





INSTITUT NATIONAL
DE L'INFORMATION
GÉOGRAPHIQUE
ET FORESTIÈRE

A NEW SEGMENTATION BASED CLASSIFICATION METHODOLOGY

IGN : THE FRENCH NATIONAL MAP AGENCY

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SUMMARY

■ OVERVIEW OF THE FRENCH ALTIMETRY PRODUCTION

- A new Height Scale DTM production
- Specifications and metadata
- Some production numbers

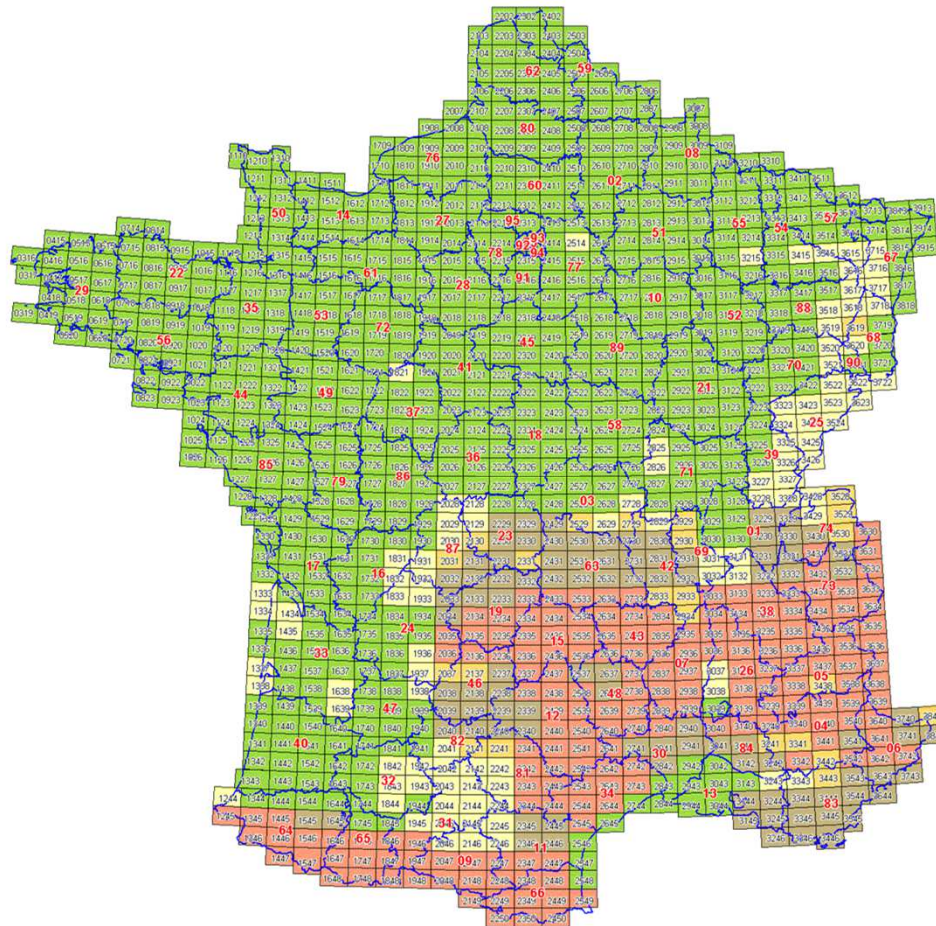
■ EVOLUTION OF THE LIDAR PROCESS

- Main steps
- Segmentation based classification
- Results

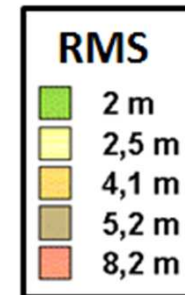
OVERVIEW OF THE ALTIMETRY PRODUCTION

OVERVIEW OF THE ALTIMETRY PRODUCTION

■ FROM 1970 TO 2006, BD-ALTI



- 25m of resolution
- Based on contour lines with varying spaces
- Heterogeneous accuracy



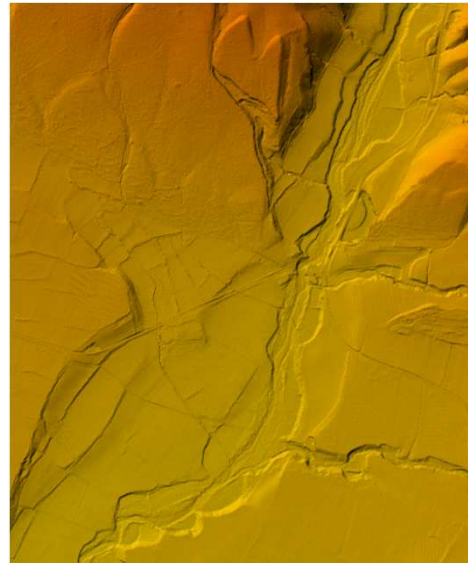
- Updating issue...

OVERVIEW OF THE ALTIMETRY PRODUCTION

- FROM 2004 TO 2008 :
PROJECT OF A NEW HEIGHT SCALE ALTIMETRY REFERENTIAL



BD-Alt 25m

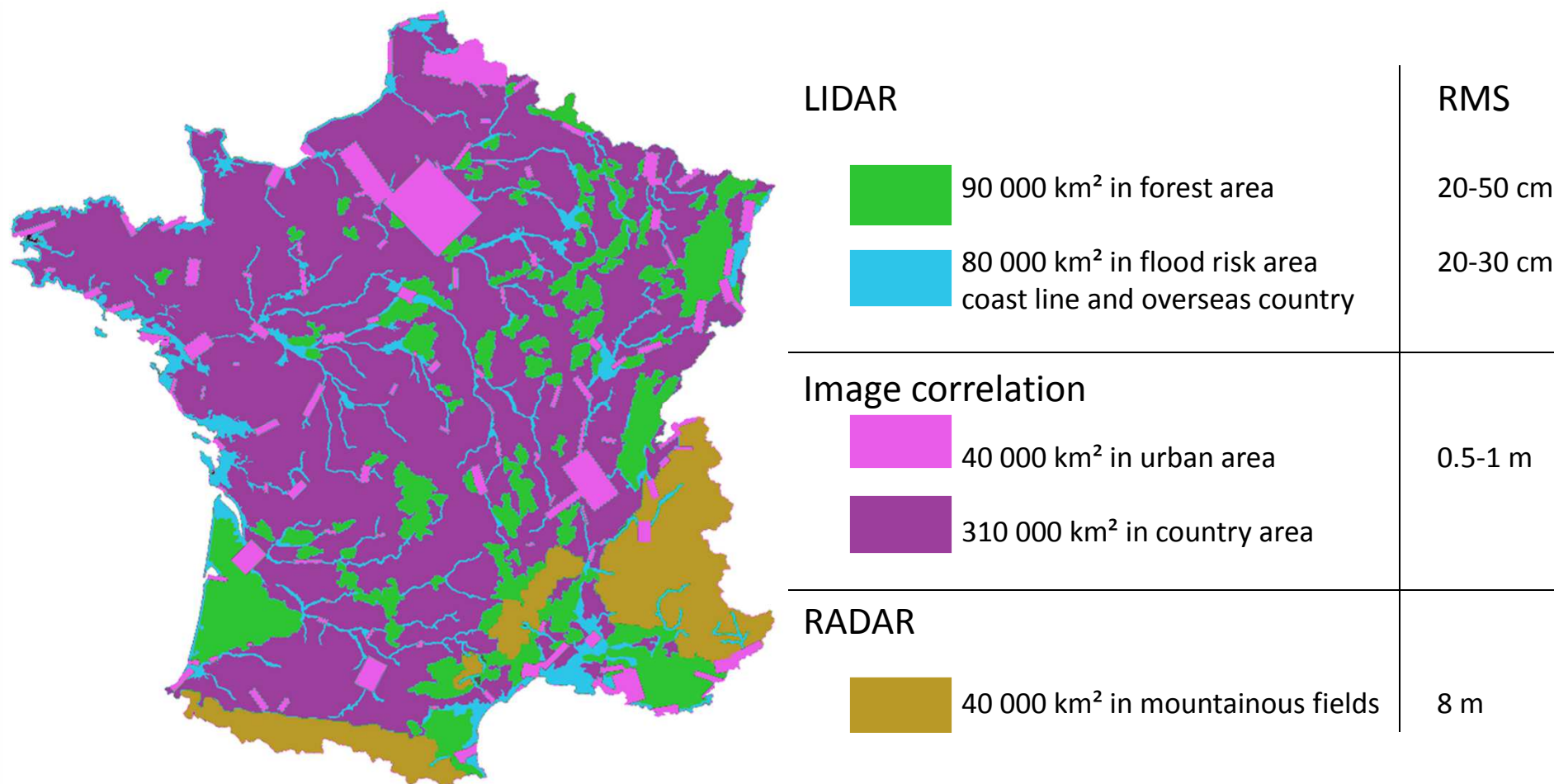


RGE-Alt 1m

- THE PRODUCTION BEGAN IN 2009 AND SHOULD BE FINISHED IN 2017

OVERVIEW OF THE ALTIMETRY PRODUCTION

■ A PRODUCTION USING DIFFERENT TECHNOLOGIES...



OVERVIEW OF THE ALTIMETRY PRODUCTION

■ ... AND DIFFERENT PROVIDERS WITH SPECIFIC QC PROCESS

■ IGN 67%

- 4 airplanes
- 3 large-format cameras (IGN laboratory)
- 2 LIDAR
- 40 full-time persons (20 for LIDAR)



ALS70-HP



ALTM Gemini

■ Partnership 18%

- LIDAR points clouds in flood risk and urban areas
- Regional DTM by image correlation

■ LIDAR Subcontractor 8%

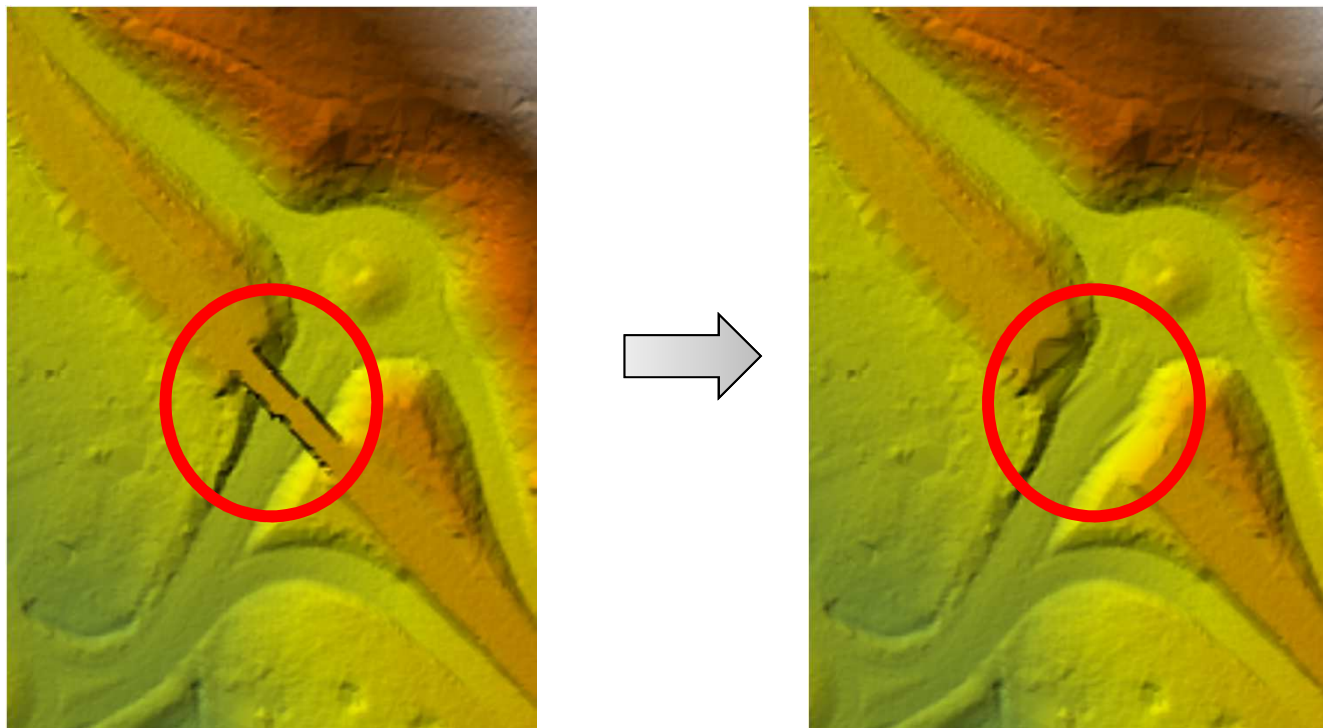
- For acquisition and post processing

■ External Radar data 7%

OVERVIEW OF THE ALTIMETRY PRODUCTION

■ MAIN SPECIFICATIONS OF LIDAR MODELING PROCESS

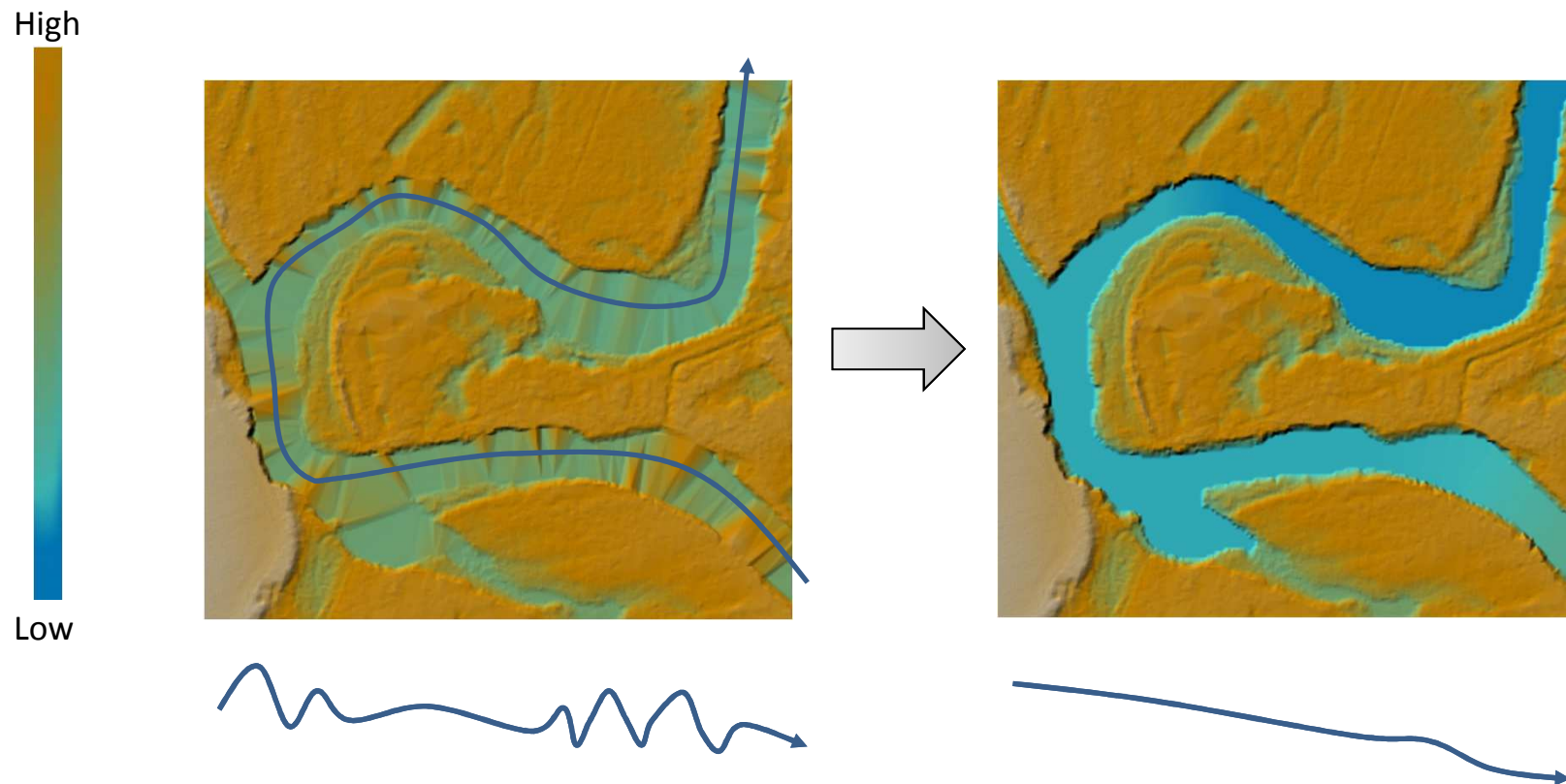
- Open bridges



OVERVIEW OF THE ALTIMETRY PRODUCTION

■ MAIN SPECIFICATIONS OF LIDAR MODELING PROCESS

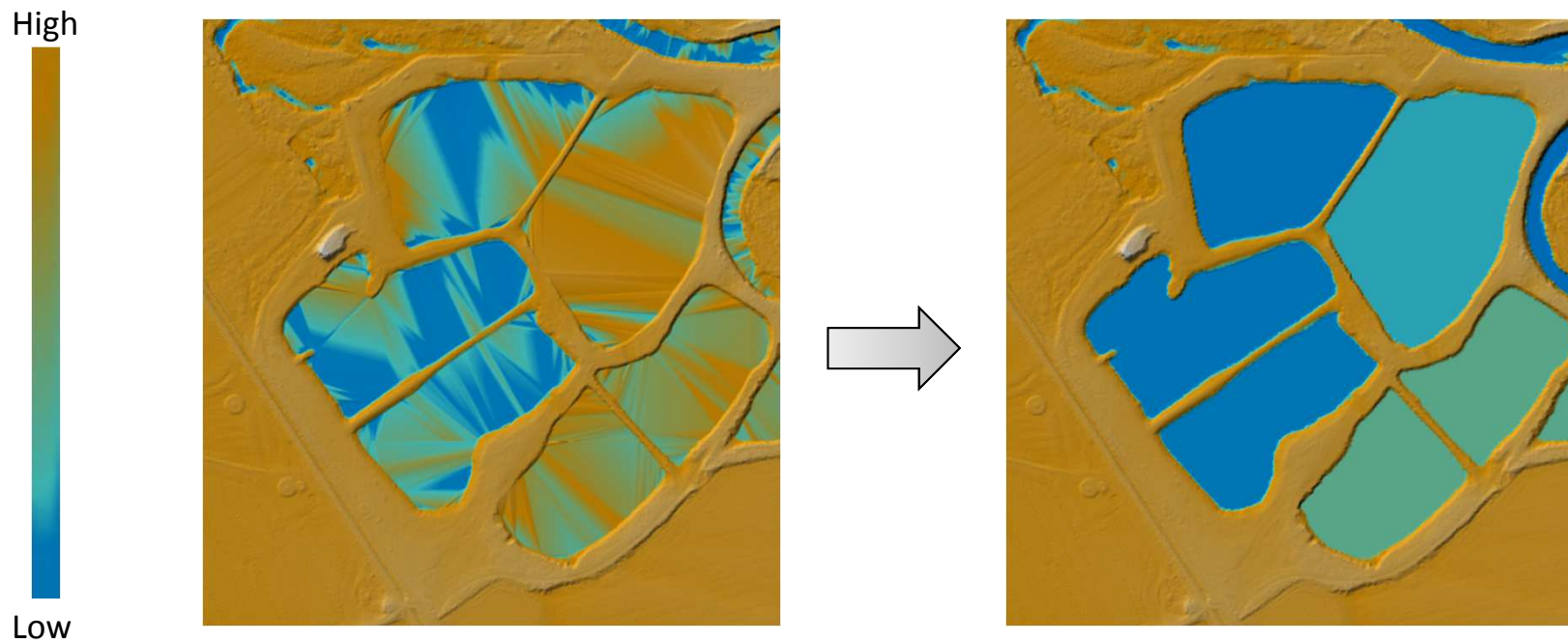
- Flatten rivers in the flow direction



OVERVIEW OF THE ALTIMETRY PRODUCTION

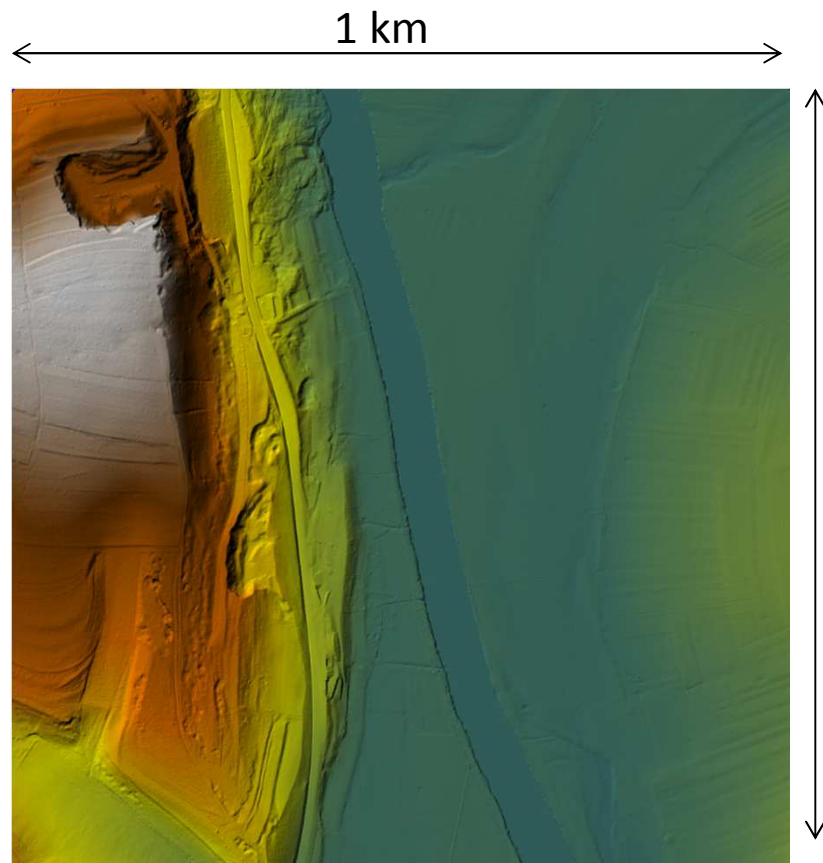
■ MAIN SPECIFICATIONS OF LIDAR MODELING PROCESS

■ Flatten lakes



OVERVIEW OF THE ALTIMETRY PRODUCTION

■ A TILE OF RGE-ALTI



DTM with 1 meter of resolution



Source Mask



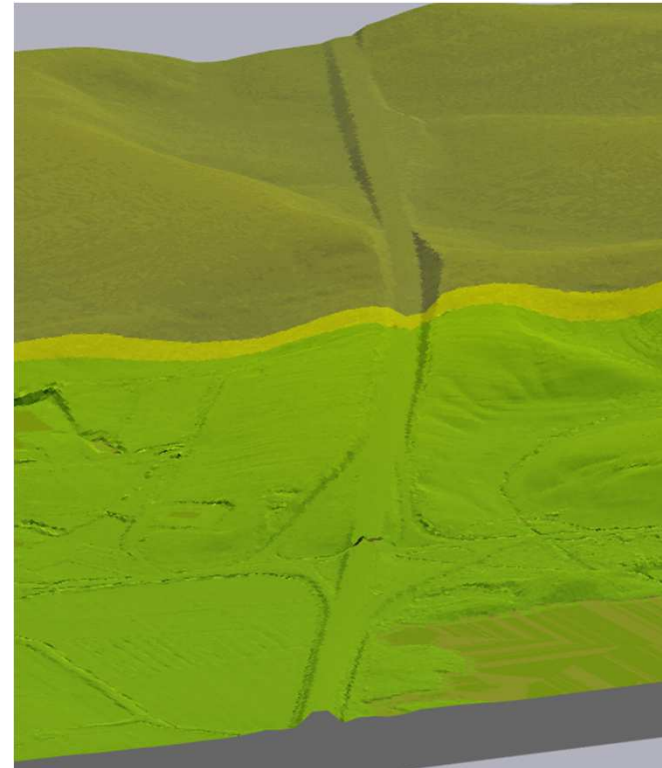
Distance Mask

OVERVIEW OF THE ALTIMETRY PRODUCTION

- SOURCE MASK (EXTRACT OF DATA BASE)



Top view



3D view
No gaps between sources

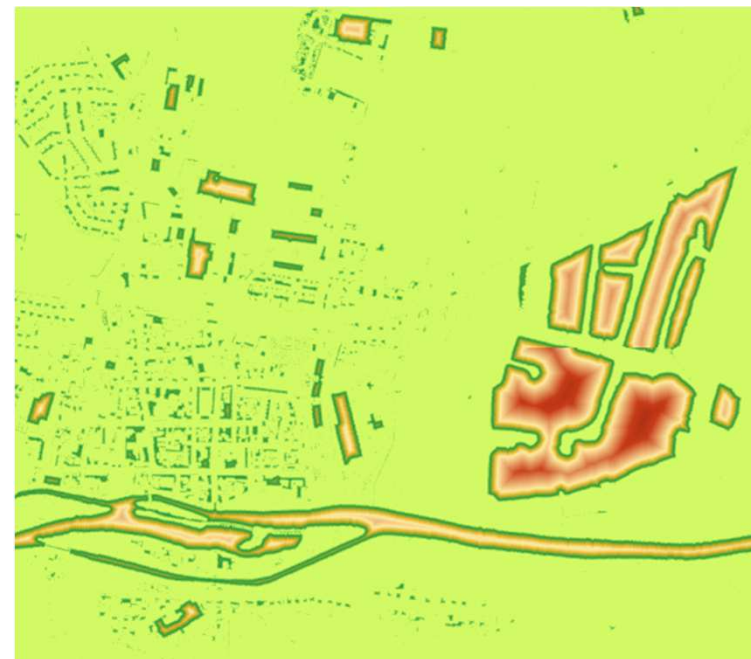
OVERVIEW OF THE ALTIMETRY PRODUCTION

■ DISTANCE MASK (8 BIT GEOTIFF)

- Metric distance color map :



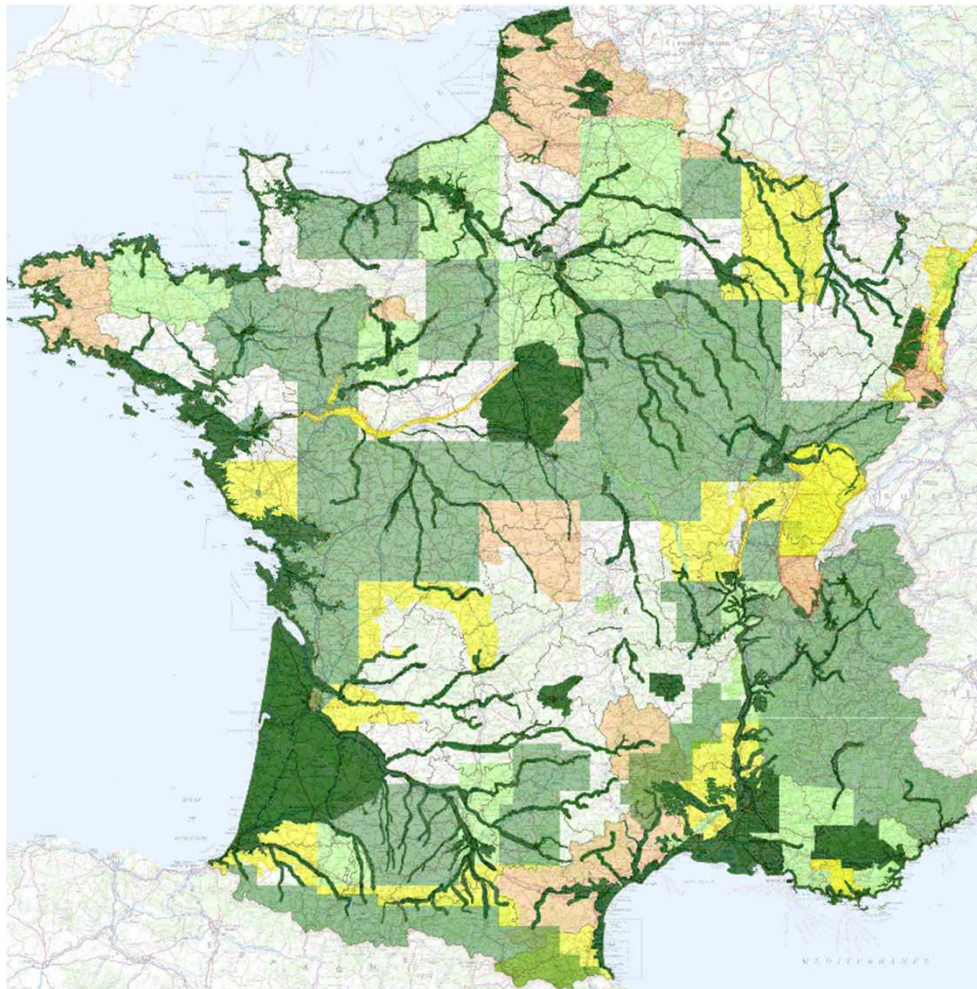
A ground echo



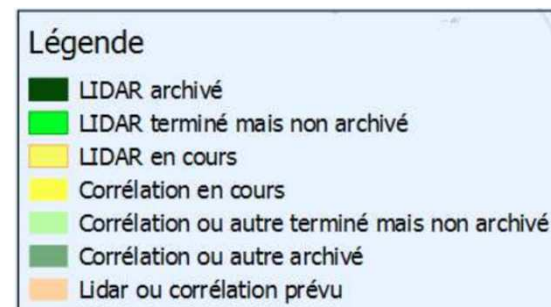
Distance mask

OVERVIEW OF THE ALTIMETRY PRODUCTION

■ PROGRESS OF PRODUCTION



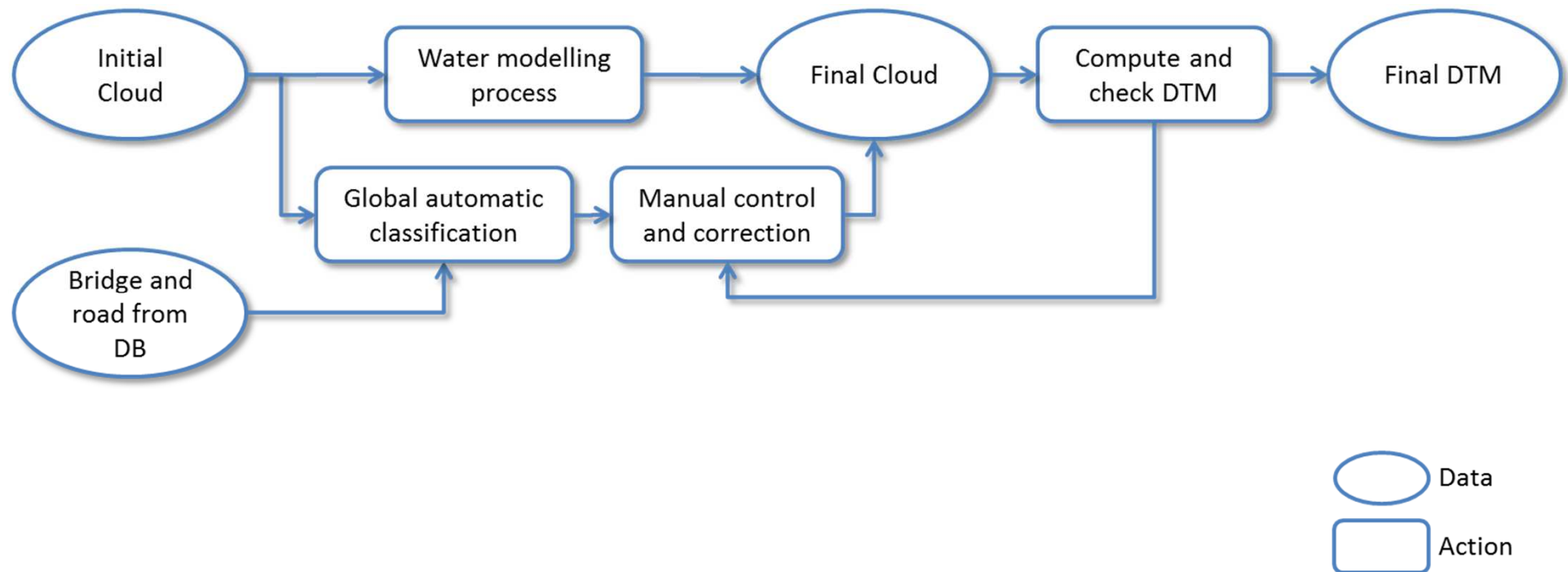
- 65% of the program is produced (365 000km²/ 560 000 km²)
- 75 000 km² remaining LIDAR data
- We need to produce faster to complete the production in 2017 !



EVOLUTION OF THE LIDAR PROCESSING

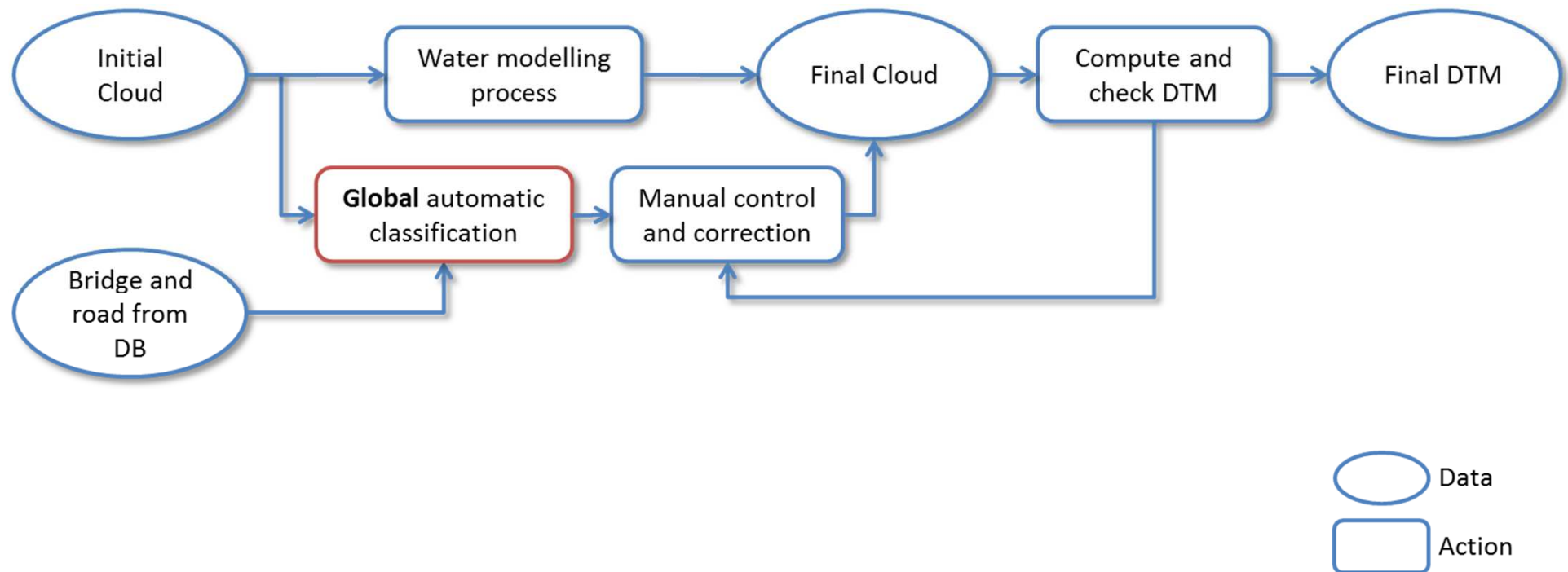
EVOLUTION OF THE LIDAR PROCESSING

■ MAIN STEPS OF THE “STANDARD” CHAIN



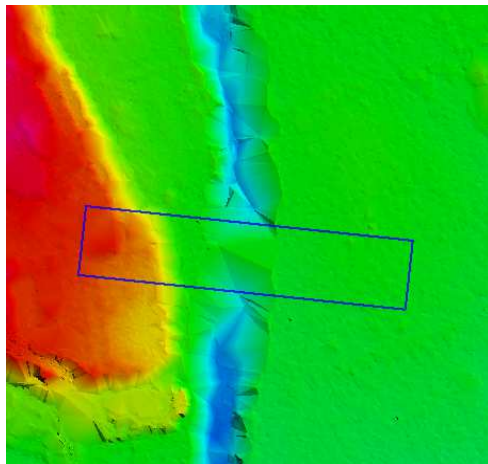
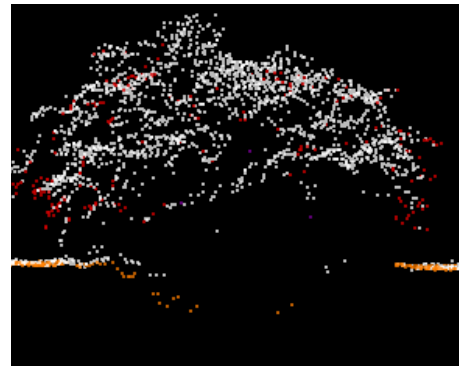
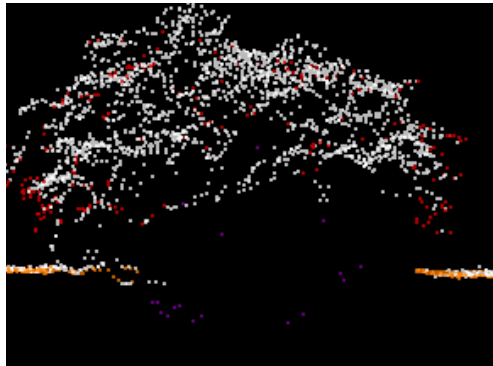
EVOLUTION OF THE LIDAR PROCESSING

■ MAIN STEPS OF THE “STANDARD” CHAIN

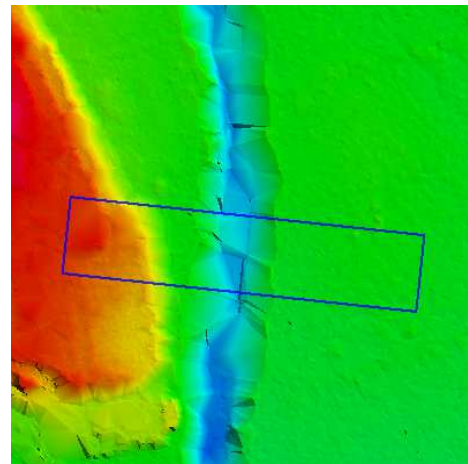


EVOLUTION OF THE LIDAR PROCESSING

■ NARROW THALWEG



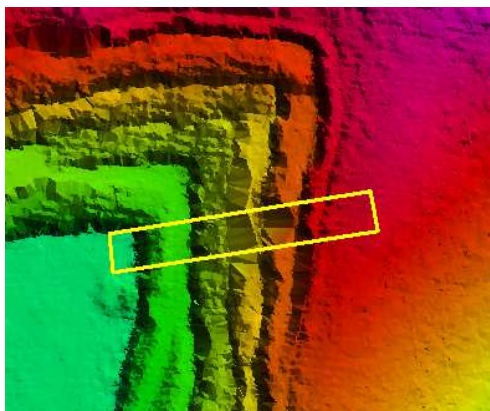
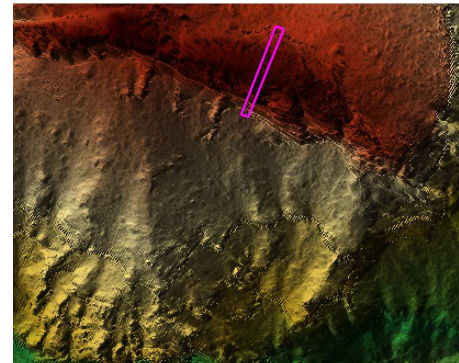
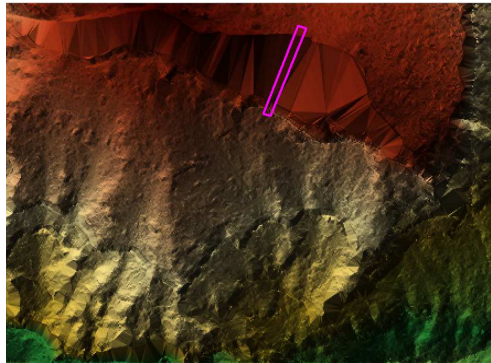
**“classic” automatic
classification**



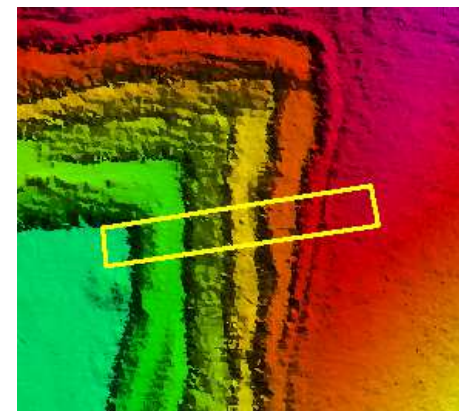
Manual correction

EVOLUTION OF THE LIDAR PROCESSING

■ BREAK OF SLOPE AREA, RIDGE



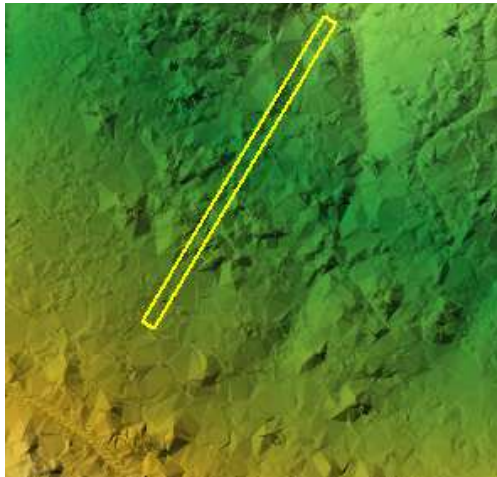
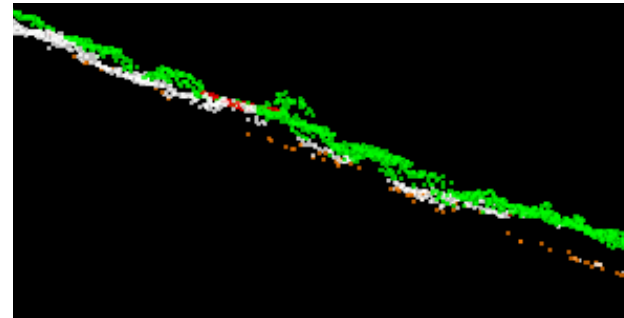
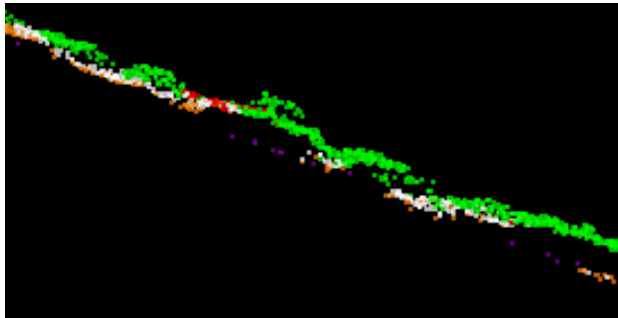
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classification**



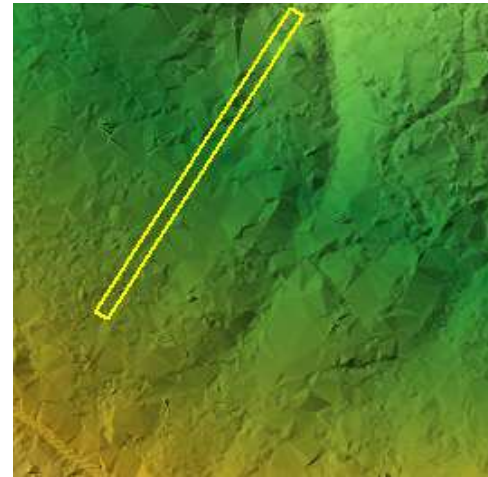
Manual correction

EVOLUTION OF THE LIDAR PROCESSING

■ VEGETATION AREA



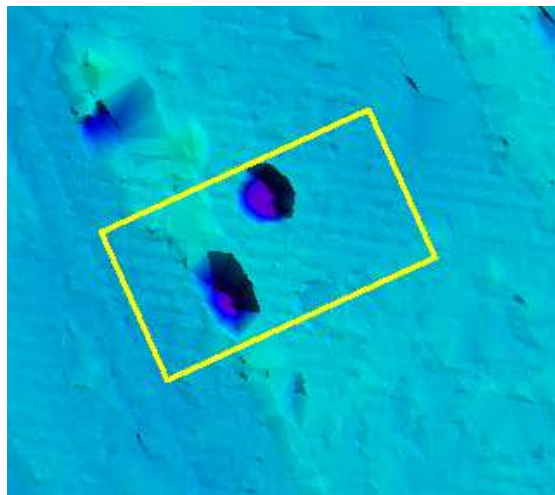
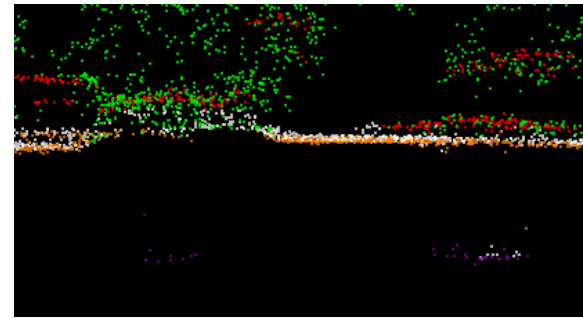
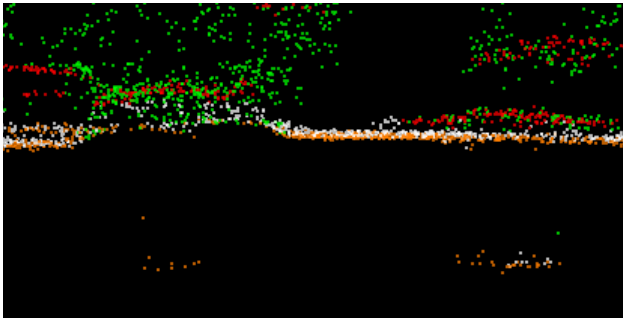
**“classic” automatic
classification**



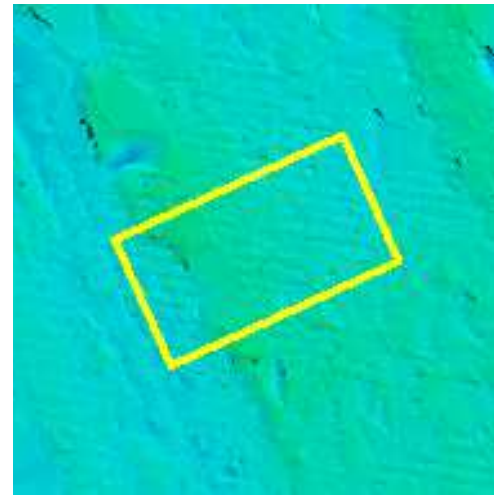
Manual correction

EVOLUTION OF THE LIDAR PROCESSING

■ LOW POINTS IN URBAN AREA



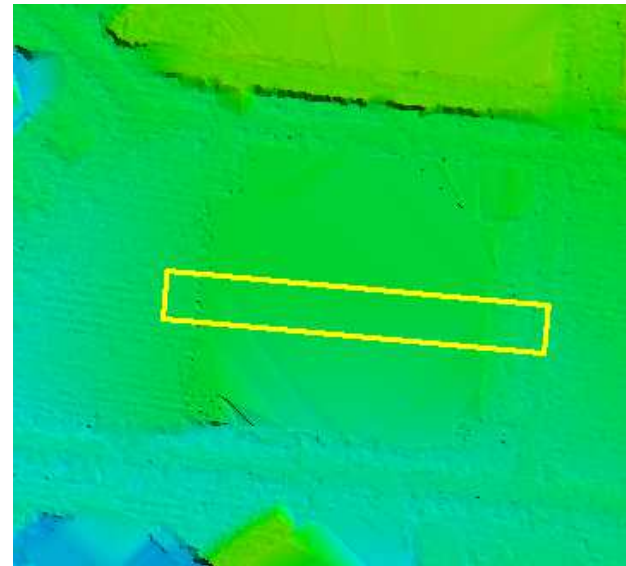
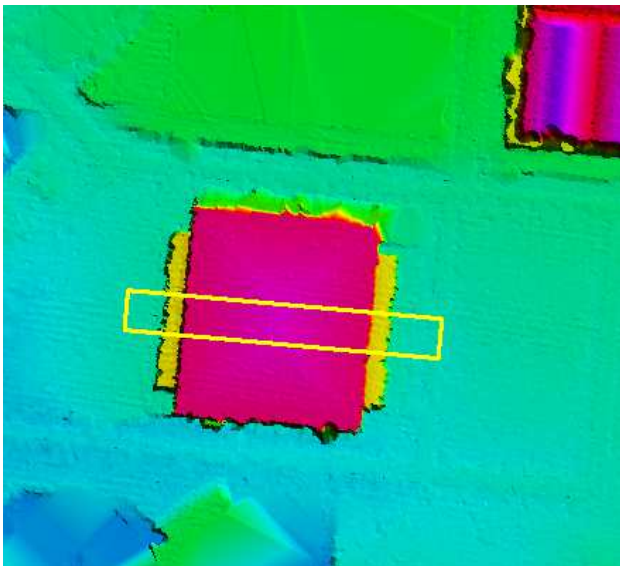
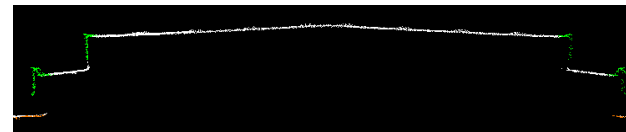
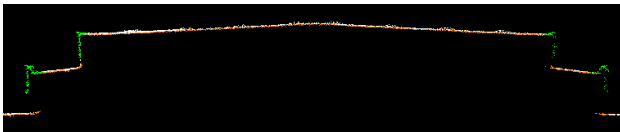
**“classic” automatic
classification**



Manual correction

EVOLUTION OF THE LIDAR PROCESSING

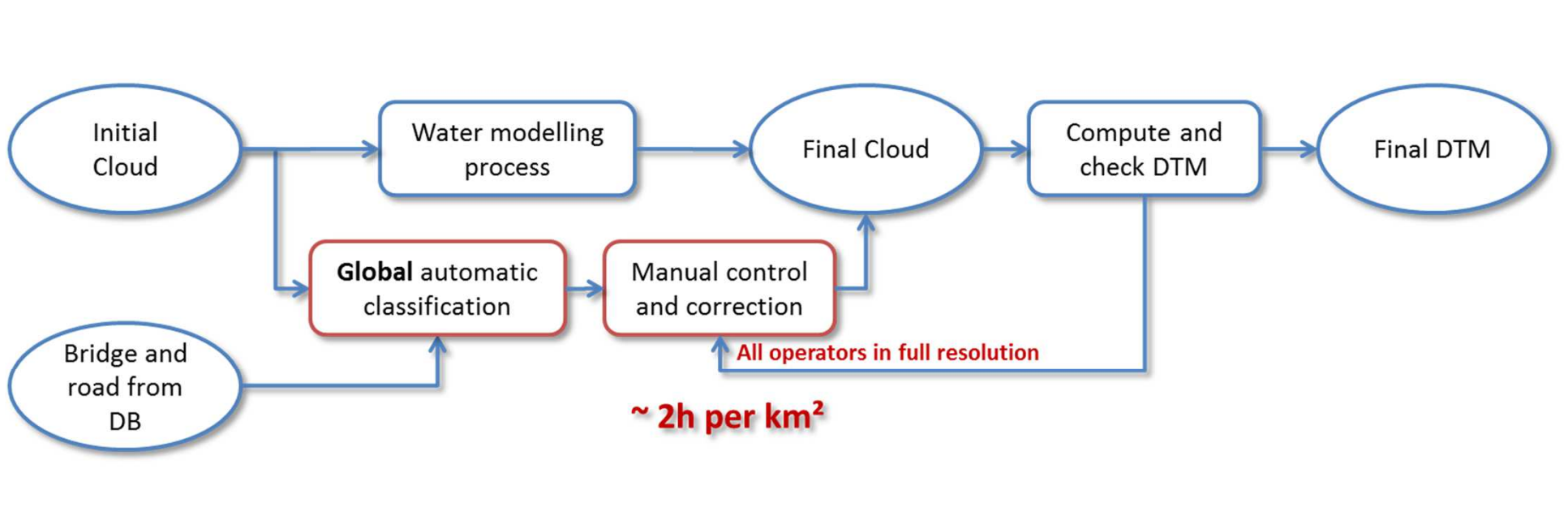
■ LARGE BUILDING



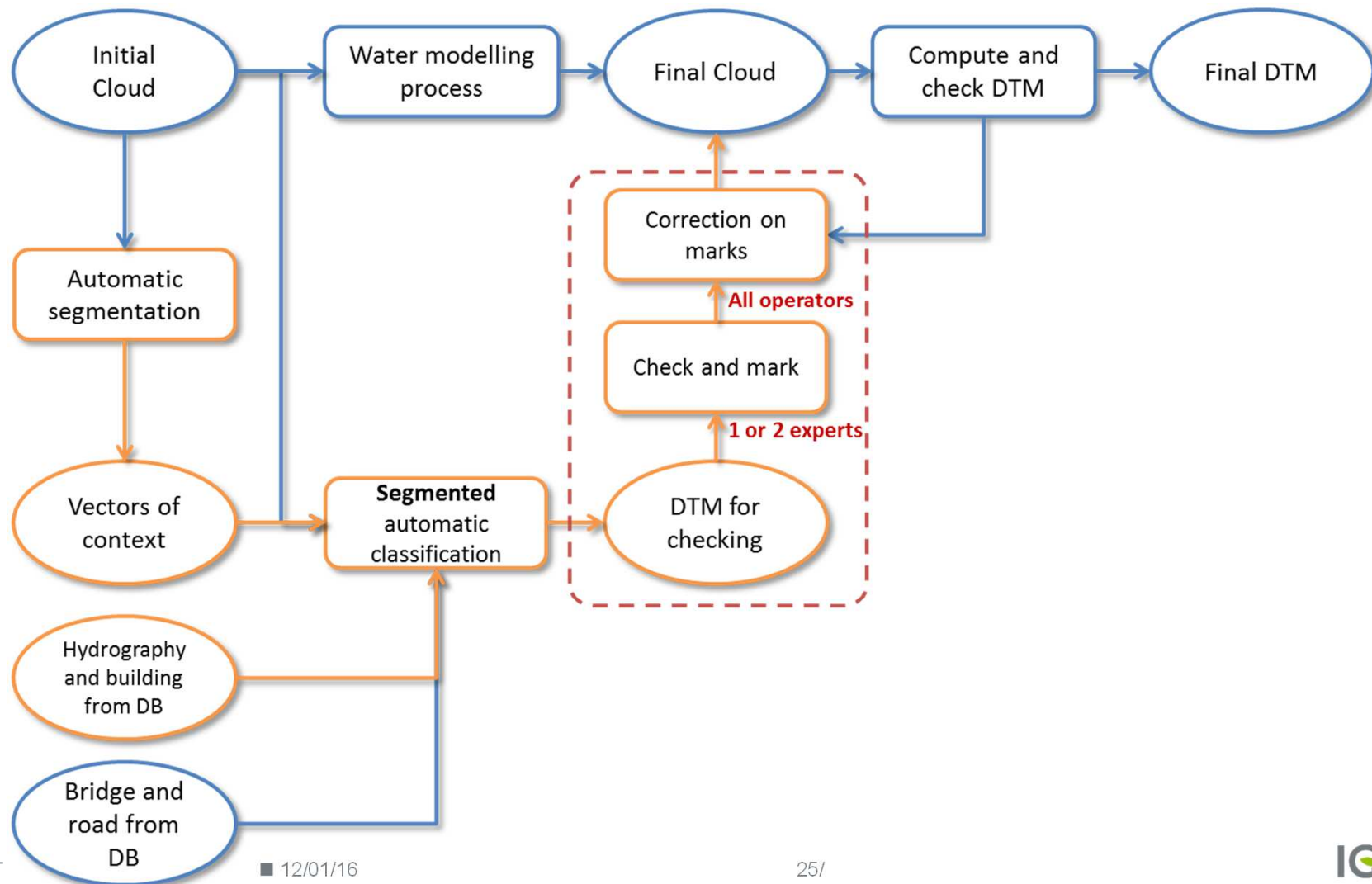
“classic” automatic
classification

Manual correction

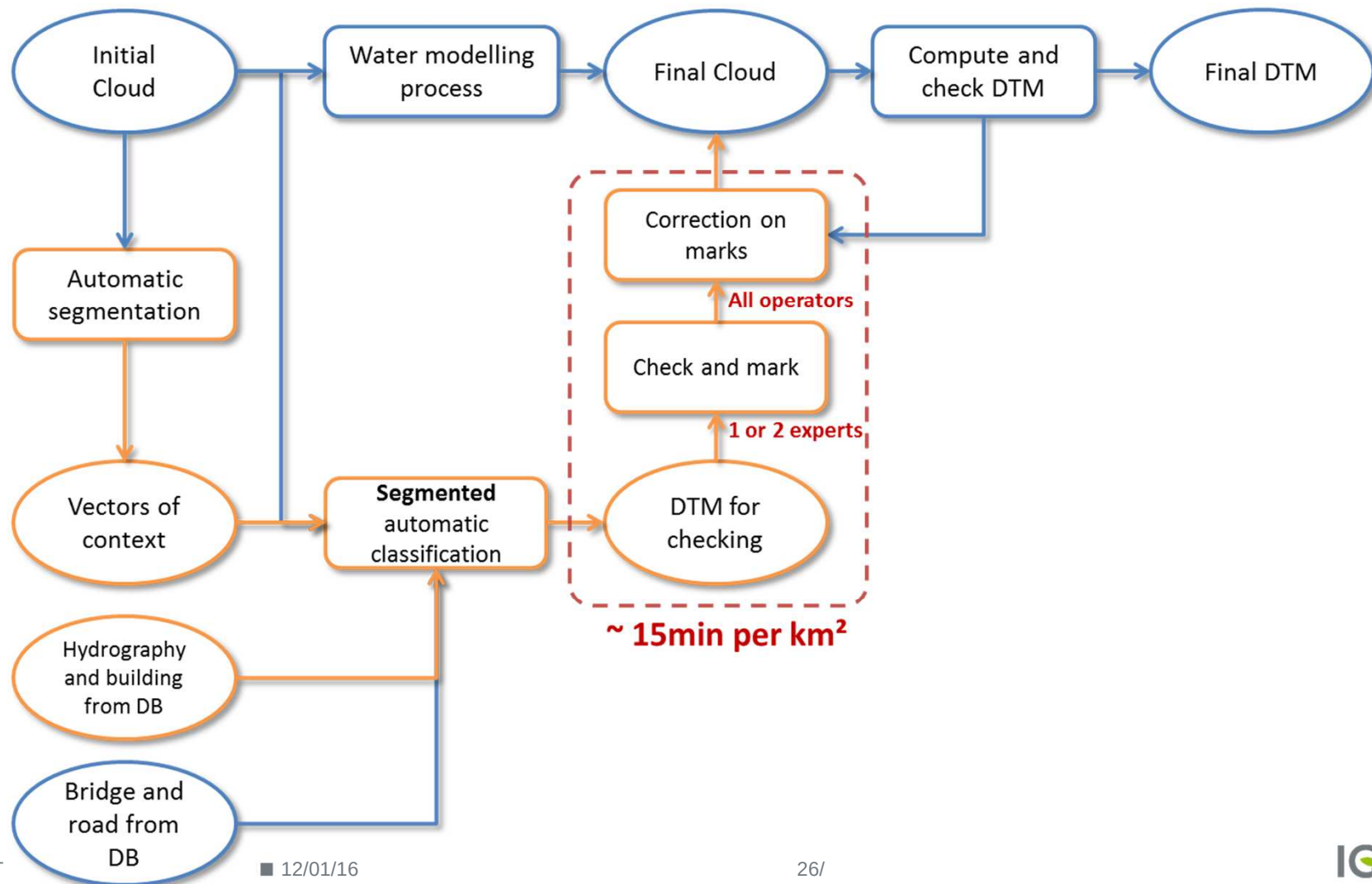
- MAIN STEPS OF THE “STANDARD” CHAIN



■ MAIN STEPS OF THE “XPRESS” CHAIN IN STUDY



■ MAIN STEPS OF THE “XPRESS” CHAIN IN STUDY



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION



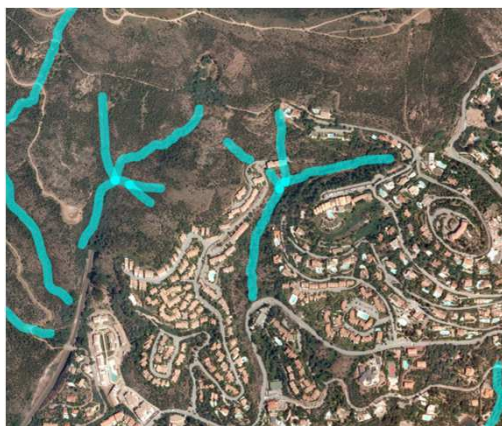
Urban area



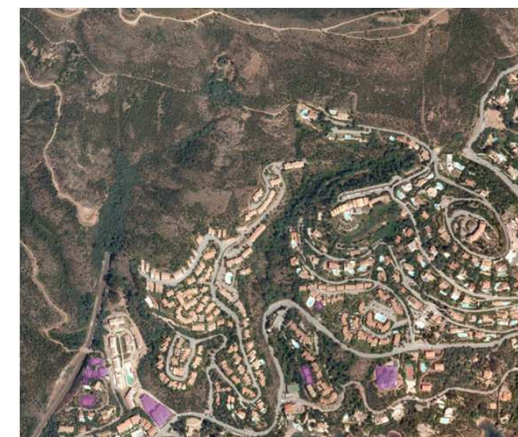
Vegetation area



Break of slope area



Hydrographic network



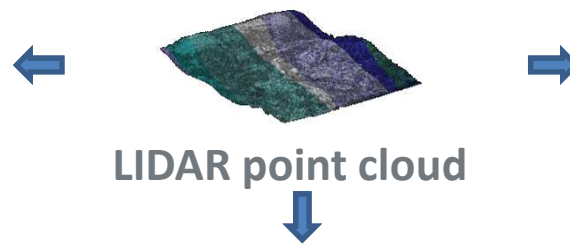
Building

EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION



Urban area



LIDAR point cloud



Vegetation area



break of slope area



Hydrographic network



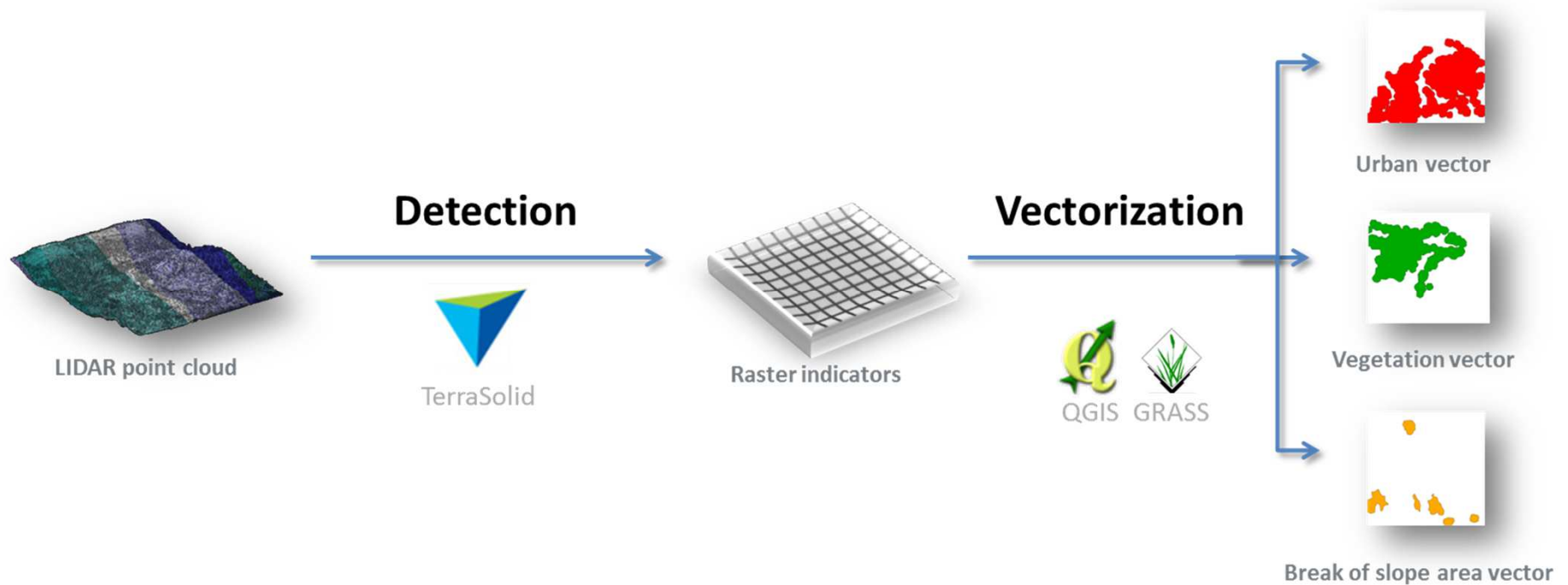
BD-Uni



Building

EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION : DETECTION

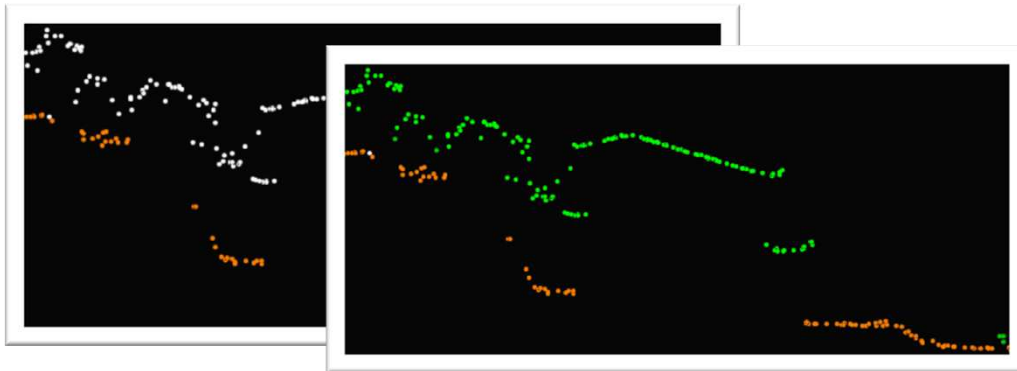


Ground points classification **with**
low-restricting parameters



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION : DETECTION

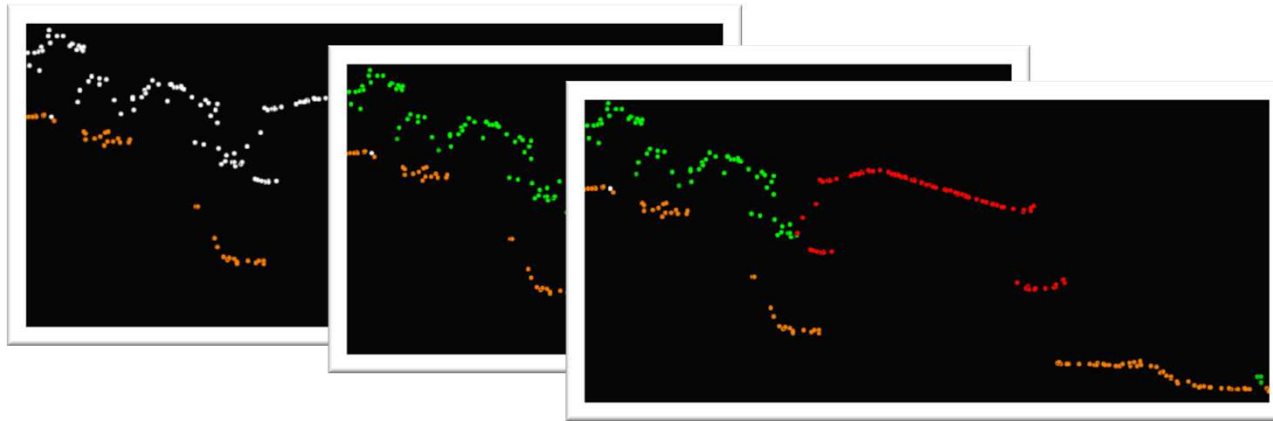


Vegetation points classification



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION : DETECTION

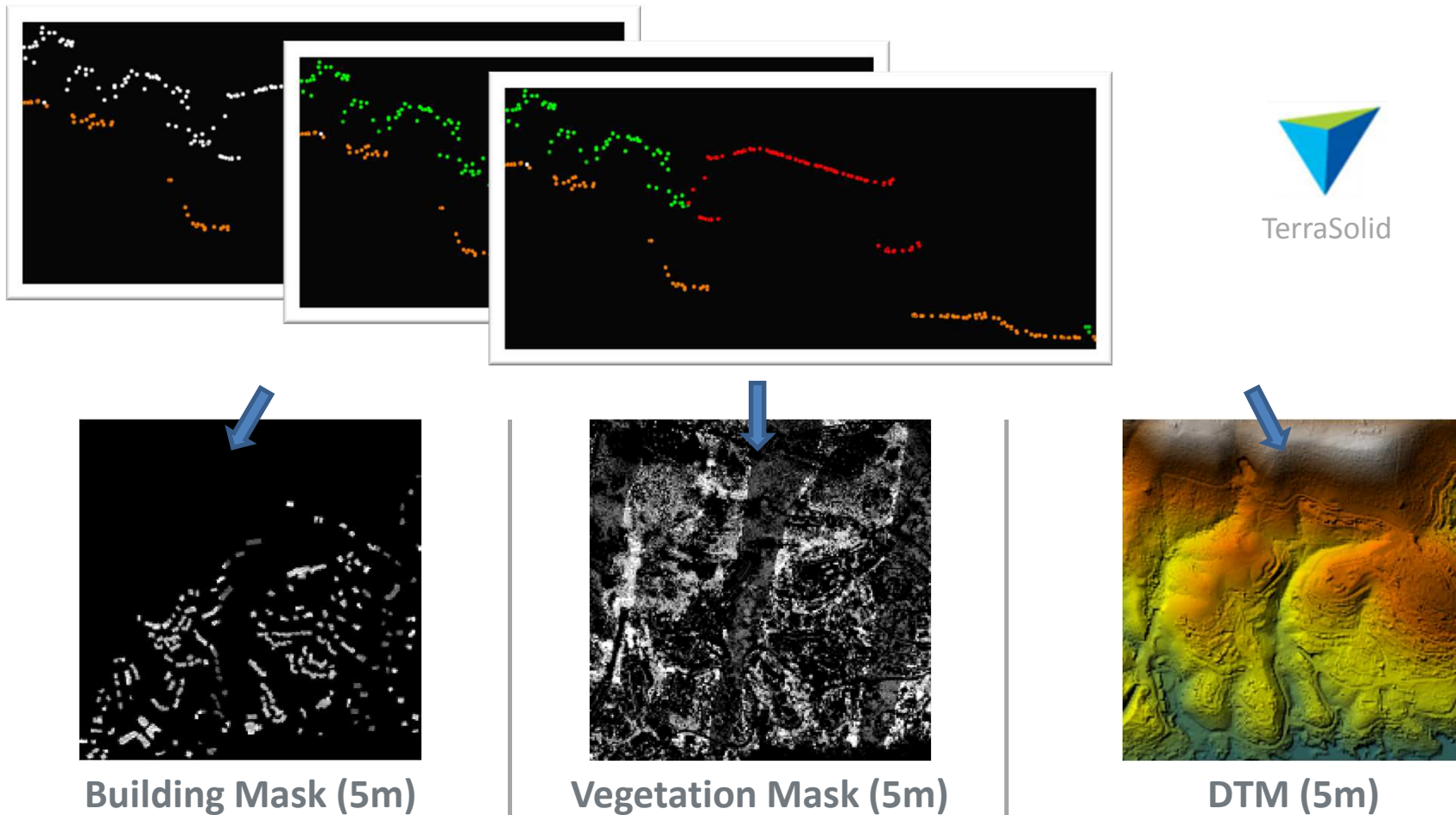


Building points classification



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTATION : DETECTION

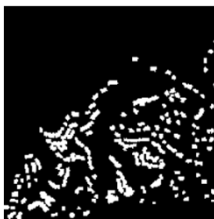


EVOLUTION OF THE LIDAR PROCESSING

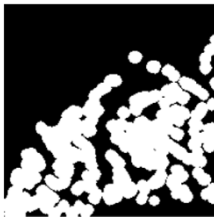
■ IGN'S AUTOMATIC SEGMENTATION : VECTORIZATION



From mask of building



Thresholding



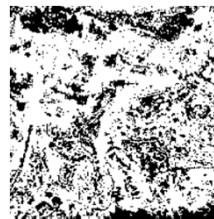
Buffering



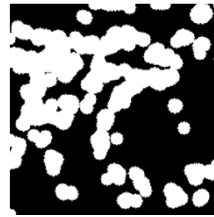
Filtering small areas and
vectorization

Urban area vector

From mask of vegetation



Thresholding



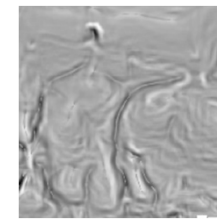
Closing



Filtering small areas and
vectorization

Vegetation vector

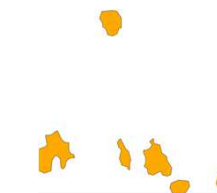
From DTM



Curvature computing



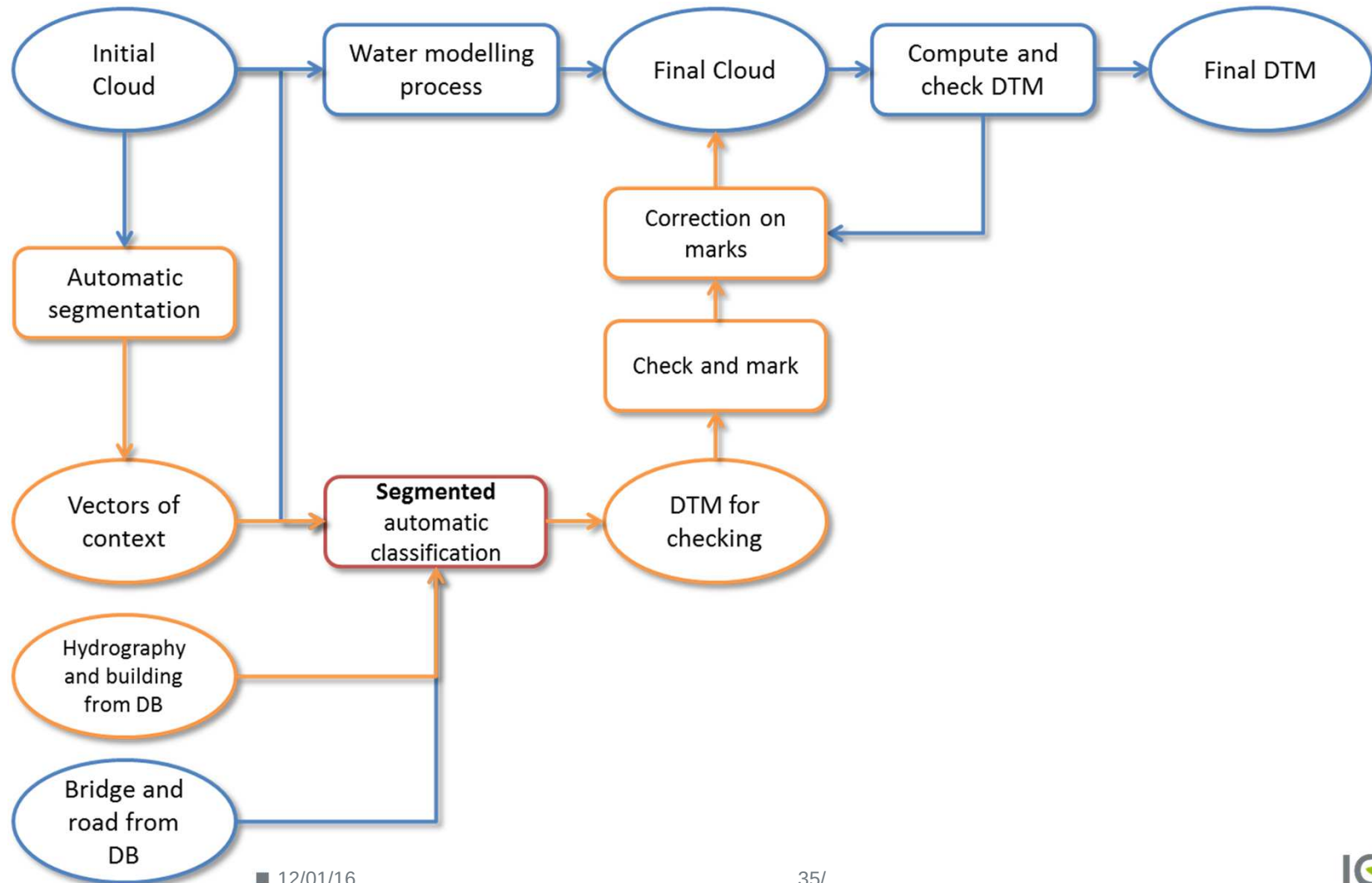
Thresholding and buffering



Filtering and vectorization

**break of slope area
vector**

■ MAIN STEPS OF THE “XPRESS” CHAIN IN STUDY

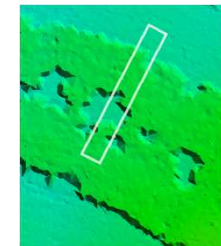
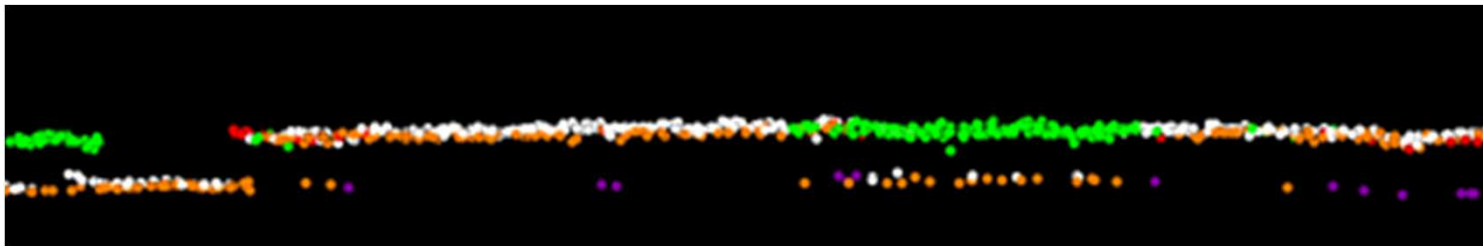


EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context	Main characteristics of the segmented classification
All the cloud	Initial global classification with reduced low point parameter

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context	Main characteristics of the segmented classification	
All the cloud	• Initial global classification with reduced low point parameter	
Urban area		• Low points are strongly filtered (underground points)

EVOLUTION OF THE LIDAR PROCESSING

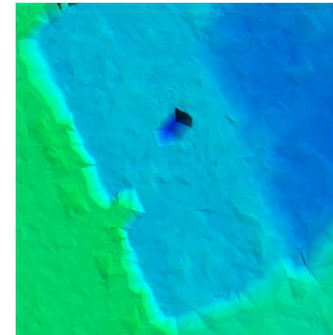
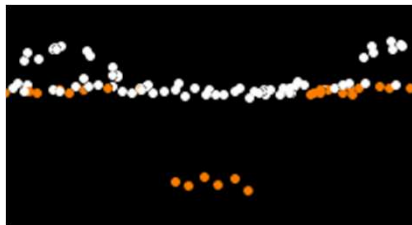
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Urban area

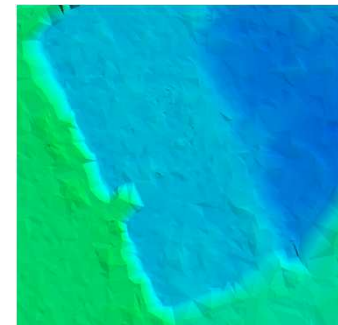
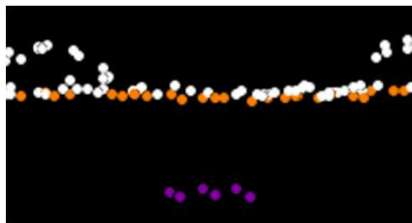


- Low points are strongly filtered (underground points)

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context		Main characteristics of the segmented classification
All the cloud		Initial global classification with reduced low point parameter
Urban area		Low points are strongly filtered (underground points)
Break of slope area		Densify ground points cloud with low-restricting parameters

EVOLUTION OF THE LIDAR PROCESSING

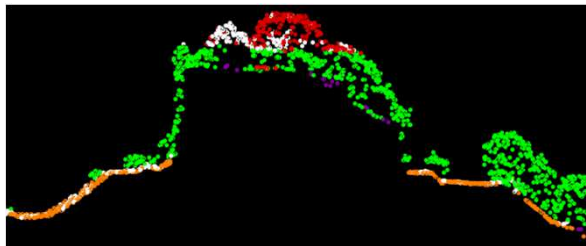
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Breaking
slope area

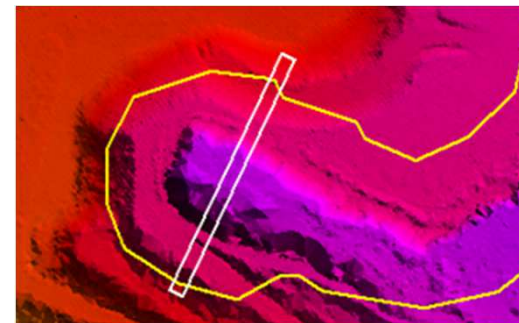
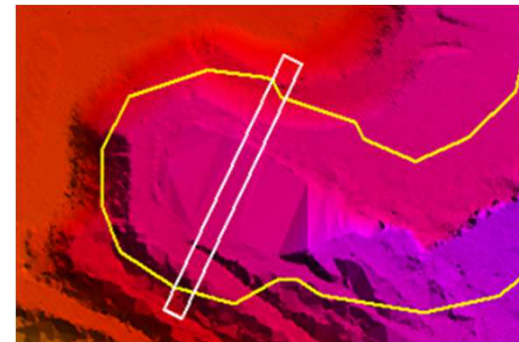
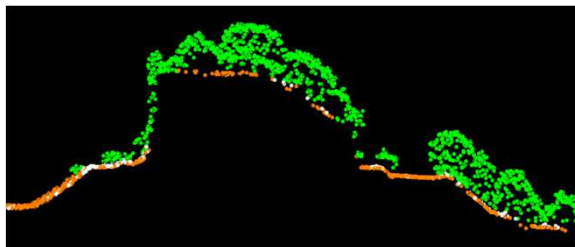


- Densify ground points cloud with **low-restricting parameters**

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context		Main characteristics of the segmented classification
All the cloud		Initial global classification with reduced low point parameter
Urban area		Low points are strongly filtered (underground points)
Break of slope area		Densify ground points cloud with low-restricting parameters
Building		Unclassify ground points (roof) and extend the ground points' research area

EVOLUTION OF THE LIDAR PROCESSING

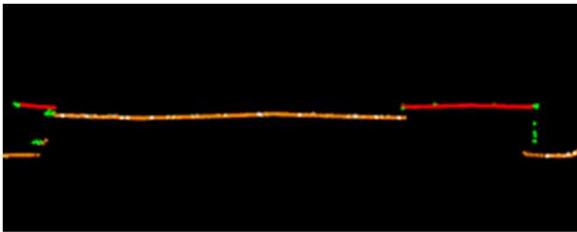
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Building

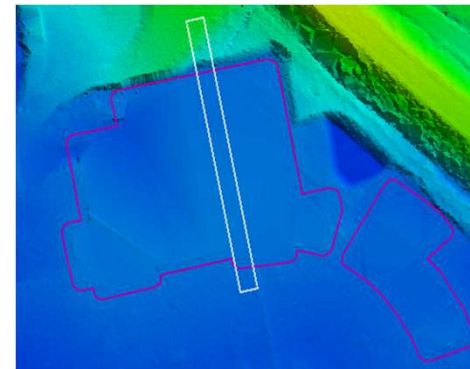
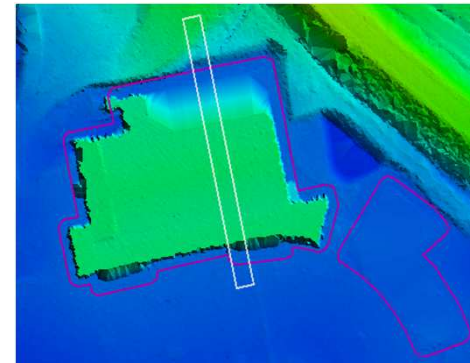
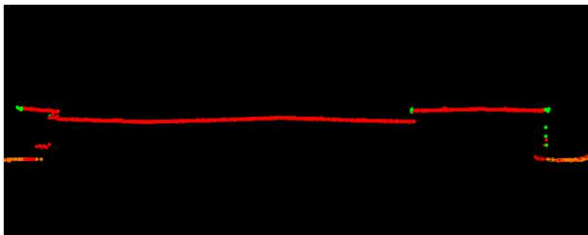


- **Unclassify ground points** (roof) and extend the ground points' research area

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context		Main characteristics of the segmented classification
All the cloud		Initial global classification with reduced low point parameter
Urban area		Low points are strongly filtered (underground points)
Break of slope area		Densify ground points cloud with low-restricting parameters
Building		Unclassify ground points (roof) and extend the ground points' research area
Vegetation		- Reset ground point's classification with high-restricting parameters and echo filtering Use of low points as ground with low-restricting parameters

EVOLUTION OF THE LIDAR PROCESSING

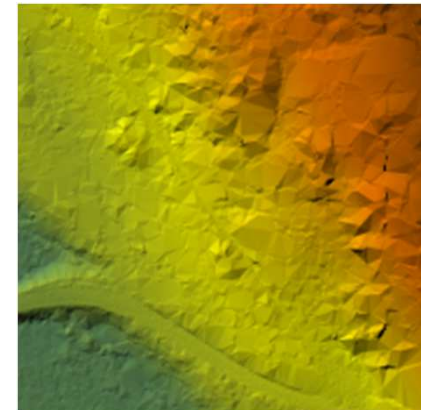
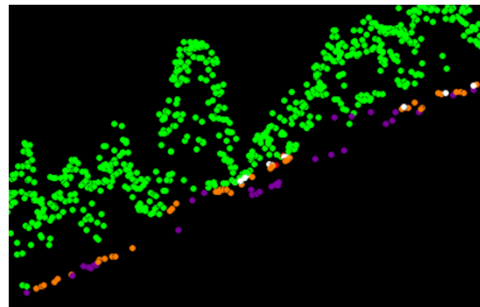
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Vegetation

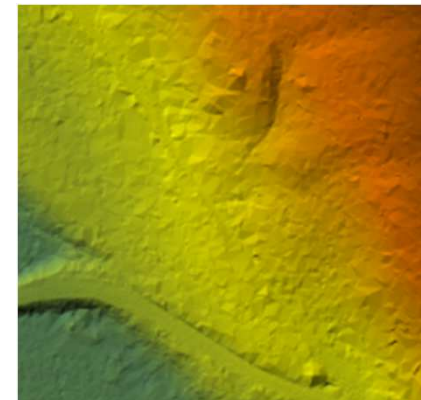
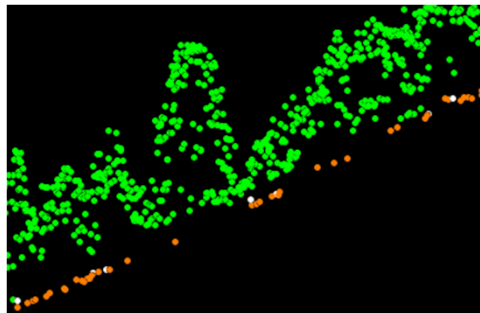


- Reset ground point's classification with **high-restricting parameters** and **echo filtering**
- **Use of low points as ground** with low-restricting parameters

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context		Main characteristics of the segmented classification
All the cloud		Initial global classification with reduced low point parameter
Urban area		Low points are strongly filtered (underground points)
Break of slope area		Densify ground points cloud with low-restricting parameters
Building		Unclassify ground points (roof) and extend the ground points' research area
Vegetation		- Reset ground point's classification with high-restricting parameters and echo filtering Use of low points as ground with low-restricting parameters
Hydrographic network		Use of low points as ground with low-restricting parameters

EVOLUTION OF THE LIDAR PROCESSING

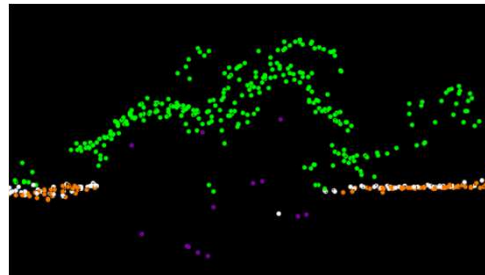
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Hydrographic
network

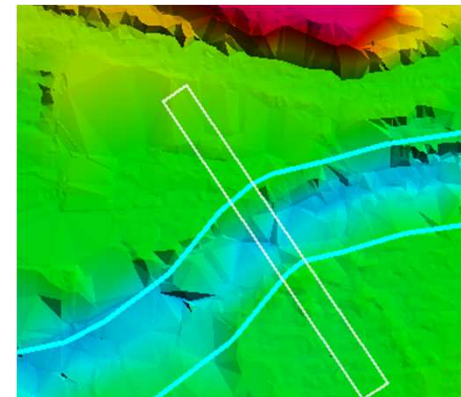
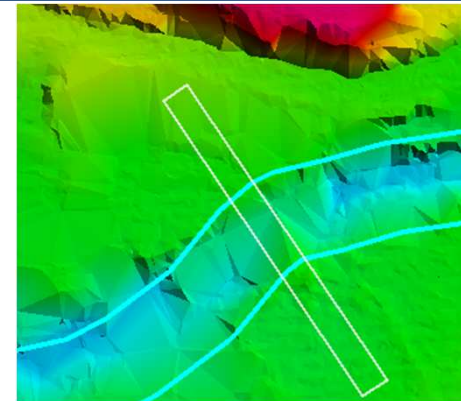
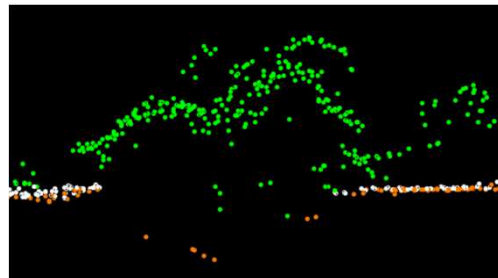


- Use of low points as ground with low-restricting parameters

■ Standard process



■ New process



EVOLUTION OF THE LIDAR PROCESSING

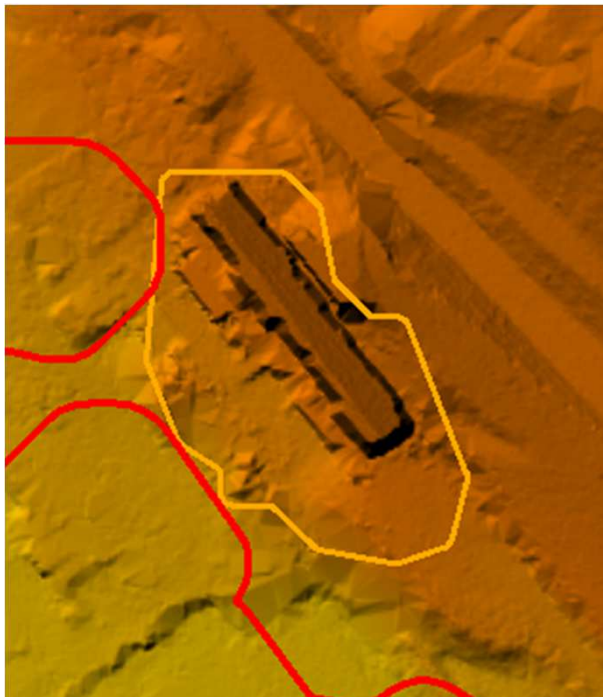
■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

Context		Main characteristics of the segmented classification
All the cloud		Initial global classification with reduced low point parameter
Urban area		Low points are strongly filtered (underground points)
Break of slope area		Densify ground points cloud with low-restricting parameters
Building		Unclassify ground points (roof) and extend the ground points' research area
Vegetation		- Reset ground point's classification with high-restricting parameters and echo filtering Use of low points as ground with low-restricting parameters
Hydrographic network		Use of low points as ground with low-restricting parameters

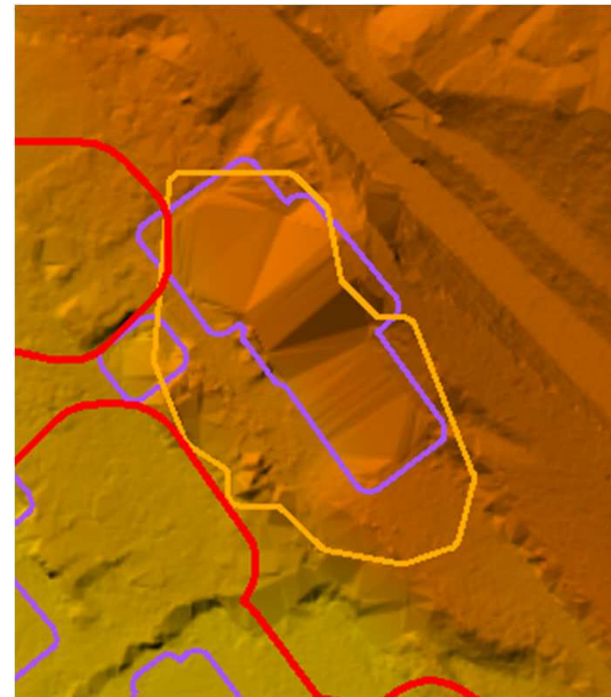
EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

■ Overlapping conflicts



Without building request
in break of slop area



With building request
in break of slop area

EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

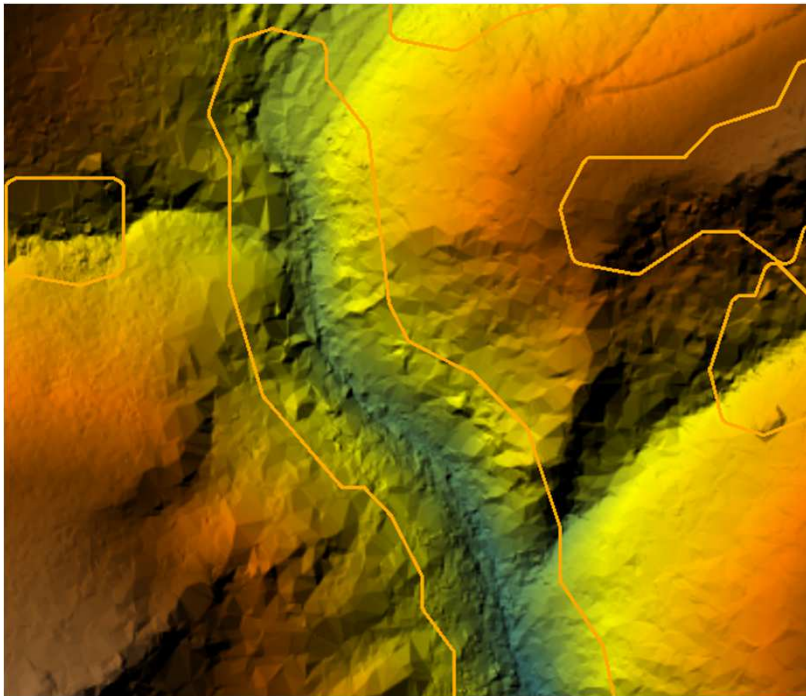
- Overlapping conflicts



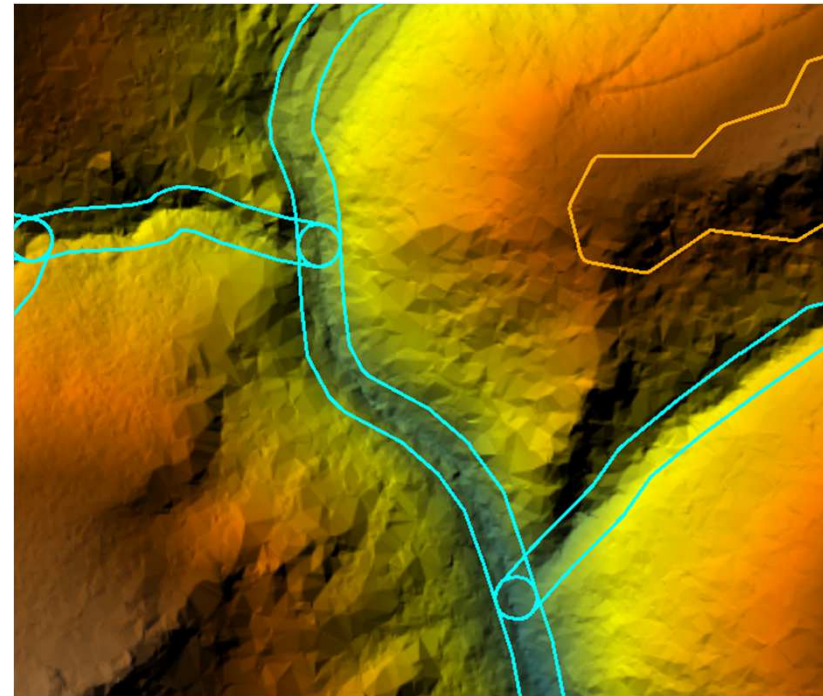
EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

■ Overlapping conflicts



Raw break of slope detection

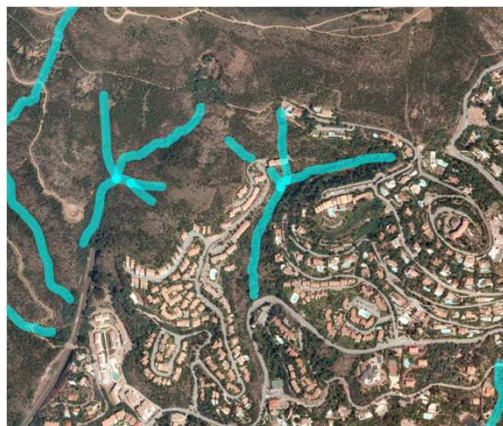


Break of slope area using
Hydrographic network filter

EVOLUTION OF THE LIDAR PROCESSING

■ IGN'S AUTOMATIC SEGMENTED CLASSIFICATION

- Overlapping conflicts

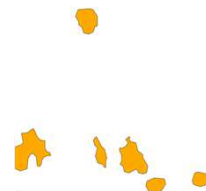


Hydrographic network



Building

Used for filtering



Used in the request

break of slope area
vector

EVOLUTION OF THE LIDAR PROCESSING

■ DATA SETS OF TESTS AND FIRST RESULTS

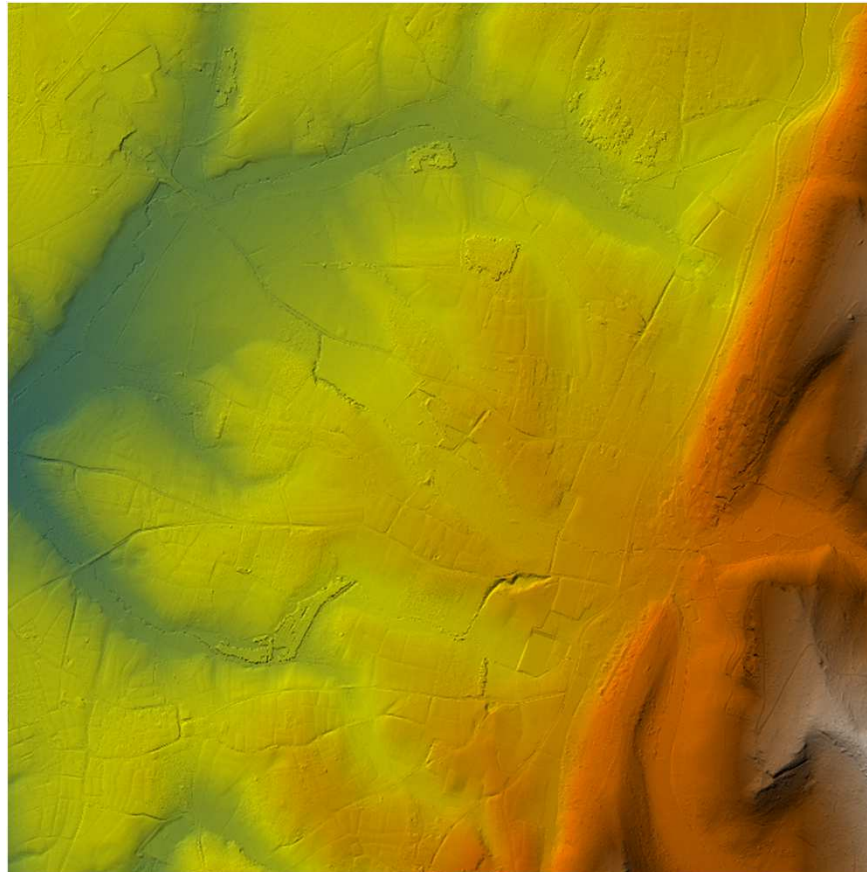
- 9 km² of fields
- 25 km² with swamps, low vegetation and embankments
- 25 km² with low vegetation and rocky areas
- 25 km² with mountains and urban areas
- 25 km² with mountains and forests

- 1200 km² with mountains, fields, vegetation and urban areas

EVOLUTION OF THE LIDAR PROCESSING

- DATA SETS OF TESTS

- 9 km² with fields

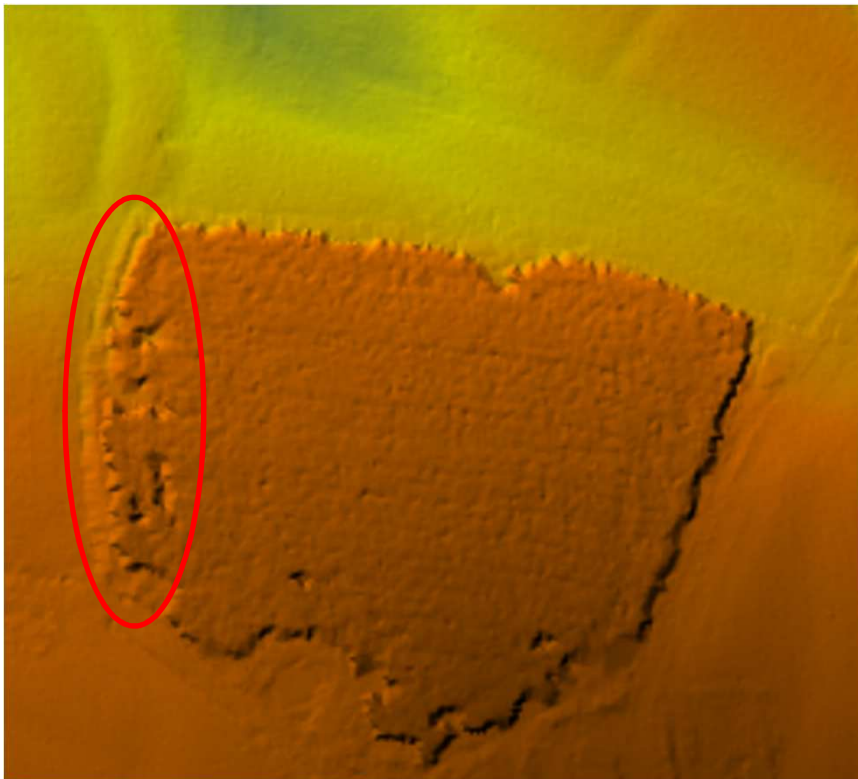


EVOLUTION OF THE LIDAR PROCESSING

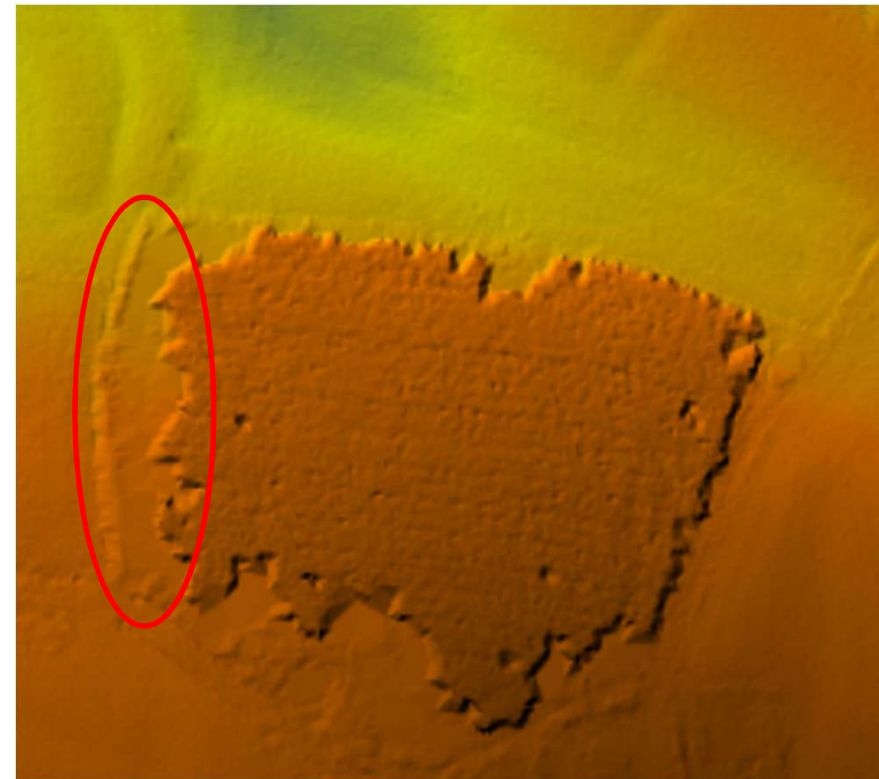
■ DATA SETS OF TESTS

- 9 km² with **fields**

No specific context



« Standard » Classification



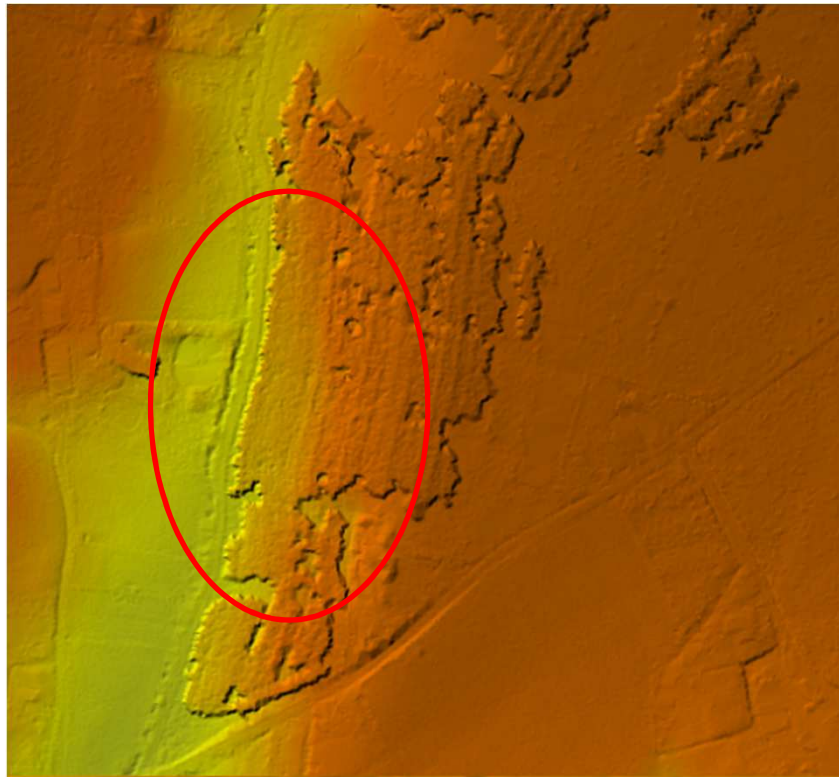
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

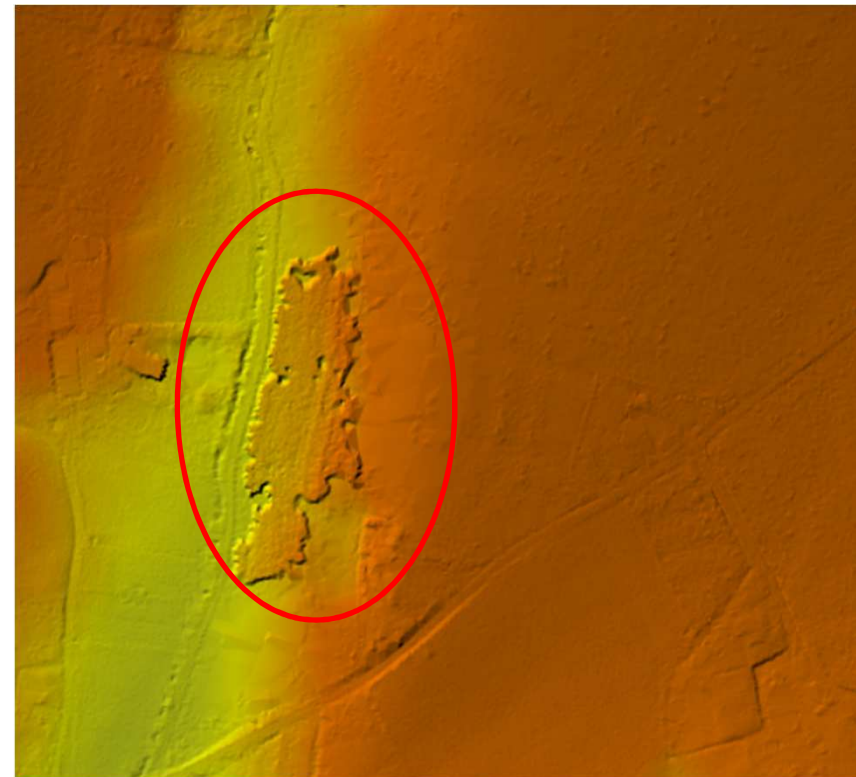
■ DATA SETS OF TESTS

- 9 km² with **fields**

No specific context



« Standard » Classification



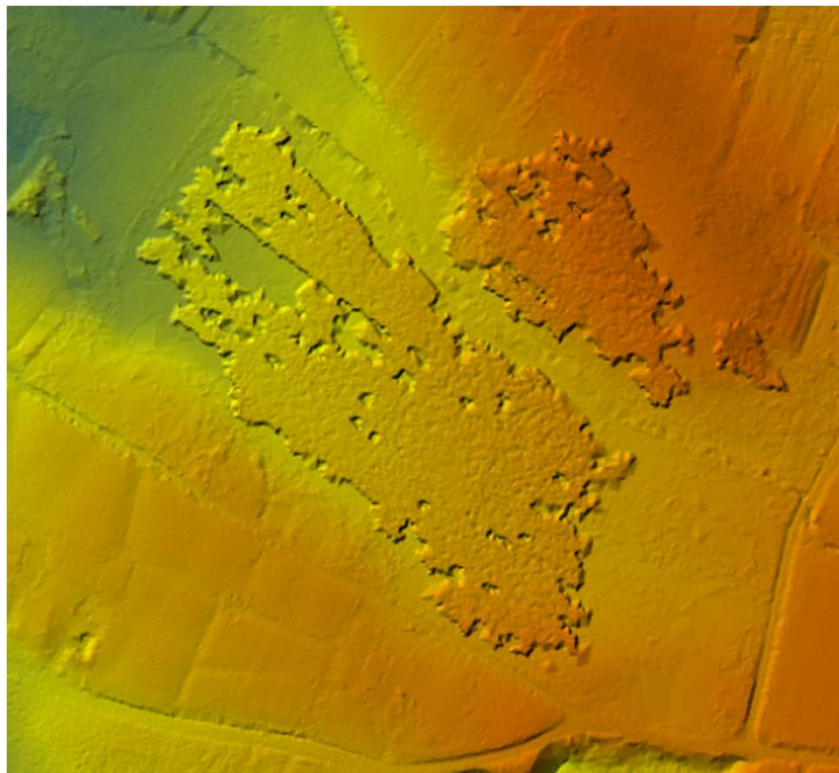
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

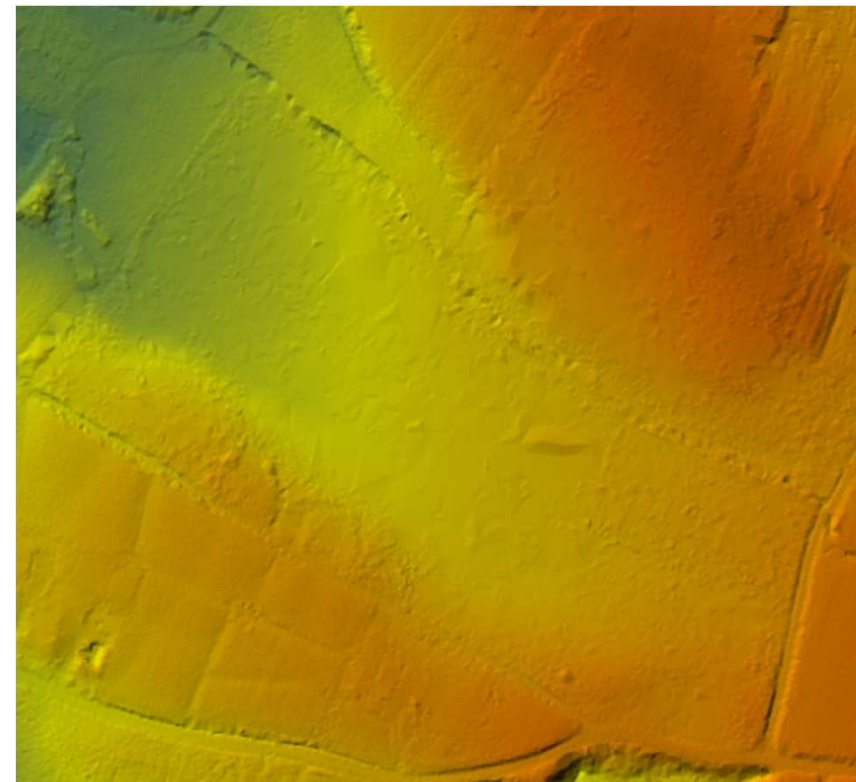
■ DATA SETS OF TESTS

- 9 km² with **fields**

No specific context



« Standard » Classification

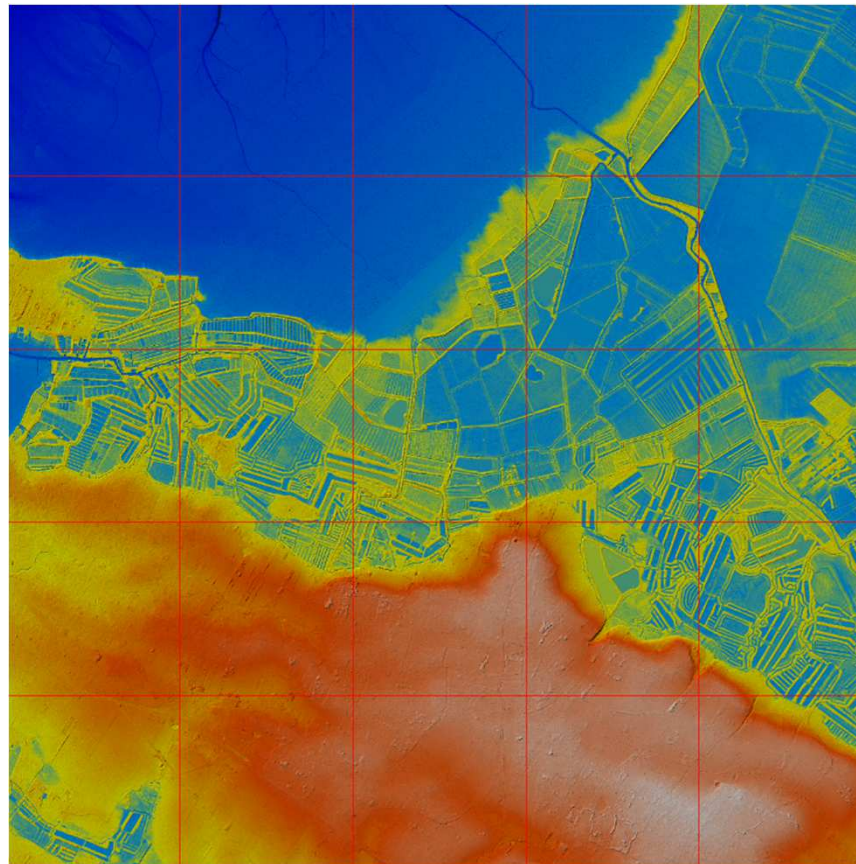


« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

■ DATA SETS OF TESTS

- 25 km² with swamps, low vegetation and embankments

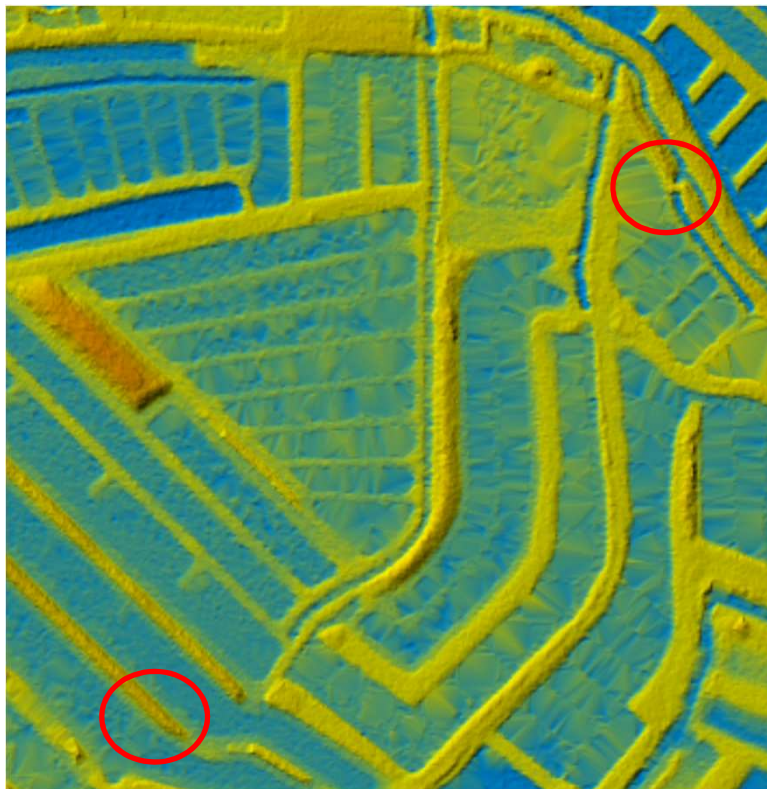


EVOLUTION OF THE LIDAR PROCESSING

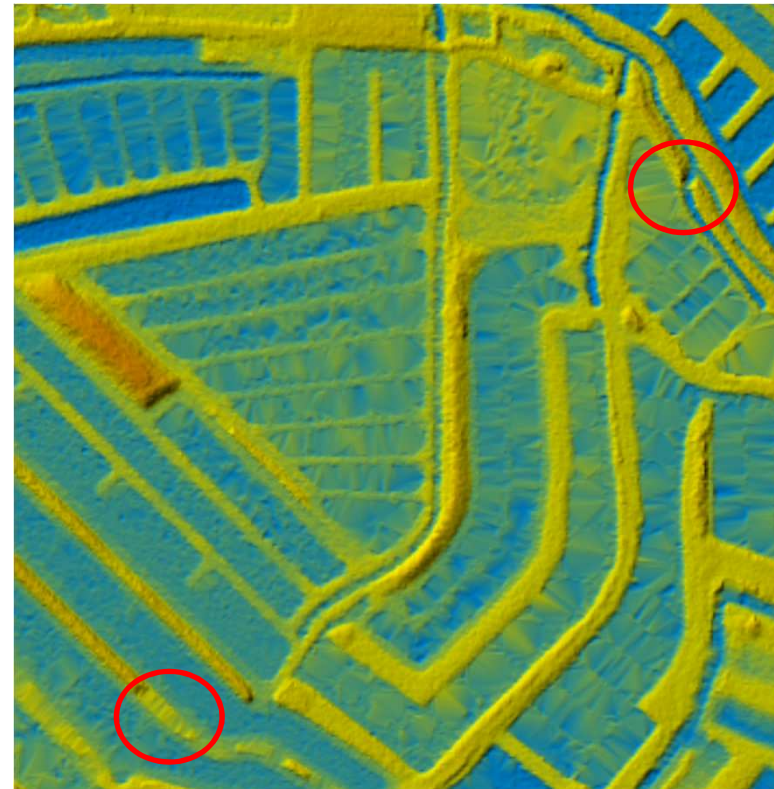
■ DATA SETS OF TESTS

- 25 km² with **swamps**, low vegetation and **embankments**

No specific context



« Standard » Classification



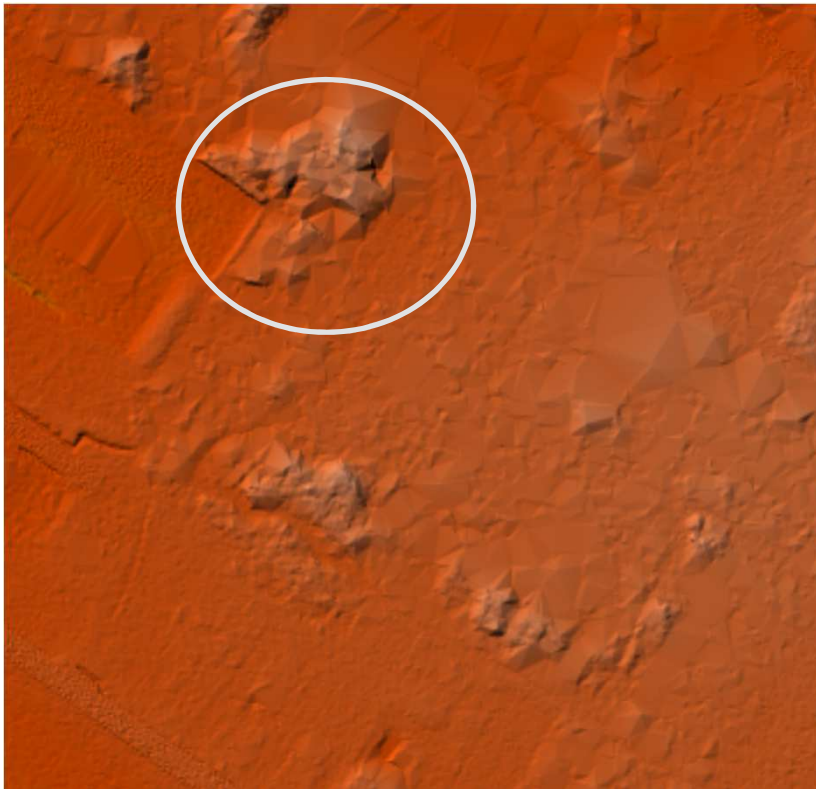
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

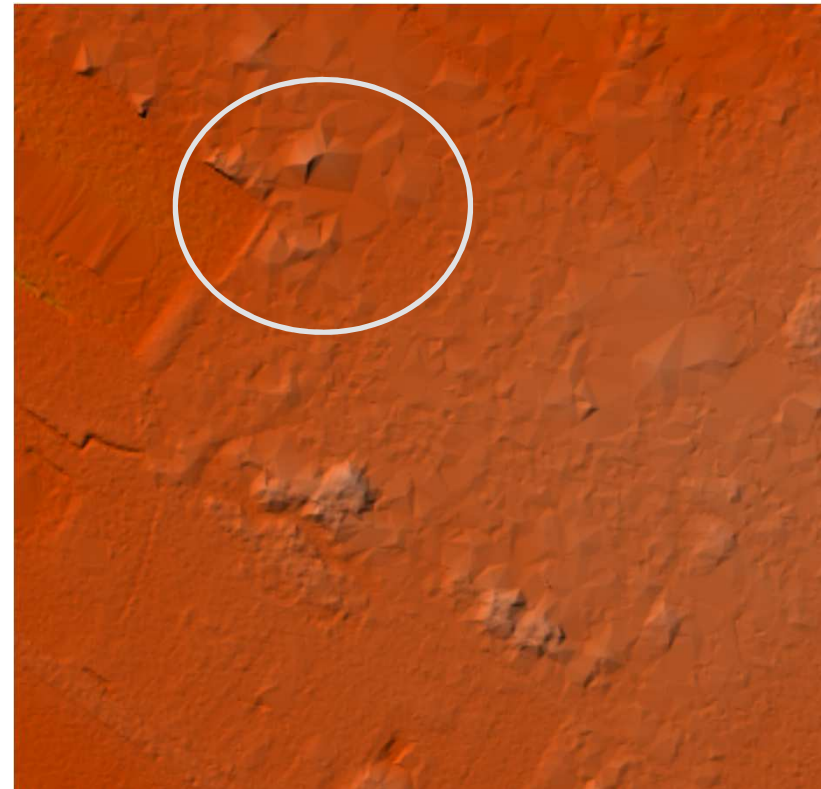
■ DATA SETS OF TESTS

No specific context

- 25 km² with swamps, **low vegetation** and embankments



« Standard » Classification

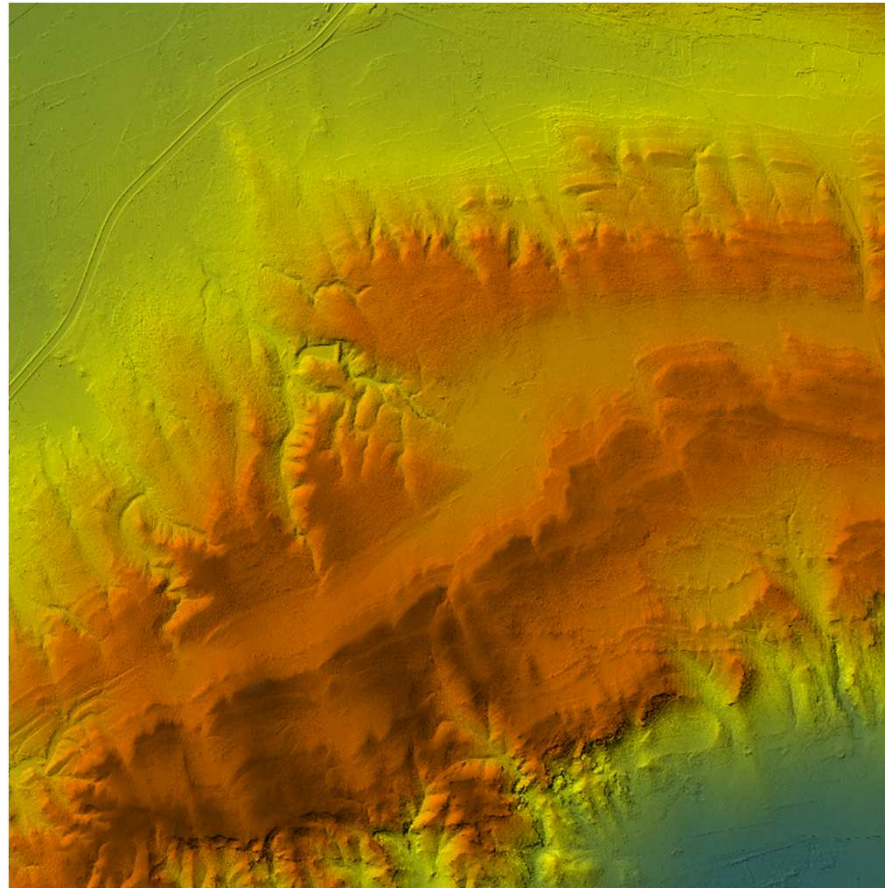


« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

■ DATA SETS OF TESTS

- 25 km² with rocky and low vegetation areas

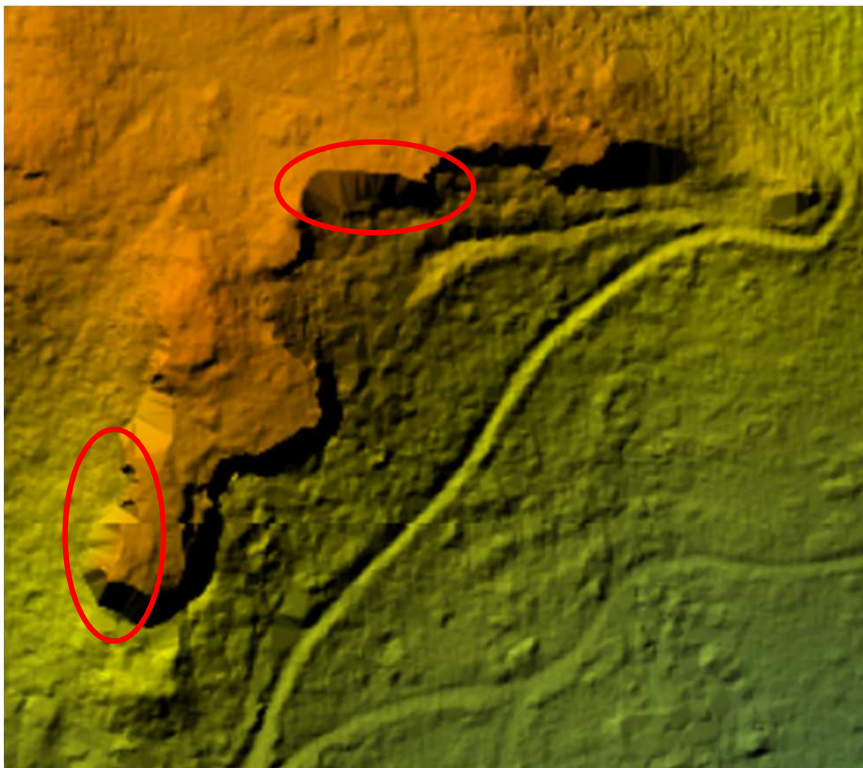


EVOLUTION OF THE LIDAR PROCESSING

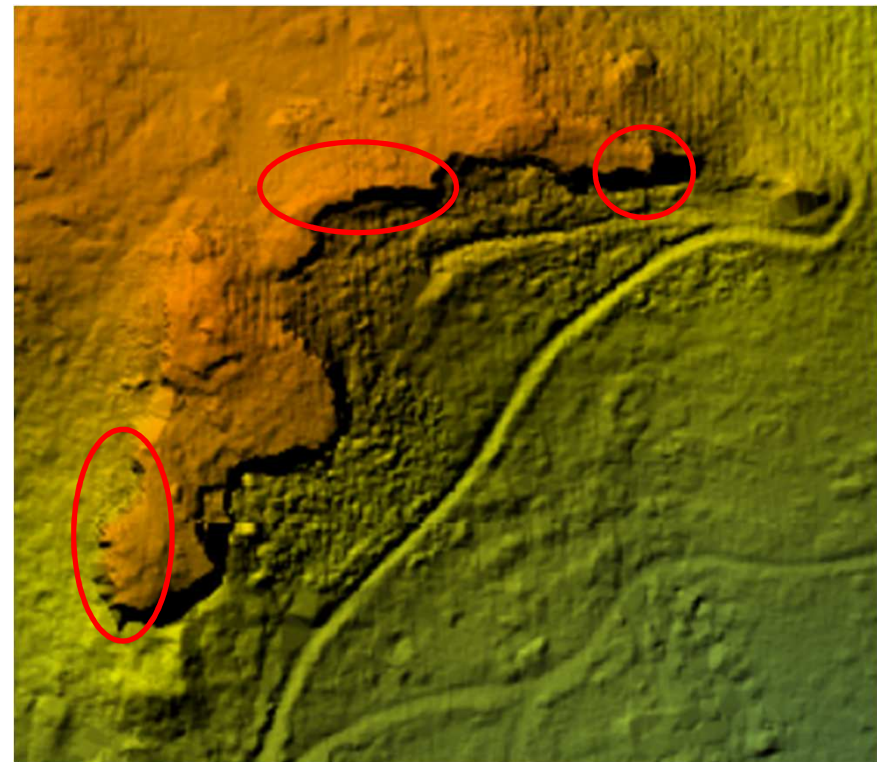
■ DATA SETS OF TESTS

- 25 km² with **rocky** and low vegetation areas

Break of slope area



« Standard » Classification



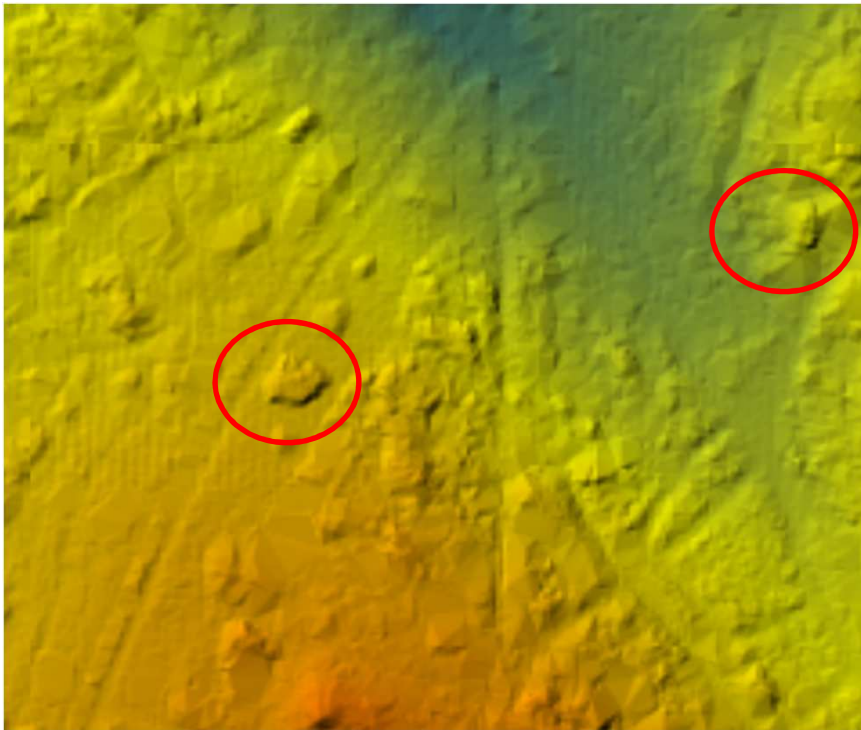
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

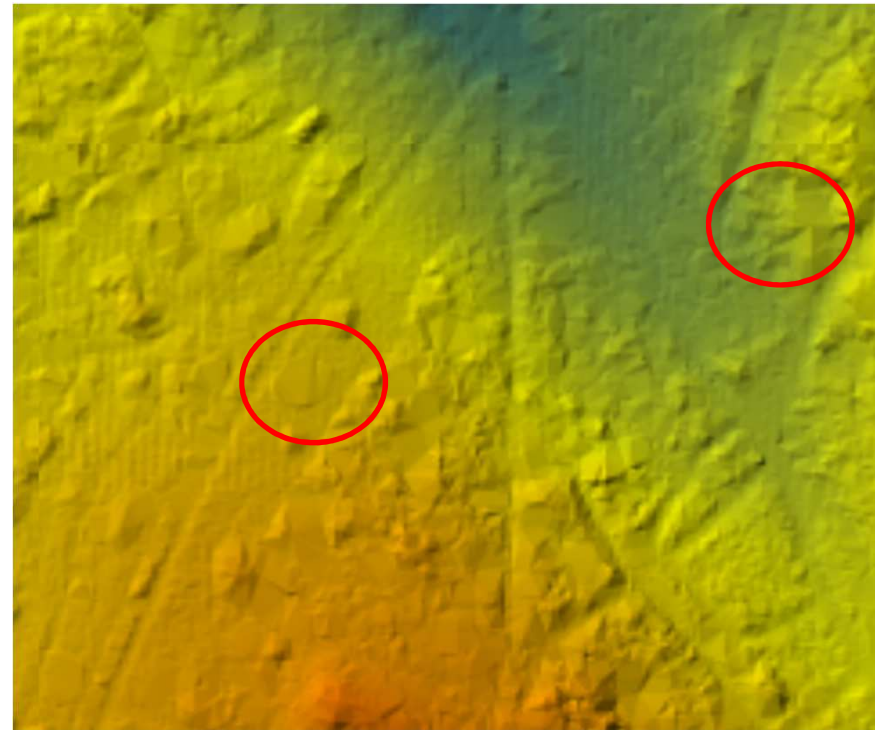
■ DATA SETS OF TESTS

- 25 km² with rocky and **low vegetation** areas

No specific context



« Standard » Classification

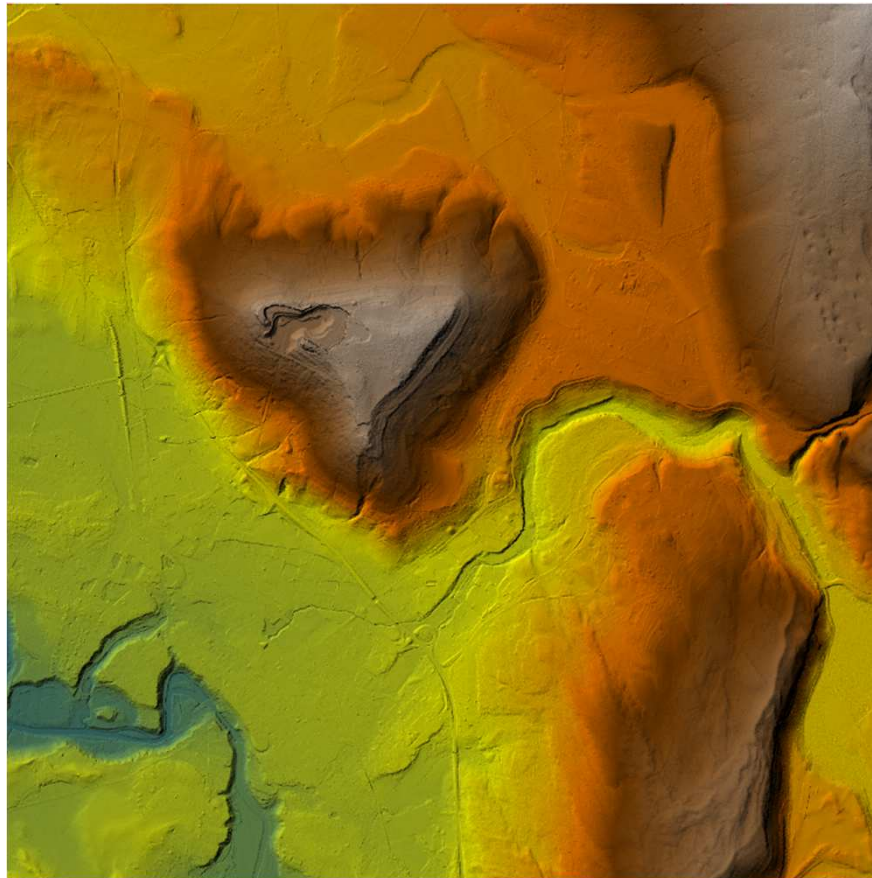


« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

■ DATA SETS OF TESTS

- 25 km² with mountains and urban areas

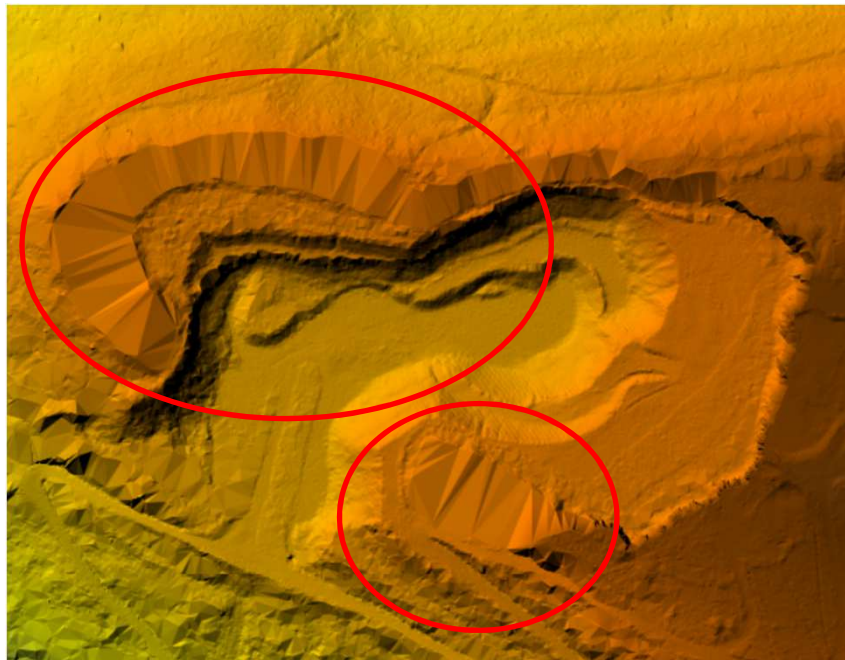


EVOLUTION OF THE LIDAR PROCESSING

■ DATA SETS OF TESTS

- 25 km² with **mountains** and urban areas

Break of slope area



« Standard » Classification



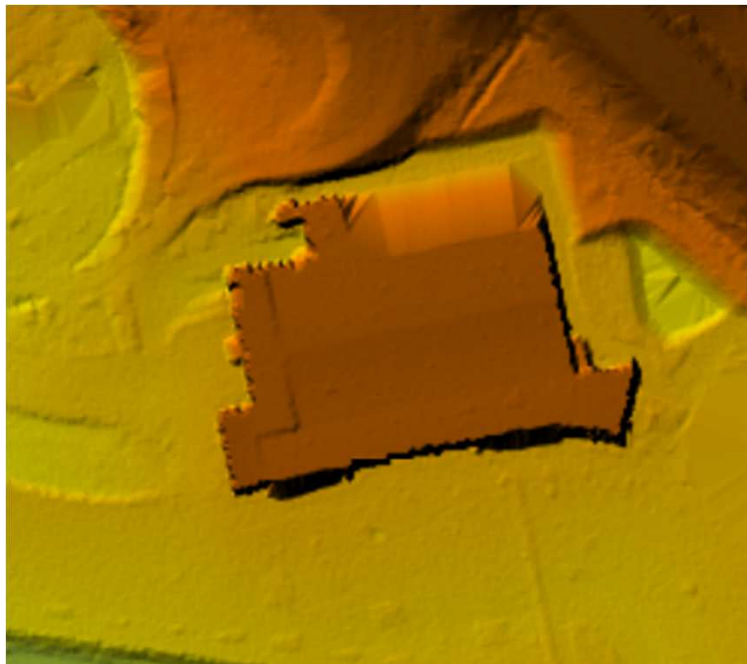
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

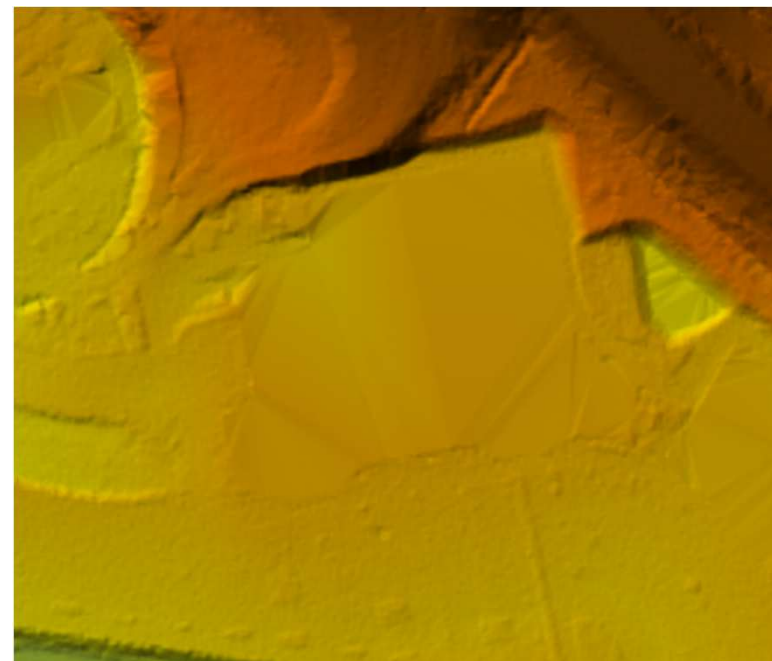
■ DATA SETS OF TESTS

- 25 km² with mountains **and urban areas**

Building



« Standard » Classification



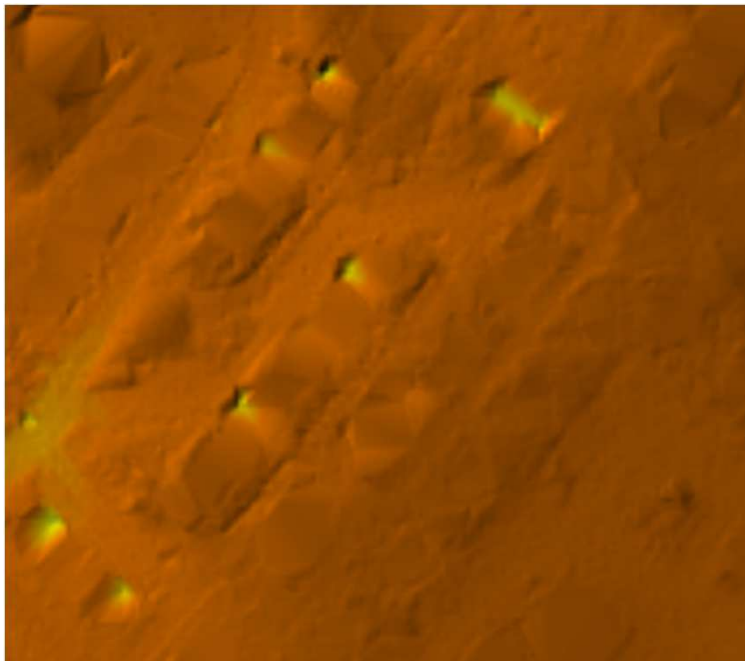
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

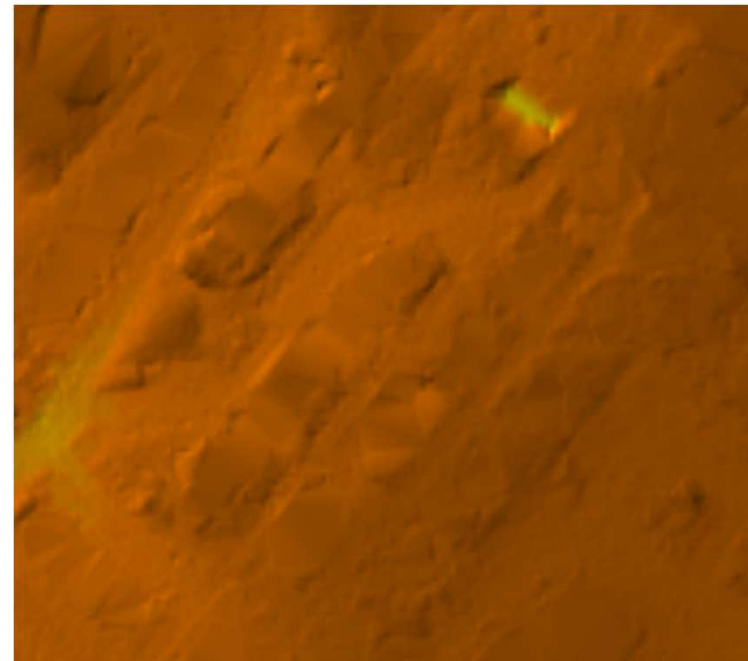
■ DATA SETS OF TESTS

- 25 km² with mountains **and urban areas**

Urban area



« Standard » Classification

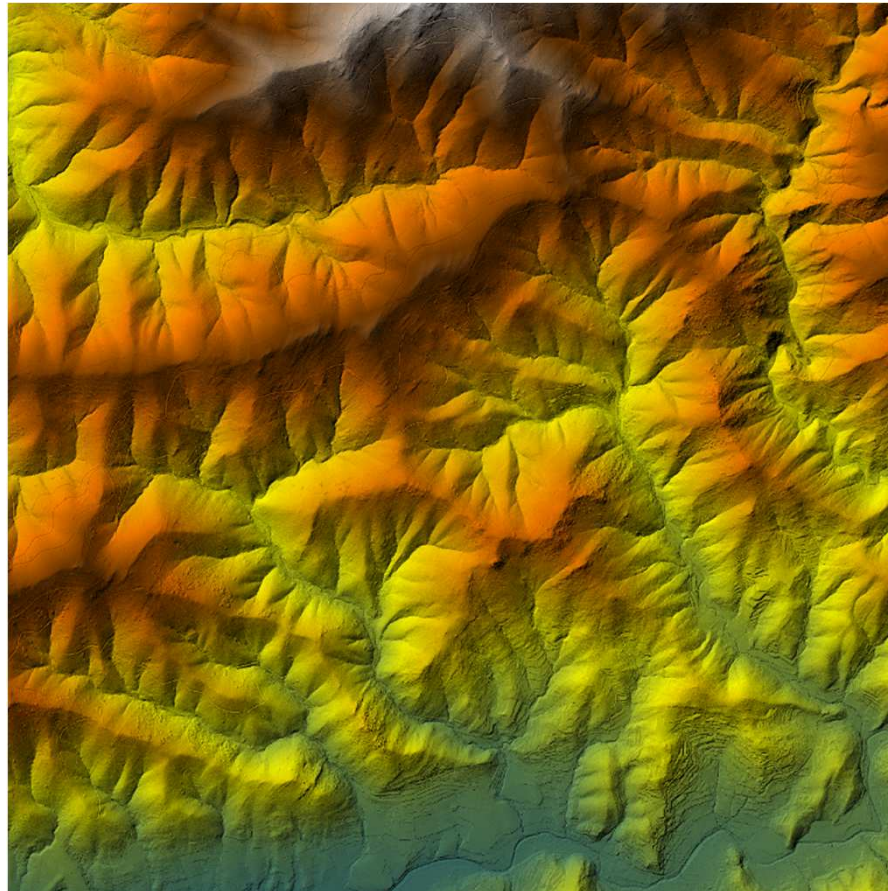


« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

- DATA SETS OF TESTS

- 25 km² with mountains and forests

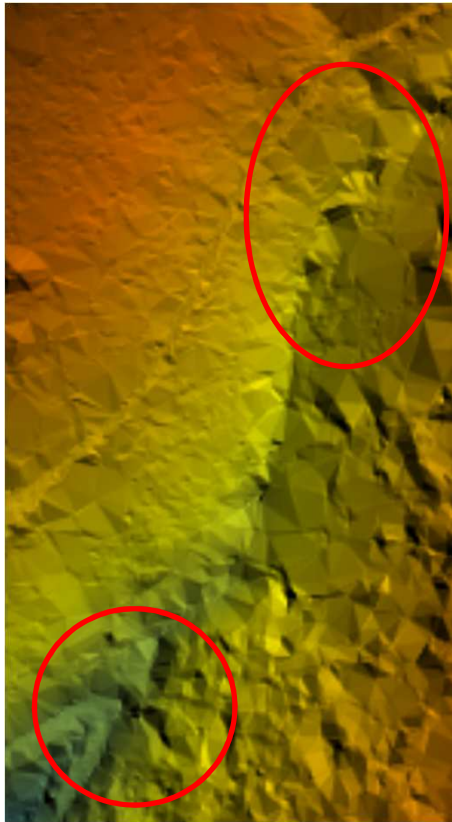


EVOLUTION OF THE LIDAR PROCESSING

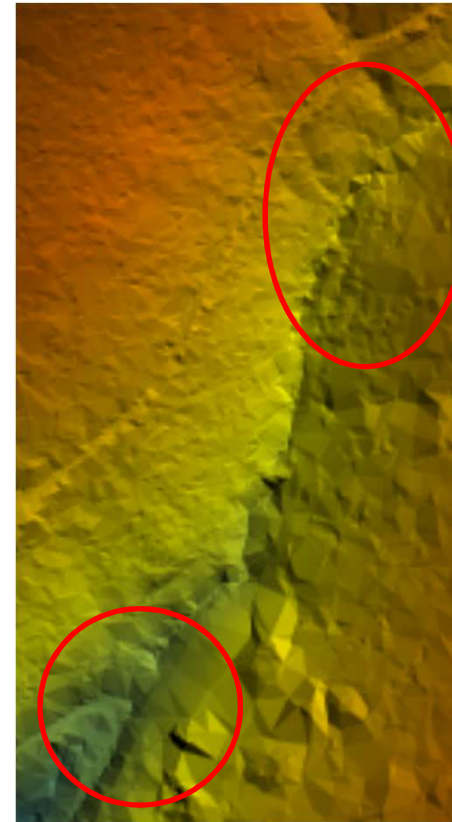
■ DATA SETS OF TESTS

- 25 km² with **mountains** and forests

Hydrographic network



« Standard » Classification



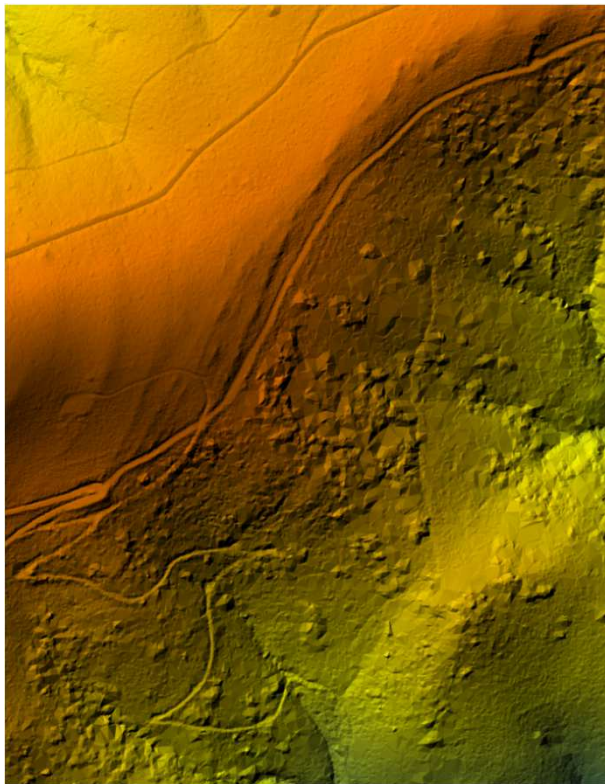
« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

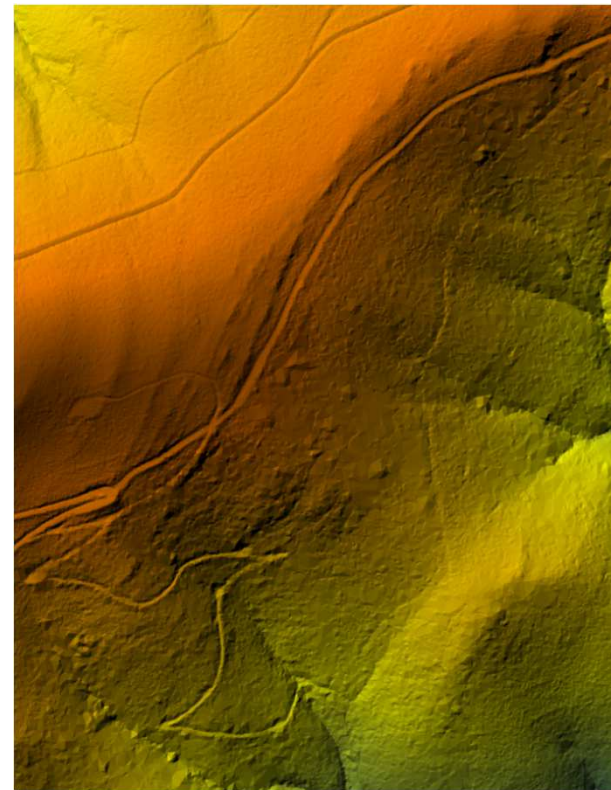
■ DATA SETS OF TESTS

- 25 km² with mountains and **forests**

Vegetation area



« Standard » Classification

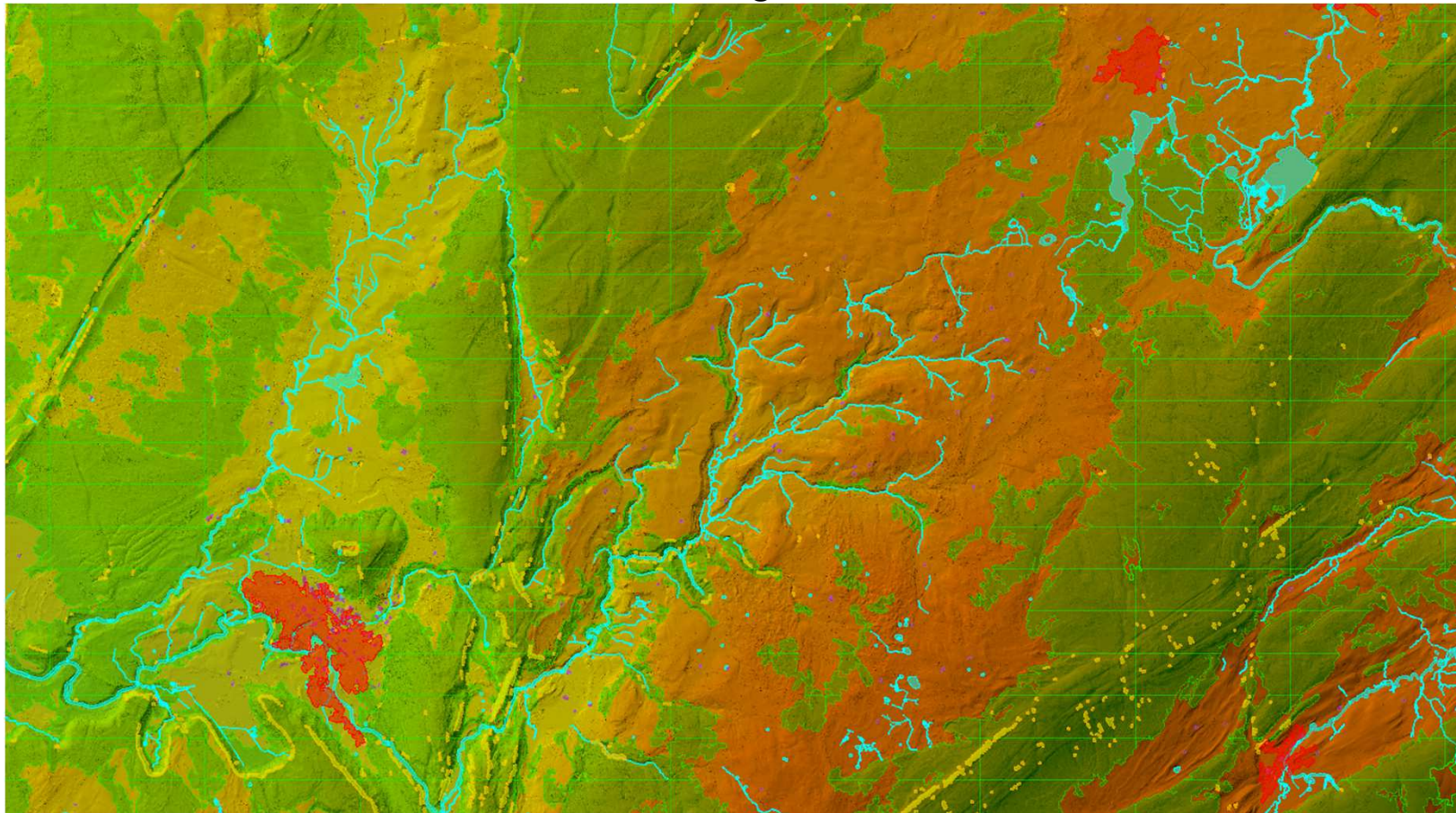


« Xpress » Classification

EVOLUTION OF THE LIDAR PROCESSING

- DATA SETS OF TESTS AND FIRST RESULTS

- 1200 km² with mountains, fields, vegetation and urban areas





Thank you for your attention !

aymeric.godet@ign.fr