BULLETIN
Theia Land Data Centre

n° 7 - July 2017

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A word
from the Scientific and Technical Directors

Since its inception, the Theia land data centre has greatly contributed to the effort of pooling satellite images, developing innovative algorithms and providing value-added products and services. Scientific Expertise Centres (SEC) have been set up and products are being prepared. The Land Cover Scientific Expertise Centre (OSO SEC) produced an initial high spatial resolution map of land cover for mainland France using Sentinel 2 data. A forest biomass map is now available and a workshop was held to show the progress made by the Urbanisation/Artificialisation Scientific Expertise Centre. A new Regional Animation Network (RAN) was created in Ile-de-France and the two Languedoc-Roussillon and Midi-Pyrénées RANs were merged into a single Occitanie RAN.

To continue preparing and creating new products, Theia employees are organising a workshop on 15 and 16 June 2017 in Montpellier for SEC members and RAN coordinators.

Theia's success is primarily due to our scientists whose work has seen the centre gain influence. Our institutions are also playing their part by providing steadfast support even at difficult times.

Nicolas Baghdadi   Arnaud Sellé

LATEST NEWS

Remote sensing for studying urban environments

The first workshop on «remote sensing for studying urban environments» (TEMU), organised with support from CNES, took place at the Météopole site in Toulouse on 16 and 17 January, with over 60 participants.

TEMU's objective is to better unite the national community working in urbanisation by using high and very-high spatial resolution satellite imagery (optical, LiDAR, radar and thermal). The major issues in urbanisation were discussed in particular, such as heat islands, climatology, planning and sustainable cities.

The conclusions of this workshop will help promote the work carried out by the Urbanisation/Artificialisation SEC.

**Jean-Louis Roujean
(CNRM / Météo France)**

Launch of the Urban Scientific Expertise Centre

The first Urban SEC meeting took place on 2 February 2017 at CNES premises in Paris. Around twenty representatives from the main laboratories and organisations working in the field attended.

This initial meeting took place further to the «Remote sensing for studying urban environments» workshop organised in Toulouse in January 2017 to offer real «urban» products, showing the benefits of satellite imagery to scientific and user communities. Several «standard products» were identified for the SEC :

- Urban footprint,
- Urban forms,
- Urban vegetation,
- Indicators

Not all of these products have the same level of maturity and methodological solutions have already been developed by the SEC partner teams.

The objective of the SEC is therefore to compare/combine these different approaches to define the methodological tools best suited to each product. The objective for 2017 is to test/develop several methodologies for the «most mature» product, to select the most relevant solution and move on to the production phase (2018). These developments will be completed in close collaboration with the developments of the Land Cover Scientific Expertise Centre (OSO SEC).

To join the Urban SEC, please contact one of its coordinators.

Anne Puissant (Live / Unistra)

Theoretical and practical training on remote sensing

Remote sensing training took place from 6 to 8 June 2017 at Avignon university on the topic «from space imaging to mapping data: managing the processing chain with open-source tools».

Atelier Télédétection pour l'Etude des Milieux Urbains
Météo-France - Toulouse - 16 & 17 janvier 2017

This training was organised by the relevant Theia regional animation network (PACA RAN), the PACA Booster, the Seine Espace Booster, Theia, Avignon university, the CRIGE (regional centre for geographical information), IdGeo, Terranis, CNES and CS. It aimed at SMEs, researchers and students looking for an introduction into space imaging data and tools. Basic theoretical knowledge of remote sensing and initial experience in processing using QGIS were required.

The draft programme was :

- Tuesday 6 June (morning): potential for aerospace remote sensing (Thales Alenia Space/Safe centre and PACA RAN)
- Tuesday 6 June (afternoon): OTB/Monteverdi (IdGeo and Terranis)
- Wednesday 7 June (morning): OTB/Monteverdi (IdGeo and Terranis)
- Wednesday 7 June (afternoon): OTB/Monteverdi (IdGeo and Terranis) and PEPS (CNES)
- Thursday 8 June (morning): Geostorm (CS SI)
- Thursday 8 June (afternoon): Snap (CS SI)

The registration fees amount to €180 per trainee, including teaching costs and meals (breaks, lunches and dinners). Registration was free for students from Avignon university (priority given to Master's students).

Philippe Rossello (GeographR)

Detecting changes in high temporal frequency image series

The first day of the «detecting changes in high temporal frequency image series» SEC took place on 3 February 2017 at CNES in Paris, bringing together around thirty people from various backgrounds such as IT, geography, mapping, the environment and so on.

This meeting between data processing specialists (space imaging in particular) and specialist data consumers in their subject areas, enabled a comparison of approaches and various needs, with participants explaining them to each other and working towards a common vision and vocabulary.

After a presentation by Nicolas Baghdadi on the role of the SEC within Theia and an introduction from Pierre Gançarski on his vision of the SEC, the lively debates mostly focused on defining the notion of change (types, observation frequencies, etc.) as well as the characteristics of the methods to be implemented to detect them. Various presentations were given

OTB training session

on both methodological and subject-related aspects.

Lastly, discussions helped position this SEC with respect to other, more subject-specific SECs.

Pierre Gançarski (Unistra)

A data centre for biodiversity

The Forum for Ecoscope users dedicated to collective discussions on priority «Products & Services» to be developed took place on 26 April 2017 in Paris.

After two years operating as «Ecoscope, data centre», it was time for a review and to plan ahead, listening to observation system players in research on biodiversity and all data users. The national research and expertise scene is changing, but pressures on biodiversity and disruption to ecosystems, remain. Promoting dialogue, accessing research data sets and complementary observations:
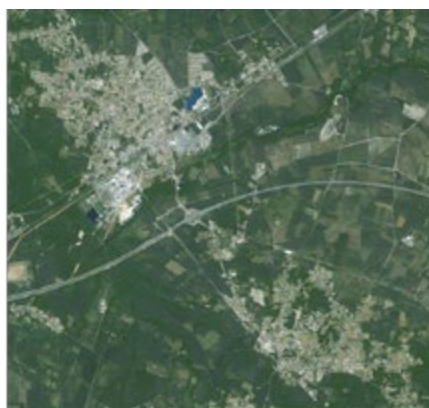
all these challenges are still relevant.

For more information on the e-infrastructure services, go to : fondationbiodiversite.fr.

Aurélie Delavaud (Ecoscope)

In-situ action plan in conjunction with the Scientific Expertise Centres

The Scientific Expertise Centres (SEC) are developing innovative methods to use satellite data for «continental surface» issues. Creating value-added products sometimes requires using in-situ data to calibrate the products. The in-situ data are not currently used to their best in the Theia portal.

An inventory of the data used by SECs is being taken as part of integrating in-situ data into the Theia portal. A questionnaire has been sent to the nineteen SEC managers. It is based on the type of in-situ data, the location, accessibility and various descriptive elements. Nine responses have been received.

Sylvie Galle (IRD, CNRS - INSU)

Marais Urbanisation Industrialisation
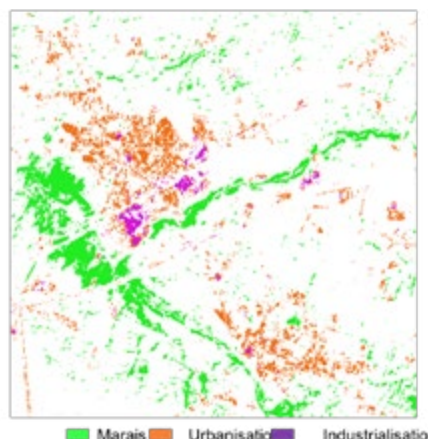
Extraction of temporal patterns from image series

Launch of Sentinel 2B

The big news for the start of the year: the Sentinel 2B satellite was launched on 7 March. The newcomer's mission is running smoothly; the satellite is already acquiring data on Europe with great regularity. However, the technical teams must be given the time to set all the parameters in order to obtain images of the best possible quality. Between them both, the Sentinel 2 satellites will be able to observe at least all of Europe and Africa every five days. For the rest of the world, the frequency will «only» be 10 days until a relay satellite or a new reception station is up and running in 2017.

CNES has started to use the Muscate data production centre on behalf of Theia, starting with level 2A data from Sentinel 2A. These data are rectified to eliminate atmospheric effects and come with a good cloud mask, thanks to the MAJA processing chain resulting from collaboration between CNES, CESBIO (Centre for the Study of the Biosphere from Space) and DLR (the German Aerospace Centre), and based on the CNES MACCS.
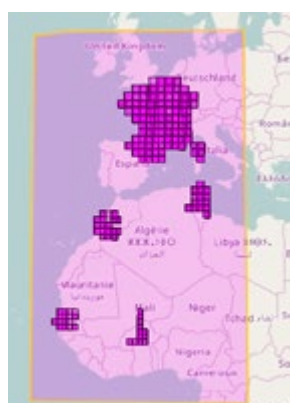
Tiles processed byTheia

The running-in period took longer than expected, but operation is now nominal and the production zone is gradually growing in all the planned areas. Over 10,000 images await you on the Theia server, for France (and Réunion), northern Spain, Belgium, Morocco, Tunisia, Senegal and a transect from Burkina Faso to Mali. The processed data date from November 2015 until three days ago. By the time this article is published, images of Madagascar and the Yangtze valley in China should have been published.

Example of a level 2A product for Dakar, Senegal. The clouds that were detected are marked in green.

At the same time as production, we are fine-tuning the settings for various parameters in the MACCS used to produce the data. Various versions are available, based on the date of production. The contents of these versions is explained here. It is possible for the transition from version 1.1 to 1.3 or 1.4 to result in small variations in surface reflectance. We will reprocess all these data with consistent settings once the ESA has reprocessed the level 1C data to offer better data superimposition.

Over 300 people have already downloaded Sentinel 2 level 2A data produced by Muscate: we have received only a little feedback on its quality and usefulness. Please tell us what you think, even if you are satisfied !

Olivier Hagolle (Cesbio / Cnes)

Distribution of Theia products in the CNES IDS

After Sentinel 2 reflectance processing entered pre-production on the CNES Space Data Infrastructure (IDS), processing continues.

The changes that were required to take account of the new ESA tiled format, applicable from December 2016, have been made. Production can therefore extend in time up to real time, with a gradual extension in processed zones, to eventually cover the areas that come from the results of the call for scientific projects.
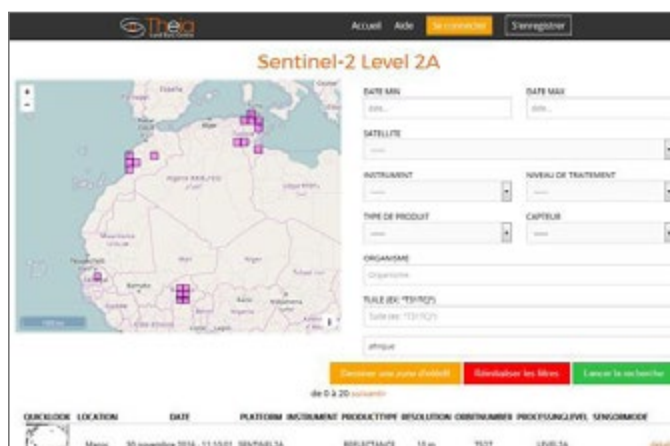
Search and consultation interface for the Sentinel 2 reflectance products

However, these initiatives must be associated with a switch from the Theia IDS to the new CNES Calculation cluster. This operation is planned for April, with an initial «ramp-up» phase for disk array performance.

At the same time, the first distribution of snow-cover scale products will take place in May 2017 for a new dedicated collection. CNES also mandated support to prepare the integration of the Land Cover (OSO) chain and the distribution of the 2017 version of the OSO demonstrator in mainland France.

Provision of the 30-year history of Spot (Spot World Heritage) archives is now subject to a phase 2 project that will be cross-functional at the data centres. Over 15 million Spot scenes will be processed and made available with two processing levels, level 1A (as conventionally distributed for Spot products) and the orthorectified level, aligned with the Sentinel 2 reference. The total processing time required is estimated at 18 months once the developments are made with the objective of making the archives available by the end of 2018.

In the field of hydrology, (hydroweb.theia-land.fr), lake time series are updated using Jason 3 in Hysope. For rivers, new operational Jason 3 virtual stations are being used, identical to the Jason 2 virtual stations. In June 2017, operational Jason virtual stations will be created combining Jason 2 and Jason 3 measurements. Likewise, the Sentinel 3 mission will be taken into consideration.

Arnaud Sellé (Cnes)

Land cover maps

The Land Cover SEC had committed to producing a 2016 land cover map for mainland France before the end of the first quarter of 2017. This was provided here on 30 March 2017. It is a 10-m resolution map, with the same nomenclature as that used for the latest 17-class Landsat prototype products.

The map is mainly based on Sentinel 2 data from late 2015 to late 2016, but Landsat 8 data were also used.

In terms of quality, the statistics indicate something quite similar to what was obtained with Landsat 8. The improvements made by Sentinel 2 are significant (you just have to look at the map), but they are not visible for the overall statistics for the whole territory.

Display interface

The classification is displayed on a very-high resolution imagery background. We can play with opaqueness (cursor below the image). If you click on a pixel, the class name appears.

In the top right-hand corner of the display interface, you will find a button that enables you to display 2 additional layers :

- Validity : : this is the number of valid dates (no clouds or shadow) used to recognise the class of each pixel. You will see that there are significant differences between the zones due to satellite ground track coverage and, of course, the weather.
- Confidence : this is the probability of the class selected for each pixel. The classification algorithm makes a majority vote from 100 individual classifiers. Confidence is the percentage of classifiers that voted for the majority class. With 17 classes, this probability could be under 6%, but overall it is higher than 40%. We can see that confidence is lower in the West, the Mediterranean basin and large cities. Conversely, it is high in large central areas of cultivation and forests (you can see the Landes forest on the confidence map).

Below the image display are the validation statistics. Firstly there are overall percentages :

- OA: Overall Accuracy, which gives the percentage of well-classed pixels.
- Kappa: statistical index similar to OA, but adjusted downwards to take account of the fact that random classification would also have well-classed pixels.

For each class, we also display the FScore, a metric with an optimum value of 1, which combines over- and under-sensing.

As the classes for other land development surfaces are very mixed up, the FScore of the 4 classes together was added. For annual cultivation (summer and winter) the classification procedure does not enable validation with the same set of data as the rest of the classes. The FScore is therefore provided with both classes together, but also measured with the classes separated using a restricted data set.

Downloading files

To download raster files in the Geotiff format, you can use the following links:

- land cover, nomenclature
- validity map
- confidence map

Standardised maps with 20-m pixels (instead of 10 m for the current version) are also available. Vector products in Esri Shapefile format will follow slightly later.

Please remember to voice your opinion by responding to the online survey available here.

Jordi Inglada (Cesbio / Cnes)

France land cover classification, from Landsat 8 to Sentinel-2.
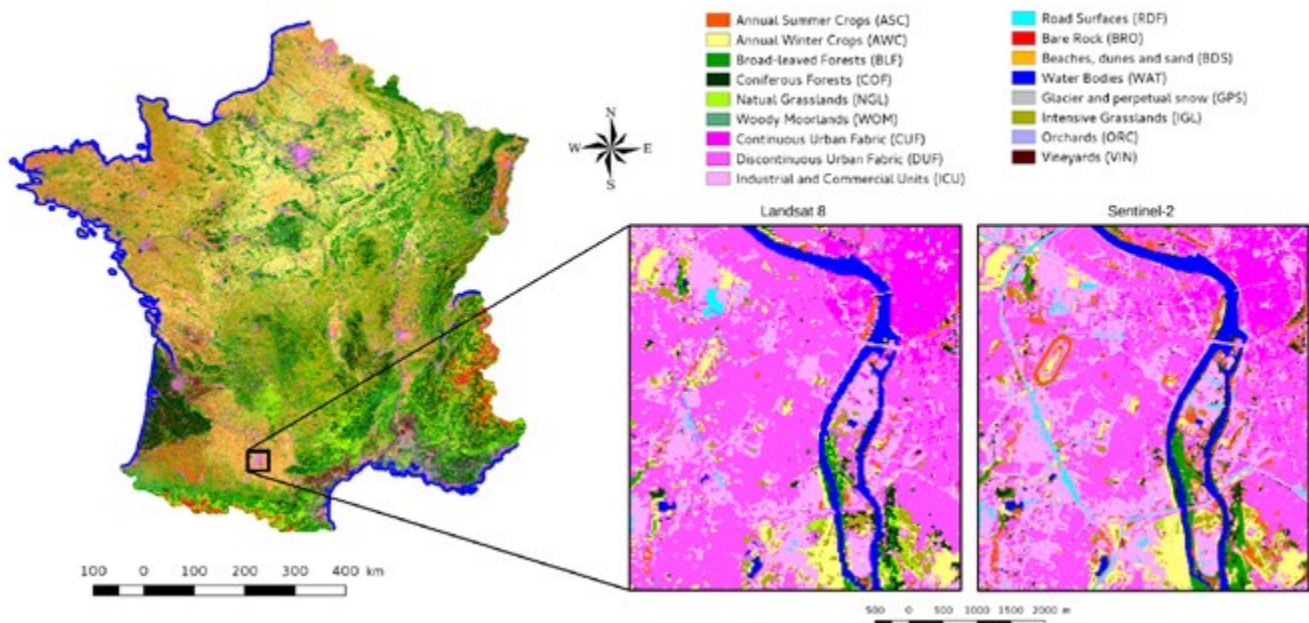
Colours of the continental waters SEC

The «colours of the continental waters» SEC expanded at the beginning of 2017. The SEC now includes the various French teams working on lakes, rivers or estuaries in France and abroad: the LOG associated with LEGOS (Cross-Mekong flight project) GET (SAMSAT2 and OBS2CO projects) and the French biodiversity agency (AFB) associated with the LOV and the UR Recover (Telquel project). These teams will coordinate their work to break down the main scientific and technical barriers required to operate the monitoring of continental surface water quality via remote sensing (S2, S3 and L8). This notably requires (i) to add more detailed documentation of the optical properties of continental waters as well as to populate databases, (ii) the development of pre-processing suited to the subject area, including ad hoc atmospheric corrections and the automated sensing of water surfaces, (iii) the development and validation of inversion algorithms suited to the complexity and diversity of continental water types.

Sentinel and Landsat imagery for public water policies

Meeting the objectives of European and national directives on water surfaces (e.g. WFD for continental waters and MSFD for marine waters) requires the monitoring of key parameters for these ecosystems such as the temperature, transparency, chlorophyll a concentrations, suspended matter and dissolved organic matter. Today, this monitoring is too loose in terms of time and space, taking account of the cost associated with field measurements. The AFB/Irstea centre (UR Recover) in hydro-ecology for bodies of water in Aix-en-Provence has been conducting research and development projects since 2014 to complete this monitoring using satellite imagery. These projects are in line with the ideas of decision-makers and managers, notably by requiring sampling in the field that is synchronous with satellite passages (at more or less 3 days) in the decree on monitoring water bodies.

Today, the water surface temperatures, derived from thermal infra-red bands from Landsat imagery, are produced with errors of 1.5 to 2°C continuously within the centre (Simon et al., 2014). They are used to more-accurately model the temperature of the various layers of the water body (Prats et al., 2015). The investigations, conducted in the Tosca Telquel project (remote sensing of the ecological quality of lakes, 2015-2017) (i) provided an algorithm for rectifying atmospheric effects and sunglint on the Sentinel (S2 and S3) and Landsat (L8 and archives) images suited to water targets regardless of altitude, temperature and salinity (Harmel et al. submitted in 2017), (ii) launched the creation of documentation on the optical properties of the bodies of water, required to develop inversion algorithms. This work is now included in the «Colours of the continental waters» SEC.
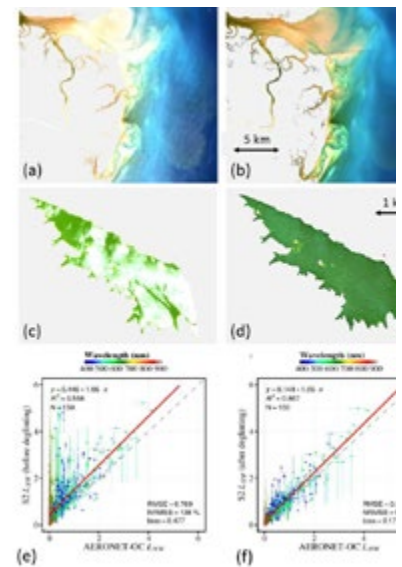
Results obtained further to atmospheric rectification of the Sentinel 2 images, prior to (LH column) and further to (RH column) rectification of the effects of sunglint. At (a, b) at the AERONET-OC site (estuary, Australia, 19 February 2016), at (c, d), at Naussac lake (France, 7 July 2016) and at (e, f) comparison of reflectance leaving the water between the Aeronet - OC sites and found using Sentinel 2 images

**Jean-Michel Martinez (IRD), Thierry Tormos (AFB)**

Madagascar forest biomass map

The substantial use of the French Guiana forest biomass map strongly encouraged us to repeat this work for Madagascar (Tosca support). An approach based on the regression-kriging technique for remote sensing data and other climate variables (Earth rainfall climatology, temperature, etc.) was used.

The methodology follows four main phases: (1) establishing a model (Random Forest) to link the in situ estimations on biomass to the parameters derived from space data (EVI, coverage percentage and elevation) and climate data, (2) applying the established model (stage 1) to derive a preliminary biomass map, (3) estimating the best linear regression between the metrics (variables) derived from the LiDAR waveforms from the Glas/ICESat satellite (footprint of around 60 m in diameter) and in situ biomass data (forest aboveground biomass «AGB»), (4) improving the accuracy of the biomass map obtained previously (step 2) by adding the kriged residue (Glas AGB – stage 2 map).

A 250 m x 250 m resolution biomass map was produced with a mean quadratic error (RMSE) of 74 Mg/ha (R^2=0.71). This map has high potential considering its accuracy compared to the two global AGB maps from Baccini and Avitabile. The comparison between the two global maps and the in-situ AGB data for Madagascar shows that both global maps have significant errors (RMSE of between 135 and 168 Mg/ha).

Nicolas Baghdadi (Irstea)
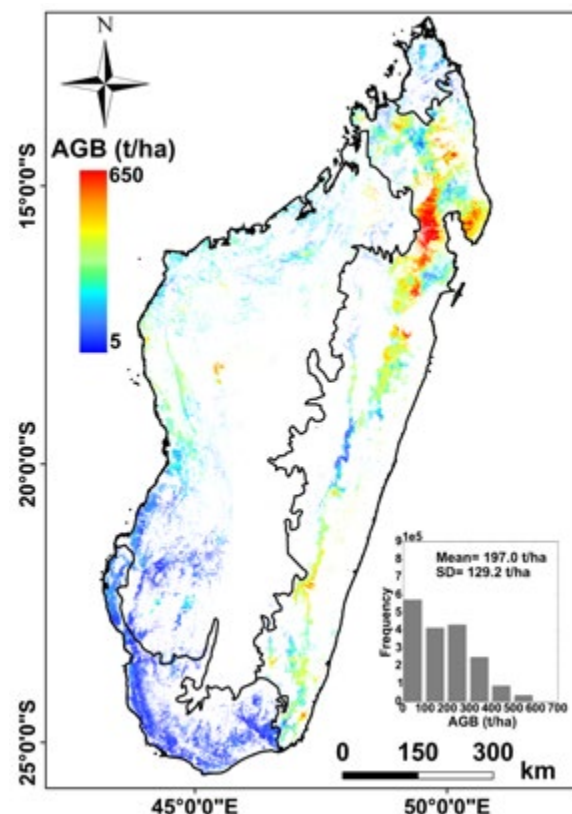
Forest biomass map for Madagascar, 250 m x 250 m resolution

Creation of the Ile-de-France RAN

The Ile-de-France region has just launched a new RAN based on urban issues. Between Paris and the Saclay plateau, which is fast developing, the potential for new applications offered by remote sensing is high.

Remote sensing is undergoing the same change in context as other IT domains: big data, increased number of images, increasing size, temporal repetitiveness and the types of sensor. As such, Earth observation images are used to supply and add to all the information taken on the ground.

In addition, the Saclay plateau is now a ground for experiments for future city uses, solutions that will aid the daily lives of users and inhabitants. New requirements are appearing, smart city requirements, notably for the Saclay Plateau Public Development Establishment and the Urban Agglomeration Community of Paris Saclay.

In addition, the themes covered in the RAN include the control or update of land cover information, traffic data (car park occupancy and traffic), land or structural deformations, heat islands, etc.).

This new Ile de France network will unite researchers using or processing remote sensing data, those interested in urban development and urban land management and potential end users.

There are three objectives to this network: promoting new collaboration, combining sets of data on the region and addressing new lines of research to encourage the emergence of new areas of application.

The deadline for launching this new RAN is set for 28 June 2017.

Bernard Rosier et Elise Koeniguer (Onera)

Contribution of the Southern Theia Regional Coordination Network: GeoDEV RAN - SEAS systems

SEAS (satellite-assisted environmental monitoring) systems are Skills Centres for remote sensing supported by direct satellite reception means. Based on the historic Sea-Net network led by the IRD (L-band receiving stations for NOAA satellites) in the 90s, they serve user communities with satellite data inside geographical sub-regions located in the inter-tropical belt.

The first system created was the Guiana SEAS, founded in 2005 by the IRD, CNES, the region of Guiana and the State (direct reception of Spot 2, 4 and 5 and Envisat/Asar). The Indian Ocean SEAS system validated in 2007 (IRD, Réunion Region, Réunion University and the State) entered into service in 2012. The Geosud system (Spot 6-7) inspired by the SEAS model, entered into service in 2014, the same year as the Gabon SEAS system (Landsat 8 and CosmoSkyMed) at the origin of the creation of the Gabon Space Observation and Research Agency (Ageos).

In 2016, the founding members of the GeoDEV RAN offered to help in their respective developments by transferring capacities, skills and tools from Theia. Within this context, their integration in the GeoDEV network as regional focal points is being formalised.

With this networking, new opportunities for collaboration and cooperation are appearing in terms of sharing data and pre-processed products, but also in terms of new subject area applications for institutional communities: transfer of Geosud IDS, Stand Alone Muscate and application chains from the Theia SEC (OSO for example).

The future projects on upgrading and developing the SEAS systems concern Guiana and Réunion, but transfers to Ageos are also planned; collaboration was established with other national structures to organise similar exchanges (Morocco, Madagascar and Haiti) in the context of existing or future Skills Centres.

Jean-François Faure (IRD)

Vigisat

Atlantic IMT, the engineering and digital technologies public higher education institution (formerly Télécom Bretagne), is the coordinator of the VIGISAT programme project, initially part of the 2007-2013 Region-State Project Contract then the 2014-2020 version. Atlantic IMT is therefore suggesting its scientific partners pool their skills in the context of the BreTel (Brittany remote sensing) Group to promote this scientific project linked to the Brittany Remote Space Sensing Network and, more broadly, the West of France. Therefore, this programme is building a resource and processing centre to create a regional space observatory based on various application subjects for land and sea surfaces.

In addition, the acquisition of data from the Vigisat programme mainly uses the station of the same name, the main French station for direct reception and analysis of high-resolution radar satellite images. The Vigisat station, located in Brest, is operated by the company Collecte Localisation Satellites (CLS), who operates, maintains and provides services to the members of BreTel.

Already labelled a «Télécom & Société numérique Carnot Institute platform», the Vigisat programme aims to develop in line with national programmes on labelling large scientific structures and European programmes of the same type.

Direct reception and analysis of high-resolution radar satellite images VIGISAT

Nicolas Bellec (Groupement BreTel)

Economic potential of Theia

In the context of the Theia regional coordination network, CES-BIO, in conjunction with CNES, via the «E2L» cooperative company, conducted exploratory work to assess how the themed centre could contribute to the development of new service offerings and result in «economic dynamics» founded on remote space sensing.

Interviews with researchers and workshops took place in the Occitanie region. Feedback was then gathered from institutional players. Mapping qualifying «the development potential" based on four areas, revealed both the potential and the diversity of the subjects.

Structuring a system of research players in relation to remote sensing

Theia is primarily perceived as a collaborative environment for the scientific community and an infrastructure for accessing data.

The study revealed that it is not so much the laboratories that are involved, but the «individual» researchers in the context of their specific projects.

⇨ The proposed theory is to qualify the project - researcher pair with respect to the various areas that contribute to the development potential :

1. TRL (Technology Readiness Level) in the context of the project

2. SRL (Service Readiness Level)

3. Targeted level of value

4. Availability for development

The involvement of the researchers revealed dynamics based on motivation but the lack of involvement of the laboratories in a more formal context is limiting as there is no guarantee of sustainability for the dynamics at play.

Dynamics for development via the invention of new services

The community of researches can only grasp the usefulness of this work by building relationships (stimulation, reaction and collaboration) with a system of non-research players.

A good proportion of the potential uses of space data is not intuitive and requires changes in representation and behaviour.

The challenge is to envisage how Theia is can be the means for going from a conventional «research towards the transfer of technology» approach in relation to the company using the technical innovation to an «Innovation Research» approach that accompanies change by working with the end users and companies inventing the design of new services.

"Theia RANs", the regional link to coordinate innovation ecosystems

Within Theia, the transfer/development dimension of the SEC work was well understood by all researchers encountered, but leaves room for various approaches and practices. The Theia regional coordination networks (RANs) are coming up with a new way of structuring development processes.

The link between a regional Theia specialism in line with specific regional contexts seems to be a first step towards creating innovation ecosystems for the emergence of services from SEC work re-integrating usage system players. This «open-design» model could be coordinated by the RANs based in their regions.

Bernard Thumerel (E2L Espace et Living lab)

Towards a 2017-2020 roadmap

1. Extending the internal structuring of Theia via the RANs and submitting the first results of researcher contribution.

2. Building a regional institutional appeal to ensure sustainability for a specific resource for the Theia initiative towards the «Territorial Innovation Research» approach.

3. Developing pilots for the approach (Innovation Research).

4. Associating this proposal with the construction of Southern Theia, «GeoDEV»
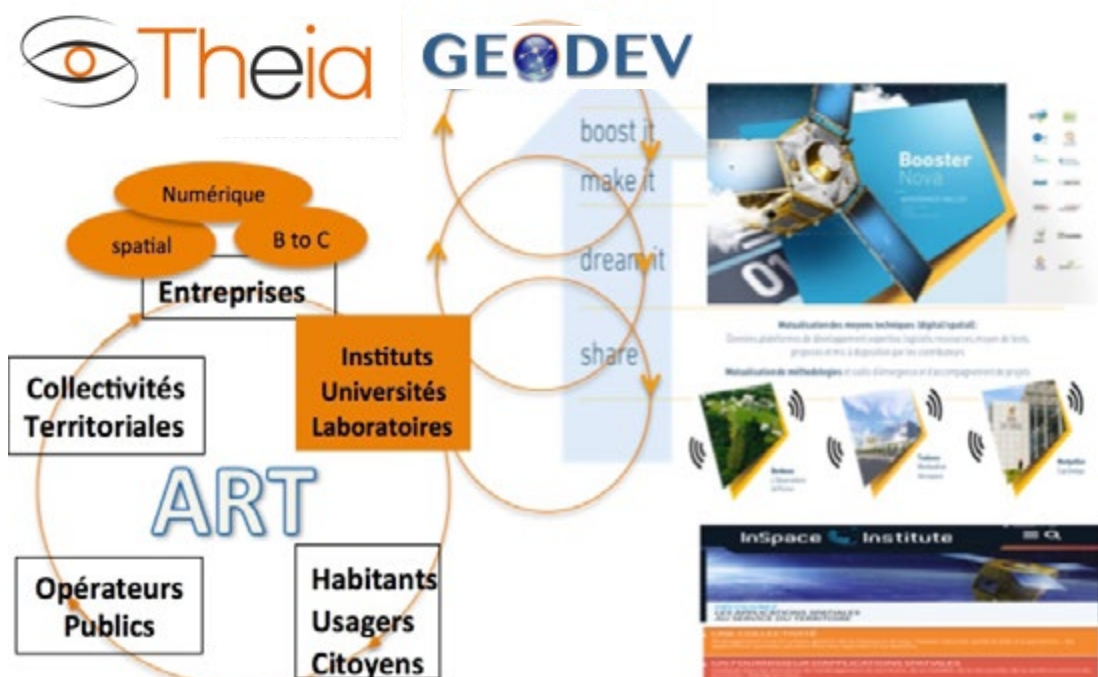
Altimeter space missions to monitor continental waters

Altimeter missions, mainly known for their ocean applications, are also used for systematic, comprehensive and continuous monitoring of the heights of lakes and rivers. Although the altimeters are optimised for ocean surfaces, with precision to the nearest centimetre, they can reach decimetre precision for continental water surfaces, sufficient for most applications. The difficulty is notably due to the size of the footprint of the radar beam on the ground (approx. 7 km in radius) for observing lakes and rivers with sub-kilometre widths.
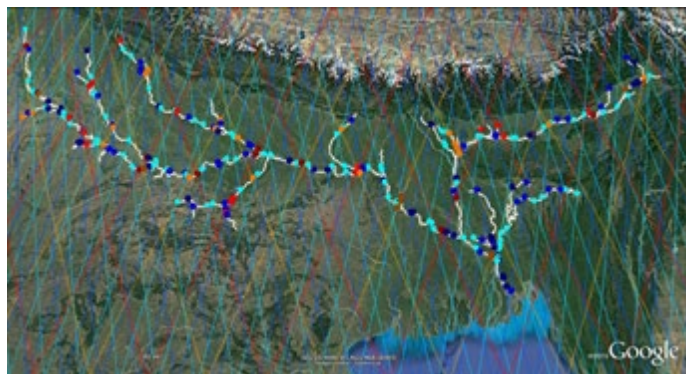
Potential virtual altimeter stations in the Ganges/Brahmaputra (white). 30 Jason 3 stations (red), 36 Jason 2 stations (current orbit, orange), 93 Sentinel 3A stations (blue) and 96 Sentinel 3B stations (Cyan, from end of 2017). Tracks on the ground of the missions are represented with the corresponding colours.

Although water is generally a surface that is more reflective than land, the combination of land and water within the observed scene disrupts the signal recorded by the altimeter and makes water height estimations more complex.

Various studies, notably at the initiative of LEGOS, were conducted to improve not only the quality of data, but also the density of the observed water surface network. The development of dedicated processing algorithms (retracking) enabled a clear improvement in data quality, and promising solutions are being created. Lastly, studies were carried out to automatically couple the altimeter data with optical imagery. This coupling not only enables the most reliable measurements to be selected in principle, but also makes the continental water surface network exponentially denser and monitors the stock of water in large lakes or reservoirs. A demonstrator of this work, Hydroweb, was created in 2003 by LEGOS and is now operated by CLS for Theia. This hydrological database will be an essential means of validation for the Swot mission, which will revolutionise the continental water surface monitoring scene as soon as it is launched in 2021.

Since 1992, Aviso has been the centre for distributing and promoting altimeter data for CNES. From the end of the 1990s, hydrology applications have been established, using measurements from Topex/Poseidon and ERS satellites. To date, over a hundred users interested by altimeters in hydrology have signed up.

Nicolas Picot (Cnes)

Bluecham

Populations are facing challenges of increasing complexity, at the heart of cross-cutting environmental and social challenges. In Oceania, the impacts of climate change are no longer a theory and the first actual refugees there to prove it. Decision-makers must come up with new methods, compare visions, compare variants and assess risks before making strategic choices. Bluecham SAS, an innovative company that came from the IRD, is based in Nouméa to be closer to this prime land. Its role is to make the scientific knowledge required for understanding phenomena and taking action useful and adoptable on time. The teams, specialised in space-time analysis, modelling and interoperability, are creating a link between social demand and subject-area experts, thanks to «full web» technology called Qëhnelö™ and a distributed approach for resources and actors.

On 13 March 2015, Bluecham deployed an operational hub in four hours in Vanuatu, to meet the needs of the emergency teams after the most violent cyclone the region had seen to date (350 km/hr). With daily very-high-resolution flow analysis, this system made the first assessments possible and enhanced the effectiveness of operations. The same year, Bluecham received an award from the Australian deputy prime minister and two awards

from the ocean remote sensing community. Since, Qëhnelö™ is asserting itself in the Pacific as a new vector for the development of space data use.

Didier Lille (Bluecham SAS)