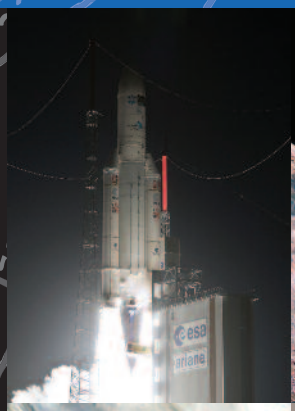
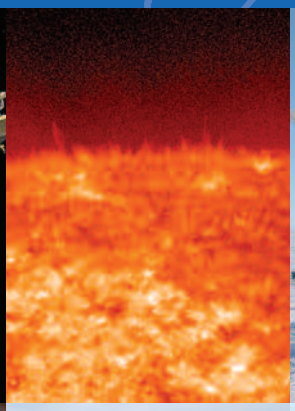
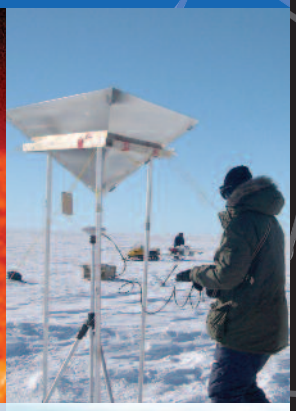
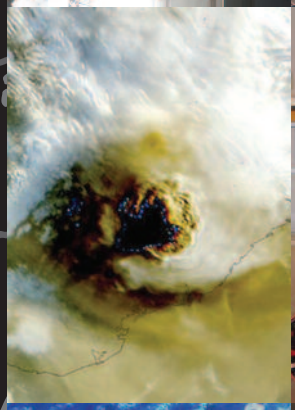
Annual Report **2011**








Norsk Romsenter
NORWEGIAN SPACE CENTRE

NSC-Report 2013/1

Management 2011

Øyvind Stene

Board
Øyvind Stene, Chairman
Edel Storelvmo, Vice Chairman
Marian Nymark Melle
Jøran Moen
Paul Narum

Deputy members:
Kjetil Storaas Hansen
Kirsti Lovise Slotsvik

Bo Nyborg Andersen

Management
Bo Nyborg Andersen,
Managing Director

Facts about the Norwegian Space Centre

The Norwegian Space Centre (NSC) is a government agency under the Ministry of Trade and Industry. NSC was established in 1987, when Norway became a member of the European Space Agency (ESA).

NSC is responsible for organizing Norwegian space activities, particularly with respect to ESA and the EU, and for coordinating national space activities. See Objectives box below for further information.

NSC manages governmental interests in the Andøya Rocket Range (90%) and in Norwegian Space Centre Properties (100%), which in turn owns 50% of Kongsberg Satellite Services AS.

In 2011, the total budget was NOK 682 million, and the NSC had 35 employees.

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.

Contents

From the Director

The year 2011 was successful, but to a degree like that of an intermediate season. It was more than a year until the 2012 ESA Council meeting at ministerial level, and Norwegian participation in EU's GMES programme was on hold. The NSC budget was at its greatest, partly due to payments into the EU Galileo programme. The main effort for NSC lay in ensuring that Norwegian space investments were well utilized to benefit Norwegian actors.

The ESA had initially scheduled a Ministerial Meeting in 2011. But because of the economic situation in Europe, it was postponed until November 2012. As a consequence, some of the ongoing ESA programmes were about to run out of funds toward the end of the period. Fortunately Norwegian actors were not particularly affected.

NSC's achievements result largely from activities that enable others in Norway to be successful in their space efforts. However, some tasks are best performed internally by the NSC staff. A review showed that it is more profitable to hire qualified people in project-related positions than to engage consultants. As a consequence, the number of NSC employees went up. Most of the new positions were temporary and project-related in areas such as monitoring tropical forests, Arctic telecommunications and further development of AIS.

The Space Centre's success rests on three key factors: the expertise of the staff, the dedication and knowledge of the Board and a "space department" that cares. The Ministry of Trade and Industry's involvement in the space sector resulted in the decision to evaluate the Norwegian space programmes, in practice the Space Centre's commitments through the ESA and national support schemes. The PwC consultancy was engaged, and it began working in the latter half of 2011. We hope that the final evaluation will contribute to positive development of space activities in Norway.

For me, 2011 was an important year. The Board advertised the Managing Director vacancy in connection with the end of my term in May 2012. I am grateful to the outgoing Board led by Øyvind Stene for appointing me to the second, final term.

The outgoing Board contributed considerably by being a corrective to administration and by providing valuable strategic input to joint activities.

The new Board led by Edel Storelvmo will continue the smooth cooperation with administration and with the Ministry of Trade and Industry. This shows promising for the future.

Norwegian Space Centre, 18.06.2012

Bo Andersen

In 2011, the first two satellites of the European Galileo navigation system were launched from French Guiana. Norway has been involved in development of the system through its membership in ESA and is now taking part in the development phase through an EU agreement. The Galileo system is expected to be operational in 2015 and will when fully complete have 30 satellites. ©ESA - P. Carril

Report of the Board 2011

Rockets, astronauts and remote-controlled Mars robots dominate public perceptions of work in space. People envision astronauts in white space suits on space missions. Advanced space telescopes that capture radiation from the birth of the universe. Giant antennas located on exotic highlands meticulously search for signs of other forms of life.

The more realistic space activities that affect everyday life are less spectacular. They include satellites that provide everything from navigation services to information on the salinity of the oceans. They're about industries that push the limits of technologies and about financial challenges and cooperation across borders.

Even though they are less spectacular, these aspects of space activities have the greatest impact on the daily functioning of societies. Should satellites fail, major service sectors may collapse. Weather forecasts, television broadcasting, automated teller machines, rescue operations and taxi bookings all depend on satellite communications. Space-based infrastructure has become an invisible but indispensable part of everyday life, and the importance of space initiatives will only increase in the years to come.

A vision of benefit

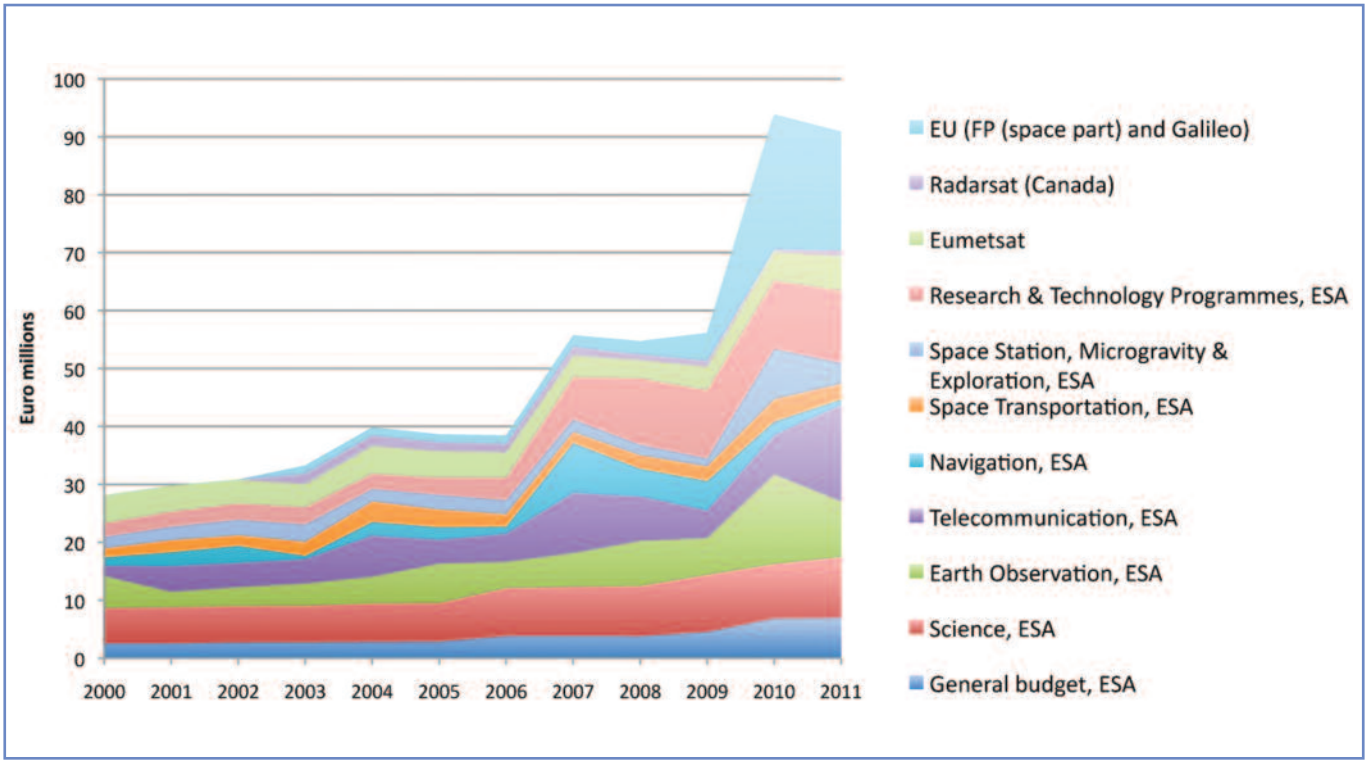
The guideline for Norwegian space activities has always been to focus on the beneficial rather than the spectacular. Norway became a member of ESA in 1987 principally because of industrial spin-off effects and public benefit. Twenty years later, it's apparent that membership has created workplaces, profitability and an administration that is advanced in its uses of space-based infrastructures. The NSC Board believes in the continued importance of space activities in contributing to social development.

The Board is aware of its duty to contribute to the vision of the Norwegian Space Centre:

"Norway shall be the country that benefits most from space."

ESA membership is the key means of fulfilling that national vision. In 2011, NSC managed international space activities amounting to NOK 509 million, divided by NOK 132 million in ESA membership fee and NOK 377 million in optional programmes, see Figure 1. The ESA membership fee is allocated to the scientific programme and ESA operation. The optional programmes are chosen in sectors in which the NSC believes that Norwegian companies, research communities and administration will benefit the most or be able to assert themselves. Otherwise, Norway contributed NOK 75 million via the NSC budget to the development of Galileo in the EU. The NSC also manages national support scheme funds used to position R&D communities for subsequent ESA contracts. Both ESA commitments and national support scheme funding have spin-off effects evident in increased turnover for space companies, as shown by the calculated spin-off factors. Norway is one of very few countries that calculates the effect

Figure 1. Norway participates in international space activities through membership in the European Space Agency (ESA), the EU space programme and bilateral agreements.



of public space initiatives. In "The Space Economy at a Glance 2011" (OECD), national spin-off factors for 2009 were compared: Norway 4.7, Denmark 3.7, Britain 1.9 and Belgium 1.7. The spinoff factors of American and Norwegian space initiatives are at about the same level. This shows that NSC efficiently manages government funds.

In 2011, preparations began for the Ministerial Meeting in 2012. At the Meeting, guidelines will be set for European space initiatives up to 2020, and Norway must clarify the programmes and economic constraints of its intended participation. NSC provides professional advice to the Ministry of Trade and Industry, based on its knowledge of Norwegian interests, qualifications and anticipated benefits. The Government will make the final decision. The NSC Board underscores the importance of continued governmental commitment to space activities, because space is an increasingly vital part of the Norwegian infrastructure, economy, high-tech development and international obligations.

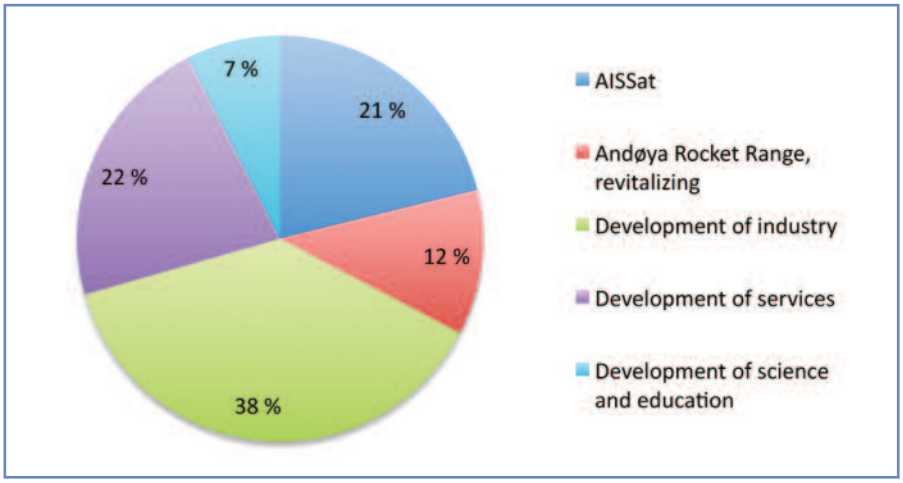


Figure 2. The national support scheme strengthens Norwegian actors so they are better positioned to compete for national and international contracts. In 2011, 30 companies received a total of NOK 52.9 million in national support funding.

International cooperation

Norway is small in the space sector. So it must make itself an attractive partner in larger space projects. The launch of the ICI-3 sounding rocket from Svalbard in December 2011 is an example of a successful high-tech, Norwegian-led international project. Japanese instruments played a vital role in the project. NSC has previously entered a bilateral cooperation agreement with the Japan Aerospace Exploration Agency (JAXA) and has supported the implementation of the ICI-3 project at the University of Oslo through the national support scheme.

In 2007, NSC and Centre National d'Etudes Spatiales (CNES), the French space agency, entered a cooperation agreement. In 2011, joint activities increased in marine monitoring, one of the many possible sectors for cooperation covered by the agreement. NSC provided national support scheme funding to ensure that the Norwegian Defence Research Establishment could work with CNES at the technical level. Likewise, in 2011 NSC provided national support scheme funding to The Norwegian Mapping Authority to follow up Norwegian-French cooperation in exploring the effects of the ionosphere on navigation signals.

In the autumn of 2011, NPP, the new NASA weather satellite, was launched. KSAT's Svalsat ground station on Svalbard supports it. The launch marked a new step in the bilateral Norwegian-American cooperation in weather and environmental satellites. It was this cooperation that triggered the laying of undersea fibreoptic cables between Svalbard and the mainland in 2003. Kongsberg Satellite Services (KSAT) is responsible for technical cooperation with NASA under a general agreement in which NSC is the Norwegian party.

Support programme funding

NSC manages the national support programme funding that enables Norwegian actors to be better positioned for national and international space contracting. Several Norwegian communities have become world leaders in their specialized niches because their technical developments were supported early on.

Support programme funding also is available for incentives in science and education as well as for positioning for utilizing satellite data and for safeguarding vital infrastructures. In 2011, support programme funding amounting to NOK 52.9 million was provided to 30 actors in 43 contracts; see Figure 2.

In 2011, Norway saved millions of kroner (NOK) when improved models of ash plume spread allowed airspace to be held open during the Grimsvatn eruption on Iceland. In 2010 and 2011, the Norwegian Institute for Air Research (NILU) and the Norwegian Meteorological Institute (DNMI) jointly compiled a national strategy for using satellite data in assessing airborne volcanic ash concentration. NSC provided national support scheme funding for the work. NILU also is involved in ESA projects dealing with volcanic ash dispersion.

Kongsberg Spacetec in Tromsø will deliver modem technology for the ground systems for the Sentinel 1, 2 and 3 Earth observation satellites. The contracts were won in competition with companies round the world. Spacetec said that national support scheme funding from NSC and the ESA GSTP programme were a great help in developing the technology now sold. Two projects, scientific activities at the Andøya Rocket Range and acquisition of the AISSat-2 satellite, received continued support in the past year.

Spin-off effects

Since the 1990s, the spin-off factor has been used to measure the effect of

governmental funding on space activities, see Figure 3. The factor is the ratio of the additional turnover achieved by space sector companies to the funding they receive from the support programme or ESA contracts.

The spin-off factor rose from slightly less than 3.5 in 1997 to 4.8 in 2011. This means that for each NOK of governmental funding from the national support programmes or the ESA, the companies have attained additional turnover of nearly 5 NOK. The Board believes that this is proof that governmental commitment in space activities is profitable and leads to industrial development and workplaces. The Board emphasizes that further growth depends on increased commitment, both public and private.

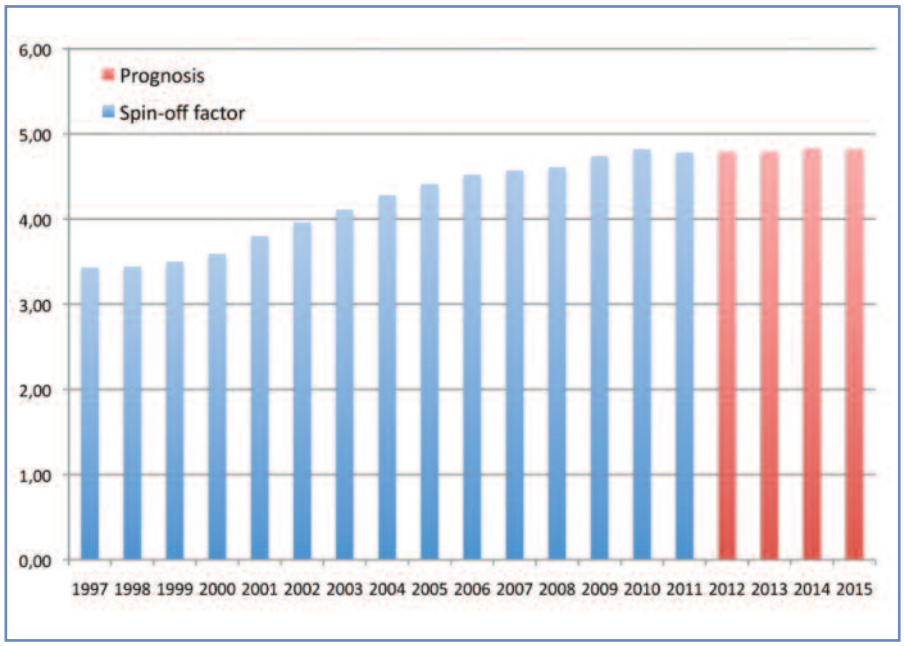


Figure 3. The spin-off factor is a measure of the effect of Norwegian space commitment through the ESA and national support schemes. The Figure is based on information provided by 26 companies and institutes in Norway. In 2011 the spin-off factor was 4.8.

Space industry

Space industry is a vital business sector in the country. In 2011, the turnover of Norwegian-produced goods and services in the space sector went up 5% to a total of NOK 6 billion (see Figure 4), of which 69% went to export. Turnover in satellite communications accounted for a considerable part of the export income. Vizada Norway (including Marlink) and Telenor Satellite Broadcasting accounted for the largest portion of it. In addition, high-tech niche companies delivered to the international space industry.

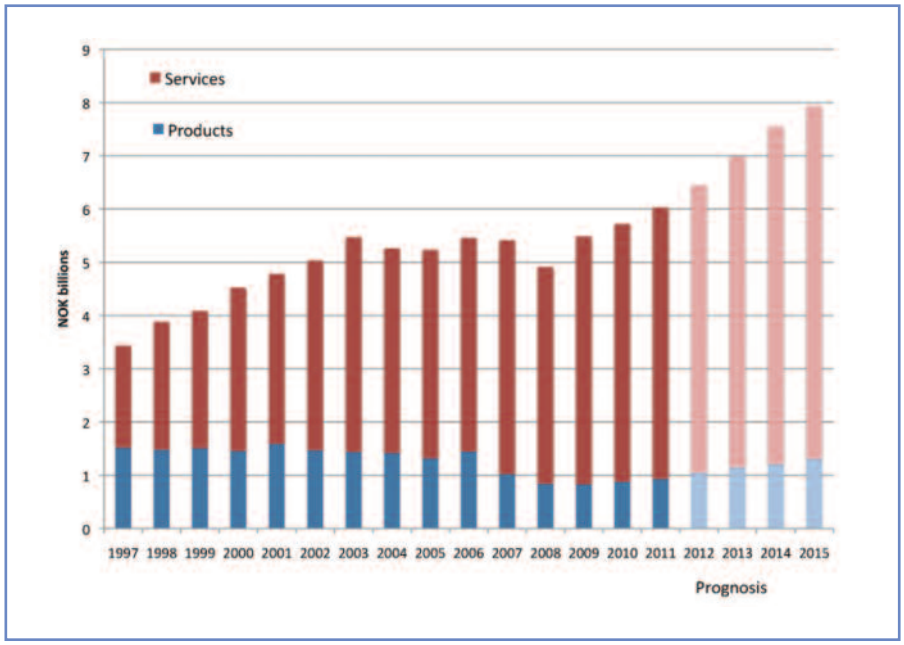
Kongsberg is a large, key player with products and services for launchers, satellites, satellite data processing and earth station services implemented by an increasing number of antennas round the globe. In November, the Kongsberg Group strengthened its space segment by purchasing Norspace at Horten, a leading supplier of communications satellite electronics.

In the summer of 2011, the ESA received many bids in the competitive tendering for the ground segment for new GMES programme satellites. In December 2011 it was announced that KSAT of Norway had won key roles in the ground segment, and contract negotiations started in January. KSAT may get both the downloading of global data and the near real-time processing for Northern Europe in the GMES programme. In the long run the contracts may be large.

From the perspective of spin-off effects it may be mentioned that in 2011 Kongsberg Spacetec won the contract for the architecture of the open part of the Barents Watch web portal. There is reason to believe that Spacetec's ESA and EUMETSAT experience were instrumental in awarding the contract.

NSC has recently been the driving force for technology transfer involving greater use of ground-based technolo-

Figure 4. Turnover of Norwegian-produced goods and services in the space sector from 1997 to 2011, including the companies' forecasts up to 2015. In 2011, the total space sector turnover was NOK 6 billion.



gies in space activities. At a broad industry meeting in Stavanger, NSC invited the ESA to present its challenges to a range of Norwegian technical communities, including those in the energy sector that faces challenges similar to those of space. Under NSC influence, ESA's General Support Technology Programme (GSTP) now will be used for faster evaluation of innovative solutions.

The international space station and space transport

The Space Station now is completed. In the spring of 2011, the ESA Council unanimously decided that Europe should continue use of it. In 2011, NASA's space shuttles flew their last missions, ending an era in space travel history. There still are no plans for starting ESA training of Norwegian astronauts. The global financial crisis has curbed plans for manned space flight in the USA, Europe and Russia.

The international launch market is stable. The Ariane-5 launch vehicle, developed by ESA, orbited eight large communications satellites in five launches and now has 50% of the market. Moreover, the ATV resupply spacecraft carried cargo to the Space Station (ISS). Norwegian companies have steady production runs for Ariane, but the market for Arianespace, that markets, integrates and launches the launch vehicles, is critical due to market fluctuations and low profits. Under direction of ESA, the structure of the European rocket industry is being revaluated with the goal of improving efficiency. The revaluation was not finished in 2011. But its preliminary conclusion is that not even Europe can have reliable access to space without continued public support.

Satellite communications

One of the goals of Norway's long-term plan for space activities is to work for better communications solutions in the High North. In 2011, NSC contributed to SINTEF leading an ESA project on communications needs and the availability of capacity in the High North up to 2020. Telenor Satellite Broadcasting, Marintek, Euroconsult and Telesat Canada also contributed. The project is relevant to the Government's High North Strategy, and in May the issue also was highlighted in the Arctic Council's new agreement on Arctic search and rescue.

NSC has been involved in obtaining an ESA contract for studying Ka band wave propagation in the High North. Several Norwegian actors are interested in the study, the goal of which is to ensure reliable signals from satellites low on the horizon.

Satellite communications is a sector in which Norway has competitive companies. In 2011, several of them gained approval of projects in various elements of the ESA Advanced Research in Telecommunication Systems (ARTES) programme that facilities development of technologies and of a company's core products. Moreover, some projects have gained Strategic Initiatives (StrIn) support, an ESA tool for offsetting deficit in ESA return on other programmes in which Norway is involved.

In 2011, Norway´s joining of ARTES-7, enabled Norwegian companies to test and space qualify new components for communications satellites. This was of great value, because commercial satellites seldom can be used for qualification of new equipment.

AISSat-1, the Norwegian observation satellite launched in 2010, has provided useful data in the testing phase. It is in a polar orbit and provides the Norwegian Coastal Administration with updated information on shipping in Norwegian waters 16 times a day. AISSat-1 has attracted international attention.

NSC was active in getting Norwegian players in key elements of the ESA satellite-based Automatic Identification System (AIS) programme. Moreover, Norway has contributed AIS data for testing to the ESA and the European Maritime Safety Agency (EMSA). In this way we have shown what sort of data our own satellite, AISSat-1 can deliver. NSC now is working to position Norwegian interests for the next phase of ARTES, both by influencing the nature of ESA's forthcoming AIS activities and by positioning Norwegian AIS activities so they may play central roles in the future.

Satellite navigation

Galileo is the largest European joint infrastructure commitment and the largest ever EU space project. Together with GPS, Galileo will be Europe's as well as Norway's primary system for positioning, navigation and timing. With its appreciable economic activity, demanding topography and management responsibility for extensive land and sea areas, Norway needs better, more reliable navigational aids. Satellite navigation is a reliable, cost-effective solution.

EU's midway evaluation in 2011 showed that the implementation of Galileo will be slightly more expensive than initially estimated. The Commission will continue implementation with funding already allocated up to 2014, when part of the system is scheduled to be operational. In this phase, NSC has taken part in various committees and working groups, to safeguard Norwegian interests. In addition, Norwegian companies have secured major contracts for development and operating the system. The Commission has put forth proposals for further development and operation of the system up to its completion in 2020. The budget is seven billion Euros and is recommended as part of the EU budget for the forthcoming period.

The Public Regulated Service (PRS) is an encrypted Galileo service for public sector user groups with the strict requirement that it always should be available. Access rules for the Galileo PRS service were set in November 2011. Through our participation in Galileo, subject to a supplementary agreement, Norway may have full access to PRS, as do EU countries. The process for entering such a supplementary agreement has started.

The EU's satellite navigation programmes also include a support system, the European Geostationary Overlay Service (EGNOS). It aims to

ensure the quality and reliability of GPS satellite signals in Europe. In March 2011, the Safety of Life service in EGNOS was certified for aviation. This means that Norwegian aviation authorities may now introduce satellite-based procedures for using EGNOS in landing at Norwegian airports (for the present, not the northernmost). Norway is working in several areas to ensure that performance is as good in Norway as it is elsewhere in Europe.

NSC has recently supported the Ministry of Fisheries and Coastal Affairs with follow-up of the Norwegian radio navigation plan, which now is in its final phase with evaluations of the uses for and vulnerability of satellite navigation in various sectors of society.

Earth observation

In January 2011, the EU started a new programme, GMES Initial Operations (GIO). This puts Norway in a complicated situation. Our many years of participation in Global Monitoring for Environment and Security (GMES) through the ESA and EU's seventh Framework Programme (FP7) no longer are sufficient to ensure Norwegian user and industry interests, Consequently, in 2011 NSC compiled further supporting material relevant to GIO and briefed the agencies concerned on the situation. In December 2011, the Government decided that Norway should start negotiations with the EU on Norwegian participation in GMES Initial Operations.

The ESA Earth Observation Envelope Programme (EOEP) has three research satellites in orbit: the Gravity field and steady-state Ocean Circulator Explorer (GOCE), the Soil Moisture and Ocean Salinity (SMOS) mission and the Sea ice thickness and ice sheet topography (CryoSat) satellite. In 2011, NSC arranged for Norwegian use of these three satellites through the national support scheme and/or ESA PRODEX funding. With the SWARM satellites to be launched in 2012 for precision measurement of the Earth's magnetic field, in 2011 NSC supported the establishment of a global magnetic field data base at the University of Bergen. In the spring of 2011, a contract was set up between the Norwegian Embassy in Tanzania, Tanzania's forest service and research communities in Norway and Tanzania for knowledge transfer and capacity building in monitoring tropical forests using satellites and lidar. NSC was instrumental in establishing the contract, on behalf of the Government forest project. NSC was among the organizations that prompted the Group on Earth Observations (GEO) to launch the Global Forest Observations Initiative (GFOI) in 2011. The location of the GFOI main office will be decided in 2012.

Space research

In 2011, the ESA scientific programme made two important decisions on the satellites and space exploration probes to be built for scientific applications in the coming years. The Norwegian scientific community is pleased that the next two missions will be the Solar Orbiter satellite and the EUCLID cosmology mission. Solar physics and cosmology are two leading Norwegian commitment sectors in astronomy. So NSC has long worked to strengthen these two fields in the ESA and to position Norwegian researchers and companies for participation.

In 2011 there were no clarifications concerning ExoMars – ESA's plan for sending a satellite and a rover to Mars, respectively in 2016 and 2018. By the end of the year it was apparent that the planned cooperation with the USA on ExoMars should be discontinued. Since then, the ESA has turned to Russia for possible Mars mission cooperation. Independently, NASA's new Mars vehicle, Curiosity (Mars Science Laboratory) was launched in 2011. Several of the instruments on Curiosity were tested on Arctic Mars Analogue Svalbard Expeditions (AMASE). Moreover, in the summer of 2011 Mars related instruments were tested on Svalbard in a major AMASE with international participants.

Data from the Japanese Hinode solar satellite were downloaded to SvalSat and processed at the Institute for Theoretical Astrophysics data centre at the University of Oslo. The contract for operation and the data centre will be extended in 2012 and is financed by the ESA scientific programme.

The large Mars500 analogue simulation of a manned mission to Mars was completed in Moscow in the autumn of 2011. There were no Norwegian "astronauts" on board, but Norwegian researchers in psychology were involved in analysing the experiment for ESA.

In 2011, there have been extensive building works at the Andøya Rocket Range (ARR), following earmarking in 2010 and 2011 of NSC national support funds for upgrading the infrastructure at the Range. Despite the ongoing construction work, in 2011 ARR maintained a high level of activity. From the Norwegian side, the highpoint was the launch of the ICI-3 sounding rocket in December, for which ARR had technical responsibility.

Communications and education

The Communications Department was the only NSC department that would have liked to see greater emphasis on astronauts. Children and young people are fascinated by space travel and rockets, and national role models mean much for enthusiasm. Fortunately, Swedish astronaut Christer Fuglesang likes Norway, which was evident in the "Fill up the black holes" event that drew more than a hundred participants from schools, administration and research. In addition, NSC staff members held more than 200 lectures during the year, and the auditorium at NSC headquarters hosted 2000 guests. NSC was at the Oslo Science Fair and the Astro Festival, two large, open events that drew in all some 20,000 to 30,000 visitors. The interest was outstanding for testing hybrid rockets, black holes, space missions and practical satellite navigation.

The romsenter.no website is the principal channel for reaching people interested in space, both professionals and the general public. In 2011, work began on a new website that aims to be even more fascinating in astronomy and

space travel and to make services clearer to users in administration, business and schools.

There was an average of two mentions a day of NSC in the media, and visits to the website are stable at about 120,000 unique visitors and 1.1 million pages viewed.

The future need for professionals in the natural sciences and technologies was instrumental in the start of the AnSat student satellite programme in 2006. To date, 122 university and college students have taken part in the programme that involves the planning, building, testing and launch of satellites that deliver data.

In 1962, the first research rocket was launched from Norway, and many who experienced those pioneer days are growing old. So, in cooperation with the Norwegian Museum of Science and Technology and the Norwegian Aviation Museum, NSC has initiated a space history project in which veterans relate their recollections of space activities of the 1950s to the 1980s. Some of their stories will be remembered during the 50th anniversary at Andøya on 18 August 2012.

Oslo, 01.03.2012

Øivind Stene, Chairman

Jøran Moen

Edel Storelvmo

Paul Narum

Marie Nymark Melle

Bo Andersen, Managing Director

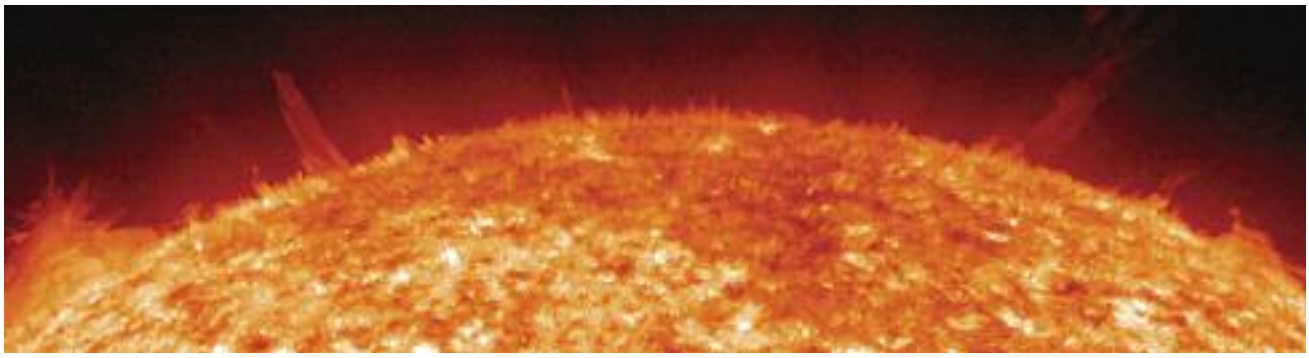
Figures from profit and loss account 2011

NOK 1000 (Average exchange rate for 2011: 1€=NOK 7,7931)	**2011**	**2010**
PROGRAMME ACCOUNTS		
Programme income:		
Programme revenue from Ministry of Trade and Industry	**551 963**	**565 909**
Other revenues	12 757	11 072
Total programme income	*564 720*	*576 981*
Programme expenses:		
ESA, Mandatory basic activities	37 333	37 935
ESA, CSG Kourou	9 992	10 381
ESA, Mandatory scientific programmes	81 490	75 562
ESA, Earth observation	75 214	125 164
ESA, Telecommunications	114 571	54 932
ESA, Navigation	7 351	18 723
ESA, Space station, Microgravity and Exploration	33 590	41 335
ESA, Space transportation	20 972	30 938
ESA, Technology development	96 992	91 261
EASP	27 430	28 144
Radarsat	7 790	3 003
NSC support scheme	52 000	58 400
Total programme expenses	*564 725*	*575 778*
PROGRAMME RESULT	***-5***	***1 203***
OPERATING ACCOUNTS		
Operating income:		
Operating revenue from Ministry of Trade and Industry	48 700	47 400
Other operating revenues	54 228	52 639
Total operating income	*102 928*	*100 039*
Operating expenses:		
Salaries and social expenses	30 973	28 713
Other operating expenses	66 139	72 059
Total operating expenses	*97 112*	*100 772*
Depreciation	576	638
Operating profit	***5 240***	***-1 371***
Net financial income	-24	-18
OPERATING RESULT	***5 216***	***-1 389***
TOTAL RESULT	***5 211***	***-186***

January

Solar research reported in Science

Scientists at the Institute for Theoretical Astrophysics of the University of Oslo have contributed to the understanding of why the Sun's corona is so much hotter than its photosphere (the visible surface). Together with American colleagues they studied data from the Solar Dynamics Observatory and Hinode solar satellites. High-resolution images show that mass is transferred in fountainlike jets that are accelerated upward into the corona. The coronal heating mechanism remains unknown. But the results suggest the direction in which research should continue. A paper reporting the research was published in the 7 January 2011 issue of Science ©NASA/ESA

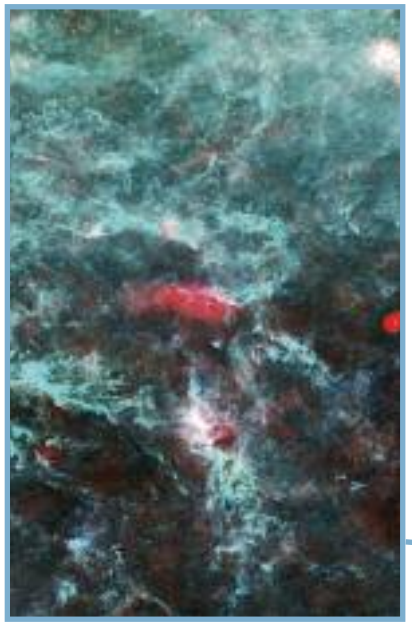


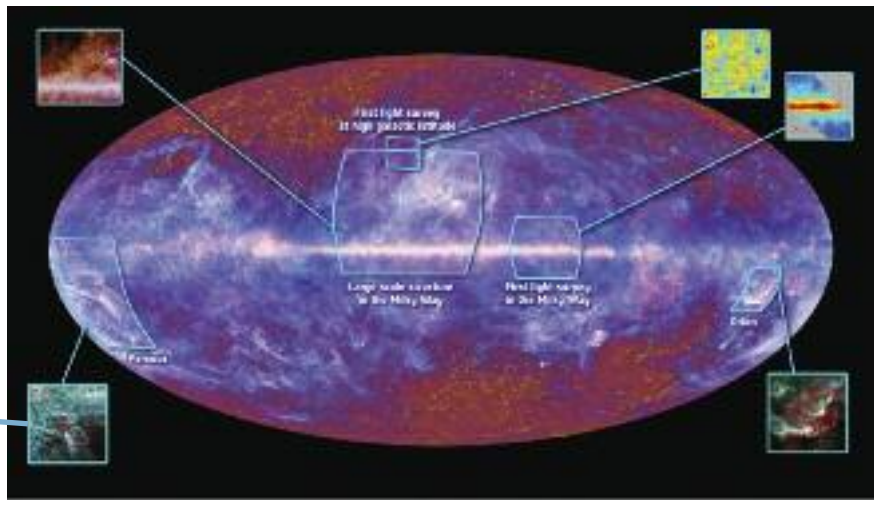
Presens supplies pressure sensors

Presens of Oslo will supply pressure sensors for ADM-Aeolus, the ESA wind mission satellite. The company has supplied sensors to the oil and gas industries for many years and now is further developing its technology for space applications. The sensors will monitor pressure in one of the main instruments on board so it may be used as long as possible. ©Presens AS

Planck's cosmic theatre

Europe's Planck Space Observatory examines the microwaves left after the Big Bang and immediately thereafter. The data enable scientists to better understand what happened when the universe formed about 14 billion years ago. The first results reveal thousands of new galaxies that may provide insights into how the oldest structures in the cosmos were formed. The image shows newly-discovered galaxy clusters found by Planck and confirmed by the XMM-Newton X-Ray telescope. Cosmologists at the University of Oslo are among those having access to the first data from Planck. ©ESA/Planck Collaboration





February

Ice data for all

Now scientists round the world can download accurate data on changes in the Earth's ice masses. The ESA CryoSat satellite uses a specialized radar altimeter to measure ice thickness down to the centimetre level. The data provide insights into the variations of volumes of ice on Earth. CryoSat data are publically available for all scientists needing information on the thickness of glaciers on land and sea ice in Polar Regions, which are key indicators of climate change. In March and April, CryoSat measurements were compared with ground measurements, see page 12.

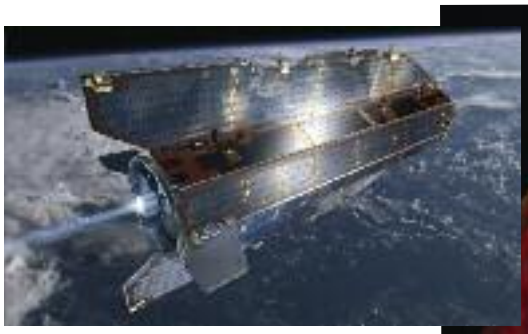
©ESA/AOES

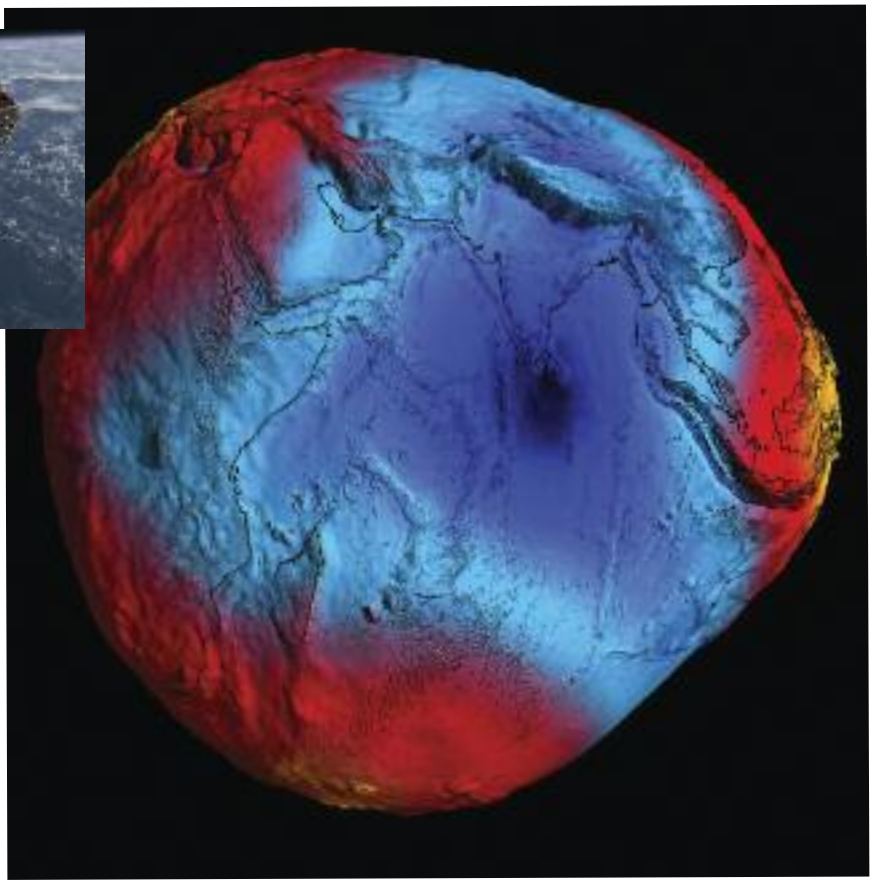
Memorable day for Ariane

Ariane launchers have carried satellites and space probes into orbit since 1979. The 200th launch was completed on 15 February. The launcher carried the Johannes Kepler Automated Transfer Vehicle (ATV), which docked eight days later at the International Space Station. Three Norwegian companies, Nammo Raufoss, Kongsberg Defence & Aerospace and Norspace, supply components for a total value of NOK 10 million to each Ariane 5 rocket.

©ESA - S. Corvaja, 2011

March





Gravity field in detail

It looks like something in a sci-fi film, with fins, a specialized design and an ion thruster that propels it vibrationless through space. After two years in low orbit, the GOCE gravity satellite has provided the most accurate map ever of the geoid. Now all elevation measurements can be based on an extremely precise zero elevation reference surface. This improves the accuracy of navigation signals, maps and climate models.

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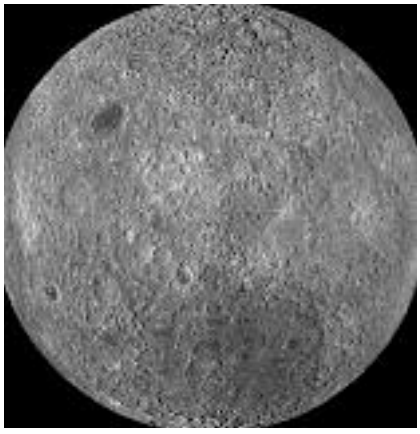
Safer landing with GPS

Many small airfields in Norway have a minimum visibility for landing of 500 metres. The European space-based EGNOS system will eventually make safe landings possible with visibility down to 70 metres. EGNOS is an augmentation system that supplements GPS by warning of errors in positioning data. In March, the system was certified by European civil aviation authorities for airfields that don't have their own navigation systems for landing. This will be important for a country such as Norway, with many exposed, small airfields. Using EGNOS will reduce delays and increase efficiency while improving safety. ©Widerøe



Far side of the Moon

Images taken by the Lunar Reconnaissance Orbiter show that the far side of the Moon has had less volcanic activity than the near side visible from Earth. Thicker crust may be the cause. So scientists wonder why the near and far side thicknesses differ. The images are taken at an altitude of 50 km and have a resolution of 100 m per pixel.

©NASA
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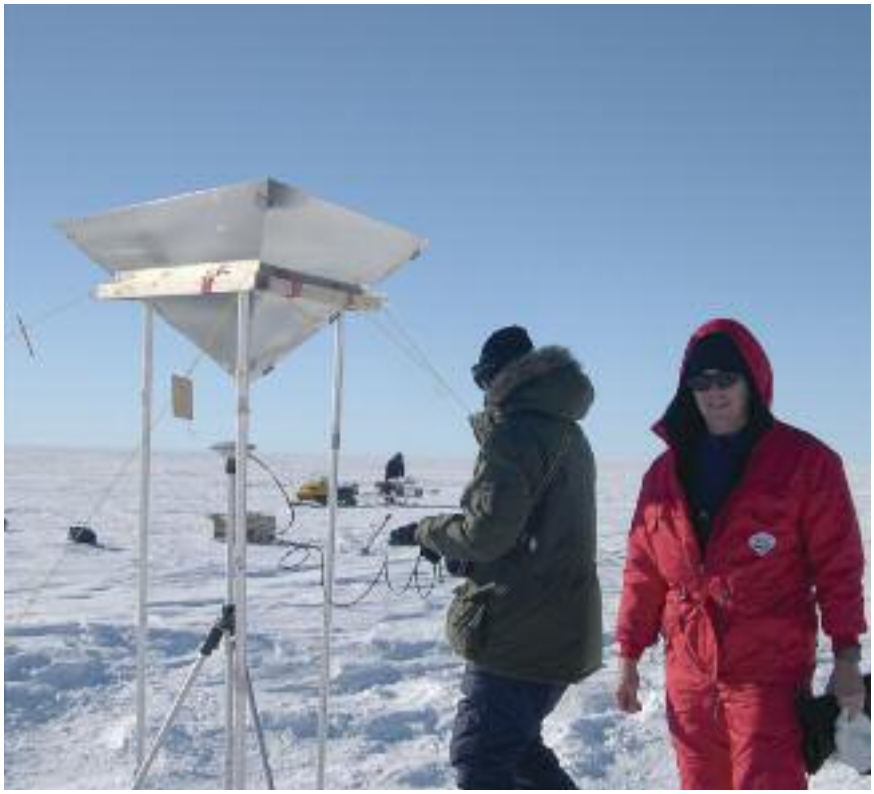
April

50 years since Gagarin

On 12 April 1961, Yuri Gagarin of the Soviet Union was the first man in space. He completed a trip of 1 hour and 48 minutes in Earth orbit. He landed in Kazakhstan after ejecting from the Vostok capsule that he sat in. The achievement made Gagarin world famous and led to the American start of the Apollo programme that resulted in the Moon landing of 1969.



Arctic measurement validation

The CryoSat satellite was launched in 2010 to measure the thickness of glacial and sea ice, important information related to climate. Data quality was ensured through simultaneous measurements on the ground. In March and April, a validation campaign was conducted on Greenland, on Svalbard, in Canada and in the Fram Straight. CryoSat data are available to all scientists, see page 10.

©Malcolm Davidson ESA

AIS overview

The Norwegian AISSat-1 observation satellite has fulfilled expectations after its launch in July 2010. Monitoring of oil spills and illegal fishing has been improved because the satellite provides an overview of all vessels larger than 300 tons and all passenger ships in waters off Norway and around Svalbard. In April, AISSat-1 identified a vessel that leaked oil into the sea north of the coast of Finnmark. Work on the next generation AIS satellite has started. It will be patterned on AISSat-1.

©FFI/NASA

May

Galileo station in Svalbard

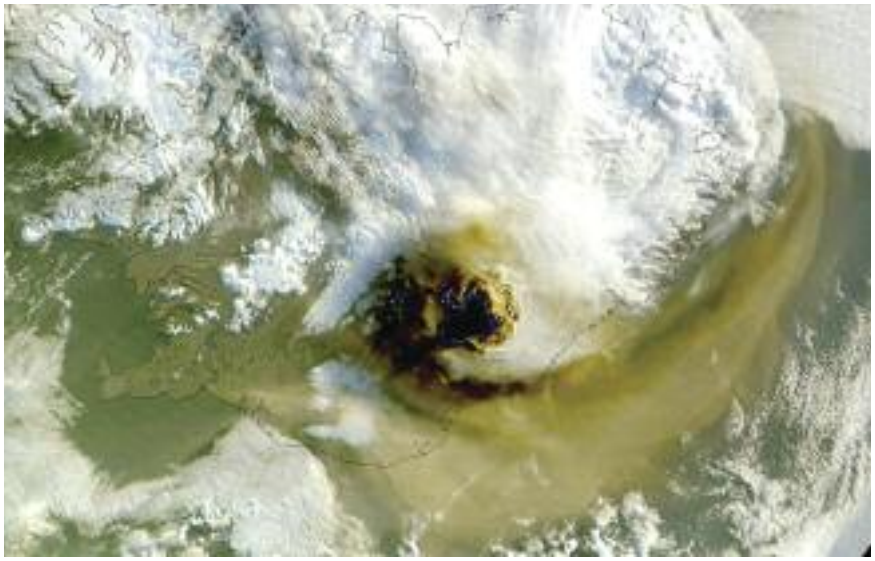
On 20 May, the ESA opened the northernmost Galileo satellite network ground station in Svalbard. The station checks the timestamps and positions of Galileo satellites and sends corrections when necessary. The Galileo system is a civilian satellite navigation system now being implemented in Europe. The southernmost ground station is at the Troll Base in Antarctica. A third station on Norwegian ground is being built on Jan Mayen. ©ESA-J. Huart / KSAT

Kongsberg to Mercury

In 2015, the BepiColombo space exploration probe will be launched toward Mercury, to explore the planet's origin and development. It is scheduled to arrive in 2022 and will explore Mercury's geology, atmosphere and magnetic field and will send large amounts of quality data back to Earth. This requires a lot of solar power. Kongsberg Defence & Aerospace has been awarded the contract for the mechanical and electronic controls of the probe's solar panels. The technology will be subjected to extreme stress, due to radiation and temperatures ranging from plus 200 to minus 150 degrees Celcius. ©ESA - AOES Medialab

Saatellites see ash plumes

When the Grimsvatn volcano on Iceland erupted, satellites contributed to Norwegian airspace being held open. A special team from the CAA - Norway, Avinor, the Norwegian Meteorological Institute and NILU used satellite data, ground measurements and models of ash dispersion to provide ash concentration notices during the eruption. The notices resulted in airspace being kept open, which saved society from delays, cancelled flights and millions of kroner (NOK). ©NASA



June

Space station air healthy

In 2007 and 2008, the air on board the Space Station was monitored by the Analyzing Interferometer for Ambient Air (ANITA). In addition to ensuring healthy air for the astronauts, ANITA has brought recognition to SINTEF scientist Atle Honne, the scientist behind the analytical tools it uses. Mr. Honne received the SAE Wright Brothers Medal, awarded in recognition of significant contributions to aeronautical and space technologies.

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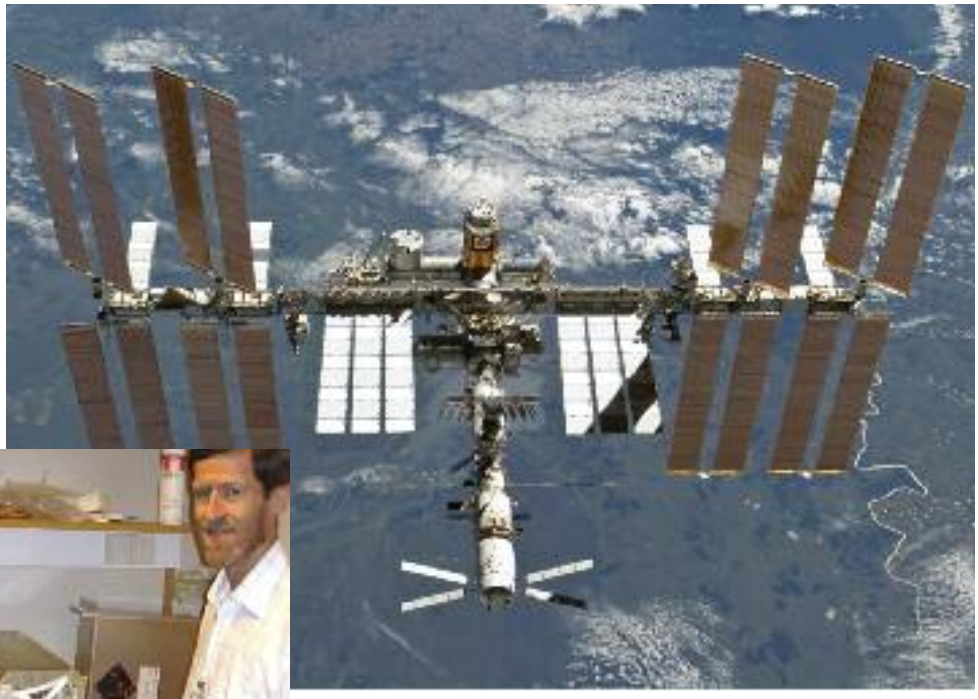


American for Telenor

The contract for building Telenor's next satellite, Thor 7, was awarded to Space Systems/Loral of the USA. The satellite will be orbited by an Ariane launch vehicle from French Guiana in late 2013. Thor 7 will provide increased capacity for maritime service and broadcasting and will cover the North Sea coast of Norway, the Red Sea, the Baltic Sea, the Persian Gulf and the Mediterranean. ©Telenor

©ESA/CNES/Arianespace/Photo Optique vidéo du CSG - S. Martin

July

Last shuttle mission

On 21 July, the Atlantis shuttle landed at Kennedy Space Center, marking the end of the American space shuttle programme. Since 1981, space shuttles have carried astronauts and equipment into space, principally for the Russian Mir space station and for the International Space Station. Shuttles were also used to deploy satellites and in repairing the Hubble space telescope. The accidents with Challenger in 1986 and Columbia in 2003 showed that space isn't risk-free. Atlantis, Endeavour and Discovery will end up in American museums, while NASA is planning the next phase of human spaceflight to asteroids, the Moon and perhaps Mars. ©ISS Expedition 28 Crew, NASA ©NASA/Dimitri Gerondidakis

Space Camp now 15

For the past 15 years, hundreds of young space enthusiasts have attended the European Space Camp at the Andøya Rocket Range. In the course of a week, they plan, build and launch a student rocket to 10 km altitude. The programme also includes talks, excursions and sun bathing at midnight. ©European Space Camp

August

From oil to space

Participants from the space industries and the oil and gas sector met at the Space and Energy Conference in Stavanger to exchange technology and expertise. Both sectors operate in remote, demanding environments, with strict requirements on safety, equipment and routines. ESA Director General Jean-Jacques Dordain was one of the main speakers. ©ESA - J. Mai

Mars tests on Svalbard

Since 2003, in summer there has been an Arctic Mars Analog Svalbard Expedition (AMASE) on Svalbard to test equipment to be used on Mars. In August, an X-Ray apparatus and a chemical sensor for organic molecules were field tested. Both instruments were included in NASA's Mars mission in November, see page 19. The Svalbard test site is similar to the Gale crater where the rover will land in August 2012. ©Kjell Ove Storvik/AMASE

September

Oslo Science Fair

The Nammo Raufoss hybrid rocket roared as it was fired up at the Oslo Science Fair. While conventional rockets cannot be stopped once started, this rocket can be regulated, stopped and restarted. The goal is for it to be steerable through the atmosphere, so scientists may collect data from the most interesting layers. Crown Prince Haakon tested the demonstration model. ©Jon Solberg

Mission accomplished

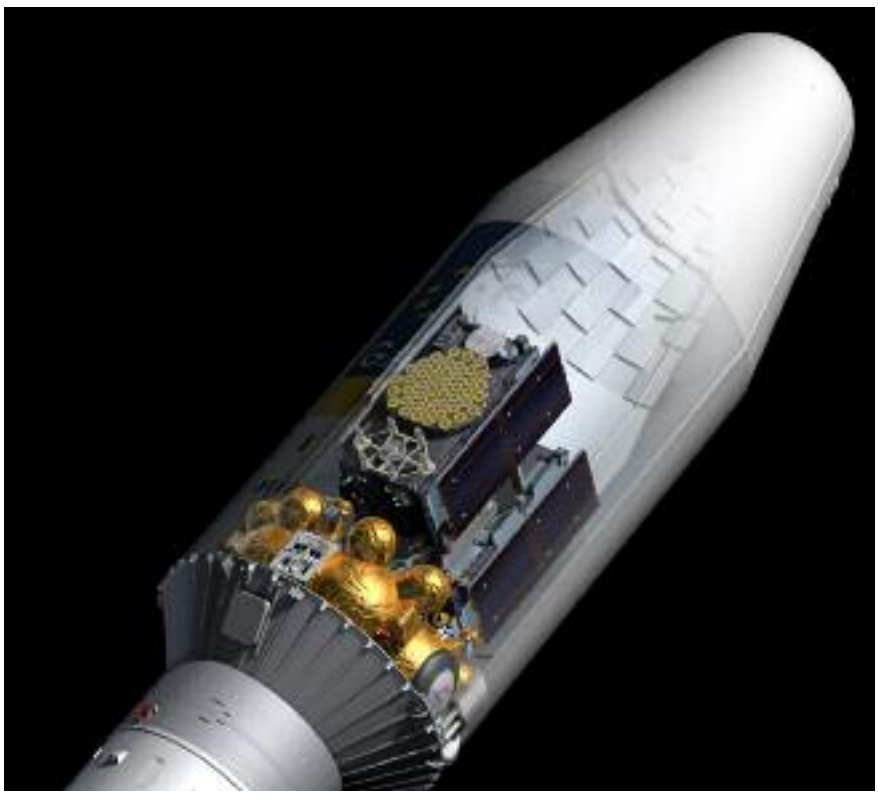
As satellites approach the end of their useful lives, they must be de-orbited so they don't collide with other satellites and create space litter. The wreckage from rockets and decommissioned satellites is an increasing problem for satellite owners and other users of space. So after 16 years of service, in September the ESA ERS-2 radar satellite was moved to a lower orbit. There it will burn up in the atmosphere within a few years. ©ESA

Thinner Arctic ice

From September on, the extent of Arctic sea ice reached a minimum. Over the past ten years, the area of the ice has gone down by 9.4%. The melting results in thick multiyear ice being replaced by thinner annual ice. Measurements from new satellites also show that ice volume is decreasing. ©erikwkolstad / iStockphoto.com

October

Galileo launched on Soyuz
The first two satellites of the Galileo European navigation system were launched on a Soyuz launch vehicle from the European base in French Guiana. The Galileo system is expected to be operational in 2015 and when fully complete will have 30 satellites. It will have ground stations round the globe, see page 13. Together with GPS, Galileo will improve accessibility and performance in areas now having poor coverage. ©ESA - S. Corvaja, 2011

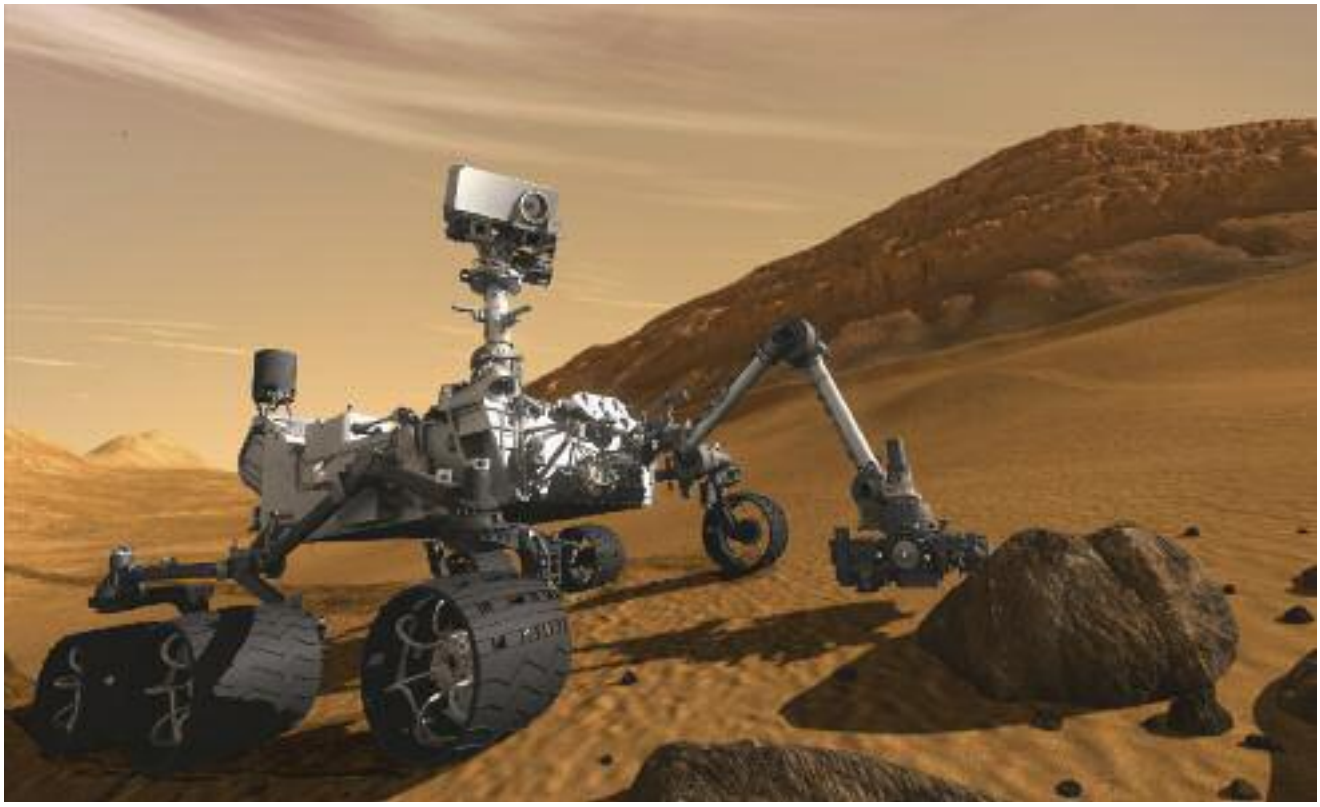


Kongsberg buys Norspace
Norspace of Horten has specialized in electronics for communications satellites and has been awarded several Galileo system deliveries. Kongsberg Defence & Aerospace acquired all the shares in the company and changed its name to Kongsberg Norspace. ©ESA - P. Carril

November

Curiosity on the way

NASA's Curiosity rover was launched from Florida 26 November and started its eight month long journey to Mars. The remote-controlled rover will investigate the chemical composition of air and soil and search for organic molecules or other traces of life on the surface of our red neighbour planet. Two of the instruments on board Curiosity were tested on Svalbard, because its geology is similar to that on Mars, see page 16.



Back from "Mars"

After 17 months in isolation, the subjects in the Mars500 experiment finally opened the hatchway to the outside world. In June 2010, the six "astronauts" – three Russians, a Chinaman, a Frenchman and an Italian, let themselves be locked up in a facility near Moscow. For 520 days, they simulated a mission to Mars to test how the psychological challenges of isolation, monotony and lack of privacy affected them. Preliminary results indicate that they handled the situation well, that contact with friends and family on Earth is important, and that with time, astronaut food is dull. Scientists at the University of Bergan are taking part in the analysis of material from Mars500.

December

Rocket through space weather

The Aurora still pose unresolved issues, not least associated with what scientists call space weather. Space weather is driven by the solar wind. It interferes with radio signals and in northern areas may cause aircraft to loose radio contact and GPS signals to indicate erroneous positions. The ICI-3 sounding rocket was launched up through the Aurora from Svalbard to collect data on how space weather affects radio signals. In the long run, the knowledge gained may be used to forecast space weather and its effect on GPS and radio signals. The rocket reached an altitude of 350 km before it plunged into the Barents Sea after 10 minutes. ©T.Abrahamsen/Andøya Rocket Range

First signs of life from Galileo

The Redu ground station in Belgium received the first signals from the Galileo satellites launched in October. Testing will continue until all instruments on board are found to be working properly. This will take several months. The civilian, European Galileo satellite navigation system will have 30 satellites when fully implemented in 2020.

©ESA / J.Huart

Organization of the Norwegian Space Centre as per 1 November 2012

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