

water

environmental-technologies

land

irstea

Science and Technology
for Environment
and Agriculture







AllEnvi

PEER

INSTITUT CARNOT Irstea

Engagement reconnu
STRATÉGIE NATIONALE POUR LA BIODIVERSITÉ

OUR MISSION

Editorial


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Jean-Marc Bournigal
President

Since the Kyoto protocol, the environment and global change have taken centre stage worldwide, paving the way for significant developments in environmental sciences and technologies.
Inherently multi-disciplinary, these involve every field from the experimental sciences to the human, economic and social sciences. At Irstea, scientific approaches are used to study complex ecosystems, land, water and biodiversity, as well as their relations with human activities. The goal is to produce concrete solutions to environmental issues, through strong partnerships with national and local government departments and with economic actors.
The multi-disciplinary approach, partnerships and concrete solutions make Irstea what it is. Each day, its researchers tackle the challenge of adapting to global change, to promote development which is sustainable and environmentally-friendly.



WATER

Water department

Water availability, pollution, aquatic environments, natural risk, irrigation, fishing, infrastructure, etc. – water management is more than ever an issue for the world as a whole.
In the EU, the water framework directive requires that member states ensure that bodies of water achieve the right ecological standard.

The study and management of surface waters and related activities involve almost half of the entire Irstea workforce.
The institute has launched a wide range of activities devoted to water resources and aquatic environments, as well as to related infrastructure and uses.
It has the expertise and skills required to understand the interactions between human activities and the environment, to create system models and to develop the necessary tools for short and long-term management.

Five research themes :

- *hazards and risks related to the water cycle*
- *biological and ecological responses to contamination of the aquatic environment (ecotoxicology and bioindicators)*
- *management of water, of water uses and services, and of their impacts*
- *quality of aquatic ecosystems and ecological restoration*
- *risks due to rapid gravity flows, the safety of hydraulic installations and vulnerability to hazards*

Irstea in brief

- 2012 annual budget: **115** million euros, including 31% own resources
- **9** centres in France
- **3** research departments for land, water and environmental technologies
- **18** research units, **5** joint research units
- **1,650** employees, tenured and term contract, including:
  - **1,050** researchers, engineers, PhD students and post-doctoral researchers
  - **600** technicians and administrative staff
- **450** top-ranking publications per year
- **11,000** teaching hours in higher education per year
- Awarded the Carnot Institute Label in **2006** and **2011**



The blue and green corridors are regional planning tools used to map continuities and breaks in the landscape. Above is an example of the green corridor.



The "spectron" is a prototype which can measure the quality of grapes prior to harvesting, using infra-red spectrometry. A further innovative application of the technology has been the automatic sorting of plastic materials.



Irstea has worked for the past 30 years on monitoring working dams to ensure their safety. In 2004, the technical support centre, combining the know-how of Irstea and the scientific and technical network of the French public-works ministry, was set up to monitor all hydraulic installations.

A targeted research institute

Irstea is a major player in environmental science and technologies and reports to both the Research and Agriculture ministries. It is a striking example of integrated environmental research focused on the regional scale and on applied solutions.

Science and technology for the environment

Combining the experimental sciences, the economic and social sciences and computing (modelling, data integration), Irstea's multi-disciplinary teams of researchers and engineers work on how to adapt to global change in a number of fields:

- environmental risk: flooding, avalanches, forest fires, diffuse pollution,
- monitoring continental aquatic environments, water resources, water uses,
- clean technologies: environmental technologies, environmental assessment, ecotoxicology, processing of organic waste for energy production
- regional development planning,
- environmental sociology and economics: observatory for biodiversity, remote sensing, green and blue corridors.

Three strategic challenges for the next 10 years

Scientific strategy at Irstea focuses on three major challenges involving important environmental issues:

- **environmental quality:** "linking methods and technologies to understand and act",
- **sustainable management of land and water:** "generalise multi-sectoral approaches to improve integration of land and water",
- **management of natural risks:** "widen the approach to risk by studying environmental-system viability".

AllEnvi
Structuring environmental research

Founding member of the National Research Alliance for the Environment (AllEnvi) created in 2010, Irstea strongly contributes to structuring environmental research.

Jean-Marc Bournigal is the vice president of AllEnvi for development, transfer and public policy support.

Irstea's chief scientific staff head 5 of the 18 working groups and committees : Water Sciences, Risks, Biodiversity, Environmental Evaluation, Europe and International.

our vocation



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Irstea scientists in its nine regional centres are in direct contact with the regions on which their research is based. In the environmental sciences, there are very close ties between experimentation, theoretical models and technological innovation and the result is close collaboration with public authorities and the local economy.

Environmental-technologies department

Companies must reconcile productivity and environmental protection.
They are now responsible for the impact of their activity on resources
and the environment.

The development of environmental technologies adopts a comprehensive (cradle to grave) and multi-criteria (environmental, economic and social) approach.
Research applications cover the agro-industrial sectors, e.g. agriculture and agri-food industries, waste management and storage, waste treatment and new technologies.
The innovative results produced by the scientists are then transferred to industrial partners.

Four research themes :

- *technologies for sustainable agricultural systems*
- *technologies for clean, energy-efficient processes*
- *water and waste technologies and processes*
- *integration, modelling and environmental assessment*

Indicators

- 30 % of research concerns global change, in particular climate change
- 70 % deals with surface water
- Success rate for ANR (national research agency) projects: approximately 45 %
- Over 2 m€ each year in European funding, 30 projects selected for FP7 (29 % success rate)
- 68 foreign researchers hosted at Irstea
- 211 research contracts and 72 collaborative projects with 250 companies
- €250,000 in licence fees from 59 active licencess
- Active in 11 competitiveness clusters, including two world class
- Incubator for innovative companies (Minéa) with two companies launched each year on average



The underwater test facility makes it possible to study the effects of the avalanche on obstacles and the effects of an obstacle on the flow of the avalanche.

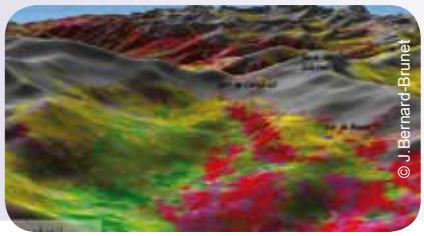
INSTITUT CARNOT Irstea

Irstea received Carnot certification in 2006 and 2011

Carnot certification is granted for a renewable period of four years to research entities known as the Carnot institutes. They focus on research partnerships to assist the socio-economic sector as well as their own research to maintain their scientific and technological skills and know-how. The Association of Carnot Institutes brings them together to create an active, integrated network and take full advantage of their shared commitment to research partnerships and innovation.



Field data is combined with satellite images to produce maps of remotely-sensed data, e.g. the mountain vegetation shown here.



Remote sensing and modelling are two essential tools to describe and understand systems. Above, satellite remote sensing and modelling were used to map mountain vegetation and summer pastures for management purposes.

Scientific cooperation

Irstea works on a partnership basis with research organisations (Cirad, CNRS, INRA, INRIA, IRD, etc.) and universities on shared topics. It also collaborates on a multidisciplinary approach with the Research and higher-education centres near its regional centres. Via its teaching activities and training of PhD students, the institute makes a major contribution to training experts in the environmental sciences.

Research for public policies

Irstea works in a range of scientific fields with scientists active in mathematics, computer sciences, physics, hydrology, geography, economics, sociology, etc. All contribute to appraisal and assessment consultancy projects to support public decision-making at the request of regional government agencies and local governments.

Public private partnership

Irstea carries out collaborative research with industrial companies. There are currently 130 research contracts, both with large groups such as EDF, Veolia and GDF Suez, and small- and medium-sized companies. The institute is active in a dozen competitiveness clusters and has its own incubator for innovative start-ups, Minéa, in Montpellier.

In Europe and around the world

In Europe, Irstea has a high success rate in calls for projects for EU. Irstea is the French member of PEER and is also a member of the European network for continental waters (Euraqua).
Management of water for agricultural purposes in the Mediterranean region and water management in North America are two central components in its international strategy. The institute has also established active partnerships in Australia and New Zealand and contacts with emerging countries (Brazil, South Africa).

Irstea, member of the PEER network

The PEER (Partnership for European Environmental Research) network comprises environmental research organisations from seven European countries: Denmark, Finland, France, Germany, Italy, the Netherlands and the United Kingdom.
It advises the European Commission in relation to water and the environment for the framework programmes and contributes to drafting reports (see Adaptation to climate change, formulation of new policies in Europe and ecosystem services). It plays a major role in training PhD students in the environmental sciences via FP7 People programme *(www.peer.eu)*.

research at irstea



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Irstea's research work is central to the question of global change which is relevant at every level, from climate change to alterations in local vegetation. Adaptation to global change will require coordinated efforts by public authorities, economic forces and both public and private research in all fields, on the local, national and global levels. Below are three examples of research by Irstea highlighting this need.

Land department

In rural and periurban areas, sustainable development largely depends on how relations between the natural environment and human activities are managed. Multi-disciplinary approaches combining ecology, remote sensing and human sciences are particularly well suited to the study of sustainable-development processes and to encompassing a region's multiple aspects. They help clarify the relations between the various uses, i.e. residential, productive (e.g. agriculture and forestry) and for environmental conservation, to determine their reciprocal effects and analyse public policies designed to manage them.

Three research themes :

- *spatial analysis and regional development*
- *vulnerability of terrestrial ecosystems*
- *regional development and multi-functional agriculture*

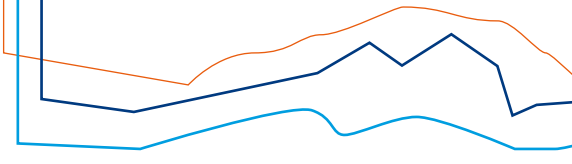
Spatial data to support regional management

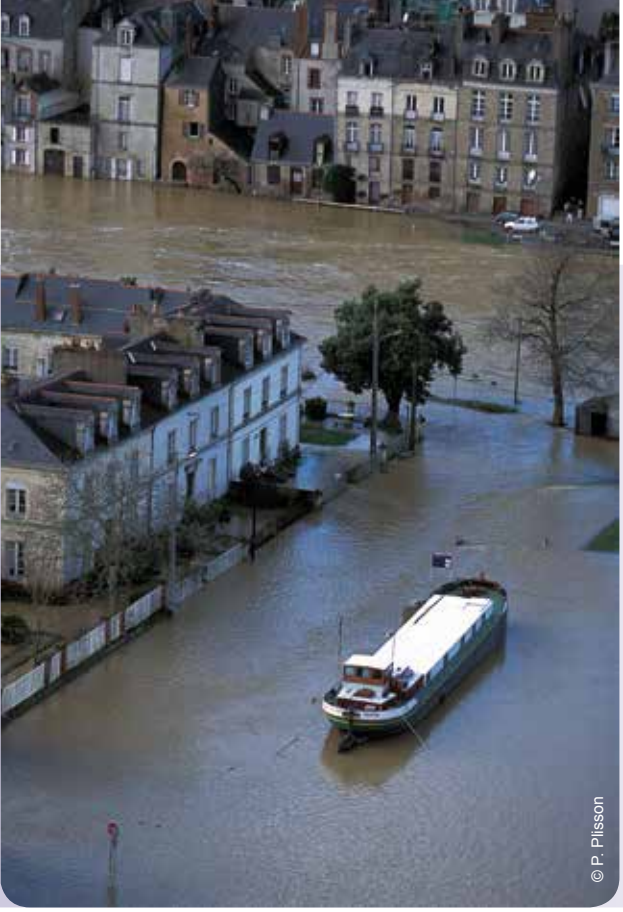
In a partnership with AgroParisTech, Cirad and IRD in Montpellier, Irstea is now the leading French research institute in spatial remote sensing applied to the environment.

The researchers design sensors that are fitted to satellites, planes and drones. The signals recorded are used to understand and monitor regional changes and their relation to human activities.

The new tools are also a useful form of communication for government representatives since they allow the public to see how sustainable development issues affect the region.

Scientific and technical partnerships have been formed with national and European space agencies (CNES, ESA) and leading firms in the spatial sector (Thales, Spot Image, Astrium, etc.) to help complete this research.





Floods illustrate the links between land use and hydrosystem management, between human development and the environment. Hydrological measurements over many years are required to model and predict high-water situations.

Diatoms are microscopic algae present in all aquatic environments. They are used as indicators of water quality.
Gomphoneis minuta is the sign that overall water quality is average to mediocre (left).
Cymbella lanceolata is the sign that overall water quality is good (right).





▲ Bioindicators to evaluate the ecological quality of aquatic environments

Bioindication methods are used to characterise the ecological quality of environments, changes in quality and the causes of the change, based on the study of animal and plant biodiversity. Irstea develops reference methods for aquatic environments using fish, macro-invertebrates, macrophytes and algae as indicators of water quality. Its research teams are now focussing on areas common to bioindication and ecotoxicology and working on the priorities for restoring aquatic environments.

Irstea scientists provide the Environment ministry and Onema* with science advice on setting up monitoring programmes for continental aquatic biodiversity. They also design national reference indicators for continental surface water and estuaries. This work all helps to achieve the operational goals of the European Water framework directive.

** The French National Agency for Water and Aquatic Environments*



Remote sensing is used to monitor changes in a region. Above is the Hérault department and the Salagou lake, with the A75 highway to the right and the village of Clermont-L'Hérault.

Energy recovery from household and organic waste ▼

To supply 10% of net annual electricity produced in France using biomass contained in waste – that is the goal of work by the "Water and waste technologies and processes" team in conjunction with the most advanced industrial companies** in the waste-recovery sector.

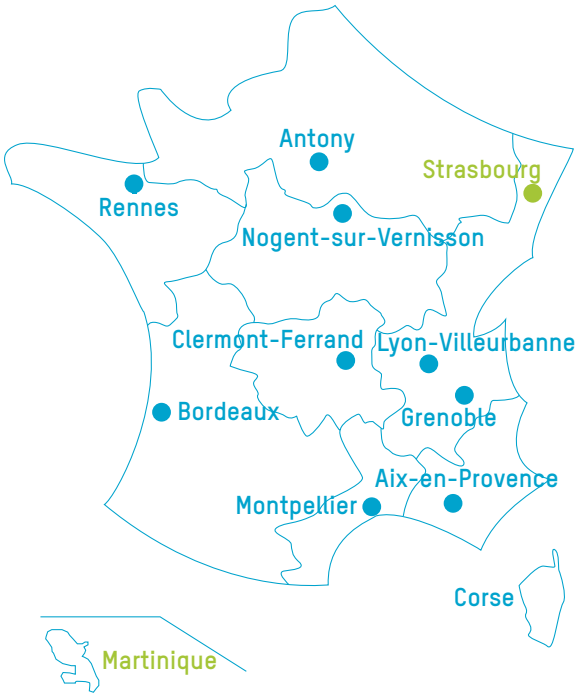
Initial research involves identifying the best micro-organisms and the most effective metabolic methods to degrade the organic matter. The processes are tested under real conditions during an experimental phase in semi-industrial reactors, then in industrial demonstrators. At the same time, economists and sociologists carry out studies to assess social acceptability of the processes.

*** Suez environnement, Naskéo Environnement, Evalor, CEVA, Geotexia and Semardel.*

The new waste-storage centres are landfills where the break-down of organic matter is accelerated to produce methane, a renewable energy.



Irstea
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