IRD
Institut de recherche
pour le développement

2015 Annual report

Editorial

'Partnership with the IRD is different'

In 2015, my first year at the head of the IRD, I had the privilege of witnessing not only the quality of the work produced with our scientific partners in developing countries but also the intense relationship that exists with our institutional partners. When talking to politicians and the heads of the scientific institutions and universities with which we work, we often hear that, 'partnership with the IRD is different'.

During this first year, I was pleased to see that the model offered by the IRD does in fact offer a real alternative: one of the IRD's main strengths is its in-depth knowledge of the countries in which it operates, which is attributable to a historical and continuous presence in the field that dates back to the time of our predecessor, ORSTOM. We are thereby able to adapt the broad goals of the international development agenda to the situation and challenges that exist on a local level, as we demonstrated at COP 21 and as shown by our response, which was coordinated with all French public research bodies, to epidemics such as Ebola and Zika.

To strengthen this position yet further, the IRD launched a reorganisation process in 2015 so that everyone could find his or her place and contribute to the modernisation of the establishment's governance and management with a common outlook: to make the IRD an indisputable and strategic part of our country's development aid and research policy and an essential channel through which all French and francophone research is projected towards developing countries.

Last year, 2015, was also marked by an upturn in our scientific work. It is not that the IRD was waiting for the arrival of the new governing body to increase its scientific output, particularly in the form of joint publications with partners in the South, as well as the relevance of this output with regards to development challenges, given the fact that its research topics chiefly concern the intertropical and Mediterranean zone. This dynamic is not new. However, I do believe that we have reignited the IRD's ability to play a highly original role, thanks to its structure, in the global landscape of scientific research.

It is our ability to work together, with our French partners and partners in developing countries, particularly on the boundaries of the various disciplines and on the boundaries of pure science and applied science, where new scientific ideas often tend to emerge, which will make the IRD a major player in a world of science that is, more than ever before, committed to the service of sustainable and human development.

Jean-Paul Moatti
Chairman & Executive Director

Key figures

- **2,048 agents, with 820 researchers and 1,228 engineers and technicians**
- **56 research units**
- **35% of agents working outside mainland France**
- **30 representations abroad in French overseas regions and collectivities**
- **3,825 publications in 2014**
- **Annual budget – €234.5 million**

2015 Highlights

- IRD takes part in the **third International Conference on Financing for Development**

- IRD, the French Ministry of Foreign Affairs and International Development (MAEDI) and the OECD's Development Centre organised a **side event at this conference held in Addis Ababa** (Ethiopia) from 13 to 16 July 2015. For more information

- **Jean-Paul Moatti, Chief Executive Officer of IRD**
  Professor Jean-Paul Moatti was appointed Chairman and Chief Executive Officer of IRD while Jean-Marc Châtaigner was named Deputy Executive Director. For more information (in French)

- **The origin of all AIDS strains identified**
  An international study run by IRD researchers and a number of partners confirms that the O and P variants of the HIV-1 virus responsible for AIDS have their origins in gorillas in south west Cameroon. For more information

- **IRD takes part in MEDCOP21**
  Marseille hosted the Mediterranean Civil Society Forum for Climate Change (MEDCOP21) on 4 and 5 June 2015. IRD and its partners from the Global South took part in different focus sessions, themed workshops and public events. For more information (in French)

- **AllEnvi at Expo 2015 in Milan**
  The French Research Alliance for the Environment (AllEnvi), coordinated by Inra, was a partner of the French Pavilion at the Expo 2015 in Milan. For more information (in french)

- **COP21**: **IRD actively involved**
  At the 21st **Conference of the parties of the United National Framework Convention on Climate Change (COP21)**, IRD and its partners from the Global South organised several scientific workshops. For more information

- **Launch of the '4 per thousand' initiative**
  On 1st December 2015, at the time of COP21, the French Minister for Agriculture officially launched the worldwide '4 per thousand: soils for food security and the climate' initiative. For more information (in French)

1. Challenges and solutions

1.1 Improving human health

With regard to the major health issues covered by SDG 21 and 32, the overall aim of IRD's 'Health and Societies' department is to contribute to efforts to improve the health of populations in Southern countries through five main subject areas:

- controlling/eradicating infectious agents and/or preventing their emergence;
- fighting the rapid spread of so-called 'civilisation' diseases;
- fighting diseases related to nutritional deficiency or to excess weight;
- promoting a risk-free sex and reproductive life;
- studying practices, assessing action and renewing certain approaches within the framework of healthcare policies.

Key figures

- **9 joint research units**
- **2 international joint units**
- **5 ICL (international combined laboratories)**
- **13 JEAI (young teams affiliated with IRD)**
- **748 publications in 2014**

1.1.1 Gorilla Origins of the Last Two AIDS Virus Lineages Confirmed

Two of the four known groups of human AIDS viruses (HIV-1 groups O and P) have originated in western lowland gorillas, according to an international team of scientists from the Perelman School of Medicine at the University of Pennsylvania, the Institut de Recherche pour le Developpement, the University of Edinburgh, and others. The scientists led by Dr. Martine Peeters from the University of Montpellier conducted a comprehensive survey of simian immunodeficiency virus (SIV) infection in African gorillas. Beatrice Hahn, MD, a professor of Medicine and Microbiology, and others from Penn were part of the team, whose findings appear online this week in the Proceedings of the National Academy of Sciences.

HIV-1, the virus that causes AIDS, has jumped species to infect humans on at least four separate occasions, generating four HIV-1 lineages -- groups M, N, O, and P. Previous research from this team found that groups M and N originated in geographically distinct chimpanzee communities in southern Cameroon, but the origins of groups O and P remained uncertain.

The four cross-species transmissions have had very different outcomes in humans. Group M gave rise to the AIDS pandemic, infecting more than 40 million people worldwide by spreading across Africa and throughout the rest of the world. Groups N and P, at the other extreme, have only been found in a few individuals from Cameroon. However, group O, although not as widespread and prevalent as group M, has nonetheless infected about 100,000 people in west central Africa.

The team screened fecal samples from western lowland gorillas, eastern lowland gorillas, and mountain gorillas in Cameroon, Gabon, the Democratic Republic of Congo, and Uganda for evidence of SIVgor infection. They identified four field sites in southern Cameroon where western lowland gorillas harbor SIVgor. "Viral sequencing revealed a high degree of genetic diversity among the different gorilla samples," explains Hahn. "Two of the gorilla virus lineages were particularly closely related to HIV-1 groups O and P. This told us that these two groups originated in western lowland gorillas."

"Understanding emerging disease origins is critical to gauge future human infection risks," adds Dr. Peeters. "From this study and others that our team has conducted in the past it has become clear that both

[1] SDG 2 - End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

[2] SDG 3 - Ensure healthy lives and promote well-being for all at all ages.

chimpanzees and gorillas harbor viruses that are capable of crossing the species barrier to humans and have the potential of cause major disease outbreaks.

This work was funded in part by grants from the National Institutes of Health (NIH (R37 AI50529, R01 AI 058715, P30 AI 045008, R37 AI 066998, R01 AI064001, AI 089246). For further information

1.1.2 How the zika virus infects human cells

Like its cousins the dengue and chikungunya viruses, zika is an emerging virus. Since the 2007 epidemic in Micronesia which revealed its existence, it broke out in French Polynesia in late 2013 with 55,000 people affected, and has now reached Brazil. Researchers from IRD, INSERM (French National Institute for Health and Medical Research) the Institut Pasteur and their Thai partners have recently described for the first time how it infects humans following a mosquito bite and then spreads through the patient. Their discoveries open the way to developing a treatment.

An emerging virus
A newcomer to the arbovirus family, zika is causing quite a stir. After Micronesia in the Pacific in 2007, then French Polynesia in late 2013, it is now affecting Brazil, giving rise to fears that it will reach the French West Indies sooner or later. A team of researchers from IRD, INSERM (French National Institute for Health and Medical Research) the Institut Pasteur and their Thai partners have recently described the biology of the virus for the first time - how it infects the host, replicates and spreads.

A simulated mosquito bite
Zika is transmitted by Aedes aegypti and A. albopictus mosquitoes. When the insect bites a human, its snout probes around looking for a blood vessel. In doing so, it deposits virus particles in the victim's epidermis and dermis. To simulate infection in a laboratory, researchers inoculated a zika virus isolate, collected during the 2013 epidemic in French Polynesia, with three types of human skin cells, namely keratinocytes, found in the epidermis, and fibroblasts and dendritic cells, located in the dermis. The latter are immune system cells playing a key role in the production of appropriate antibodies.

The virus destroys dermis cells to spread
The result was that 100% of the fibroblasts were infected within 72 hours. The other cells were also affected, especially the keratinocytes. Using electronic imaging, the researchers demonstrated that the virus uses autophagy to replicate, a mechanism consisting of the partial degradation of cyctoplasm by the cell itself. This phenomenon eventually leads to cellular apoptosis, or death by breaking up, and in this way boosts dissemination of the pathogenic agent. These reactions result in the formation of an oedema in the skin section, which does in fact match one of the symptoms seen in patients suffering from zika fever.

Preventing infection
Having confirmed that the virus does in fact target cutaneous cells, the team identified the cell receptor enabling the virus to enter fibroblasts. It is a protein called "AXL". The scientists then checked the antibodies' effectiveness against this protein, together with small silencing RNAs that suppress target genes. These fully extinguish this receptor, thereby blocking infection of the cell and greatly reducing the rate of cell infection.
All of this work is a first as regards zika virus biology. It opens the way to identification of therapeutic targets to produce a treatment, which is currently based solely on dealing with the symptoms. For further information

1.1.3 Fighting mosquito resistance to insecticides

Controlling mosquitoes that carry human diseases is a global health challenge as their ability to resist insecticides now threatens efforts to prevent epidemics. Scientists from the CNRS, IRD, Université Claude Bernard Lyon 1, Université Joseph Fourier in Grenoble and Institut Pasteur in French Guiana[3] have identified

[3] From the Laboratoire d'Ecologie Alpine (CNRS/UJF/Université de Savoie Mont-Blanc) which belongs to the Observatoire des Sciences de l'Univers in Grenoble, the Unité d'Entomologie Médicale at the Institut Pasteur in French Guiana, the Laboratoire Maladies Infectieuses et Vecteurs, Ecologie, Génétique, Evolution et Contrôle

new genetic markers for mosquito resistance to insecticides, which could improve its detection in the field. This work was published in Genome Research on 23 July 2015.

The ability of mosquitoes to resist insecticides represents a serious threat to the prevention of diseases such as malaria, dengue and Chikungunya. The detection and monitoring of the resistances developed by natural mosquito populations will be essential to enabling their management in the field for as long as there are no alternatives to the use of insecticides.
Some of these resistance mechanisms remain little known. For example, genetic factors for the metabolic resistance of mosquitoes, linked to the biodegradation of insecticides by detoxification enzymes[4], are still poorly understood. **The scientists used a novel approach involving massive DNA sequencing in order to identify the genetic bases for this resistance in the Aedes aegypti mosquito**, a close cousin of the Asian tiger mosquito and the vector of dengue fever and Chikungunya in tropical regions. Indeed, rather than sequencing the entire genome of the mosquito — a costly and laborious process — **the scientists used bioinformatic techniques to target more than 760 genes potentially involved in insecticide resistance.** After analyzing these genes by very high-throughput sequencing, the team determined that an increase in the activity of detoxification enzymes in resistant mosquitoes was often triggered by a rise in the number of copies of genes coding for these enzymes. They were also able to demonstrate that mutations affecting these enzymes could increase the biodegradation of insecticides in resistant mosquitoes.

The researchers also observed that the biomarkers of resistance appeared to be little conserved in some continents. These findings suggest that among the large panel of detoxification enzymes acquired by mosquitoes during their evolution (sometimes more than 200 genes), some are re-used by these insects to resist chemical insecticides, depending on gene flow between populations, their evolutionary history, the appearance of mutations, as well as environmental changes, such as the use of pesticides in agriculture.

These findings represent a major step forward in our understanding of the genetic mechanisms developed by mosquitoes to adapt to insecticides, and provide new opportunities to detect them at an early stage (for example, using molecular tests). This will improve their control in the field, and make it possible to adapt treatments to different resistance phenomena.

This work also allowed the scientists to initiate a consortium involving more than 40 countries and ten institutions, with a view to compiling **the first global map of mosquito resistance mechanisms to insecticides[5].** This key initiative has already received the support of the World Health Organization (WHO).

And in the future?
IRD researchers will remain at the forefront in the fight against new epidemics and emerging infectious risks (Zika, Ebola) while reinforcing the One Health [6] approach made possible by the Institute's interdisciplinary structure.
Research into the impact of pollution on the environment and health will be stepped up. Finally, the question of reducing inequalities (social, gender, geographic and economic) in access to care will be made a priority in the context of demographic and epidemiological transition where chronic diseases are affecting a growing proportion of the population.

1.2 Climate change – the search for solutions

IRD has made the study of climate change one of its research priorities. It conducts multidisciplinary research in more than 25 countries, in regions that are key to understanding environmental changes and that are especially vulnerable to the impact that these changes could have.

(CNRS/IRD/Université de Montpellier), the Pôle Rhône Alpes de Bioinformatique at Université Lyon 1 and their international partners.

[4] Detoxification is a biological process that enables an organism to inactivate toxic substances of internal or external origin. It can reduce the pharmacological or toxicological activity of a substance, generally through an enzymatic process, and facilitate its elimination.
[5] WIRES consortium: Worldwide mapping of Insecticide REsistance in Dengue vectors.

[6] The *One Health* approach aims to strengthen ties between human health, animal health and environmental management.

To support public policies, IRD researchers:

- study climate mechanisms in order to anticipate changes, both at global and regional level;
- measure the impacts of climate change on ecosystems and the living conditions of populations, to propose solutions for adaptation;
- develop solutions to control and mitigate the factors of climate change (especially man-made greenhouse gases).

Faced with these complex issues, in which interactions between communities and their environment are particularly strong, the IRD proposes an integrated scientific approach. The strength of its network of partners, both in the Global North and South, means it can develop highly multidisciplinary research programmes at regional scales. IRD promotes the consideration of climate aspects in development issues, by using the direct results of its research, developing decision-making aids, transferring knowledge to the populations, training experts and building research capacity in countries in the Global South.
For more information

Key figures

- **38 research units**
- **over 200 researchers**
- **16 joint international laboratories**
- **9 environmental observatories**
- **13 young teams associated with the IRD**

1.2.1 COP21 IRD's involvement

IRD has served as an observer for the United Nations Framework Convention on Climate Change since 2014 and was actively involved throughout 2015 preparing for COP21 with its partners from the French higher education and research system, and especially with the academic and scientific communities from developing countries.

It co-organised two major international scientific conferences in the run-up to COP21, Climate-Smart Agriculture (Montpellier, 16-18 March) and Our Common Future under Climate Change (Paris, 7-10 July), mobilising the scientific community from the Global South and upholding the conviction set out in the final declaration of the Paris conference, which affirms that research is pivotal not only in investigating and raising global awareness of climate change, but also in identifying solutions to mitigate and adapt to environmental changes and assessing their implementation and level of acceptability to populations .

Drawing on the research conducted over several years, IRD also co-organised more than 70 scientific events in France and other countries where it works, and contributed to preparatory workshops and scientific coordination work related to COP21 on a number of French campuses via the COMUE university and institutions communities.

IRD was the only French EPST (Public Scientific and Technical Research Establishment) to have its own stand in the Climate Generation space at Le Bourget during COP21, where it welcomed 89,000 people, and was also present at the Solutions21 exhibition at the Grand Palais, on the stand run by the French ministry for national education, higher education and research (42,000 visitors).
Through the dozens of events co-organised with its partners at Le Bourget and the various actions over the two weeks of COP21, IRD reaffirmed a number of positions that it believes arise directly from current scientific knowledge, or its limits:

- in Southern countries, more than elsewhere, it is imperative that action against climate change goes hand-in-hand with sustainable development goals to combine mitigation and adaptation to climate change, environmental protection and a reduction in inequalities;
- research has to support public policies to ensure that the fight against poverty is allied with environmental protection: diagnoses after climate events, measuring impacts, identifying solutions and technology breakthroughs that help populations adapt to the changing environment, and capacity building for research and information sharing in the Global South;
- science must operate on a multi-disciplinary and long-term basis, which provides an integrated and global vision of sustainable development issues. This is why the IRD works to create and consolidate environment observatories in Southern countries.
- Climate science is universal and has to be developed on the basis of academic knowledge from the North and the South, while taking into account the know-how and knowledge of the populations themselves. For more information

1.2.2 The West Pacific Ocean, at the heart of the climate machine

The Pacific's "western boundary currents" convey huge quantities of warm water containing salt and nutrients and have a considerable influence on the climate. Although they were discovered long ago, still little is known about these ocean systems. Significant research efforts have been undertaken in the last seven years. An IRD team with Chinese, Australian and American partners recently published a report in Nature magazine on the state of knowledge on these Pacific currents, their variations, their impact and their response to climate change.

A little-understood system of currents
The Pacific's western boundary currents were among the first dynamic systems studied by pioneering oceanographers. However, until now, little was known about their complex structure. Given their significance in ocean-atmosphere interaction, scientists have been redoubling their efforts for the last seven years. Following the SPICE programme, focused on the south-western Pacific, IRD researchers and their Chinese, Australian and American partners are continuing this work within the CLIVAR programme across the whole Pacific. Their objective is to understand exchanges of heat and water masses, possible changes in them as a result of increased greenhouse gas effects, and their impact on climate. They have recently published a report on the current state of knowledge in Nature magazine.

Great variability
The scientists show that this ocean system functions as a single entity. For example, when a warm El Niño episode occurs, the entire western boundary currents system shifts to higher latitudes. It is also affected by other factors, such as the seasons, local monsoon winds, etc. It consequently shows great variability within seasons, from one year and decade to the next, and indeed over the longer term. In places, such as the Solomon Sea, the amounts of warm, saline water conveyed can double between a cold and a warm El Niño phase.

A central role in world climate
In return, this system of currents affects the climate in many ways. First of all, flows towards the Indian Ocean, via the Indonesian archipelago, contribute to the world's thermohaline circulation, the "conveyor belt" spreading heat and regulating the climate across the globe. In addition, it exchanges heat and water masses with the equatorial zone and its famous "warm pool", a huge reservoir of warm water in the middle of the Pacific. This is the planet's main "heat pump", supplying flows of heat and humidity for the majority of the Earth's atmosphere. Lastly, one branch of the current peels off towards the South Pole. Depending on the intensity of the currents and their spatio-temporal variation in the inter-tropical zone, this system can disrupt the world's weather quite considerably. The consequences of these phenomena – cyclone formation, changes to precipitation patterns and the functioning of natural and agricultural ecosystems – strongly affect societies around the world.

With climate change, western boundary currents in the Pacific, as in other oceans, have intensified over the last century. They have extended towards the poles, where they have heated up two to three times more than in the rest of the world's oceans. How will the climate respond to these fundamental changes? The challenge for researchers now is to find out… For further information

1.2.3 The '4 per thousand' initiative: improving soil carbon sequestration

IRD, Inra and Cirad have joined forces for the '4 per thousand' scientific initiative launched by the Consultative Group on International Agricultural Research (CGIAR), as part of the Lima-Paris Action Agenda. The goal of this initiative is to reduce greenhouse gas emissions and improve carbon sequestration in agricultural soils, and it is a promising avenue for research. It also contributes to food safety and to the security of agricultural jobs.

The project was announced by the French Ministry of Agriculture during COP21 and will assess and identify the most appropriate cultural practices for mitigation and adaptation, and for sustainable development issues to the benefit of farmers' well-being.
A first meeting bringing together all members of the '4 per thousand' initiative will lay down the governance rules and clarify the principles shared by all the projects' backers. It will be held in close liaison with the Moroccan ministry for agriculture in the run-up to COP22.
The '4 per thousand' initiative will thus strive to become a collaborative platform involving different agricultural stakeholders in practical projects. It will also carry out fund-raising work and attempt to establish a virtual expertise hub that will promote the outcomes of the international research and scientific cooperation programme.

And in the future?
IRD, a key contributor at COP22
After its involvement in COP20 and 21, IRD will naturally take part in COP22, putting special focus on Mediterranean issues. Through their actions, IRD and its partners will continue to uphold the positions it defended at COP21. The Institute will organise and support a whole series of events throughout the year and during COP22. Many of these events will draw on the work conducted in countries around the Mediterranean, although IRD will continue to work with Inra, Cirad and the CGIAR on the scientific element of the '4 per 1000' initiative and other three-way cooperation projects.
COP22 will also be an opportunity to spotlight the network of Mediterranean Experts on Climate and Environmental Change (MedECC) formed during MedCOP21.

1.3 Protecting biodiversity

Protecting biodiversity is at the heart of Sustainable Development Goal 15 (SDG 15)[7] and an important area of research for IRD. Its staff work at different levels to study the ecology, evolution, dynamics and functioning of land-based ecosystems and living resources (plants and animals).

The scientific questions raised by the 'Ecology, Biodiversity and Continental Ecosystem Functioning' (Ecobio) department primarily look at the role of living organisms and environments and their interactions in:
- the functioning of continental ecosystems and the services they provide to communities;
- the adaptation of continental ecosystems to global changes (uses and climates);
- protecting diversity;
- their resilience to global and demographic changes;
- the relationships between continental systems and the climate mechanisms.

Key figures

- **11 research units**
- **849 publications in 2014**

1.3.1 Half of the Amazonian tree species are endangered

One in two tree species in the Amazon could be endangered. The Amazon Tree Diversity Network international consortium, which includes the IRD, has just revealed in the Science Advances journal that, according to the predicted deforestation scenarios, 36% to 57% of Amazonian species are at risk of disappearing, i.e. up to 8,700 species out of the 15,000 estimated during the first inventory of the Amazonian Basin, published two years ago.

According to these results, when considered at the scale of the planet, it is feared that 40,000 tropical tree species may be exposed to a risk of extinction and that the proportion of endangered plants on the planet has increased to one fifth.

Red alert for 8,700 tree species
According to the criteria of the International Union for Conservation of Nature (UICN) – the most commonly used to determine the conservation status of any species – the research team believes that 36% to 57% of Amazonian tree species are threatened with extinction, i.e. up to 8,700 species, including the famous Brazilian walnut, which has significant economic implications for the countries of the region. To date, only a minute part of these species features on the NGO's red list. Some may even disappear before they can be observed and described…
Should these results be confirmed, the amount of endangered plants on the planet would increase to 22%.

Simulating the variation in the population size of each species
In 2013, the research team had already published the first inventory of Amazonian Basin trees in the Science journal. Through statistical calculation, the total number of species had then been estimated at 15,000 – compared to the 12,000 identified to date on the planet. This initial inventory also helped assess the

[7] SDG 15 - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

distribution area and number of individuals per species. In the new study, the researchers modelled the variation in the population sizes of each species, based on the different deforestation scenarios identified.

Destruction of up to one third of the forest by 2050
With the construction of dams and mines, forest fires and droughts increased by climate change, etc., the Amazon forest is facing a wave of threats. Specialists believe that nearly 20% of the forest has disappeared since the 1970s. By 2050, based on the predicted deforestation scenarios, it should shrink by up to another 30%.In the best case scenario, in which protected areas (national parks, indigenous reservations implemented to reinforce the territorial rights of aboriginal people) would contribute to the preservation of the vegetation, the surface area of the forest will still be reduced by 10%.

This trend can be observed throughout the intertropical zone. The new study claims that some 40,000 tropical tree species across the world could be facing the same risk of extinction. For further information

1.3.2 Asian gudgeon bring new terror to rivers

Small in size but significant in terms of the ecological and economic damage they cause, Asian gudgeon are invading a great number of water courses across the world, particularly in Europe. These fish carry a half-animal/half-fungal parasite, which has very likely been present in China for millions of years and which is fatal to most other fish species. Having discovered this pathogen 10 years ago, IRD researchers and their partners have recently demonstrated how quickly it can spread in a Turkish catchment area. Three years after the arrival of the gudgeon, between 80 and 90% of fish were contaminated, including farmed bass, a species of great economic importance in the Mediterranean.
Arriving from China 50 years ago, a small fresh water fish from the carp family, known as the 'Asian gudgeon', has since caused devastation in the rivers of Europe and North Africa. This creature has successfully colonised various aquatic environments due to its highly efficient strategy for reproduction. But most importantly, as demonstrated in a study by the IRD and its partners, published in Emerging Microbes and Infections (Nature), it is propagating a devastating mycosis, a cousin of the well-known chytrid fungus, which has decimated frogs and toads throughout the world over the last few decades.

A parasite from another age
This small invasive fish is the healthy carrier of a parasite named Sphaerothecum destruens, bordering between the animal and fungal kingdoms. This organism, the type of which was only discovered recently, emerged several million years ago when animals and fungi became differentiated. The research team discovered this parasite in the Asian gudgeon in 2005 and subsequently observed its damaging effects on other fish species under laboratory conditions.

A mortality rate of up to 90%
To confirm these initial experimental findings and validate their epidemiological models, scientists monitored the wild populations of fresh water fish over a four-year period, from 2009 to 2013, in a catchment area in South-East Turkey. Only three years after the introduction of the Asian gudgeon and its deathly parasite in 2006, all were infected. Between 2009 and 2013, the number of fish fell by 80 to 90%.

A long-standing conspiracy
Scientists subsequently conducted a phylogenetic analysis of different strains of the pathogen Sphaerothecum destruens, taking samples from the tissue of various family lines of Asian gudgeon in Europe, as well as from infected salmon in the United States. Their findings suggest that the pathogen and its Asian host have been evolving jointly and concurrently for thousands of years. This confirms the origin of the parasite and explains why the Asian gudgeon, which has evolved with it, is not affected.

Contaminated sea fish
In addition to the serious ecological problem it causes, the Asian gudgeon has an even more worrying potential economic impact: researchers have discovered its parasite in bass cultured in the brackish water of a Turkish aquaculture farm, having previously believed that it could only affect fresh water species. This fish is hugely important in economic terms, with an industry representing 400 million euros per year in the Mediterranean.
The research team is sounding the alarm bell. The risk of this disease emerging on a worldwide scale is very real. Animal health organisations and environmental protection agencies will now need to take urgent action to contain the rapid spread of this pathogen across Europe and the rest of the world. For further information

1.3.3 Discovery of a new flowering plant in Gabon's forest

A new flowering plant has been discovered in Gabon's tropical forest by Gabonese and French botanists from the Plant Ecology, Systematics and, Evolution laboratory (Paris-Sud University/CNRS) and the Diversity, Adaptation and Development of Plants laboratory (IRD/Montpellier University). This flowering plant belongs to a new genus and a new species, and is part of the Annonaceae family. It was named Sirdavidia solannona in honour of Sir David Attenborough, the British naturalist, film director and BBC TV presenter whose work has influenced and inspired numerous biologists. The related study was published in PhytoKeys on 4 February 2015.

The discovery of a new species of Annonaceae came as quite a surprise in this region of Gabon's Monts de Cristal national park, as the area has already been extensively explored by botanists and lies just a few hundred yards from a main road. Despite major efforts to prospect across the area, the new species Sirdavidia solannona was only found at two locations, so for the moment it has been listed as 'endangered ' using the International Union for Conservation of Nature's scale of threatened species.

The flowers on this new plant, with their reflexed red petals and bright yellow stamens forming a cone, do not match any existing Annonaceae genus description. Analysis of the DNA samples confirmed the need to create a new genus to classify the new plant. The researchers also noted that its closest relative, Sirdavidia, is a species endemic to an isolated forest area in Tanzania more than 3,000 km away.

Additionally, the Sirdavidia solannona flowers are suggestive of a 'buzz pollination' syndrome, a very specific form of pollination by bees that move their flight muscles rapidly causing vibrations as they collect and release pollen from stamen. Sirdavidia flowers are in fact very similar in appearance to those in the tomato family (Solanaceae), specialists for buzz pollination. This similarity with Solanaceae inspired the new species name.
'If this new system of pollination is confirmed, it would be an exceptional discovery, because it would be the first recorded case in Magnoliidae and early-diverging angiosperms (flowering plants) in general, representing 10,000 species around the world", explain Drs. Couvreur and Sauquet.

A special page devoted to this new species can be found on the World Annonaceae Scratchpad website.

1.3.4 New diseases affecting rice and cassava discovered

IRD researchers and their partners in Benin, Burkina Faso and Côte d'Ivoire have, for the first time, described new diseases affecting rice and cassava, two basic food crops in the many countries in the Global South. These diseases are caused by Xanthomonas genus bacteria that attack the leaves and stalks and they are spreading in West Africa as rice growing expands and uses more intensive methods.

An emerging disease due to more intensive rice-growing
In rice, this bacterial disease is also known as 'bacterial leaf spot' and is one of the most serious disorders affecting the plant. It is found in most rice-growing regions across the world, except for Mediterranean areas, and causes considerable damage with up to 30% yield loss. It was first reported in Africa in the 1980s, with cases in Madagascar, Senegal and Nigeria. More recently, with the expansion of rice-growing and the introduction of high-yield varieties over the last few decades, scientists have observed its emergence in West Africa, where rice-growing has increased massively since 2000. More intensive farming increases the risk of pathogen emergence.
The bacteria is now found in most regions and especially Mali and Burkina Faso where the researchers characterised it. The disease has also recently been reported in the north of Benin. Further investigations need to be carried out to measure how far it has spread in these countries.

Very diverse strains in genetic terms
The genetic analyses of the Xanthomonas strains collected in Mali and Burkina Faso show that these African strains are very diverse, and appear to be related to either the imported Asian strain or an older African strain. Their genetic evolution is also very rapid.
The researchers have also shown that the severity of symptoms varies greatly from one strain to another, regardless of place, period or type of plant on which they were collected. This suggests that less virulent strains live alongside highly virulent strains in the same environments.
Finally, scientists have observed the bacteria on different host plants, as was previously described in Asia. In addition to rice crops, it was found in weeds and perennial grasses, as well as in wild rice varieties. These plants are a natural reservoir for the disease, outside crop growing seasons.

The disease confirmed to affect cassava in Côte d'Ivoire
In cassava, the disease caused by the Xanthomonas bacteria genus, known as 'bacterial blight', appeared in the middle of the last century in Brazil and has followed the expansion of cassava growing across the world. In fact, cassava is now the world's sixth biggest food crop with more than 700 million people dependent on it for food safety. The disease affects the propagation material, i.e. the stem, and is the plant disorder that causes the highest losses, with up to 30% of harvests lost. Its presence has recently been confirmed by IRD researchers and their partners in Burkina Faso and Ivory Coast, where it was reported in 1979. However, the responsible pathogen had not been characterised until now. The researchers have used new genetic methods to confirm that it is in fact the Xanthomona genus bacteria. **This result is worrying in that cassava growing is continuing to expand in different parts of the country and elsewhere in the sub-region.**

Given the extent and severity of bacterial epidemics over the past few years in Africa, it is now crucial to develop disease-resistant rice and cassava varieties. Researchers have identified certain resistant rice varieties grown in Burkina Faso, together with the gene that gives the plant this characteristic. These results will help guide selection procedures towards relevant varieties to strengthen food safety in affected countries.

1.3.5 IPBES: an international group of experts in biodiversity

The Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services (IPBES) was founded in April 2012, under the auspices of the United Nations Organisation, to assist governments and strengthen the resources of emerging countries, thus helping them address biodiversity issues.
The biodiversity equivalent of the Intergovernmental Panel on Climate Change (IPCC), the IPBES endeavours to identify and develop decision-making aids and practices that encompass all relevant knowledge on biodiversity and ecosystem services from scientific research, governments, non-governmental organisations, local stakeholders and indigenous peoples.
France's presence on the IPBES is the outcome of the coordination efforts led by the French Foundation for Research on Biodiversity: 39 French members, including 9 IRD researchers, were selected in 2014 and 2015. This is clear acknowledgement of the excellence of the scientific work conducted in this field by IRD.
For more information (in French)

And in the future?
After EU ratification of the Nagoya protocol, France is going to roll out its system for application of the new European regulations on research and development into genetic resources and traditional knowledge. This requirement is an opportunity for IRD to draw up an inventory of its collections and the traditional knowledge acquired, maintained and shared by the Institute.
Two new JEAI (young teams affiliated with the IRD) will strengthen the existing partnership networks in West Africa for the themes of bio-invasions and surveillance of emerging crop diseases: the Coana project in Mali (with the IMPE unit – plant-micro-organism-environment interactions) and the IBAO project in Benin and Niger (with the CBGP – Centre for biology and management of populations).

1.4 Understanding global changes, quantifying hazards and mitigating risks

The IRD research teams from the 'Department of Internal and Surface Dynamics of Continents' (Disco) study the physical and biogeochemical functioning of continental environments, in a context where global changes (climatic, economic, demographic and so on) mean that we need to revise some of the knowledge acquired over the past few decades and consider the fact that the tipping points in the earth's 'operating system' may soon be crossed. The work done by the Disco teams focuses on two main structural areas: observation and modelling of the continents' physical environments, and the interactions between changes to the physical environments and socio-economic dynamics. The scientific goals are the understanding of global changes and above all climate change, the quantification of hazards, risk mitigation and the prospects for new resources.

Key figures

- **11 joint research units**
- **3 joint service units**
- **7 ICL (international combined laboratories)**
- **7 JEAI (young teams affiliated with IRD)**
- **1,345 publications in 2014**

1.4.1 A new type of earthquake discovered off Peru

Researchers from the Peruvian Geophysics Institute, IRD and the University of Nice Sophia Antipolis have discovered a new type of slow earthquake off the coast of Peru and, in Nature Geoscience, have put forward a tectonic stress relaxation model to enable better estimates of the seismic hazard.
It is well known that the stresses caused in subduction zones cause earthquakes that can sometimes be powerful, such as the Chile earthquake in 2010.

Until recently, researchers thought that active faults followed seismic cycles with periods where stresses accumulated resulting in an earthquake when the stress was released, before the forces built up again in the fault and the cycle started again as the plates moved. About fifteen years ago, satellite methods used to measure deformations in the earth's crust highlighted a different form of plate relaxation where no significant seismic activity occurs, known as aseismic slip transients. Until now, two types of aseismic slip had been described: slow slip during the inter-seismic phase and post-seismic slip after major earthquakes.
The team of geophysicists specialised in the Andes have now discovered a new mechanism in northern Peru. In this area, subduction of the Nazca oceanic plate under the South American continent, at a rate of approximately 6 cm/year, is mainly an aseismic movement. The phenomenon observed by the researchers comprises a simultaneous sequence of moderate seismic activity (magnitude 5.8-6.0) and slow slips. The slip is formed and develops immediately after two moderate earthquakes of 6.0 and 5.8 magnitude respectively. This phenomenon is also different from the aseismic transient processes observed because the size of the slip is not connected to the scale of the earthquake that causes it. In fact, a 5.8 magnitude earthquake can cause a larger slip than a 6.6 magnitude equivalent. This is the first time that a mixed seismic/aseismic process has been observed, with the two forms of slip appearing to interact during the sequence.

The process was brought to light using geodesic measurements and an original seismological analysis. It illustrates a new form of stress relaxation in subduction zones.
Better knowledge of the friction properties along the main active faults and of the processes via which the accumulated stresses are released is required to develop predictive models. These models will allow for better seismic risk management. For more information (in French)

1.4.2 Andes : a giant paleolake in the land of glaciers

At the foot of the Andes, a gigantic lake, Tauca, covered the Bolivian Altiplano during the last deglaciation. Using an original method developed from fossil micro-algae called diatoms, researchers from IRD, CNRS and Aix-Marseille University have recently shown the effect on the regional climate of the disappearance 14,000 years ago of this salt-water giant, 3,500 metres up in the mountains. The lake's drying out also gave rise to the world's largest salt crust (11,000 sq. km) which now covers the famous Uyani salt flats.

The last deglaciation in the Bolivian Andes
IRD researchers and their partners from CNRS and Aix-Marseille University have recently shown the regional influence of the Tauca paleolake, which occupied the Bolivian Altiplano at the time of the last deglaciation. The phase within which this gigantic lake reached its maximum extent began 16,000 years ago. It then gradually dried up and disappeared some 2,000 years later.
To study the lake's possible influence over the region's climate, the scientists reconstituted its isotopic composition by means of an original method making use of fossil micro-algae called diatoms.

Micro-algae as evidence of humidity conditions
The amount of oxygen isotopes ($\delta^{18}O$) contained in these fossils provides evidence of the geochemical condition of the water in the lake in which the algae grew. This isotopic composition gives scientists an accurate indicator of temperatures and humidity conditions in the region at the time when the algae were

alive. When rainfall increases and the lake level rises, the isotopic ratio of the oxygen in the water drops, the opposite being the case when rainfall declines.

Regional climate influence
The researchers then turned their attention to changes in the lake's isotopic composition which they reconstituted with another isotopic signal, recorded in an ice core extracted from the summit of Mount Sajama, overlooking Tauca's former location. This ice core revealed, around 14,500 years back, a $\delta^{18}O$ peak that was unusual compared to other ice records from the Andes. On the other hand, this peak was consistent with measurements taken from diatom fossils contained in the former lake's sediment. This study therefore shows that snow samples from Sajama were apparently formed during this period, based on the mix between the humidity in the atmosphere and that from the evaporation of the lake.
This finding suggests that in very specific cases like this, with the presence of a nearby lake, paleo-climatic records such as measuring precipitation from ice cores may be skewed by the local hydrological cycle, and should be interpreted with such an influence in mind. For more information

1.4.3 Using mobile phones to forecast rain

The Rain Cell, or Rain Measurement from Cellular phone networks, project is based on an innovative, 'green' concept to address climate and social issues by measuring rainfall and anticipating the risks of a flood or drought, making use of the mobile telephone networks.

The method uses a simple idea: rain attenuates the signals sent out across the network from one antenna to another. These fluctuations can be measured to determine precipitation at any point in the network, potentially in real time. The advantage lies in making use of a quality infrastructure, set up and maintained by the telehone operators.
The principle has been studied since the 2000s by teams of Dutch, Israeli, French and German researchers but had never been tested in a tropical zone. Yet it is in countries in the Global South that the method would be the most valuable, in that the ground measurement networks are insufficient and that hydro-climatic risks are constantly rising, especially in the fast-growing metropolitan centres.
Working with operator Telecel Faso, a pilot site was set up to validate quantitative rainfall estimates using microwave links over the mobile phone networks for the first time in Africa.
The results of the Rain Cell concept validation process in Ouagadougou, through comparison with rain gauges and the Xport radar, demonstrate that detection (95% success rate) and quantification (global bias under 10%) of rain using operational microwave links are excellent. The data provided by Telecel Faso can be used to measure rainfall at time intervals of just 5 minutes. At this very fine scale, consistency with radar information is very good.
On the back of this success, the project led to an international workshop from 30 March to 2 April 2015, bringing together 90 participants from 18 countries, including many of IRD's partners in West Africa and several international organisations.
Converting the try
Applied to an entire telephone network, the method would provide high-resolution rainfall maps in real time at city, country or watershed level.

There are plenty of potential applications:
- Urban hydrology
- Early warning systems for floods and decision-making processes
- Assimilation in weather forecasting models
- Information for farmers
- Insurance companies
- Climatology archives and climate services
- And so on.

Africa offers enormous potential for developing the method at regional scale and making the concept operational. However, other regions of the world could benefit from these developments and potential partners have already come forward in Asia and South America.
To develop Rain Cell applications and make the most of the concept, partnerships need to be formed between telephone operators, R&D teams and users. This is something that the IRD teams and their partners intend to work on in the future. For more information

And in the future?
In 2016, research teams will be heavily involved in the international agenda on climate change and sustainable development, taking part in COP22 and the third United Nations Conference on Housing and Sustainable Urban Development (Habitat III in Quito).

1.5 Protecting vulnerable populations

The globalisation process coupled with the changes brought about by human activity affecting the balance between people and their environments have dramatically transformed contemporary societies in both the Global North and South. These processes have triggered multiple social changes, with social, identity and territorial reconstruction, greater mobility and movement of people, goods and ideas, increased inequalities, new forms of exclusion and social achievement, and new forms of violence and conflicts. This social restructuring in turn influences the stability of societies and the sustainability of systems, as well as the safety and well-being of populations. It also reveals different vulnerabilities and varying capacities for resilience.
Understanding contemporary societies in the Global South while analysing the dynamics, transformations, adaptations and resistances that underlie and drive them is a major area of research for IRD.

The 'Societies and Globalisation' department brings together the majority of IRD's social science researchers. Anthropology, economics, geography, demography and sociology are the main disciplines represented. The department also includes archaeologists, historians, legal experts, urban planners, political scientists and linguists, as well as several environment and life science researchers (agronomy, ecology, pedology, hydrology, health, remote sensing, modelling and geomatics).

IRD thus conducts multidisciplinary research in eight main subject areas:
- governance, relationships with power and institutions;
- inequalities, vulnerability and adaptability;
- gender relations;
- interactions between nature and societies;
- affiliations, resources and territories:
- migrations, mobility, movement and social reconstruction;
- education and knowledge;
- urbanisation, cities in the Global South and development.

Key figures

- **12 joint research units**
- **2 international joint units**
- **3 JEAI (young teams affiliated with IRD)**
- **3 ICL (international combined laboratories)**
- **213 articles, 78 books, and 151 book chapters in 2014**

1.5.1 Madagascar confronting its crises

Over fifty years, Madagascar has seen its per capita GDP fall by one-third, while it has almost tripled in Sub-Saharan Africa. Since its independence in 1960, each period of growth has been brutally offset by a socio-political crisis, compromising any hope of economic take-off. Why doesn't a country with so many assets—natural and human resources, etc.—manage to get out of this pattern of back sliding? IRD researchers and their Malagasy partners are working to solve this riddle.
From original statistical surveys and through a critical summary of the existing research works, the IRD scientists and their Malagasy partners proposed an economic and socio-political review of the history of the Grande île. Consequently, they explain its disappointing performances through three structural characteristics: social fragmentation, geographical dispersion of the population and the absence of intermediary bodies between the citizens and the higher echelons of the State. These are just some of the peculiarities that perpetuate not only the strong concentration of power, but also, paradoxically, weaken successive regimes and permit their overthrow.

A fragmented society
Malagasy society is strongly divided into class groups (castes) dominated by the "grandes familles", a system run by powerful families that has endured throughout history. Today still, despite the official abolition of castes at the beginning of the 20th century, this inequitable hierarchical structure remains deeply entrenched. As statistical surveys of the Malagasy elite show, more than 50% of members of the ruling class are descended from this oligarchy, which represents barely 1% of the total population.

In spite of the democratisation that began in the 1980s, power has remained in the hands of this politico-economic oligarchy. At the highest level of power, the presidents and their close entourages continue to extend their control over society. Today, more than 80% of the members of the elite operate in at least two spheres of influence from among the army, business, politics or even religion, maintaining their domination over the population, who, despite their democratic claims, respect this hierarchical order.

A "scattered" population and no opposition
The population of the island, the majority of which is rural, is very scattered throughout the territory. In their analysis, the researchers highlight the crucial effect of this "scattering" of the population on the functioning of Malagasy society. The low density and isolation of populations in rural areas results in the atrophy of "intermediary" bodies, a missing vertical link between the citizens and the fundamentally urban elite. Neither the local authorities, the political parties, the associations, the unions, nor other civil society organisations exercise real opposition. In the absence of these links between the population and the rulers, the latter are neither forced nor encouraged to take into account the majority interests, nor to have a medium or long-term vision for the country, only serving short-term vested interests.

The Malagasy paradox
The split between the population and the presidential clan, as well as the extreme concentration of power, invariably led throughout history to the fall of the regimes in place. In fact, the low popular backing of the governments leads to their weakening, in a context of increased aspirations that feed popular protest. The unfair effects of the growth periods, which essentially benefit a small fraction of urban society and accentuate inequalities, engender a deep dissatisfaction in society. This feeling, exacerbated by electoral irregularities and corruption, has systematically given rise to the overthrow of ruling teams.
This rereading of Malagasy history shows that, behind the declared discussions and ideologies, which may vary, the system and the practices in the highest echelons of the State have evolved little, maintaining the multi-faceted inequalities between nobles and working classes, coastal regions and highlands and rural and urban areas. Even so, the Grande île has shown signs of the ability to overcome its problems: episodes of democratic change, the emergence of a class of entrepreneurs open to the outside world, control of violence and a rise in citizen aspirations. The whole challenge for the Malagasy authorities lies in upholding these transformations by establishing a new social contract between the elite and the population.
For further information

1.5.2 Hanoi : the metropolis is weakening the "craft villages"

Vietnam has thousands of "craft villages". Each one specialises in a particular craft:works of art, religious objects, textiles, basket-weaving,food processing, etc. In particular the capital, Hanoi, has more than 500 on its outskirts.
Grouped into "clusters", these villages have modernised themselves and diversified since the country's economy opened up in the 1980s.However, the ancient systems of production are being undermined by the competition for real estate and labour driven by the globalisation of the markets and the metropolitanisation of the capital.
The rapid growth of industrial production in emerging market countries is affecting global stability. This new dimension is weakening traditional systems of production, which are hugely demanding in terms of labour. In Vietnam in particular, the IRD researchers and their Vietnamese partners are analysing the impact of globalised industry on the ancient systems of the "craft villages".

A traditional system that has modernised itself
The region around the capital, Hanoi, is known for these villages, where the tradition of craft-work is continued. More than 500 villages, specialising in the manufacture of works of art, religious objects, food, industrial, textiles, and basket-work products have evolved only a few kilometres away from the capital. Some of them have been there for more than a thousand years. In fact, in the densely-populated Red River delta craft work has always been associated with rice cultivation, because it employed great numbers of people at times other than the growing season.
Since the country's economy opened up in the 1980s, this production system has modernized itself and has grown in importance. Encouraged by the opening of the borders and the government's incentive policies, these villages have diversified and intensified their production, which is increasingly geared towards export. Grouped in "clusters" of the same activity, the craft villages bring together a concentration of several thousands of workers. Currently they provide employment for almost 20% of the rural population of working age, and these workers benefit from an income several times greater than that derived from agriculture.

The craft industry currently under threat
However, as revealed by the surveys conducted by geographers and economists between 2003 and 2013, there are many factors restraining their development. Firstly, there is competition from China and the Vietnamese formal sector, as well as the need to adapt to international production standards. The access to

real estate is another fresh obstacle to the development of the village enterprises, since the metropolitanisation of the capital is increasing land pressures and speculation. It is becoming increasingly difficult for the craft workers to have access to agricultural land. This is of benefit to heavy industry, which is financed by capital from outside the country and supported by the government because of its image of modernity. However, despite providing employment on a large scale, this industry recruits on a temporary and discriminatory basis. Its work-force is composed essentially of young people and often uniquely of women, a cheap work-force recruited to perform repetitive tasks with little prospect of skills training. Offering an uncertain future by virtue of possible relocation, it does not permit a working class to put down roots in the host regions. Conversely, the advantage of the craft villages is that their workers are able to put down roots; they have succeeded in creating a class of village crafts persons who pass their skills and expertise on from one generation to another.
Therefore, the future of these production systems, which provide remunerative, stable employment, is under threat and they are facing the challenge posed by the globalisation of the markets and the metropolitanisation of the capital. For further information

1.5.3 Camps and refugees: a world of transformations

Driven by war, poverty and humanitarian tragedies, twelve million people live cut-off from the world, grouped together in camps for refugees or migrants. This organised confinement, a source of marginalisation and social displacement, does not however make it a lifeless and sterile environment. Life goes on for the refugees and their life paths take new turns. For more than twenty years, researchers at IRD and their partners have been surveying and analysing the transformations at work in the camps.

How the world handles the undesirable
These detention centres on the margins of society are cropping up across the world, out of sight and out of most minds.
Around 20 million people across the world currently live in camps for refugees and displaced populations in the South, transit zones and workers' camps in emerging countries, and the migrant 'jungles' or administrative retention centres in the North.
For better or for worse, they have been driven from home by political, economic, humanitarian or environmental tensions over the past few decades. The largest contingent are refugees living the South, in countries bordering their own.
'This confinement, this marginalisation, is the world's way of handling the undesirable,' says anthropologist Michel Agier. 'The people that the nation states don't want, people seen as a form of waste, amassed in especially fenced-off areas.' If proof was needed of their invisibility, these camps rarely feature on the official maps of the host countries.

A factor in local development?
'Contrary to received opinion, the set-up of a refugee camp is not necessary a bad omen for the host region. Over time, these structures turn out to be anything but a burden and are, instead, the source of a certain degree of prosperity locally,' explains political scientist Hélène Thiollet.
The camps receive international aid and contribute to the local economy by creating services and infrastructures – 'public assets' that did not previously exist. They may even structure economic and commercial activity in the area, providing labour, consumption and cross-border movement of goods, funds and people. The presence of refugees therefore generates positive externalities, the impact of which influences the entire zone, beyond the camp or districts taken over by displaced populations. Since 86% of refugees and displaced populations remain in Southern countries where public assets are often lacking, these material and immaterial contributions have a substantial impact in the regions concerned.
For example, the camps around Daadab in Kenya – the largest concentration of refugees in the world – received $100 million in aid in 2010, leading to $25 million in trade on the ground. 'The HCR, which provides material assistance and legal protection for refugees, has adopted a deliberate policy to ensure that local populations benefit from aid,' Thiollet specifies. The goal is to minimise tensions between local and displaced populations, and to obtain the goodwill of the local and national authorities while preventing inequalities that benefit the newcomers.'

Sites of anthropologic transformation
When it comes to family organisation, language, social hierarchy, customs and eating habits, exile and refugee camps dramatically alter the existence of these people.
'The experience of displacement brings a new form of socialisation, very different from the homeland context, with the mixing and confrontation of cultures, societies and backgrounds, and the globalised world present through the international organisations,' Michel Agier goes on.
Events leading to exodus and the ensuing chaos when people flee their homes often means that families become dispersed. When they get to the camps, households rarely manage to come back together in quite the same way. Other family set-ups thus emerge, different from the traditional arrangements, with siblings

without their parents under the authority of the eldest, married adults regrouping differently, isolated individuals forming their own groups according to village or regional affinities, and so on. 'The dispersion of Palestinian families in different camps across the Middle East develops and maintains a form of social organisation that transcends borders and time,' young anthropologist Hala Abou Zaki comments.
The camps are also melting pots where languages are shaken up. A form of global English takes precedence over the refugees' mother tongues, due to the high number of international aid workers.
As such, social hierarchies are often turned upside down. 'Because they speak better English and have already gained responsibility as families reconfigure, young people often become the main contacts for international aid, breaking away from – and sometimes causing conflicts with – the traditional arrangements where the family elders have authority,' explains Agier.

The tricky return home
Going back doesn't mean resuming the positions held before departure, years or decades before.
'Whether it is spontaneous or organised, the return of refugees is a major concern, for them, for the HCR and for the host and home countries,' architect and anthropologist Pedro Neto points out. 'Things never quite go to plan.'
Firstly, not that many displaced people actually manage to return to their country or region. Settling the crisis that triggered exodus or achieving the conditions required for resettlement is no easy matter. Meanwhile, the people have changed during their exile and may no longer want to return to their old lives.
'The camps mainly take in refugees from rural areas,' the researcher says. While they are there, they adopt new standards of living, which may still be rudimentary but which are different from anything they knew previously. So, when the time comes, they no longer want to go back home.' With the services available in certain camps and the contact they have had with the international organisations, the refugees have enjoyed a certain level of sanitation, benefited from vocational training, and acquired social and linguistics skills they wouldn't find or use in their primitive rural context.
Nonetheless, return support schemes are designed to help them settle back in their home regions.

Practical and symbolic architecture
'From plastic sheets to real urban engineering, including well-established villages and settled districts, these camps are the site of some very specific, diverse architecture,' Michel Agier believes. Against all expectations, humanitarian emergencies do not necessarily mean anarchy and disorder.
The HCR intervenes as a genuine 'project manager' and requires specialist aid as soon as a camp is set up, so that it can optimise installations.
'The swift provision of resources and prompt support when setting up these structures testifies to the importance of regional development and the layout of camps,' architect Anooradha Iyer Siddiqi continues, with reference to the Daadab camps in Kenya, where 450,000 refugees live today. Immediately after the Somalian civil war and the populations influxes in 1991, the UN agency called on Swedish and German architects to draft the plans. This set the stage for a 'humanitarian industry' with specific standards on the size and shape of tents, how they should be set up on the ground, how to lay out different quarters, water supply, the width of traffic lanes, and so on. For more information (in French)

And in the future?
Looking ahead to Habitat III
Habitat III (17-20 October 2016 in Quito) is the UN's next event for member states, local governments, research organisations, companies involved in urban development and civil society, focused on defining a World Urban Agenda to meet SDG 11[8]*.*
Chaired jointly by France and Ecuador, this conference will look at the outcomes achieved by the Agenda established at Habitat II (3-14 June 1996 in Istanbul) and review the 22 themes selected by the Conference's preparatory committee and its secretariat.
Several IRD researchers are heavily involved in this preparatory process and the institute will take part in several events to highlight the need to strengthen interdisciplinary and partnership-based research as the urban environment become increasingly complex. The research programmes led by IRD across the world over the past few years, including in Ecuador, will be spotlighted.

1.6 Improving ocean resource management

The 'Oceans: climate and resources' department takes an integrated approach to mobilise knowledge and know-how as it researches issues surrounding the development of the oceans and the processes that affect the intertropical zone, working in partnership with communities from the Global South.

This approach focuses on a number of scientific goals:

[8] ODD 11 - Make cities inclusive, safe, resilient and sustainable.

- understanding and anticipating the role of the oceans in climate variability and global climate change, along with the impacts for populations in Southern countries;
- understanding the functioning of marine ecosystems (deep-sea, coastal and shore areas), their multiscale variability (time and space) and the impact of changes in ocean ecology on the populations in Southern countries;
- enabling the exploitation of resources while protecting biodiversity (SDG 14[9]) to support our partners in the South;
- studying the impact of ocean pollution on deep-sea, coastal and shore ecosystems in the intertropical zone.

It brings together IRD's oceanographers specialising in different disciplines: physicians, chemists, bio-geochemists, biologists, ecologists and fisheries scientists.

Key figures

- **8 joint research units**
- **4 joint service units**
- **1 service unit**
- **5 international combined laboratories**
- **10 young teams associated with the IRD**
- **621 publications in 2014**

1.6.1 A new future for corals

Coral reefs, true reservoirs of biodiversity, are seriously threatened by human activities and climate change. Consequently, their extinction has often been heralded. Now, researchers are painting a less gloomy picture: the planet's reefs are not doomed to disappear. But they will be very different from the ones we presently know. A new coral fauna will emerge, coming from the species that are most resistant to temperature increases.

Some reefs are recovering

Are coral reefs condemned to disappear? During the first decade of the 21st century, the intensification of cyclones, the phenomenon of coral bleaching due to ocean warming, outbreaks of a coral-eating starfish and coral diseases left us with this fear. But today, scientists are revising their pessimistic forecasts from the previous decade. In fact, recent research works show that, while numerous coral species have indeed been declining for more than 30 years, other are holding firm or even increasing in abundance. Consequently, some reefs have recently managed to recover.

Expanding coral genera

During a vast international study over fifteen years, IRD researchers and their partners observed the ecological development of seven coral reefs throughout the world: two in the Caribbean, in Belize and in the American Virgin Islands, and five throughout the Indo-Pacific Ocean in Kenya, Taiwan, Hawaii, Moorea and the Great Barrier Reef in Australia. Consequently, the scientists have shown the increase of certain genera, like the Porites reef corals, real reef builders that can resist temperature rises well.

They have also put these recent changes into perspective with regard to past events recorded in fossil reefs, showing that the abundance and structure of coral populations have already varied greatly over the course of past millennia.

Towards new underwater landscapes

These new data have enabled them to refine their mathematical models and to revise their forecasts for the coming decades. As ocean temperatures continue to rise, a subset of "winning" species will thrive: those that have the greatest heat tolerance, the best population growth rates or the greatest longevity. These species should progressively populate the planet's reefs, until they dominate them entirely.

Consequently, the underwater landscapes of the future will be very different to the ones that have been known for millennia. However, much remains to be discovered regarding this new coral fauna and its features. One question in particular remains: will these new eco-systems continue to meet the needs of the populations who depend on them? For further information

[9] SDG 14 - Conserve and sustainably use the oceans, seas and marine resources for sustainable development

1.6.2 When tropical fish colonise the Mediterranean

Since the opening of the Suez Canal in 1869, many fish species from the Indo-Pacific basin have invaded the Mediterranean. A third of them have colonised waters that are cooler than those of their original habitat, thus extending their climatic niche. These results suggest that the expansion of marine species in response to climate change has so far been underestimated. The results come from the research conducted by an international team from IRD's CoReUs unit (now part of the ENtropie joint research unit) and the CRIOBE (Insular Research Center and Environment Observatory – CNRS/Perpignan University/EPHE). The study featured on the front page of the March 2015 edition of Ecology Letters magazine.
In 1869, the Suez Canal created a direct link between the Red Sea and the Mediterranean, and the latter involuntarily became the site of the world's largest invasion of species. More than 90 fish species from the Indo-Pacific basin have thus made their way into the Mediterranean since then. But does this colonisation match their original climatic niche? To find out, French, Italian and Israeli researchers put together more than 800 scientific papers on spatial distribution in the Mediterranean and the Indo-Pacific basin, looking at 30 invasive fish species; the frequency of observation for other species was not considered reliable.
The scientists were able to demonstrate that 33% of these 30 tropical species settled outside their climatic niche, in much cooler waters (differences of up to 6°C) than in the areas where they were geo-referenced. These climatic niches now provide the basis for models used to predict biological invasions and the effects of climate change on the distribution of species. 'In a terrestrial environment, these predictive models appear reliable. In a marine environment, our results suggest they significantly underestimate the potential expansion of invasive species,' explains Valeriano Parravinci, a research lecturer at CRIOBE and the study's first author.
In fact, other than climatic niches, it would also be useful to include the ecological niches of marine species in these models. 'It is vital that new factors are integrated: currents that can carry larvae hundreds of kilometres, biological interactions and the potential competition between species,' the researcher explains. In the Mediterranean, some tropical fish species more used to fierce competition in the Pacific have not come up against many 'rivals', while others have found plenty of food. For more information

1.6.3 Ocean acidification reduces shellfish size

An international study, coordinated by IRD and Paleosofia APEMA (Italy), shows that the reduction in size observed in certain marine organisms during mass extinctions in the past could be the result of ocean acidification. The smaller size would have helped the species to survive in higher concentrations of CO_2, a phenomenon which may reoccur in the future with global warming. These results were published in the journal *Nature Climate Change* on 20 April 2015.
An international team of marine biologists and palaeontologists studied how marine gastropods (sea snails) withstand acidification in the oceans. To do so, they used natural CO_2 sources, e.g. sites of volcanic gas emission in Sicily, as test sites to simulate the modification of seawater chemistry produced in past eras and likely to reoccur in the future.

The results of their study were published in journal *Nature Climate Change* on 20 April 2015 and explain why marine species that survived previous mass extinctions linked to ocean acidification were greatly reduced in size**,** a phenomenon known as the 'Lilliput effect'. They provide compelling evidence on the impact that ocean acidification could have on marine ecosystems unless the quantities of carbon dioxide discharged into the atmosphere are slashed.

According to Vittorio Garilli (Paleosofia-APEMA, Italy), co-director of the study, 'two snail species living near CO_2 sources in shallow water were almost one third smaller than those gathered in normal pH conditions. They have adapted their metabolic rates to cope with the acidified seawater. These physiological changes allowed the animals to maintain calcification and to partially repair shell dissolution**.'**
Some snails were studied at the IAEI laboratory of environmental studies in Monaco, where their calcification rates were measured in aquariums. Riccardo Rodolfo-Metalpa (IRD, New Caledonia), the study's other director, explains: 'these organisms have developed an astonishing capacity for calcification and resistance to shell dissolution, in pH conditions that were considered too low for calcification at all**.** The organisms, which are exposed to high levels of CO2 over multiple generations, provide clues to the changes we can expect in marine ecosystems as CO_2 emissions continue to rise uncontrollably and also explain previous mass extinctions.'

Jason Hall Spencer (Plymouth University, UK) and Marco Milazzo (Palermo University) add: 'these snails show similar variations in size as those observed in fossil organisms. What is more, the results highlight the physiological benefits of dwarfism.'

Richard Twitchett, (Natural History Museum, London) continues: "fossil archives show that mass extinctions and the emergence of dwarfism in certain marine shellfish have been repeatedly linked to previous episodes of global warming. Similar changes will probably affect an increasing number of marine ecosystems, especially given the speed at when ocean acidification and warming are occurring.'
Jason Hall Spencer concludes: "it is vital that we develop understanding of the mechanisms that help certain species survive when exposed to very high levels of CO_2, because gas emissions are already having negative effects on marine trophic networks and threatening food security.'
To find out more

And in the future?
IRD will endeavour to encourage the emergence of multidisciplinary projects that tackle scientific development issues and goals related to the oceans and consistent with the SDGs. It will put the priority on integrated research into measures designed to adapt to climate change and will promote an ecosystem approach to marine environments and their exploitation. The Oceans department will help construct evolution scenarios for socio-ecosystems, taking into account climatic and environmental risks and pressures on renewable resources. It will support the modelling work being done at the interface between physical, ecological, economic and social sciences to assess the evolution of marine ecosystems and their exploitation against a background of global change. A new ICL will be founded in Vietnam in 2016 to study relationships between the environment and communities (SEDES – Services from delta coastal waters and their sustainability).

2. Partnerships and innovations

2.1 IRD across the world

IRD's international network, comprised of representations, observatories, ICL and young affiliated teams, is unique in its long-term presence in the Global South and in its in-depth knowledge of research fields and partners. It guarantees reliable, high quality research, conducted jointly with partner countries and forming part of those countries' priorities.

In 2015, IRD's governance was completely overhauled and now firmly intends to refocus on its original purpose: research excellence for 'development'. Interdisciplinary research, in close collaboration with local partners and ultimately aimed at 'development', helps tackle the contemporary challenges faced by societies in the Global South and North. This kind of research endeavours to facilitate closer relationships between scientists, policy-makers, civil society and economic stakeholders. In line with the principles of France's scientific diplomacy, the aim is also to establish a partnership 'for the long term, respecting the identity of all parties and based on the principles of co-learning [...], co-design, joint planning, joint coordination, joint production, co-publishing, joint promotion, joint evaluation and of course, as far as possible, co-funding.'[10]

This vision goes hand-in-hand with a new international partnership approach, applied consistently with other French academic and research establishments.

Key figures

- **IRD is active in nearly 90 counties.**
- **A network of 30 representations abroad and in the French overseas territories**

Focus on the 2030 Agenda for Sustainable Development
IRD was present at the Conference on Financing for Development in Addis Ababa in July, at the international conference on 'Our Common Future Under Climate Change' in Paris, at the United Nations Sustainable Development Summit in September, and at the Paris Climate Change Conference (COP 21) in December. It was active throughout the year, working alongside its partners to promote the voice of science in the international governance of sustainable development.

Contributing to French scientific diplomacy and policies on aid for development
IRD was a stakeholder in the processes that led to the joint policy paper from the French Ministry of Foreign Affairs and International Development (MAEDI) and the Ministry for National Education, Higher Education and Research (MENESR): Development through research: France's ambition for scientific diplomacy. At the end of 2015, a new framework agreement was signed with the French development agency (AFD) to work with them to coordinate actions for implementation of the sustainable development agenda. IRD also strengthened its ties with Expertise France and with the French diplomatic network, at governance level and also through its representations.

Improving IRD's positioning and that of research for development in the EU
IRD has assured its European partners of its commitment to coordinate research focused on development of the Global South. 17 projects were funded as part of the first round of calls for Horizon 2020. In Senegal, the EU delegation commissioned IRD to conduct a prospective study to support Senegal and the EU's joint plan. To this end, a group of 30 researchers from Senegalese institutions and IRD will be put together.
Similarly, the Societies and Globalisation department won a call for tenders from the European Commission's General Directorate for Development and Cooperation (DG DEVCO). This will call on IRD's scientific expertise in sensitive contemporary issues linked to the Sustainable Development Goals.
IRD offers support in mounting H2020 and Europeaid projects The Institute also organised information days on Horizon 2020 calls for 2016-2017 in France and in Sub-Saharan Africa with workshops on mounting projects in Senegal and training for African national Horizon 2020 focal points in Ghana. Finally, IRD took part in the European Development Days, a major European event devoted to development in the Global South and a highpoint in the year, with a presentation session, a stand for the NOPOOR European project and the participation of Jean-Marc Châtaigner on the closing panel.

[10] From the report on *Development through research: France's ambition for scientific diplomacy.* MAEDI-MENESR with the participation of IRD - November 2015.

Closer relationships with international organisations and the COPs' secretariats
IRD conducted a wide-reaching survey within the United Nations (17 agencies, funds and UN programmes covered) looking at the governance of the UN system and the links between development actions and humanitarian interventions. The first round of results was presented to the Secretary General of the United Nations and the agency heads in New York in November 2015. It could inspire changes within the UN system. In addition, an IRD researcher was appointed to one of the four vice chairs of the United Nations Convention to Combat Desertification (UNCCD) Bureau of the Committee on Science and Technology at the Conference of Parties (COP) held in Ankara in October 2015.

Strengthening ties with NGOs
Practical actions were undertaken in 2015 to strengthen partnerships with NGOs. In November 2015, the seminar on 'Humanitarian Transition and Ethical Debates in Côte d'Ivoire: What Visions and What Perspectives?' was organised jointly by the French Red Cross Fund, the French Ministry of Foreign Affairs and International Development (MAEDI) crisis unit and IRD in Abidjan.
In New Caledonia, the Oreanet project, a participatory network to fight acanthasters, a type of starfish that preys upon coral, received financial backing from the New Caledonian government and the French Ministry of Foreign Affairs and International Development (MAEDI) in 2015. This will help it extend its action across the region. In addition, an agreement was signed with NGO ENDA-Third World in Senegal.
IRD also takes part in the Convergences forum, a platform for thought, action and advocacy in Europe to develop a Zero exclusion, Zero carbon, Zero poverty world.

IRD and science in the French-speaking world
Although English tends to dominate in scientific discussions, in 2015 IRD actively contributed to the visibility and vitality of the French language. Ties have been strengthened with the University Agency for Francophonie (AUF) and the International Organisation of Francophonie (OIF), and with countries in the French-speaking world, such as Haiti.
A three-way agreement with the AUF and the Egyptian Science and Technology Development Fund was signed in Egypt. This will enable e a call for projects in 2016, targeting Egyptian, Lebanese, Jordanian and French researchers. Different topics will be covered: Water and water technology, renewable energy and green technology, health, and human and social sciences.
In Haiti, the AUF and IRD have been involved in various projects including support for the Haitian doctoral college (CDH). The initial evaluations of the laboratory sessions held in 2015 have helped promote a culture of research evaluation in Haiti. The CDH was founded in late 2011 and brings together 3 Haitian establishments (Haiti State University, Quisqueya University and Haiti Superior School of Infotronics).

And in the future?
IRD will continue to promote scientific ties between French-speaking Africa and English-speaking Africa, and will bring new impetus to cooperation with the OIF and its Member States by taking an active role at the summit to be held in November 2016.
The European dimension will feature at the heart of IRD's new strategy with a stronger European Affairs department and new representation in Brussels. This department will structure its action so that it can influence European policy on research and development in the early stages of its definition, incorporating the context of the 2030 Agenda and the work programmes of the main General Directorates (DG RI and DG DEVCO). By clearly pinpointing the research priorities likely to interest IRD researchers, calls for projects can be identified early on while providing consolidated aid when mounting European projects. There will be more mobilisation and reinforced training for researchers on the subject of ERC grants to increase the number of individual applications submitted. IRD will also position itself with regard to new partnership tools such as ERANET COFUND, the JPI and article 185 of the EU Treaty.

2.1.1 Latin America

The IRD's work in Latin America is mainly focused in the Andes and the Amazon, on a continent where countries all have very different levels of development. The IRD's network in the region comprises 8 representations and a dense and varied set of scientific partners (universities and public research institutes). In this region, IRD's research mainly explores hydroclimatic variability at regional level in the past and the present day, Andean geosciences, oceanography, aquatic and land biodiversity, food security, environmental quality, health and the social sciences.

IRD, a major stakeholder in South-South-North cooperation
A seminar on South-South-North cooperation was held in Brasilia in October 2015 in conjunction with the project to support bilateral political dialogue on science and technology among EU Member States and Brazil (B.BICE+), coordinated by IRD. This seminar brought together representatives from South Africa, Brazil, Europe, Argentina, Namibia and Angola. A joint declaration on cooperation between Brazil and South Africa was signed at the end of the gathering. The Brazilian and European partners presented the PIRATA oceanic observation programme - Prediction and Research Moored Array in the Tropical Atlantic – coordinated by IRD as a model of South-South-North cooperation.

The long migration of Amazonian cat fish finally decoded
By comparing the isotopic ratios of strontium in the Amazonian rivers and in the otoliths of the large Amazonian catfish, Brachyplatystoma rousseauxii, biologists from the ICL-EDIA (Evolution and Domestication of Amazonian Ichthyofauna), the Amazonian Ichthyofauna research network (RIIA), and hydro-geochemists from SNO-HYBAM have demonstrated that this fish follows the longest migration known in freshwater (> 8,000 km return): it is born in the rivers at the foot of the Andes, migrates to nurseries near the Amazon estuary on the other side of the continent and then returns to the reproduction areas in which it was born (natal homing*). This extraordinary life cycle is now jeopardized by the development of hydropower dams in the Amazon basin. A considerable fall in the populations of this apex predator could have serious consequences on the ecosystem through a system of trophic cascades, but also for human populations in the Amazon because the species is an important fishing resource.

Slip without earthquakes in the northern Andes
Over the last fifteen or so years, the development of GPS networks in subduction zones has identified slips where no significant earthquake has occurred: these are known as 'aseismic slip transients'. A team of geodesists and seismologists from Géoazur (CNRS, UNS, IRD/OCA) worked with French and Peruvian

partners (Peruvian Geophysics Institute) to observe a process in northern Peru where seismic activity and aseismic slips interacted in a complex manner over several months. This is the first time that a mixed seismic/aseismic process has been observed, with the two forms of slip seemingly interacting during the sequence. The various types of slip provide information on the different types of friction occurring along the interface between plates and illustrate the variety of behaviour at different points on the subduction interface. The study suggests that similar processes could contribute to easing a signification portion of stress, especially in subduction zones with similar characteristics to those in northern Peru. This work was published in Nature Geoscience.

An autonomous underwater vehicle to explore 2015's el Niño
In 2015, following the development of an intense El Niño event in the equatorial Pacific, IRD and IMARPE (Peruvian Institute of the Sea) launched the CIENPERU observation programme in Peru. Its aim is to develop better understanding of the impact of an El Niño event in Peru's coastal region, which is one of the globe's most productive marine ecosystems. As part of this programme, several operations were carried out such as the fitting of sensors (temperature and salinity) at several fixed points along the coastline and the deployment of drifting oceanographic devices (ARGO floats) off the coast. In addition, an autonomous underwater vehicle (glider) was launched with support from the INSU/CNRS technical division, and used to collect high spatial resolution hydrographic and biogeochemical parameters (e.g. oxygen and chlorophyll) over four months. These measurements were taken in addition to the regular monitoring of oceanographic conditions by the IMARPE and form a valuable database to help better understand how this unique marine environment functions. The CIENPERU programme is based on several activities developed by the DISCOH (Dynamics of the Humboldt current system) ICL, the main framework for multidisciplinary research conducted by IRD in partnership with the IMARPE over the last decade or so.

Launch of an exhibition of the future of our cities
The exhibition entitled Yo soy la nueva ciudad invites us all to think about the future of our cities and how to build them differently. It is based on IRD's work on urban planning, conducted in partnership with its Mexican partners and most notably the UNAM (National Autonomous University of Mexico). Since its inauguration at the UNAM's Unversum (science museum), the exhibition has travelled to many other cities and sites such as Campeche, La Paz, the Mexican Senate and Panama. It has even been translated ready to show in France, so that a wider public can reflect on their city.

2.1.2 Asia

IRD has been present in South East Asia since 1976 and has four representations there. Research is conducted on a partnership basis and tackles a wide array of topics such as agriculture and environment, biodiversity, aquaculture, health, geology and so on.

Exploring biodiversity
After the 2014 Lengguru expedition, the biggest scientific expedition ever led in Indonesia, work to exploit the data collected began in 2015. The expedition also resulted in a travelling educational photography exhibition in France and Indonesia, entitled The Lost World of Lengguru, a scientific expedition to West Papua, and an initial paper on the discovery and description of four new orchid species.

Images from the interior of Indonesian volcanoes
In April 2015, as part of the DOMERAPI project, IRD teams and their Indonesian colleagues completed a large-scale seismic tomography experiment. Over 18 months, approximately fifty seismometers, placed in the region surrounding the Merapi and Merbabu volcanoes, continuously recorded regional seismic activity, which is frequent in this subduction zone. This information on the source of magma supply is crucial in understanding the origin of eruptive phenomena at regional level. As part of a partnership with Bandung Institute of Technology, this work is now producing the first images of the internal structure of Merapi and images – though still very limited at high resolution – of the internal structure of an andesite volcano.

Vast measurement campaign in Vietnam
As part of the ANR COASTVAR (Multi-scale and multi-method study of coastal variability in the Gulf of Guinea and Vietnam) project, an intensive measurement campaign was run on Nha Trang beach in Vietnam from 27 November to 5 December 2015. The goal was to use innovative technology to quantify the natural resilience of the Vietnamese coast to the combined pressures of natural hazards such as typhoons and growing anthropisation. The team in the field was made up of 24 French and Vietnamese scientists.

IRD at the heart of international events in Thailand
At the Regional Forum on Climate Change held in Bangkok from 1st to 3rd July 2015, IRD presented its research work on the 'French expertise' stand which it helped to organise with Cirad and the AFD. Several IRD researchers recognised internationally for their work on climate change spoke about their research during oral presentations in the scientific sessions or presented it on posters at the side events.
To coincide with the International Year of Soils, IRD also co-organised the International Soil Conference in Petchabury from 18 to 21 August. The conference brought together more than 400 researchers.

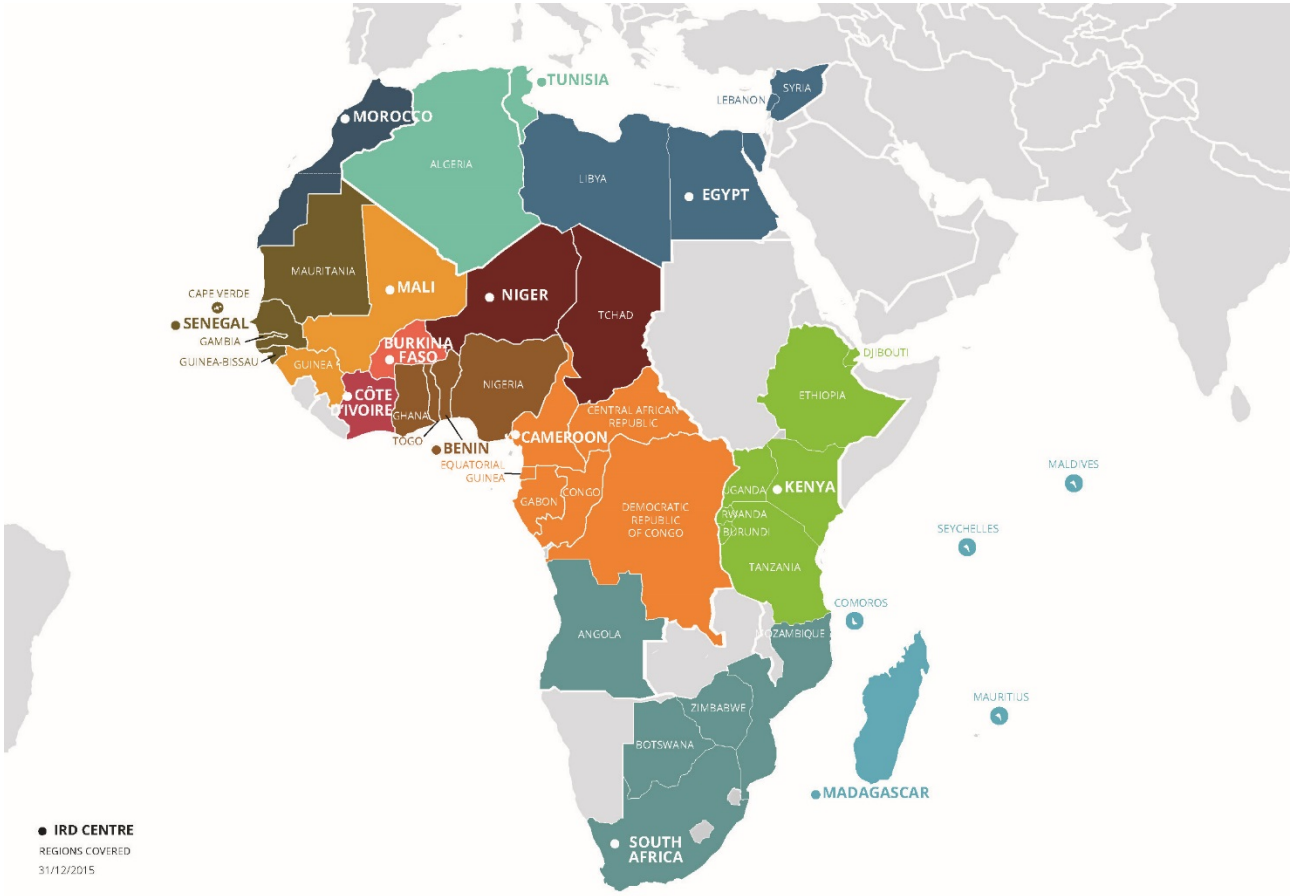
A symposium on Ethics in Research for International Development
Organised by IRD's ethics and professional conduct advisory board and the Vientiane University of Health Sciences, this symposium was open to IRD researchers and their partners and was held in Laos on 26-17 October 2015. It brought together more than 230 people.

Botanical research in tropical Asia
A symposium on botanical research in tropical Asia was held from 6 to 11 December 2015 in Vientiane (Laos), after similar events on 'Flora in Cambodia, Laos and Vietnam' in Phnom Penh in 2008 and Hanoi in 2010. This event boosted North-South cooperation for the study of tropical flora. The participants came from several tropical Asian countries and shared their expertise in various fields such as taxonomy, plant systems, phytochemistry, biogeography, ethnobotanics and conservation.

2.1.3 Africa and the Mediterranean

As is the case for French policy on aid for development, Africa and the Mediterranean are priority regions for IRD.

The Sahel Maghreb research and training platform takes shape
Driven by the vision of an extensive Sahel-Maghreb research, training and innovation scope powering economic development and ensuring the security and well-being of populations, the Sahel Maghreb training and research platform (PSM) has been devised as a major coordination tool for the 2030 Agenda and its SDGs. The workshops organised in September and November 2015 set down five priority scientific areas and one cross-disciplinary component for capacity building. These areas form the platform's foundations. On the French side, it will be developed by IRD together with Cirad and the AFD.



Regional cooperation on water and the environment in the Mediterranean region

The Cesbio unit in Tunisia has introduced an innovative method for analysing water requirements and actual consumption in the main agricultural plains. Remote sensing provides access to spatialized estimates of evapotranspiration from surfaces, and can thus be used to estimate water withdrawals over large surface areas. This work was included in the 'best student papers' at the International society for optics and photonics (SPIE) conference in 2015.

In addition, 34 Tunisian, Moroccan and Algerian auditors took part in the winter school organised by IRD in March 2015 in partnership with the National Institute of Agronomics in Tunis (INAT) and the Tunisian National Institute for Research on Rural Engineering, Water, and Forests (INRGREF) on the theme of 'Observation techniques and analysis approaches for water management in Mediterranean agricultural watersheds'.

Finally, the Lagunotox project has led to the installation of passive sensors to detect the presence of toxins caused by the proliferation of phytoplanktonic algae in the southern Mediterranean lagoons and especially Bizerte (Tunisia), Nador (Morocco) and Mellah (Algeria). This surveillance network will let decision-makers establish a balanced management policy for the lagoons concerned by these episodes of algal bloom.

Research as part of C2D contracts in Côte d'Ivoire

In 2015, IRD was entrusted with the coordination of four sub-components of the higher education and scientific research programme making up the second phase of the debt reduction and development contract (C2D) in Côte d'Ivoire for 2016-2019. One sub-component is designed to support relevant research projects for social and economic development in Côte d'Ivoire, one takes 'Expert group review and promotion' as its theme, one is entitled 'Support for the creation of a research observatory' and one 'Support for the strengthening and creation of PhD schools'. This comes on the back of a very positive review of IRD's work during implementation of the research capacity building component in the first phase of the C2D (2014-2017).

Greater presence in Mali

The Nutripass joint research unit in Mali is running an evaluative research programme on the nutritional impact of social transfers via two projects headed by the Malian government with a number of international partners including the World Bank, Canadian Cooperation, the World Food Programme and Unicef. This evaluation work, implemented in partnership with the International Food Policy Research Institute (IFPRI) in several regions of Mali, led to several innovations including the use of remote supervision of areas that IRD

was unable to visit for security reasons: data was collected by local interviewers using the telephone network and tablet computers, and checked every day. Feedback was then provided to the interviewers over the phone.
IRD's presence in Mali has been strengthened via the partnership with the Applied Molecular Biology Laboratory (LBMA) for the development of groundbreaking biotechnological tools for the characterisation and epidemiological surveillance of diseases affecting rice and cassava. This work led to the creation of the CoANA (Coalition against agricultural pests) team of young researchers affiliated with IRD.
In addition, the network for the fight against helminths and their effects on public health (RELACS), funded by the Parraf programme, was involved in the Malian programme to fight neglected tropical diseases (NTD) and the management of the side effects of Praziquantel, a drug widely used to treat bilharzia. RELACS is also involved in the sub-regional project for integrated malaria and NTD control.

New partnerships in Senegal
An agreement has been signed with the Council for the Development of Social Science Research in Africa (Codesria), an independent organisation whose main goal is to facilitate research, promote publications based on research and create forums in which African researchers can share opinions and information.

A move towards a marine institute for Africa
After a positive evaluation by a joint external commission, the ICEMASA[11] ICL was renewed for five years in South Africa. Its impact on the development of human capital through its Master's and PhD courses has been acknowledged. The programme focuses on the study of physical processes on various scales from local to ocean basin, as well as ocean bio-geochemistry, climate interactions and the impacts of global changes on marine ecosystems. It is already part of a regional network with several institutes from neighbouring African countries such as Mozambique, and European stakeholders such as Norway's Nansen-Tutu Centre for Marine Environmental Research. In the long term, the laboratory intends to set up an international marine scientific institute for Africa. In November 2015, Cap Town University and IRD signed a letter of intent for the creation of this institute.

2.1.4 Overseas

Accounting for 97% of the French maritime area and 84% of French biodiversity, the overseas territories are of major significance for France and IRD. With its overseas territories, France is closely involved in other regions of the world such as South America and the Caribbean, the Indian Ocean and the Pacific.

[11] *International Centre for Education, Marine and Atmospheric Science over Africa* (http://www.icemasa.org/).

- **IRD CENTRE**
  REGIONS COVERED
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Several oceanographic missions in the Pacific
L'Atalante is a multidisciplinary research vessel that serves as a working platform. It set off from Hobart (Tasmania) and sailed the Pacific from February to October 2015 for four scientific campaigns, bringing together between 20 and 30 researchers of different nationalities.

- Outpace (Nouméa-Papeete, 18 February-3 April 2015): 45 days to study the South Pacific's capacity to capture CO_2 via micro-algae;
- Vespa (Nouméa - Nouméa, 22 May-17 June 2015): 27 days to determine the nature, structure and origin of the Loyalty Ridge by acquiring geophysical data and rock dredging;
- Cassiopée (Nouméa-Nouméa/equatorial region and the Solomon Sea, 18 July-24 August 2015): study of deep equatorial oceanic currents (1,000 m or more) and recovery of moored instrument packages installed since July 2012;
- Tecta (Nouméa - Nouméa, 2 September-10 October 2015): 39 days to study a major tectonic event having affected the South West Pacific 50 million years ago by acquiring geophysical data.

Studying sharks off Reunion Island
Headed by the Institute since late 2011, the 'Knowledge of the ecology and habitat of two shark species' (Charc) programme reported its results in February 2015. This was the first scientific study conducted on Reunion Island focused on bull sharks and it helped identify certain key factors that influence the presence and spatial distribution of these little-known sharks around the island. All the data and results from the Charc programme were handed to the public authorities to help with measures aimed at reducing risks for sea users.

Solarest: developing solar energy in Guiana
The project entitled 'Estimation and Prediction of solar radiation by processing satellite images to improve photovoltaic energy penetration rates in Guiana (Solarest)', run by the University of Guianan and IRD in Cayenne, reported its results in November 2015. Solarest helped develop knowledge and methods using

satellite images and mathematical models to estimate the amplitude and dynamics of solar radiation reaching ground level. It has opened the way for the establishment of an expertise hub bringing together stakeholders in research and the private sector to press ahead with solar energy development and to export this expertise to neighbouring countries.

2.2 IRD inspiring change

Protecting the planet and ensuring humankind's survival will depend on our joint capacity to invent a future that reconciles economic performance with social and environmental issues. The convergence of these sometimes contradictory interests calls governance models and the conventional 'development methods' into question. It overturns the prevailing analytical frameworks and forces us to come up with radically different technologies, products and lifestyles.
Against this background of profound upheaval, research for, with and by countries in the Global South has one clear responsibility: helping to understand the phenomena at work, their interactions, their implications and the levers for transformation. Academic research can play a major role in analysis and interpretation, but also in establishing new development models and the related innovation processes.
Research, technology and innovation (mentioned in SDG 9[12] and 17[13]) will be crucial in honing these new production methods and new ways of living together. Now, more than ever, academic research has to draw on innovation to help open up new avenues for sustainable development.

IRD is a driving force when it comes to managing the current changes, by:
- encouraging multidisciplinarity to understand complex phenomena and inform decisions about the challenges and possibilities for sustainable development in the Global South;
- mobilising researchers for education and strengthening research communities in the Global South;
- putting its research to use to spur innovation (technologies, products, production methods, etc.) by actively promoting results and through open and collaborative co-creation in partnership with the civil and corporate worlds.

It is vital that the findings of research are turned into solutions to achieve a sustainable future.

Key figures

- **94 agreements signed with the private sector**
- **Revenues of €3.2 million**
- **Support for around 100 start-ups**
- **15 new Young Teams created**
- **170 study grants awarded**

2.2.1 Informing public policy and contributing to innovation

One of IRD's main tasks is to see that the findings of research are converted into innovations and development actions. The findings of development research are promoted among policy-makers (with the aimed of informing public policy) and in the business sector. This promotional work comes in many different forms, partnerships and services. These include expert assignments, awareness-raising initiatives, the protection of inventions, technology transfer, and an array of research partnerships with private partners or foundations.

Close to 100 public-private partnerships signed
With research partnerships, scientific service provision, corporate sponsorship, transfer of biological materials and confidentiality agreements, an increasing number of researchers are turning to public-private partnerships to bring their research work to fruition. These research partnerships, signed with industrials, entrepreneurs, professional associations, and corporate foundations, encompass the themes of the

[12] Build resilient infrastructure, promote sustainable industrialization and foster innovation.

[13] Revitalize the global partnership for sustainable development.

Institute's five scientific departments. In 2015, 94 agreements were signed with the private sector for a total amount of over €3.2 million.

The CarSGUY project: a research partnership to measure carbon stocks in soils
In French Guiana, the Eco&Sols unit works with 'Terres Inovia', the technical centre for oilseed crops, grain legumes and industrial hemp, as part of the CarSGUY project. It has received ADEME (French environment and energy agency) funding of €174,878 and applies an original deforestation method to assess carbon stocks in soil and look at future trends.

The APEX project: sponsorship to study sharks in New Caledonia
In 2015, the Entropie unit received financial backing from the Total corporate foundation (€100,000) and the PEW Charitable Trusts (€52,778) for a major scientific project studying sharks in the reefs of New Caledonia, in the context of the development of a natural marine park in the Coral Sea. APEX aims to improve the state of knowledge on these top predators and help set up one of the largest marine protected areas in the world.

And in the future?
In 2016, these partnerships will be stepped up, bringing the public and private researcher teams closer together and encouraging long-term collaboration.

Protecting inventions and technology transfer
As part of awareness-raising, detection and protection of innovation initiatives, five new patent applications were filed in 2015. The number of active patent families in the portfolio stands at 108. Nearly 70% of this portfolio is jointly held with other public and/or private institutions. The percentage of patents jointly held with partner research centres in the Global South is stable at around 30% of the portfolio. IRD is also shareholder in two 'technology transfer acceleration companies' (SATT).
The large majority of IRD's exploitable technologies (73 patent families and 4 other non-patented technologies) have been assigned to CVT Valorisation Sud to seek industrial partners for licence agreements. So far, CVT has formalised two agreements, including one licence agreement with the NGO *Graine de Vie*. This licence comes in addition to the others already applicable.

A licence agreement to encourage reforestation in Madagascar
After the groundwork done by CVT Valorisation Sud, 2015 saw the signature of a licence agreement with NGO *Graine de Vie* for use of technology patented by IRD, Cirad and the CNRE[14] in Madagascar, designed to recreate vegetation cover in depleted, even barren soil, relying on the ability of certain plants, known as "nurses", to stimulate the formation of the tree root system when the plants are raised in nurseries. *Graine de vie* is an NGO formed in 2009. It works to offset the carbon footprint of populations in industrialised countries by planting trees in developing countries. It employs more than 300 people, mainly in Madagascar.

And in the future?
In 2016, IRD will produce an intellectual property charter, to be discussed in the working groups made up of researchers, experts and partners.

More than 100 incubated innovative companies
More than a hundred innovative entrepreneurs of various origin receive support via the schemes devised and set up by IRD: Bond'Innov (France), iNCubateur in Nouméa (New Caledonia), Innodev incubator (Senegal), Paceim (programme of aid for innovative start-ups) and internal support for spin-off activities.
To increase this number, IRD promotes North-South networking of support structures (incubators, special programmes, etc.) around the initiators of innovative business projects focused on markets in the Global South.

Supporting the creation of innovative businesses in the Mediterranean
Paceim mobilises the expertise of scientific and technical diasporas in France with the ambition of supporting the start-up of a hundred or so innovative businesses in Algeria, Morocco, Tunisia and Lebanon. The IRD leads this programme in partnership with around fifteen institutions to the South of the Mediterranean. Last year saw a third group (28 beneficiaries) received backing via Paceim, while the Technopolis group reported back on the outcome of the scheme at the fifth steering committee meeting held at the French Ministry of Foreign Affairs and International Development (MAEDI) in Paris.
To date, Paceim encompasses 86 projects, with 32 start-ups created and a dozen currently being established. The launch of the fourth and final call for projects is planned for 2016. Negotiations are now underway for the construction of a wider scheme covering Europe and Africa.

Promoting research and raising awareness about innovation in Côte d'Ivoire
As part of the debt reduction and development contract (CD) signed by France and Côte d'Ivoire, IRD is contributing to the modernisation and reform of universities and *grandes écoles* in Côte d'Ivoire via the AMRUGE programme. In this respect, it leads training actions designed to promote research and reinforce innovation capacities, working hand-in-hand with the Ivorian Ministry for Higher Education and Scientific Research. In 2015, an initial training cycle was introduced for around fifty beneficiaries, after which a dozen 'promotion correspondents' were appointed in each of the Ivorian academic institutions and had the opportunity to work in immersion within the French ecosystem.
With their new expertise, these correspondents will be able to roll out promotional initiatives in their institution and raise awareness among their scientific community (researchers and students). Promotion units may be set up in the universities and research centres in the long term. Work on this component will continue over 2016.

And in the future?
In 2016, work to raise awareness of innovative business creation will be stepped up for research teams. These initiatives will form part of an Innovation Campus project at the Bondy site. Special focus will be given to training and support schemes for young researchers and project initiators. North/South exchanges will be keenly encouraged and there will be specific support for actions involving diasporas.

Expert input based on scientific evidence
In 2015, an expert group review was set up on 'Deep-sea mineral resources in French Polynesia', commissioned by the French Polynesian government and the French state government. Over the year, the

[14] *Centre* national de recherches sur l'environnement

multidisciplinary and multi-institutional panel of experts met three times to utilise and synthesise the available information in the areas of anthropology, economics, the environment, law, geoscience and technology in order to provide input for public policy-making. In addition to the 24 detailed contributions and related mapping, the panel of experts produced a clear and accessible summary report and an executive summary, together with nice consolidated recommendations. The work will be published in 2016 and distributed at the public information session to be held in Papeete in May.
The social science research teams were heavily involved in consulting activities for institutions over 2015, responding to calls for bids (around 20 calls from EuropAid, AFD, United Nations, etc.) and requests from public authorities and private businesses.
Other reports produced in 2015 include 'in-depth analysis of data on poverty and the job market in Burundi' from a team in the Dial unit, for the Burundi government with funding from the African Development Bank.

And in the future?
In 2016, there will be further efforts to promote researchers' skills and expertise among public stakeholders. The goal is to raise the profile of this role as 'advisors to policy-makers', which is increasingly in demand. Expanding the expertise offering and focus on external funding.

2.2.2 Strengthening research capacities

Capacity building is a cross-cutting task that involves all the Institute's scientific activities. It is based on the belief that development requires stronger scientific communities in the Global South while mobilising research to the benefit of educational excellence and innovation, a belief that lies at the heart of sustainable development dynamics The Institute has therefore set up teams of researchers who work alongside their partners to help strengthen the countries' capacities to train students, structure research teams, produce and disseminate knowledge and innovations that will serve development.

In 2015, this task resulted in a series of grants for researcher training, team-building, and the mounting of educational and training programmes.
IRD has continued its work in training for research via a number of programmes.
Support for PhD students remains crucial. In 2015, 29 ARTS[15] bursaries were granted. For researchers, engineers and technicians already embarked upon a scientific career, 17 new BEST[16] training grants were awarded.
Support for emerging teams in developing countries is also vital to increase our partners' autonomy and international competitiveness. As such, 15 new teams were selected as part of the JEAI programme for young teams affiliated with the IRD. A training workshop bringing together all the teams receiving backing in Maghreb was held at the Tunis Science City in September 2015. There, Professor Ahmed Djebbar, a mathematician and science historian, ran a conference open to the public on the history of science in the Arab world and their role in intercultural exchange and activities.
To strengthen France's efforts in scientific cooperation, IRD joined up with other partners with the same objective for training in the Global South. IN2P3[17] and the Mérieux Foundation have appointed IRD to manage their support services for PhD students in the Global South. Seven new thesis projects received backing in 2015. IRD and the UPMC[18] ran the international PhD programme on 'Modelling complex systems', which selected 10 new PhD students in 2015. In Peru, 8 students from the Franco-Peruvian Doctoral School of Life Sciences received a grant. IRD and the AFD took part in the social sciences summer school in Danang in Vietnam in July 2015. The theme was 'Shared development issues in the ASEAN[19]: analysis method and application'.

These actions and partnerships now form the historical basis for IRD's actions and capacity building work. Reflection work is underway to look at how this capacity-building task can be repositioned while improving the way it is implemented, so that we can capitalise on the work already done.
IRD fully intends to get further involved in producing educational content through university programmes (Master's courses) or shorter courses (summer schools) devoted to sustainable development issues. Building knowledge on development is crucial if communities in partner countries are to take on-board and disseminate the findings of research. These projects will need to draw on the energy and expertise of all the

[15] Research scholarships for doctoral research in the Global South

[16] Scientific and technology exchange grants (BEST)

[17] Institut national de physique nucléaire et de physique des particules (French Institute for Nuclear and Particle Physics).

[18] Université Pierre et Marie Curie.

[19] *Association of Southeast Asian Nations.*

students and researchers who have received training from or worked alongside IRD. Identification work has begun to enable the development of an 'alumni' network that will enhance the IRD community's human potential.

Two regional Master's courses developed in 2015

Together with Montpellier University, 8 European and African universities and the AUF[20], IRD is involved in a regional project for a Master's in 'Water resources and environmental risks in African cities' run jointly by universities in Benin, Cameroon and Côte d'Ivoire

With four universities and the AUF, plus support from the Gabon agency for national parks, IRD is also working on the development of a Master's in the management of marine and coastal environments in Cameroon and Gabon

The 'Marseille international campus', designed to bring together academic stakeholders to make a scientific contribution to the agenda on sustainable development goals, is another aspect of this task. It was launched in 2015 with the organisation of a summer school on SDGs involving Aix-Marseille University, the AFD and support from the local authorities.

IRD also began work to redefine the terms of its intervention and ensure better coordination between the various capacity building tools. The goal of this pilot phase in the programme to support the creation of regional Master's courses is to strengthen the dissemination of the findings of research in countries in the Global South while working, right from the design stage, on the courses' educational and scientific components, including the use of innovative, distance-learning tools. The diversification of services also includes short courses to help researchers from the Global South promote their findings. In 2015, a two-week course gave 30 researchers from the Global South the opportunity to draft their projects, develop an expertise offering and learn more about media relations.

[20] University Agency for Francophonie

3 Dynamics and communities

3.1 Moving forward, driven by new ambitions

IRD's reorganisation
Since the new governance established in March 2015, IRD has changed its organisation and held a wide-ranging review that is reflected in a strategic plan to be adopted in 2016.
The new organisation, approved during the board meeting held on 10 July 2015, is based on three divisions:

- a Science division headed by CEO, Jean-Paul Moatti;
- a Development, Global Issues and Partnerships division headed by Deputy Executive Director, Jean-Marc Châtaigner;
- a Support for Research and the International Scientific Community division headed by General Secretary, Bruno Acar.

The decision to create these three divisions comes in response to several goals:

- placing the Scientific division at the centre of the organisation, as is to be expected in a public scientific and technical research establishment (EPST) first and foremost focused on research;
- giving the main global issues greater consideration within the organisation while improving the structure of IRD's partnership strategy to the benefit of the human development agenda;
- bringing all the resource functions together in a single Support division.

These three divisions continue to work closely together to anticipate the research structures' requirements and the specific aspects of their operations in Southern countries.
Support for research and the international scientific community: new challenges and new tools
Consolidating the resource functions and optimising the quality of service provided to researchers and partners is a major challenge for IRD. It means creating the conditions required to coordinate and manage the resources that support research and enable the Science and Development divisions to refocus on their core activity, while recognising and endorsing management functions within the establishment overall, and supporting the changes required as the IRD presses ahead with its new ambitions.
To better meet the requirements of research for development, IRD redefined its main operating procedures in 2015 in order to:

- better contextualise its action and adapt the application of rules to multiple, changing realities;
- place cross-functionality and a culture of teamwork at the heart of IRD's operating procedures;
- forge close relationships between head office and laboratories, line management and agents, and expatriates and local partners;
- make the operating procedures more flexible and responsive.

As such, a principle of subsidiarity has been applied, with three goals: repositioning the head office to steer scientific activities, rethinking the devolvement process and bolstering the first level formed by the units.

3.2 Accompany, secure and promote individual career paths

Key figures

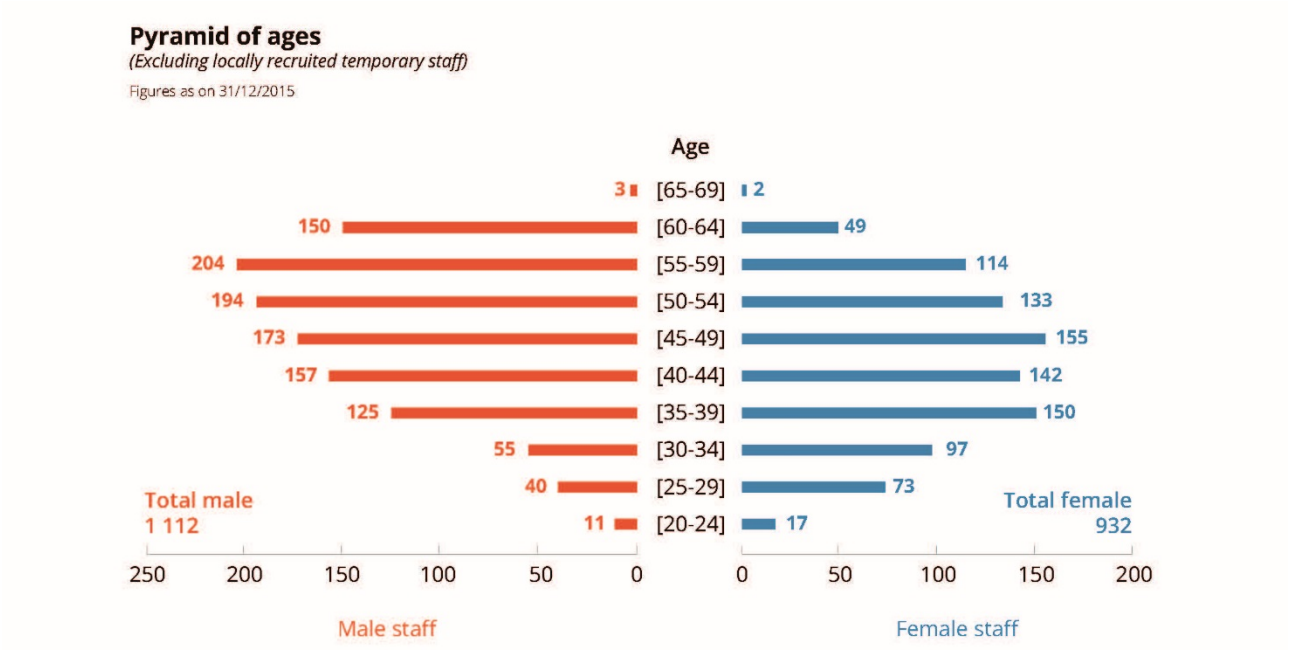
- **10 engineer and technician competitive selection sessions held**
- **20 researcher positions opened**
- **19,198 movements including 113 departures on postings and 166 long-term assignments**
- **38 International Volunteers in Administration (VIA) taken on**
- **15 post-doctoral researchers taken on**

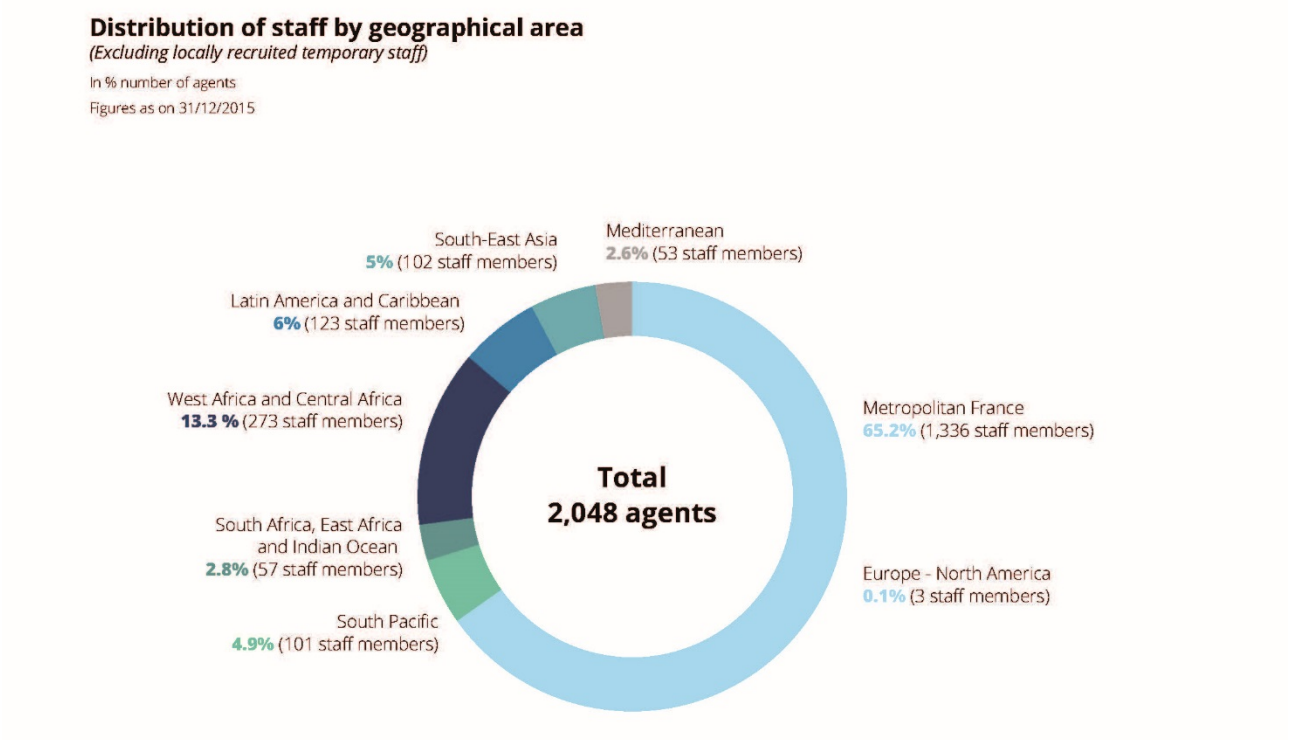
Recruitment
In 2015, ten engineer and technician competitive selection sessions were organised, mainly for 'research' functions within the units (6 out 10 positions). Twenty researcher positions were offered via competitive selection (10 CR2 research associate positions and 10 DR2 research director positions) in all disciplines represented within the Institute.

Training
The development of cross-cutting expertise was continued, with managerial capacities for top-level and intermediate supervisory roles, project management and training in how to chair meetings. In addition to the cycle for young researchers through research partnerships, innovative actions for the scientific community focused on educational design expertise, including distance learning and a seminar introducing MOOCs. The development of professional expertise led to new actions with training on state regulations, how to respond to a EuropeAid call for projects, how to manage a EuropeAid grant agreement and ERDF financial arrangements.

Employment policy
A new agreement on the employment of disabled workers for 2015-2017 was signed by the FIPFHP disability organisation and IRD. Through this, the Institute can continue the actions undertaken to facilitate the integration of workers with disabilities and adapt working conditions for agents with health issues.
To improve the support available for agents who are expatriated or on extended assignments, a partnership with a new assistance firm – ISOS – will give staff access to support in crisis situations and help raise awareness on how to avoid hazardous situations.
On the question of work-life balance, the IRD AOS agreement has been extended for a year pending negotiations. After a call for tenders, the holiday voucher benefit scheme has been reintroduced.

Professional equality is an important issue for the Institute, in particular in terms of partnerships with developing countries. It is part of a national policy where the public sector has a duty to set an example.





3.3 Careful resource planning

Key figures

- **Annual budget €234,5 million**
- **Expenses €232,916 million**

Research the focus of the budget strategy

Although the national financial and budgetary context is ever more restrictive, meaning a reduction in the Institute's SCSP subsidiary[21] of approximately €640k compared to 2014 (down 0.31%), research benefited from additional contributions in 2015 with a €1 million bonus to meet the units' operating and local recruitment requirements. A sum of €250k for scientific equipment was also allocated to the research units.

A specific allocation of close to €100k for forecasting requirements in emergency situations (post-earthquake studies or other natural catastrophes, etc.), thereby strengthening IRD's capacity for response in crises where multidisciplinary teams need to be mobilised rapidly.

Scientific infrastructures benefited from sustained efforts. These were primarily targeted at the finalisation of operations such as OceanoMed for an amount of €300k to group the MIO laboratory (Mediterranean Institute of Oceanology), the Pytheas joint service unit and all the oceanography resources together at the same site to create a centre of excellence for fundamental and applied oceanographic research. 2015 saw the start of the next phase of the CPER[22] (2015-2020) for which IRD is committed for an amount exceeding €2 million for the period in question. Within the framework of this plan, the Pangee-Lafara operation has been launched to modernise the geochemical and isotopic platforms at the Midi-Pyrénées Observatory (€150k contribution from IRD for 2015).

Investing on behalf of the research environment

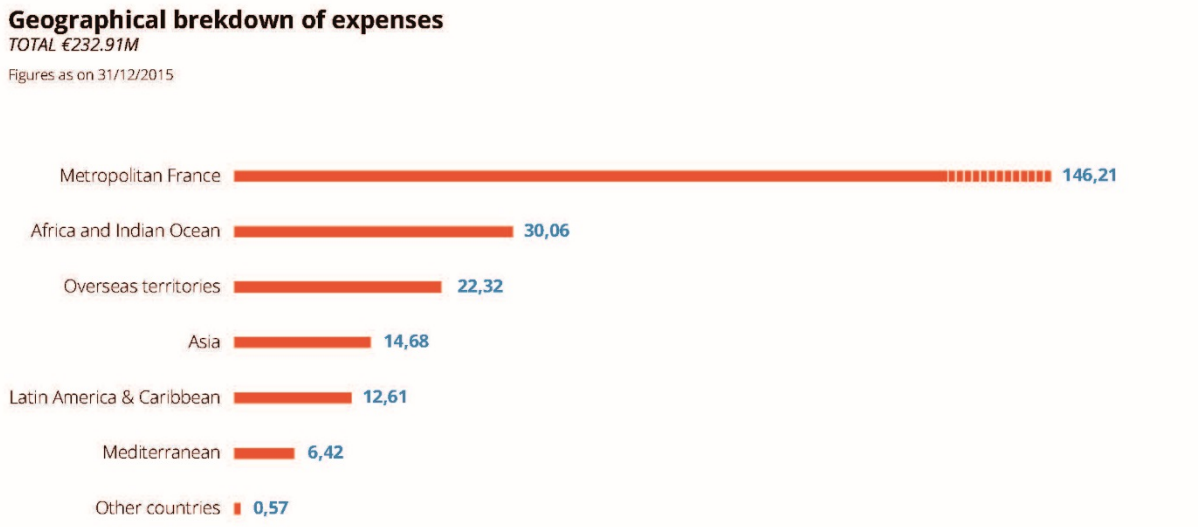
The multi-annual real estate strategy scheme (SPSI) 2012- -2015 continues to be applied. With an authorised €4 million commitment in 2015, with €3.2 million of that used in credit appropriations, the fund enabled the completion of work to resolve issues at sites where there were high risks for personal safety and the security of property, including asbestos removal work at the Guyana centre, energy efficiency work at various sites and work to improve access.

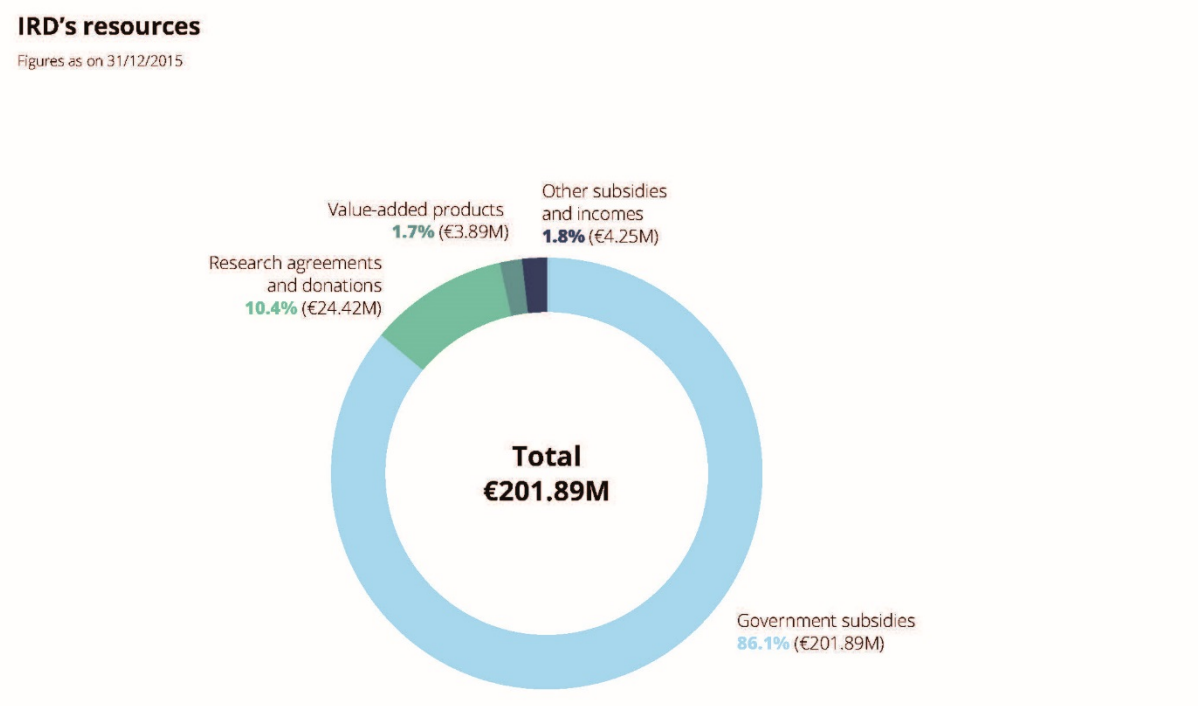
[21] Public service grant

[22] Contrat de plan Etat-Région – Government-Region Planning Contract.

The telecommunications and information systems master plan (SDSIT) saw the commitment of more than €1 million for continuation of necessary modernisation work in all IRD strategic fields (research, partnerships and management, with a view to pooling and modernising tools at research unit level).
The plan to renew and modernise the vehicle fleet, launched in 2013 for a three-year period, recoded expenses of more than €1.1 million in 2015. This plan was drafted to comply with ministerial recommendations and, beyond that, with the goal of improving and securing conditions for scientific research in countries in the Global South. With a view to rationalising costs and improving service, the fulfilment of this investment plan takes place within the scope of a framework agreement for procurement in the Mediterranean and Sub-Saharan Africa.

Financial statement
Net income for the year came to €234.474 million with expanses amounting to €232.916 million. Funds received correspond to a € 201.898 million government subsidy (SCSP) (i.e. 86.1% of total income), research contracts (24.428 million, i.e. 10.4%), services provided and other income (€8.149 million, i.e. 3.5%). The payroll represents €168.077 million, €25.27 million of which is expatriation or away-from-home allowances, i.e. 72.16% of expenses. Research unit expanses amount to €146.795 million, i.e. 63% of the resources used in 2015.





3.4 A new information system for the new ambitions

Key figures

- **4,200 information system users**
- **252 million emails exchanged on the IRD platform**

Serving the science support activities

The professional workshops run over the first half of the year helped clarify and formalise financial management, ready to comply with the key points of the GBCP (public budgetary and accounts management) reform as from 1 January 2016. The results of these workshops were built on as part of the project to implement the new financial information system, SIFC EPST, which is based on the SIFAC solution pooled by the AMUE, the French shared-services agency for Universities and Higher Education and Research Institutions.

The Climate under Surveillance website – www.climat-sous-surveillance.ird.fr – is designed for young people and the wider public, and went online in 2015 in the frame of the COP21.

An application to manage contacts and track the circulation of communication materials produced by IRD was also commissioned. Its architecture enables devolved management which is well suited to local operations.

Overcoming the digital divide in Africa

The Tandem project for digital research networks in West and Central Africa, developed in partnership with Cirad and Renater[23], has been selected by the European Commission to receive a €1.2 million grant. Several initiatives have been organised as part of the project:

- organisation of an international event (Africa, Europe, Latin America) in Ghana bringing together donors and politicians (60 attendees);
- collecting requirements for digital services from more than 500 scientists in West and Central Africa;
- presentation of the project to the ICT forum organised by the European Commission.

Strengthen IRD's international communication network

After moving to new premises, the new Quito, Santiago, Tunisia and CREC (Cotonou Entomological Research Centre) sites have now been connected to the IRD network.

Network speeds have been boosted in Mali, Benin, Cameroon and Bolivia. A satellite link has been rolled out at the Niakhar site in Senegal.

The Eduroam/Guest wifi has been opened up to the IRD's representations. Security has been improved using flow prioritisation techniques, creating back-up connections, in Africa for example, and monitoring local networks.

Adjusting infrastructure services to requirements while keeping costs in check

The economic model based on infrastructure services located in a private cloud means the provision of computing power can be adjusted to actual needs. The main factors behind changes in the scope of the cloud in 2015 were a 500% increase in individual network file storage quotas (from 1 to 5 GB), the implementation of GBCP infrastructure and the provision of new services.

Supporting and assisting IS users

4,200 IS users – IRD agents or otherwise – use the email service. 252 million emails were exchanged over the IRD platform in 2015, of which 22 million were outgoing.

The service centre was called on 13,000 times, mainly for issues concerning account access, workstation configuration and help with starting a video conference

[23] the *Reseau National de Télécommunications pour la technologie, l'Enseignement et la Recherche* (National telecommunications network for Technology, Education and Research);

3.5 Promoting IRD's image

As research becomes increasingly international, IRD aims to draw on its scientific excellence and unique international scientific cooperation model to firmly establish science as a driving force in the new development agenda. Two of the key objectives in the 2016-2020 strategic plan are promoting IRD's image and consolidating the identify of 'planet IRD'.

Key figures

- **60 press releases and press kits**
- **19 scientific news sheets**
- **Sciences au Sud newspaper, with 75,000 copies circulated**
- **Nearly one million visits to the IRD's websites**
- **Close to 2,450 new photographs added to the Indigo image bank**
- **20 films produced, co-produced or in production**
- **55 colloquiums supported**

Sixty press releases and press kits were issued in 2015, primarily to promote the findings of IRD research in the fields of climate change and the Institute's participation in French and international events leading up to COP21 (Climate Smart Agriculture, MEDCOP21, UNESCO conference, COP21). They led to almost 2,660 mentions in the press, including 28 articles in Le Monde, 26 AFP reports, 23 interviews or programmes on France Inter, 50 on RFI, 11 articles in Libération and 15 in Le Figaro (paper versions only).

Scientific news sheets present the most recent IRD research results two or three times per month. To date, more than 500 sheets have been published online on the IRD institutional website. Intended for French and foreign media, the governing ministries, IRD partners, decision-makers and the public, they provide an up-to-date summary of current research information. In 2015, 19 scientific news sheets resulted in more than 150 articles in the press.

The Sciences au Sud newspaper, with 75,000 copies circulated in more than 100 countries, continues to open up its columns to partner institutes. In 2015, this included interviews with Irina Bokova, Director General of UNESCO, Laurence Tubiana, ambassador in charge of climate negotiations and Marc-Antoine Pérouse de Montclos, political scientist specialised in Nigeria.

IRD's websites benefit from very high visibility in the South. In 2015, audience growth was high for all our representations' websites. Meanwhile, the www.ird.fr website received close to one million visits. IRD is also building up its presence on social media, with 446 publications on Facebook (up 59%) and 1,227 publications on Twitter (up 86%).
Nearly 2,450 new photos covering a number of the Institute's research disciplines were added to the Indigo image bank which now contains almost 60,500 documents, accessible over the internet.
Twenty films were produced, co-produced or are currently in production. The film entitled 'payer sa vie' on the subject of prostitution in Latin America was premiered in Paris and Marseille. A series on deserts going under the name 'Planète sable' was filmed in several African countries for TV channel Arté, while the documentary series on the Lengguru expedition in West Papua is now being validated. A film on the origins of AIDS, 'Sida, la piste africaine', was also shot for TV channel France 5 with IRD researchers and their partners from Cameroon and Senegal.
Fifteen films produced or co-produced by IRD were screened at Le Bourget during COP21 – 25% of all the films shown there. Around sixty films were screened around the theme of COP21 in 18 countries via French institutions, French embassies and IRD's representations.
IRD took part in thirty or so festivals in France and abroad, including the international scientific film festival 'Parisciences'.
Fifty-five colloquiums received support, including Climate Smart Agriculture 2015[24] and EBODAKAR 2015[25], which brought together researchers in social sciences and stakeholders in the response to Ebola in West Africa.

[24] http://csa2015.cirad.fr/index.php/csa2015

[25] http://ebodakar2015.sciencesconf.org/

And in the future?
Despite its considerable international presence and its major historical and human investment, IRD suffers from a relatively low profile. To highlight its unique model and its leadership, IRD's action has to be made clearer and its attractiveness boosted. There is also a need to promote its knowledge and know-how and to federate and equip its staff. In other words, we need to make people much more aware of the fundamentals, values and commitments of IRD. We need to define new guidelines for communicating on and sharing information, by overhauling institutional communication to position it within a clear strategy for content and exchange, rolled out to the wider IRD community.

3.6 A stronger corporate social responsibility policy

Since 2012, IRD has been required to establish a report on its greenhouse gas emissions as part of French national policy to tackle climate change. Through its corporate social responsibility policy, approved by its board of directors on 29 March 2013, IRD has committed to going beyond the legal requirements and issuing a report on its emissions in France and abroad.

After a full review of its emissions covering activities by the France-South representation in 2014, emissions reports were produced for the head office in Marseille and IRD's representation in Senegal. The results obtained at these sites will contribute to reflections on the methodology to be applied to extend the emissions reports to all IRD sites in France and abroad.

3.7 Sharing knowledge and getting young people interested

In 2015, IRD's action aimed at the general public put the priority on climate change with exhibitions, conferences and debates, workshops, film shows and participatory actions specifically aimed at young people in France and the overseas collectivities and regions, and in our partner countries in the Global South.

Key figures

- **almost 1,000 young people and around 50 teachers involved**
- **371 public events in France (28%) and the overseas collectivities and regions (19%), and in our partner countries in Africa (29%) and Latin America (20%).**
- **4 new exhibitions**
- **Around thirty books published or co-published**

In all, almost 1,000 young people and around 50 teachers benefited from the various initiatives run in 2015, most notably Cities in Question and Climate under Surveillance.
From the conferences and debates organised to participation in various events (festivals, science fairs, environment days and so on), IRD researchers were involved in a total of 371 public events in France (28%) and the overseas collectivities and regions (19%), and in partner countries in Africa (29%) and Latin America (20%). Most of these actions concerned environmental issues in Southern countries.
The events were an also an opportunity to present four new exhibitions which were devoted to rivers in the context of climate change, urban development and the Lengguru exhibition. In all, IRD's exhibitions, of which there are thirty or so in the catalogue, have been presented on 130 occasions in France, the overseas collectivities and regions, and more than twenty other countries.
Editorial output focused on the main research for development issues, with around thirty works published or co-published on environmental questions such as climate change and biodiversity protection in Southern countries. The new Editions IRD online bookstore opened in late 2014 and now offers some a number of new titles. There are more than 300 publications on sale in all, a third of which are available in digital format.

Climate under Surveillance: a transmedia project on the role of research
To coincide with COP21 in Paris in December 2015 and looking ahead to COP22 next November in Marrakech, IRD has developed a transmedia project known as Climate under Surveillance. This comprises a participatory multimedia web platform (in French) – www.climat-sous-surveillance.ird.fr – with a series of humorous cartoons (Paroles d'appareils - The instruments speak), a game involving around fifteen secondary school and further education students (200 young people in all) across the world over 2015/2016, a series of mediation actions and a social media campaign, and is designed to demonstrate the scientific instrumentation used to observe and study climate change. The web platform contains educational files, explanatory videos and a selection of multimedia resources (films, conferences via podcasts, exhibitions, etc.), a calendar of events, portraits and video interviews of researchers, plus a Q&A area where participants can ask scientists questions to learn more about the climate. Thirty experts from IRD or partner organisations answered questions in the run-up to COP21.

Promoting open access to knowledge
Several tools have been developed to provide open access to resources. IRD collects all publications by its researchers and makes them available via the Horizon database and the HAL open archive. The Horizon database is very widely consulted with 10,000 pdf documents downloaded every day, most notably in countries in the Global South. In 2015, it ranks fourth among French open archives in the Ranking Web of Repositories[26], just behind HAL to which IRD also contributes; worldwide, it is ranked 142nd overall and 38th for wealth of content (out of a total 2,200 open archives rated).
In 2015, IRD played an active role in Open Access Week, a national initiative with the theme 'Researchers, set your publications free!'. By the end of the operation, more than 300 publications had been made available via open access on Horizon or HAL.
As part of the PeTroLAC project (tropical pedology open access) backed by the French ministry for national education, higher education and research with a grant of €50,000, 2,000 documents and 2,000 maps from IRD have been scanned. This digital collection (the full versions of a total 4,500 documents, 2,500 of which were already available) is the largest French and international collection on tropical pedology offering the full versions of texts via open access over the internet.
More than 18,000 consultations have been recorded via the Scopp.it! account Open access pour la recherche pour le développement[27].
Finally, work began on NumeriSud, a platform set up to share scientific resources and training tools. This digital campus is set to be inaugurated in 2016.

[26] http://repositories.webometrics.info/en/Europe/France (*January 2016 rating)*

[27] http://www.scoop.it/t/open-access-recherche-pour-le-developpement

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