SATELLITE EVENT
TOULOUSE
EUROPEAN CITY OF SCIENCE
ESOF 2018

CLIMATE FROM SPACE

SPACE TOUR

JULY 2018

METEO FRANCE

CLS
COLLECTE LOCALISATION SATELLITES

Observatoire Midi-Pyrénées
OMP

CLIMATE FROM SPACE

Study, understand, adapt

To understand the climate change, such global phenomenon needs to be studied from above. In Toulouse, a unique European industry exists. An industry which designs and manufactures instruments and key satellites for Earth observation but not only...
This industry composed by organizations, public institutions and private companies processes, archives, adds value and analyses space data in order to understand our climate and forecast the climate of tomorrow.

From space and thanks to this "integrated industry", made in France, companies and institutions are organized and offer solutions to understand and respond to the impacts of climate change on ECONOMY, ENVIRONMENT and SOCIETY.

During the ESOF space Tour, organized in the Cité de l'Espace, we invite you to meet us, Météo-France[1], Observatoire Midi-Pyrénées[2] and CLS[3]. We will be happy to present you our researches, our observations, our tools and our solutions dedicated to the climate, the protection of our planet, its resources and its humanity.

1 Météo-France is the French national meteorological and climate service responsible for weather forecasting, particularly for severe weather events, to preserve past climate and study the climate of the future.To this end, Météo-France manages observation infrastructures, develops numerical weather and climate prediction models, conducts research studies (for example by contributing to the work of IPCC) and trains future experts in this field. The institution has an intensive computing system. Its update in 2014 has enabled to multiply by 12 the computing power. The strenght of Météo-France resides in this unique approach combining state-of-the-art research and operational expertise. Thus, it can advise the public authorities on meteorological risks and how to adapt to climate change.

2 CLS, a subsidiary of the French Space Agency, ARDIAN & IFREMER, is a worldwide company and pioneer provider of monitoring and surveillance solutions for the Earth since 1986. Its mission is to deploy innovative space-based solutions to understand and protect our planet, and to manage its resources sustainably. CLS employs 700 people, at its headquarters in Toulouse (France) and in its 26 other sites around the world. The company works in six strategic areas of activity: sustainable fisheries management, environmental monitoring, maritime surveillance, fleet management, energy & mining, space & ground systems. CLS process environmental data and positions from 80,000 beacons per month (drifting buoys, animal tags, VMS beacons, LRIT tracking, etc.), ocean and inland waters observations (more than 20 instruments onboard satellites daily deliver information to CLS on the world's seas and oceans). In addition we monitor land and sea activities by satellite (nearly 10,000 radar images are processed each year by CLS). The CLS Group had a turnover close to 115 million Euros in 2016 and plans to increase it to about 125 million in 2017. The group, which has been achieving strong growth these last few years, has set ambitious goals to take advantage of the opening-up of new markets. www.cls.fr

3 L'Observatoire Midi-Pyrénées (OMP) is an Observatory of Sciences of the Universe (OSU) and a component (internal school) of the Toulouse III University - Paul Sabatier (UT3PS). It federates the UT3PS universe, planet and environment sciences laboratories around the missions of research, observation, teaching, diffusion of the scientific culture and international cooperation common to OSU . It is the core of the «Universe, Planet, Space, Environment» cluster (UPEE) of the UT3PS. The OMP covers a vast scientific field ranging from the study of the big bang and the distant universe to the actual functioning of the various envelopes of our planet and their interactions, through the study of the planets. Solar system and the internal Earth. OMP is responsible for or a stakeholder in more than 50 Community-based Observation Services, Community Codes, and Data Processing and Archiving Centers nationally and for the most part inserted into European and international networks and consortia. The Observatory contributes to research on crucial societal issues such as the impacts of human action on our planet (climate, pollution and health, water resources, biodiversity), natural hazards, CO2 storage, etc. and develops an original strategy of cooperation with laboratories in the human and social sciences and health.

Contacts

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ECONOMY

Climate change is a reality that affects all economic sectors: agriculture, transport, tourism even the energy. The agricultural sector is particularly affected, with severe damage in Africa and Asia. How to accompany these changes? How to adapt?
We are trying to respond to that needs from space.

FARMING

Mitigate climate change using intermediate crops

In Europe, cultivated areas represent about 20% of the land and have long periods of soil non exploited between two crops. In order to limit the impact of global warming, the use of techniques to trap atmospheric CO2 or reduce the amount of solar energy arriving on land may become an essential resource.

Using intermediate crops, rather than leaving bare soils, combines both effects. Using satellite data from all over Europe, Météo-France researchers analyzed the evolution of albedo - the fraction of solar energy returned by a surface-agricultural plots following simulations of introduction of intermediate crops in areas where climate and crop types are propitious to this solutions.

The cumulative effects of carbon storage, reduced fertilizer requirements and increased albedo would offset nearly 7% of the annual GHG emissions of the agricultural and forestry sector in Europe.

Contact: Météo France

What strategies can be adopted to mitigate the effects of climate change on our agricultural practices?

Thanks to the long-term monitoring of agricultural instrumented sites, CESBIO researchers analyze climatic and anthropogenic factors such as water, energy, carbon fluxes and greenhouse gases in order to identify the best environmental strategies. mitigation in the face of climate change.

They are also developing methodologies combining spatial and temporal remote sensing data to model the landscape / regional contribution to climate change and to quantify the effect of potential mitigation levers for climate change.

Speaker :
Eric CESCHIA is a researcher at the Center for the Study of the BIOsphere from Space (CESBIO) since 2003. His scientific expertise concerns the measurement and modeling of energy, water, carbon and GHG fluxes/budgets of agricultural plots/ landscapes in a perspective of climate mitigation as well as Earth Observation based on high resolution optical remote sensing.

How to become a fish farmer when you always has been a rice farmer ?

With global warming, rising waters are changing the coastal landscape and territorial economy. In Asia, the intrusion of salted water into rice fields sterilizes crops and deprives farmers of their earnings.

CLS, a subsidiary of the French space agency (CNES), offers governments strategic tools such as: maps to predict salted water intrusion, useful for targetingaffected rice farmers and to help them converting to fish farming. This solution has been studying by some countries such as Vietnam.

Sophie Besnard, from CLS is here to tell you more regarding this subject. Sophie is doctor in oceanography, meteorology & environment. She started her carrier at CLS as an oceanographer in 2006. In 2014, she was promoted Head of meteorology & oceanography. Since 2017, Sophie Besnard is in charge of the relations with the French institutions and the key accounts.

Fishing : Science calls the Tune(a)

Today, marine resources are too often depleted (due to overfishing and illegal, unreported, and unregulated fishing) and are also victims of human activity (pollution). These stocks will only be able to adapt to global warming if we return to sustainable fishing levels. Today, scientists have found that stocks of certain species such as bigeye tuna in the Pacific have been reduced to less than 20% of their original biomass as a result of fishing pressure.

This pressure, added to the effects of global warming, might lead to their stock collapse. The reasonable threshold established by scientists is around 40%. According to recent simulations, the peak pressure that major tuna stocks will experience, from the combined effects of fishing and climate change, should occur by mid-century.

For more than 30 years, CLS has been working for the sustainable management of marine resources using satellite observation. More recently, CLS has begun modelling marine ecosystems. What do these CLS models predict for the future? Stocks of albacore tuna are expected to decline until the 2060s in the Pacific. A decrease linked to global warming, regarding the most critical scenario of the IPCC. Information proving that the resource must be preserved until then so as not to jeopardize local population.

Patrick Lehodey, from CLS is here today to tell you more on that's subject. After his PhD, Patrick Lehodey worked for the Secretariat of the Pacific Community, devoting his research to tuna ecology and fisheries oceanography. He joined CLS in 2006 to develop the marine ecosystem modelling activities with the objective of providing new operational tools and products for the monitoring and management of fisheries, based on the use of satellite data.

TOURISM

Ski resorts are increasingly using the preparation of slopes and the use of artificial snow. This trend should be confirmed with climate change context, snowfall gradually decreasing. Optimizing snow work is therefore a major challenge for ski areas.

The PROSNOW project, launched in September 2017 by Météo-France, aims to develop a decision support service for growing snow production based on snow heights and snow stocks forecast, snow cover models on slopes, snowfall satellite images and snow heights measured on slopes. PROSNOW brings together twelve European partners.

Contact: Météo France

ENERGY

Météo-France is a major player in Copernicus, the European monitoring and surveillance program for the Earth and its ecosystems, which aims to provide free satellite data and environmental services on a global and European scale.

As part of Copernicus' Climate Change component, Météo-France contributes to develop new seasonal forecasting products, such as probability of occurrence of extreme phenomena.

The establishment, in collaboration with RTE, will also produce indicators to meet the needs of energy suppliers and to balance supply and demand in renewable energies.

Contact: Météo France

ENVIRONMENT

Temperature, sea levels rising, resurgence of extreme events: our environment is the first affected by climate change.
In order to study these multiple evolutions, satellite data are precious. They allow us to monitor current developments across the globe and to validate climate models used to simulate Earth's behavior in the long term.

WORLD

Météo-France actively participates in developing various IPCC reports (the Intergovernmental expert panel on Climate Change), based on its CNRM-CM Earth system model.

According to the IPCC, it is almost certain that in most continental regions, extreme heat will be more numerous in the future and cold extremes rarer, at daily and seasonal scales.

By the end of this century, it is very likely that heat waves will be more frequent and will last longer, that extreme precipitation events will become more intense and common over mid-latitude continents and in humid tropical regions.

It is likely that the overall frequency of tropical cyclones will decrease or will remain the same, but the average precipitation and maximum average wind speed associated with tropical cyclones will probably increase.

Contact: Météo France

CITIES

Météo-France: analysing urban climate

In cities, the artificialization of surfaces creates a specific climate. This best-known manifestation is called " the heat island": an overheating effect compared to the surrounding countryside.

To this phenomenon must be added the upsurge and the intensification of heat waves in a climate change context. In addition, cities which are becoming increasingly populated, will be more energy-intensive.

For years, Météo-France has been conducting interdisciplinary studies to support efforts and reflection of urban areas in mitigating and adjustment to climate change. Thanks to satellite data, Météo France has thus developed and validated a model that can simulate effects of different adjustment solutions, separately and cumulated.

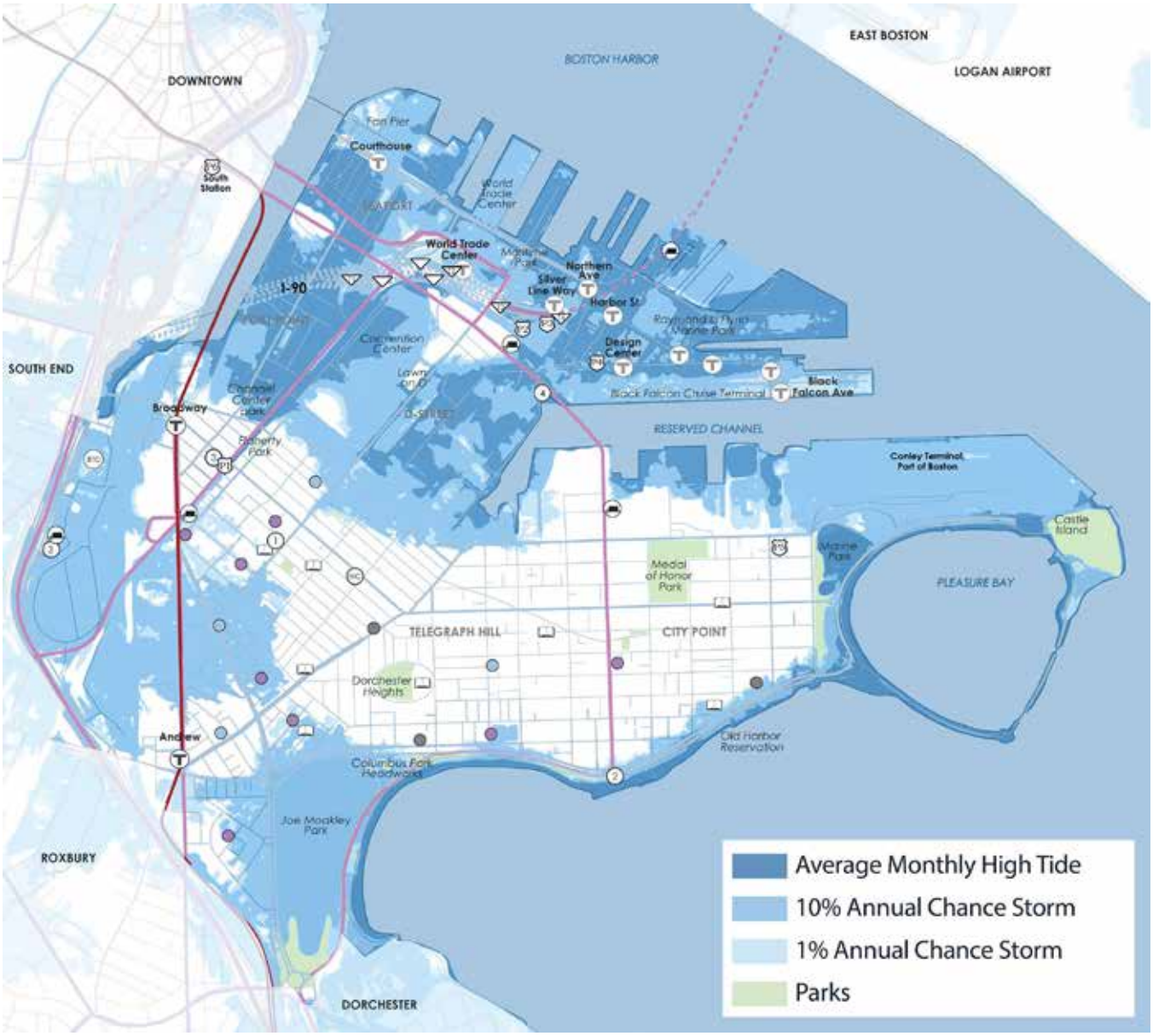
Boston is a city impacted by the Climate change. In this context, the American city created the «Climate Ready Boston» program. The objectives of this program : plan and mitigate the effects of climate change.

The city of Boston has recruited a team of experts including the American subsidiary of CLS: Woods Hole Group to provide a study focused on coastal areas and neighborhoods in the southern Boston waterfront.

The goal of «climate Ready South Boston» is to develop a series of short-and long-term strategies to protect the city from sea-level rise, coastal floods and storms, while creating social benefits, Environmental and economic benefits for people living in the south of the city.

CLS has used many satellite information to provide scenarios and solutions.

Contact: Météo France



OCEAN - SEA LEVEL

Mean Sea Level Rise – Key indicator of global warming

The ocean is our planet's main carbon pump, the Earth's largest heat concentrator. Understanding climate mechanisms means understanding the ocean.
But how to understand this gigantic maritime territory.

Over the past 30 years, ocean observing systems have experienced a revolution. The arrival of space oceanography satellites was the cornerstone of this renewal. CLS, a pioneer since the beginning, receives, processes and qualifies this data for the international community.

The Ocean is the planet's main carbon pump and has the largest capacity for storing heat.
Understanding climate mechanisms primarily means understanding the ocean.

But how can we learn more about this immense maritime territory? Over the last 30 years, observation systems for the ocean have made giant leaps. The development of satellites for space oceanography and collection of environmental data has been the driving force behind this revolution.

From the start, CLS was a pioneer in the field, and receives, processes, and qualifies these satellite data for the entire international community. As world leader in altimetry and the exclusive operator of the ARGOS system for location and collection of environmental data, CLS works daily with experts in climatology.

A warning to sceptics

According to scientists, many islands will have disappeared between now and the end of the century, leading to the exodus of their populations. To those who still doubt the accuracy of measurements of mean sea level, CLS engineers reply calmly that there is no longer any doubt whatsoever.
Since 1992, the mean level of the seas has risen... On average this level has risen by 3.3 mm/year and the figure is accurate to within half a millimetre.

He is here today! Dr. Marc Lucas is a senior oceanographer at CLS. He holds a BSc in ocean Science from the University of Plymouth UK, an MSc in Oceanography and a PhD in Physical Oceanography both from the University of Southampton, UK. After 3 post Docs in both France and Germany mostly focused on numerical modelling, he joined the CLS team dedicated to providing metocean services to the Offshore Energy industry where he set up the operational services delivery system.

OMP : Melting Ice, Rising Sea: Is Earth's Response to Current Climate Change ?

Through the study of the water-energy cycle, variations in sea level and mass transfers of water from the earth to the ocean at regional and global scales (see Figures 1 and 2), the LEGOS tries to understand the causes of such changes and how they respond to forcing human activities such as greenhouse gas and aerosol emissions, and natural forcing (solar variability, volcanic eruptions)..

Speaker : Benoit Meyssignac LEGOS
Benoit Meyssignac leads a scientific career around the crucial issue of climate change. He defended a thesis on «regional variations of sea level at climatic scales» is currently used by CNES stationed at LEGOS in Toulouse. His research focuses on the study of the oceanic response to climate change. He is particularly interested in variations in the mass and heat content of the ocean, as well as changes in sea level and changes in global circulation at climatic scales. Member of the IPCC since 2016, he received this year the Christian Le Provost prize from the Academy of Sciences.

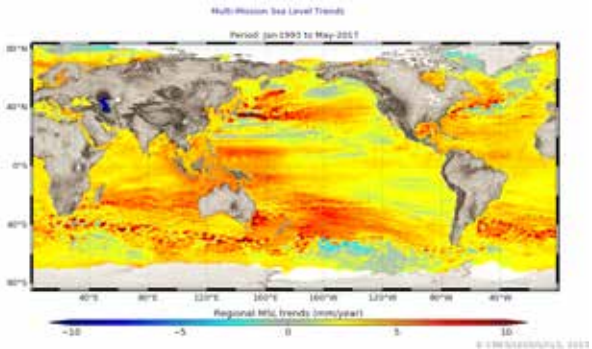


Figure 1:
Global mean sea level rise observed by satellite altimetry and global mean sea level budget. The global mean sea level is the sum of the thermal expansion of the ocean, ice melt from mountain glaciers, ice mass loss from Greenland and Antartica

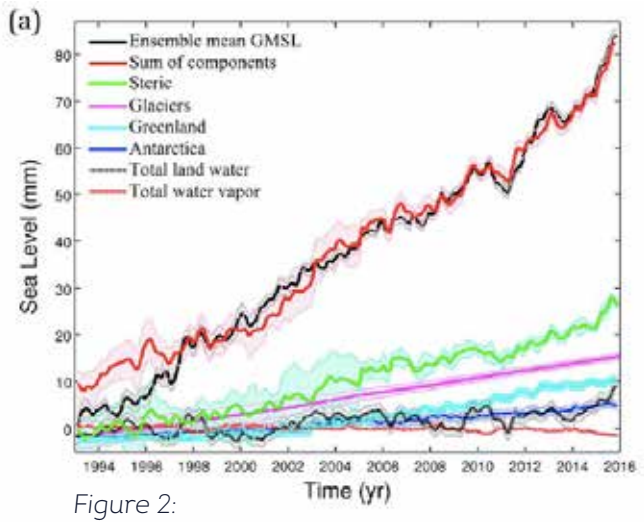
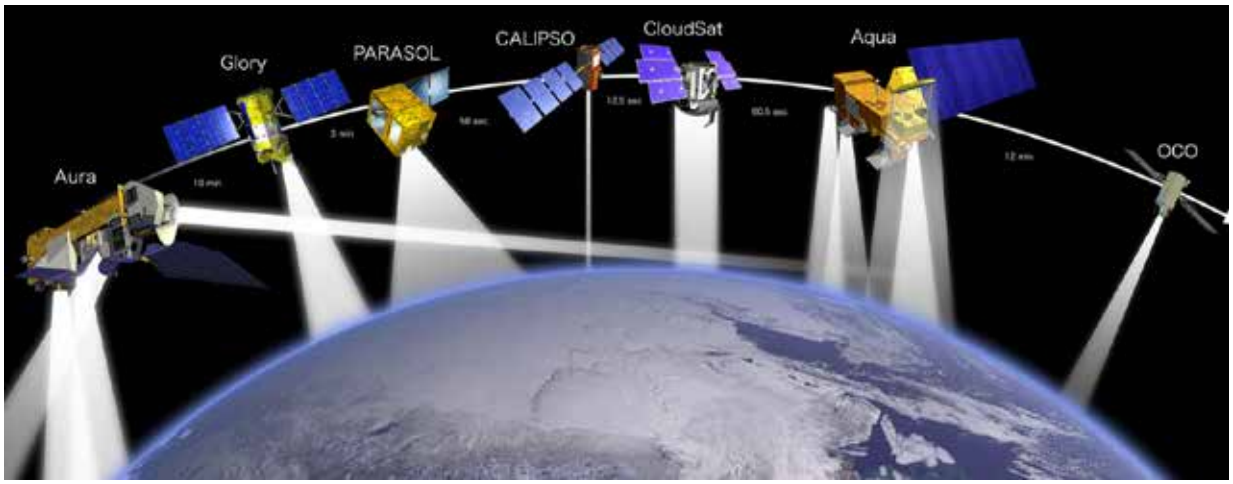


Figure 2:
Regional sea level rise observed by satellite altimetry. Sea level does not rise uniformly because of the non-uniform redistribution of heat in the ocean.

OMP : How will Earth's clouds respond to ongoing climate change ?

At the Aérologie laboratory in Toulouse thanks to active spatial remote sensing (CALIPSO satellite lidar) we are looking for clues and document the vertical variability of clouds on a global scale.



The A-Train satellite constellation dedicated to Earth observation, which includes the CALIPSO lidar and CloudSat radar.

BIODIVERSITY

Biodiversity, high stakes for humanity

How to measure the impact of global warming on biodiversity? The study of migratory species or animal populations, living in extreme territories, is possible only from space. In 1978, CNES, NASA and NOAA created the ARGOS satellite location and environmental data collection system.

Data from the system are acquired, processed and shared by CLS with the international scientific community. Each month, the company tracks over 8,000 animals. More than 100,000 have been monitored since the 1980s.

Thanks to these informations, scientists have been able to measure the impact of g lobal warming on biodiversity, come and meet our experts Marc Lucas, engineer at CLS, he will present you the results of many studies on polar bears, elephant seals, king penguins or albatrosses.

Contact: CLS

8000 animals are monthly tracked from space thanks to ARGOS satellites system. ©CLS

SOCIETY

The news reminds us regularly, extreme meteorological events become sadly frequent. Typhoon, cataclysmic earthquakes, migration of climate refugees, how to respond? How can we be ready to face that changes? Satellite solutions, meteorological vigilance from space or localized warning systems are key to our resilience.

AFFECTED POPULATIONS

Soil pollution : What impacts for ecosystems and populations?

Soils are essential for our societies because they are linked to many socio-economic domains (economic, ecological, agriculture). However, they are subject to attacks and can sometimes be irreversibly degraded. Many sites are affected by pollution, past or present, due to either sustained agro-industrial activities or intensive exploitation of metals and / or hydrocarbons.

These pollutants affect the soil and its functions, and spread to groundwater, on the surface towards the ecosystems, to the atmosphere and consequently to man (through respiration or ingestion).

Thanks to remote sensing tools (multispectral satellites: MODIS, SENTINEL II, positioning: GNSS, Radar: SENTINEL I or geodesy: GRACE etc.), the impacts of mining / industrial / agricultural contaminations are studied at the Geosciences Environment Laboratory in Toulouse, France. focused its scientific activity on research and management, in the tropics, natural resources and environmental monitoring (climate change, monitoring interfaces water / soil / atmosphere, natural hazards).

Speakers:
José Darrozes, (Geosciences Environnement Toulouse) Associate Professor of Toulouse III University Paul Sabatier, specialist in remote sensing and wavelet processing he is involved in the activities of reflectometry to observe the effects of climate change on the water cycle and the impact mining activities.

Elodie Robert (Geosciences Environnement Toulouse)is an expert in the field of environmental monitoring (canopy dynamics, monitoring of suspended matter in the water, presence of phosphates, nitrates, etc.) using measurements and field data as well as satellite images (remote sensing) and GIS. It is also working on the study of population vulnerabilities through quantitative and qualitative surveys (semi-structured interviews).

CLIMATE REFUGEES

Typhoons, cyclones, tsunamis, mere words we Westerners hear while for others they are a violent reality that is difficult to resist. Organisations such as the UNHCR (United Nations High Commission for Refugees) or the Red Cross are in the front line and need the most efficient way of deploying emergency resources.

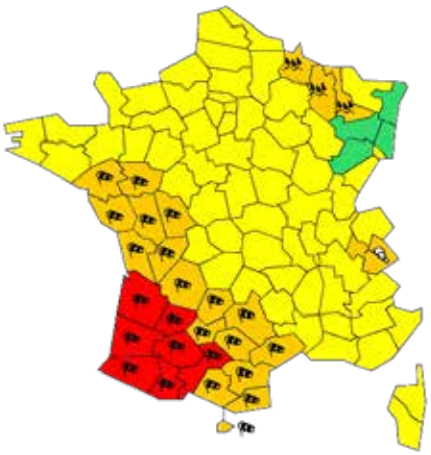
NOVACOM SERVICES, a CLS subsidiary, geolocates the vehicles of organisations working in the front line to save lives. Christophe VASSAL, Chief Executif Officer of CLS, headquarter of NOVACOM SERVICES explains: «The trust which these organisations have placed in NOVACOM SERVICES enables close cooperation in the field through the Humanav Next project that is consolidating and legitimising our involvement in the humanitarian world.»

CLS tracks 100 000 terminals by satellite each year © CLS

By helping the victims of these disasters through its solutions, CLS and its subsidiary are indispensable players wherever extreme climate situations occur.

Contact: CLS

ALERT SYSTEMS



Weather alert over metropolitan France and overseas Empowered by the French gouvernment, Météo-France has for mission the safety of people and properties.

Thus, Météo-France is responsible for weather warnings, by which people and public services can make informed decisions in their day-to-day activities using a colour chart updated twice a day, seven days a week and all year round together with a follow-up bulletin.

Weather warnings are based on numerical weather prediction models (NWP) using real-time atmospheric data. Satellite data represent 92% of all data in the global model Arpège of Météo-France.

VIETNAMESE FISHERMEN

In 2006, the typhoon Chanchu proved devastating when it killed many fishermen. The Vietnamese then decided to equip themselves with a CLS solution: Movimar.

This advanced technology has coupled a fishery surveillance system with another for sending early warnings of typhoons by satellite. Three surveillance centres in Vietnam keep watch over the boats and their environment. When they receive a warning the crews can then move away before the storm hits them.

Contact: CLS

OMP : How to anticipate and prepare for environmental changes ?

Faced with the challenges posed by global change, it is essential to improve our understanding of our planet's Ecology and Environment, anticipate its possible evolutions and provide elements for decision support.

The EcoLab laboratory is working on these issues through integrated approaches that rely on the combination of in situ data / experimentation, satellite data and numerical modeling.
Today, the emergence of new satellite missions and the development of environmental observation services, our observation capacity is unprecedented.

Exploring the possible synergies between these data sources (observed or / and modeled) to better understand the evolution of our land system and its resources is therefore one of the major scientific and technical issues of today.

Speaker: :
Sabine Sauvage is a Research Engineer at CNRS assigned to ECOLAB. She works on water resources and more specifically on modeling the transfer of contaminants in river water systems for 18 years. His research has focused on the development of models describing the biophysical interactions between flows, biology and chemistry of biogenic elements and contaminants in rivers by integrating interface zones and buffer zones between surface waters and beds. processes at the watershed scale.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