Science in the Palace
Exhibition « Satellites: Art and Technology »
Royal Palace, Brussels - 25 July > 7 September 2008

In orbit around our beautiful, yet fragile planet, satellites are watching.

Their sophisticated on-board sensors record data which allow scientists not only to monitor our Earth, but also to understand more clearly its atmosphere, oceans, etc.

Since 1979, Belgium and France have been cooperating in the field of Earth observation. Along with Sweden, the two countries concluded an agreement on developing a family of satellites for civilian uses, known as SPOT (from the French Satellite pour l'observation de la Terre). The implementation of this intergovernmental agreement is a matter for Belgian Federal Science Policy and CNES (Centre national français d'études spatiales). The first satellite, SPOT 1, was launched in February 1986 and the most recent, SPOT 5, in May 2002.
The three sensors on board SPOT 5 allow the acquisition of 3D images (HRS sensor), high-resolution images (HRG sensor) and global images (VEGETATION sensor).
The Toulouse firm of Spot Image was entrusted with the distribution and exploitation of the high-resolution images. The VEGETATION images-processing centre (CTIV), established in Belgium, is responsible for processing, archiving and distributing VEGETATION data.

A series of satellite images from various parts of the world recorded over the past 20 years is on show in the Palace's main gallery. Exhibited like works of art, these images reveal the beauty of our planet.

What is a satellite?
In astronomy, a satellite is a celestial body revolving around a planet (e.g. the Moon, which is the Earth's natural satellite).
In astronautics, it is a man-made vehicle orbiting the Earth; an artificial satellite.

50 years ago, the former USSR launched the first satellite; Sputnik. Since then, it is estimated that something like 4 000 satellites have been sent into orbit.

There are different types of satellite: communications satellites (e.g. television, IT data exchange,…), navigation satellites (GPS system), space probes (planetary exploration), orbital stations (microgravity experiments) and, lastly, Earth observation (or remote-sensing) satellites.

What is remote sensing?

Remote sensing is most widely accepted as denoting the acquisition of information about objects using measuring tools that remain distant from these objects. Human sight is the foremost example of a remote-sensing system.
Spatial remote sensing in space refers to all the know-how and techniques used to determine the characteristics of the surface and atmosphere of the Earth or other planets, with help of data collected by sensors installed on board satellites.

It uses measurements of electromagnetic rays emitted or reflected by the objects under investigation within specific frequency ranges (e.g. infrared, visible, microwave).

The information obtained helps to provide solutions to society's needs in a variety of areas: science (e.g. meteorology, oceanography, environmental studies, geology…), humanitarian and security applications (monitoring of natural and human disasters), public service (as a decision-making support tool), and business.

Belgian Science Policy Office launched its first Earth observation national research programme in 1985.

This programme complements the Belgian participation in international space programmes (such as those of the European Space Agency, ESA) or in the SPOT programme.

Today, under the name STEREO 2, the programme continues to respond to Belgian Earth observation strategy, aimed primarily at:

- → ensuring widespread use of satellite data as an information source
- → consolidating Belgian scientific expertise and allowing its take-up within internationally renowned research centres

GMES, Global Monitoring For Environment and Security, is a European initiative aiming at offering services distributing information about environment and public security monitoring, with the help of land, sea and atmosphere satellite measurements. These information networks will assist governments, organisations and private-sector bodies with making their decisions globally as well as at local level.
Within this framework, numerous Belgian partners are active in extremely diverse fields, e.g. crop forecasts in Africa, flooding in critical zones, ozone concentration measurements, maps of crisis regions for humanitarian aid, etc.

And to do what?

Satellite imagery is a favoured source of useful information for the scientific community, as tools for helping public institutions with decision-making and management and also for the development of products and services in the private sector.

Application fields include:

Agriculture

Today, agriculture must successfully produce sufficient amounts of high-quality food for a booming population, but at the same time pay increased attention to the environment. This is what is known as sustainable agriculture.

The most direct application of satellite images is crop recognition. This is used for statistical ends and to control crop areas in order to allocate farm subsidies.

In precision agriculture, close monitoring of plant growth using satellite data enables better adaptation of the amounts of fertilisers and pesticides used as well as more effective irrigation. Some soil characteristics, such as organic matter or moisture content, can also be deduced.

In some parts of Africa, early yield projections using crop growth models developed on the basis of satellite data would make it possible, for example, to take the necessary action in time to avoid famine.

Ecology and Land Use Management

Growing numbers of ecosystems are coming under threat from human activities such as deforestation, urbanisation and the exploitation of natural resources. This trend is having severe environmental as well as economic repercussions.

Satellite images are a major help tool for the study and protection of regions of high ecological value (e.g. tropical forests, river deltas) or economically important (e.g. the threat to the Great Plains from extensive livestock farming).

Diseases spread by carriers in ruminants (e.g. blue tongue disease) are a major problem both in developing countries and in our regions. They result in significant losses of income for rural populations. Data from satellite images make it possible to estimate the probability of vectors being present and specify their progression rate. Given the high health and economic stakes involved, determining a region's ecological vulnerability is vital for the coordinated management of crisis situations.

Meteorology

At present, 16 geostationary weather satellites (located above the same vertical point on Earth) are participating in the global observation system of the World Meteorological Organisation (WMO), enabling continuous Earth observation between 70° latitude North and 70° latitude South.

They are supported by polar satellites that supply far more detailed images, but do not allow a same region to be monitored continuously.

Alongside meteorological applications (weather bulletins, cyclone forecasts…), data from weather satellites are also used in a host of other areas: climate research, oceanographic applications (measurement of the sea surface temperatures or of sea levels, modelling of sea currents, etc.), observation of ice and snow-covered surfaces, monitoring of the Earth's vegetation at global level (e.g. forest fires, desertification, harvest forecast models…).

Aquatic Environments

Some 40% of the world's population live within 100 km of the sea. Many people depend on the seas and oceans for a living (e.g. fishing, port activities, tourism).
Eighty percent of all human activities take place in coastal areas, inevitably damaging the marine environment through the empting of fuel tanks, waste water disposal, the extraction of sand and overfishing, causing coastal erosion and sedimentation.

In coastal areas, satellite data are used to pinpoint the exact location of navigation channels, take measurements of underwater depth and detect oil spills, but also to observe coastlines, water quality, sedimentation and fragile marine ecosystems such as coral reefs and mangrove swamps.

Out to sea, satellite data are used to map currents, measure and observe water surface temperature, help determine the most appropriate routes for shipping lanes, and improve models predicting wave height and storm severity.

Regional Planning

Rising populations and urbanisation entail a continual expansion and adaptation of transport infrastructures, housing, supply of drinking water and of all things necessary for economic growth.

Satellite data and especially very high-resolution images lend themselves particularly well to local and regional planning.

In urban areas, the automatic detection of changes in terms of buildings and roads facilitates the updating of maps. Detailed cartography of green areas enables more efficient management of these. Satellite data can also be useful for impact studies, for example the evaluation of the impact of impermeable surfaces on water run-off.

Environmental Risks and Humanitarian Aid

The number of natural disasters recorded over the past ten years has virtually doubled compared to the previous decade. 2007 saw 25 000 people killed in the wake of natural disasters. The number of people affected, particularly by flooding and drought, reached over 200 million and the economic cost stood at around 75 billion dollars.

Another effect of global warming, which is responsible for a rise in the intensity and frequency of meteorological disasters, has been to increase human vulnerability to extreme events.

The consequences of disasters can be limited through adapted management, including not only prevention (risk assessment, regional and local planning) but also adequate assistance. Remote sensing is a particularly suitable tool for the roll-out of each of these phases.

Multi-temporal series can reveal telling changes in relation to a risk of volcanic eruption or earthquake. Elsewhere, data from weather satellites are vital for the development of hydrological models useful in assessing flood risk. Satellite images also make it possible to assess very rapidly the repercussions of an ongoing or recent natural disaster on a wide region, which is vital for arranging aid.

Since 1 November 2000, the International Charter "Space and Major Disasters" has aimed to supply civil protection, relief, defence and security agencies in member countries with the satellite data necessary for the efficient management of natural and human disasters, thus helping to mitigate their repercussions.

Global Monitoring

The world's population is rising steadily while available surface areas and resources remain stationary. The Earth is coming under ever increasing pressure: you only have to think of the large-scale deforestation, decline in natural areas, pollution, and climate change, to name but some examples.

This evolution could have disastrous consequences without a sustainable approach to economic development and management of the Earth's natural resources. Over the past decade, awareness has grown about the fact that the Earth is a vast living entity and that phenomena occurring on one side of the planet may have severe consequences on the other side. El Niño and the greenhouse effect are vivid examples of this.

This mounting consciousness has been reflected in the conclusion of international treaties and conventions, such as the Climate Convention, the Kyoto Protocol for reductions in greenhouse gases, the Vienna Convention for protecting the ozone layer, or the United Nations Convention on biodiversity.

Satellites are the perfect tools and often the only ones capable to study at global level the interactions between oceans, continents and the atmosphere. They allow changes to be monitored across vast expanses and, thus, the development of a deeper understanding of the phenomena. They are used, for example, to observe vegetation, map changes in land use, measure ozone concentrations and monitor ocean temperatures.

In this way, satellites provide the information necessary in order for decision-makers to choose options compatible with the sustainable development of our planet..

Made in Belgium

Launched in October 2001, PROBA 1 is the name of the first Belgian satellite. Its development was handled by the company Verhaert (near Antwerp) at the request of the European Space Agency.

Although the satellite was expected to have a maximum working life of just two years, it is still functioning today. Each day, it beams high-resolution images back to the whole of the scientific community (for example, images of forest fires in southern France, the eruption of Etna, the filling of dams in China).

Proba 2, whose launch is scheduled for 2009, will be tasked with observing the Sun.

From 2011, Proba V ('V' as in vegetation) will be in charge of observing the Earth's vegetation. It is expected therefore to take over from the VEGETATION sensors installed on board the Spot 4 and Spot 5 Earth observation satellites.

The Proba 3 project, which is also currently in preparation, will involve the launch of two small satellites in formation for the purpose of demonstrating advanced technologies.

As a State administration, the Belgian Science Policy Office is tasked with maximising Belgian scientific and cultural potential in the service of political decision-makers, industry and ordinary citizens: "a policy for and by science".

The Belgian Science Policy Office and its ten Scientific Institutes employ some 2 700 staff.

National Archives and State Archives in the Provinces / Belnet / Royal Library of Belgium / Centre for Historical Research and Documentation on War and Contemporary Society / Belgian Institute for Space Aeronomy/ Royal Belgian Institute of Natural Sciences / Museum of Natural Sciences / Royal Institute for Cultural Heritage / Royal Meteorological Institute of Belgium /Royal Museum for Central Africa / Royal Museums of Art and History / Royal Museums of Fines Arts of Belgium / Royal Observatory of Belgium / Planetarium of the Royal Observatory of Belgium / Scientific and Technical Information Service

For more information: http://eoedu.belspo.be