

## THE LIVING LAB APPROACH FOR THE DEVELOPMENT OF SPACE APPLICATIONS: LESSONS LEARNED FROM THE RITA PROJECT

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### ABSTRACT

The overall objective of RITA was to explore the conditions for the emergence of a European network of Living Labs dedicated to developing applications of satellite remote sensing and geographic information. RITA project was funded (2008-2010) by the "Regions of Knowledge" program of the EU FP7. The aim of RITA was to test the applicability of the approach implemented by the project "Pôle d'Expérimentation et d'Application des Technologies Spatiales (PATS)" developed in the French Midi-Pyrénées region in a different European region, namely Catalonia in Spain. This approach combines the concepts of experimental territory and Living Lab. The strategy followed by RITA relied on the development of pilot projects implementing a dynamic of co-construction of needs and products or services with users groups. Three main themes were addressed: agriculture, health, and land management. RITA led to explore new avenues for the development of uses of space technology and allowed progress in various fields, such as analysis of the value chain.

*Keywords:* Living Lab, remote sensing, territorial development

### 1 INTRODUCTION

The RITA project was developed at the crossing of two different concerns emanating from different actors.

The first concern deals with the difficult development of operational and efficient utilization of the data provided by Earth observation satellites. Except in some areas, such as meteorology, science, or defence, this development is slow when compared to the one of other space technologies such as positioning and telecommunication. A totally different concern relates to the economic, social and environmental development of rural territories in a society where major cities are driving the economy, leading to a strong imbalance of development between the two types of territories. Innovation appears as a crucial issue for the survival of rural territories.

In the beginning of the 2000s, CESBIO, a public research laboratory, started to develop

the so-called Observatoire Spatial Régional (OSR, Regional Space Observatory) which objective was to serve scientific research by providing long term in-situ and satellite observations at intermediate scales, from local to regional. CESBIO started in parallel to work on web-mapping tools and SEIS (Shared Environmental Information System).

In 2007, a project, called PATS, started in the Midi-Pyrénées region with the ambition to serve both the development of remote sensing applications and the development of a rural territory. PATS adopted a bottom-up approach, where the needs and constraints of the users and stakeholders were at the centre of the discussions and of the technological developments. The data and results obtained by CESBIO in the frame of the OSR provided the basis for illustrating the capabilities of remote sensing and for initiating pilot projects. PATS puts at the centre of its approach the development of a SEIS, as a way to share and capitalize information and data. In fact, PATS was building a Living Lab, a new way of structuring the dynamics of innovation with an emphasis on user involvement in the creation of new services and products. This innovative approach offers an alternative to industrial innovation practices and is widely supported by the European Commission.

The preliminary results we obtained led us to propose the RITA project in the frame of the Region of Knowledge FP7 program. The overall objective of RITA was to explore the conditions for the emergence of a European network of Living Labs dedicated to developing applications of satellite remote sensing, and more generally of geographic information.

The aim of RITA was to test the applicability of the approach implemented in the framework of PATS in a different region, namely Catalonia, Spain. This approach combines the concepts of experimental territory and Living Lab.

The section 2 provides some details on the implementation and results of the OSR, PATS, and RITA projects, while the section 3 summarizes the main learnings of these projects.

## **2 THE BACKGROUND OF RITA**

### **2.1 Regional Space Observatory**

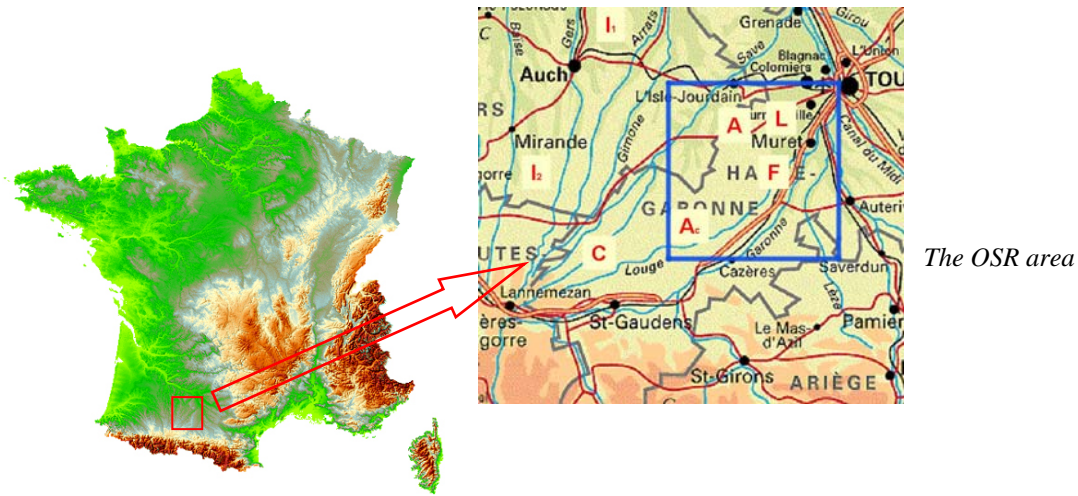
When CESBIO started to implement its Observatoire Spatial Régional (OSR) in the 2000's, its aim was first to serve its research on land surface functioning (e.g. water and carbon fluxes, vegetation productivity) at local, landscape, river basin and regional scale. For that, CESBIO set up several micrometeorological ground stations and started to collect data from ground surveys and satellite observations. The experimental area is a 50x50 km zone located to the south of the city of Toulouse. Apart from a significant surface occupied by urban settlements, this area is mainly devoted to agriculture, with some woodlands and grasslands.

A second aim of this OSR is to provide data for designing and testing algorithms used for satellite data processing and for validating the products. This was for example the case during the preparation of the SMOS mission. In order to prepare the Venus mission, CESBIO started to acquire in 2002 times series of high ground resolution satellite images. Approximately one cloud free SPOT or FORMOSAT-2 image have been acquired every month since 2002, with a higher temporal sampling during some periods. These acquisitions are now performed in the frame of the CNES' Kalideos programme.

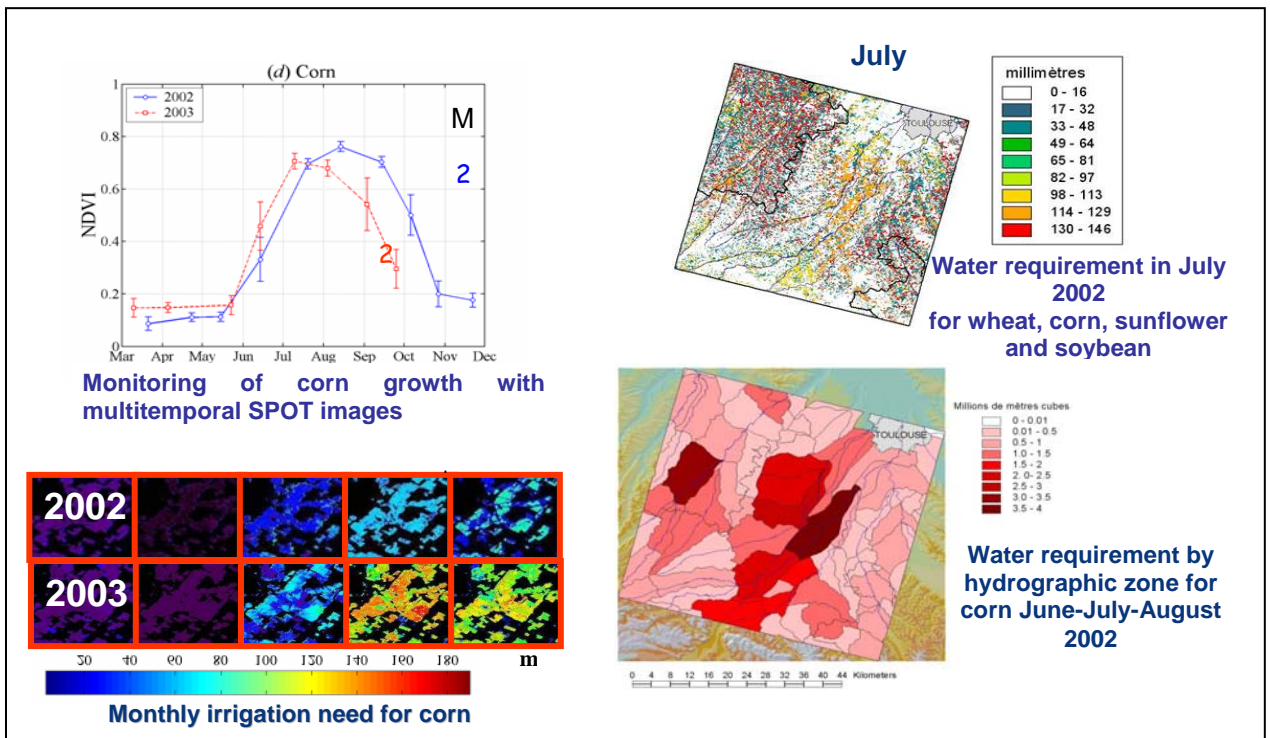
The data collected over the OSR are used for a number of purposes, such as land cover monitoring, crop and surface fluxes modeling, water and carbon fluxes estimation.

A third goal of the OSR is to provide a framework for academic training. Depending on the student course, it allows for example to train students to the measurements of environmental variables using various types of devices (water and CO<sub>2</sub> fluxes using eddy-

correlation techniques, sensible heat fluxes using scintillometers). The large set of data collected since nearly 10 years is also used for student projects.



The OSR area

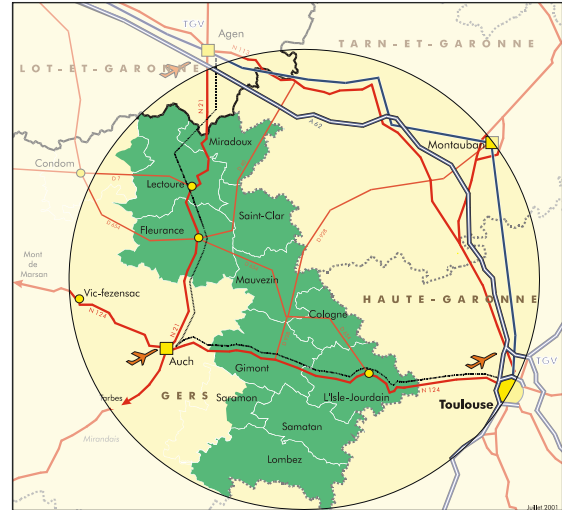


Examples of results obtained over the OSR by coupling monthly SPOT images, meteorological data and models.

From the beginning, the OSR was also intended to carry out demonstration projects with different actors of the territory. The emphasis is on the use of multitemporal decametric resolution images for applications in areas such as agri-environment issues, watershed management, and urban sprawl monitoring. These demonstration projects are designed for preparing the actors to using future operational missions, especially Pleiades and Sentinel-2.

## 2.2 Cluster for the experimentation and application of space technologies

The participation of CESBIO to the project "Pôle d'expérimentation et d'Application des Technologies Spatiales" (PATS) was a logical continuation of the OSR. PATS is a project driven by the Pays Portes de Gascogne (PPG) and co-financed by the French government. The PPG is an association which brings together 159 rural municipalities located in the west of the city of Toulouse. These municipalities share a common project for the economic, social and environmental development in their territory. The Communauté de Communes de la Lomagne Gersoise (CCLG) is a member of PPG and is the project supervisor of the PATS project. For policy makers, PATS is a way to develop the attractiveness, the economy and the environmental policy of its territory. The tool it chose towards this goal is the development of the uses of space technologies.



The Pays Portes de Gascogne territory

Together with the PPG, the CCLG and the CESBIO, the Aida consultancy company is the fourth partner of the technical core-team which implements the PATS project. Aida has brought into the project the idea of testing the concept of Living Lab. We quote below the presentation of the Living Lab concept by the authors of the study "Living Lab e-Inclusion" (Genoux and Schweizer, 2009):

*"Around a research methodology focused on users, the concept of Living Lab is organizing an information area and encounters between researchers, enterprises and civil society. By actively involving users, such exchanges allow going into ideas and concepts in depth, to co-produce prototypes, to test utilizations and to improve products, processes or services prior to production and deployment on the marketplace. The Living Labs are environments for open innovation immersed in real life, where innovation brought by the user is fully integrated with the process of co-designing new products, services or societal infrastructures. "*

The declination of the concept of Living Labs by the PATS puts at the center of the process the idea of creating an experimental territory for space technologies. The concept of territory of experimentation is an original declination of the concept of Living Lab. We start from the assumption that innovation is fostered by the proximity between research laboratories, training institutions, economic actors, policy makers, utilities and users. The animation of the invention, the evolution of organizations and services, integrating the new resources offered by ICT require working with user groups across the territory. With the PATS, the Pays Portes de Gascogne organizes an environment conducive to the introduction of new tools around satellite applications. It structures an experimental territory at a scale where public policy is implemented. Thus, it creates a favorable environment for economic innovation.

In practice, panels of users have been organized around the different topics of interest. The initial topics correspond to the priorities set up by the PPG in its development plan. Meetings have been organized where the current capabilities of remote sensing and web mapping tools were presented by scientists. The materials used mainly came from the results obtained by the Observatoire Spatial Régional. The attendees of these meetings included final users (e.g. farmers, members of municipal assemblies), private actors (e.g. agricultural cooperatives and SMEs), regional state directorates, and territorial communities. From these meetings emerged the identification of needs and users. Pilot projects were defined which implement a dynamic

of co-construction of needs and products or services with user groups. The actors involved are willing to lend themselves to testing of applications / services derived from space technology and contribute to express specifications. Three main themes were addressed:

- *Agriculture*: we work with agricultural cooperatives, technical institutes and other stakeholders. Several pilot projects are underway to improving for example the management of intermediate crop for trapping nitrates and for fighting against erosion, or to increasing the yield and quality of sunflower crops. We mainly use SPOT and Formosat-2 data, with ground resolution ranging from 8m to 20m. Depending on the final user, we work at the field scale or at the territory scale.
- *Health*: We conducted a mission to support health professionals involved in the territory of PPG. Meetings have dealt with the appropriateness of using some space applications in the light of existing practices, organization and evolution of the current health system for issues such as maintaining quality care in rural areas, the effects of population aging, etc.. The conclusions of this exercise helped to establishing the specifications of an experiment and the associated business model.
- *Territory management*: we have developed with elected officials and technicians from three municipalities of Lomagne Gersoise a tool that allows to work collectively on local spatial plans (town planning, PLU, and sustainable development plans, PADD), bringing to light the constraints, the opportunities and taking into account environmental issues such as the new directives on green corridors. Use of spatial information proved to be a valuable tool for going deeper in the strategic analysis and for changing practices.

The whole approach, presented under the name E2L (Espace et Living Lab), was positively evaluated by the European Network of Living Labs (ENoLL) in 2010. E2L is now a member of ENoLL.

### **2.3 The RITA project**

The RITA project has been funded by the "Regions of Knowledge" program of the EU FP7. It started in March 2006 and ended in November 2010. The RITA project resulted from the coincidence of four ingredients:

- assumptions proposed by CESBIO regarding the development of remote sensing applications,
- the existence of the PATS project, anchored in a territory with collectively defined objectives for its development
- the concept of Territorial Living Lab proposed by the consulting firm Aida
- and the willingness of two Spanish partners, the Institut de Ciència i Tecnologia Ambiental (ICTA-UAB) and the Fundacion Forum Ambiental (FFA) to experiencing a similar dynamic in their territory of Catalonia.

During the course of the project, the Comarca de la Selva, a local authority in Catalonia, joined the group and established relationships with its French counterparts, PPG and CCLG.

RITA's major objective is to test the applicability of the PATS Living Labs concept in a different region, namely Catalonia, Spain. The Spanish partners are motivated to create a similar dynamics of innovation on their territory, the Catalonia district. Within its general objective of testing the Living Labs concept in two different regions, the partners have defined specific objectives. The action plan has four objectives:

- Scientific objectives: to draft the specifications of a Shared Environmental Information System (SEIS). We also performed a review of the current systems and of their uses.

- Economic objectives: to test the concept of Living Labs as a tool for economic innovation within the concerned territories.
- Objective of networking of territories: to reveal the feasibility of implementation of the concept on the Spanish territories and to formalize the actual participation of the Spanish partners.
- Methodological objective: to test the ability of the approach to gather territories being subject to economic structural changes and to duplicate it on other territories, in any activity or research area requiring the results to be tested in the fieldwork.

The RITA project is the product of a convergence of ideas and assumptions originally argued by CESBIO and ICTA-UAB.

The first assumption is that there is a significant potential of development for applications of remote sensing in the fields of land and resources management on geographical areas ranging from the commune to the region. This potential remains largely underexploited. Its development is hampered by a diverse set of factors. These factors include the ignorance of the possibilities of remote sensing, the difficulty of data access (availability of suitable satellite data, costs ...), the skill level required to exploit the data, the difficulty to assess profitability of services, and the diversity of needs and actors. In addition, the approach usually followed to developing remote sensing applications is most often of top-down type and implemented by vertically integrated operators and non-specialized lines of business. This approach, implemented for over twenty years, has shown its limits to develop the market in the area of remote sensing applications for land management.

The second assumption is that the development of spatial data infrastructures and the trend towards the provision of public data, especially under the impetus of the European Directive INSPIRE, constitute a favorable framework for greater use of products and services based on remote sensing. The success of initiatives such as NASA (Worldwind, 2003) or Google (Google Earth, 2005) demonstrates the value of providing geo-spatial data through simple and open channels.

### **3 MAIN LEARNINGS FROM THE RITA PROJECT**

The ideas we present here are based on the four years experience acquired within the PATS and RITA projects. We do not pretend that they are of general value in every context, nor that we have explored all the questions and issues. We simply hope that this feedback from experience could be useful to others.

The role of one or several public research laboratories is crucial in the process of building a territorial Living Lab devoted to the development of the use of remote sensing. Scientists are seen by the actors as bringing scientific knowledge and moreover as neutral partners, with no commercial or political interest. It is the responsibility of the scientists not to disappoint this opinion. Research laboratories as well as the other actors shall also clearly define their interest and clarify the limits of their action. For example, laboratories can drive demonstration projects, but they shall not operate operational services in order not to compete with private companies.

When working on a given territory, whatever its size is, interactions with local policy makers are common. Policy makers can play a positive role since they have the legitimacy to encourage innovation policies, they bear projects, and they can mobilize networks and actors more easily than a laboratory. However, the time of policy is not the one of research, and priorities or local positions may change. In order not to depend too much on policy hazards, and to stabilize the process, laboratories must have their own scientific strategy.

Before starting to contribute to a Living Lab, laboratories will be in a better position if they already have knowledge, data and scientific results over a pre-existing experimental area, built for scientific purposes. Furthermore, partnerships established with some actors will be an asset. This way, laboratories limit their dependency to external factors and in the same time they already have materials which can be used to start the Living Lab.

The drawback of this approach is that it is a long term investment. Establishing something similar to the OSR takes several years, without speaking of the needs to motivate research teams on the long run.

A Living Lab involves many different actors with sometimes conflicting interests and implies a number of meetings. In addition, it has to consider the links between local, regional, national and European policies. This is for example the case with the environmental policies. These policies are implemented at the local and regional level, whereas they are decided at the upper levels. We believe that not only technical expertises are needed to operate a Living Lab, but also skills in social sciences. In the course of RITA, the Aida Company has brought these skills to the project. One has to be aware that rural territories often suffer of a lack of manpower, and especially of people with a technical background. Consequently, the project engineering might heavily lean on the academic staff, until additional resources are found to hire dedicated people. Despite this difficulty, there are still several short term benefits for the territories, such as for example links with the whole research community through the involved laboratories. We experimented that these links are useful to bring expertise to local authorities in various areas, including the ones which are not directly connected to the topic of the Living Lab.

The users are central in the Living Lab approach. Our experience shows that a significant effort has to be devoted to training users to new technologies. One difficulty is to explain that it might take time to convert these new technologies into operational services. On the other side, it also takes time to the moderators and scientists to understanding users' needs. If the Living Lab wants to keep its users on the long run, users shall not been seen as guinea pigs. Users should benefit of some return from their contribution to the experiments, such as for example a privileged access to some information and tools during an agreed period of time. As far as possible, it is worthwhile to identify areas where some quick returns can be achieved, even if it is outside the initially planned topics.

According to our experience, the private companies are the most difficult actors to involve in a Living Lab, especially if one of the objectives is to build cluster of SMEs (Small and Medium Enterprises) for developing collaborations and for sharing expertises and tools.

It is feasible, while not always easy, to engage a single company to develop a prototype service once the needs, the market and the funding lines are identified. It is more difficult to involve several companies in a collaborative project and to make them adopt an open innovation approach. There are several restraints to that, such as limited investment capacity, intellectual property issues, competition, or risk of partner failure. Working on an increased participation of SMEs is one of our objectives for the coming years, with the idea that services should be provided by companies which operate in the same economic sector than their users.

One of our projects is to promote a cluster of SMEs in order to work on SEIS and Web mapping tools. From the beginning of the PATS project, we set the objective to establish a Spatial Data Infrastructure (SDI) which will be managed by the local authorities. This SDI is seen as an essential way to structure and make durable the Living Lab approach and to favour the use of Earth observation data. This SDI would allow to capitalize and to share the

collected data and to provide information to the various stakeholders. The RITA project revealed that remote sensing products are very seldom available on the existing SDIs, even though SDIs are a way to increase the wide spreading of remote sensing products. RITA also showed that two major features are required if one wants to move from display of images to real decision support systems. First, SDI should not only provide information from the servers towards the users, but would be more efficient if the architecture and the software allowed users to upload data on the server and interact with applications. Second, a variety of client interfaces are needed to fit specific requirements, even if the servers accessed are the same.

### **3 CONCLUSIONS**

The concept of experimental territory is an original form for running a Living Lab. We started from the assumption that innovation is fostered by the proximity between research laboratories, training institutions, economic actors, policy makers, public sector organizations and users. These actors are willing to experiment services derived from space technology and to contribute to express specifications. The strategy followed by RITA relied on the development of pilot projects implementing a dynamic of co-construction of needs and products or services with users groups.

Work is still in progress, and many aspects have still to be explored. We hope that the lessons learned from the project will allow to disseminate the concept to other European regions and to build a European network of territorial Living Labs devoted to the development of uses and services based on Earth observation data. We think that this would be a significant contribution to the GMES programme of the EU.

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