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INSTITUT NATIONAL DE L'INFORMATION GÉOGRAPHIQUE ET FORESTIÈRE

CHANGER D'ÉCHELLE

# LIDAR DATA: INNOVATION PERSPECTIVES FOR CADASTRE

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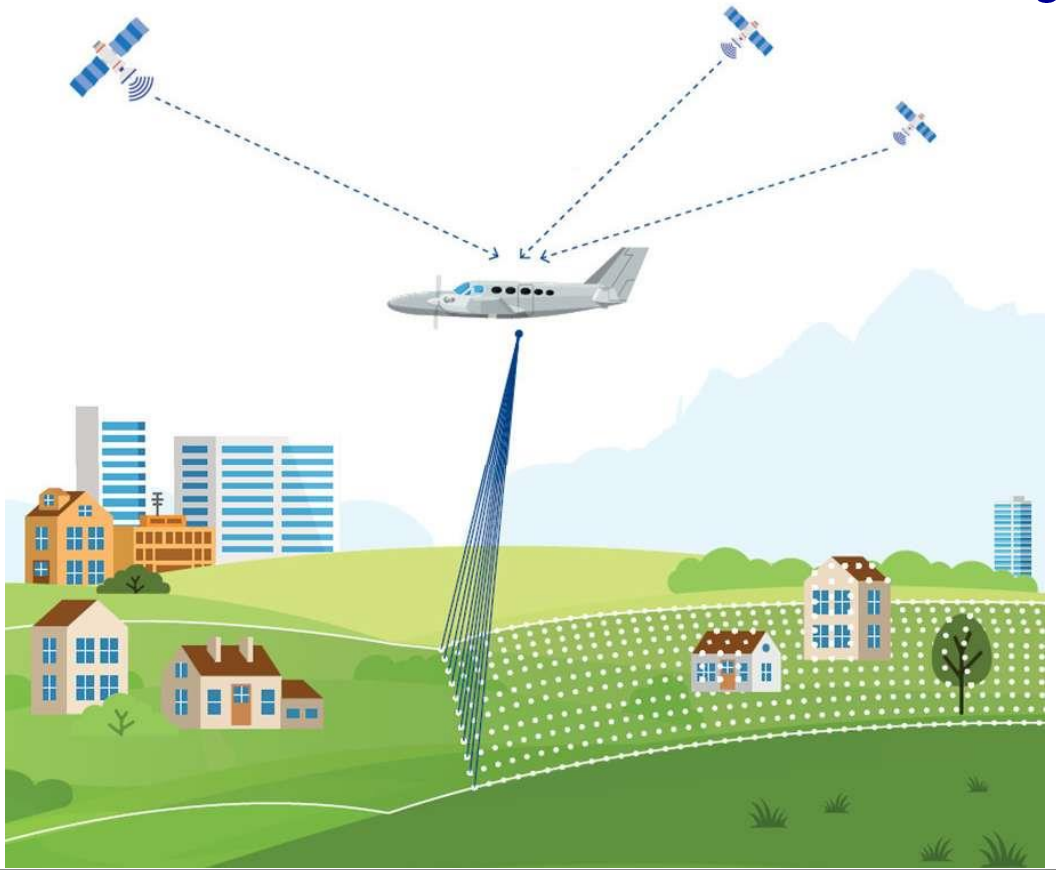
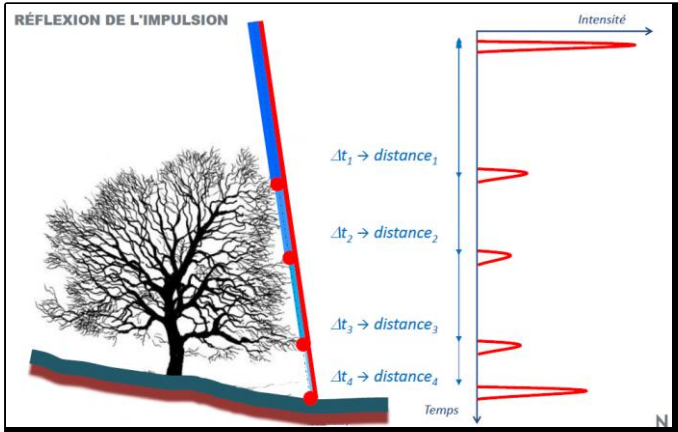
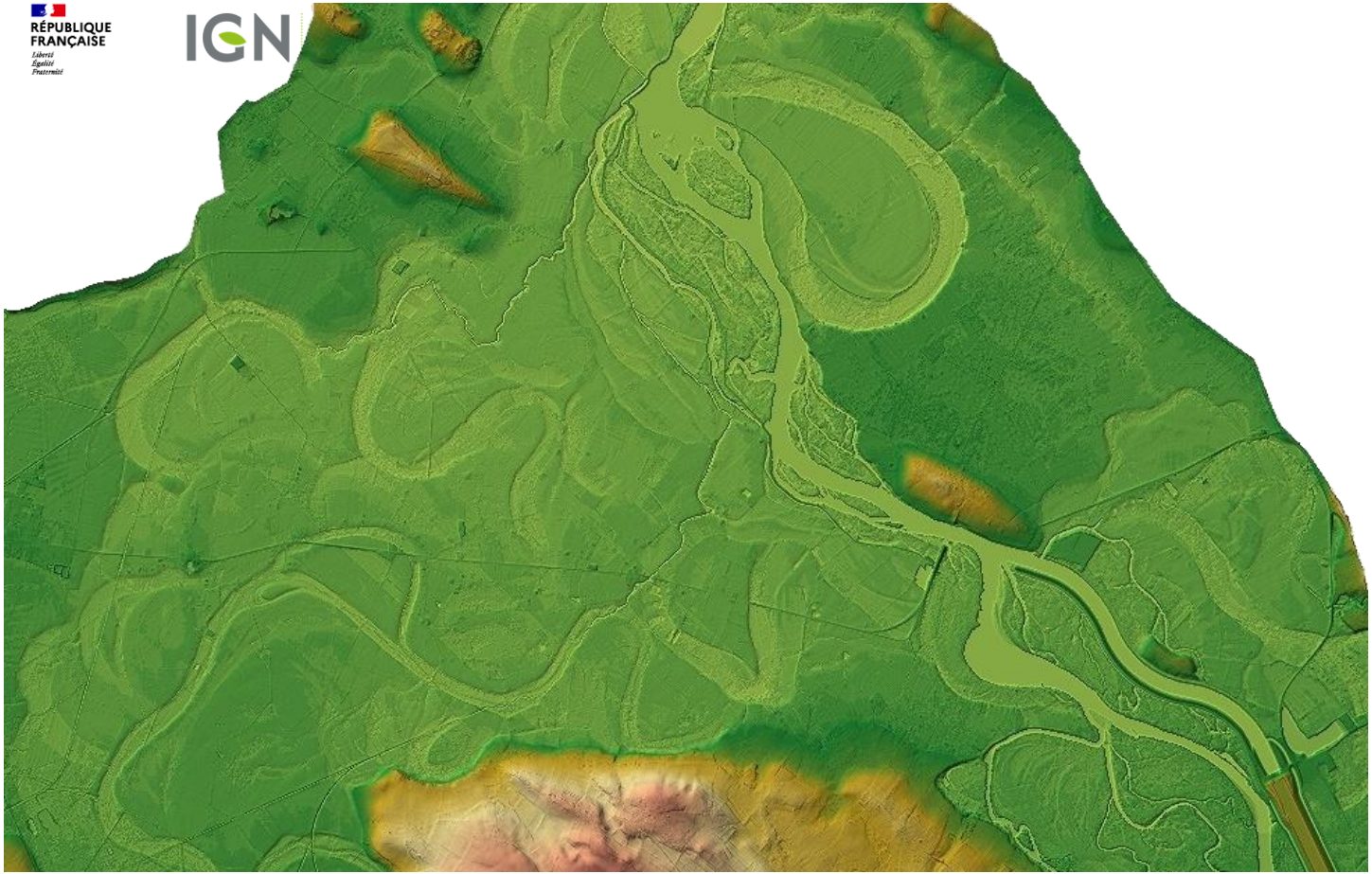
# Lidar

## light detection and ranging




RÉFLEXION DE L'IMPULSION
Intensité
$\Delta t_1 \rightarrow distance_1$
$\Delta t_2 \rightarrow distance_2$
$\Delta t_3 \rightarrow distance_3$
$\Delta t_4 \rightarrow distance_4$
Temps
N

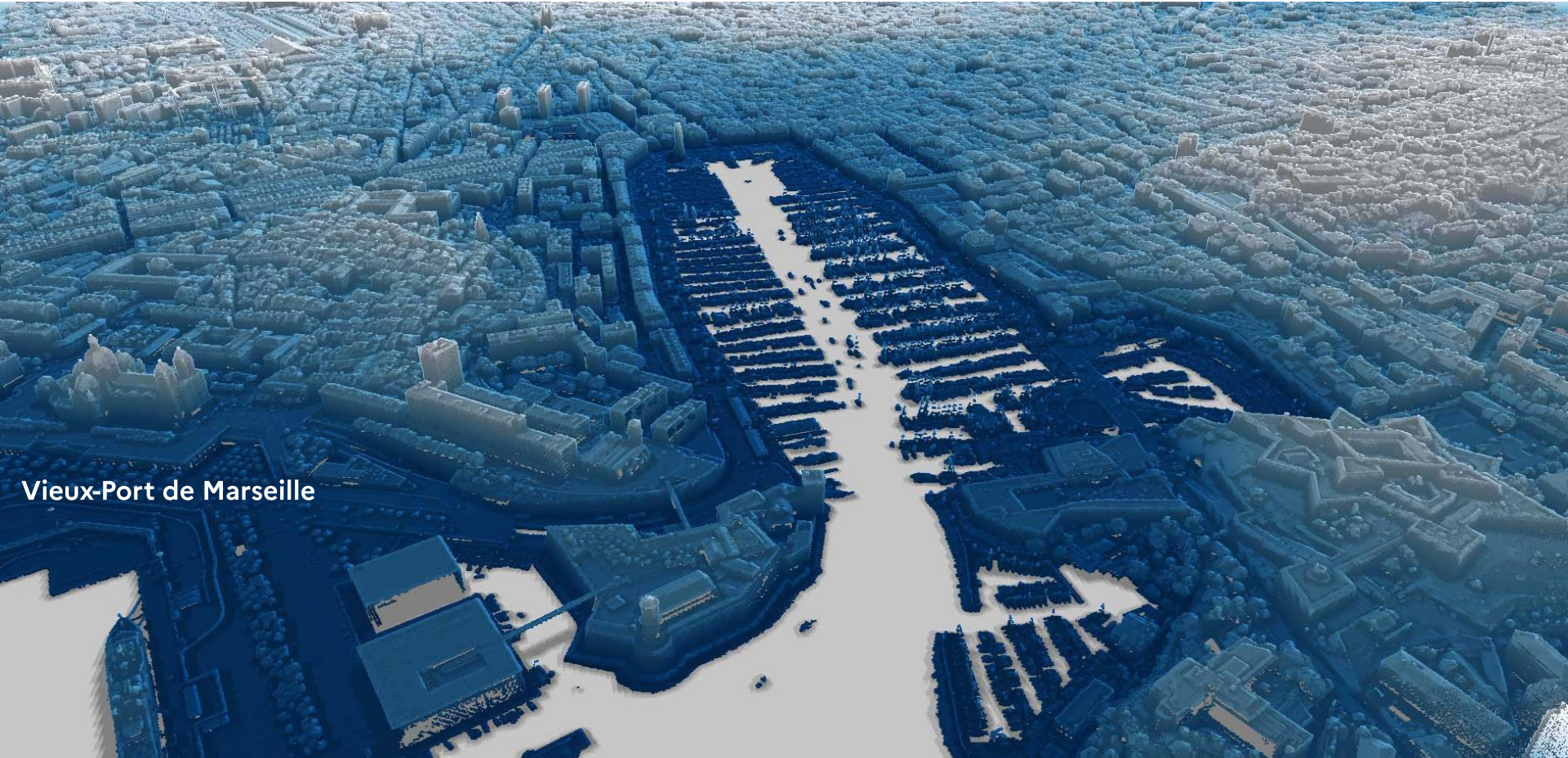


# LIDAR HD

- IGN is setting up and coordinating a **national High Density Lidar (HD) programme** to address various public policies (agriculture, forestry, flood risk prevention in particular). IGN is involved in all phases :
  - Acquire airborne Lidar data with 10 pts/m$^2$ minimum
  - Process the Lidar point clouds to meet the various needs of public policies, and transform raw point clouds into classified ground/"above the ground" point clouds and DTMs
  - Host and disseminate the point clouds and processing results in open data,
  - Support users in the manipulation of point clouds and their by-products.
- Implementation over 5 years
- **Every product and derived product will be provided in open-data.**

https://geoservices.ign.fr/lidarhd

# Lidar data processing



# Lidar data processing

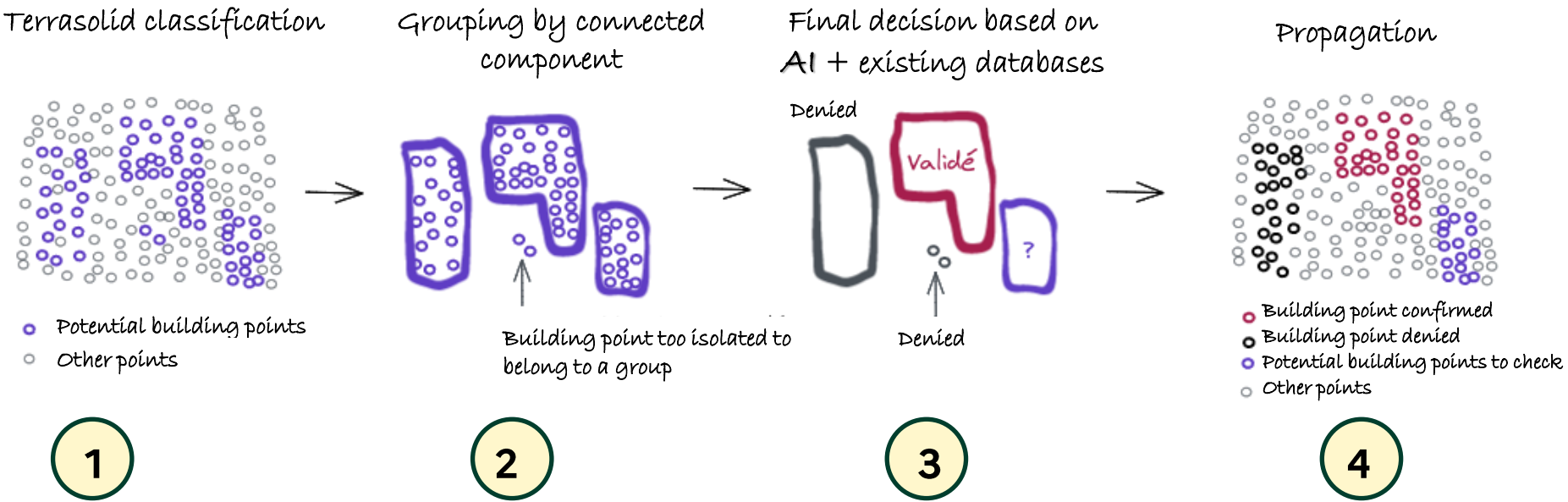
- Georeferencing
- **Data classification :**
  1. Topographic ground
  2. Others
     - Vegetation
     - Buildings
     - Bridges
     - Etc.
- From point cloud data to :
  - DTM
  - vector data → BIM

Huge data volume
**AI solutions are experimented**

# Lidar data processing

Mix approach : Terra solid classification + existing geodatabases + **AI prediction**

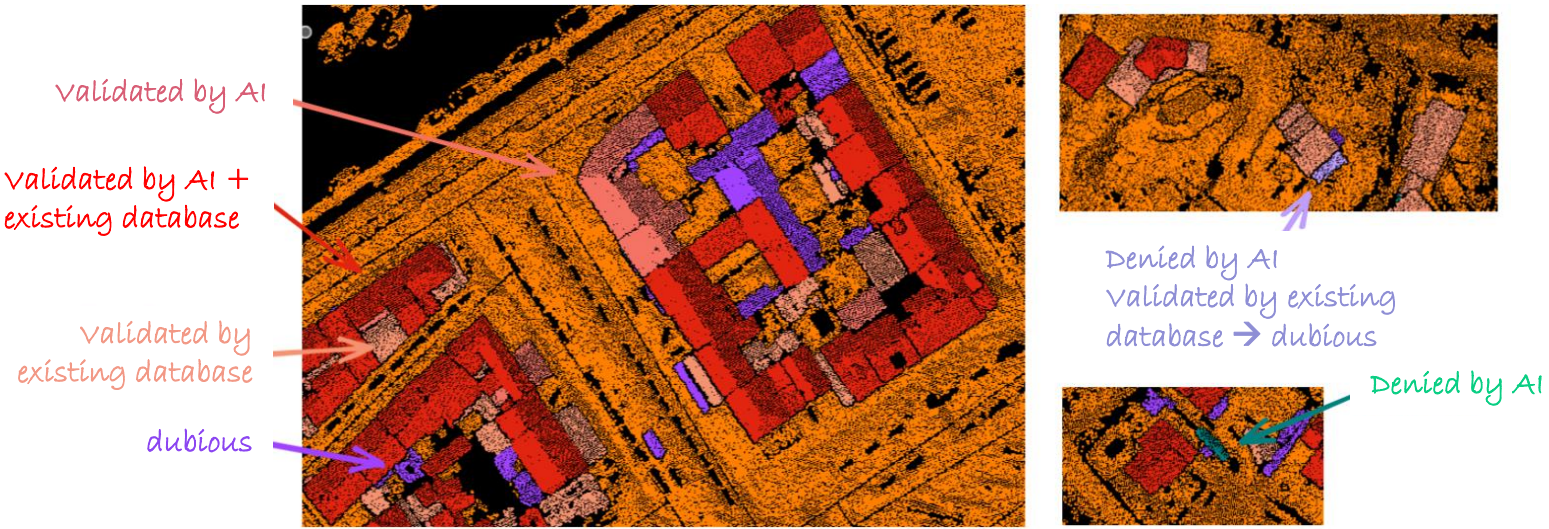
## General overview



# Lidar data processing

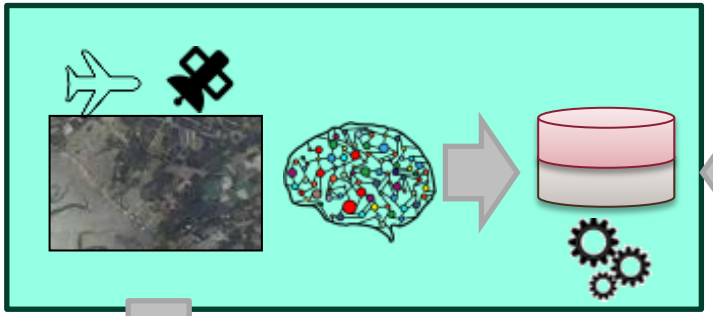
Mix approach : Terra solid classification + existing geodatabases + **AI prediction**

→
- **improves the reliability of building detection**
- **drastly reduces the need for manual inspection/edition**



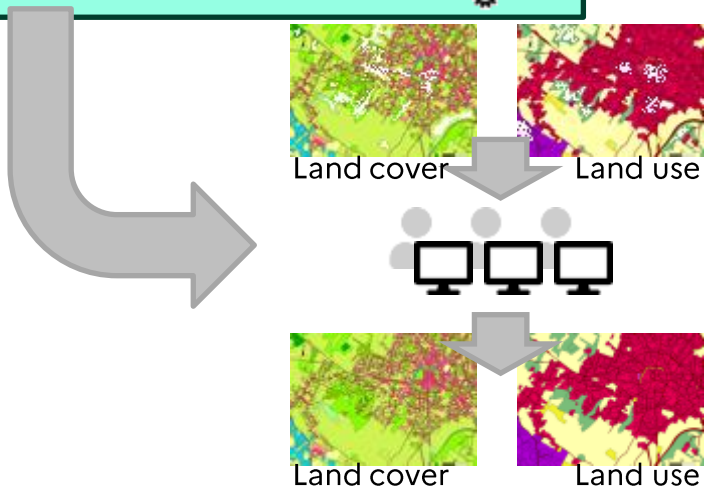
# Another example of AI for data processing

## AI automation of land cover mapping



- ***What AI?*** *Learning methods*
- ***Principe*** *:computer is trained to automatically run a task (vs writing explicit code)*
- ***Specifically deep learning***

AI is mainly used to extract objects which do not belong to any other geodatabase

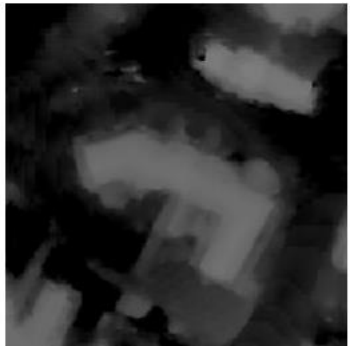


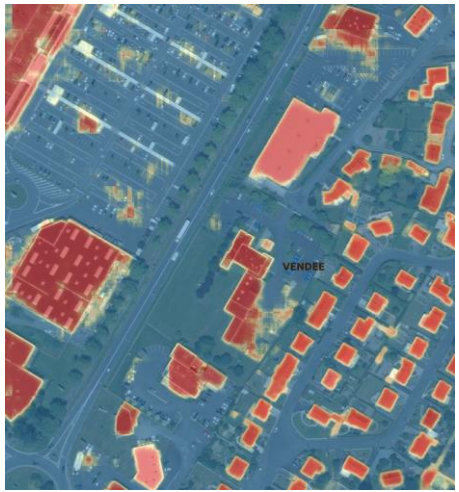

1. Production **of annotations (examples)**
2. Training of *deep learning* models
3. *deep learning* models inference
4. Vectorisation of *deep learning* results
5. Data extraction from existing databases
6. Mixing *deep learning* results + data from existing databases
7. Completion / corrections
8. Quality control

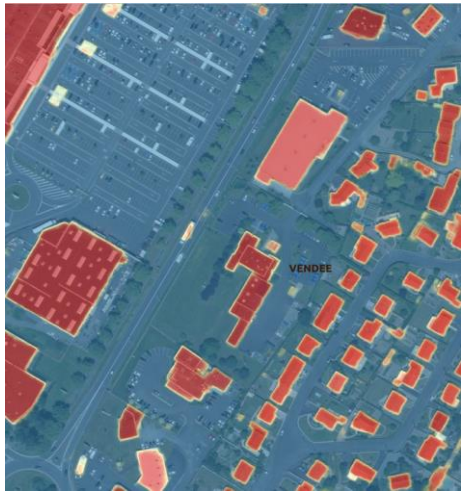
# Another example of AI for data processing

## AI automation of building mapping

- RGB orthoimage
- False color orthoimage
- Height (DSM – DTM)






Infrared :
- Vegetation
- Non vegetation

Height :
- Building
- Road

Building detection without / with height information

# AI roadmap at IGN

https://www.ign.fr/institut/feuille-de-route-ia-2022-2024

**Backbone : democratise AI**

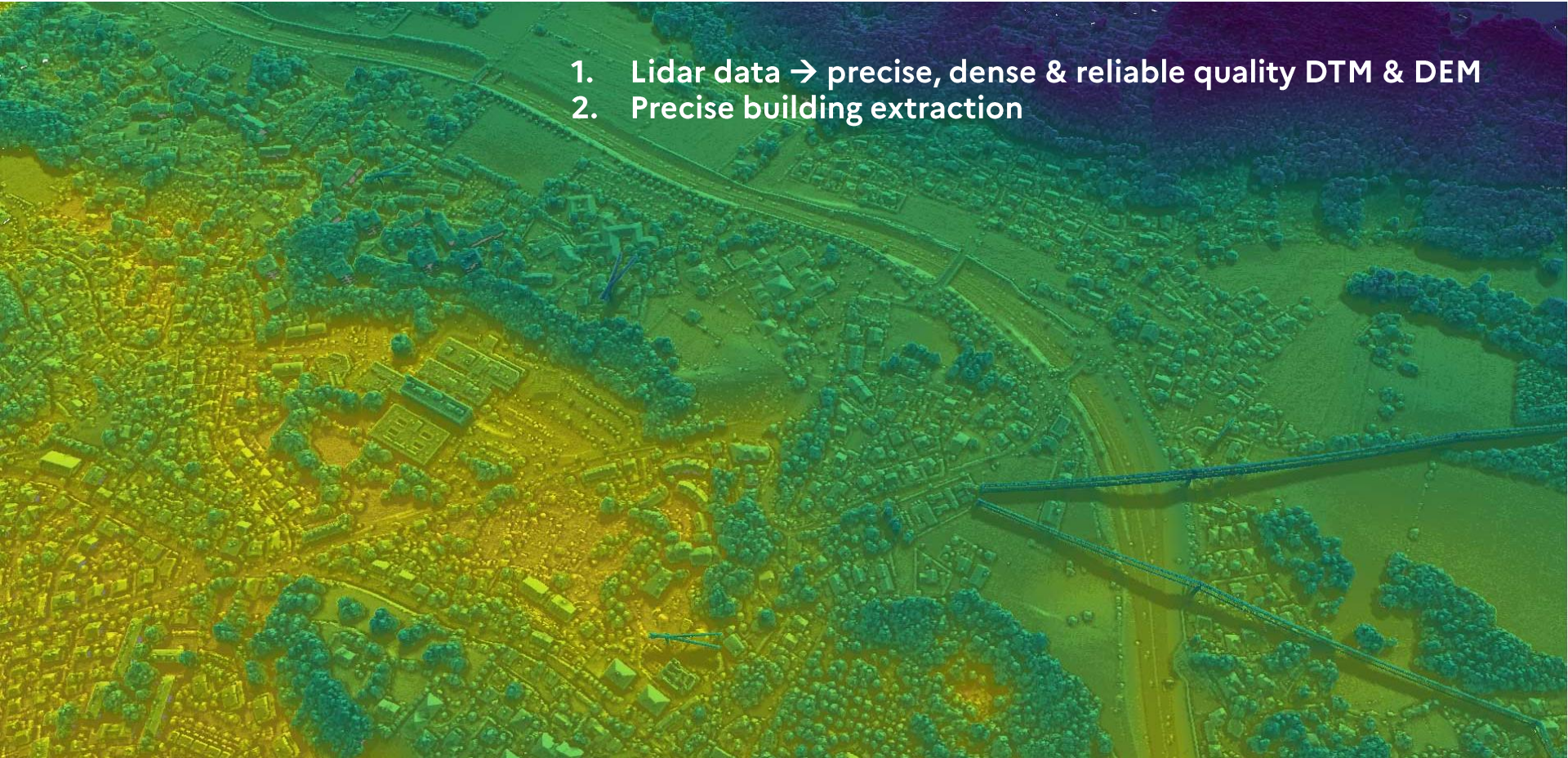
**3 main objectives :**

1. maintain the technical capacities to keep on working on the ongoing projects
2. Keep some extra resources to 1) stay up to date & 2) consider new projects
3. Support / contribute to AI communities / take an active part to ecological transition

**5 axes :**

1. Rely on commons
2. Make AI accessible at all levels
3. Create and maintain good conditions to reach the goals
4. Debate + socially and ecologically regulate AI deployment
5. Support major scientific orientations

# Lidar data for cadastre



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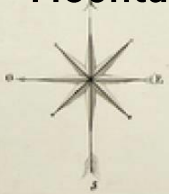
First use case : good contribution to precise georeferencing

# Lidar for cadastre

1. French cadastre is heterogeneous, as far as geometric absolute accuracy is concerned.
2. From paper maps to vectorised plan **digitisation** caused various problems like :
    - Poor georeferencing accuracy
    - Lack of continuity between adjacent sheets
3. IGN is currently involved in a joint project with DGFIP meant to optimise representation of the French cadastral maps. IGN is specifically involved in **improving the georeferencing accuracy of cadastral sheets.**
4. **Main difficulties occur with**
    - **Napoleon cadastral maps,**
    - **Mountain, forest or wooded countryside**



First use case : good contribution to precise georeferencing

# Lidar for cadastre

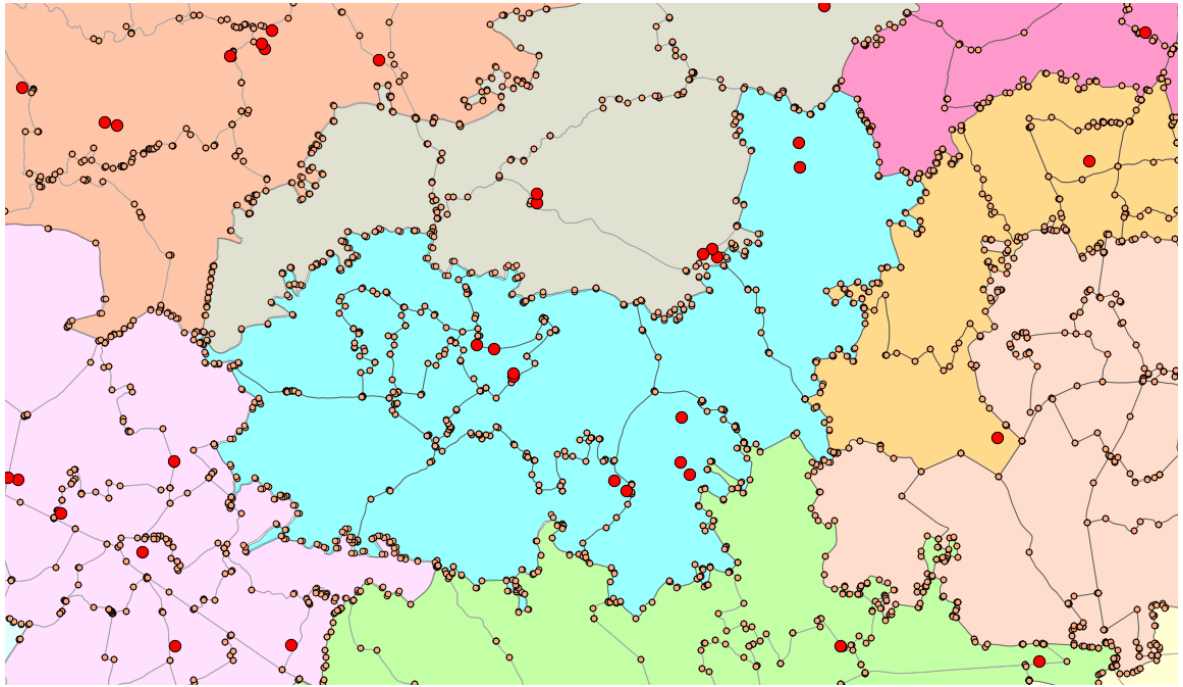
## 3 complementary ideas to get around the difficulties

1. Use a block adjustment method to georeference several sheets with few GCP
2. Rely on more ground control points (GCP)
3. Rely on information provided by Lidar data

# Lidar for cadastre

## 3 complementary ideas to get around the difficulties

### 1. Use a block adjustment method to georeference several sheets with few GCP*



Mathematic transformation is usually computed for each sheet

Block adjustment method makes it possible to compute transformations for several sheets at once 1) with few GCP 2)constraining the continuity between adjacent sheets

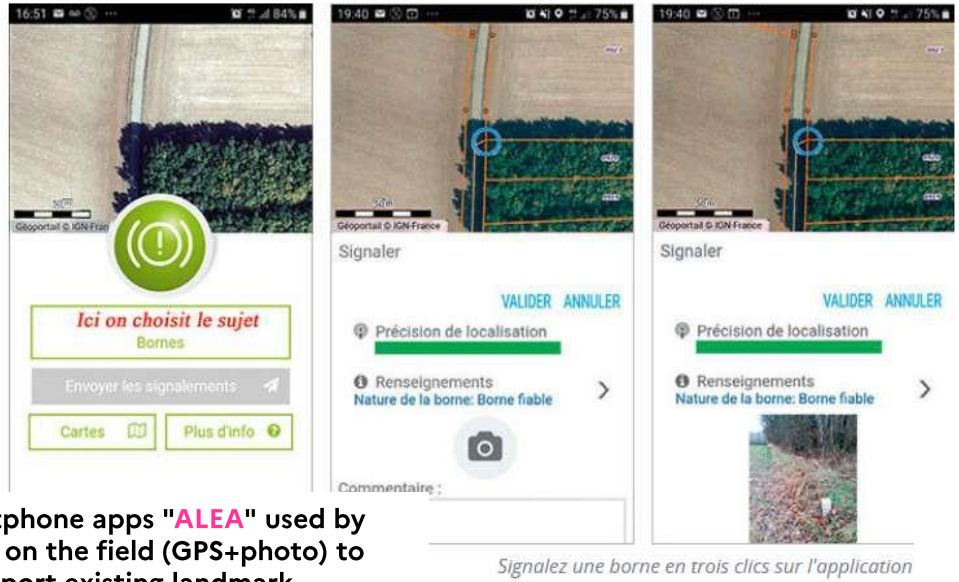
- Ground control points (GCP) :
  - visible on the map
  - known in a cartographic reference system
- Tie points
  - Same detail seen on adjacent sheets

First use case : good contribution to precise georeferencing

# Lidar for cadastre

## 3 complementary ideas to get around the difficulties

2. Rely on more ground control points (GCP) : **collaborative campaign to collect information on old landmarks**




*Signalez une borne en trois clics sur l'application*

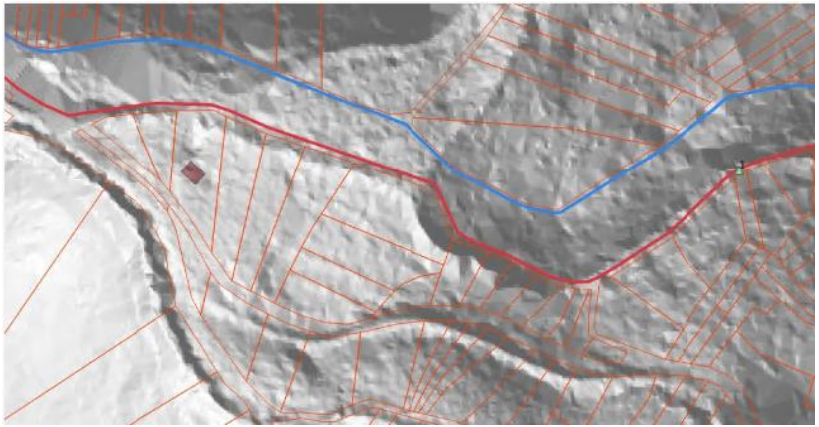
**1. smartphone apps "ALEA" used by anyone on the field (GPS+photo) to report existing landmark**

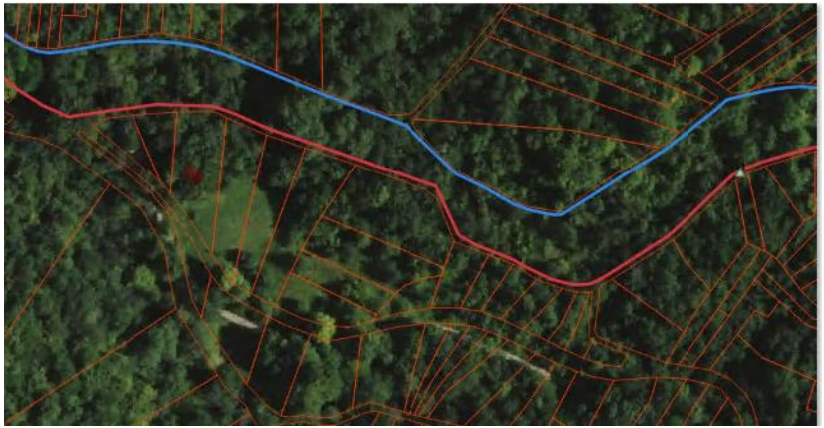
**2. Precise GPS RTK measurement**

# Lidar for cadastre

## 3 complementary ideas to get around the difficulties

### 3. Rely on information provided by Lidar data



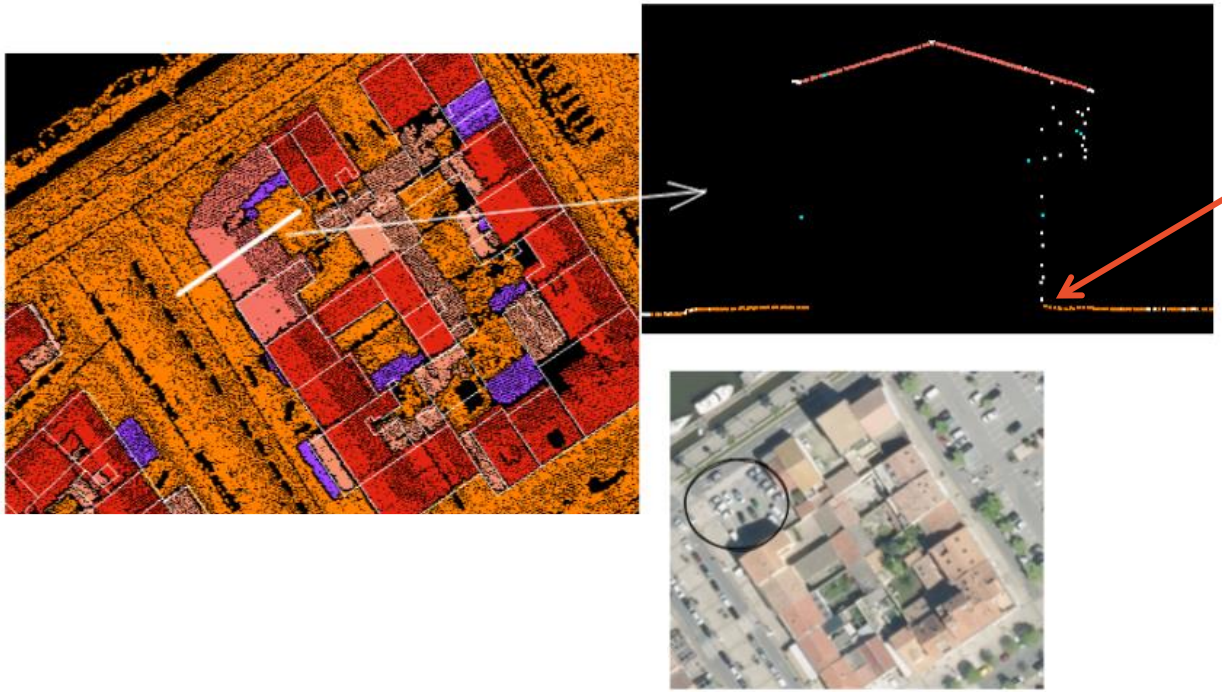


Lidar data shows structuring items **even under vegetation cover** like :

- road, path ...
- stream, ditch ...

# Lidar for cadastre

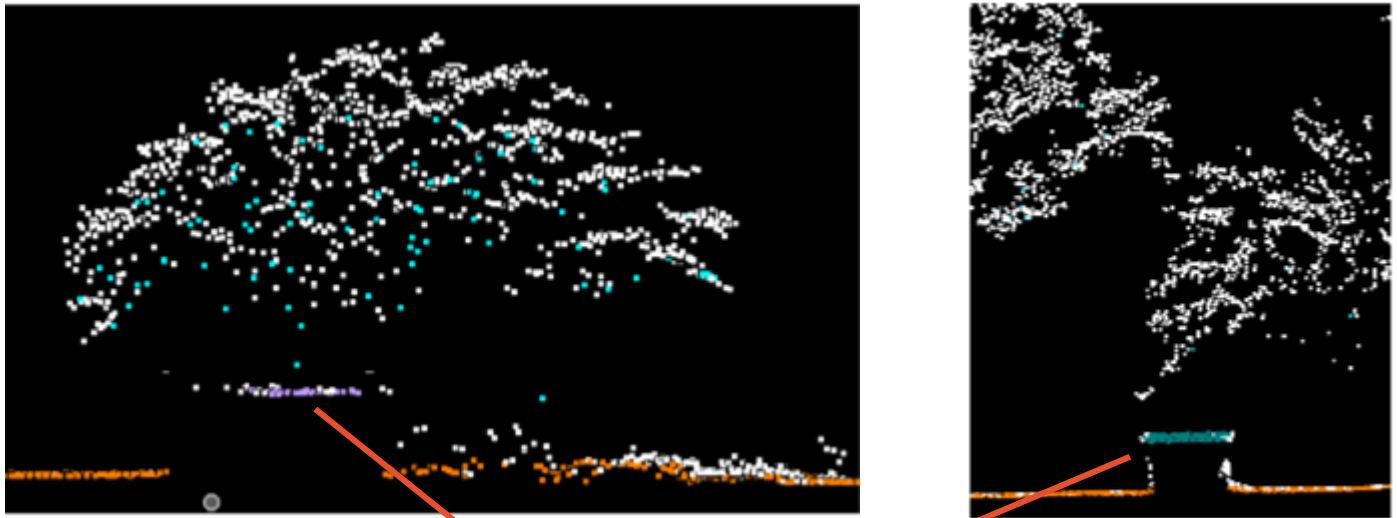
## Precise building extraction



Second use case : precise building extraction

# Lidar for cadastre

## Precise building extraction



3D points under the trees

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# THANK YOU

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