.47	3.25	2.81
	1029	752	ver	-1.25	6.44	1.38	2.38	3.44	2.50	.44	2.03
	1029	754	ver	2.19	3.81	3.88	-.47	-1.00	-1.06	2.00	-.88
	1029	760	ver	-1.06	5.78	1.19	.75	-3.56	.69	-.25	-.41
	1029	739	ver	-.94	5.28	1.06	.19	-5.88	-.09	-.69	-1.03
	1029	750	ver	-9.44	2.34	-6.06	-2.94	-5.31	-2.13	-6.56	-4.47
	1029	758	ver	.69	3.50	2.63	-1.00	-2.00	-1.41	.94	-1.66
	1029	747	ver	2.13	3.78	4.06	.06	2.75	-.50	2.38	.16
19	1030	2005	ver	-1.75	2.19	-4.19	-2.50	-11.06	5.84	-1.44	-1.19
	1030	3304	ver	3.38	3.44	.00	.19	-9.44	10.00	2.88	.06
	1030	742	ver	2.50	5.13	1.50	2.69	-4.94	8.16	2.25	2.84
	1030	746	ver	-8.19	-3.16	-8.69	-9.72	-11.00	-4.53	-6.69	-6.25
	1030	601	ver	-8.25	-6.41	-1.44	-10.66	5.75	-18.59	-5.88	-6.09
	1030	624	ver	4.44	2.72	8.00	2.75	6.69	-.06	4.38	2.81
	1030	604	ver	1.19	-7.78	4.19	-9.47	3.31	-11.03	1.69	-8.34
	1030	627	ver	.00	.00	3.63	.69	1.81	-2.31	-.25	.28
	1030	757	ver	.00	.00	1.75	-9.47	5.06	-7.69	3.19	-2.97
	1030	1070	app	-.19	3.31	.94	-.72	-.94	1.28	.69	1.47
	1030	755	app	-3.38	4.56	-.44	-2.19	2.69	-2.94	-.94	2.75
	1030	6201	app	-9.63	8.97	-4.19	6.91	-.94	1.16	-8.38	9.28
	1030	610	app	3.31	-2.06	5.69	-1.19	1.81	-2.06	2.63	-2.22
	1030	3204	app	-1.63	5.75	-2.00	-2.84	-2.69	2.56	.69	2.19
	1030	618	ver	3.31	6.28	8.19	2.34	12.06	-2.16	5.13	5.91
	1030	763	ver	-.63	.38	1.88	-2.16	1.00	-2.81	.06	-.56
21	1035	1491	app	.00	.00	7.63	2.81	-.38	2.16	2.19	1.34
	1035	2101	app	-2.56	-5.47	-2.25	.09	.19	1.53	-2.19	-2.81
	1035	2802	app	-2.50	-5.56	-3.06	-1.16	-.38	-.50	-2.44	-3.16
	1035	2100	app	-2.13	-9.03	-.31	-3.66	.25	-2.38	-1.38	-6.53
	1035	2702	app	.00	.00	-.81	1.16	.00	-.41	-.25	1.53
	1035	720	ver	-3.25	4.13	-3.19	7.34	-2.00	7.22	-3.13	6.16
	1035	2701	ver	-2.69	3.34	-1.75	4.38	-3.06	2.66	-2.50	4.72
	1035	804	ver	2.38	-3.03	7.06	-2.06	1.25	-3.91	3.56	-1.97
	1035	803	ver	1.19	-2.53	5.63	.56	1.56	.22	2.50	-.88

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
21	1035	2007	app	-.13	-1.00	-1.19	.72	.31	-.44	-.44	.69
	1035	802	ver	3.63	3.28	10.94	5.88	3.13	5.03	5.69	4.59
	1035	717	ver	-2.94	-6.59	-2.75	-1.59	-.56	-.53	-2.63	-4.09
	1035	729	ver	1.00	-5.81	1.63	-.22	3.69	1.25	1.44	-3.19
	1035	730	ver	1.94	1.28	2.44	5.78	4.00	6.50	2.31	3.63
	1035	733	ver	-2.56	2.03	-3.31	3.63	-2.31	2.34	-2.81	3.69
	1035	731	ver	-.06	-5.88	-.25	-1.91	1.75	-1.53	.06	-3.63
	1036	2100	app	1.38	-3.81	-1.25	-.81	-1.19	-2.06	-1.69	-2.50
	1036	2001	app	8.38	3.31	3.94	1.44	1.69	.50	4.44	-.47
	1036	808	app	.00	.00	-1.63	-3.44	-1.81	-1.75	-1.00	-4.84
	1036	3005	app	1.31	-.97	.81	-.59	2.18	.69	.81	-1.88
	1036	2101	app	.00	.00	-1.88	3.44	-1.96	2.63	-2.38	1.88
	1036	3003	ver	3.00	2.63	.88	2.13	.91	2.47	1.06	.56
	1036	2906	ver	-.81	-.72	-1.56	1.97	.13	2.28	-1.94	.59
	1036	3103	ver	-.56	.53	-1.75	-1.81	-1.38	-.19	-1.31	-3.19
	1036	3104	ver	-2.56	3.91	-2.88	2.09	-1.56	4.22	-2.50	.88
	1036	3102	ver	2.56	4.97	.69	2.25	.44	3.50	1.25	.78
	1036	2903	ver	.38	4.47	-2.81	5.63	-3.56	4.56	-2.88	3.88
	1036	2904	ver	2.06	-.13	-.31	1.50	-.19	.94	-.50	-.13
	1036	1067	ver	-2.88	-2.78	-2.00	-2.69	.63	-.31	-2.00	-3.72
	1036	810	ver	5.25	1.84	2.75	1.63	2.38	1.56	2.88	.03
	1036	5904	ver	2.50	3.00	1.00	4.19	1.81	4.44	.88	2.72
	1036	2902	ver	7.06	2.16	3.00	2.78	1.50	1.28	3.06	.88
	1036	811	ver	5.69	3.88	1.00	4.50	-1.13	2.50	1.00	2.50
	1036	5901	ver	4.38	4.63	.38	3.84	-1.31	2.91	.69	2.00
21	1037	808	app	.00	.00	.38	-5.25	2.06	-6.13	1.63	-.34
	1037	6206	app	.00	.00	.88	-1.78	.44	-1.34	3.88	-4.94
	1037	765	app	-3.00	9.00	-2.25	6.00	-2.00	5.97	.13	5.66
	1037	3204	app	.00	5.06	1.00	1.03	-.50	1.47	1.81	2.69
	1037	760	ver	-1.19	8.22	-.06	5.25	-1.94	5.97	1.38	4.53
	1037	758	ver	-2.88	.63	-1.81	-2.94	-3.31	-2.44	-.63	-2.31
	1037	752	ver	-3.88	2.09	-3.69	-1.31	-.94	-2.28	-.56	-.34
	1037	735	ver	-9.63	-7.00	-9.50	-9.97	-6.19	-11.06	-5.75	-9.84
	1037	734	ver	1.31	8.59	1.13	5.69	5.94	4.09	5.56	5.91
	1037	736	ver	-5.81	6.97	-6.00	4.75	-1.13	3.28	-1.00	3.47
	1037	748	ver	-4.13	3.19	-3.88	-1.47	-1.50	-2.47	-1.88	2.22
	1037	739	ver	-2.13	4.31	-.75	1.22	-3.94	2.41	.06	.53
	1037	750	ver	-8.00	4.03	-7.50	1.94	-6.06	1.66	-3.94	-.19
	1037	740	ver	-2.56	1.25	-.94	-1.72	-5.25	-.09	-.56	-2.88
	1037	747	ver	-.50	.13	.06	-4.09	.94	-4.50	1.75	-1.66
	1037	754	ver	-3.81	.06	-2.75	-3.81	-4.31	-3.31	-1.88	-2.50
21	1038	763	ver	.38	1.31	2.19	-2.91	1.75	-3.72	.38	-1.16
	1038	746	ver	.00	3.69	-4.44	-.41	-7.94	2.72	-1.56	.28
	1038	615	ver	-.75	1.06	2.00	-8.16	8.94	-11.22	.31	-2.53
	1038	601	ver	-7.69	2.06	-4.44	-7.75	3.50	-11.28	-6.38	-1.59
	1038	627	ver	.00	.00	5.88	-2.97	5.63	-5.84	.88	-1.50
	1038	624	ver	2.31	5.38	7.50	2.00	7.50	-.59	3.13	3.66
	1038	757	ver	.00	.00	-5.88	-8.47	-4.06	-5.94	-1.25	-4.75
	1038	2005	ver	.13	1.38	-3.88	.63	-11.81	4.63	-1.88	-1.09
	1038	3304	ver	3.00	2.53	-.25	3.81	-10.56	8.00	.88	.69
	1038	742	ver	1.94	4.47	1.25	3.91	-5.31	5.91	.81	2.56
	1038	618	ver	3.50	7.91	5.56	.28	9.94	-1.81	4.13	4.59
	1038	604	ver	1.75	-7.72	4.75	-11.78	4.69	-13.25	2.06	-9.94
	1038	6201	app	-9.00	11.69	-4.56	4.88	-.25	1.59	-7.88	8.97
	1038	755	app	2.94	3.44	.75	-4.34	3.38	-3.08	2.50	-.56
	1038	610	app	-.75	.72	4.44	-.81	1.88	-2.75	-.25	-.53
	1038	1070	app	4.25	4.97	3.56	1.06	1.50	1.94	3.56	2.19
	1038	3204	app	2.31	4.88	-4.19	-.78	-6.50	3.09	.50	.75
21	1039	736	ver	5.81	1.22	7.38	2.06	1.06	-.31	4.06	3.81
	1039	3209	ver	4.13	-.88	6.13	-.38	2.50	-1.34	3.38	.69
	1039	3208	ver	3.88	-3.63	5.63	-3.00	.50	-4.69	2.56	-1.63
	1039	750	ver	3.75	-3.31	5.13	-2.66	-2.25	-5.28	1.50	-1.06
	1039	738	ver	4.75	-5.69	6.25	-5.16	-.06	-7.25	2.88	-3.81
	1039	5802	app	.00	.00	2.50	2.25	2.19	.94	1.25	5.88
	1039	780	app	-5.19	-2.50	-2.06	-1.72	1.44	-.13	-2.94	-.56
	1039	1084	app	-8.00	-2.19	-4.81	-1.00	-1.06	.34	-5.50	.72
	1039	1241	app	.81	.28	2.19	.47	-5.19	-1.69	-1.56	1.31
	1039	6306	app	.00	.00	2.44	-.56	1.94	.69	.06	-1.31
	1039	5803	app	-3.00	-1.59	-.31	.53	.63	-.16	-1.25	3.94
	1039	817	ver	-2.31	-4.59	-.31	-3.91	-3.88	-5.03	-3.00	-2.53
	1039	3213	ver	-4.38	.28	-1.50	.25	.50	2.00	-3.06	.19
	1039	818	ver	2.19	-4.91	4.38	-4.88	2.00	-4.91	1.75	-4.66
	1039	3310	ver	-1.00	2.72	.94	2.63	-2.88	2.16	-2.06	2.75
	1039	6304	ver	-1.94	3.19	.06	2.84	-3.75	2.59	-3.06	2.56
	1039	819	ver	3.31	-8.50	5.81	-8.97	5.38	-7.72	3.44	-9.66
	1039	3211	ver	.94	5.72	3.31	5.94	2.50	6.34	1.19	6.41
	1039	820	ver	-2.75	-3.22	.19	-3.16	2.63	-1.31	-1.25	-3.09
	1039	737	ver	3.00	-2.44	4.69	-1.66	-.94	-3.69	1.50	.03

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
	1040	6306	app	.00	.00	1.31	-.94	2.31	1.31	.63	-2.56
	1040	1241	app	-1.13	.66	-1.38	.91	-4.38	.56	-2.81	.66
	1040	6206	app	10.75	-3.69	10.44	-3.00	7.19	-3.84	9.13	-2.88
	1040	1084	app	-9.13	-1.88	-6.69	-.22	-4.25	.47	-5.69	-.41
	1040	780	app	-6.56	-2.53	-4.25	-1.44	-1.75	-.25	-3.44	-2.00
	1040	5802	app	.00	.00	1.50	3.25	1.25	1.53	2.44	4.59
	1040	5803	app	-2.75	-1.63	-.94	1.47	-.34	.19	.19	2.56
	1040	812	ver	-1.63	-3.25	-.50	-.38	-1.31	-2.00	.13	.81
	1040	1067	ver	5.88	-1.56	6.38	.47	4.50	-.94	6.19	1.28
	1040	815	ver	-1.13	-5.25	-.06	-3.41	-.69	-4.13	.06	-2.94
	1040	822	ver	-2.00	-6.06	-.56	-5.28	-.06	-4.66	-.63	-5.69
	1040	814	ver	-6.50	-1.38	-4.25	.28	-2.19	.84	-3.31	.19
	1040	821	ver	-3.69	-.88	-1.88	1.25	-1.00	.91	-1.13	1.63
	1040	2906	ver	1.38	-3.00	2.50	.00	1.56	-1.81	3.13	1.31
	1040	3110	ver	-6.63	.78	-4.88	1.66	-3.69	2.50	-4.63	1.19
	1040	5908	ver	-3.38	1.50	-1.63	3.56	-.81	3.28	-.94	3.94
	1040	786	ver	-9.56	-.25	-6.56	1.06	-2.63	2.63	-5.19	.44
	1040	778	ver	2.13	-2.56	4.31	-1.59	6.50	-.41	4.94	-2.19
	1040	3107	ver	.44	-1.78	1.13	-.28	-.19	-1.00	.88	.09
21	1041	3016	app	-1.06	-1.56	-1.00	1.28	.69	1.34	-.75	.28
	1041	2706	app	-.75	-1.47	-2.94	-.44	-1.19	-1.47	-2.13	-.09
	1041	5803	app	.00	.00	3.06	-2.63	.19	-3.50	.63	-1.94
	1041	716	ver	3.88	5.53	2.63	4.72	2.88	3.34	2.56	5.69
	1041	705	ver	-.06	-5.53	.50	-6.16	.00	-7.00	-.31	-5.72
	1041	715	ver	2.63	-.91	4.19	-1.41	3.25	-2.00	2.94	-1.28
	1041	5804	ver	.69	-2.63	3.38	-3.69	1.56	-4.19	1.44	-3.59
	1041	701	ver	1.81	-.56	2.25	1.09	3.06	.88	2.06	.53
	1041	702	ver	.38	.19	.19	2.88	1.94	2.84	.50	2.03
	1041	773	ver	.00	.00	-1.56	4.84	2.06	5.09	-.06	3.34
	1041	774	ver	-4.00	-2.50	-4.44	2.84	-1.06	3.53	-3.31	.84
	1041	2807	ver	2.69	1.66	3.00	4.91	4.81	5.19	3.25	3.66
	1041	769	ver	-6.69	-3.13	-5.19	2.00	-2.88	3.13	-4.94	-.38
	1041	704	ver	1.63	-1.16	1.44	-1.09	1.69	-1.94	1.13	-.78
	1041	5807	app	-3.19	-3.78	-1.13	.94	.69	2.06	-1.31	-1.41
	1041	1084	app	-6.06	-6.16	-.13	-2.59	-.88	-.84	-2.31	-5.38
	1041	2804	app	.75	5.31	2.19	3.47	.56	2.44	.63	4.19
21	1042	725	ver	6.06	.31	4.94	-2.19	3.75	-3.19	5.13	-1.16
	1042	711	ver	-1.13	-1.22	-3.50	-4.03	-6.00	-5.81	-3.19	-3.44
	1042	733	ver	.94	9.50	-1.31	4.78	-3.31	4.16	-.25	5.53
	1042	717	ver	-2.94	-1.78	-2.69	-7.31	-1.81	-5.53	-1.50	-5.66
	1042	720	ver	-2.50	8.59	-3.50	3.22	-4.13	3.91	-2.31	4.44
	1042	732	ver	.25	4.88	-.50	.53	-.88	.91	.31	1.78
	1042	2804	app	-1.88	6.88	-1.63	4.47	-1.25	4.47	-1.50	5.94
	1042	5802	app	-.69	1.63	.44	-2.78	1.94	-1.00	1.13	-.91
	1042	3016	app	.00	.00	.19	1.22	-.06	-.81	-1.00	2.50
	1042	5702	app	2.88	2.16	1.56	-1.75	.38	-2.13	2.25	-.75
	1042	2007	app	3.44	6.09	1.25	1.63	-.69	.97	2.19	2.38
	1042	5803	app	-3.06	.56	-1.81	-2.75	-.31	-1.50	-1.50	-.88
	1042	712	ver	-2.56	.50	-2.00	-1.91	-1.31	-1.66	-1.94	-.31
	1042	713	ver	-.13	-.91	-.56	-3.25	-1.00	-3.81	-.50	-2.00
	1042	708	ver	-3.75	-.31	-3.25	-3.53	-2.56	-2.88	-2.94	-1.94
	1042	729	ver	.00	.00	.75	-5.84	2.13	-3.53	2.00	-4.00
	1042	730	ver	1.56	6.19	1.44	.47	1.94	2.09	2.75	2.03
	1042	731	ver	.31	-.56	-.19	-5.72	-.25	-4.72	.88	-4.34
	1042	721	ver	-.19	3.28	-.63	-.56	-.88	-.28	.00	.75
37	905	3306	app	4.00	-5.13	2.56	-3.72	2.56	-3.59	2.88	-4.44
	905	3005	app	.88	-.75	-.69	1.16	-.63	.88	.31	-.63
	905	1070	app	1.19	-.28	-.50	1.16	-.88	1.22	.44	.63
	905	1241	app	.00	.00	-1.31	1.41	-1.06	1.53	-1.31	.53
	905	3105	ver	4.38	.38	2.88	2.13	2.88	1.97	3.63	.69
	905	6204	ver	.63	-.44	-1.00	1.03	-1.13	1.09	-.31	.31
	905	3103	ver	-2.31	-2.84	-4.00	-1.13	-4.19	-1.28	-2.81	-2.34
	905	3104	ver	-1.63	1.44	-3.25	3.19	-3.31	3.03	-2.31	1.84
	905	3102	ver	.00	.00	-1.75	1.72	-2.06	1.56	-.44	.59
	905	1067	ver	1.31	-2.19	-.13	-.38	.00	-.59	.56	-2.06
	905	3204	ver	.38	-1.16	-1.25	.41	-1.44	.38	-.38	-.44
	905	2005	ver	.69	.06	-1.00	1.50	-1.19	1.56	-.25	.91
	905	6104	ver	-1.06	1.06	-2.56	2.72	-2.63	2.63	-1.81	1.50
	905	3304	ver	2.75	1.97	1.06	3.38	.88	3.47	1.75	2.88
37	906	5908	ver	.13	2.97	-.06	4.03	.00	.00	.25	2.94
	906	1067	ver	.94	-.34	-.19	.69	.00	.00	.56	-1.50
	906	2908	ver	1.63	.44	1.44	1.94	.00	.00	1.19	.66
	906	814	ver	-1.56	-.56	-1.38	.19	.00	.00	-.88	-.31
	906	812	ver	.00	.00	-.69	1.69	.00	.00	-.88	-.25
	906	821	ver	1.44	-2.97	1.25	-1.88	.00	.00	1.50	-2.97
	906	3107	ver	-.13	.97	-1.13	1.56	.00	.00	.00	-.25
	906	2909	ver	.81	-.16	.94	1.19	.00	.00	.75	.28
	906	3111	app	.00	.00	.00	.00	.00	.00	1.38	-.41
	906	1084	app	-.38	-.75	.00	.00	.00	.00	.38	-.34
	906	3208	ver	-.13	2.31	-1.50	2.38	.00	.00	.44	.44
	906	3110	ver	-3.06	.44	-3.25	.53	.00	.00	-1.88	-.13
	906	3209	ver	-.81	2.75	-1.88	2.66	.00	.00	.06	1.09
	906	5906	ver	-2.06	1.13	-2.75	2.66	.00	.00	-2.81	.78

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
40	1043	3111	app	-.94	.41	.25	.09	.81	.25	.06	.06
	1043	1084	app	-3.06	-.72	-1.56	-.22	-1.19	-.19	-2.56	-.59
	1043	1241	app	.00	.00	-.81	-.84	-.88	-.63	.81	-1.91
	1043	2007	app	2.25	-.88	3.19	1.84	2.19	1.50	1.00	-.53
	1043	3016	app	-3.25	-2.34	-1.13	-.84	-.94	-.94	-3.38	-1.50
	1043	750	ver	1.19	1.84	.38	1.63	-.06	1.72	1.56	.09
	1043	729	ver	5.06	-1.28	5.38	.84	4.31	.56	4.00	-1.59
	1043	5804	ver	-.88	.41	.31	2.00	-.06	1.84	-1.31	.59
	1043	822	ver	-3.19	-1.56	-2.50	-1.88	-2.19	-1.72	-2.38	-2.28
	1043	2802	ver	1.56	-1.31	2.25	.91	1.25	.66	.56	-1.34
	1043	3107	ver	-.63	1.59	-.56	1.91	-.88	1.94	-.44	.56
	1043	3208	ver	.00	-.53	-.31	-.81	-.44	-.69	.56	-1.94
	1043	701	ver	2.88	1.41	4.81	3.00	4.31	2.88	2.69	2.13
	1043	772	ver	.00	.00	2.31	1.63	2.50	1.50	-.13	1.00
	1043	2706	ver	-.88	.03	1.25	2.13	1.13	1.91	-1.38	1.06
	1043	5908	ver	-1.31	2.88	-.38	3.69	-.50	3.66	-1.25	2.66
	1043	733	ver	2.75	1.19	3.69	3.94	2.56	3.59	1.44	1.50
	1043	716	ver	.31	-1.06	2.06	1.13	1.63	.88	-.38	-.31
	1043	2804	ver	1.25	2.03	2.44	3.91	2.00	3.72	.63	2.34
40	1044	733	ver	3.31	.03	2.50	1.47	.31	.84	.69	.44
	1044	711	ver	2.38	1.84	1.81	3.25	.63	2.75	.19	2.47
	1044	716	ver	2.06	-1.53	1.75	-.25	1.19	-.63	.38	-.94
	1044	704	ver	.56	-1.94	.25	-.78	-.13	-1.06	-1.00	-1.50
	1044	2804	ver	2.38	.91	1.88	1.97	1.13	1.66	.50	.97
	1044	705	ver	1.75	-3.06	1.38	-1.97	.88	-2.28	.13	-2.81
	1044	5702	ver	4.88	-.50	4.19	.78	2.81	.28	2.56	-.22
	1044	731	ver	4.06	-3.25	3.19	-2.09	1.56	-2.59	1.50	-3.31
	1044	721	ver	3.88	-.66	3.19	.50	1.94	.06	1.63	-.59
	1044	771	ver	-.56	1.41	-.56	2.38	-.31	2.25	-1.50	1.72
	1044	2807	ver	2.50	.75	2.50	1.78	2.88	1.66	1.63	1.19
	1044	1084	app	-1.50	.59	-1.63	1.03	-1.06	1.16	-2.19	-.03
	1044	3111	app	.06	-.81	-.06	-.81	.81	-.50	-.31	-2.22
	1044	2007	app	5.06	-.28	4.25	1.13	2.69	.53	2.50	.13
	1044	3016	app	-1.56	-1.78	-1.56	-.75	-1.31	-.91	-2.56	-1.34
	1044	1241	app	.00	.00	-.94	-.63	-1.13	-.28	-1.19	-3.09
	1044	767	ver	.50	.00	.31	.81	.38	.72	-.63	-.06
	1044	2706	ver	-.06	-.31	-.19	1.00	-.38	.69	-1.44	.50
	1044	5803	ver	1.31	1.22	.69	2.16	-.19	1.84	-.63	.97
	1044	702	ver	-2.50	-2.94	-2.56	-1.84	-2.31	-2.03	-3.56	-2.44
	1044	772	ver	.75	-1.22	.81	-.09	1.06	-.25	-.25	-.56
	1044	5705	ver	3.31	3.88	3.06	5.06	2.75	4.75	1.81	4.38
	1044	701	ver	4.31	2.28	4.13	3.34	4.13	3.16	3.13	2.63
	1044	703	ver	.00	.00	.00	1.28	.06	1.03	-1.19	.88
	1044	707	ver	-1.50	.16	-1.69	1.53	-2.06	1.19	-3.00	1.03
	1044	2906	ver	4.44	.03	3.56	.81	2.31	.50	2.19	-.69
	1044	2908	ver	.94	-.84	.44	-.13	-.13	-.31	-.69	-1.34
	1044	2909	ver	1.31	.19	.94	.91	.75	.78	.00	-.22
	1044	5802	ver	3.00	1.53	2.25	2.50	1.06	2.13	.81	1.19
	1044	729	ver	6.38	-2.63	5.38	-1.63	3.69	-2.06	3.75	-3.03
	1044	2802	ver	3.44	-.22	2.63	.91	1.13	.44	1.00	-.34
	1044	715	ver	3.25	.34	2.88	1.34	2.44	1.09	1.69	.41
	1044	5804	ver	-.06	2.25	-.56	3.16	-1.13	2.91	-1.75	2.09
	1044	712	ver	1.13	.72	.63	1.72	-.06	1.41	-.63	.69
	1044	708	ver	-1.31	1.72	-1.94	2.72	-2.88	2.38	-3.25	1.63
	1044	732	ver	3.56	1.25	2.75	2.44	1.38	1.97	1.13	1.31
	1044	720	ver	1.13	.00	.25	1.25	-1.50	.72	-1.50	.06
40	1045	750	ver	.00	-2.47	-.13	1.97	-.38	2.41	-.19	-.03
	1045	736	ver	3.13	-.50	3.31	3.44	3.00	3.84	3.13	1.75
	1045	737	ver	.13	-.41	.13	3.28	-.13	3.63	.06	1.72
	1045	817	ver	-.88	-1.84	-1.38	1.13	-1.25	1.25	-1.06	-.09
	1045	3208	ver	2.31	-4.63	1.81	-1.03	1.81	-.81	2.06	-2.59
	1045	3310	ver	-2.06	-.06	-4.38	3.47	-3.69	3.34	-3.13	1.72
	1045	.6304	ver	.00	.00	-3.00	3.69	-2.06	3.50	-1.38	1.78
	1045	812	ver	-.75	-.66	1.75	.75	.94	1.19	.56	.72
	1045	738	ver	3.31	-5.59	2.81	-1.47	2.75	-1.19	3.00	-3.34
	1045	780	ver	-3.44	-1.53	-4.25	-1.41	-3.53	-1.78	-3.50	-1.13
	1045	1241	app	-.13	-5.09	-1.38	-.38	-1.31	-.09	-.88	-2.66
	1045	2007	app	.00	.00	4.44	-.31	3.19	.22	2.38	.81
	1045	1084	app	-1.69	.47	-1.63	.28	-1.25	.03	-1.31	.84
	1045	3016	app	-3.25	1.94	-1.69	.06	-1.63	-.16	-2.00	1.72
	1045	3111	app	1.56	-.56	.31	.34	1.00	.03	1.25	.16
	1045	778	ver	-.63	-1.19	-1.63	-.78	-.94	-1.13	-.81	-.66
	1045	821	ver	-1.88	.97	-.81	1.63	-.94	1.69	-1.13	1.84
	1045	814	ver	-.75	-.06	-.63	.00	-.31	-.19	-.31	.44
	1045	5908	ver	-1.00	3.75	-.06	4.47	-.19	4.53	-.31	4.63
	1045	815	ver	-1.69	-3.69	-.81	-1.75	-1.06	-1.53	-1.19	-2.28
	1045	1067	ver	1.69	-4.06	3.13	-1.34	2.50	-.88	2.38	-2.22
	1045	3107	ver	.63	1.06	1.13	3.72	.88	4.00	.88	2.78
	1045	751	ver	2.63	-1.72	2.94	3.03	2.44	3.59	2.56	.91
	1045	3211	ver	1.25	-6.31	-.63	-4.13	.06	-4.38	.50	-5.09
	1045	822	ver	-2.38	-2.56	-3.31	-.78	-2.88	-.91	-2.63	-1.41
	1045	3110	ver	1.38	-1.31	.44	-.06	.94	-.28	1.19	-.38

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
40	1046	5803	app	-1.06	1.06	-.88	1.78	-.94	.44	-.31	2.66
	1046	1084	app	-2.06	-.69	-.81	1.63	.94	.78	-1.69	1.22
	1046	780	app	-4.44	-3.38	-2.50	-.78	-.94	-1.03	-4.13	-1.31
	1046	1241	app	-.50	-3.25	4.06	-2.94	.38	.69	.44	-.66
	1046	5802	app	.00	.00	.13	.28	.00	-.34	.81	1.59
	1046	3209	ver	-1.50	-.78	2.00	.25	.13	2.41	-.75	1.59
	1046	737	ver	-.63	-.41	2.69	-.19	-.06	2.16	.31	1.91
	1046	736	ver	2.75	-.63	6.06	-.63	2.94	1.84	3.69	1.69
	1046	750	ver	-2.06	-3.16	1.69	-3.28	-1.94	-.28	-1.06	-.75
	1046	816	ver	1.56	-2.25	5.81	-1.66	2.75	1.53	2.44	.31
	1046	6304	ver	.00	.00	4.94	1.75	2.94	5.13	.63	2.75
	1046	3310	ver	-4.50	-.34	.00	1.19	-2.00	4.19	-3.88	2.28
	1046	3211	ver	-.94	-8.13	2.63	-6.09	2.13	-4.38	-.44	-5.69
	1046	818	ver	.63	-4.69	4.75	-2.91	3.44	-.44	1.19	-2.13
	1046	3208	ver	.38	-4.72	3.88	-4.19	1.31	-1.78	1.25	-2.34
	1046	738	ver	1.63	-5.22	5.44	-4.94	2.25	-2.09	2.50	-2.78
	1046	817	ver	-1.75	-2.69	1.44	-1.84	-.38	.06	-1.00	-.38
40	1047	1241	app	.00	.00	1.56	-.69	.25	.13	1.75	-1.25
	1047	5802	app	3.13	2.41	1.75	.53	.19	-.41	1.19	1.09
	1047	5803	app	2.50	3.03	1.00	1.47	.13	.69	.56	2.09
	1047	780	app	-2.38	-1.31	-3.19	-1.13	-1.06	-.47	-2.81	-.66
	1047	1084	app	.00	.00	-1.13	-.19	.50	.09	-1.00	.38
	1047	5908	ver	.75	5.16	-.19	4.28	-.06	4.19	-.25	4.72
	1047	822	ver	-2.50	-2.34	-2.44	-2.50	-1.63	-1.78	-2.19	-2.41
	1047	3107	ver	.88	.53	1.00	-.53	-.06	-.44	.88	-.56
	1047	1067	ver	4.69	-1.63	4.63	-3.16	2.75	-3.44	4.31	-3.16
	1047	3110	ver	-.81	.84	-1.00	.81	.25	1.50	-.75	1.03
	1047	814	ver	-.19	-.25	-1.25	-.56	.13	-.31	-1.13	-.03
	1047	821	ver	.44	2.28	-.50	1.41	-.38	1.28	-.63	1.84
	1047	812	ver	.69	.28	-.25	-1.50	-1.88	-2.25	-.75	-1.16
	1047	2906	ver	3.19	.78	2.19	-1.09	.31	-1.97	1.63	-.72
	1047	815	ver	-.13	.22	-.44	-.84	-1.19	-.91	-.56	-.69
	1047	778	ver	.00	-1.13	-.56	-.97	1.38	-.25	-.25	-.56
40	1048	2807	ver	2.06	3.59	3.44	2.72	3.88	3.72	2.63	1.72
	1048	716	ver	.00	.00	1.31	-.34	1.75	-.59	.63	-1.03
	1048	704	ver	-.94	.78	.31	.28	.63	.25	-.44	-.47
	1048	1084	app	.00	.00	.81	-1.22	.19	-.56	-.44	-2.25
	1048	2706	app	-2.00	-1.28	-.44	-1.78	.31	-1.34	-1.06	-2.63
	1048	3016	app	-2.00	1.59	-.63	.78	-.19	1.66	-1.44	-.19
	1048	2804	app	-.69	1.78	.31	1.41	.19	.59	-.56	.78
	1048	5803	app	-.75	1.22	.00	.81	-.50	-.34	-1.00	.28
	1048	715	ver	1.38	1.91	2.44	1.38	2.38	1.03	1.50	.66
	1048	5804	ver	.00	2.22	.88	1.69	.56	1.03	-.13	1.00
	1048	705	ver	-.63	-.84	.50	-1.31	.56	-1.63	-.31	-2.03
	1048	727	ver	-2.19	-.31	-1.06	-.72	-.94	-1.16	-1.81	-1.41
	1048	701	ver	3.63	6.28	4.94	5.56	5.25	6.00	4.13	4.69
	1048	702	ver	-2.31	2.56	-.94	1.78	-.44	2.59	-1.69	.81
	1049	3016	app	.00	.00	.25	.50	-.06	-.06	-2.44	-.47
	1049	5802	app	-.75	1.44	-.69	-.88	.00	-.56	-.19	.13
	1049	5803	app	-1.06	1.66	-.81	-.13	-.19	.03	-1.00	.69
	1049	2007	app	1.88	2.63	.38	.66	-.31	.75	1.75	-.31
	1049	5702	app	1.75	.78	.69	-1.03	.31	-.97	1.56	-1.66
	1049	2804	app	.25	2.13	.13	.88	.25	.84	-.38	.84
	1049	733	ver	-1.38	4.34	-2.94	2.28	-3.63	2.38	-1.38	1.28
	1049	725	ver	6.25	2.69	5.44	1.56	5.00	1.44	5.31	.69
	1049	708	ver	-4.31	2.69	-4.38	1.00	-4.06	1.09	-4.44	1.34
	1049	732	ver	-.38	3.34	-1.13	1.25	-1.19	1.41	-.19	1.13
	1049	720	ver	-2.81	2.78	-3.88	.25	-3.94	.53	-2.25	.19
	1049	730	ver	-.31	6.34	-.94	3.53	-.56	3.94	.69	4.16
	1049	729	ver	.00	.00	-.25	-2.97	.44	-2.50	1.25	-1.81
	1049	731	ver	.81	-1.63	.00	-4.13	.13	-3.81	1.38	-3.88
	1049	721	ver	1.00	1.63	.44	-.22	.38	-.13	1.00	-.31
	1049	717	ver	-.63	-3.94	-1.06	-6.69	-.56	-6.28	.38	-5.91
	1049	712	ver	.25	.56	.31	-.72	.56	-.75	-.25	-.56
	1049	711	ver	.25	7.13	-1.19	5.97	-2.13	5.81	-.75	4.44
40	1050	6304	ver	.00	.00	5.25	1.19	3.63	4.75	1.44	2.06
	1050	3310	ver	-4.56	2.41	.31	3.44	-1.31	6.66	-3.06	4.41
	1050	818	ver	-1.19	-4.19	3.38	-2.84	2.48	-.25	.25	-2.19
	1050	3211	ver	-2.25	-7.09	1.88	-5.50	1.50	-3.72	-.81	-5.16
	1050	816	ver	1.50	-3.53	6.06	-3.28	3.38	.22	3.06	-1.56
	1050	750	ver	-.94	-3.00	3.06	-3.28	-.19	.09	.75	-1.06
	1050	738	ver	1.00	-4.78	5.13	-4.75	2.31	-1.53	2.63	-2.84
	1050	3208	ver	-1.69	-5.00	2.13	-4.69	-.13	-2.03	-.13	-3.09
	1050	737	ver	-1.69	1.03	1.94	1.09	-.56	3.72	-.13	2.94
	1050	817	ver	-2.88	-2.22	.75	-1.59	-.81	.50	-1.31	-.34
	1050	736	ver	.63	1.31	4.25	1.16	1.14	3.97	2.25	3.19

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
40	1050	780	app	-4.63	-3.06	-1.81	-.72	-.31	-1.19	-3.25	-1.28
	1050	1241	app	-1.50	-3.31	3.19	-3.34	-.06	.66	.06	-1.31
	1050	5802	app	.00	.00	.88	.53	.63	-.59	1.56	1.59
	1050	1084	app	-3.25	-.09	-1.13	2.06	.50	1.00	-1.88	1.59
	1050	5803	app	-2.00	.59	-1.13	1.50	-.81	.09	-.50	2.19
	1050	3209	ver	-2.63	-1.06	1.31	-.31	-.31	2.03	-1.06	.88
	1051	5803	app	2.44	2.31	-1.38	1.69	-.94	.38	-1.13	2.25
	1051	5802	app	4.94	1.75	.94	.44	.81	-.69	1.25	1.25
	1051	780	app	-1.69	-2.25	-1.69	-.53	-.13	-.84	-2.75	-.94
	1051	1241	app	.00	.00	3.31	-3.13	-.19	.56	.88	-1.91
	1051	1084	app	.00	.00	-1.19	1.53	.44	.63	-1.81	1.22
	1051	5908	ver	2.31	2.31	.63	2.25	1.00	1.84	.13	2.53
	1051	778	ver	.38	-2.59	.75	-1.09	2.00	-1.16	-.44	-1.47
	1051	822	ver	-1.69	-1.28	-.50	-1.34	-.81	-.22	-2.06	-1.16
	1051	815	ver	.94	-1.84	.13	-3.19	-.81	-2.56	-.75	-2.47
	1051	1067	ver	5.56	-.34	4.69	-2.94	2.69	-1.78	3.81	-1.75
	1051	3110	ver	.38	2.41	1.19	2.97	1.56	3.59	-.19	2.94
	1051	3107	ver	2.00	1.13	2.13	-.78	.44	.59	.88	.09
	1051	812	ver	3.88	-.47	.88	-2.25	.13	-2.63	.81	-1.31
	1051	2906	ver	5.38	.84	2.06	-1.06	1.25	-1.53	2.06	-.06
	1051	814	ver	2.75	-1.25	1.63	-.06	3.00	-.75	1.00	-.25
	1051	821	ver	.56	.72	-1.25	.72	-.81	.19	-1.75	1.00
40	1052	1084	app	.00	.00	.69	-1.84	.31	-.50	-.06	-2.38
	1052	2804	app	1.00	3.25	1.38	1.59	.63	.56	.50	1.56
	1052	5803	app	-.19	2.72	.13	.97	-1.38	-.38	-.88	.88
	1052	2706	app	-1.56	.06	-1.13	-1.31	.25	-1.22	-1.63	-1.31
	1052	3016	app	-1.69	2.09	-1.06	.59	.19	1.50	-1.63	.41
	1052	704	ver	1.69	1.22	2.06	-.28	2.50	-.56	1.38	-.34
	1052	716	ver	.00	.00	.38	-1.47	.81	-2.13	-.31	-1.41
	1052	715	ver	2.06	1.66	2.50	.03	2.19	-.44	1.69	-.09
	1052	5804	ver	-1.00	2.16	-.56	.44	-1.44	-.25	-1.44	.28
	1052	727	ver	-.88	-.50	-.50	-2.06	-.63	-2.75	-1.31	-2.09
	1052	2807	ver	1.31	4.88	1.94	3.38	3.25	4.47	1.44	3.16
	1052	702	ver	-2.44	1.25	-1.88	-.25	-.56	.63	-2.38	-.41
	1052	701	ver	4.44	5.31	5.00	3.78	5.69	4.22	4.38	3.63
	1052	705	ver	.56	-.28	.94	-1.84	.88	-2.38	.19	-1.91
40	1053	711	ver	-.31	7.38	-.63	3.19	-.81	3.25	-.38	3.03
	1053	733	ver	-2.94	8.91	-2.25	3.38	-2.44	3.44	-1.38	3.84
	1053	731	ver	-.56	-.44	1.69	-5.47	1.75	-5.44	2.19	-4.22
	1053	732	ver	-2.94	5.19	-1.25	.63	-1.25	.66	-1.00	1.53
	1053	708	ver	-5.06	2.47	-2.94	-.66	-2.88	-.66	-3.50	.34
	1053	2804	app	-.75	3.59	.75	.94	.81	.94	.00	1.59
	1053	5702	app	-.31	3.44	.69	-1.09	.63	-1.03	1.00	-.53
	1053	2007	app	-1.44	6.13	-.75	.81	-.94	.91	.00	1.25
	1053	3016	app	.00	.00	-.25	.09	-.38	.00	-2.31	-.47
	1053	5803	app	-3.75	3.03	-1.06	.19	-.94	.16	-1.81	1.47
	1053	5802	app	-2.44	2.81	.63	-.94	.81	-.94	.31	.66
	1053	725	ver	4.25	2.03	4.75	-1.31	4.63	-1.28	4.44	-1.16
	1053	720	ver	-4.56	4.41	-2.69	-1.06	-2.69	-1.00	-1.94	.06
	1053	717	ver	-2.94	-2.88	.06	-7.84	.25	-7.81	.44	-6.19
	1053	729	ver	.00	.00	3.50	-5.00	3.69	-4.97	3.81	-3.06
	1053	730	ver	-1.63	7.03	1.19	1.75	1.31	1.81	1.75	3.34
	1053	721	ver	-2.19	2.06	-.56	-2.00	-.56	-1.97	-.56	-1.16
	1053	712	ver	-2.00	1.44	-.31	-1.06	-.25	-1.06	-1.13	-.28
42	1054	780	app	-1.50	-3.88	-3.69	-1.13	-1.50	-.47	-2.63	-1.16
	1054	1241	app	.56	-4.00	-1.00	1.28	-2.13	2.34	-.31	1.94
	1054	5802	app	.00	.00	.06	2.34	-.88	.97	1.69	2.69
	1054	1084	app	-.38	.16	-2.06	2.53	-.25	2.72	-.88	2.53
	1054	5803	app	-1.19	.13	-1.44	2.31	-1.75	1.13	.13	2.56
	1054	6206	app	9.25	-12.44	8.13	-7.34	6.56	-6.69	8.88	-6.66
	1054	736	ver	4.88	-2.66	4.00	1.94	2.50	2.19	4.94	2.56
	1054	817	ver	.50	-5.97	-.94	-1.78	-1.25	-1.22	-.06	-1.34
	1054	750	ver	.81	-6.38	-.19	-1.44	-1.88	-1.00	.69	-.75
	1054	816	ver	.38	-8.03	-1.25	-3.06	-2.00	-2.03	-.56	-2.50
	1054	3211	ver	-1.00	-8.06	-3.31	-4.03	-2.06	-2.75	-2.56	-3.84
	1054	737	ver	3.44	-3.25	2.38	1.25	1.25	1.59	3.31	1.81
	1054	3310	ver	-1.50	-1.44	-3.88	3.44	-3.31	5.00	-3.31	3.78
	1054	818	ver	-1.50	-7.28	-3.88	-2.78	-2.94	-1.28	-3.25	-2.47
	1054	6304	ver	.00	.00	-2.63	5.06	-1.81	6.97	-2.19	5.41
	1054	3209	ver	1.31	-3.69	-.31	.66	-.44	1.47	.50	1.06
	1054	738	ver	2.06	-7.66	.81	-2.84	-.31	-2.22	1.63	-2.25
	1054	764	ver	-7.69	-8.19	-8.81	-3.50	-10.06	-3.03	-7.94	-2.91
	1054	3208	ver	2.31	-5.47	1.00	-.94	.19	-.38	1.88	-.44

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
42	1055	1084	app	.00	.00	-.88	2.72	.44	2.06	-.88	3.53
	1055	5803	app	3.31	-.03	.00	.72	.38	-.31	.00	2.09
	1055	1241	app	.00	.00	3.25	-1.69	.44	1.09	2.25	-.97
	1055	5908	ver	.88	1.53	-.44	2.78	-.13	2.44	-.56	3.81
	1055	1067	ver	4.63	-2.34	4.00	-3.47	2.44	-2.63	3.44	-2.28
	1055	3107	ver	2.50	-.69	2.75	-1.22	1.44	-.19	2.19	-.22
	1055	3110	ver	-2.06	-1.38	-1.13	.41	-.88	.91	-1.44	1.06
	1055	814	ver	-.75	-2.03	-1.56	.38	-.50	-.13	-1.56	1.22
	1055	812	ver	4.19	.28	1.63	-.06	1.00	-.38	1.38	1.31
	1055	780	app	-2.13	-4.88	-1.88	-2.00	-.63	-2.19	-1.94	-1.38
	1055	5802	app	3.00	.16	-.50	.25	-.63	-.63	-.56	1.72
	1055	821	ver	1.31	-3.53	-.13	-2.25	.25	-2.66	-.25	-1.22
	1055	2906	ver	4.13	-1.38	1.25	-1.84	.63	-2.22	1.06	-.41
	1055	815	ver	2.13	-3.31	1.63	-3.28	.88	-2.81	1.25	-2.22
	1055	778	ver	-3.00	-6.78	-2.50	-4.09	-1.50	-4.09	-2.63	-3.50
	1055	822	ver	-2.69	-4.38	-1.38	-3.16	-1.63	-2.31	-1.81	-2.50
42	1056	701	ver	6.00	.88	3.31	1.44	4.63	1.59	3.44	1.13
	1056	1084	app	.00	.00	.13	-1.78	.38	.34	-.56	-2.72
	1056	2804	app	6.50	2.66	2.25	1.53	.63	.50	2.00	1.78
	1056	5803	app	5.56	2.03	1.44	-.19	-1.44	-1.19	.81	.06
	1056	3016	app	.00	-1.69	-2.13	-.53	.13	.03	-1.88	-1.00
	1056	2706	app	2.19	-.78	-1.63	.97	.31	.34	-1.13	.94
	1056	705	ver	2.94	-1.09	-.94	-1.34	-1.31	-2.06	-1.00	-1.28
	1056	2807	ver	1.25	1.22	-.63	2.34	1.81	3.13	-.38	1.78
	1056	715	ver	6.06	.28	2.63	-.44	1.88	-.91	2.44	-.44
	1056	5804	ver	3.31	1.44	-.13	-.09	-1.75	-.53	-.56	-.06
	1056	702	ver	-.81	-1.78	-3.13	-.53	-.81	-.06	-2.88	-.97
	1056	727	ver	6.94	-.16	2.81	-.44	2.25	-1.34	2.81	-.31
	1056	716	ver	.00	.00	-4.50	.69	-4.25	-.50	-4.25	.91
	1056	704	ver	4.75	-.22	1.06	.16	1.50	-.44	1.19	.16
	1057	2007	app	1.00	8.44	-1.63	3.47	-.94	1.91	.50	4.09
	1057	5802	app	1.19	2.63	1.13	-1.50	-.44	-.34	.88	.00
	1057	5803	app	.50	2.41	.31	-.81	-.81	.34	-.38	-.06
	1057	2804	app	2.75	3.09	1.56	.34	1.56	.59	1.31	.13
	1057	3016	app	.00	.00	-2.06	.13	-.38	.06	-3.38	-2.78
	1057	5702	app	2.69	2.72	.63	-1.63	1.00	-2.56	2.00	-1.19
	1057	729	ver	.00	.00	.06	-5.38	-1.94	-4.38	.44	-2.91
	1057	712	ver	-.25	2.94	-1.19	.25	-1.44	.78	-1.69	.13
	1057	713	ver	1.81	4.91	.13	2.06	.56	1.75	.31	1.59
	1057	711	ver	-2.81	7.31	-5.94	3.63	-4.31	1.72	-4.19	2.94
	1057	733	ver	.19	10.22	-2.44	5.03	-1.81	3.38	-.19	5.78
	1057	717	ver	3.56	-4.06	3.19	-9.31	1.63	-8.72	3.81	-7.19
	1057	708	ver	2.38	1.44	1.63	-1.94	1.00	-1.38	1.44	-1.44
	1057	720	ver	-1.69	3.06	-3.13	-2.34	-3.69	-2.91	-1.56	-.75
	1057	731	ver	2.69	-.81	1.63	-5.91	.75	-6.00	2.69	-4.31
	1057	732	ver	.13	4.38	-1.38	-.13	-1.63	-.50	-.38	.81
	1057	721	ver	-.38	3.03	-1.75	-1.03	-1.94	-1.22	-1.06	-.38
	1057	730	ver	-.88	8.84	-1.50	3.41	-2.88	3.69	-.56	5.53
44	907	1501	app	-1.81	-2.31	.00	.00	.00	.00	-1.38	-1.69
	907	1084	app	-.19	.44	.00	.00	.00	.00	.50	1.38
	907	2706	ver	.00	.00	4.75	1.31	.00	.00	.06	.81
	907	2007	ver	.88	.34	4.69	5.31	.00	.00	1.00	.72
	907	2704	ver	-1.75	-2.03	2.63	1.16	.00	.00	-1.69	-1.44
	907	5803	ver	.06	-.78	1.69	2.44	.00	.00	.44	-.28
	907	3016	ver	.88	-.25	4.38	-.03	.00	.00	1.06	.69
	907	815	ver	-2.19	-2.03	-4.06	.28	.00	.00	-1.38	-1.44
	907	821	ver	.69	-1.78	.56	-.25	.00	.00	1.31	-1.06
	907	1067	ver	.00	.00	-2.44	3.63	.00	.00	.88	.41
	907	814	ver	-2.44	.38	-2.56	.22	.00	.00	-1.75	1.25
	907	812	ver	-1.75	-.34	-1.56	3.63	.00	.00	-1.19	.06
	907	5702	ver	.69	-.72	4.06	3.66	.00	.00	.88	-.28
	907	5706	ver	1.19	-1.34	5.44	-.47	.00	.00	1.38	-.50
	907	5802	ver	-.25	-.13	1.19	3.94	.00	.00	.19	.28
	907	5804	ver	.13	-.44	2.06	1.94	.00	.00	.56	.22
	907	5906	ver	-2.81	.06	-3.00	3.69	.00	.00	-2.19	.50
	907	2909	ver	-.38	.19	.63	1.66	.00	.00	.13	.91
	907	2906	ver	-.50	-.47	-.06	3.81	.00	.00	.06	-.09
	907	2804	ver	1.25	-.47	3.88	2.38	.00	.00	1.56	.13
	907	2802	ver	-.81	-.91	1.44	3.84	.00	.00	-.50	-.56
44	908	5906	ver	-3.50	.22	-3.44	5.00	.00	.00	-2.63	1.00
	908	5804	ver	-.13	.22	2.38	3.25	.00	.00	.50	.97
	908	5802	ver	-.81	-.09	1.38	5.03	.00	.00	.00	.50
	908	5706	ver	.31	-1.75	5.50	-.78	.00	.00	.69	-1.03
	908	1067	ver	.00	.00	-2.63	5.03	.00	.00	1.13	.91
	908	821	ver	.69	-2.38	.69	-.16	.00	.00	1.44	-1.44

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
44	908	1501	app	-2.38	-2.97	.00	.00	.00	.00	-1.69	-2.22
	908	1084	app	-.13	.16	.00	.00	.00	.00	.56	1.25
	908	2706	ver	.00	.00	5.81	1.41	.00	.00	.31	.66
	908	814	ver	-1.88	-.47	-2.06	-.25	.00	.00	-1.19	.63
	908	812	ver	-1.94	-1.28	-1.38	3.91	.00	.00	-1.06	-.56
	908	3016	ver	.38	.13	4.56	.34	.00	.00	.75	.97
	908	5702	ver	.44	-.47	4.88	4.78	.00	.00	1.06	.00
	908	2007	ver	.31	.47	5.38	6.41	.00	.00	.94	.88
	908	2704	ver	-2.19	-1.84	3.44	1.84	.00	.00	-1.75	-1.34
	908	5803	ver	-.56	-.97	1.75	3.13	.00	.00	.19	-.28
	908	2802	ver	-.88	-.88	2.25	5.00	.00	.00	-.13	-.34
	908	2804	ver	.94	-.69	4.31	2.84	.00	.00	1.56	-.03
	908	2906	ver	-.63	-.59	.25	4.91	.00	.00	.25	.09
	908	815	ver	-2.19	-2.63	-4.25	.75	.00	.00	-1.19	-1.63
	908	2909	ver	-.38	.13	1.00	2.16	.00	.00	.25	1.00
46	909	1084	app	-.63	1.69	.00	.00	.00	.00	.63	1.00
	909	1501	app	-2.94	.09	.00	.00	.00	.00	-1.44	-1.03
	909	2802	ver	-2.13	.78	2.06	2.50	.00	.00	-.25	-.59
	909	1067	ver	.00	.00	.00	2.53	.00	.00	2.06	-.63
	909	2007	ver	-1.44	1.53	4.13	2.84	.00	.00	.38	-.06
	909	5906	ver	-4.81	2.09	-3.00	3.81	.00	.00	-2.94	1.16
	909	5803	ver	-1.88	1.47	1.25	2.16	.00	.00	-.25	.28
	909	5802	ver	-2.13	1.72	1.19	3.16	.00	.00	-.31	.50
	909	5706	ver	.00	.00	4.44	-2.13	.00	.00	1.19	-1.34
	909	5702	ver	-.44	.75	4.50	1.75	.00	.00	1.25	-.72
	909	3016	ver	-.44	1.22	3.19	-1.22	.00	.00	.69	.00
	909	2909	ver	-1.63	1.91	.44	1.41	.00	.00	-.13	.94
	909	812	ver	-3.50	1.34	-1.25	3.22	.00	.00	-1.63	.34
	909	815	ver	-2.63	-1.22	-2.63	.03	.00	.00	-.81	-1.84
	909	2908	ver	-1.94	1.84	.31	2.22	.00	.00	-.31	.84
	909	2906	ver	-1.75	1.28	.81	3.28	.00	.00	.19	.22
	909	2804	ver	-.63	1.16	3.13	1.19	.00	.00	.94	-.13
	909	5804	ver	-1.38	2.06	1.69	1.97	.00	.00	.19	.91
	909	814	ver	-3.50	1.50	-2.94	.13	.00	.00	-2.13	.81
	909	2706	ver	-1.06	1.59	3.88	-.38	.00	.00	.13	.13
	909	821	ver	1.06	-.06	2.25	-.09	.00	.00	2.69	-.84
48	910	1084	app	-.69	.94	.00	.00	.00	.00	-.25	1.75
	910	1501	app	-2.38	-2.41	.00	.00	.00	.00	-2.31	-2.59
	910	2802	ver	-.75	-.53	1.88	4.72	.00	.00	-.69	-1.56
	910	2804	ver	2.38	.06	5.63	3.16	.00	.00	2.25	-.34
	910	2906	ver	.31	.16	.81	4.69	.00	.00	.94	-.63
	910	2908	ver	-.19	-.28	1.00	2.13	.00	.00	.19	-.47
	910	2909	ver	-.63	.63	.94	1.94	.00	.00	-.38	.75
	910	5702	ver	.56	-.31	4.50	4.56	.00	.00	.19	-1.28
	910	5705	ver	1.25	3.69	6.06	5.56	.00	.00	.56	3.56
	910	5706	ver	3.94	-1.88	9.25	-.91	.00	.00	3.13	-1.75
	910	5802	ver	-.06	.41	1.75	4.81	.00	.00	.25	-.38
	910	5803	ver	-.06	.00	2.00	3.47	.00	.00	.13	-.50
	910	5906	ver	-2.75	1.09	-2.88	4.84	.00	.00	-1.94	.59
	910	5908	ver	-.31	3.84	-.31	5.06	.00	.00	.38	4.06
	910	821	ver	.19	-.66	.44	.63	.00	.00	.88	-.47
	910	1067	ver	.00	.00	-2.69	3.56	.00	.00	1.56	-.38
	910	814	ver	-2.75	.38	-2.44	-.25	.00	.00	-2.19	1.13
	910	815	ver	-2.50	-1.41	-4.44	.66	.00	.00	-1.25	-1.38
	910	812	ver	-1.81	-.22	-1.56	3.97	.00	.00	-1.13	-.88
	910	2706	ver	.00	.00	5.88	1.47	.00	.00	-1.00	-.03
	910	5804	ver	.06	.03	2.50	2.50	.00	.00	.06	-.19
	910	2007	ver	1.06	2.16	5.50	7.78	.00	.00	.63	.94
50	915	6101	app	-2.13	-.63	-.63	-.47	-.50	-.28	-.44	.22
	915	6201	app	-.94	.13	1.06	.81	1.19	.78	.81	1.72
	915	3207	app	-.25	-.34	-.19	-.16	-.31	-.22	.25	-.41
	915	2005	app	-1.25	-.75	-.19	.09	-.19	-.16	-.38	.41
	915	6106	app	.00	.00	-.13	-.06	-.25	-.03	.44	-.41
	915	6105	app	-.25	-.03	.06	-.25	.06	-.06	.75	-.25
	915	601	ver	-2.94	-2.38	-.88	-1.97	-.59	-1.84	-1.00	-1.00
	915	6207	ver	-1.81	.94	-2.06	1.44	-2.25	1.16	-1.75	.94
	915	3201	ver	-2.81	-1.50	-.63	-1.03	-.44	-.91	-.75	.00
	915	1700	ver	-1.25	-1.28	.25	-.53	.31	-.69	.06	.06
	915	1070	ver	-.94	-.78	.50	-.06	.56	-.19	.31	.50
	915	3303	ver	-.81	-2.41	.56	-1.31	.56	-1.66	.19	-.88
	915	765	ver	-1.31	-.88	-.75	-.53	-.81	-.59	-.50	-.47
	915	764	ver	-1.19	1.66	-1.25	1.91	-1.38	1.78	-.81	1.56
	915	763	ver	-2.06	-2.22	-.38	-1.41	-.31	-1.56	-.63	-.72
	915	762	ver	-1.81	-2.91	-.25	-1.91	-.19	-2.16	-.56	-1.34
	915	760	ver	-.31	-2.78	.31	-2.22	.25	-2.41	.44	-2.16
	915	737	ver	-2.50	.69	-2.63	.72	-2.69	.72	-2.06	.41
	915	738	ver	.63	-1.88	.44	-1.47	.31	-1.72	.75	-1.88
	915	759	ver	-1.00	-2.25	.38	-1.84	.44	-1.84	.44	-1.31
	915	758	ver	-1.25	-1.41	-.38	-.97	-.38	-1.06	-.25	-.75
	915	757	ver	-1.56	-1.09	-.31	-.91	-.25	-.78	-.06	-.41
	915	756	ver	-1.44	2.03	-.19	2.16	-.06	2.31	.06	2.69
	915	766	ver	-.25	.50	1.44	.75	1.63	.91	1.56	1.53
	915	754	ver	-.38	-1.19	.63	-.78	.63	-.81	.75	-.47
	915	751	ver	.56	-.31	1.00	.09	.88	-.03	1.19	.03
	915	750	ver	.25	1.28	.38	1.69	.25	1.50	.63	1.47

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
50	915	749	ver	-3.38	-2.34	-1.81	-2.19	-1.69	-2.00	-1.63	-1.47
	915	748	ver	-3.13	.13	-1.81	.03	-1.59	.31	-1.44	.59
	915	741	ver	.13	-.13	.88	.56	.91	.31	.88	.66
	915	740	ver	-.13	.06	.56	.84	.44	.56	.50	.91
	915	604	ver	-1.63	-3.50	.19	-2.63	.25	-2.81	-.13	-1.91
	915	605	ver	-1.50	-3.25	.31	-2.09	.31	-2.41	-.19	-1.44
	915	607	ver	-3.50	-3.13	-1.63	-2.19	-1.56	-2.38	-2.00	-1.44
	915	603	ver	.63	.75	2.69	1.88	2.75	1.59	2.13	2.72
	915	602	ver	-2.44	-1.75	-.38	-.91	-.25	-1.00	-.69	.00
	915	742	ver	-.69	-1.38	.63	-.38	.63	-.69	.31	.03
	915	755	ver	-1.81	.44	-.25	.81	-.19	.88	-.19	1.47
	915	745	ver	-1.25	-1.97	-.13	-1.31	-.19	-1.47	-.19	-.97
	915	746	ver	-1.44	-.44	-.25	.13	-.25	.03	-.25	.53
	915	747	ver	-2.69	.13	-1.63	.25	-1.56	.38	-1.31	.66
	915	3202	ver	-1.56	-.66	.25	-.28	.38	-.16	.19	.56
	915	3204	ver	-1.44	-1.19	-.38	-.81	-.31	-.81	-.25	-.44
	915	3205	ver	-.94	-.84	-.19	-.53	-.25	-.59	.00	-.38
	915	3206	ver	.00	-.97	.38	-.72	.31	-.78	.69	-.75
	915	736	ver	-1.31	-.41	-1.25	-.34	-1.31	-.34	-.75	-.53
	915	735	ver	-.38	-2.81	.06	-2.72	.06	-2.69	.50	-2.69
	915	734	ver	1.50	2.84	1.88	2.81	1.88	2.91	2.38	2.81
	915	611	ver	-.25	-.25	1.69	.84	1.69	.56	1.19	1.59
	915	6102	ver	-2.75	-.78	-1.38	-.84	-1.25	-.56	-1.06	-.22
	915	3301	ver	.00	.00	2.06	1.16	2.13	.88	1.50	2.00
	915	6206	ver	.19	-.69	.25	-.06	.06	-.38	.38	-.41
	915	6103	ver	-1.94	-.28	-1.00	-.34	-.94	-.13	-.56	.00
	915	6204	ver	-.25	-2.22	.63	-1.50	.56	-1.75	.56	-1.31
	915	6203	ver	-.63	-.88	.63	-.16	.63	-.31	.50	.25
	915	6104	ver	-1.56	.06	-1.00	-.06	-.94	.13	-.44	.09
52	913	3207	app	.50	-.06	.25	-.13	.25	.06	-.13	-.34
	913	6201	app	-.75	.16	-.38	-.03	-.50	-.16	-.13	.34
	913	2005	app	.31	-.19	.44	-.19	.13	.03	.31	.03
	913	6105	app	.19	.41	.00	.16	.25	.03	-.19	-.16
	913	6106	app	.00	.00	-.31	-.16	-.25	-.03	-.69	-.50
	913	6101	app	-.25	.59	-.06	.34	.06	.03	.13	.41
	913	601	ver	-.63	-.75	-.25	-1.00	-.25	-1.31	.00	-.75
	913	3301	ver	.00	.00	.44	-.03	.06	.06	.63	.47
	913	6207	ver	-.56	-.09	-.81	-.06	-1.06	.38	-1.38	-.22
	913	6102	ver	-.81	-.25	-.69	-.56	-.44	-.91	-.56	-.59
	913	6103	ver	-.63	-.16	-.63	-.44	-.44	-.66	-.63	-.56
	913	3206	ver	.25	-.38	.13	-.47	.13	-.38	-.13	-.59
	913	6206	ver	.06	-.03	-.13	.00	-.44	.47	-.63	-.06
	913	6204	ver	.25	-1.00	.31	-1.03	.06	-.81	.13	-.91
	913	6203	ver	.06	-.53	.25	-.59	.00	-.50	.19	-.41
	913	758	ver	-.56	-.59	-.50	-.69	-.63	-.63	-.63	-.66
	913	757	ver	-1.00	.47	-.94	.25	-.81	.03	-.88	.25
	913	766	ver	1.19	2.03	1.44	1.75	1.56	1.44	1.69	1.88
	913	754	ver	.63	.19	.69	.06	.63	.06	.63	.09
	913	751	ver	1.56	-.03	1.44	-.09	1.31	.09	1.19	-.16
	913	750	ver	1.50	1.34	1.31	1.31	1.13	1.59	.88	1.19
	913	749	ver	-.56	-.38	-.31	-.66	-.19	-.94	-.19	-.56
	913	748	ver	-.88	1.47	-.81	1.16	-.56	.81	-.69	1.06
	913	605	ver	-.75	-2.22	-.38	-2.22	-.81	-2.03	-.31	-1.75
	913	603	ver	.69	-1.03	1.13	-1.06	.75	-.94	1.31	-.53
	913	602	ver	-.88	-.59	-.44	-.72	-.69	-.78	-.25	-.31
	913	604	ver	-.19	-1.59	.19	-1.69	-.06	-1.66	.25	-1.31
	913	742	ver	-.06	-.47	.19	-.47	-.19	-.22	.13	-.13
	913	755	ver	-1.69	1.50	-1.44	1.28	-1.44	1.13	-1.31	1.44
	913	745	ver	-.88	.13	-.75	.06	-.94	.16	-.81	.22
	913	746	ver	-.38	1.94	-.25	1.81	-.38	1.84	-.25	1.97
	913	747	ver	-1.00	1.28	-1.00	1.06	-.88	.88	-.94	1.03
	913	759	ver	1.75	1.91	1.88	1.75	1.88	1.66	1.94	1.88
	913	760	ver	.69	-1.72	.69	-1.78	.50	-1.56	.44	-1.75
	913	741	ver	1.63	-.44	1.69	-.47	1.44	-.22	1.44	-.38
	913	740	ver	.81	1.53	.88	1.53	.56	1.88	.63	1.66
	913	762	ver	-.38	-.31	-.06	-.34	-.38	-.16	-.06	.03
	913	763	ver	-.63	.09	-.31	.00	-.56	.03	-.25	.34
	913	6104	ver	-.63	.34	-.75	.13	-.56	-.03	-.88	-.09
	913	607	ver	-1.63	-.41	-1.25	-.47	-1.50	-.44	-1.13	-.06
	913	1700	ver	-.06	.22	.19	.13	.00	.16	.25	.41
	913	1070	ver	.06	.53	.31	.44	.13	.47	.31	.69
	913	3303	ver	.06	-.81	.31	-.81	-.13	-.53	.25	-.44
	913	765	ver	-.19	-.09	-.25	-.19	-.31	-.06	-.50	-.25
	913	764	ver	2.00	2.13	1.69	2.09	1.63	2.34	1.25	1.84
	913	736	ver	.06	-.19	-.19	-.31	-.13	-.19	-.50	-.56
	913	737	ver	.00	-.06	-.25	-.19	-.25	-.03	-.63	-.50
	913	738	ver	1.69	-1.94	1.38	-1.94	1.19	-1.56	.88	-2.13
	913	3205	ver	-.31	.09	-.38	-.06	-.38	.00	-.50	-.09
	913	3201	ver	-.38	.28	.06	.00	.06	-.31	.38	.31
	913	3202	ver	-.44	.00	-.13	-.22	-.13	-.47	.06	-.03
	913	3204	ver	-.19	-.53	-.13	-.72	-.13	-.75	-.19	-.66

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
62	917	6201	app	.25	.50	.13	.28	.00	.31	.13	.97
	917	6105	app	-.44	-.50	-.38	.03	-.31	-.13	-.63	-.44
	917	6101	app	.44	.03	.31	.09	.19	-.06	.31	.34
	917	3207	app	-.06	-.53	.19	-.03	.31	.03	-.38	-.50
	917	2005	app	-.38	-.41	-.25	-.38	-.19	-.16	-.69	-.06
	917	601	ver	-.25	-1.63	-.44	-1.81	-.56	-1.91	-.31	-1.19
	917	3202	ver	.44	-.88	.31	-.94	.19	-1.03	.38	-.47
	917	3201	ver	.50	.13	.31	-.09	.13	-.22	.44	.59
	917	1700	ver	.88	.84	.94	.75	.88	.88	.69	1.22
	917	1070	ver	.63	.25	.69	.19	.63	.31	.38	.66
	917	3303	ver	.13	-1.31	.31	-1.44	.31	-1.16	-.13	-.91
	917	765	ver	.25	-.06	.44	.22	.50	.31	.00	.09
	917	605	ver	-.50	-2.72	-.38	-2.97	-.44	-2.69	-.75	-2.22
	917	607	ver	-.88	.47	-.88	.25	-.94	.41	-1.06	.97
	917	764	ver	1.13	1.38	1.38	1.91	1.56	2.03	.75	1.41
	917	763	ver	.25	-.88	.25	-1.03	.19	-.91	.06	-.44
	917	762	ver	.25	-.75	.38	-.91	.31	-.66	.00	-.28
	917	760	ver	.63	-2.31	.88	-2.06	.94	-1.91	.38	-2.09
	917	759	ver	1.19	-.03	1.13	.00	1.06	.00	1.00	.28
	917	758	ver	-.06	-.84	.06	-.66	.06	-.59	-.31	-.59
	917	757	ver	.38	-.22	.31	-.06	.25	-.19	.25	.06
	917	756	ver	.56	2.28	.44	2.41	.38	2.28	.44	2.53
	917	754	ver	.94	-.84	1.00	-.69	1.00	-.66	.75	-.59
	917	745	ver	.19	.09	.31	.19	.31	.31	-.06	.41
	917	755	ver	-.19	1.44	-.25	1.44	-.31	1.38	-.31	1.78
	917	742	ver	.38	-.44	.50	-.53	.50	-.28	.06	-.03
	917	741	ver	1.69	-.16	1.94	.03	2.00	.22	1.44	.09
	917	740	ver	.88	.28	1.13	.44	1.19	.72	.56	.53
	917	737	ver	.00	.00	.19	.59	.38	.59	-.31	.00
	917	736	ver	-.56	-.09	-.38	.44	-.25	.44	-.81	-.06
	917	735	ver	1.00	-1.41	1.13	-1.00	1.19	-1.06	.81	-1.28
	917	611	ver	1.19	1.75	1.25	1.47	1.19	1.69	1.00	2.25
	917	603	ver	-.06	-1.16	.00	-1.50	-.13	-1.25	-.25	-.63
	917	602	ver	-.50	-1.00	-.56	-1.25	-.69	-1.16	-.69	-.47
	917	746	ver	.06	.75	.13	.81	.13	.91	-.19	1.06
	917	747	ver	-.50	.03	-.50	.25	-.56	.13	-.63	.28
	917	748	ver	-1.38	-.28	-1.50	-.06	-1.56	-.31	-1.44	-.03
	917	749	ver	-.31	-1.50	-.44	-1.47	-.56	-1.63	-.38	-1.19
	917	750	ver	.38	2.09	.69	2.53	.81	2.69	.06	2.19
	917	751	ver	.94	-.34	1.13	.00	1.19	.09	.63	-.22
	917	604	ver	.25	-1.66	.25	-1.84	.19	-1.72	.06	-1.19
	917	6204	ver	.56	-.63	.75	-.50	.75	-.31	.25	-.34
	917	6207	ver	-.63	-.22	-.25	.31	.00	.56	-1.06	-.19
	917	6206	ver	.19	-.16	.56	.25	.75	.53	-.19	-.03
	917	6203	ver	.69	.47	.81	.47	.81	.63	.44	.81
	917	3204	ver	.38	-.66	.38	-.50	.38	-.53	.19	-.41
	917	3205	ver	-.06	-.50	.00	-.25	.06	-.22	-.31	-.31
	917	3206	ver	.63	-1.16	.81	-.75	.88	-.72	.38	-1.03
	917	3301	ver	.00	.00	.06	-.34	-.06	-.13	-.19	.56
	917	6102	ver	-.13	-.66	-.25	-.50	-.38	-.72	-.19	-.41
	917	6103	ver	-.13	-.97	-.19	-.66	-.25	-.84	-.25	-.78
	917	6104	ver	-.19	-.88	-.19	-.47	-.13	-.63	-.38	-.78
63	916	6201	app	.44	1.13	.44	-.13	.31	.03	.31	.72
	916	3207	app	-.50	.69	-.06	.31	.19	.28	-.31	-.19
	916	2005	app	-.75	.53	-.44	-.44	-.19	-.19	-.88	-.16
	916	6101	app	.38	1.16	.25	.28	.00	.16	.38	.69
	916	6105	app	-.38	.31	-.19	-.03	-.25	-.28	-.13	-.44
	916	601	ver	.31	-.34	.19	-1.50	-.13	-1.47	.19	-.69
	916	763	ver	.19	.72	.31	-.44	.31	-.22	.06	.22
	916	762	ver	.31	1.00	.56	-.16	.19	.16	.13	.44
	916	760	ver	.31	-1.19	.69	-1.88	.88	-1.75	.31	-1.94
	916	759	ver	.94	.19	1.00	-.72	.94	-.72	.94	-.38
	916	758	ver	-.25	.38	.00	-.38	.06	-.31	-.19	-.28
	916	757	ver	-.19	.66	-.19	-.13	-.38	-.22	-.13	.13
	916	754	ver	.75	.88	.94	.09	.94	.13	.75	.25
	916	6203	ver	.38	1.44	.56	.50	.69	.66	.25	.84
	916	6204	ver	.50	.09	.81	-.75	1.06	-.56	.44	-.59
	916	6206	ver	-.06	1.09	.50	.56	1.00	.75	.00	.16
	916	755	ver	-.13	2.31	-.13	1.38	-.31	1.38	-.19	1.81
	916	742	ver	.44	.72	.69	-.38	.34	-.03	.25	.13
	916	740	ver	.63	1.16	1.06	.34	1.38	.59	.56	.38
	916	737	ver	.00	.00	.38	-.28	.63	-.41	.25	-.91
	916	3204	ver	-.06	.81	.06	.00	.06	.03	.00	.22
	916	745	ver	.00	1.25	.25	.34	.38	.50	-.06	.59
	916	1700	ver	.94	1.66	1.06	.56	1.13	.75	.81	1.13
	916	1070	ver	.75	.78	.94	-.28	.94	-.09	.69	.25
	916	3303	ver	.06	-.63	.38	-1.78	.63	-1.41	-.13	-1.25
	916	764	ver	.88	1.31	1.38	.94	1.69	.94	1.06	.38

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
63	916	3201	ver	.44	.81	.25	-.41	-.06	-.38	.31	.97
	916	3202	ver	.38	-.13	.25	-1.19	.00	-1.19	.31	-.53
	916	3205	ver	-.56	1.34	-.31	.69	-.25	.69	-.50	.66
	916	3206	ver	-.19	.91	.13	.38	.31	.34	-.06	.13
	916	736	ver	-.81	.84	-.44	.47	-.25	.38	-.63	.00
	916	6104	ver	-.50	.31	-.38	-.16	-.50	-.38	-.31	-.38
	916	3301	ver	.00	.00	.13	-1.41	.19	-1.03	-.31	-.44
	916	6207	ver	-.88	.94	-.25	.56	.19	.69	-.75	-.06
	916	6103	ver	-.94	.22	-.88	-.41	-1.06	-.59	-.75	-.41
	916	751	ver	.50	.47	.88	-.13	1.06	-.06	.56	-.34
	916	750	ver	-.13	2.41	.31	1.94	.63	2.00	-.06	1.53
	916	749	ver	.25	-.97	.19	-1.88	-.13	-2.00	.25	-1.44
	916	748	ver	-1.19	1.22	-1.31	.53	-1.56	.28	-1.06	.72
	916	747	ver	-1.00	1.56	-1.00	.84	-1.13	.72	-.94	.97
	916	746	ver	-.13	2.31	.06	1.41	.06	1.50	-.19	1.69
	916	604	ver	.50	-.41	.56	-1.63	.63	-1.38	.31	-.91
	916	605	ver	-.56	-1.50	-.38	-2.81	-.19	-2.41	-.88	-2.03
	916	607	ver	-.31	1.13	-.19	-.13	-.19	.16	-.50	.66
	916	603	ver	.50	.63	.63	-.75	.69	-.38	.19	.19
	916	602	ver	-.13	.09	-.13	-1.19	-.19	-.97	-.31	-.31
	916	6102	ver	-.56	.44	-.63	-.34	-.94	-.53	-.44	-.06
	916	735	ver	.19	-.84	.44	-1.34	.50	-1.44	.38	-1.59
66	914	3207	app	-.25	.75	-.31	.44	-.50	.19	-.38	.22
	914	2005	app	.63	1.72	.13	.41	.19	-.19	-.13	.63
	914	6105	app	1.19	-.53	.69	-.66	.56	-.25	.81	-.78
	914	6106	app	.00	.00	-.06	-.03	-.25	-.03	.00	-.31
	914	6201	app	1.63	1.88	.31	.25	.63	.25	.19	.75
	914	6101	app	.44	.53	-.75	-.44	-.56	.06	-.69	-.13
	914	601	ver	.25	-1.09	-1.19	-2.53	-.88	-2.16	-1.19	-2.03
	914	3301	ver	.00	.00	-1.19	-2.00	-.88	-2.53	-1.44	-1.44
	914	6103	ver	-.13	-.66	-1.00	-1.19	-1.00	-.66	-.94	-1.09
	914	6104	ver	-.56	-.25	-1.19	-.59	-1.25	-.16	-1.13	-.63
	914	6203	ver	.88	.22	.13	-1.03	.19	-1.41	-.06	-.81
	914	6204	ver	.94	-.47	.44	-1.56	.44	-2.09	.25	-1.47
	914	759	ver	1.06	1.41	.06	.31	.25	.41	.06	.59
	914	760	ver	1.38	-1.63	1.00	-2.50	.94	-2.94	.88	-2.50
	914	762	ver	.69	.38	-.13	-1.28	.06	-1.88	-.38	-.91
	914	763	ver	.75	-.53	-.31	-2.06	-.06	-2.38	-.44	-1.69
	914	764	ver	1.00	1.94	1.00	1.66	.81	1.28	.94	1.41
	914	741	ver	1.81	1.56	1.44	.56	1.44	.03	1.25	.63
	914	740	ver	2.13	1.84	1.81	.78	1.81	.06	1.63	.81
	914	605	ver	.69	-.31	-.19	-2.19	.00	-2.91	-.50	-1.75
	914	607	ver	.88	2.88	-.19	1.13	.06	.75	-.44	1.59
	914	603	ver	1.38	.13	.25	-1.84	.50	-2.44	-.06	-1.31
	914	602	ver	3.19	3.13	1.88	1.38	2.19	1.19	1.75	1.91
	914	765	ver	.00	.25	-.38	-.44	-.44	-.66	-.50	-.47
	914	3303	ver	1.25	1.84	.56	.22	.75	-.56	.31	.53
	914	1070	ver	1.19	1.75	.31	.38	.44	.06	.13	.69
	914	1700	ver	1.75	2.81	.75	1.38	.94	1.09	.63	1.72
	914	3201	ver	1.44	1.28	-.13	-.22	.25	.16	-.13	.31
	914	3202	ver	.81	.25	-.56	-1.03	-.31	-.72	-.56	-.63
	914	3204	ver	.56	.66	-.25	-.25	-.19	-.25	-.25	-.09
	914	3205	ver	.63	-.19	.13	-.91	.06	-1.00	.06	-.88
	914	3206	ver	.81	-.34	.50	-.84	.44	-1.03	.44	-.94
	914	6206	ver	-.06	1.03	.06	.38	-.13	-.44	-.13	.19
	914	6102	ver	-.38	-.84	-1.56	-1.56	-1.44	-.91	-1.44	-1.34
	914	6207	ver	.06	.00	.38	-.41	.13	-1.16	.19	-.72
	914	735	ver	.75	-1.13	.31	-1.56	.25	-1.50	.31	-1.63
	914	734	ver	1.19	3.25	.75	2.94	.63	3.13	.81	2.81
	914	736	ver	.50	-.59	.31	-.84	.13	-.91	.31	-1.03
	914	737	ver	-.94	.78	-.94	.66	-1.19	.53	-.94	.38
	914	758	ver	.31	-.34	-.31	-1.22	-.31	-1.41	-.38	-1.13
	914	757	ver	.69	.81	-.31	-.03	-.19	.28	-.31	.16
	914	756	ver	1.19	3.97	.19	3.13	.31	3.50	.25	3.34
	914	766	ver	3.38	2.69	2.06	1.53	2.25	2.03	2.06	1.91
	914	754	ver	1.56	-1.53	.81	-2.47	.88	-2.53	.81	-2.34
	914	751	ver	.06	-.13	-.19	-.78	-.31	-1.13	-.31	-.84
	914	750	ver	-1.31	4.22	-1.38	3.69	-1.50	3.19	-1.50	3.50
	914	749	ver	.63	-.56	-.63	-1.56	-.38	-1.06	-.56	-1.25
	914	748	ver	.13	.25	-1.00	-.41	-.88	.28	-.88	-.22
	914	747	ver	.13	.72	-.75	-.03	-.69	.28	-.69	.13
	914	746	ver	.88	.50	.13	-.63	.25	-.84	.00	-.44
	914	745	ver	.75	1.06	.13	-.09	.19	-.41	.00	.09
	914	755	ver	1.69	2.91	.56	1.78	.75	1.97	.56	2.09
	914	742	ver	1.63	1.38	.94	-.16	1.06	-.81	.69	.16
	914	608	ver	.75	3.25	-.50	1.38	-.19	1.00	-.69	1.94
	914	611	ver	2.88	3.69	1.81	1.81	2.13	1.25	1.56	2.31

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
72	901	6020	app	.00	.00	-.94	-1.69	.00	.00	.31	-1.00
	901	1241	app	-1.50	.38	.06	.47	.00	.00	-1.13	-1.28
	901	1070	app	1.38	2.06	.88	1.25	.00	.00	1.81	.88
	901	3105	ver	2.94	1.72	2.69	2.88	-3.63	-6.75	3.69	.22
	901	3304	ver	.13	1.25	.31	.38	.69	.97	.50	-.03
	901	2005	ver	.00	1.50	.00	.81	-.44	.19	.38	.22
	901	3102	ver	-.69	2.06	-1.94	2.44	-7.81	-6.16	.06	.88
	901	1067	ver	.00	.00	-.13	1.75	-8.19	-10.44	.88	-1.56
	901	3103	ver	-3.19	-.75	-4.13	-.16	-10.13	-9.00	-2.44	-2.00
	901	3104	ver	-2.94	3.44	-3.56	4.31	-9.69	-4.88	-2.19	2.06
	901	3204	ver	.06	1.97	-.25	1.81	-2.81	-2.03	.63	.66
	901	6204	ver	-.94	1.00	-.81	.56	-1.81	-.97	-.50	-.34
	901	6104	ver	-2.75	2.78	-2.88	3.47	-7.56	-3.66	-2.06	1.34
73	903	6020	app	.00	.00	.00	.00	.00	.00	-.13	-.41
	903	1070	app	1.13	2.00	.00	.00	.00	.00	1.25	1.03
	903	3204	ver	.63	2.06	-.94	-1.41	.00	.00	1.00	.75
	903	3105	ver	2.38	1.91	.44	-4.66	.00	.00	3.38	.03
	903	3304	ver	.88	1.09	-1.75	-.72	.00	.00	.69	-.16
	903	3104	ver	-3.44	3.34	-4.50	-2.53	.00	.00	-2.50	1.78
	903	3102	ver	-.50	2.09	.00	-2.75	.00	.00	.44	1.03
	903	3103	ver	-3.63	-.72	-3.75	-5.97	.00	.00	-2.69	-2.00
	903	1067	ver	.00	.00	-2.19	-7.91	.00	.00	1.19	-2.16
	903	2005	ver	.00	1.09	-2.31	-1.16	.00	.00	-.06	-.19
	903	6204	ver	-.69	.84	-3.31	-2.00	.00	.00	-.63	-.56
	903	6104	ver	-2.63	2.59	-4.81	-2.81	.00	.00	-1.94	.84
74	902	1501	app	.44	-2.44	-.44	-.75	.00	.00	-1.81	-3.28
	902	1084	app	-.38	.56	-1.00	.13	.00	.00	-3.13	-.28
	902	2808	app	.00	.00	1.44	.66	.00	.00	-2.56	-1.34
	902	2807	ver	3.50	2.22	4.50	3.31	3.38	3.03	1.06	.97
	902	5807	ver	2.31	.97	3.13	1.19	2.44	.66	-.38	-.22
	902	5908	ver	2.25	3.88	.69	4.25	2.38	4.88	-.25	3.25
	902	2909	ver	2.50	1.28	1.56	2.19	2.38	2.72	.06	.47
	902	5906	ver	.00	.00	-2.44	1.53	-.38	2.97	-2.19	-.47
	902	821	ver	4.06	.00	2.56	.47	4.13	1.09	1.56	-.66
	902	814	ver	.13	.91	-.69	.50	.50	.53	-2.63	.13
	902	3016	ver	4.88	3.28	5.81	4.53	4.63	4.34	2.50	2.00
	902	812	ver	1.19	-.31	-1.19	1.56	.69	3.13	-.94	-.81
	902	813	ver	4.81	3.84	5.31	3.75	5.13	3.25	2.13	2.75
	902	5702	ver	3.38	-.97	2.50	2.38	2.21	3.78	1.56	-1.91
	902	5705	ver	4.56	4.38	5.06	6.56	4.00	6.91	2.44	3.16
	902	5706	ver	3.06	1.03	4.13	2.94	2.56	2.94	.81	-.31
	902	5802	ver	2.75	-.47	.94	1.97	2.00	3.44	.69	-1.13
	902	5803	ver	2.94	-.13	1.56	1.94	2.31	3.06	.81	-.91
	902	2804	ver	2.56	.03	1.88	2.31	1.88	3.19	.44	-.91
	902	2706	ver	1.88	.81	3.00	3.13	1.25	3.25	-.25	-.56
75	904	1084	app	.00	.00	.00	.00	.00	.00	-2.75	.25
	904	1501	app	-1.38	-2.25	.00	.00	.00	.00	-1.63	-2.97
	904	2908	ver	.56	-.53	1.13	1.81	.00	.00	.25	-.44
	904	821	ver	3.13	-1.19	2.94	.41	.00	.00	1.94	-.47
	904	814	ver	.25	-.03	.00	.22	.00	.00	-2.31	.50
	904	812	ver	-1.25	-2.28	-1.25	1.38	.00	.00	-.44	-1.41
	904	5908	ver	1.13	2.91	.75	4.47	.00	.00	-.13	3.78
	904	5906	ver	-2.31	-.84	-2.63	2.50	.00	.00	-1.81	.25
	904	5803	ver	.13	-.34	1.31	2.69	.00	.00	.56	-.78
	904	5802	ver	-.75	-1.19	.31	2.53	.00	.00	.31	-1.38
	904	5706	ver	1.19	2.53	4.56	3.59	.00	.00	.06	-.41
	904	2706	ver	.13	2.13	3.94	3.53	.00	.00	-.63	-1.16
	904	2909	ver	.88	1.00	1.56	2.56	.00	.00	-.25	.78
	904	5702	ver	.00	.00	2.63	3.94	.00	.00	1.56	-1.72
	904	5705	ver	2.38	5.47	5.44	7.19	.00	.00	1.81	2.94
	904	3016	ver	4.13	4.41	6.94	4.91	.00	.00	2.31	1.97
	904	2807	ver	3.13	3.47	5.75	3.75	.00	.00	1.06	1.13
	904	2804	ver	-.06	.44	1.94	3.13	.00	.00	.13	-.88
90	911	1084	app	-.63	.06	-.75	-.06	.00	.00	-.81	-.03
	911	3005	app	-.31	3.03	-.38	.22	.00	.00	1.06	1.69
	911	3111	app	.00	.00	1.13	-.16	.00	.00	.44	.59
	911	2802	ver	.00	.00	-1.88	-2.16	1.31	-2.47	.13	-2.06
	911	2807	ver	2.63	1.44	1.00	1.66	4.13	1.63	1.50	.63
	911	2906	ver	-.06	1.59	-1.06	-.66	.75	-.88	.50	.00
	911	5911	ver	.00	-1.09	-.38	-.81	.88	-.72	-.56	-1.16
	911	812	ver	-1.56	1.09	-2.38	-1.06	-.75	-1.28	-.94	-.38
	911	814	ver	-1.38	-.53	-1.38	-.84	-.75	-.78	-1.38	-.66
	911	821	ver	-2.44	1.38	-2.75	.31	-1.81	.28	-2.19	.72

DD	SERIE	NUMP	V_A	DX1	DY1	DX2	DY2	DX3	DY3	DX4	DY4
90	911	5807	ver	1.06	-.78	.00	-.31	2.31	-.25	.13	-1.16
	911	5802	ver	-.31	1.47	-1.75	-.50	.75	-.75	-.06	-.25
	911	5803	ver	-.25	.81	-1.63	-.75	.88	-.94	-.19	-.69
	911	5804	ver	.50	1.00	-.88	-.09	1.69	-.25	.31	-.28
	911	3110	ver	-.31	-.66	.75	-1.16	-.38	-1.06	.25	-.25
	911	2804	ver	-.50	.72	-2.25	-.50	.88	-.69	-.81	-.84
	911	2706	ver	.00	.94	.38	-1.47	.06	-1.59	1.38	.06
	911	822	ver	1.06	-2.50	2.44	-3.31	.88	-3.22	2.00	-2.09
	911	815	ver	-1.81	1.69	-1.44	.00	-1.63	-.09	-.88	1.13
	911	2908	ver	-.31	1.50	-1.19	.19	.63	.06	-.19	.41
	911	2909	ver	.31	1.53	-.50	.69	1.25	.63	.19	.69
	911	5906	ver	-2.81	1.94	-3.44	-.13	-2.19	-.31	-2.13	.66
	911	3016	ver	3.06	2.66	1.31	2.78	4.56	2.75	1.94	1.75
	911	3107	ver	-1.06	1.94	-.13	.00	-1.19	-.06	.31	1.56
90	912	5802	ver	-.25	1.22	-1.56	-.50	.81	-.72	.06	-.34
	912	2906	ver	-.25	1.06	-1.19	-.88	.50	-1.09	.38	-.41
	912	2908	ver	-.38	1.13	-1.19	.00	.50	-.13	-.13	.13
	912	2807	ver	2.38	.88	.94	1.19	3.94	1.19	1.50	.25
	912	2804	ver	-.56	.84	-2.19	-.16	.75	-.31	-.81	-.53
	912	3005	app	-.19	2.72	-.31	.22	.00	.00	1.13	1.44
	912	1084	app	-.69	.00	-.75	-.06	.00	.00	-.69	-.06
	912	3111	app	.00	.00	1.06	-.16	.00	.00	.63	.53
	912	2802	ver	.00	.00	-1.75	-1.84	1.25	-2.13	.19	-1.88
	912	5803	ver	-.13	.69	-1.38	-.66	1.00	-.81	.00	-.66
	912	5804	ver	.50	.78	-.75	-.16	1.69	-.28	.38	-.34
	912	5807	ver	.75	-1.00	-.13	-.47	2.00	-.41	.00	-1.22
	912	5906	ver	-2.81	1.94	-3.44	.16	-2.19	-.03	-2.13	.75
	912	5911	ver	-.31	-.84	-.56	-.50	.56	-.41	-.63	-.81
	912	822	ver	.69	-2.28	1.94	-3.03	.44	-2.94	1.69	-1.94
	912	1067	ver	.13	.75	.44	-1.41	.13	-1.56	1.50	-.09
	912	3110	ver	-.13	-.69	.88	-1.13	-.19	-1.03	.63	-.31
	912	815	ver	-1.81	1.81	-1.50	.28	-1.69	.19	-.81	1.25
	912	821	ver	-2.50	1.31	-2.81	.44	-1.94	.38	-2.19	.75
	912	812	ver	-1.63	1.47	-2.44	-.41	-.94	-.59	-1.00	.13
	912	814	ver	-1.81	-.25	-1.81	-.47	-1.19	-.41	-1.69	-.34
	912	2909	ver	-.19	1.25	-.94	.56	.69	.50	-.19	.50
	912	3016	ver	2.94	2.59	1.38	2.81	4.50	2.81	2.00	1.84
	912	3107	ver	-1.13	1.70	-.38	.00	-1.31	-.03	.25	1.38

10.6.2 LIST OF ALTIMETRIC RESIDUALS

A list of altimetric residuals is given hereafter. They derive from the whole sets of measurements and two assessing methods.

The abbreviations denote the following expressions :

STEREO : number of the stereo-orthophoto which is paired to the orthophoto, as stereomate.

ORTHO : number of the orthophoto.

NUMS : number of the round of measurements

NUMP : number of the point which is pointed to.

DZ1, DZ2 : heighting residuals resulting from two transformations of the co-ordinates, the first one based on two points, (see 5.1.1.a), the second one, on the whole fixed points (see 5.1.1.b) in meters.

LIST OF ALTIMETRIC RESIDUALS

(in meter)

stereo	ortho	NUMS	NUMP	DZ1	DZ2
11	13	12	3111	0	-2.352
	13	12	1241	-3.635	-6.029
	13	12	2007	8.756	6.222
	13	12	5706	2.666	-.194
	13	12	2802	5.438	2.995
	13	12	2807	-.01	-2.874
	13	12	5705	4.306	1.716
	13	12	702	0	-2.873
	13	12	2704	3.283	.482
	13	12	812	2.453	.07
	13	12	701	3.428	.78
	13	12	5702	5.385	2.824
	13	12	2804	4.918	2.4
	13	12	2706	3.692	.966
	13	12	1501	3.98	1.498
	13	12	1067	1.571	-.829
	13	12	818	-2.427	-4.8
	13	13	3111	1.972	.365
	13	13	3016	0	-1.108
	13	13	813	-.967	-2.121
	13	13	814	.66	-.869
	13	13	816	-3.226	-4.703
	13	13	817	0	-1.663
	13	13	821	1.778	.306
	13	13	2802	6.542	5.022
	13	13	3107	1.463	-.152
	13	13	822	.116	-1.513
	13	13	815	1.525	-.055
	13	13	5706	1.743	.629
	13	13	1067	2.46	.897
	13	13	2007	9.414	7.984
	13	13	1501	4.467	2.984
	13	13	1241	-2.291	-3.859
	13	13	818	-.558	-2.145
	13	14	3111	0	-3.225
	13	14	712	5.243	2.459
	13	14	715	3.554	.878
	13	14	716	5.175	2.732
	13	14	713	7.231	4.413
	13	14	5706	.036	-1.94
	13	14	3016	-1.709	-3.67
	13	14	703	0	-1.906
	13	14	704	5.17	2.538
	13	14	705	6.11	3.304
	13	14	708	4.995	2.163
	13	14	1501	2.88	-.028
	13	14	1067	1.325	-1.783
	13	14	2007	8.662	5.891
	13	14	1241	-3.85	-6.973
	13	14	818	-1.685	-4.853
	13	15	3111	.955	-1.83
	13	15	721	7.581	3.845
	13	15	722	5.313	.831
	13	15	723	7.042	3.342
	13	15	725	7.619	3.806
	13	15	732	7.581	3.855
	13	15	736	0	-2.574
	13	15	737	-.161	-2.776
	13	15	733	9.082	5.366
	13	15	2007	9.062	5.351

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	13	15	1501	3.918	.481
	13	15	5706	2.151	-3.21
	13	15	3016	0	-5.386
	13	15	1241	-2.731	-5.726
	13	15	1067	1.609	-1.407
	13	15	818	-1.068	-3.966
	13	16	3111	2.47	.059
	13	16	738	-1.742	-4.263
	13	16	764	-.865	-3.294
	13	16	3110	1.41	-1.086
	13	16	5802	6.625	4.053
	13	16	5803	6.608	3.973
	13	16	5906	5.721	3.147
	13	16	2704	3.506	.221
	13	16	2706	3.867	.732
	13	16	3209	0	-2.392
	13	16	1241	-1.798	-4.288
	13	16	1501	4.947	2.286
	13	16	5706	2.596	-.803
	13	16	3016	0	-3.406
	13	16	2007	10.313	7.546
	13	16	1067	2.1	-.396
	13	16	818	.363	-2.091
	13	17	3111	1.716	-.544
	13	17	1501	3.019	.927
	13	17	5706	.558	-1.028
	13	17	3211	0	-2.279
	13	17	5705	4.602	2.66
	13	17	5807	2.954	1.063
	13	17	5908	2.143	.058
	13	17	5702	6.657	4.678
	13	17	3016	-1.181	-2.759
	13	17	2807	0	-1.574
	13	17	2906	5.358	3.128
	13	17	3208	-.597	-2.855
	13	17	2908	3.662	1.547
	13	17	1241	-2.945	-5.153
	13	17	2007	8.004	5.983
	13	17	1067	1.382	-.82
	13	17	818	-.799	-3.031
	13	18	3111	0	-1.313
	13	18	1241	-3.248	-4.487
	13	18	772	-.022	-.497
	13	18	774	3.899	2.837
	13	18	3016	0	-.427
	13	18	5909	.778	-.307
	13	18	5807	1.246	.406
	13	18	767	.696	-.15
	13	18	768	-3.041	-3.508
	13	18	769	2.912	1.951
	13	18	5804	2.278	1.199
	13	18	5706	.859	.419
	13	18	1501	2.557	1.464
	13	18	2007	8.571	7.573
	13	18	1067	.663	-.572
	13	18	818	-3.309	-4.589
	13	19	3111	0	-1.234
	13	19	5706	2.137	.122
	13	19	777	7.495	5.989
	13	19	778	1.481	.031
	13	19	780	2.768	1.392

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	13	19	783	1.289	-.135
	13	19	785	-4.089	-5.813
	13	19	786	-.224	-1.808
	13	19	775	4.633	2.71
	13	19	3016	0	-2.022
	13	19	1501	2.014	.587
	13	19	2007	9.466	7.948
	13	19	1241	-2.708	-4.009
	13	19	1067	.778	-.527
	13	19	818	-1.962	-3.231
14	10	20	1241	.403	-2.55
	10	20	720	3.729	.51
	10	20	721	4.261	1.102
	10	20	723	4.285	1.135
	10	20	725	5.19	2.004
	10	20	729	5.171	2.191
	10	20	730	2.637	-.419
	10	20	731	4.928	1.88
	10	20	732	5.121	1.962
	10	20	2007	4.629	1.482
	10	20	5703	1.454	-1.942
	10	20	5803	4.599	1.545
	10	20	2803	2.924	-.206
	10	20	5702	4.727	1.525
	10	20	708	2.232	-.88
	10	20	714	0	-3.424
	10	20	717	4.662	1.715
	10	20	2802	5.476	2.46
	10	20	815	1.586	-1.338
	10	20	817	0	-2.789
	10	20	1067	2.207	-.743
	10	20	2906	4.547	1.636
	10	20	6105	-1.236	-4.201
	10	20	6206	.295	-2.656
	10	21	1241	.119	-1.003
	10	21	1067	1.524	.418
	10	21	3107	.024	-.766
	10	21	5802	3.612	2.313
	10	21	5906	2.282	.983
	10	21	2803	.714	-1.033
	10	21	5702	3.204	1.185
	10	21	3208	-.35	-1.212
	10	21	2906	3.932	2.97
	10	21	2007	3.606	1.781
	10	21	737	.067	-.585
	10	21	738	-1.78	-2.968
	10	21	750	-1.522	-2.534
	10	21	764	.081	-.847
	10	21	812	2.848	1.836
	10	21	2802	3.868	2.53
	10	21	736	1.237	.618
	10	21	734	.003	-1.373
	10	21	5703	0	-2.732
	10	21	733	4.816	2.969
	10	21	817	0	-.525
	10	21	815	1.353	.336
	10	21	5803	3.33	1.848
	10	21	6105	-1.54	-2.706
	10	21	6206	-.391	-1.502

stereo	ortho	NUMS	NUMP	DZ1	DZ2
18	15	22	2906	0	.072
	15	22	5906	0	-.216
	15	22	6007	-.131	-.145
	15	22	815	.153	.151
	15	22	812	-.523	-.497
	15	22	1067	.712	.635
76	72	901	3105	-.598	-1.165
	72	901	2005	.238	-.205
	72	901	3102	-1.659	-2.108
	72	901	3103	-1.624	-2.08
	72	901	3104	-1.353	-1.879
	72	901	3204	.779	.312
	72	901	6204	2.381	1.906
	72	901	6104	.662	.095
	72	901	6020	-.314	-.695
	72	901	3304	2.365	1.953
	72	901	1070	-.225	-.645
	72	901	1241	1.477	.816
	72	901	1067	-.314	-.982
78	74	902	2807	.302	.502
	74	902	821	-3.261	-2.376
	74	902	1084	-2.575	-1.618
	74	902	1501	1.247	2.142
	74	902	5706	1.273	1.488
	74	902	5802	.351	1.336
	74	902	5803	.433	1.361
	74	902	5906	-.371	.611
	74	902	5908	-1.153	-.26
	74	902	5705	.827	1.534
	74	902	5702	.957	1.721
	74	902	3016	.944	1.142
	74	902	2706	-.076	.392
	74	902	2909	-.293	.471
	74	902	2808	-1.122	-.344
	74	902	5807	-1.525	-.881
	74	902	2804	-.157	.686
	74	902	813	-1.815	-1.522
	74	902	814	-1.418	-.444
	74	902	812	.303	1.371
77	73	903	3204	-1.872	-.51
	73	903	1070	-1.695	-.056
	73	903	6204	.108	1.428
	73	903	2005	-1.381	.129
	73	903	6104	-.323	.492
	73	903	6020	-.283	1.591
	73	903	3304	-.819	.847
	73	903	3105	-.678	.145
	73	903	3104	-2.576	-1.532
	73	903	3103	-4.71	-3.287
	73	903	3102	-4.51	-3.049
	73	903	1067	-.283	-.022
79	75	904	2908	.171	.177
	75	904	1084	.142	.16
	75	904	1501	2.295	2.265
	75	904	5906	.152	.201
	75	904	5908	-.628	-.659

	75	904	5803	.852	.854
	75	904	5802	.19	.244
	75	904	5706	.497	-.128
	75	904	2706	.252	-.155
	75	904	2804	.532	.457
	75	904	5705	.646	.455
	75	904	5702	.973	.829
	75	904	3016	2.733	2.083
	75	904	2909	-.277	-.421
	75	904	2807	.304	-.337
	75	904	814	1.158	1.193
	75	904	821	-.934	-.977
	75	904	812	.305	.432
38	37	905	3105	-2.381	-.072
	37	905	3005	.713	1.273
	37	905	3102	-2.512	3.202
	37	905	3103	-17.17	-12.324
	37	905	3104	-2.948	.55
	37	905	3204	-9.867	-5.121
	37	905	3304	0	6.685
	37	905	6204	-8.996	-4.512
	37	905	6104	-2.571	-.331
	37	905	3306	6.25	9.285
	37	905	1241	-1.846	-2.302
	37	905	2005	-4.845	.859
	37	905	1070	-3.145	3.3
	37	905	1067	0	-.492
39	37	906	3208	6.931	1.299
	37	906	3110	16.778	12.552
	37	906	3111	2.57	-3.44
	37	906	3209	8.774	2.999
	37	906	5906	.305	-4.119
	37	906	5908	5.413	2.457
	37	906	1084	3.739	-.058
	37	906	2908	-2.486	-6.441
	37	906	2909	0	-1.625
	37	906	3107	0	-6.3
	37	906	821	6.559	3.874
	37	906	1067	9.886	5.258
	37	906	814	.314	-3.957
	37	906	812	2.934	-2.5
47	44	908	2706	-1.47	-1.335
	44	908	815	-.561	-.041
	44	908	5804	-3.273	-2.862
	44	908	5906	.04	.505
	44	908	5802	-3.08	-2.603
	44	908	5706	3.288	3.253
	44	908	5702	1.91	2.23
	44	908	3016	0	-.039
	44	908	2909	-2.374	-2.046
	44	908	2906	0	.536
	44	908	821	4.219	4.601
	44	908	2804	-.553	-.178
	44	908	2802	-.198	.264
	44	908	5803	-1.659	-1.222
	44	908	2704	-2.347	-2.298

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	44	908	2007	-.705	-.339
	44	908	1501	-.969	-.554
	44	908	1084	-1.553	-1.106
	44	908	1067	2.131	2.627
	44	908	814	-.908	-.448
	44	908	812	.53	1.052
45	46	909	2802	1.147	1.314
	46	909	5804	-2.407	-2.39
	46	909	5906	-.108	.08
	46	909	5803	-.905	-.812
	46	909	5802	-1.484	-1.273
	46	909	5706	2.797	1.473
	46	909	5702	3.16	2.899
	46	909	3016	0	-1.337
	46	909	2909	-2.699	-2.923
	46	909	2908	-2.109	-2
	46	909	2906	0	.403
	46	909	2804	-.112	-.199
	46	909	2706	1.139	.305
	46	909	2007	.607	.485
	46	909	1501	.812	.833
	46	909	1084	-.462	-.34
	46	909	1067	1.589	1.873
	46	909	821	2.78	2.728
	46	909	815	-.618	-.264
	46	909	814	-2.277	-2.094
	46	909	812	.881	1.238
49	48	910	2802	1.77	.835
	48	910	815	.795	.231
	48	910	821	8.052	6.584
	48	910	5908	1.491	.201
	48	910	5906	-1.222	-2.086
	48	910	5803	-1.239	-2.31
	48	910	5802	-2.968	-3.78
	48	910	5706	0	-3.965
	48	910	5705	1.976	-.046
	48	910	5702	6.647	4.775
	48	910	2909	2.639	.814
	48	910	2908	-2.024	-3.07
	48	910	2906	0	-.438
	48	910	2804	.64	-.825
	48	910	5804	-2.507	-3.742
	48	910	2706	6.918	3.824
	48	910	2007	.65	-.874
	48	910	1501	1.319	.083
	48	910	1084	1.014	-.029
	48	910	1067	2.864	2.158
	48	910	814	2.802	1.822
	48	910	812	.361	-.163
91	90	911	2802	5.029	2.735
	90	911	814	1.712	-.585
	90	911	2909	.001	-2.208
	90	911	3005	1.016	-1.273
	90	911	3016	1.618	-.348
	90	911	3107	-.571	-2.94
	90	911	3111	1.531	-.83
	90	911	5802	2.935	.632

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	90	911	5803	3.218	.941
	90	911	5804	1.944	-.316
	90	911	5807	2.134	-.017
	90	911	5906	2.14	-.161
	90	911	5911	5.991	3.85
	90	911	2908	.941	-1.342
	90	911	2906	3.819	1.474
	90	911	2807	0	-1.969
	90	911	2804	2.321	.081
	90	911	3110	3.765	1.444
	90	911	1084	3.119	.834
	90	911	1067	2.877	.553
	90	911	822	0	-2.377
	90	911	821	4.698	2.449
	90	911	815	.881	-1.458
	90	911	812	3.168	.83
92	90	912	2802	5.113	3.065
	90	912	1084	1.999	-.024
	90	912	3110	3.37	1.222
	90	912	2804	1.774	-.089
	90	912	2807	-.14	-1.018
	90	912	2906	4.274	2.045
	90	912	2908	1.276	-.731
	90	912	2909	.455	-1.292
	90	912	3005	.24	-1.795
	90	912	3016	-1.764	-2.653
	90	912	3107	-1.057	-3.374
	90	912	3111	.698	-1.59
	90	912	5911	5.812	4.306
	90	912	5906	2.101	.026
	90	912	5807	1.875	.332
	90	912	5804	1.439	-.492
	90	912	5803	3.453	1.465
	90	912	5802	2.996	.918
	90	912	1067	2.413	.255
	90	912	815	.151	-2.061
	90	912	821	2.757	.854
	90	912	822	-.14	-2.48
	90	912	814	1.057	-1.007
	90	912	812	2.138	-.074
53	52	913	601	.411	1.182
	52	913	737	-.229	.11
	52	913	738	-.553	-.123
	52	913	740	-1.633	-.936
	52	913	741	7.12	7.774
	52	913	6206	.051	.467
	52	913	742	-1.348	-.609
	52	913	755	-1.371	-.602
	52	913	745	-1.39	-.663
	52	913	746	-.851	-.086
	52	913	747	-1.322	-.612
	52	913	3204	.283	.969
	52	913	3205	-.263	.369
	52	913	3206	-.954	-.467
	52	913	3207	-.056	.292
	52	913	3301	-.007	.797
	52	913	6101	-.784	-.024
	52	913	6102	-.24	.477
	52	913	6103	-.236	.419
	52	913	6104	-1.382	-.837

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	52	913	6105	-1.419	-.995
	52	913	6106	-.084	.266
	52	913	6201	-.236	.526
	52	913	6204	-.41	.259
	52	913	6203	-.214	.521
	52	913	3202	-.371	.415
	52	913	3201	-.063	.687
	52	913	2005	-1.54	-.824
	52	913	1700	-1.111	-.354
	52	913	1070	-1.684	-.936
	52	913	765	-1.893	-1.325
	52	913	764	-.24	.144
	52	913	763	-1.591	-.783
	52	913	762	-1.127	-.369
	52	913	748	-.571	.117
	52	913	749	-3.06	-2.275
	52	913	760	-1.483	-.839
	52	913	759	-1.496	-.744
	52	913	758	-1.335	-.64
	52	913	757	-1.586	-.856
	52	913	766	-.641	.134
	52	913	754	-2.476	-1.758
	52	913	751	-.675	-.145
	52	913	750	-1.464	-1.066
	52	913	605	0	.826
	52	913	607	-.884	-.115
	52	913	736	0	.331
	52	913	603	.835	1.645
	52	913	604	-.263	.553
	52	913	602	-1.062	-.295
67	66	914	601	.414	1.14
	66	914	607	-.862	-.137
	66	914	608	-.094	.632
	66	914	611	-3.053	-2.307
	66	914	734	-.848	-.393
	66	914	735	-2.235	-1.725
	66	914	2005	-1.858	-1.181
	66	914	3201	-.744	-.039
	66	914	3202	-1.193	-.455
	66	914	3204	-1.172	-.525
	66	914	3205	-1.653	-1.051
	66	914	3206	-1.442	-.963
	66	914	3207	-.861	-.497
	66	914	3301	.317	1.073
	66	914	6101	-.744	-.028
	66	914	6102	-.311	.367
	66	914	6103	-.828	-.206
	66	914	6104	-.933	-.403
	66	914	6105	-1.728	-1.3
	66	914	6203	-.51	.183
	66	914	6204	-.961	-.326
	66	914	6206	.374	.796
	66	914	6201	-1.219	-.502
	66	914	6106	-.266	.101
	66	914	1700	-.798	-.084
	66	914	1070	-1.006	-.299
	66	914	765	-.959	-.408
	66	914	764	-.803	-.408
	66	914	763	-.946	-.186
	66	914	762	.049	.766
	66	914	760	-.87	-.253
	66	914	759	-1.564	-.855

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	66	914	758	-1.847	-1.189
	66	914	757	-2.153	-1.465
	66	914	756	-.876	-.212
	66	914	766	-1.214	-.486
	66	914	736	-.098	.254
	66	914	754	-1.385	-.705
	66	914	751	-1.141	-.625
	66	914	750	-.405	.004
	66	914	749	-2.77	-2.03
	66	914	748	-.886	-.234
	66	914	747	-.482	.192
	66	914	746	-1.394	-.674
	66	914	745	-2.691	-2.006
	66	914	755	-1.563	-.839
	66	914	742	-.395	.305
	66	914	741	9.122	9.749
	66	914	740	-2.215	-1.556
	66	914	737	-.597	-.24
	66	914	603	.594	1.354
	66	914	605	-.098	.677
	66	914	602	-.83	-.107
51	50	915	601	-.273	.305
	50	915	607	.019	.595
	50	915	611	-3.975	-3.419
	50	915	734	-1.511	-.618
	50	915	735	-.578	.245
	50	915	3202	-.264	.298
	50	915	3204	-.356	.309
	50	915	3205	-1.07	-.352
	50	915	3206	-1.262	-.4
	50	915	3207	-.631	.371
	50	915	3301	-.688	-.142
	50	915	6101	.218	.805
	50	915	6102	-.45	.183
	50	915	6103	-1.014	-.319
	50	915	6104	-1.282	-.478
	50	915	6105	-.56	.362
	50	915	6106	.366	1.363
	50	915	6201	-.816	-.229
	50	915	6203	-.776	-.16
	50	915	6204	-.47	.209
	50	915	6206	-1.012	-.078
	50	915	3201	.313	.911
	50	915	2005	-1.097	-.466
	50	915	1700	-1.498	-.906
	50	915	1070	-1.534	-.933
	50	915	765	-1.107	-.328
	50	915	764	-1.955	-.987
	50	915	763	-1.024	-.484
	50	915	762	-.784	-.194
	50	915	760	-1.075	-.372
	50	915	759	-.67	-.077
	50	915	758	-1.06	-.408
	50	915	757	.294	.909
	50	915	756	-1.106	-.458
	50	915	736	0	1.017
	50	915	737	-2.296	-1.281
	50	915	766	.648	1.218
	50	915	754	-1.593	-.964
	50	915	751	-2.31	-1.488
	50	915	750	-1.664	-.714
	50	915	749	-1.29	-.731

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	50	915	748	.468	1.126
	50	915	747	.181	.816
	50	915	746	.177	.758
	50	915	745	-.897	-.277
	50	915	755	-1.196	-.617
	50	915	742	-.872	-.265
	50	915	741	7.568	8.262
	50	915	740	-2.223	-1.569
	50	915	738	-1.768	-.847
	50	915	604	.487	1.018
	50	915	605	0	.522
	50	915	603	-.471	.07
	50	915	602	-1.693	-1.11
18	15	1001	5911	.658	.453
	15	1001	6011	0	-.213
	15	1001	813	0	-.198
	15	1001	781	-.555	-.759
	15	1001	780	.339	.127
	15	1001	785	.792	.589
	15	1004	701	-.187	-.247
	15	1004	705	.949	.946
	15	1004	715	.051	.024
	15	1004	5804	-.27	-.26
	15	1004	2806	-1.041	-1.118
	15	1004	767	-1.871	-1.921
	15	1004	716	2.347	2.278
	15	1004	5705	.081	.047
	15	1004	704	.211	.177
	15	1004	1501	0	.013
	15	1004	2805	-.815	-.827
	15	1004	2706	0	-.094
	15	1004	2705	1.041	.981
	15	1005	731	2.036	.403
	15	1005	2802	.764	-.772
	15	1005	5802	0	-1.505
	15	1005	708	1.574	-.24
	15	1005	2803	1.246	-.605
	15	1005	721	2.755	.83
	15	1005	732	3.615	1.69
	15	1005	714	0	-2.606
	15	1005	733	4.391	2.481
	15	1005	5803	-.1	-1.731
	15	1005	5703	3.393	.841
	15	1005	5702	3.243	1.212
	15	1006	731	2.036	.403
	15	1006	2803	1.246	-.605
	15	1006	708	1.574	-.24
	15	1006	5802	0	-1.505
	15	1006	733	4.391	2.481
	15	1006	714	0	-2.606
	15	1006	732	3.615	1.69
	15	1006	721	2.755	.83
	15	1006	5803	-.1	-1.731
	15	1006	2802	.764	-.772
	15	1006	5703	3.393	.841
	15	1006	5702	3.243	1.212
17	16	1007	6011	0	-.312
	16	1007	813	0	-.418
	16	1007	778	.925	.59
	16	1007	783	.386	.056

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	16	1007	814	-.237	-.557
	16	1007	785	.555	.171
	16	1007	1084	-.026	-.35
	16	1007	5911	.773	.403
	16	1007	780	.739	.417
	16	1008	1501	0	-.078
	16	1008	712	.457	.329
	16	1008	715	-.329	-.508
	16	1008	713	.271	.164
	16	1008	727	-.179	-.32
	16	1008	705	.483	.367
	16	1008	704	-.148	-.343
	16	1008	725	.881	.729
	16	1008	716	.727	.445
	16	1008	722	1.025	.719
	16	1008	2705	.254	-.007
	16	1008	2704	0	-.437
	16	1008	5804	-.258	-.345
	16	1008	5705	-.275	-.472
	16	1008	2804	-.129	-.243
	16	1009	5706	1.147	-.188
	16	1009	775	1.054	.039
	16	1009	2807	1.973	.579
	16	1009	702	1.347	-.085
	16	1009	703	0	-1.459
	16	1009	3016	1.533	.144
	16	1009	772	1.298	.049
	16	1009	768	2.436	1.115
	16	1009	5807	0	-.195
	16	1010	729	1.935	1.343
	16	1010	2802	.698	.17
	16	1010	2803	-.301	-.579
	16	1010	5702	.002	-.138
	16	1010	733	.714	.469
	16	1010	5701	.122	-.298
	16	1010	720	0	-.094
	16	1010	721	.186	-.038
	16	1010	732	1.719	1.5
	16	1010	731	.672	.215
	16	1010	730	-1.135	-1.572
	16	1010	717	.301	-.369
	16	1010	2007	-.39	-.646
	16	1010	2101	0	-.677
	16	1010	5802	1.259	.716
31	12	1023	750	0	-.216
	12	1023	1700	-1.063	-2.063
	12	1023	613	3.738	2.691
	12	1023	758	1.849	.97
	12	1023	754	2.109	1.174
	12	1023	1070	-3.488	-4.457
	12	1023	765	1.03	.433
	12	1023	3204	2.484	1.631
	12	1023	755	.25	-.784
	12	1023	618	0	-1.091
	12	1023	735	-.46	-.949
	12	1023	734	-.003	-.344
	12	1023	616	1.183	.166
	12	1023	766	.209	-.834
	12	1023	760	.54	-.221
	12	1023	6201	3.601	2.571
	12	1023	739	2.123	1.323

stereo	ortho	NUMS	NUMP	DZ1	DZ2
22	19	1031	2007	3.522	1.394
	19	1031	803	0	1.269
	19	1031	1491	-3.036	-2.204
	19	1031	717	1.369	.825
	19	1031	730	-1.273	-2.63
	19	1031	731	1.583	.268
	19	1031	720	0	-2.607
	19	1031	733	3.112	.984
	19	1031	2701	1.421	-.978
	19	1031	802	-1.057	-.038
	19	1031	804	3.581	1.244
	19	1031	729	1.751	.957
	19	1031	2702	3.518	1.432
	19	1031	2802	1.114	.07
	19	1031	2101	1.909	1.365
	19	1031	2100	-1.411	-1.35
	19	1032	1067	.351	.586
	19	1032	810	.386	.504
	19	1032	5901	-1.004	-.979
	19	1032	5904	-1.418	-1.186
	19	1032	2906	-.036	.23
	19	1032	2904	-.527	-.3
	19	1032	2903	-2.467	-2.333
	19	1032	2902	.638	.793
	19	1032	811	-1.183	-1.024
	19	1032	2100	0	.286
	19	1032	3102	-.334	-.403
	19	1032	3103	-1.706	-1.763
	19	1032	3104	1.995	2.027
	19	1032	2001	2.078	2.139
	19	1032	3003	2.269	2.326
	19	1032	3005	-.639	-.451
	19	1032	2101	-.281	-.036
	19	1032	808	0	-.133
	19	1032	6105	-.506	-.285
	19	1033	765	2.101	1.287
	19	1033	747	.626	-.722
	19	1033	754	.829	-.558
	19	1033	735	-2.484	-3.081
	19	1033	734	1.196	.829
	19	1033	736	0	.141
	19	1033	807	-.578	-1.366
	19	1033	748	.744	-.512
	19	1033	808	0	-1.591
	19	1033	740	2.042	.734
	19	1033	739	2.212	1.049
	19	1033	760	-.576	-1.66
	19	1033	758	3.594	2.28
	19	1033	750	.828	.685
	19	1033	6105	-2.257	-2.472
	19	1033	752	-.592	-1.426
	19	1033	3204	4.93	3.655
	19	1033	6206	2.943	2.728
	19	1034	627	-1.442	-.822
	19	1034	601	-1.159	-.265
	19	1034	757	-3.015	-1.7
	19	1034	746	-2.235	-1.286
	19	1034	2005	-1.806	-.381
	19	1034	742	-1.635	-.448
	19	1034	615	-1.744	-1.033
	19	1034	1070	-1.493	-.397
	19	1034	3304	.52	1.524
	19	1034	624	-.505	.316

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	19	1034	604	0	.4
	19	1034	618	.015	.598
	19	1034	763	-.065	.39
	19	1034	3204	0	1.736
	19	1034	6201	-.185	.764
	19	1034	755	-2.009	-1.115
	19	1034	610	1.246	1.72
20	21	1035	720	0	-1.769
	21	1035	2802	1.409	.919
	21	1035	2007	2.146	.804
	21	1035	2702	1.418	.126
	21	1035	802	-3.304	-2.037
	21	1035	803	0	1.42
	21	1035	804	.7	-.779
	21	1035	2701	1.461	-.138
	21	1035	733	1.004	-.322
	21	1035	731	2.561	1.832
	21	1035	730	-1.036	-1.782
	21	1035	717	1.759	1.678
	21	1035	729	1.361	1.093
	21	1035	1491	-3.851	-2.773
	21	1035	2100	-.174	.223
	21	1035	2101	1.566	1.502
	21	1036	2100	0	-.859
	21	1036	2101	.609	-.25
	21	1036	3102	2.424	1.563
	21	1036	3104	2.9	2.039
	21	1036	3003	.845	-.015
	21	1036	810	1.732	.872
	21	1036	5901	-5.299	-6.16
	21	1036	5904	1.012	.153
	21	1036	2906	2.275	1.416
	21	1036	2904	1.175	.316
	21	1036	2902	1.852	.992
	21	1036	811	.019	-.84
	21	1036	1067	.531	-.329
	21	1036	3103	2.502	1.641
	21	1036	2903	.311	-.549
	21	1036	3005	.455	-.405
	21	1036	2001	2.135	1.275
	21	1036	808	0	-.861
	21	1037	760	1.892	-.023
	21	1037	735	.944	-.73
	21	1037	734	1.726	.182
	21	1037	736	0	-1.286
	21	1037	748	2.388	.39
	21	1037	750	1.455	.024
	21	1037	3204	3.568	1.574
	21	1037	758	2.964	.946
	21	1037	754	1.667	-.394
	21	1037	747	.731	-1.307
	21	1037	752	.485	-1.298
	21	1037	808	0	-2.161
	21	1037	739	2.397	.452
	21	1037	740	3.663	1.639
	21	1037	765	2.437	.668
	21	1037	6206	2.789	1.325
	21	1038	6201	1.412	.995
	21	1038	3304	1.318	.864
	21	1038	742	2.357	1.849
	21	1038	2005	.59	-.054
	21	1038	746	.959	.56

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	21	1038	601	-.361	-.76
	21	1038	615	-.147	-.447
	21	1038	618	.015	-.239
	21	1038	763	-.864	-1.064
	21	1038	604	0	-.164
	21	1038	624	.293	-.07
	21	1038	627	-.643	-.907
	21	1038	3204	0	-.825
	21	1038	1070	.104	-.386
	21	1038	755	1.185	.812
	21	1038	757	-.619	-1.209
	21	1038	610	1.246	1.046
43	40	1046	5803	5.726	.883
	40	1046	737	4.606	2.27
	40	1046	817	0	-1.743
	40	1046	3209	3.984	1.193
	40	1046	3208	-1.612	-4.357
	40	1046	750	10.792	6.998
	40	1046	816	0	-5.344
	40	1046	3211	-4.204	-6.54
	40	1046	818	-3.957	-6.976
	40	1046	6304	7.81	4.107
	40	1046	3310	2.99	-.394
	40	1046	1084	7.544	2.793
	40	1046	1241	10.727	6.659
	40	1046	736	5.008	2.81
	40	1046	780	10.358	5.653
	40	1046	738	-2.428	-6.222
	40	1046	5802	2.323	-1.79
	40	1047	1241	6.829	7.309
	40	1047	3107	-1.141	-4.85
	40	1047	812	2.874	1.429
	40	1047	1067	1.622	1.083
	40	1047	821	0	4.442
	40	1047	5908	-2.148	1.501
	40	1047	814	-2.492	-1.446
	40	1047	778	-14.426	-11.908
	40	1047	3110	.932	.393
	40	1047	822	0	-4.161
	40	1047	1084	-.165	1.9
	40	1047	780	2.846	4.797
	40	1047	2906	4.125	2.227
	40	1047	815	1.843	.512
	40	1047	5803	-3.245	-1.067
	40	1047	5802	-2.641	-2.161
	40	1048	715	-.735	-.171
	40	1048	2807	-9.494	-9.127
	40	1048	702	0	.345
	40	1048	701	-.158	.351
	40	1048	5804	-5.618	-4.988
	40	1048	705	1.349	1.95
	40	1048	727	5.731	6.308
	40	1048	704	.411	.963
	40	1048	716	-11.388	-10.87
	40	1048	5803	-1.894	-1.252
	40	1048	1084	0	.645
	40	1048	3016	4.998	5.341
	40	1048	2804	-1.655	-1.049
	40	1048	2706	11.117	11.553
	40	1049	733	-9.254	.739
	40	1049	731	-5.07	5.66
	40	1049	720	-13.614	-4.124

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	40	1049	730	-17.774	-6.776
	40	1049	729	-12.647	-1.079
	40	1049	3016	0	4.934
	40	1049	5803	-10.17	.66
	40	1049	717	0	11.434
	40	1049	725	-.044	9.345
	40	1049	708	-11.284	-.989
	40	1049	721	-13.521	-3.494
	40	1049	732	-11.614	-1.621
	40	1049	712	-14.321	-4.194
	40	1049	711	-29.247	-19.187
	40	1049	5802	-13.267	-1.9
	40	1049	2804	-10.587	-.427
	40	1049	5702	-.398	8.858
	40	1049	2007	-7.797	2.162
41	42	1054	736	6.379	2.111
	42	1054	816	0	-6.75
	42	1054	3211	-4.938	-9.243
	42	1054	818	-.995	-5.977
	42	1054	750	10.944	5.436
	42	1054	6304	15.562	9.865
	42	1054	1241	15.419	9.535
	42	1054	3310	7.267	1.946
	42	1054	737	6.059	1.679
	42	1054	817	0	-3.854
	42	1054	3208	2.278	-2.517
	42	1054	764	7.689	2.557
	42	1054	738	3.192	-2.505
	42	1054	3209	2.434	-2.21
	42	1054	6206	5.878	.331
	42	1054	1084	6.091	-.132
	42	1054	780	11.064	4.804
	42	1054	5803	5.421	-.915
	42	1054	5802	1.575	-4.159
	42	1055	5908	-3.206	1.828
	42	1055	780	2.329	5.3
	42	1055	1241	10.473	12.266
	42	1055	1067	1.481	1.359
	42	1055	815	1.538	.385
	42	1055	3107	.74	-3.065
	42	1055	822	0	-4.688
	42	1055	3110	1.684	1.709
	42	1055	778	-19.291	-16.32
	42	1055	814	-2.304	-.364
	42	1055	821	0	6.212
	42	1055	812	-.135	-1.877
	42	1055	2906	1.022	-1.31
	42	1055	5803	-3.715	-.449
	42	1055	1084	-1.551	1.42
	42	1055	5802	-3.464	-2.407
	42	1056	1084	0	.797
	42	1056	5803	-.866	-.068
	42	1056	704	.411	1.224
	42	1056	705	.321	1.125
	42	1056	5804	-5.618	-4.818
	42	1056	701	-1.186	-.366
	42	1056	702	0	.849
	42	1056	2807	-7.438	-6.593
	42	1056	715	2.349	3.161
	42	1056	727	6.759	7.568
	42	1056	716	-14.472	-13.654
	42	1056	2804	-3.712	-2.908

stereo	ortho	NUMS	NUMP	DZ1	DZ2
	42	1056	3016	3.97	4.819
	42	1056	2706	8.033	8.865
	42	1057	2007	-10.49	.519
	42	1057	729	-15.863	-3.247
	42	1057	717	0	12.382
	42	1057	730	-15.517	-3.637
	42	1057	720	-15.097	-4.59
	42	1057	731	-6.957	4.789
	42	1057	732	-15.375	-4.299
	42	1057	721	-10.948	-.039
	42	1057	712	-11.78	-.771
	42	1057	713	-2.773	8.203
	42	1057	711	-26.685	-15.743
	42	1057	733	-13.016	-1.939
	42	1057	5802	-14.302	-1.954
	42	1057	5803	-11.032	.781
	42	1057	2804	-10.173	.937
	42	1057	3016	0	5.954
	42	1057	5702	-6.034	4.372
	42	1057	708	-13.028	-1.718

923 records selected.

10.7 LIST OF THE ORTHOPHOTO WORKING GROUP

10.7.1 LIST OF OPERATIVE CENTERS

ACRONYMS	NAMES
GID (DK)	Geodaetic Institut of Denmark-Copenhaguen (Denmark)
IFAG (D)	Institut für angewandte Geodäsie (Federal Republic of Germany)
IGM (I)	Istituto geografico militare - Firenze (Italy)
IGN (F)	Institut géographique national - Paris (France)
IPTU (A)	Institut für Photogrammetrie, der Technischen Universität Wien-Vienna (Austria)
IPUS (D)	Institut für Photogrammetrie der Universität Stuttgart (F.R. Germany)
ITC (NL)	International Institut for Aerial Survey and Earth Science-Enschede (The Netherlands)
ITPT (I)	Istituto di Topografia del Politecnico Torino (Italy)
NBS (SF)	National Board of Survey - Helsinki (Finland)
NLS (S)	National Land Survey - Gävle (Sweden)
NRC (CDN)	National Research Council - Ottawa (Canada)
UCL (GB)	University college London (U.K.)
WH (CH)	Wild-Heerbrugg Company (Switzerland)

10.7.2 LIST OF MEMBERS AND ASSOCIATE MEMBERS

COUNTRY	NAME	ADDRESS
AUSTRIA	Dipl. Ing. R. KALLIANY Prof. Dr. K. KRAUS	IPTU : Gusshausstrasse 27-29/122 A-1040 - WIEN
CANADA	Marius C. VAN WIJK	formerly NRC - Now : Topographic Survey of Energy, Mines, Resources , 615 Booth Street OTTAWA - K 1 A O E 9
DENMARK	Lars Tyge JØRGENSEN	formerly GID, which was merged into National Survey and Cadastre, Rentemestervej 8, DK-2400 KØBENHAVN
FINLAND	Mrs Pirkko NOUKKA	NBS : Maanmittaushallitus PL 84 - SF-00521 HELSINKI 52
FRANCE	GUY DUCHER Ing. général WG President	IGN : 2 Avenue Pasteur - BP 68 F - 94160 SAINT-MANDÉ
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10.8 LIST OF ABBREVIATIONS AND ACRONYMS

C.C.D. = charge-coupled device (in French : dispositif à transfert de charges)

CNES = centre national d'études spatiales (the French space agency).

D.E.M. = digital elevation model.

D.T.M = digital terrain model (here, similar to D.E.M).

Ec. type = écart-type (see standard deviation).

E.M.Q = erreur moyenne quadratique (see r.m.s.e).

ESA = european space agency.

G.C.P. = ground control point

G.I.S = geographic information system.

G.P.M = Gestalt Photo-Mapper

H = flying height (related to the survey to rectify).

I.S.P.R.S = International Society for Photogrammetry and Remote Sensing.

K = kilo (10^3) for example at 1 : 50 K-scale means at 1 : 50,000-scale.

M.N.T. = modèle numérique du terrain (in English D.T.M)

N.A. = not available.

NASA = National Aeronautics and Space Administration (U.S.A.).

N.H.A.P. = National High Altitude Photography (U.S.A.).

N.M.A.S. = National Map Accuracy Standards (U.S.A.).

px = x-parallax between image-points on the orthophoto and its stereomate.

R.M.S.E. = root mean square error; it refers to the accuracy of a product assessed through n measurements and is computed as being equal to $\sqrt{\frac{\Sigma(vi^2)}{n}}$

in which vi is the true error of each measurement (measured value minus true value). The r.m.s.e is superior or equal to the standard deviation.

St. dev = standard deviation; it refers to the precision of a product, assessed through n measurements, i-e to the spread of the observations, whether or not the mean value around which the spread is measured approximates the true value. It is computed as being equal to $\sqrt{\frac{\Sigma(v_i-v_m)^2}{n-1}}$

in which v_i is the true error and v_m the mean value of the n measurements.

U.S.N.M.A.S = United States National Map Accuracy Standards.

10.9 ACKNOWLEDGEMENTS

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- GID (DK), IGM (I), IGN (F), IPUS (D), ITPT (I) for preparation of control, check points and contours.
- IFAG (D), IGN (F), ITC (NL), for production of the major part of the required ortho and stereo-orthophotos, as well as NBS (SF), NLS (S) and the Wild Company (WH) for the useful complementary products they delivered.
- IGN (F), IPTU (A) for carrying out the major part of the measurements; NRC(CDN) and UCL (GB), for the additional part they were able to take regarding measurements.
- IGN (F) and its school (E.N.S.G) that fostered completion of the test, so that full results could be obtained from these measurements and conclusions fully drawn.

But the work which supports this report would have never been done if so many people, engineers, experts, technicians, operators, team members, students, WG participants or associates... had not been so active and eager to succeed in achieving their tasks, accepting sometimes to do much more than they had envisaged to do at the beginning.

We are extremely grateful for their cooperation which makes Europe be something more than an abstract entity and I really enjoyed managing the successive stages of the test,seeing how cooperation could successfully work through so many countries, agencies, experts.

I would like to express special thanks to people whose name can be associated to dedicated parts, though they are too numerous to list them all here. Yet I want to mention :

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LIST OF THE OEEPE PUBLICATIONS

State — May 1991

A. Official publications

1 *Trombetti, C.:* „Activité de la Commission A de l'OEEPE de 1960 à 1964" — *Cunietti, M.:* „Activité de la Commission B de l'OEEPE pendant la période septembre 1960—janvier 1964" — *Förstner, R.:* „Rapport sur les travaux et les résultats de la Commission C de l'OEEPE (1960—1964)" — *Neumaier, K.:* „Rapport de la Commission E pour Lisbonne" — *Weele, A.J. v. d.:* „Report of Commission F." — Frankfurt a. M. 1964, 50 pages with 7 tables and 9 annexes.

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3 *Cunietti, M.:* „Emploi des blocs de bandes pour la cartographie à grande échelle — Résultats des recherches expérimentales organisées par la Commission B de l'O.E.E.P.E. au cours de la période 1959—1966" — „Use of Strips Connected to Blocks for Large Scale Mapping — Results of Experimental Research Organized by Commission B of the O.E.E.P.E. from 1959 through 1966." — Frankfurt a. M. 1968, 157 pages with 50 figures and 24 tables.

4 *Förstner, R.:* „Sur la précision de mesures photogrammétriques de coordonnées en terrain montagneux. Rapport sur les résultats de l'essai de Reichenbach de la Commission C de l'OEEPE" — „The Accuracy of Photogrammetric Co-ordinate Measurements in Mountainous Terrain. Report on the Results of the Reichenbach Test Commission C of the OEEPE." — Frankfurt a. M. 1968, Part I: 145 pages with 9 figures; Part II: 23 pages with 65 tables.

5 *Trombetti, C.:* „Les recherches expérimentales exécutées sur de longues bandes par la Commission A de l'OEEPE." — Frankfurt a. M. 1972, 41 pages with 1 figure, 2 tables, 96 annexes and 19 plates.

6 *Neumaier, K.:* „Essai d'interprétation. Rapports des Centres de la Commission E de l'OEEPE." — Frankfurt a. M. 1972, 38 pages with 12 tables and 5 annexes.

7 *Wiser, P.:* „Etude expérimentale de l'aérotriangulation semi-analytique. Rapport sur l'essai »Gramastetten«." — Frankfurt a. M. 1972, 36 pages with 6 figures and 8 tables.

8 „Proceedings of the OEEPE Symposium on Experimental Research on Accuracy of Aerial Triangulation (Results of Oberschwaben Tests)"
Ackermann, F.: „On Statistical Investigation into the Accuracy of Aerial Triangulation. The Test Project Oberschwaben" — „Recherches statistiques sur la précision de l'aérotriangulation. Le champ d'essai Oberschwaben" — *Belzner, H.:* „The Planning. Establishing and Flying of the Test Field Oberschwaben" — *Stark, E.:* Testblock Oberschwaben, Programme I. Results of Strip Adjustments" — *Ackermann, F.:* „Testblock Oberschwaben, Program I. Results of Block-Adjustment by Independent Models" — *Ebner, H.:* Comparison of Different Methods of Block Adjustment" — *Wiser, P.:* „Propositions pour le traitement des erreurs non-accidentelles" — *Camps, F.:* „Résultats obtenus dans le cadre du project Oberschwaben 2A" — *Cunietti, M.; Vanossi, A.:* „Etude statistique expérimentale des erreurs d'enchaînement des photogrammes" — *Kupfer, G.:* „Image Geometry as Obtained from Rheidt Test Area Photography" — *Förstner, R.:* „The Signal-Field of Baustetten. A Short Report" — *Visser, J.; Leberl, F.; Kure, J.:* „OEEPE Oberschwaben Reseau Investigations" — *Bauer, H.:* „Compensation of Systematic Errors by Analytical Block Adjustment with Common Image Deformation Parameters." — Frankfurt a. M. 1973, 350 pages with 119 figures, 68 tables and 1 annex.

9 *Beck, W.:* „The Production of Topographic Maps at 1 : 10,000 by Photogrammetric Methods. — With statistical evaluations, reproductions, style sheet and sample fragments by Landesvermessungsamt Baden-Württemberg, Stuttgart." — Frankfurt a. M. 1976, 89 pages with 10 figures, 20 tables and 20 annexes.

10 „Résultats complémentaires de l'essai d'«Oberriet» de la Commission C de l'OEEPE — Further Results of the Photogrammetric Tests of «Oberriet» of the Commission C of the OEEPE"
Härry, H.: „Mesure de points de terrain non signalisés dans le champ d'essai d'«Oberriet» — Measurements of Non-Signalized Points in the Test Field «Oberriet» (Abstract)" — *Stickler, A.; Waldhäusl, P.:* „Restitution graphique des points et des lignes non signalisés et leur comparaison avec des résultats de mesures sur le terrain dans le champ d'essai d'«Oberriet» — Graphical Plotting of Non-Signalized Points and Lines, and Comparison with Terrestrial Surveys in the Test Field «Oberriet»" — *Förstner, R.:* „Résultats complémentaires des transformations de coordonnées de l'essai d'«Oberriet» de la Commission C de l'OEEPE — Further Results from Co-ordinate Transformations of the Test «Oberriet» of Commission C of the OEEPE" — *Schürer, K.:* „Comparaison des distances d'«Oberriet» — Comparison of Distances of «Oberriet» (Abstract)." — Frankfurt a. M. 1975, 158 pages with 22 figures and 26 tables.

11 „25 années de l'OEEPE"
Verlaine, R.: „25 années d'activité de l'OEEPE" — „25 Years of OEEPE (Summary)" — *Baarda, W.:* „Mathematical Models." — Frankfurt a. M. 1979, 104 pages with 22 figures.

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13 *Timmerman, J.; Roos, P. A.; Schürer, K.; Förstner, R.:* On the Accuracy of Photogrammetric Measurements of Buildings — Report on the Results of the Test "Dordrecht", Carried out by Commission C of the OEEPE. — Frankfurt a. M. 1982, 144 pages with 14 figures and 36 tables.

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15 *Jaakkola, M.; Brindöpke, W.; Kölbl, O.; Noukka, P.:* Optimal Emulsions for Large-Scale Mapping — Test of "Steinwedel" — Commission C of the OEEPE 1981—84. — Frankfurt a. M. 1985, 102 pages with 53 figures.

16 *Waldhäusl, P.:* Results of the Vienna Test of OEEPE Commission C.— *Kölbl, O.:* Photogrammetric Versus Terrestrial Town Survey. — Frankfurt a. M. 1986, 57 pages with 16 figures, 10 tables and 7 annexes.

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18 *Förstner, W.:* Final Report on the Joint Test on Gross Error Detection of OEEPE and ISP WG III/1. — Frankfurt a. M. 1986, 97 pages with 27 tables and 20 figures.

19 *Dowman, I. J.; Ducher, G.:* Spacelab Metric Camera Experiment — Test of Image Accuracy. — Frankfurt a. M. 1987, 112 pages with 13 figures, 25 tables and 7 appendices.

20 *Eichhorn, G.:* Summary of Replies to Questionnaire on Land Information Systems — Commission V — Land Information Systems. — Frankfurt a. M. 1988, 129 pages with 49 tables and 1 annex.

21 *Kölbl, O.:* Proceedings of the Workshop on Cadastral Renovation — Ecole polytechnique fédérale, Lausanne, 9—11 September, 1987. — Frankfurt a. M. 1988, 337 pages with figures, tables and appendices.

22 *Rollin, J.; Dowman, I. J.:* Map Compilation and Revision in Developing Areas — Test of Large Format Camera Imagery. — Frankfurt a. M. 1988, 35 pages with 3 figures, 9 tables and 3 appendices.

23 *Drummond, J.* (ed.): Automatic Digitizing — A Report Submitted by a Working Group of Commission D (Photogrammetry and Cartography). — Frankfurt a. M. 1990, 224 pages with 85 figures, 6 tables and 6 appendices.

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B. Special publications

— Special Publications O.E.E.P.E. — Number I

Solaini, L.; Trombetti, C.: Relation sur les travaux préliminaires de la Commission A (Triangulation aérienne aux petites et aux moyennes échelles) de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.). Ière Partie: Programme et organisation du travail. — *Solaini, L.; Belfiore, P.:* Travaux préliminaires de la Commission B de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.) (Triangulations aériennes aux grandes échelles). — *Solaini, L.; Trombetti, C.; Belfiore, P.:* Rapport sur les travaux expérimentaux de triangulation aérienne exécutés par l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (Commission A et B). — *Lehmann, G.:* Compte rendu des travaux de la Commission C de l'O.E.E.P.E. effectués jusqu'à présent. — *Gotthardt, E.:* O.E.E.P.E. Commission C. Compte-rendu de la restitution à la Technischen Hochschule, Stuttgart, des vols d'essai du groupe I du terrain d'Oberriet. — *Brucklacher, W.:* Compte-rendu du centre «Zeiss-Aerotopograph» sur les restitutions pour la Commission C de l'O.E.E.P.E. (Restitution de la bande de vol, groupe I, vol. No. 5). — *Förstner, R.:* O.E.E.P.E. Commission C. Rapport sur la restitution effectuée dans l'Institut für Angewandte Geodäsie, Francfort sur le Main. Terrain d'essai d'Oberriet les vols No. 1 et 3 (groupe I). — I.T.C., Delft: Commission C, O.E.E.P.E. Déroulement chronologique des observations. — Photogrammetria XII (1955—1956) 3, Amsterdam 1956, pp. 79—199 with 12 figures and 11 tables.

— Publications spéciales de l'O.E.E.P.E. — Numéro II

Solaini, L.; Trombetti, C.: Relations sur les travaux préliminaires de la Commission A (Triangulation aérienne aux petites et aux moyennes échelles) de l'Organisation Européenne d'Etudes Photogrammétriques Expérimentales (O.E.E.P.E.). 2e partie. Prises de vues et points de contrôle. — *Gotthardt, E.:* Rapport sur les premiers résultats de l'essai d'«Oberriet» de la Commission C de l'O.E.E.P.E. — Photogrammetria XV (1958—1959) 3, Amsterdam 1959, pp. 77—148 with 15 figures and 12 tables.

— *Trombetti, C.:* Travaux de prises de vues et préparation sur le terrain effectuées dans le 1958 sur le nouveau polygone italien pour la Commission A de l'OEEPE. — Florence 1959, 16 pages with 109 tables.

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— Publications spéciales de l'O.E.E.P.E. — Numéro III

Solaini, L.; Trombetti, C.: Rapport sur les résultats des travaux d'enchaînement et de compensation exécutés pour la Commission A de l'O. E. E. P. E. jusqu'au mois de Janvier 1960. Tome 1: Tableaux et texte. Tome 2: Atlas. — Photogrammetria XVII (1960—1961) 4, Amsterdam 1961, pp. 119—326 with 69 figures and 18 tables.

— „OEEPE — Sonderveröffentlichung Nr. 1"

Gigas, E.: „Beitrag zur Geschichte der Europäischen Organisation für photogrammetrische experimentelle Untersuchungen" — *N. N.:* „Vereinbarung über die Gründung einer Europäischen Organisation für photogrammetrische experimentelle Untersuchungen" — „Zusatzprotokoll" — *Gigas, E.:* „Der Sechserausschuß" — *Brucklacher, W.:* „Kurzbericht über die Arbeiten in der Kommission A der OEEPE" — *Cunietti, M.:* „Kurzbericht des Präsidenten der Kommission B über die gegenwärtigen Versuche und Untersuchungen" — *Förstner, R.:* „Kurzbericht über die Arbeiten in der Kommission B der OEEPE" — „Kurzbericht über die Arbeiten in der Kommission C der OEEPE" — *Belzner, H.:* „Kurzbericht über die Arbeiten in der Kommission E der OEEPE" — *Schwidefsky, K.:* „Kurzbericht über die Arbeiten in der Kommission F der OEEPE" — *Meier, H.-K.:* „Kurzbericht über die Tätigkeit der Untergruppe „Numerische Verfahren" in der Kommission F der OEEPE" — *Belzner, H.:* „Versuchsfelder für internationale Versuchs- und Forschungsarbeiten." — Nachr. Kt.- u. Vermesss.-wes., R. V, Nr. 2, Frankfurt a. M. 1962, 41 pages with 3 tables and 7 annexes.

— *Rinner, K.:* Analytisch-photogrammetrische Triangulation eines Teststreifens der OEEPE. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. Nr. 1, Wien 1962, 31 pages.

— *Neumaier, K.; Kasper, H.:* Untersuchungen zur Aerotriangulation von Überweitwinkelaufnahmen. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. Nr. 2, Wien 1965, 4 pages with 4 annexes.

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— „OEEPE — Sonderveröffentlichung Nr. 3"

Neumaier, K.: „Versuch »Bedford« und »Waterbury«. Gemeinsamer Bericht aller Zentren der Kommission E der OEEPE" — „Versuch »Schweizer Block«. Gemeinsamer Bericht aller Zentren der Kommission E der OEEPE." — Nachr. Kt.- u. Vermess.-wes., R. V, Nr. 13, Frankfurt a. M. 1966, 30 pages with 44 annexes.

— *Stickler, A.; Waldhäusl, P.:* Interpretation der vorläufigen Ergebnisse der Versuche der Kommission C der OEEPE aus der Sicht des Zentrums Wien. — Österr. Z. Vermess.-wes., OEEPE-Sonderveröff. (Publ. Spéc.) Nr. 3, Wien 1967, 4 pages with 2 figures and 9 tables.

— „OEEPE — Sonderveröffentlichung Nr. 4"

Schürer, K.: „Die Höhenmeßgenauigkeit einfacher photogrammetrischer Kartiergeräte. Bemerkungen zum Versuch »Schweizer Block« der Kommission E der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M., 1968, 25 pages with 7 figures and 3 tables.

— „OEEPE — Sonderveröffentlichung Nr. 5"

Förstner, R.: „Über die Genauigkeit der photogrammetrischen Koordinatenmessung in bergigem Gelände. Bericht über die Ergebnisse des Versuchs Reichenbach der Kommission C der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1969, Part I: 74 pages with 9 figures; Part II: 65 tables.

— „OEEPE — Sonderveröffentlichung Nr. 6"

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— „OEEPE — Sonderveröffentlichung Nr. D-7"

Förstner, R.: „Das Versuchsfeld Reichenbach der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1972, 191 pages with 49 figures and 38 tables.

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Neumaier, K.: „Interpretationsversuch. Berichte der Zentren der Kommission E der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1972, 33 pages with 12 tables and 5 annexes.

— „OEEPE — Sonderveröffentlichung Nr. D-9"

Beck, W.: „Herstellung topographischer Karten 1:10 000 auf photogrammetrischem Weg. Mit statistischen Auswertungen, Reproduktionen, Musterblatt und Kartenmustern des Landesvermessungsamts Baden-Württemberg, Stuttgart." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1976, 65 pages with 10 figures, 20 tables and 20 annexes.

— „OEEPE — Sonderveröffentlichung Nr. D-10"

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— „OEEPE — Sonderveröffentlichung Nr. D-11"

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— „OEEPE — Sonderveröffentlichung Nr. D-13"

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— „OEEPE — Sonderveröffentlichung Nr. D—15"

Timmerman, J.; Roos, P. A.; Schürer, K.; Förstner, R.: „Über die Genauigkeit der photogrammetrischen Gebäudevermessung. Bericht über die Ergebnisse des Versuchs Dordrecht der Kommission C der OEEPE." — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1983, 131 pages with 14 figures and 36 tables.

— „OEEPE — Sonderveröffentlichung Nr. D—16"

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Schürer, K.: Über die Genauigkeit der Koordinaten signalisierter Punkte bei großen Bildmaßstäben. Ergebnisse des Versuchs „Wien" der Kommission C der OEEPE. — Nachr. Kt.- u. Vermess.-wes., Sonderhefte, Frankfurt a. M. 1987, 84 pages with 3 figures, 10 tables and 42 annexes.

C. Congress reports and publications in scientific reviews

— *Stickler, A.:* Interpretation of the Results of the O.E.E.P.E. Commission C. — Photogrammetria XVI (1959—1960) 1, pp. 8—12, 3 figures, 1 annexe (en langue allemande: pp. 12—16).

— *Solaini, L.; Trombetti, C.:* Results of Bridging and Adjustment Works of the Commission A of the O.E.E.P.E. from 1956 to 1959. — Photogrammetria XVI (1959—1960) 4 (Spec. Congr.-No. C), pp. 340—345, 2 tables.

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Content

page

G. Ducher: Test on Orthophoto and Stereo-Orthophoto Accuracy 9