

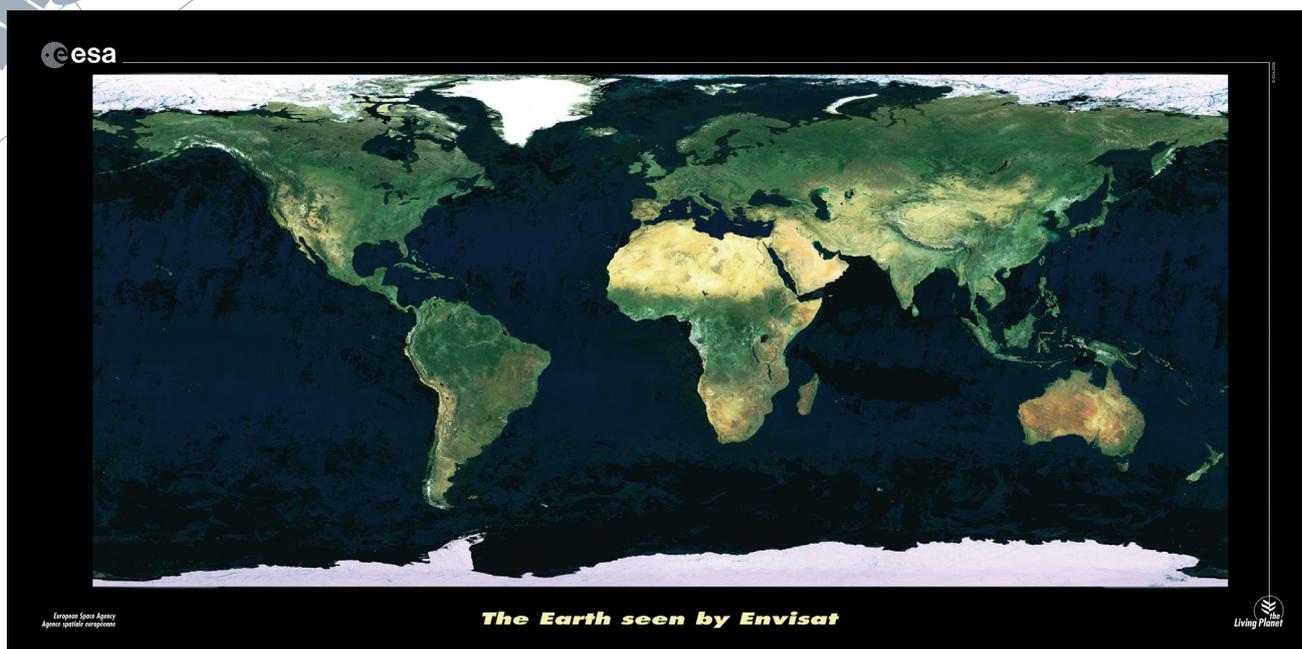
EARTH SCIENCES

SCIENCES DE LA TERRE

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Eruption of the Eyjafjallajökull volcano, Iceland, April 17, 2010
Le volcan islandais Eyjafjöll en éruption, le 17 avril 2010



[Fig. 1]

Because of their capacity to cover the Earth in a few hours or observe certain points of the globe permanently, satellites are an exceptional tool to monitor the planet. Their highly precise measurements enable to establish its current state but also to understand its dynamic evolution and the interactions between the layers which form it from the Earth core to the highest layers of the atmosphere. The combination of satellite and in situ observations (ground, balloons, planes, buoys, etc.) and physical models enables to establish forecasts of certain geophysical phenomena such as in meteorology or oceanography with the ocean forecasting system Mercator. The impact of man on his environment, climate change, major disaster management are all challenges for the current and future generations. Satellites are essential tools in this quest of knowledge and sustainable environment management. CNES and its partners in Europe and in the world contribute to this quest through the multilateral cooperation missions and major programmes in which it takes part in Europe such as GMES (Global Monitoring for Environment and Security) and its international coordination actions

such as the one as part of the CEOS (Committee on Earth Observation Satellites), the armed wing of the large international programme GEOSS (Global Earth Observation System of Systems) in space.

The year 2008 was placed under the sign of Earth with the International Polar Year and the International Year of Planet Earth. The year 2009 ended with the Copenhagen climate change summit, which emphasized the need for a better understanding of the Earth climate and its evolution.

Space and the climate

Jason-2 OSTM was launched on June 20, 2008 and thus marks the transition from research to operation in the field of altimetry. While Jason-1 was developed in cooperation with NASA, Jason-2 welcomed new partners: NOAA and Eumetsat, two operational meteorology agencies which took over the satellite operations for CNES and NASA.

The question of climate change and the continuity of environmental missions was at the heart of the ESA Ministerial Council of November 2008 when it came to its decisions

concerning the development of the Meteosat Third Generation programme, the second phase of the GMES programme and a new climate change programme. The GOCE satellite launched on March 17, 2009 and in which the French scientific community was greatly involved will enable to define more precisely the geoid and oceanic circulation. SMOS, which was launched on November 2, 2009, will enable to better characterize ground humidity and the oceans' salinity, two essential parameters in understanding the water cycle and the great oceanic currents. They will provide an abundance of data for researchers all over the world.

The importance of a better understanding of the Earth "machine" as part of an integrated vision through observation from space was put forward at the seminar of scientific prospective of Biarritz in March 2009. The recommendations that stemmed from this seminar will form the basis of CNES' programme in Earth observation for the coming years.

The European programme GMES (Global Monitoring for Environment and Security)

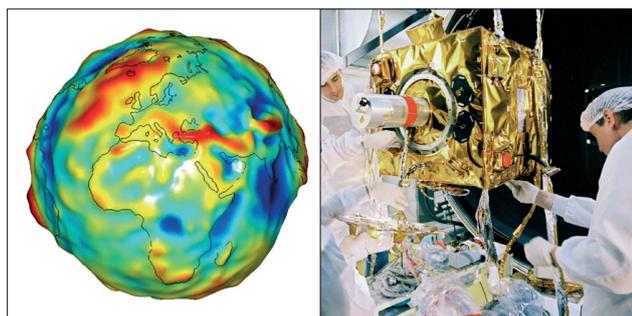
GMES is the European programme aiming at answering the needs of operational services for environment and security policies. It is at the heart of the European strategy for Earth observation.

Under the French Presidency of the EU, CNES was asked to organize the GMES forum held in Lille on September 16 and 17, 2008. With over 800 participants, it proved to be a great success and was the opportunity to present to users, politicians and the public the first services of the GMES programme in the fields of oceanography, air quality, ground occupation, risk management and security.

CNES is associated to the programme through its mission contributions and the signing of a support agreement with ESA on the Sentinel-2 and Sentinel-3 satellites dedicated to the observation of surfaces and oceans.

Mission exploitation

Exploitation of the missions SPOT, DEMETER, Jason, PARASOL, CALIPSO, IASI on MetOp, Champ, GRACE and GOCE is going on. The integration of the IASI data is having a positive impact on weather forecast in the medium term. IASI has also detected important ammonia emissions above India. The data from the A-Train, which includes PARASOL and Calipso, helps researchers to better understand the role of clouds and aerosols in the evolution of climate. DEMETER has detected electromagnetic signals associated with earthquakes, while the gravity field and its variations have been detected by the Champ, GRACE and GOCE missions.



[Fig. 2]

[Fig. 3]

The thematic poles whose objective is to unite scientific communities to achieve a combined analysis of space data and in situ data offer innovative solutions to the international community: ICARE (clouds, aerosols, radiation) ETHER (atmosphere chemistry). There is a reflection at the moment to structure the organisation of a continental surfaces pole.

Future prospects

2010, towards an operational programme for GMES

After a pre-operational phase financed by the budget of the seventh Framework Programme, the European Commission suggests the start in 2011 of a programme called GIO (GMES Initial Operations) to prepare for an operational programme. Moreover, ESA is moving forward with the development of the Sentinel-1 and Sentinel-4 satellites, units A and B, decided during the Ministerial Councils in Berlin in 2005 and the Hague 2008 as well as a Sentinel-5 Precursor satellite and preparatory studies for Sentinel-5 and Jason-CS which will be decided at the next ESA Ministerial Council.

2010-2011, missions aiming to better understand the water cycle

The year 2010 will see the launch of three essential missions for the communities that work on climate change: Cryosat (ESA mission for the study of ice), Megha-Tropiques (in cooperation with India to study the Monsoon and tropical regions) and SARAL (Indian-French satellite equipped with and ARGOS instrument and altimeter to measure the level of oceans and continental waters, AltiKa).

Preparing the future

As part of the ESA Earth Explorer programme, three missions were selected for phase A studies. These missions are Biomass, to study the biomass of forests and its role in the carbon cycle, Premier to understand the processes at the interface between the troposphere and the stratosphere, a crucial region in climate change study, and CoRe-H₂O to assess the water resources from ground snow and sea ice. A mission will be selected in early 2011. Moreover, a call for proposals was launched by ESA in late 2009 to identify the next mission. The selection of two or three projects will take place in late 2010.

The development of the CNES projects (Megha-Tropiques, Pleiades, Ven μ s, SARAL, Swarm, CFOSAT) is moving forward as well as phase A studies of IASI NG with Eumetsat and ESA to be flown onboard post-EPS in order to provide meteorologists with humidity and atmospheric temperature profiles, and researchers with precious data of the climate and the chemical composition of the atmosphere. MISTIGRI, in cooperation with CDTI, is dedicated to measuring the surface temperature and the restitution of energy flux between vegetation and the atmosphere. Finally SWOT, in cooperation with NASA, aims to measure the level of oceans and continental waters with a never-before-achieved precision.

Fig. 1: This mosaic of global land cover images taken by the MERIS instrument onboard ESA's environmental satellite shows the entire planet in its true colours. To produce the mosaic, a total of 1561 satellite orbit passes were used over the period May-November 2004.

Fig. 2: Global model of amplified gravity variations by the satellite GRACE.

Fig. 3: The MLI instrument being set up onboard the Myriad-type PARASOL microsatellite.