Austrian Research Centre for Forests

BFW.

Serving Forest & People

Research - Monitoring - Training

Exploiting the DSM for vegetation analysis: example from forestry

Klemens Schadauer, Christoph Bauerhansl and Christian Ginzler (WSL)

2ndEuroSDRWorkshop on High Density Image Matching for DSM Computation

Federal Office of Metrology and Surveying (BEV) **13. 06. 2013**

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Multifunctional Forests

- As stated in the Austrian forest act
  - biodiversity function
  - well fare function
  - recreation function
  - protective function ←
  - economic function ←

- **Information on all topics is needed**

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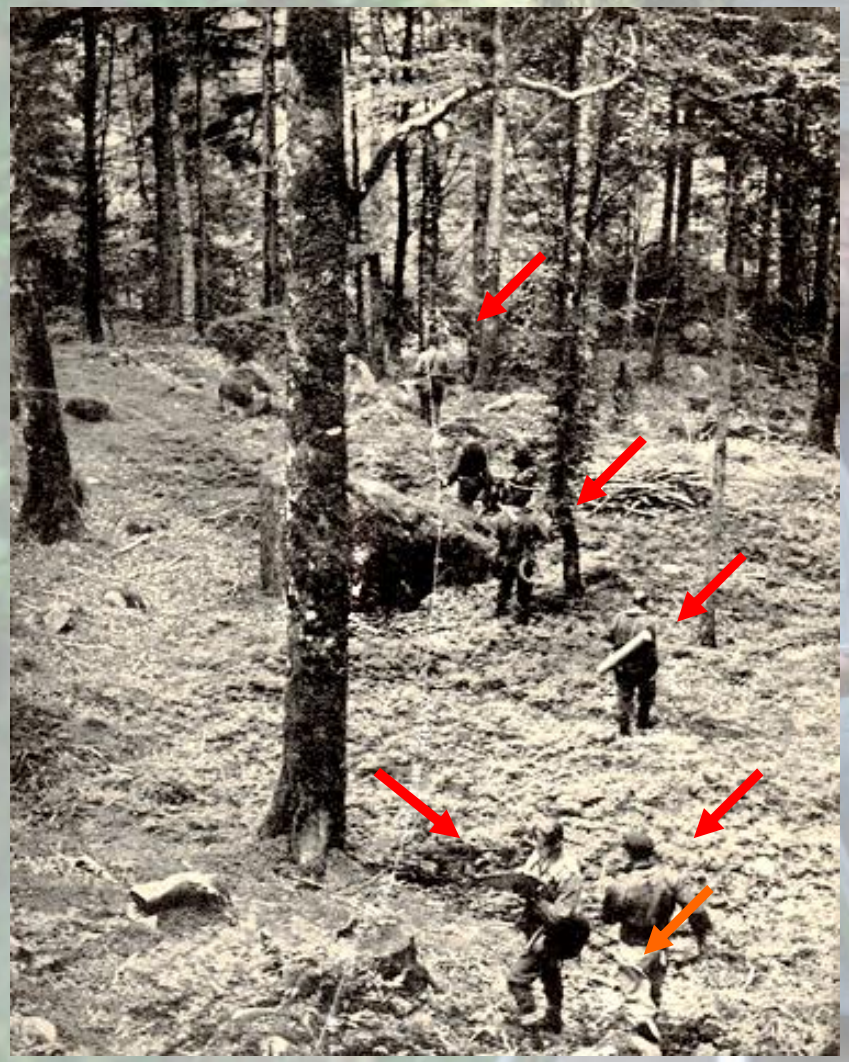
Old European NFIs ~1925

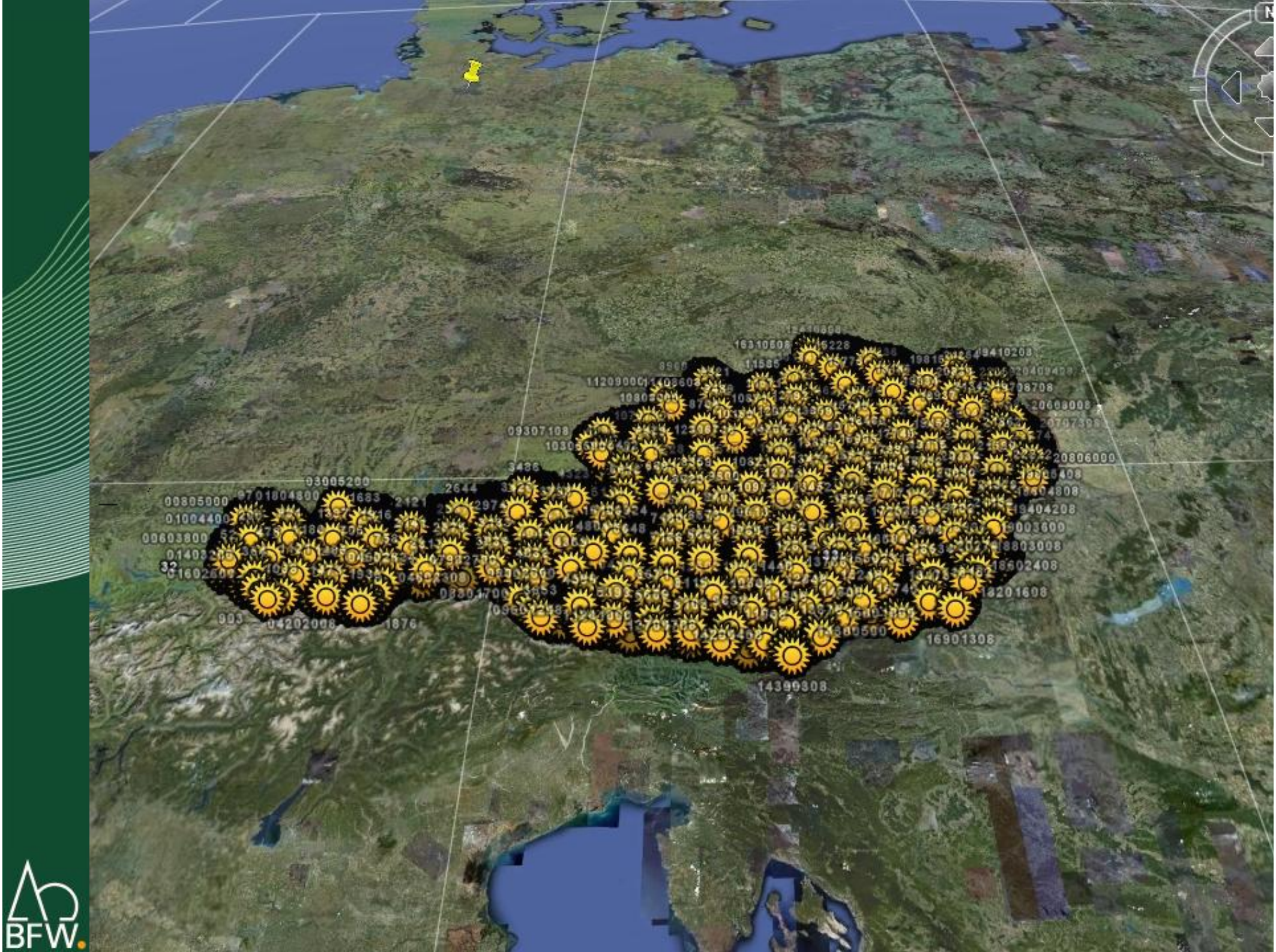
Swedish NFI

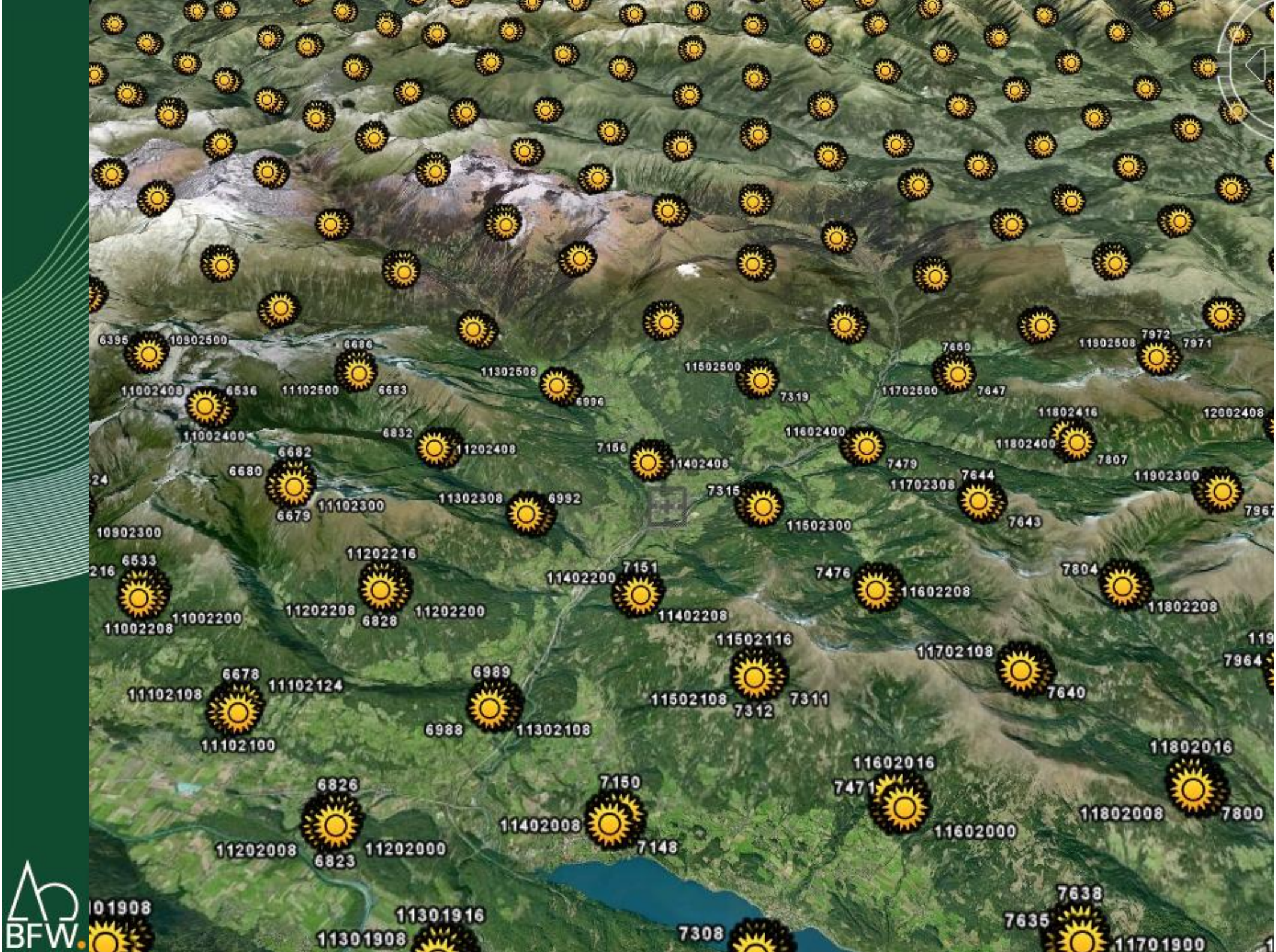


Finish NFI

Statistical based forest inventories in Austria

- 1961 - 1970 temporary Design
- 1971 - 1980 temporary Design
- 1981 - 1985 start permanent Inventory
- 1986 - 1990 first re-assessment
- 1992 - 1996 second re-assessment
- 2000 - 2002 third re-assessment
- 2007 - 2009 fourth re-assessment
- 2011 - 2013 Kyoto Inventory


BFW.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11002400
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11202408
7156
11402408
11602400
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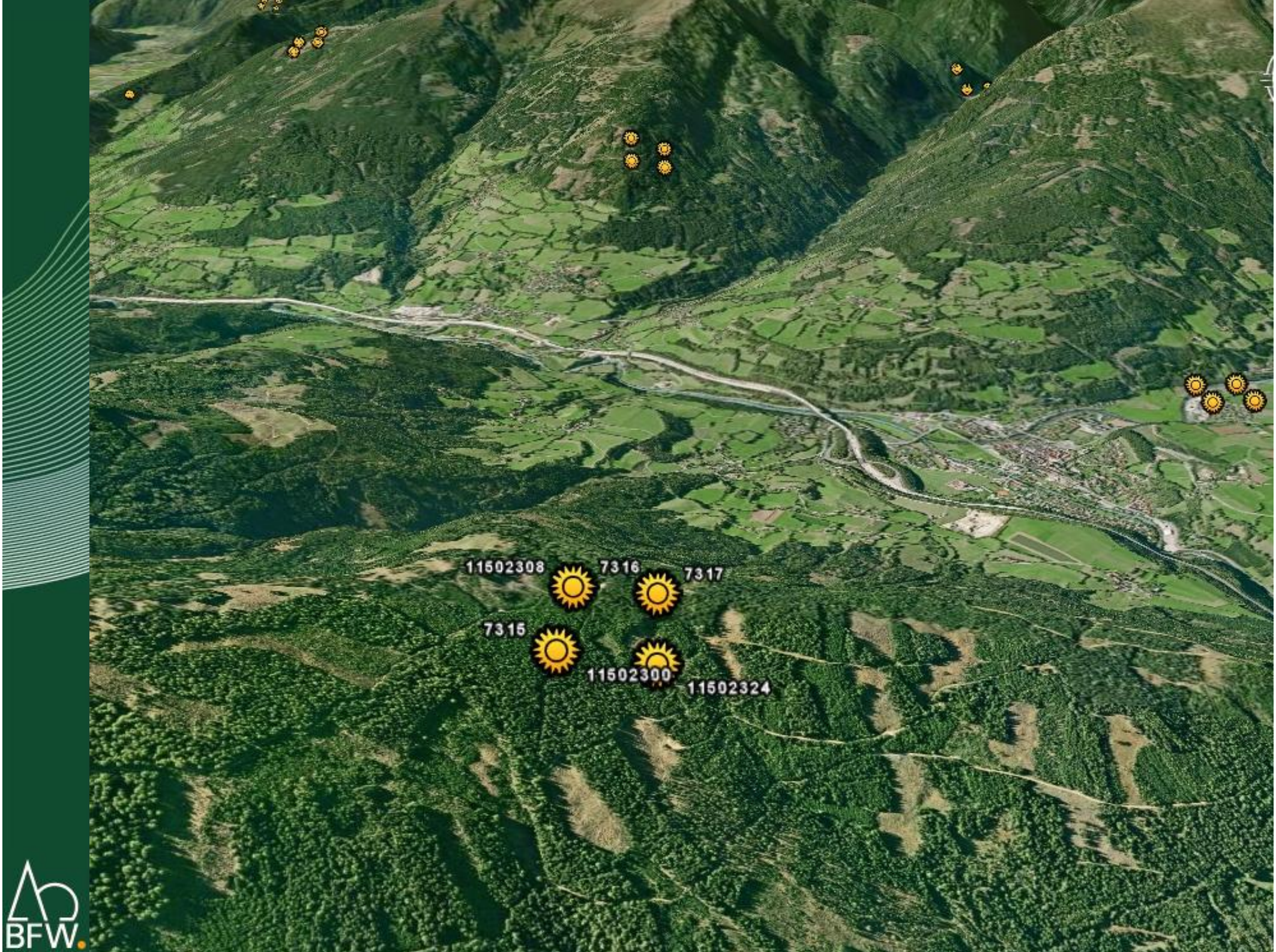
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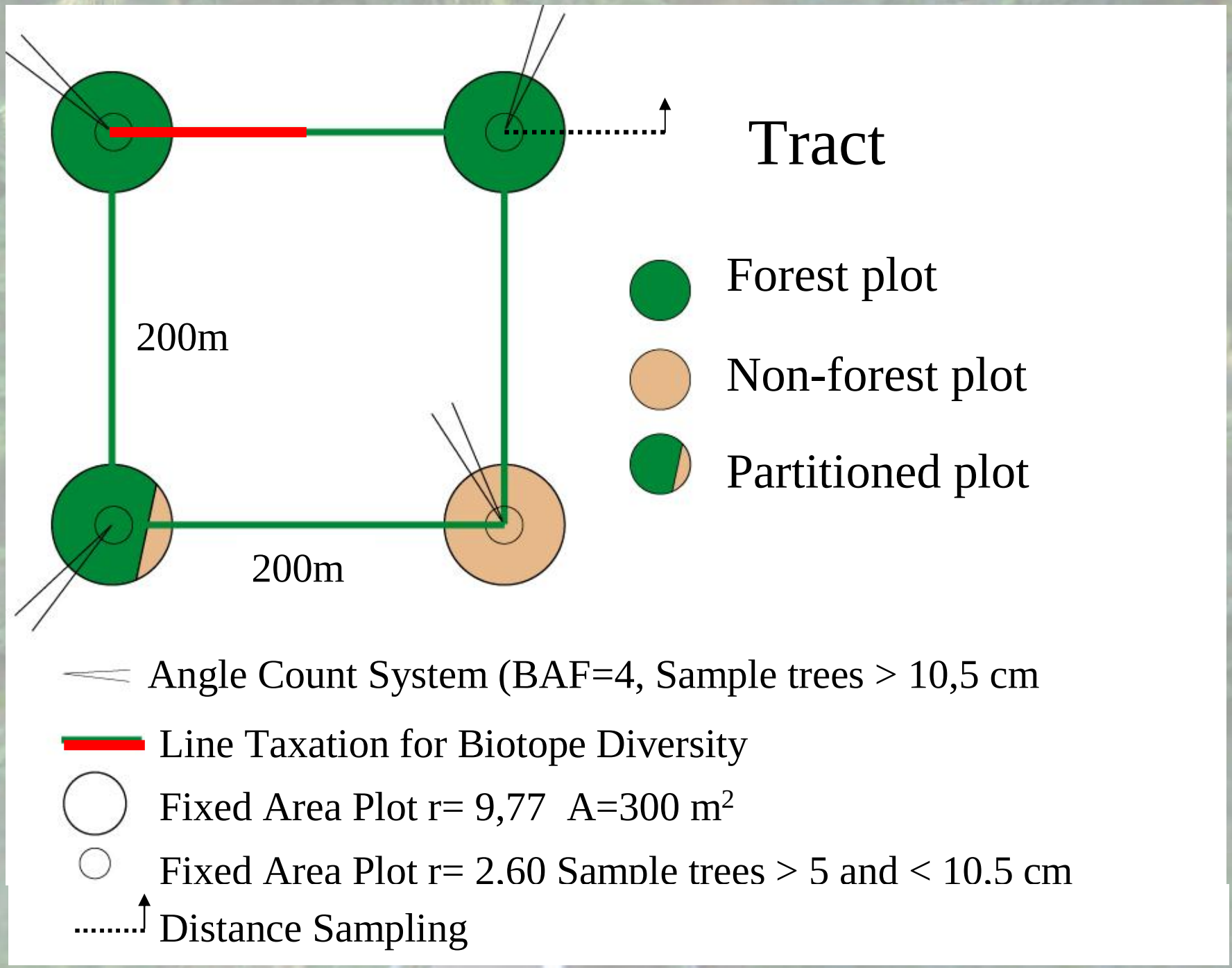
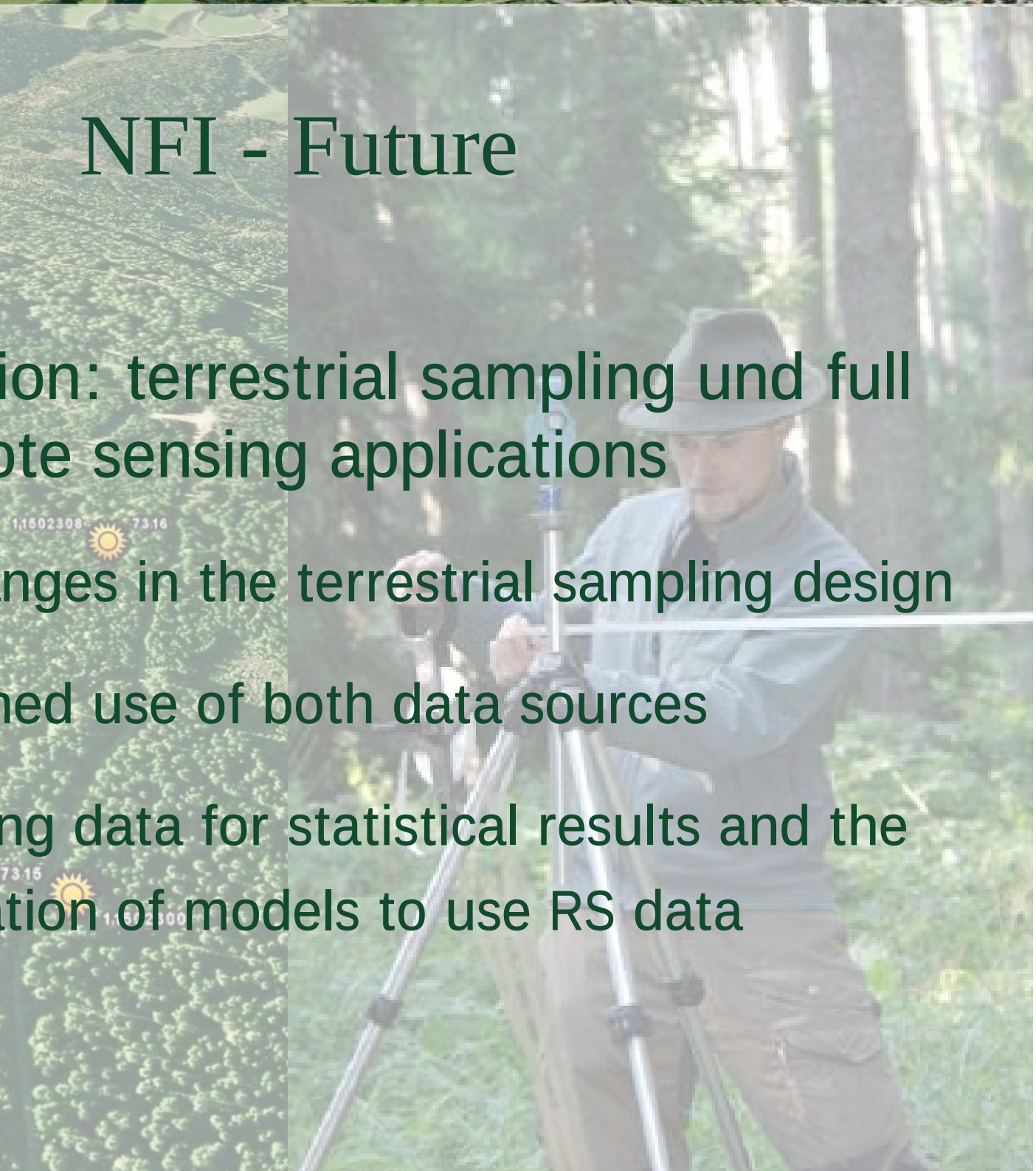

Tract
200m
200m
Forest plot
Non-forest plot
Partitioned plot
Angle Count System (BAF=4, Sample trees > 10,5 cm
Line Taxation for Biotope Diversity
Fixed Area Plot r= 9,77 A=300 m²
Fixed Area Plot r= 2.60 Sample trees > 5 and < 10.5 cm
Distance Sampling

NFI - Future

- Combination: terrestrial sampling und full area remote sensing applications
  - no changes in the terrestrial sampling design
  - combined use of both data sources
  - sampling data for statistical results and the calibration of models to use RS data



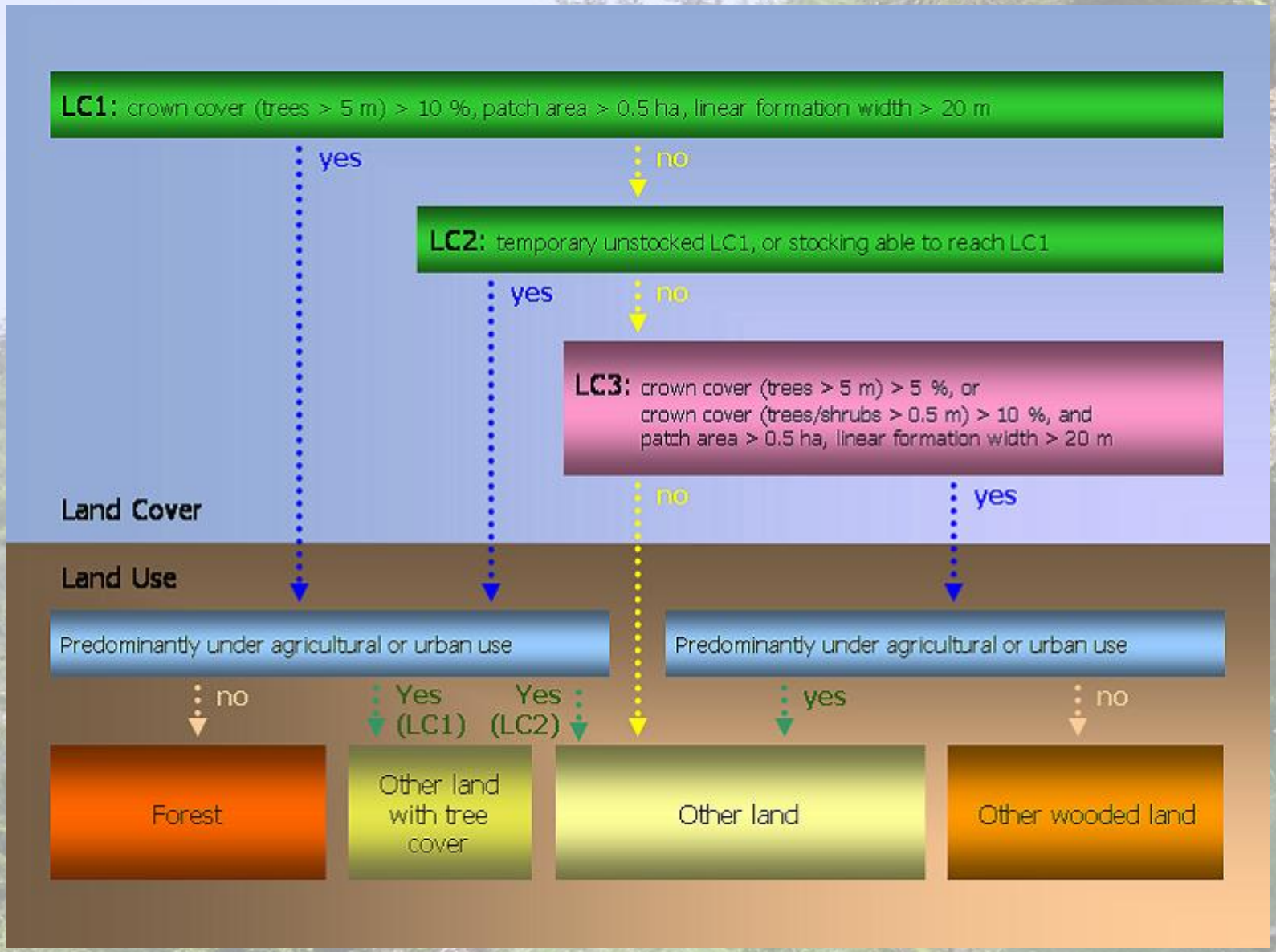
Use of remote sensing

- Spawning bridges in space and time
  - Space
    - Small area estimates
    - Wall to wall mapping
  - Time
    - 6 years cycle for terrestrial sampling
    - 3 years cycle for aerial photos
    - Yearly estimates for some main parameters?

Use of remote sensing

- Airborn Laserscanning – actual
  - Forest area
  - Growing stock (modelling)
  - Tree biomass (modelling)
- Matching – additional for future
  - Harvests
  - Increment?

Forest area - Definition



Lanz, 2008

Forest area - Definition

Forest {{LC[Tree 10%] □ LU[*tua]}
□ LU(□*pau)}* □ *LC[wsc]* □ *LU(add)*

where the square brackets, [.], indicate that quantitative thresholds must be considered and parentheses, (.), indicate that qualitative criteria (nominal scale) must be considered.

Gabler et. al. 2012

Forest area – Definition Land Cover

- Threshold approach with minimum criteria
  - minimum area
  - minimum crown cover
  - minimum height
  - minimum width

Forest area – Match

- Aerial photos
  - UltraCam XP 2009
  - 20cm GSD
  - RGBI
  - 80/30 overlapping
- MatchT
  - undulating
  - each third pixel
  - balanced – only image pairs

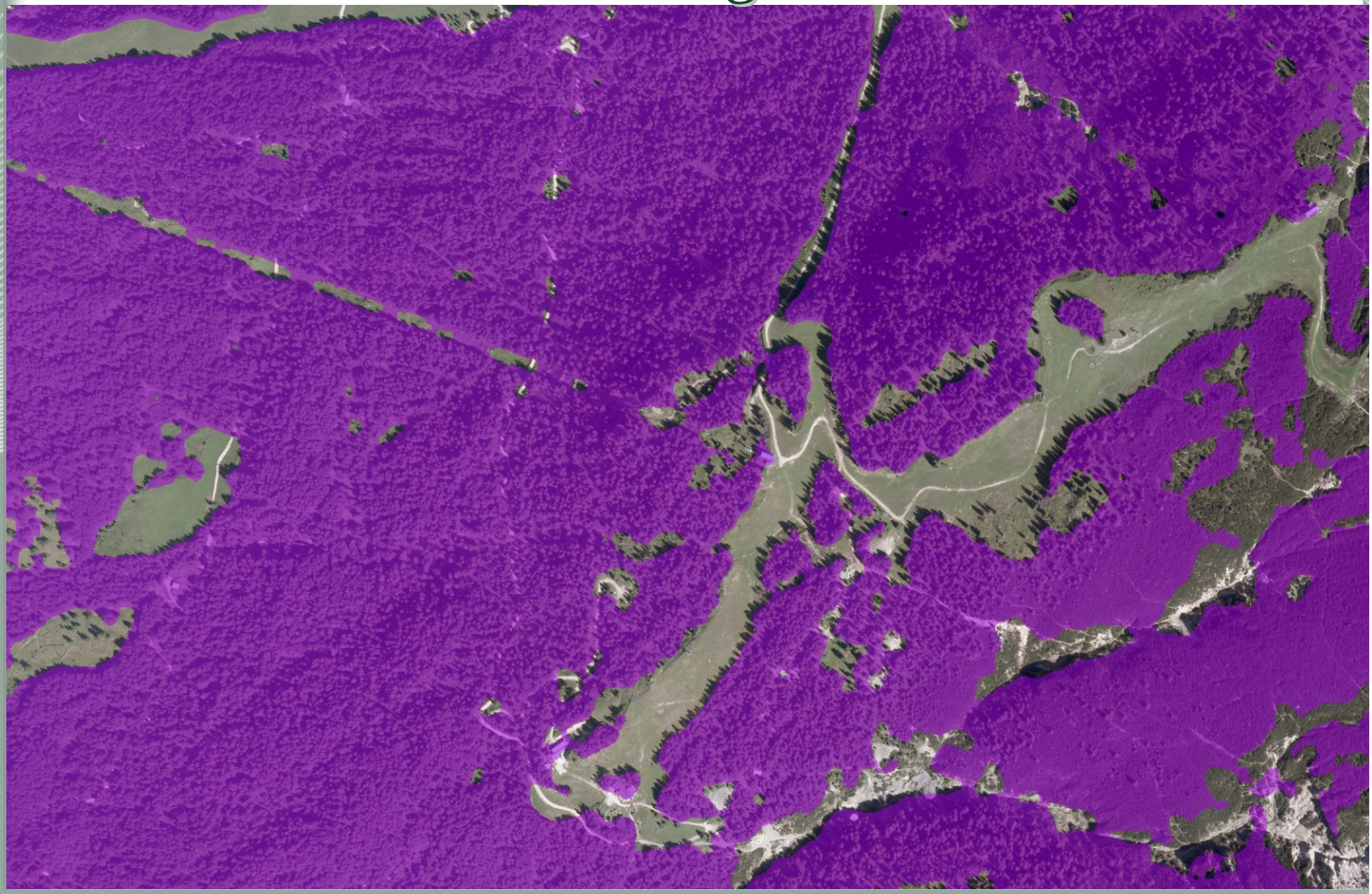
Forest area – ALS - Match

Forest area – ALS

min. height 2m

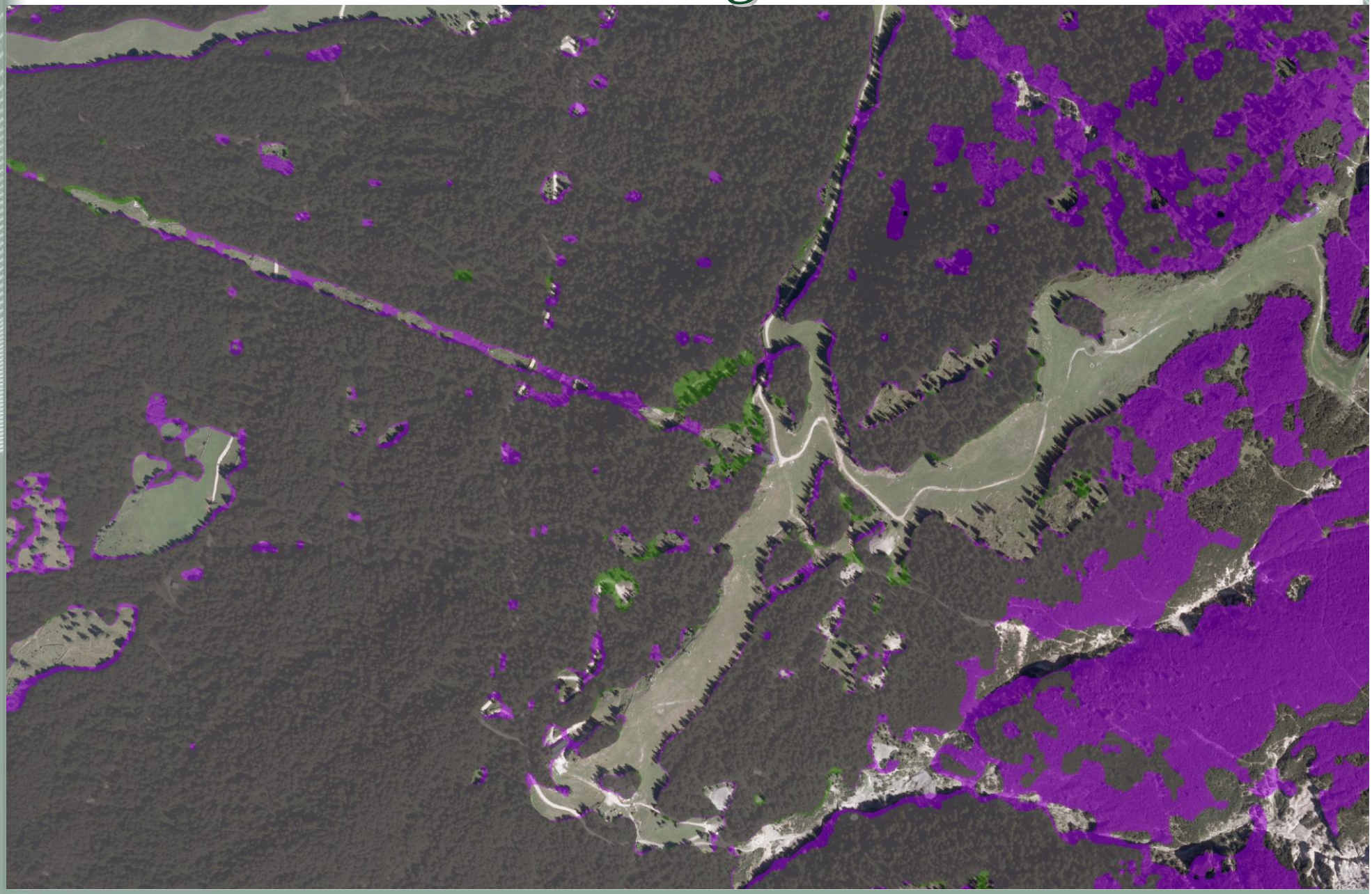
Forest area – Match

min. height 2m



Forest area – ALS – Match

min. height 2m



Forest area – ALS – Match

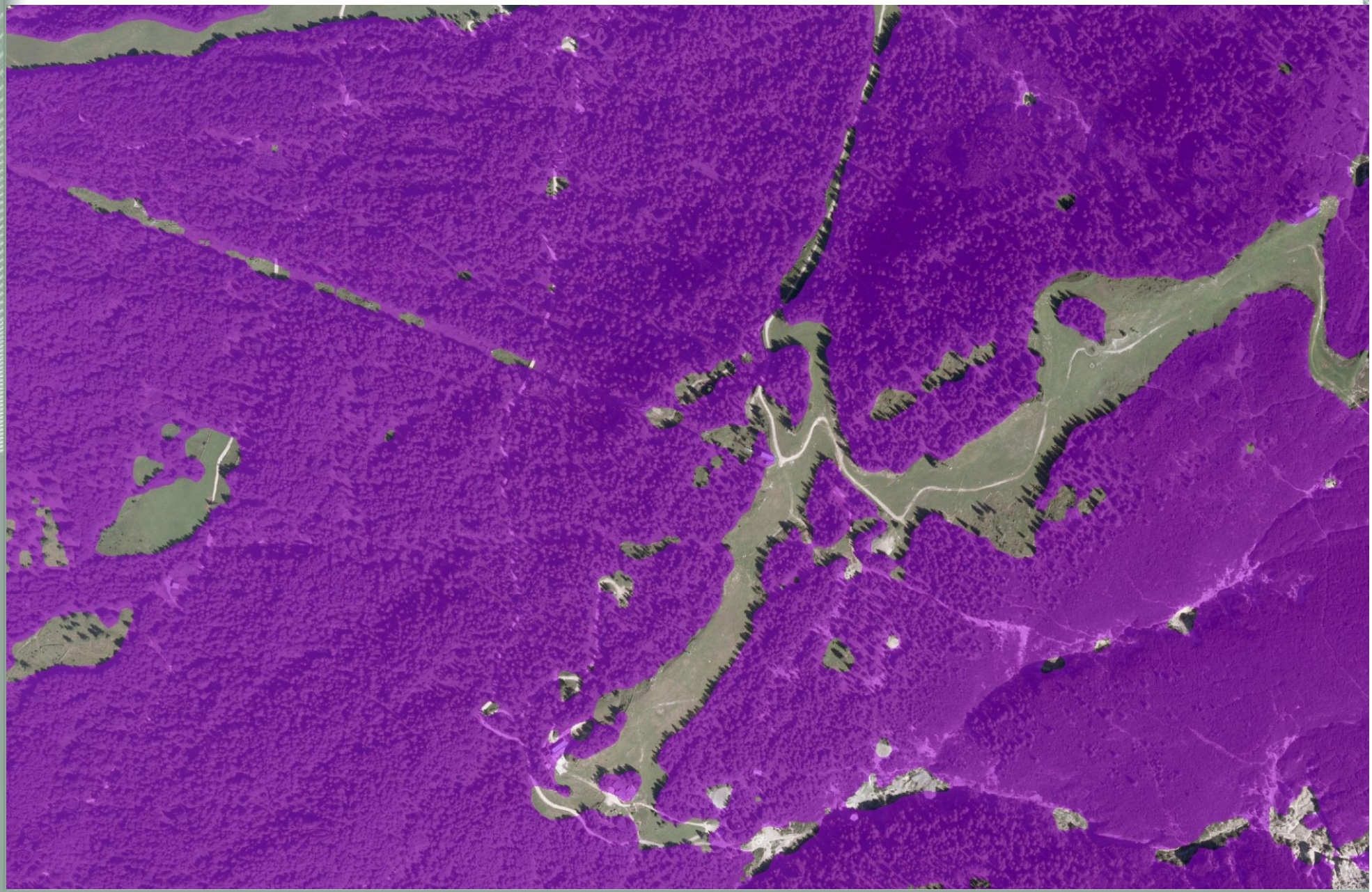
min. height 2m

Forest area – ALS

min. height 0,5m

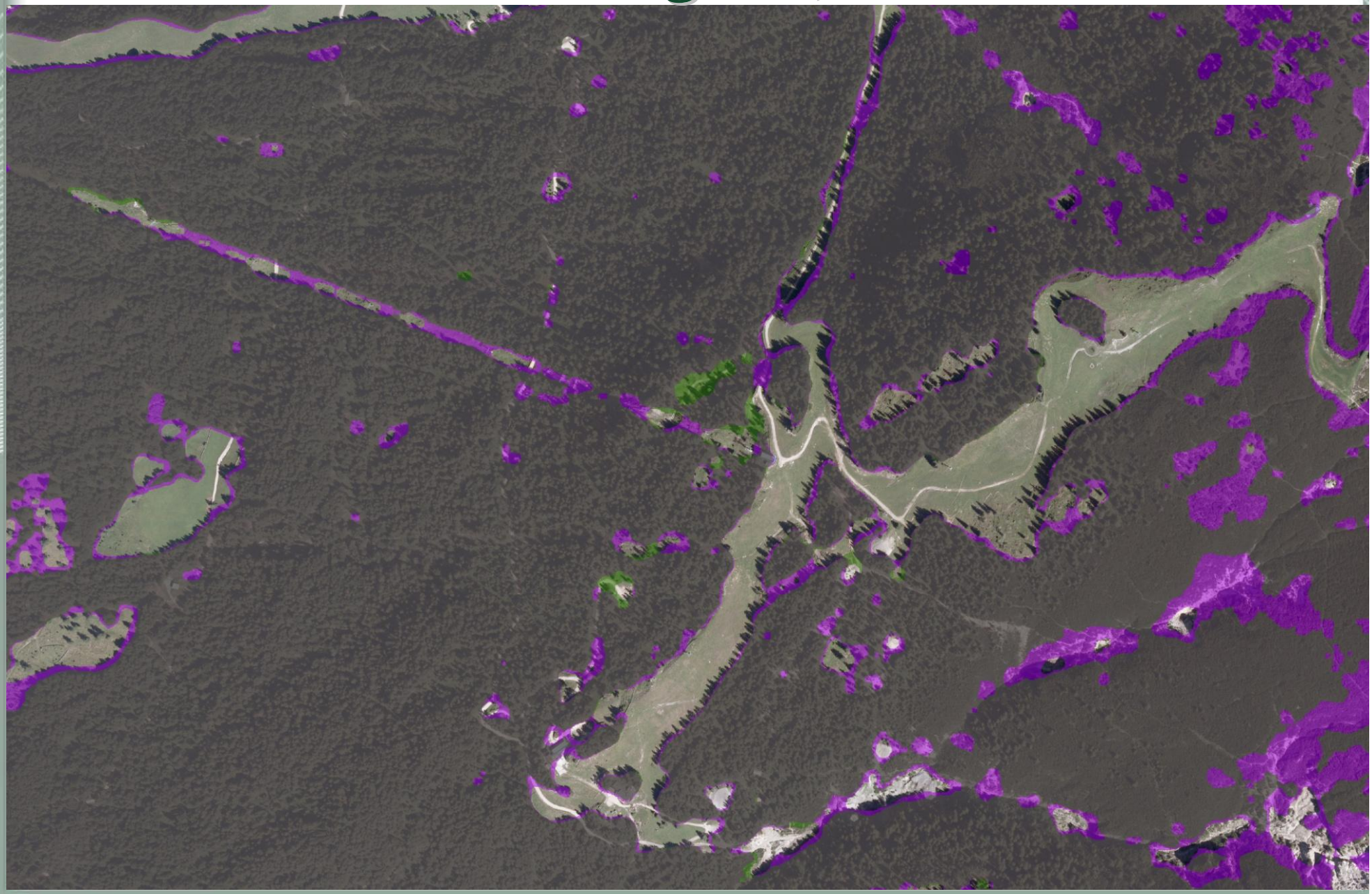
Forest area – Match

min. height 0,5m



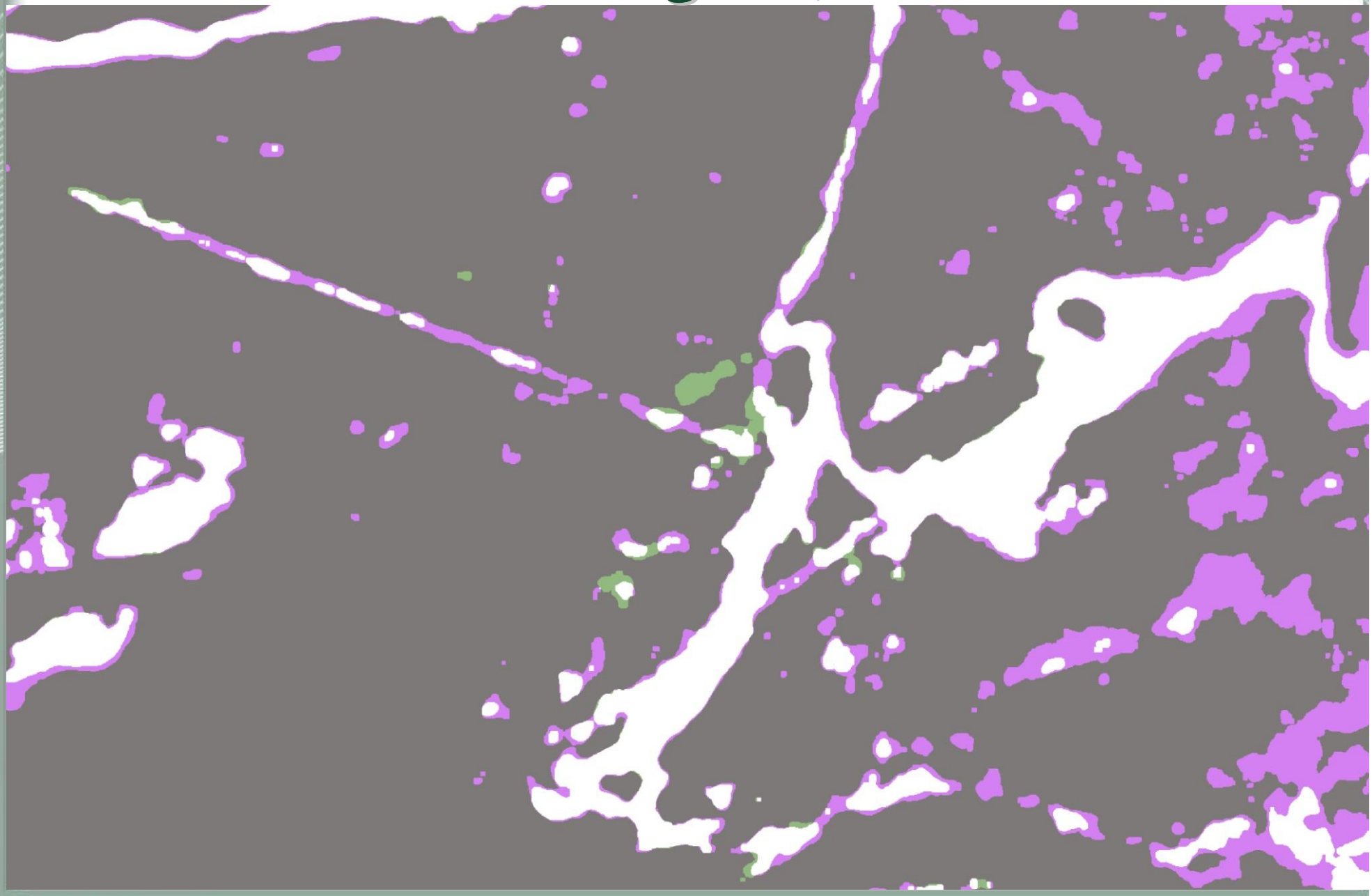
Forest area – ALS - Match

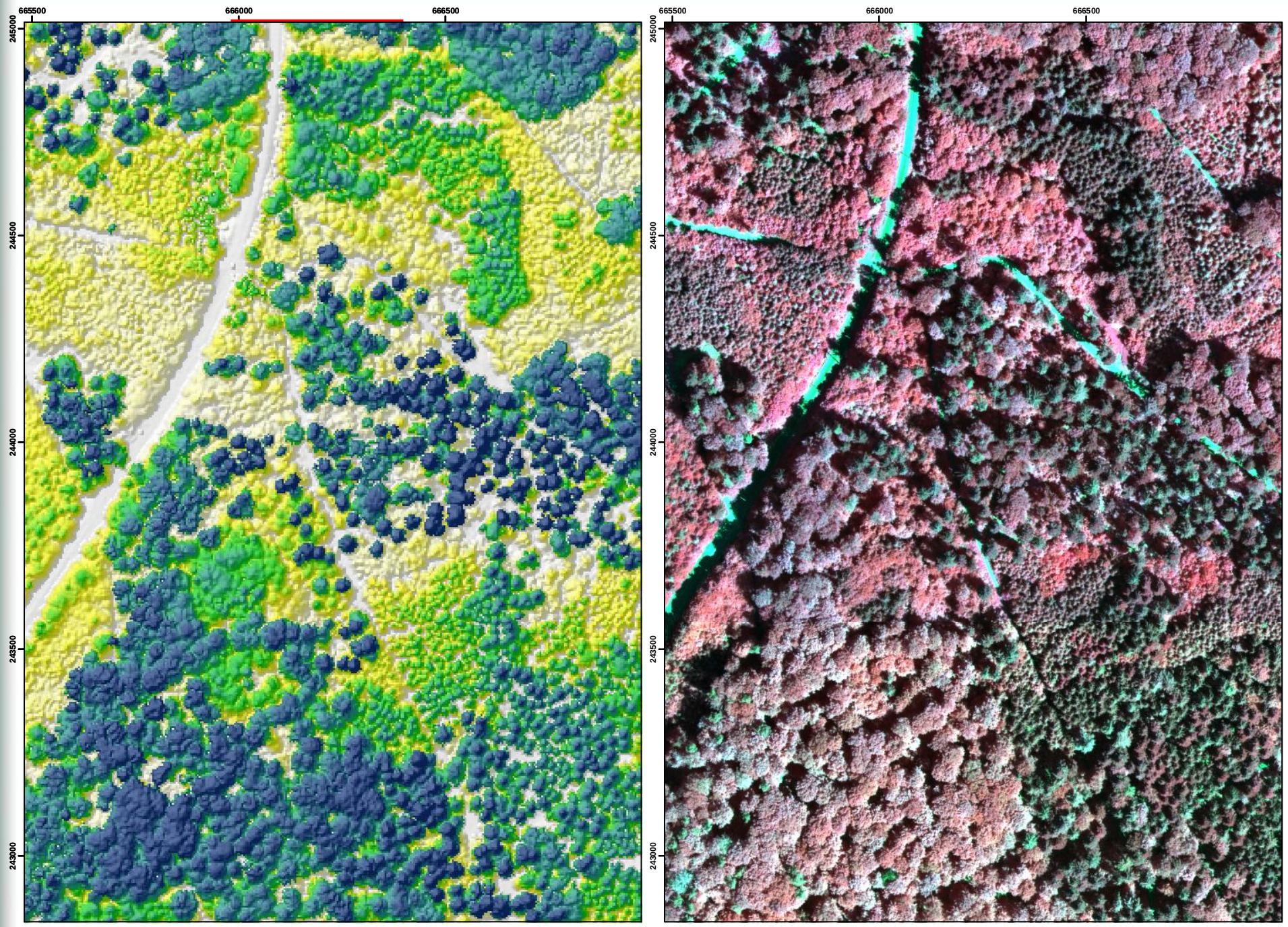
min. height 0,5m



Forest area – ALS - Match

min. height 0,5m

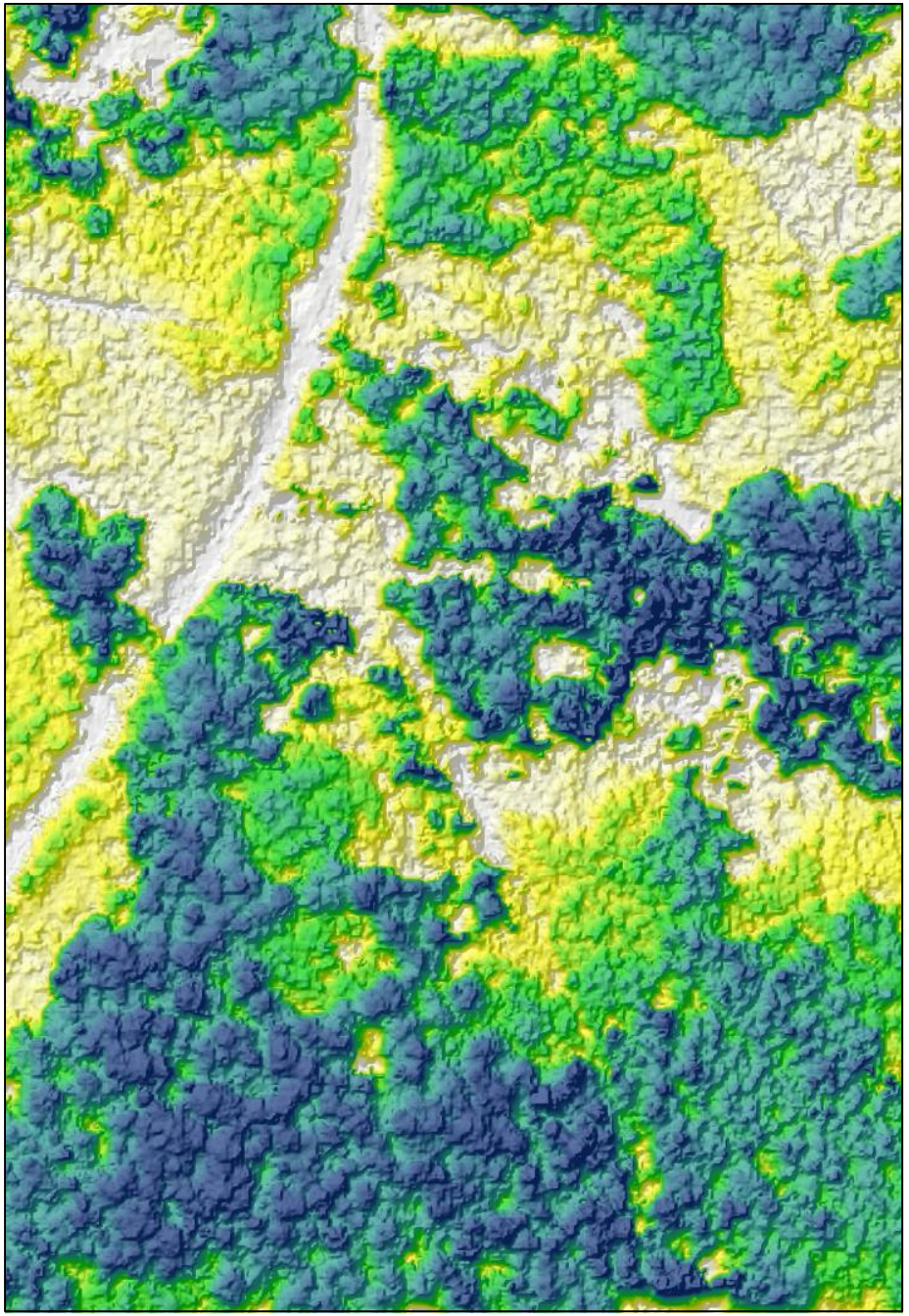




Bremgarten (AG): Flugdatum 24.06.2010

Bremgarten (AG): Flugdatum 09.09.2011

ALS



Flugdatum 24.06.2010

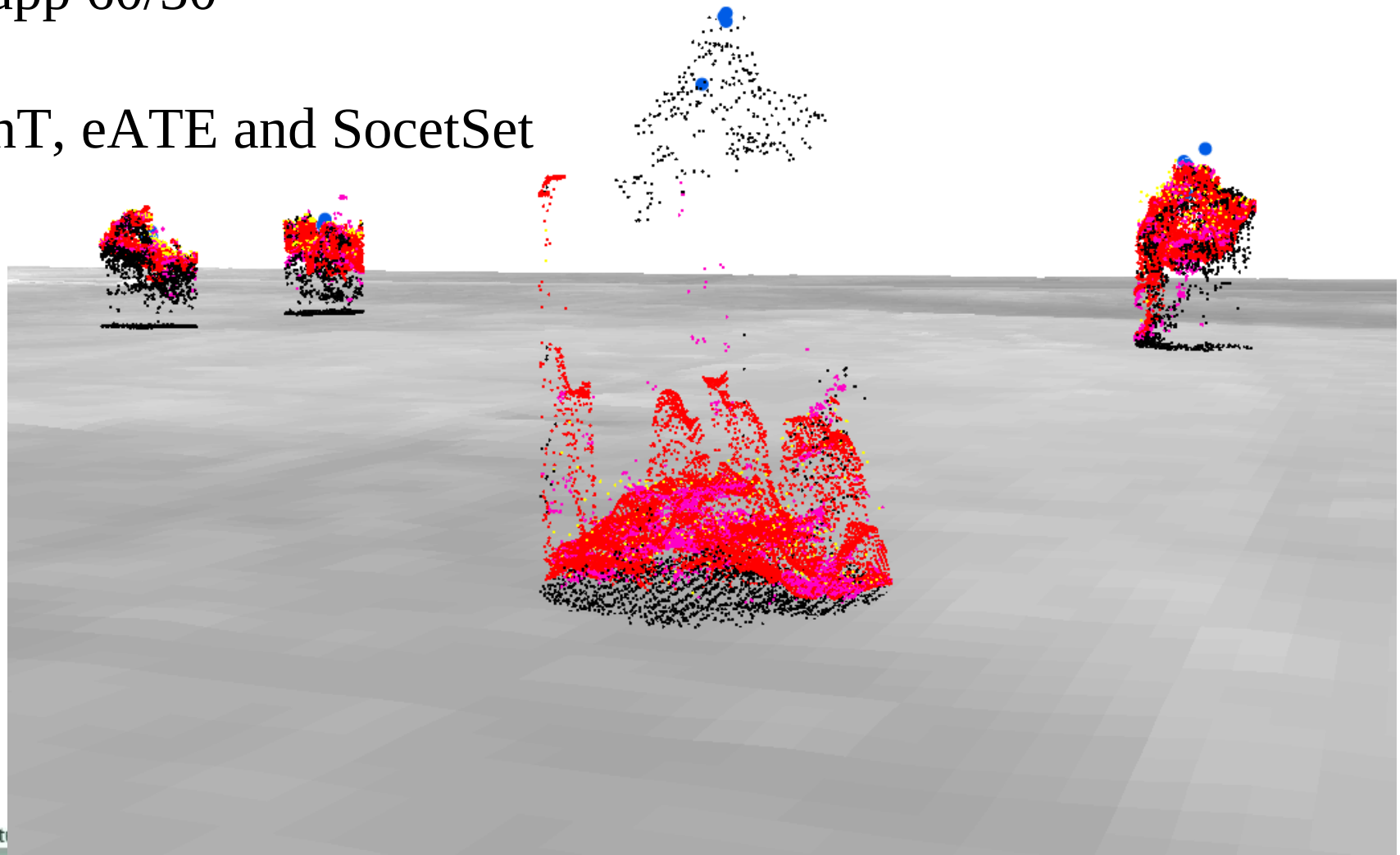
Match - SocetSet

Missing Pinus tree

Missing Pinus tree

UltraCam XP 2009
RGBI 8bit
20cm
overlapp 60/30

MatchT, eATE and SocetSet



Combined use - modelling

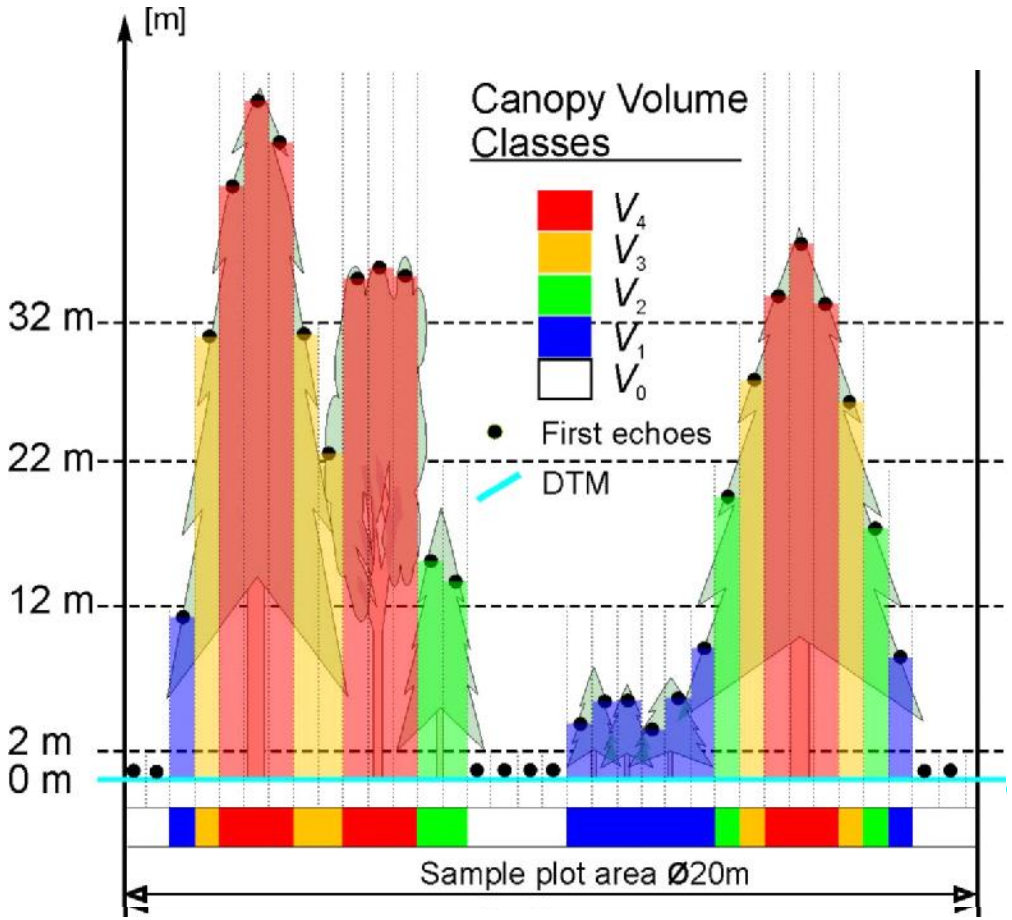
- Ground measurements are diameter based
  - Flugsand- und Flugerdeböden
  - Verkarstungsgefahr
  - Seichtgründigkeit
  - schroffe Lagen
  - Abrutschungsgefahr
  - Kampfzone
- **Remote sensing is height based**

Combined use - modelling

Stem volume = Function (canopy volume)

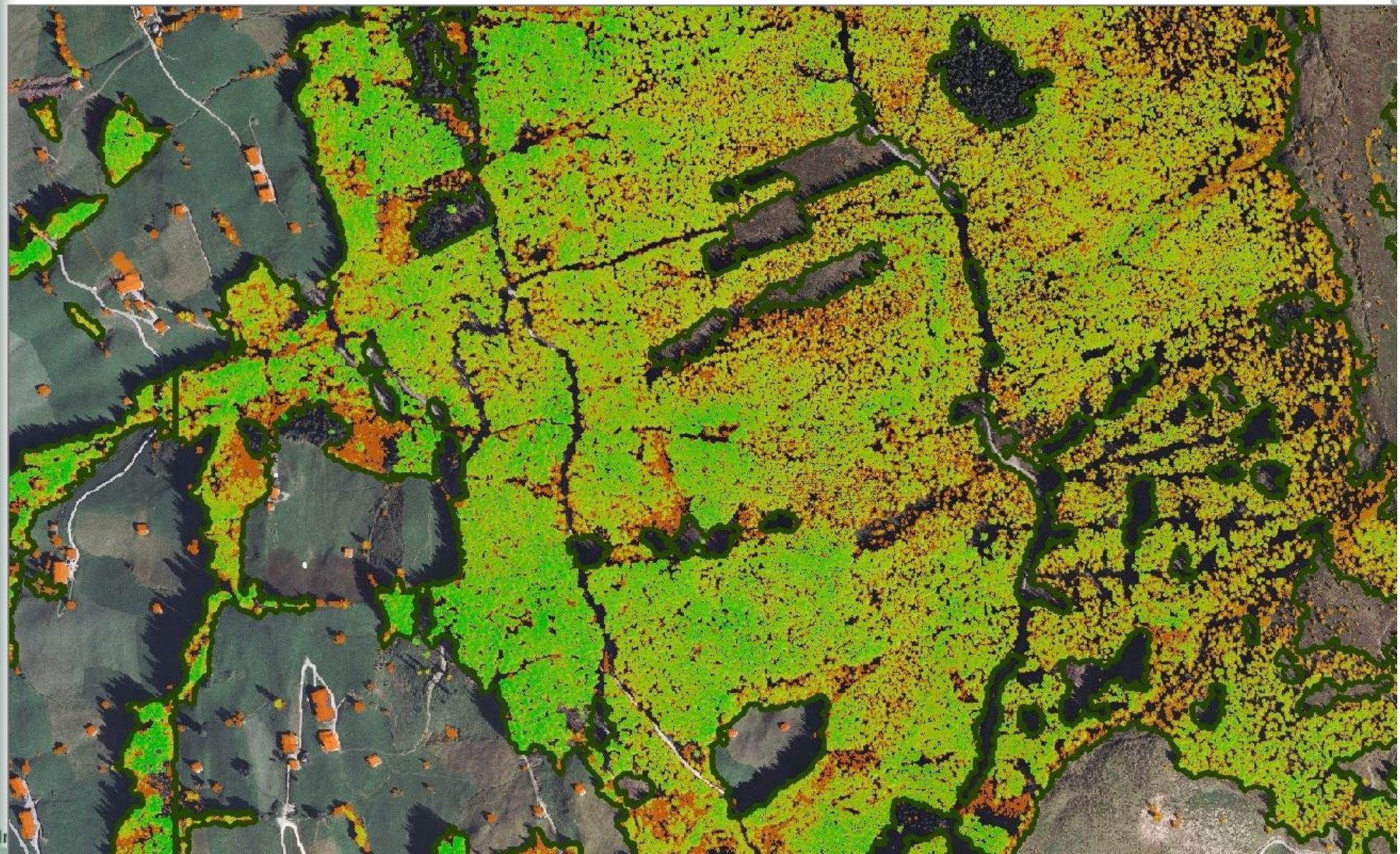
$$v_{\text{stem,fi}} = \sum_{i=1}^{n} b_i \cdot v_{\text{can},i}$$

$$v_{\text{can},i} = f_{\text{first-echo},i} \cdot dh_{\text{mean},i}$$



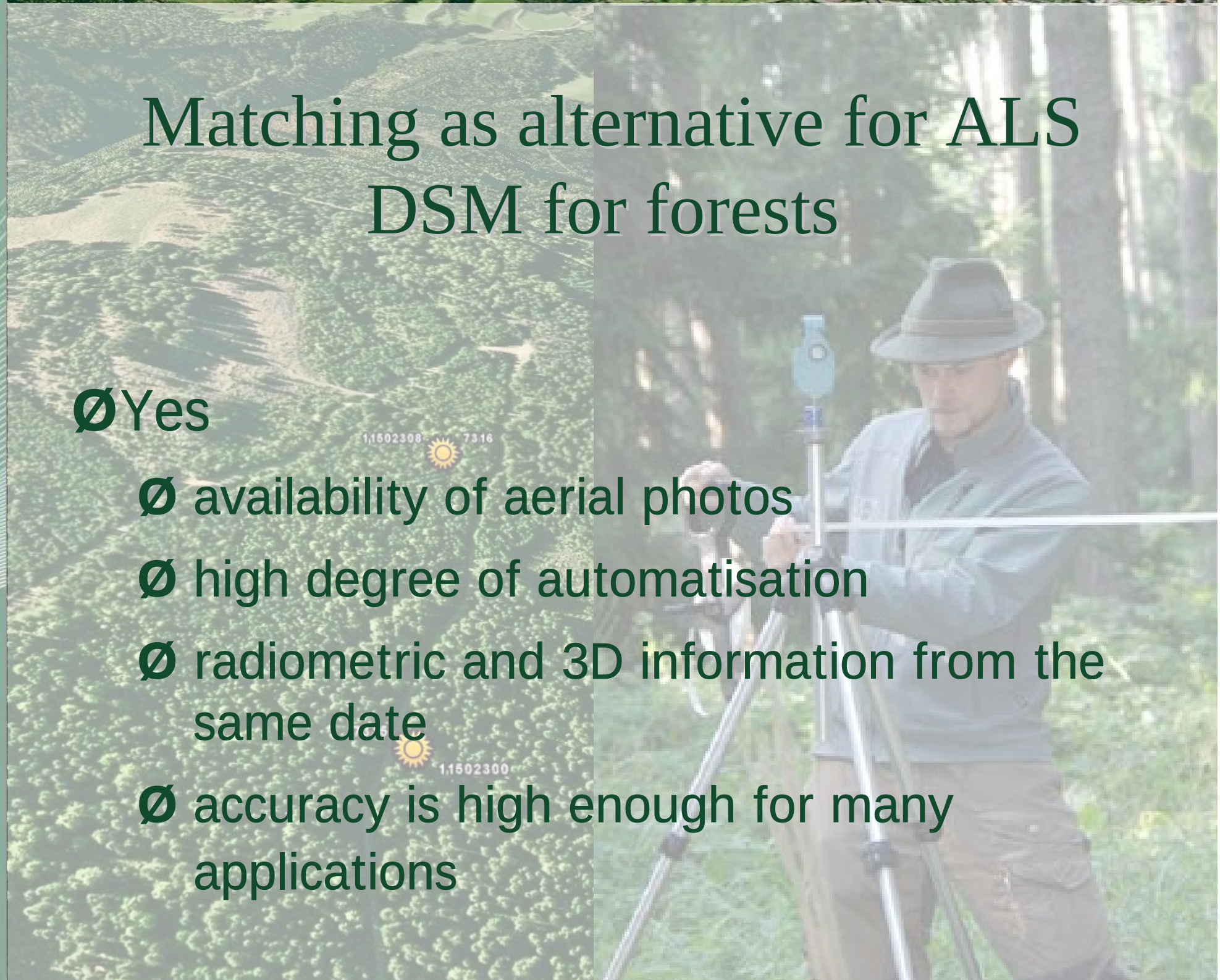
Hollaus et al., 2007

ALS stem volume map



Matching as alternative for ALS DSM for forests

- Yes
  - availability of aerial photos
  - high degree of automatisation
  - radiometric and 3D information from the same date
  - accuracy is high enough for many applications



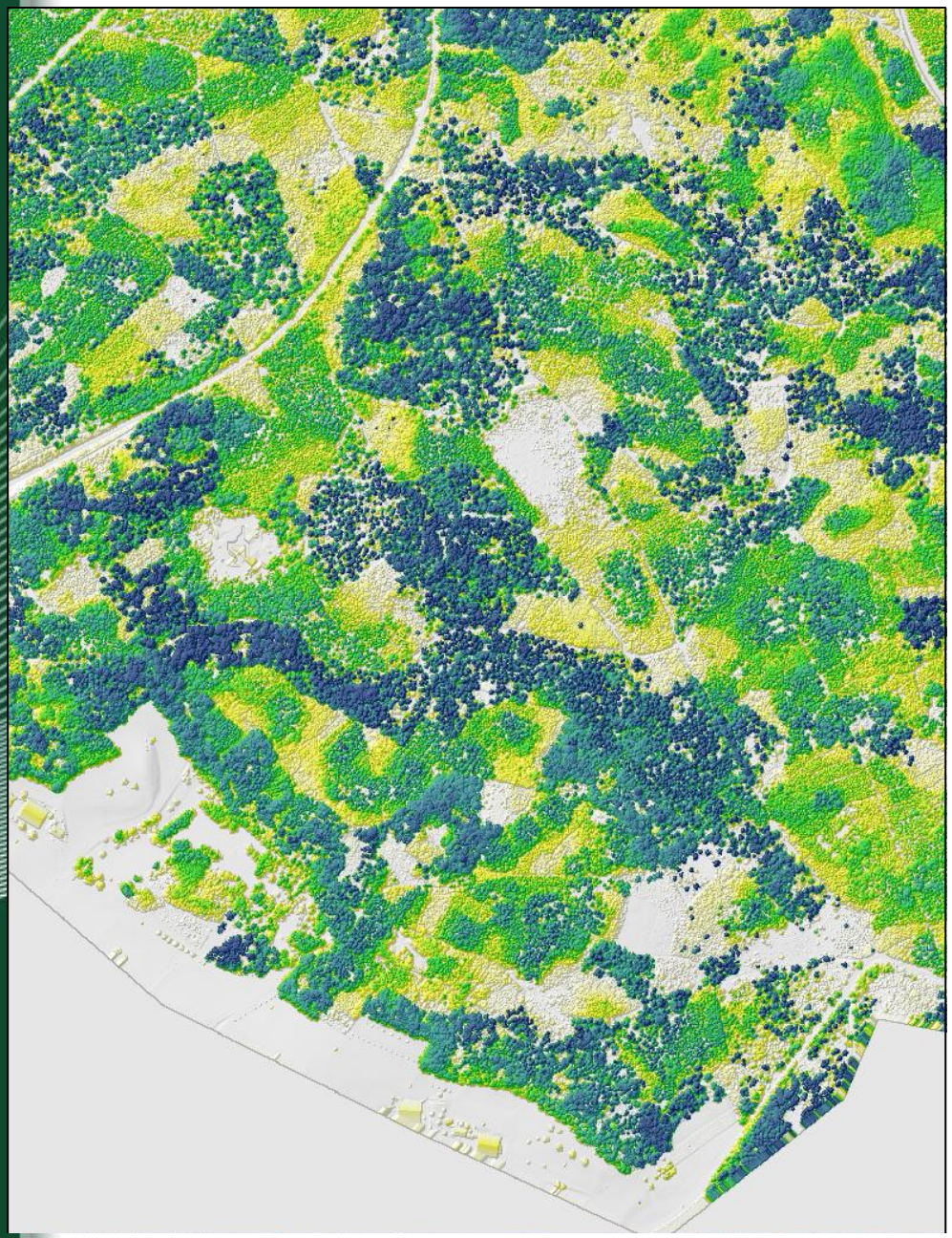
Matching as alternative for ALS DSM for forests

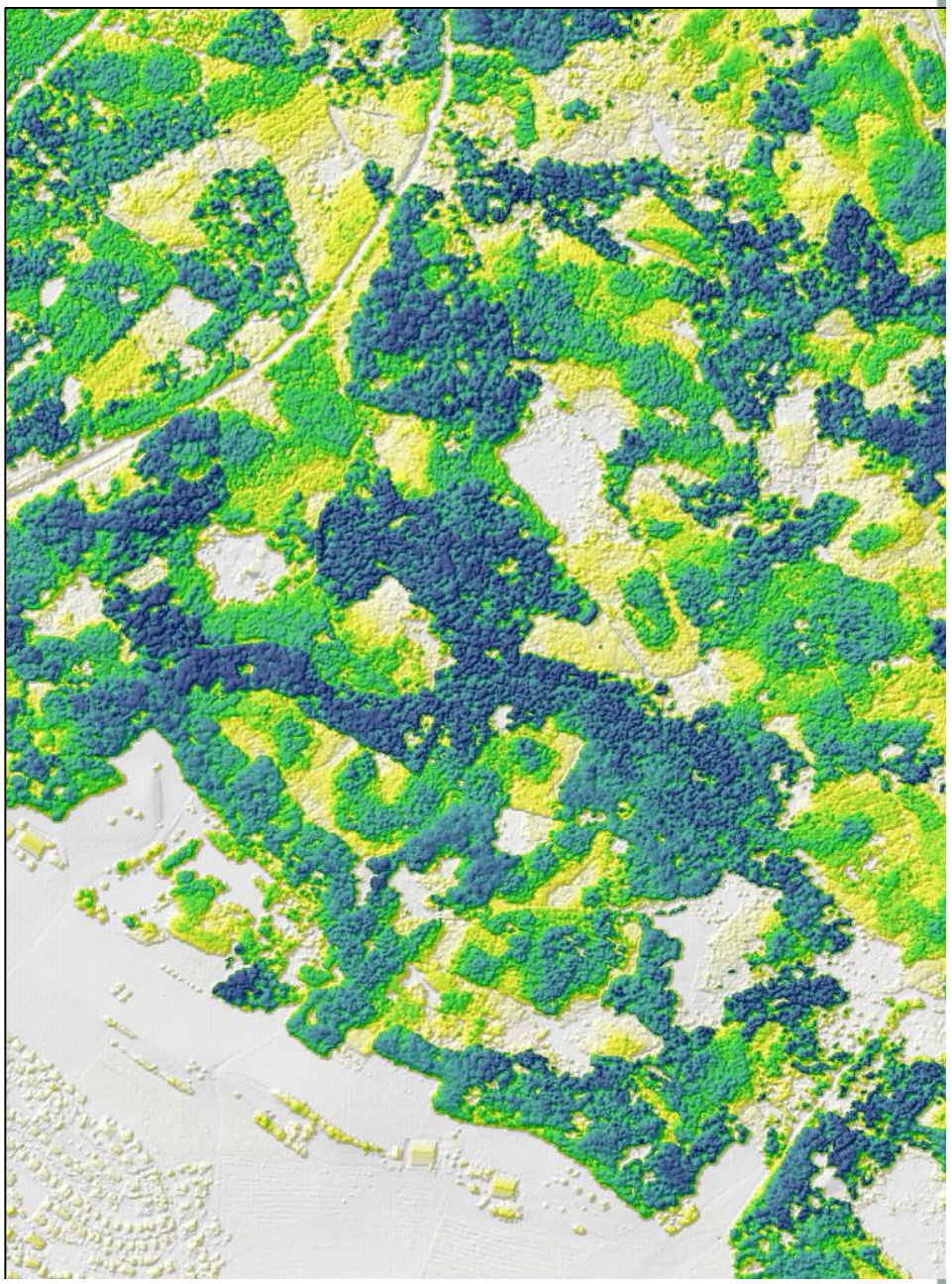
- No
  - for information below the forest canopy
  - terrain information is needed
  - to detect single trees
- Unclear
  - shadows at the forest borderline and inside the forest (forest gaps)

Challenges for matching applications

- Homogenous data sets for all of Austria
  - different qualities of aerial photos
  - different overlaps, light conditions, ...
  - software solutions for harmonization?
- Homogeneity in time – change estimation
- huge datasets – hard- and software
  - performance versus quality

Thank you for your attention!





Bremgarten (AG): Flugdatum 09.09.2011 Flugdatum 24.06.2010

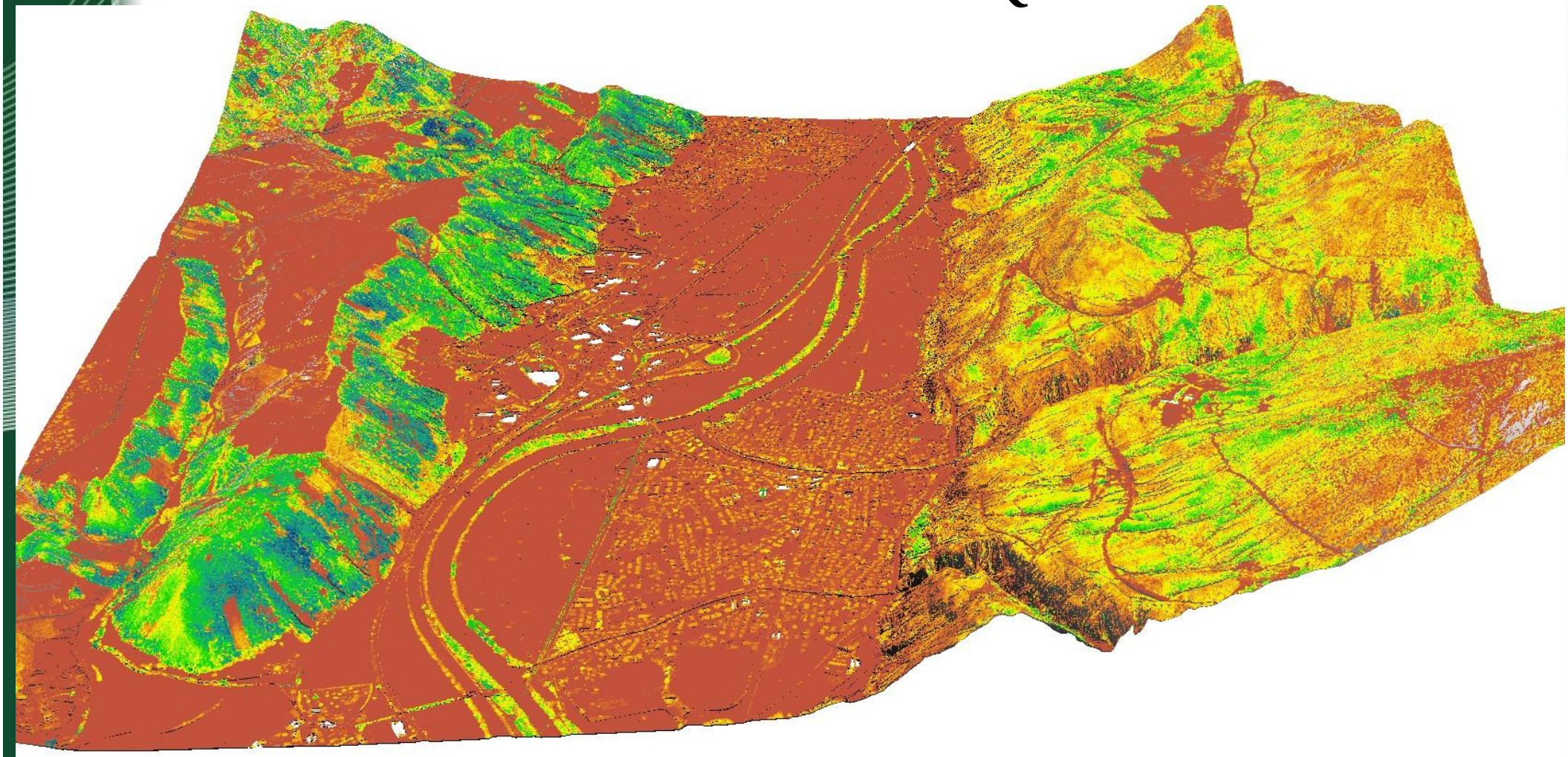
3D Daten aus Luftbildern

Zusätzliche Rauminformationen

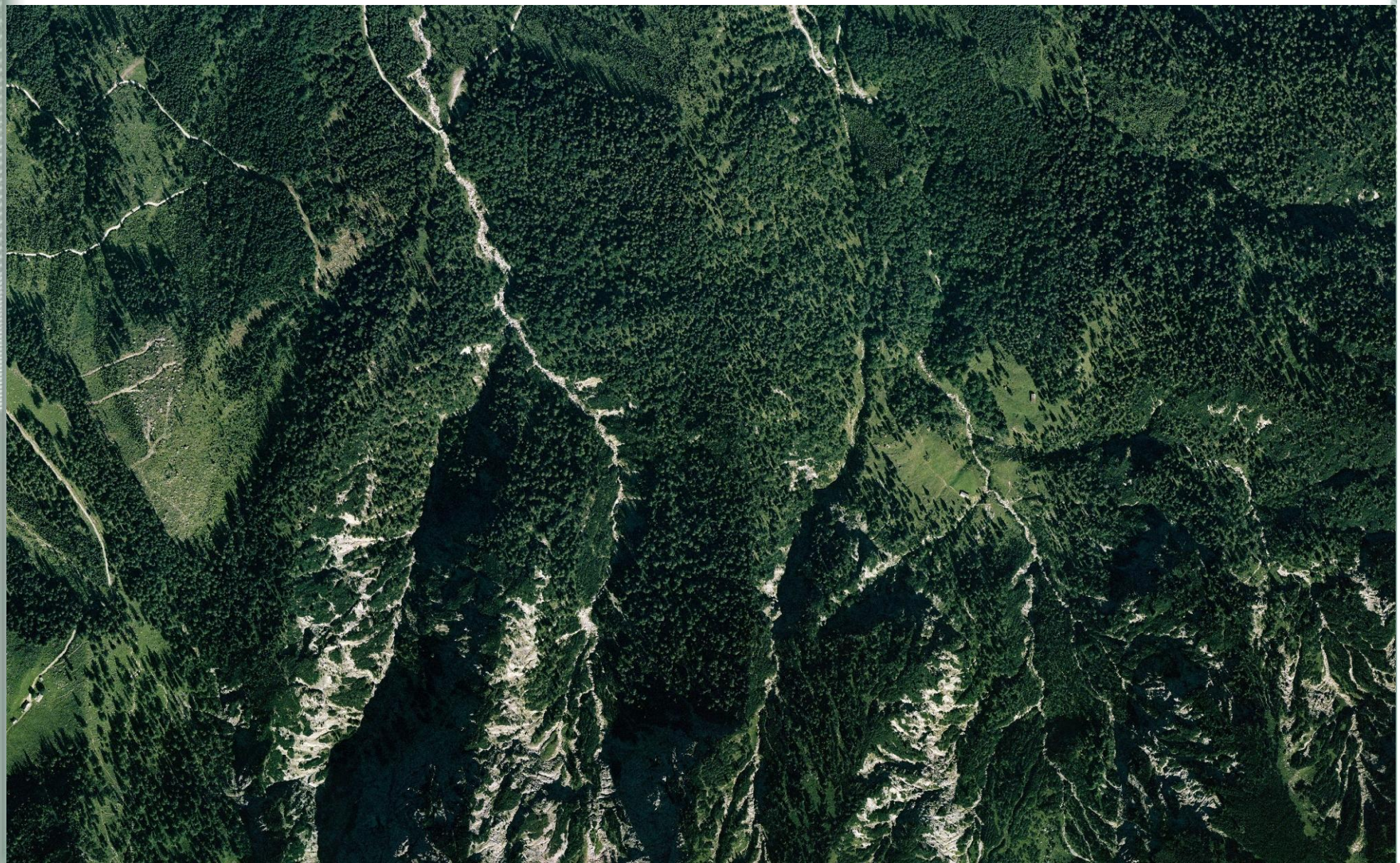
Wildtierhabitate - Qualität

Zusätzliche Rauminformationen

Wildtierhabitate - Qualität

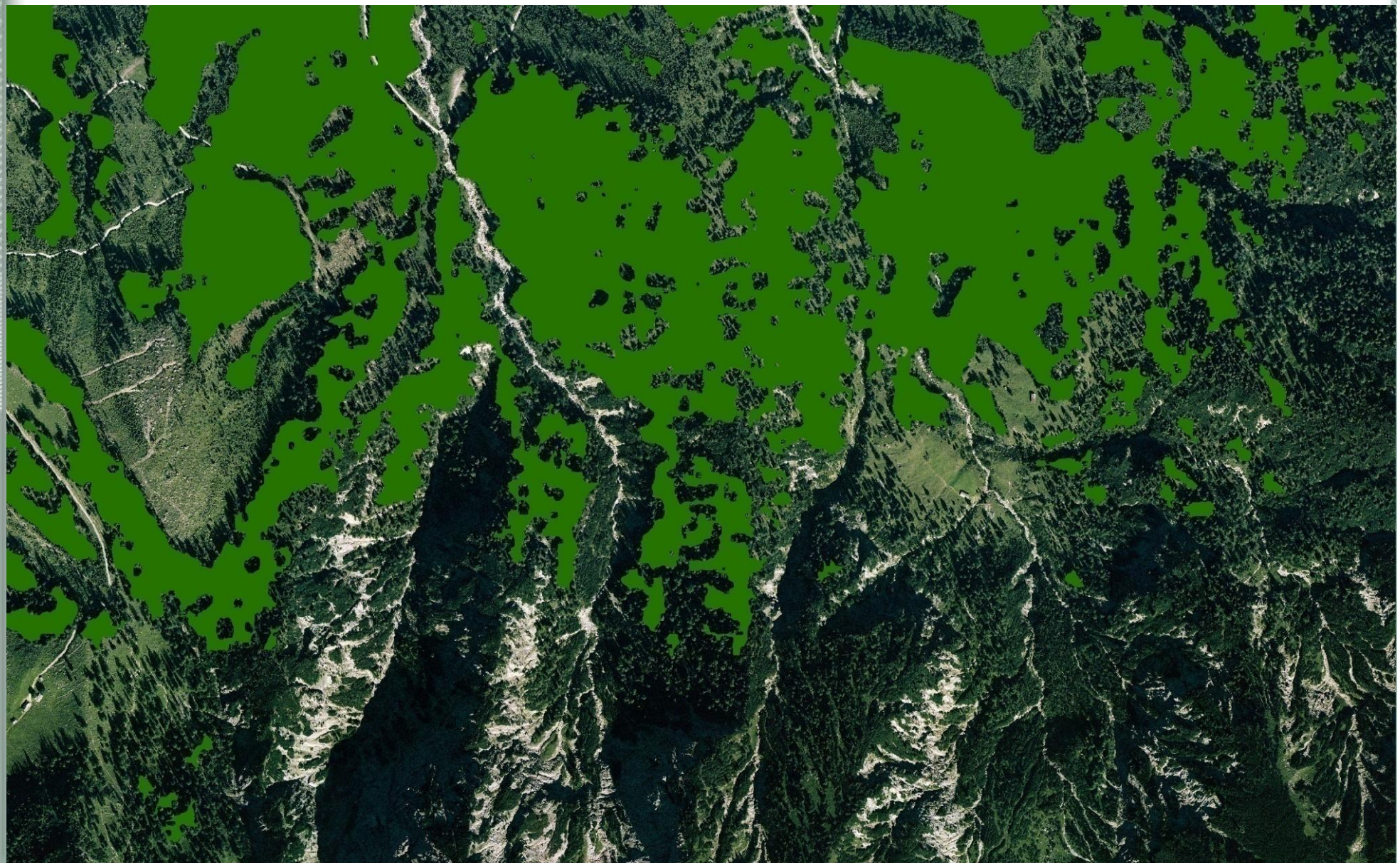


ÖWI Laser-Waldkarte - Walddefinition



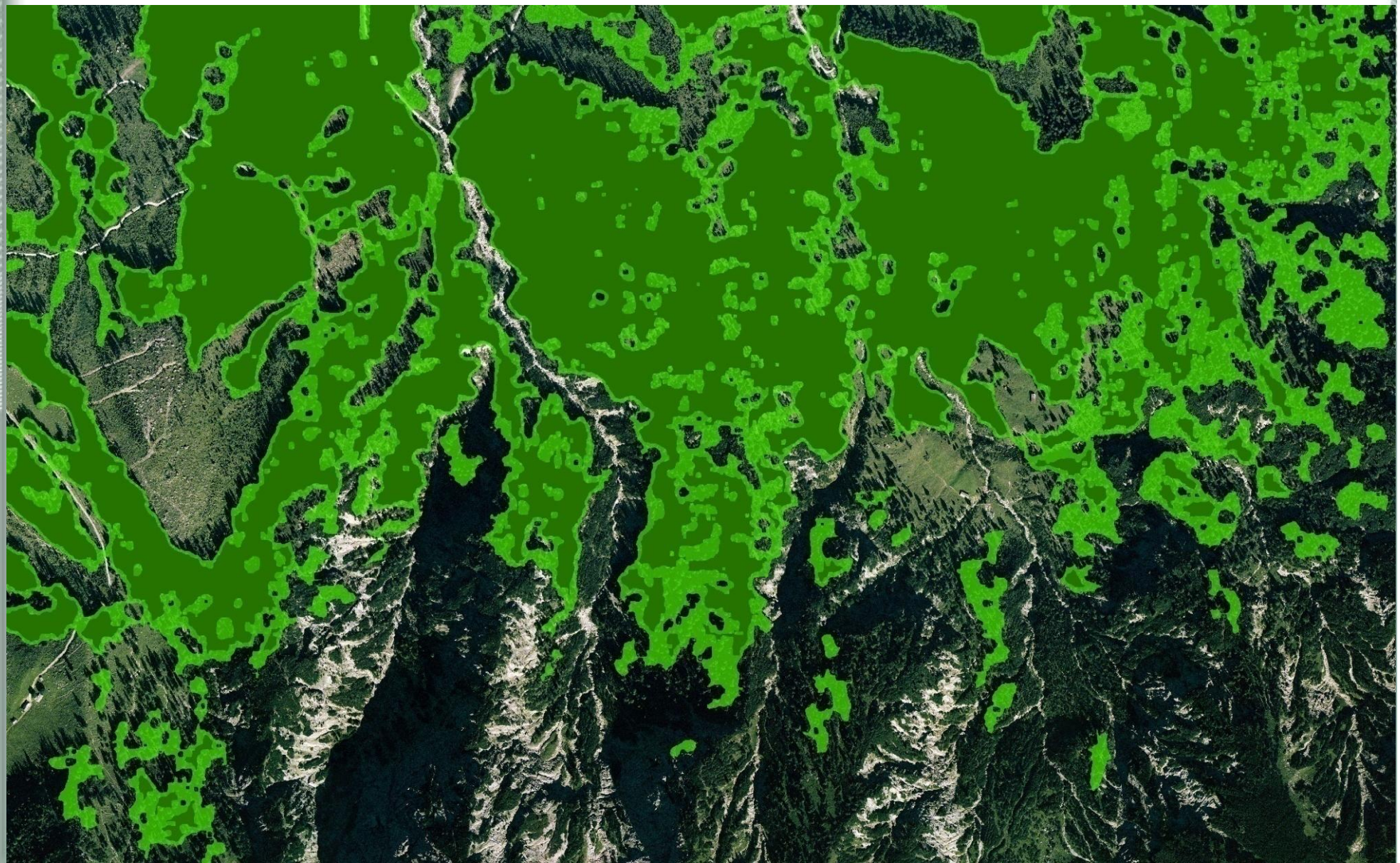
ÖWI Laser-Waldkarte - Walddefinition

Überschirmung 50% Höhe > 2m



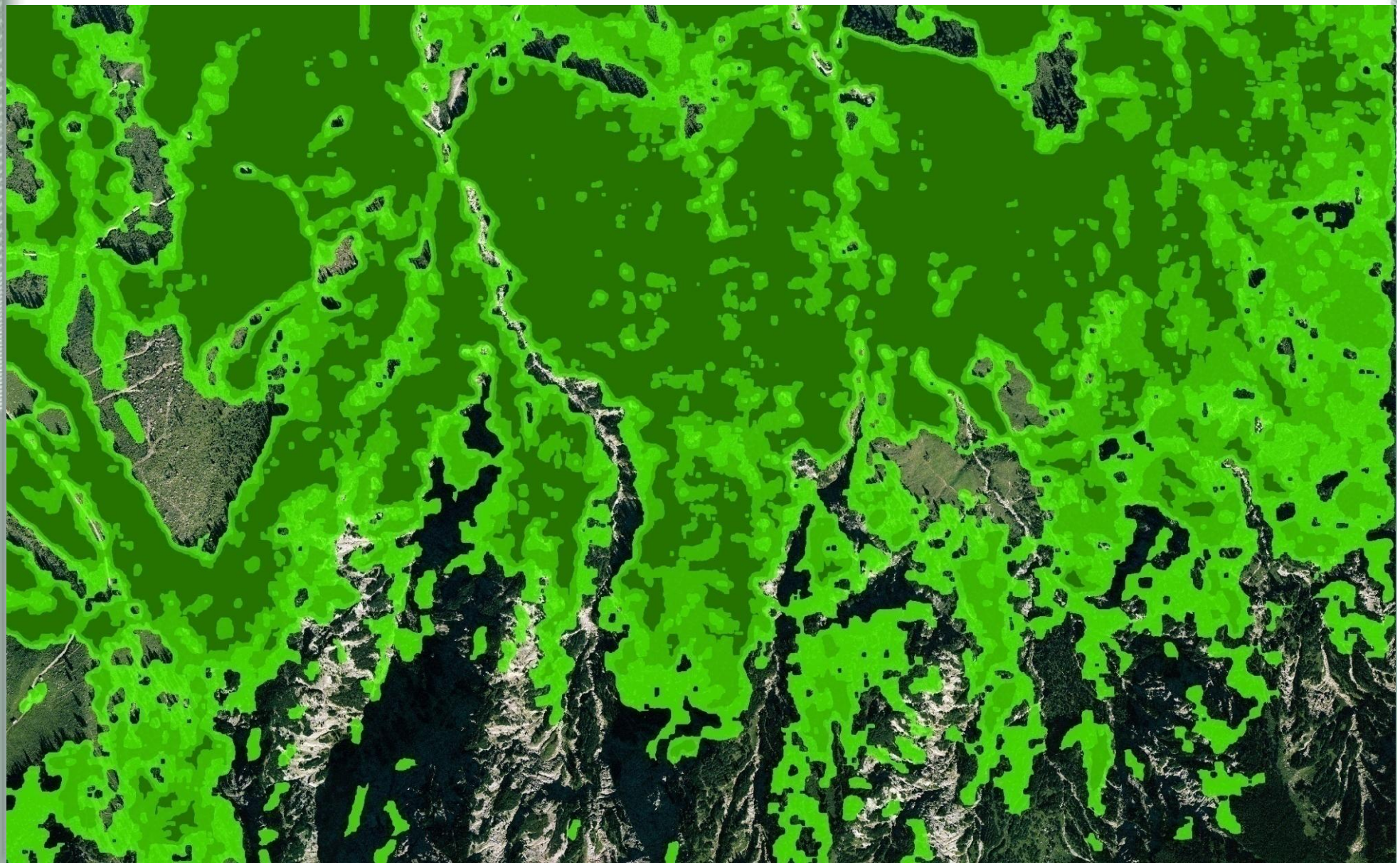
ÖWI Laser-Waldkarte - Walddefinition

Überschirmung 50%, 30% Höhe > 2m



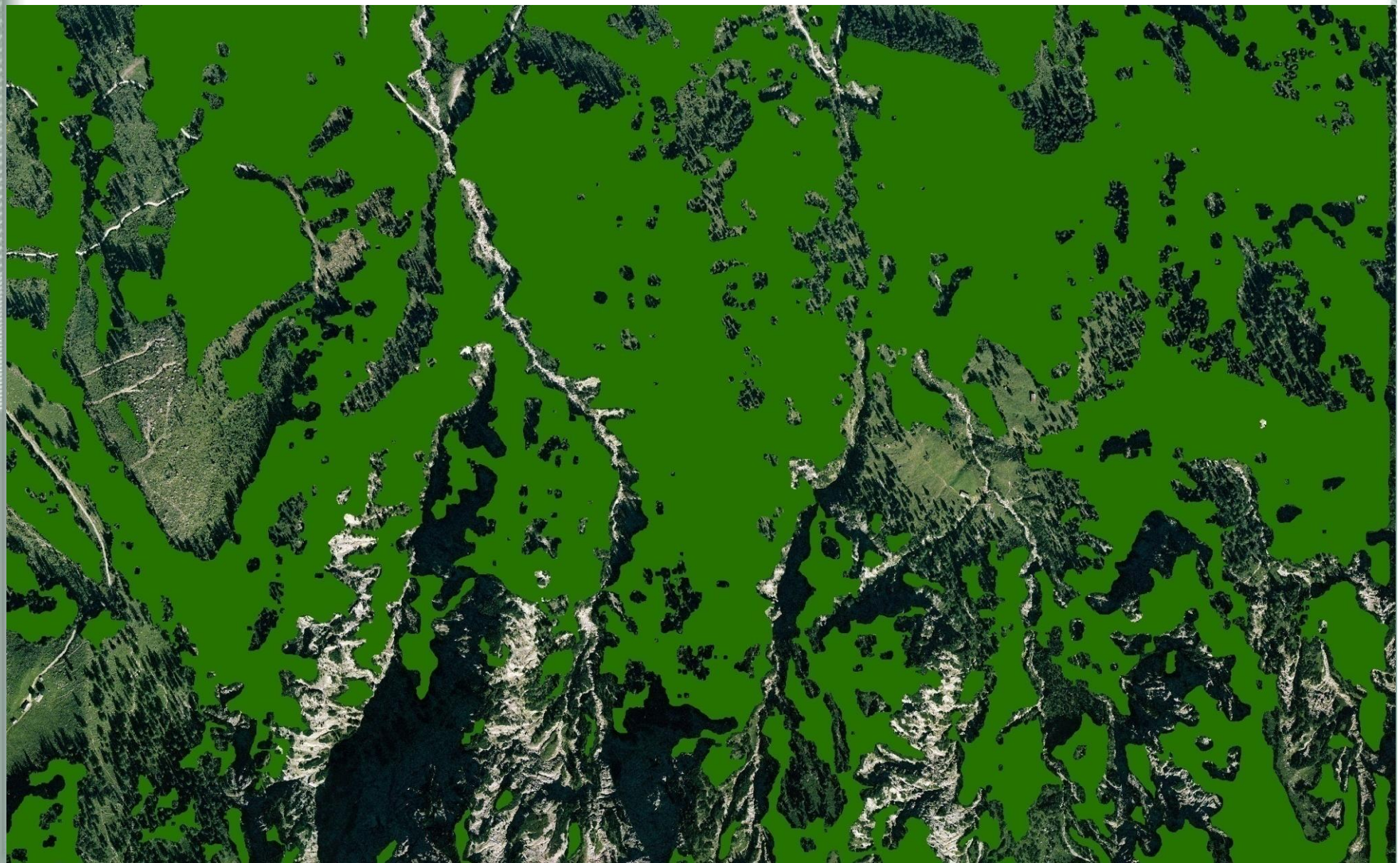
ÖWI Laser-Waldkarte

Überschirmung 50%, 30%, 10% Höhe > 2m



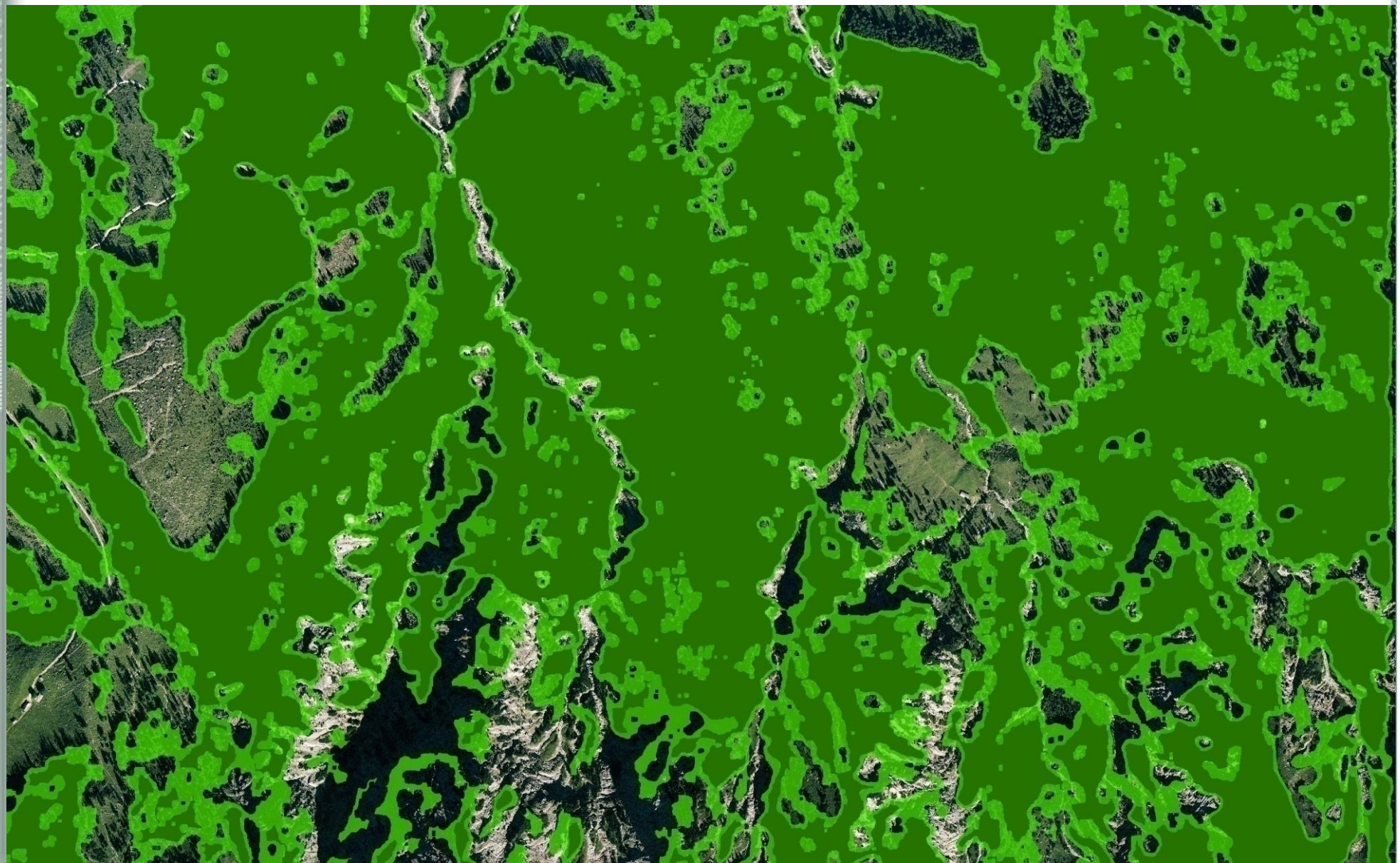
ÖWI Laser-Waldkarte

Überschirmung 50% Höhe > 0,5m



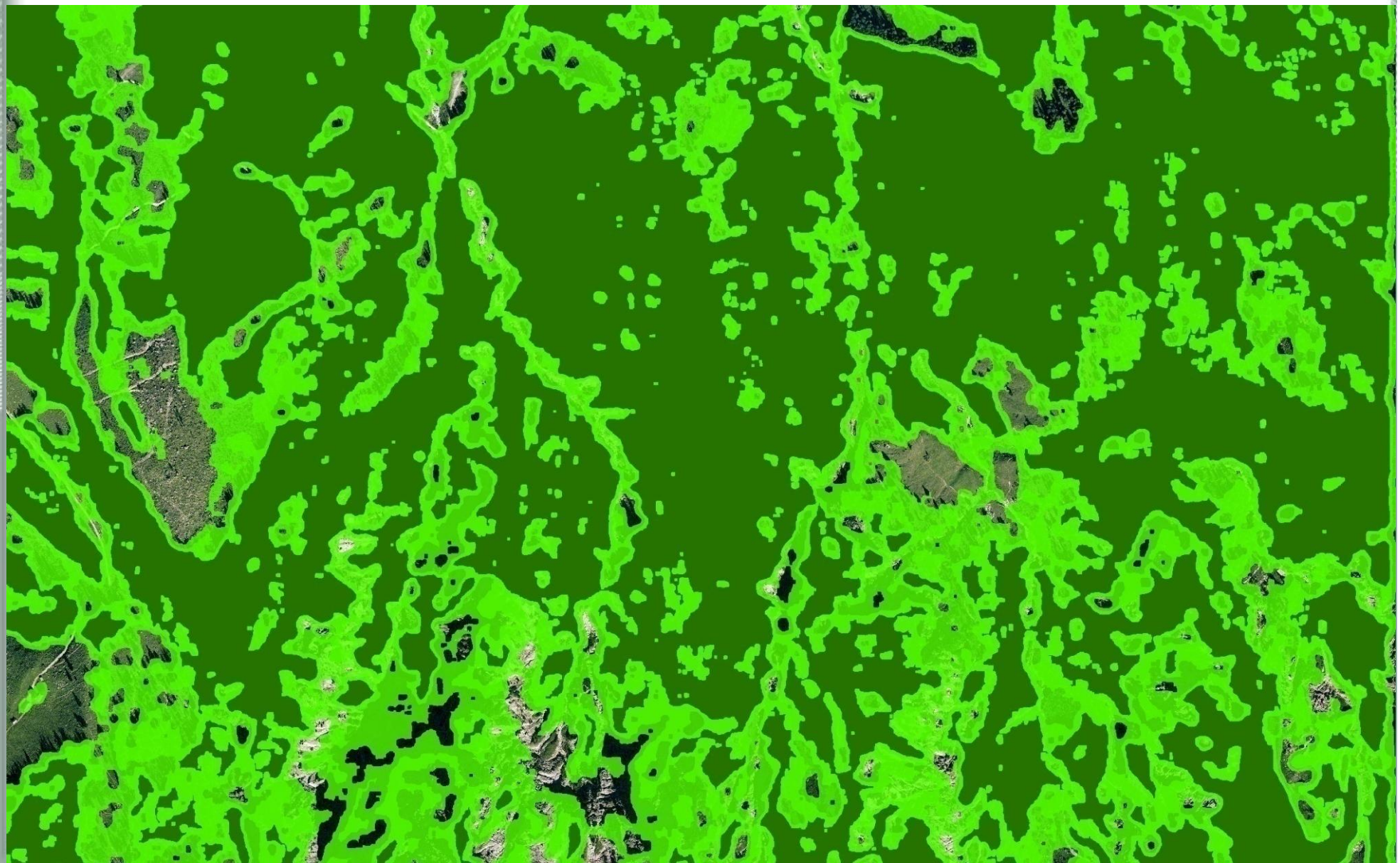
ÖWI Laser-Waldkarte

Überschirmung 50%, 30% Höhe > 0,5m



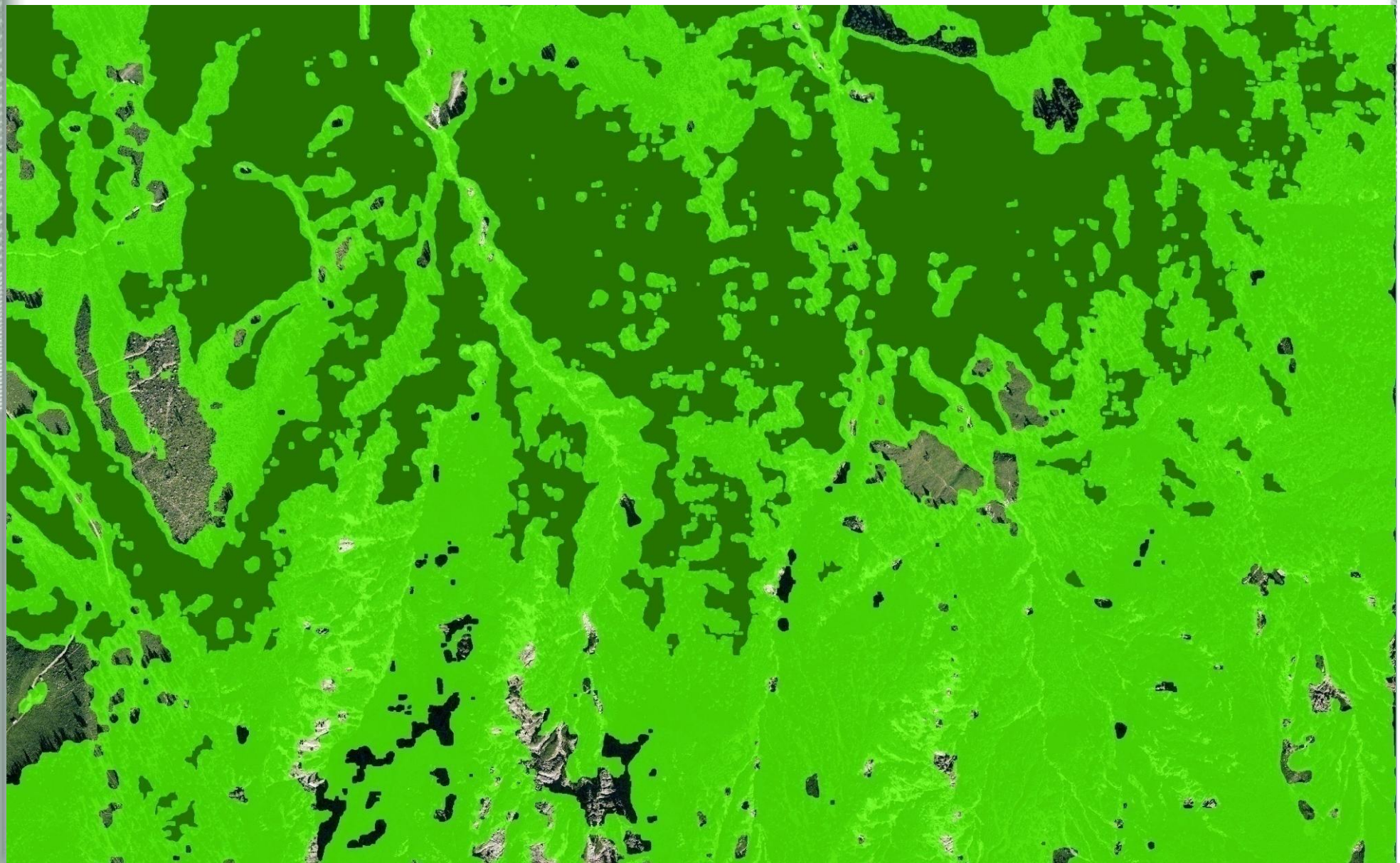
ÖWI Laser-Waldkarte

Überschirmung 50%, 30%, 10% Höhe > 0,5m



ÖWI Laser-Waldkarte

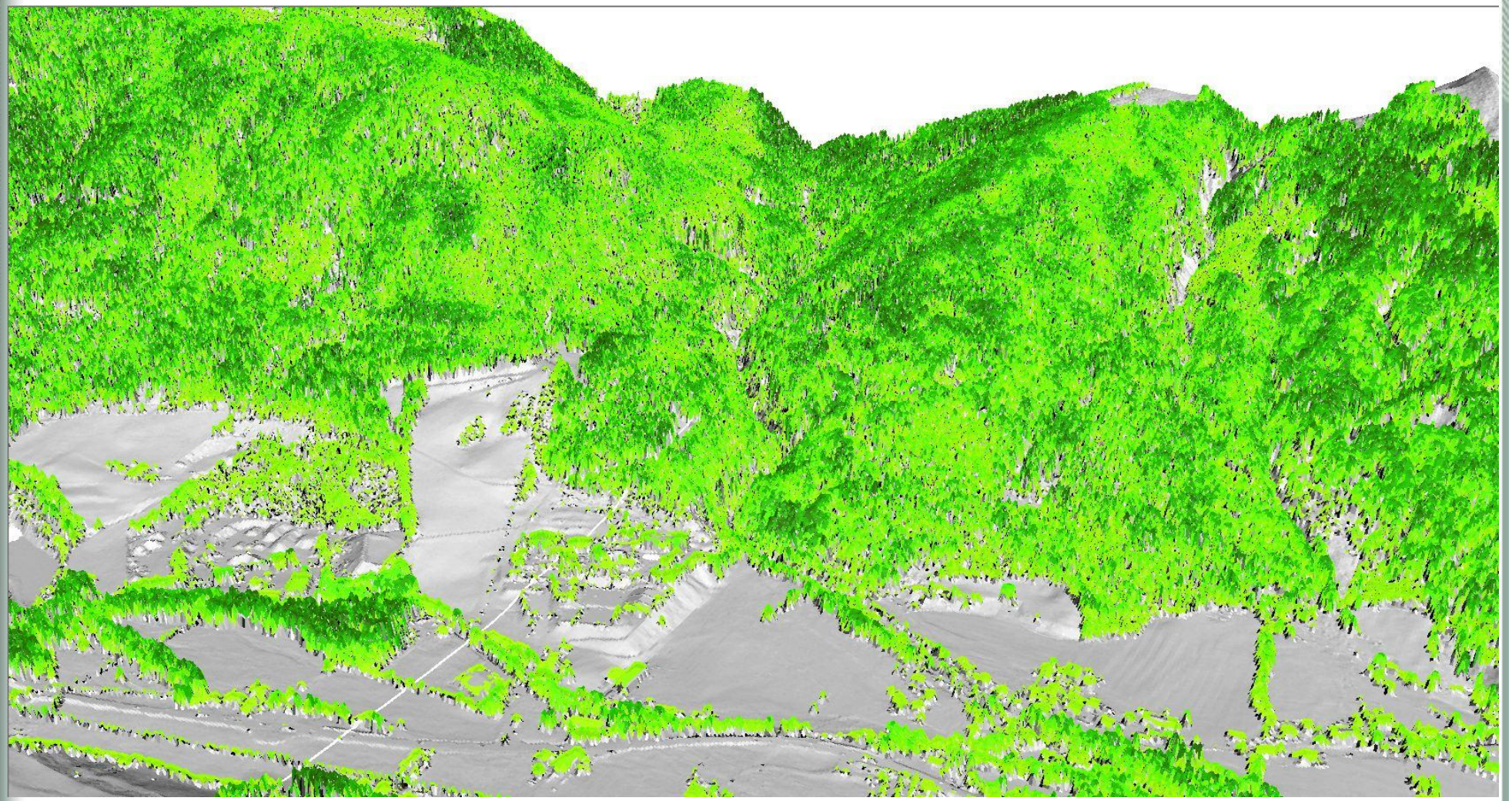
Überschirmung 50%, 10% Höhe > 2m, 0,5m



ÖWI - Zukunft - Fernerkundung

ÖWI - Zukunft - Fernerkundung

Laser Oberflächenmodell



ÖWI - Zukunft - Fernerkundung

Luftbild Oberflächenmodell