



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

A journey through time: Digitizing, processing and publishing historical aerial imagery in Switzerland

- *The 1946 Showcase*

wissen wohin
savoir où
sapere dove
knowing where



Holger Heisig, Philip Jörg, André Streilein

EuroSDR Workshop on Geoprocessing and Archiving of Historical Aerial
Images

IGN headquarters | 94165 Saint-Mandé, France, 3rd – 4th June 2019



Media reception



LE TEMPS

SE CONNECTER SERVICES S'ABONNER

RUBRIQUES - EN CONTINU BLOGS VIDÉOS MULTIMÉDIA - T MAGAZINE

RECHERCHER

Accueil > Suisse > 1946: quand les Américains prenaient la Suisse en photo depuis les airs



GÉOGRAPHIE

1946: quand les Américains prenaient la Suisse en photo depuis les airs

Juste après la seconde Guerre Mondiale, une soixantaines de bombardiers américains ont photographié l'ensemble du territoire helvétique en quatre mois. Ces images, restaurées et numérisées, sont désormais consultable en ligne

2 minutes de lecture

Histoire

ATS

Publié mardi 21 mai 2019 à

14:57, modifié mardi 21 mai



Schweiz Ausland Wirtschaft Sport People

Ihre Story, Ihre Informationen, Ihr Hörvergnügen! feedback@zmk

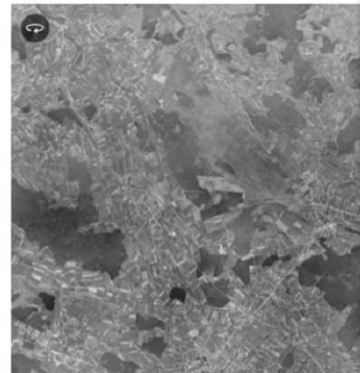
Eine Zeitreise

21. Mai 2019

So anders sah die Schweiz nach dem Weltkrieg aus

In 73 Jahren kann sich vieles ändern. Das zeigen die 1946 aus amerikanischen Fliegern aufgenommen

Flughafen Zürich



Business directory

Noticeboard

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In pics: Historic photos taken by US bombers show changing face of Switzerland



A before and after image of Zurich's Kloten Airport. Photo: Swiss Federal Office of Topography

The Swiss government has just published a remarkable archive of historical photos taken from the air which reveal how much the country has changed in the last 70

Swiss online media titles from 21 & 22 May 2019



ABO «AMERIKANERBEFLIEGUNG» vor 42 Minuten

Eine Zeitreise – dank der Bilder aus den Bombern

1046 suchten die Amerikaner und die Briten eine Beschäftigung für ihre
Rei der Operation «Casey Jones» dem

az AARGAUER ZEITUNG

START AARGAU SCHWEIZ AUSLAND WIRTSCHAFT SPORT LEBEN

Jetzt aktuell: FC Aarau • Regierungskrise in Österreich • Niki Lauda

HISTORISCHE LUFTAUFAHMEN

1946 und heute: Diese Bilder zeigen, wie sich der Aargau verändert hat

AZ • Zuletzt aktualisiert am 23.5.2019 um 15:31 Uhr



swissinfo.ch

#20yearsSWI

#SWISSHISTORYPICS

American aerial photos show Switzerland in 1946

By Helen James



Neue Zürcher Zeitung

Schweiz

BILDSTRECKE

Amerikanische Bilder zeigen die Schweiz nach dem Zweiten Weltkrieg – aus der Luft

Im Sommer 1946 überflogen amerikanische Bomber in friedlicher Mission die Schweiz: Sie machten Luftbilder. 73 Jahre später werden die Aufnahmen veröffentlicht. Sie zeigen ein einzigartiges Bild einer verschwundenen Schweizer Landschaft.

2014 1946



Swiss online media titles from 21 & 22 May 2019



Die Schweiz 1946

Aus SRF News vom 21.05.2019.

News >

Panorama >

Fotoflüge von US-Bombern

Die Schweiz aus der Luft – damals und heute

1946 wurden die Waffen an Bord von 66 US-Bombern durch Fotoapparate ersetzt. Sie lieferten einzigartige Luftbilder.



US-Bomber liefern einzigartige Bilder

So sah die Schweiz 1946 von oben aus

Watson

Schweiz International Wirtschaft Sport Leben Spass Digital Wissen Blogs Videos Wettbewerbe

Schweiz > Wissen > Operation «Casey Jones»: So hat sich die Schweiz seit 1946 verändert



bid: map.geo.admin.ch

73 Jahre in einem Klick: So hat sich die Schweiz seit 1946 verändert

Swiss online media titles from 21 & 22 May 2019



Why so much media attention?

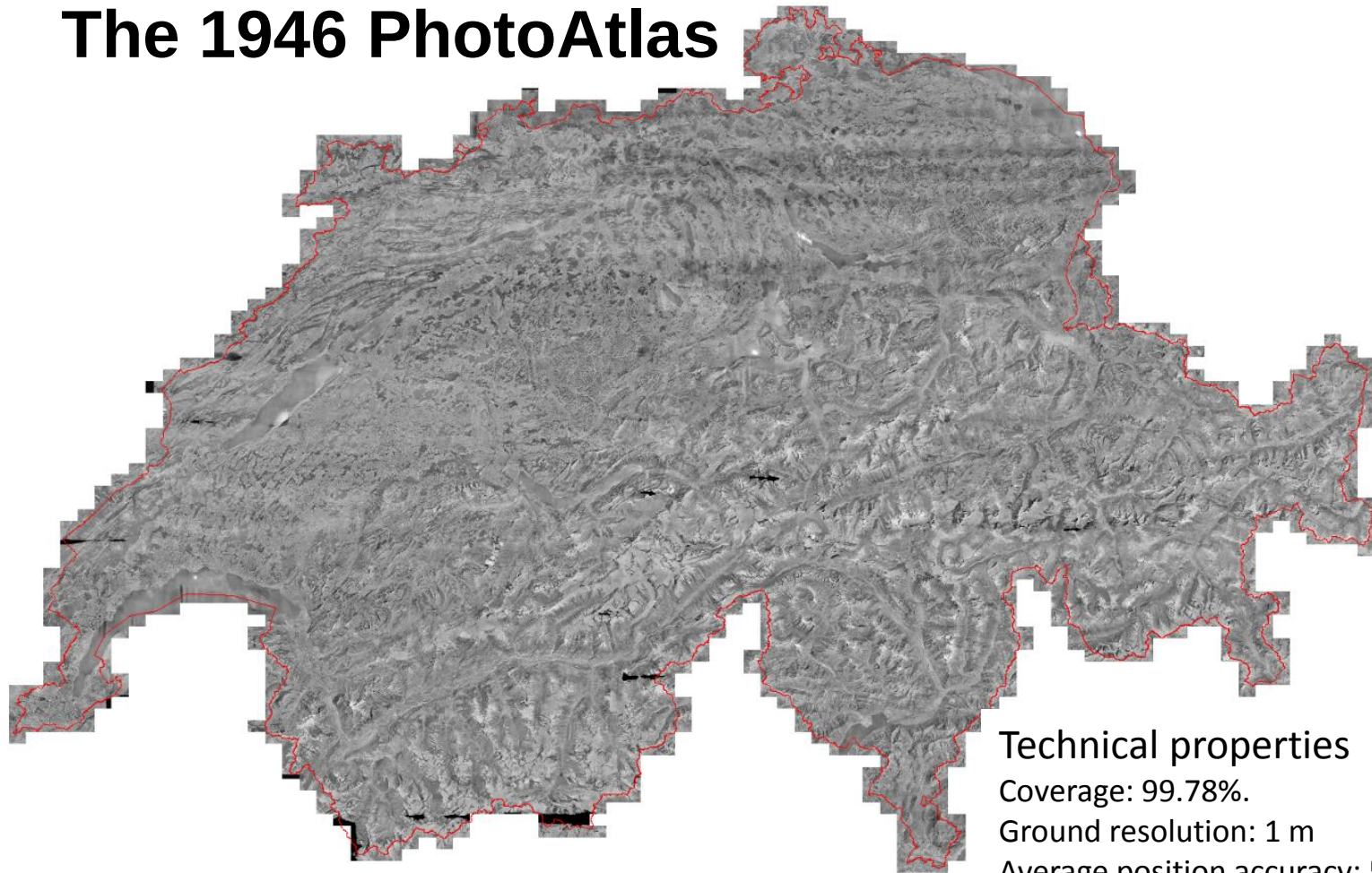
- «New» Ortho-mosaic released: Switzerland in 1946
- Unique and country-wide ortho-photo coverage
- Snapshot of a long disappeared landscape
- Basis for the general public and research to make the enormous changes in the Swiss landscape visible.
- Convenient and fast online viewing and comparing
- Published and promoted through press release on 21 May 2019



2. The products



The 1946 PhotoAtlas



Technical properties

Coverage: 99.78%.

Ground resolution: 1 m

Average position accuracy: 5 – 10 m



Online viewing and comparing

- Central platform: www.maps.ch
- 4 languages (English, French, German, Italian)
- Search for dataset, e.g. “1946”
- Display “SWISSIMAGE HIST 1946” dataset
- Use *Advanced tools/ Compare* to compare with most recent Orthodata or map data



Online viewing and comparison



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In collaboration with the cantons

Search for a place or add a map:

[Try out test.map.geo.admin.ch](#) [Full screen](#) [Report problem](#) [Help](#) [Mobile version](#) [DE](#) [FR](#) [IT](#) [EN](#) [RM](#)

► Share

► Print

► Draw & Measure on map

▼ **Advanced tools**

Import

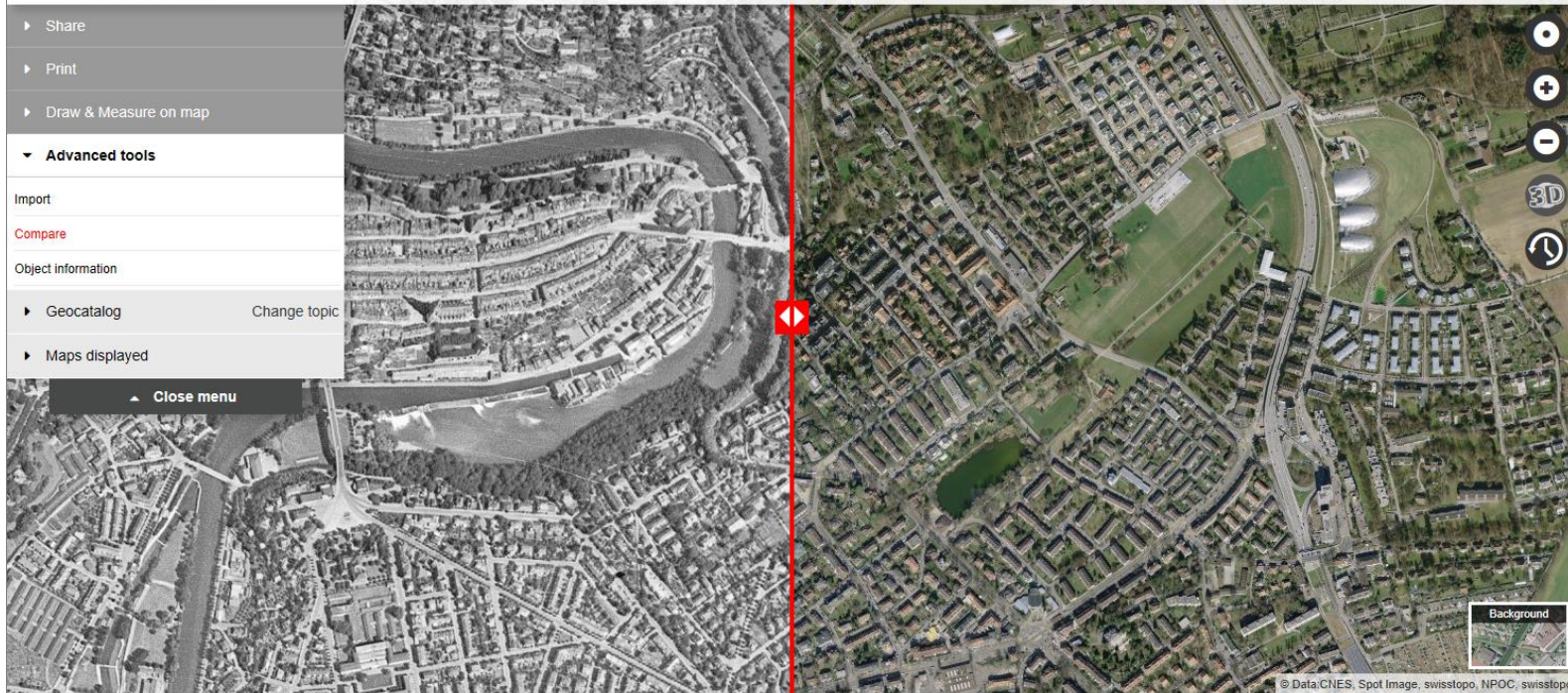
[Compare](#)

Object information

► Geocatalog [Change topic](#)

► Maps displayed

Close menu



Background

© Data: CNES, Spot Image, swisstopo, NPOC, swisstopo

[geo.admin.ch](#) Copyright & data protection



Some interesting changes

- <https://s.geo.admin.ch/81e15c2760>
- <https://s.geo.admin.ch/81e1607ffc>
- <https://s.geo.admin.ch/81e161c330>
- <https://s.geo.admin.ch/81e1631d91>
- <https://s.geo.admin.ch/81e164488d>
- <https://s.geo.admin.ch/81e1664fa3>
- <https://s.geo.admin.ch/81e167c987>



Querying metadata of acquisitions

Advanced tools

Geocatolag Change to

Maps displayed

- ☒ Aerial Images swisstopo b/w 1946
- ☐ Hiking trails
- ☐ Public transport stops
- ☐ Register of Buildings and Dwellings
- ☐ Journey through time - Maps 1864

Transparency

Looking for more maps?

Close menu

Select a year

All	2010	2009	2008
2007	2006	2005	2004
2003	2002	2001	2000
1999	1998	1997	1996
1995	1994	1993	1992
1991	1990	1989	1988
1987	1986	1985	1984
1983	1982	1981	1980
1979	1978	1977	1976
1975	1974	1973	1972

Object information

Aerial Images swisstopo b / w (Federal Office of Topography swisstopo)

Picture number 19460120030089

Flight date 08-06-1946

Film type bw

Quickview

More info [Link to object](#)

Order (CHF 91.55)



But still printable

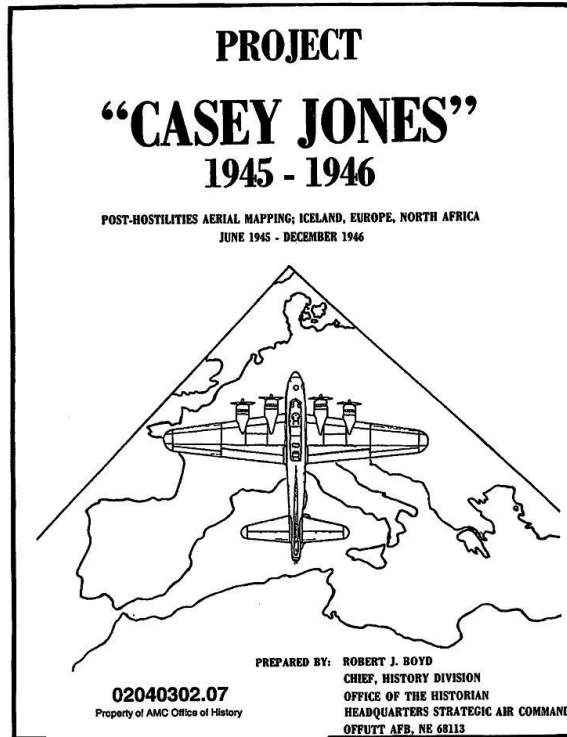




3. Historic Context



Not bombing but photography

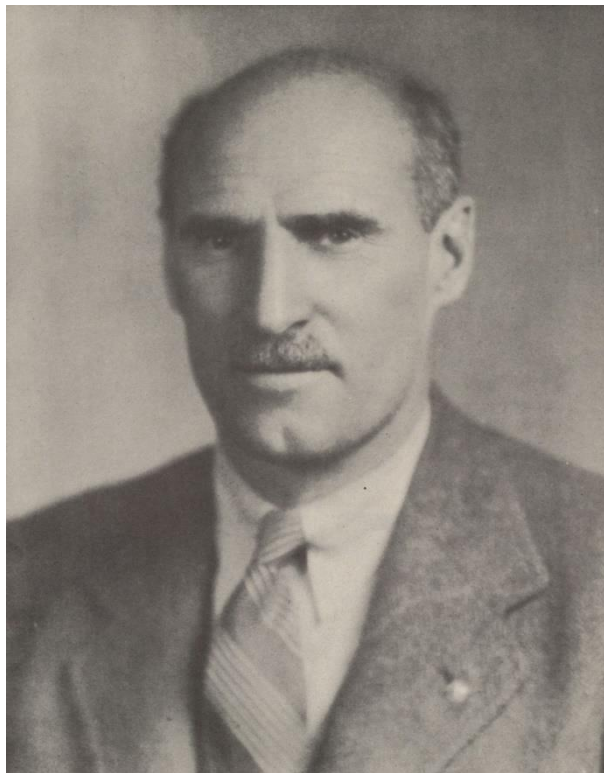


Robert J. Boyd:
Project «Casey Jones»
1945–1946. Post-Hostilities
Aerial Mapping; Iceland,
Europe, North Africa
June 1945 – December 1946
[1988], 61 S.

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defense articles or services is implied or intended.*



Project «Casey Jones» 1945–1946

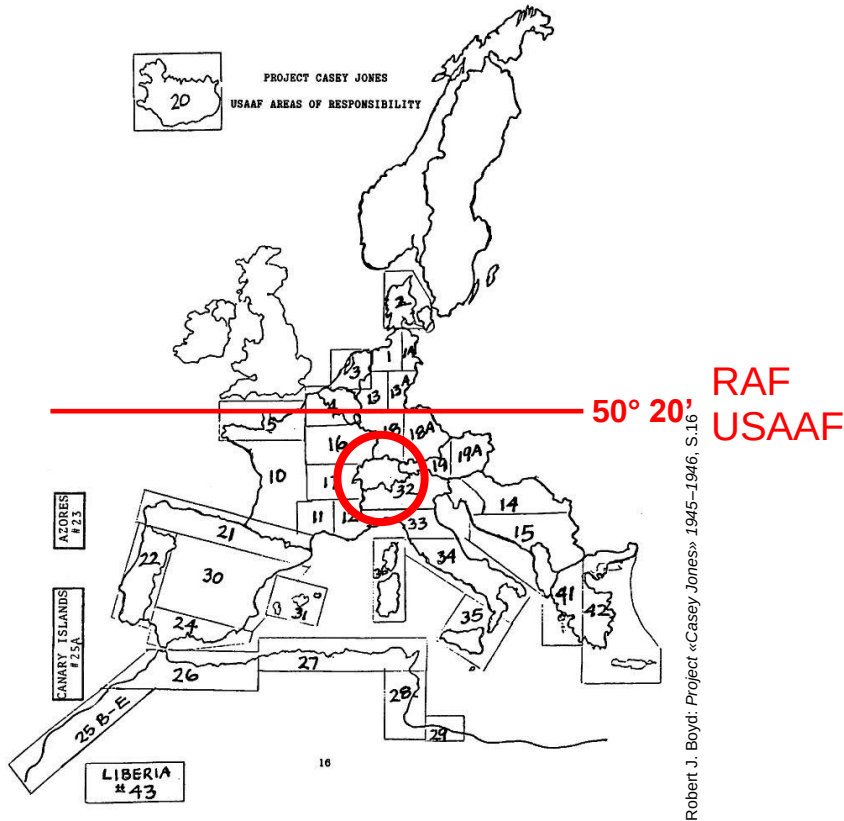


Casey Jones Cyclopedica of Aviation Terms, New York/London, 1946

- Named after American aviation pioneer Charles S. «Casey» Jones (11.1.1894–2.2.1976)
- Mid 1944: Start of planning («top secret»)
- Gigantic (photo) mapping project
 - over 2 million square miles
 - 66 participating aircraft



Project «Casey Jones» 1945–1946



Common project of

- *US Army Air Force
USAAF*
- *RAF Royal Air Force
(UK)*



Diplomatic agreements with Switzerland

D'entente avec le Gouvernement du Royaume-Uni de Grande-Bretagne, le Gouvernement des Etats-Unis d'Amérique fait établir une carte mondiale à l'échelle de 1: 1'000'000 de miles devant servir à la navigation aérienne internationale et intercontinentale. Les services photographiques de l'armée des Etats-Unis, ayant des bases établies sur plusieurs continents, ont commencé le relevé photographique aérien qui est déjà terminé en grande partie ou en voie d'exécution en ce qui concerne l'Europe. Les autorisations nécessaires pour effectuer les prises de vues sur leurs territoires respectifs ont été accordées par les autres pays neutres.

Schweizerisches Bundesarchiv BAR E27 / 22042

- Creation of a world map 1:1'000'000 for international and intercontinental aviation
- Most of the aerial photographs in Europe have already been completed or are in the process of being completed.



Diplomatic agreements with Switzerland

Au cas où l'autorisation sollicitée serait accordée, les prises de vues photographiques aériennes seraient effectuées dans les conditions suivantes:

(a) Les photographies seraient prises à bord d'avions américains où se trouveraient, si cela est désiré, des observateurs suisses, et à une altitude de 6000 à 8000 mètres suivant la topographie du terrain survolé;

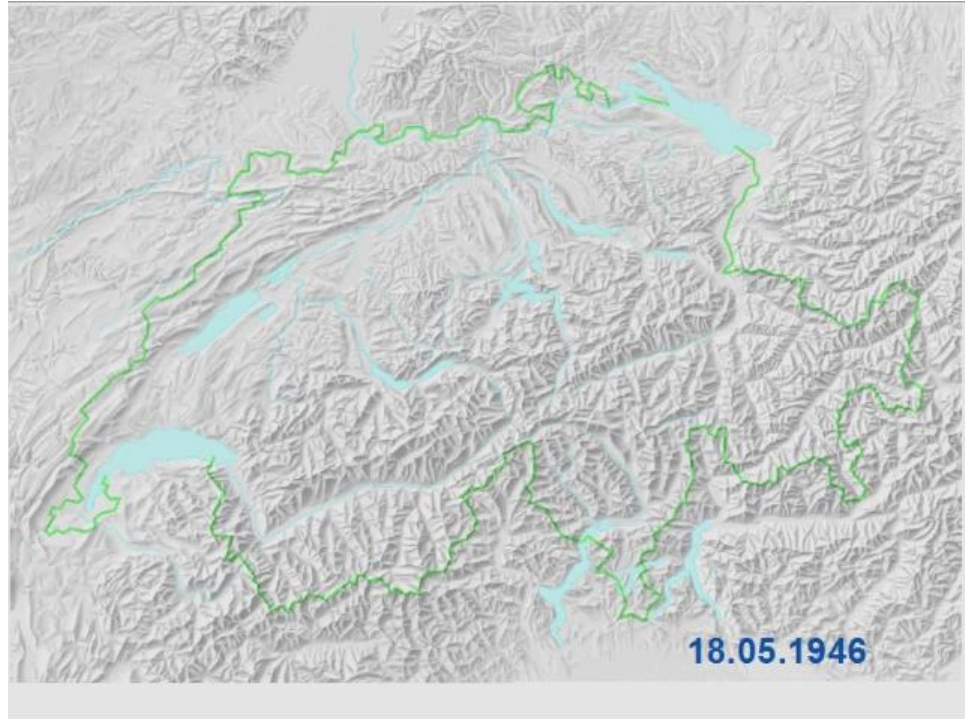
(c) Le nombre nécessaire de ces cartes serait tiré et un négatif des films serait mis à la disposition des autorités suisses;

Schweizerisches Bundesarchiv BAR E27 / 22042

- American aircraft with - if desired - Swiss observers on board
- A copy of the negatives would be made available to the Swiss authorities.

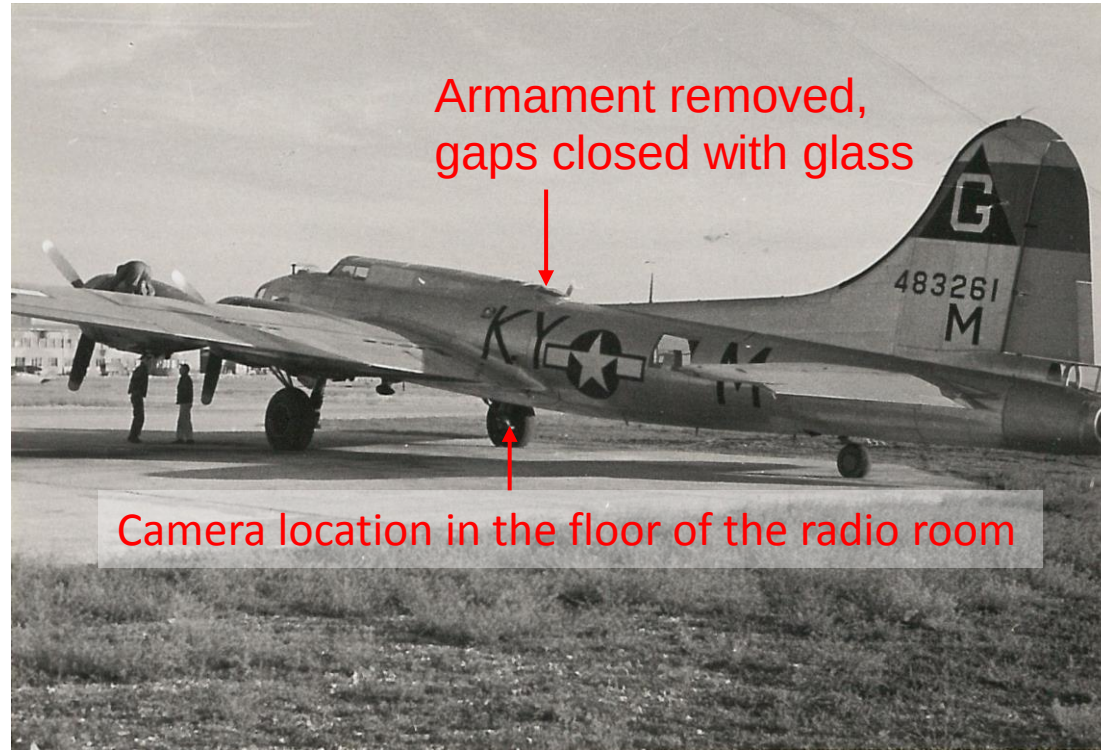


Chronology of *US Army Air Force* Image acquisition in 1946





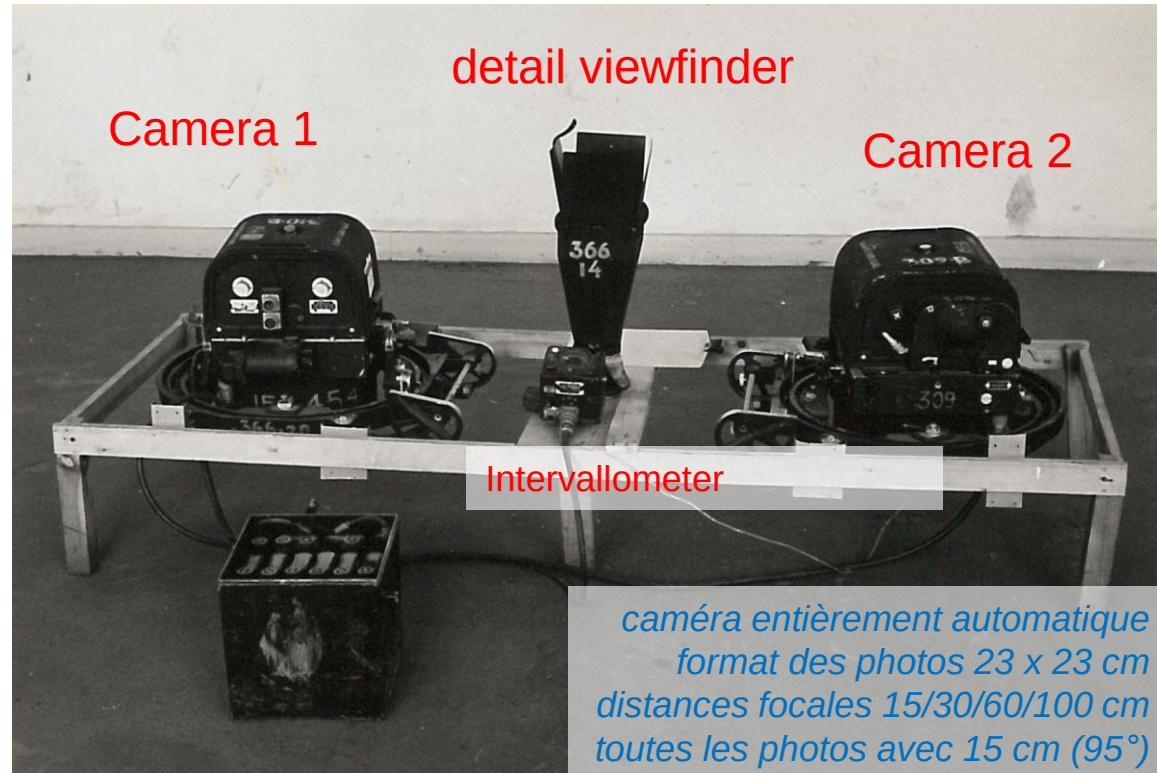
Recording Aircraft Boeing B-17 G



BAR E27/22042, Bericht der Fliegerrequisite der Landestopographie, Mai/Juni 1946, Abb. 28



«Mount Camera Vertical» Typ A-11



BAR E27/22042. Bericht der Fliegerrequisite der Landestopographie, Mai/Juni 1946, Abb. 21.



Navigator in the nose of Boeing B-17 G



BAR E27/22042, Bericht der Fliegergruppe der Landestopographie, Mai/Juni 1946, Abb. 34



View from the nose sideways



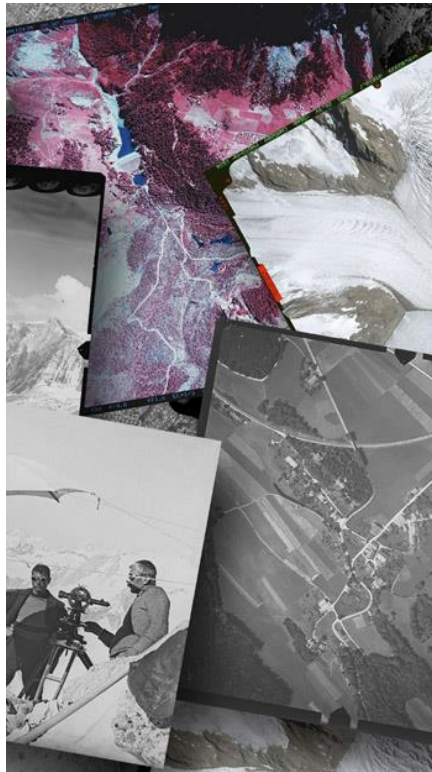
BAR E27/22042, Bericht der Fliegerrequisite der Landesopographie, Mai/Juni 1946, Abb. 36



4. The photo archives



The image collection of swisstopo



- collection period: late 19th to early 21st century
- scope: Approximately half a million analog recordings
- a valuable treasure of historical geodata and part of Switzerland's landscape memory.
- shall be preserved and made available to the public in its entirety.

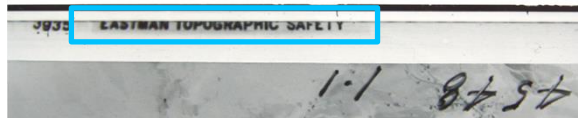


Conservation & Scanning plan of aerial imagery

Massnahmenplan Bilder		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021												
Luftbilder für Siegfriedkarte Glasnegative 1926–1954 45'000 Ex.	Konservierung																								
	Erfassung																								
	Scan																								
	Bereitstellung in %	0	0	0	20	40	60	80	100																
Terrestrische Aufnahmen Glasnegative 1915–1947 80'000 Ex.	Konservierung																								
	Erfassung																								
	Scan																								
	Bereitstellung in %					0	10	20	30	40	50	60	70	80	90	100									
Luftbilder für Übersichtspläne V+D Glasnegative 1927–1952 75'000 Ex.	Konservierung																								
	Erfassung																								
	Scan																								
	Bereitstellung in %									0	10	20	30	45	60	75	90	100							
Luftbilder 18x18 cm Acetat- und Nitratnegative 1946–1972 43'681 Bilder	Konservierung																								
	Erfassung																								
	Scan																								
	Bereitstellung in %	50	70	90	100																				
Luftbilder s/w 23x23 cm Negative Polyester 1967–2003 142'332 Bilder	Konservierung																								
	Erfassung																								
	Scan																								
	Bereitstellung in %	48	48	48	54	62	70	78	84	92	100														
Luftbilder Farbe 23 x23 cm Farbdias, Infrarot 1998–2008 105'216 Bilder	Konservierung																								
	Scan																								
	Mikrofilm																								
	Bereitstellung in %	40	40	40	40	40	40	40	40	40	45	50	55	60	65	70	75	80	85	90	95	100			
Bereitstellung in % des Gesamtbestands		23	26	30	36	40	45	50	56	59	62	64	67	69	72	74	77	81	83	86	89	93	96	98	100
Total Bilder		491'229																							
Anzahl Bilder bereitgestellt		112'983	129'357	145'731	175'205	198'129	221'053	243'977	273'451	288'188	302'925	315'205	327'486	339'767	352'047	364'328	376'609	397'077	409'358	421'638	438'013	454'387	470'761	483'042	491'229



Materiality and condition of the 1946 negatives



Film with lettering:

Signature of the recording

Type of the original film:

"3935 EASTMAN

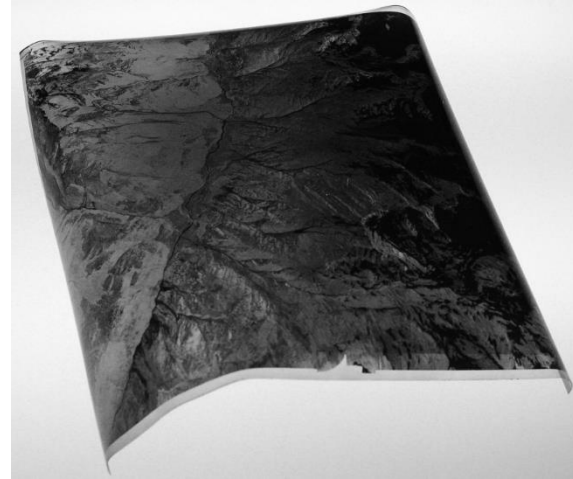
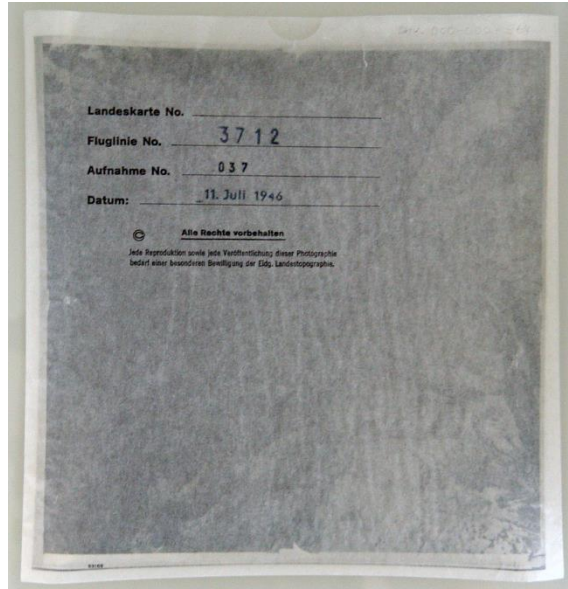
TOPOGRAPHIC SAFETY"

"Safety" = not fire
endangered

Duplicate negative on nitrate
film!



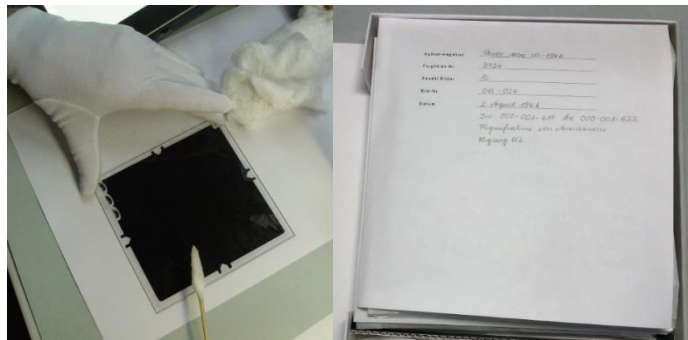
Materiality and condition of the 1946 negatives



Left: Film in the original cover
Right: swelling of the film



Safekeeping the 1946 originals



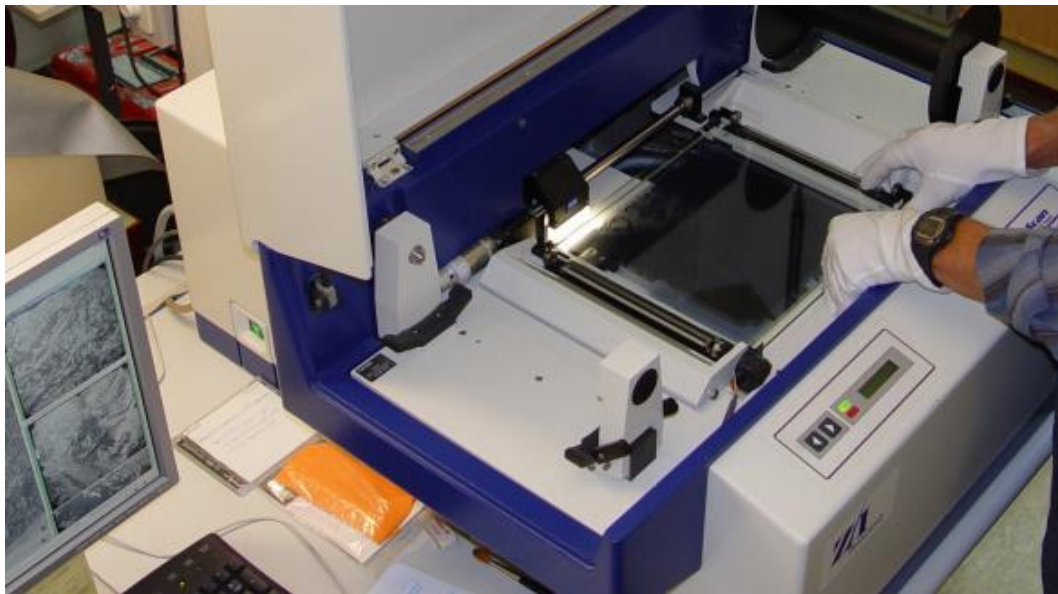
Left: Once

Right: Now



Scanning the 1946 originals

Number of scans	4117
Base	Negative
Scan resolution	14 micron





Metadata

LUBIS FRA

Version 4.4.1 | 17.02.2017

• No Changes since Version 4.4.1

Version 4.4.1 | 10.03.2018

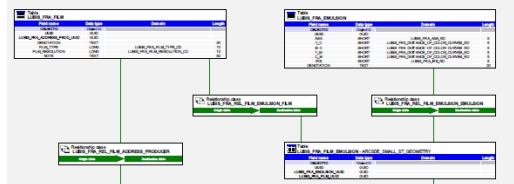
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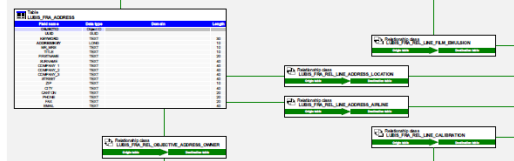
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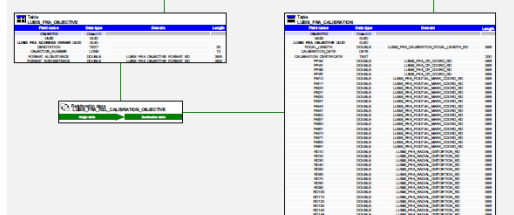
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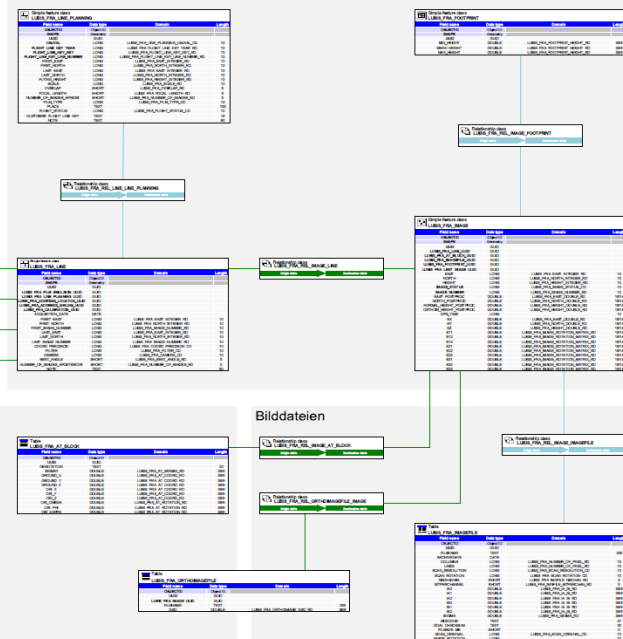
Ownership



Orientierung



Geometrie

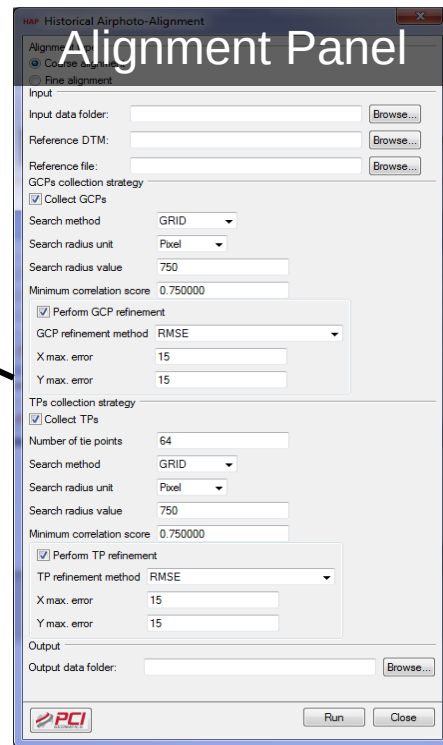
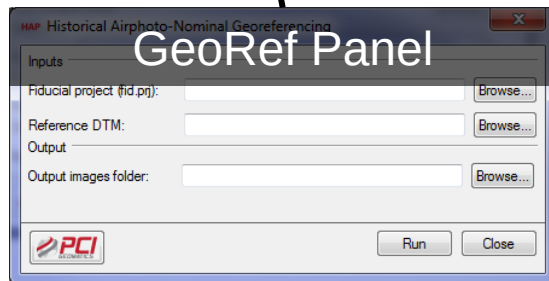
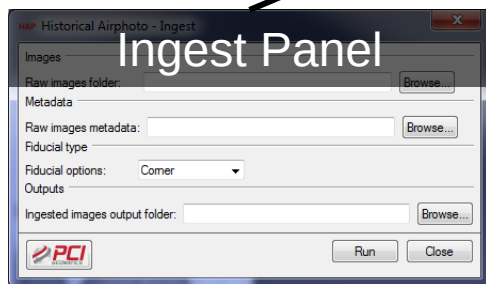
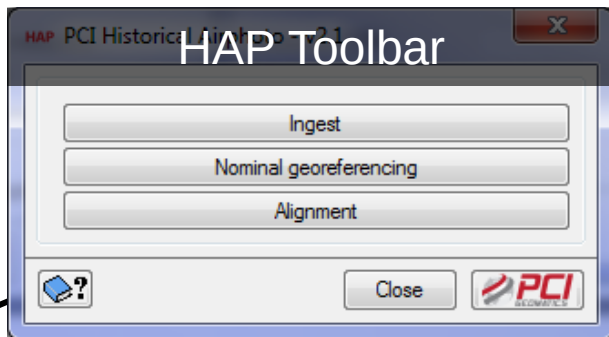




5. Processing

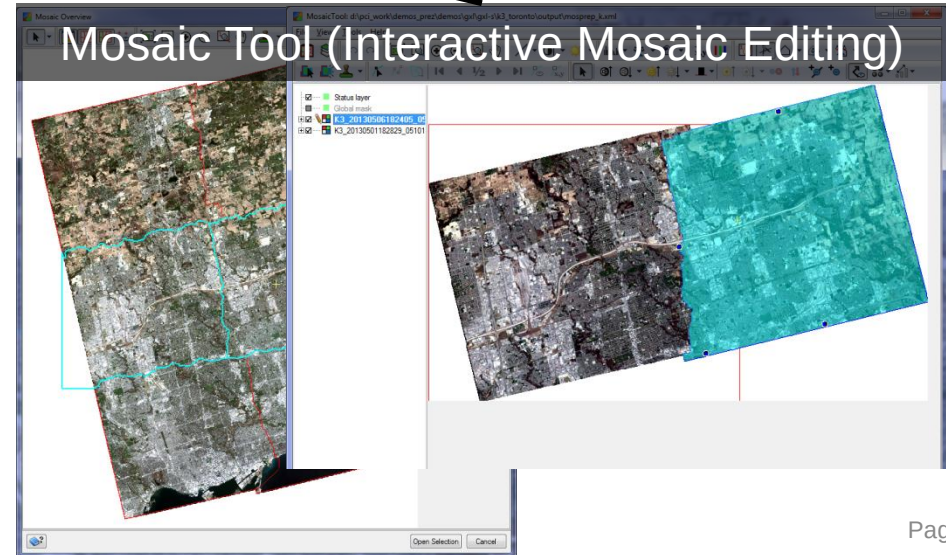
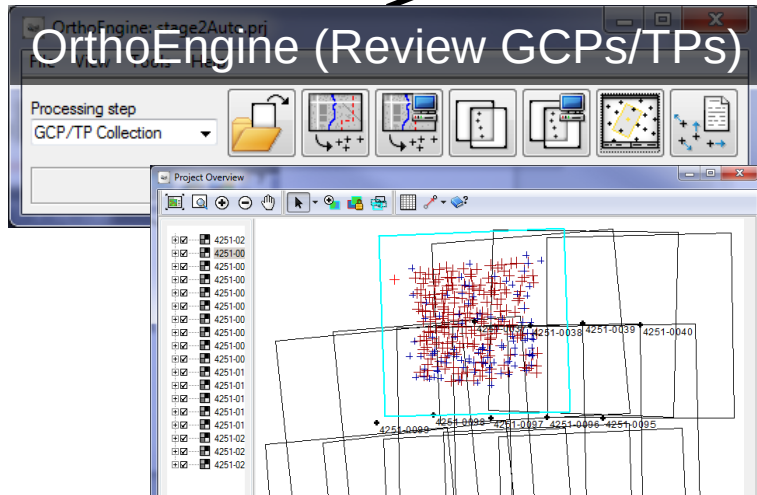


Image Orientation with HAP (Historical Air Photo), a module by PCI Geomatica.





HAP Quality Assurance Interface





HAP Image Metadata Requirements

- Physical paper dimensions
 - Height and width in inches
 - Dimensions cannot vary more than %5 between photos
- Approximate flying altitude or scale
 - Altitude in feet
- Approximate image centers
 - Estimate of scene centers < 2 km (in our case: < 100m!)
 - Longitude / Latitude (DD) WGS84
- Camera focal length
 - Focal length in millimeters



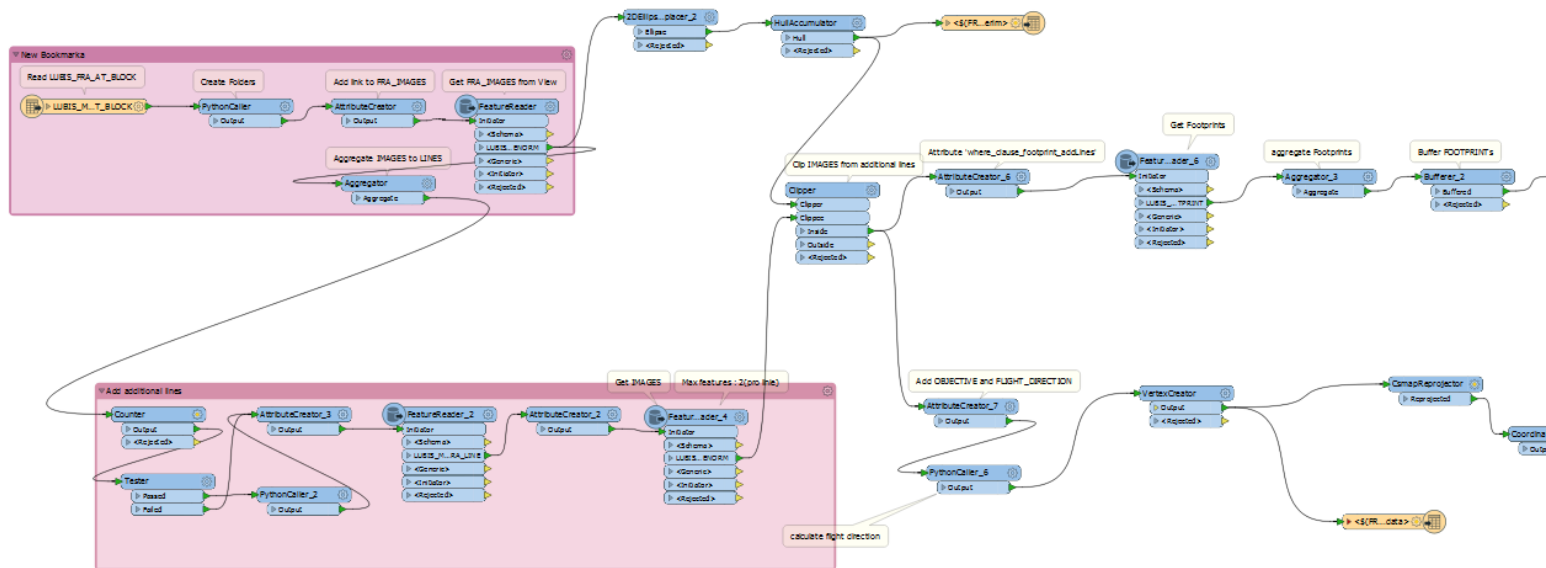
Reference Data Requirements for HAP processing

- Reference image
 - Resolution similar to uncorrected photos (1:5)
- Elevation model
 - Resolution should be less than 1:10 ratio between DEM and uncorrected photos



Automated data preparation with FME & Python

- Clipping & masking reference orthophoto etc.

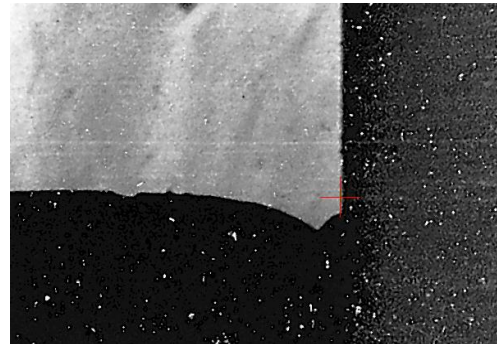




Building the Internal Orientation

	Dist X Top	Dist X Bot	Dist Y Left	Dist Y Right
	16001.82	16008.30	15989.80	16012.70
	15948.80	15955.01	15957.02	15971.11
	15966.80	15969.80	15998.01	16005.81
	16172.99	16169.11	16174.87	16181.58
	16083.54	16091.42	16088.32	16100.13
	16109.41	16101.40	16103.11	16111.40
	16036.74	16048.69	16066.56	16086.53
	16166.11	16166.11	16159.21	16165.11
	16185.00	16171.30	16181.40	16179.70
	16144.72	16128.33	16149.02	16144.20
	16116.47	16124.68	16085.54	16150.22
	16155.10	16150.71	16168.72	16164.43
	16108.65	16109.40	16157.30	16183.81
	16097.92	16089.60	16112.70	16132.60
	16191.07	16157.02	16125.70	16148.92
	16197.82	16166.30	16130.06	16157.11
	16200.63	16157.30	16111.74	16137.20
	16215.90	16178.72	16179.01	16204.81
	16069.61	16091.70	16083.82	16091.88
	16072.00	16079.13	16063.90	16093.00
	16170.01	16154.02	16132.61	16139.50
	16160.01	16134.11	16118.05	16122.21
	16158.13	16134.54	16111.01	16116.30
	16155.91	16167.43	16163.20	16204.70
mean	16120.19	16112.64	16108.76	16125.19
	16120.21	16112.67	16108.78	16125.21
stddev	73.79	62.93	60.41	60.27
inch	8.88	8.88	8.88	8.88
mm	225.59	225.49	225.43	225.66

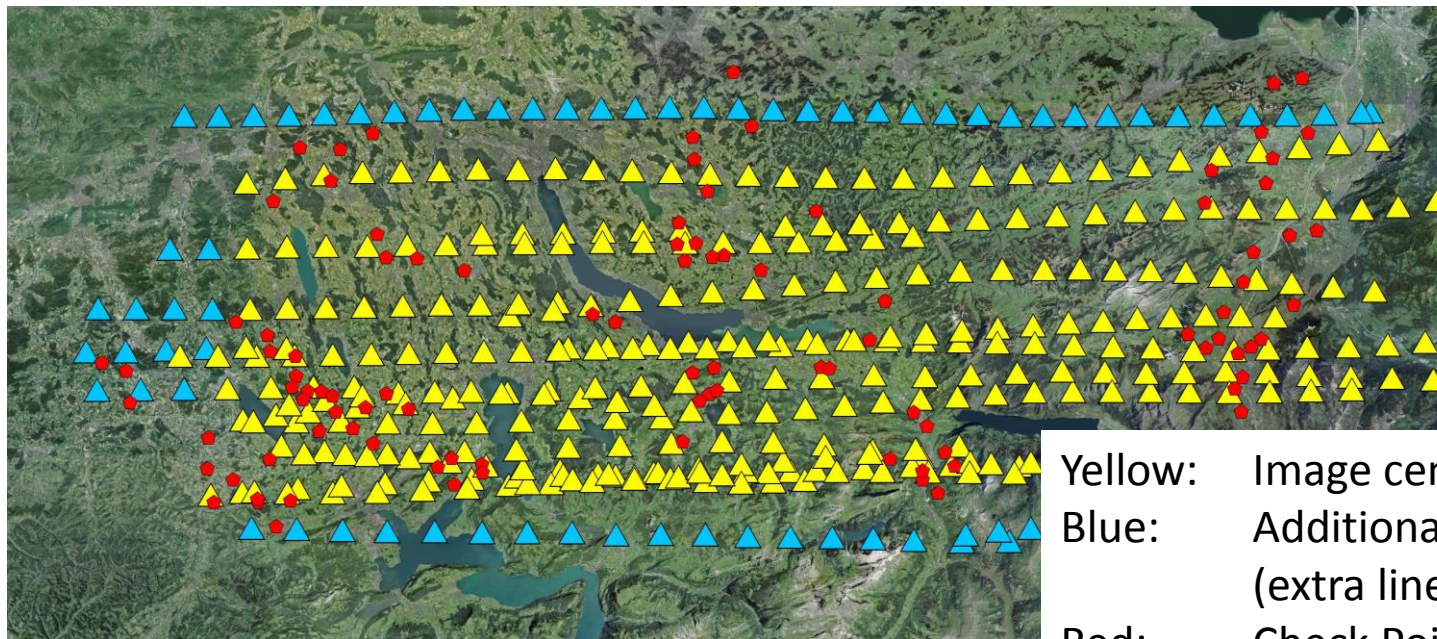
- Focal Length known (153.37 mm)
- No existing calibration files.
- No Fiducial Marks
- Calibration determined through manual measurements of image 'corners' from representative set of images
- Difficulties running automated fiducial mark detection





Typical block configuration

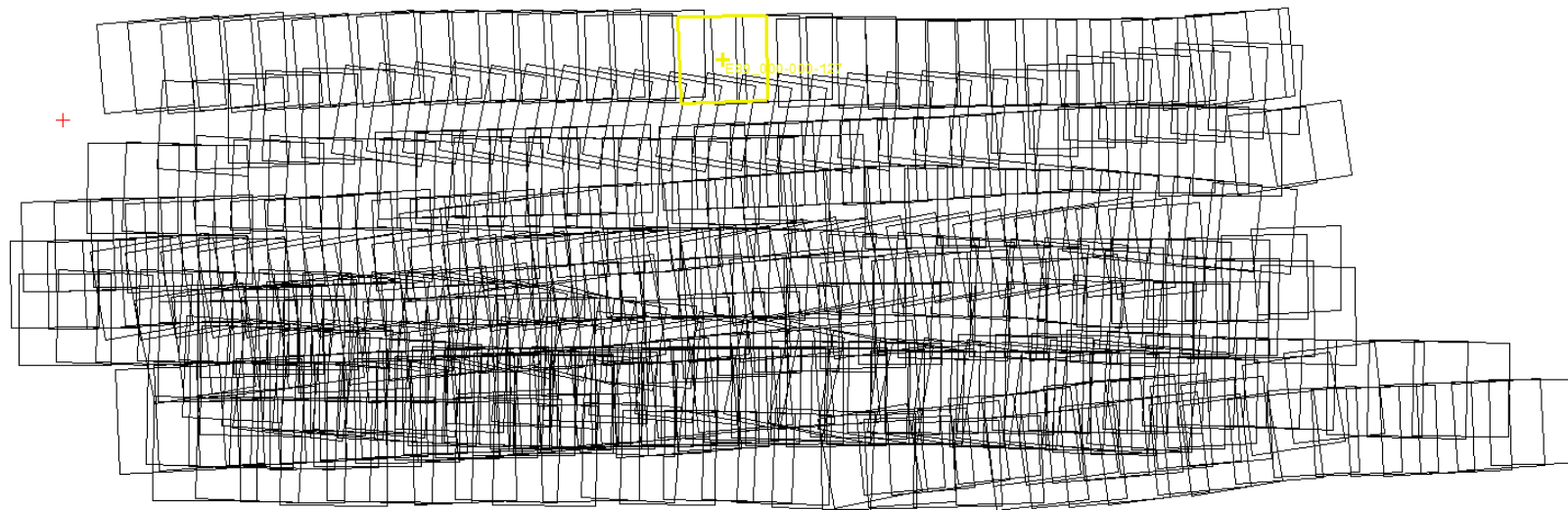
In total: 14 Photogrammetric blocks with 300-400 images each.



- Yellow: Image centers
- Blue: Additional images
(extra line or extended line)
- Red: Check Points

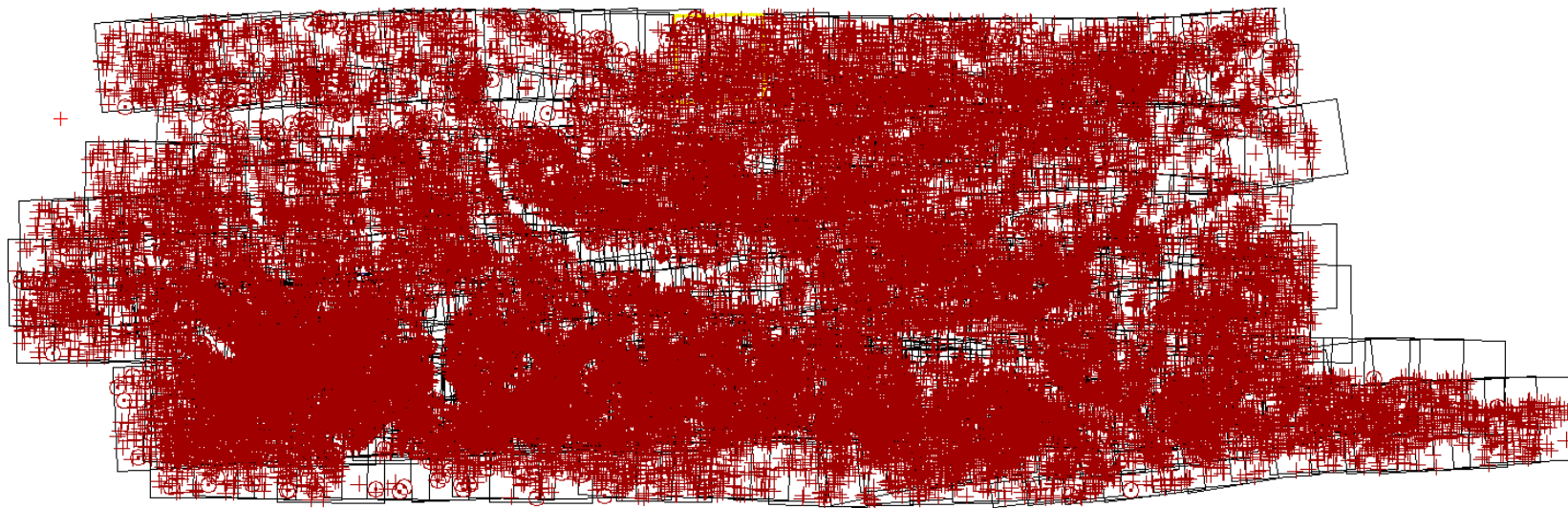


Image footprints



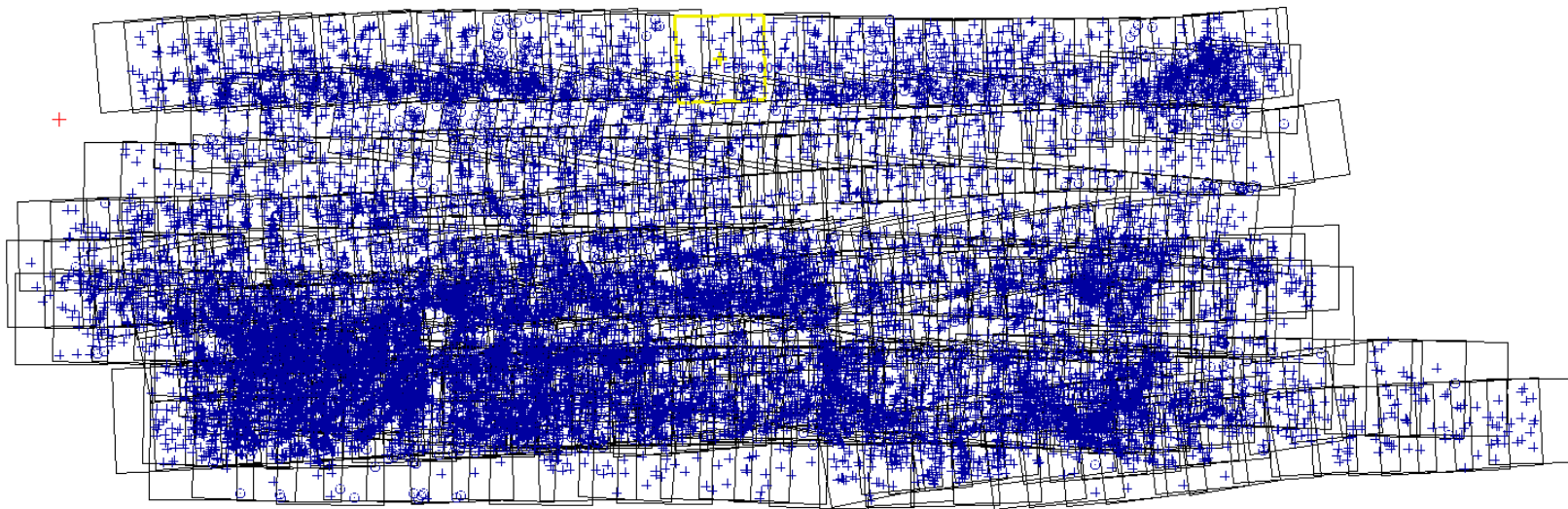


Running the HAP process results in
1) Huge number of automatically detected GCPs



 and

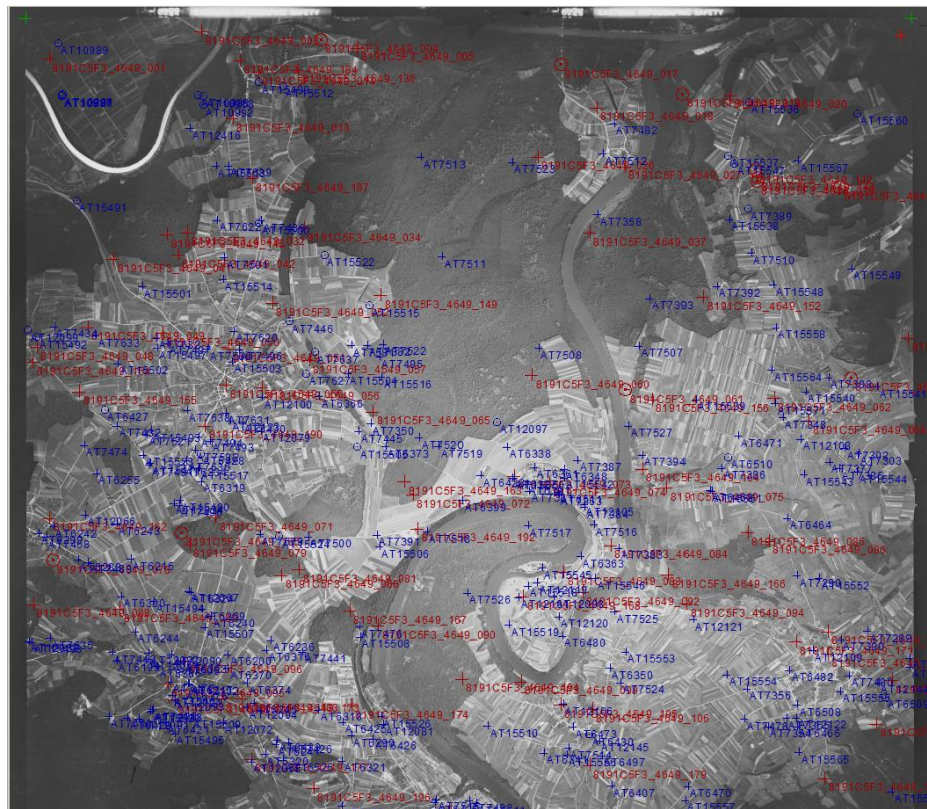
2) Huge number of automatically detected TPs





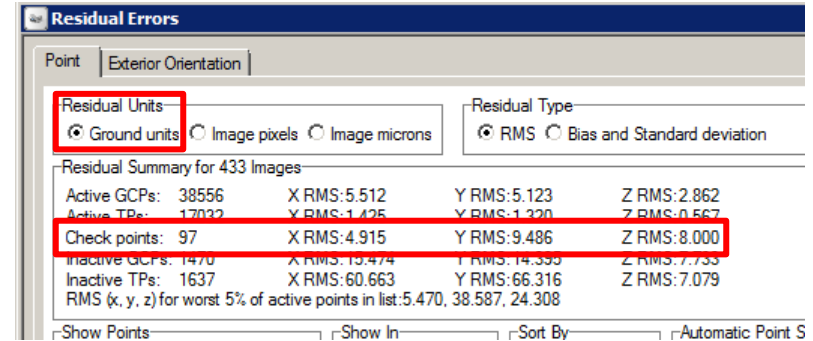
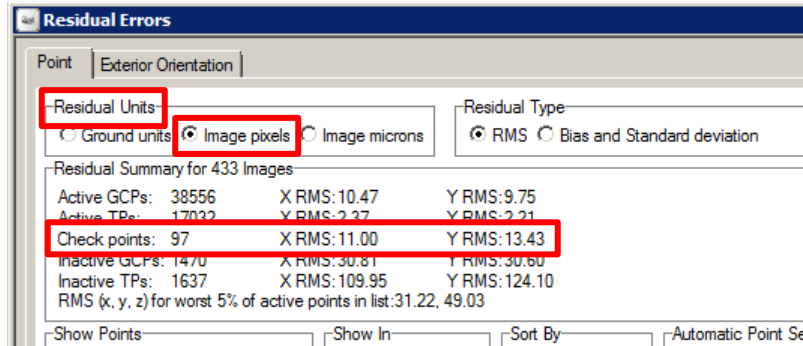
Residuals on manual Check Points:







RMS Error on Check Points in [pixel] (left) and [m] (right) for a typical block





Quality assurance on the ortho-photo





Quality assurance on the ortho-photo

1946 Ortho



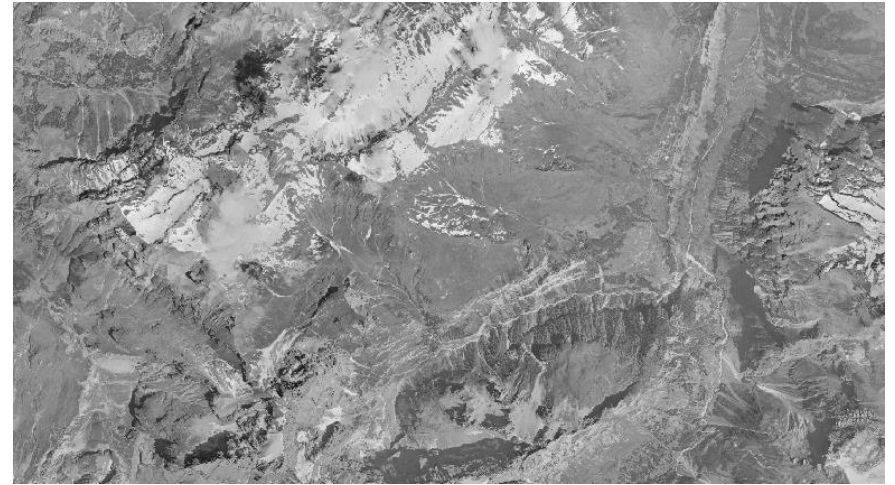
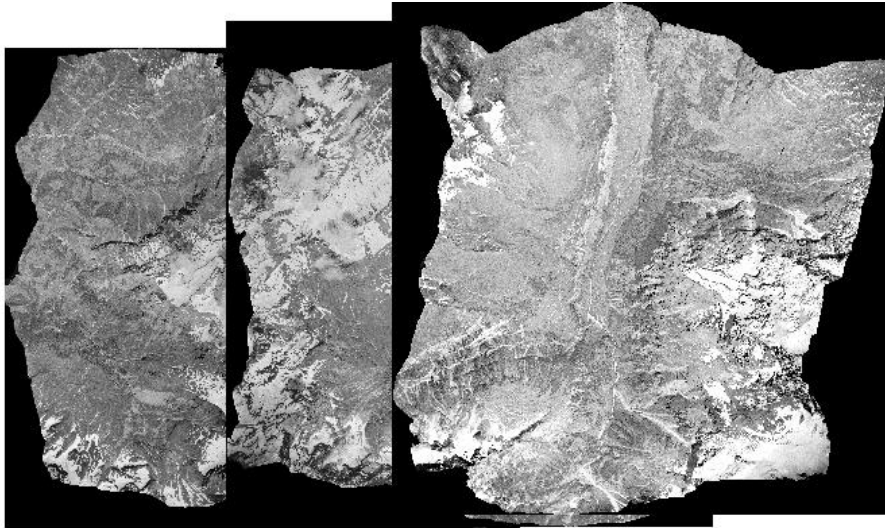
Recent Ortho





The mosaicking process

- Highly automated
- sw: INPHO Orthovista
- Manual improvement, minimizing cloud cover





6. Outlook



Our mission

Current:

around 400'000 aerial images (starting 1926) in the archives

329'885 images digitized & metadata collected

45'689 images oriented

4'117 images oriented for 1946 coverage

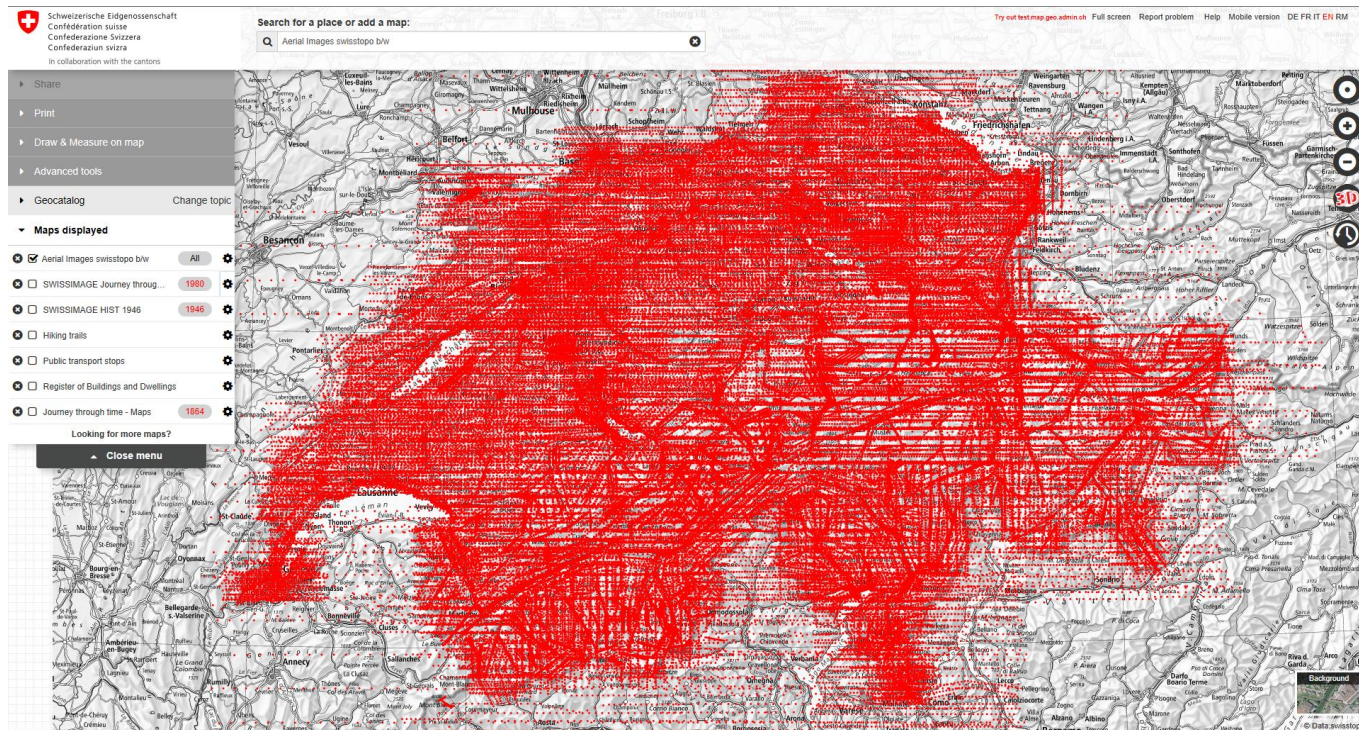
→ less than 1%! of the archives

My personal opinion:

“We should not rest until the last scanned image in the archives is oriented, orthorectified and published”



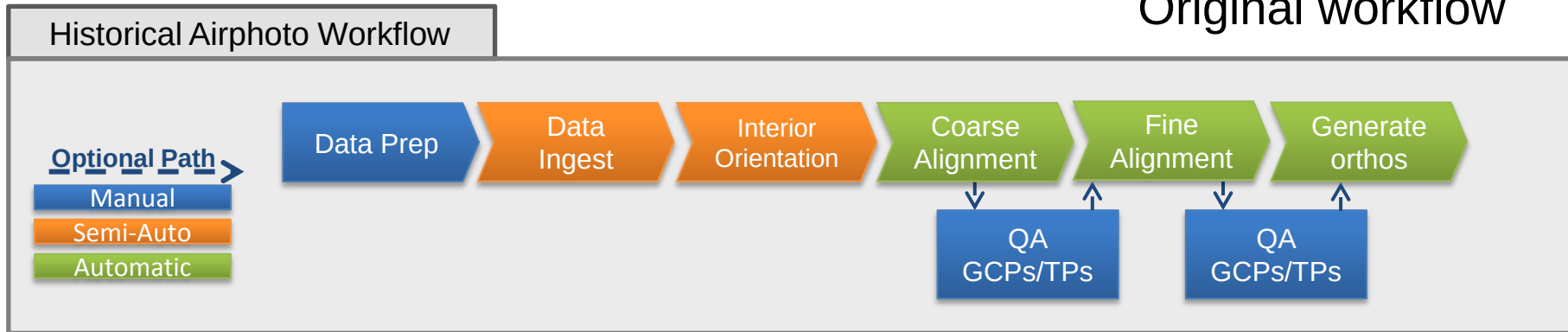
Projection centers of 329'885 images already digitized images



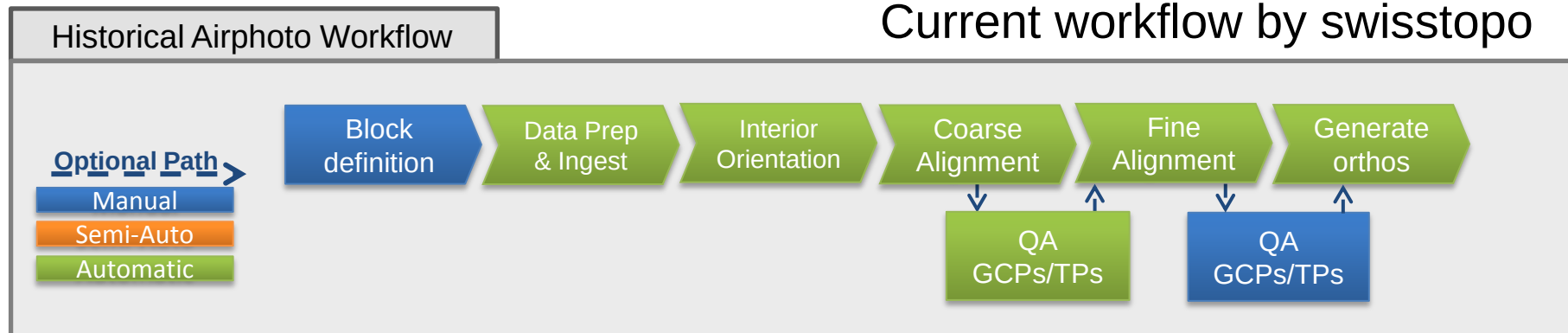


Towards fully automated workflows

Original workflow

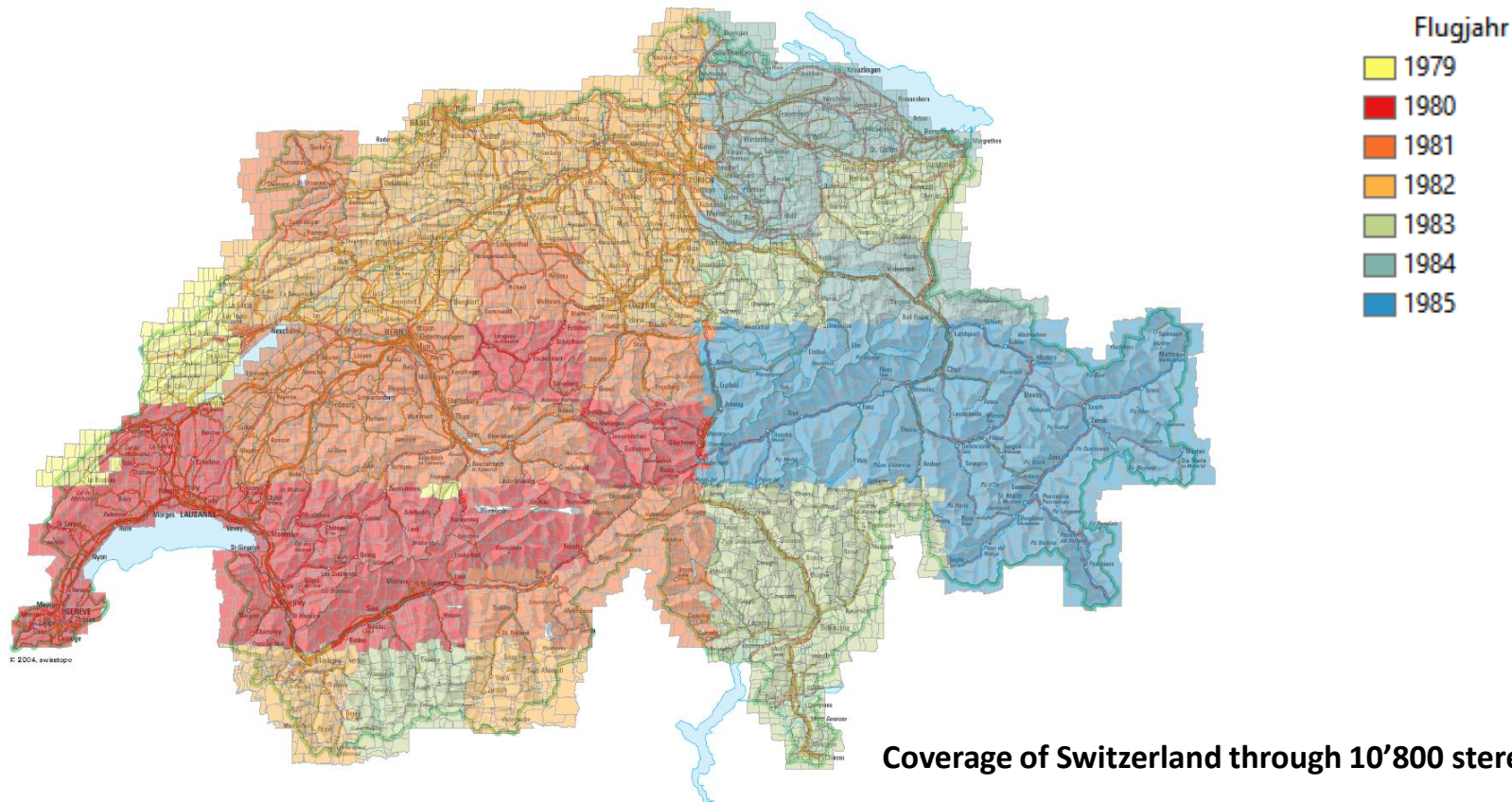


Current workflow by swisstopo



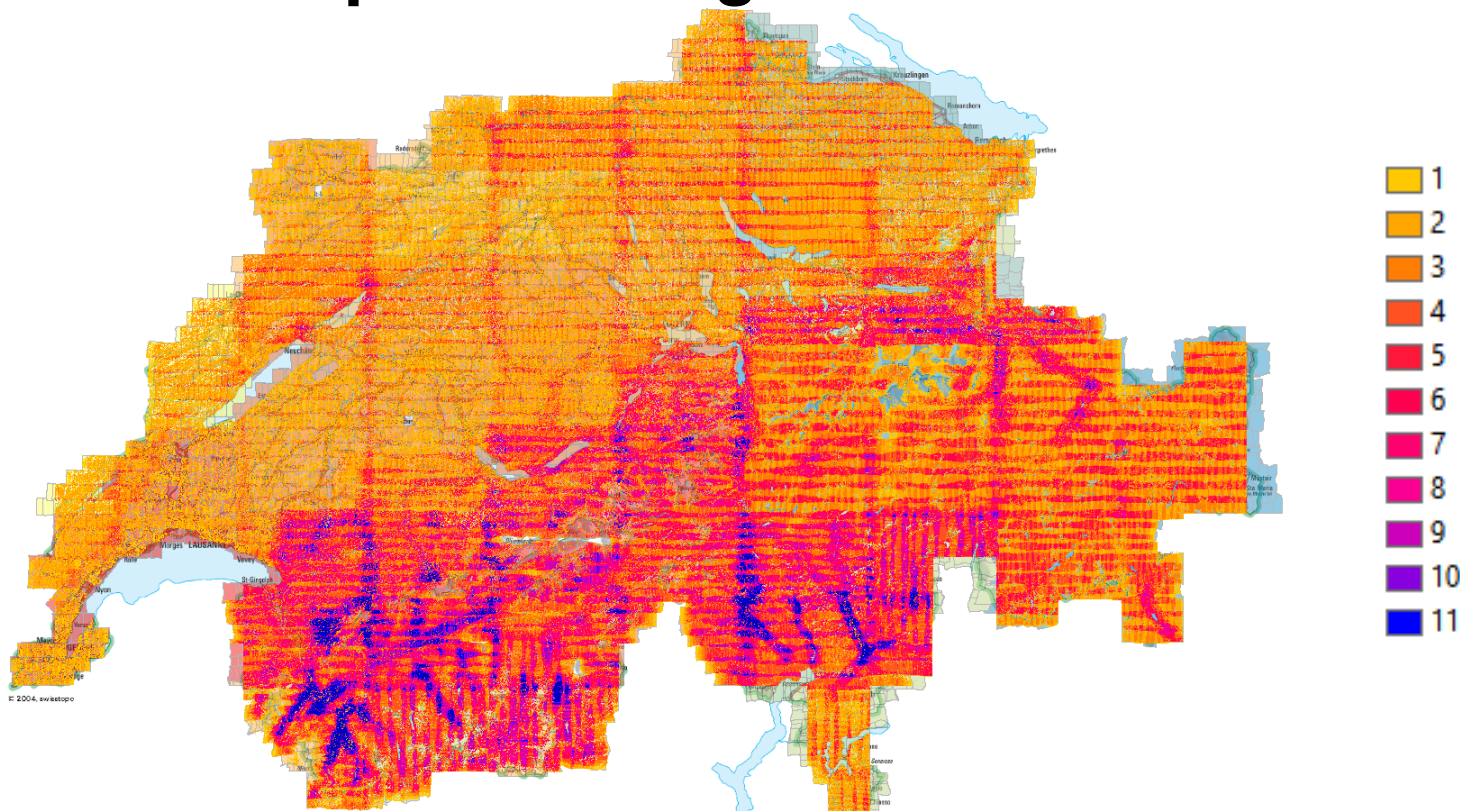


Application example: Historic Aerial Images from the 1980's





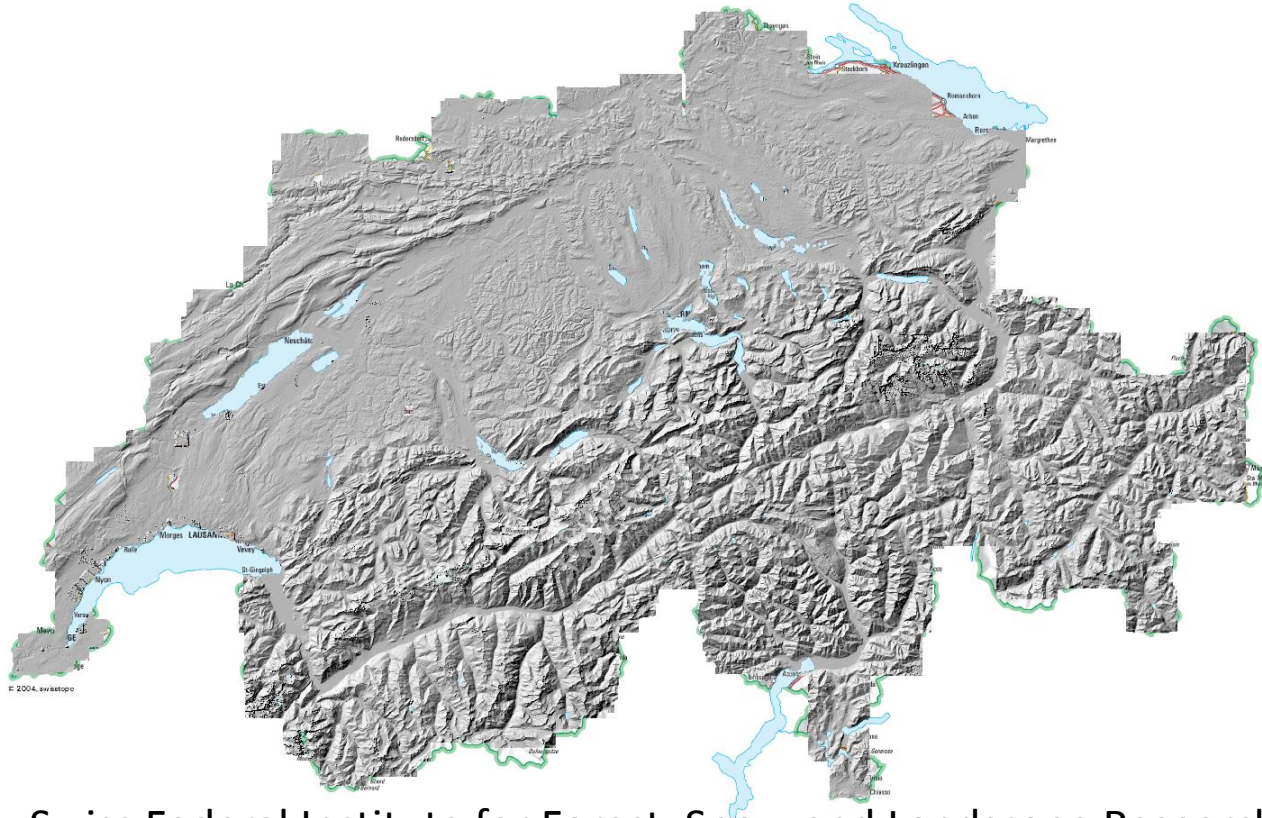
Historic Aerial Images from the 1980's: Multiple coverage in the stereo models



Swiss Federal Institute for Forest, Snow and Landscape Research WSL



Country-wide Derived Surface Model from Historic Air Photos

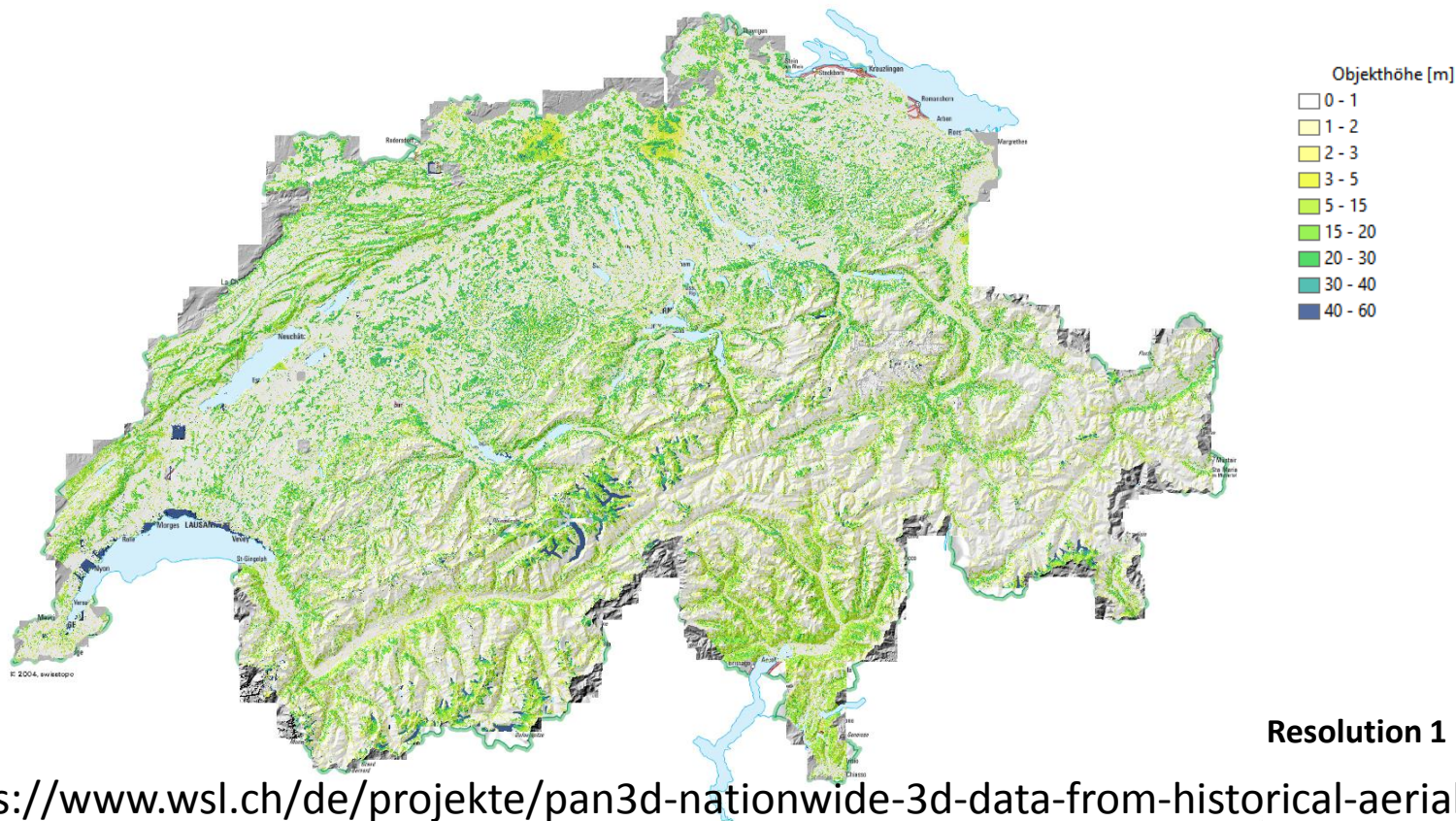


Resolution 1 m x 1 m

Swiss Federal Institute for Forest, Snow and Landscape Research WSL



Country-wide Vegetation Height Model from Historic Air Photos



<https://www.wsl.ch/de/projekte/pan3d-nationwide-3d-data-from-historical-aerial-imagery.html>



Aletsch glacier – biggest glacier of the Alps: 1981 and today

