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is the increase in CO_2 emissions due to the advent of the industrial era. **38 %**

A space for the climate

Atmosphere

GREENHOUSE GASES

They are a natural phenomenon, important for life on our planet, that ensure an average temperature on Earth of 15°C, compared with -18°C if they were absent. Water vapour, carbon dioxide, methane and ozone are the main greenhouse gases (GHGs). Human activities generate a surplus of GHG emissions, inducing an additional greenhouse effect that causes global warming.

How satellites help

The instruments on board satellites are designed to measure air quality and the concentration of methane in the atmosphere, as well as to study the atmosphere's chemistry, the radiative impact of clouds and aerosols, etc. These satellite sensors operate in the visible and non-visible wavelengths.

Close-up on...

...particles in suspension

The suspended particles found in the atmosphere can be of natural origin (volcanic eruptions, forest fires, desert dust, etc.) or come from human activity: road traffic (especially diesel engines), industry, agriculture and combustion (chimneys, individual heating, etc.). Fine particles are a threat to the human respiratory system.

The new sensors carried on satellites are now helping to monitor and study these potentially hazardous pollutant phenomena, and France is at the leading edge in this field.

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is how many hectares of forests are disappearing each year (three times the size of Switzerland)

13 millions

A space for the climate

Biosphere

DEFORESTATION

The aim of this practice is to clear new land for farming and commercialise rare tree species. It can have an irreversible effect if conducted excessively, leading to a loss of biodiversity and genetic richness, affecting the water cycle and increasing the risk of fires, landslides and soil erosion.

How satellites help

Earth observation satellites provide detailed information on very large areas, repeatedly and at a lower cost, in regions of the world where access may be difficult. For example, satellites have enabled us to map all of the forests in the Congo Basin, which cover more than 3 million km² (five times the size of France).

Close-up on...

...desertification

Desertification affects 40% of the Earth's land surface. It directly impacts one billion people in the world. The inappropriate management of agricultural and pastoral areas, combined with frequent droughts, has increased the vulnerability of arid areas and exacerbated the process of desertification.

Satellite data are invaluable for analysing changes in soil conditions and assisting the authorities and international agencies with decision making.

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is the number of glaciers that have disappeared in recent decades **600**

A space for the climate

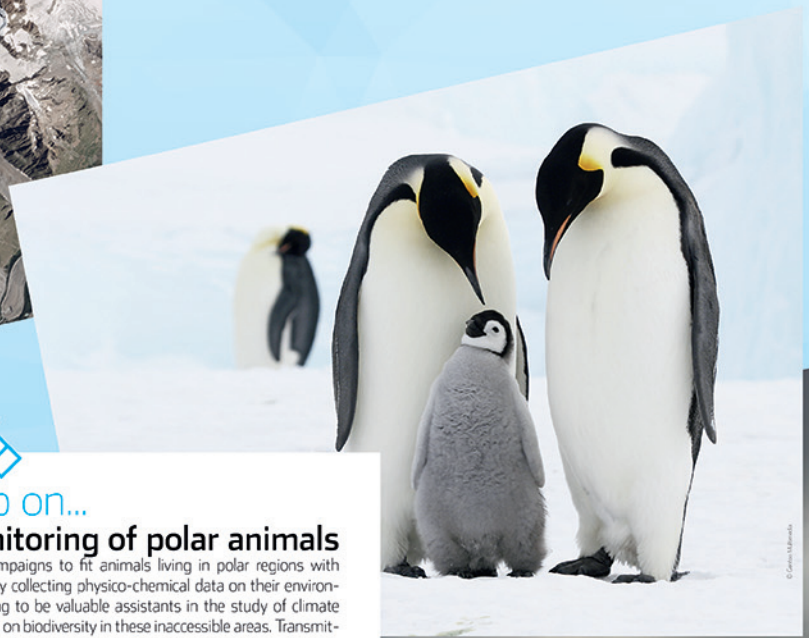
Cryosphere

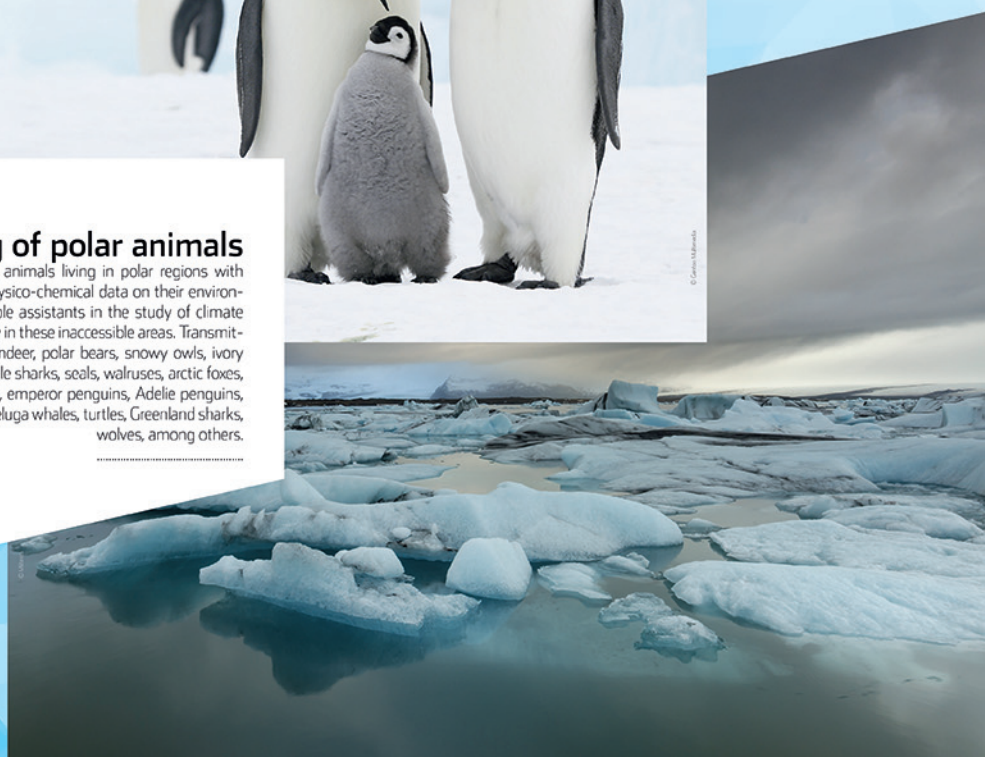
GLACIAL MELTING

Many mountain ranges risk losing most, or even all of their glaciers within a few decades, as a result of global warming, with serious consequences on water resources for downstream populations and for ecosystems in general. As for the melting of the ice pack, it is one of the factors influencing the living conditions of Inuit populations and the fate of polar bears.

How satellites help

Very specific instruments, such as radar altimeters, measure the extent and thickness of ice with great precision. Satellites are very well adapted to monitoring these sparsely populated or uninhabited areas that are difficult to study by other means. At the same time, optical or radar imaging instruments are used to measure its extent.





Close-up on...

...the monitoring of polar animals

There are regular campaigns to fit animals living in polar regions with Argos transmitters. By collecting physico-chemical data on their environment, they are proving to be valuable assistants in the study of climate change and its impact on biodiversity in these inaccessible areas. Transmitters have been fitted to caribou, reindeer, polar bears, snowy owls, ivory gulls, eagles, humpback whales, whale sharks, seals, walruses, arctic foxes, black throated divers, king penguins, emperor penguins, Adelie penguins, elephant seals, petrels, albatrosses, beluga whales, turtles, Greenland sharks, wolves, among others.

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is the percentage of the world's population living in coastal areas **60 %**

A space for the climate

Hydrosphere

RISING OCEANS

Mean sea level has risen by six centimetres over the past 20 years, with large regional variability. It is the best indicator of climate change, since it incorporates the warming of the ocean, inflows of fresh water from the melting of polar ice caps and glaciers, and also variations in inland waters (lakes, rivers and groundwater).

How satellites help

Satellite radar altimetry can determine the level of the oceans instantaneously with centimetre precision, using data from the radar altimeter combined with ultra-precise orbit measurements provided by the DORIS system and laser-based distance calculations, supplemented by GPS measurements. Thanks to satellites, the global mean level of the oceans has been measured continuously since 1993.

Close-up on...

...fresh water

The resources of inland water bodies are essential to the survival of terrestrial and aquatic ecosystems, as well as for human activities (irrigation, industry, energy, transport). They are heavily affected by climate change. Monitoring the dynamics of inland water bodies is therefore of major scientific importance. In the future it will also be of operational importance for the management of water resources. The altimetry techniques used on the oceans are becoming increasingly powerful, and can also be applied to measuring the level of inland water bodies, yielding data that are fundamental to this issue of water resources.

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is the proportion of disasters leading to activation of the International Charter for Space and Major Disasters that were caused by climate events **75 %**

A space for the climate

Humans and the climate

THE IMPACT OF CLIMATE CHANGE

Now that human influence on climate change has been clearly established, we are in turn discovering the dramatic impact of climate change on humans. Its consequences affect our homes, health, environment and way of life. Climate refugees, pollution, water shortages, heat waves, epidemics, reduced biodiversity, natural disasters: these are just some of the phenomena about which scientists are alerting the public authorities.

How satellites help

Satellites are becoming fundamental to climatology, through their ability to obtain highly precise measurements, over the entire planet, to complement readings taken on the ground, which are necessarily more limited in scope. They provide data that is homogeneous (collected by the same instrument over every point on the globe), repetitive (over long periods of time) and automatic.

Close-up on...

...the International Charter for Space and Major Disasters

Created in 1999 by the French, European and Canadian space agencies, the purpose of the International Charter on Space and Major Disasters is to respond to the emergency mapping needs of countries affected by natural disasters. In just a few hours, satellite images are sent to the affected countries, free of charge, in order to assess the damage and best organise the arrival of relief efforts.

A true spirit of solidarity from out of this world!

"Over the past decades, satellite technologies have been instrumental in providing evidence of the finite nature of resources on our planet and the fragile balance between human beings and their environment".
IPCC, Nobel Peace Prize in 2007

CNES
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A space for the climate

CNES and the climate

Commitment of the President of CNES:

"Following a year of great achievements and important decisions in 2014, our Space policy in 2015 will hinge on climate-related challenges.

The first reason is that several scientific and technological programmes we have been working on for years will begin to bear fruit. This is true for the Jason 3 satellite, to be launched next summer and which will **continue the investigation of the oceans, begun with Topex-Poseidon in 1992** and later pursued by Jason 1 and 2.

Secondly because several projects, each of them innovative in its own right, are currently being developed. Swot will enable us to **learn more about the global dynamics of terrestrial surface waters**, IASI NG will **further improve weather forecasting and Merlin will study methane and its impact on the greenhouse effect**.

Finally, because **France will be hosting the COP 21 Conference in Paris in December**, an event that will bring together all those concerned by climate change. **Space will naturally be a constant topic of discussion**, given its vital contribution to knowledge of our planet and especially of its evolution.

In 2015 the overriding objective will thus be to bring global warming under control. Success is imperative because as the UN Secretary General has said quite rightly: **'There is no plan B, because there is no planet B'**.

This is why CNES will be making Space for the climate in 2015."

A state-owned industrial and commercial establishment (EPIC), CNES helps the government shape French space policy and implements it in five key strategic areas: Ariane, Sciences, Observation, Telecommunications and Defence.

CNES's 2 450 employees work at four centres of excellence: the Toulouse Space Centre, where tomorrow's orbital systems are designed; the Launch Vehicles Directorate, in charge of all launcher developments; the Guiana Space Centre, which operates European launch vehicles; and finally Head Office, where French space policy is crafted.

It has a budget of over €2.1 billion for 2015, of which 80% goes directly to industry, supporting 16 000 highly skilled jobs in France. CNES also plays a key role in economic diplomacy. To this end, CNES maintains close relations with the space industry and its partners within the European Space Agency, the European Commission and space powers all around the world.

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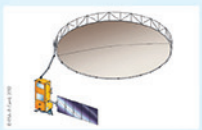
Earth observation missions with a french contribution

Understanding climate change is of fundamental importance in the 21st century. Out of the fifty or so climate parameters studied (ECV: Essential Climate Variables), more than half are monitored by satellites.
Through the space missions it develops or in which it participates, CNES is one of the key players in the study of these major themes:

- **The ocean**
- **The solid Earth**
- **Land surfaces**
- **The atmosphere**



BIOMASS
ESA

2020

ECV : forests, biomass

Goal : repetitive measurement of forest biomass on a global scale

CNES : support for French scientists on the project

CALIPSO
France, United States

2006

ECV : aerosols, clouds

Goal : study of the radiative impact of clouds and aerosols for predicting climate change, at different levels of the atmosphere

CNES : Development of the satellite platform (Proteus) and the infrared imager Data processing

CFOSAT
France, China

2018

ECV : waves and winds

Goal : study of sea state in order to characterise, on a global scale, surface wind direction and speed, and wave direction, amplitude and wavelength

CNES : provision of the Swim (Surface Waves Investigation and Monitoring) instrument, a wave spectrometer. Data processing

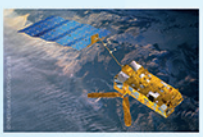
CRYOSAT
ESA

2010

ECV : sea-ice state and extent, level of the oceans

Goal : study of variations in sea ice, level of the oceans

CNES : development of the Doris system that determines the precise position of the satellite on its orbit, to the nearest centimetre; processing and expert analysis of scientific data



IASI
(sur MetOp)
France, Eumetsat, England

2006, 2012, 2018

ECV : water vapour, atmospheric temperatures, ozone and atmospheric composition (greenhouse gases)

Goal : provision of data for operational meteorology, on air quality, atmospheric chemistry. IASI-NG will ensure its continuity

CNES : overall technical responsibility for instruments, development of the data processing software as well as development and operation of a technical expertise centre

IASI NG
(sur MetOp-NG)
France, Eumetsat, England

2021

ECV : water vapour, atmospheric temperatures, ozone and atmospheric composition (greenhouse gases)

Goal : provision of data for operational meteorology, on air quality, atmospheric chemistry. IASI-NG will ensure IASI's continuity

CNES : overall technical responsibility for instruments, development of the data processing software as well as development and operation of a technical expertise centre

JASON-2 et 3
France, United States, NOAA, Eumetsat, CE (only for Jason 3)

2008 et 2015

ECV : sea level

Goal : measurement of the mean level of the oceans, surface wind speeds, mean wave height, etc.

CNES : contracting authority for the satellite and mission system, provision of the satellite platform

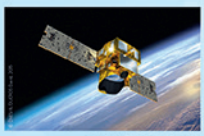
MEGHA-TROPIQUES
France, India

2011

ECV : radiation budget, rain, water cycle

Goal : study of the contribution of the water cycle to climate dynamics in the tropical atmosphere

CNES : provision of the main instruments (Madras, Saphir and Scarab); data processing



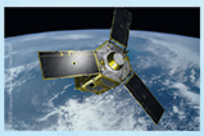
MERLIN
France, Germany

2019

ECV : methane

Goal : measurement of atmospheric methane as well as its variations in space and time

CNES : provision of the satellite platform (Myriade Evolutions); data processing



PLEIADES
France

2011 et 2012

ECV : land use, vegetation, continental ice sheets

Goal : coverage of all European defence and civil needs with sub-metre precision (very high resolution)

CNES : prime contractor for the entire Pleiades system

SENTINEL-2A
ESA, EC

2015

ECV : land use, vegetation, continental ice sheets

Goal : high-resolution (10-20m) multispectral optical observation

CNES : support for satellite development and operation; distribution of data to French users; Sentinel Products Exploitation Platform (PEPS)

SENTINEL-3A
ESA, EC

2015

ECV : sea level, sea surface temperature, water colour

Goal : sea level, sea surface temperature, water colour

CNES : support with the development and operation of these satellites Distribution of data to French users Sentinel Products Exploitation Platform (PEPS)

SARAL-AltiKa
France, India

2013

ECV : level of the sea, ice and inland water bodies

Goal : study of ocean variability (coastal areas, inland water bodies and extent of continental ice sheets)

CNES : development of the instruments (AltiKa, Doris), data processing

SMOS
ESA, Spain

2009

ECV : soil moisture, ocean salinity

Goal : measurement of ocean salinity and soil moisture

CNES : provision of the satellite platform (Proteus) Prime contractor for the satellite, control of satellite and related operations; processing and expert analysis of scientific data

SPOT 5
France, Belgium, Sweden

2002-2015

ECV : land use, vegetation, continental ice sheets

Goal : exploration of Earth resources, detection and monitoring of human activities and natural phenomena, as well as the impact of natural disasters

CNES : responsibility for the project and for maintaining the satellite in operational condition

SWOT
France, United States, England, Canada

2020

ECV : levels of the sea and of inland water bodies

Goal : global measurement of water levels of rivers, lakes and flood

CNES : provision of satellite instruments and platform, the satellite control centre and a data processing centre

VENµS
France, Israel

2016

ECV : vegetations

Goal : monitoring vegetation and providing data on the influence of environmental factors and human activity on land surfaces

CNES : provision of the superspectral camera, development and provision of the image processing and distribution centre

STRATOSPHERIC BALLOONS

Goal : in situ collection and study (chemistry and dynamics) of samples from the atmosphere

CNES : CNES's balloon activity is the world's largest; France's expertise in balloon design, manufacture, release and operation is recognised throughout the world