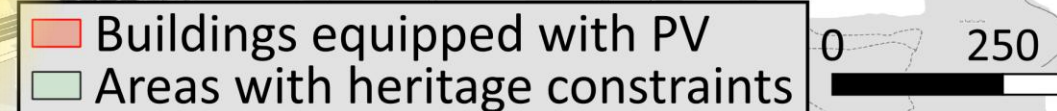


# Data-driven sOLar Massive deployment in European Nations

## Données LiDAR et orthophotos pour la cartographie de la production photovoltaïque Française

Mohamed Ennhiri (LOCIE, CNRS), Alessia Boccalatte (LOCIE, USMB), Boris Nerot (LOCIE, USMB), Stephan Plassart (LISTIC, USMB), **Martin Thebault (LOCIE, CNRS)**

07/07/2026



# Where are the rooftop PV panels installed?

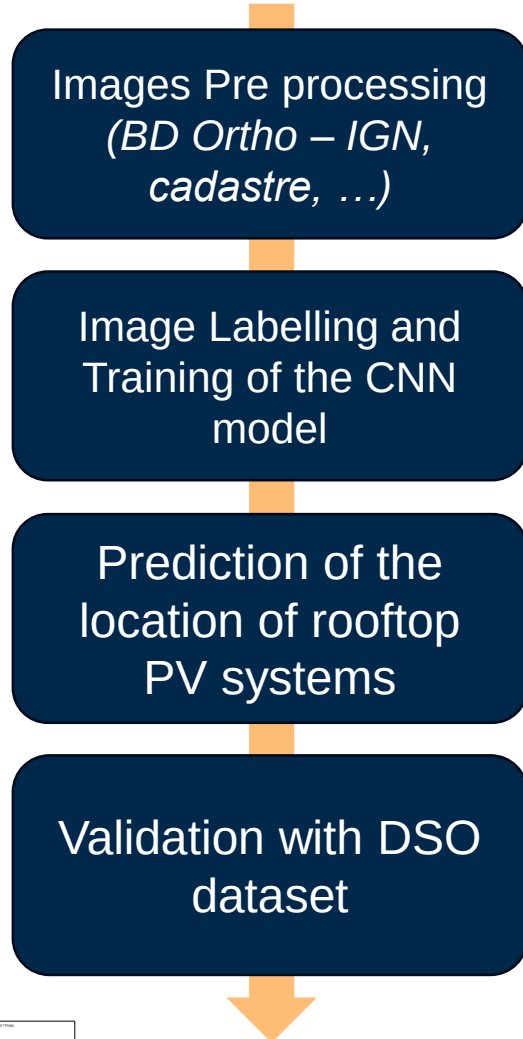
- Estimating the **installed capacity** / **estimating and forecasting energy production**
- Knowing **where they are and where they are not yet** > Deployment strategy and decision aiding for urban planners, municipalities, grid operator, researcher
- **Understanding** levers and barriers behind **solar PV adoption** (projections, energy policies etc)

Building-wise tool to scan all French buildings and detect rooftop PV system.



# Mapping the existing Rooftop PV systems

## Methodology



# Mapping the existing Rooftop PV systems

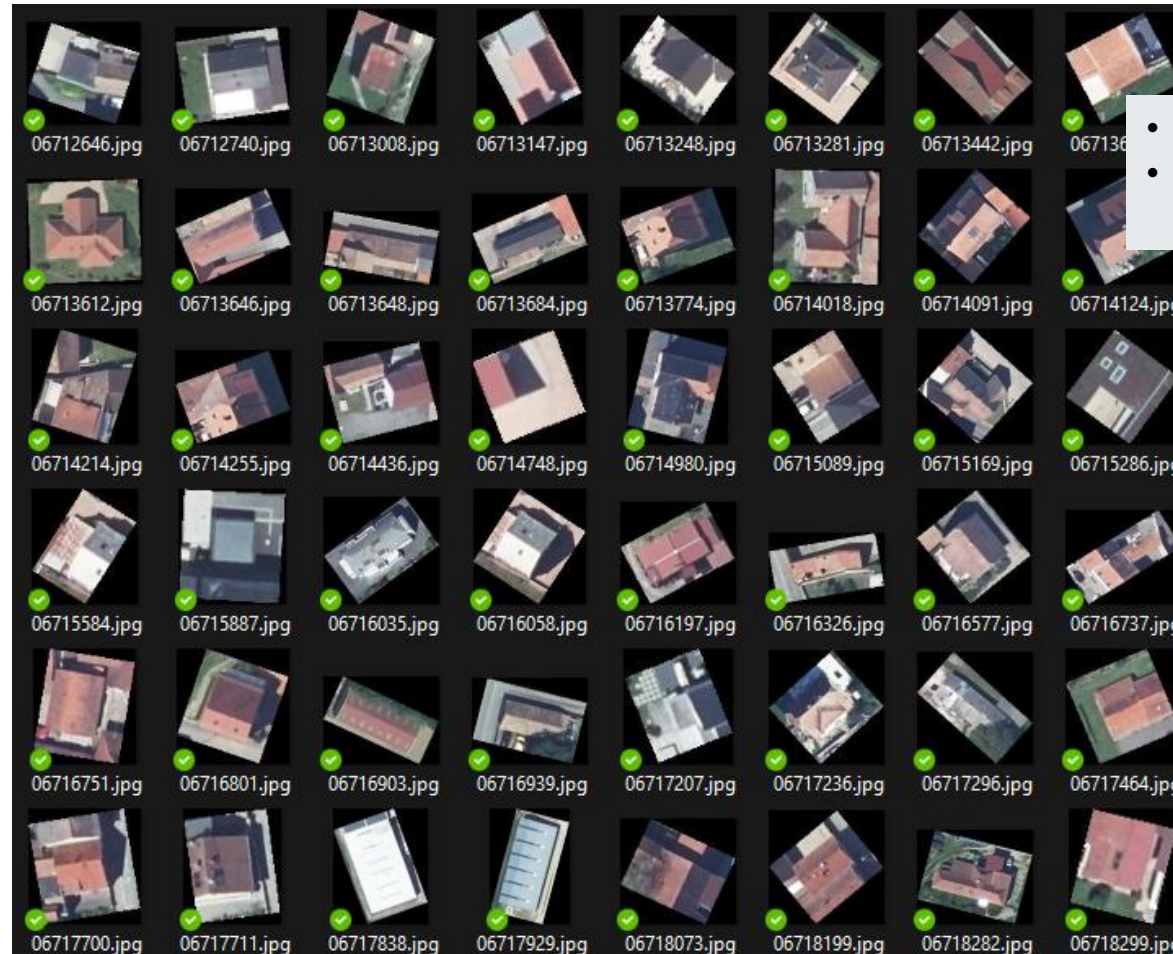
## Methodology

Images Pre processing  
(BD Ortho – IGN,  
cadastre, ...)

Image Labelling and  
Training of the CNN  
model

Prediction of the  
location of rooftop  
PV systems

Validation with DSO  
dataset'



- France métropolitaine + Corse
- 40 millions images of individual buildings (1 day/dept on 5 threads)

# Mapping the existing Rooftop PV systems

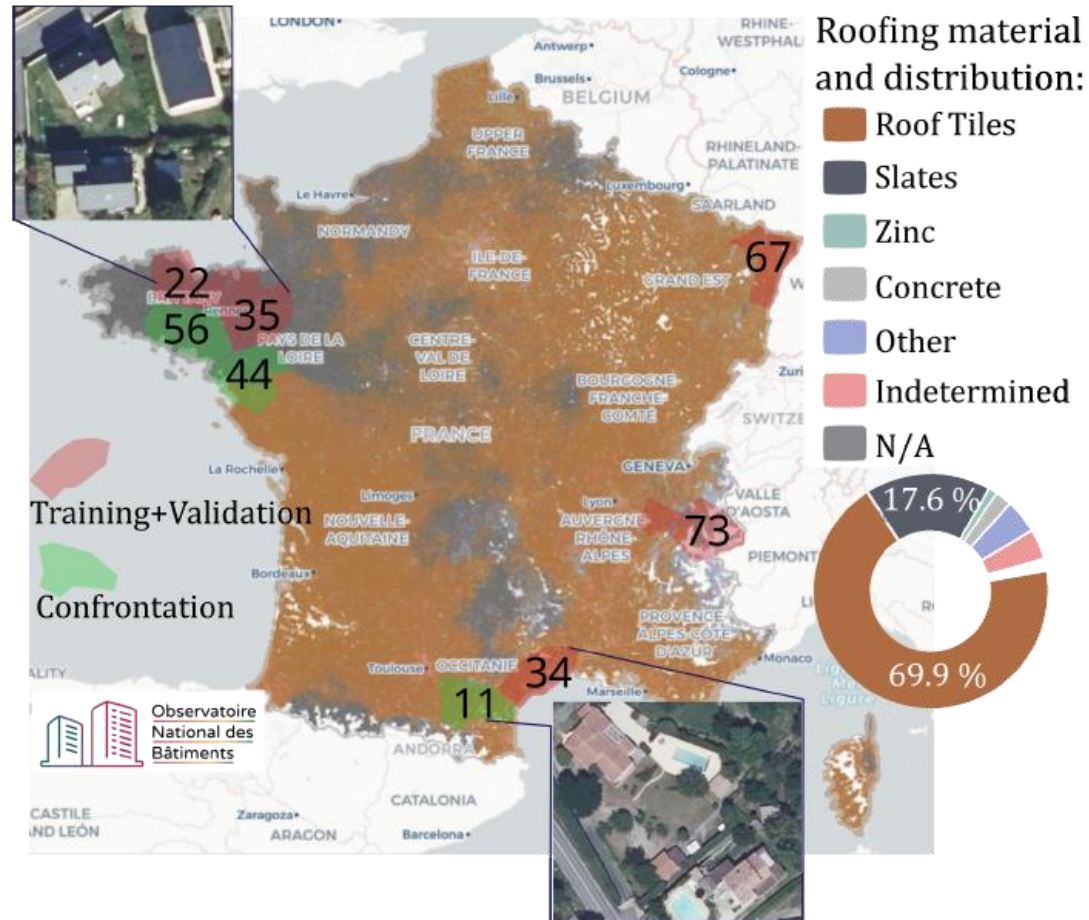
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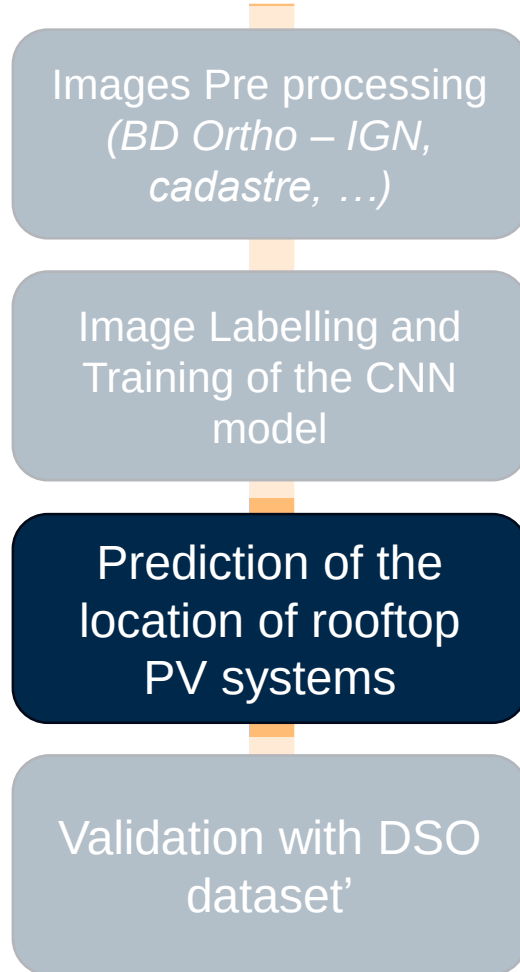


- France métropolitaine + Corse
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- French **urban heterogeneities**
- **35 000 hand labelled** images 75% noPV/25% PV
- Additional dataset from the literature (Kasmi et al.)

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$$precision = \frac{TP}{TP + FP}$$

$$recall = \frac{TP}{TP + FN}$$

$$F1 = \frac{2 \times prec \times rec}{prec + rec}$$

Table 3: Confusion matrix on the validation dataset

|           |       | Reference |         |
|-----------|-------|-----------|---------|
|           |       | No PV     | PV      |
| Predicted | No PV | TN=8531   | FN=185  |
|           | PV    | FP=552    | TP=4556 |

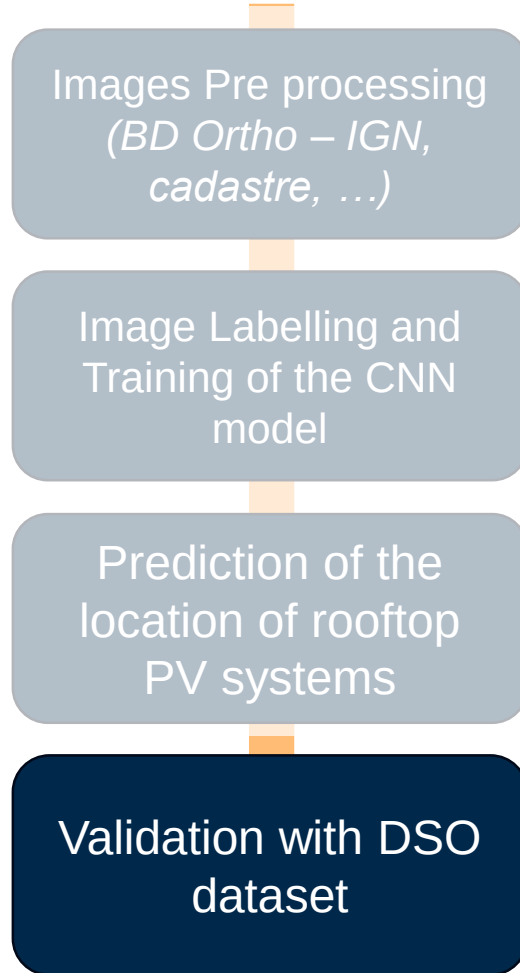
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- Efficient net B2 (CNN)
  - Prec=89.2%
  - Recall=96.1%
  - F1=92.5%

# Mapping the existing Rooftop PV systems

## Methodology



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- Additional dataset from the literature (Kasmi et al.)

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  - Prec=89.2%
  - Recall=96.1%
  - F1=92.5%

- Validation with data from the grid operator

**ODRÉ**  
OPENDATA RÉSEAUX-ÉNERGIES

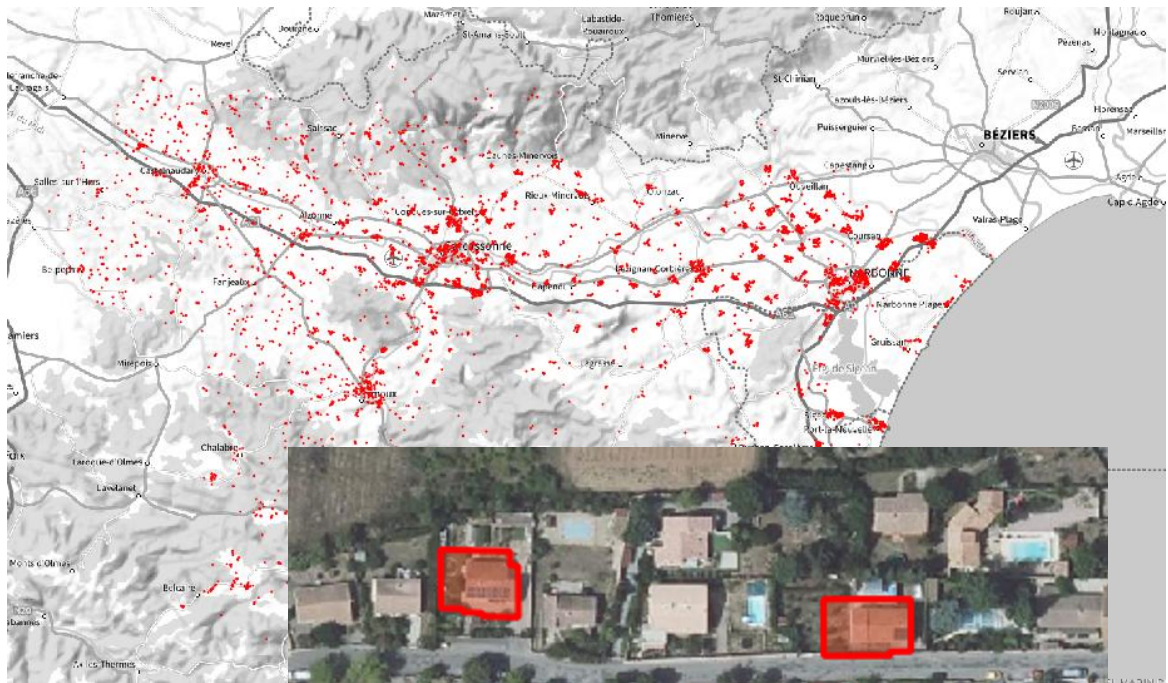
Rte  
Le réseau  
de transport  
d'électricité  
France  
mobilité  
BIOGAZ  
LA COOPÉRATION EN ÉNERGIE

**natran**  
**elengy**

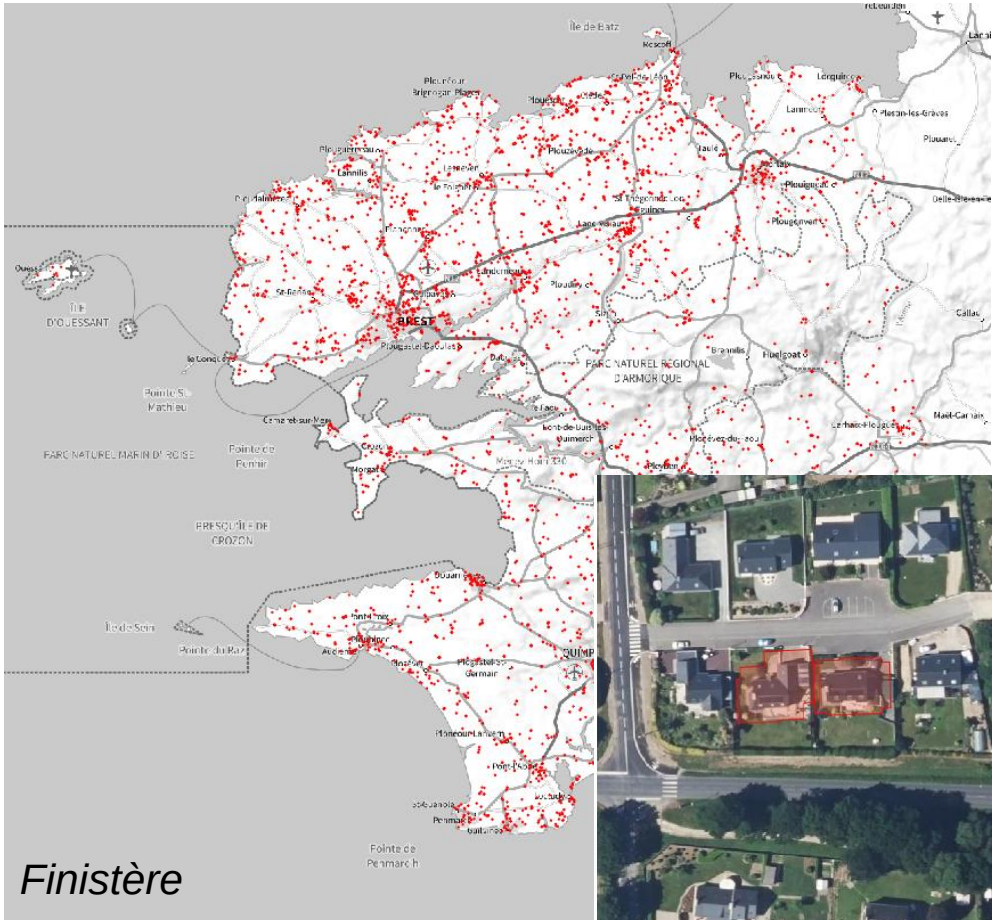
**storengy**  
**TERÉGA**

**dunkerque LNG**  
fluxys  
**weathernews**

# Department scale

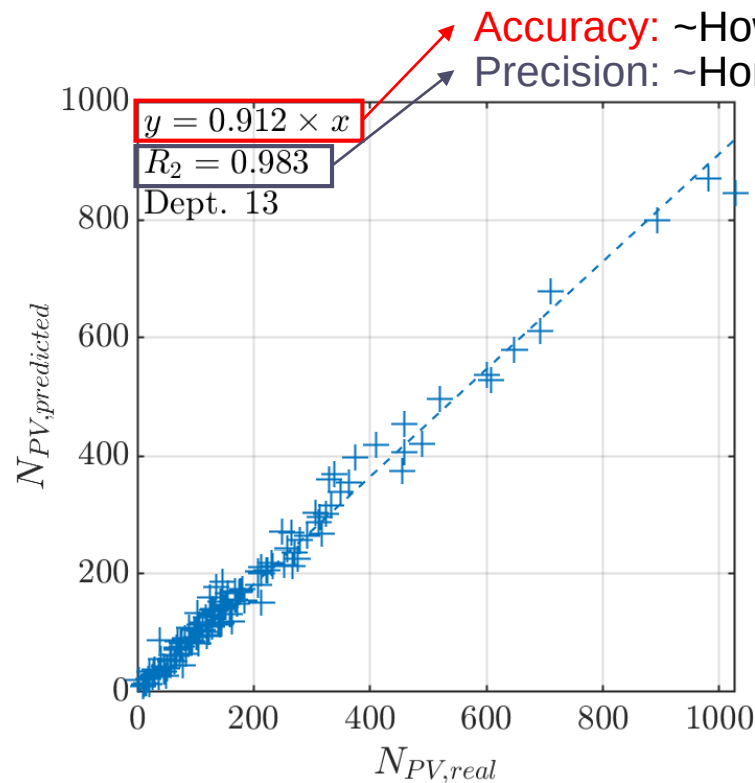


Aude

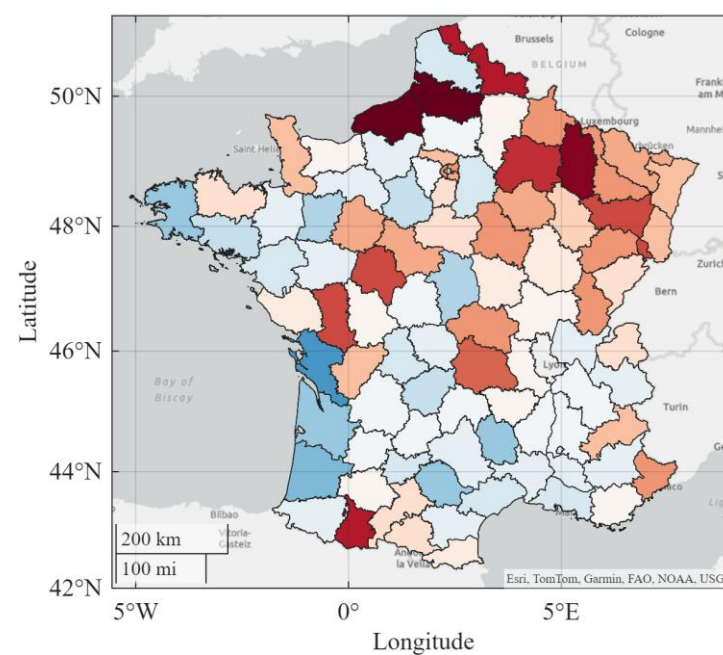


Finistère

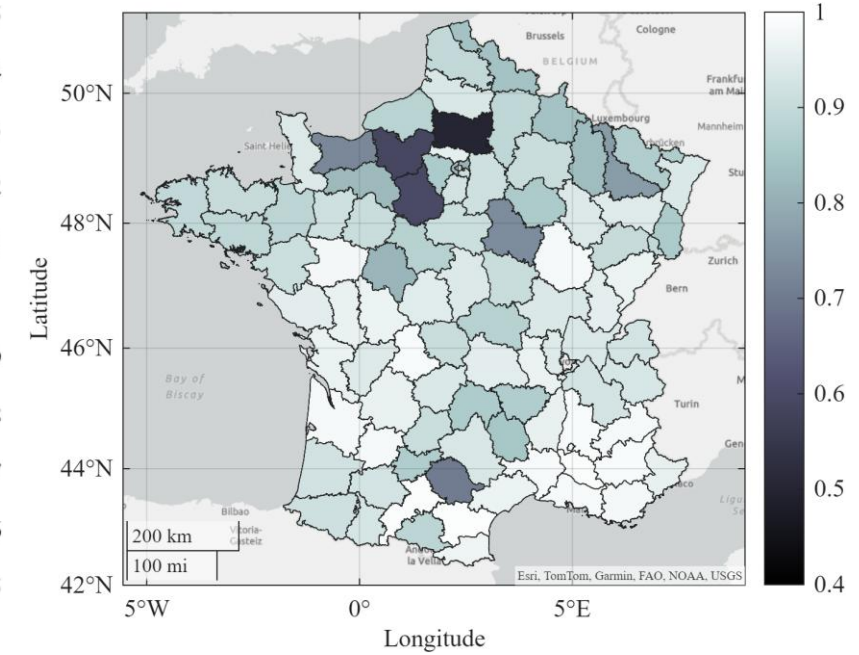
# Results for each municipality and validation with Grid Operator (DSO) data (ENEDIS)



Number of installations (Prediction) VS  
Number of installations (Real)



Accuracy

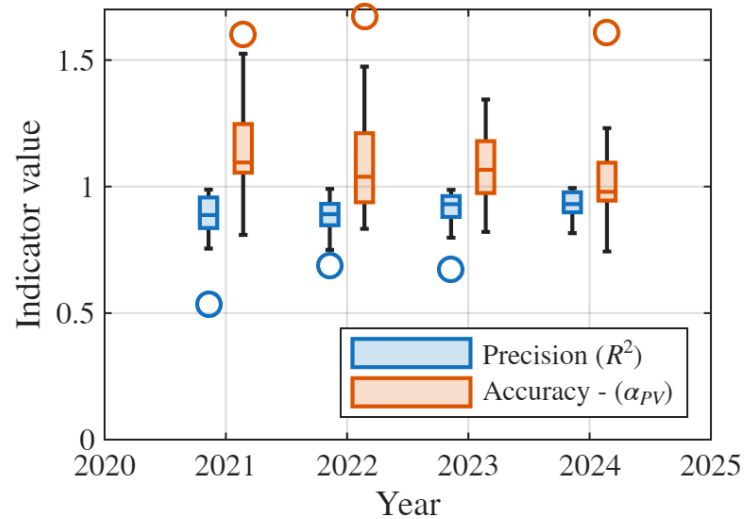
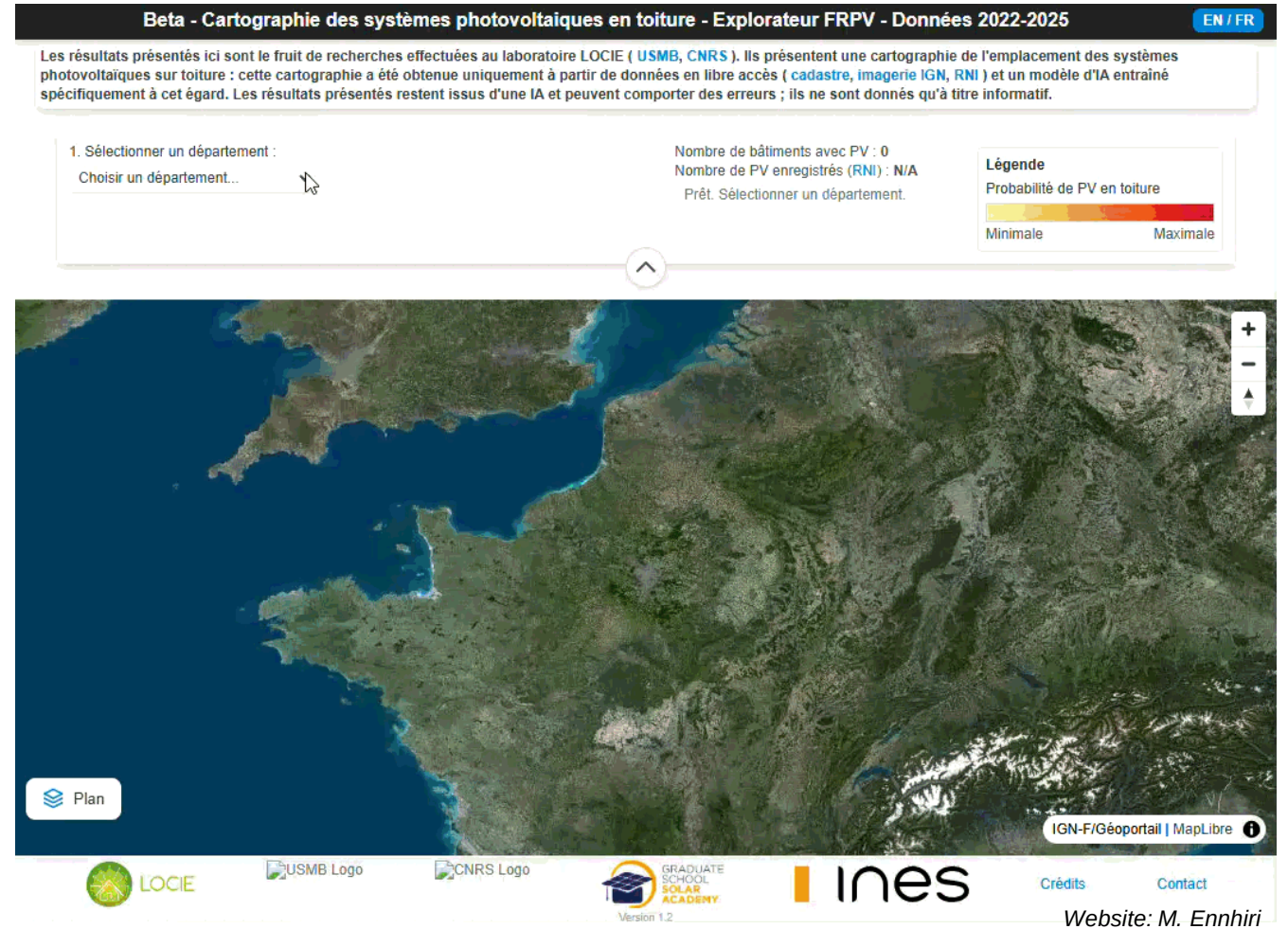


Precision

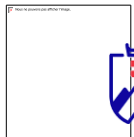
- Good agreements
- Differences either due to the model, the image quality, the building footprint or the official PV registry

# Results at the national scale

- 40 millions buildings scanned
- 800 000 RPV systems identified (2022-2024)
- Strong correlation with ground truth in more than 34 000 municipalities
- Updated every year (last update sept. 2025)
- All data are in **open access** (3 databases, 1 tool, 1 website)



# Données LiDAR et orthophotos pour la cartographie de la production photovoltaïque Française



# DOLMEN : From classification to power estimation

First full département: *Tarn-et-Garonne*.

5 058 panels detected, 99.1 % bound to a roof plane. The map below is the live database overlaid on satellite imagery — colour = azimuth.

**1 641**

tiles processed  
99.4 % of 1 651 — in 1 h 16 min

**5 058**

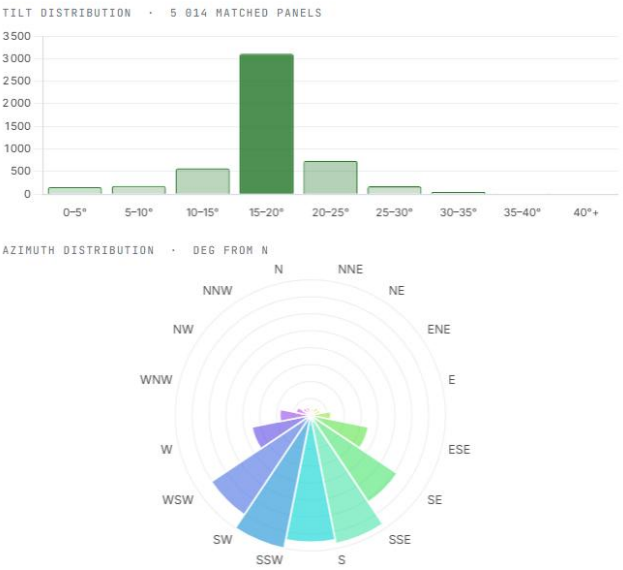
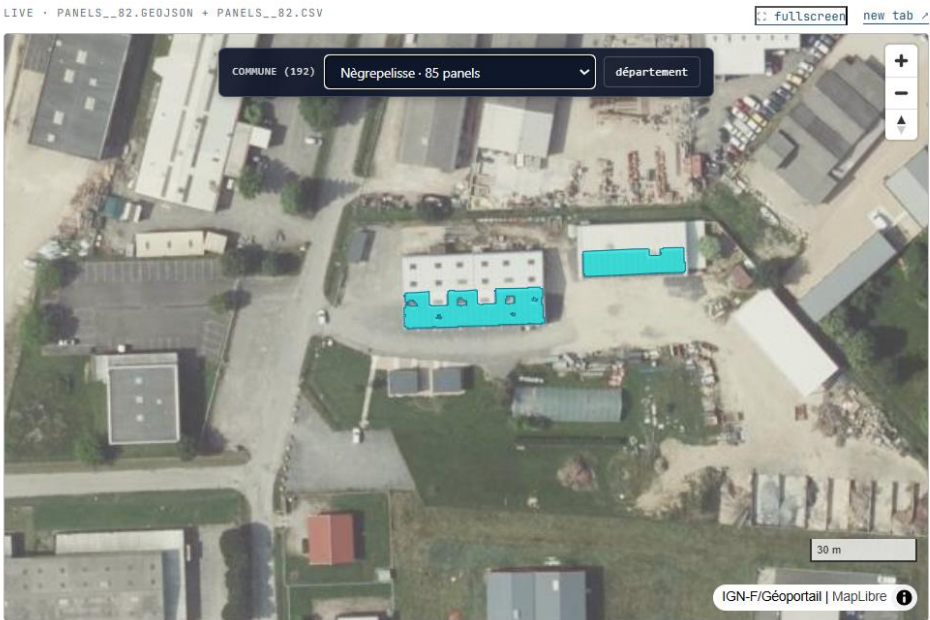
panels detected  
across 4 190 buildings

**99.1 %**

have tilt + azimuth  
3-tier match · nothing dropped

**364 301**

m<sup>2</sup> of true inclined surface  
+4.0 % vs flat 2D area



**Collaborations:** RTE, PSL, NTNU Trondheim, Observatoire de l'Environnement de Bretagne, Agglomération de Pau

