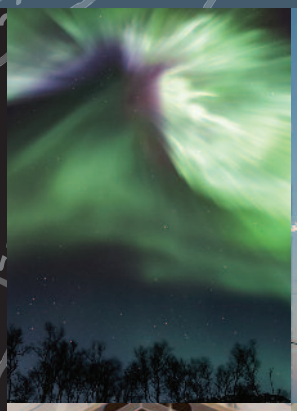
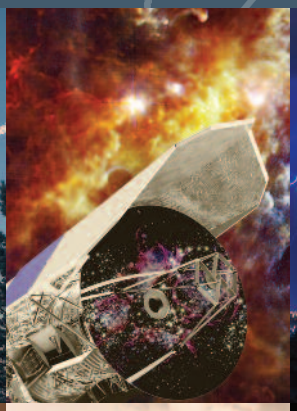
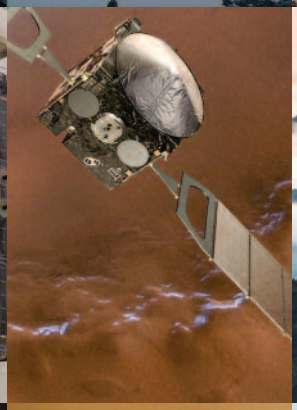
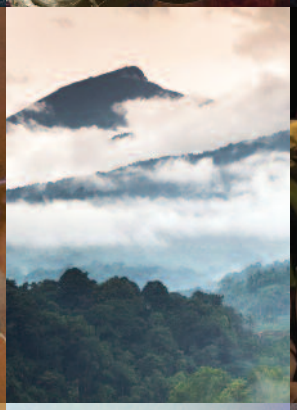
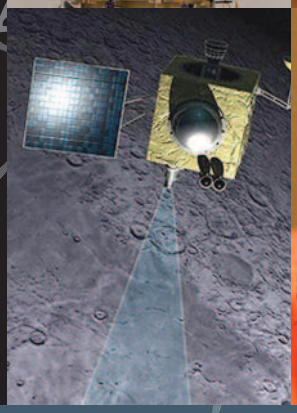
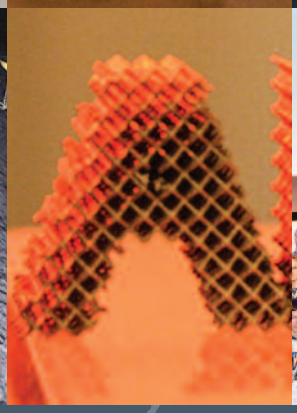
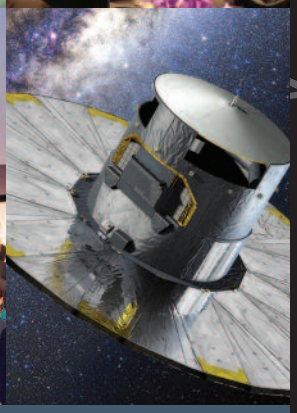
Annual Report **2013**





Norsk Romsenter
NORWEGIAN SPACE CENTRE

NSC-Report 2014/5

Management 2013

Edel Storelvmo

Board
Edel Storelvmo, Chairman
Kjetil Storaas Hansen, Vice Chairman
Marian Nymark Melle
Mats Carlsson
Kirsti Lovise Slotsvik

Deputy members:
Kari Nygaard
Frode Berge

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.

In 2014, the total budget was NOK 879 million, and the NSC had 39 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,
- facilitate the meeting of user needs in the space sector.

Contents

From the Director

It took a while, but more than 25 years after the first official report was published, the Government has presented a White Paper on Norwegian Space Activities to the Storting (Parliament). Entitled “Between heaven and Earth: Norwegian space policy for business and public benefit", it continues the focus on benefit that the Norwegian Space Centre (NSC) has had for the past ten years. It achieved broad political support in the Storting.

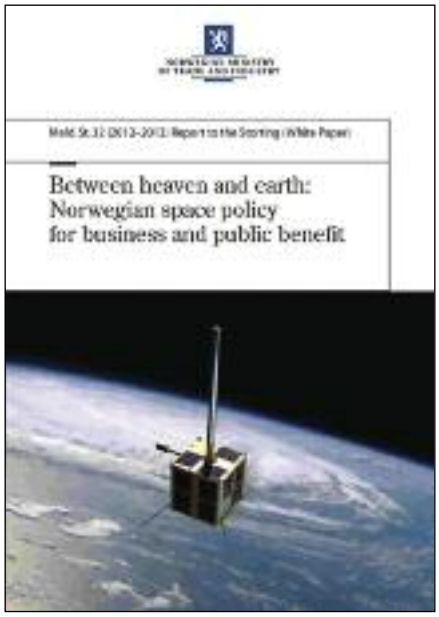
Space activities clearly have business value as well as greater social use value and consequently for years have been prioritized by the Ministry of Trade, Industry and Fisheries, with the backing of the Storting. So it’s significant that the Storting now has explicitly given this emphasis clear political support.

Throughout its eight-year tenure that ended in 2013, the Stoltenberg II Government significantly strengthened public investment in space activities. The Solberg Government that took office in 2013 has kept up that commitment, as evident in its decision that Norway shall participate in the EU initiatives of the Galileo satellite navigation programme for the period 2014-2020.

Galileo is the biggest investment in a public space programme in which Norway has taken part. Participation is vital for Norway in Europe and globally. We have the ground infrastructure that is a prerequisite for safe system operation. It includes ground reference stations on Svalbard and Jan Mayen and at the Troll Base in the Antarctic. Moreover, Svalbard is significant in communication with satellites active in the search and rescue elements of Galileo.

Norwegian companies have delivered key elements to the space and ground segments of Galileo. Norway is among the smaller countries that have been most successful in gaining contracts. This is due to its activity in the ESA development programme and to the guaranteed industrial return in ESA.

The Norwegian involvement of ESA in Galileo has enabled Norwegian



industry to win contracts in the EU Galileo programme, in which free competition prevails.

Norway was a full participant in the development phase of the ESA and EU Copernicus (former GMES) environmental and security system through 2013. NSC led an effort in 2013 to give the Government a basis for evaluating further participation in Copernicus for the 2014-2020 period.

ESA participation was evidence of the Government’s initiative in preparing for the 2012 ESA Council meeting at Ministerial level. Utilization of the industrial development potential and user benefit are pillars of Norwegian ESA participation. Within the optional ESA programmes Norway has an efficient, niche industry that attains an industrial return commensurate with our financial commitment. However, return in the ESA mandatory programme is unacceptably low. This is due to several factors including limited space sector capability in fields of the ESA scientific programme, increasing vertical integration in the European space industry, new member countries in ESA, focus on areas with high spin-off effects as well as lower productivity growth in Norwegian industries than those of our European competitors. NSC is working with ESA and Norwegian space sector companies to improve industrial return in the mandatory programmes.

The White Paper aims to strengthen NSC’s strategic consultancy capability toward the Ministry of Trade, Industry and Fisheries and toward other Ministries and agencies. At the end of 2013 NSC's responsibilities for managing State ownership in Norsk Romsenter Eiendom and in the Andøya Rocket Range (renamed Andøya Space Centre effective 6 June 2014) ceased. These State-owned enterprises now are managed directly by the Ministry of Trade, Industry and Fisheries. In connection with the change, the name of Norsk Romsenter Eiendom was changed to Space Norway, which initiated build-up of its own organization.

The year 2013 was buoyant for NSC, and the staff and Board are prepared to continue contributing to the positive development.

Norwegian Space Centre, 10 April 2014

Bo Andersen

Report of the Board 2013

Steady course might stand as the motto for Norwegian space activities since Norway became a space country in 1962 with the first launch from the Andøya Rocket Range. The goal of the country's space activities has always been to find solutions meeting the needs of society. Indeed, over the five decades that Norway has been involved in space, satellites have contributed to easing and improving everyday tasks, including safer shipping, speedier communications, better oil spill monitoring and more accurate weather forecasting.

The parliamentary decision of 1987 that Norway be a member of ESA was pragmatically rooted in the utilitarian and commercial aspects of space activities. In advance, a governmental study emphasized the industrial potential and social benefit that would open up as a consequence of ESA membership.

The years of ESA membership have contributed to Norway now having an annual space sector turnover of NOK 6 billion. Technological developments, as through ESA programmes, have been instrumental in our now being at the forefront of fields such as maritime satellite communications, navigation systems and Earth observation. Norwegian scientists are among the world leaders in solar research, cosmology and space weather, and satellite data are extensively used in administration.

The Government's goals for Norwegian space activity:

- Profitable companies, growth and employment
- Meeting important needs of society and user groups
- Greater return on international space collaboration
- High-quality national administration of space activity

Source: Meld.St.32 (2012-2013) Report to the Storting (White Paper) Between heaven and earth: Norwegian space policy for business and public benefit

White Paper

In April the Minister of Trade and Industry presented a White Paper that clearly stated that space activities should continue to be a tool for Norwegian interests. The four goals listed in the White Paper can be summarized in two words: Business and benefit.

The Storting endorsed the White Paper. In turn that gave Norwegian space activities clear strategic goals, guidelines and delineated policy areas for the years to come. The multiparty agreement on the overall objectives for Norwegian space activities was a good starting point for further NSC work.

The NSC Board has long emphasized the necessity of allocations for the NSC being sufficient to enable it to follow up increasingly demanding tasks in the ESA, the EU and at the national level. So it's reassuring that the White Paper goes in for strengthening NSC's consultative and advisory capabilities.

The NSC has led the compiling of "Norwegian space strategy 2020" which emphasizes the strategic initiatives that NSC must implement during the period up to 2020 to ensure realization of the primary objectives of the White Paper.

Several actors

The most significant change in the European space arena since the turn of the millennium is that the EU has become a key actor through the Galileo satellite and Copernicus climate programmes. Both programmes originated in ESA, which designed and built the first satellites and still is responsible for technical quality and further development of satellites and ground equipment.

As a full member, Norway can influence ESA's strategic choices. Yet as Norway is outside the EU, the greater challenge is to ensure that Norwegian needs are on the agenda. Accordingly, the NSC has taken part in all forums in which Norwegian needs can be considered. Through its full participation in the EU Galileo programme that the Government and the Storting approved in 2013, Norway is involved in the decision-making processes.

The result thus far is that Galileo is well adapted to Norwegian conditions in that the satellite constellations have good coverage at northern latitudes. Moreover, in addition to satellites, a network of ground stations is needed to ensure optimum system operation. Three of the ground stations are located on Norwegian territory; on Svalbard, on Jan Mayen and in Antarctica. This underscores the importance of space country Norway as a partner, as it offers a favourably located ground infrastructure.

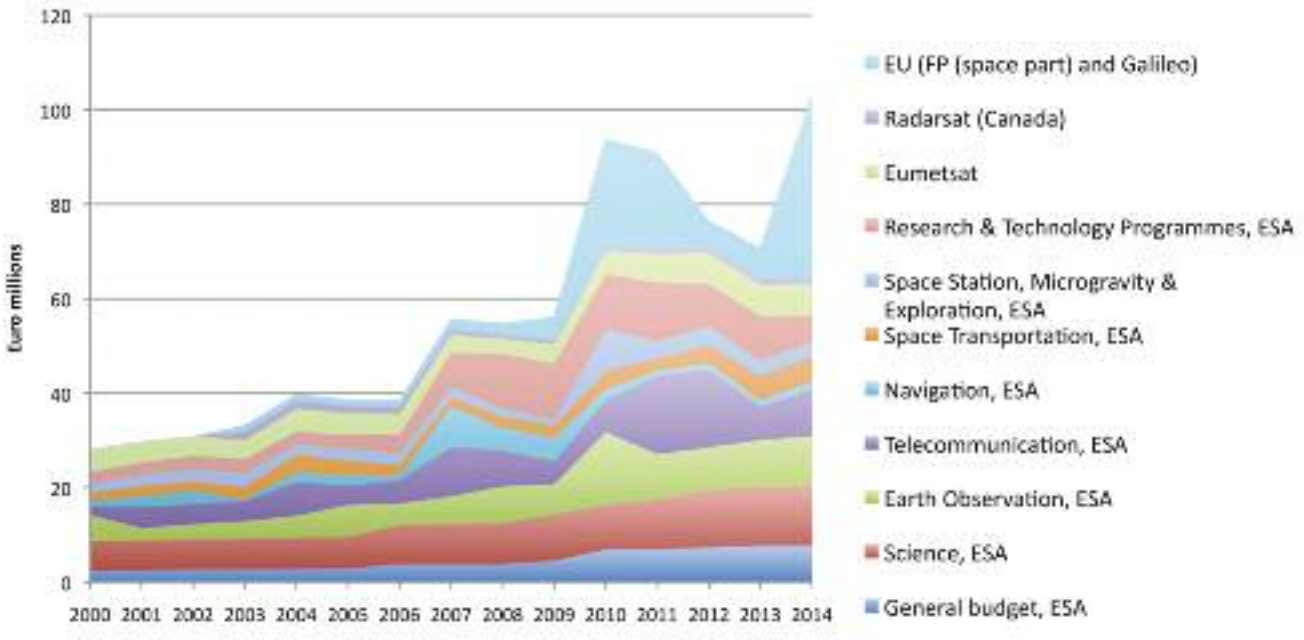
EU - ESA cooperation

At the 2012 ESA Council meeting at Ministerial level it was decided that the ESA and its member countries should look into the organizational model of the ESA after 2020, especially as related to EU programmes. The EU started a similar study project. The NSC has analyzed the first ESA drafts of organizational models, particularly in view of Norway not being in the EU. At time of writing there's no clarification of the nature of organization between the EU and the ESA.

The NSC also has followed up the relationship to the EU through bilateral meetings with the European Commission's Directorate-General for Enterprise and Industry.

Support schemes

NSC manages the national support schemes, a subsidy arrangement for supporting development in Norwegian companies and institutes. The programme contributes to positioning actors for future space deliveries or uses of satellite data and is coordinated with ESA programme activities. Support schemes are also used to support selected scientific and educational activities as well as to ensure socially-vital infrastructure. The programme is announced each autumn. In 2013, 32 contracts were entered, providing 27 companies and organizations with



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

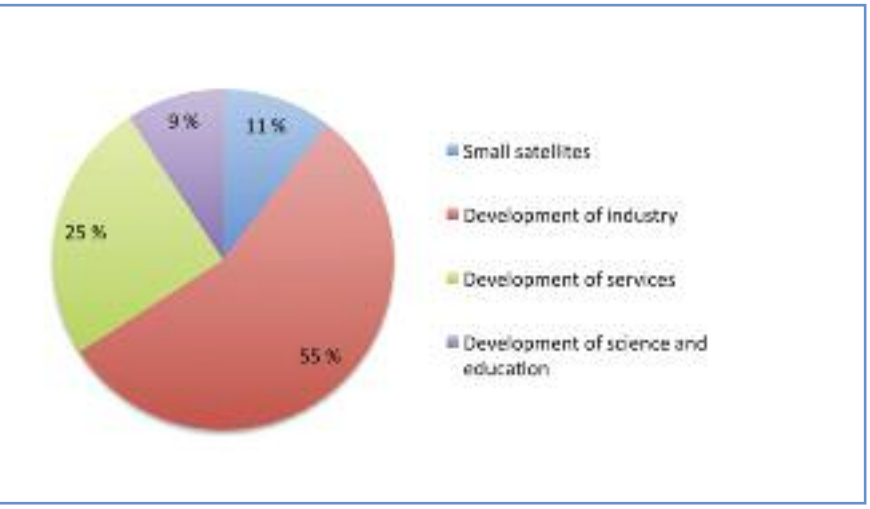
support scheme funding for a total of NOK 35 million.

The support schemes have played an important role in strengthening capabilities and positioning Norwegian companies and research communities for international and national roles in space activities. Several Norwegian communities are among the world leaders in their niches.

Spin-off effects

Since the 1990s, the spinoff-factor has been used to measure the effect of governmental funding on space activities. 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 spinoff factor rose from slightly less than 3.5 in 1997 to 4.8 in 2013. This means that for each NOK of government funding from the national support scheme or ESA, the companies attained additional turnover of nearly five NOK. This proves 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.

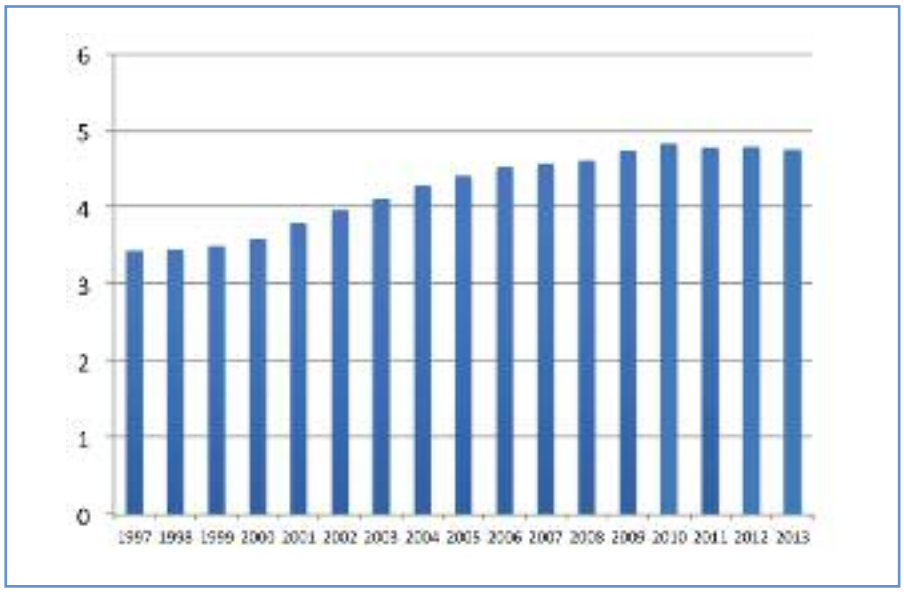


The National Support Scheme strengthens Norwegian actors so they are better positioned to compete for national and international contracts. In 2013, NOK 35.4 million was disbursed.

Space industry

Space industry is a vital business sector in the country. In 2013, the total turnover of Norwegian-produced goods and services in the space sector was NOK 6.3 billion, the same sum as in previous years.

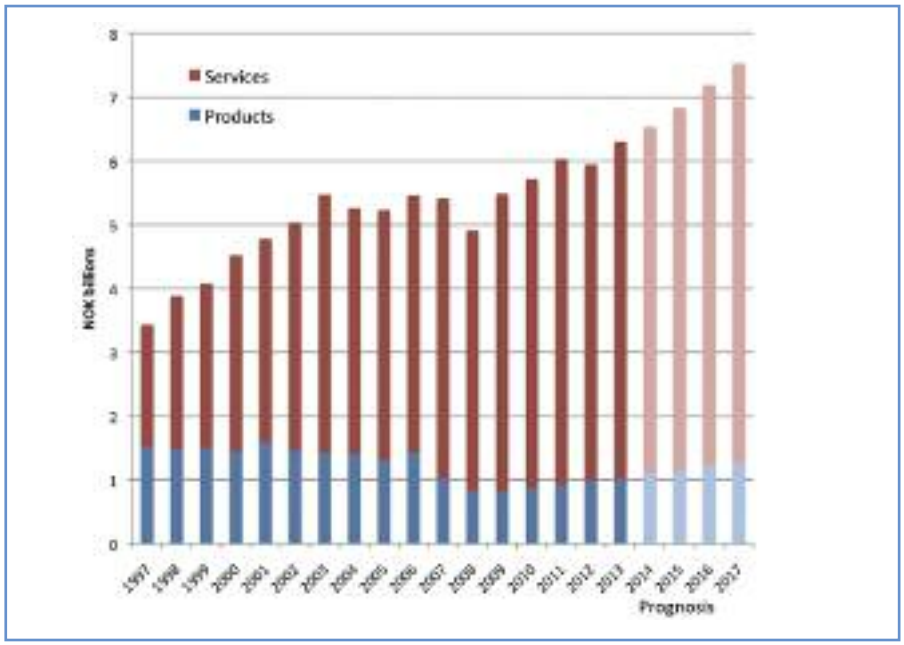
The share of exports remained high at about 70%. Turnover in satellite com-



The spinoff factor is a measure of the effect of Norwegian space commitment through ESA and national support schemes. The figures are based on information provided by 28 companies and institutes in Norway. In 2013 the spinoff factor was 4.8.

munications accounted for a substantial part of the income from exports, the greater share of it from Astrium Services and Telenor Satellite Broadcasting. In addition, Norwegian niche companies delivered high-tech goods and services to the international space industry. Of them, the Kongsberg Group was a leading actor with goods and services for launch vehicles, satellites, processing of satellite data, navigation and earth station services, with a steadily increasing number of antennas round the globe.

NSC has been involved in technology transfer, particularly in augmenting the potential of ground-based technologies in space activities. We have arranged



Turnover of Norwegian-produced goods and services from 1997 to 2013, with the companies' forecasts up to 2017. The total space sector turnover in 2013 was NOK 6.3 billion.

for ESA to present its forthcoming challenges to a broad spectrum of technological communities in Norway. This has contributed to the ESA General Support Technology Programme (GSTP) enabling the rapid evaluation of innovative solutions.

The International Space Station and space transport

In 2013, the problem of finding matching payloads for the Ariane 5 double-launch strategy restricted the number of launches to five. In all, six larger communications satellites and an ATV resupply spacecraft for the International Space Station (ISS) were launched. Telenor's Thor 7 satellite is scheduled for orbiting by an Ariane launcher in 2014.

Norwegian companies have 2010-2015 period contracts totalling about NOK 300 million for series delivery to Ariane 5.

Norwegian-developed electro optical technology was space qualified on board the Proba-V satellite orbited by a Vega launcher. One of the Soyuz launches orbited the ESA Gaia space observatory. Norwegian companies have delivered items on board Gaia.

The 2012 ESA Council Meeting at Ministerial level approved continued upgrading of Ariane 5 for a larger payload capacity. At the same time it was decided to initiate development of the Ariane 6 launcher intended to be more competitive in the commercial launch market. If the ESA member countries approve the development at the Council Meeting at Ministerial level in December 2014, Ariane 6 should be ready for launch in 2021. Thereafter, Ariane 5 will be phased out.

The Kongsberg Group and Nammo are developing new launch vehicle technologies in the ESA Future Launchers Preparatory Programme (FLPP). In the same programme, Nammo is also developing hybrid thrusters for student and scientific rockets to be launched at Andøya.

The International Space Station was in operation throughout 2013. Development of a new Norwegian AIS receiver for the Space Station started in 2013.

The existing AIS receiver will be used until the new one is installed. Several other Norwegian instruments and experiments are being developed for use on the Space Station in coming years.

Satellite communications

The satellite communications sector may be divided into services and products. The global commercial market, in which the customers are mostly private companies and military organizations, still dominate the sector. The Norwegian actors face many competitors, historically large American companies, but now also Asian ones (mostly Japanese, Indian and Chinese) are entering the market. The truly greater challenges are in the globalization of satellite communication value chains. No longer does mastering a technology and developing new products that outperform those already on the market ensure success. Access to markets now is limited by strong global value chains.

The three largest Norwegian satellite communications services actors still are the commercial providers, Telenor, Astrium Services and Inmarsat Solutions. Together they have a turnover of about NOK 3 billion.

The Kongsberg Group still is the largest Norwegian actor in satellite communications products. Kongsberg Norspace signed an agreement on supply to the European Data Relay System (ERDS) satellites, which affords the possibility of space qualification of key products from now on. The Kongsberg Defence Communications (KDC) integration of satellite communications with its other products can contribute to innovative solutions for the Norwegian Defence. Kongsberg Seatex is now developing a new generation of AIS receivers that will be verified on board the first Norsat satellite.

In Europe, a new Air Traffic Management (ATM) system called SESAR is being developed. Sintef and Avinor now are taking out and later will deliver SESAR services via satellite.

Maritime activities and requirements are key challenges for Norwegian development. Marintek is a hub for the maritime user segment, industry and research. With NSC support, Marintek has now established an ESA ambassador platform. This increases the chances of initiating ESA projects angled toward and tied to Norway, in addition to making Norwegian actors visible in the European and global arenas.

Satellite navigation

Satellite navigation is the nigh dominant technology for all applications including positioning, location, tracking and navigation. It is a critical infrastructure that is decisive for safety and operations in sectors such as oil and gas, transportation, energy supply, communications networks and financial transactions.

The Galileo satellite navigation programme is now being built. It is the first time the EU has invested in a comprehensive common strategic and essential service infrastructure. Galileo is an independent system while EGNOS is an overlay service that improves performance for GPS users. The common European infrastructure will greatly benefit Norwegian areas, and Norway has taken part in the development of Galileo and EGNOS.

Geographically Norway is peripheral to the principal areas of interest for EU countries. So NSC has actively worked to ensure that services in our areas, particularly the High North, are as good as those at lower latitudes. In 2014 the system will have up to ten satellites in orbit and will enter its operative phase. Galileo is scheduled to be fully developed and fully operational by 2020.

The Storting has approved continued Norwegian participation in Galileo and EGNOS in the 2014-2020 period, for which the EU budget is 7 billion Euro. For Norway, participation incurs a financial obligation of about 200 million Euro. To date, Norwegian space companies have entered Galileo contracts for a total of 50.7 million Euro.

There has been a delay in the general minimum standards for the Public Regulated Service (PRS), a service provided by Galileo and restricted by governments to authorized users. So Norwegian industrial participation has been postponed. The NSC has used the informal consultation process of the European Commission (EC) to gain a clear picture of and influence the development of PRS regulations.

Kongsberg Satellite Services built and started operating a Galileo search and rescue ground station on Svalbard. The station is connected to Norway's Joint Rescue Coordination Centre Northern Norway in Bodø. From 2014 on, Kongsberg Satellite Services will have operational responsibility for the EGNOS and Galileo stations on Svalbard, on Jan Mayen and in Antarctica.

As part of its effort to strengthen focus on the downstream sector, NSC took part as a regional partner in the European Satellite Navigation Competition (ESNC). The Norwegian run-up finalist was a secure app that enabled insurance company customers to report claims from mobile phones. It reached the finals in Munich and was favourably mentioned, but didn't win. NSC intends to take part in ESNC in 2014.

Norwegian small satellites

The AISSat-1 satellite has performed well since it was launched in 2010. Norway is one of few countries to have orbited a functioning AIS satellite and hence is an attractive bilateral collaborator. The orbiting of the AISSat-2 satellite on a Russian Soyuz launcher from the Baikonur Cosmodrome has been slightly delayed. According to plan, the satellite should be orbited in 2014. As AISSat-1 still functions properly, the delay has no impact on data continuity.

The Norwegian Coastal Administration and NSC entered an agreement that calls for NSC assuming responsibility for operation and replacement of AIS satellites from 2014 on and for the Coastal Administration being responsible for data distribution to users and perhaps for data interchange with international public sector partners. The NSC ordered an AISSat-3 on behalf of the Coastal Administration to ensure

long-term data continuity. According to plan, AISSat-3 will be orbited in 2014/2015.

In 2013, NSC initiated purchase of the next generation of Norwegian small satellites, NorSat-1, with orbiting planned for 2016. The main goal is to contribute to further development of Norway's capabilities in and technologies for satellite-based AIS monitoring and contribute to knowledge of the solar effects on the Earth's climate and environment.

Space activity in the High North

The NSC and Telenor Satellite Broadcasting have worked together in a project assessing the needs for and potential solutions for broadband communications in the Arctic and the High North. The project is expected to finish in the summer of 2014. Alternative satellite systems in hyperelliptic orbits have been evaluated and analyzed, and ship traffic in the area has been analyzed using data from the Norwegian AIS satellites. In January 2013 a large national user seminar was held with participants from the public and private sectors.

In 2013, NSC initiated the "Rom som verktøy i Arktisk samarbeid" (Space as a tool in Arctic cooperation) project. The project is scheduled to last for two years and is partly financed by the Ministry of Foreign Affairs "Arctic cooperation" arrangement. The project aims to increase awareness of the importance of space activities for Arctic cooperation. The Norwegian Institute for Defence Studies participates in the project. In 2013, a project inception meeting was held with participants from many relevant Ministries.

Earth observation

In 2013 the NSC's major effort in Earth observation was compiling a comprehensive report entitled "Norsk deltaking i EU sitt jordobservasjonsprogram Copernikus (2014-2020" (Norwegian participation in the EU Copernicus Earth observation programme (2014-2020)). The report will be the reference for the Government's discussion on further Norwegian participation in the EU Earth observation programme. In compiling the report, NSC had dialogues with several Norwegian agencies and institutes.

Norwegian ground stations were significant when ESA's three Swarm magnetic field satellites were orbited in the autumn of 2013 and when ESA's GOCE gravity field satellite disintegrated in the atmosphere after a successful mission.

In 2013, ESA's success with the CryoSat research satellite led to the EU choice of a more ambitious operational pattern as a basis for the forthcoming operative sea level satellites of the Copernicus programme. At the request of Norwegian user communities, the NSC in 2013 signed an extension of the Radarsat agreement that will ensure Norwegian users coverage by the Radarsat-2 satellite in the 2015-2017 period.

In 2013 NSC completed a remote sensing strategy for the Svalbard

Abbreviations and technical terms in text

AIS – Automatic Identification System (for ships at sea)

ATM – Air Traffic Management (for European air traffic)

ATV – Automated Transfer Vehicle, unmanned spacecraft developed by ESA

Copernicus – European programme for environmental monitoring and safety

DG Enterprise – Directorate-General for Enterprise and Industry, EC agency

EGNOS – European Geostationary Navigation Overlay Service, system complementing GPS to improve performance for satellite navigation users

EDRS – European Data Relay System (for communication between satellites)

ESNC – European Satellite Navigation Competition, annual, for bringing forth ideas for use of satellite navigation

ESA – European Space Agency (of which Norway is a member)

Galileo – European civilian satellite navigation system

GOCE – Gravity field and steady-state Ocean Circulation Explorer, gravity field satellite developed by ESA

GPS – Global Positioning System, American military satellite navigation system

GSTP – General Support Technology Programme, for developing technology in ESA

IRIS – Interface Region Imaging Spectograph, ultraviolet (UV) solar space observatory launched April 2013

ISS – International Space Station

PRODEX – Programme for Development of Experiments, ESA programme for technical assistance and support for scientific activities

PRS – Public Regulated Service, a service provided by Galileo and restricted by governments to authorized users

SESAR – Single European Sky ATM Research, European system for modernizing air traffic systems

SIOS – Svalbard Integrated Earth Observing System, European programme for developing Svalbard related research infrastructure

Integrated Earth Observing System (SIOS).

The portion of the electromagnetic spectrum used in radar satellite measurements is attractive for ground-based telecommunications operators. So in 2013 the NSC became involved in efforts to ensure that such vital series of measurements from space may continue.

Tropical forests and climate

The NSC has a task for the Ministry of the Environment's "Norwegian Climate and Forest Initiative" programme. The support is financed through Norad. In 2013 the NSC contributed to the development of the Global Forest Observation Initiative (GFOI) and to the development of the use of satellite data in tropical woodlands.

Space research

Norwegian scientists had key roles when the scientific results from the ESA Planck space observatory were presented in the spring of 2013. The Planck mission has provided new insights in key astrophysical phenomena, such as the validity of Einstein's general theory of relativity, the distribution between ordinary material, dark material and dark energy, as well as the large scale structure of the universe.

Norway was a vital collaborator for NASA in the IRIS space observatory orbited in 2013. The first IRIS results shown in December are promising.

The launch of the Norwegian ICI-4 sounding rocket from Svalbard was planned for December 2013 but was postponed due to an accident in September with a similar thruster on another rocket at Andøya. After the accident, NSC was involved in the commission of inquiry.

The forthcoming NorSat-1 small satellite will have scientific instruments for observation of the sun and for space weather near the Earth. In 2013, NSC also supported the ESA PRODEX programme in a field campaign on Svalbard for testing equipment relevant to the forthcoming ESA ExoMars mission.

Communications and education

NSC's website at romsenter.no is the prime tool for reaching decision-makers, companies and other space actors, the media, research institutes, students, pupils and teachers. New Net pages were launched in May, and response from space actors, the media, schools and the general public has been positive.

HiNCube, the first satellite in the AnSat student satellite programme was launched on 21 November from Yasny in Russia. The satellite is in orbit, but despite exhaustive listening, no signals have been received. Otherwise, the University of Oslo student satellite soon will be ready for launch, while NTNU students are completing their satellite. To date, 227 students have taken part in the programme. Of them 111 have graduated with Bachelor's or Master's degrees. Since the programme started in 2006, AnSat has helped recruit students to space-related topics and studies at educational institutions.

Media monitoring from 2013 counted 600 mentions of NSC, slightly less than the year before, due to the new website requiring much work.

An extension to the Fram Museum to house the Gjøa was opened in June. At the opening NSC had a stand that showed how satellites have changed research work in the Arctic. Moreover, NSC participated in the Oslo Science Fair that drew some 20,000 visitors.

NSC staff members held some 220 lectures. In all 2200 people attended about 55 meetings held at the NSC at Skøyen in Oslo. Two of three visitors were Oslo and Akershus county lower secondary school science class pupils that came to the Space Centre to learn more about space travel and astronomy.

Trainees

In 2013, two trainees worked with "the strategic importance of space" from the European and global perspectives. One of the trainees focused on the strategic importance of space in the Arctic. She contributed to NSC's application to the Ministry of Foreign Affairs support scheme that resulted in the "Rom som verktøy i Arktisk samarbeid" (Space as a tool in Arctic cooperation) project. The other trainee looked more closely at the relationship between the ESA and the EU and compiled a report on the Europeanization of the ESA.

Oslo, 14 March 2014

Edel Storelvmo, Styreleder

Kjetil Storaas Hansen

Marie Nymark Melle

Mats Carlsson

Kirsti Lovise Slotsvik

Bo Andersen, Adm.direktør

Extract of annual accounts for 2013

EXTRACT OF ANNUAL ACCOUNTS (Average exchange rate for 2013: 1€= NOK 7.8058)	**2013**
Administrative appropriation from the Ministry of Trade and Industry	47 740 170
Other income*	86 862 160
Operating income	*134 602 330*
Salaries and social expenses	35 687 906
Other operating expenses	105 904 740
Total operating expenses	*141 592 647*
Ordinary operating result	-6 990 317
Finance income and finance costs	13 830
RESULTS, ORDINARY ACTIVITIES	**6 976 487**

*Income in the profit and loss accounts comprises mostly an appropriation from the Ministry of Trade and Industry and other income derived mostly from services delivered to other space organizations.

Personnel costs and other operating expenses are the principal costs. The latter includes purchases from subcontractors to fulfil service obligations that we incur from other space organizations from which we receive income.

ALLOCATION OF APPROPRIATION	
Appropriation from the Ministry of Trade and Industry	***505 329 924***
ESA Pension	465 552
ESA Mandatory basic activities	42 684 164
ESA Mandatory CSG Kourou	10 961 191
ESA Mandatory Science Programme	95 887 714
ESA Earth Observation	76 797 534
ESA Microgravity	12 972 902
ESA Navigation	10 662 670
ESA PRODEX	26 307 207
RADARSAT	9 179 250
ESA Space Situational Awareness	6 364 367
ESA Space Station	12 109 064
ESA Technology Development	46 643 379
ESA Telecommunications	54 771 925
ESA Space Transport	39 677 179
Esrange/Andøya Special project	18 077 760
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January

Space weather forecast

Space weather arises when streams of particles and energy emitted by the Sun enter the Earth's magnetic field and ionosphere. We most often see space weather as geomagnetic storms and aurora in the far north. Extreme space weather can knock out satellites and electronic systems on the ground. So space weather forecasts can contribute to avoiding or mitigating problems.

Norway has long conducted research on the aurora and space weather. The Norwegian Mapping Authority initiated reporting of ionosphere weather data to the ESA's Space Weather Coordination Centre (SSCC). The data comes from a network of ground sensors in the Arctic and will improve space weather forecasting for all of Europe.

Space weather forecasting is part of ESA's Space Situational Awareness program in which Norway is a contributor.

©Fredrik Broms

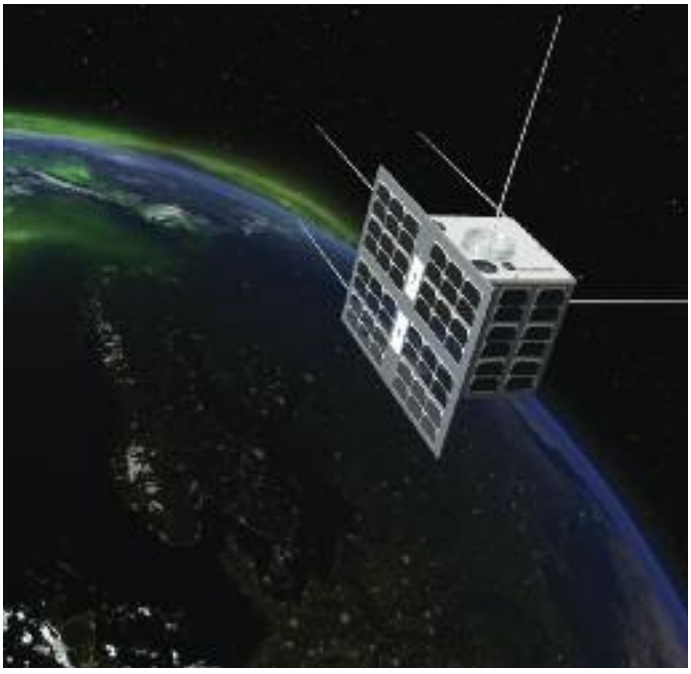
New Norwegian satellite

In January NSC announced an international tender competition for a platform for NorSat-1, a new satellite scheduled to be orbited in late 2015. The Institute for Aerospace Studies (UTIAS) of the University of Toronto was the successful bidder. For slightly less than NOK 20 million, the Canadians will build the satellite platform, that is the shell of the satellite, and integrate payloads for launch.

NorSat-1 will be used to acquire new knowledge of the Sun, the Sun-Earth interaction and the Sun's influence on the Earth's climate and environment. National and international research communities will make the instruments in its payload. NorSat-1 will be small, 20 x 20 x 40 cm, and will be in a polar orbit about 550 km above the Earth.

NorSat-1 will also carry an AIS receiver for tracking of ships from space, as does AISSat-1 (see April). The new AIS receiver will be more sophisticated and will test new detection algorithms.

©Trond Abrahamsen



February

Near-Earth objects (NEOs)

In the morning of 15 February, a meteorite sped down toward Chelyabinsk in Russia. Russian scientists estimated its mass at 10,000 tons and that it exploded at an altitude of 30 to 50 km. The shockwave of the explosion blew out windows in the area below, and glass fragments caused many injuries. The meteorite was the largest to hit the Earth since the Tunguska event in Siberia in 1908.

A few hours later the same day, the 2012 DA14 asteroid swept by the Earth at a distance of 27,000 km. The paths differed, but seldom have two near-Earth objects appeared almost simultaneously.

ESA's new NEO Coordination Centre (NEOCC) will be busy, see May.

©Константин Кудинов / wikimedia

Record for Ariane

Ariane set a record with the 54th successful launch in a row. The European launch vehicle is the world's most reliable orbiting system.

Ariane launchers are used to orbit satellites, space sondes and other heavy payloads. The 54th launch from the Europe's Spaceport at Kourou, French Guiana, orbited two large telecommunications satellites, one Spanish and one Azerbaijani. Together the two payloads weighed ten tons.

Several Norwegian companies have won Arianespace contracts for millions of NOK and deliver various items for launch vehicles. Among them are Nammo Raufoss, Kongsberg Defence & Aerospace and Kongsberg Norspace.

©ESA/CNES/Arianespace/OptiqueVideo du CSG

March

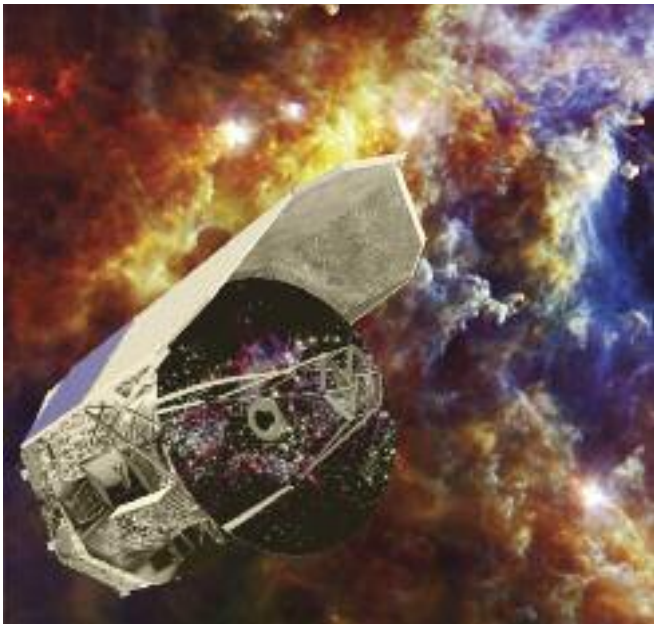
Mission completed for Herschel

In May 2009 an Ariane 5 launch vehicle placed the Herschel and Planck Space Observatories at the Sun-Earth L2 Lagrangian point. Herschel studies the formation of stars and galaxies, while the Planck measures the cosmic microwave background left over from the Big Bang of cosmology.

To be able to observe the coldest and dustiest objects in space, the Herschel instruments were cooled to -271 °C, as close as possible to absolute zero (0 K) at -273.15 °C. The instruments were placed on top of a tank filled with a superfluid helium coolant. But even at so low a temperature, evaporation occurs. After almost four years in space, the coolant ran out.

While active, Herschel made unbelievable observations of many objects, from exploding galaxies to conditions in remote parts of the universe, to newborn solar systems being formed around young stars.

©ESA - C. Carreau



Future private space travel

Private companies are looking at the space travel market. Companies such as Bigelow Aerospace and SpaceX already have contracts for transport to and new modules for the International Space Station. Moon tourism can be a new business, and several companies are planning lunar charting and resource extraction. The asteroid belt is seen as promising for extracting metals and minerals, and remote-controlled vehicles for exploring asteroids are being designed by Deep Space Industries and by Planetary Resources. Farther in the future Mars beckons. SpaceX founder Elon Musk's Mars One reality concept for colonizing the planet with 80,000 Earthlings has the most mentioned in the media. ©Inspiration Mars

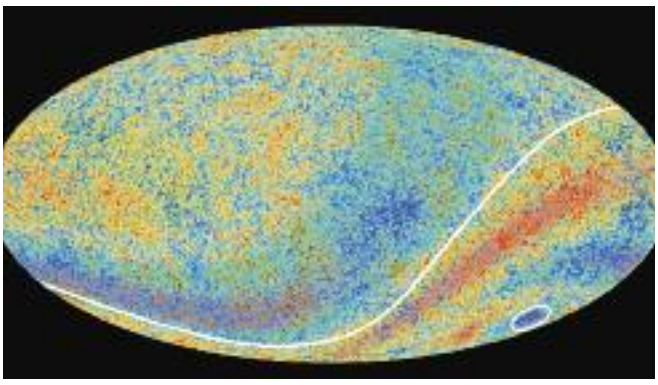
Planck provides a new view of the Universe

The 21st of March was the joint publication day for the research results from the ESA Planck Space Observatory. Observations of the Cosmic Microwave Background (CMB) provide astronomers with the most accurate ever descriptions of the composition of the universe and how it has developed with time. The CMB radiation is the remainder of the first light emitted by the universe when it was 380,000 years old. It reveals the basic structure of the universe, that subsequently produced stars and galaxies.

There's much evidence that the universe can have a preferred direction (as shown in the photo) at variance with the assumptions of the standard model. Moreover, not all of the standard model's assumptions remain valid on the large scale.

The cosmology group at the Institute for Theoretical Astrophysics at the University of Oslo has access to Planck data. The Research Council of Norway and NSC have supported the project, and vital parts of one of the two instruments on board have been delivered by a Norwegian company.

© ESA and the Planck Collaboration



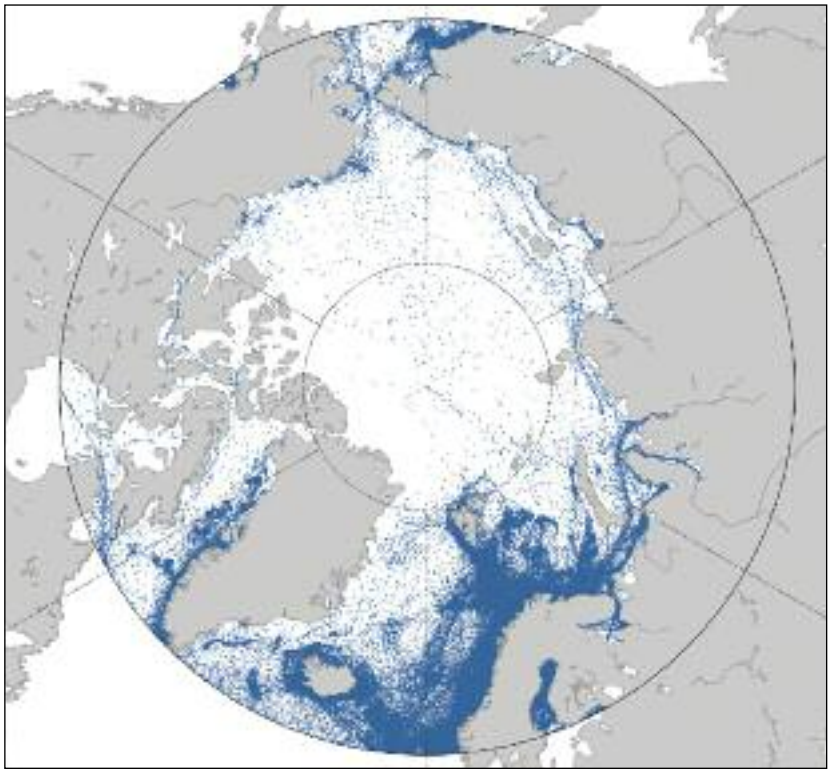
April

A thousand days in space for AISSat-1

For more than a thousand days, the Norwegian AISSat-1 has kept an eye on ship traffic from space. It has circled the Earth more than 14,500 times. For each orbit, AISSat-1 registered some 30,000 ships round the globe, and Norwegian authorities now have better than ever overview of ship traffic along the coast, around Svalbard and in the rest of the Arctic.

The data indicate that 90% of Arctic ship traffic is in Norwegian waters and fishing vessels make up a sizeable part of it. The Governor of Svalbard, the Norwegian Coastal Administration, Norwegian fisheries management, the Norwegian Armed Forces and the Joint Rescue Coordination Centre have benefited from the data stream from the satellite.

AISSat-1 has been so successful that its successor, AISSat-2, has been built and will be orbited in 2014.



Dark lightning

Dark lightning is produced by electrically charged clouds, just as is ordinary visible lighting. But dark lightning is a discharge of gamma radiation that is not visible and therefore is called dark lightning. The phenomenon has been recognized since 1991, but little is known about how often it occurs and whether it has any connection with ordinary lightning. Professor Nikolai Østgaard and colleagues at the University of Bergen examined data from a thunderstorm over Venezuela. By comparing measurements from two satellites, one registering gamma radiation and the other registering visible light, they found that dark lightning was followed by a pulse of radio waves and ordinary lightning. So apparently dark and visible lightning are basic parts of the process of a thunderstorm.

In the next few years, Professor Østgaard will use data from the Space Station to study various types of lightning such as dark lightning, elves, fairies and sprites in the atmosphere.

May

Europe to monitor asteroids

The meteorite that exploded over Chelyabinsk in Russia released more energy than 20 Hiroshima atom bombs and damaged a large area (see February). It was not detected by present-day programs for detecting asteroids and other near-Earth objects.

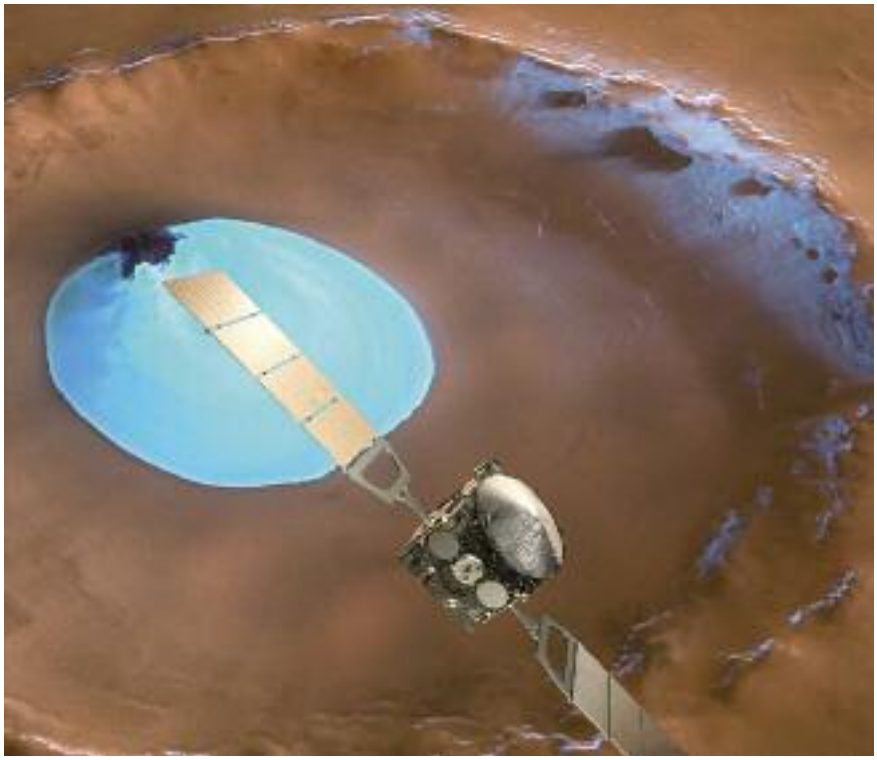
This suggests a need for better asteroid monitoring and earlier warning. So ESA has recently opened the new Near-Earth Object Coordination Centre (NEOCC) at the ESA research institute near Rome. The NEOCC is tasked with coordinating and providing data on near-Earth objects in real time to research institutes, organizations and decision-makers. ©ESA - P.Carril

Space initiatives profitable

Each NOK that Norwegian space companies receive in support for new technology leads to a return of close to NOK 5. This is the conclusion of NSC's annual spinoff report based on data from 28 companies and institutes that have received national support funding from NSC or have been awarded ESA space project contracts. The result shows that each NOK 1 in support funding or contract remuneration is repaid and results in an additional return of NOK 4.8. This is a yield of 480% and shows that the companies have invested in the right projects at the right times. Norwegian companies such as Kongsberg Satellite Services, Kongsberg Norspace and Kongsberg Seatex have been awarded NOK million contracts for delivery to the major European space programmes Galileo and Copernicus. The ESA Proba V satellite (photo) that was orbited 7 May will acquire data on vegetation, the environment and other Earth observation parameters. The satellite also carries Norwegian technology supplied by T&G Elektro, so it may be tested under the demanding conditions of space.

©ESA/CNES/Arianespace/Optique Video du CSG

June



Mars Express tenth anniversary in space

For ten years, the Mars Express European mission has provided an enormous amount of new knowledge about our red neighbour planet. It has charted the surface of Mars in detail and has transferred data on Martian geology, atmosphere, climate and development.

One of the most important results is the discovery of minerals that clearly indicate that there has been liquid water on Mars. Methane has been found in the atmosphere, and relatively new topography indicating glaciation has been charted. The mission also has found 3.5 metre thick layers of ice under the North and South Poles.

©ESA/DLR/FU-Berlin-G.Neukum

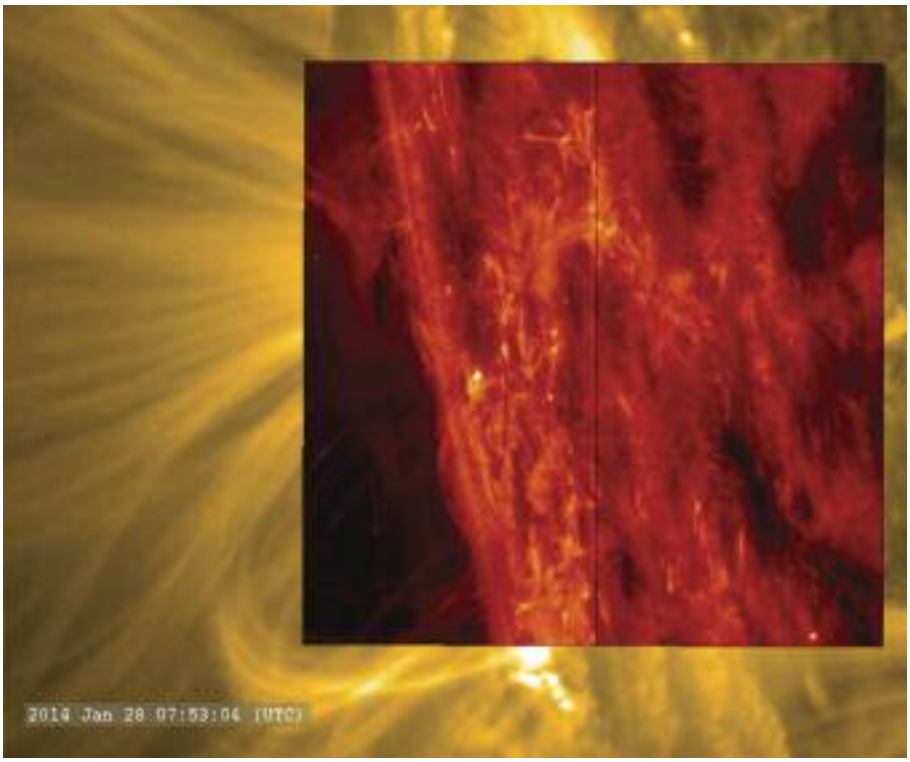
Cooperation with NASA

The IRIS solar satellite is a Norwegian-American joint project that aims to contribute to understanding one of the greater mysteries of the Sun: Why is the Sun's atmosphere hotter than its surface? The luminous envelope of the sun, called its photosphere, has a temperature of about 6000 °C. The outermost layers sof the solar atmosphere have a temperature of several million degrees.

The IRIS satellite will make detailed observations of the solar atmosphere. These will provide insights on the energy transportation and distribution in the solar atmosphere and how solar storms originate and develop.

The IRIS data will be downloaded at Svalbard according to an agreement between NSC and NASA. The Solar Physics Group of the Institute of Theoretical Astrophysics at the University of Oslo will contribute software for resolving IRIS data in readable format, for rapid display of data and for numerical simulation of the outer layer of the Sun. Moreover, all data from the satellite will be stored in an electronic archive at the Institute.

©NASA's Scientific Visualization Studio



July

Martian clay on Svalbard

Svalbard is one of the places on Earth that best resemble Mars. Among its other attributes, Svalbard has volcanoes that have erupted in a cold permafrost environment. Svalbard also is the only known place having minerals like those found in Martian meteorites. The cold, dry Arctic desert climate contributes to the locations being well preserved and not broken down by biological processes.

In 2013 the Arctic Mars Analog Svalbard Expedition (AMASE) tested instruments including the PanCam camera, the Close-up Imager (CULPI) microscope and a Raman spectrometer that analyzes clay minerals. These instruments are all part of ESA's ExoMars project, which according to plan will start missions to Mars in 2016 and 2018. ©Kjell Ove Storvik/AMASE

Evaluating nature

A natural ecosystem that ensures pure water and soil, prevents avalanches and stores carbon can be of greater value than were it cultivated to produce food or raw materials. But what is the monetary value of a natural ecosystem? The Mount Rinjani National Park on the island of Lombok in Indonesia uses ESA satellite data in an initative to chart the natural ecosystem and assess its monetary worth. Aided by satellites, scientists measure elevations and slopes in terrain, chart forest types and soils to determine the spectrum of plants of a forest, study water circulation and assess the carbon stored by the national park. This bookkeeping of natural capital makes it easier for decision-makers to make choices that promote sustainable development.

©jiduha / 123RF Stock Photo

August

Snake robots for other planets

Scientists of ROBOTNOR at NTNU/ SINTEF in Trondheim are devising robots that resemble snakes. They consist of several segments and slither along an underlying surface. Snake robots are smooth and move by exploiting the irregularities of a surface. These characteristics enable snake robots to serve many purposes, such as pipe inspection, fire fighting or search and rescue in buildings collapsed after a catastrophe.

They also may be useful in space. For example, a snake robot may be launched, land with and ride on a rover until the rover comes to places it cannot negotiate. The snake robot then is uncoupled from the rover and slithers along to further explore the surface.

With ESA support, ROBOTNOR has initiated a project jointly with NSC and the Centre for Interdisciplinary Research in Space (CIRiS) at NTNU Social Research.

©SINTEF ICT

Joining forces to explore the solar system

The 12 largest space organizations have drawn up a road map for further research of the solar system. At first the space organizations intend to initiate a manned mission to the Moon and to an asteroid near the Earth. The intent is to acquire new knowledge and to test transport systems, living modules and other key systems for missions deeper into space. The cornerstone of the new charting is continued cooperation on the International Space Station to find solutions to the challenges of manned space travel.

In the long term the space organizations envision the first landing of humans on Mars sometime in the 2030s. Thereafter other manned missions will continue exploration of our red neighbour planet. Future space travel was one of the themes of the Ilan Ramon Congress in Tel Aviv, when NASA director Charles Bolden and NSC deputy director Geir Hovmork took part in a panel debate.

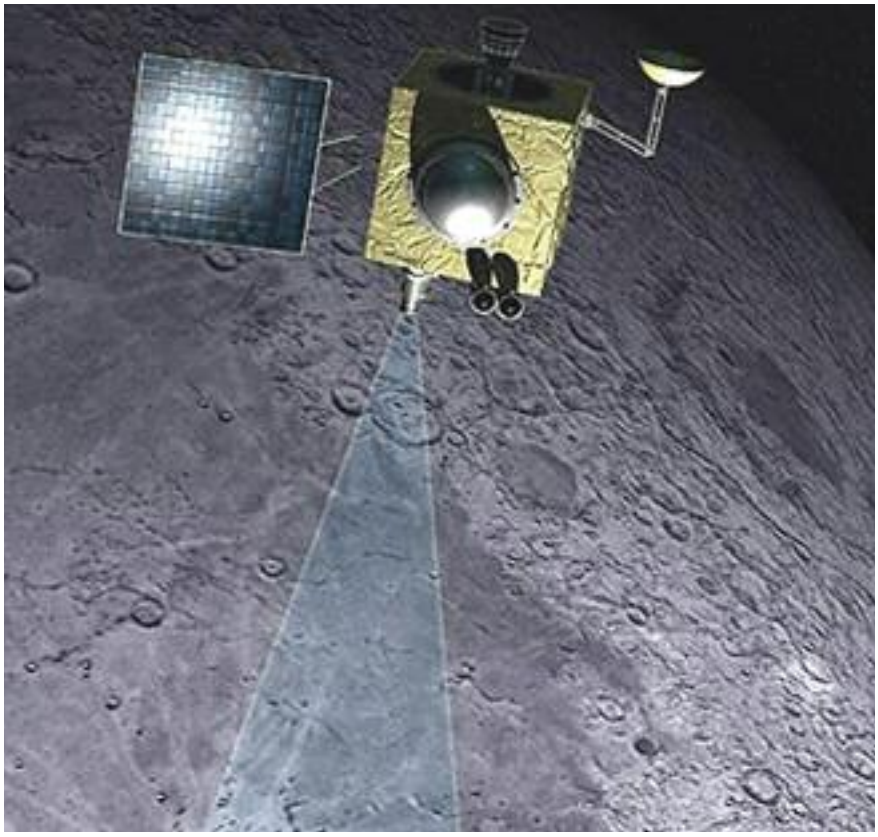
©Israel Space Agency & Fisher Institute

September

Water detected on the Moon

Scientists have discovered water on the moon. The water was formed in a warm, viscous magmatic layer under the lunar surface and thereafter pushed up toward the surface when a meteorite hit the Moon.

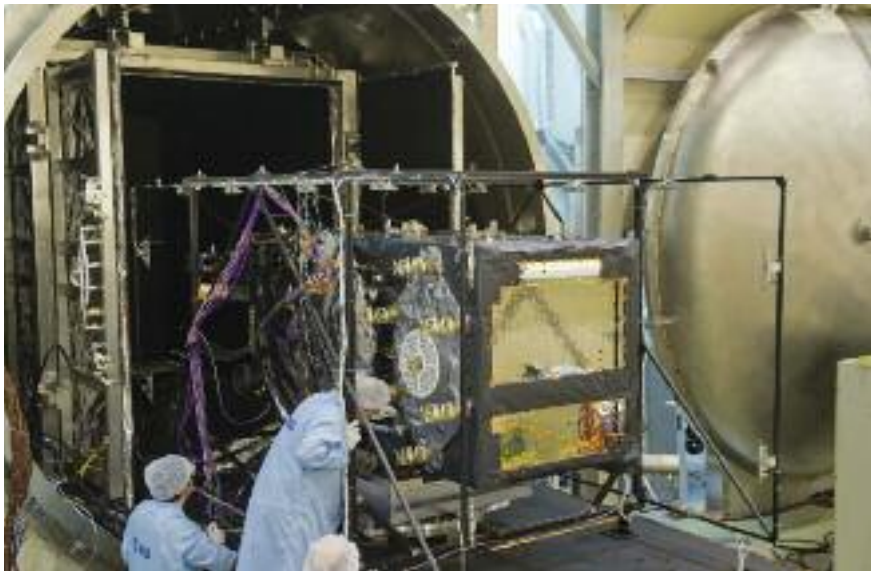
The occurrence of water was detected by NASA's Moon Mineralogy Mapper on board the Indian Chandrayaan-1 sonde that orbits the Moon. ©ISRO



First Dane in space

In September ESA astronaut Andreas Mogensen was notified that he was scheduled for duty on the International Space Station in 2015. He then will be the first Dane in space. Pool immersion is part of astronaut training.

©NASA/ESA–J. Blair



Galileo search and rescue

The search-and-rescue station on Svalbard was completed in September. It is part of the Galileo system that in turn is part of the COSPAS-SARSAT global rescue network.

Upon receiving a distress signal, a Galileo satellite will forward its relevant details via a ground station, such as the one on Svalbard, to the various search and rescue centres. The resulting increase in location data accuracy along with faster detection time can spell the difference between life and death in the High North. Galileo also returns confirmations of distress signals received, a new feature not supported in today's systems.

The tests have been promising, but more Galileo satellites must be orbited before the system can be used. The photo shows a satellite being tested at the ESA ESTEC technical centre in the Netherlands.

©ESA-Anneke Le Floc'h

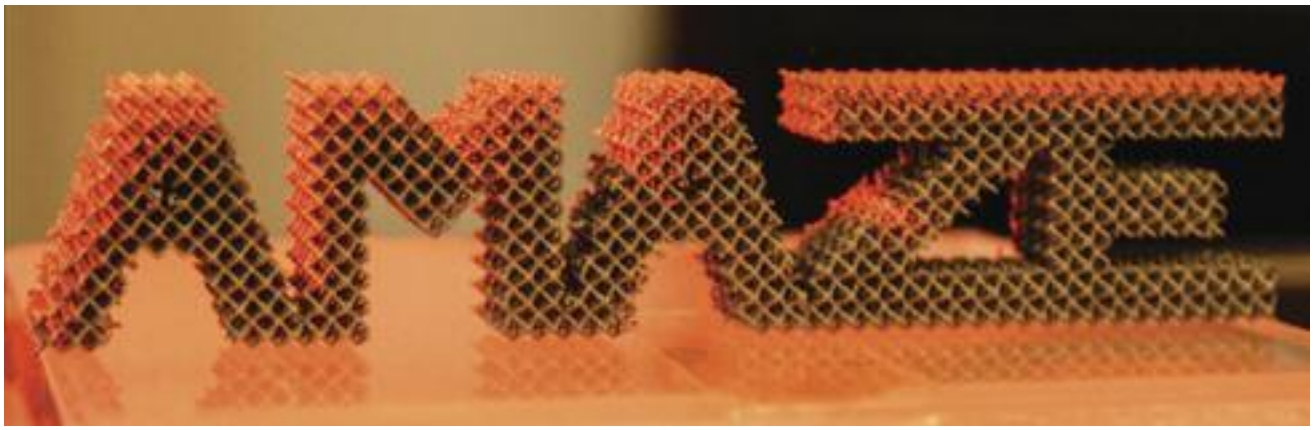
October

Metal printing in space

3D printing has been in use for several years. Layer upon layer of material are printed, based on a digital pattern to form a three-dimensional object. Plastic is the most-used material, but Norsk Titanium has developed a method for printing items of titanium. The method was one of several metal printing technologies exhibited when ESA presented the AMAZE research project.

Metal printing in 3D may be used to make parts for rockets, space sondes and satellites. It uses less metal and energy than do traditional stamping or pressing from a metal sheet. A 3D printer has been ordered for the International Space Station. In the future, astronauts on board may be able to make spare parts or tools.

©ESA-N. Vicente

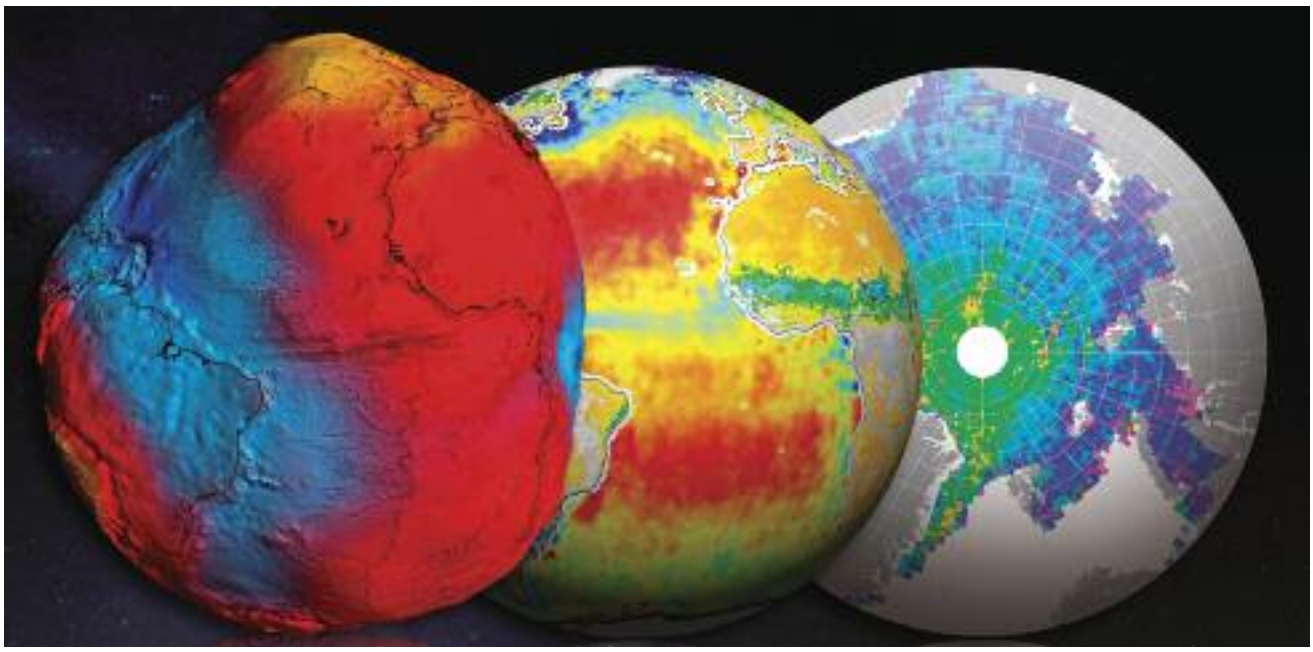


Gravity field measurements end

The Earth's gravity field varies around the globe. The GOCE satellite was orbited in 2009 to measure variations of the gravity field as observed from space. Data from the satellite have been used to compile a new model of the gravity field, a geoide, which is the starting point for extremely accurate measurements in surveying, building, transportation and other sectors. GOCE results also have led to new understanding of the development of sea level, the circulation patterns of the major currents and the first high-definition chart of the border layer between the Earth's outer shell and its mantel.

The fuel used to keep the satellite accurately in orbit finally was exhausted. On 21 October the ESA announced that GOCE had plunged into the sea near the Falklands islands.

GOCE was the first in the Earth Explorer series of environmental and climate satellites. The two other Explorers still in space, CryoSat and SMOS, are still performing their measurements. ©ESA



November

Claim settlement via satellite

The Ansurs system for claim reporting won the Norwegian part of the European Satellite Navigation Competition. It uses navigation satellite data to attach accurate times and locations to images sent in by insurance company customers. So claim filing can be simpler, faster and cheaper than the current practice of sending an assessor to a site to take photos. Ansur was the Norwegian entry in the international European Satellite Navigation Competition (ESNC).

The first prize went to Kinexon GmbH, a company formed by German students for a system for analyzing and visualizing sports training parameters on a mobile device. The top award earned the title of Galileo Master, an award of 20,000 Euro and a half year of support at a freely-elected regional organizer.

Swarm determination of the Earth's magnetic field

Barely a month after GOCE, the first Earth Explorer satellite, disintegrated in the atmosphere, a fourth element in the series was launched. The three satellites in the Swarm constellation together examine the Earth's magnetic field to determine why it has become weaker.

The Earth's magnetic field originates in its core of liquid iron that rotates slowly. The field protects life on Earth from high-energy radiation from space. But scientists are not certain about its origin and how it is maintained.

The three Swarm satellites are in polar orbits. Two of them fly parallel at an altitude of 450 km, while the third is at an altitude of 530 km.

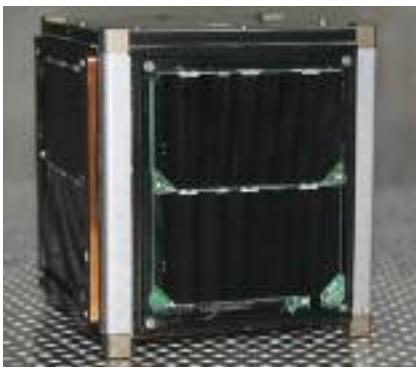
Swarm proved knowledge of the processes within the magnetic field, both at altitude and deep in the interior of the Earth. This new knowledge will also aid understanding of other planets such as Jupiter and Saturn, as well as of the Sun, all of which have magnetic fields. ©ESA/ATG Medialab

Student satellite orbited

Narvik University College's student satellite, the HiNCube, was launched from Russia on 21 November. In all, 67 students were involved in building the satellite, which was lofted by a Russian Dnepr rocket with 31 other small satellites from round the world. The HiNCube measures 10 x 10 x 10 cm and weighs less than 1 kg.

HiNCube is the first satellite launched under ANSAT, the Norwegian student satellite programme.

ANSAT was started by NSC and NAROM at the Andøya Rocket Range, to generate interest in studies in technology and the natural sciences as well as to strengthen cooperation between educational institutions and industries. ©ESNC Lars Helge Surdal, KDA



December

Surveying a billion stars

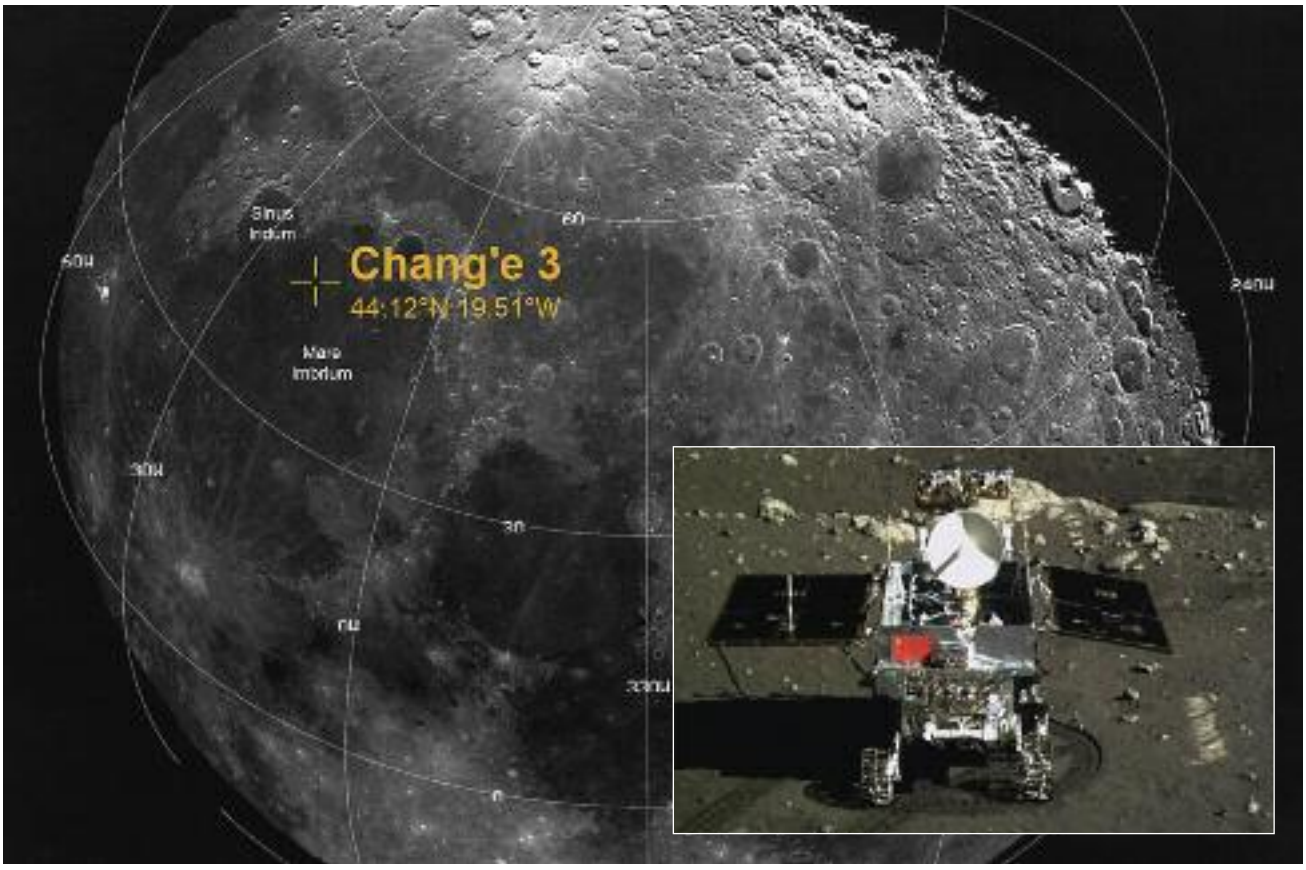
On 19 December the Gaia space observatory was launched. Gaia data will be used to study stars in the Milky Way to determine how galaxies are formed and developed, detect exoplanets and contribute to computations of the amount of dark matter in the universe. It will scan the Milky Way to determine distances, positions, directions, speeds, and chemical compositions of a billion stars. Each star will be observed some 70 times during the five-year life of the mission. The result will be the most complete star map ever. The space observatory instruments are so accurate and have such high resolution that were they placed on the Moon, they could measure the length of the thumb of a person standing on the Earth. The instruments on board have a precision down to a millionth of a degree. Technology delivered by Kongsberg Defence & Aerospace at Kjeller enabled that precision. Prototech in Bergen also supplied technology to Gaia.

©ESNC ESA–D. Ducros

India to Mars, China to the Moon

The Indian and the Chinese space programmes have gone far forward. Earlier in the autumn of 2013, India launched an orbiter that will reach Mars in September 2014.

China had a goal of landing on the Moon and on 14 December became the third country to do so, after the USA and Russia, by landing a sonde on the Moon. The Chang'e 3 sonde has a rover, named Yutu, after the lunar goddess Jadekanin. The rover weighs 140 kg, has six wheels and several instruments, including a radar, a spectrometer and a camera. Yutu's mission is to chart the minerals on the surface of the Moon. The next step is to land a lunar sonde that can send back samples of the surface, hopefully within 2020.



©ESNC Xinhua (lander) og NASA (location)

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