BULLETIN
Theia Land Data Service Center

n° 10 - March 2019

Content

A word
from the Scientific and Technical Directors

Since Theia's creation 6 years ago, a long way has been covered thanks to the support of our stakeholder organizations and the strong involvement of our scientists, researchers and engineers.

The last Theia seminar, from 17 to 18 October 2018 in Montpellier, was a success with 180 people present: researchers, academics, but also representatives of local authorities and companies.

The seminar gave the opportunity to assess Theia's achievements and challenges whereas the French Earth System Research Infrastructure (called Data Terra) is being set up.

Integrating into Data Terra while pursuing the activities of the three Theia's components (Data and Services Infrastructures, Scientific Expertise Centres, and Regional Theia Animations) is the key of Theia's future.

Pooling and innovation, mentioned in all the contributions gathered in this Bulletin, as well as the engagement of Theia's members, whom we have chosen to start portraying with this issue, remain our main assets. As a final word, we welcome on board AgroParisTech, which joined Theia at the end of 2018. ■

News

Nearly 180 participants for the 2018 edition of Theia seminar at Agropolis International, Montpellier, on 17 and 18 October.

Theia 2018: stimulating challenges for the future

The 2018 Theia seminar, held on 17 and 18 October in Montpellier, was dedicated to a wide topic: "From spatial data to geoinformation services for the management of territories and natural spaces". Among the 180 people gathered, researchers and academics were the majority, but 25 local authorities and more than 30 companies were also represented. The 4th OTB Users' Day held the next day took advantage of this dynamic (read page 2).

Five sessions structured the two-day event: Theia network's latest news on data and service provision (session 1); the dynamism of Theia in the region (session 2); algorithms and processing at the service of the community (session 3); soil-related expertise and applications (session 4); and, finally, expertise and applications related to hydrology and agriculture (session 5). Each day, a round-table hosted discussions and debates: on Wednesday, about the challenges of regional animation; on Thursday, about Theia's role to meet the challenges of land and natural space management. The program reflected the growth of Theia's activities in each of its components - data infrastructures, scientific expertise centers or regional animation networks.

The seminar also provided an opportunity to review the current status of Data Terra, the French Earth System Observation Research Infrastructure, being implemented (read page 4). Building on its successfull expansion, Theia's future now depends on its ability to integrate Data Terra while continuing to follow its virtuous path and combining its three core components. Coordinated and consolidated data infrastructures (value-adding products cataloging, on-demand processing services, etc.) provide access to the diversity of images, and the under-development DINAMIS will be an integral component of Data Terra (read page 7).

Infrastructures make it possible to produce and disseminate the algorithms and thematic products resulting from the Scientific Expertise Centers (SECs), whose dynamism, quality and originality guaranteed by the Theia Scientific Committee must continue to thrive. Active and interconnected Regional Animation Networks (RANs), in which each partner contributes to the emergence of innovative and widespread applications, constitute Theia's third pillar.

On this last point, the exchanges during the seminar showed that new actors could be mobilized, at ministerial (Agriculture, Environment, Digital) or institutional level. For example, the new Innovation and Applications Department of CNES shares many objectives with the RANs. Finally, while Theia's multi-regional nature gives the cluster a rather national identity, its principles can be transposed to other scales, particularly in the countries of the South, for which access to spatial information represents a strong development potential. So many stimulating challenges for the future! ■

Nicolas BAGHDADI (Irstea, Tetis), Philippe MAISONGRANDE (Cnes), Pierre MAUREL (Irstea, Tetis) & Arnaud SELLE (Cnes)

OTB: 4th Users' Day

In 2005, to support the Pleiades mission, CNES developed the Orfeo Tool Box (OTB), an open source remote sensing image processing software (www.orfeo-toolbox.org).

Since then, OTB has become a true Swiss Army knife for remote sensing: pre-processing, segmentation, classification, python interface, visualization software and a plugin for QGis revised to improve the user experience. Like most free software, OTB adopted in 2015 an open governance model. CNES and Irstea, two active contributors, took the opportunity of the Theia seminar to organize the 4th OTB Users' Day, on 19 October 2018, at Agropolis International in Montpellier.

These users meetings provide an excellent opportunity to identify needs and imagine new ways to adapt the tool. The morning session gave users the opportunity to present their own work and to discuss it with the community. In the afternoon, three workshops proposed different levels of training (beginners session, python interface, and an introduction to deep learning using a remote module). An exchange space also allowed users to chat directly with developers.

More than 70 participants gathered at Agropolis International during the 4th OTB Users' Day, on October 19, 2018 in Montpellier.

Thanks to the Theia seminar, the 4th OTB Users' Day was attended by a large part of the French remote sensing community. Among the 70 participants, a significantly high number, some had traveled from England, Ireland, Spain, Croatia and Belgium. Most of them belonged to public institutions and private companies (industrial, startup), representing quite accurately the users community and its constant expansion. ■

Rémi CRESSON (Irstea), Manuel GRIZONNET, Julien MICHEL , Victor POUGHON, Yannick TANGUY & David YOUSSEFI (Cnes)

TeleScop, the 1st SCOP in remote sensing

TeleScop, the first French cooperative and participatory company (SCOP) in remote sensing, mapping and public policy support, was created in August 2018 in Montpellier by three engineers and doctors from the Maison de la Télédétection.

Organized around three poles - acquisition, production, operation - and a communication service, it covers the entire satellite-image value chain.

At the interface between the scientific community and end users, the team meets the public and private stakeholders' needs for advice, expertise and training on spatial data in environment, agriculture and spatial planning.

The activity starts with services delivery in collaboration with consulting firms and research laboratories: R&D on light pollution, production of MNS and land use maps in southern France, scientific and technical support on the green and blue grid, editorial management of the GeoDEV RAN website. ■

Bastien NGUYEN DUY-BARDKJI (La TeleScop Manager)
latelescop.fr/

Annual meeting of the Nouvelle Aquitaine RAN

Theia Nouvelle Aquitaine Regional Animation Network (RAN) held its annual meeting on November 30, 2018 in Pessac. The Aquitaine Observatory of Universe Sciences (OASU) hosted this event in its new premises. The meeting brought together about twenty regional, public and private actors, strongly involved in the research/development and production/marketing of space imagery products for Earth system observation.

This meeting provided an opportunity to present Theia's new products in the region, to focus on the new structuring projects carried out by Nouvelle Aquitaine RAN (NA-RAN) members and to discuss new directions for the future. NA-RAN's visibility in the Nouvelle Aquitaine Region was a strong point that emerged from the discussions. In this respect, NA-RAN took note of the discussions initiated between CNES and the French regions for the establishment of conventions. NA-RAN thus strongly approved during the meeting the willingness of the CNES to actively involve RAN in the definition of these conventions. The participants welcomed an approach that will only increase the visibility of remote sensing activities in the region.

NA-RAN has set itself the objective of expanding its network by 2019 in order to better federate the various regional dynamics for the promotion of remote sensing in space. This integrative approach should strongly rely on the OASU. The next meeting of the ART Nouvelle Aquitaine in June 2019 will assess the outcome of these actions. ■

Bertrand LUBAC (Bordeaux University and Nouvelle Aquitaine RAN)
www.theia-land.fr/fr/art-nouvelle-aquitaine

Summer University in Iran

Theia with the Faculty of Geomatics Engineering of K University. N. Toosi in Tehran (Iran) organized, from July 7th to 10th, 2018, a one-day seminar, with cross-presentations by French and Iranian researchers, and a three-day Franco-Iranian Summer School offering different applied workshops. The event pursued three objectives:

- present and train in the use of the free satellite image processing software OTB (OrfeoToolBox);
- share the experiences acquired within Theia network in terms of value-added products;
- train Iranian partners in the methods and algorithms developed in Theia's scientific expertise centers.

A group of French researchers (Irstea, Cnes, CNRS, IRD, IGN, and University of Strasbourg) had made the trip. They were able to meet a very diverse Iranian audience of researchers, Master's and PhD students, ministries and private actors. ■

Nicolas BAGHDADI (Irstea, Tetis)

Seminar and workshops followed one another during the Franco-Iranian Remote Sensing Summer School in Tehran (Iran).

Remote sensing data and fire

Irstea, with the support of CRIGE (Comité Régional de l'Information Géographique) and of theTheia Sud Regional Animation Network, organized an event on December 7th, 2018, at Arbois (Aix-en-Provence), on the theme "Remote sensing data and fire". The event attracted nearly 50 people.

Three sessions presented different types of work: those of the partners in the Tosca Acado program (session 1); those of other research organizations and/or users (session 2); testimonies from foreign researchers on the damage observed after the large fires in Portugal and Greece (session 3). The day ended with a round table bringing together several types of users of the data collected by the Theia Fire SEC.

Fire of July 22th, 2009, on the commune of Marseille

The exchanges showed the interest of this meeting between researchers and users. Discussions focused on the conditions of access to the data; the possibility of setting up a working group on a pilot area (for example, Rognac fires could be studied on the basis of field data and with different objectives and satellite data processing); but also on the value of data acquired by drones as a complement to field and satellite data.

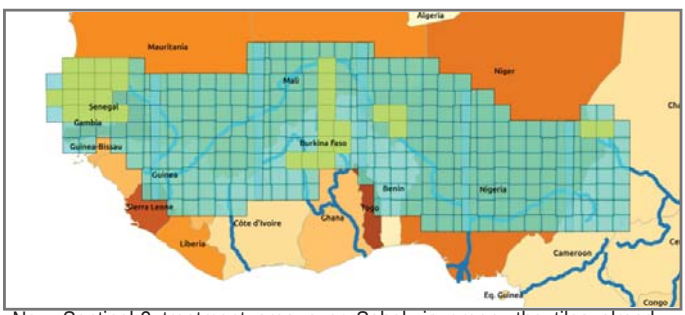
For those who missed the event, speakers' slideshows will soon be available on Theia's website. ■

Marielle JAPPIOT (Irstea, CES Incendie)
http://www.theia-land.fr/en/fire-sec

MUSCATE turns to West Africa

Thanks to the improvement of its efficiency when producing Sentinel-2 level 2A data with the MAJA processor, the MUSCATE center is now able to make a large extension to the zones it processes. At the request of the Swot project, a large area covering the western Sahel and in particular two major African river basins (Niger and Senegal) has thus been selected.

Applications will include river monitoring, land use and vegetation dynamics. Several French laboratories will be involved, including the GET, Cesbio, Legos in Toulouse and the Tetis laboratory in Montpellier.



New Sentinel-2 treatment area over Sahel: in green, the tiles already treated, in blue, the new tiles.

The selected area meets the following constraints:

- does not exceed 300 tiles;
- proposes a contiguous zone;
- avoids the most cloudy areas - such as the coasts of the Gulf of Guinea;
- covers almost the entire basins of Senegal and Niger (except systematically cloudy or completely desert areas);
- possibly completes related administrative areas. The latter has led to cover the whole of Senegal, Gambia, Burkina Faso, the whole of western and southern Mali, northern Guinea, Côte d'Ivoire, Benin and Nigeria, southern Niger and western Chad.

Production has just started, with the westernmost area (UTM 28). When production reaches the acquired data in real time, the area a little further East (UTM 29) will be put into production. It will still be a few months before all areas are treated. ■

Olivier HAGOLLE (Cesbio, MUSCATE)

The 4P1000 Initiative: Soil for food security and climate

Launched in March 2015 by Stéphane Le Foll, French Minister of Agriculture, Agri-Food and Forestry, in front of an audience of 750 scientists from more than 70 countries gathered in Montpellier for the 3rd "Climate Smart Agriculture" Scientific Conference, the 4P1000 Initiative is based on the research work accumulated by the scientific community, particularly the French scientific community, on the relationship between soil and climate.

This expertise shows that it is possible to move from an agriculture emitting greenhouse gas (GHG) to an agriculture acting as a sink of GHG while reducing its own emission contribution and ensuring food security for a growing world population. Promoting adapted agricultural practices targeted to increase soil carbon stocks by 0.4% (4‰) can offset annual GHG fluxes.

Officially on the international agenda at the Paris Climate Change Conference in 2015, the 4P1000 Initiative is built around two components: a program for multi-stakeholder actions, state and non-state, and an international program of research and scientific cooperation. The latter has since defined four complementary research priorities:

- Reduce the uncertainties in soil organic Carbon Balance
- Define drivers of Changes and Best practices; Adoption at farm and territorial levels
- Promote the emergence of enabling environments for land-based Carbon sequestration
- Design Monitoring, Reporting and Verification (MRV) process

On 7 and 8 November 2018, nearly 80 participants, including some representing larger networks (including Theia), met in Sète (France). The workshop aimed to identify science fronts and priority research actions to be programed to develop the four pillars of the research component. The Sète Call adopted at the end of the workshop demands the mobilization of financial resources to support a research effort up to the climate challenges. ■

Jean-Luc CHOTTE (IRD, 4P1000 Initiative)
www.4p1000.org

Data Terra: Building a French and European actor

With 4 data centers (Theia, Odatis, ForM@Ter and Aeris), 20 data and service centres/infrastructures, 30 scientific expertise consortia and various transversal devices, Data Terra Research Infrastructure has become, in spring 2018, one of the very large French research infrastructures dedicated to the observation of Earth System. Its mission is to bring together all the work carried out in the field of Earth satellite observation on a national scale, but also to promote the visibility of French research on global change.

Already, Data Terra has successfully applied to various European projects. Within the European Open Science Cloud Initiative (EOSC), Data Terra has been recognized as the French partner of the ENVRI-FAIR project, which aims to bring together Cloud information systems and services across the EU. Data Terra was also called upon by two other European initiatives: INFRAEOSC (on-demand access and processing services) and HPC (computing system performance), both to consolidate the national and European offer in computing infrastructure but also to contribute in terms of governance and services. A great work programme for 2019. ■

Frédéric HUYNH
(IRD, Data Terra director)

Monitoring annual snow cover duration in French mountains

Snow cover duration is a useful indicator for hydrology and climate science but also for mountain fauna and flora studies. From a compilation of 6,205 Sentinel-2 images and 593 Landsat-8 images, the snow cover duration maps at 20m resolution of the past two years have been produced for the French Alps and the Pyrenees.

These maps were produced as part of the Snow Covered Surface SEC activities and with CNES support from the instantaneous snow products available on Theia.

Explore the map: http://osr-cesbio.ups-tlse.fr/echangeswww/majadata/simon/snow-Maps.html

This product offers a synthetic view of snow conditions along a year and thus simplifies the use of Theia data by stakeholders. The team is now working toward an automation in order to distribute this type of product on an annual basis. ■

Simon GASCOIN (Cesbio),
Manuel GRIZONNET & Germain SALGUES (Cnes)
www.theia-land.fr/en/snow-covered-surface-sec

SWOT National Days: 3rd Edition

The 3rd edition of the French SWOT National Days was held at Cnes, Toulouse, from 20 to 21th November, 2018. The meeting brought together about 150 persons in order to assess the actions implemented but also to list remaining challenges and to prepare for the renewing of the community.

The SWOT preparatory program is focusing on strategic five axes, and it addresses all surfaces (Ocean, Water Surfaces on Land and Costal/Estuaries Areas) and support research activities in assimilating SWOT data into the models. It is built on the heritage of 25 years of altimetry and the support of Odatis and Theia data centers. The next Tosca Roses tender will be issued in 2019 and will select the new Science Team for the next four years from 2020. Strengthening SWOT work is necessary three years before the next launch. The SWOT annual scientific meeting that will be held from 17 to 20 June 2019 near Bordeaux will give the opportunity to define priority themes for the future Science team. ■

Selma CHERCHALI (Cnes, SWOT et SWOT Downstream)

The 2018 French Satellite Application Plan: Spatial solutions to better know territories

The assessment of the French PAS 2011-2017 showed that the acculturation effort undertaken had fostered a wider diffusion of satellite practices and made them closer to end-users. The will to be closer to the users drived the PAS 2018.

An exemplary elaboration method

It was built mainly on mobilization of the units in the two ministries (Directorates General, Regional and Marine services, public agencies)... Finally, about 140 people participated to the definition of the PAS 2018.

10 thematic working groups were set up: aeronautics, rail and river, maritime domain, smart transport, crisis management, atmosphere and climate, risks, planning, biodiversity, monitoring and coastal protection.

The development was proceeded in four steps, from March 2016 to December 2017:

- free expression of expectations in each working group, analysis of the identified topics including their technical feasibility,
- proposals which seem useful, by each working group, and their description : need, content, expected gains, risks if not made, priority, considered pilot, expected delivery,
- validation: search for a pilot for each proposed action, approval of the selected actions by the Steering Committee.

By the end, 20 actions were registered in the PAS 2018 and 65 actions proposed by the GTs did not find a pilot.

This approach has highlighted two encouraging aspects: the strong motivation of the actors and, a great richness in terms of needs expressed by the services. Thematic and supporting actions

The thematic actions retained within the PAS 2018 are grouped in seven topics:

- to improve decision-maker knowledge in crisis management,
- to anticipate the level of air pollution,
- to improve transport safety and efficiency,
- to observe environment to better protect fauna and flora,

Meeting French Copernicus users

In December 2018, the French Ministry in charge of ecological and solidarity-based transition, along with IGN, published a study detailing the outputs of land use products from the Copernicus local component in France. This study was realized for the European Environment Agency. It relies upon an on-line survey carried out from June 7th to July 5th 2018. The vast majority of respondents works in the public sector – administration or research (88%) and represent quite equitably national, regional and local levels.

The study first reveals the lack of knowledge of the local component of the Copernicus products. Only the land cover and land use data of the Natura 2000 areas and of the Urban Atlas are well-known, respectively by 78% and 68% of the respondents. Nevertheless, they remain sparsely used: by 27% and 17% of the respondents, respectively. Comparing with available national data, users appreciate their better thematic classification (34% for land cover and land use data of the urban atlas, and 27% for Natura 2000 data).

The report recommends some improvements in terms of communication and documentation regarding access modes, possible uses, accuracy, data production processes as well as their availability. Finally, it underlines that on the long-term, the users expect a homogeneous and compatible nomenclature between all the different Copernicus land cover and land use products. ■

Frédérique JANVIER (MTES - CGDD)

Reading the whole report (in French)

« Résultats de l'enquête sur les usages des produits de la composante locale du service Copernicus Land », Rapport, Service de la donnée et des études statistiques, Ministère de la transition écologique et solidaire et Institut national de l'information géographique et forestière, Décembre 2018.
www.eionetfrance.fr/?q=node/1199

- to monitor climate change,
- to know the environment to estimate its services,
- to know land use evolution in order to better optimize it.

In addition to these thematic actions, 17 supporting actions were selected, grouped into five themes:

- to strengthen relationship between the national agencies gathered in the Technical and Scientifical Network and the services of the two ministries,
- to gather the stakeholders, to promote knowledge incorporation and good practices sharing,
- to help services of the two ministries to develop their practices in the satellite domain,
- to encourage innovation and emergence of projects by developing an ecosystem of SMEs and very small enterprises,
- to facilitate access to spatial data, derived data and related processing tools.

PAS 2018 is accessible at the address:
www.ecologique-solidaire.gouv.fr/plan-dapplications-satellitaires
All the actions are listed in the appendices. ■

José DEVERS (French Ministry in charge of Environment and Ministry in charge of Territorial Cohesions)

A long-term digital archive: accessibility and reusability over time

The exponential all-areas digital growth has recently brought up a sustainability concern with digital information across administrations and companies. Among the numerous projects – public or private, at national, European or global level – dedicated to the archiving of digital information over time, the Centre Informatique National de l'Enseignement Supérieur (CINES) provides a genuine digital repository for long-term preservation to the French higher education and research community. Since 2006, this offer has been available to any institution producing or collecting a large amount of digital documents presenting a patrimonial value for the community.

The CINES service commits not only to preserve the document and the information it contains, both in their intellectual substance and in their physical aspect, but also to make them available and understandable for an unrestricted period of time. This implies to mitigate the devastating effects of various inevitable risks such as the loss of the knowledge of the content of the files, format obsolescence, physical device deterioration, or software or player devices end of life. For this purpose, quality control processes for the digital object itself and associated services have been implemented and guarantee proper conservation. Certifying the activity (agreement with the French National Archives, CoreTrust seal accreditation) validates the approach and insures trust with users communities.

An ever growing archive service

Ten years after launching its first instance of the platform, CINES now hosts some 20 archive projects. Among them we may mention the digital PhD theses, collected and uploaded by the Agence Bibliographique de l'Enseignement Supérieur; or journals and manuscripts digitized as part of the Persée program for Human and Social Sciences or by academic libraries as Cujas or Sainte-Geneviève; or the scientific publications uploaded by researchers in the HAL tool. In addition, Geosud has delegated the Spot and RapidEye national coverage imagery acquired and reprocessed by the project to CINES. The partnership with the Museum National d'Histoire Naturelle will soon allow the preservation of digitized herbaria corresponding to a 400To database! The archive platform has interfaces with the information systems of each of the institutions using the service, providing a fully automated process. About 900,000 objects are currently stored, resulting in more than 50 To in volume.In accordance with the French national strategy for scientific heritage preservation and for open science promotion, CINES works to broaden archiving to new types of data, i.e. simulation or observation data (in situ data, etc.). A collaboration with, among others, the French research infrastructure Data Terra could soon be achieved if supported financially by the European Commission. ■

Olivier ROUCHON (CINES)
www.cines.fr

Geosud Data Infrastructure
An on-line processing service for HR and VHR optic imagery

Geosud Data Infrastructure provides standardized access services to more than 12,000 HR and VHR images (IDSv1). In 2017-18, the build of a new on-line and on-demand processing service platform has started (IDSv2). Its objective is to assist Geosud adherents with HR and VHR image analysis.

A User Companion

This new service should open during the 2018-2019 winter, first to Geosud adherents who are experts in the field, before expending to the whole Geosud and Theia community. From a user point of view, the Geosud portal will now offer an Analysis modul. The latter will propose a process catalog designed as a user companion in all operations: picking images compatible with a selected process, configuring the process, and then running it. A HPC computing resource will permit to preview processes results almost in real time. The user will thus be able by trial/error to adjust the processing parameters before running it on a whole image. Finally, the history of the performed analyses as well as resulting data will remain usable for other analyses. Each adherent will dispose of a storage space enabling the management of the generated data.

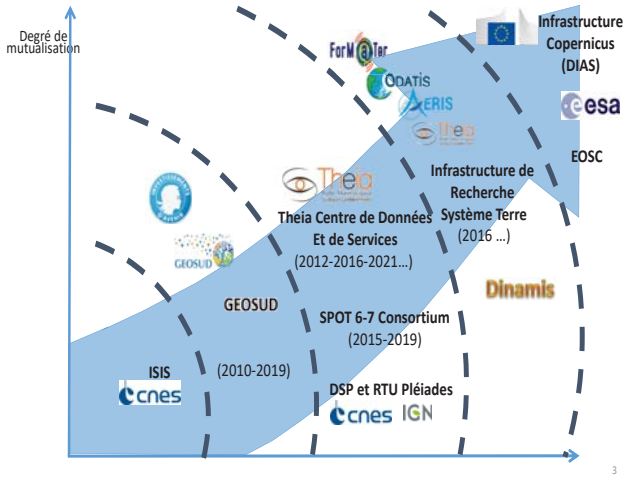
The module relies on the implementation of a WPS-standard processing server backed to the regional computing cluster Meso@LR. Based on the open-source tool Zoo-project together with the open-source search engine ElasticSearch, the system provides an entirely standardized environment, ensuring images and processes searching, configuration and running in the Meso@LR datacenter.

Backed to a HPC computing environment, the design enables hosting operational processing workflows coming from Theia SECs, then their production and their provision as a catalog of products and standard services (discovery services, visualization…). To this end, Geosud infrastructure seeks already financing through Theia and the Data Terra Research Infrastructure, in order to design and prototype these new functionalities. ■

Jean-Christophe DESCONNETS (IRD, Espace-Dev),
Rémi CRESSON (Irstea, Tetis)
ids.equipex-geosud.fr/

DINAMIS
Preparing the independence of the satellite research for the next ten years

Nurturing the dynamism of the French satellite-imagery-based innovation ecosystem requires guaranteeing the supply over the next ten years of a complementary set of satellite images (very high and high resolution, optics, radar, etc.). Several French research public bodies – Cnes, CNRS, IGN, IRD, Irstea, Cirad – are thus proposing to implement a unified national portal DIMAMIS – acronym for the French Dispositif Institutionnel National d'Approvisionnement Mutualisé en Imagerie Satellitaire – to take over from existing mechanisms (ISIS, Geosud, Spot 6-7 consortium).



DINAMIS is meant both to continue and complement existing and developing satellite services infrastructures in France and on an international scale.

DINAMIS will constitute a transversal component of the emerging Data Terra Research Infrastructure and will deliver services and R&D to the scientific community, French public stakeholders, and private actors.

A cluster of services

DINAMIS mechanism pursues six objectives:

- Cataloging or harvesting existing catalogs of all free or publicly acquired images (Landsat, Sentinel, Spot 1-5, Pléiades, Spot 6-7);
- Acquiring systematically or on-demand new VHR commercial images (today, Pleiades and Spot 6-7; tomorrow possibly Pleiades-Neo) thanks to a pooled purchasing policy;
- Access to these different images, whether raw or ortho-rectified;
- Supporting image requesters in order to translate their professional needs into image specifications;
- Storing and archiving the data acquired through the mechanism when they are not furthermore handled;
- Managing user subscription and authentication processes to the mechanism.

DINAMIS will offer a web portal (under construction) containing explanatory support pages, a meta-catalog application for all images in the archive (under development), as well as a request application for new Very High Resolution spatial images (Pleiades, Spot 6-7 and Spot 1-5). It will also ensure the coordination with the receiving stations situated in the French overseas territories (SEAS mechanisms). The new Pleiades and Spot 6-7 image requesting service (through satellite programming or

through Airbus DS archives) is already operational and can be used by public stakeholders and scientists already members of Geosud and Theia.

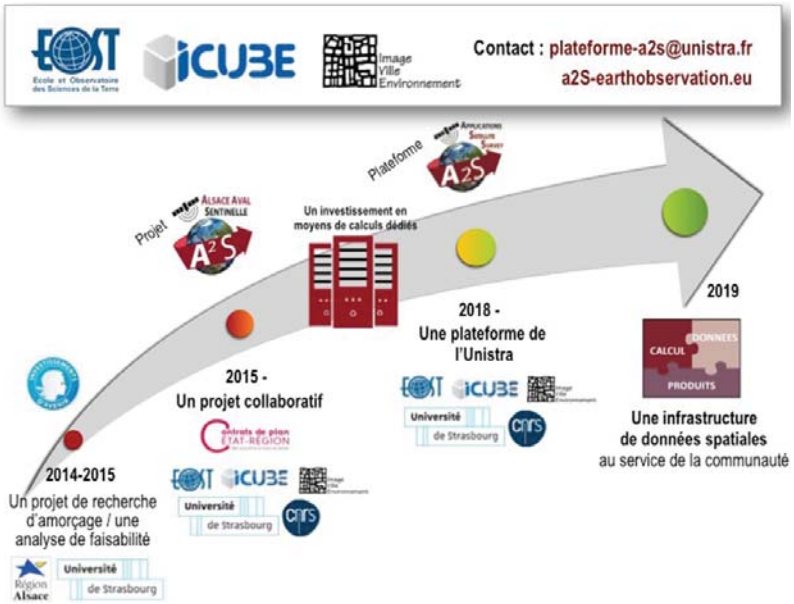
- To create a Geosud account: http://ids.equipex-geosud.fr/web/guest/comment-adherer
- To create a Theia account: https://sso.theia-land.fr/theia/register/register.xhtml
- To request images: https://dinamis.teledetection.fr/login

DINAMIS funding is currently subjected to several negotiation rounds, primarily between all the original supporting organisms, and then with the principal beneficiaries (ministries, public operators, regions). It may be supplemented by answering calls for project and, if necessary, by asking financial contribution to DINAMIS members. ■

Pierre MAUREL (Irstea, Tetis)

A2S Platform
An innovative computing infrastructure for products and partners

A2S is a processing platform of the University of Strasbourg and CNRS dedicated to Satellite Survey Applications. This platform is taking over from the project A2S (Alsace Aval Sentinel), whose preparatory work has started in 2012, aiming to create an information production infrastructure based on time series of Sentinel images. From the design phase this project has been supported by both the Alsace Region and the University of Strasbourg in the framework of the Future Investment Program (IDEX). This preliminary phase has materialized in 2015 through an investment of the State-Region Contract (CPER). From the beginning, A2S has been thought as a collaborative project gathering three French labs: EOST, ICube, LIVE . Since summer 2018, A2S has been labeled as a platform from the University of Strasbourg who is sharing the tutorship with the CNRS.



A2S on-going time-line.

A2S platform is providing a layered services offer for processing massive streams of Earth observation satellite data firstly in support of local research teams and Grand-Est Theia Regional Animation Network users, but is also targeted to be used beyond regional boundaries as a spatial data infrastructure.

To reach these goals, the platform possess its own resources gathering:

- 1) computing and storage resources (44 nodes, 1040 core, 11TB scratch/home) integrated in an High Performance Computing Center, thus allowing capacities extension;
- 2) dedicated software for workflow management of parallel computations, ingestion and preformatting tools (Sentinel, Landsat, Pléiades), and thematic modules for information extraction from temporal image series; and
- 3) dedicated manpower with a system manager and an IT development engineer, both are backed by the expertise of the researchers of the associated three labs.

The chosen path for the design of the platform is to target the processing in short time of massive time series of image data, primarily in stream mode, but also for on demand processing of archive data; both execution modes should be able to address wide areas of interest covering at least a national extent. The thematic processing chains, developed in the associated labs and presently integrated into the platform are MPIC-OPT: Earth surface deformation measurement, Water-S1 et S2: water surface detection using Sentinel-1 and/or Sentinel-2 data, URBA-OPT: urban footprint mapping, Burnout: burn areas mapping, DSM-OPT: digital surface model creation, and ImCLASS: generic mono class classifier based on artificial intelligence.

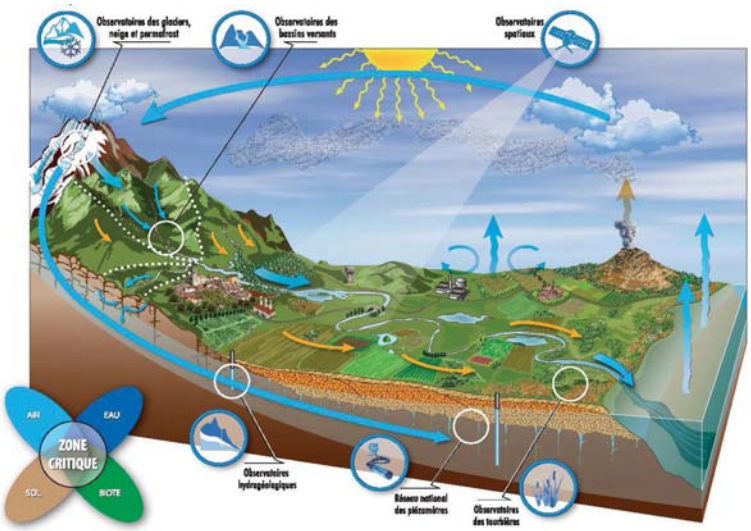
Now, eighteen months after the reception of the computation racks, the first set of processing chains are running. Beyond this step, the strategy for the sustainable development of the platform is, on one hand, to develop and operate new products (data, models, process, and services) with new partners coming from all horizons; and on the other hand, to integrate this resource as an infrastructure associated to the Data Terra Research Infrastructure, particularly for Earth surface and subsurface themes. ■

AS2 Team

OZCAR (Critical Zone Observatories – Application and Research) Research Infrastructure

What is OZCAR RI?

The OZCAR Research Infrastructure (RI) is one of the 23 French RI approved in the environmental field. OZCAR focuses on the critical zone – this very thin veneer at the surface of our planet, between the un-weathered bedrock of the lithosphere and the atmospheric boundary layer; where water, energy and matters transfers occur; and where water, soil, rocks and living organisms interact. This zone is critical for humanity because we extract our water, energy and food resource from this zone, and we also store our wastes in it.



The Critical Zone is where humanity extracts its water, energy and food resource and also stores its wastes.

OZCAR RI brings together 22 observatories labeled by research organizations and universities that have documented, for a long time, a hundred sites ranging from the plot to large basins like the Amazon, through watersheds of a few km² to a few hundred square kilometers. These observatories sample various compartments of the critical zone: the cryosphere (snow, glaciers, permafrost), watersheds, underground aquifers, peatlands, in order to document energy, water, carbon and substances (sediment, carbon, nitrate, phosphorus, chemical elements, but also contaminants) cycles. Some observatories do monitor them from space. Although initially designed to answer local scientific questions, these observatories share the same scientific objective: describing, understanding and modeling the evolution of the critical zone in the very context of the Anthropocene and global changes.

OZCAR RI services

The data produced by OZCAR RI observatories, with sometimes monitoring histories longer than 50 years, are its prime asset. For the moment, these data are distributed by each observatory according to their own methods. A common Information System (IS), the Theia-OZCAR IS, is under construction and aims to increase the visibility and use of these data by making them FAIR (Findable, Accessible, Interoperable, Reusable) (►Read *Theia Bulletin* n°9, published in June 2018, for more details).

The other asset of the OZCAR RI is its instrumental park, acquired thanks to the French "Investment d'Avenir" program, Critex (Innovative equipment for the Critical Zone ►www.critex.fr/). The park is composed of state-of-the-art equipment, particularly for the in situ acquisition of high frequency geochemistry data and geophysical data (gravimetry, seismic measurements, magnetic resonance, etc.) The use of the instruments is open to the scientific community. Similarly, new projects can rely on multidisciplinary and well-documented observation sites. However, the arrangements for providing the instruments and access to the sites still need to be defined. ■

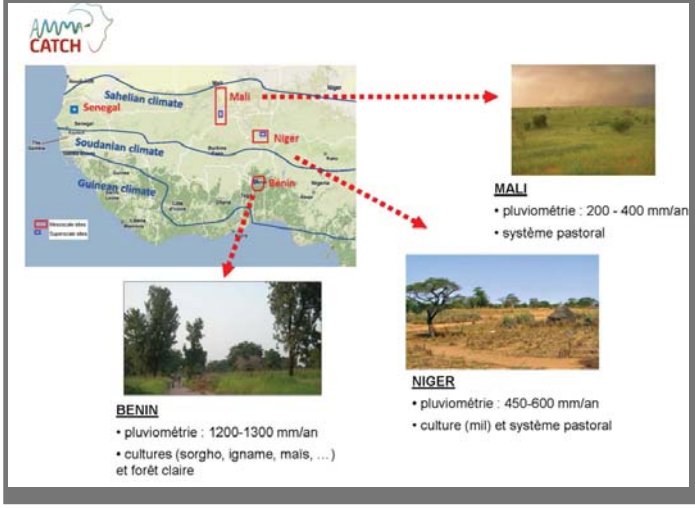
Isabelle BRAUD, Jérôme GAILLARDET
(OZCAR RI Executives)
& Fatim HANKARD (OZCAR RI Project Engineer)
www.ozcar-ri.org

AMMA-CATCH: 30 years of Hydro-Climatic Observations on West Africa

West Africa is a region in rapid transition in terms of climate, demography and land use. This region is also a hot spot for global change in all its components. Yet, Africa is still cruelly lacking in adequate in situ measurements in order to document ongoing environmental changes at appropriate scales, as well as to capture possible indications of future trajectories. In addition, considerable uncertainties remain in climate model simulation, notably concerning water cycle and precipitations.

Documenting and providing quality observations on this region of the world constitutes the main motivation for the AMMA-CATCH Observatory. For 30 years, the Observatory has been collecting data from three highly instrumented sites, located at different latitudes so as to sample the high eco-climatic gradient of the region. In each site, AMMA-CATCH documents the various terms of the hydrological cycle (rain, infiltration, groundwater recharge, river flows, and evapotranspiration), the energy balance, and the vegetation cycle.

Scientific results achieved through these observations are detailed in a recent article published in the *Vadoze Zone Journal.* The datasets are already available on the Amma-Catch database and will be integrated in the forthcoming in situ Theia-OZCAR Information System. ■



The three AMMA-CATCH observation sites document the high eco-climatoc diversity in West Africa

Sylvie GALLE (IGE, Grenoble),
Manuela GRIPPA (GET, Toulouse),
Christophe PEUGEOT (HSM, Montpellier)
www.ozcar-ri.org/amma-catch/

L'Avion Jaune
Watching and Unveiling

L'Avion Jaune is a French company specialized in Earth Observation imagery. Launched in 2005 in Montpellier (France), the company has pioneered the use of mapping drones, before extending further its capacities with the use of ULM, planes and helicopters. Since 2012, on-board equipment for aerial cartography (multispectral camera, LIDAR) and training programs dedicated to these technics have come to complete its offering. Current activities balanced between conducing high-resolution aerial imagery missions and R&D effort to develop light and innovating mapping systems. New related image treatments, especially deep learning, figure also on our team's research agenda.

Drone image of Mururoa recife for geomorphological analysis.

An innovating company highly connected with research

Innovation driven, L'Avion Jaune won, with IRSTEA's support, the French Research Ministry's Prize for "emergence" in 2004. On regular basis, our company engages with different research organisms as part of cooperative projects on environment (TALVEG2, SODA). Consultancy are also proposed and carried out to answer research teams' specific needs: archeology for CNRS and INRAP, erosion for BRGM, drones training for IRD and IRSTEA.

L'Avion Jaune's reputation stakes on its high rate of success in atypical missions in very specific expertise areas: vegetal study, erosion monitoring, littoral areas and riparian buffer zones. The high complementarity of its team, which has progressively grown to welcome specialists in image acquisition and treatment, in photometry and on-board equipment, strengthens its capacity for action. The permanent team comprises now twelve persons.

Let us mention here some the most challenging assignments we performed:

- Drone mapping of Mururoa and Fangataufa atolls(French Polynesia) for CEA,
- 3D mapping of French Aquitaine littoral (300km) for BRGM,
- Quick mapping of the damages caused by the Klauss tempest for IFN,
- Yearly Multispectral Mapping of large vineyard areas, conducted jointly with Fruition Science (Grape Harvesting Support Program),
- Development and production of a crisis mapping system "SC2" for the French National Gendarmerie,
- Mapping of the pre-Inca vestiges in Bolivia, by fixed-wing drone flying at over 4000m in altitude (CNRS),
- 3D-mapping of energy plants (EDF)
- Drone Multispectral Imagery over tens of thousands of hectares in Gabon.

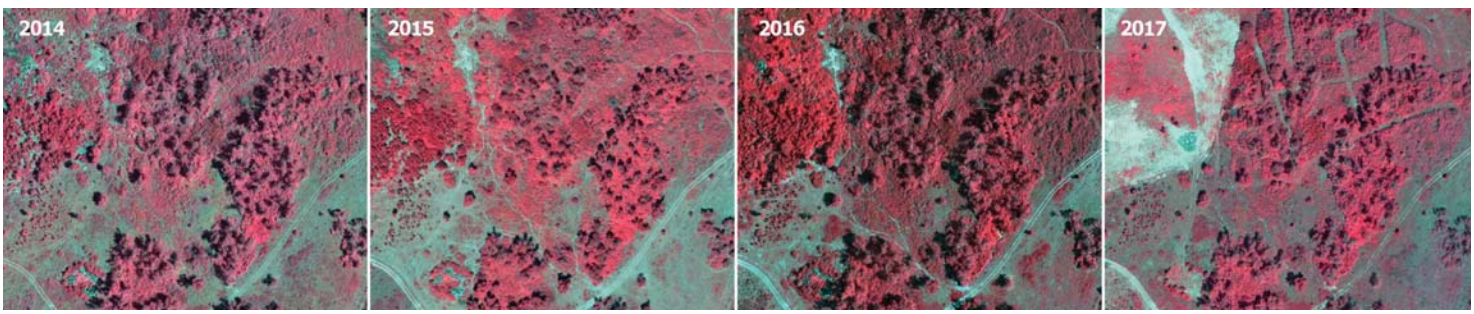
Thinking further and outside the box

Beyond these flagship missions, L'Avion Jaune values realism and pragmatism rooted in its large experience. Looking for "outside of the box" discovery since its creation, our company knows how to manage risks and has conducted over 500 successful missions. Never engaging before having thoroughly assessed demands, sometimes very exotic or ambitious, that we receive, we ensure the satisfaction and the renewed trust of our customers. Our priority development areas today are crisis mapping, natural risks and environment.

Yellow Scan, our sister company stemming from L'Avion Jaune's R&D, entered the LIDAR for drone market in 2015 and now figures among world leader companies in this sector. Based on this result, YellowScan is now hiring various professional profiles to support its development. (►www.yellowscan-lidar.com/company/career). ■

Michel ASSENBAUM
& Bruno ROUX (L'Avion Jaune)
www.lavionjaune.fr/

Multitemporal monitoring of an ecological restoration area with multispectral imagery at 5 cm/pixel



Coupling Sentinel-1 (radar) and Sentinel-2 (optical) to estimate soil moisture at plot scale

The spatio-temporal monitoring of soil moisture in agricultural areas is of great importance for different applications related to the continental water cycle. The in situ measurement permits monitoring soil moisture but this technique is expensive and could not be realized over large scale. The importance of remote sensing here is to make the operational mapping of soil moisture possible at large scale and at high spatio-temporal resolution.

The radar data have been widely used to estimate and map soil moisture over bare soil (depth 5-10 cm). Several physical, empirical and semi-empirical models allow the inversion of the radar signal to estimate the soil moisture at different scales (sub-parcel, parcel, and grids of m^2 to some km^2). The estimation of soil moisture over vegetation areas is more recent and requires coupling both radar and optical data to take into consideration the characteristics of the vegetation: Leaf Area Index – LAI – and Normalized Differential Vegetation Index – NDVI.

To map soil moisture in the presence of vegetation cover, most studies use the semi-empirical model "Water Cloud". In this model, the total radar backscattered signal is modeled as a sum of the vegetation contribution and the soil contribution multiplied by the attenuation factor (due to the presence of vegetation). The contribution of the vegetation is expressed as a function of characteristic parameter of the vegetation (LAI, NDVI or the water content in vegetation). The soil contribution which depends on the soil moisture and surface roughness in addition to the instrument's parameters in particular the angle of incidence, the wavelength, and the polarization, is modelled using a physical backscattering model (IEM for example) or a semi-empirical model.

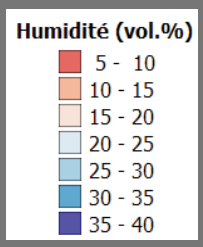
South of France, Bekaa valley… from model to maps

Theia scientific expertise center (SEC) "Soil Moisture at very high spatial resolution" proposes soil moisture maps at high temporal resolution (a map each 6 days) at sub-parcel scale over several sites in France (today over the Occitanie and PACA regions) and also overseas (today over the Bekaa Valley, Lebanon).

The algorithmic development and the production of the soil moisture maps, conducted in collaboration with Mehrez Zribi of the CESBIO, were carried out thanks to the support of Irstea (UMR Tetis) and CNES (TOSCA project). The data used are issued from the series of Copernicus radar Sentinel-1 and optical Sentinel-2 images. The inversion of the algorithm of the radar signal uses the neural network. It is applied on agricultural parcels extracted from the land cover map prepared by the Theia Land Cover SEC and presented by Jordi Inglada. The final product is proposed at intra-parcel scale (from 0.2 hectares). Thanks to a large field campaign near the city of Montpellier (nearly 500 measurements in situ), the estimation of soil moisture on these maps reaches an accuracy of about 6 vol.%. ■

Nicolas BAGHDADI (Irstea, Tetis –
Soil Moisture at very high spatial resolution SEC
www.theia-land.fr/en/soil-moisture-very-high-spatial-resolution-sec

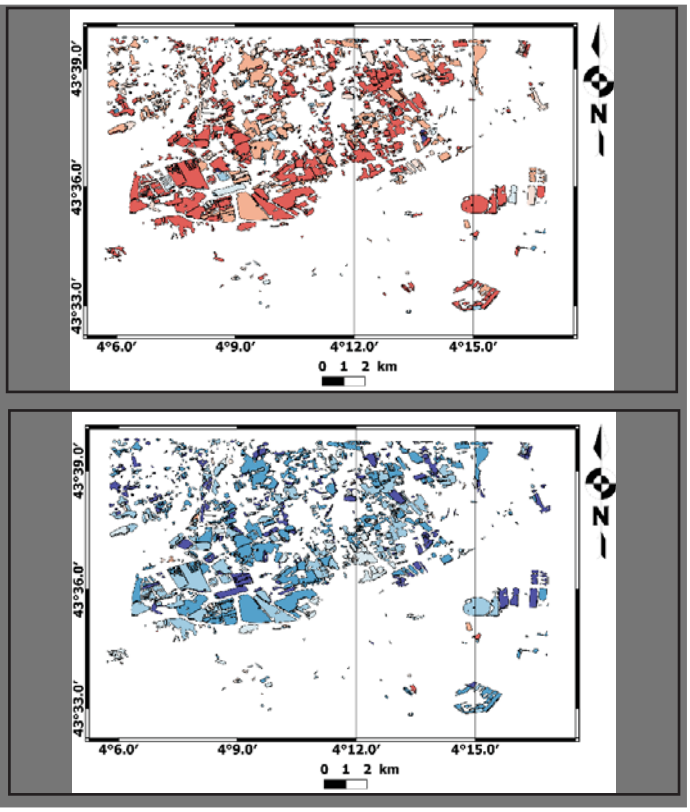
Humidity maps at sub-parcel scale (Homogeneous zones measuring 0,2 hectares and more) using Sentinel-1/2 data.



The two soil moisture maps right correspond to two radar images at 19 and 26 January 2017 over a small zone of the Occitanie region.

The map of 19 January 2017 shows that the soil of the study site is dry and the soil moisture values are between 5 and 15 vol.%.

The map of 26 January 2017 shows that the soil is very wet with values between 25 and 35 vol.%.



Data and products from both Land Cover and Soil Moisture at very High Spatial Resolution SECs, are available on Theia website: www.theia-land.fr/f

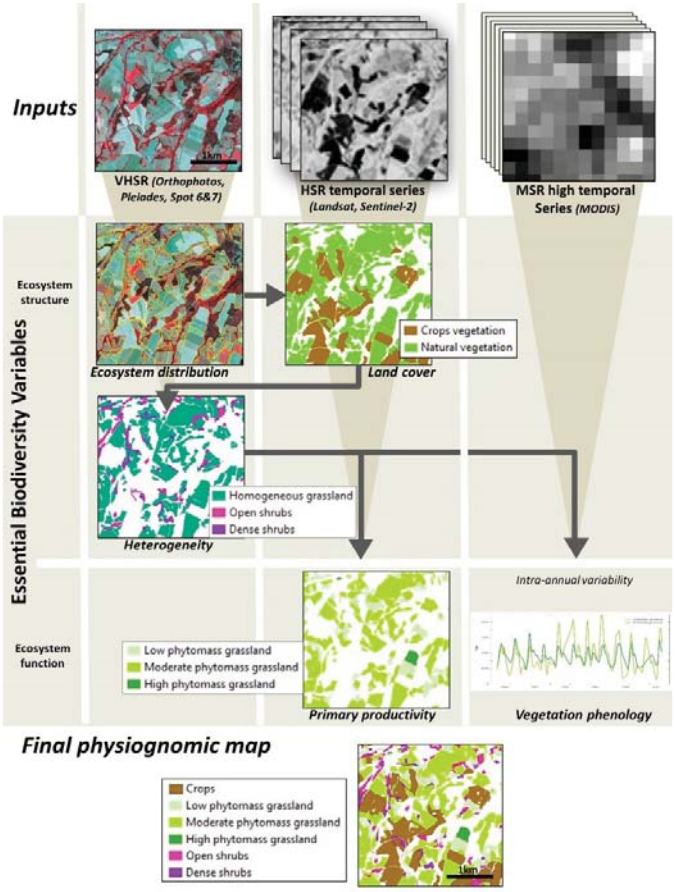
Documenting in essential variables for biodiversity by remote sensing

Global biodiversity is currently going through a major crisis that is degrading ecosystems, their functions and therefore the services they provide to humanity. Its preservation has thus become a central challenge for sustainable development at national, European (Natura 2000 and the Habitats Directive) and international level (Convention on Biological Diversity, 2011-2020).

The increasing availability of open access satellite images such as new modes of data analysis can help to achieve biodiversity conservation objectives by strengthening monitoring processes at various spatial and temporal scales. Open and free access to data thus has a direct impact on our ability to measure the impact of anthropogenic pressures, providing new opportunities to predict the consequences of changes at different scales and make mitigation measures more effective.

Essential variables for biodiversity

The concept of essential biodiversity variables (EBVs) is intended to help structure global biodiversity monitoring, as well as to harmonize and standardize biodiversity data from heterogeneous sources, in order to capture a minimum number of critical variables to study, report and manage biodiversity change.



In their contribution to the special issue of MEE, Alleaume et al. show the value of leveraging multiple remote-sensing data sources with complementary spatial resolutions and revisiting capacities to focus on five candidate EBVs identified in natural and semi-natural open ecosystems (i.e. excluding closed forests, urban and agricultural areas).

This forms a generic method for deriving indicators based on: (i) ecosystem distribution, (ii) land cover, (iii) heterogeneity, (iv) primary productivity, and (v) plant phenology.

Alleaume S., Dusseux, P., Thierion, V., Commagnac, L., Laventure, S., Lang, M., Féret, J.B., Hubert-Moy, L., Luque, S. (2018) "A generic remote sensing approach to derive operational Essential Biodiversity Variables (EBVs) for conservation planning", *MEE*, 9(8) : 1822-1836 DOI 10.1111/2041-210X.13033

A special issue of Methods in Ecology and Evolution (MEE) in August 2018 brought together a set of articles giving concrete and operational examples of methodologies using satellites for effective management:

Luque, S; Pettorelli, N; Vihervaara, P; Wegmann, M. 2018. « Improving biodiversity monitoring using satellite remote sensing to provide solutions towards the 2020 conservation targets »; *MEE* 9(8):1784-1786 DOI: 10.1111/2041-210X.13057

Multi-temporal (RS) remote sensing observations are particularly relevant for automatically quantifying habitat loss, degradation and fragmentation. They also make it possible to optimize field data collection by focusing on representative sites, with significantly improved cost-effectiveness ratios. Ten candidate variables derived from spatial remote sensing have recently been identified and referred to as remotely sensed or remotely accessible EBVs (RS-EBVs) (Skidmore et al., 2015, Pettorelli et al., 2016a;).

Pettorelli, N., Wegmann, M., Skidmore, A., et al. (2016) «Framing the concept of Satellite Remote Sensing Essential Biodiversity variables: challenges and future directions.» *Remote Sensing in Ecology and Conservation* 3(2): 122-131

Skidmore, A.K., Pettorelli, N., Coops, N.C., et al. (2015) «Agree on biodiversity metrics to track from space». *Nature* 523: 403-405.

Among the current challenges to improve the contribution of remote sensing to biodiversity conservation, strengthening multiple collaborative frameworks between remote-sensing scientists, conservation biologists and ecologists is necessary to improve the effectiveness of conservation methodologies and strategies. ■

Samuel ALLEAUME
& Sandra LUQUE (Irstea, Tetis)

To go further, the Landscape SEC, to be launched in late March 2019 aspires to identify different indicators, including landscape parameters at various scales.

By monitoring landscape fragmentation and alteration of natural habitats, these indicators will contribute to biodiversity conservation.

http://www.theia-land.fr/en/landscape-sec

Broadening satellite Data Access, while continuing to adress difficult questions

Interview with Olivier HAGOLLE

Researcher at Cesbio
www.cesbio.ups-tlse.fr/

and Surface Reflectance SEC facilitator
www.theia-land.fr/en/surface-reflectance-sec

You are the facilitator of the Surface Reflectance SEC. When and how did you engage with Theia?

Olivier Hagolle: I took part in Theia since its inception in 2008. Our starting point resulted from a frequent observation: users were spendng a lot of time in data preprocessing, and the problems they encountered were often the same: orthorectification, calibration, cloud detection, correction of atmospheric and directional effects. Pre-processing and atmospheric adjustment being my specialty, I clearly saw the importance and feasibility of a common service for data preparation. The preprocessing chains running today in the MUSCATE Theia Center, thanks to French Space Agency, CNES, are the result of that work.

At Cesbio, we strongly supported turning Theia into an operational production structure for high-quality products using Sentinel-2 systematical acquisitions, which were already lurking on the horizon. We sensed the revolution that the Copernicus data would bring to our domain, and it has been confirmed every day since. The same vision has now disseminated among all data providers, and ready-to-use products – Analysis Ready Data (ARD) – are now becoming the norm. Given the available resources of actors like ESA, unless we continue to advance on our part, the risk does exist that the quality of their products makes up for ours.

What is Theia's greatest achievement? What are the problems encountered?

Olivier Hagolle: Before Theia, our users' network consisted in a handful of research units. Making the most of Copernicus, Theia has supported a French dynamics in favor of Earth observation: innovative public and private services have emerged; scientific communities and spatial planning specialists have met. Nearly 1,500 users have already downloaded our products now, and only half of them are located in France. Each day, two to three users are directly questioning me. It is very rewarding, but the time needed to support the production – choosing parameters and treatment zones; answering questions; promoting products; and looking for new budget allocations to pursue the process – is taken from my research time. The same is probably true for the other SEC facilitators.

My passion is intact and I do not mean to complain, but Theia SECs and RANs have generated hope and motivation, which could sadly fold down if Theia funding organizations revert from alimenting – by opening positions, maintaining budgets and financing computing facilities – the efforts from a handful of researchers in their laboratories.

What is the main challenge for Theia's future?

Olivier Hagolle: A few years ago, we – spatial institutions and research centers – were almost the only ones to enjoy an easy access to Earth observation data. We could thus develop very useful products with moderate research efforts. Demonstrating the potential of these images and realizing pioneer products (i.e. the land cover map for France as soon as 2015) were the main stakes. The open and free Copernicus model and the success of our demonstration applications have both since supported the emerging of private actors, who are often more efficient and reactive than us in terms of developing simple products demanding heavy computing resources. In this new context, I do believe we should now go back to basics: addressing difficult questions, using elaborate models and a thorough field validation.

« To as a mediator between research and users to contribute to the developing of a true regional satellite-based economy

Interview with
Philippe ROSSELLO

Sud RAN Co-facilitator
www.theia-land.fr/fr/art-sud

and Director of GeographR
www.geographr.fr

How did you became one of the facilitator of the Sud Regional Animation Network?

Philippe Rossello: The Emmah Department of Inra in Avignon prompted me into taking charge of the Regional Animation Network (RAN) for the Sud region. Dominique Courault, its director, thought my company, GeographR, was in capacity to take on the issues and to meet the needs in the regional context. I was already convinced that it was essential to develop remote sensing in our region, and this facilitation mandate offered a good way to keep a constant watch on satellite-based products. Putting GeographR into such light contributed finally to reinforce the visibility of my consulting, even if the benefits in terms of contracts are still very marginal. Supporting the regional actors to use satellite-based resources for environmental monitoring, for assessment of climate change impacts or documenting land use evolution remains however the main stake. It is crucial to capitalize the investments dedicated to spatial information.

How do you envision your role as a facilitator between research and users?

Philippe Rossello: This mediation is essential to reinforce the dialogue between academics, companies, local authorities, national and regional conservation areas… Users waver before questioning researchers because both communities remain very segmented. Theia regional animation network has to foster these discussions. It can involve setting-up joint projects, modest or ambitious. In the Sud region, we are trying to bring together different kinds of regional actors, public and private, without exclusion. Users are inquisitive and willing, but their needs concern very narrow territories. They thus expect the Sud RAN to act directly on their territory. Unfortunately, current South RAN financial means do not allow us to meet this expectation.

What does constitute the greatest Sud RAN achievement?

Philippe Rossello: With approximatively 50 trainees, the two-day technical training organized with the Avignon University in 2017 has been a great success. We did not expect such a large craze. An event at the Maison de la météo et du climat (Weather and Climate House) in Les Orres has enable us to present the remote sensing potential to alpine actors. In the mountains as on the plains, remote sensing constitutes a precious tool to broaden knowledge and databases.

The national conference dedicated to remote sensing scheduled in September 2019 in Aix-en-Provence will bring a new momentum for our actions. Organized by the CRIGE in partnership with the Sud RAN, this event will constitute a milestone in our regional animation. CRIGE and GeographR will now facilitate jointly the Sud RAN. The rapprochement is an excellent news for the development of the economy and the broadening of knowledge related to satellite-based products – from the monitoring of the health of alpine lakes to the identification of the area best suited for the installation of renewable energies equipment. GeographR, with its will to create bridges between public and private sectors, and CRIGE, with its large network of public and local actors, are more than complementary. The animation dynamics must be constant to prevent any loss of momentum and impetus at regional level.

»

Bulletin Theia

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