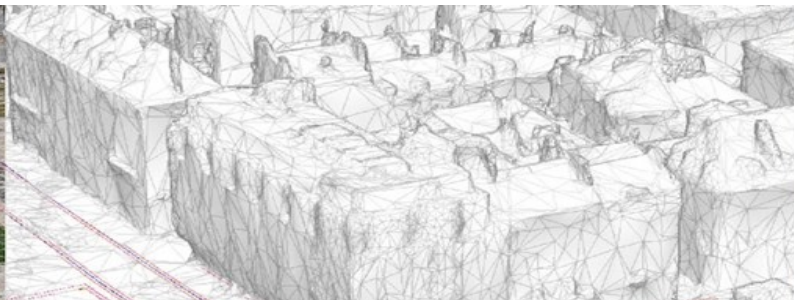
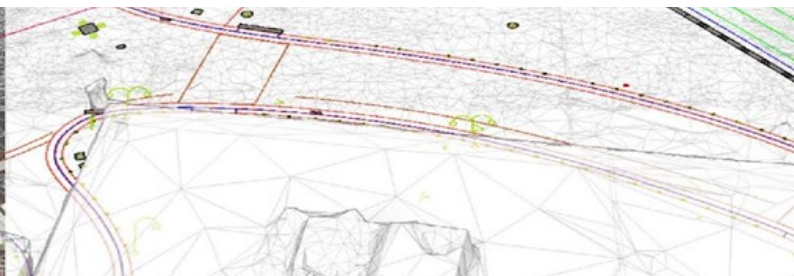
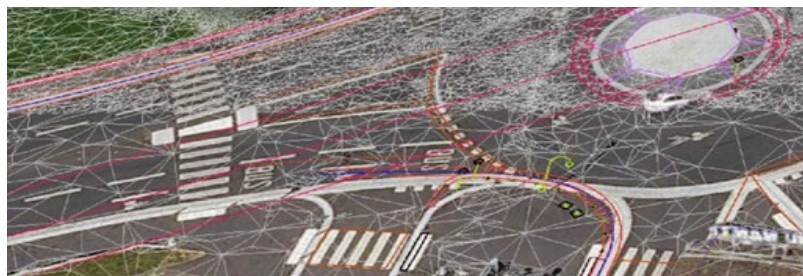




TOWARDS A NATIONAL 3D DIGITAL TWIN AT IGN

Bruno Vallet, Antoine Lavenant, Stéphane Chataigner, Nicolas Paparoditis



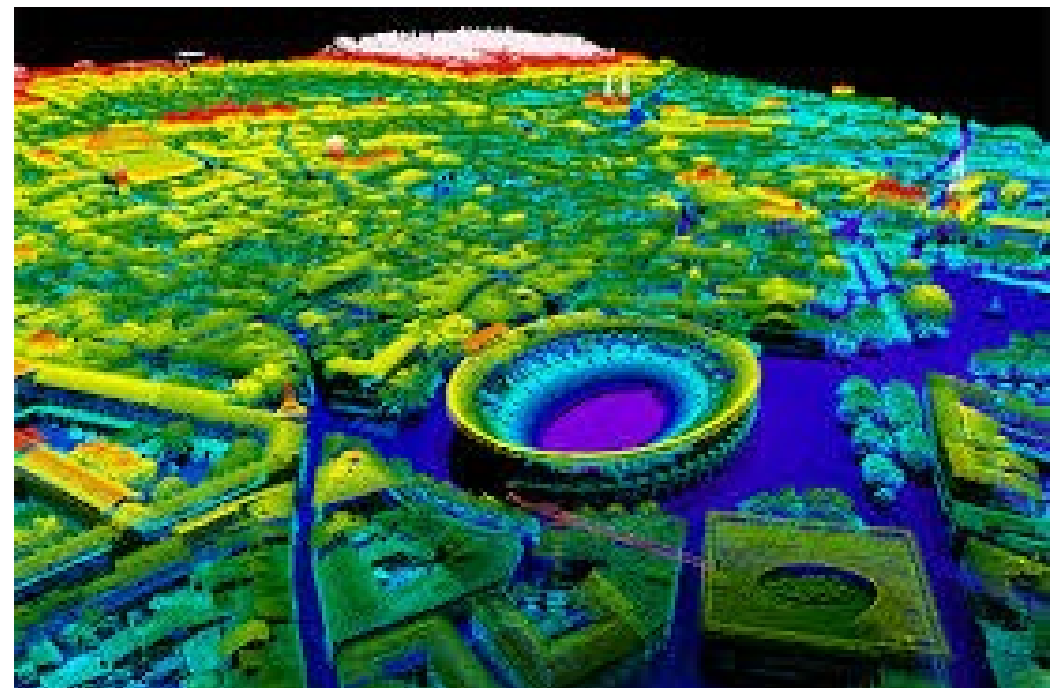
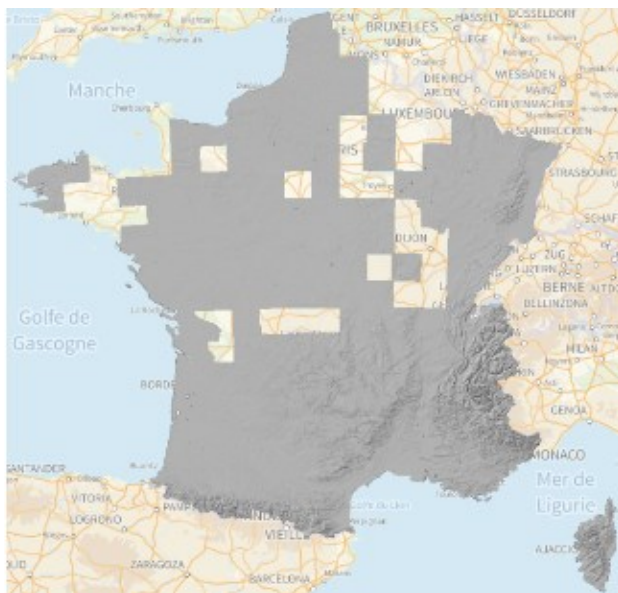
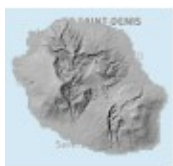
- Acquiring France in 3D: the **LidarHD** project
- The future of 3D mapping at IGN-F:
the **JNFT** (3D Digital twin of France and its territories) project
- Recent **research** preparing JNFT

THE FENCH NATIONAL LiDAR HD PROGRAMME

OBJECTIVES

The french national LiDAR HD programme was funded to meet three major needs :

- Prevention of natural hazards (flooding, landslides, etc.)
- Improving knowledge of forest resources
- Agriculture: monitoring of the Common Agricultural Policy
- + many other uses, but which did not contribute directly to the financing



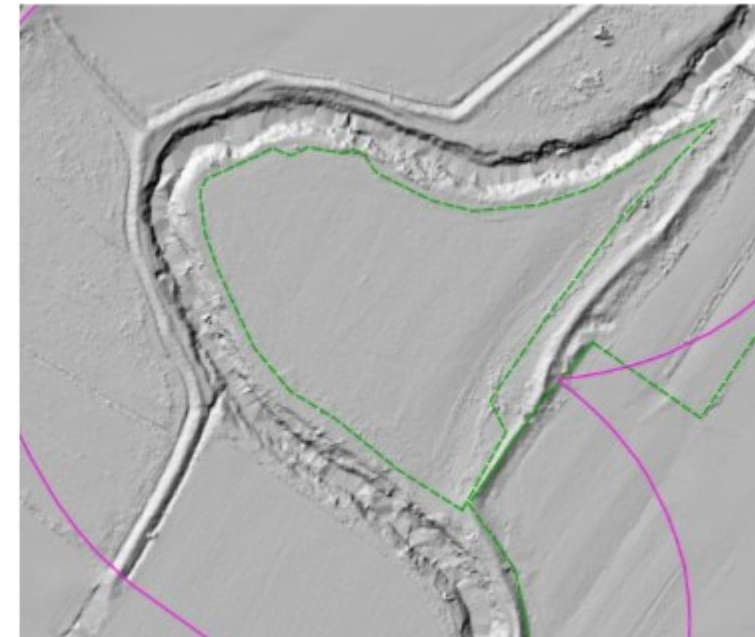
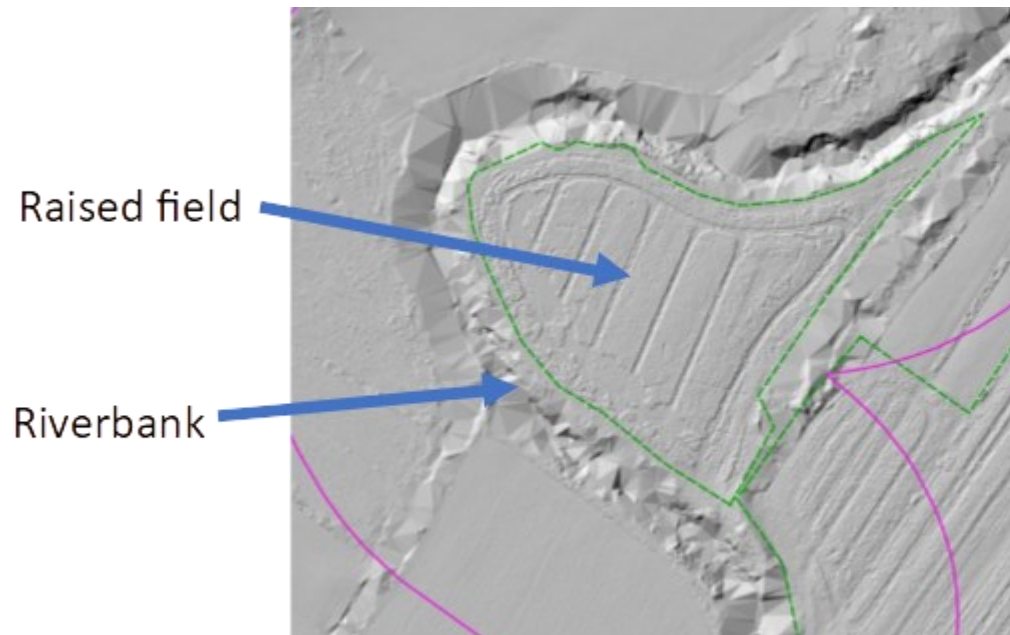
STATUS

- 93% of the territory covered as of 01/2026.
- Acquisition density = 10 points/m²
- Scheduled for completion in 2027

Next : development of an update programme based on feedback

FEEDBACK ON FLOOD RISK

- Detection of riverbanks and dykes, obscured by riparian vegetation, failing in the case of summer acquisitions.
- Local treatments (classification of bridges, improvement of raised fields, injection of old data acquired in winter) improve soil description in areas acquired in summer but are costly.

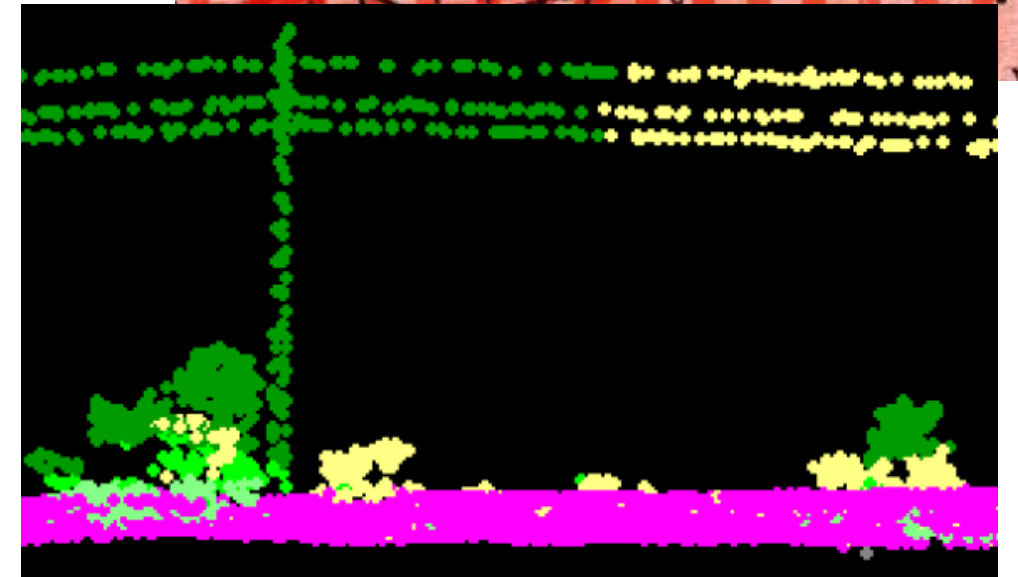
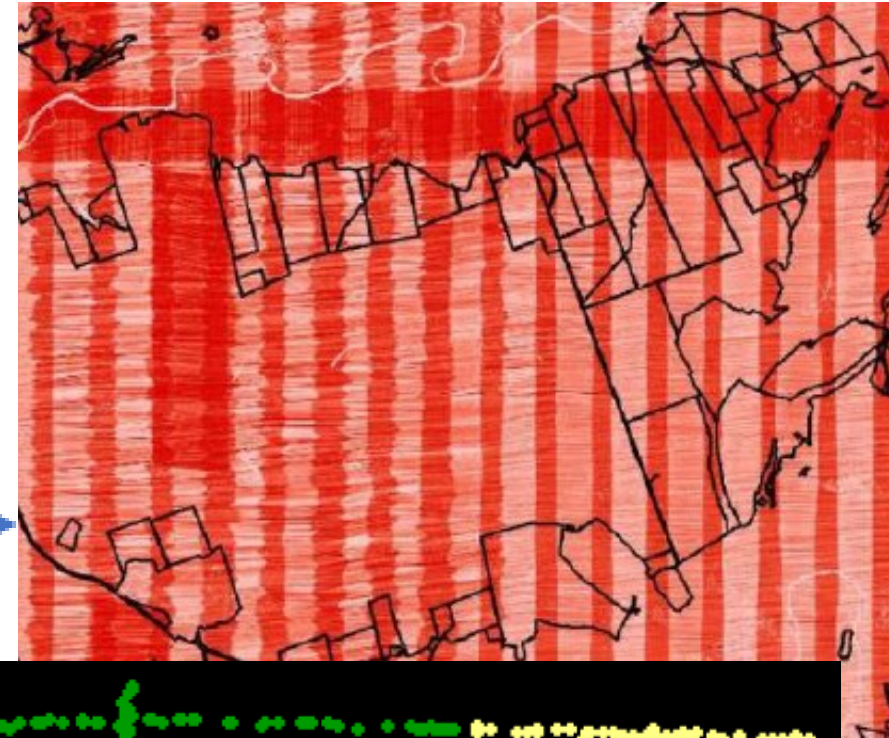


Conclusion: necessary to systematise winter acquisitions

FEEDBACK ON FOREST RESSOURCES

Items for improvement to enhance knowledge of forest resources :

- spatial homogeneity in the distribution of LiDAR points, not only horizontally but also vertically
- homogeneous distribution of points density
- larger angle variability
- minimise occlusions
- better classification



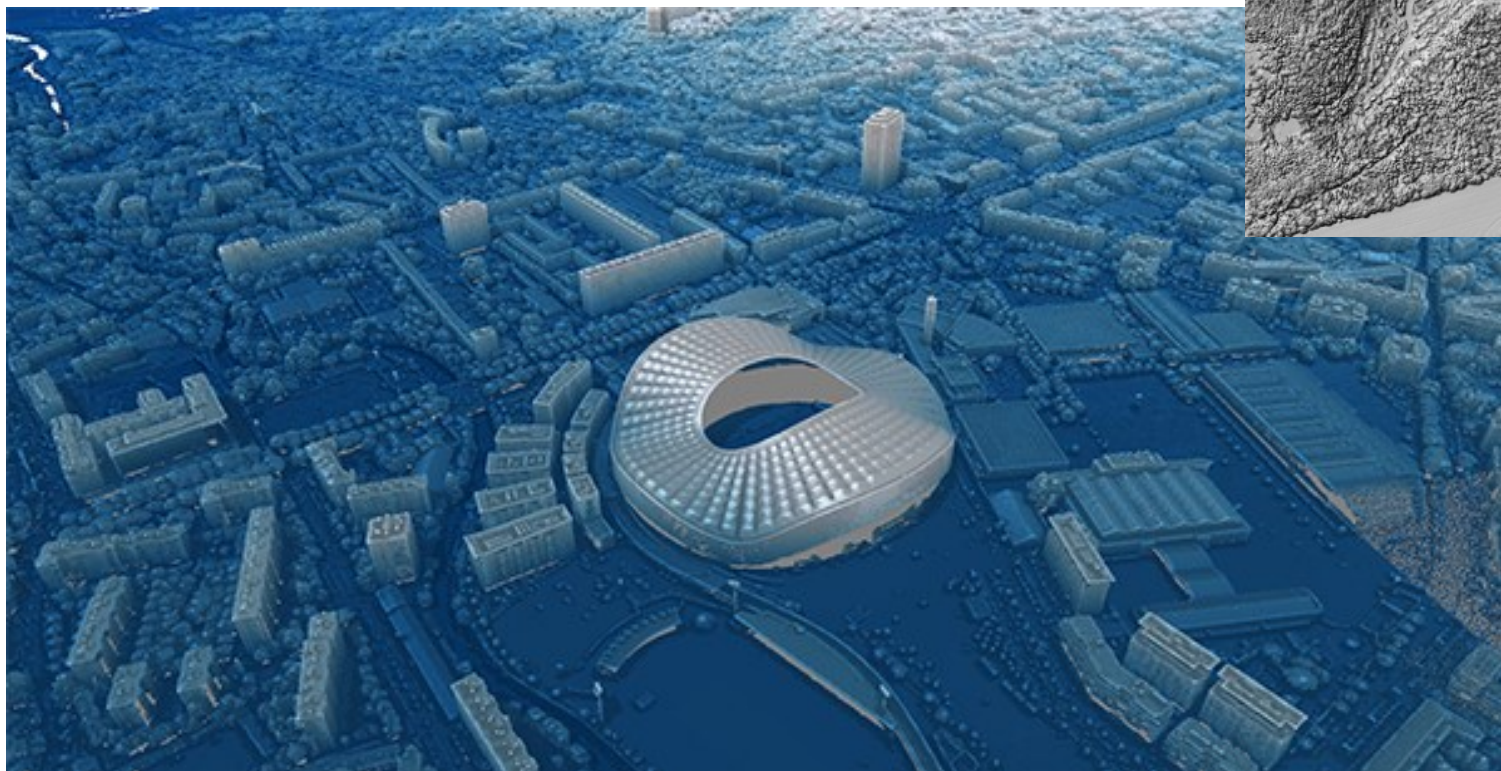
Conclusion: The acquisition specifications would need to be updated.

THE FENCH NATIONAL LiDAR HD PROGRAMME

AGRICULTURAL MONITORING

No advanced application has been found for monitoring the common agricultural policy yet :

- seeking use cases that could contribute to this by utilising update data



OTHER CHALLENGES

- combine LiDAR and camera acquisitions
- design new automatic classification processes
- ... fundraising !

JNFT: TOOLKIT DECISION-MAKING IN THE FACE OF CLIMATE CHANGE

GIVEN THE COMPLEXITY OF OPTIMIZING
PUBLIC POLICY CHOICES,

IT BECOMES NECESSARY
TO PROJECT INTO THE FUTURE
THROUGH SIMULATION

TO ASSESS THE **FORESEEABLE COURSE**
OF ECOLOGICAL PHENOMENA

AND THE **ANTICIPATED IMPACT**
OF POSSIBLE ACTION SCENARIOS,

THEREBY FOSTERING
A COMMON UNDERSTANDING

□ **DIGITAL TWIN OF THE TERRITORIES**

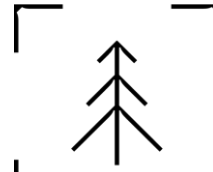
8 MAJOR ANTHROPOCENE CHALLENGES



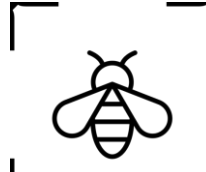
URBANIZATION



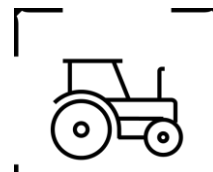
RISKS



FOREST



BIODIVERSITY



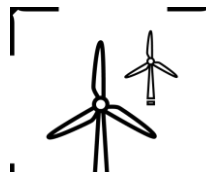
AGRICULTURE



COASTLINE



WATER



ENERGY



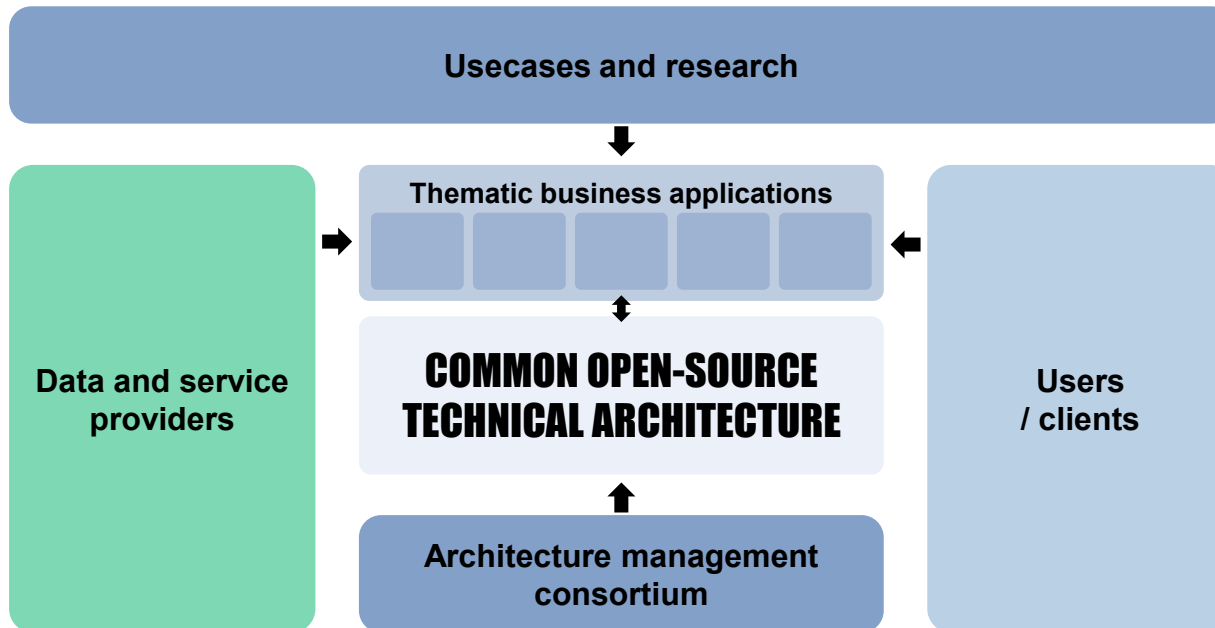
JNFT: OVERVIEW OF THE PROJECT AND ITS GOALS

DIGITAL TWIN OF FRANCE AND ITS TERRITORIES

The digital twin of France and its territories is a **TOOL-BASED APPROACH**, supported by a consortium of public and private players, enabling the development of a **COMMON OPEN-SOURCE ARCHITECTURE** built in support of **IDENTIFIED BUSINESS USECASES**

Build a **COMMON OPEN-SOURCE ARCHITECTURE**

 that can be completed and adapted to easily build JNTs



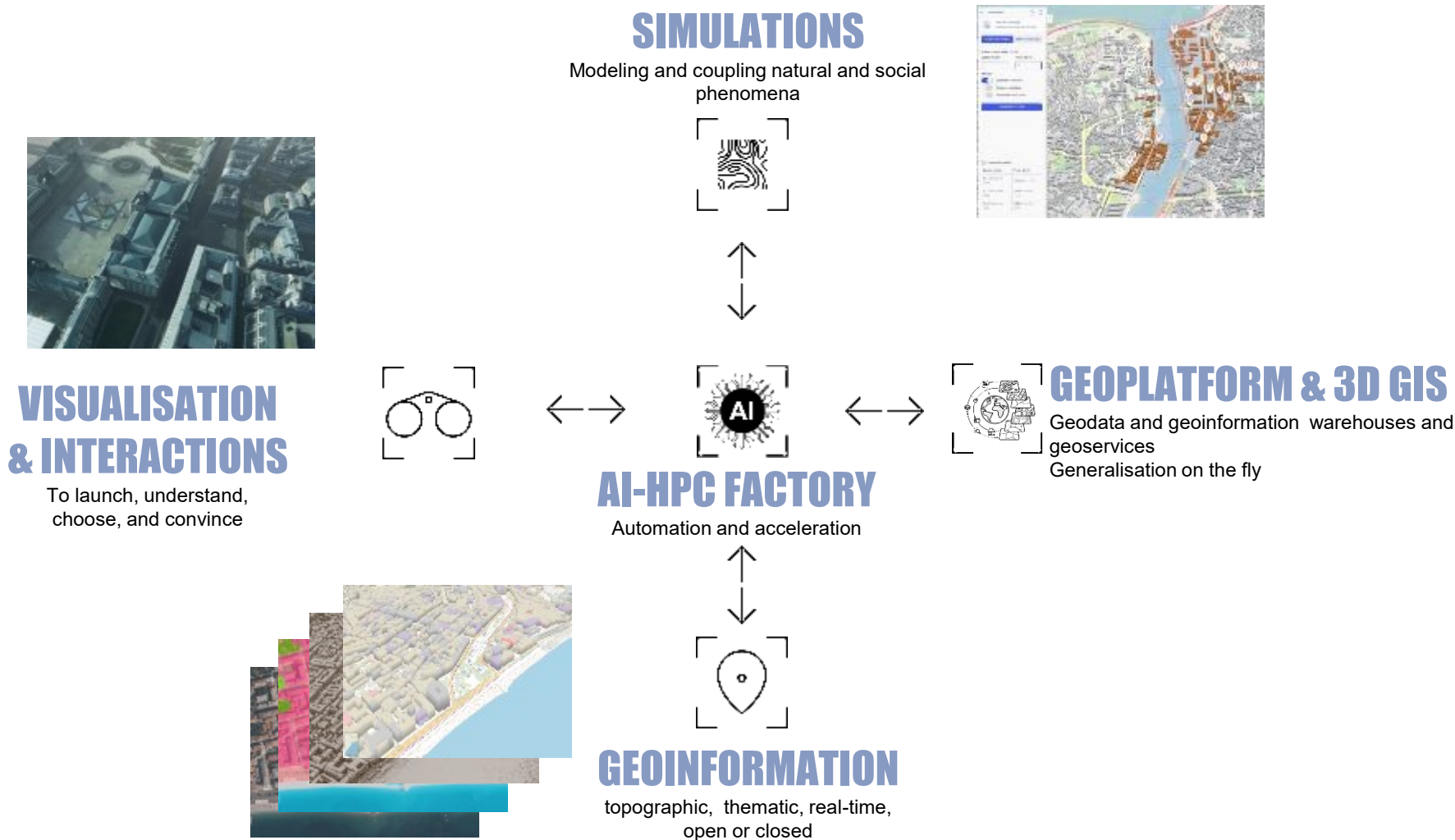
Developed around **REAL BUSINESS USECASES**

OBJECTIVES

- **Reduce the costs of local initiatives** and facilitate their replication in other areas
- **Cross-fertilise expertise and viewpoints relating to different public policies**, by establishing a framework for interoperability and interface
- **Set up a science platform** to facilitate the development of technological advances from R&D
- **Build an ecosystem of services and business applications** with higher added value and facilitating access to them for local players
- **Encourage the development of an economy around territory digital twins**

JNFT: AN OPEN FOUNDATION OF TECHNICAL SERVICES

DESIGNED TO ANSWER BUSINESS USECASES



JNFT: DATA PRODUCED WITHIN THE PROJECT

MESHES, 3D MODELS OF CITIES AND TERRITORIES AT THE NATION SCALE



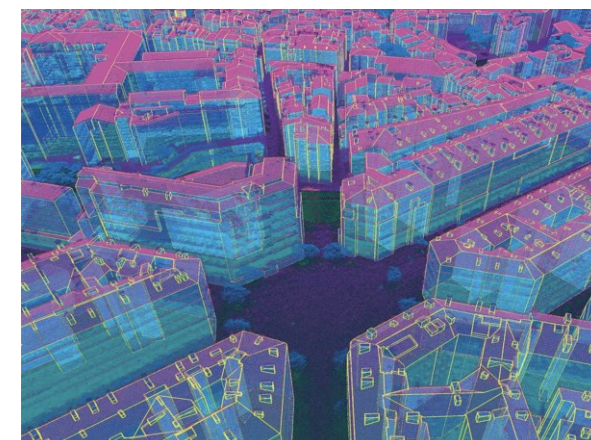
**3D MESH (UNTEXTURED)
WITH WASURE TECHNOLOGY (IGN)**



**3D TEXTURED MESH
(IGO)**



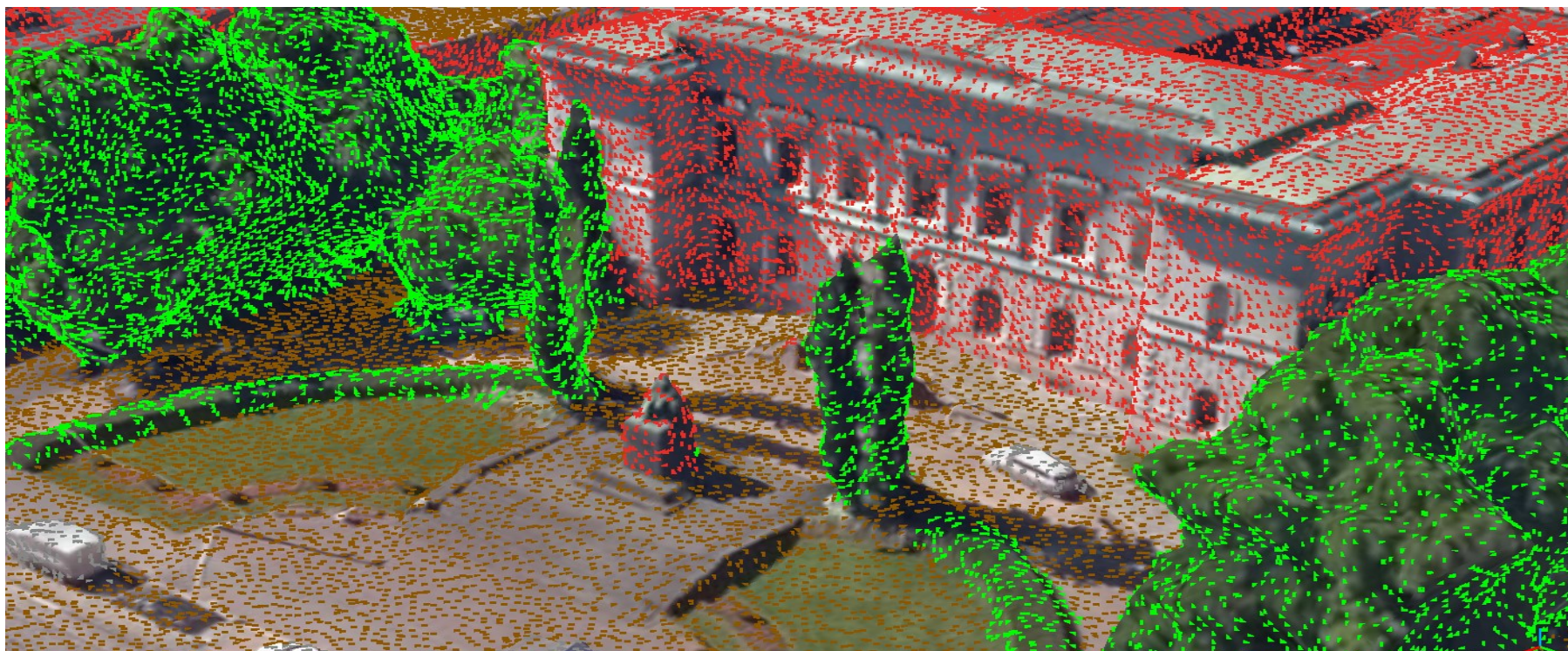
**3D VECTOR MODEL
(SIRADEL)**



**3D AUTOMATIC RECONSTRUCTION MODEL
WITH SIMPLICITY TECHNOLOGY (LUX CARTA)**

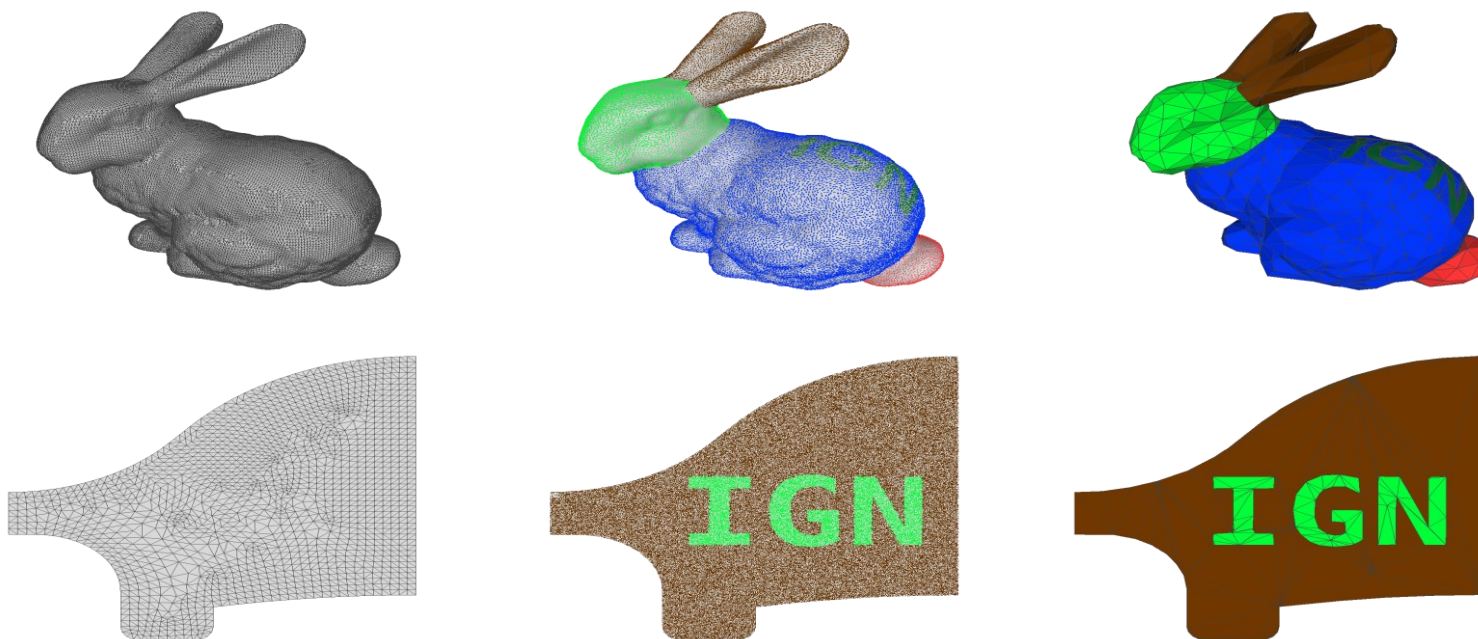
CONTEXT AND OBJECTIVES

- Textured meshes will be produced by JNFT. Combine 3D geometry + radiometry
- Use this representation for semantic segmentation
- Input for object based 3D reconstruction (CityGML)



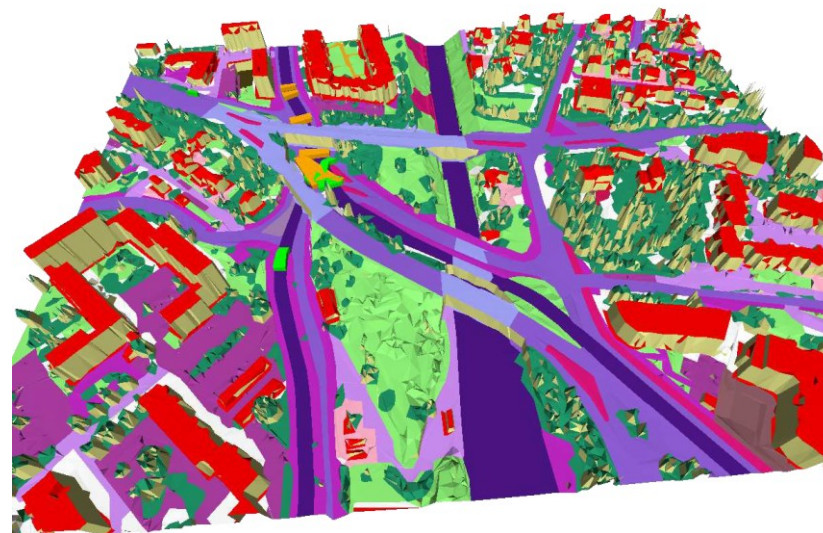
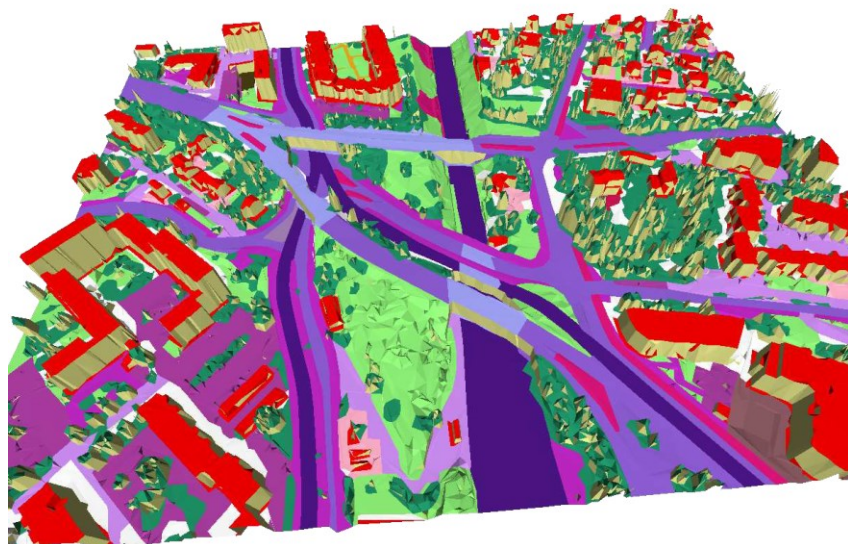
CONTEXT AND OBJECTIVES

- Object based 3D models (CityGML) costly + complex object relationships
Embed objects in a single mesh
- Solution: decimate meshes while aligning edges to boundaries between classes
Objects become subsets of triangles



CONTEXT AND OBJECTIVES

- 3D models are not navigable: combine 3D mesh + navigable networks to make 3D mesh navigable
- Surfacic (subsets of triangles) AND navigable networks
- Handle bridges/tunnels in 3D

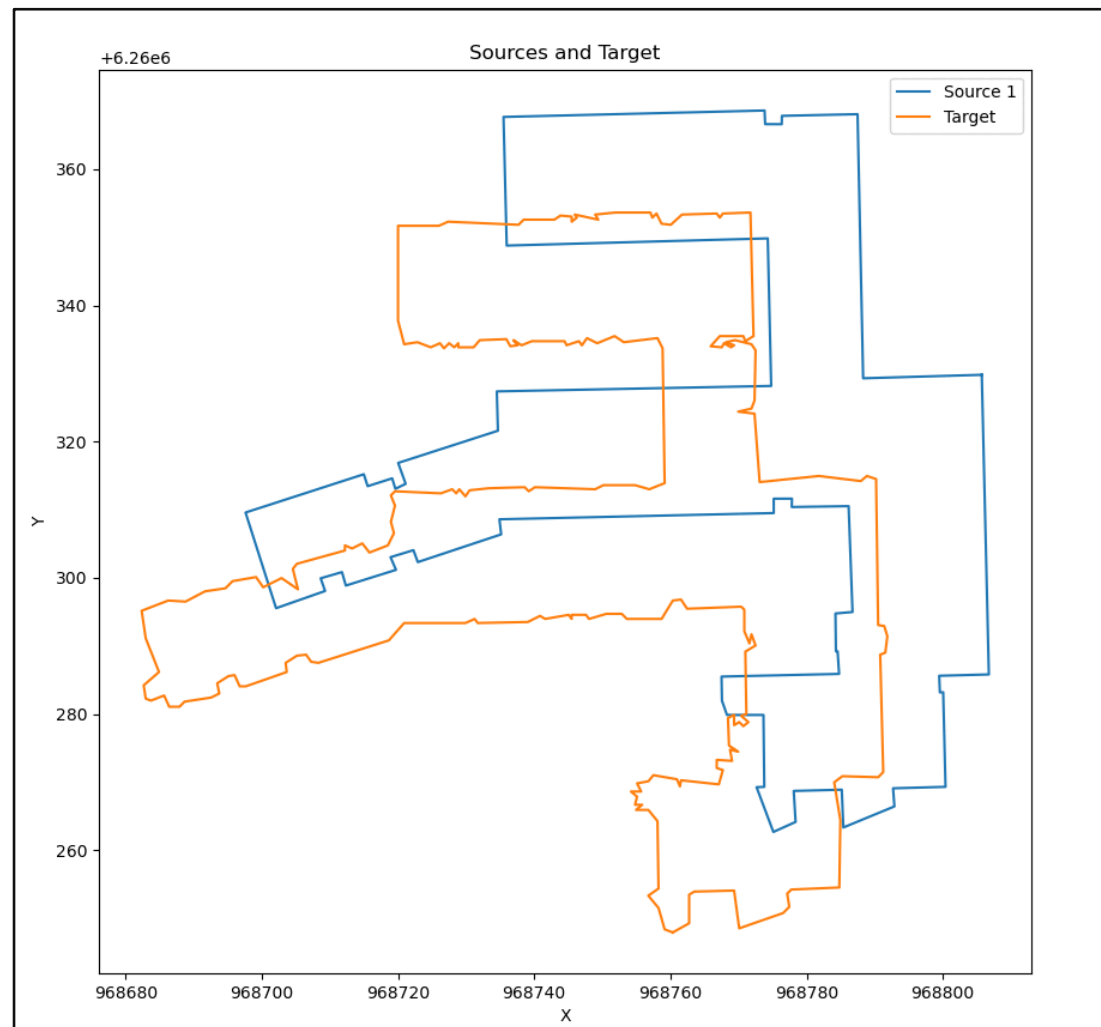


CONTEXT AND OBJECTIVES

- JNFT will require to combine IGN topographic database (BD Topo) building footprints and LIDAR HD for 3D building reconstruction

Requires a precise registration:

- Rigide (per object translation only)
- Non rigid (per vertex translation)
- Semi-rigid (per edge translation)
- Preserving adjacency and alignement



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