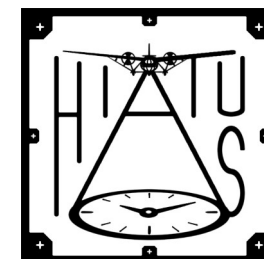


GEOMETRIC AND RADIOMETRIC PROCESSING OF HISTORICAL AERIAL PHOTOGRAMMETRIC CAMPAIGNS



HIATUS ANR PROJECT "HISTORICAL IMAGE ANALYSIS FOR TERRITORY EVOLUTION STORIES"



<https://anr-hiatus.github.io/>

arnaud.le-bris@ign.fr

HIATUS project

"Historical Image Analysis for Territory evolUtion Stories"

IGN/LaSTIG , LETG Rennes, ICUBE, DYNAFOR, LIVE, KERMAP



- **IGN/LaSTIG** : D. Craciun, A. Le Bris, L. Lelégard, C. Huet, E. Rupnik, C. Mallet
- **LETG-Rennes** : T. Corpetti, G. Fernandez-Garcia
- **ICUBE** : P. Gancarski, H. El Amouri
- **DYNAFOR** : D. Sheeren, Y. Hamrouni, V. Ferreira
- **LIVE** : P.-A. Herrault, A. Puissant + S. Derminon (Univ. Paris Saclay)
- **KERMAP** : A. Lefebvre

Context

Which data to analyze des **long-term spatio-temporal evolution of territories** ?



Topographic maps



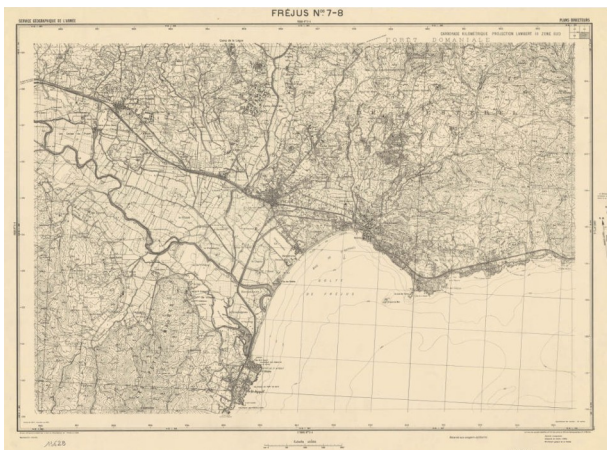
Archival aerial images



Archival satellite images

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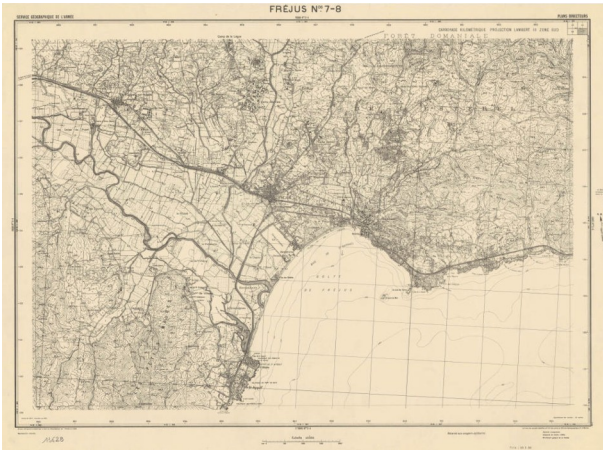
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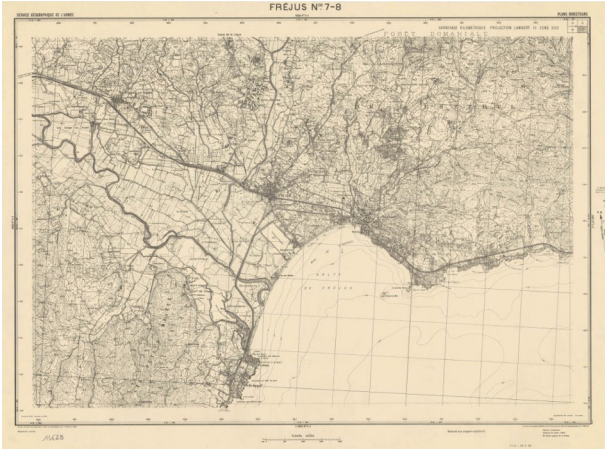
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Which data to analyze des **long-term spatio-temporal evolution of territories?**



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Archival aerial images

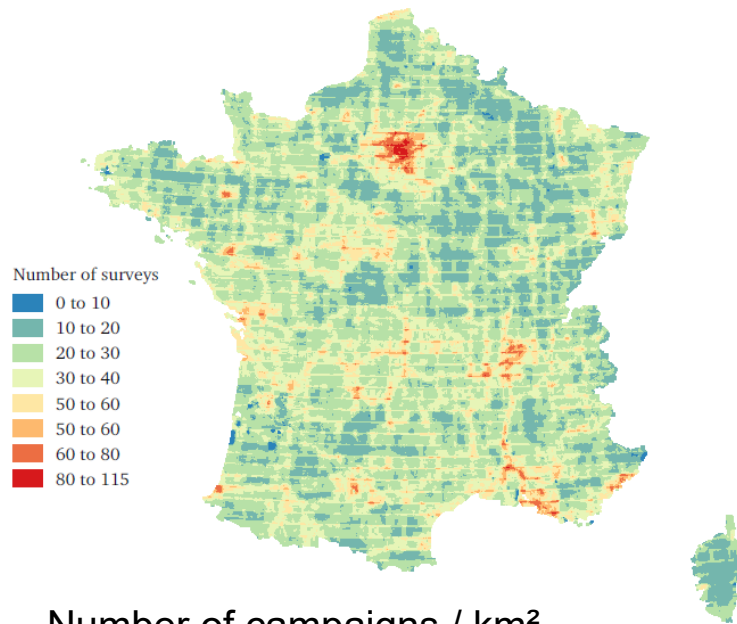


Archival satellite images

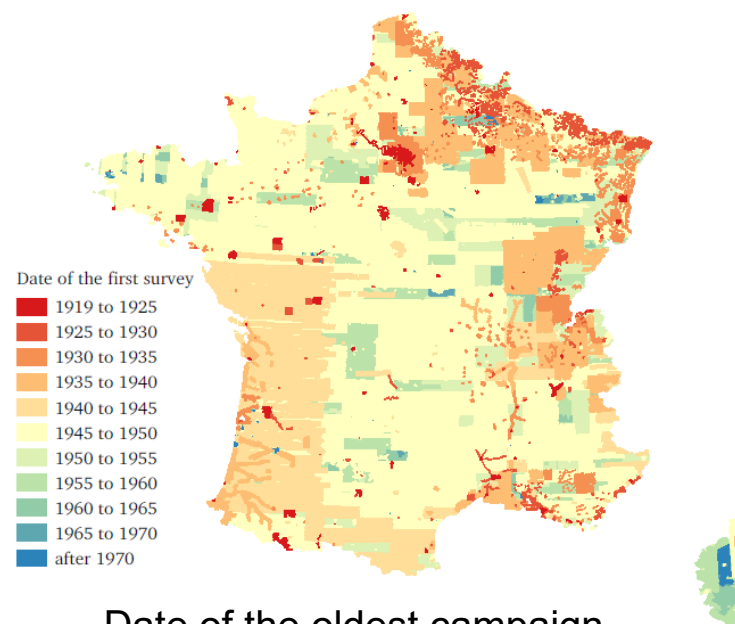
→ **Archival aerial images** : a unique and still not widely used source :

- to observe the evolution of territories
- to detect (geometric / semantic) changes
- to produce historical land cover maps

Archival aerial images in France



Number of campaigns / km²



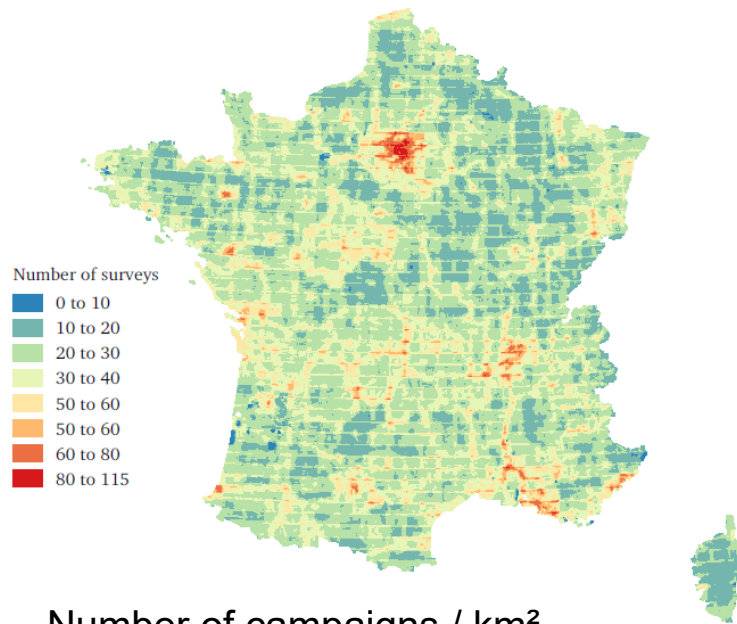
Date of the oldest campaign

→ Archival aerial images:

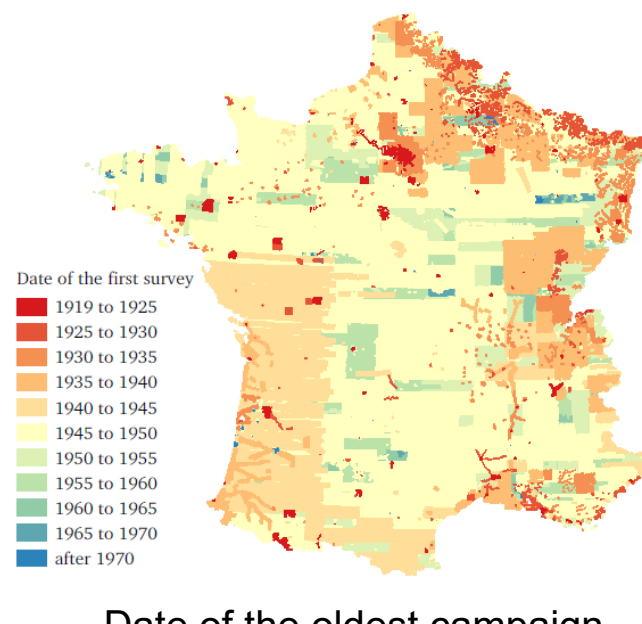
- Available everywhere
- Long time series



Archival aerial images in France



Number of campaigns / km²

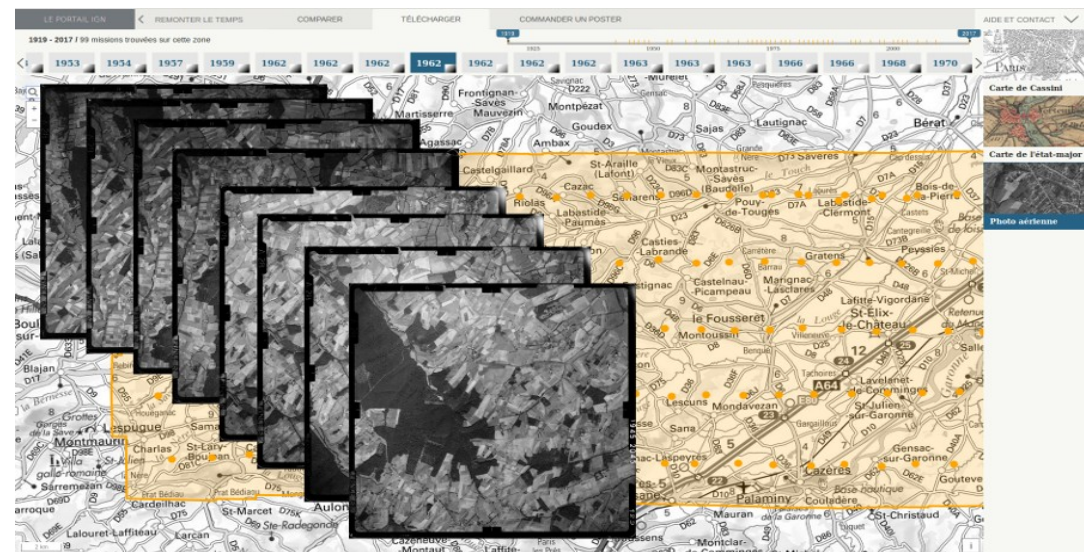


Date of the oldest campaign

→ Archival aerial images:

- Available everywhere
- Long time series
- Scanned and available through web services

<https://remonterletemps.ign.fr>



Possible use cases?

- Many possible use cases
 - Artificialization

When was this DB building object built ?



Possible use cases?

- Many possible use cases
 - Artificialization
 - Forest extension



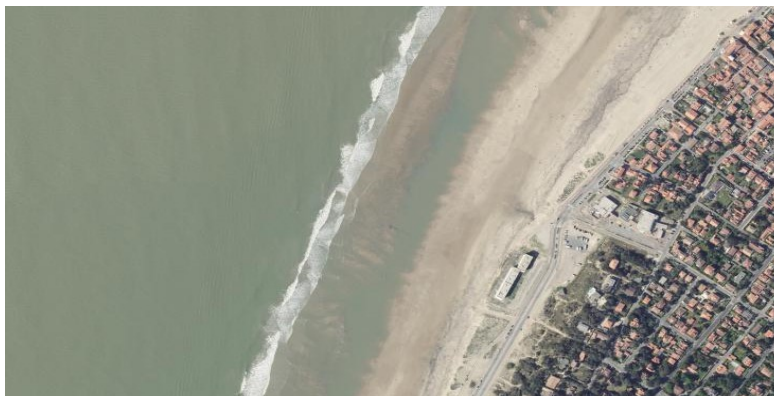
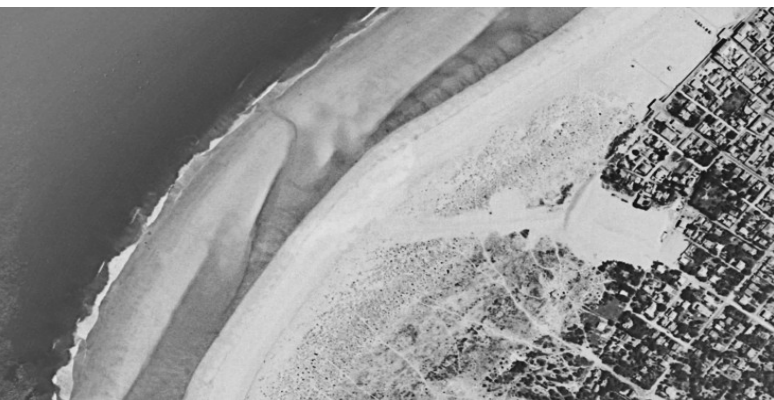
Possible use cases?

- Many possible use cases
 - Artificialization
 - Forest extension
 - Agricultural practices:
 - parcels evolution
 - removal of hedges
 - possible exposition to harmful products ?



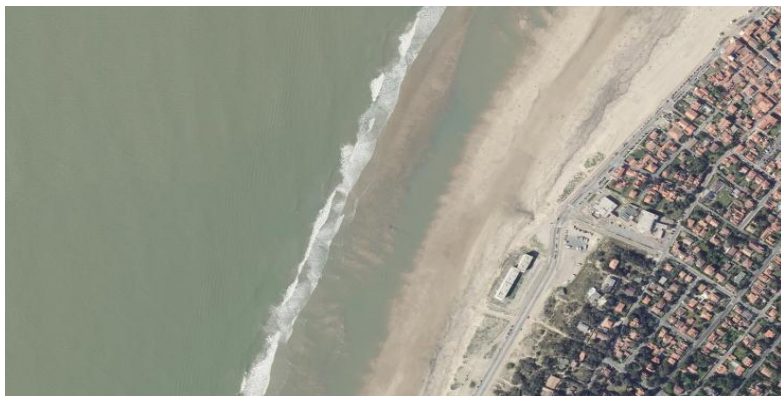
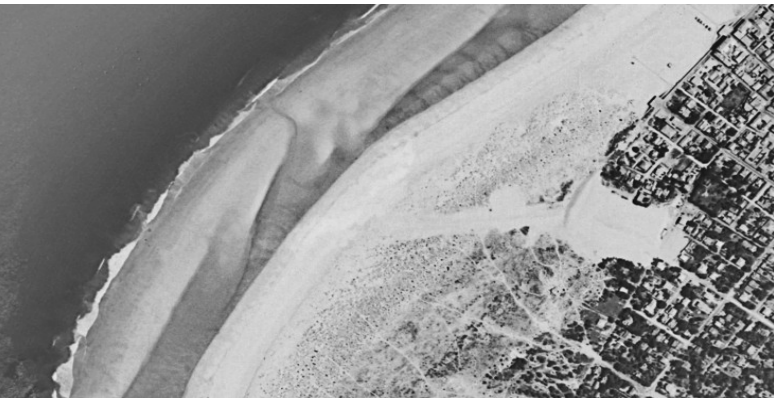
Possible use cases?

- Many possible use cases
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 - Agricultural practices:
 - parcels evolution
 - removal of hedges
 - Littoral erosion

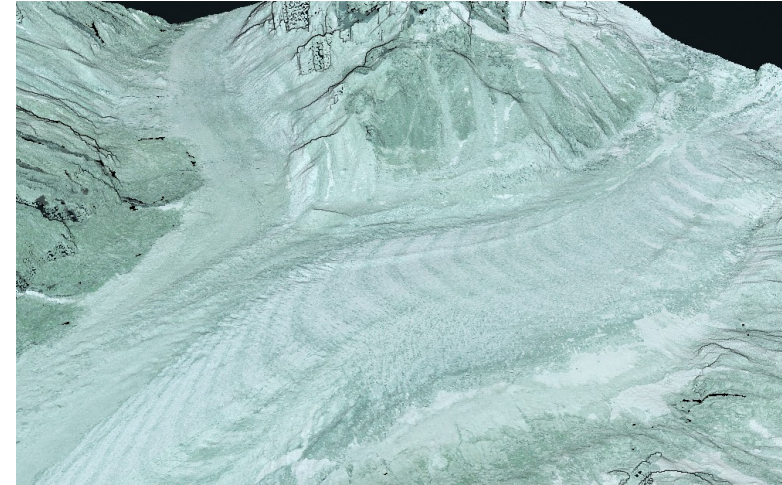


Possible use cases?

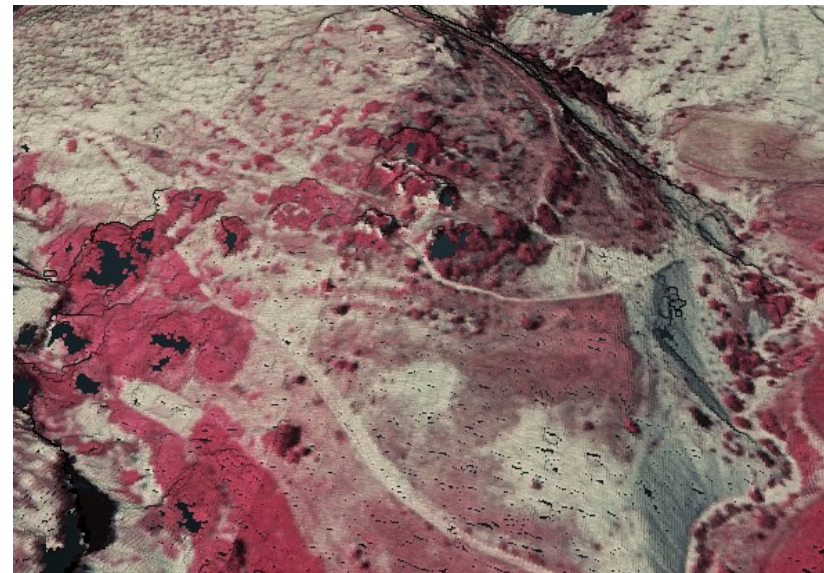
- Many possible use cases
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- Glacier evolution



- Archeology



Possible use cases?

- Many possible use cases

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- Glacier evolution

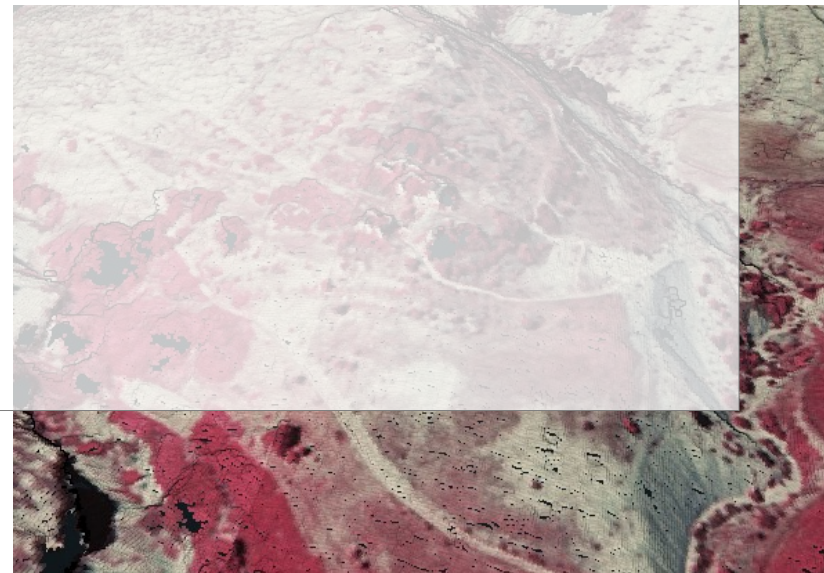


Wonderful data!

Let's go and process them!

- Archeology

But not...



Archival aerial images?

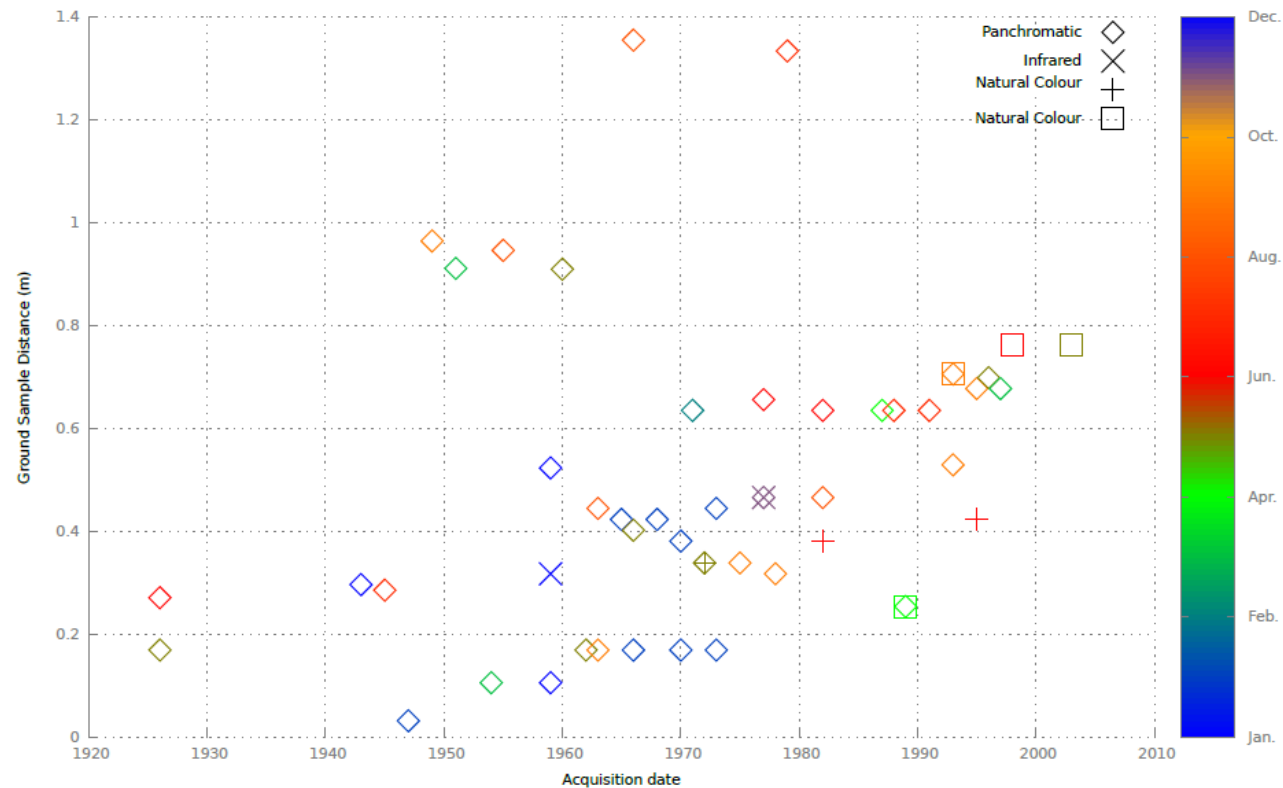
- Very heterogeneous data
(spatial resolution, spectral configuration, season, network structure. ...)



Fréjus study area ; urban area ; 3 km x 2 km

Archival aerial images?

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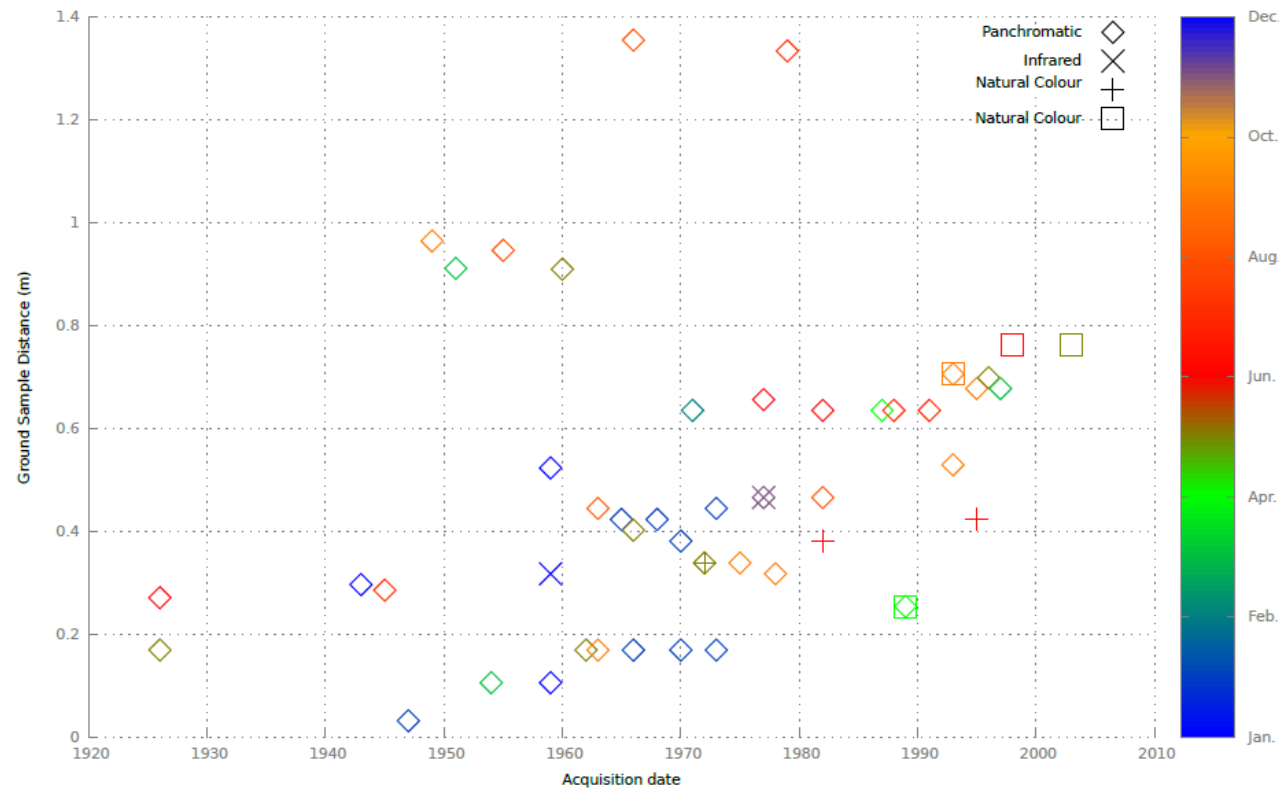


Fréjus study area ; urban area ; 3 km x 2 km

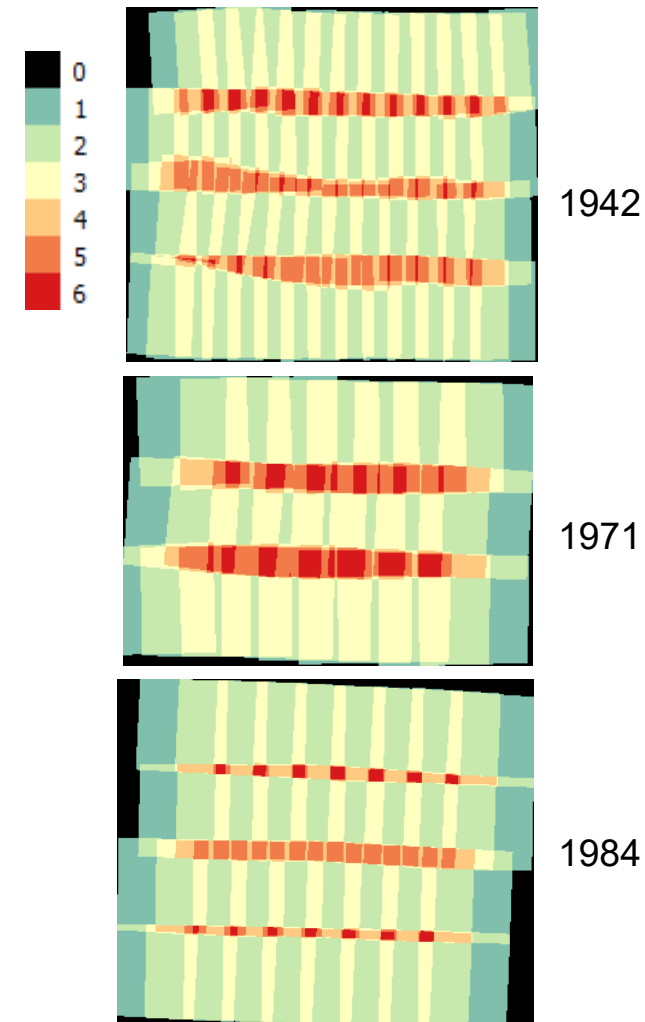
Archival aerial images?

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Number of images



Fréjus study area ; urban area ; 3 km x 2 km



Archival aerial images?

- Multi-view acquisitions → 3D information...



Fréjus study area ; urban area ; 3 km x 2 km

Archival aerial images?

- Multi-view acquisitions → 3D information...
but require pose estimation / internal and external calibration



Fréjus study area ; urban area ; 3 km x 2 km

HIATUS project



"Historical Image Analysis for Territory evolUtion Stories"

- **Geometric and radiometric processing**

HIATUS project



"Historical Image Analysis for Territory evolUtion Stories"

- **Geometric and radiometric processing**
- **Data analysis**
 - Pbs: heterogeneity, quality and imprecise data and lack of reference data

HIATUS project



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HIATUS project

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- **Geometric and radiometric processing**
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 - **Semantic segmentation – Transfer learning**
 - Integrate spatio-temporal constraints / data quality / thematic constraints in transfer learning process

HIATUS project

"Historical Image Analysis for Territory evolution Stories"

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- **Data analysis**

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- **Change detection and image+DSM time series analysis**

- **Semantic segmentation – Transfer learning**

→ Integrate spatio-temporal constraints / data quality / thematic constraints in transfer learning process

- **End user interaction**

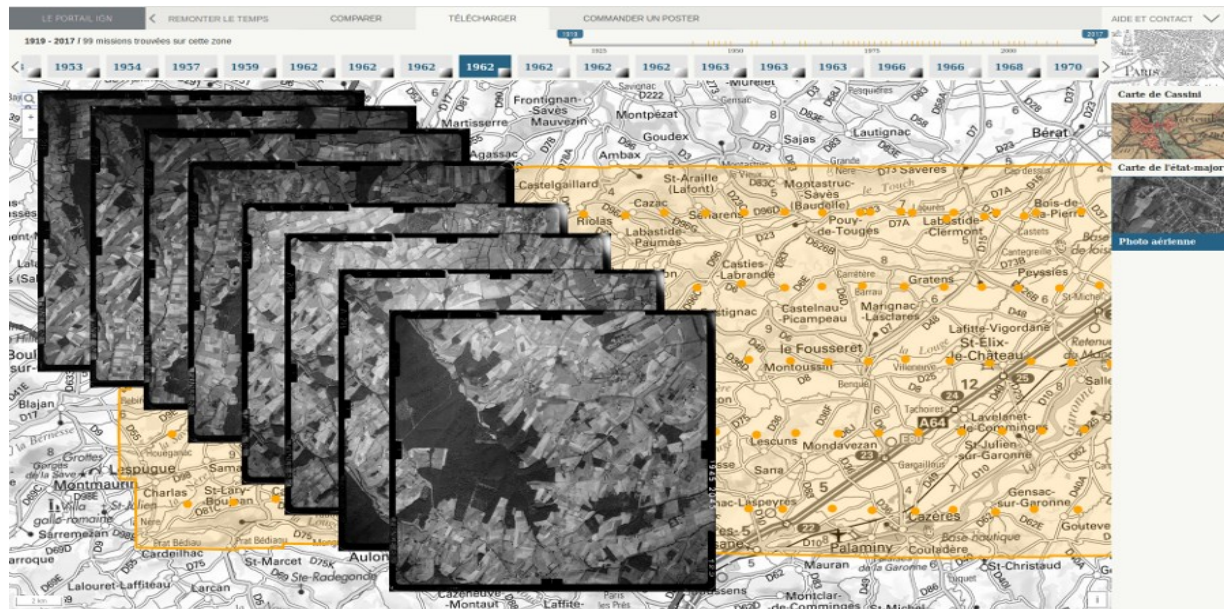
→ Develop an online viewer to show the evolution of territories for some land cover use cases and an interactive change detection tool

GEOMETRY

Archival aerial images?

In France, scanned image are available at :

<http://remonterletemps.ign.fr>



Some **metadata** are available:

- Coarse flight plan
- Focal
- Physical size of images
- Scan parameters (dpi)
- Calibration [rarely]

Usual photogrammetric pipeline

- **Image orientation:**

- Interior orientation [image per image]
- Relative orientation: "en l'air" model [all images + camera metadata]
- Absolute orientation: georeferenced model [all images + position metadata + GCPs]

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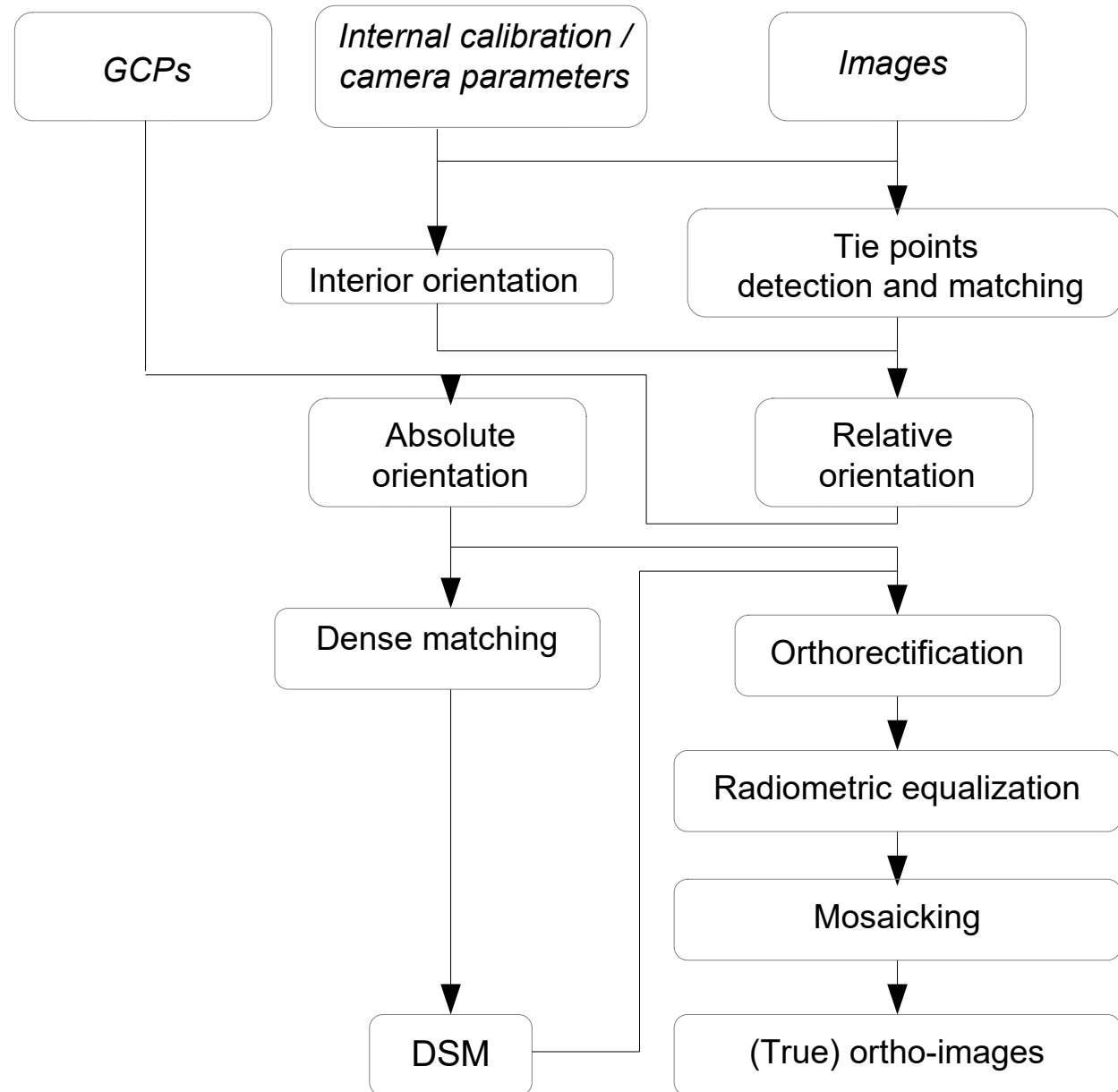
- **Final products:**

- Dense matching – DSM
- Orthoimage (orthorectification + mosaicing)

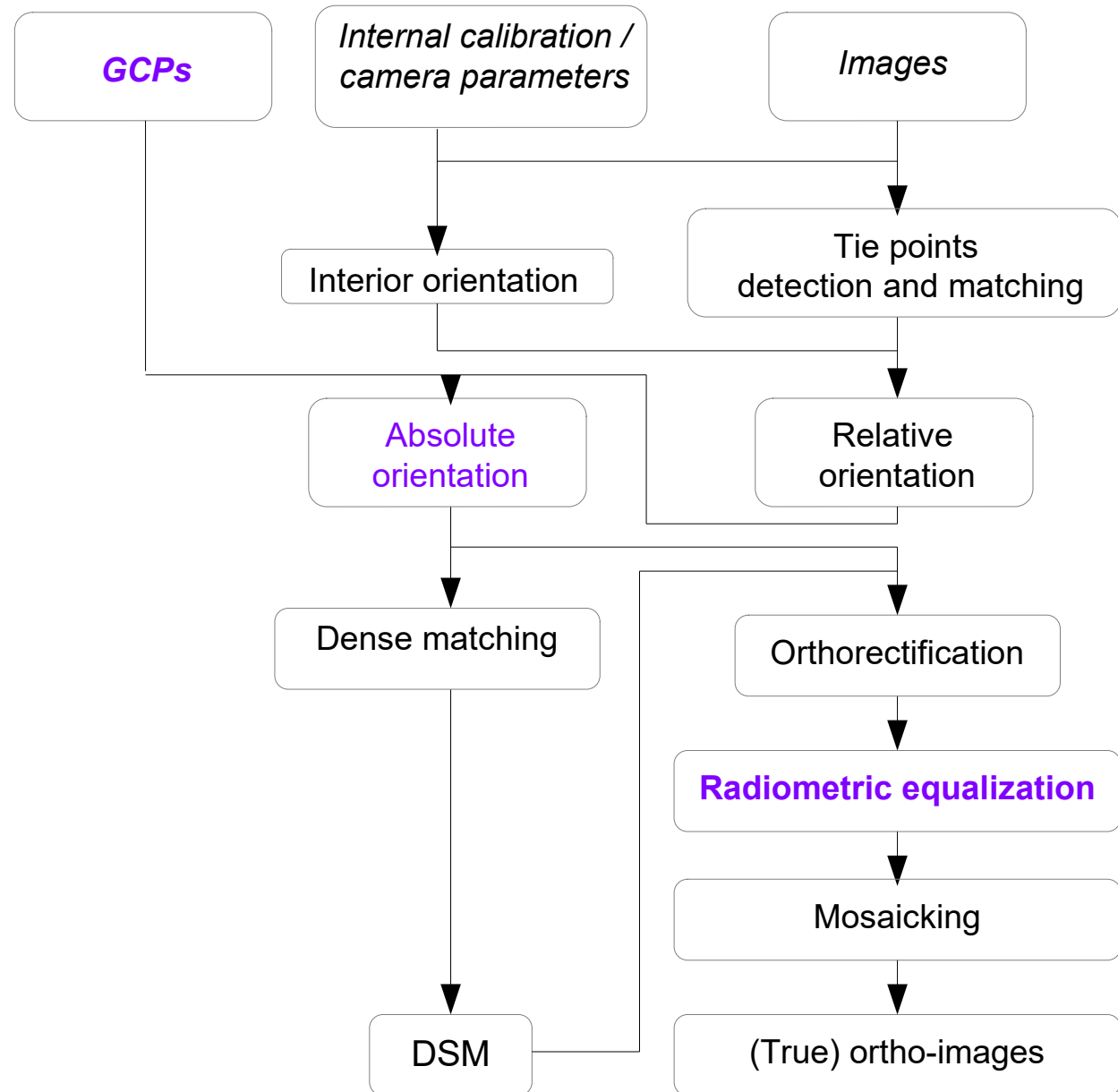
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Usual photogrammetric pipeline



Main issues

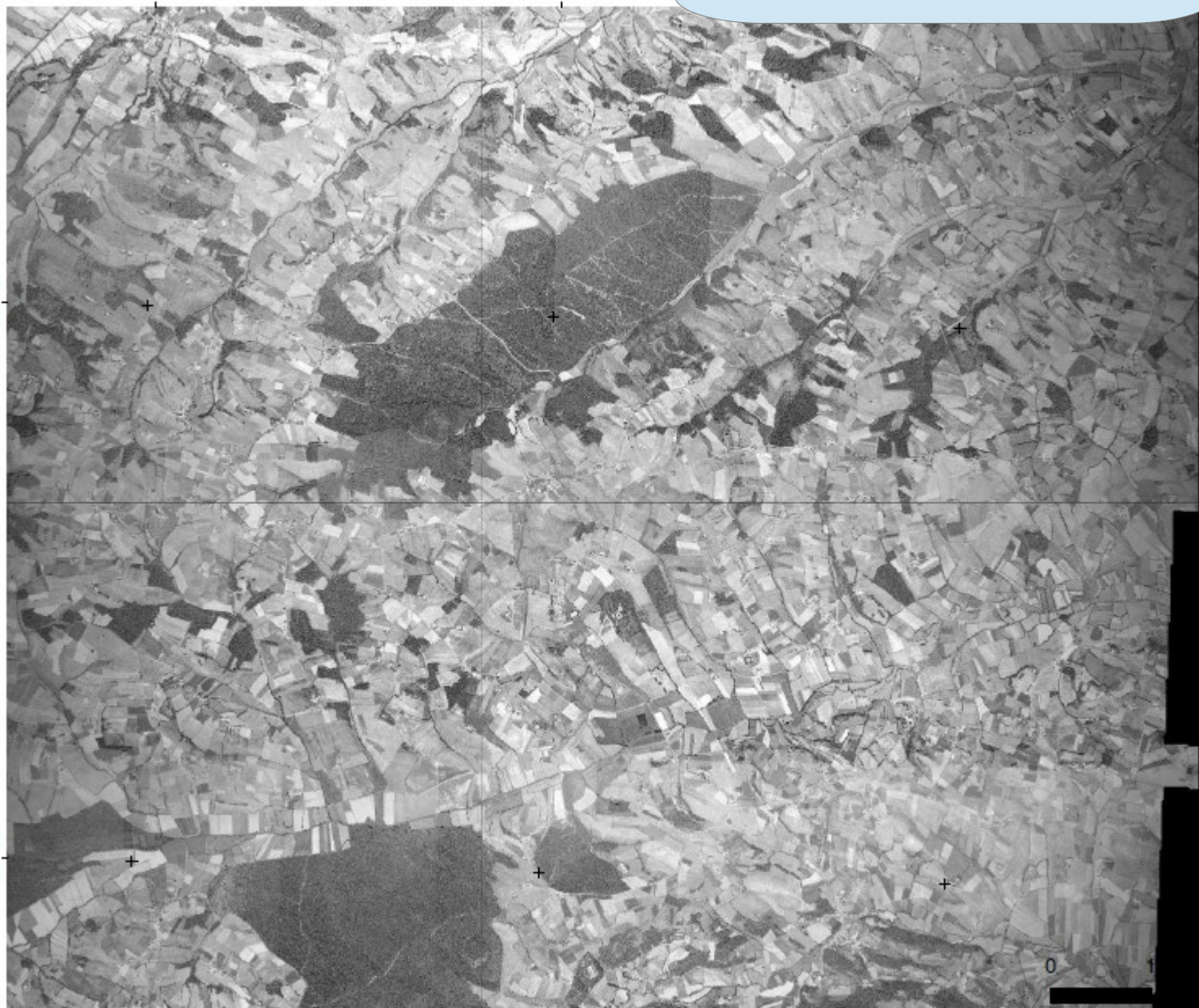
Using only available data...



Fabas study area ; 12 km x 10 km ; **recent ortho-image (IGN BDOrtho)**

Using only available data...

Coarse camera positions
Coarse camera calibration



Fabas study area ; 12 km x 10 km ; **ortho-image from an acquisition of 1984**
pose+calibration directly out of available metadata

Using only available data...

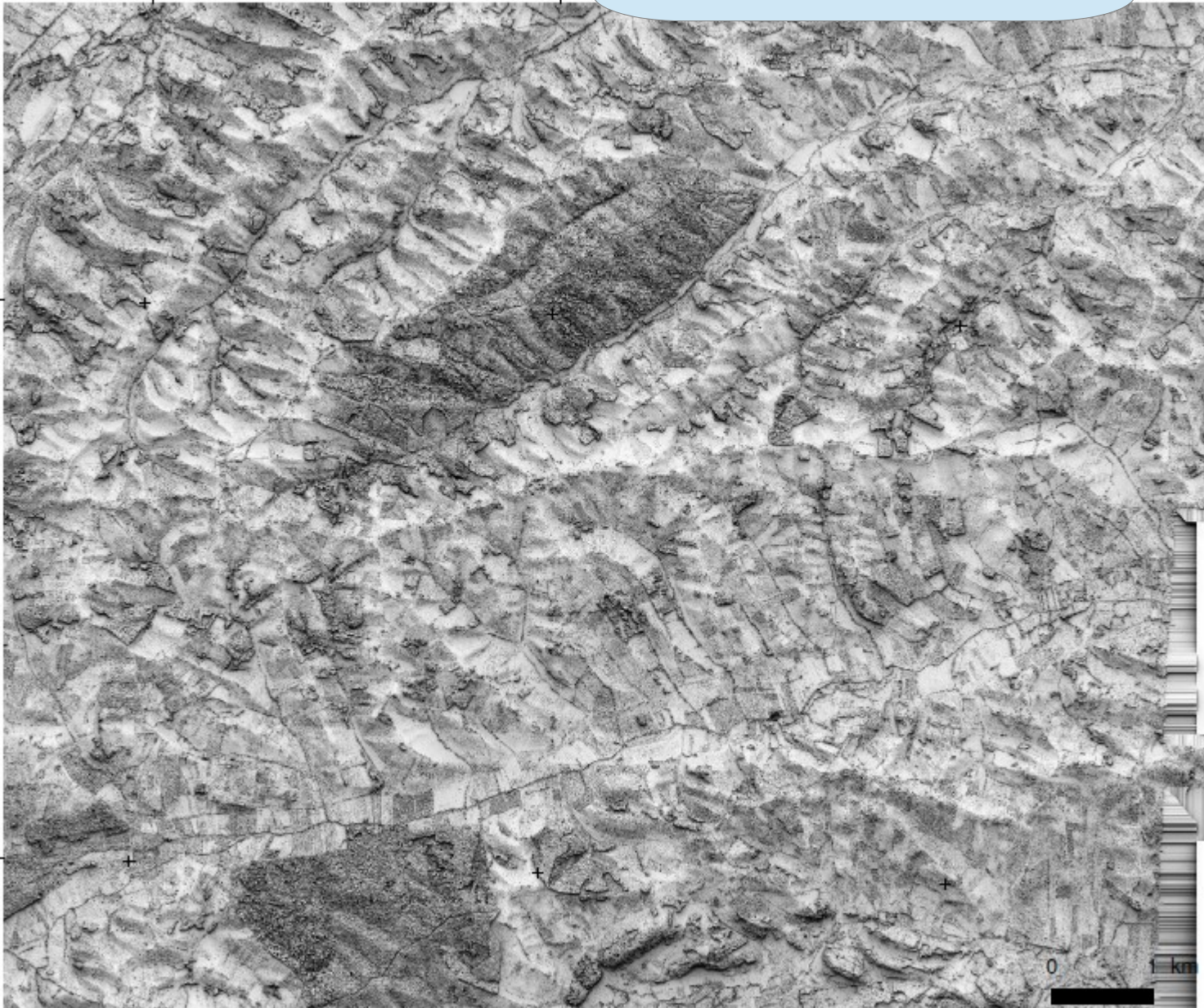
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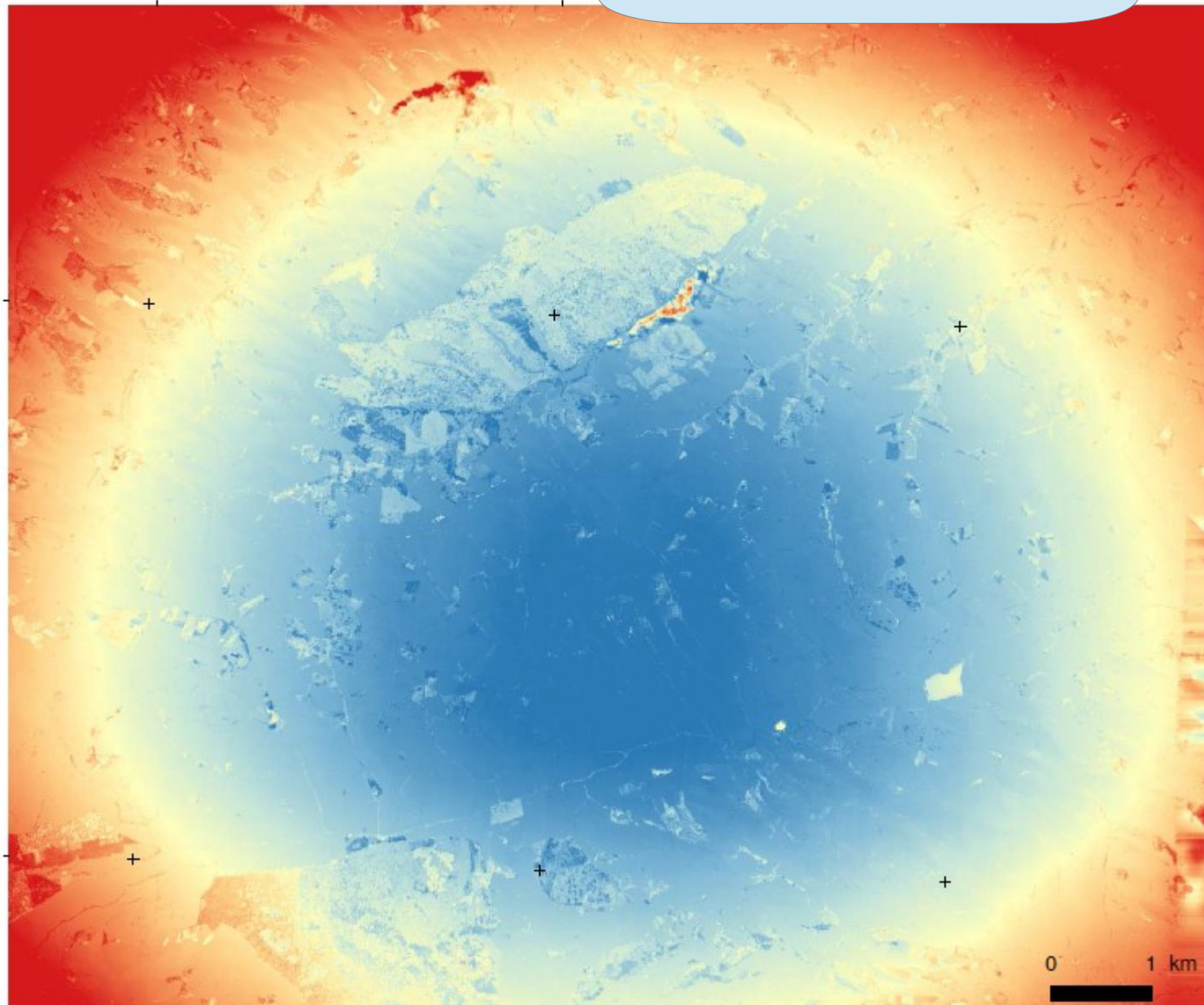
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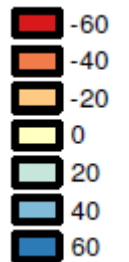
Fabas study area ; 12 km x 10 km ; **DSM from an acquisition of 1984**
pose+calibration directly out of available metadata

Using only available data...

Coarse camera positions
Coarse camera calibration



Difference (m)

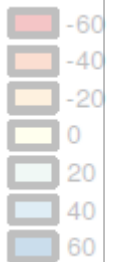


Fabas study area ; 12 km x 10 km ; **altimetric difference between "1984" DSM and present "reference" DSM**

Using only available data...

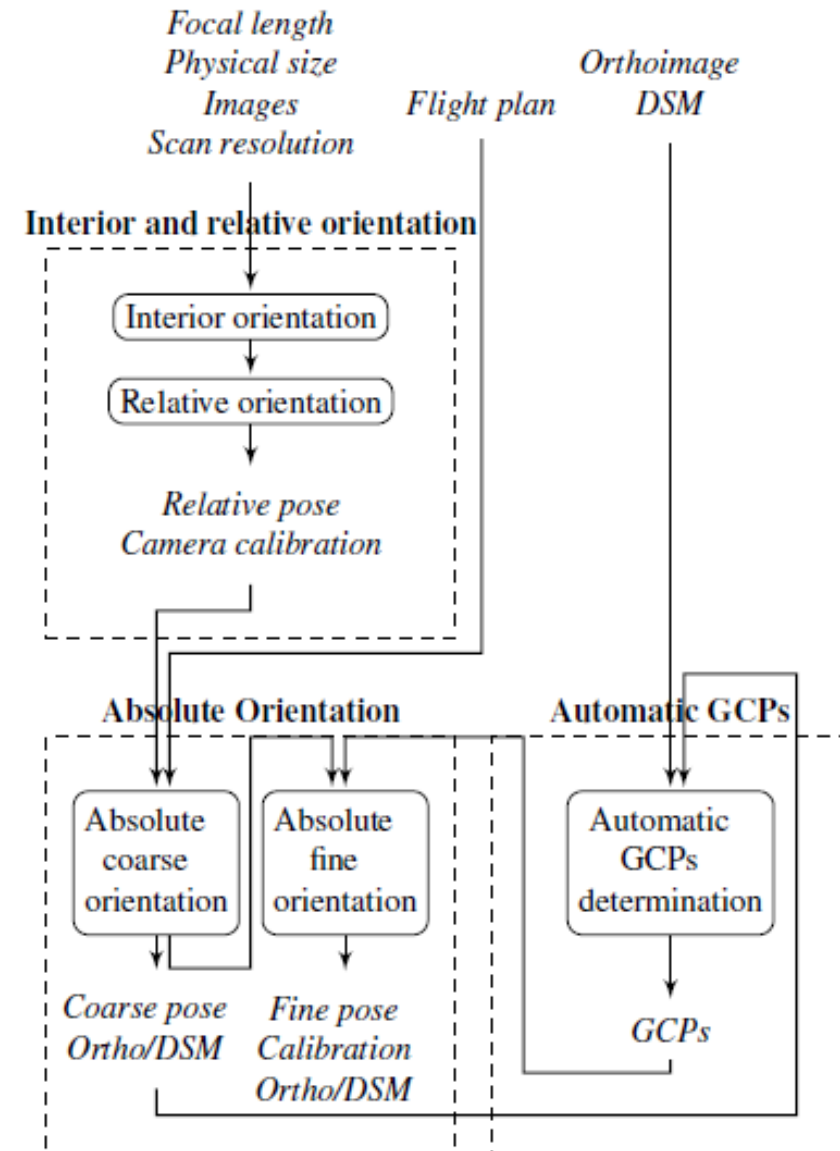
Need for GCPs...

Difference (m)



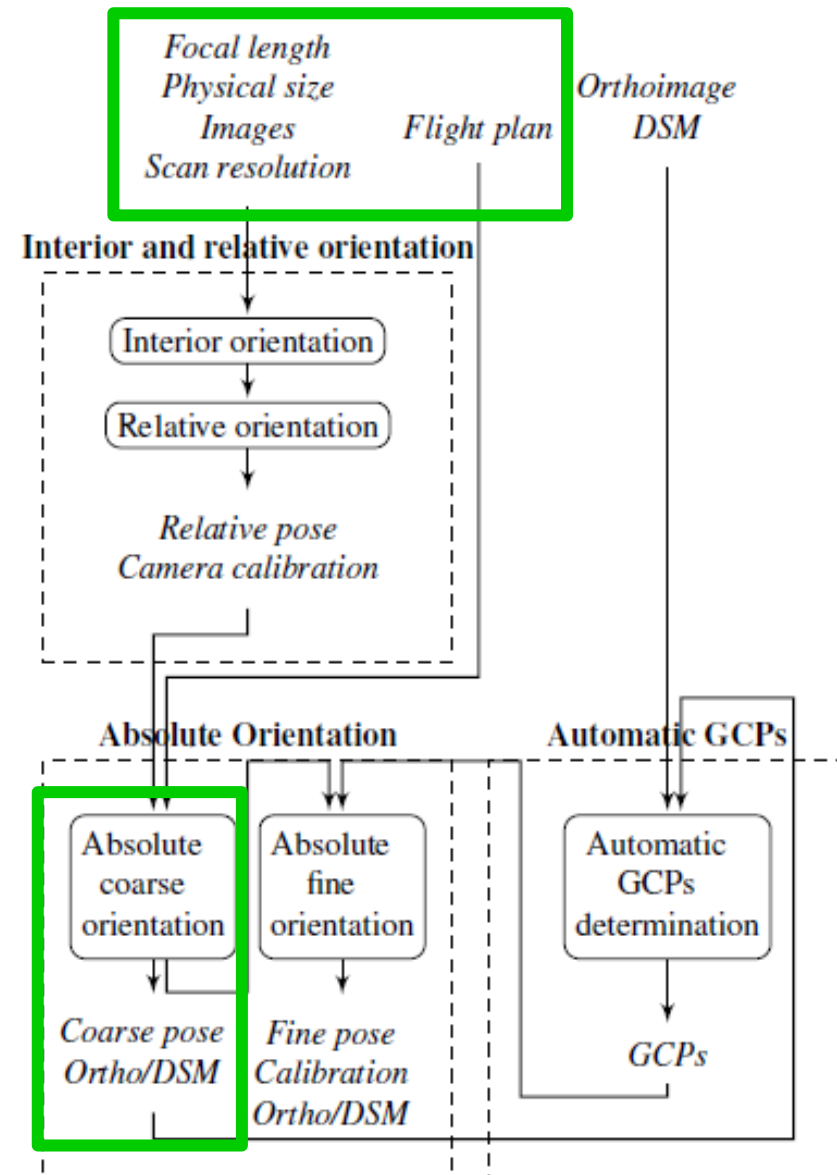
Fabas study area ; 12 km x 10 km ; **altimetric difference between "1984" DSM and present "reference" DSM**

Proposed approach



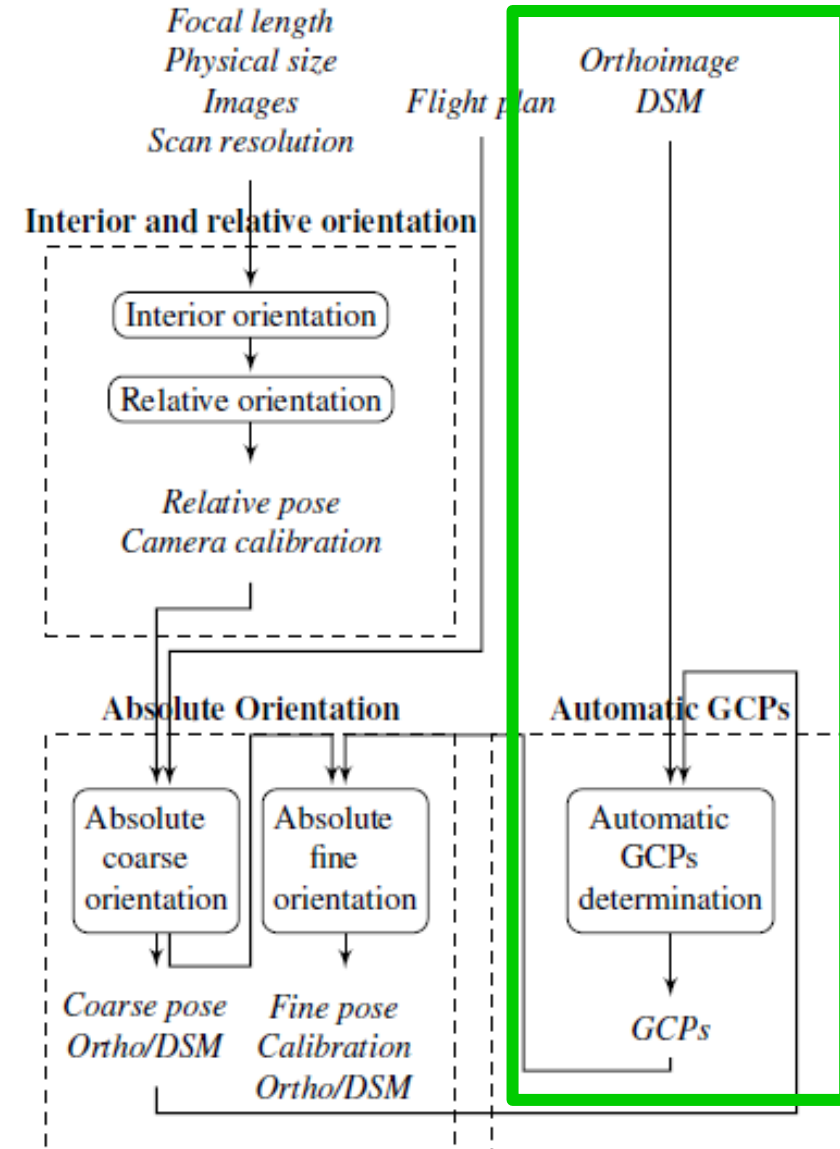
Proposed approach

- Use metadata provided with images :
→ "Coarse" initial solution



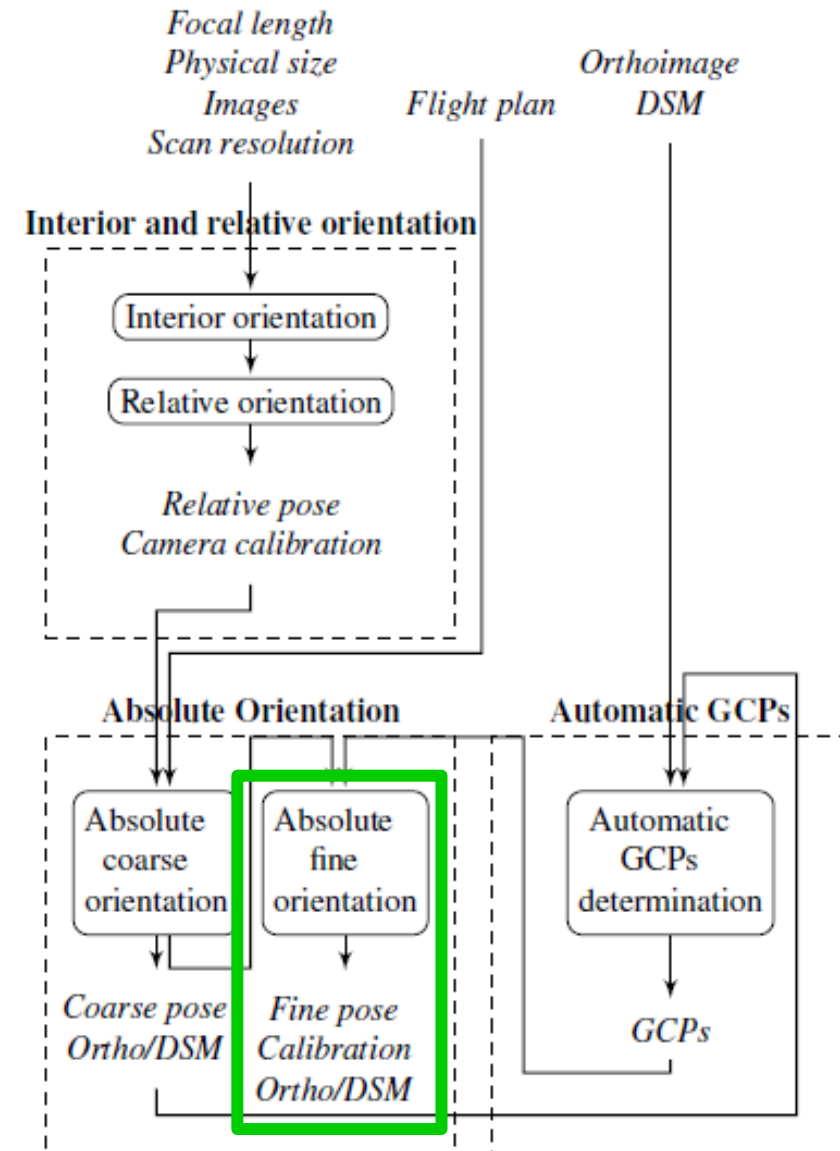
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- Use metadata provided with images :
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- Detect automatically GCPs :
Detect and match homologous points between archival
"coarse" ortho-images/DSM and recent reference ones



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- Use metadata provided with images :
→ "Coarse" initial solution
- Detect automatically GCPs :
Detect and match homologous points between archival
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Proposed approach : automatic GCPs

Inter-date homologous point detection → need for a method robust to diachronism...

- [\[Aubry et al., 2014\]](#) → designed to detect homologous points
between recent images and historical paintings
→ **multi-modal and multi-temporal !**
- [SuperGlue \[Sarlin et al., 2020\]](#) → deep learning based, take into account point spatial arrangement
- [GlueStick \[Pautrat et al., 2023\]](#) → deep learning based, detect and match points and lines

For each point → 3D ground coordinates

- Georeferenced ortho-images → planimetric coordinates in map reference system
- DSM → altimetric information

Important amount of false matches → RANSAC filtering (simple 2D transform)

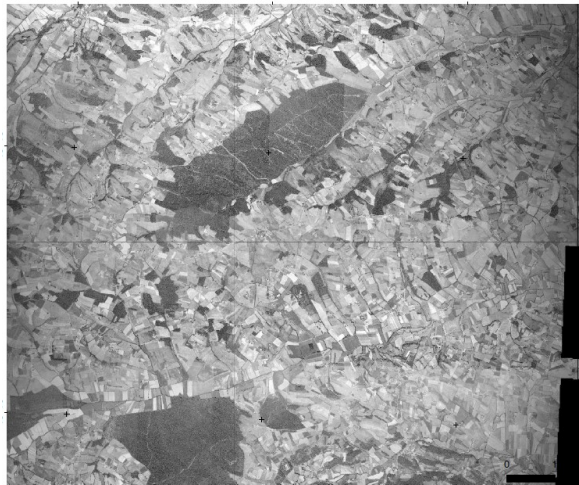
For remaining matches

→ reproject points from "old coarse" ortho-image (+ DSM) to archival aerial images

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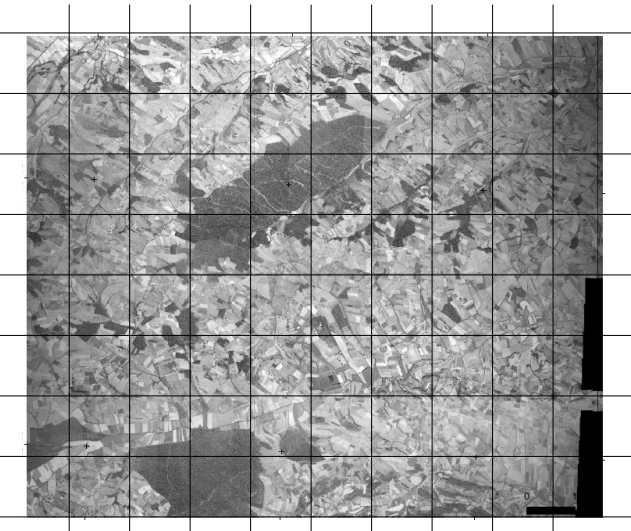


- Tile based approach

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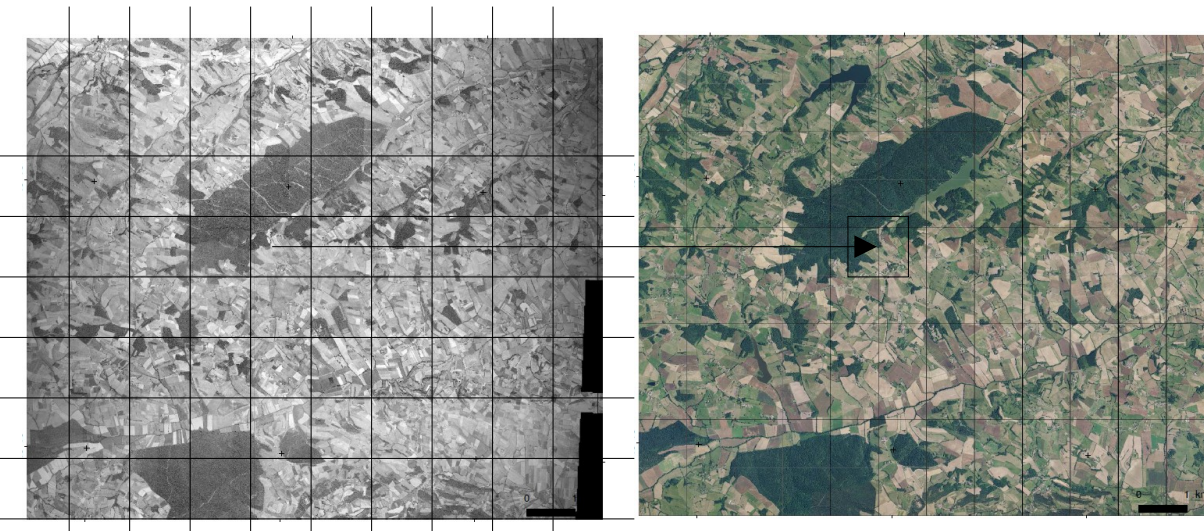


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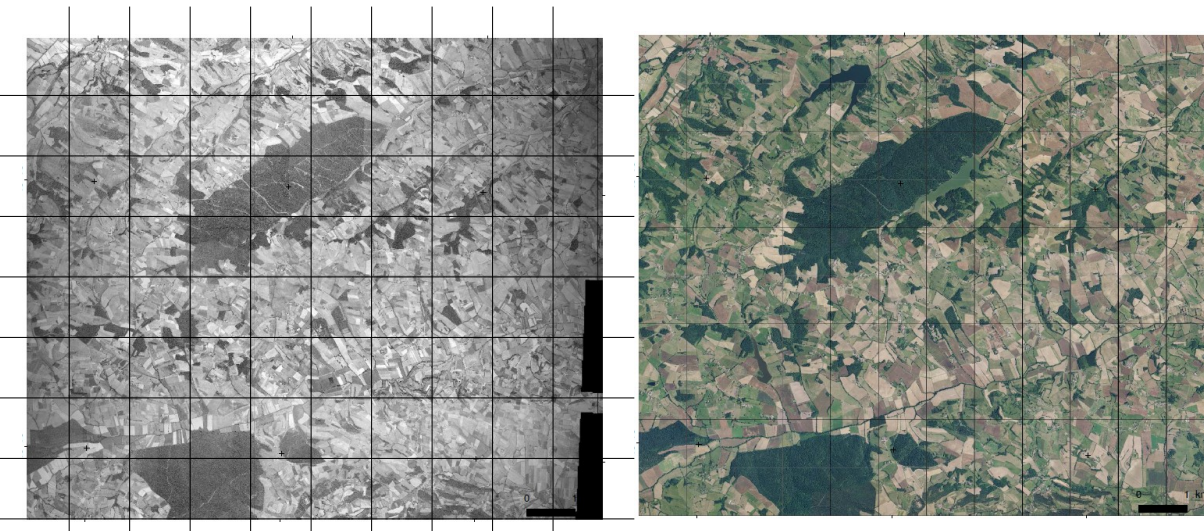


- Tile based approach
- Exploit coarse georefencing to retrieve the same image part in recent data

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- Tile based approach
- Exploit coarse georefencing to retrieve the same image part in recent data
- In practice:
 - first step on (10x) downsampled images to improve «coarse 2D tile position »
 - Second step at full resolution

Automatic GCPs



Fabas
1942



Fréjus
1954

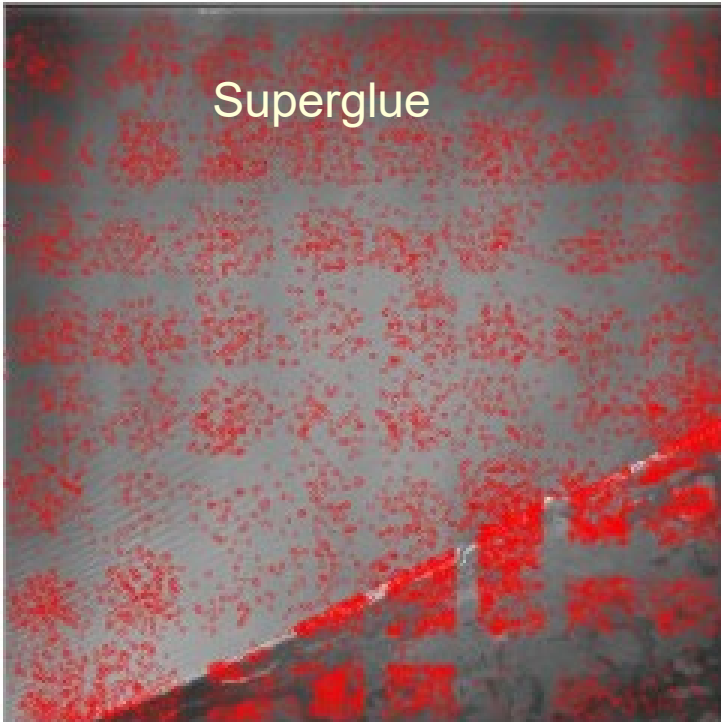


Automatic GCPs

Superglue vs. [Aubry 2014]?

- | | |
|--|---------------|
| + fast | + slower |
| + works generally well | - more robust |
| - but sometimes surprising results :
either many points
or no points
within tiles | |

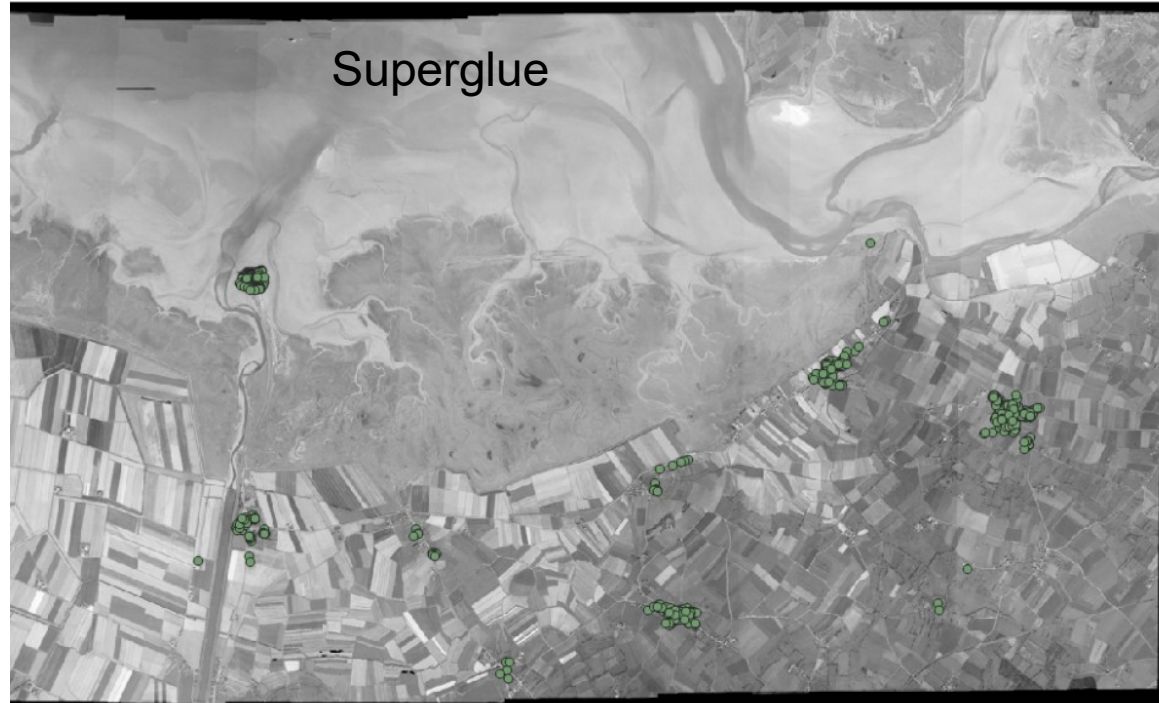
Superglue



[Aubry 2014]



Superglue



Visual assessment

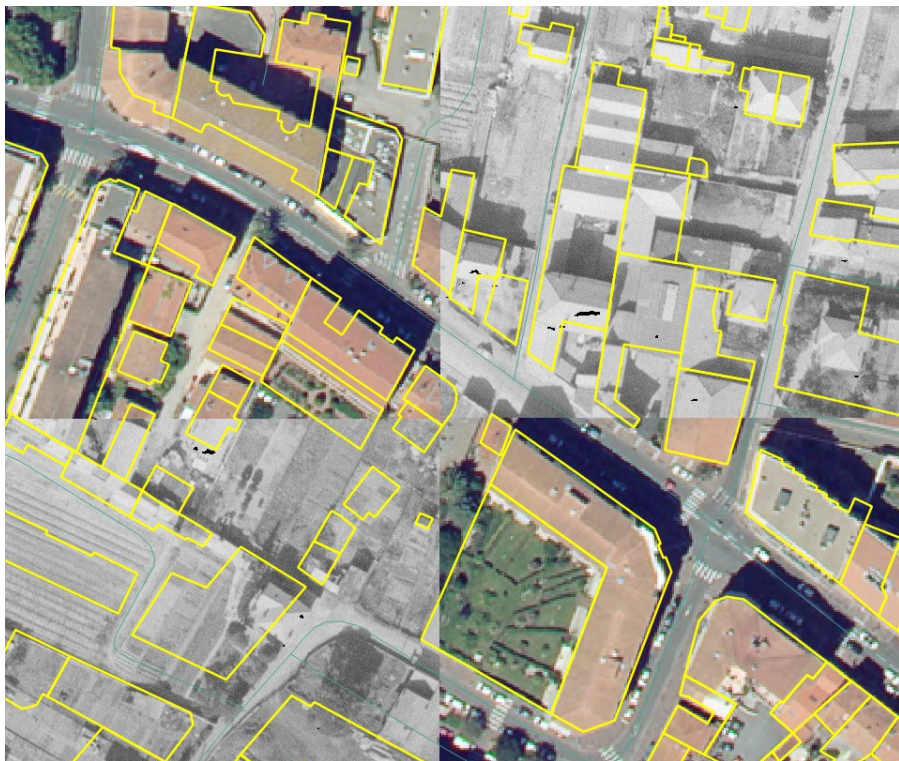


Fréjus (1954, coarse calibration)



Fabas (1942 , coarse calibration)

Visual assessment

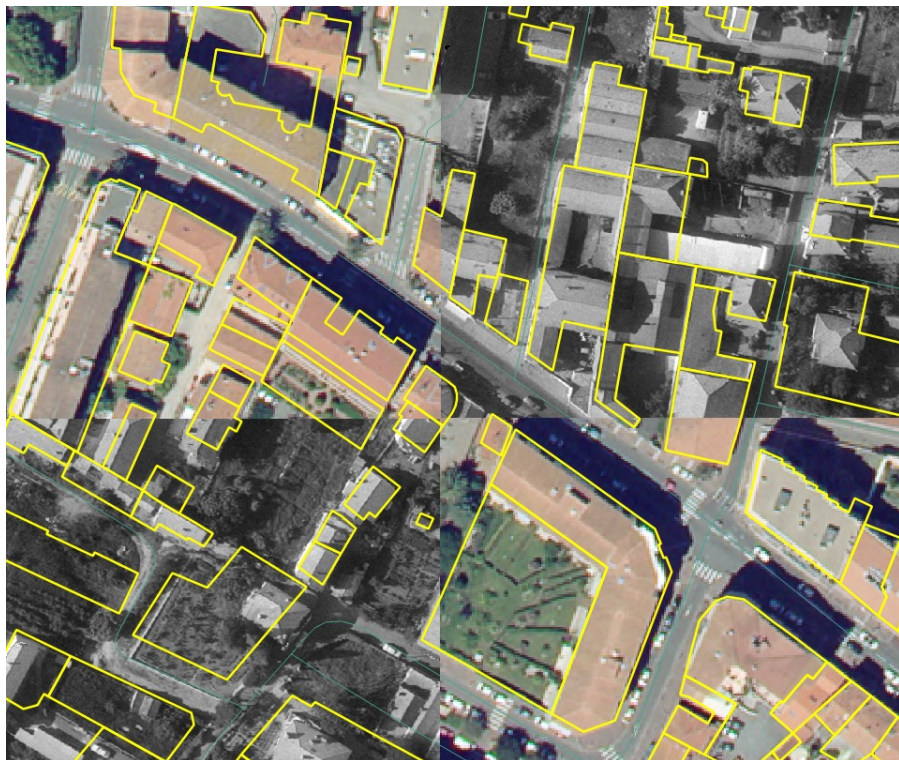


Fréjus (1954)



Fabas (1942)

Visual assessment

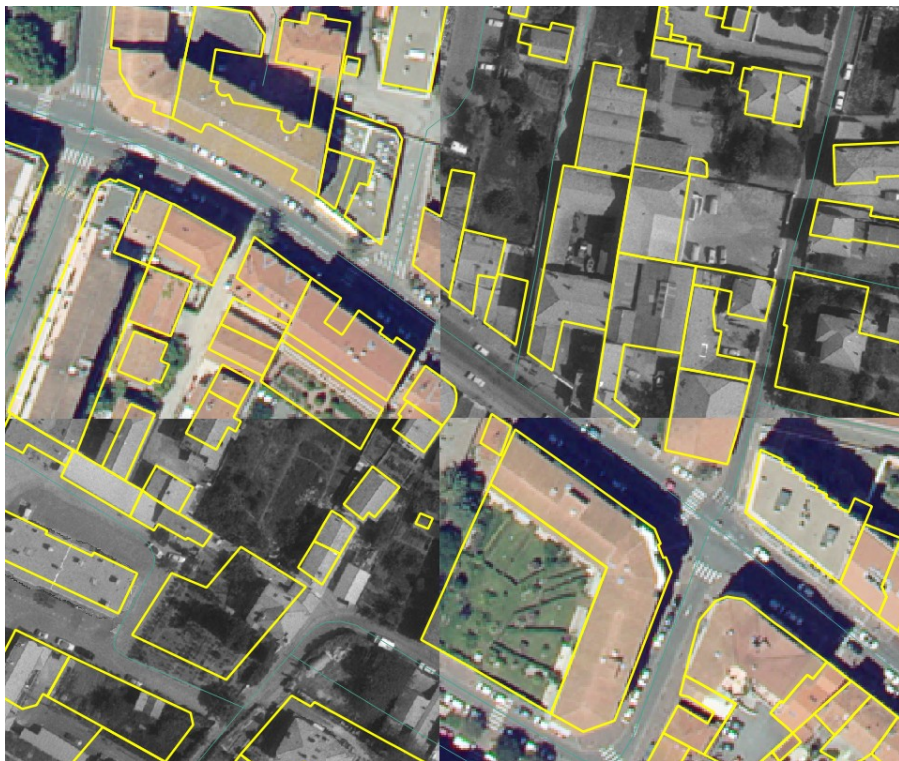


Fréjus (1966)

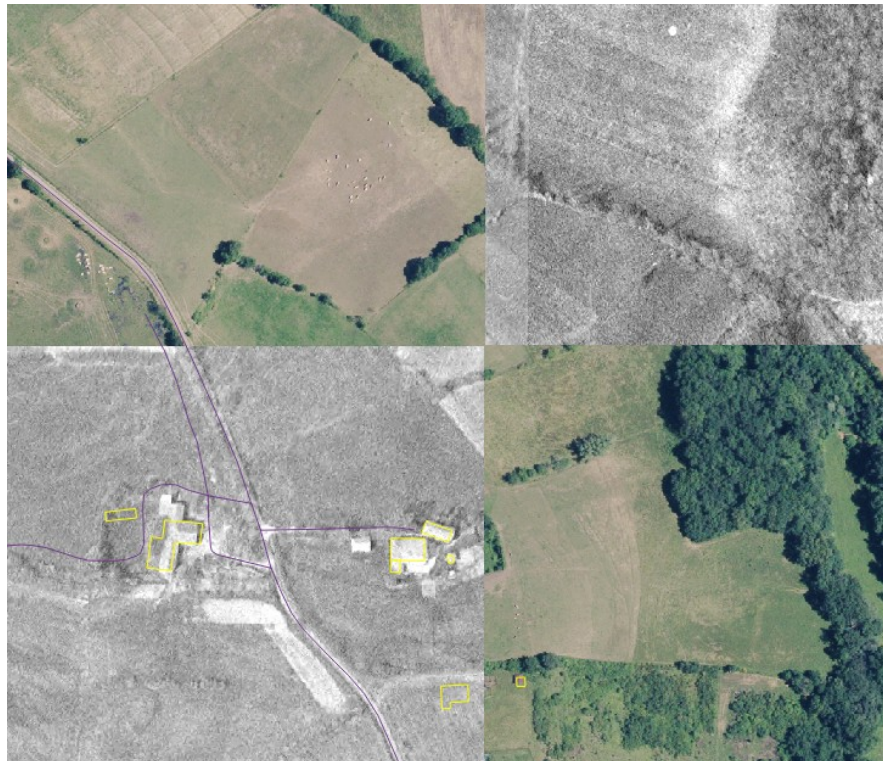


Fabas (1962)

Visual assessment

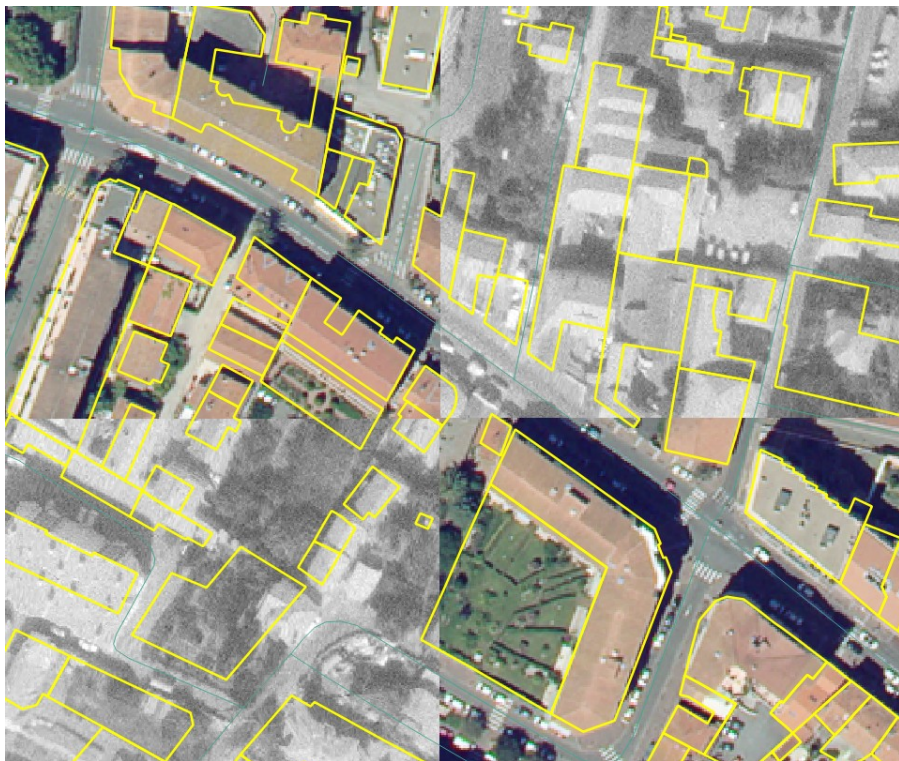


Fréjus (1970)

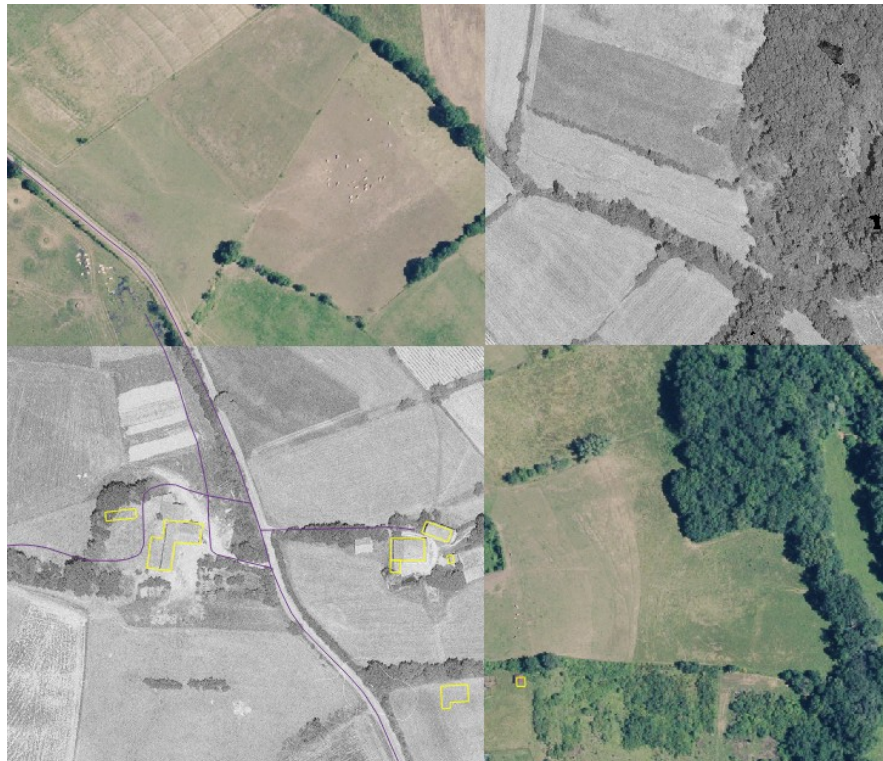


Fabas (1971)

Visual assessment

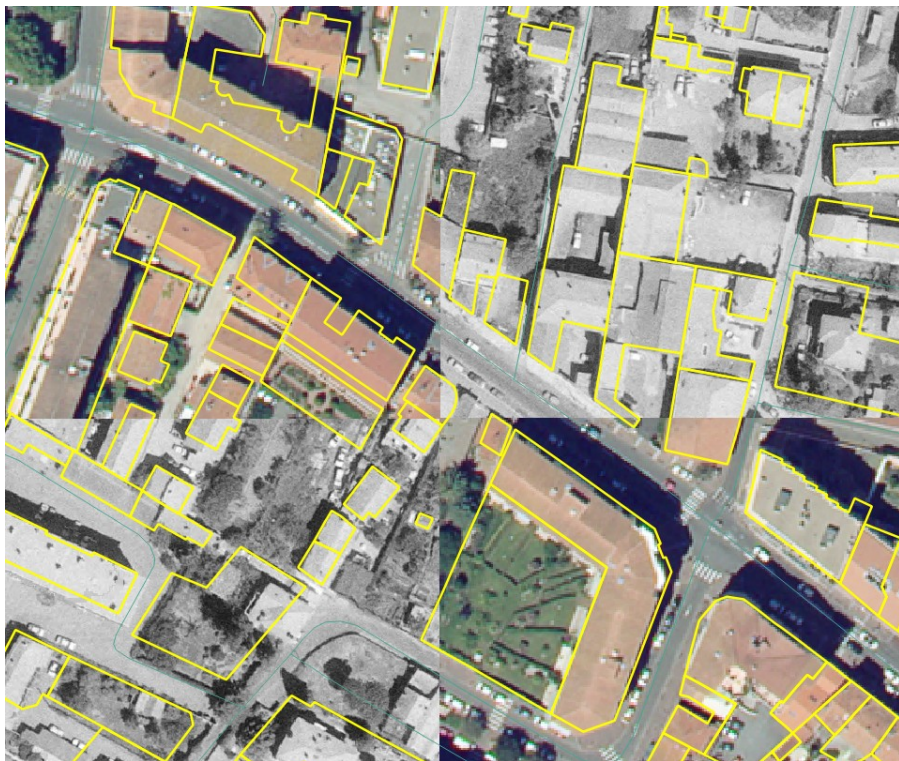


Fréjus (1978)



Fabas (1984)

Visual assessment



Fréjus (1989)

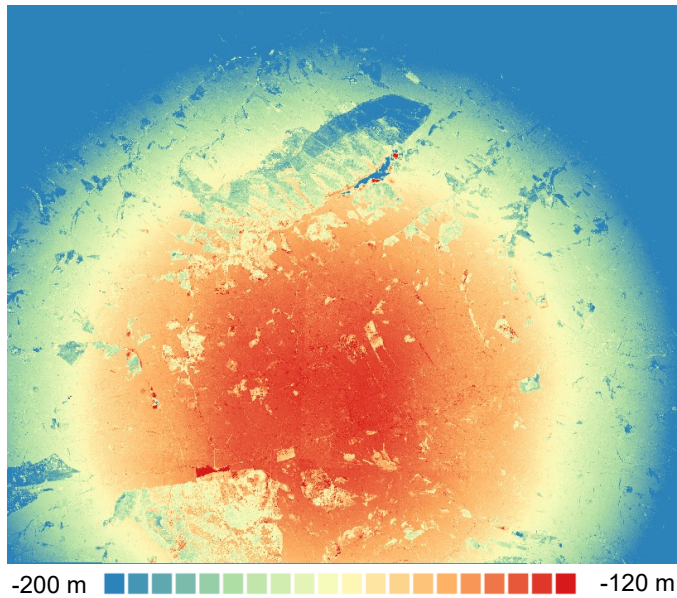


Fabas (1992)

Automatic GCPs: results

Altimetric differences between obtained old DSM and reference DSM

Fabas (1971)

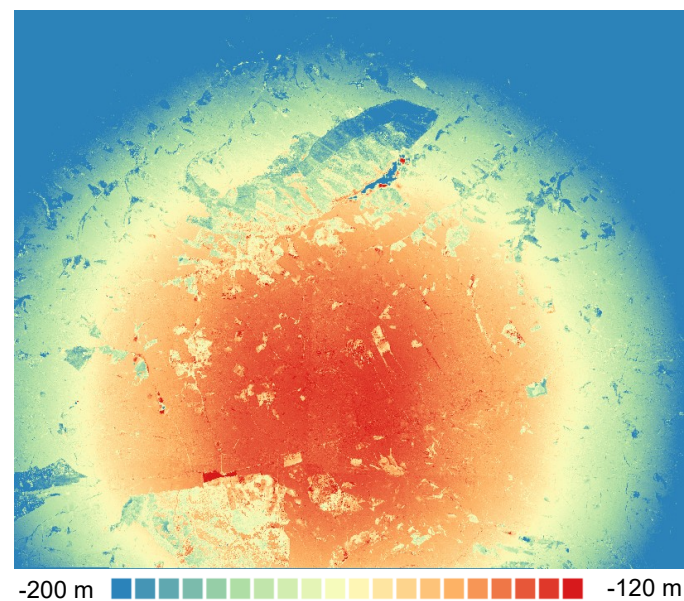


DSM "coarse calibration"

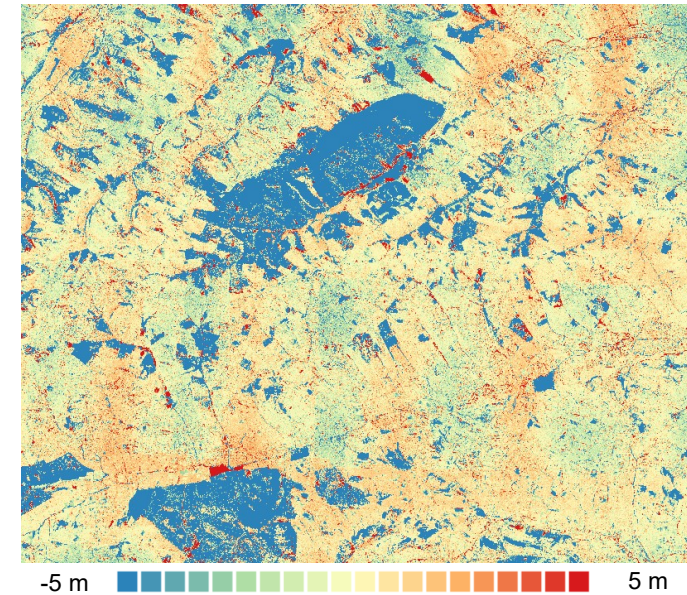
Automatic GCPs: results

Altimetric differences between obtained old DSM and reference DSM

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DSM "coarse calibration"

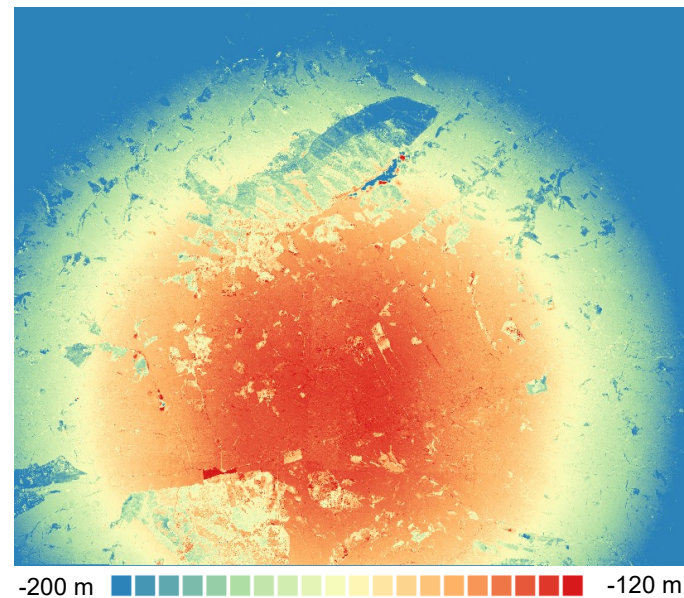


DSM "final calibration"
automatic control points
taken into account in bundle
adjustment

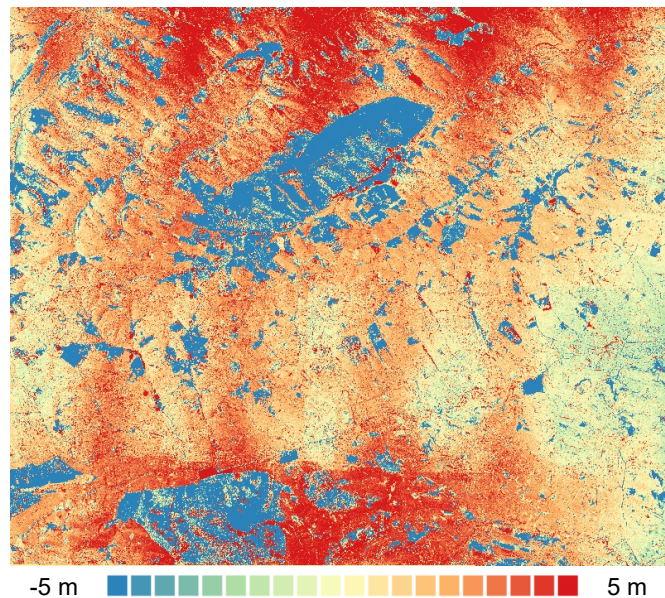
Automatic GCPs: results

Altimetric differences between obtained old DSM and reference DSM

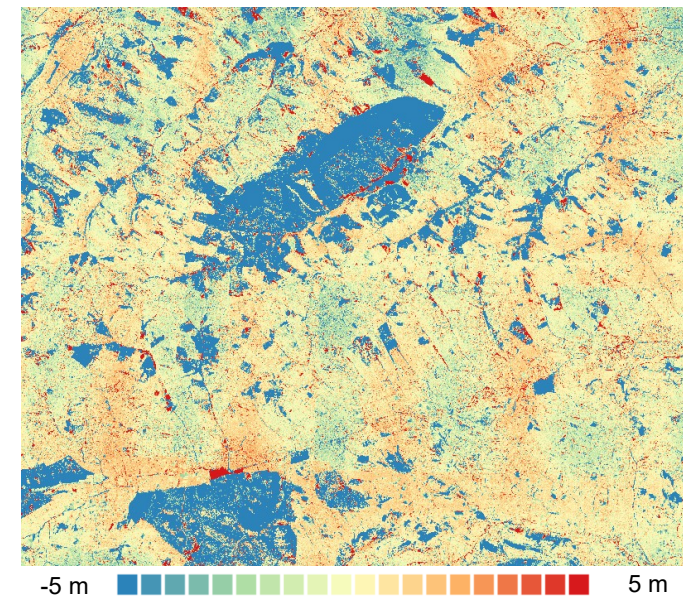
Fabas (1971)



DSM "coarse calibration"



DSM "coarse calibration"
polynomial model applied to
correct altimetric
deformations



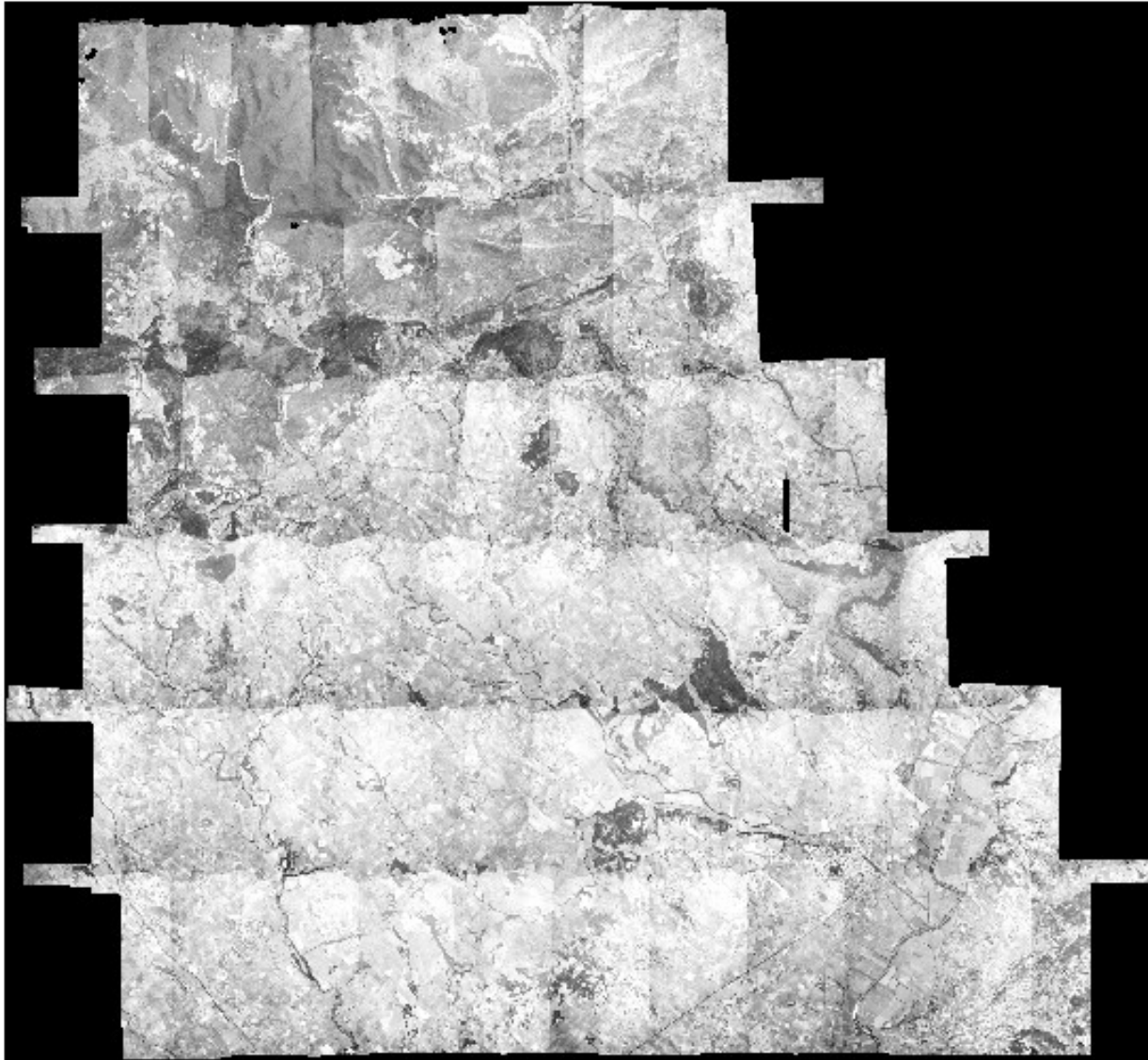
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adjustment

RADIOMETRY

Radiometric issues

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...



Radiometric issues

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→ main phenomena to consider : vignetting, hot spot, fog, ...

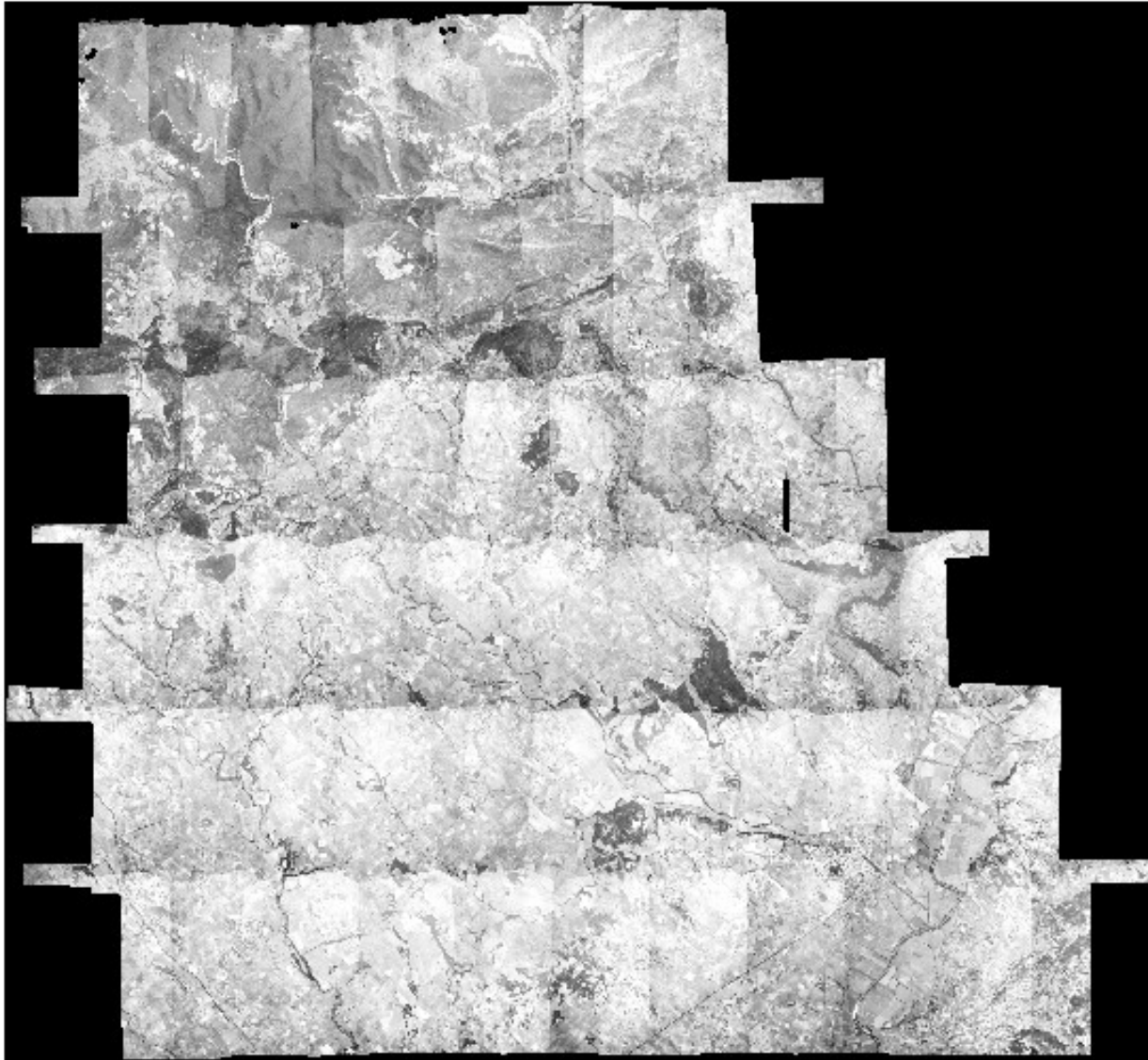
2 considered methods:

- Parametric model:
 - An additive polynomial correction model for each image
 - Minimize differences between ortho-images in overlapping areas
 - Computed at low resolution

Radiometric issues

How to perform radiometric corrections to obtain homogeneous mosaics?

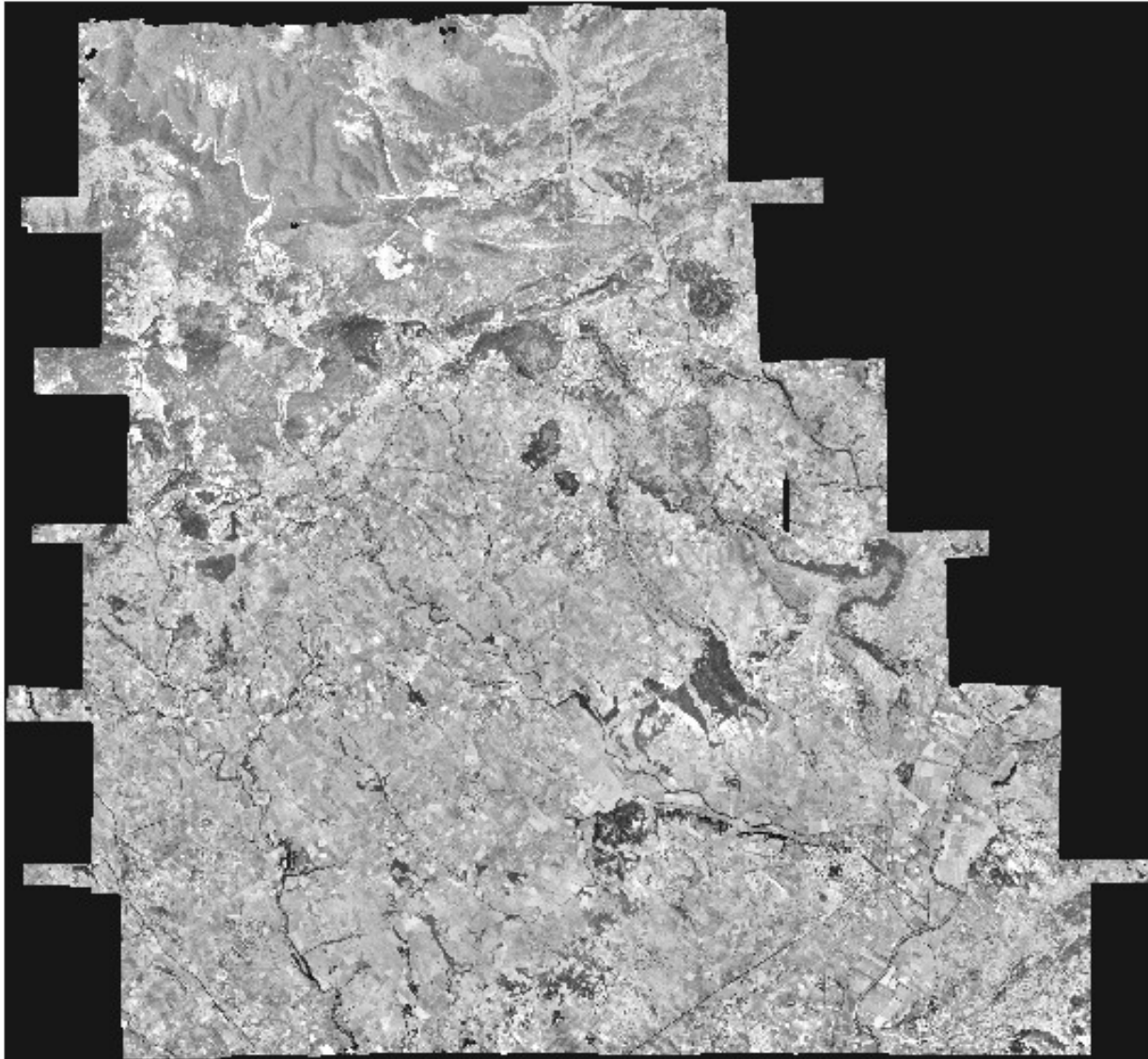
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Radiometric issues

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...



- Parametric model

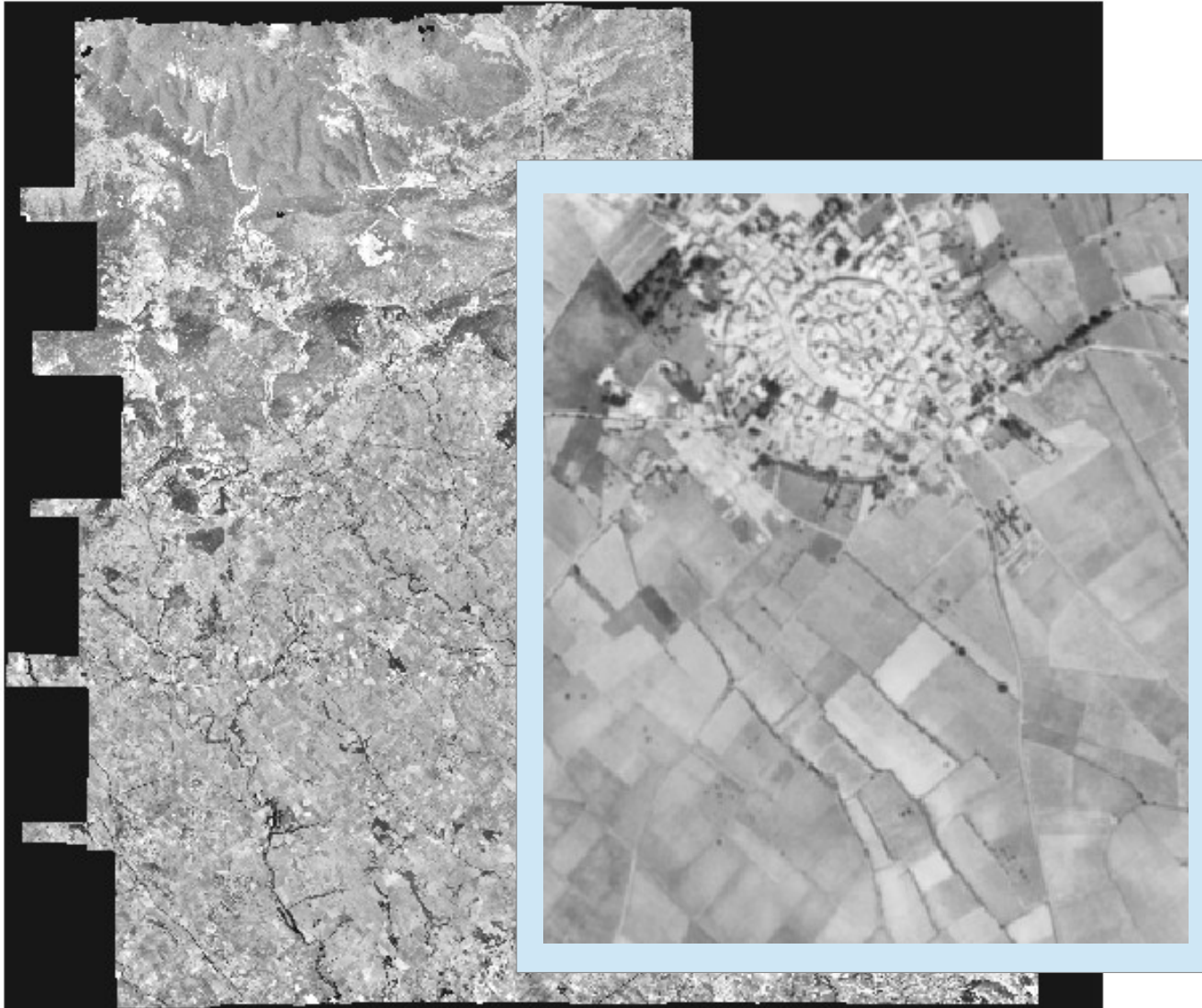
Additive polynomial model

Sometimes tends to smooth images

Radiometric issues

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...



- Parametric model

Additive polynomial model

Sometimes tends to smooth images

Radiometric issues

[*Lelégard et al., 2020 , 2022*]

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...

- Non parametric model:

- Estimate at low resolution a gain and offset correction grid for each image

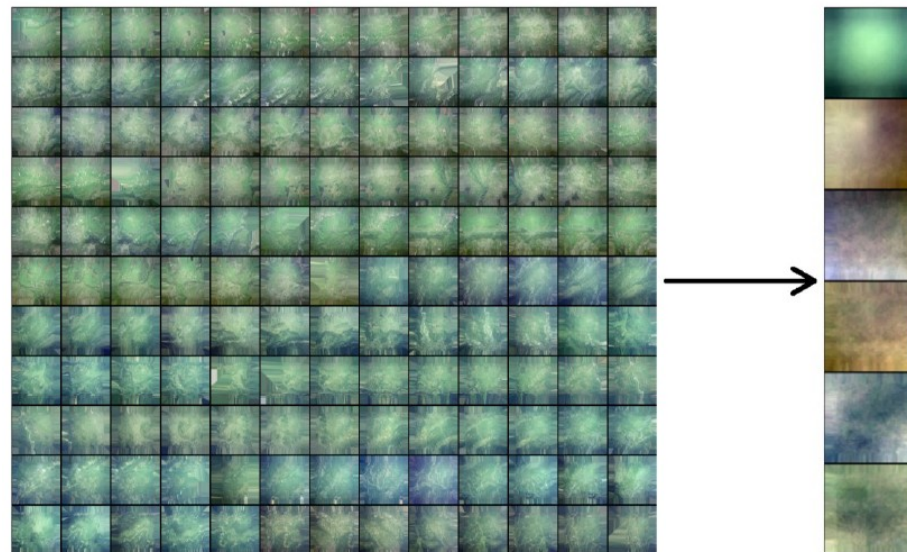
- Apply Walis filtering to each image

- gain and offset estimated for each pixel = correction grid

$$Img'(x, y) = \frac{\sigma_0}{\sigma_w(x, y)} \cdot (Img(x, y) - \mu_w(x, y)) + \mu_0$$

- Obtain a low frequency correction model:

- PCA decomposition applied the whole set of correction grids



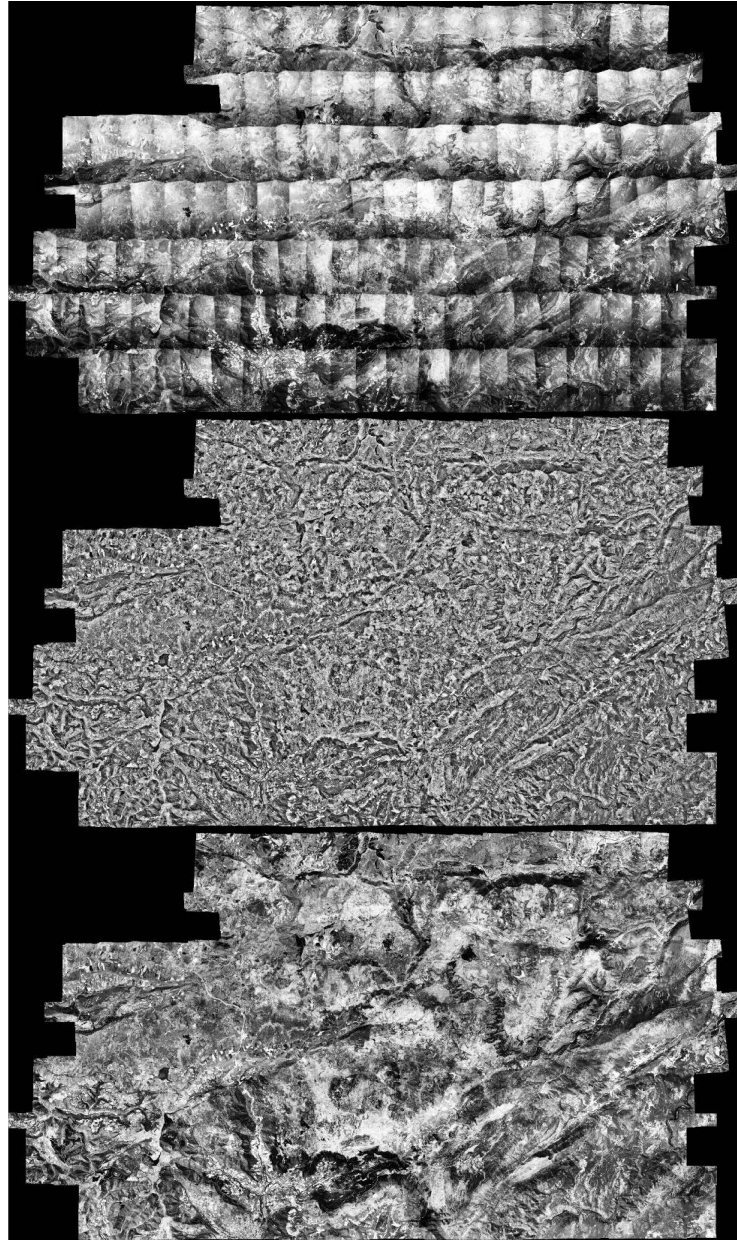
Radiometric issues

[*Lelégard et al., 2020 , 2022*]

How to perform radiometric corrections to obtain homogeneous mosaics?

- Non parametric model

Statistical gain / offset correction



Raw
orthophotomosaic

Raw statistical
equalization
(Walis filtering)

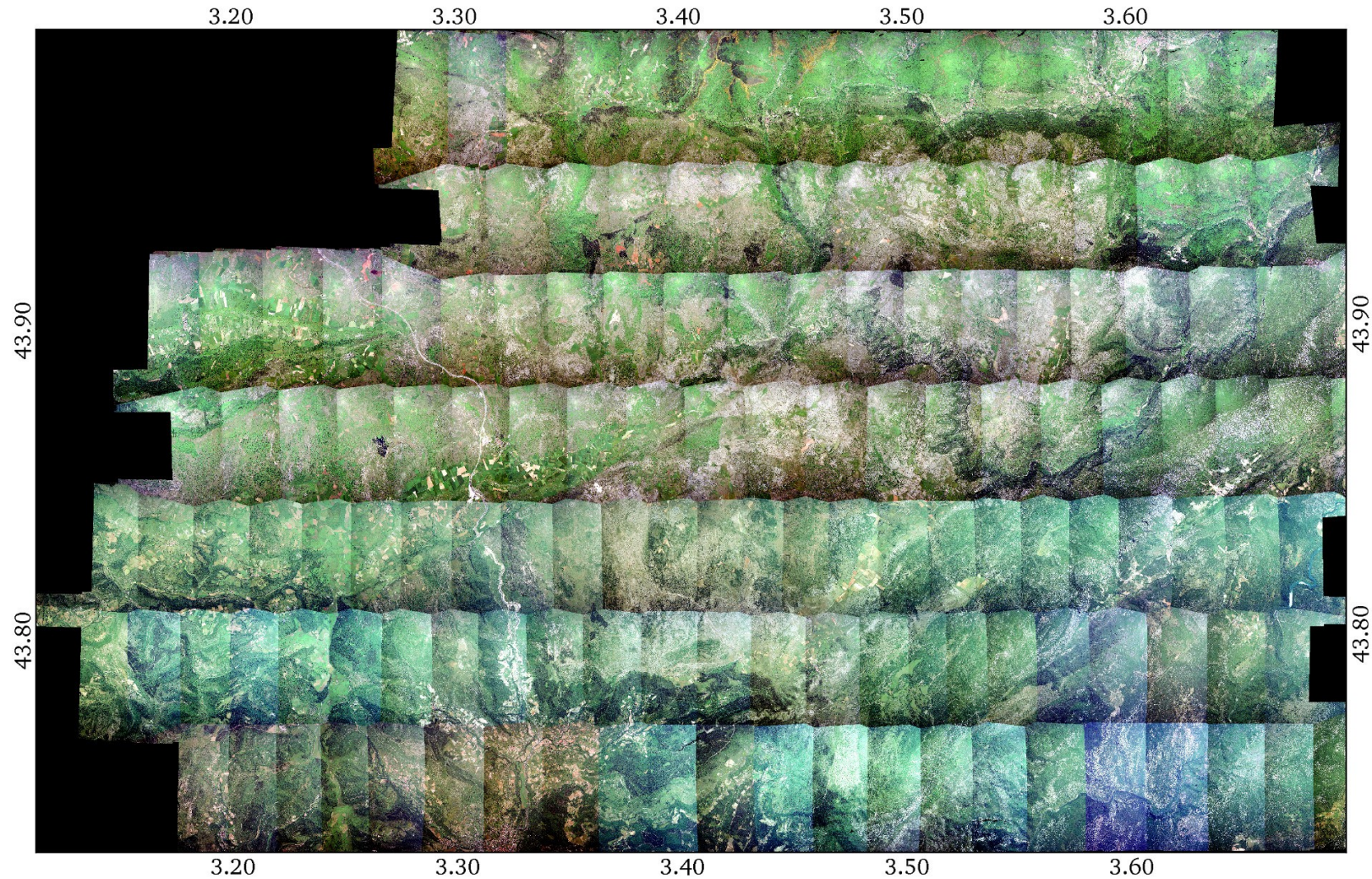
Proposed
correction

Radiometric issues

[*Lelégard et al., 2020 , 2022*]

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...



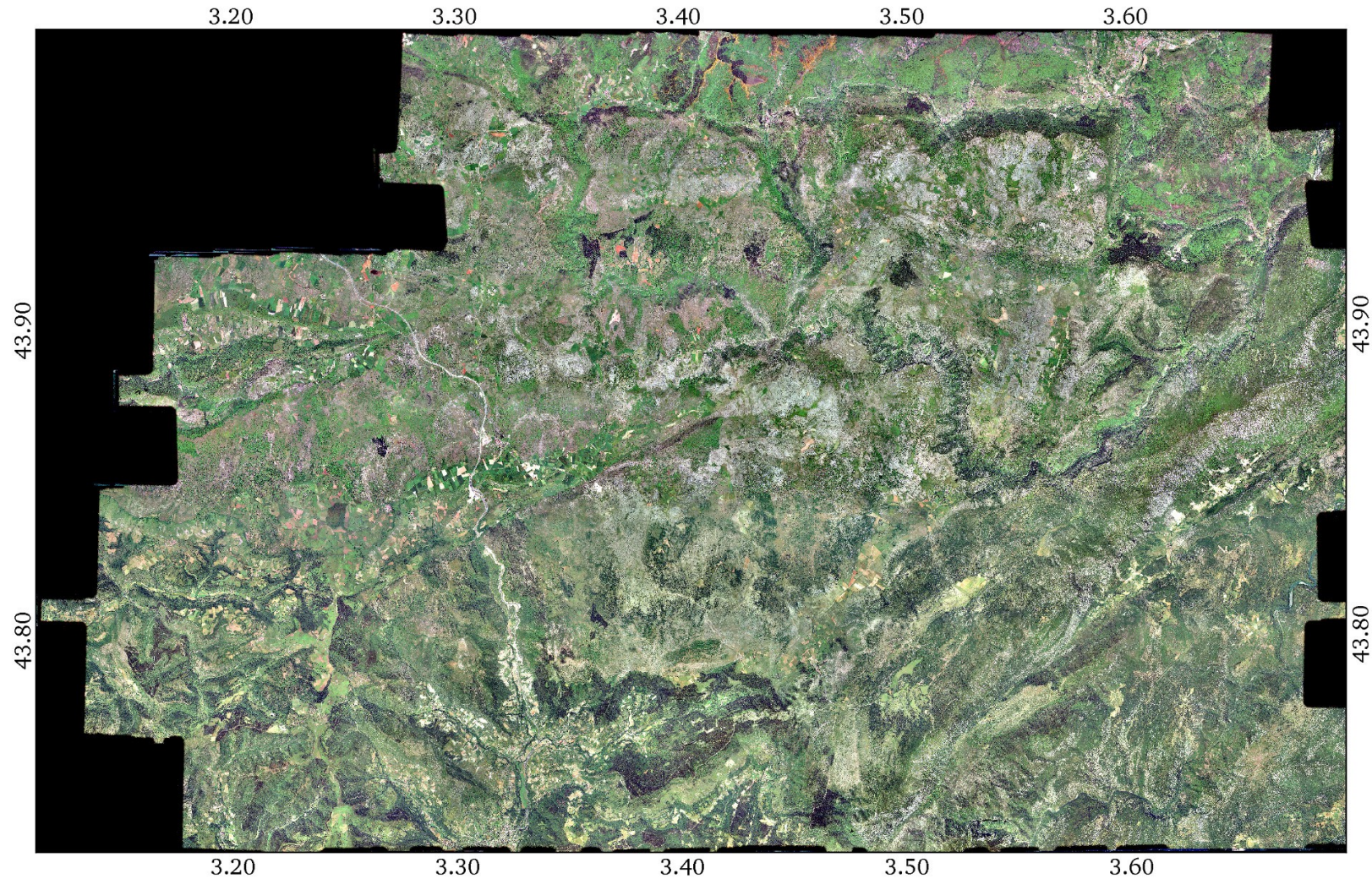
Larzac : raw mosaic

Radiometric issues

[*Lelégard et al., 2020 , 2022*]

How to perform radiometric corrections to obtain homogeneous mosaics?

→ main phenomena to consider : vignetting, hot spot, fog, ...



Larzac : non parametric model

Radiometry : non parametric model

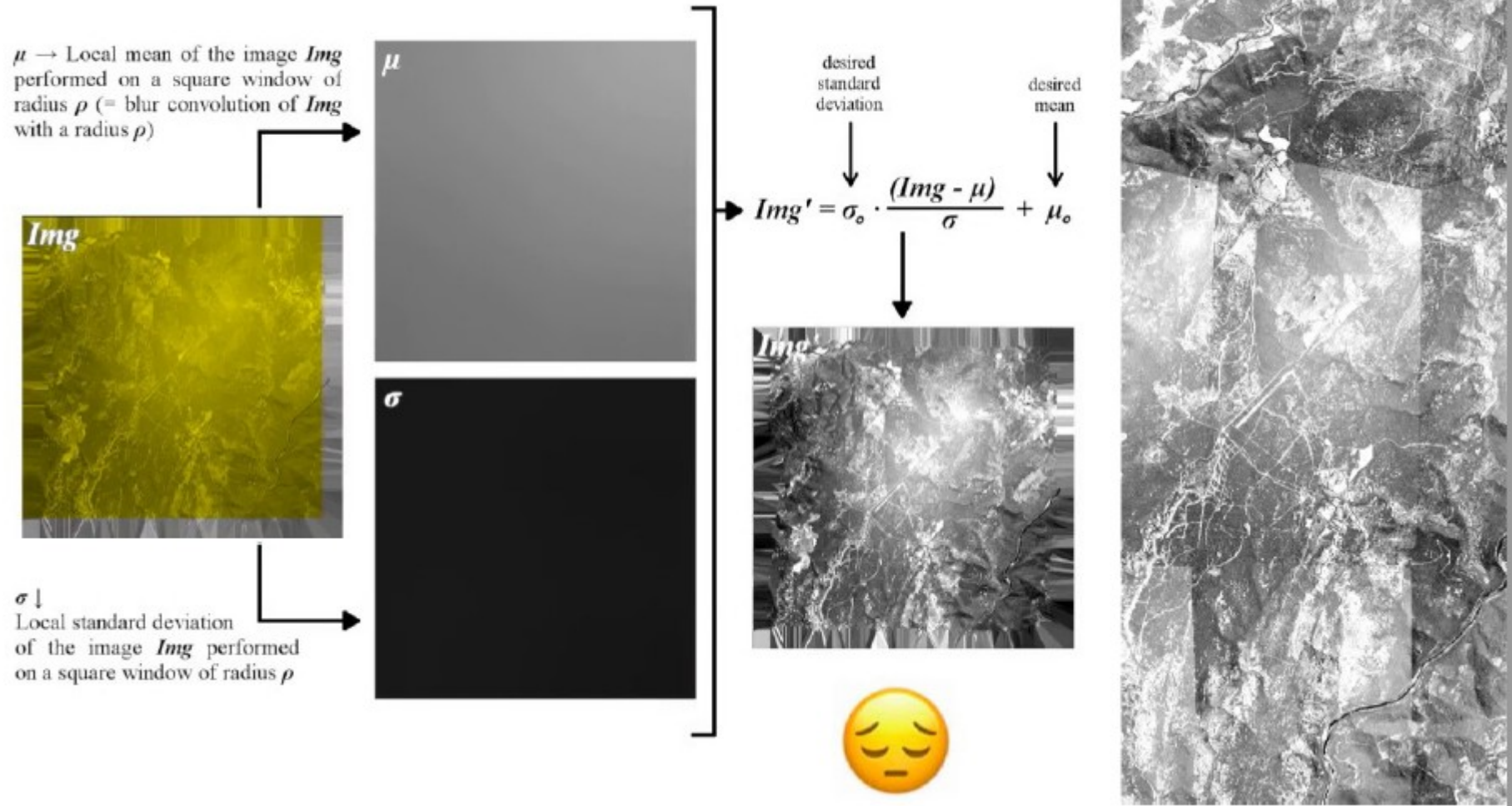
[*Lelégard et al., 2020 , 2022*]

Needs to define :

- the size of the Walis filter
- the number of PCs to keep

→ Develop metrics to help to define these parameters.

Impact of the filter size on the Walis correction : how to have a correction suitable at different scales?



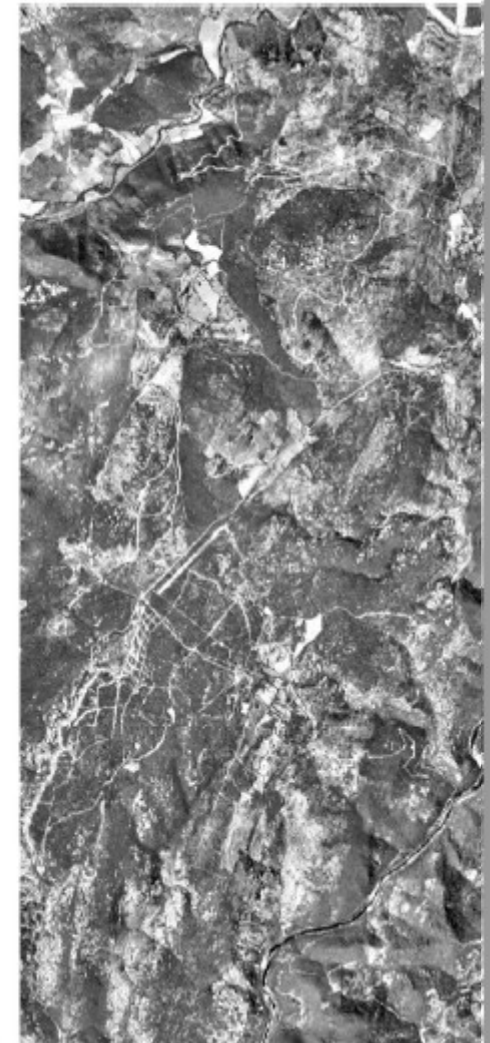
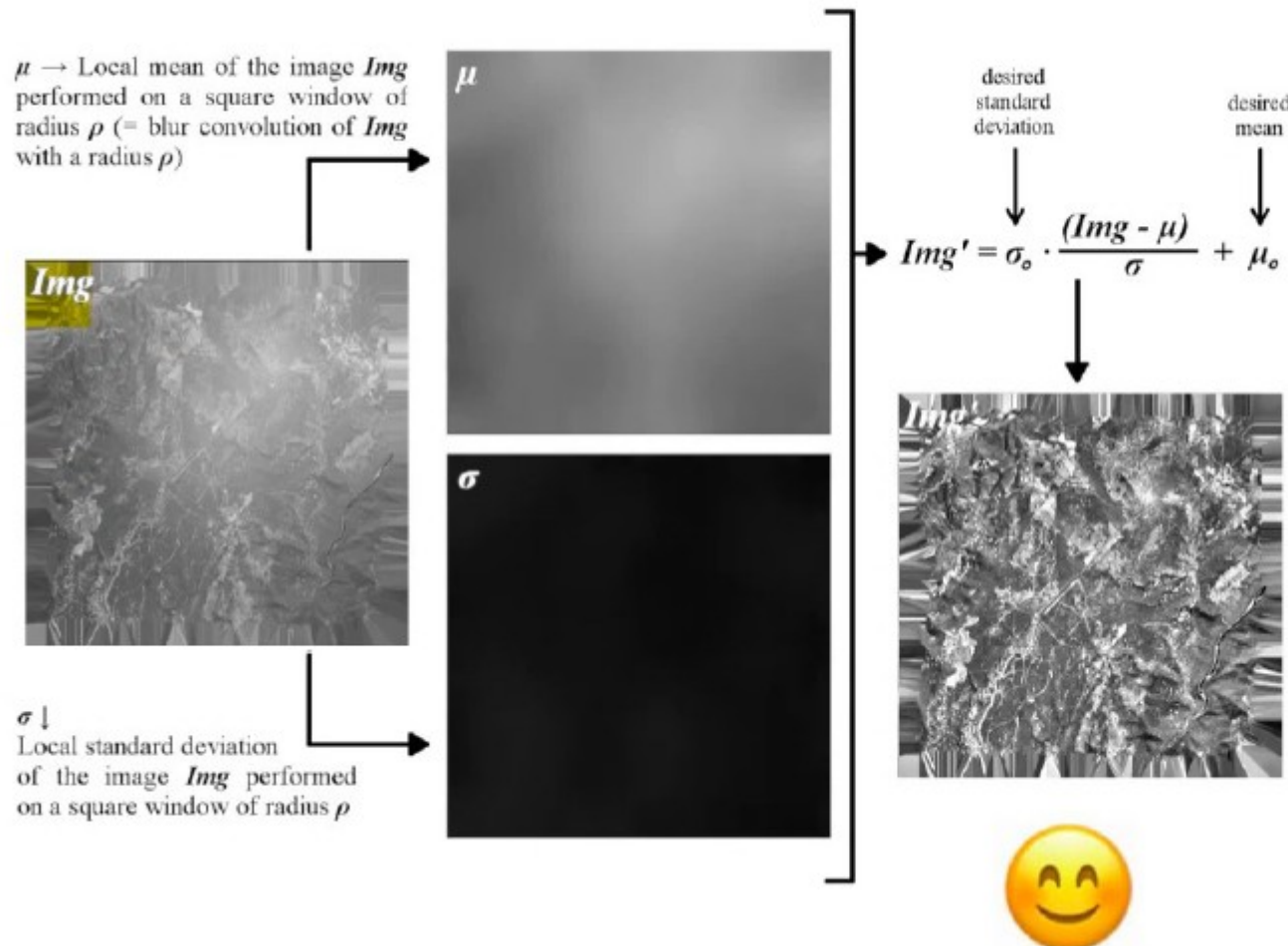
Radiometry : non parametric model

[Lelégard et al., 2020 , 2022]

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Radiometry : non parametric model

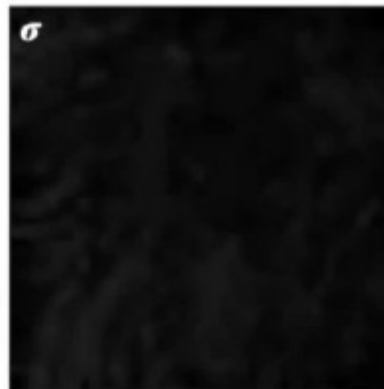
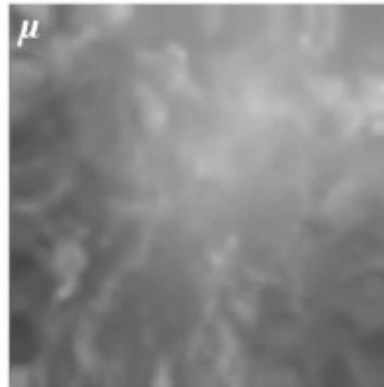
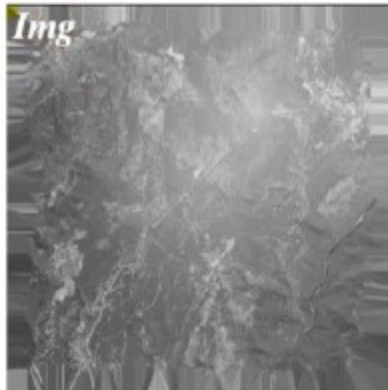
[Lelégard et al., 2020 , 2022]

Needs to define :

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- the number of PCs to keep

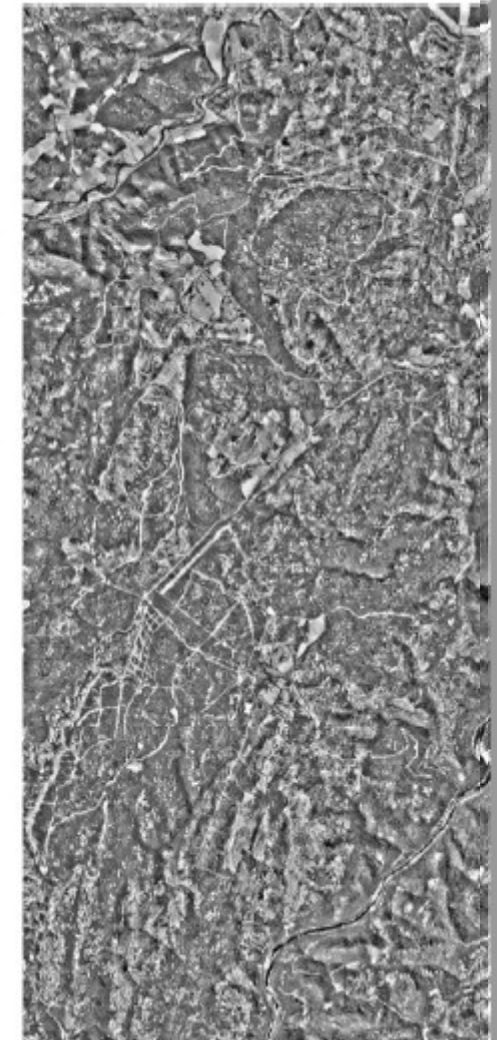
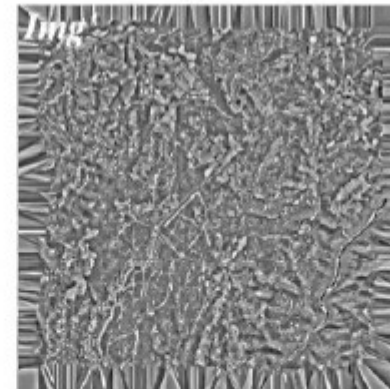
Impact of the filter size on the Walis correction : how to have a correction suitable at different scales?

$\mu \rightarrow$ Local mean of the image *Img* performed on a square window of radius ρ (= blur convolution of *Img* with a radius ρ)



$\sigma \downarrow$
Local standard deviation of the image *Img* performed on a square window of radius ρ

$$Img' = \underset{\substack{\text{desired} \\ \text{standard} \\ \text{deviation}}}{\sigma_o} \cdot \frac{(Img - \underset{\substack{\text{desired} \\ \text{mean}}}{\mu})}{\sigma} + \mu_o$$



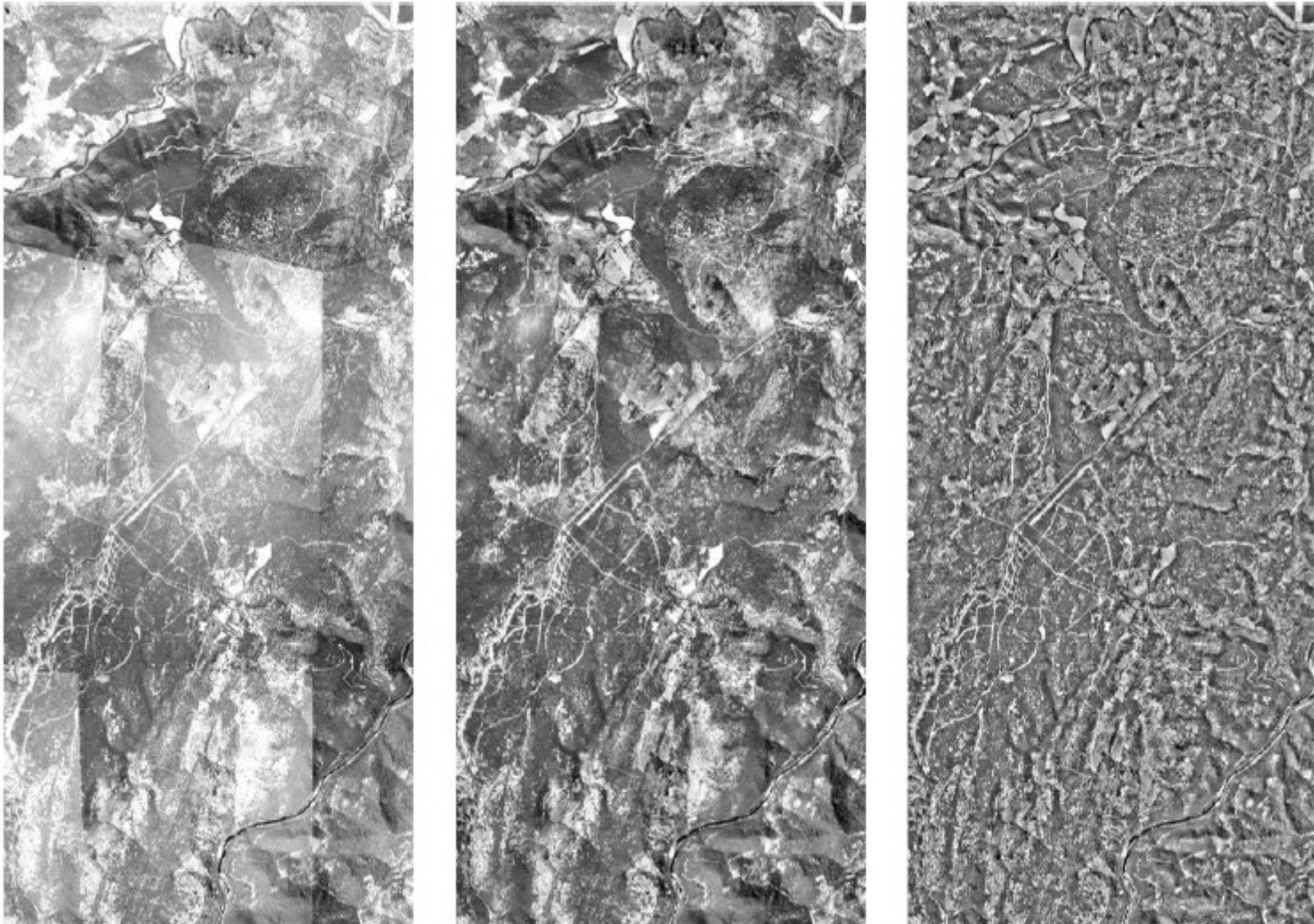
Radiometry : non parametric model

[*Lelégard et al., 2020 , 2022*]

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Impact of the filter size on the Walis correction : how to have a correction suitable at different scales?



Radiometry : non parametric model

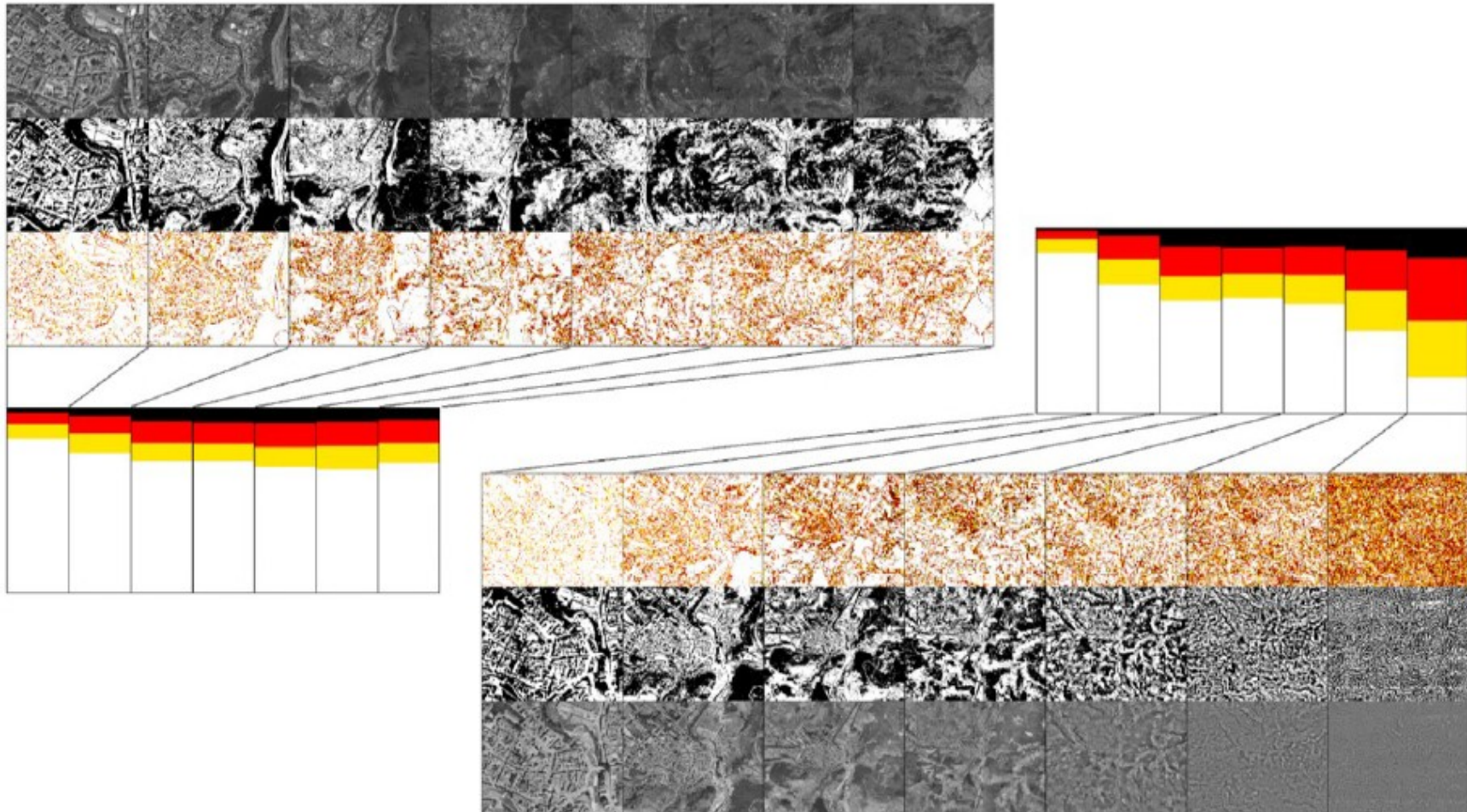
[*Lelégard et al., 2020 , 2022*]

Needs to define :

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Impact of the filter size on the Walis correction : how to have a correction suitable at different scales?



An invariance by closing and opening metric score is considered

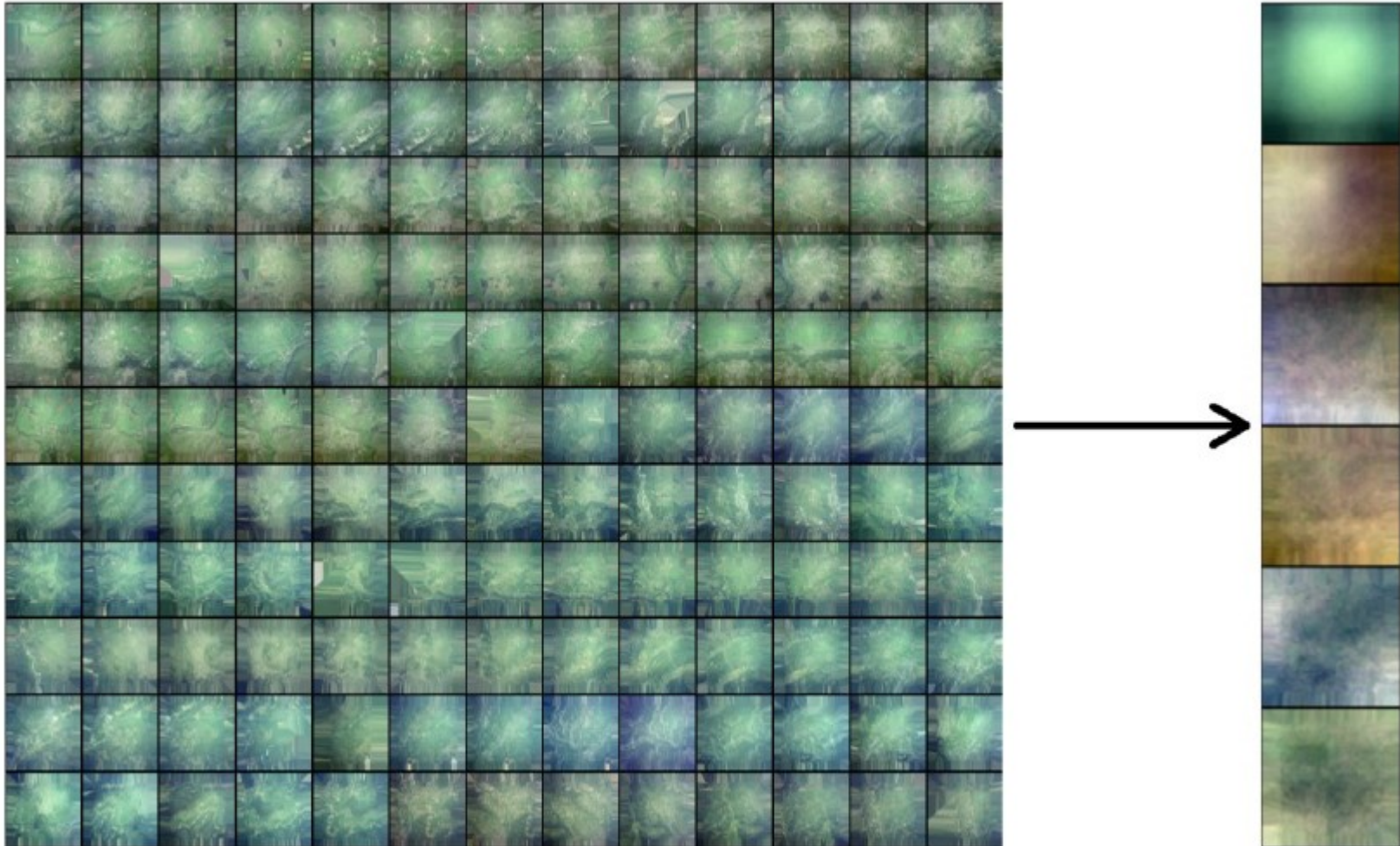
Radiometry : non parametric model

[*Lelégard et al., 2020 , 2022*]

Needs to define :

- the size of the Walis filter
- the number of PCs to keep

Impact of the number of kept PCs on the final correction?



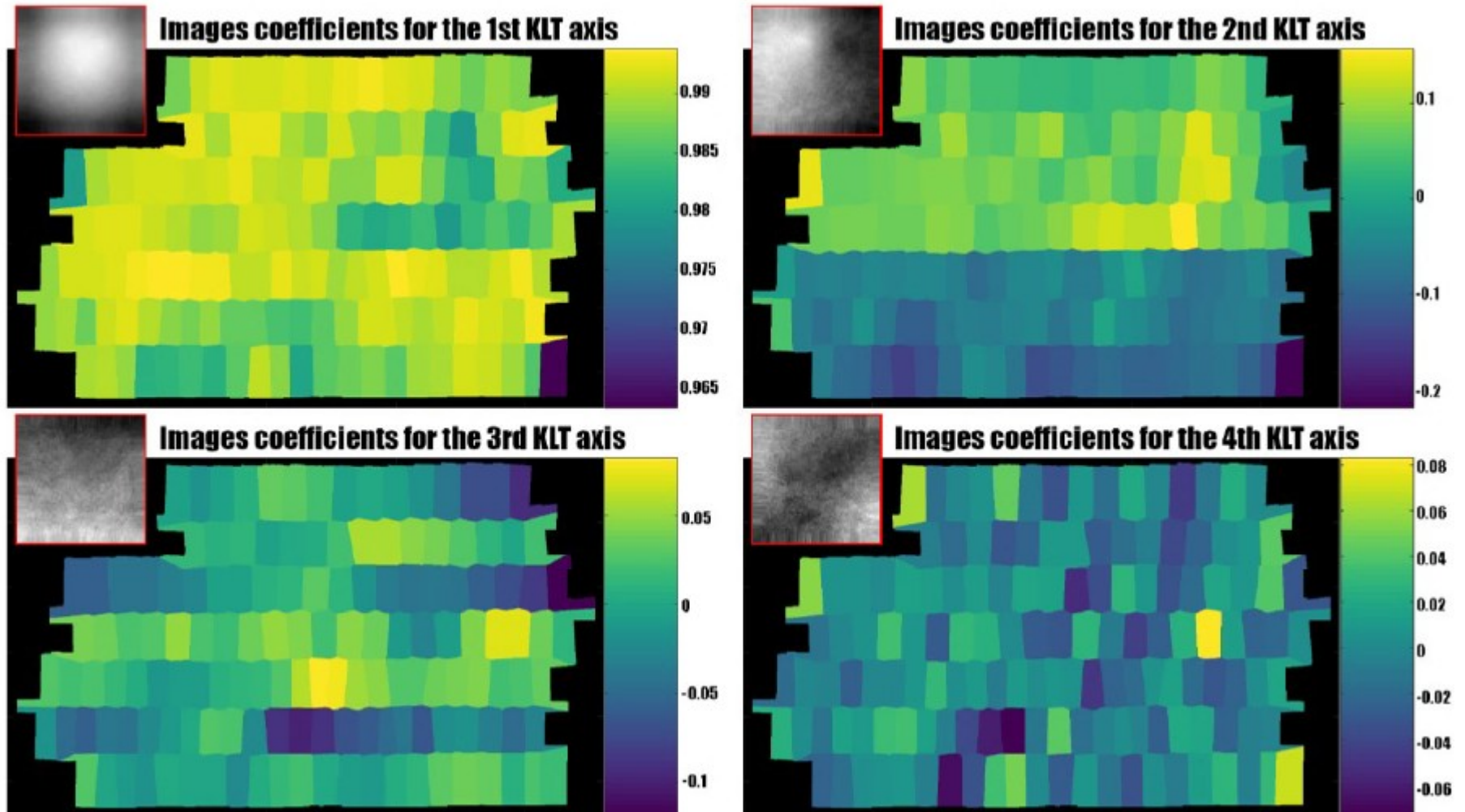
Radiometry : non parametric model

[*Lelégard et al., 2020 , 2022*]

Needs to define :

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Radiometry : non parametric model

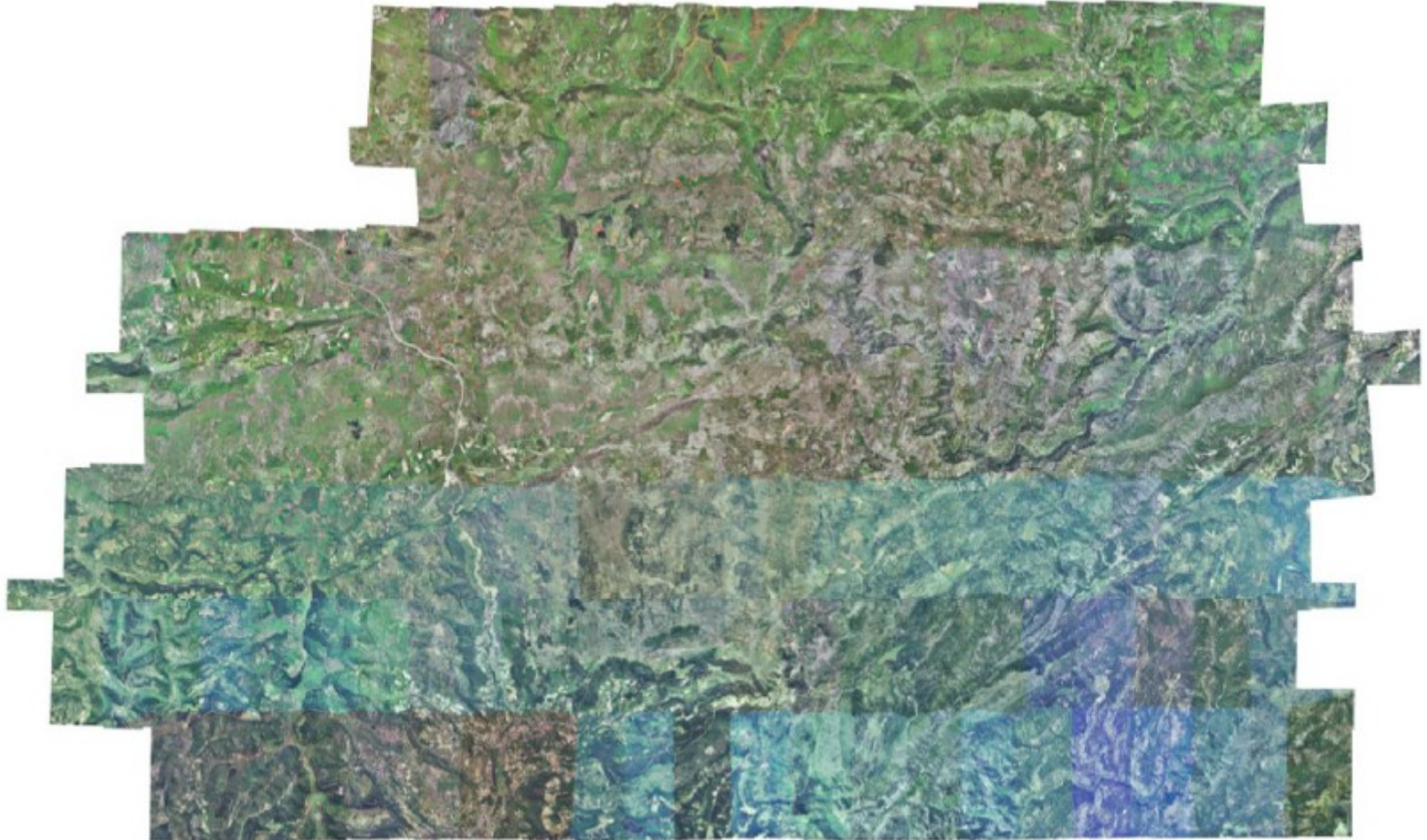
[*Lelégard et al., 2020 , 2022*]

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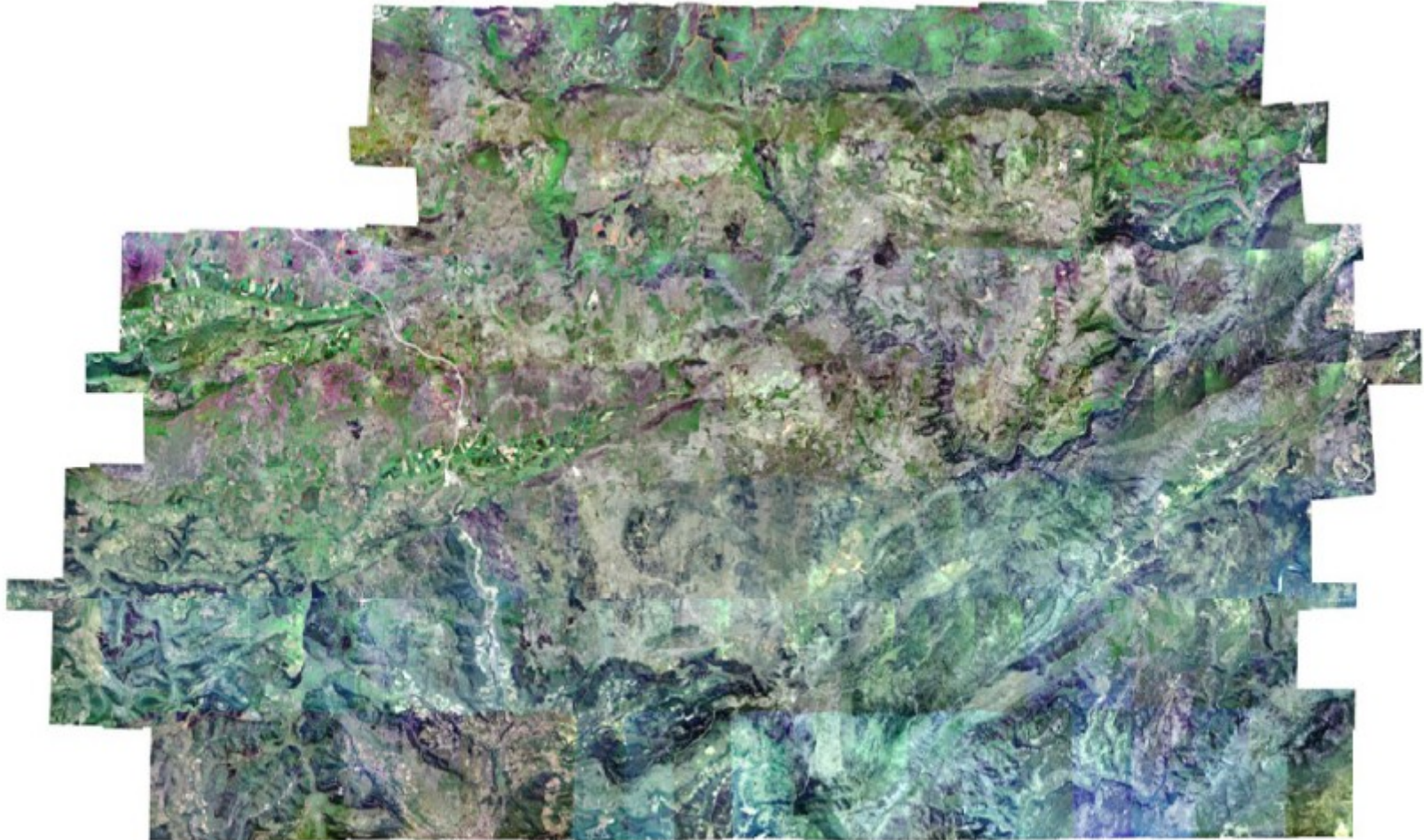
Radiometry : non parametric model

[*Lelégard et al., 2020 , 2022*]

Needs to define :

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Impact of the number of kept PCs on the final correction?



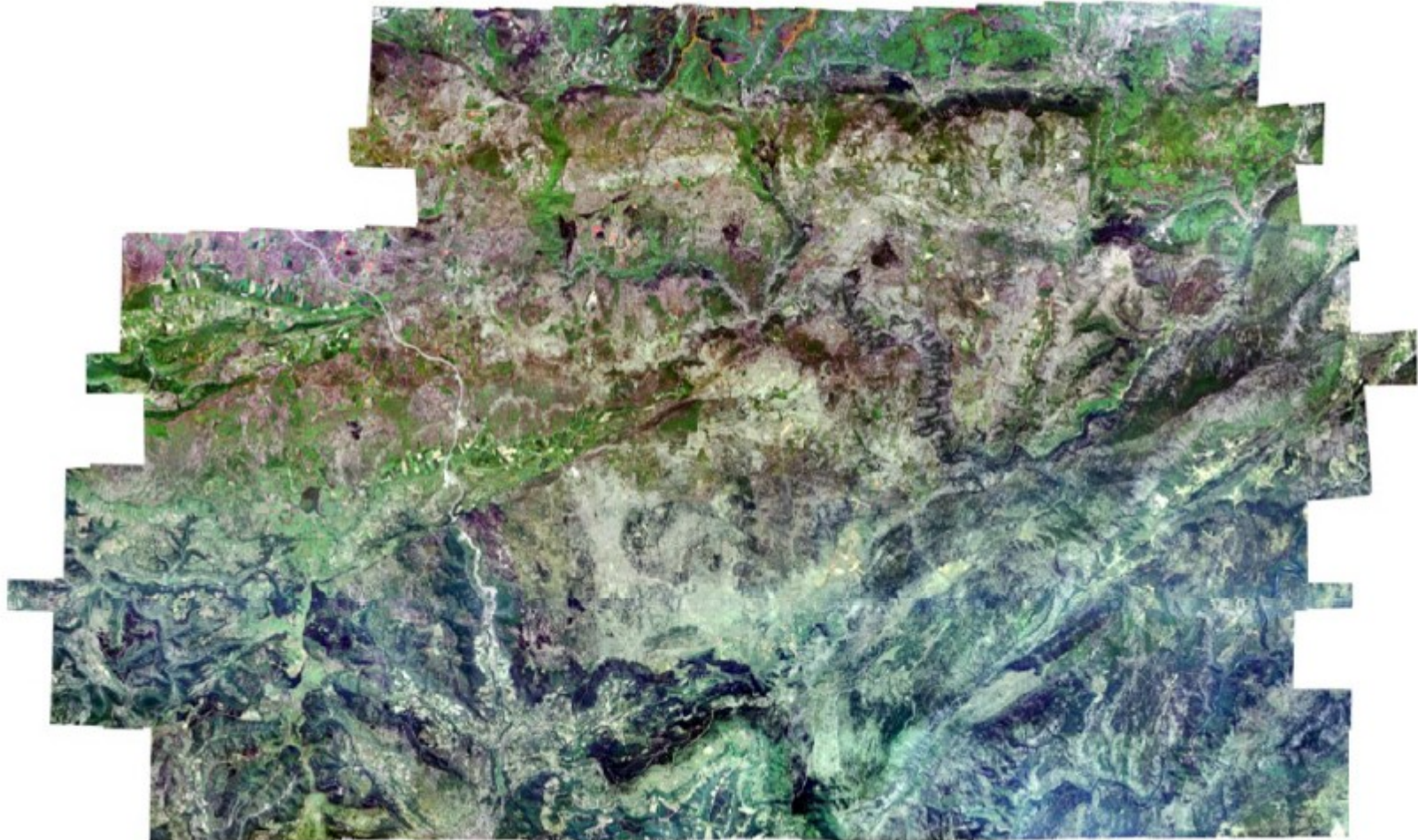
Radiometry : non parametric model

[*Lelégard et al., 2020 , 2022*]

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TOWARDS OPERATIONAL

Results / perspectives: geometry

- Fully automatic method to generate orthoimage+DSM time series
- Perfectible results but generally compatible with remote sensing analysis



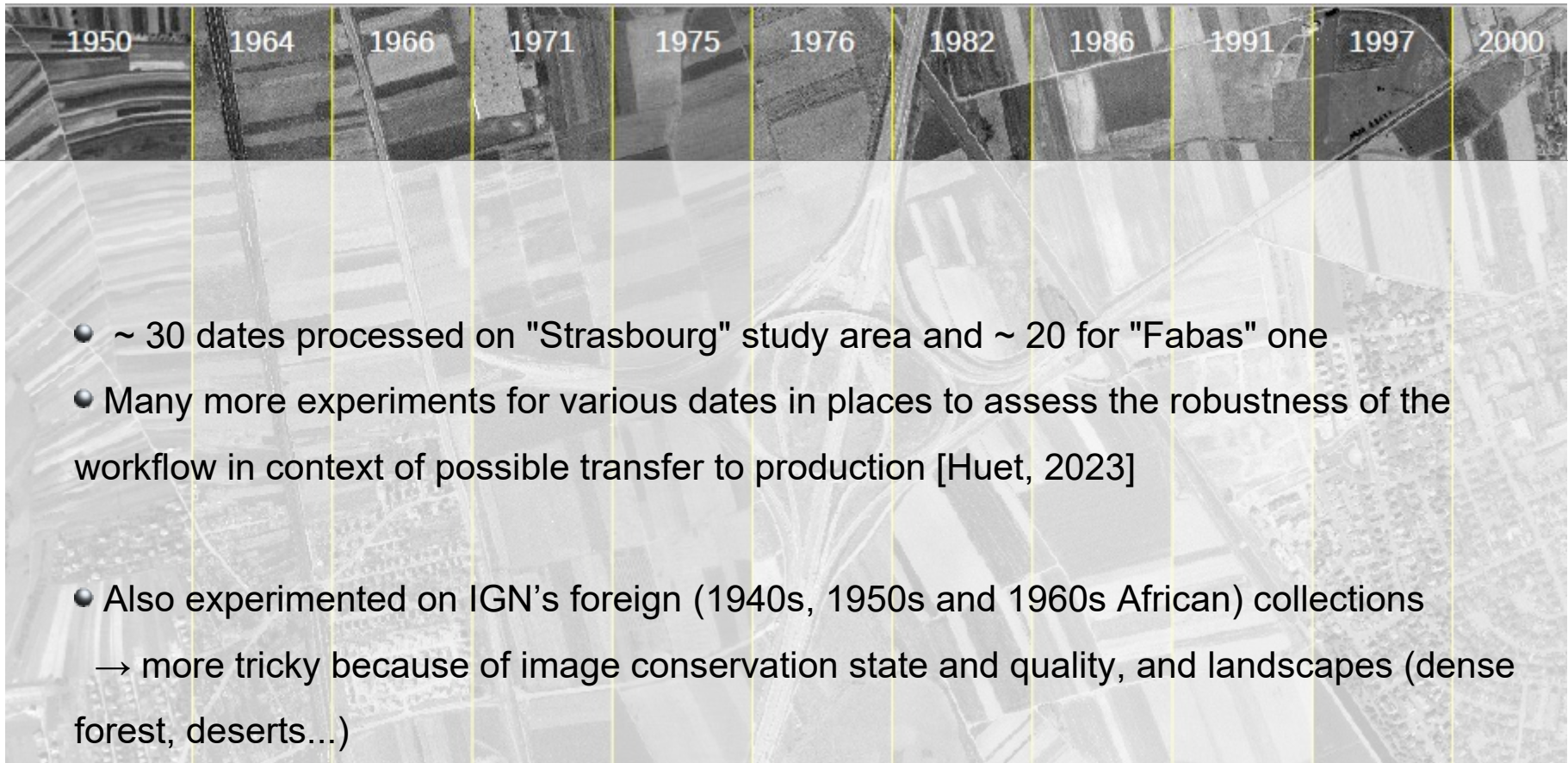
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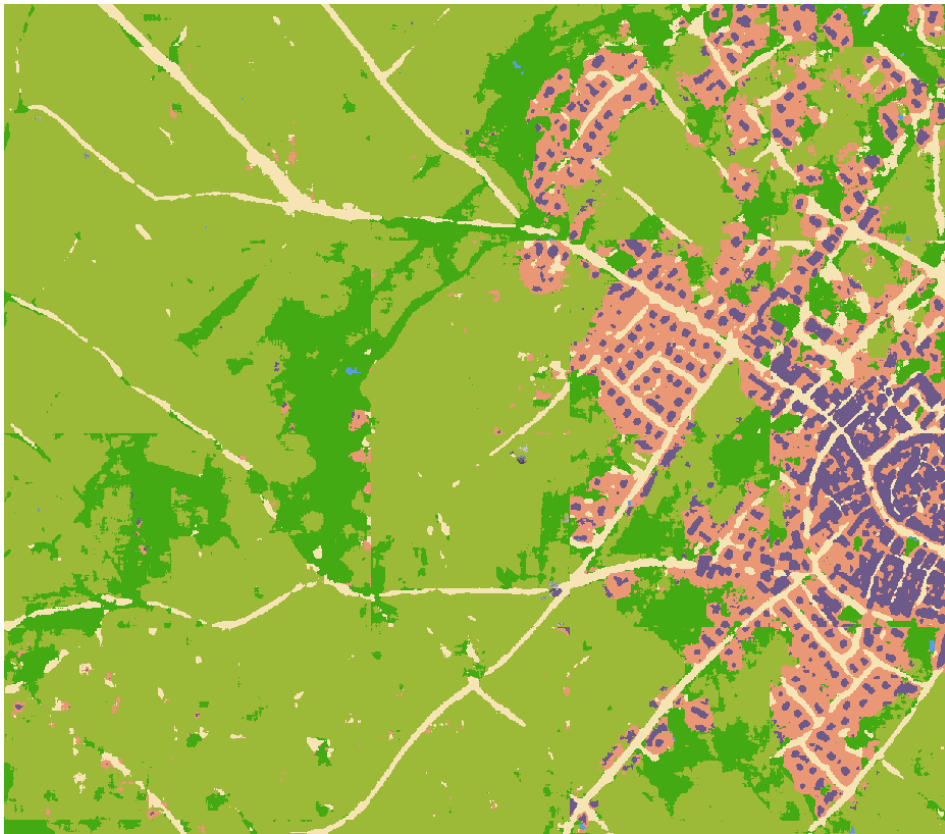
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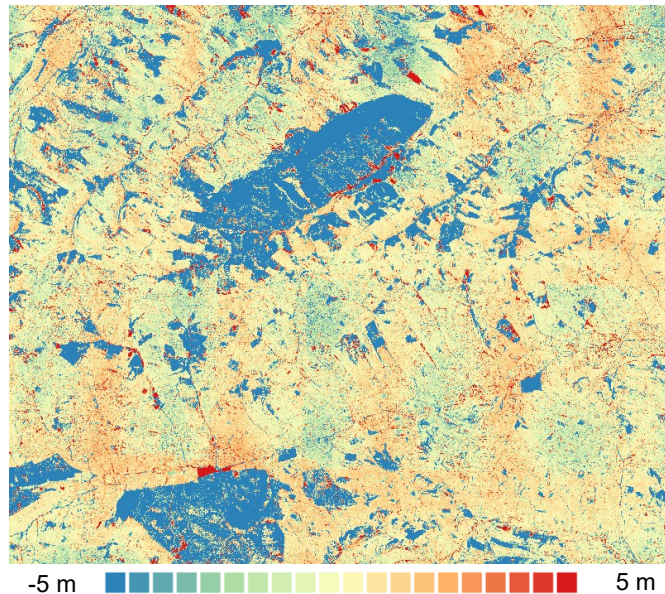


Results / perspectives: geometry

- Fully automatic method to generate orthoimage+DSM time series
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But still some difficulties / limits...

- How to cope with areas where huge changes occurred
- Reduced errors for DSMs, but can still lead to problems when calculating differences between DSMs .

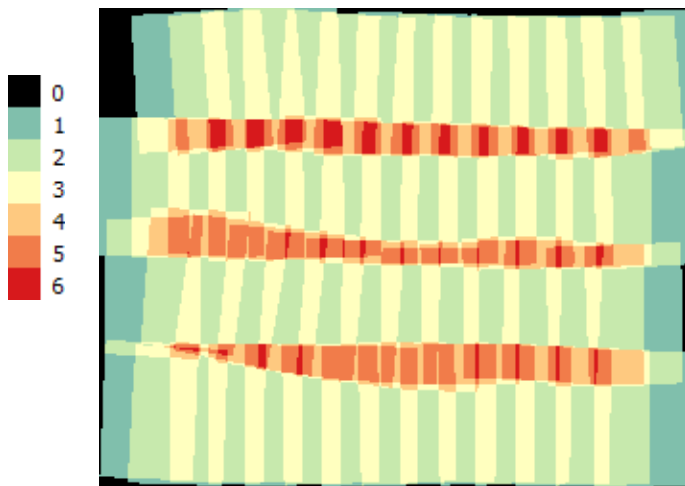


Results / perspectives: geometry

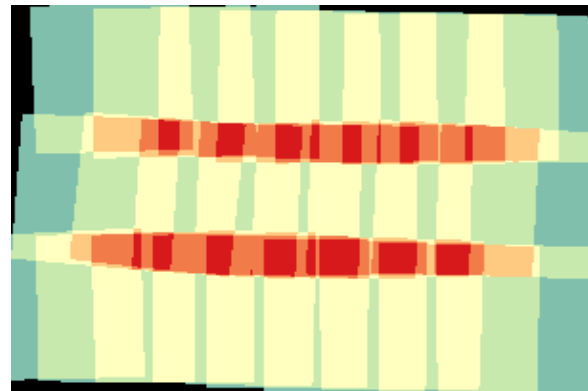
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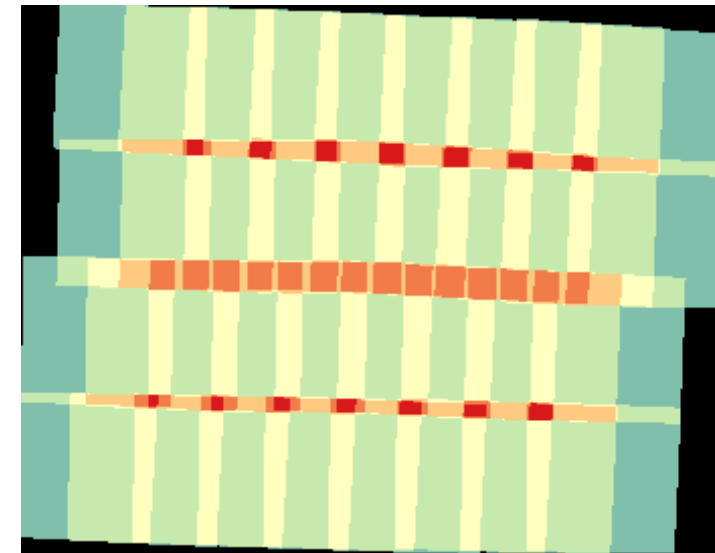
- How to cope with areas where huge changes occurred
- Reduced errors for DSMs, but can still lead to problems when calculating differences between DSMs .



1942



1971



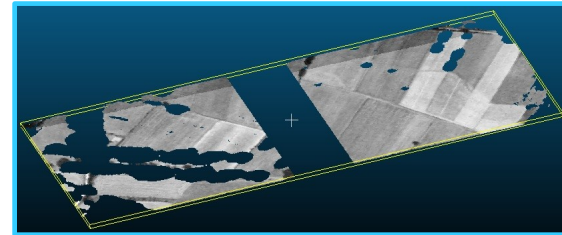
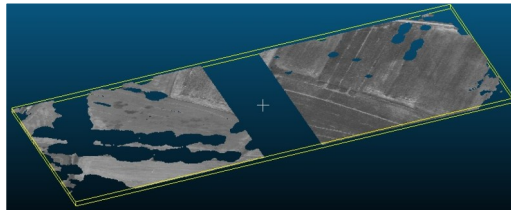
1984

Number of images (Fabas)

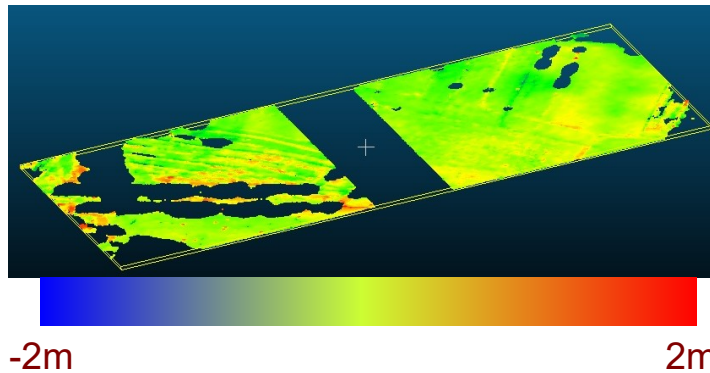
Results / perspectives: geometry

[Craciun et al., 2022]

- Current work, especially to have better landmarks in rural / natural areas
- 2D/2D registration of image patches (HoG)
- Overground filtering (DSM texture)



- DSM registration (first at patch level)

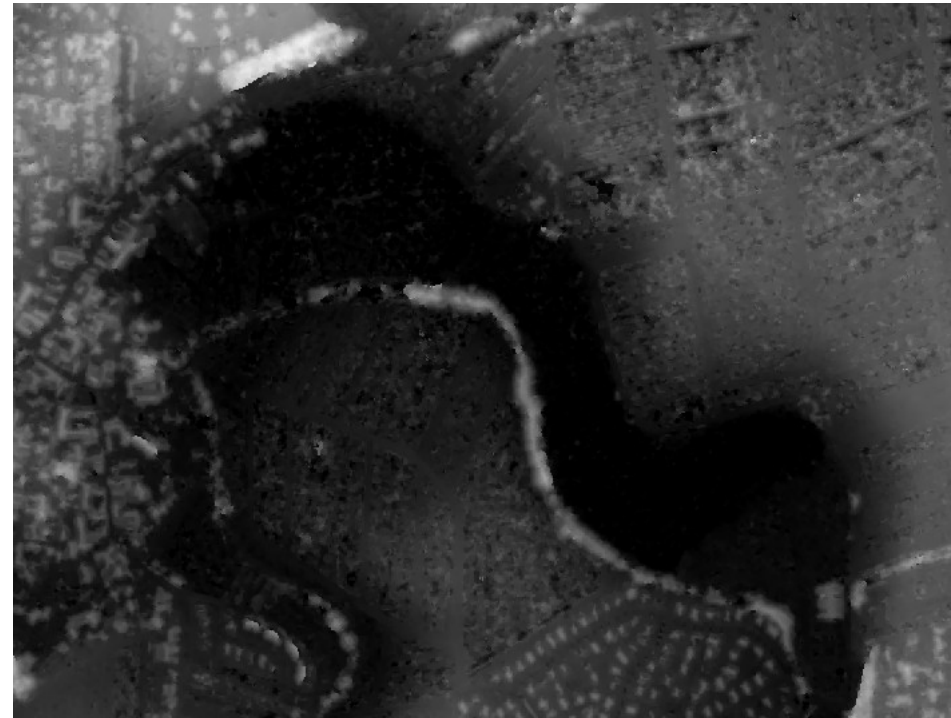
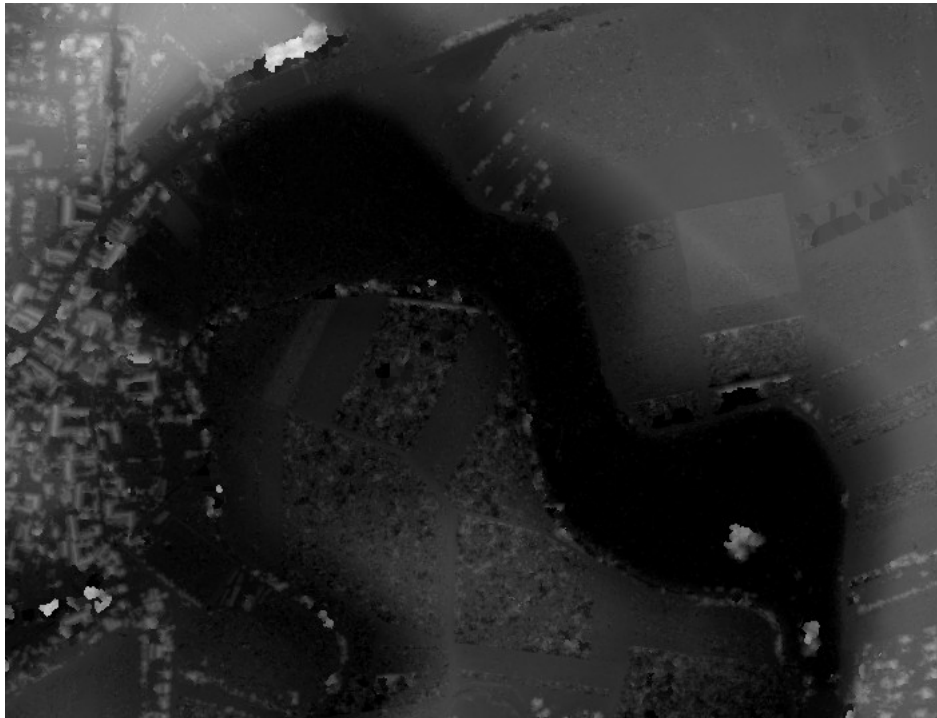


Results / perspectives: geometry

- Fully automatic method to generate orthoimage+DSM time series
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But still some difficulties / limits...

- How to cope with areas where huge changes occurred
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- Possible (important) noise artefacts related to image scale, noise, texture, conservation state and landscape

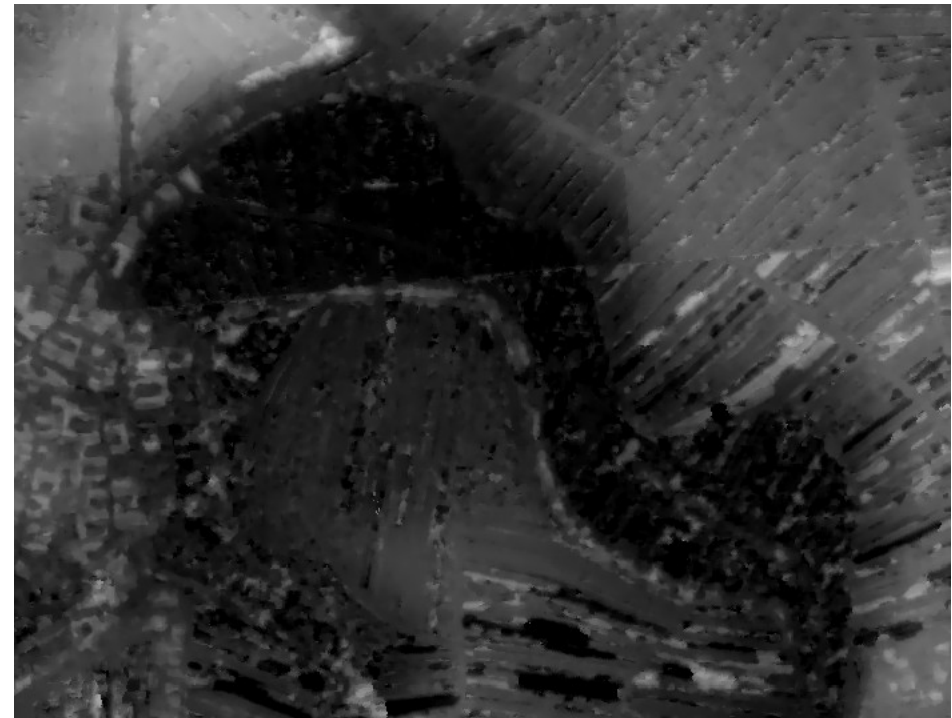
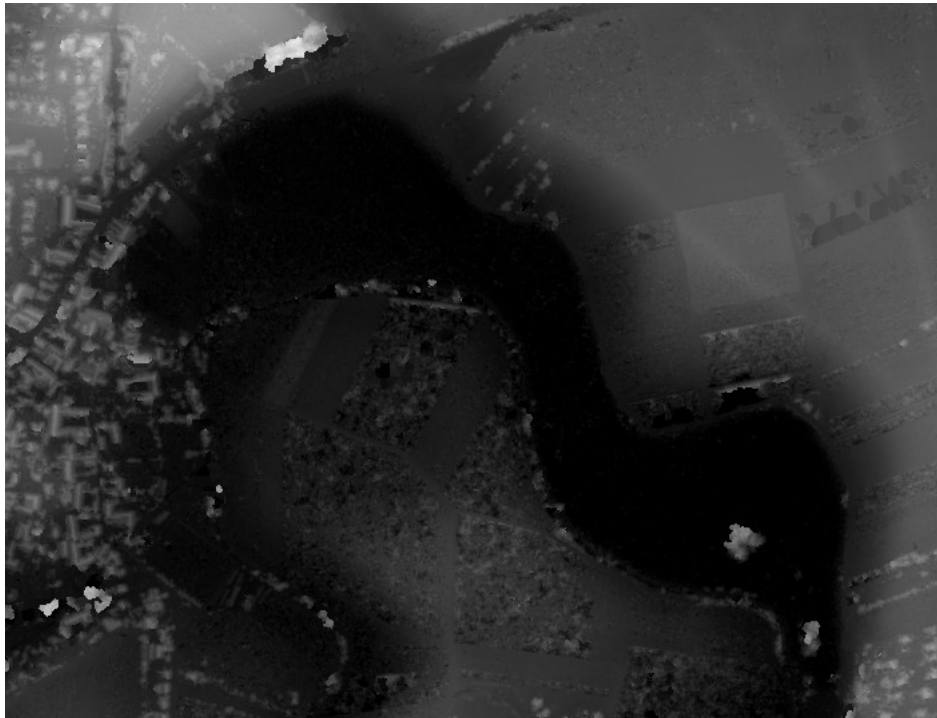


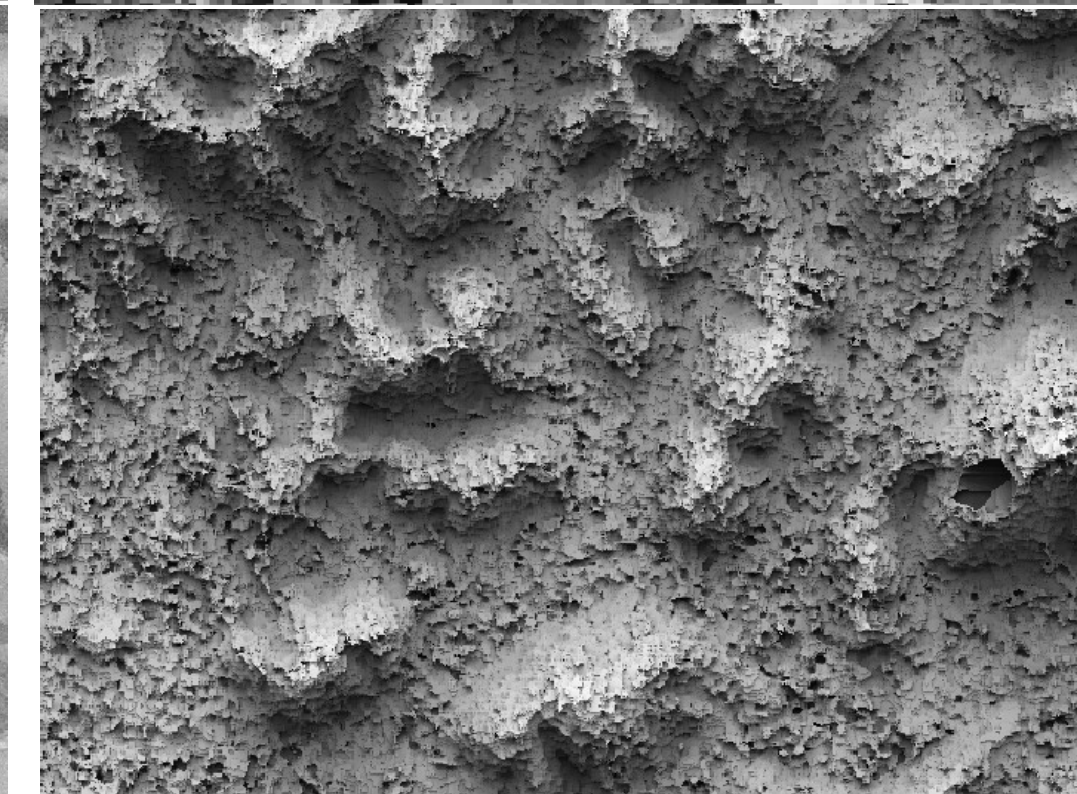
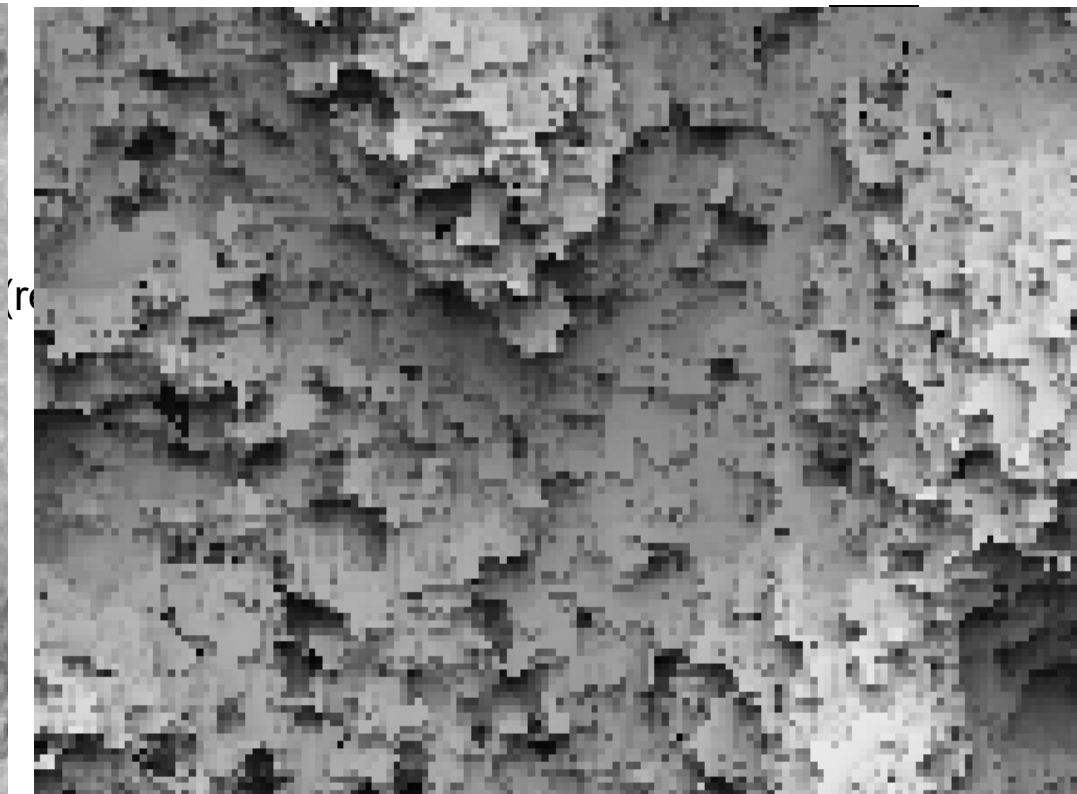
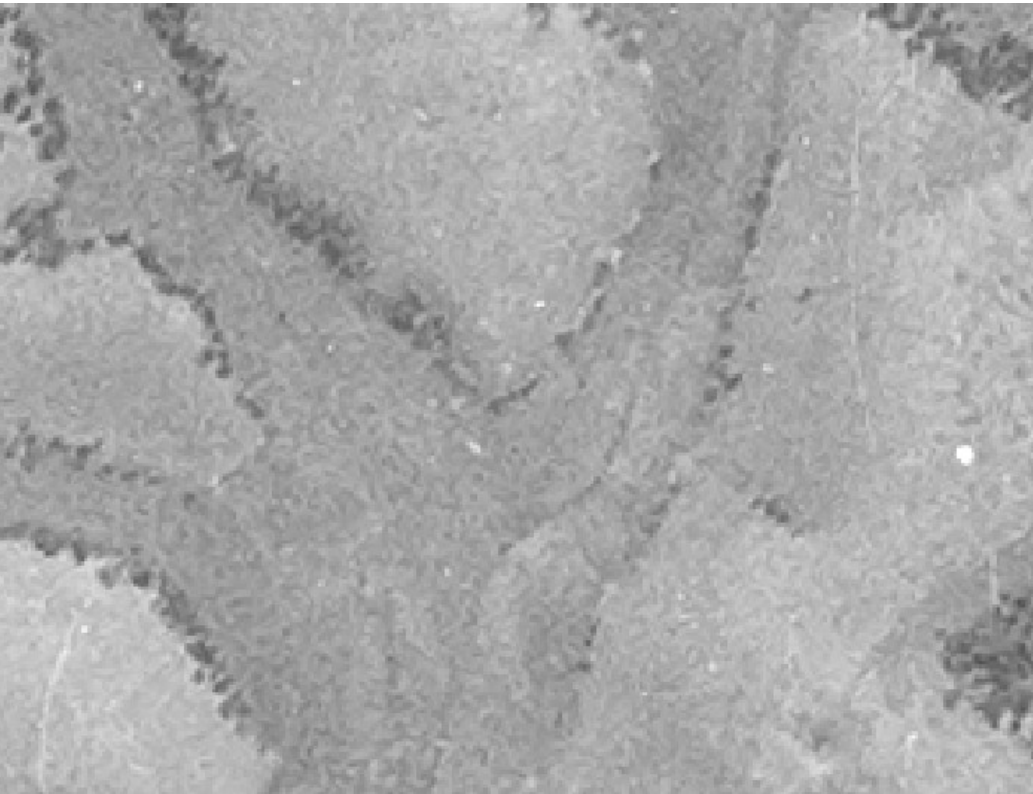
Results / perspectives: geometry

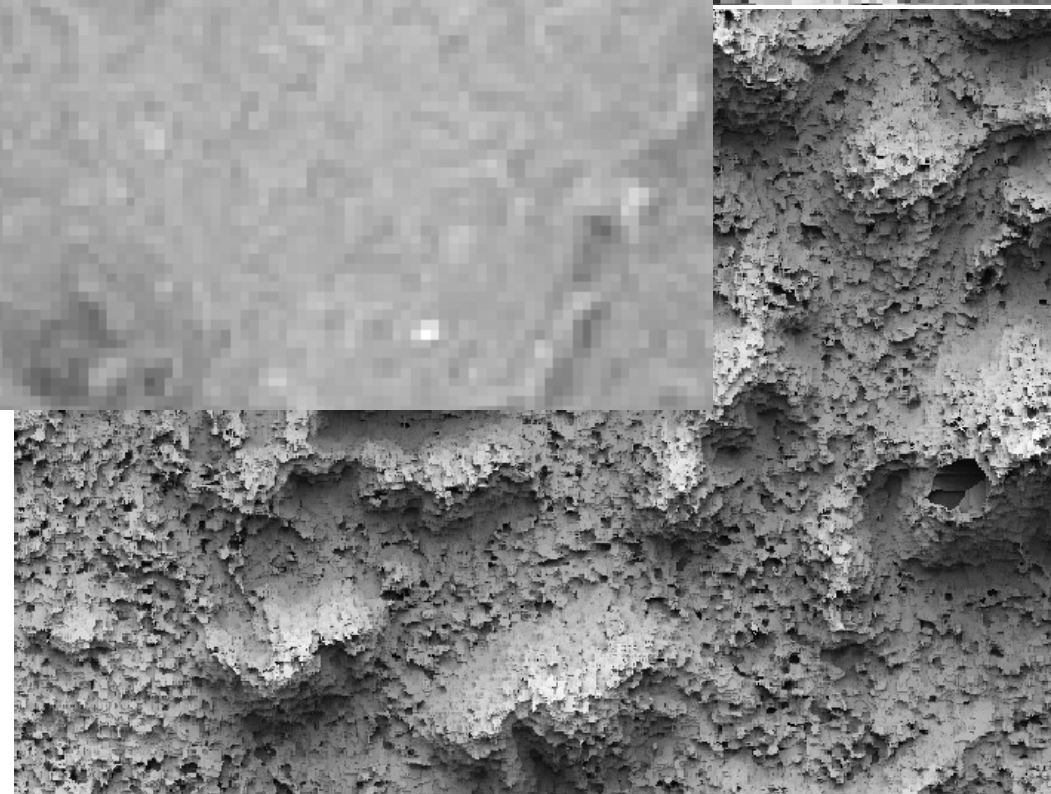
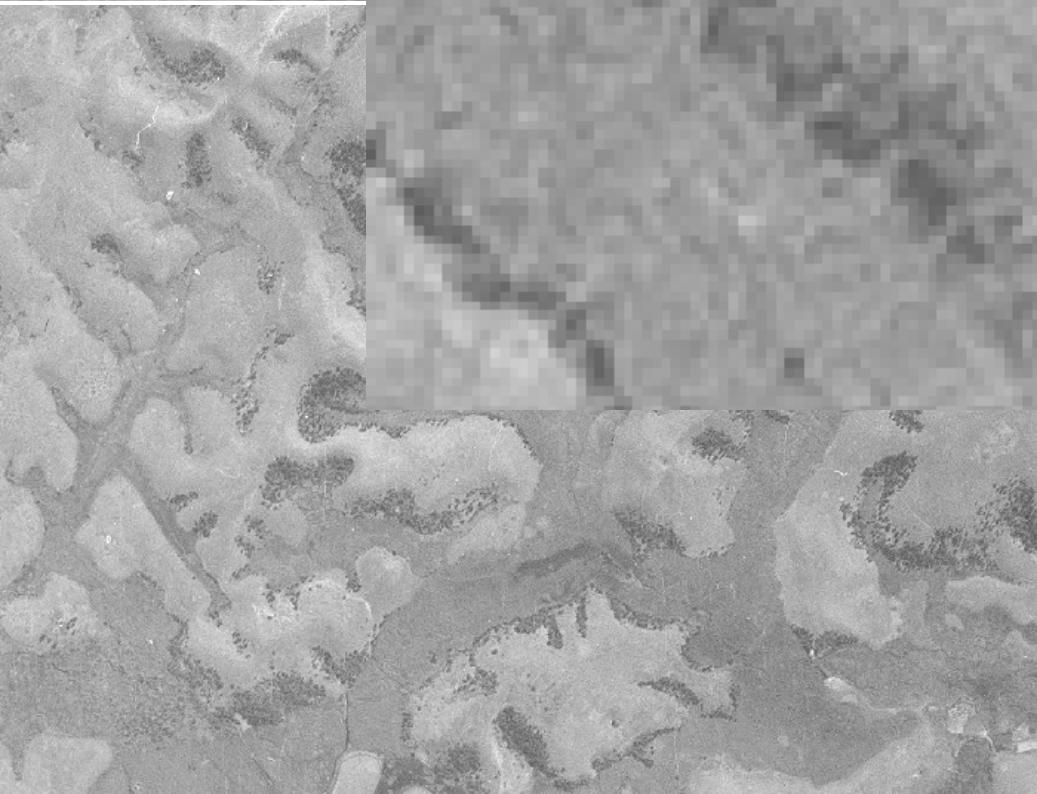
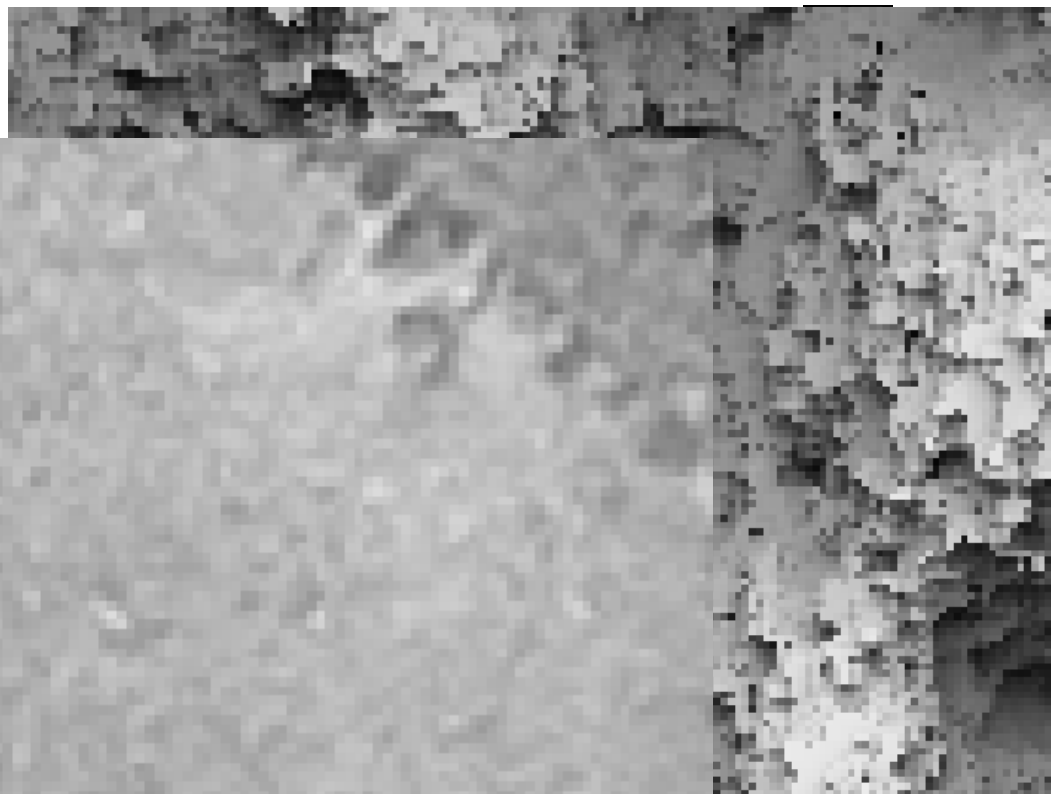
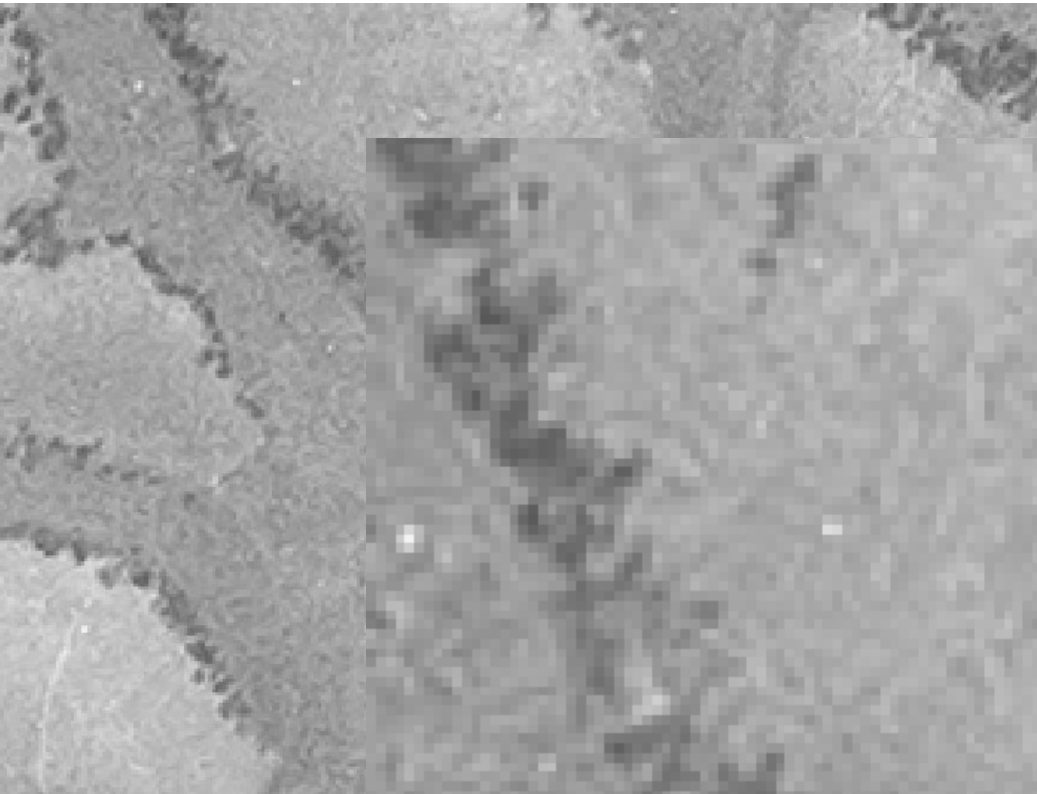
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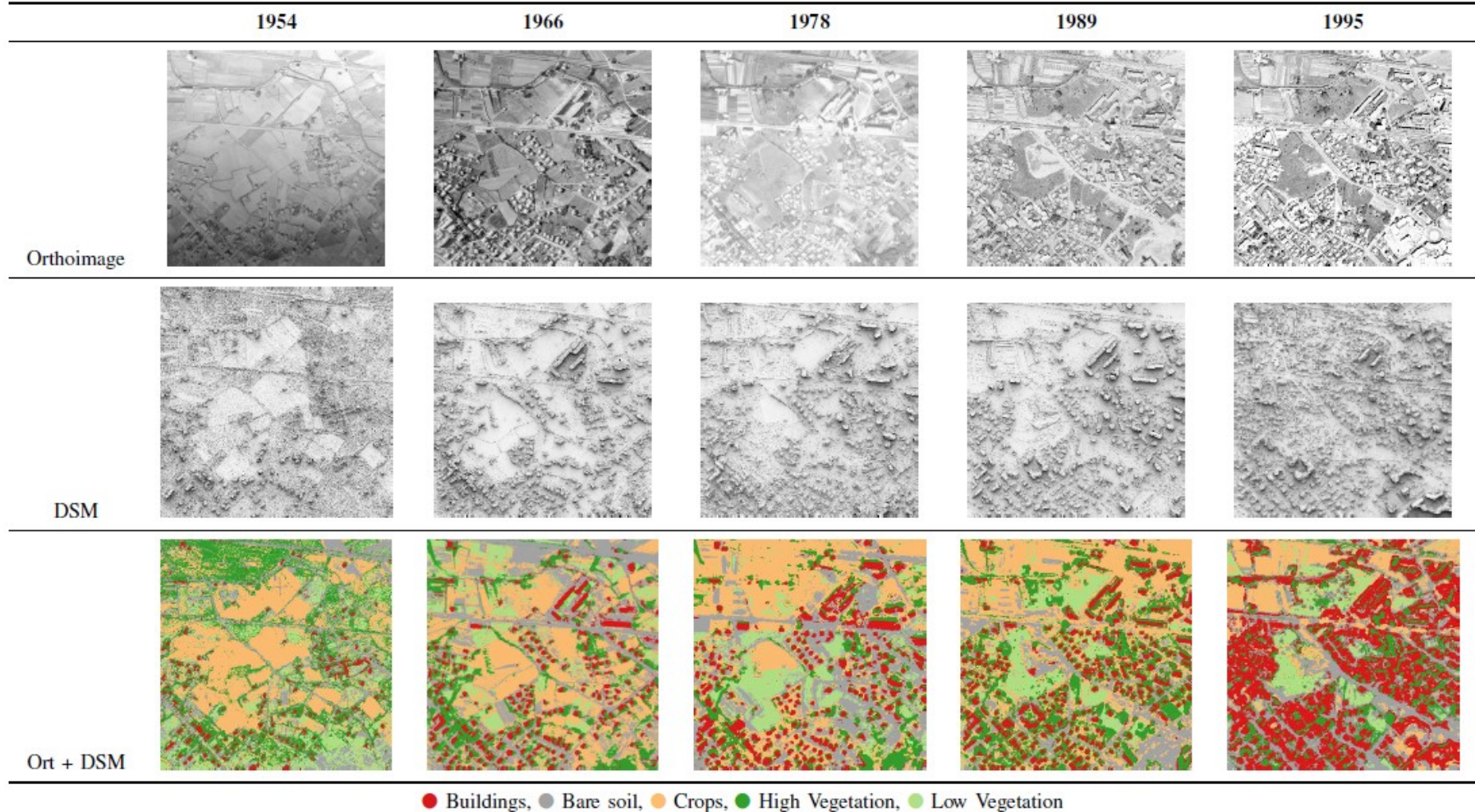
TIMES SERIES ANALYSIS?

LC classification and change analysis?

Historical orthoimages+DSM time series ?

→ opportunities...

- Change detection
- Temporal regularization of classifications



LC classification and change analysis?

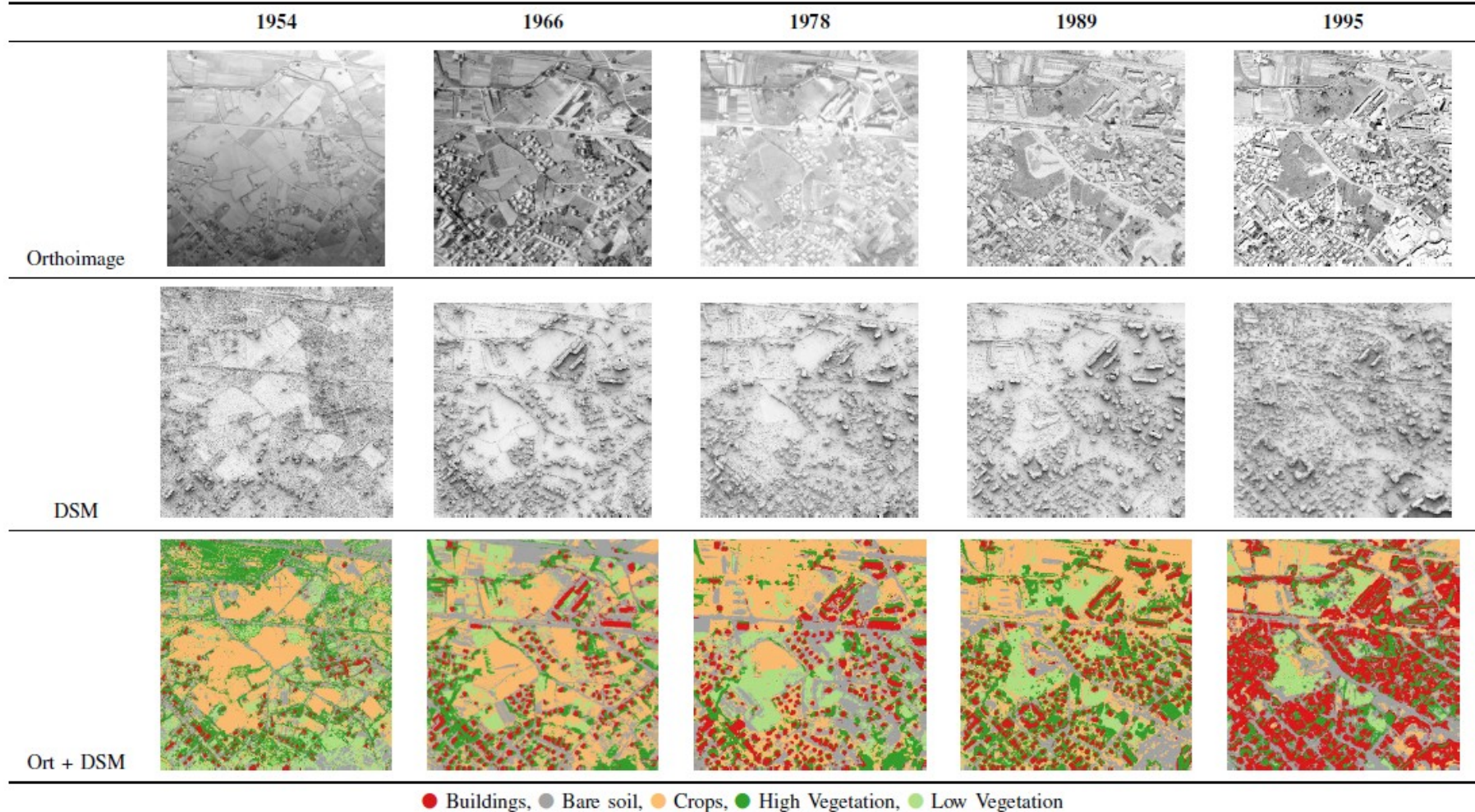
Historical orthoimages+DSM time series ?

→ opportunities...

- Change detection
- Temporal regularization of classifications

and difficulties

- Heterogeneous data: images' scale, DSM quality
- images' quality (noise/artifacts), pb image orientation, radiometry.
- Which training data?



LC SEMANTIC SEGMENTATION RETRIEVING PAST FOREST MAP

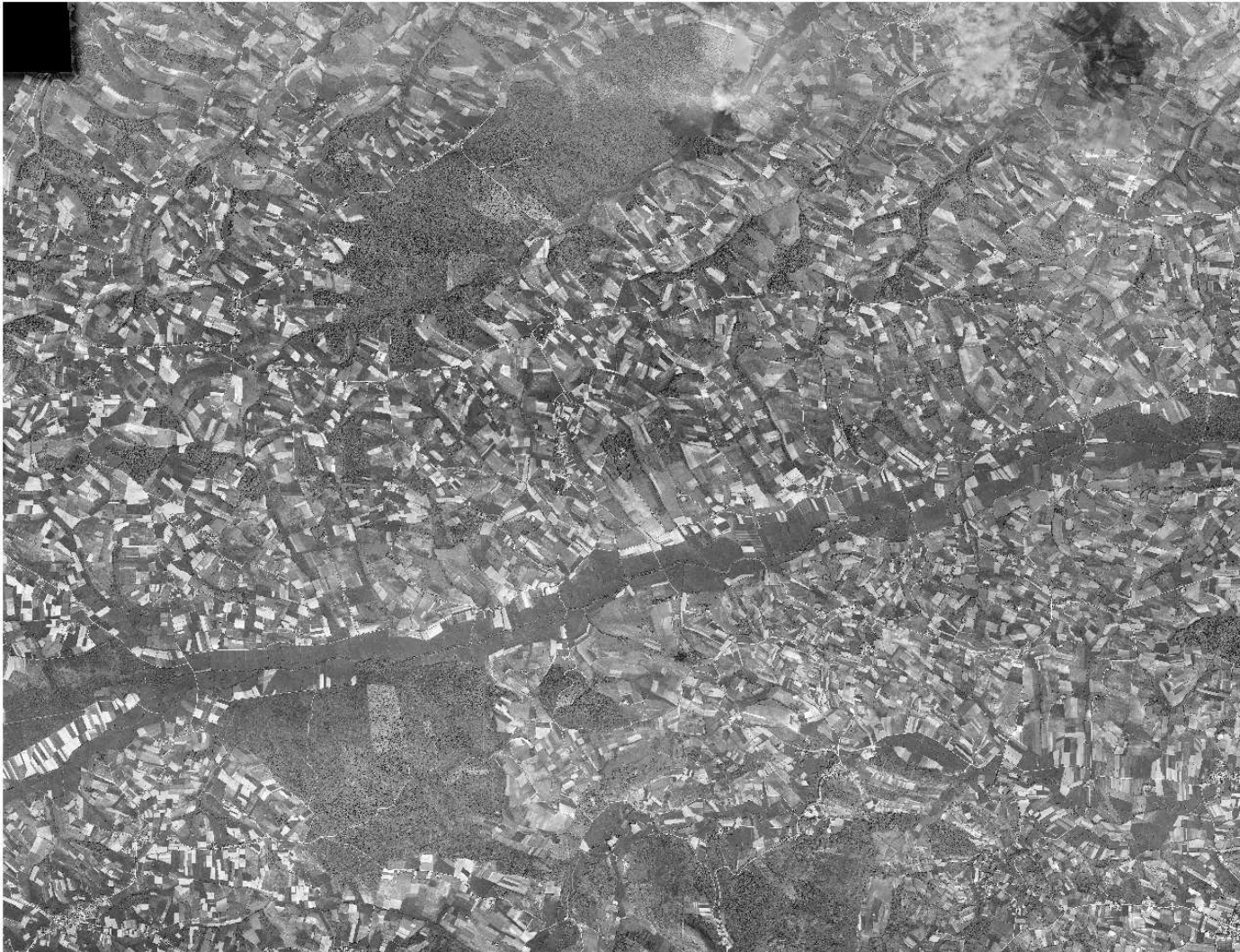
[D. Sheeren et al., 2023]

Past forest maps

[D. Sheeren et al., 2023]

Study area : Fabas (south-western France) - 172 km²

Ortho-image 1942 (GSD 75cm)



Past forest maps

[D. Sheeren et al., 2023]

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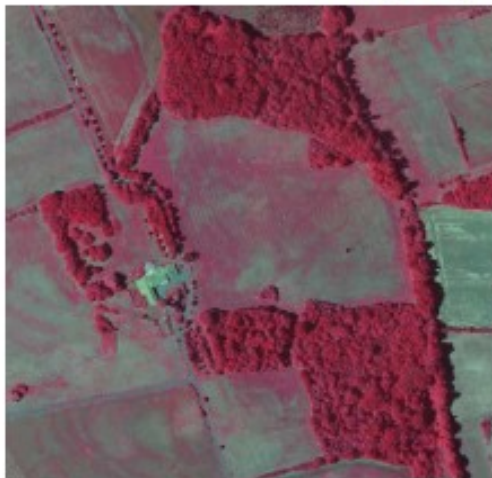
Ortho-image 1942 (GSD 75cm)



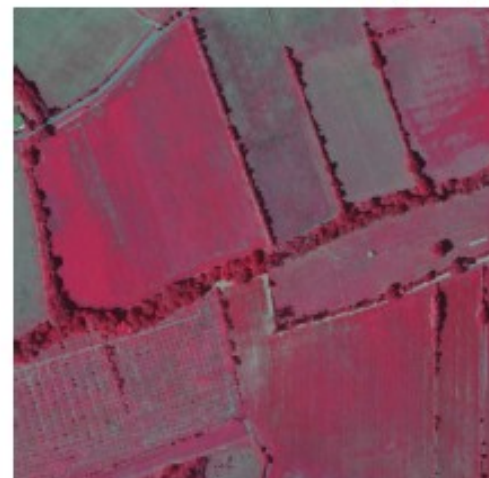
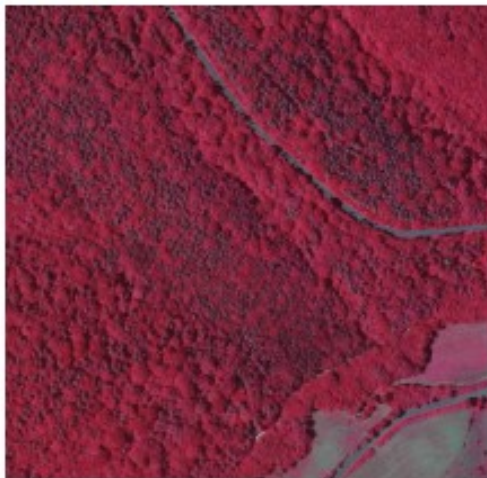
Ortho| 1942 (IGN) - ANR Hlatus



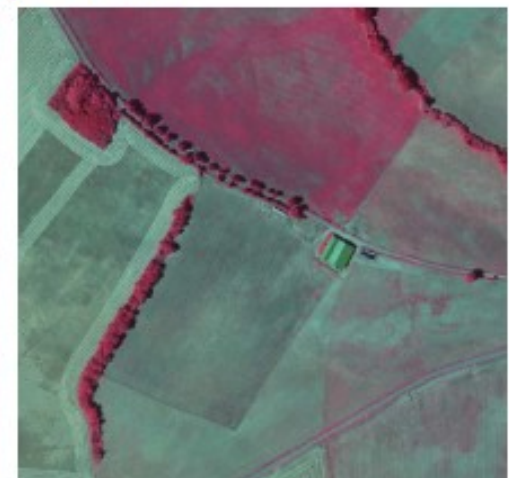
Ortho| 1942 (IGN) - ANR Hlatus



BDOrtho IRC 2019 (IGN)



BDOrtho IRC 2019 (IGN)



Past forest maps

[D. Sheeren et al., 2023]

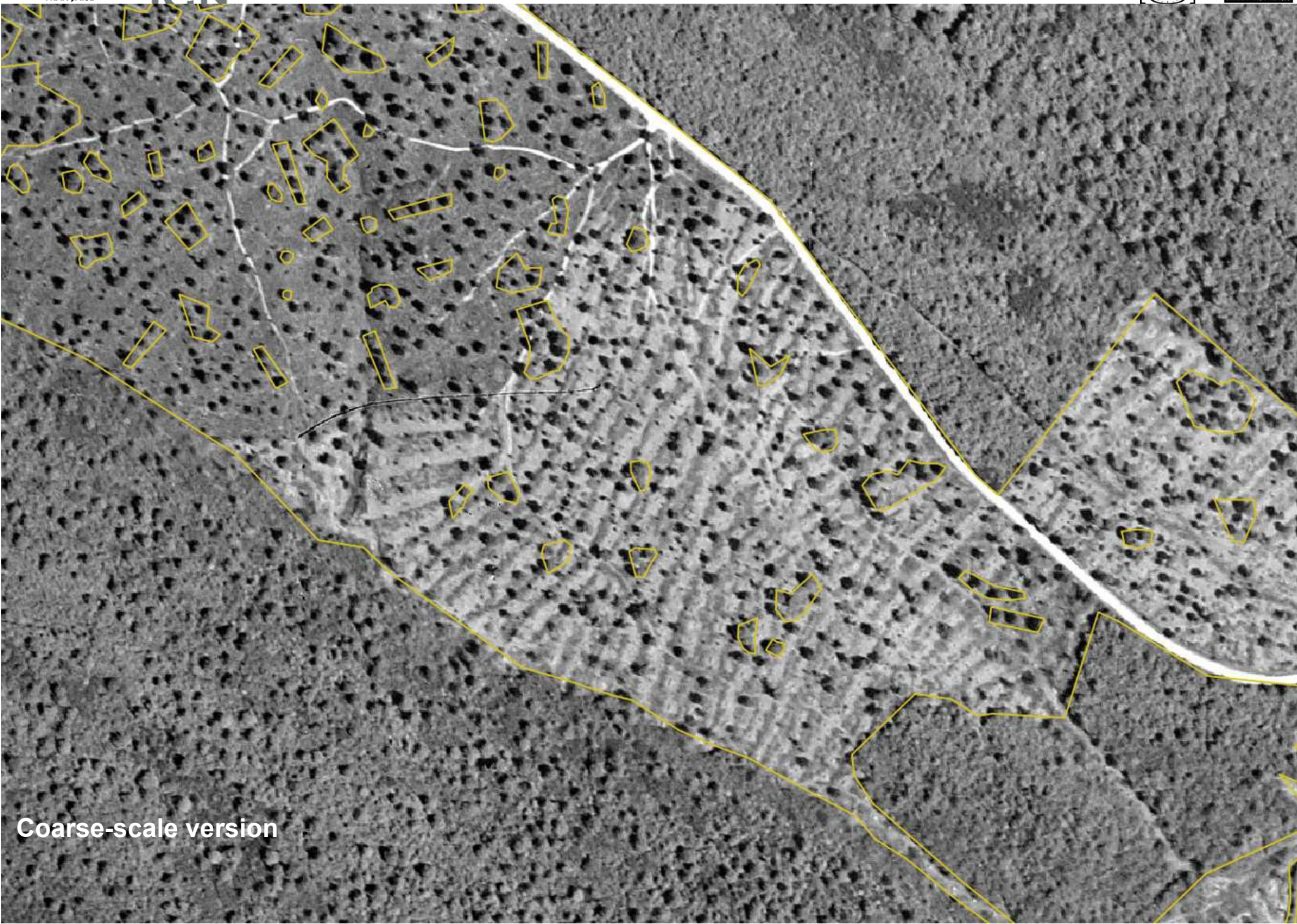
Build a reference dataset : annotating 3484 256 x 256 pixels image tiles

Legend:

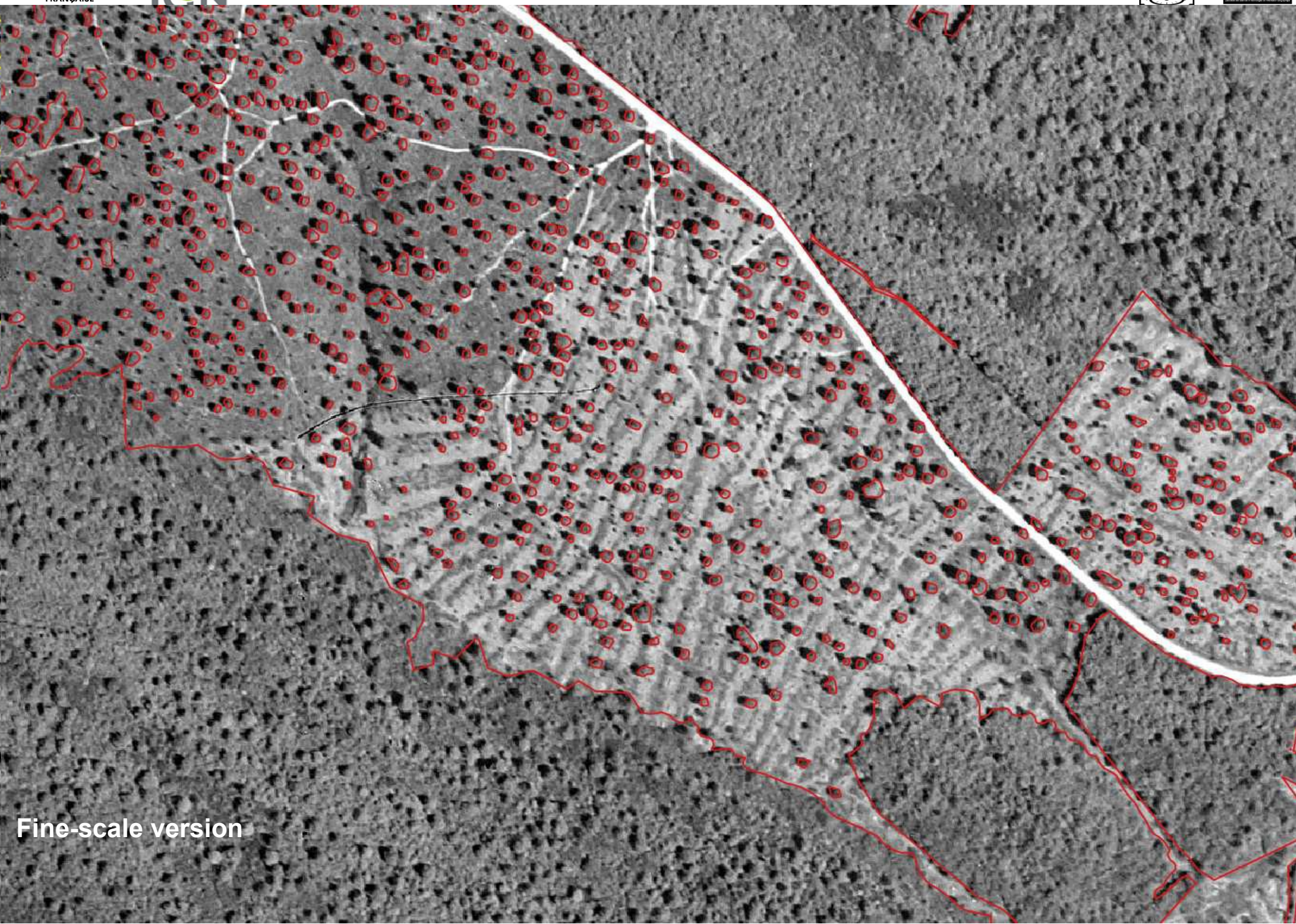
- ▶ per pixel label: (1) tree / (0) non tree
- ▶ per tile label: (a) pure, (b) mixt, (c) hedges, (d) individual trees

Two versions:

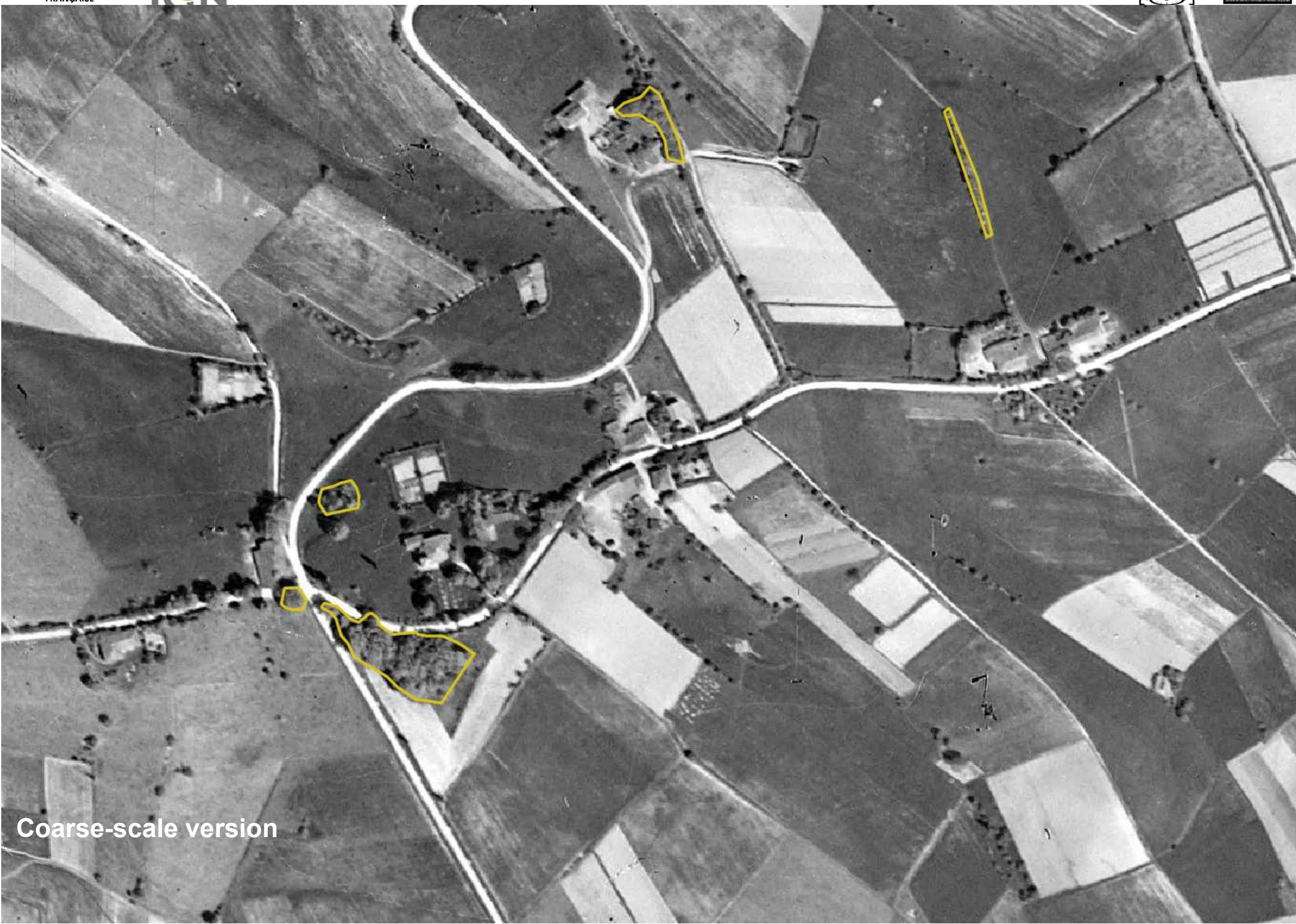
- ▶ coarse-scale dataset
 - Manual delineation with cartographic **generalisation** (agregation, simplified contours, small objects ignored)
 - 4-8 minutes / tile
 - 1 operator / tile
- ▶ fine-scale dataset
 - Manual delineation of **all tree elements** (isolated trees, hedges ...)
 - 10-30 minutes / tiles
 - 2 operators per tile



Coarse-scale version



Fine-scale version



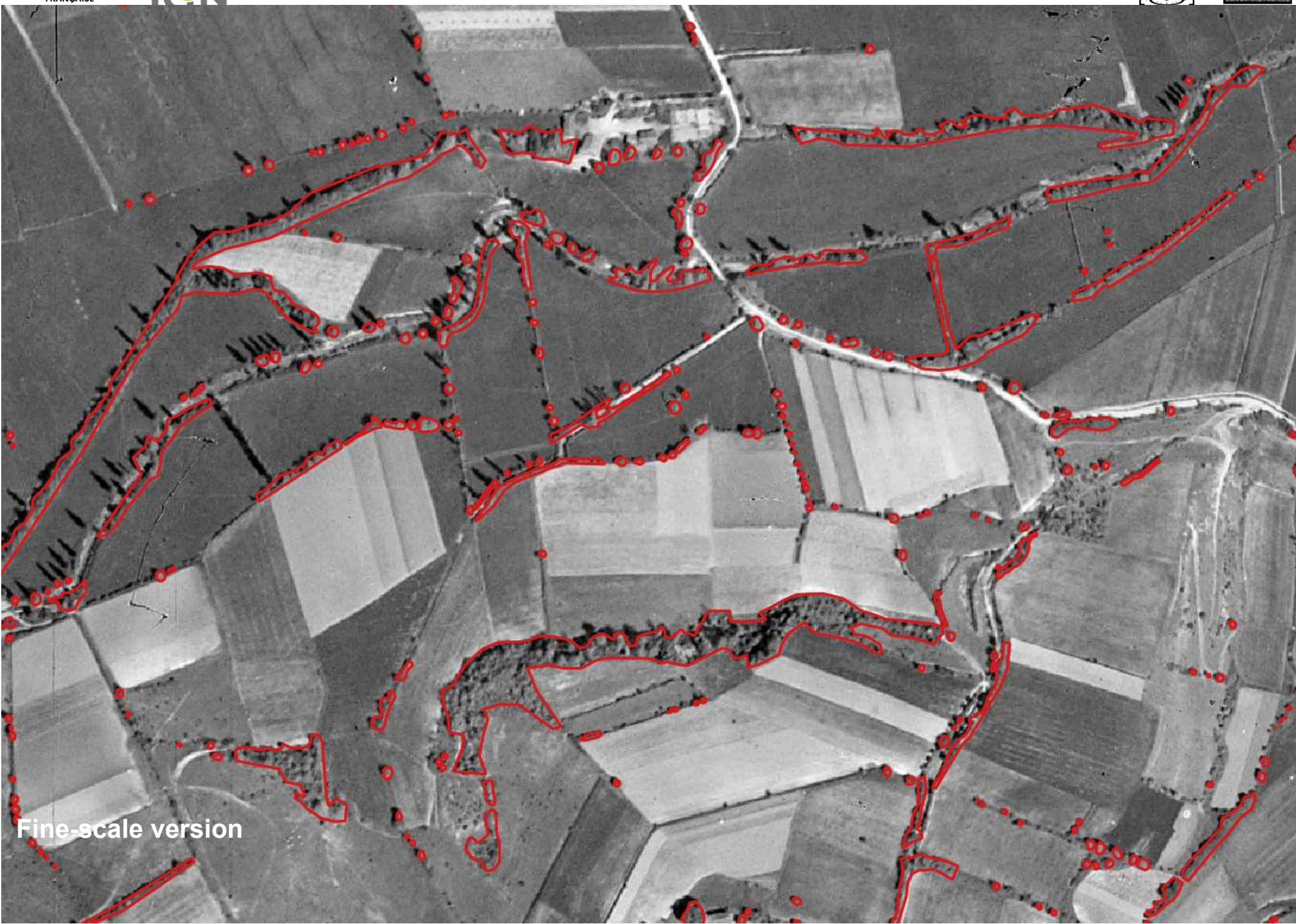
Coarse-scale version



Fine-scale version



Coarse-scale version



Fine-scale version

Past forest maps

[D. Sheeren et al., 2023]

U-Net architecture [Ronneberger et al. 2015]:

- ▶ pre-trained encodeur (MobileNet-v2)
- ▶ U-Net + scSE (attention mechanism; Roy et al. 2018)

Protocol:

- ▶ Applied to both datasets coarse vs.fine
- ▶ 3259 tiles (train/validation) and 225 (test) tiles
- ▶ Geometric data augmentation and contrast enhancement

Past forest maps

[D. Sheeren et al., 2023]

U-Net architecture [Ronneberger et al. 2015]:

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- ▶ Applied to both datasets coarse vs.fine
- ▶ 3259 tiles (train/validation) and 225 (test) tiles
- ▶ Geometric data augmentation and contrast enhancement

Performance evaluation according to the number of tiles:

- ▶ coarse-scale: F-score from 66.6% (n=750) to 69.9% (n=3250)
- ▶ fine-scale: F-score from 64.8% (n=750) to 72.6% (n=3250)

OBSERVED	Non-tree	95.6 %	4.37 %
	Tree	9.27 %	90.7 %
		Non-tree	Tree
		PREDICTED	

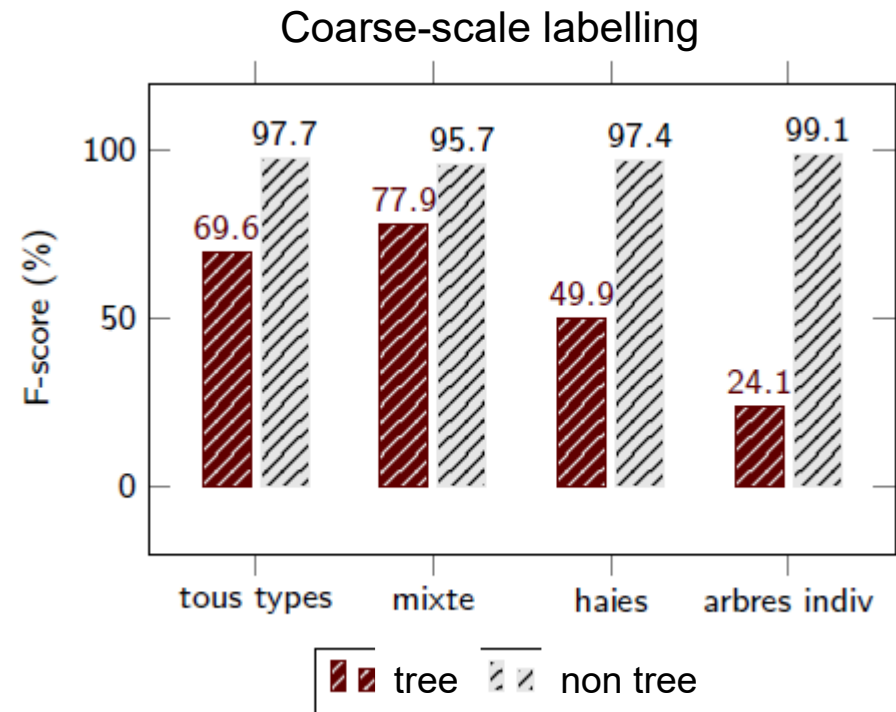
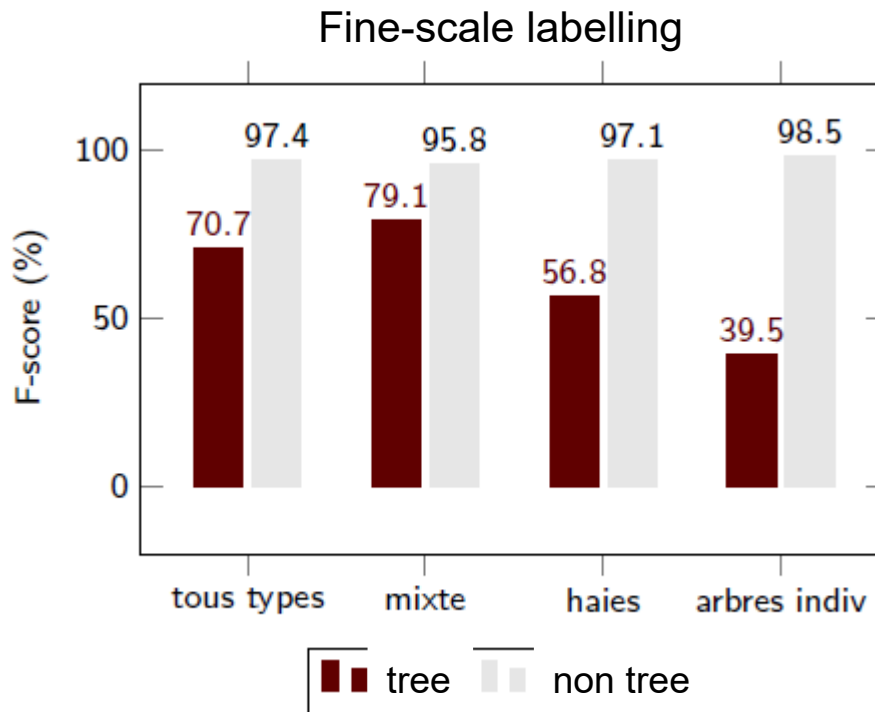
OBSERVED	Non-tree	96.8 %	3.18 %
	Tree	20.4 %	79.5 %
		Non-tree	Tree
		PREDICTED	

Past forest maps

[D. Sheeren et al., 2023]

Performance depends on the kind of tiles:

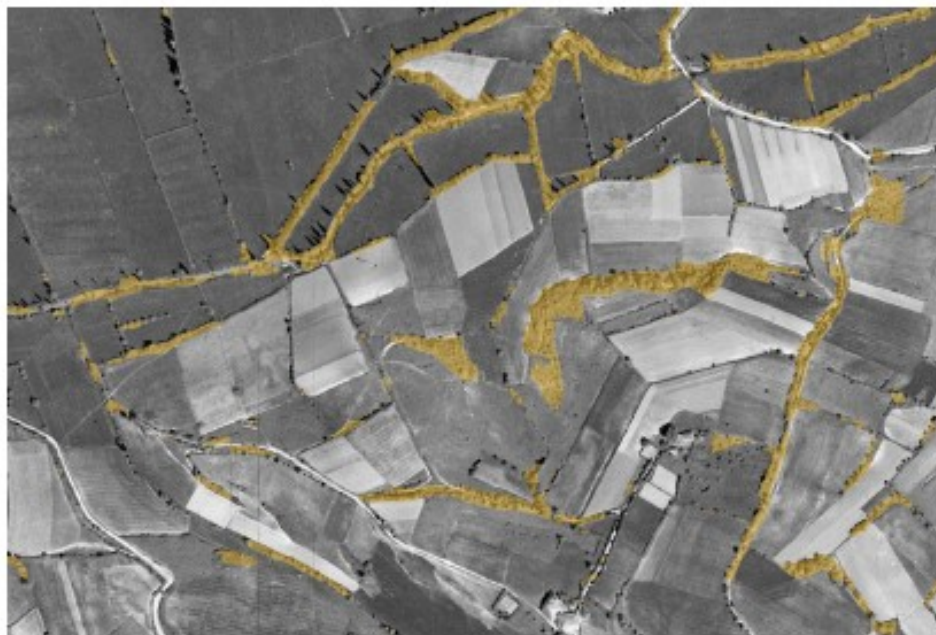
- ▶ decrease for small objects
- ▶ better for fine-scale labelling (+7 à +15% F-score difference)
- ▶ quality more important than quantity



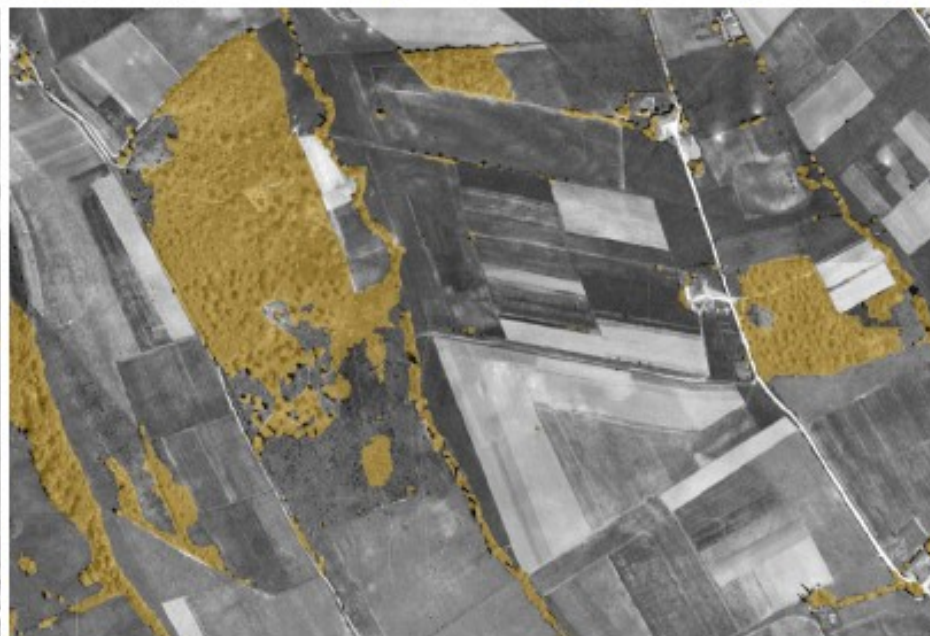
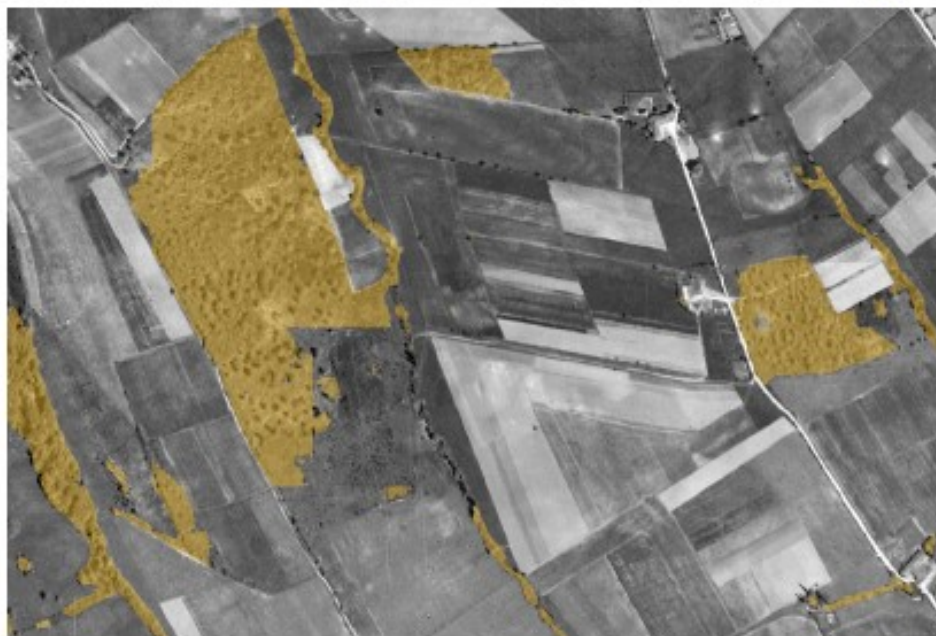
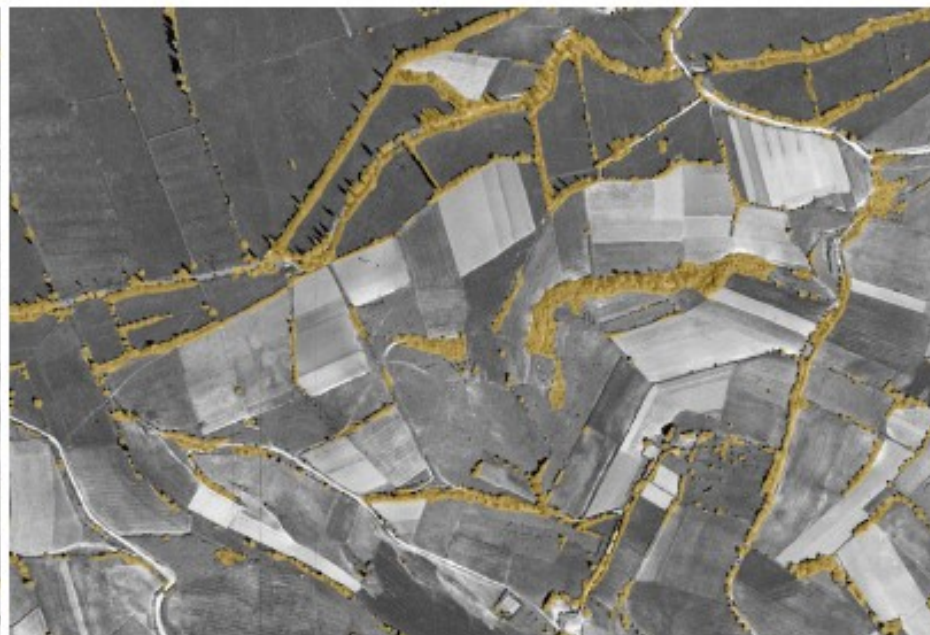
Past forest maps

[D. Sheeren et al., 2023]

Coarse-scale labelling



Fine-scale labelling



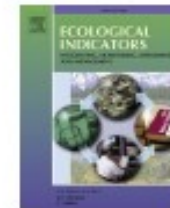
RETRIEVING PAST LAND COVER



Contents lists available at [ScienceDirect](#)

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind



Original Articles

Textural indices of aerial images reveal urban landscapes temporal dynamics and their effects on plants and birds

Suzie Derminon ^{a,*}, François Chiron ^a, Audrey Muratet ^b, Pierre-Alexis Herrault ^b

^a Université Paris-Saclay, CNRS, AgroParisTech, Ecologie Systématique et Evolution, 91190 Gif-sur-Yvette, France

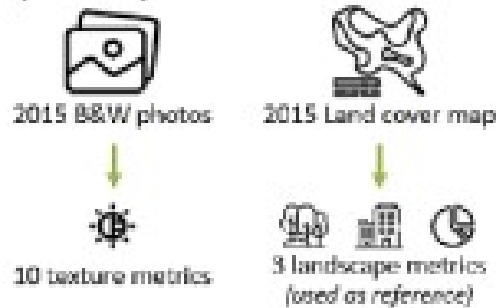
^b Laboratoire Image Ville Environnement (LIVE), CNRS, University of Strasbourg, Strasbourg, France

Past land cover

[S. Derminon et al., 2024]

Performance of texture-based model for present (2015)

1. Inputs for year 2015



2. Selections of best texture-based models



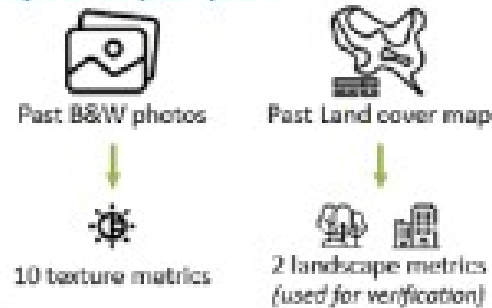
3. Predictive power of best models



Selection of 1 texture based model per landscape metric

Performances for past data (1966, 1976, 1986 & 2000)

4. Inputs for past years



5. Application of 2015's best texture-based models to past data



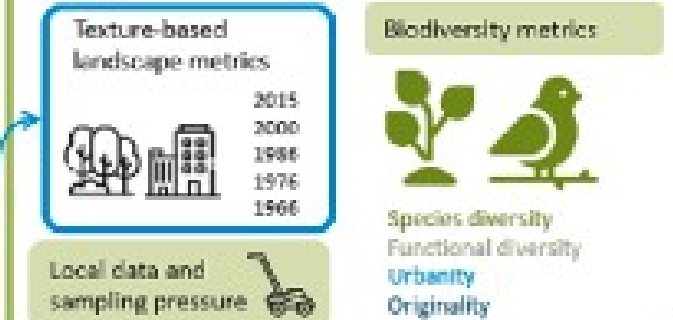
6. Verification of the models' predictive power



Texture based estimation of 2 landscape metrics for each year

Ecological case studies Effects of present and past years

7. Inputs



8. Model selections for each year



9. Full model combining all selected variables

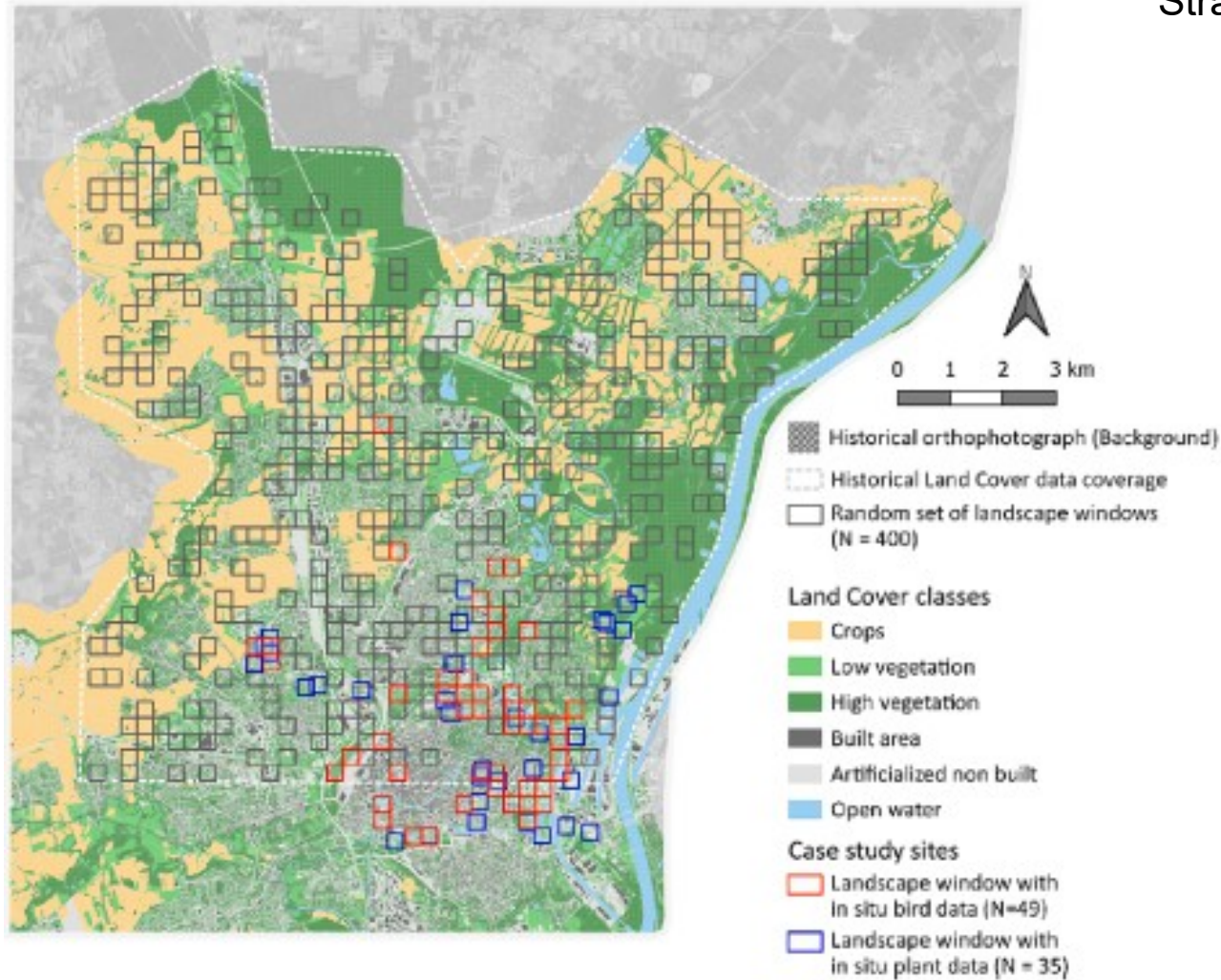


Independent variance explained by present and past landscape metrics

Past land cover

[S. Derminon et al., 2024]

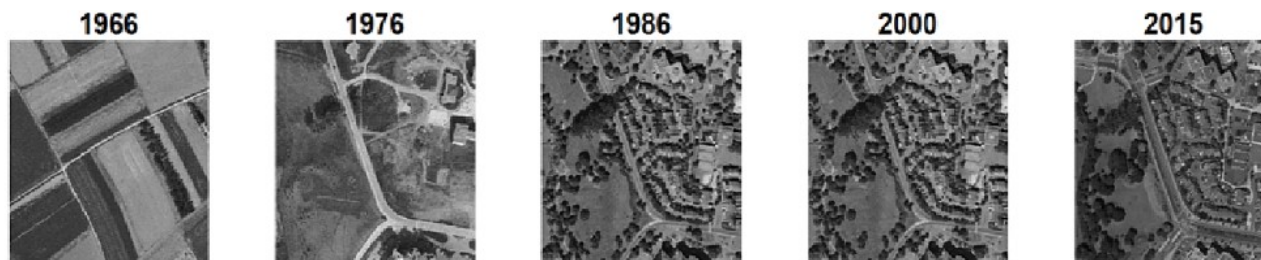
Strasbourg dataset



Past land cover

[S. Derminon et al., 2024]

Raw image

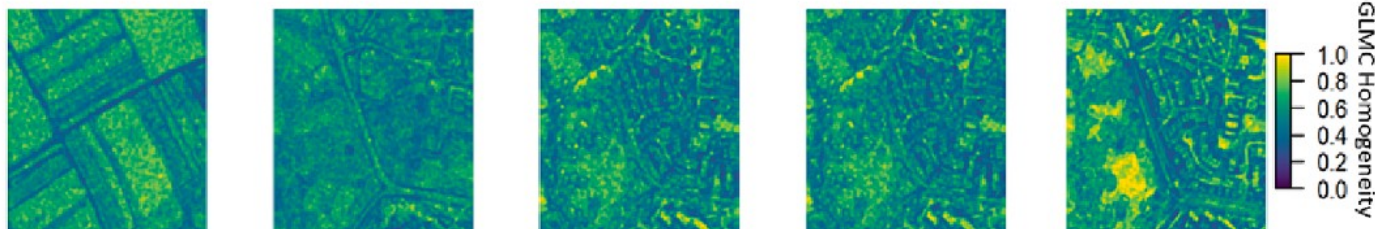


Textural Representations:

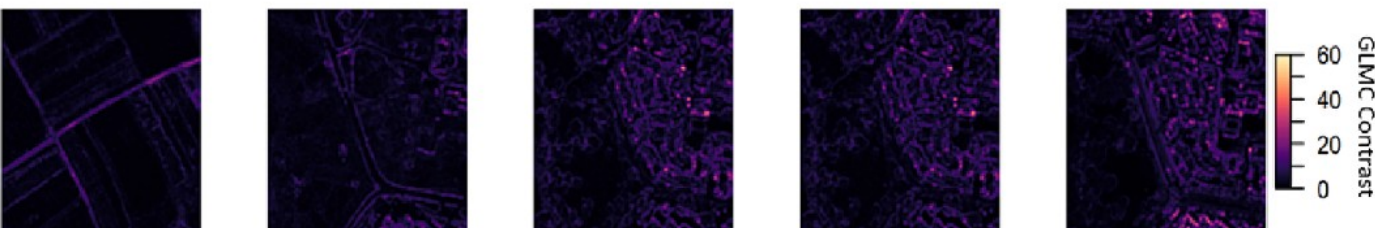
Brightness
(18 gray levels)



GLCM Homogeneity

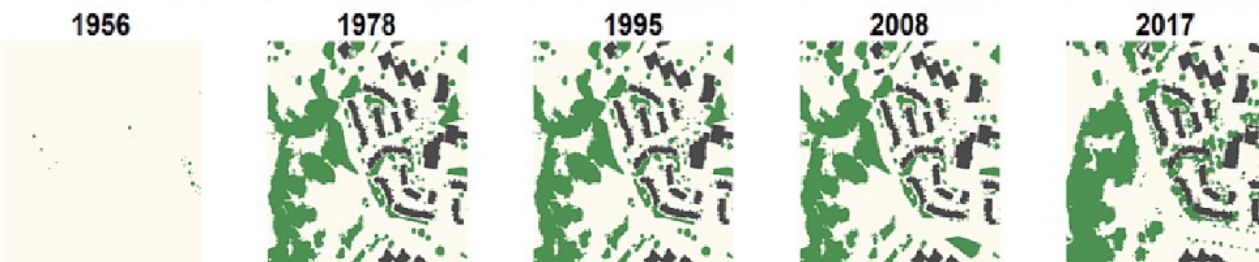


GLCM Contrast



Vectorial Representation:

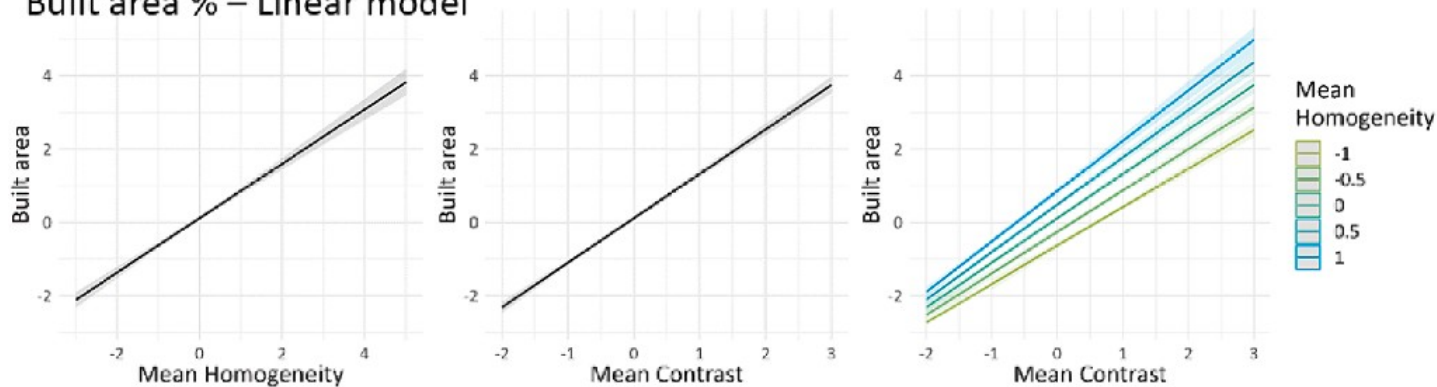
High vegetation and
built area land cover



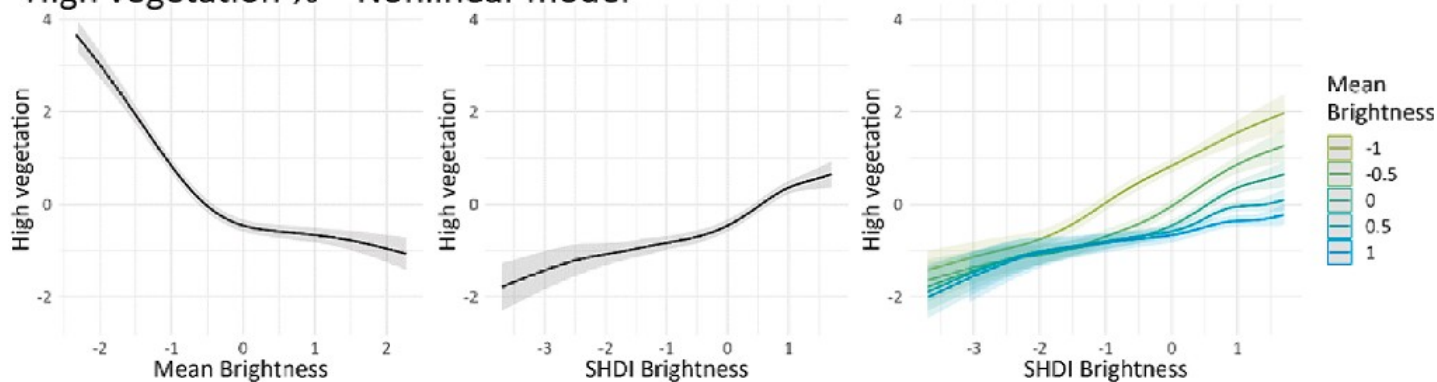
Past land cover

[S. Derminon et al., 2024]

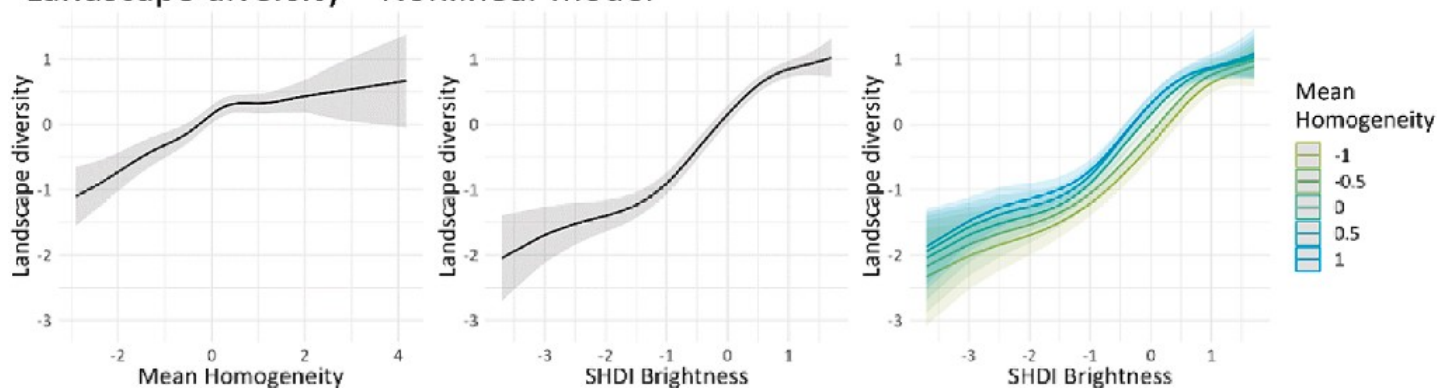
Built area % – Linear model



High vegetation % – Nonlinear model



Landscape diversity – Nonlinear model



LC SEMANTIC SEGMENTATION CHANGE DETECTION / TRANSFER LEARNING

LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB



Ortho-image 1981



BD référence 2018

- Bâtiments
- Cultures
- Végétation haute / forêt
- Routes
- Eau
- « Buffer » bâtiment

LC semantic segmentation

How to train a classifier?

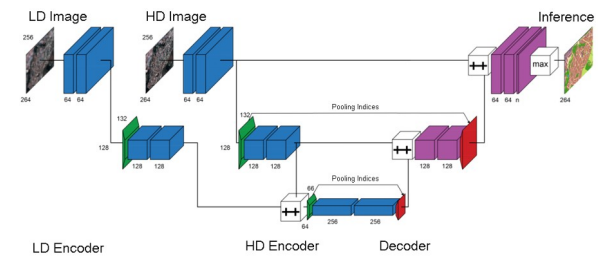
→ Diachronism between old images and available DB



Tests with a U-net CNN

→ Results vary according to the distribution of training / validation / test tiles

- Bâtiments
- Cultures
- Végétation haute / forêt
- Routes
- Eau
- « Buffer » bâtiment



LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB



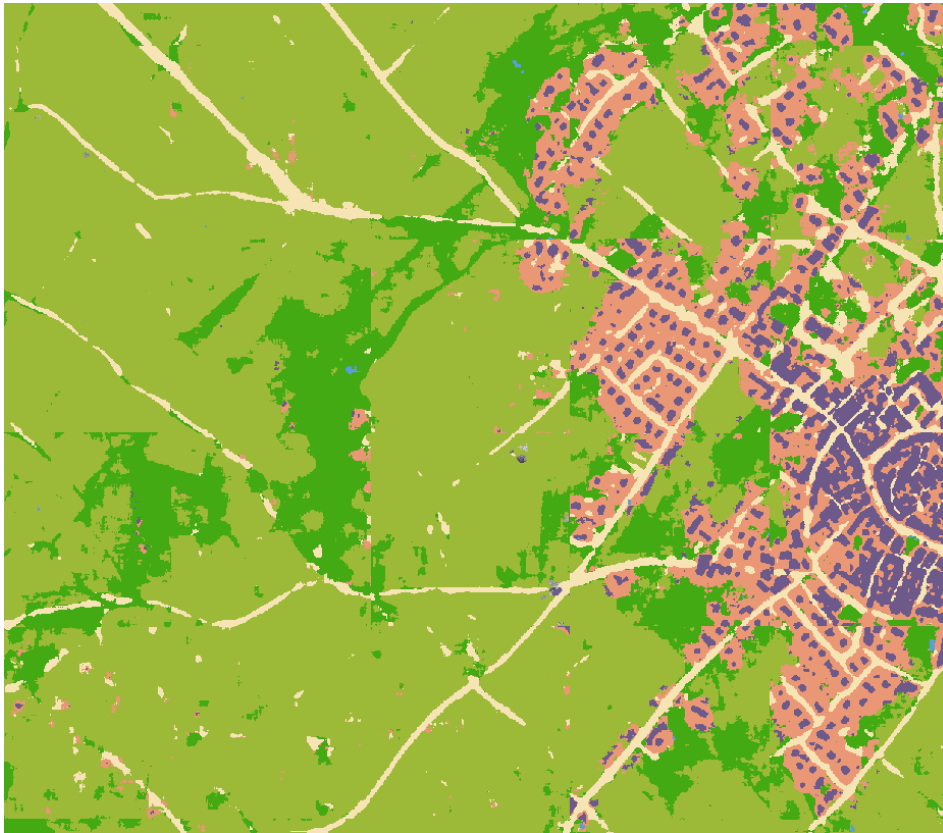
- Bâtiments
- Cultures
- Végétation haute / forêt
- Routes
- Eau
- « Buffer » bâtiment

Errors mostly occur on training tiles...
= overfitting

LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB



- Bâtiments
- Cultures
- Végétation haute / forêt
- Routes
- Eau
- « Buffer » bâtiment

Improvement using a CNN ensemble.

LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB

Why not detecting coarsely change to eliminate the very changed parts of the dataset ?

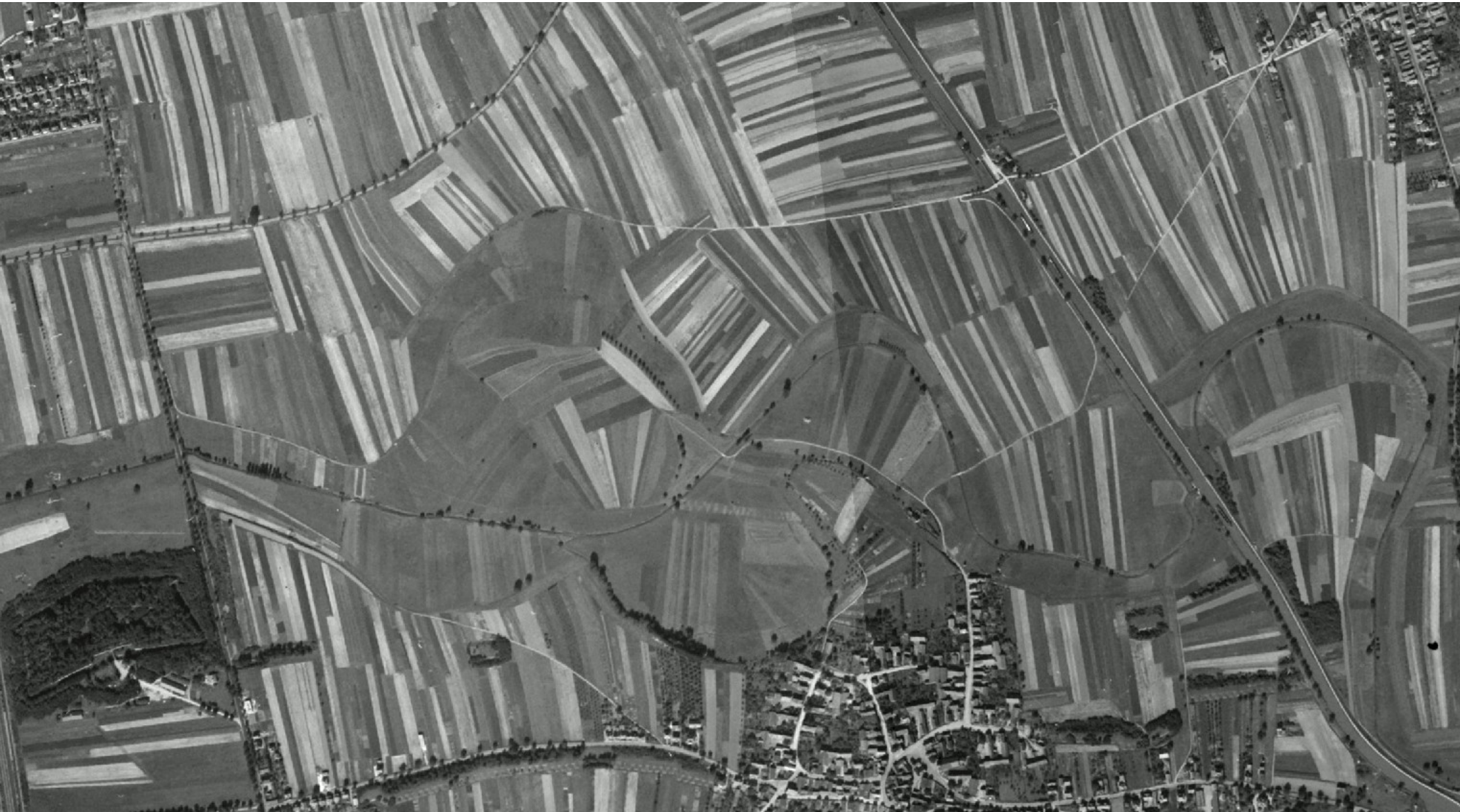
Train a siamese network (shared weights) to (try to) detect changed patches using the whole ~30 dates image dataset.

→ Generate pairs of date t1 / date t2 image patches
either at a same location (non change), or at two (randomly) distinct location (change)

LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB



LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB

Why not detecting coarsely change to eliminate the very changed parts of the dataset ?

Very coarse (wanted and unwanted) change are detected.

LC semantic segmentation

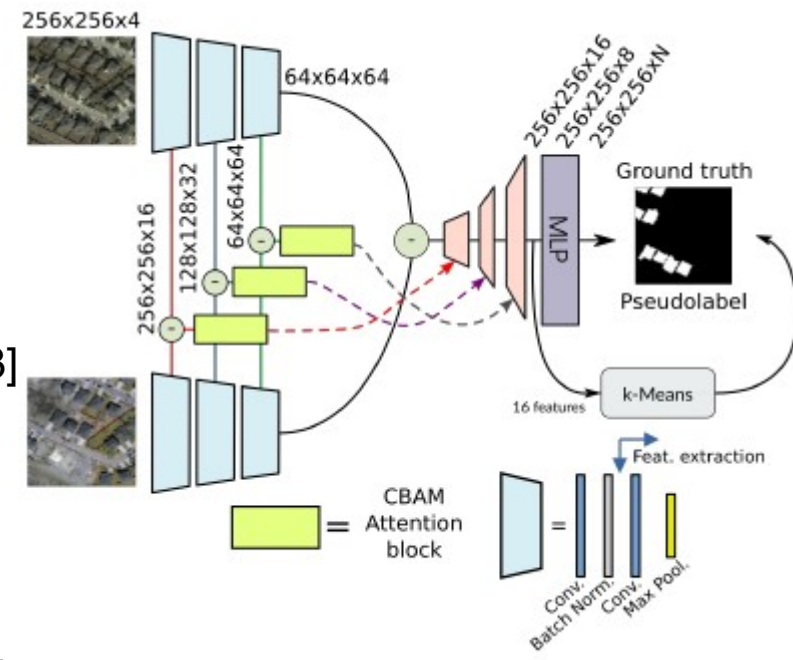
How to train a classifier?

→ Diachronism between old images and available DB

Why not detecting coarsely change to eliminate the very changed parts of the dataset ?

Very coarse (wanted and unwanted) change are detected.

The change score is then introduced to weight the pixel contribution to the loss when fine tuning a semantic segmentation on an old image. [Ongoing work]



LC semantic segmentation



1993 image superimposed with 2023 IGN COSIA LC product (used as reference LC DB)

LC semantic segmentation



1993 image superimposed with 2023 IGN COSIA LC product (used as reference LC DB)

LC semantic segmentation



Coarse change map based weight

LC semantic segmentation



1993 image superimposed with obtained (only image based) LC inference

LC semantic segmentation



1993 image superimposed with obtained (only image based) LC inference (only for training tiles)

LC semantic segmentation

How to train a classifier?

→ Diachronism between old images and available DB

Why not detecting coarsely change to eliminate the very changed parts of the dataset ?

Interesting results...

but still limited for rare classes (orchards, vineyards) that have changed more than expected along time...

Perspective: try to simulate "old" images out of recent ones



1950 1964 1966 1971 1975 1976 1982 1986 1991 1997 2000

Thank you for your attention.

<https://anr-hiatus.github.io/>

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