# ai4ge

**An automatic 3D geospatial information capability**

Simon BAILLARIN (CNES)

simon.baillarin@cnes.fr

QUANTCUBE TECHNOLOGY · IGN · ONERA · Qwant · CS · cnes · GEOSAT · CLS · AIRBUS · bpifrance

# Outline

- AI4GEO CONTEXT AND INITIATIVE
- AI4GEO DEVELOPMENT PLATFORM
- FIRST RESULTS
- PERSPECTIVES

01

# AI4GEO CONTEXT AND INITIATIVE

# Geospatial information market booming, driven by demand for 3D

**Annual growth**
**> 12%**

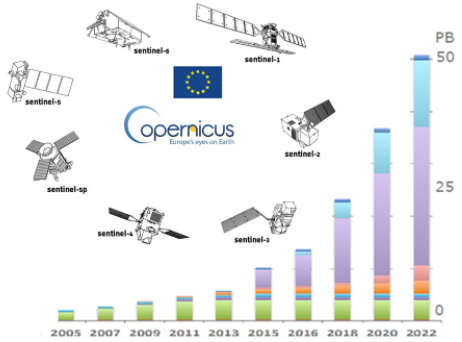
**~$100 billions**
**in 2020**

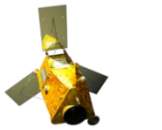
Bloomberg

Business

**Geospatial Analytics Market Size Worth $134.48 Billion by 2025: Grand View**

**Multiple markets in demand (urban monitoring, environment, economic intel, autonomous vehicles, …)**



# At the same time, multiple sources of data abound, which multiplies opportunities

**Accessible, global, high resolution (spatial, spectral, temporal)**

IOT
Internet of Things

EU Open Data Portal

QUANTCUBE TECHNOLOGY · IGN · ONERA · Qwant · CS · cnes · GEOSAT · CLS · AIRBUS · bpifrance

# Manufacturing costs and production times are too high



- AI4GEO project : to develop an automated solution for producing 3D geospatial information (3D objects)
  - Guarantee an homogeneous level of performance in reconstructing 3D surfaces
  - Process large coverage by distributing algorithms on a parallel infrastructure
  - Qualify the results according to standardized accuracy classes for downstream applications

- R&D project over 4 years, 2 axes in parallel, 9 partners.
  - AXIS 1: Technological building blocks focused on 3D imaging, segmentation and bulk processing.
    Collaborative work
  - AXIS 2: Applicative components addressing 6 industrial sectors (urban mapping, environment, autonomous vehicles, …).
    Work carried out by each industrial partners.

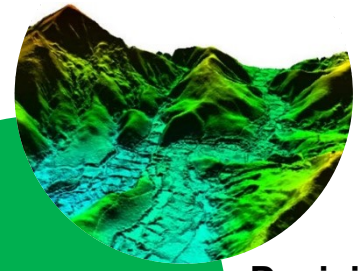
# AXIS 2 : Applicative components



Urban monitoring

3D Urban Map:
Semantic 3D mapping of cities

AIRBUS



Environment

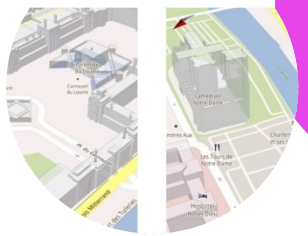
Decision support mapping
(Land use & water management)

CLS
COLLECTE LOCALISATION SATELLITES

Geospatial data management

GeoData platform

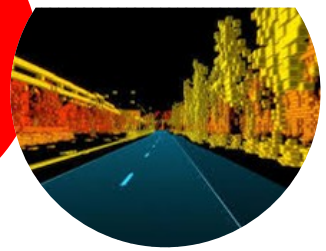
Qwant



Customer market

QwantMap 3D:
3D Search Engine

GEOSAT



Autonomous vehicles

Support for HD map production

QUANTCUBE TECHNOLOGY

Economic Intelligence

Urban growth indicator

# AXIS 1 : a 4 years collaborative work plan



**T0+48**

*Urban* : **LOD3** VHR with semantic
*Global* : Classification in VHR, based on **30 classes**, **change detection** and **characterisation of activities**.
Tests sites : 10 cities + 5 regions + 1 country
AI4GEO Platform final version

**T0+36**

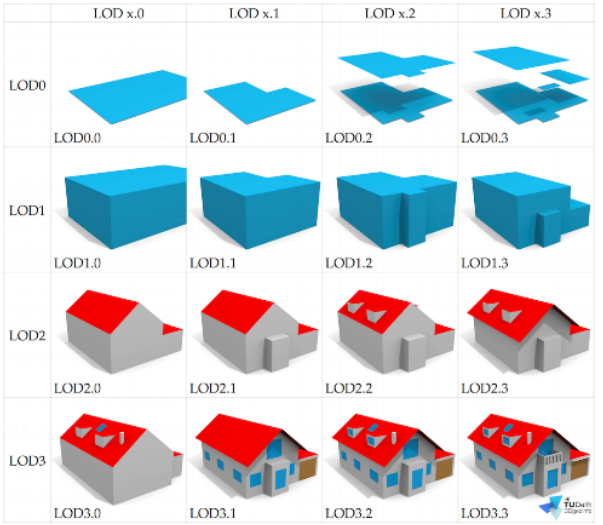
*Urban* : **LOD2** VHR **(0.5m)**.
*Global* : Classification in VHR, based on **20 classes** and **change detection**
Tests sites : 10 cities + 5 regions
Dev Platform 3rd version

**T0+24**

*Urban* : **LOD1** VHR **(1m).**
*Global* : Classification in VHR, based on **15 classes** and **change detection**
Tests sites : 5 cities + 2 regions
Dev Platform 2sd version

**T0+12**

*Urban* : **LOD0** VHR **(1m)** (building/not building)
*Global* : Classification in HR (20m), based on **10 classes**
Tests sites : 1 city (Toulouse)+ 1 region (french PACA)
Dev Platform 1st version





QUANTCUBE TECHNOLOGY · IGN · ONERA · Qwant · CS · cnes · GEOSAT · CLS · AIRBUS · bpifrance

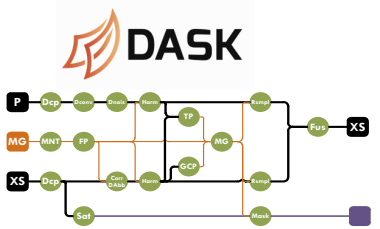
02

# AI4GEO DEVELOPMENT PLATFORM

# Concepts inherited from previous works (bulk processing)



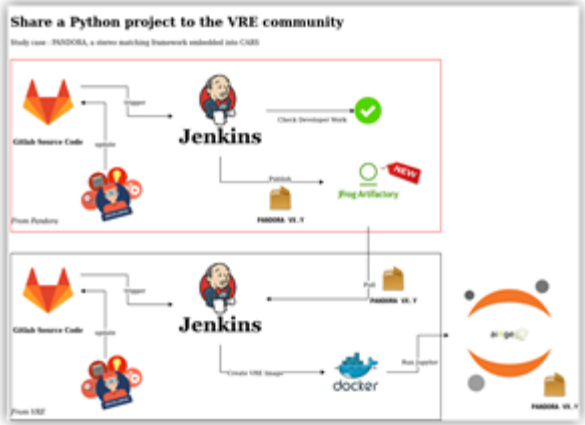
- Massive image production & scalability
  - Workflow using 2 levels of parallelization (inter node/intra node)
  - Dask used for intra node




- Interoperability and portability (HPC & Cloud)
  - Deployed on CNES HPC + OVH & Orange clouds
  - SafeScale (https://github.com/CS-SI/SafeScale) + dockerisation

SAFESCALE docker

- Acceleration of development: Agilty + Software factory



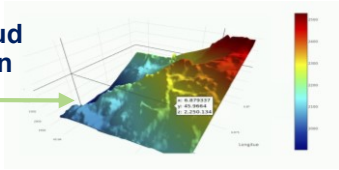

- Reference processing framework for new EO missions and platforms

# Ex. of massive 3D processing with Satellite Stereo Pipeline on OVH Cloud

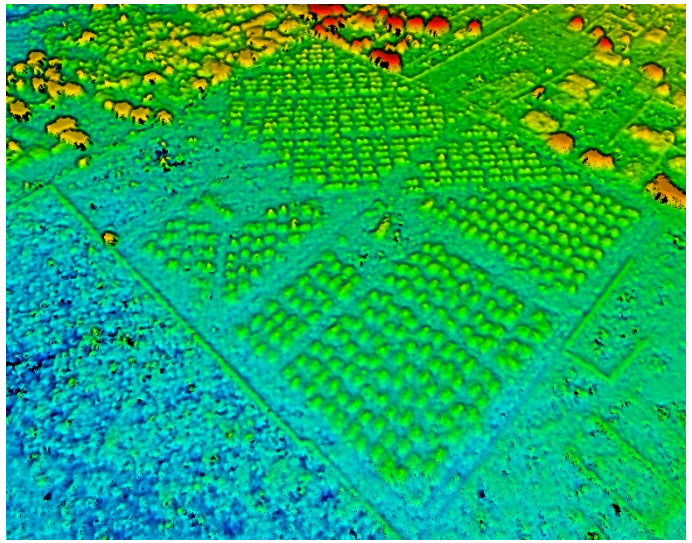


- Framework deployed on OVH cluster

SAFESCALE → Computer cluster creation and resizing → DASK → Image tiling and processing orchestration → cnes Stereo Pipeline → Points cloud production



- 3D images and DSM from Pleiades tri-stereo (**400km²**)



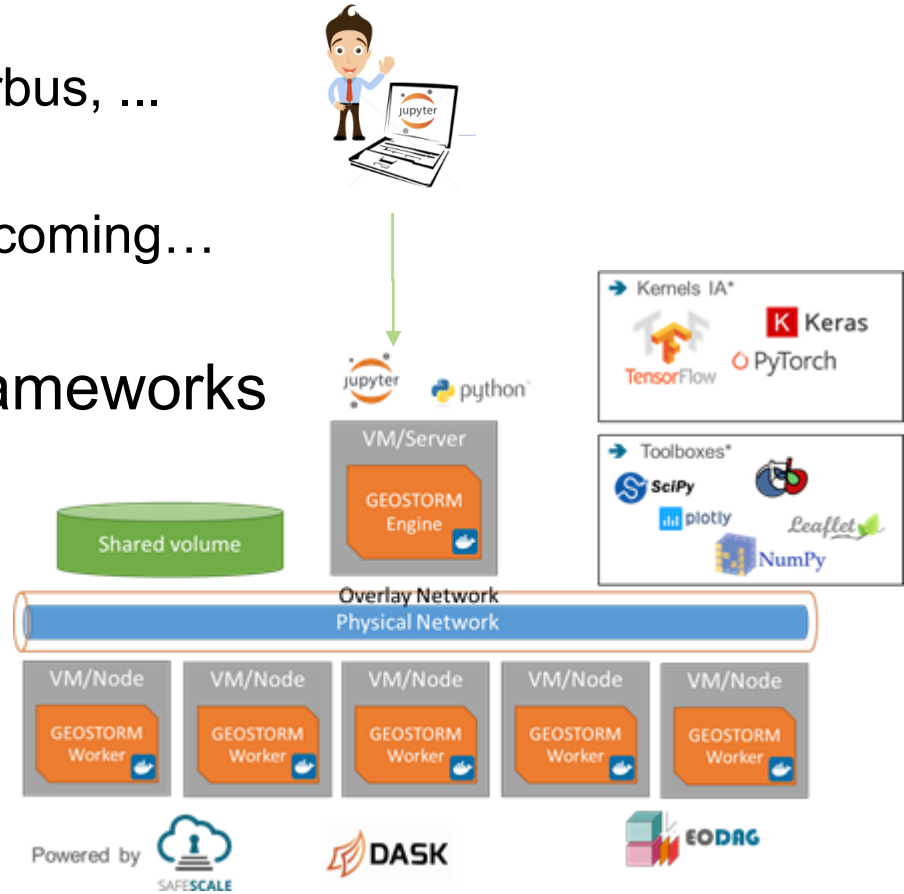
| 16 compute nodes node features | Proc. time |
|---|---|
| 32 vCPUs, 240 GB RAM, 400 GB SSD | 9 min 10s |

QUANTCUBE TECHNOLOGY · IGN · ONERA · Qwant · CS · cnes · GEOSAT · CLS · AIRBUS · bpifrance

# Processing Framework improvment for Analytics

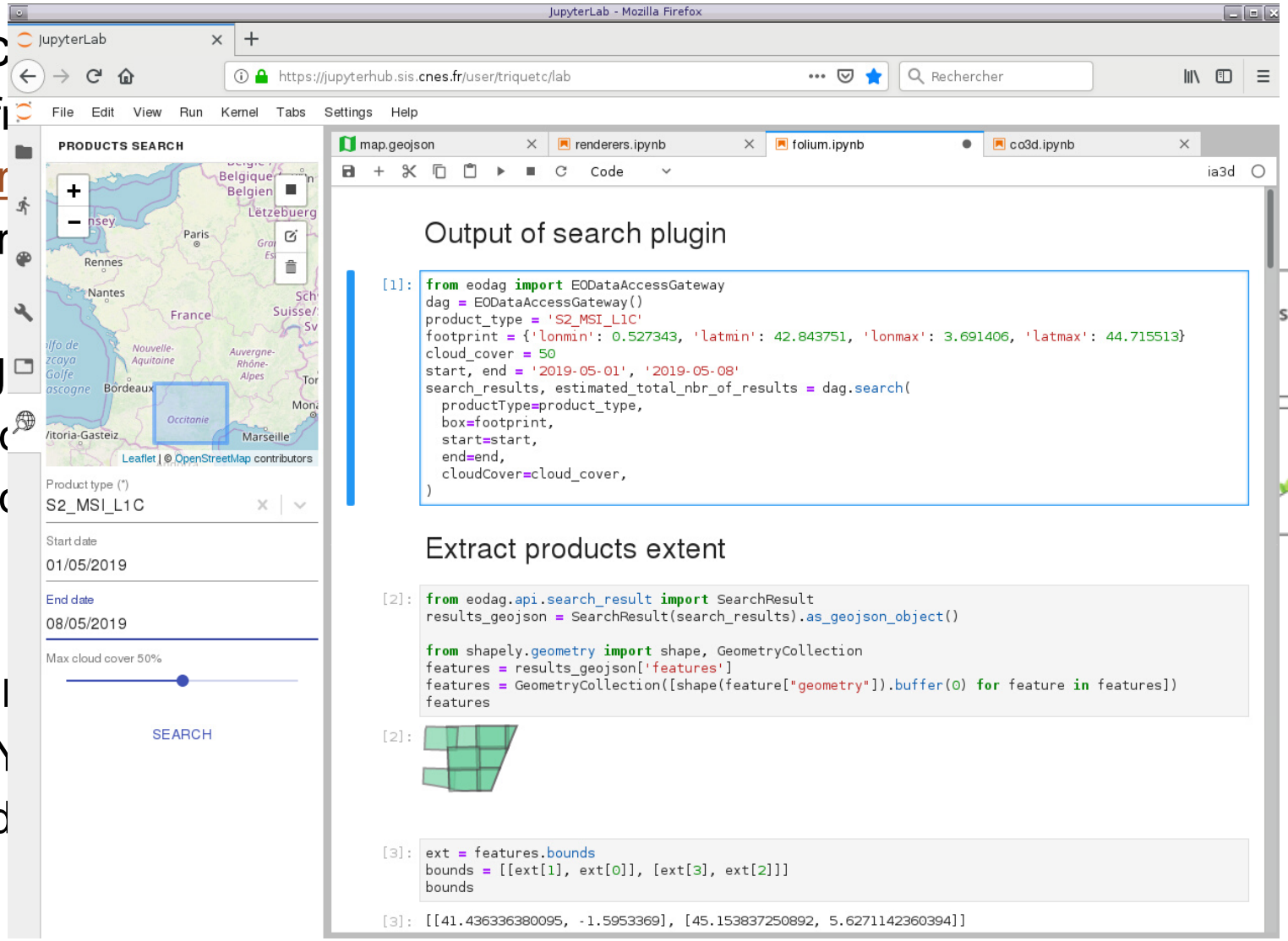


- Multi-sources data access
  - Access to catalogues from Copernicus, THEIA, Airbus, ...
  - EODAG (https://pypi.org/project/eodag/)
  - Connectors to OpenStreetMap and other sources coming…
- Foster the use of image processing and AI frameworks
  - Integration with PanGeo (DASK, XARRAY…)
  - Embed IA Kernels & processing toolboxes (OTB)
- From prototype to operational
  - interactive mode : JUPYTER
  - web native and virtual desktop (noVNC), IDE (VS Code)



# Processing Framework improvment for Analytics

- Multi-sources data acc
  - Access to catalogues fi
  - EODAG (https://pypi.or
  - Connectors to OpenStr
- Foster the use of imag
  - Integration with PanGe
  - Embed IA Kernels & pr
- From prototype to oper
  - interactive mode : JUPY
  - web native and virtual d

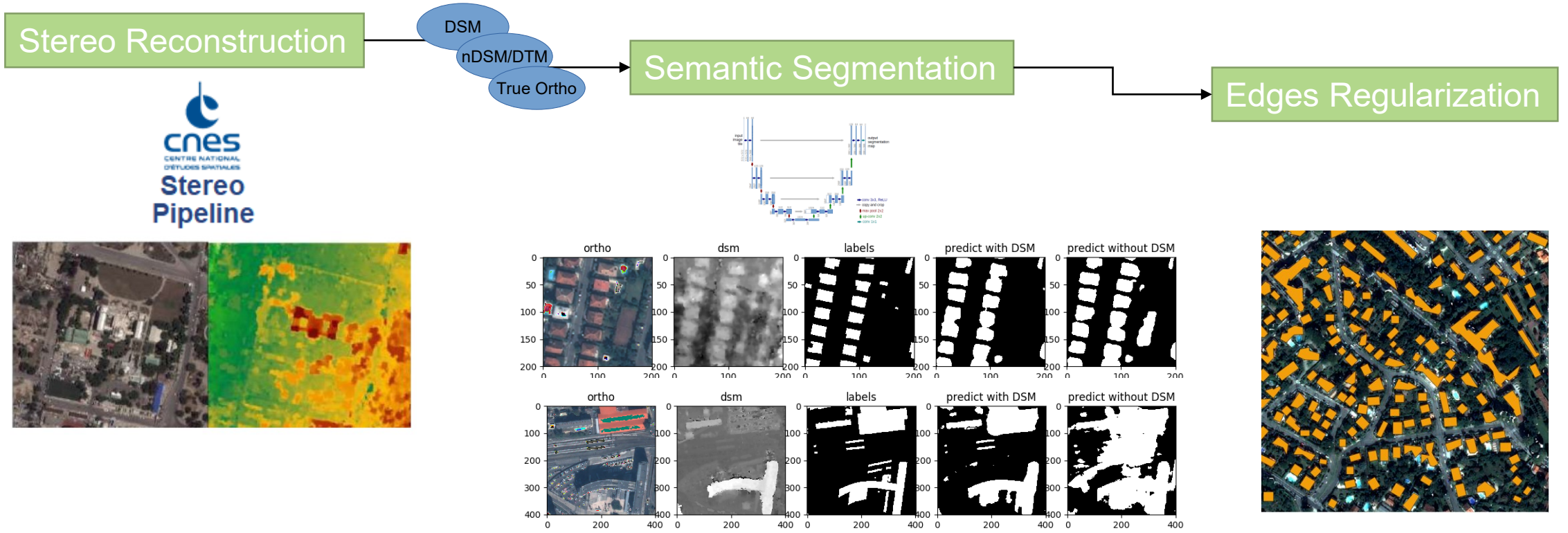


03

# FIRST RESULTS

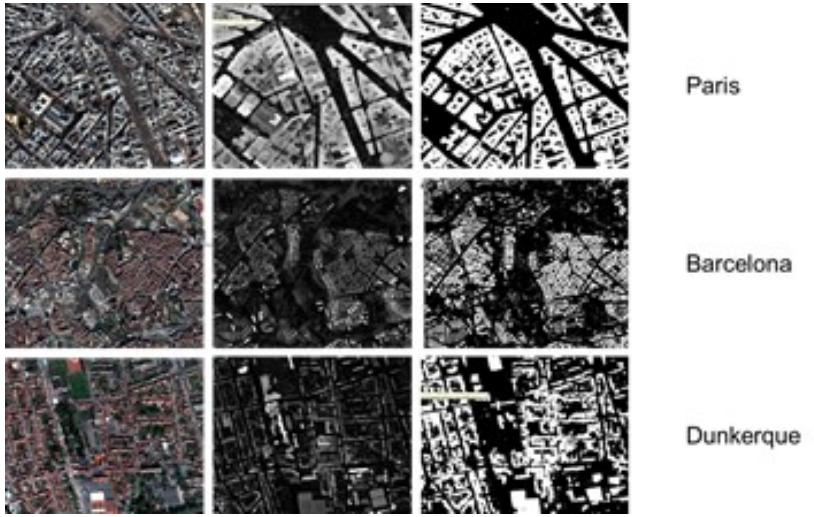
# Example of application : LOD0 in urban areas (1/2)

- Urban mapping, re-constructions progress …
- Pipeline for building extraction from Pleiades stereo tuples (ortho + DSM)



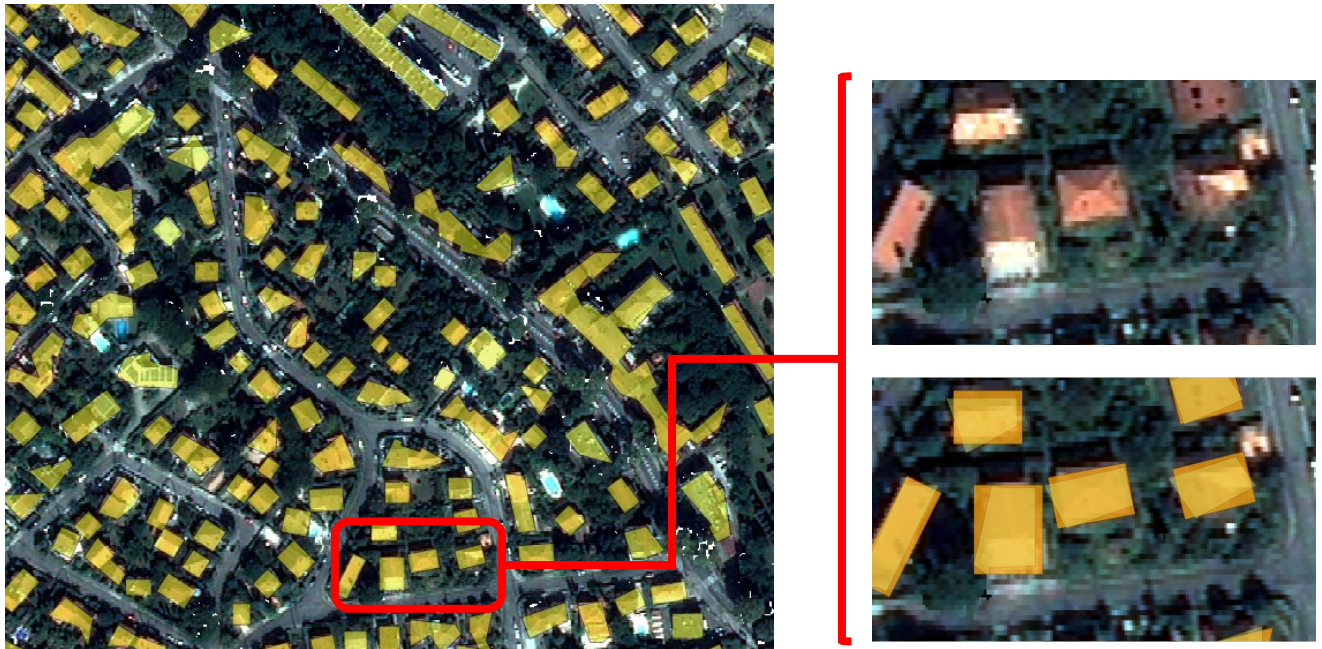
# LOD0 in urban areas (2/2)

- Semantic segmentation
  - Classical U-Net based
  - Learning on Toulouse datasets (OSM + manual labels)
  - Inference on other datasets
  - Parallelisation by tiles 1000x1000

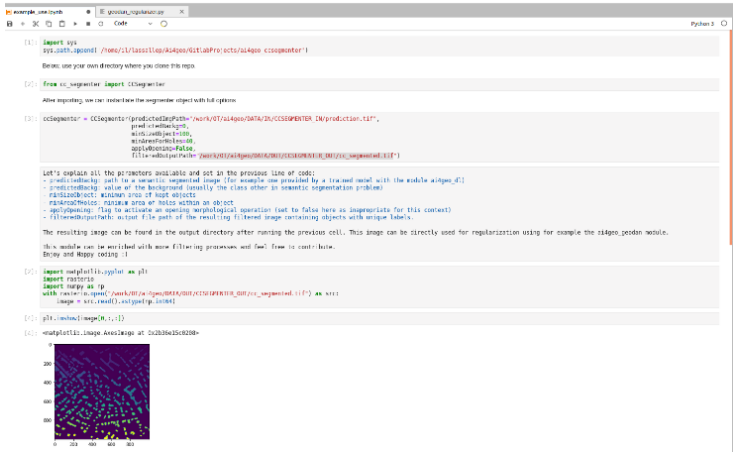



| ID | Accuracy | mIoU | F1Score | Precision | Recall | IoU |
|---|---|---|---|---|---|---|
| unet | 0,933 | 0,818 | 0,835 | 0,895 | 0,782 | 0,717 |

- Edge regularization
  - Based on GEODAN algorithm
  - Improve to better fit with building constraints (edges oriented, limit nb of right angles, …)



# Summary



- A fully integrated environment
  - Facilitate **prototyping AI-based solutions** at large **scale**,
  - **Data access with connection to existing databases**,
  - Deployable on **HPC or Cloud infrastructures** for massive processing.

- Very promising results on large scale LOD0
  - First release expected June 2020
  - LOD1 preliminary products for Nov 2020.

*Results LOD0 on Barcelona*

- Collaborative environment for scientists
  - **Already accessible** on CNES infrastructure,
  - Foster sharing of new methodologies with **labeled datasets,**
  - Promote the usage of **open source toolboxes** such as OTB,
  - Environment for multi-thematics research program = post-docs opportunities open !

- Contact us !

**https://www.ai4geo.eu**