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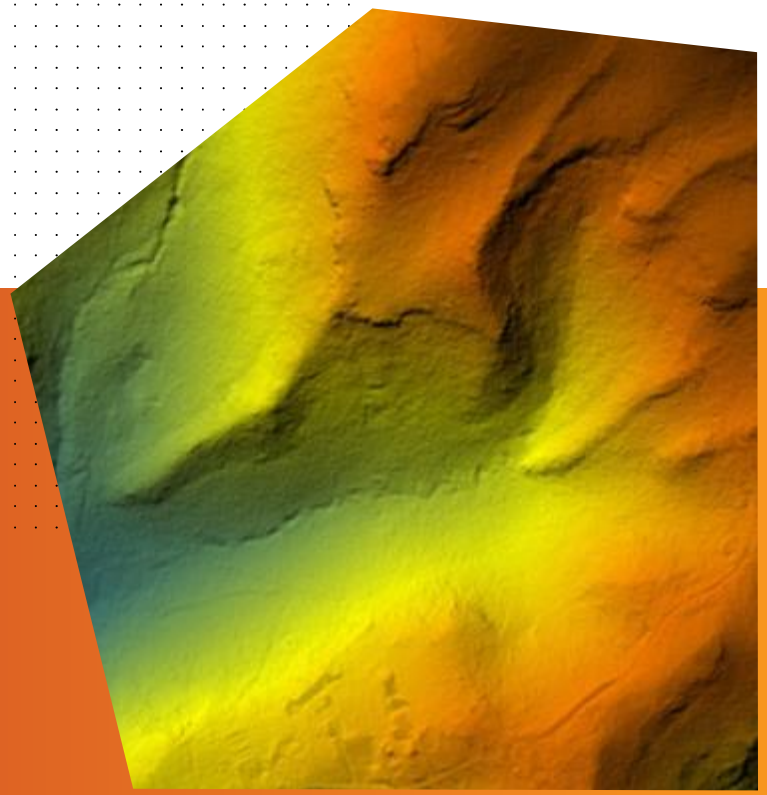

DEEP LEARNING EXPERIMENTATIONS

First steps in introducing deep learning into major IGN data production processes

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4. Zoom on timber : data generation
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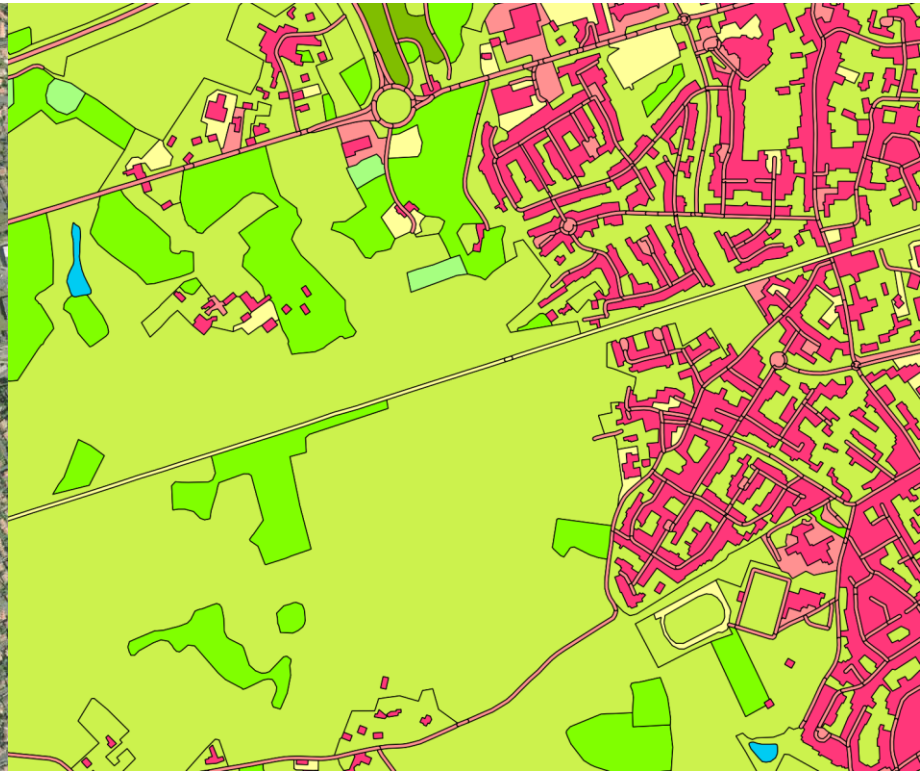
Illustrative example

Land artificialisation monitoring based on OCS GE, a land cover/usage map

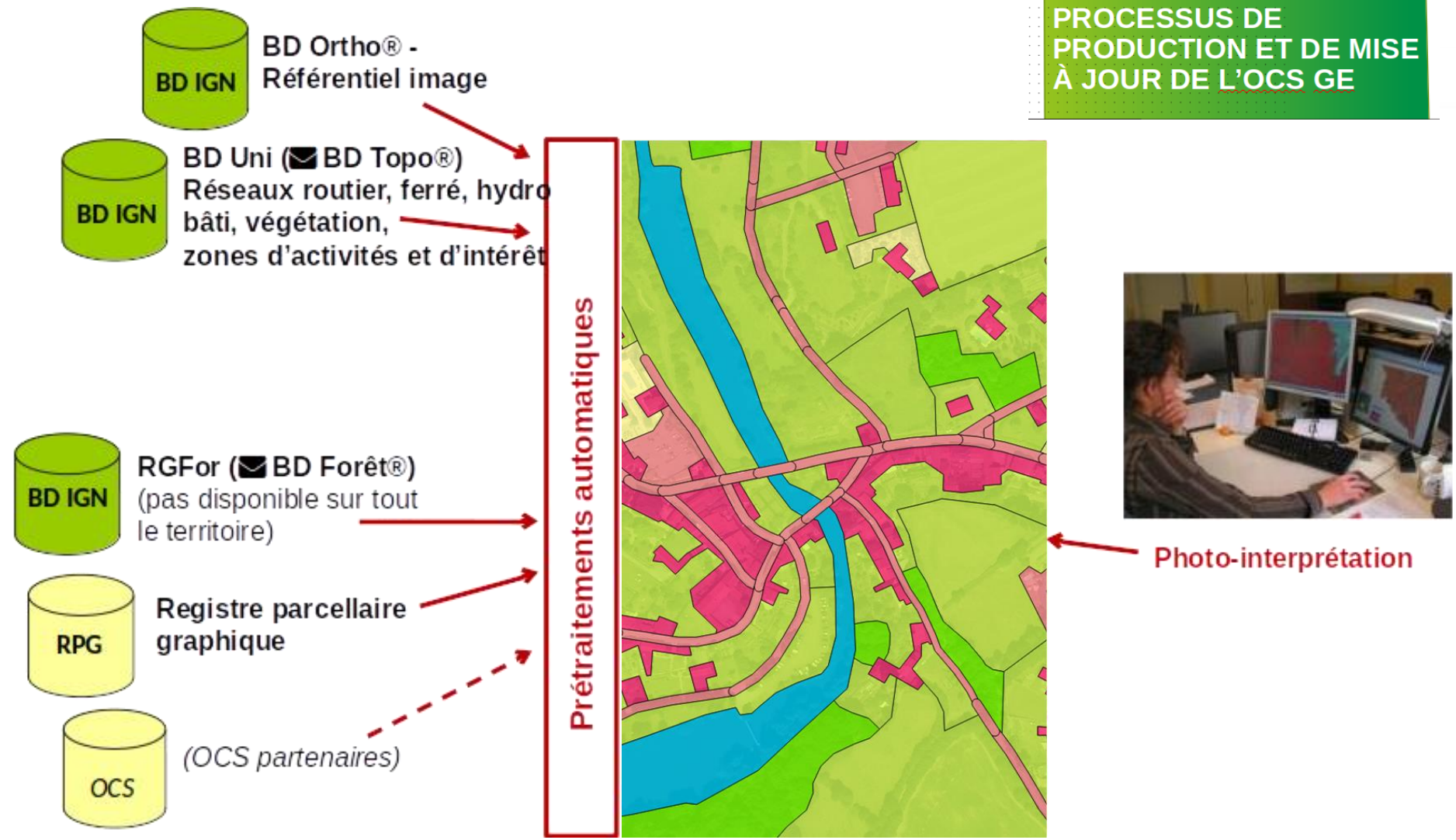
ORTHO HR®



OCS GE

Orthophotos (25cm/pix), Land Cover (14 fields)

ÉVOLUTION DU PROCESSUS DE PRODUCTION ET DE MISE À JOUR DE L'OCS GE



Current process

Current project using OCS GE

OCS GE Qualities / Defaults

- better definition than other land cover products
  - Corine Land Cover : 25 ha
  - OCS GE : 200 up to 2500 m²
- sufficiently detailed to build land artificialisation indicators
- updated every 3 years (French territory)

- complex to build
  - lots of external sources
  - lots of manual processes
  - change detection and updates processes are not yet fully defined

Expected improvements

- **minimizing** the number of external resources
- **limiting** manual work
- **shorter** chain of process
- computation launched **as soon as** the orthophotos are produced
- **no need to wait** for updated databases
- **stability** of the detection year after year

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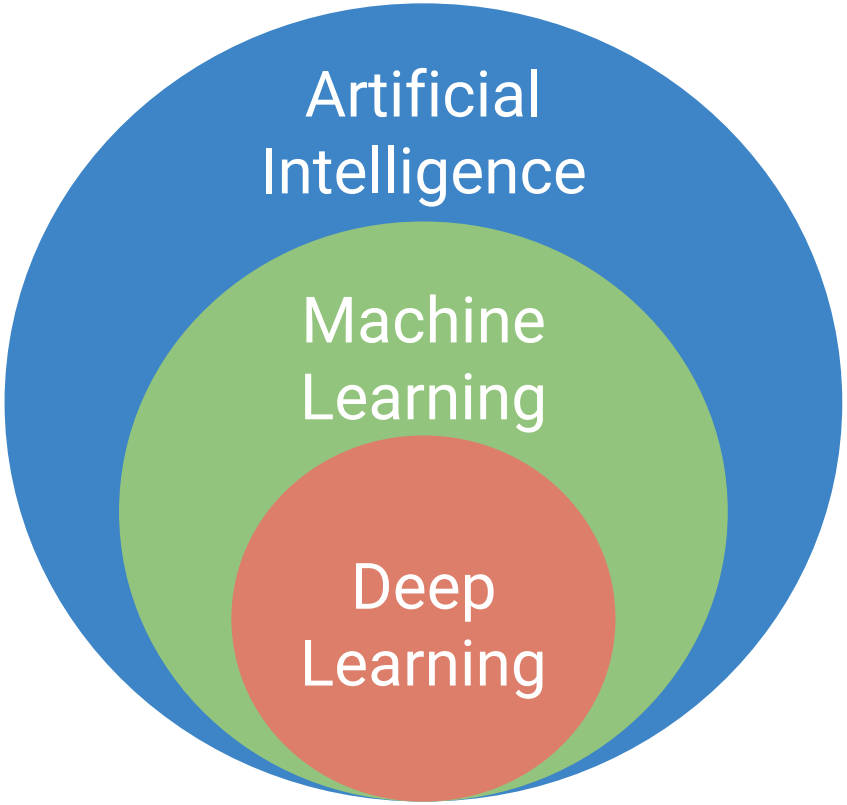
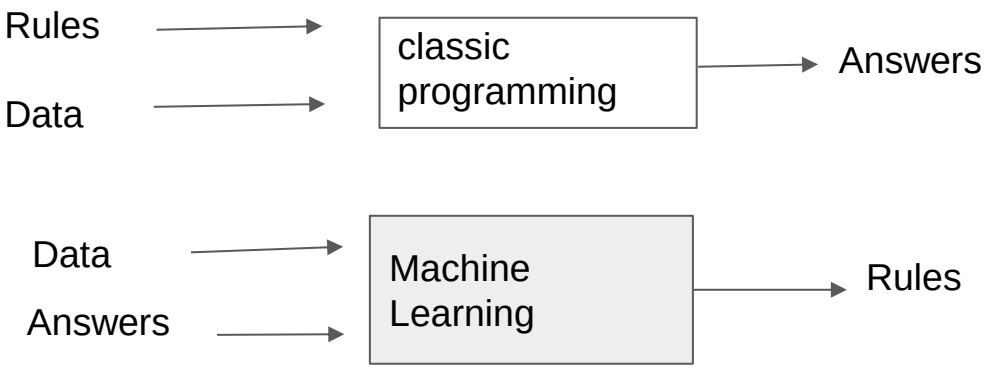
Deep Learning 101

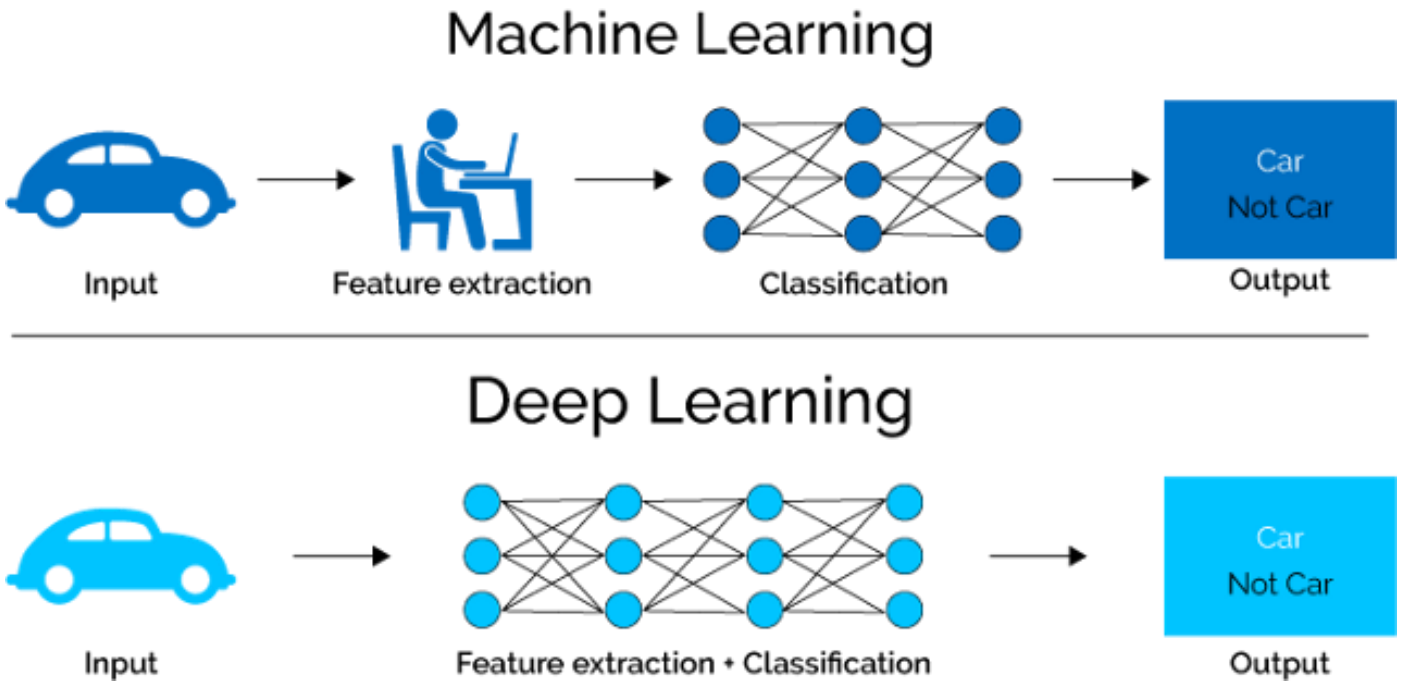


AI domains :

- planification
- natural language processing
- optimisation
- expert systems
- games
- ...

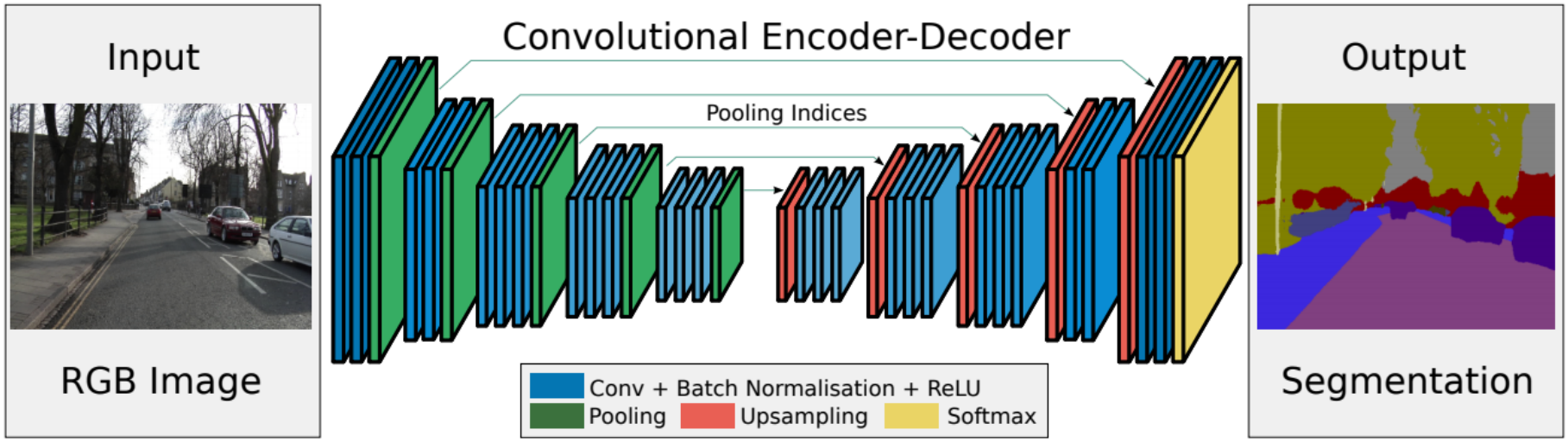


Machine Learning vs Deep Learning



- Less manual work
- Proven better than ML for image interpretation

At the core of deep learning : a model



Model architectures :

- **Convolutional Neural Network** (image, video)
  - image classification
  - object detection
  - **semantic segmentation**
- Recurrent Neural Network (temporal data, text, sound)
- Generative Adversarial Network (image, text, sound)
- ...

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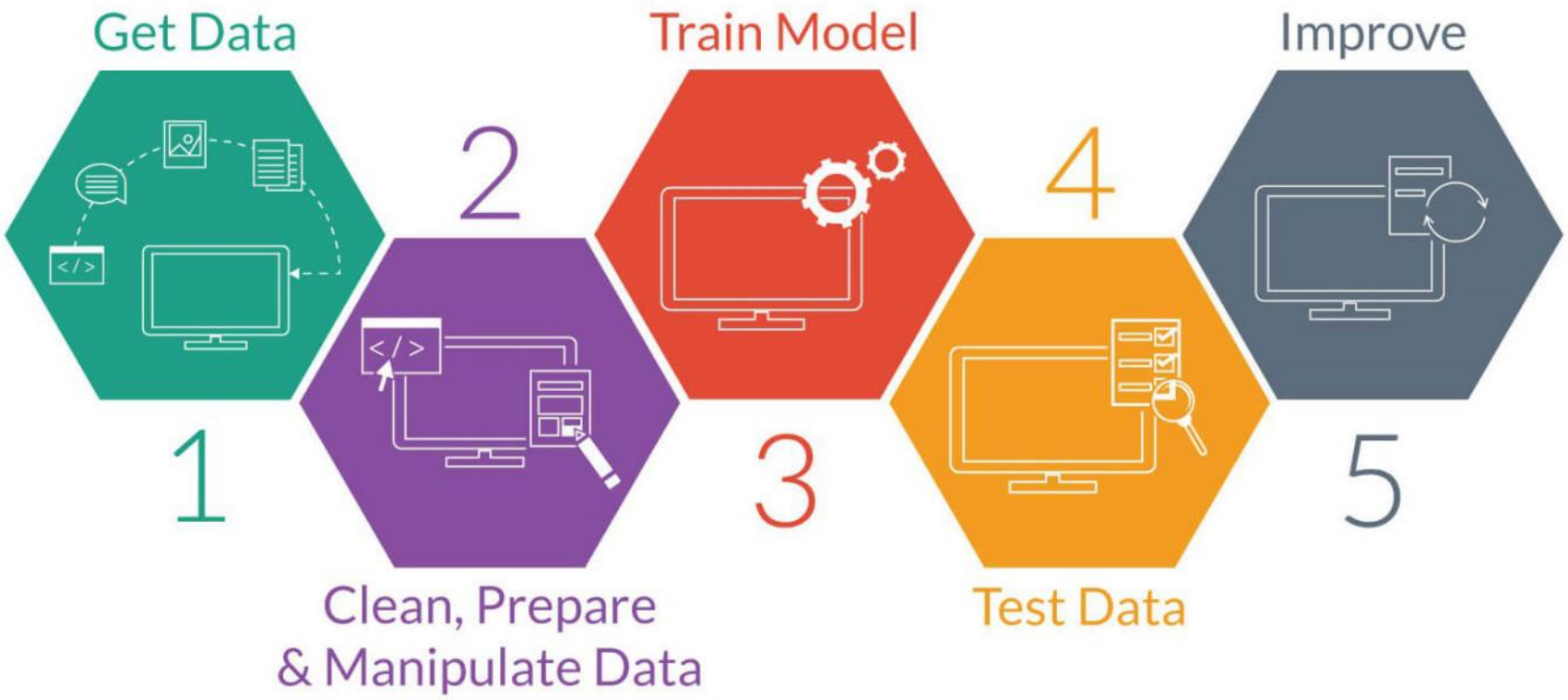
Deep Learning workflow (before deployment in production)



Once the models are stabilized and adequate
→ Integration into a production pipeline

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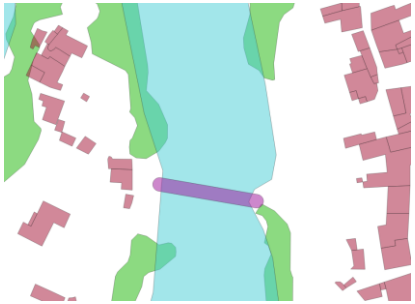
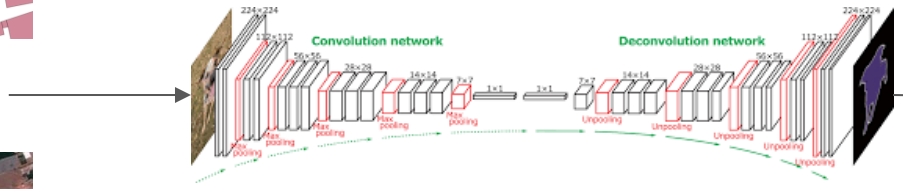
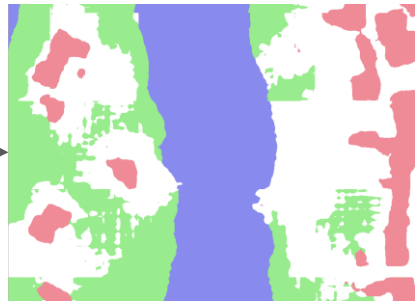
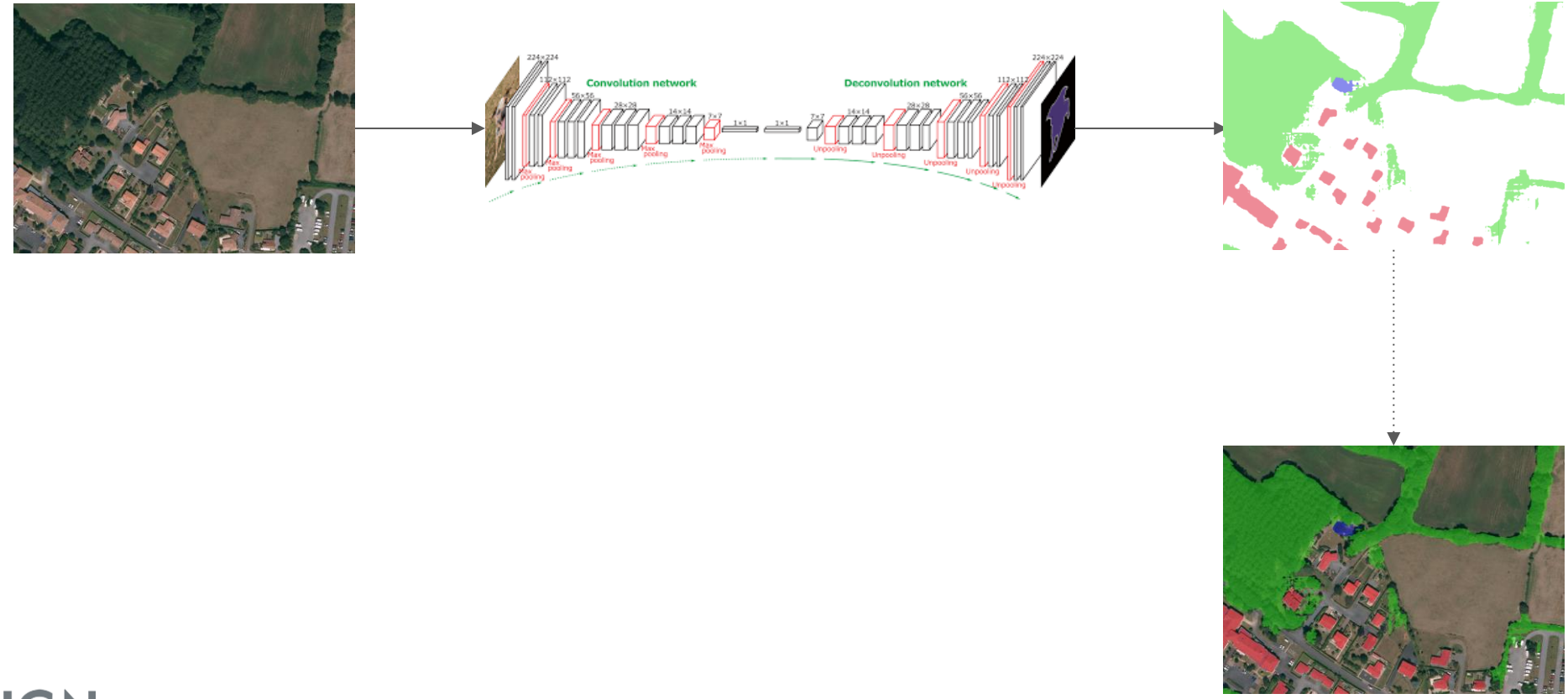
Deep Learning : learning phase







Deep Learning : detection phase



Insights from a year of experiments

Organization - timeline

Summer 2018 (1 month)

- Gathering of r**aw data** (aerial & satellite, vectorized data)
- **Infrastructure** setup
- **Data set** generation
- **Basic working codes** for several objectives (forest id, detection of change in buildings, building segmentation)

Hackaton (2 days)

- **Presentation**
- **Modification** of the proposed codes
- New and better datasets
- **Evaluation** (metrics, visualisation)
- **Improvement** proposals

Termos v1 (4 month)

- More **diverse datasets**
- New **models**
- Generation of **metrics** to rank the results
- **Bigger** territories investigated
- **Multiclass** detection
- ...

Termos v2 and beyond

- **Training** of additional personnel
- New **objects** of interest
- **Target : OCS GE**

Organization - workforce and infrastructure

Developers and data specialists

- Deep Learning
- Satellite data
- BDUni
- RGFor
- OCS GE
- ...

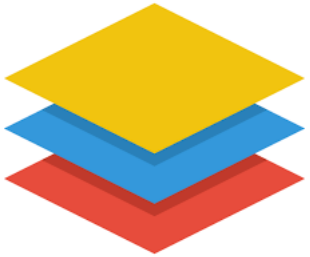
Computation power

- 6 upgraded computers with GPU (8 and 11 GB) and 32 GB of RAM
- 6 workstations for code development, data treatment, data visualisation, etc.

Lots of meetings with :

- researchers
- potential end users
- decision makers
- software developers
- ...

Mode of operation

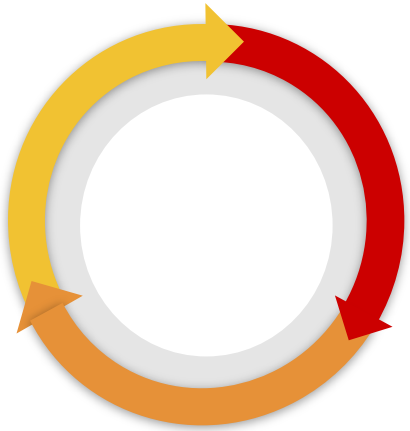


Training datasets :

- several zones in France
- several objet type

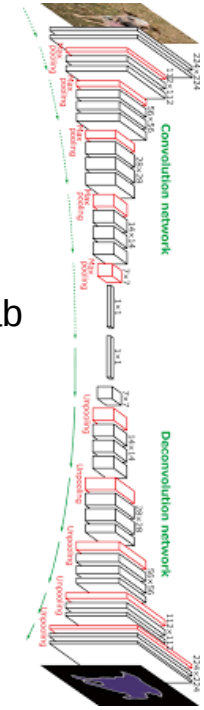
Raw data sources :

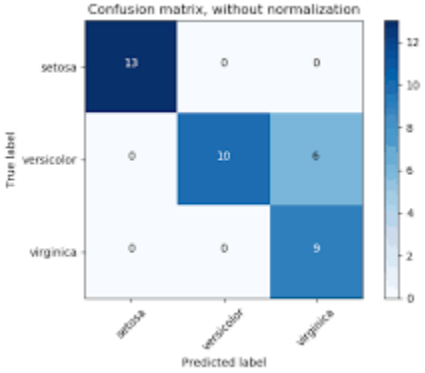
- BD ORTHO
- BD ALTI
- BD UNI
- RG For
- SPOT
- …



Models :

- UNet
- DeepLab





Evaluation :

- qualitative
- quantitative

Model **Comparaisons**
Analysis of detection failures

Ground truth from BDUNI/RGFor

Termos v1 Deep Learning output

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Zoom on timber

or how to relatively quickly build a ground truth data

What is in the database (RGFor)

What we need : exhaustivity

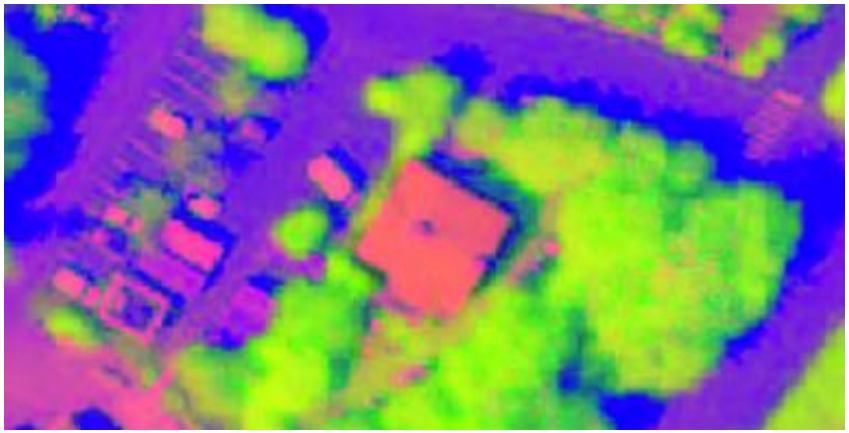
Methodology using Orfeo toolbox

Apply a geometric segmentation at the right level of detail

→ no shadows, separation between trees and grass

Use **Machine Learning**

- Manually define features (ndvi, bi2, ...)
- Apply Random Forest algorithm to distinguish timber from the rest



Orfeo ToolBox : Open Source processing of remote sensing images (https://www.orfeo-toolbox.org/)

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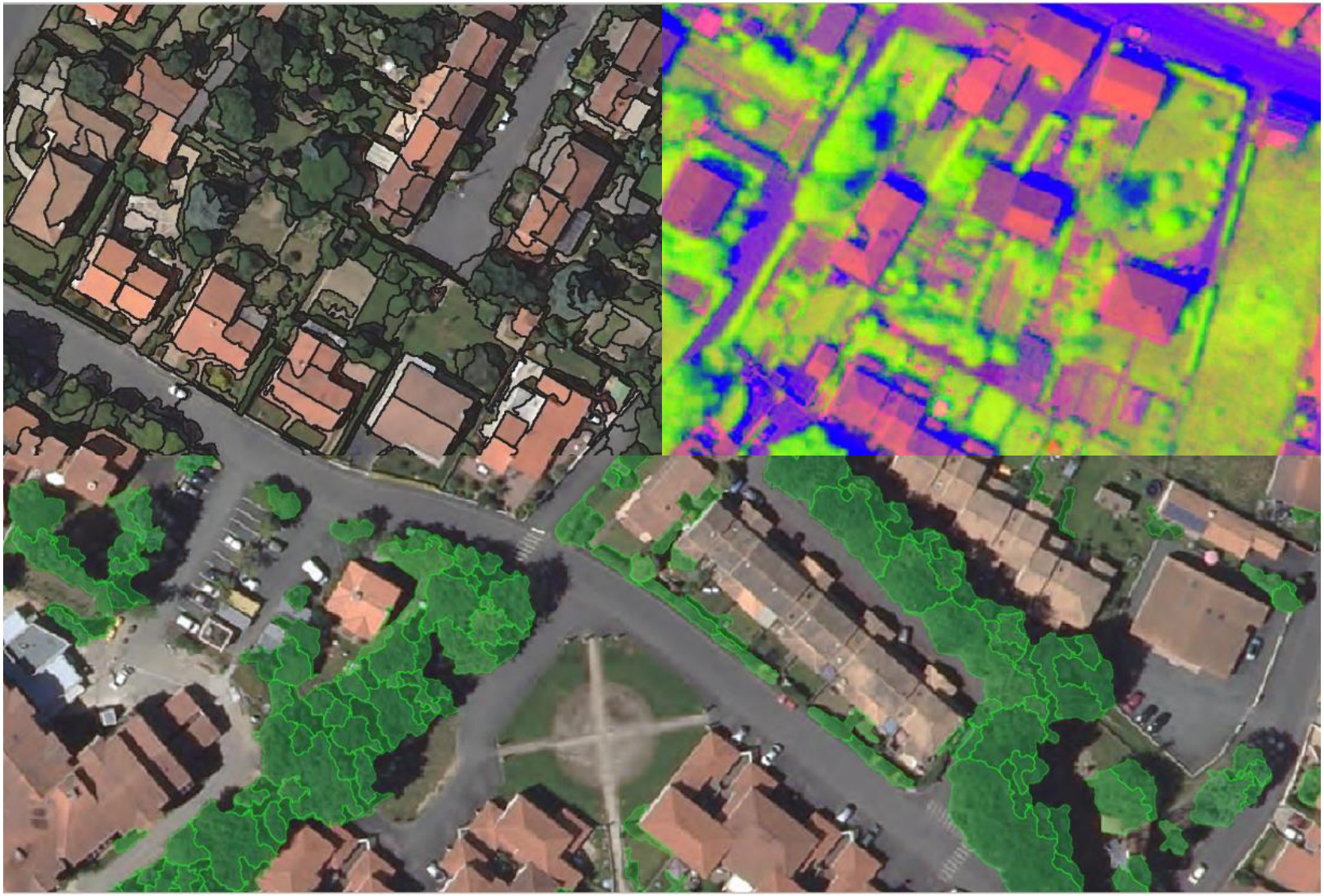

Geometric segmentation and feature representation (top)
Machine learning output (bottom)

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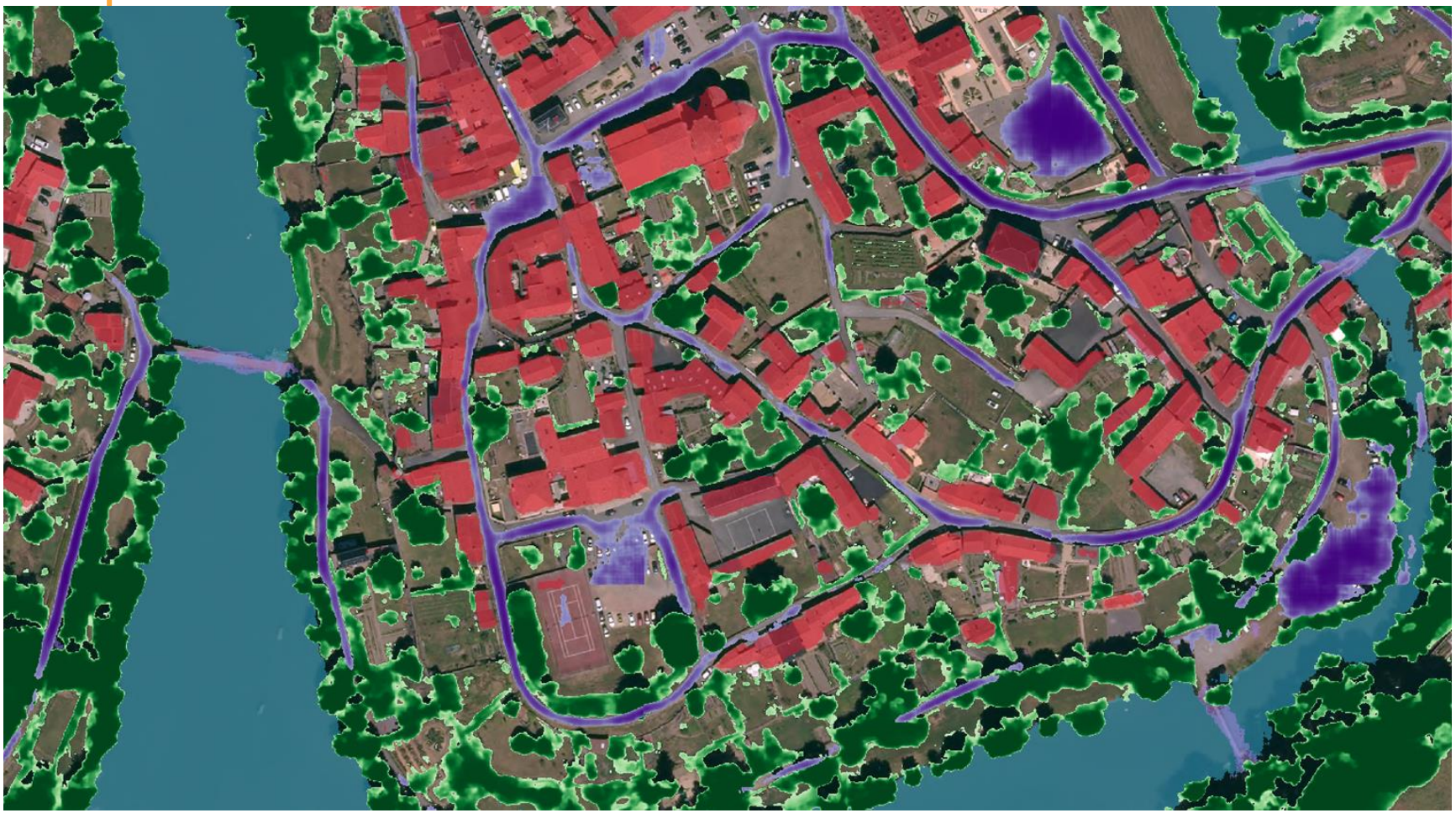
Summary and perspectives

Up to date results : better timber, work in progress on asphalt



What is a “good data” ?

Nomenclature

- IGN: complex (minimum surface, mixed component)
- DL: what you see is what you learn / get

Visual rendering

- IGN: vector
- DL: raster

Semantic

- IGN: usage or cover
- DL: mostly cover

IGN strength

We are currently in the process of producing a very accurate and clean dataset for **urban areas** (with 7 general classes and several subclasses) in France (10 "departements" from 2015 up to 2018)

→ datasets are the most valuable asset in the Deep Learning community (famous dataset : ImageNet, Mapillary, ...)

We have access to more data, particularly height information, close infrared images

→ allows us to limit the size of dataset (<< 1M samples) but we can't profit from pre-trained models

Perspectives

- Change detection and alert system
- Accelerate the update of main IGN databases (BDUni, RGFor, ...)
- Fault detections during the transformation from PVA to orthos photos
- Real time Mobile Mapping
- ...

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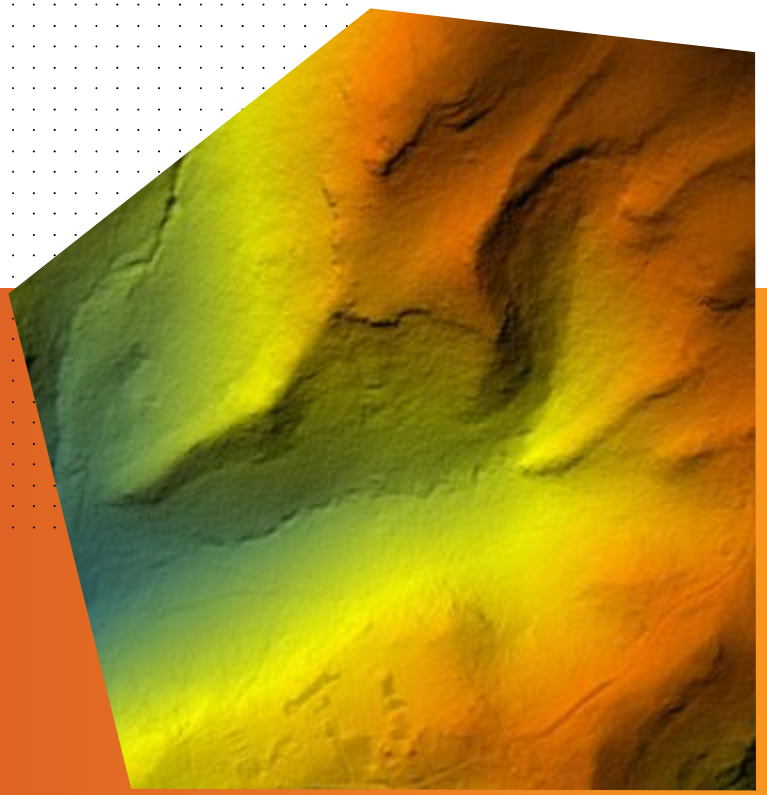

THANK YOU FOR YOUR ATTENTION

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