RÉPUBLIQUE
FRANÇAISE

Liberté
Égalité
Fraternité

IGN
INSTITUT NATIONAL
DE L'INFORMATION
GÉOGRAPHIQUE
ET FORESTIÈRE

Institut national de l'information géographique et forestière

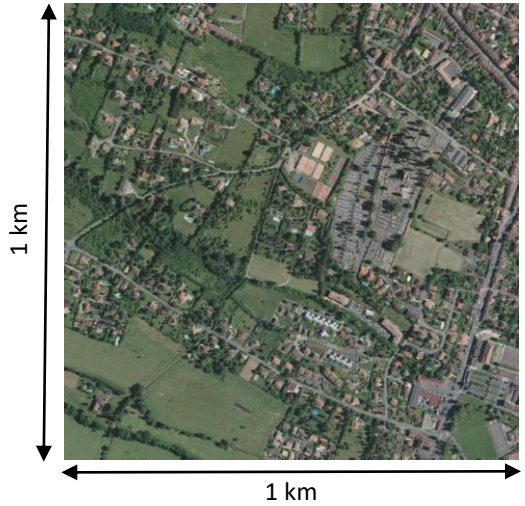
AI for the production of a land cover layer

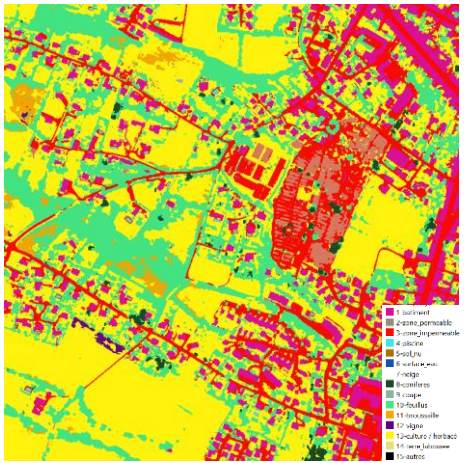
Artificial Intelligence (AI) > Deep learning > Semantic segmentation > **CoSIA**

AI task
Predict pixelwise land cover with a semantic nomenclature of 16 classes

AI nomenclature :

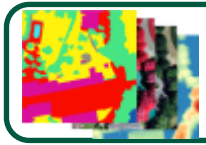
- Different from OCS GE
- Only land cover (**no land use**)
- Pixel-level (20 cm)
- Has flexibility w.r.t. OCS GE needs = can evolve



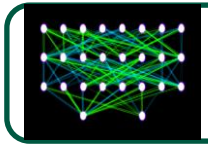


Building AI Commons

a- Annotations



b- Training datasets



c- Models

d- Predictions (CoSIA)

Takeaway #1

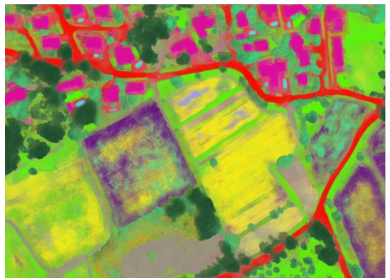
- Producing national high-resolution land cover mapping with the help of ML techniques has proven to be successful
- We are exploring the use cases of some of its byproducts we consider particularly valuable (models, CoSIA…)
- Now that a new production process is in place, there is room for a lot of further improvement and there are still many challenges!

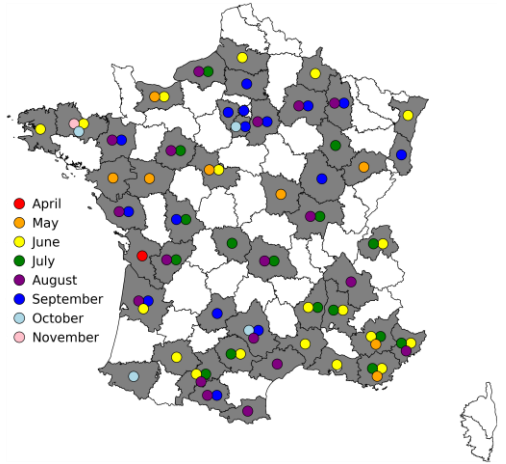
CoSIA current production

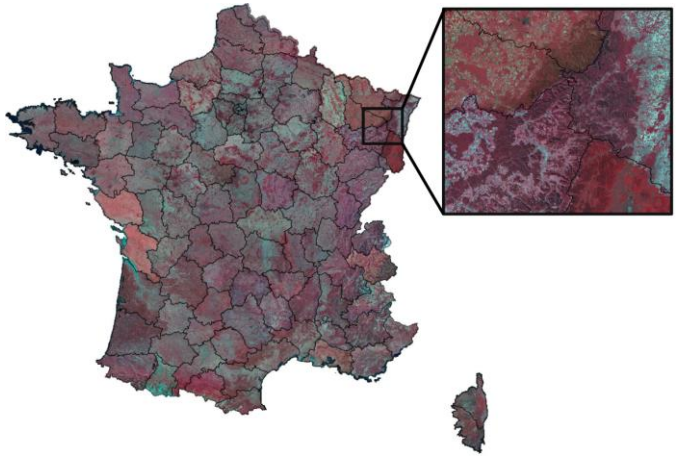
OA (%)	RVB	RVBI	RVBIE
U-Net	85,2	85,7	86,2

Great results ! But some remaining **errors**…

- Weak attributes for crops/vines with linear pattern
- Confusion between pervious surfaces and bare soil
- Confusion between greenhouse and building for certain roof types
- AI generalization capabilities (spatial and temporal)
- Prototype available http://preprod-cosia.ign.fr
- Webinar 10/10







Scientific challenges : FLAIR

FLAIR
French Land cover from Aerospace ImageRy

Being at the forefront of AI = very time/resources consuming
→ Share and involve the scientific/technical community through challenges !

Objectives:

- Provide high value-added learning data and codes
- Federate the scientific and technical community around a research axis
- Foster collective brainpower

(Nov. 2023 -> March 2023) **FLAIR # 1 : Semantic segmentation and domain adaptation**

- 10k€ won for the three winners
- ~ 300 participants with > 1600 submissions
- ~ + 10 mIoU points exploiting newest architectures and data mining

	mIoU
baseline	54.56
1ère place	65.92
2nd place	65.60
3ème place	64.93

https://ignf.github.io/FLAIR/#FLAIR1

Attempting to resolve the remaining bottlenecks: data fusion aerial - satellite

Despite gains following the first challenge, still room for improvements !
Especially surfaces with **phenological patterns** (agriculture/forests/herbaceous cover..)

Sentinel-2, great candidate !

- High temporal resolution (5 days vs. 3 years..)
- Multi-spectral resolution (10 bands vs. 4 bands)

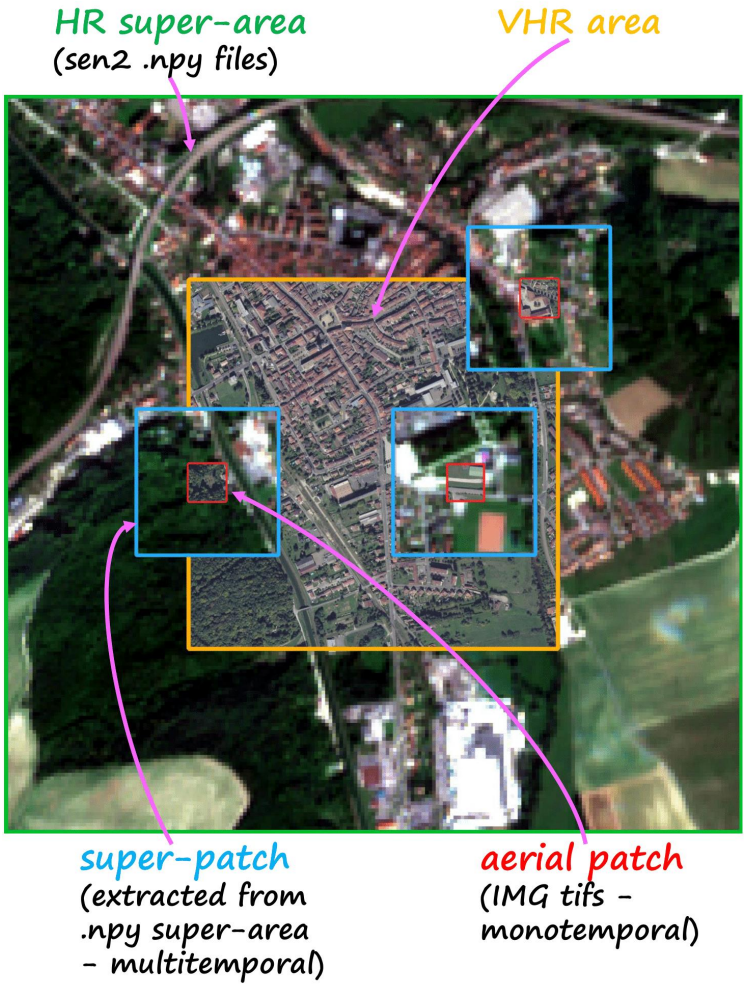
FLAIR #2 : textural and temporal information for semantic segmentation from multi-source optical imagery

→ data fusion methods to combine VHR aerial imagery and HR Sentinel-2 time series !
→ Organized with ENSG and CNES and supported by an FPCUP
→ Launched May 25th on CodaLab

FLAIR #2: data fusion aerial - satellite

Challenges :

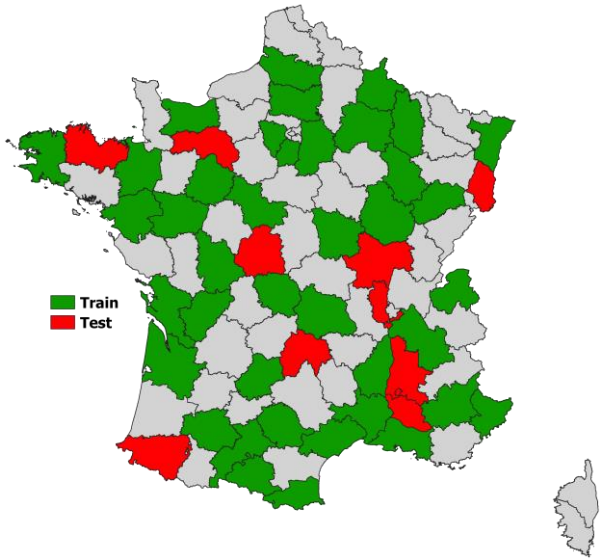
- Multi-resolution: IGN ortho @ 20 cm , Sentinel-2 @ 10 m
  - ❖ Super-areas and super-patch strategies to provide broader spatial context + sufficient Sentinel-2 pixels



FLAIR #2: data fusion aerial - satellite

Dataset figures

- ➔ 20,384,841,728 pixels annotated at 0.20 m spatial resolution
- ➔ 77,762 patches (512×512)
- ➔ 51,244 satellite acquisitions with broader spatial context
- ➔ 50 spatio-temporal domains and 916 areas covering 817 km²
- ➔ 13 semantic classes (+ optional ones)

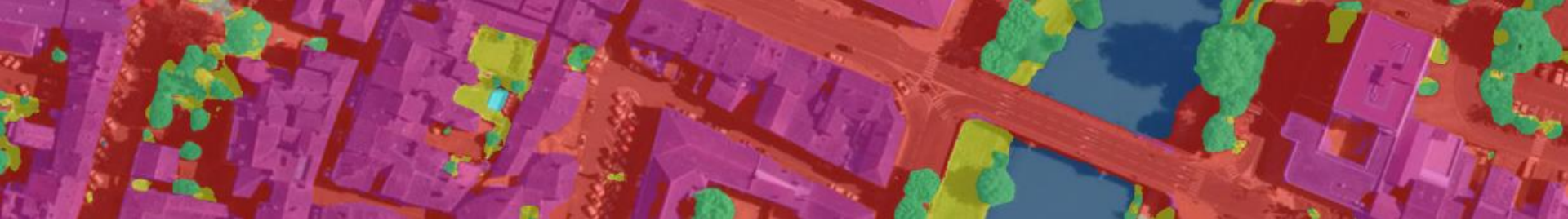


Takeaway #2 : Main outcomes

- Interest of a variety of actors (public/private ; geodata / AI ; academic / operational…). ~300 registrations ; ~50 submitters.
- Some insights on how to gain performane (attention-based models ; model ensembling ; use of S2 data…)
- Great way to share the operational challenges with academic communities
  - **Accepted at NeurIPS 2023!**
- A great entry point for those interested in our AI activities

Takeaway #3 : Important features of the challenges

- Large-scale, diverse, high-quality labels…
- Constructed with a production context in mind
- Built around scientific questions that are relevant for multiple settings (geographic generalization ; multi-sensor deep learning strategies…)
- Lots of data preparation
- Relevant baseline work



- Challenge page : https://codalab.lisn.upsaclay.fr/competitions/13447
- FLAIR dataset and context page : https://ignf.github.io/FLAIR/#FLAIR2
- FLAIR #2 GitHub : https://github.com/IGNF/FLAIR-2-AI-Challenge