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Enabling better regional management through information systems

July 2021

Information systems combine science and geomatics to support elected officials in integrated regional management.

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Report written by Roxane Jupin (DAPP) and Frédéric Bray (geomatics specialist in the LESSEM COMPET unit; He designed *Maploup's* current interface and automated the way the application operates).

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Enabling better regional management through information systems

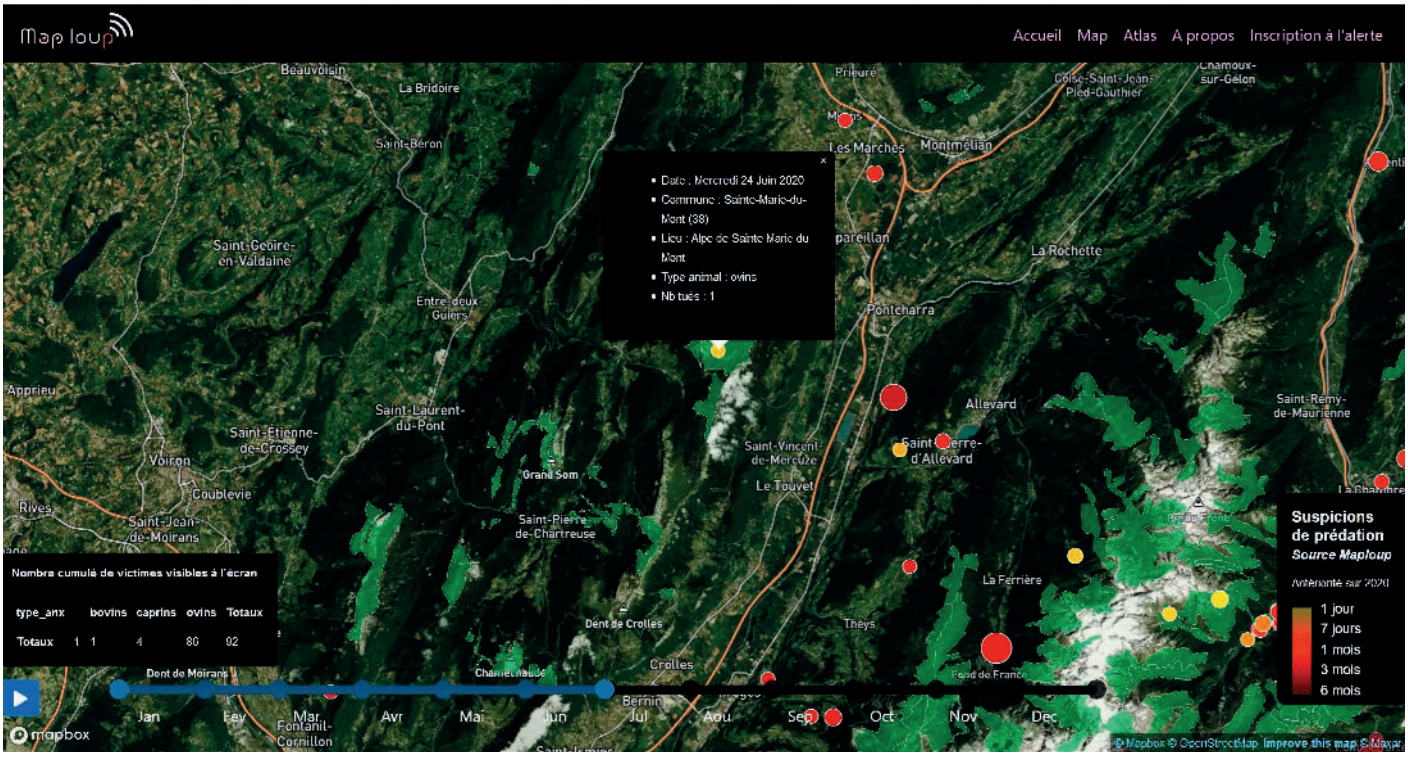
Data and information systems form a strategic interface for both public policy and research. They make it possible to tackle the challenges of sustainable regional development from multiple angles and provide a decision-support tool. Many INRAE teams contribute to their development and to promoting their uptake and use in both research and support for public policy. This is particularly true of the LESSEM research unit in Grenoble and SIDDT, the regional information system portal used to produce enhanced regional diagnostics, and the Maploup mapping and early-warning tool, which supports upland livestock stakeholders in mountain areas.

As early as the 1980s, the French Ministry of Agriculture launched the 'Observatoire de la montagne' with support from INRAE Grenoble, marking the beginning of dedicated geomatics expertise. These capabilities underpinned research into regional development and the implementation of tools designed to support public policy. LESSEM, INRAE's mountain ecosystem and society laboratory in Grenoble, has contributed significantly to these efforts. Supporting stakeholders on the ground in managing their regions is one of the objectives of the laboratory's research. One of the missions of its COMPET team, driven by the unit's scientific, technical and technological expertise, is to support LESSEM teams by designing and implementing information systems related to mountain ecosystems and societies.

LESSEM: a laboratory committed to expertise and public policy support

Created through the merger of the DTM 'mountain region development' unit and the EM 'mountain ecosystem' unit, LESSEM brings together expertise in ecology as well as in the humanities and social sciences. The laboratory therefore addresses environmental issues from ecological, economic and social angles. The teams' work spans the full spectrum from academic research to support for public decision-making on a range of environmental subjects. Some research themes are also linked to projects supported at the European level via the Alpine Convention and the EU Strategy for the Alpine Region.

To meet these scientific and methodological challenges, LESSEM consists of four teams of 44 permanent staff and 43 non-permanent staff: ASTRRE focuses on socio-ecosystemic approaches to regions in an effort to identify more sustainable and equitable ways of managing interactions between ecological and socio-economic systems. BIOSES focuses on biodiversities and socio-ecosystems and studies the ecological and social processes involved in managing, conserving and restoring nature. DYNAMICS focuses on global change, dynamics and the sustainable management of forest and grazing areas in mountain regions and develops knowledge, concepts, models, indicators, databases and operational frameworks to understand and anticipate the dynamics of forest and upland livestock ecosystems. COMPET is a skills platform that develops research into nature-based solutions for natural hazard prevention, using disciplinary and interdisciplinary approaches that combine geosciences, ecology, forest sciences, geomatics and remote sensing, in conjunction with the drones, laboratories and experimental sites of its technical platforms.



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Using tools developed by LESSEM, managers can visualise and assess risks on a regional scale. Here, the *Maploup* platform maps suspected wolf attacks.

COMPET: an operational team

Alongside its research agenda, the COMPET team strengthens and streamlines the consolidation of scientific data, from acquisition through to publication. In practice, this includes developing digital tools that support regional management.

A number of LESSEM tools and research activities—including expert appraisal and support for public decision-making—have an operational focus.

Through these two latter activities, the unit is fully engaged in supporting public policy. In this capacity, COMPET team members contribute to multiple stages along the data life cycle, from data collection to processing and packaging into end-products that can be shared and used.

The regional information system portal (https://siddt.inrae.fr), and the *Maploup* (https://maploup.fr)platform, a geolocalisation platform and early-warning system for suspected wolf attacks–are designed specifically to facilitate the operational roll-out of indicators and decision-support platforms for socio-ecosystem management.

Frédéric Berger

Research Engineer specialising in forest protection and head of the COMPET team at LESSEM (INRAE)

"The interest in SIDDT expressed by local and regional authorities has been—and continues to be—extremely valuable for its development. Our next step is to enhance the portal by bringing together other specialist tools developed at LESSEM. That is a public policy challenge for managers, and a scientific and technical challenge for our team and research unit. LESSEM was created through the merger of two units in January 2020. One of our core responsibilities is to share our work, externally and internally, to strengthen collaboration with our partners and with other units and divisions across the Institute. Some remarkable projects have already emerged. One example is the national mapping of 'protection forests' that act as a buffer against rockfall risk — work we are producing to showcase forest-based solutions within natural-risk prevention policy. This mapping is also intended to enrich the SIDDT. As part of the project, we manage a database containing 10,000 recorded trajectories across the Alps region. The richer SIDDT becomes — in terms of its database and indicators — the better it will be able to address a wide range of issues. To achieve that, we need to secure ministerial funding and have the necessary human resources."

A shared integration system: the regional information system portal

The regional information system portal (SIDDT) provides access to the 'regional' LESSEM database. This database brings together data that is useful for regional work, either produced by LESSEM itself or drawn from external sources.

It includes municipal environmental data; demographic data from the National Institute of Statistics and Economic Studies (INSEE); data from the Agreste agricultural census; grazing surveys managed by LESSEM for upland livestock services and available via Pâturoscope (https://enquete-pastorale.inrae.fr), and data from Alpages Sentinelles, produced by LESSEM and upland livestock services and available at https://alpages-sentinelles.fr.

These datasets are wide-ranging: population mapping, socio-economic and geographic data, transport networks, slope and altitude constraint metrics, and more.

SIDDT not only enables users to view data for a given area–from municipal to regional scale–but also to cross-reference datasets. This meets a clearly expressed need from local and regional authorities to enhance regional diagnostics. Regional managers can compare the data that interests them to produce increasingly robust diagnostics, which are essential for shaping management policy. Although primarily designed for managers, the portal is open access (https://siddt.inrae.fr/).

SIDDT: STRONG POTENTIAL TO MEET REGIONAL NEEDS

Among the many tools that LESSEM develops and co-develops, several could ultimately be incorporated into the regional information system portal. These include Evaloscope, which monitors approaches to tourism diversification in the Alps; Prosnow, which provides anticipatory snow-cover forecasts for Alpine ski resorts; Adamont, which offers resources and tools to anticipate climate change in mid-mountain areas; the Platrock multi-software platform, which assists with rockfall risk assessments; and *Maploup* , which reports livestock attacks in near real time.

All of these tools support regional management. Taken individually, they provide diagnostics that managers can use on the ground. Bringing them together on the SIDDT portal would improve the platform's effectiveness by broadening its scope and ensuring coherence in regional action undertaken by different stakeholders. Managers would be able to enrich their diagnostics with additional datasets, or combine multiple data types depending on the issue under study.

A TECHNICAL CHALLENGE

All SIDDT tools are observation, early warning and forecasting tools that support regional management. Despite

this shared purpose, they vary widely in structure, scale, operating systems and programming languages. Enabling these databases to interact involves major technical challenges for the COMPET team and raises questions like: how can the platform be adapted to include new, very large datasets? Is the existing architecture fit for purpose? Would changing the operating system be necessary – implying future upgrades and ongoing maintenance? Does the software have the technical capacity to support intense use? What maintenance would be required? Should programming languages be harmonised?
In addition to technical considerations, the issue of access is central: is SIDDT a portal that provides access to each individual tool, or should the latter be embedded as modules within SIDDT to make it a more powerful integrated platform? Will the tools be more visible when amalgamated? If the platform becomes more capable, will training be required to ensure uptake? These questions reflect the range of options possible to develop SIDDT and increase the visibility of each tool.

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Field research contributes to the development of regional diagnostic tools.

From public policy to a monitoring tool: the *Maploup* example.

INRAE and upland livestock services in the Auvergne-Rhône-Alpes and Provence–Alpes–Côte d'Azur (PACA) regions first began working together in the framework of a grazing survey conducted by SUACI, an agricultural public-interest service, between 2011 and 2019. Cooperation has continued since 2012 on the Alpages Sentinelles project. Two web interfaces were developed: one as a result of the grazing survey (Pâturoscope) and the other following the Alpages Sentinelles project. LESSEM contributed expertise from A to Z, from data centralisation and validation to web-based visualisation using online mapping.
The presence of wolves in France is addressed in several public policy frameworks, including the 2014 law on the future of agriculture, food and forestry (LAAAF); the 2016 law for the restoration of biodiversity, nature and landscapes; pastoralism preservation plans; and the classification of the species as 'vulnerable' on the International Union for Conservation of Nature (IUCN) Red List.. These are legislative and policy frameworks with which elected officials, livestock farmers and shepherds must contend.
Action 6.1 of the 2018–2023 National Wolf Plan recommends that real-time information on attacks be shared between farmers, shepherds, the French Office for Biodiversity (OFB, formerly ONCFS[1]), managers of protected areas, and the departmental directorates for

1 The French agency for biodiversity (AFB) and the national hunting and wildlife agency (ONCFS) joined to form the new French Office for Biodiversity (OFB) on1st January 2020.

Dominique Narboux

Director of the Association drômoise d'économic montagnarde (ADEM), Drôme region

The ADEM supports and helps develop upland livestock activities. Our 2014 study on changes in predation confirmed an increase in wolf attacks, as experienced by farmers and shepherds in the area. ADEM therefore joined the Maploupscheme — led by the AURA upland livestock network in the Auvergne-Rhône-Alpes region, and the union for the protection of upland livestock and rural activities (USAPR) — to better support professionals and elected officials. The 'Atlas' section of Maploup is an objective, at-a-glance information tool that tracks changes in predation. At ADEM, we were able to quantify a 43% increase in attacks between 2019 and 2020. This kind of contextual information helps us fine-tune the technical support we provide to farmers, shepherds and elected officials inxorder to sustain upland livestock farming, which is vital in our area. In the Drôme region, small sheep and cattle farms are a source of agricultural activity and maintain the areas between alpine pastures and farms. Sustaining them is therefore a major challenge.

Pierre-Yves Bonnivard

President, USAPR and mayor of Saint-Colomban-des-Villards (Savoie)

I am the mayor of a town in the Belledonne massif, which spans across the Savoie and Isère regions. Alongside other elected officials, we needed to assess the presence of wolves in our region. Regional authorities that record predation incidents had this data but did not compile it. As a result, information was incomplete and arrived too late for us to respond effectively on the ground. We therefore came up with a tool that would consolidate this information and spread it quickly. The coordinating regional Prefect for the Wolf Plan encouraged the idea in 2017, but we lacked the technical capacity to deliver it. The Isère alpine pastures federation (FAI), the Savoie alpine economy society (SEA) and ADEM Drôme therefore joined us to develop an initial version. Thanks to that cooperation, together with INRAE's involvement, the tool offers more than originally planned. We can see where wolves are active and can better support farmers and shepherds, which is the purpose of the map. *Maploup* provides us with precise data and robust evidence to mobilise the human, administrative and financial resources needed to provide a response. It is a mediation tool between farmers, shepherds, elected officials and state services that supports cooperation.

A few figures, one year after the launch of *Maploup* (as of 31 January 2021)

- 150 connections per day on average (around 4,000 connections per month),
- 26,000 text messages sent since 28 July 2019 (an average of 81 text messages per day),
- 10,000 emails sent since 28 July 2019 (an average of 31 emails per day),
- Livestock farmers are the main recipients of warning messages, followed by elected officials and shepherds,
- Most users are in regions where the scheme has been rolled out.

territories (DDT). It also suggests ways to do so (radio networks, mobile phone warning systems alerts, etc.).

MAPLOUP PROTOTYPING BY UPLAND LIVESTOCK SERVICES

The first system for identifying and mapping wolf attacks was commissioned by three organisations: the Union for the protection of upland livestock and rural activities (USAPR), which brings together 150 mayors, the Savoie alpine economy society (SEA73) and the Isère alpine pastures federation (FAI38). The system received regional funding secured by USAPR.

An initial version of *Maploup* was developed and tested in 2017, with the departments of Isère, Savoie and Drôme the first to benefit from the scheme. The tool marked suspected wolf attacks on a map and warned farmers and shepherds by email or text message.

Depending on the locality, the farmer or shepherd reported the incident by phone to upland livestock services or the local directorate (DDT), which (1) entered the attack on a map and (2) processed a request for an official predation assessment.

Until the report was officially confirmed by upland livestock services or local authorities (DDT), the Maploup report and its location–while provisional–met an operational need to inform.

However, incidents were added to the map and text-based warning messages were sent manually. Time-consuming and only somewhat accurate, the warning process needed to be automatic.

A SECOND VERSION OF *MAPLOUP* ENRICHED BY LESSEM TO SECURE, AUTOMATE AND VISUALISE

In 2019, upland livestock services in the area drew on LESSEM's geomatics expertise to develop a reliable IT system that would protect user data and provide a clear, real-time map of wolf attacks. A service contract was signed thanks to regional funding and supplemented by national funding obtained by SEA73 and ADEM Drôme. The assignment aimed to automate the warning process and secure data previously stored in a *cloud*environment. Mapping of the attacks also needed fine tuning.

AUTOMATING AND SECURING DATA

A new version of *Maploup* was then developed by LESSEM's COMPET team, in consultation with future users. To automate text warning messages, reduce operational complexity, and ensure real-time, simultaneous information for all subscribers, it was first necessary to redesign how attacks were recorded so that they would automatically trigger an email or text warning message. Recording attacks, map displays and warning messages were automated by replacing the unsecured *cloud* with a database integrated into *Maploup* and directly connected to both the mapping component and a phone texting programme. Thanks to this automation, 300 people can be notified in under a minute.

The information perimeter has also shifted from a broad area (an entire massif) to a 10 km radius – an approach that will soon be reviewed with users of the application.

DATA MAPPING: IMMEDIACY AND LONG-TERM MONITORING

The local authority records the attack and the data is geolocated using a geographic information system, or 'GIS'. The *Maploup* platform provides access to two complementary mapping features: Map and Atlas. The Map section displays all predation cases entered over a given year, by area, with geolocation. The Atlas section provides the same verified and updated information using the integrated *Géoloup* database managed by regional environmental authorities (DREAL).

In both cases, a time bar allows users to view data over a chosen period: from January to December of the

current year in the Map section, and from 2009 to the previous year in the Atlas section.
Subscribers to the *Maploup* service are managed via an authenticated web administration interface. *Maploup* is developed in compliance with the General Data Protection Regulation (GDPR). Following requests from users, changes were made in January 2021 to make it possible to filter data by region and town. Whereas Map supports immediate action by presenting an attack as quickly and as accurately as possible, Atlas provides access to historical data.

USING *MAPLOUP* BEYOND ITS CURRENT SCOPE

Regional elected officials and stakeholders now have a tool to support regional management and upland livestock activity. One year after its launch, the application developed in the Auvergne-Rhône-Alpes region is already stoking interest elsewhere in France and potentially abroad.
Launched in July 2019, the application initially covered Isère, Savoie, Haute-Savoie and the Drôme in the larger region of Auvergne-Rhône-Alpes. Since January 2021, its scope has extended to the Var, Alpes-de-Haute-Provence and Hautes-Alpes in the larger Provence-Alpes-Côte d'Azur region.
The regions of Ain, Alpes-Maritimes and Bouches-du-Rhône were expected to join the scheme by 2022.

Technical note

Data in *Maploup* is secured through compartmentalised databases, separated by region and integrated into the platform. This architecture restricts access rights to the relevant region only. Beyond data security, a key advantage of using integrated databases is that an attack report can be linked to the automatic triggering of a text warning message via an API (an external text message delivery service). Each time a new attack is recorded in the database, Maploup sends a request containing all the information to be included in the message and the list of subscribers to notify. The provider issues the text messages and subscribers are alerted automatically.

USING MAPLOUP FOR OTHER SPECIES

The team could go further still by adapting the system to other large predators such as bears or lynx, which are also present in France and elsewhere in Europe. Reflecting a clearly identified need, local environmental authorities (DREAL) have already changed the name of the database from *Géoloup* to *Géoprédateurs*.

These opportunities, still in an exploratory phase, present a major technical challenge: how can the tool be adapted to other contexts, warning system needs and predator species? Would a separate tool be needed for each type of predator added to the current system? How should a suspected attack be recorded when it may involve several types of predators?
With the aim of providing a powerful and comprehensive tool for managers on the ground, the COMPET team would like to draw on research carried out by LESSEM teams – and INRAE more broadly – to develop predictive analyses of predator movement. Similar to approaches used to map terrestrial and aquatic networks, ecological connectivity could be used to run simulations of potential wolf movements. This would allow farmers, shepherds and elected officials to be warned of attacks AND anticipate them.
In addition to its potential for the management of large predators, *Maploup* is considered an option in other fields of action. Research is underway on the subject of forest resource data with the aim of mobilising the same mapping and warning capabilities to prevent forest-related risks ■

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Scientific data underpins the observation, warning and forecasting tools developed by LESSEM. Pooling data from several research departments enriches and strengthens these tools.

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