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Innovative Methods and Products of the "Urbanization and Artificialization" Scientific Expertise Centre



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1. Background and Objectives of THEIA

The THEIA data and services centre (www.theia-land.fr) is a consortium of 12 French public institutions involved in Earth observation and environmental sciences (CEA, CEREMA, CIRAD, CNES, IGN, INRA, CNRS, IRD, Irstea, Météo France, AgroParisTech, and ONERA). THEIA initiated in 2012 with the objective of increasing the use of space data by the scientific community and the public actors. The first years allowed structuring the national science and user communities, to pool resources to facilitate access to data and processing capacities, to federate various previously unrelated initiatives, and to disseminate the French achievements nationally and internationally.

THEIA is structuring the science community through **1) Scientific Expertise Centres (SEC)** to provide the community with tools and treatment methods adapted to different thematic fields ; **2) Regional Animation Networks (RAN)** to federate users (scientists and public / private actors); **3) the setup of a mutualized Service and Data Infrastructure (SDI)** distributed between several centers, allowing access to a variety of products (Figure 1).

The THEIA centre is one of the component of the "Earth System" Research Infrastructure with ODATIS (Data and Service for the Ocean), ForM@Ter (Data and Service for the Solid Earth) and AERIS (Data and Service for the Atmosphere).

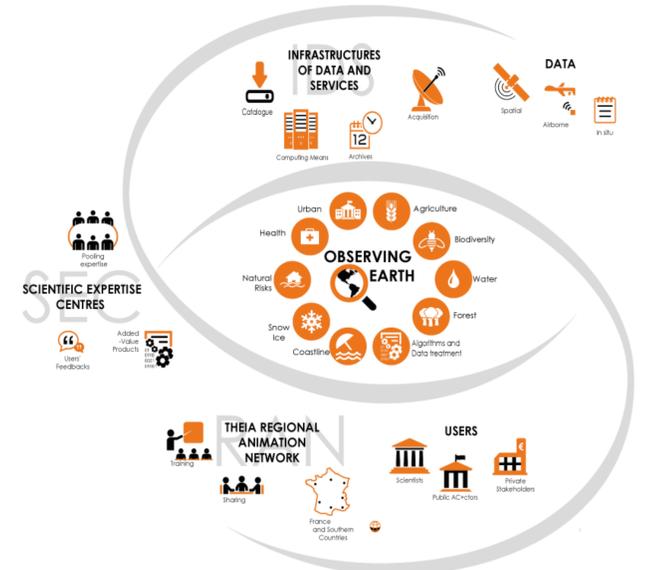


Fig. 1. THEIA's structure and governance scheme

2. Activities of the 'Urban' Scientific Expertise Centres (SEC)

The "Urban" SEC brings together teams from several research laboratories in France that carry out research and develop innovative data processing methods

for **urban remote sensing** using optical and SAR sensors. They are working on validation of the urban products provided by the THEIA SDI, and try to demonstrate user-tailored applications.

Urban footprint at medium scale (10m)

Mapping urban footprint with machine learning algorithm based on object-oriented approach and times series S2

(<http://a2s-platform.unistra.fr>)

Urban Vegetation At large scale (50 cm)

Mapping "low" and "high" vegetation at large scale with **Pléiades** imagery combined with LiDAR data and using deep convolutional neural networks or machine learning algorithms

(<http://www.kermap.com/montpellier/>)

Urban footprint at large scale (1-2m)

Mapping urban buildings with semantic segmentation of **Spot 6/7 images** using deep convolutional neural networks

Extraction of samples from Spot 6/7 images

- 1.25.10³ images patches, representing 12.5% of the available terrain truth

Estimated building map obtained at 1.5 spatial resolution

(<https://mdl4eo-cartes.irstea.fr>)

Urban fabric classes

Links with the SEC for land cover (**OSO SEC**)

Example of result from Iota2 Land cover map on Strasbourg with urban atlas as samples to improve the classification

(<http://osr-cesbio.ups-tlse.fr/~oso/>)

Relationships between Urban SEC and RANs

to disseminate the outputs to the user communities and to aggregate user needs ...towards a portfolio of complementary urban products,

Several research developments

- * Integration of S1 & S2 times series in the processing chain for mapping :
 - Urban foot print at medium scale
 - Urban fabrics
- Fusion of Sentinel 2 & SPOT6/7 imagery *
- * Development of a chain to detect changes (bi-date / imCLASS) and to produce automatically Digital Surface Model by using stereoscopic imagery (DSM-OPT).
- Adaptation to the South * Countries with others thematic classes