

Annual Report 2005



Management 2005



*Suzanne Lacasse
Chairman of the Board*

Board

Suzanne Lacasse, Chairman
Erik Solhjell, Vice Chairman
Øyvind Stene
Jøran Moen
Inge Marie Holten

Deputy members:
Paul Narum
Elisabeth Tørstad



*Rolf Skår
Managing Director*

Management

Rolf Skår, Managing Director

Objectives

In accordance with governmental guidelines and in co-operation with and to benefit Norwegian industry, research, public-sector bodies and Norwegian interest in general, the objectives of the Norwegian Space Centre are to:

- promote the development and coordination of Norwegian space activities,
- co-ordinate the Ministerial interests and needs within space activities,
- prepare proposals for integrated long-term programmes for Norwegian space activities and submit these to the Ministry of Trade and Industry,
- manage Norwegian Space Centre resources and efficiently distribute funding from the Norwegian State and other sources,
- mind Norwegian interests in liaison with space sector organizations in other countries as well as international organizations and contribute to coordinating Norwegian space activities with those elsewhere,
- manage State holdings in space-related companies in the private sector,
- facilitate the meeting of user needs in the space sector

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Thanks and goodbye!

Today is the last of my second term as Director of the Norwegian Space Centre.

It provides the opportunity to express gratitude, to reflect on the importance of space for everyone and in particular to consider that here in Norway, we have been able and still are able to exploit the potentials that space affords.

Upon assuming the directorship in May 1998, I told the staff that I hoped they would notice that I had been here when I stood down.

It's been an honour to have led the Space Centre in these years. A small but thoroughly capable and committed staff has cohesively worked as a team. It's the result of that teamwork that constitutes the lasting result of my terms in the Space Centre.

We have been unconventional, we have prioritized differently, and we have been sufficiently bold to safeguard Norwegian interests in the collaborative international space efforts in which we take part. We have accomplished this in a manner understood by our international partners, and we have gained respect for our consistent approach in discussions. That has concretely been proven by our having been appointed to the key ESA committee chairs and programme boards that we sought.

The greater part of Norwegian governmental commitment is channelled via the ESA. Hence, we have had some influence, and accordingly have chosen the sort and extent of our participation in ESA optional programmes. That has benefited Norway. We receive our relative share of the industrial tasks, perhaps more importantly, by paying 2% of the costs we benefit 100%. I'm particularly pleased that after the last ESA Council of Ministers meeting in Berlin, Norway participates in accordance with its net national income (NNI) level, about 2%.

The Norwegian Space Centre prioritizes the beneficial in preference to the more spectacular or media focused, such as national astronauts or its own scientific satellites.

So the experience of my directorship didn't include the orbiting of a Norwegian



ESA Director General Jean-Jacques Dordain thanks Rolf Skår for his achievements for Norwegian and European space activities. ©Norwegian Space Centre

satellite. Nonetheless, I hope that we have laid the foundation for future Norwegian satellites for monitoring our sea areas, not only because we are a Space Centre dedicated to using satellites, but because we believe that Norway can develop a small, efficient sea monitoring satellite. The result will be a cost-effective means of monitoring our sea areas, jointly with surveillance aircraft and coast guard ships.

I wish to take this opportunity to acknowledge the gratification of my terms as the Director, with special thanks to the staff, my team. Together, we have made a lasting impression.

And to the Board of the Space Centre and to the senior political staff and civil service of the Ministry of Trade and Industry go thanks for having trusted me and allowed me to be myself and a bit of an entrepreneur.

I have chosen to devote much of my time away from the Space Centre head office in Oslo. Prospects are created principally by using international space cooperation to benefit national actors. I've had the privilege of taking part in the development of an outstanding new activity on Svalbard and of seeing the potential of an exciting development of the Norwegian Troll station in the Antarctic.

It's quite natural, then, that my last working day as the Space Centre Director is away from the head office in Oslo.

Thanks and goodbye!

Oksebåsen, Andøya, 31 May 2006

Rolf Skår
Rolf Skår

Report of the Board 2005

Introduction

The Norwegian Space Centre is under the Ministry of Trade and Industry (NHD) and has an independent Board appointed by NHD.

The main objective of the Norwegian Space Centre is to contribute to creating growth in high-tech national industries, meet public needs, play a leading role in the global market for space-related ground infrastructure and attain a recognized international position in space research for Norwegian research communities. Activities are financed by appropriations in the Ministry of Trade and Industry's budget.

Membership in the European Space Agency (ESA) is instrumental in attaining these goals. The Norwegian Space Centre supports Norwegian interests in ESA and co-ordinates national space activities.

Expanded prospects

The single most significant event in 2005 comprised the new prospects for Norwegian space activities resulting from the ESA Council of Ministers meeting in Berlin 5-6 December. For the first time since it was founded in 1987, the Norwegian Space Centre gained acceptance for participating in the optional ESA programmes at the level of its net national income (NNI), as provided in the ESA convention.

Moreover, the Government approved extensive participation in the ESA technology and innovation programmes.

Together, participation in the ESA optional programmes amounted to €122.5 million. This is a considerable increase over the €54.8 million budgeted at the previous ESA Council of Ministers meeting of November 2001 in Edinburgh.

The Board views the national support programme increase from NOK 26.1 million (€ 3.3 million) in 2005 to NOK 49.7 million (€ 6.2 million) in 2006 combined with a corresponding upscaling of ESA participation as a clear indication that the Government and Parliament seek to capitalize on the potentials of space afforded by its exploitation. In its work and strategy, the Board will continue to prioritize

combinations of industrial possibilities, so that Norway benefits from the space programmes themselves.

Space activities in 2005

The Norwegian space sector is extensive and parts of it are completely commercial. The Space Centre's involvement and influence varies from little for the largest single actor, Telenor Satellite Services, to decisive for most other actors.

In 2005, the total turnover of space-related goods and services in Norway was some NOK 5.7 billion (€714 million). Of that sum, Norwegian produced goods and services accounted for NOK 5.2 billion (€651 million), of which 82% were to export. Measured in NOK, turnover fell by 1% from 2004 to 2005. A greater part of the decline over the last few years is due to changes in exchange rates (most exports are invoiced in USA, and from 2003 to 2005, the rate from USD to NOK fell by 10%).

In 2005, Telenor, the country's largest actor in the satcom sector, ordered a new satellite to replace Thor 2, to ensure longevity in satcom, where mobile communications, relaying of content and distribution of TV signals comprise the principal activity.

Exports account for 82% of turnover in the space sector. Turnover expressed in NOK fluctuates in step with the

exchange rates between NOK and USD and between NOK and EUR.

Turnover in NOK in 1990 to 2005 of Norwegian produced goods and services is shown in Fig. 1. Expressed in USD, growth would have been steadier but not as rapid in 1997-2003.

Telenor and Nera activities in commercial satellite communications continued to account for the greater part of space-sector turnover. Some smaller high-tech companies spawned by research communities and some highly specialized oil industry equipment companies have been successful in the space sector with competitive niche products.

These companies' forecasts are for continued growth, as shown in Figure 1.

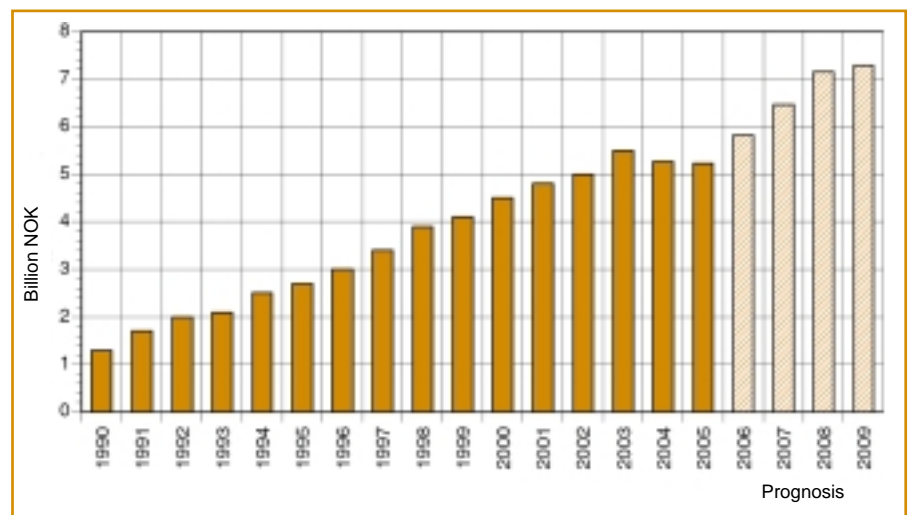
The growth is contingent upon an upswing in Norwegian public and private commitment as well as on continued involvement in satcom and in satellite navigation.

Governmental commitment for continued growth now is ensured.

In 2005, Norwegian commercial deliveries to ESA programmes totalled about NOK 175 million (€22 million). The total ESA turnover since Norway became a member in 1987 amounts to about NOK 2505 million (€314 million).

In 2005, the spin-off effect factor continued its climb, up to 4.4, which outstripped expectations (Figure 3).

Figure 1: Turnover of Norwegian-produced goods and services, 1990-2005, with company forecasts up to 2009. Figures in NOK.



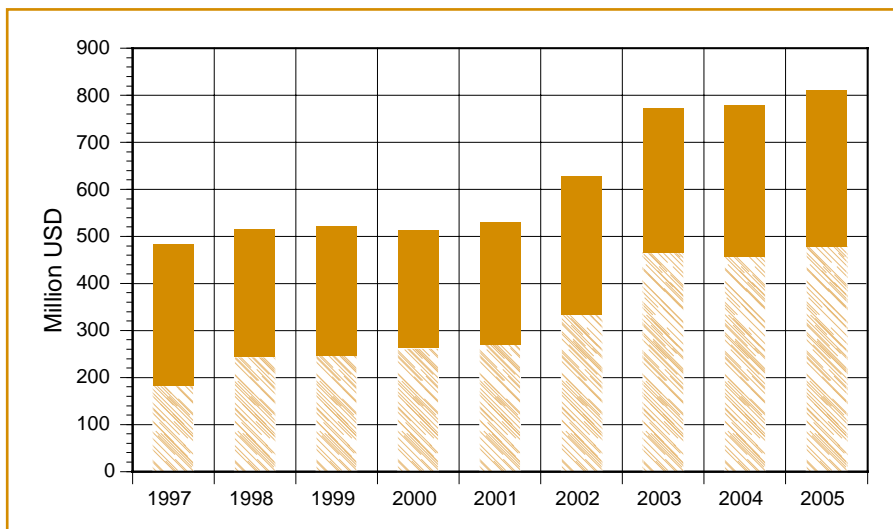


Figure 2: Turnover of Norwegian-produced goods and services, 1997 - 2005 with Telenor turnover shown hatched. Figures in US dollars.

This means that for each million NOK of governmental support through ESA or national support programmes, space-sector companies have on the average attained an additional turnover of NOK 4.4 million (€ 510 thousand) [total turnover NOK 5.2 million (€ 651 thousand)]. The spin-off effect is more pronounced in Norway than in most other ESA member countries.

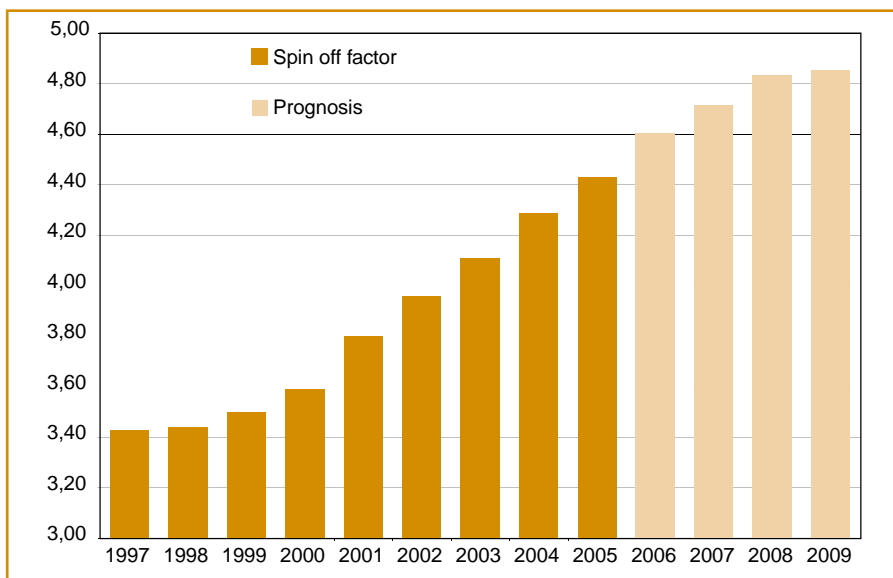
Over the past few years, there has been a recession in the European space market, principally triggered by a decline in the commercial satcom market (50% fewer satellites ordered and launched than in the 2000-2001

peak years) that has not been offset by a corresponding increase in the public sector market. Consequently, the competition for ESA contracts is ever keener. So the Board and management of the Norwegian Space Centre have identified support of Norwegian companies as a principal task, to ensure continued technological development that in turn will ensure goal-oriented spin-off effects.

Technology

The national support programme is essential to technological development, as conclusively shown by the demand

Figure 3: Spin-off factor, 1997-2005, with company forecasts up to 2009.



for products that have been supported by it. Recently, Norwegian companies have been awarded key contracts under ESA’s Technology Research Programme (TRP), and a significant elevation of Norway’s level of participation in the General Support and Technology Programme (GSTP) have enabled accomplishment and space qualification in several sectors. Moreover, prolonged GSTP commitment permits setting up longer term development in cooperation with the actors, ESA and other clients. The risk reduction afforded by stepped up governmental support has boosted commitments from industry.

Space research

The increased funding of the ESA scientific programme allocated at ESA Council of Ministers meeting in Berlin will bring about a slight short-term increase in programme purchasing power. More importantly, future new projects may be planned within a framework that in any case will not shrink. At the same time, within the existing framework, it’s clearly difficult to complete ongoing and planned projects to their scheduled completion dates.

Internationally, solar research and plans for manned missions to the Moon and later to Mars have attracted the most attention in space research. After the antenna of the MARSIS radar on board ESA’s Mars Express was finally unfolded, it began probing the sub-surface of the planet. The findings include a subsurface circular structure, about 250 km in diameter. Surprisingly, the two NASA rovers continue their detailed studies of the surface of Mars. The NASA Mars Reconnaissance Orbiter was launched and will search for evidence of subsurface water on Mars.

The high point of 2005 was the Cassini/Huygens arrival at Saturn with the subsequent successful landing of the ESA Huygens probe on Titan. Titan was found to be a globe having erosion mechanisms like those on the surface of the Earth. However, in place of water eroding silicates as on Earth, on Titan, methane erodes water ice. Unexpected winds were observed, and the probe registered two ionosphere layers.

Norwegian groups take part in the Cassini and Huygens research programmes.

National research has been distinguished by continued benefits from ongoing projects such as the SOHO and Cluster satellites and ground infrastructure. Norwegian scientists are involved via ESA in the Chinese Double Star project, which in 2004 started operating with two satellites. Norwegian scientists are also involved with the Rosetta comet chaser, launched in 2004. Norwegian companies and scientists have been assigned the task of downloading and distributing the scientific data from the Japanese Solar-B satellite, to be launched in 2006. On an ESA assignment, the unique Svalbard location will be used to increase scientific return, and the Solar-B European data centre will be built up at the University of Oslo. The NCUBE 2 student satellite was orbited, but regrettably contact with it failed. The cause of the failure apparently was in the parent satellite separator mechanism.

The Andøya Rocket Range has been busy, and particularly the ALOMAR lidar observatory has been in frequent use. Some 24 sounding rockets and a few student rockets were launched. In particular, the campaign including 22 successful launches for the Norwegian Defence Research Establishment (NDRE) and the Institute of Atmospheric Physics (IAP) at Kühlungsborn, exemplifies the German-Norwegian bilateral cooperation.

On the national scene, the Norwegian Space Centre and the Research Council of Norway have jointly charted the needs for, the prioritization of and the recommended framework of research using space. The results were put forth in *Visjon 2015 – rom for forskning som utnytter rommet* ("Vision 2015, Research in Space"), a report presented toward the end of 2005 to the Ministry of Education and Research and the Ministry of Trade and Industry. The report and the ministerial response to it together provide the background for budgetary proposals to be made in the relevant governmental channels.

Earth observation

The strengthened Norwegian commitment in Berlin triggered Norwegian participation in Earth observation at the NNI level. This will strengthen our industrial potential and build greater credibility and influence for Norwegian actors.

The Norwegian Space Centre's Earth observation activities support coverage of national user needs in research and within public administration. Access to better information on climate and environment has high priority in Europe as well as internationally.

On the national scene, this prioritization is clear in the emphasis on the SatHav and SatNat programmes. SatHav focuses on the operative aspects of sea monitoring, particularly in the far north. In the SatNat programme, the Directorate for Nature Management has developed methods for animal distribution and nature management that are ready for operationalization. On the basis of experience gained in these programmes, preliminary work has begun to initiate coordinated, national efforts in other sectors, such as meeting the needs for knowledge and monitoring of land areas and air masses. Specific examples include the operationalization of radar interferometry in snowpack settling and avalanche monitoring as well as in atmospheric chemistry and air pollution.

The international initiative to develop the Global Earth Observation System of Systems (GEOSS) over the next ten years now has the assent and participation of more than 50 countries and a corresponding number of international organizations. Its goal is to coordinate differing Earth observation systems to ensure ready access to available Earth observation data and information products that are standardized and long-lasting. The initiative reflects an international policy to implement the challenging task. Provided that the principal Norwegian actors agree upon a common strategy, Norway can decisively influence the observation systems in northern regions.

The Norwegian Space Centre plays an active role in ensuring that Norwegian

public sector users have access to vital satellite data. In 2005, the extent and utility of this type of data was demonstrated to several public sector users. The long-term agreement with Canada on Radarsat-1 and Radarsat-2 data ensures continuity of SAR data for public sector users.

The October launch of Cryosat, the first ESA Earth Explorer Mission satellite, was a failure. A new Cryosat will now be built for launch in 2009. The Cryosat is vital to the ice studies conducted by Norwegian scientists.

Satellite communication

Satellite communications is the leading sector in Norwegian space activities, accounting for two-thirds of the total annual turnover, that is, about NOK 4 billion (€501 million) in 2005. Telenor and NERA are the principal actors, with products and services in satellite broadcasting, mobile voice and data communications and broadband communications via satellite.

The Space Centre meets regularly with these actors to coordinate Norwegian satcom activities. The actors' recommendations have given the Space Centre a sound basis for influencing the work of the ESA Joint Communications Board (JCB), including the shaping of the Telecommunications Long Term Plan (2006-2010), the detailing of the ARTES elements and the delineation of the activities included in the annual plans. In 2005, the actors concluded the task with a report on Norwegian satellite communications activities commitment strategy up to the year 2010 (SATCOM 2010) and also sought to strengthen academic-industrial cooperation by financing 20% of a professorship at the Norwegian University of Science and Technology (NTNU).

Satellite navigation

The first Galileo system test satellite was launched on 28 December 2005, signalling the prelude to the European Galileo satellite navigation system that will be independent of GPS but will have receivers that can work with both systems. Norway has extensive land

and sea areas in which transport and exacting operations often take place in adverse weather. Consequently, Norway can greatly benefit from cost-effective, accurate and reliable satellite navigation systems such as GPS and Galileo.

Norway is involved in the ESA Galileo Satellite programme, which in 2005 issued invitations to build for the building of the first Galileo satellites. The Norwegian space industry is competitive and at the end of 2005 had realized notable industrial return from the programme. Invitations to bid on the building and operation of the Galileo ground segment were also issued in 2005. The Norwegian stations on Svalbard and at Troll in the Antarctic are viable candidates and could become a Norwegian pole-to-pole part of the Galileo programme.

In 2005, the first EGNOS signals were available over Europe, but to date coverage north of Trondheim is poor. In 2005, the ESA EGNOS Performance Improvement at Northern Latitude (EPINOL) was initiated with the aim of improving EGNOS northern coverage. The Norwegian Space Centre has contributed to coordinating Norwegian activities in the project.

In 2005, the Space Centre assisted the Ministry of Trade and Industry in preparations for negotiations with the EU on agreements for Norwegian participation in the Galileo development phase, and on the behalf of Norway has been an observer at the GNSS Supervisory Authority's Administrative Board. The Norwegian Space Centre shall safeguard Norwegian interests in the agreement, and accordingly a national Galileo secretariat has been set up. In 2005, the Norwegian Space Centre was appointed national project coordinator and together with the Norwegian National Security Authority has contributed to certifying Norwegian companies for supply to the Galileo project.

ESA has a dedicated Programme Board for Galileo and EGNOS programmes. In 2005, Norway was appointed chairmanship of the Programme Board, which also includes involvement with the EC.

Space transportation and the space station

In 2005, there were five Ariane 5 launches, including the successful qualification of the new, more powerful ECA version, which can take ten ton payloads to geostationary transfer orbits. In 2004, a contract was entered between Arianespace and EADS ST (the principal Ariane 5 contractor) for delivery of 30 new Ariane 5 launch vehicles up to 2009. Norwegian sub-vendor supply on the contract amounts to more than NOK 200 million (€25 million), of which some NOK 100 million (€12.5 million) was contracted in 2004 and the remainder contractually entered in 2005.

Transport of the European modules for the International Space Station has been delayed awaiting the resuming of American space shuttle operations. A space shuttle launch in 2005 revealed flaws and resulted in postponement of subsequent launches. NASA has scheduled the next launch of the Discovery space shuttle for the summer of 2006 at the earliest. The ESA Columbus laboratory and the first ATV vehicle can be launched in 2007 at the earliest.

Information and education

The Norwegian Space Centre made use of national and international events to heighten public awareness of space and space activities. In January, the Norwegian Broadcasting's direct coverage from the Space Centre of the Huygens landing on Titan was seen by a record number of viewers. Likewise, attendance was high at events such as Space Days and the Astro Festival. Astronomy and space are increasingly popular, and the staff of the Norwegian Space Centre was often interviewed on TV and radio, in newspapers and in the internet in 2005.

For several years, the Norwegian Space Centre has had a key role in the NCUBE educational project in which 80 students at five higher-education institutions have built two satellites. The first was launched in the autumn of 2005, with extensive media coverage, positively focussing on the advantages of scientific education. Support of

ongoing education in space-related disciplines, particularly abroad, imbues professional competence and affords students access to international networks that in turn will benefit business.

Norsk Romsenter Eiendom AS (NRSE) and Andøya Rocket Range AS (ARR)

Effective 1 January 2004, the State, via NHD, at no cost acquired the Norwegian Space Centre's shares in NRSE (100%) and ARR (90%). The Norwegian Space Centre, as part of its special agency authority, has the remit of managing State holdings in the limited companies that originally were its divisions and subsequently were reorganized as limited companies owned by the Foundation.

In 2005, NRSE had an after-tax deficit of NOK 1.1 million (€138 thousand) and a book equity of NOK 30.6 million (€3.8 million). The company activities comprise:

- Ownership of the communications link via submarine cables between Harstad on the mainland and Longyearbyen on Svalbard. The link evolved as planned, financially and technically.
- 50% ownership of Kongsberg Satellite Services AS (KSAT), with Kongsberg Defence & Aerospace holding the other 50%. In 2005 KSAT enjoyed a profitable year, both financially and in market share. The profit after tax was NOK 14.9 million (€1.9 million) and the book equity was NOK 93.2 million (€12 million).

There's considerable added value beyond that booked in the NRSE balance sheet.

In 2005, ARR had a group profit after tax of NOK 1.1 million (€138 thousand) and a group book equity of NOK 23.4 million (€2.9 million). The principal activity of the company is operation of a scientific infrastructure for research on the middle and upper atmosphere using rockets, balloons and lidar (ALOMAR) at Andøya and on Svalbard.

The Andøya Rocket Range is tax exempt and its activities are based on the ESAP agreement with France,

Germany and Switzerland as users and Sweden and Norway as host countries.

For further details, see the 2005 Annual Reports and accounts for these two companies.

Finances and accounts

In 2005, the Norwegian Space Centre accounts showed a deficit of NOK 3.7 million (€463 thousand) that was offset by accumulated equity from 2004. The deficit is due to the NHD appropriation for operations having been reduced by NOK 2.5 million (€313 thousand) in the revised National Budget as well as to a shortfall in services income. For 2006, the Board anticipates a modest profit.

The results of the programme are in accordance with the budget and reflect that the State's appropriations for ESA in Euros and for co-operation with Canada in US Dollars are adjusted automatically, based on the actual exchange rate upon payment.

Board

In 2005, the Board held five ordinary meetings and one extraordinary meeting as well as one meeting with NHD.

The term of the previous Managing Director of the Norwegian Space Centre ended 31 May 2006. The Board appointed Dr. Bo Andersen, former Department Director and Deputy Director, as the new Managing Director starting 1 June 2006.

Organization and personnel

As at 1 January 2006, the Norwegian Space Centre had a permanent staff of 22, with an average age of 49 and an

average period of employment of 12 years. In 2005, sick leave was 3.6%, none of it identified as work-related. There were no injuries or accidents during the year.

The Board appreciates that the Norwegian Space Centre operates with a moderately small staff, whose efforts, enthusiasm and flexibility produce visible results. A principal goal is that activities should produce results outside the Norwegian Space Centre itself.

The Board gratefully acknowledges the achievements of the staff, the results of which afford new possibilities for Norwegian space activities.

Gender equality and working environment

The Space Centre staff consists of fifteen men and seven women.

Management consists of five men and one woman. All staff are full-time employees, save for one man in a half-time position.

The Board believes that the Norwegian Space Centre has an excellent working environment with a highly-qualified staff.

The activities of the Norwegian Space Centre have no environmental impact.

Plans for the future

The considerable expansion of Norwegian involvement in the optional ESA programmes is gratifying and is evidence of the increased awareness of the importance of space for Norway in many fields. The increased involvement in the ESA programmes afford new opportunities for Norwegian industrial, user and research communities. At

once, the major challenge is to realize equally large return from the new investments. Meeting that challenge will require focus and greater efficiency in the Norwegian Space Centre's work in the years to come.

The national support programme is essential among the means of ensuring the greatest national benefit of the international investment. Consequently, increasing these means is a step in the right direction.

The Norwegian Space Centre shall work closely with various national actors to use the increased public appropriations for fulfilling the principal national goals. In particular, this applies to:

- industrial development associated with satellite communications (€30 million for 2006-2010) and technology/innovation (€32 million for 2006-2011), and
- industrial, user and social utilities in satellite navigation (€16.4 million for 2006-2010) and Earth observation (€34.8 million for 2006-2014).

Moreover, further development of the geographic advantage of the country's northern latitude for space activities remains vital, both to meet national needs and to provide services for international clients.

The aggregate development of 2005 proves that we are on the right path to fulfil our ambitious vision that "in 2015, Norway shall be the country that benefits best from space".

Oslo, 31.12.2005 • 12.06.2006



Suzanne Lacasse,
Chairman of the Board



Øyvind Stene



Erik Solhjell



Jøran Moen



Inger Marie Holten



Bo Andersen, Adm.dir.ektør

Figures from profit and loss account 2005

(NOK 1000 (€1 = NOK 7.9850 as per 31 December 2005))	2005	2004
PROGRAMME ACCOUNTS		
<i>Programme income:</i>		
Programme revenue from Ministry of Trade and Industry	275 400	251 500
Other revenues	10 345	1 048
<i>Total programme income</i>	<i>285 745</i>	<i>252 548</i>
<i>Programme expenses</i>		
ESA, Mandatory basic activities	16 280	20 747
ESA, CSG Kourou	7 834	6 369
ESA, Mandatory scientific programmes	53 047	43 630
ESA, Earth observation	58 698	33 139
ESA, Telecommunications	34 236	48 294
ESA, Navigation	16 457	12 612
ESA, Space station	20 579	14 817
ESA, Space transportation	26 463	23 827
ESA, Microgravity	50	831
ESA, Technology development	0	0
ESA, Esrange Andøya Special Project	21 291	12 993
Radarsat	9 500	10 390
NSC, National support programmes	21 766	23 197
<i>Total programme expenses</i>	<i>286 201</i>	<i>250 846</i>
PROGRAMME RESULT	-456	1 702
OPERATING ACCOUNTS		
<i>Operating income:</i>		
Operating revenue from Ministry of Trade and Industry	26 500	27 200
Other operating revenues	22 644	23 129
<i>Total operating income</i>	<i>49 144</i>	<i>50 329</i>
<i>Operating expenses:</i>		
Salaries and social expenses	15 511	12 580
Other operating expenses	36 468	31 985
<i>Total operating expenses</i>	<i>51 979</i>	<i>44 565</i>
Depreciation	174	29
Operating profit	-3 009	5 735
Net financial income	-14	-46
OPERATING RESULT	-3 023	5 689
TOTAL RESULT	-3 479	7 391

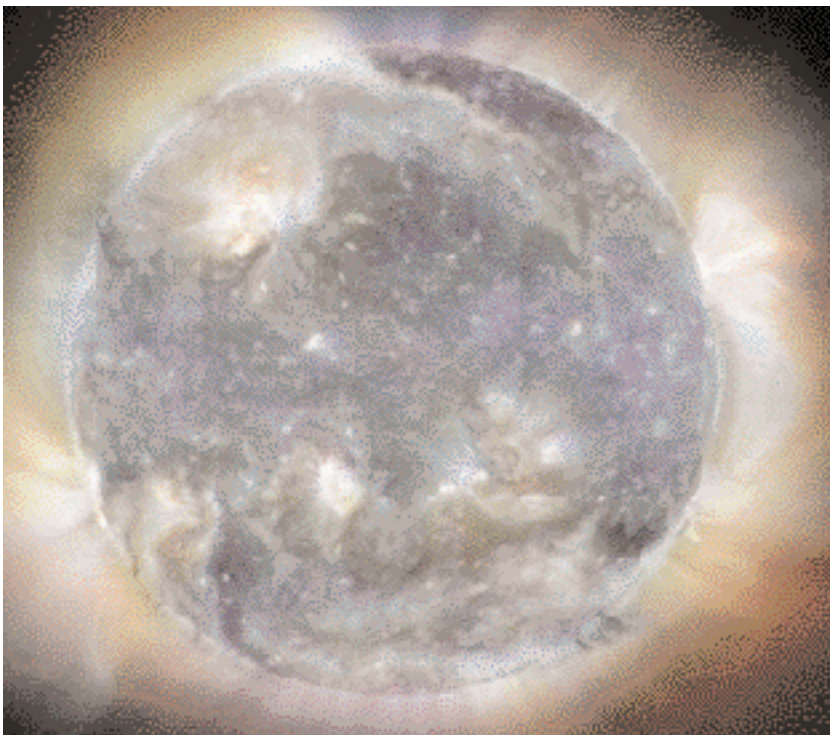
N-CUBE2

The first student satellite built in Norway was launched on 27 October from the Plesetsk Cosmodrome in Russia. More than 80 students at five Norwegian institutes of higher education planned, developed and built NCUBE-2. Contact could not be established with the satellite after launch, but just before Christmas, the world's largest radar identified an object that probably is the Norwegian student satellite. The NCUBE project has given its participants unique experience in space technology through planning and building a real satellite, setting up a ground station and searching for the satellite after launch. Moreover, they worked with international scientific communities in Europe and the USA. The second student project satellite, NCUBE-2, is scheduled for launch in 2006.

Vegard Kemnitz (left) and Eystein Sæther demonstrate NCUBE. ©NRS



SOHO



The SOHO solar observatory flies in continuous sunlight, 1.5 million kilometres from the Earth. On 2 December, it had been active for ten years. Each day, SOHO sends thousands of images and other data from the sun so that we can better understand the processes of our closest star.

SOHO has also recorded the sun's seismic waves and can "see" events on its far side. Moreover, it warns of solar storms a couple of days in advance, which permits satellites and other vulnerable electronics to be set in a guard mode before they are struck by the solar wind.

The sun shown in a composite of three images taken by the Extreme Ultraviolet Imaging Telescope (EIT) at three different wavelengths in the ultraviolet spectrum. Each wavelength reveals a unique condition on the sun. The colours are artificial. ©NASA

Huygens

On 14 January 2005, the Huygens European space probe made a historic first landing on Titan. After a seven year mission journey, the Huygens instrument capsule separated from the Cassini parent probe and then performed a controlled landing on the surface of Saturn's largest moon. Images and measurements show that

the landscape of Titan resembles but has a chemistry differing from that of the Earth. The rivers are of methane, the topography of frozen water. The atmosphere has fog, wind and clouds of hydrocarbons, and volcanoes belch water and ammonia. The NASA Cassini space probe continues to orbit Saturn and send data on the rings and

on the other moons. Media coverage of the landing on Titan set records, with coverage in TV, by radio, in newspapers and in the Internet. Not since the coverage of the Apollo missions of the 1960s has there been such extensive coverage in Norwegian media.

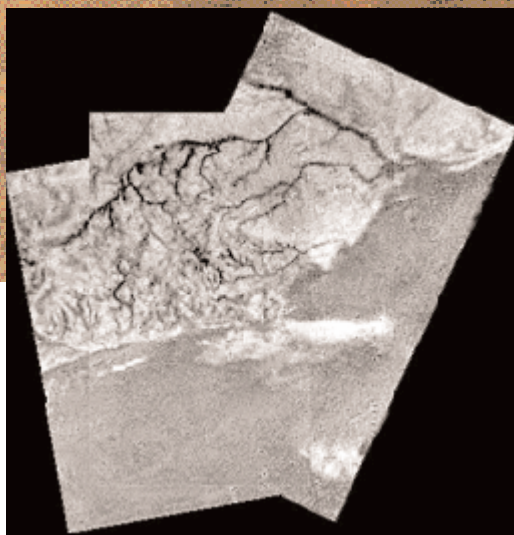
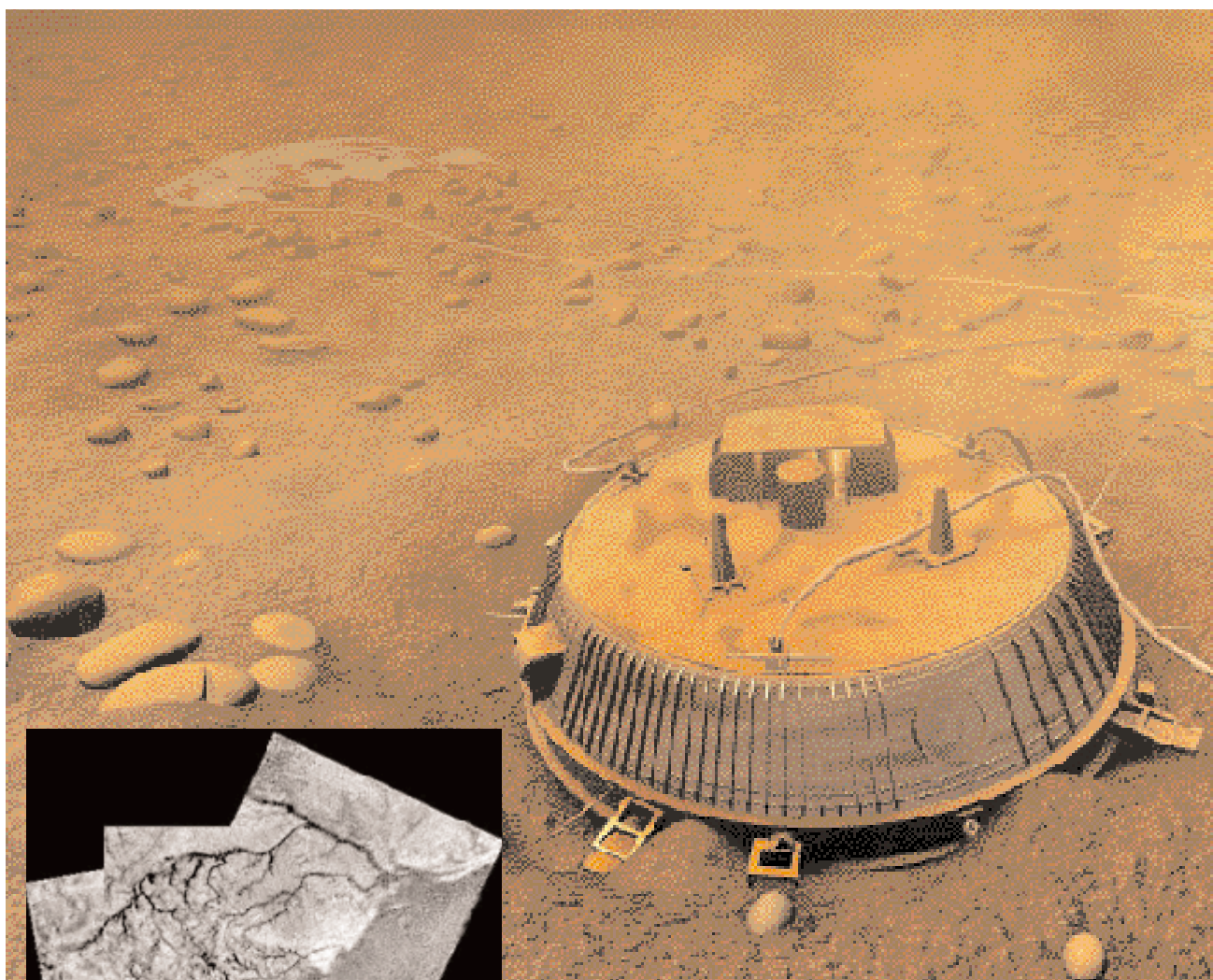


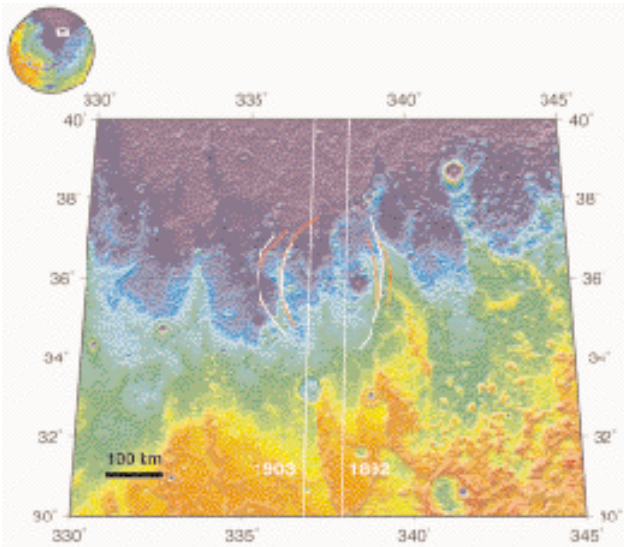
Illustration of the Huygens space probe and its parachute on the surface of Titan. For 72 minutes after landing, Huygens sent images and data back to Earth. ©ESA

Images produced during the descent show that the surface of Titan has rivers that snake through a ridged landscape on their way to the shore. ©ESA

Mars Express

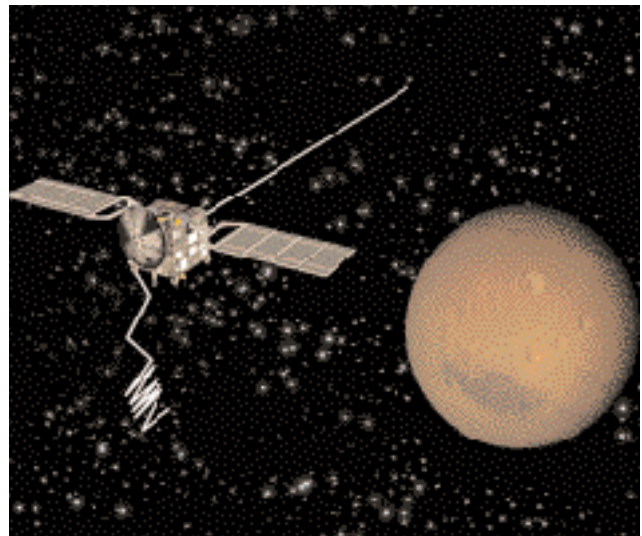
In May, the 40 metres long MARSIS antenna on the Mars Express space probe was unfolded. The antenna views bedrock by transmitting radio signals that are reflected by successive layers kilometres under the surface. One of the first finds was a circular crater, 250 km in diameter. The crater may have been formed by meteor impact and

subsequently covered by a thick sediment layer. Radar data reveal that there is water ice at the bottom of the crater. A one-kilometre thick ice layer also has been found under the surface of the Martian north pole. Other Mars Express instruments have shown that there are minerals on the surface, which bear witness that the planet once had a great amount of liquid water and has a geological history.



Topographic map of the Chryse Planitia area, which scientists believe is a buried meteor crater.

©ASI/NASA/ESA/Univ. of Rome/JPL/MOLA

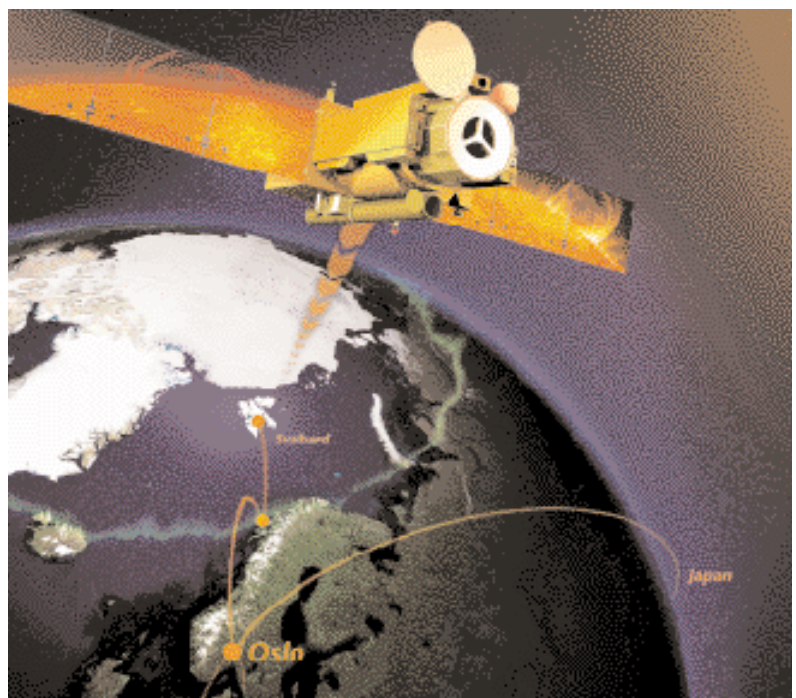


The second MARSIS antenna begins unfolding. ©ESA

Solar B

Solar B will provide scientists round the world with data on the processes occurring in the outer solar atmosphere. Onboard instrumentation includes the largest optical solar telescope ever in space. The Solar B project is a Japanese initiative, and launch is scheduled in 2006. Norwegian scientists and Norwegian companies have been assigned to download and distribute the raw scientific data acquired by the satellite.

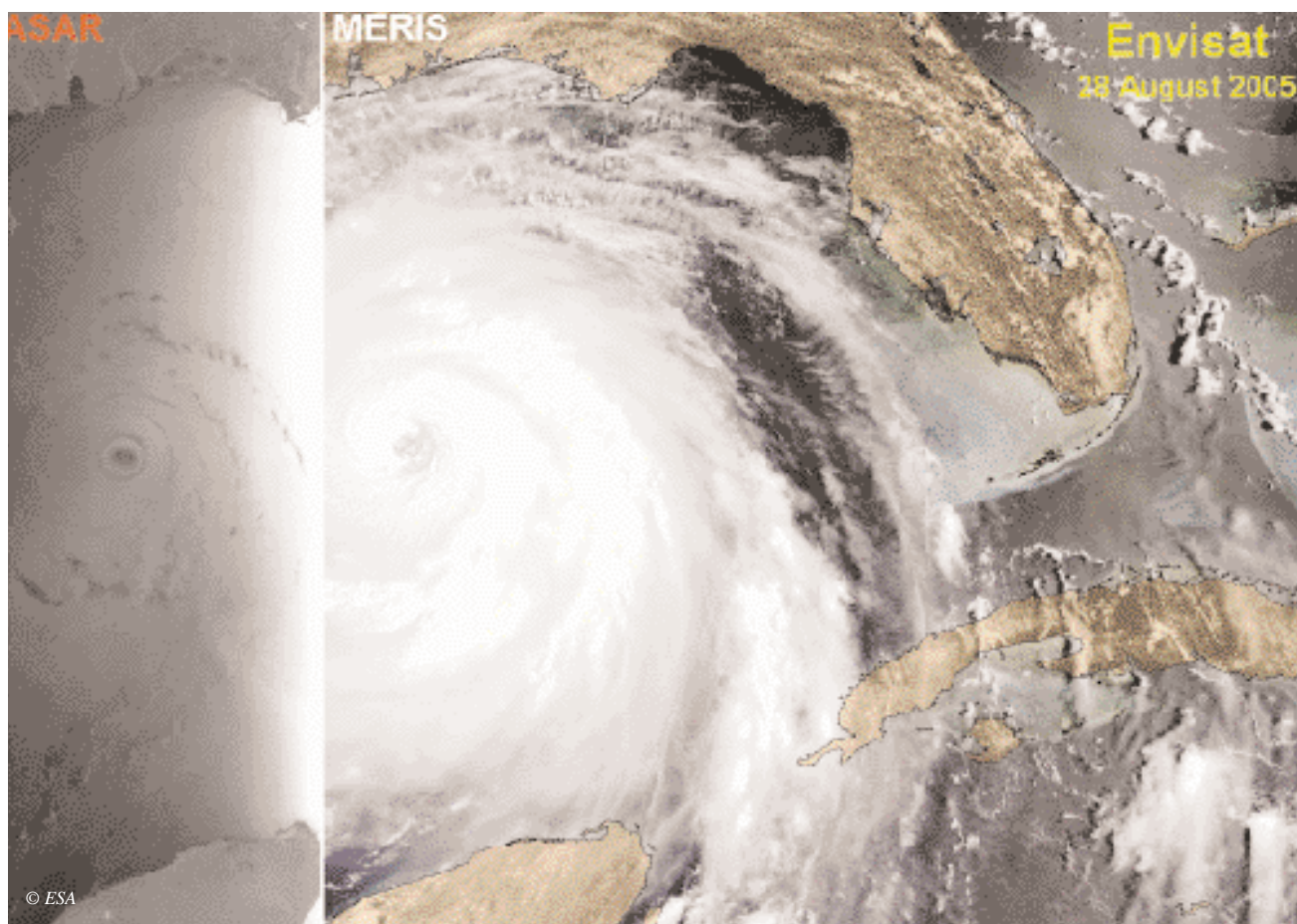
The NOK 60 million (€7.5 million) contract is among the largest ever entered between ESA and Norwegian industry and research.



The Solar B data will be downloaded at Svalbard.

©ARS/NRS

Envisat



Two Envisat images of the Katrina hurricane taken 28 August 2005. The radar image at the left shows winds at the sea surface, while the image at the right was taken by an optical instrument and shows movements of the uppermost cloud layers.

The hurricanes that struck the USA in the autumn of 2005 underscored the usefulness of satellites. For the first time, American authorities employed the international charter in which space organizations and satellite owners offer natural disaster assistance. The ESA Envisat environmental satellite monitored hurricane Katrina as it approached New Orleans in August. Measurements of wind speeds from the uppermost cloud layers down to the sea surface provided information on the development of the hurricane. During rescue operations, satellites provided the only communications links, as the local terrestrial nets were disabled.

Aerial photo of an area south of New Orleans, where the hurricane tossed a large barge on land. ©NASA



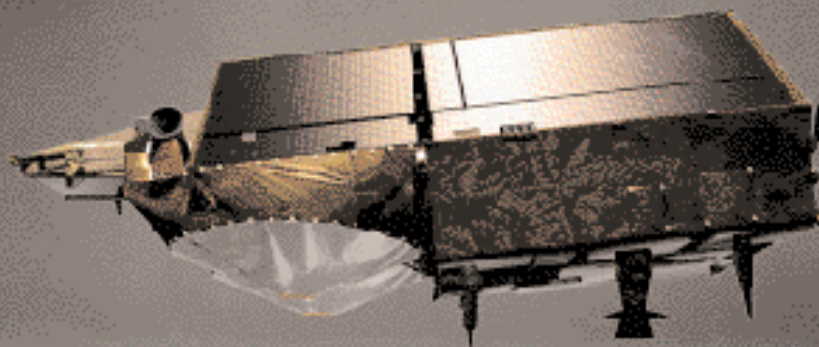
Cryosat

The Cryosat scientific satellite was designed to acquire data on ice thickness in polar regions, but was lost in the launch on 8 October 2005. Variations in the thickness of sea ice

and ice on land in polar regions is a significant factor in climate studies, so ESA accordingly has decided to build a new Cryosat for launch in 2009. Cryosat-2 is part of the ESA Earth

Explorer programme in which six satellites will acquire data on the Earth's gravitational field, wind systems, water cycles, magnetic field, radiation balance and ice thickness.

*Cryosat launch 8 October 2005.
©ESA - S. Corvaja*



©ESA

Galileo

The first test satellite in the European satellite navigation system Galileo was launched in December from Kazakhstan. Giove A will test frequencies and technologies to be used in the 30 satellites that will comprise the Galileo system. When finished and operational in 2010, the system will provide an accuracy of one metre, will be free and will be available round the globe. Together with GPS, Galileo will improve coverage in urban areas and increase the use of satellite navigation in aviation and in other crucial applications.

In the mid 1990s, the EU and ESA took the initiative to design and build the system. In 2005, Norway assumed the chairmanship of the ESA Galileo programme for two years. Norwegian companies compete for supply contracts worth tens of millions of Euros for satellites and ground segments to be built in the near future.

The EU also is committed to develop EGNOS, a system used together with GPS to ensure more accurate positioning. The goal is greater safety and accordingly greater use of satellite navigation in the landing of aircraft and helicopters.



Soyuz during the launch of Giove A from Kazakhstan. ©ESA



EGNOS aims to promote greater use of satellite navigation on board helicopters when the system is operational in 2007. ©Atle Helgesen



Hubble

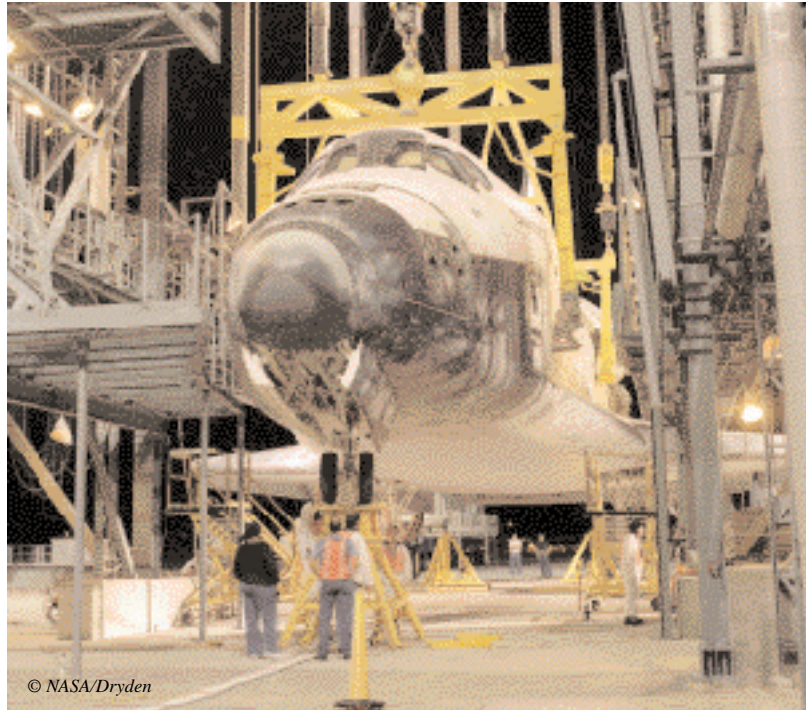
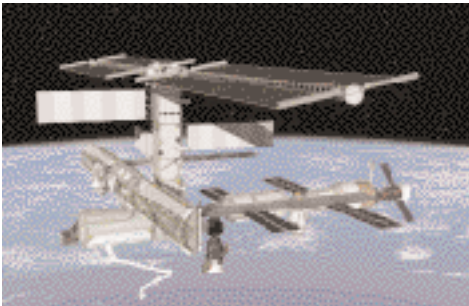
In 2005, the Hubble space telescope was 15 years old. Visitors to the Norwegian Space Centre website voted the image of the Eagle Nebula as Hubble's best. The Hubble telescope is one of the most important instruments in modern astronomy. It has become an icon reflecting human curiosity and ability to explore space. Accordingly, there were vociferous protests when NASA announced that it gave low priority to further operation of Hubble and ultimately would steer it into the atmosphere where it would burn up. But outcry was so great that Hubble was saved. In 2005 NASA recanted and now will use a space shuttle to upgrade Hubble so it can continue operation for several years.

Colour image of the Eagle Nebula is a composite of three images that show light emitted by various atoms. Red indicates ionized sulphur, green from hydrogen. Blue indicates ionized oxygen. ©NASA

Space shuttle

In July, the Discovery space shuttle completed a successful mission to the Space Station, the first in two and a half years after the Columbia disaster. During the launch, it was found that pieces of foam insulation came off the Discovery's external fuel tank. Accordingly, NASA suspended further missions until the problem is solved. Consequently, completion of the Space Station has been further delayed.

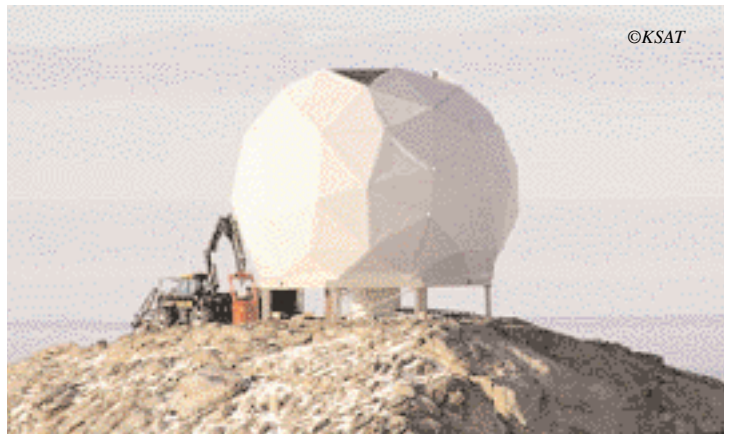
The International Space Station in December 2005. ©NASA



© NASA/Dryden

Troll

On 12 February 2005, Queen Sonja opened Troll, the Norwegian research station in the Antarctic. The station facilities include a Kongsberg Satellite Services (KSAT) satellite ground station with its antenna on a nearby peak. Together with the SvalSat station on Svalbard, the Troll ground station enables KSAT to download images from polar orbiting satellites twice in each revolution, when they pass over the Poles. So KSAT now can download data, such as on weather and oil spills, more rapidly than can other companies. The data downloaded at the Troll station are forwarded to users on a satellite link via an Earth station delivered by Eurocom of Norway.



©KSAT



©KSAT

SatNat

In nature management there's a great need for mapping vegetation and animal life. The SatNat programme has developed methods for mapping areas based on satellite data. Land cover maps for Sør-Trøndelag and Nord-Østerdalen are examples. The maps are used as a basis for showing suitable areas for many bird species. Together with field observations of birds, the land cover maps show the areas that birds are assumed to use. The Directorate for Nature Management can rapidly compile species spread maps based on land cover maps from the SatNat programme.



Land cover maps of Sør-Trøndelag and Nord-Østerdalen. ©SatNat-programmet



Species spread maps for chicken hawks and snowy owls. ©SatNat-programmet

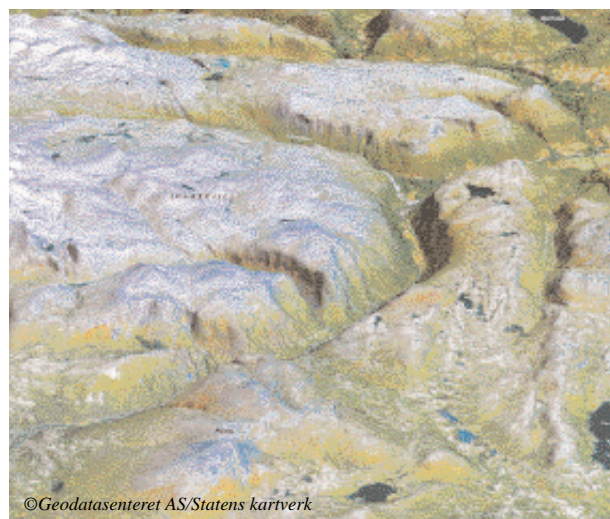
Astro Festival

Held on Sunday, 13 November at the University of Oslo, the 2005 Astro Festival drew crowds interested in astronomy. The many visitors to the Norwegian Space Centre stand left with shopping bags full of publications on space and astronomy. Some 1500 copies of "Space", a new brochure for children, went rapidly.



©Norwegian Space Centre

World's best satellite image



©Geodatasenteret AS/Statens kartverk

The Geodatasentret in Arendal won the contest for the best satellite image during the International Cartographic Association Congress held in Coruna, Spain in July. The winning image is of the Dovre mountains, in which the data have been processed to yield as realistic a view as possible.

Space Days



Full house at the Space Centre during Space Days 2005. ©Atle Abelsen

Weightless students, fatal kisses and the outer limits of the universe. The 340 visitors to the Norwegian Space Centre's Space Days held 1-2 October could view many aspects of space travel and space research. Scientists, industry representatives and amateur astronomers gave a series of talks on human activities in space. Space Days is an annual event jointly arranged by the Norwegian Astronautical Association and the Norwegian Space Centre.

Odd Roger Enoksen gave a talk on Norwegian space activities while still the Director of the Andøya Rocket Range, just before he was appointed Minister of Oil and Energy.
©Atle Abelsen

ESA 30 years and Council of Ministers meeting in Berlin

ESA was founded in 1975. At the end of 2005, ESA had 17 member countries. Nearly 2000 people work in ESA, which has an annual budget of almost three billion Euros. Norway became a member in 1987.

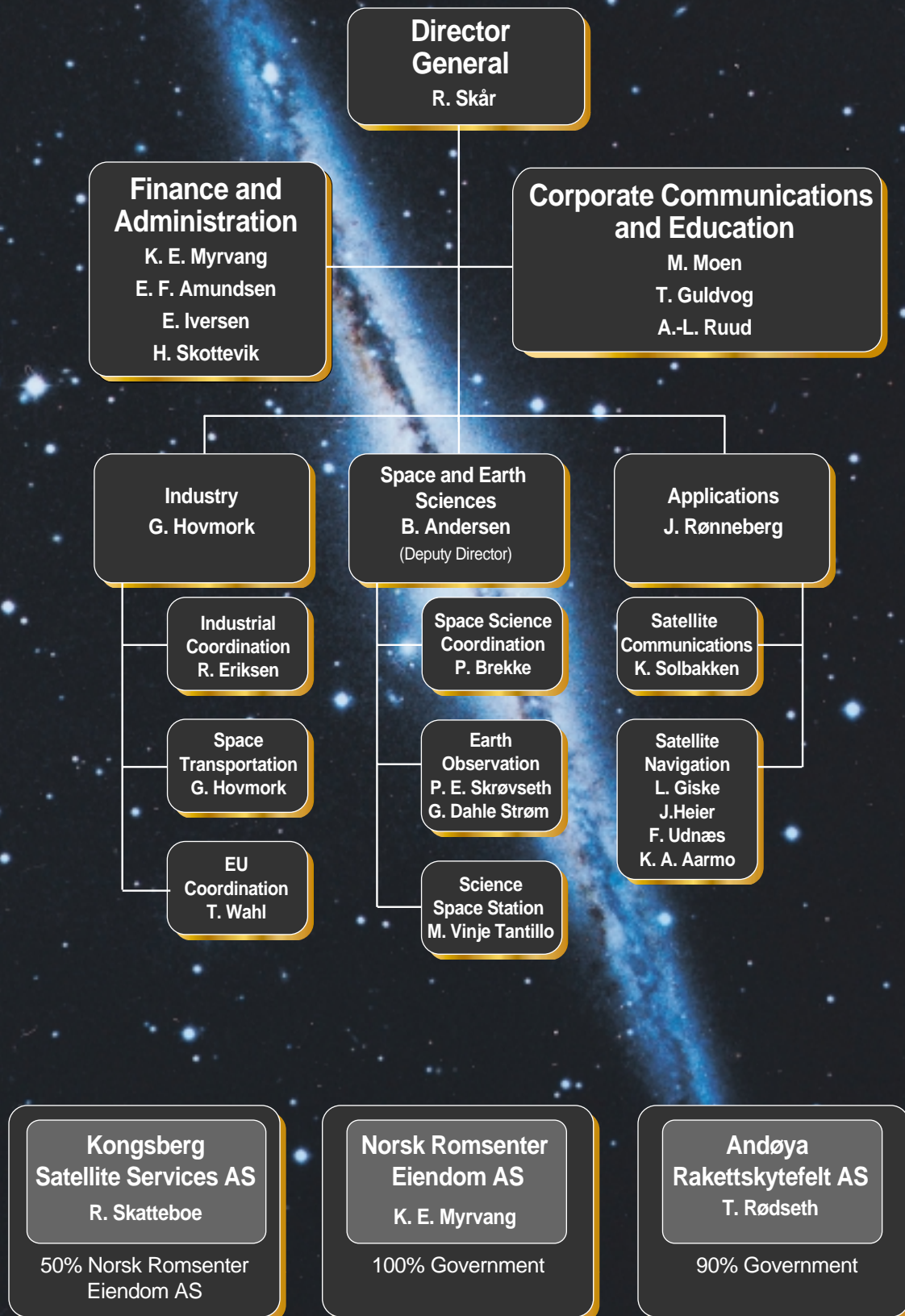
During the ESA Council of Ministers Meeting in Berlin in December, Norway entered NOK 947 million (€119 million) in new optional support programmes over the next few years. This is a marked increase and signals that Norwegian authorities are committed to the industrial, service and scientific aspects of space.

Norwegian Space Centre Managing Director Rolf Skår (left) and State Secretary, Deputy Minister of Trade and Industry Frode Berg at the ESA Council of Ministers Meeting in Berlin.

©Norwegian Space Centre



Organization of the Norwegian Space Centre (NSC) as per 1 January 2006





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