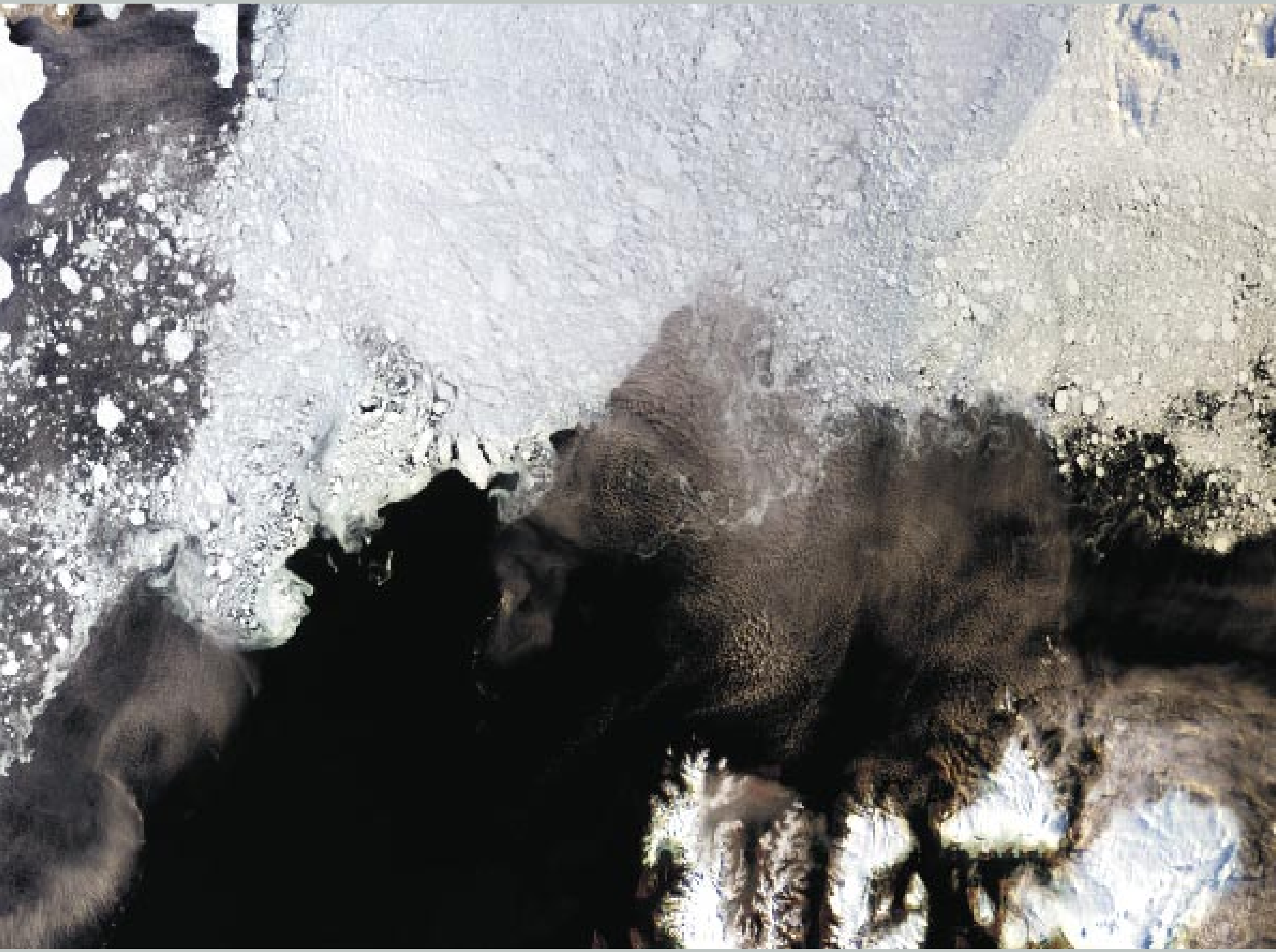
NordicSpace

Volum 15 No. 3/2007



FOCUS - Environment

- Protect our dark sky
- Water and climate on Mars

ISSN: 0805-7397

From my point of view

Satellites monitor the changing climate

Our environment is under stress, few doubt that any longer, and the consequences become clearer day by day, changes that are not at all positive.

Do satellites play a role in the fight to preserve our climate?

Not in terms of reduction in harmful emissions from human activities, but they will play a key role in terms of delivering data for further research and in monitoring the situation and evolution.

Earth observation satellites of different types circle around the Earth, and common for them all is that they deliver a very great number of data. For the European community satellites like ERS 1 and 2, and ENVISAT has delivered a series of data from 1992. Together with the American earth observation satellites, within some fields, the data series run from the early seventies. Such long running series is very valuable for scientists, and it is important that new sensors in space continue to gather the same data, in spite of new and better sensors.

During the last decades Satellites orbiting the Earth have monitored shrinking sea ice in the Arctic, decreasing glaciers around the world, increasing desert areas in Africa and shrinking water level in lakes and rivers.

Several years ago satellites detected shrinking ozone levels over Antarctica, later also over the Arctic. Researchers relatively quickly discovered the reason; uncritical use of CFK gasses in daily used remedies in the society. The politicians equally quickly took action; banned the use of such gasses and the result was an immediate decrease. Today the Ozone layer is increasing and can possibly be completely repaired within some decades.

Let us hope the politicians are up for the challenge and take necessary precautions and actions this time, thus reversing the dangerous evolution. I do not doubt that the satellites will provide the necessary data and the scientists will provide the right conclusions, but the world's politicians must take the actions.

The time for doubt is over, now actions must be taken.

Baard Kringen

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Professor Ola M. Johannessen
Nansen Environment and Remote Sensing Center

"Satellites are, and will probably still be, the most important tool for climate observations."

FOCUS Environment

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Cover photo:

Svalbard area as seen by Envisat.
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be seen. The image width is about 800 km. Credits: ESA

Professor Ola M. Johannessen talking with Nordicspace

Going back several decades, Professor Ola M. Johannessen was introduced to oceanographic science before the first earth observation satellite was launched. Since then he has been working with satellite observations and he is still working in this scientific field, following the development of new sensors and observation techniques very closely. Data from the satellites has also been the main source for his research, of course completed with in situ observations and modelling.

After a period dealing with fjord and coastal research, he later switched to research dealing with oceans and ice while working at the McGill University, Canada, in the late sixties. After several years abroad he returned to Bergen in 1974. Since then - Bergen has been his base, the whole world his working place, and ocean and ice his main scientific areas.

An interest for weather and sea from the early days as a young yachtsman has brought Ola M. Johannessen to a position as one of Europe's leading scientists within the field of oceanography and sea ice. From his research he was one of the first to warn people about the decreasing ice coverage in Arctic, an observation that would not have been possible without the earth observation satellites. The use of satellites is a matter very close to his heart– he access that this is the most important tool for science and society for large-scale observations of the climate, learn more about it, and monitor its evolution.

"If we assume that Greenland's ice sheet melts at the same rate as now, it will take about 20,000 years until the whole ice sheet is gone....."

"Within my field", says Johannessen, "the microwave satellites are the main source for information, they are not dependent of a clear sky, day or night and have given us a continual stream of data from 1978, including the development of new and better sensors".

The most valuable sensors for Johannessen's use are the altimetry and passive microwave sensors, placed in polar orbits. The best known are the European Envisat and the American IceSat. Altimeter-satellites like Topex Poseidon and Jason are also valuable, but they do not polar orbit so they cannot give information from the high latitudes, while IceSat does not give continuous information from the sensor.

It was data from passive microwave sensors that caused Ola M. Johannessen and the Nansen Centre in 1995 to raise the alarm about shrinking ice coverage in the Arctic in a paper in Nature, something which unfortunately has continued in an accelerating scale ever since. In 2004 he and his colleagues published a paper in Tellus where they for the first time predicted that the ice will disappear during the summer in the Arctic Ocean before the end of this Century.

The inland ice of Greenland is another field Johannessen has been working with. Based on altimeter data from ERS and Envisat satellites it was found that the ice sheet over 1500 metres increased with around four centimetres every year during the 1992-2005 period, but one knows that the melting is relatively strong near the margin of the ice sheet. Calculations thus indicate a melting of around 100 Giga tons ice per year from the margin of the ice sheet. That provides an increase of the ocean global sea level of 0.3 mm a year. The global ocean sea level increases with 3 mm yearly, 0.8 mm of this occurs due to melting of all other of the Earth's glaciers, the rest occurs from the ocean's expansion caused by increasing ocean's temperature due to global warming. If we assume that Greenland's ice sheet melts at the same rate as now, it will take about 20,000 years until the whole ice sheet is gone, resulting in a global sea level rise of 7 m. Johannessen says "that many overstate the importance of the melting of the Greenland ice sheet. Of course, all the ice may eventually melt sometime, but that will not happen in the foreseeable future".

Another issue regarding the melting of the ice sheet is the increasing flow of freshwater from it. That may influence the Gulf Stream and in the worst case, reduce it. That was some of the background for a new expedition to the coast of Greenland in September-October last year, an expedition Johannessen was the leader of. "The further evolution of the situation of the Greenland ice sheet and the drifting ice in the Arctic Ocean will have immense influence on the climate in our region, and also for rest of the world. This is something we will focus on to a great extent in the future, both at the Nansen Centre and part of the international climate research community", he says.

Another interesting phenomenon Ola M. Johannessen has detected on one of the expeditions to the Arctic ice edge is the reasons for the high production of biological production along the ice edge. During an expedition north of Svalbard in 1977 they detected the upwelling of deeper water along the edge of the drifting polar ice. The phenomenon is well-known along the coastline, but for the first time detected along the ice edge of this expedition. Such upwelling in the summer time, with abundance of light, 24 hours a day, provides very high biological productivity along the ice edge.

You were the initiator of founding the Nansen Centre in Bergen. Have the expectations been fulfilled?

Yes, I think so. From the small staff twenty years ago, we are now about sixty persons from 14 nations including 15 PhD students. The participating in the different types of scientific projects, production of scientific papers and delivering of facts for the society from the centre during these years make us reasonable satisfied with the progress.

Nansen Centre has expanded in Russia and in the Far East. What have these countries in common with Norway that can provide common ground for cooperation between the institutes?

For Russia it is a simple answer since Russia has great experience within the same fields as Norway in the Arctic; they have a well-developed ice research community, and they give us possibilities to participate in research programmes in the Russian areas benefiting both countries and the international community. China and India have in addition to the large ocean areas, and interests connected to the higher latitudes through teleconnection of climate processes affecting the climate in our regions and vice versa.

Increasingly more and new satellite sensors are launched, which ones do you have the most exceptions for?

One of the new satellites we have great expectations for is GOCE (Gravity Field and Steady-State Ocean Circulation). The satellite will provide possibilities to calculate ocean current for the world oceans. The satellite I personally have the greatest exceptions for is Cryosat II altimeter satellite that will be launched in 2010. This satellite is enormously important for our research regarding the present situation and evolution on Greenland ice sheet and the ice cover in the Arctic Ocean. With new and better methods for detecting the ice surfaces, we will have better possibilities calculating the mass of ice in the Arctic region. The altimetry data from the satellite will be fundamental for our calculation of ice thickness of the sea ice, and for detection of the evolution of the height of the ice sheet on Greenland.

Does Norway have the position within the field of ocean and ice research that the geographical position indicates?

After so many years in this research field, I am very disappointed of the lack of money from the Norwegian Government to interpret the data from the Earth observation satellites. Norway participates in ESA's Earth Observation Programme with nearly 70 mill. NOK/year. However the amount of funds that is available to interpret this data from Norwegian Space Centre is only about 9,5 mill. NOK/year. For comparison, my community proposed 14 millions NOK per years twenty years ago. Without our centre's participating in international programmes we would not have had possibilities to have an institute like the Nansen centre today. I will say it is a scandal to use so little for data analysis when the nation spends so much money in the ESA-infrastructure program. To me it is incomprehensible that the politicians do not see this, in this time with climate in focus, the very valuable source for knowledge that the satellite sensors provide both for local, regional and global problems.

Can the scientists play a more active role in influencing the politicians and the rest of the society?

Undoubtedly, we should and we are taking part in proposing scientific program both to the Norwegian Space Centre and the Research Council of Norway and we feel that it is their responsibility to influence the different ministries and politicians – but so far little luck. Our "job" should be to work with data and scientific problems to the benefit of the society, so my message to the Norwegian Government is:" Open your eyes and see how useful satellite observations are, then consider to give the Norwegian satellite earth observation community a significant increase in funding, 30-40 mill. NOK/year will do it – ACTION".

"I will say it is a scandal to use so little for data analysis when the nation spends so much money in the ESA-infrastructure program."

Ola M. Johannessen has no to intentions of resting on his laurels. Lately, he has been active in working with a merger of Bergen's different institutes within climate and environment to a common centre, the Nansen-Bjerknes Centre for Climate and Ocean Research. In addition, he has been elected, as one of the four members of the ESA's Science Policy's senior advisory body group for ESA's Director-General, Jean-Jacques Dordain.

We will undoubtedly hear more about ocean, ice and climate from Professor Ola M. Johannessen in the future as well.

Prof. Ola M. Johannessen
Nansen Environmental and Remote Sensing Center / Geophysical Institute, University of Bergen, Norway

Ola M. Johannessen (OMJ) is at present the Founding Director of the Nansen Environmental and Remote Sensing Center (NERSC).

Since graduating from the University of Bergen (UoB) in 1965, with the degree Cand. Real. in oceanography, he has held different faculty and research positions at the University of Sao Paulo in Brazil, McGill University in Canada and the NATO Research Center in Italy, before returning to the University of Bergen in 1974 as a tenured Assistant Professor before he was promoted to a tenured Associate Professor in 1975 and to a tenured Professor in 1987

OMJ is presently involved in the following scientific fields: Global warming detection and prediction of the Arctic climate system, including sea ice, Greenland ice sheet and deep water formation and its impact on the thermohaline circulation; CO_2 uptake and CO_2 injection in the ocean, global change studies of marine ecosystems, marine pollution, harmful algae blooms, radioactive spreading in the ocean, Indian and Southern Ocean circulation studies and socio-economic impact studies of global change.

Through his career OMJ has been the author and co-author of 473 publications of which 7 are books and 138 are in referee journals, books and proceedings (e.g. 8 in Science – 1 in Nature). OMJ has been the supervisor for 30 Master and PhD students. Presently he supervise several PhD students at the different Nansen Centres in Norway, Russia, India and China. OMJ was a contributing author to the Third Assessment IPCC Report and has been an IPCC expert reviewer for the Fourth IPCC Assessment report.

He has received 8 awards for his research and leadership. He was the Laureate of the EU Descartes Prize in Earth Science in 2005 for leading the project: Climate and Environmental Change in the Arctic (CECA). Furthermore he received the Fridtjof Nansen Medal for Outstanding Research in 2007 which is an official Norwegian decoration.

In 1986 OMJ took the initiative to start the Nansen Environmental and Remote Sensing Center (NERSC) (www.nersc.no) in Bergen, and later contributed to establishing similar institutes in Russia, India and China At present the Nansen Group, with OMJ as the leader, consists of these four institutes, employing 150 persons including 45 PhD candidates.

OMJ is elected full member of the International Academy of Astronautics, the European Academy of Science and Arts, Finnish Academy of Science and Letters, the Norwegian Academy of Technical Sciences and the Norwegian Academy of Science and Letters.

GOCE –

Improving the understanding of high latitude ocean circulation

Introduction

The primary aim of the Gravity Field and Steady-State Ocean Circulation Explorer (hereafter termed GOCE) Mission approved by the European Space Agency (ESA, 1999; Johannessen et al., 2003) is to provide unique models of the Earth's *gravity* field and the *geoid*, on a global scale with spatial resolution of 100 km and to very high accuracies of 1 mGal (1 mGal = 10^{-5} m/s^2) and 1-2 cm. This will provide new and fundamental insight into a wide range of multidisciplinary research and application areas, including solid Earth physics, oceanography and geodesy.

The Earth's geological evolution has resulted in a *gravity* field that departs significantly from an ellipsoid. The differences between the real, measured values of *gravity* and those that would be produced by the idealised ellipsoidal shaped body are denoted as *gravity anomalies*. These anomalies range typically between ± 300 mGal.

The *geoid* is a "level surface" which departs from the Earth's idealised 'ellipsoidal shape of equilibrium' by ± 100 m as a consequence of the topography and density inhomogeneities in the structure of the lithosphere and mantle that result in the *gravity anomalies*. The special significance of the *geoid* is that its shape defines the local horizontal and on land provides the reference surface for topography. Over the ocean it would correspond to the mean sea level if the surface was at rest (absence of tides and currents).

Figure 1b. *GOCE octagonal shaped satellite approximately 5 m long and 1 m in diameter (courtesy ESA).*

The GOCE payload (Figure 1a) consists of an electrostatic gradiometer (3 pairs of 3-axis, servo-controlled, capacitive accelerometers, each pair separated by a distance of 0.5 m), a 12 channel GPS receiver, and a laser retroreflector enabling tracking by ground lasers (Drinkwater et al., 2003). The spacecraft is approximately 5 m long and 1 m in diameter with fixed solar wings and no moving parts (Figure 1b). GOCE is scheduled for launch on 30 May 2008. It will fly in a Sun-synchronous, circular, dawn-dusk low Earth orbit, with an inclination of 96.5˚ and altitude of about 270 km. The nominal mission duration is 18 months, including a calibration phase and two measurement phases of 3 and 6 months duration each separated by a long-eclipse hibernation period.

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Dr. Johnny A. Johannessen has 25 years experience in satellite remote sensing in oceanography and sea ice research. In particular, he has focused on studies with the use of the synthetic aperture radar (SAR). In the recent years he has also been involved in development and implementation of integrated monitoring and operational oceanography systems.

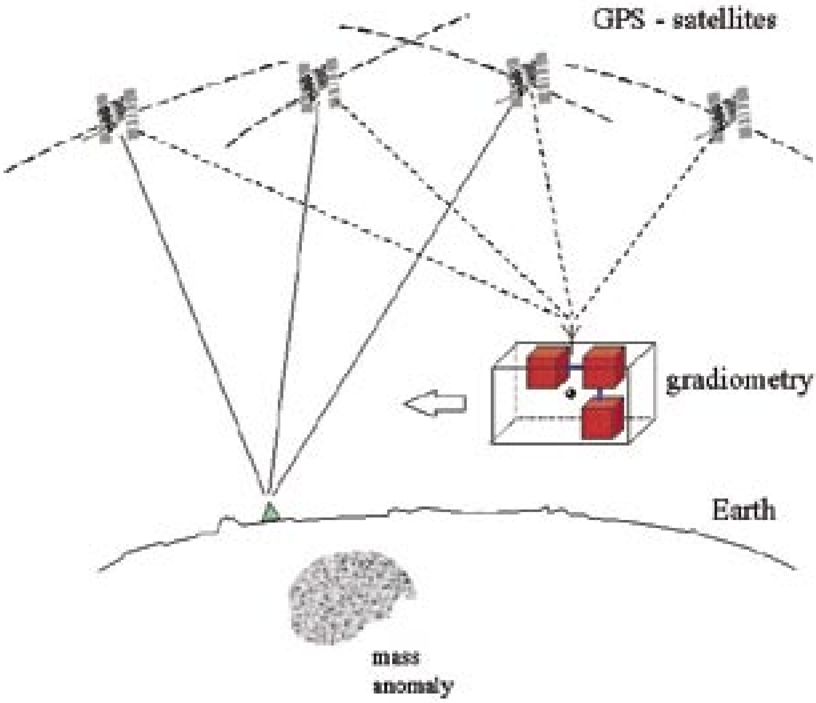

Figure 1a. *Concept of satellite gradiometry combined with satellite-to-satellite high-low tracking with GPS (courtesy ESA).*

In this short paper the research objectives and expected impact of GOCE with focus on oceanography at high latitudes are briefly addressed. The website http://www.esa.int/livingplanet/goce/ gives further details of the current status of the GOCE mission.

Expected impact of the GOCE mission in oceanography

While variations in the sea surface height and thus in the ocean currents can be derived directly from satellite altimeter data, an assessment of the absolute value of the ocean dynamic topography (mean dynamic topography plus sea level anomaly) and hence the surface current requires that the *geoid*, be subtracted from the altimetric mean sea surface height. The typical elevation scale of the dynamic topography is of the order of 0.1 to 1 m. The precision of present *geoid* models is similar on the scale of many ocean-circulation features.

The accurate and high-resolution marine *geoid*, as derived from GOCE, will in combination with precise satellite altimetry enable new estimates to be made of the absolute ocean topography at wavelengths down to 100-200 km (Figure 2). In combination with *in-situ* data and ocean models, this will, in turn, provide a high-resolution "window" on the ocean circulation at depth. Such improvements in estimates of the mean ocean circulation are much needed as addressed below.

Interpretation of Circulation at Short-Spatial-Scales. The mesoscale energy in the ocean topography (height) fields is centred at the 100-250 km half-wavelength band. Knowledge of the eddy statistics of the real ocean from altimetry, together with precise knowledge of the positions of the ocean current fronts from altimetry plus *gravity* will enable a more accurate determination of the role played by the eddies in maintaining the mean current components of the circulation. Fronts are expected to have decimetric signals in sea level relative to the *geoid* at these length scales and will thus be provided by GOCE in combination with altimetry. In turn, more reliable constraints and greater confidence can be placed in the construction and use of ocean and climate models.

Interpretation of Oceanic Flux Estimates. 1 Sv of volume transport (values of ocean volume transports are given in Sverdrup (Sv); 1 Sv = 10^6 m^3/s) corresponds to a heat transport of approximately 5×10^{13} W at mid latitudes, which is of the order of 5% of the total heat transport in a single ocean basin. Present uncertainties in ocean transports are estimated to be approximately 10%. With GOCE data the largest reduction in transport uncertainty is expected to occur in the upper ocean, which is not surprising because reduced *geoid* errors will directly provide precise constraints on upper ocean current estimates. In addition, the positive impact on surface-to-bottom transport uncertainties will also be manifested in regions of marked barotropic character such as at high latitudes. Many of these transports, play a fundamental role in the redistribution of heat from the equator to the poles. As such GOCE will contribute to improvements of our understanding of the role played by the ocean in the global climate system.

In the GOCINA project (Knudsen et al., 2006) the flow of water masses between the Northeast Atlantic and Nordic (Norwegian, Greenland, Iceland, Barents) Seas was examined. The circulation and volume transport between these ocean basins have a profound influence on the water masses leading to a horizontal and vertical density structure unlike any other ocean regions. The question is how the mean dynamic topography (MDT = mean sea surface minus the geoid) reveal this characteristics circulation regime and volume transport. An Iterative Combination Method (ICM) mean was developed combining gravity observations and synthetic gravity data derived from altimetry and several ocean MDT models

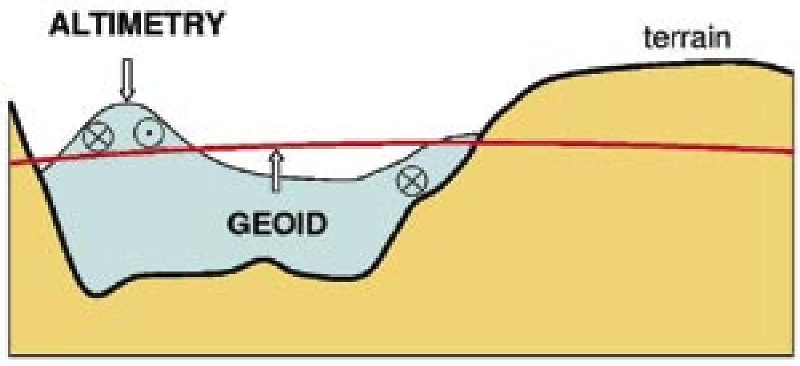

Figure 2. *Conceptual illustration of the relative slope and elevation of the geoid and the sea surface.*

to produce the best possible MDT. This new MDT map is shown in Figure 3 with a maximum elevation difference of about 80 cm. For currents following the western European shelf edge, the ICM solution has a very coherent flow. In the South–eastern Norwegian Sea, the ICM model resolution is good enough to identify the two branches of the North Atlantic water that enters the Norwegian Sea, i.e. the one directed through the Faeroe–Shetland channel and the one flowing eastward along the north side of the Iceland–Faeroe ridge. In the Irminger Sea a low of -17 cm implies the presence of a local cyclonic circulation known to exist.

Furthermore the study showed that the assimilation of SLA referenced to this ICM MDT together with salinity and temperature profiles will improve substantially the dynamic state in ocean models. The results of these simulation experiments suggest that access to the new and high quality gravity field and geoid data from GOCE will lead to more accurate volume and heat transport estimates between the North Atlantic and Nordic Seas.

Global Sea-Level Change. GOCE can also improve our understanding of past sea-level changes, and thereby improve predictions of future changes (Visser et al., 2002). For instance, more accurate models of Glacial Isostatic Adjustment and of local tectonics will result in more precise estimates of the rates of "real" global- and regional-average sea-level changes during the past century by reanalysis of the historical tide-gauge records. Moreover the more reliable determinations of ocean heat and volume fluxes can be used to improve the General Circulation Models (GCMs) employed to determine sea-level change due to thermal expansion.

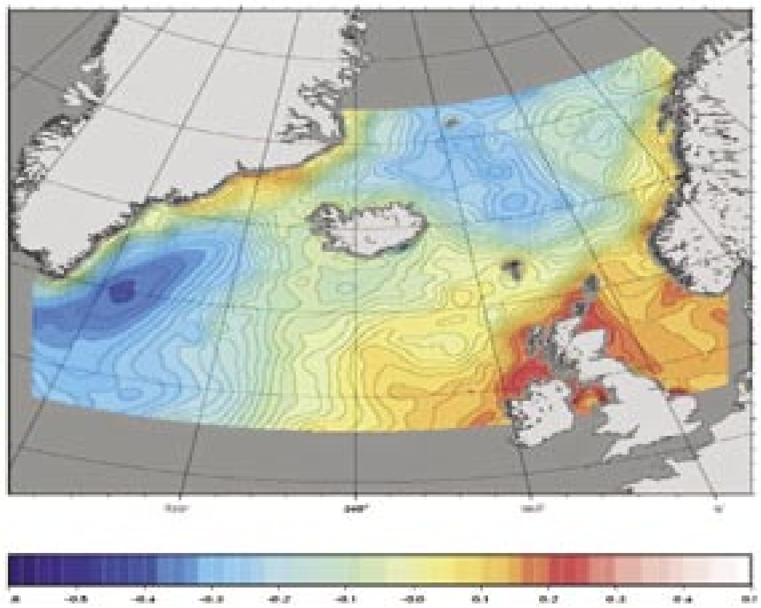

Figure 3. *Simulated mean dynamic topography across the Greenland-Scotland gap obtained from the GOCINA project (Knudsen et al., 2006; courtesy of Roger Hipkins). Maximum elevation change in the MDT of about 70-80 cm is depicted from the isobaths in an east-west direction between the Greenland and Scotland. The color-bar indicates the elevation change in unit of m.*

Summary

Data from the GOCE mission, scheduled for launch on 31 May 2008, will produce a new model of the *gravity* field and the geoid of unprecedented accuracy and spatial resolution. With the corresponding mean dynamic ocean topography derived from the GOCE *geoid* in combination with precise altimetry and *in-situ* observations practically all open ocean current systems from the strongest (Gulf Stream, Kuroshio, greater Agulhas Current regime, Antarctic Circumpolar Current) through to weaker deep-ocean circulations should be better determined in terms of location and strength. In particular, the high-spatial-resolution *geoid* afforded by GOCE is expected to

-reduce the uncertainties in mass and heat transport.

-benefit ocean modelling and forecasting

-facilitate more comprehensive investigation of sea-level changes.

Results from the GOCINA study, complemented by findings from the OCTAS project (Solheim et al., 2007) demonstrate that reliable knowledge of the comparatively high spatial variability of the steric height and MDT within the Nordic Seas and Arctic Ocean will benefit from the precise estimation of the geoid to be provided by GOCE (Knudsen et al., 2006; Siegismund et al., 2007). In addition, the GOCE data is also expected to have very important contribution to and synergy with the Cryosat-2 mission (planned for launch in 2009) for studies of the sea ice thickness in the Arctic and sub-arctic seas as demonstrated by Fosberg et al. (2007) in the ArcGICE project.

Acknowledgments. The GOCINA project was funded by EU under the contract EVG1-CT-2002-00077. The Research Council of Norway supported the OCTAS project (number 155835/700). The ArcGICE project was funded by ESA.

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GOCINA (Geoid and Ocean Circulation in the North Atlantic)

As the name indicates GOCINA determines an accurate geoid in the region between Greenland and the UK. The geoid will together with new developed mean sea surfaces and mean dynamic topography improve the analysis of the ocean circulation and transport through the straits in the region.

GOCINA is a joint European project consisting of 6 partners from Denmark, Norway, England, Scotland and France. It started in November 2002 and lasted for a period over three years and has ended now.

GOCINA has developed generic tools to enhance ocean analysis using Earth observation data from ENVISAT and GOCE. The project has examined the mass and heat exchange across the Greenland-Scotland Ridge. This analysis has given invaluable information on the ocean's role in climate. The project will in particular support the GOCE mission with a set of specific recommendation for integrating GOCE in ocean circulation studies and an accurate geoid model for validation purposes.

GOCINA is a shared cost project (contract EVG1-CT-2002-00077) co-funded by the Research DG of the European Commission within the RTD activities of a generic nature of the Environment and Sustainable Development sub-programme of the 5th Framework Programme.

New satellites for Ice and Soil

This year NASA starts planning of the Soil Moisture Active-Passive (SMAP) and the Ice, Cloud and land Elevation Satellite-II (ICESat-II) missions.

SMAP will provide the first-ever high-resolution global maps of soil moisture for early warning of droughts, improved weather and climate forecast and predictions of agricultural productivity.

ICESat-II will precisely measure the heights of ice sheets and sea-ice thickness, and provide estimates of above-ground forest and vegetation biomass.

The Landsat Data Continuity Mission

a guarantee for a continuous Earth observation data set

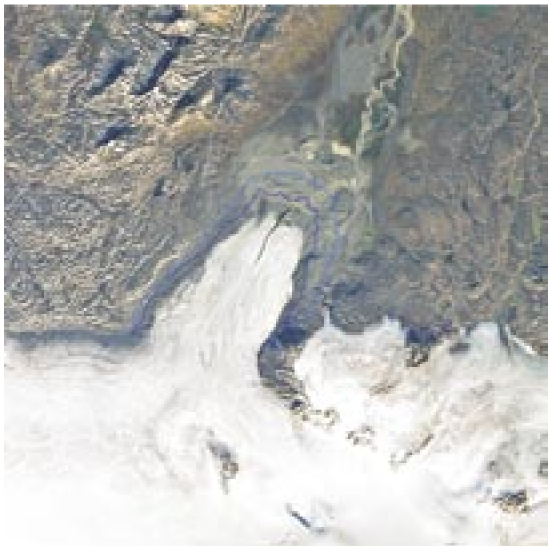
For nearly 35 years, Landsat satellites have collected data of the Earth's continental surfaces to support global change research and applications, but the continuity is in danger.

The data constitutes the longest continuous record of the Earth's surface as seen from space. Imaging Earth's land environment has happened at a resolution sufficient to record the impacts of human activities. It is very important the data collection from the sensors continue.

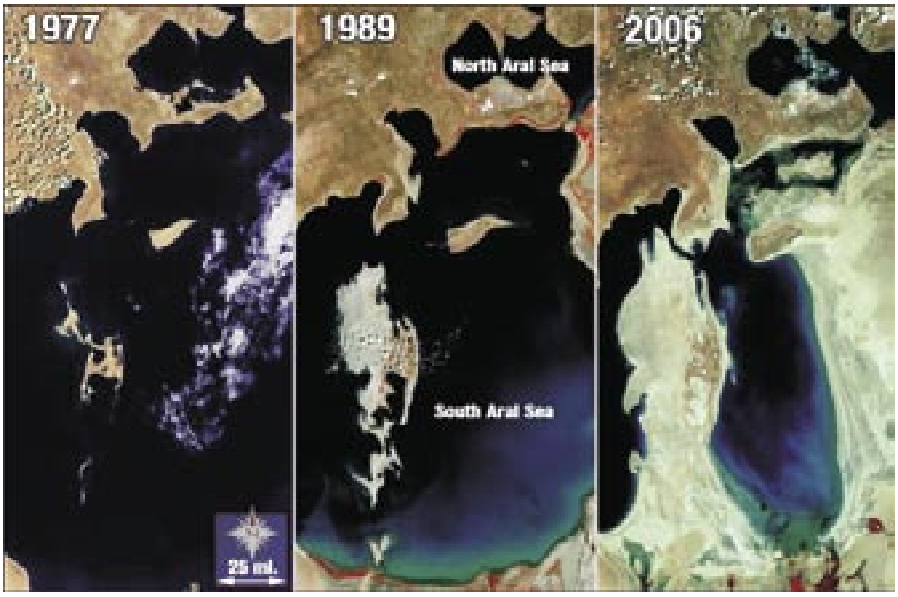
However, it is close to reaching a critical phase with regards to the continuity. The last Landsat satellite, Landsat 7, launched in 1999, has continuously collected data many years after the planned lifetime set at five years, but the risk for a gap in the Landsat data row from 1972 poses a problem because of the ageing process in the satellite. In the system Landsat 5 and Landsat 7 are still operational, but Landsat 5 is 22 years old and no redundancy remains for most of its mission's critical subsystem. Landsat 7 has lost use of its instrument Scan Line Corrector and has lost gyro redundancy.

It has become more than clear that a mission to ensure the continuous dataflow is necessary, and it is urgent. Early plans to purchase data from a privately owned and commercially operated system or possibilities to integrating Landsat-type sensors on the NPOESS platform was turned down, and in December 2005 the Office of Science and Technology Policy (OSTP) issued a memorandum adjusting the Landsat Data Continuity Mission strategy. NASA was instructed to acquire a single Landsat continuity mission in the form of a free-flyer spacecraft. The instrument will collect land surface data similar to that of its Landsat predecessors. NASA has selected an industrial company to develop the Operational Land Imager instrument for the Landsat Data Continuity Mission (LDCM). The instrument will capture images in the visible and near-infrared spectra. Under the contract terms, the company will develop, fabricate and integrate one flight-model Operational Land Imager. The company also will test, deliver and provide post-delivery support and five years of on-orbit support for the instrument.

The Landsat Data Continuity Mission is the successor to Landsat 7. It is scheduled for launch no earlier than July 2011. The following two pictures from Landsat show the very valuable source the satellite is for detecting changes in the landscape over time. Sometimes due to human influence, sometimes due to natural causes.



Eyjabakkajökull glacier, Iceland. A natural-color Landsat 7 image shows Iceland's Eyjabakkajökull glacier in 2000. The blue outlines indicate where the glacier was in 1991 and 1973. Eyjabakkajökull is an outlet glacier of the Vatnajökull ice cap in south eastern Iceland. It has been retreating since a 2.8-km surge occurred in 1972-1973. This true-color Landsat 7 image shows the glacier terminus in September 2000, by which time it had retreated 1.8 km. The light- and dark-blue outlines show the terminus extent in 1973 and 1991, respectively.



The Aral Sea lies between Uzbekistan (to the south) and Kazakhstan (to the north). It was once the fourth largest lake in the world, but the Aral Sea is now less than half of its original size. The Aral Sea is terminal, meaning no water flows out of it. It is fed by the Syr Darya and the Amu Darya Rivers, but former Soviet river diversions for irrigation made over 40 years ago have starved the Aral Sea of water.

Protect our dark sky

The presentation of a new ski jumping hill, Holmenkollen, in Oslo, ready for World Championship in 2011, reminds us of all of the light pollution that prevents even greater parts of the population from seeing a clear sky with all the stellar constellations generations before us have seen.

Europe at night. Image: NASA/GSFC

A strong beam of light, that shall indicate the continuity of the take of run right to the sky, explains the considerable contribution to the light pollution that already now prevents the inhabitants from seeing a clear sky.

Not long ago, one clear evening while waiting for the bus to take me home from work in Trondheim, 2007, I could see the Moon and a few numbers of the largest stars, but not one star formation. A lid of dust and light prevented a closer investigation of the sky. However, when I left the bus seventy kilometres outside, in an area almost free of unnecessary light, I could see the sky clearly, with all the well-known star formations; the Milky Way and the Northern Light. The difference was formidable.

Seen in relation to all other forms of pollution the problem is not the largest, but it prevents larger and larger parts of the world's population from ever seeing the star formations, formations that are interesting to see, have given origin to much of the world's mythology and given basis for different types of research. Not least, the star and star formations are still necessary for practical use, in among other navigation.

The fight for an unpolluted sky does not only involve astronomers. A UNESCO supported meeting at La Palma earlier this year concluded with, "An unpolluted night sky that allows the enjoyment and contemplation of the fundament should be considered an inalienable right."

What can we do?

Very much in fact. In addition to the masses of use, the direction of the light is very important. Light, like the light from the ski jumping hill, Holmenkollen, is the worst; an unmotivated light beam towards the sky, lighting up pollution in the atmosphere, causing an effective roof between the stars and the public on the ground. Light must be directed towards the way the public needs it; towards the ground.

> Each of us can reflect light pollution with installation of new light, we can turn off the light when we do not need it, and we can influence our neighbours to do the same.

The authorities could and should regulate people's unnecessary use of light, making people use armature that throws the light in a fixed direction, not building floodlights, not marketing light towards buildings and the sky etc. Use of so-called security light is an increasing trend. Outside people's homes about 500 W is about half of the brightest lighthouse along the cost, but the lighthouse is visible many kilometres away, the security light some metres of a private drive.

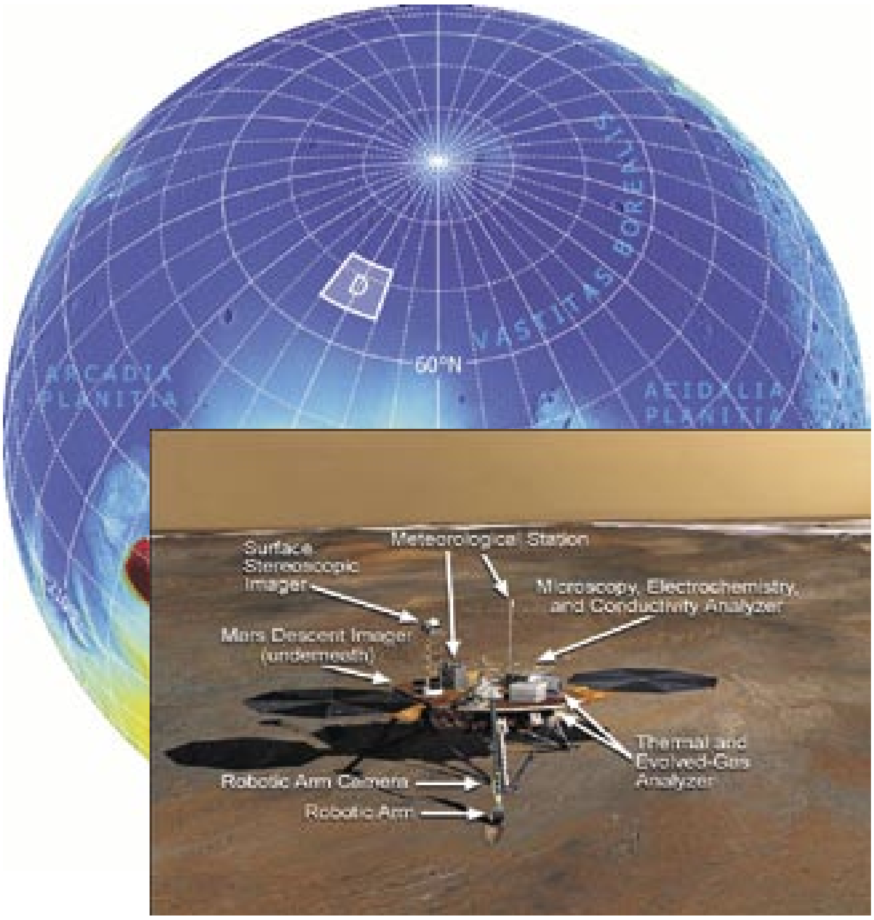
Southern England is the brightest part of Europe, with the exception of the Netherlands, and after a petition to the Number 10, signed by some thousand people, resulted in a positive response to the problem and the government promised to work with regulations to protect the sky from unnecessary light. The Czech Republic has already a law to protect the sky.

The Nordic countries, with the large unpopulated areas, have many places where the sky can be seen without pollution from nearby towns and villages, but the southern parts of the countries and Denmark have nearly the same light pollution as the rest of Europe. However, it is easier to provide information about more "sky friendly" lights before the sky is polluted, than implementing regulations in retrospect.

Possibly the ski jumping hill can be seen as a test of the public authorities' will to protect the sky? It most certainly poses a huge problem, and the sooner they realise it the better.

Water and climate on Mars

-more insight thanks to the Canadian MET weather station



If Phoenix landed on the Earth, the probe would possibly hit the Nordic countries.

Pictures: NASA

Mars has possibly the same conditions as the Earth – warm around the equator and cold around the poles. Ice caps that come and go indicate various seasons like on Earth.

However, the climate in detail has not been fully explored yet. This is about to change with regards to Phoenix, the Canadian built meteorological station with a MET station onboard, meant to become operative the summer of 2008.

After the landing in the turn of the month May/June 2008, the Canadian-built MET station onboard will daily record weather reports using temperature and pressure sensors, as well as a Light Detection and Ranging instrument (LIDAR) throughout the summer. MET will verify the current state of Mars' polar atmosphere and how water is cycled between the solid and gas phases in the Martian arctic.

Landing close to the icy north polar cap in the spring will allow the scientists to study a remarkable feature of the Martian climate, the scientists involved in the project have stated. Each spring a significant mass of water ice sublimates from the polar cap forming seasonal ice clouds, and there are lots of questions about where this water ice ends up and how stable the current ice cap is. Observing these clouds and dust storm features with the Phoenix LIDAR will provide an exciting new insight into these aspects of the climate of Mars.

The MET station's LIDAR will visualise the distribution of dust particles and measure the base of clouds at precise altitudes over the Red Planet. LIDAR technology is similar to radar, but it uses pulses of laser light instead of radio waves. The light absorbed or reflected off atmospheric molecules or particles carries information on the location, size and nature of these elements.

Phoenix' LIDAR should be able to detect water-ice clouds up to about 10 km high. The LIDAR's ability to detect dust will also help scientists better understand the 'boundary layer' on Mars. This is a region of turbulence where most weather occurs and where chemicals are mixed and transferred between the atmosphere and the surface. The boundary layer on Mars is higher than on Earth – perhaps up to 4 or 5 km during the day because of solar heating, and less at night.

The data collected on Mars by the MET station will be interpreted with computer models similar to those used for weather forecasting and climate prediction on Earth. From the distribution of dust and ice particles, scientists will extrapolate energy flows within the polar atmosphere – and better understand Mars' climate.

Studying these particles will also reveal information on the formation, duration, and movement of clouds, fog, and dust plumes. Understanding cloud formation and evolution, as well as movements of the lower atmosphere, are keys to better insights on the water cycle and potential life on Mars.

The Canadian weather station will be the first ever to have operated from the surface of another planet.

For more information: Canadian Space Agency, www.space.gc.ca

Cosmic Vision 2015-2025

Eight new mission proposals selected for ESA's future scientific programme

The space research community's long-term goals for their research programmes are to maintain the present level of research satellites in orbit around 2018 – 20 as well as working with and evaluating possible new missions.

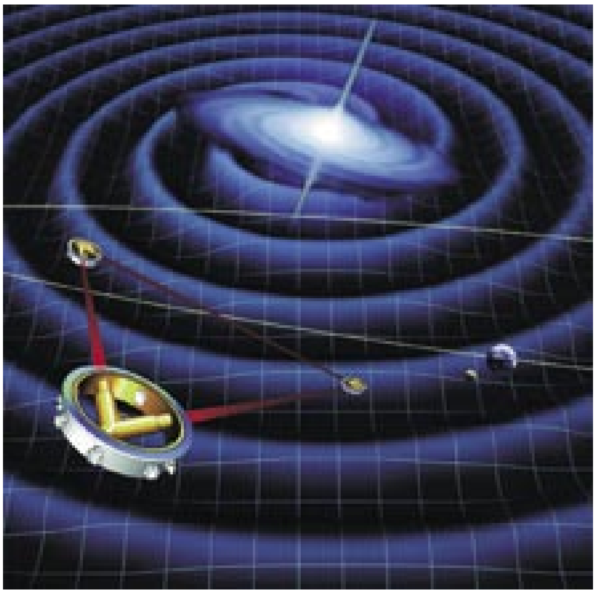
In October, after a Space Science Advisory Committee meeting (SSAC), the candidate missions were selected for further assessment and consideration for launch in 2017/2018.

That is the result of the Cosmic Vision 2015-2025's Call for Proposals announced earlier this year. The response was enormous and many interesting fields were represented in the proposals that were presented. Fifty new proposals were presented, twice the amount of proposals compared to the previous ESA calls in 1999.

Until mid-2009, SSCA and scientific working groups will assess the proposals and pre-select three 'class-M' missions and three 'class-L' missions. Class-M missions are medium-size projects, where the ESA costs do not exceed 300 million euros. Class-L missions are larger projects, with cost envelopes not exceeding 650 million euros. By the end of 2009, out of these three class-M and three class-L missions (plus LISA), two class-M and two class-L missions will be further short-listed for the definition phase (or mission 'phase A'). This phase will be run by European industries on a competitive basis between the beginning of 2010 and mid-2011. By the end of 2011, one class-M and one class-L mission each will be adopted for implementation with predicted launch in 2017 and 2018 respectively.

During the Assessment Phase, a maximum of four missions are selected by the SPC, each mission supported by a Science Team, which includes the one that proposed the mission. The Science Mission Team defines a model payload and ESA engineering teams undertake the technical assessment. The aim of the Assessment Phase is to define the mission to a sufficient level to show the scientific value and technical feasibility.

The main objectives of the Definition Phase are to establish the cost and implementation schedule for the project. At the end of the definition phase, the Prime Contractor for the Implementation Phase is selected. Competition between potential Prime Contractors is necessary. It is also essential that the design and costing is based on the actual mission, i.e. with the selected PI (Principal Investigator) funded instruments and selected new technologies, so that the competing contractors have a firm basis on which to make their proposals for the Implementation Phase.



LISA (Laser Interferometer Space Antenna) moved from Cosmic Vision 2005-2015.

Read more about the selected candidates at: www.esa.int

The selected candidate missions are:

Astrophysics

DUNE, the dark universe investigator and SPACE, the new near-infrared all-sky cosmic explorer.

PLATO - PLAnetary Transits and Oscillations of stars

SPICA - SPace Infrared telescope for Cosmology and Astrophysics

XEUS - X-ray Evolving Universe Spectroscopy a next-generation X-ray space observatory.

Solar System

Cross-Scale - multi-scale coupling in space plasmas in near-Earth space.

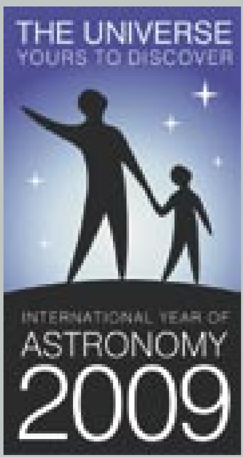
Laplace - a mission to Europe and the Jupiter System

Marco Polo - a near-Earth object sample return mission

TANDEM to explore two of Saturn's satellites,Titan and Enceladus.

LISA (Laser Interferometer Space Antenna) moved from Cosmic Vision 2005-2015.

The International Year of Astronomy 2009



New types of "International Year" keep being proposed. Halfway in the International Polar Year and the International Heliospheric Year a new interesting "Year" was introduced. The year of 2009 is chosen as the "International Year of Astronomy".

The vision of the International Year of Astronomy (IYA2009) is to help the citizens of the world rediscover their place in the. The aim of the Year is to stimulate worldwide interest, especially among young people, in astronomy and science under the central theme "The Universe, Yours to Discover".

Read more at www.astronomy2009.com

"Update" Nordicspace aim to publish news and actual information from, and to, the Nordic space-related community.

Do you have any news, let us know.

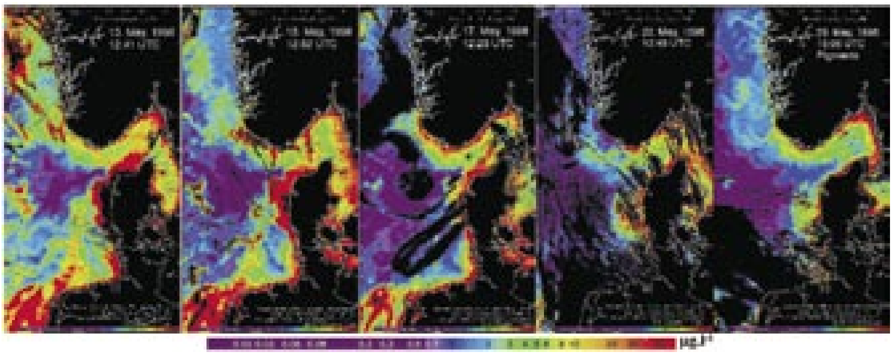
editor@nordicspace.net

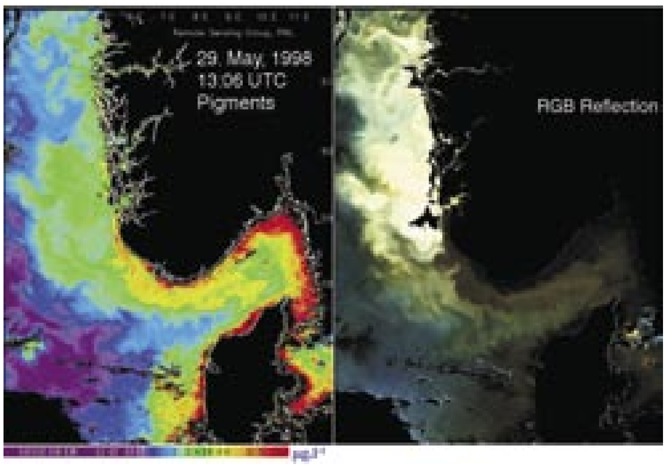
SeaWiFS ten years in space

In spite of an early Ocean Colour sensor early in the space era, the American Sea viewing Wide Field-of-view Sensor (SeaWiFS) is regarded the first Ocean Colour satellite. Launched late in 1997, the satellite can now celebrate the first ten years in space. This year the satellite has provided the scientists and the society with possibly the best calibrated, and most comprehensive biological dataset ever collected about the Earth's biological response to environmental change. Phytoplanktons in the water contain the green pigment chlorophyll, and simply enough, the greener colour the oceans have, the more chlorophyll the water has. With calibrating the sensor in relation to in situ measurements at the ocean, the content of algae can easily be estimated from space.

One of the institutes that has used data from SeaWiFS, considering the time the sensor has been operative, is the Norwegian Nansen Environmental and Remote Sensing Centre (NERSC). From the early beginning, Lasse H. Pettersson says, NERSC has, based on this data from the sensor, delivered surveys of water quality and harmful algae blossoms for public authorities and for fishing farms around the coast.

The following pictures show a time series from an algae blossom around the Norwegian coast in the summer of 1998. Since that the centre has provided such surveys on a regular basis, all based on the data from ocean colour sensors.





Several other ocean colour sensors have also been launched. Sensors, such as MERIS and MODIS, deliver the same types of data. The important thing to have in mind, Lasse Pettersson underlines, is that data from the new sensors are calibrated related to SeaWiFS data, so a continual series of Ocean Colour data can provide a basis for monitoring the evolution and status in the ocean.

Se more at: www.nersc.no

Voyager - still going strong after thirty years in space

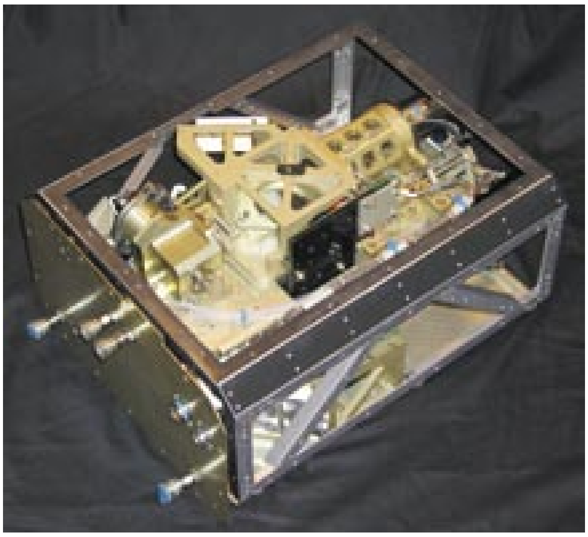
In spite of the age, and equipped with technology from the early seventies, Voyager still provides scientists with continuously new knowledge from outer space. Voyager was the first to provide detailed knowledge about the planets and space surrounding us and it has been the basis for a series of new missions. No missions has ever lasted so long and gone so deep into space as Voyager has.

Launched in 1977 both spacecraft passed by Jupiter in 1979, respectively 5 March for Voyager 1 and 9 July for Voyager 2. Saturn was passed by both in 1981 with two and half months' interval, but now number two was the first. After that the trajectory has been different, and after that Voyager 1 has probed deeper and deeper into space, and is now the most distant human-made object in the Solar System, over 15 billion kilometres from the Sun. It is on its way towards the star AC+79 3888, which it will pass in 40,000 years time.

Voyager 2 passed Uranus in 1981 and Neptune and its moon Triton in 1989 and after that also this probe has investigated the space outwards the planets. Within ten years Voyager 1 will pass the Heliopause, and thus also leave our solar system.

Is the climate on ISS healthy?

SINTEF, Norway, participates in developing new monitoring instrument



Long stays in space is not something humans are built for, and it exposes the human body for many unknown stresses. The effect from the weightlessness is one thing, but is the artificial climate onboard healthy? One cannot, like on Earth, open the window and breathe new fresh air, however, one must recycle the same air several times. People, surfaces, instruments and experiments emit all different types of gasses, and not all are healthy.

When Endeavour left for the International Space Station in August, they had a new and hopefully better type onboard, instrument that detect and monitor the air onboard.

The instrument, with the female name ANITA, is developed in cooperation between SINTEF, Norway and the German Kayser-Threde GmbH. It is based on measurement techniques developed for use on Earth, but it can be valuable for the same use in space. (The name is an acronym for: ANalysing InTerferometer for Ambient air)

The cooperation is based on developing detecting instruments for different practical uses, like detecting waste gas from industrial processes, the climate onboard submarines and others. ANITA is supposed to prevent that the astronauts breathe in gasses that can cause dislike, or at worst, health damages. Like on Earth, in addition to the natural emits, gasses can come from leakages, over-heating or failures in the air conditions. ANITA will provide the astronauts with possibilities to carry out different actions to better the situation.

The Galileo programme is slowly progressing

Around the turn of this year the second test satellite for the programme, Give-B, will be launched. It has taken much more time to develop this satellite than expected. Two years behind schedule, and over budget, the satellite is to test two types of atomic clocks – a rubidium clock similar to the clock onboard Giove-A and a passive hydrogen maser clock that represents a new development in the field.

Ulysses mission coming to a natural end

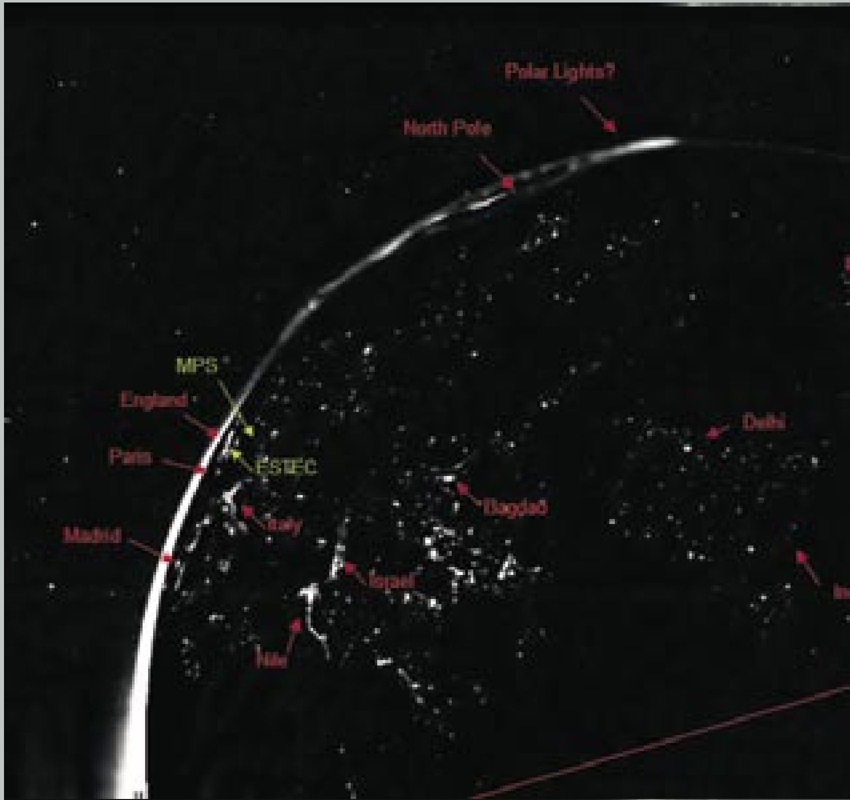
Ulysses, the mission to study the Sun's poles and the influence of our star on surrounding space is coming to an end. After more than 17 years in space – almost four times its expected lifetime – the mission is finally succumbing to its harsh environment and is likely to finish sometime in the next month or two.

Ulysses is a joint mission between ESA and NASA. It was launched in 1990 from a space shuttle and was the first mission to study the environment of space above and below the poles of the Sun.

Ulysses is in a six-year orbit around the Sun. Its long path through space carries it out to Jupiter's orbit and back again. The further it ventures from the Sun, the colder the spacecraft becomes. If it drops to 2ºC, the spacecraft's hydrazine fuel will freeze. Figure: ESA.

Return to: Nordicspace

N-7525 Flornes, NORWAY



The Earth seen from a space probe

Rosetta's navigation camera (NAVCAM) took this shot of Earth right after Rosetta's closest approach to our planet. The picture was taken at 22:56 CET on 13 November, as Rosetta's second Earth swing-by concluded, while the spacecraft was flying at a height of about 6250 km from the surface.

Inlaid:
The night side of the Earth with artifical lights created by human habiations.

Photo: ESA