

# Annual Report 2012



Norsk Romsenter  
NORWEGIAN SPACE CENTRE

NSC-Report 2013/7



*Edel Storelvmo*

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*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 2013, the total budget was NOK 751 million, and the NSC had 38 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.

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# From the Director

## Norwegian Space Centre 2012

The year 2012 was memorable for the Norwegian Space Centre (NSC) in particular and for the country's space activities in general. There were two notable events. The Ministry of Trade and Industry (NHD) assigned the PwC consultancy to evaluate Norwegian participation in the European Space Agency and the national support schemes. In addition, prolonged preparations for the ESA Council meeting at ministerial level in November in Naples marked the year.

## Evaluation

The PwC evaluation was on the whole positive within the sectors evaluated. Particular mention was made of NSC's ability to bring about synergy between ESA-related industrial incentives and the national support schemes.

PwC was amazed by the extent of Norwegian space activities and estimated that they comprised nearly 2% of world space effort. This is comparable with the global market shares for Norwegian aquaculture and oil and gas production.

NSC believes that the PwC figures are a bit high but agrees that they underscore the importance of space activities in Norway.

The PwC evaluation was a key starting point when NHD began preparing a new White Paper in late 2012.

## Meeting at ministerial level

From its establishment as a foundation in 1987, NSC has maintained that Norway's participation in ESA programmes should be commensurate with the country's relative Net National Income (NNI). Supported by the Ministry of Trade and Industry, that goal was attained through participation in new programmes declared during the ESA Council meeting at ministerial level in Naples.

Norway now is the seventh largest contributor to new ESA programmes. That's the same as the rank of the Norwegian economy among ESA member countries.

The ESA commitment is essential for our being able to focus on sectors that contribute to the development of

products in niches in which Norwegian firms are competitive, such as satellite communication. In addition to the composite long-term tasks associated with participation in the EU Galileo and Copernicus programmes, there's been a broad, national commitment in internally and externally financed programmes. NSC established a project department to ensure capable direction of the relevant activities, including tasks associated with tropical forests, the Svalbard Integrated Earth Observation System (SIOS), small satellites and Arctic communications.

Throughout the year we continued development of the AISSat-2 maritime satellite. We also initiated activities to acquire a larger platform (NorSat) for testing new technologies in space.

All in all, 2012 was a rewarding year for the Norwegian Space Centre. Many partial goals were attained and new goals were identified. We ascribe our success to political acceptance of our initiatives and to the dedication of our staff.

*Norwegian Space Centre, 26 August 2013*



*Bo Andersen*

ESA-S. Corvaja, 2012



Some years stand out above others. For Norwegian space activities, 2012 was one such year, in which:

- Norway committed NOK 1.1 billion at the ESA Council meeting at ministerial level.
- Norwegian space programmes were evaluated.
- Norway celebrated the 50th anniversary of its being a space nation.

The ESA Council meeting at ministerial level is the leading forum for European space activities. In November, the Norwegian Space Centre supported the Ministry of Trade and Industry (NHD) at the ministerial meeting in Naples. The outcome was that Norway committed up to NOK 1.1 billion to ESA optional programmes in the years to come. The financial commitment is commensurate with the ranking of the Norwegian economy among ESA countries.

PricewaterhouseCoopers (PwC) evaluated Norwegian space programmes on assignment from NHD. The contribution of the programmes to environmental and national security are considerable and long lasting, but the effects on growth and value creation are less obvious.

HM King Harald and Trade and Industry Minister Trond Giske were among the honoured guests at the national celebration of the country's 50th anniversary as a space nation held at the Andøya Rocket Range.

## 50th anniversary

- "Sometimes one millimetre is enough", as sung by Norwegian singer Anne Grete Preus. For the first Norwegian sounding rocket launch, it was a bit more, in fact three kilometres. The Ferdinand 1 rocket launched 18 August 1962 from the Andøya Rocket Range attained an altitude of 103 km. Outer space is said to start at an altitude of 100 km. In other words, Ferdinand 1 went high enough to make Norway a space nation. Three kilometres was enough.

Few then could have envisioned that 50 years later Norway would be a space

## *Vision for Norwegian space activities*

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

nation with 1000 people in space-related jobs and with a respectable share of the world space sector, or that satellite data would be basic in everyday activities, from weather forecasts to fisheries monitoring. So the 50th anniversary celebration at the Andøya Rocket Range was well attended. Its programme included a research symposium, a science conference, an art exhibition, a concert, a press seminar and public lectures. HM King Harald attended on 18 August, the anniversary day, which put the event on the national agenda. He also laid the foundation stone for the Aurora Activity Centre that will feature simulated virtual missions through the aurora out into space.

More than 1500 spectators were drawn to the Space Circus gala performance in a large circus tent next door to the Rocket Range control tower. Singers Sivert Høyem and Tonje Unstad, children from Andøya and astronaut Christer Fuglesang enlivened the Norwegian space odyssey.

## A useful tool

Even though Norway initiated space activities by launching a sounding rocket that acquired data on the aurora, research is not what has made the country a significant actor in space. The impetus has rather been the need for practical responses to the challenges involved in managing the large sea areas for which Norway is responsible. Safe navigation, effective communications and relevant Earth observations are essential. Only an infrastructure in space can meet these needs. Norway has therefore focused on acquisition of satellite data for more efficient management.

While data flows from satellites have been important in management, knowledge and safety, the effects of

contributing to the building of satellites and space probes have triggered industrial development and the building up of high-tech expertise. In research, access to data from space probes and satellites has enabled Norwegian scientists to contribute significantly in fields such as Sun-Earth interactions and cosmology.

In 2012, NSC managed NOK 497 million contributions to ESA, divided NOK 141 million in membership and NOK 356 million in optional programmes. Moreover, Norway contributed NOK 103.5 million via the NSC budget to the development of Galileo in the EU.

The PricewaterhouseCoopers (PwC) consultancy evaluated the 2012 Norwegian space programmes on assignment from the Ministry of Trade and Industry. The principal PwC finding was that the contributions of the programmes to environmental and national safety were considerable and long-lasting. PwC found tangible results in value creation, but their nature and effects on long-term growth are unclear. The Board believes that it's important to take part in the strategic discussion that the report initiated.

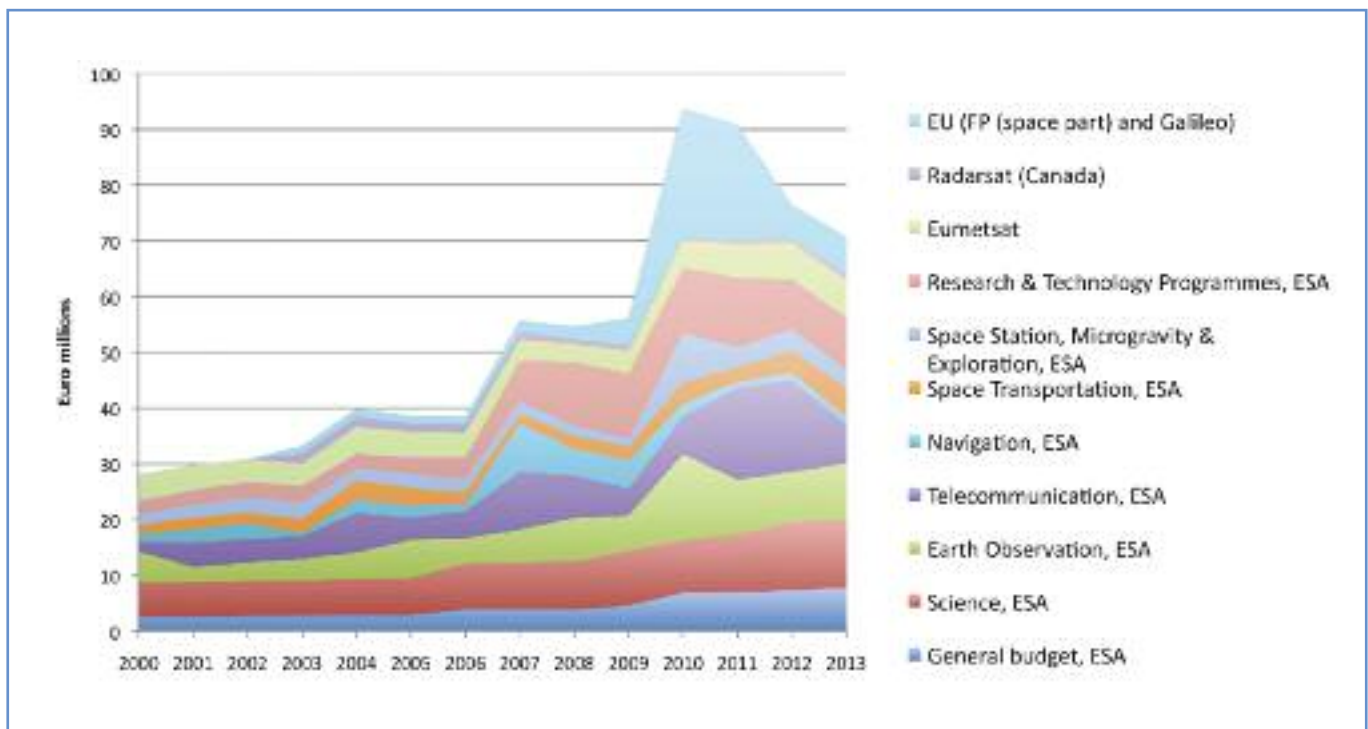
## European options in space

International cooperation is essential for Norway to have access to the data flow from space. It costs billions to build satellites. So for most countries, cooperation across borders is imperative.

For Norway, membership in the European Space Agency (ESA) is the most important tool for optimizing space investment cost-benefit. The main reason for Norway becoming an ESA member in 1987 was to realize industrial spinoff effects and public utility.

The 20 ESA member countries meet every three to four years to agree on the programmes to pursue in the years to





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

come. In November the scene was set for the Council meeting at ministerial level and exacting discussions in Naples. Even though economies in Europe are not at their best, the member countries managed to agree on the course ahead. Despite troubled economies in many countries, the delegates were willing to commit to new programmes for a total of €6.1 million.

There was full support of the programmes for the next generation of meteorological satellites, but many of the optional programmes were not as well supported as ESA had hoped.

The greatest challenges in Naples were in space transport. Agreement was reached on the development of Ariane 6 in parallel with the completion of the upgraded version of Ariane 5.

In addition to taking part in the optional programmes, all member countries pay mandatory dues to support the scientific programme and the operation of ESA. The agreements reached in Napoli apply for 2013 onward.

The Norwegian Space Centre supported the Ministry of Trade and Industry in negotiations at the meeting in Naples.

Norway committed NOK 1.1 billion to the ESA optional programmes. The funds will be disbursed over several years and are allocated to programmes that Norway views as advantageous for its industries, administration and research. The Board regards the commitment as an indication that the Government realizes the necessity of continued public involvement in the economy of the Norwegian space sector.

#### International cooperation

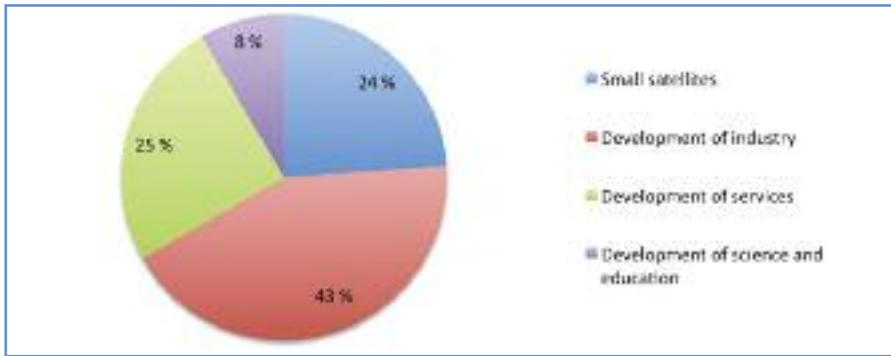
A small space nation such as Norway must arrange cooperation with several ESA member countries. Svalbard is a favourable basis for bilateral agreement because the archipelago is one of the best places in the world for downloading data from and controlling satellites in polar orbits. During the summer NSC entered a major contract with NASA for SvalSat to be a key station for the next generation of American meteorological satellites. Kongsberg Satellite Services AS (KSAT) is responsible for the technical cooperation with NASA.

Norwegian-Japanese cooperation was

strengthened in Earth observation and space research. The successful launch of Shizuku, the Japanese environmental and climate satellite, was significant in the cooperation, as it will download to Norwegian ground stations. Cooperation in ground stations and the data centre for Hinode, the Japanese solar satellite, functions smoothly, and scientists in more than 37 countries use the data centre. Official bilateral meetings were held in space weather and aurora research, including during Norwegian Prime Minister Stoltenberg's visit in Japan.

NSC continued to provide administrative support for Norwegian research communities in forest monitoring for their contributions to implementing a national forest monitoring and reporting service in Tanzania.

An official Norwegian delegation visited South Africa in connection with the opening of the new KSAT ground station there. The NSC Managing Director and the Director General of the Norwegian Coastal Administration met with South African colleagues to discuss sea monitoring.



The National Support Scheme strengthens Norwegian actors so they are better positioned to compete for national and international contracts. In 2012, NOK 42.1 million was disbursed.

### Support schemes

NSC manages the national support schemes. The funding is vital in enabling Norwegian actors to position themselves better for national and international space deliveries. Early support in development processes has enabled several Norwegian space communities to become world leaders in their niches.

Appropriations for national support schemes in 2012 totalled NOK 42.1 million. Together with unused funds from previous years, a total of NOK 46.3 million was disbursed. These funds are used for technology transfer to strengthen the positions of Norwegian actors in global markets and to develop Norwegian user communities, principally in Earth observation.

NOK 6 million were earmarked for AIS and NOK 6 million were earmarked for the Andøya Rocket Range in accordance with the letter of award. Of the remaining NOK 34.3 million, NOK 22.9 million was allocated to industrial development, NOK 9.3 million to services development and NOK 2.1 million to scientific and educational developments. In all, 28 companies and organizations received national support scheme support via 40 contracts.

### Spinoff 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.

In recent years, the Norwegian approach to assessing spinoff effects has attracted interest abroad, and countries such as Denmark have adopted its methodology. The spinoff effect report has been cited in OECD reports. PwC tested the method in its evaluation and has verified its methodology. However, PwC pointed out that long timelines (from 1985 on) can mask newer changes in recent years. NSC ran simulations from 2004 on when it was reorganized from a foundation to a governmental agency. The simulations produced high factors that reflect the positive trends in industries that have been supported via ESA or national support schemes in recent years. In

turn, this showed that the space industry has made good use of the increased governmental commitment to space from 2005 on.

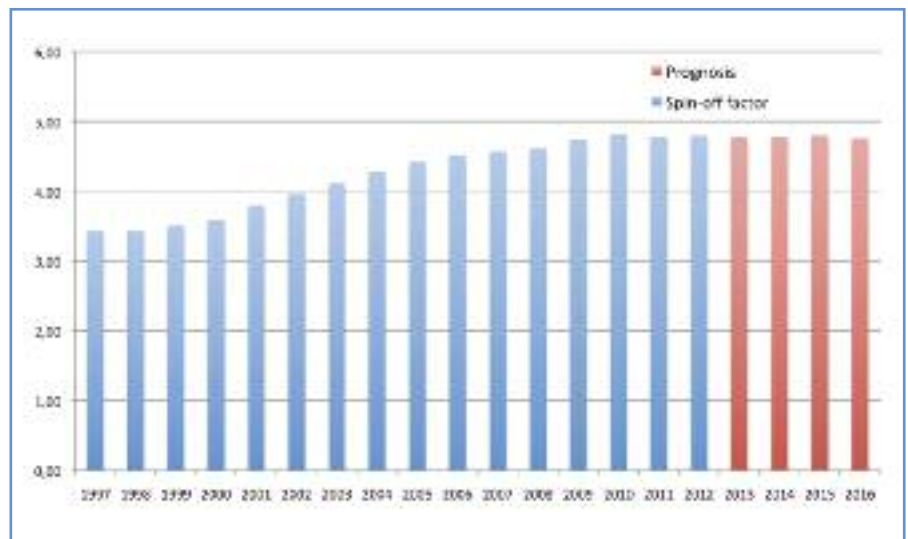
The spinoff factor rose from slightly less than 3.5 in 1997 to 4.8 in 2012. This means that for each NOK of governmental funding from the national support scheme or the ESA, the companies attained additional turnover of nearly five NOK. A simulation of the spinoff factor for 2004 on fixes it at slightly more than 7. The Board believes that this proves that governmental commitment in space activities is profitable and leads to industrial development and workplaces. Moreover, the Board emphasizes that further growth depends on increased commitment, both public and private.

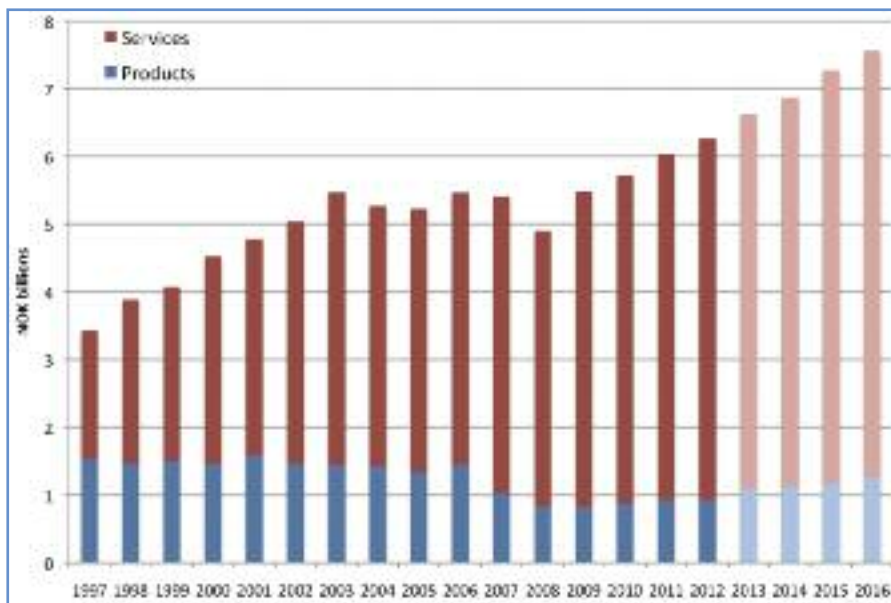
### Space industry

Space industry is a vital business sector in the country. In 2012, the turnover of Norwegian-produced goods and services in the space sector was estimated at NOK 6.4 billion.

Kongsberg Norspace is still the leading Norwegian industrial company in the space segments of satellite systems, with a staff of 100 and an annual turnover of about NOK 150 million. The company develops and produces filters, frequency converters and other devices used in optimizing

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 2012 the spinoff factor was 4.8.





Turnover of Norwegian-produced goods and services from 1997 to 2012, with the companies' forecasts up to 2016. The total space sector turnover in 2012 was NOK 6.4 billion.

signals communicated via satellites. Its developments have been successful and have led to many new contracts with ESA, from the EU Galileo programme and from Space Systems/Loral and other private sector actors. Supply to the satellite space segment is demanding because the market is small and the technical developments of relevant competitors are supported by national or regional organizations.

Turnover in satellite communications has traditionally accounted for the greater part of income in the Norwegian space economy. There are many examples of successful business developments in satellite communications. Telenor's current position can be ascribed to its predecessor, the Norwegian Telecommunications Authority, being early involved in satellite communications in the Inmarsat system in the 1970s. Later the involvement was expanded to include satellite broadcasting and broadband to ships.

Ship Equip in Ålesund is another example. The company specializes in broadband to fishing vessels, offshore and shipping. A strong market position led to the company being sold to Inmarsat for NOK 900 million. Likewise, Vizada Norge was bought by

Astrium Services (EADS). These sales show that Norwegian space sector companies possess coveted expertise and have significant market shares that make them attractive. However, for NSC, which supports industrial build-up through the national support scheme and participation in ESA, this is a two-edged sword. Investments in the space economy are so successful that companies are acquired by global concerns that in turn may move production to lower-cost countries.

In recent years, NSC has been involved in transferring technologies from ground bases to space systems. In 2012 this entailed contact with the Norwegian Centres of Expertise and other business groups and innovation entities. NSC also is on the Board of the Space&Energy network that arranged a seminar during the Transatlantic Science Week in Houston, during which new contacts were made with NASA.

#### The International Space Station and space transport

The International Space Station was operational throughout 2012. The User Support Centre at the Norwegian University of Science and Technology has had major assignments from ESA in conducting multinational experiments

on the Space Station. The Norwegian AIS instrument on the Space Station continued to supply data, both to help combat piracy in the Gulf of Aden and to aid technical studies of the envisioned next generation of AIS systems. The use of the Analysing Interferometer for Ambient Air (ANITA) instrument on board the Space Station has created further activity for SINTEF.

In 2012 there were seven successful Ariane 5 launches of 11 large communications satellites and one meteorological satellite. In addition, an automated transfer vehicle (ATV) carried cargo to the Space Station. To date, this was the greatest number of Ariane 5 launches in a single year. Norwegian companies have steady production runs for Ariane 5. In 2012, the first smaller Vega launch vehicle was launched from Kourou.

#### Satellite communications

Norwegian space sector companies are well advanced in the uses and commercial exploitation of satellite communications. Service and operator activities account for the greater part of annual turnover.

Telenor Satellite Broadcasting, owner of the Thor satellites, has recently enjoyed a significant upswing and now has an annual turnover of around NOK 1 billion. The newest satellite, Thor 7, is being built and is scheduled to be operational in the summer of 2014. It will be orbited by an Ariane 5, the launch vehicle for which Norwegian companies deliver technologies for millions of NOK for each launch.

Jotron SatCom AS is an example of a newly-started company that in 2012 merged into Jotron AS and thereby was integrated into the main company. The company inaugurated a new industry building at Skoppum in Vestfold county, in which satellite communications products have dedicated premises for assembly and test. Jotron has its first antenna in production and on the market and also is further developing its product portfolio in broadband maritime communications. Through the ESA ARTES programme, they have started development of smaller antennas for higher frequency

bands, which appear to be very promising for future maritime broadband communications.

### Communications in the high north

Norway has a well developed broadband network, with one exception: sea areas north of Bjørnøya. Here only telephone communications may be reliably accessed, and data downloading degrades with increasing latitude. This is because the northern limit of the coverage of geostationary communications satellites is about 75 °N.

Diminishing sea ice has led to increased exploration for oil and gas; the number of tourist ships has gone up, and ship traffic in the Northeast Passage can grow in summer. The need for broadband probably will go up, so NSC and Telenor Satellite Broadcasting have initiated a joint project to find solutions for broadband coverage in the high north. The project, which is relevant to the governmental high north strategy, focuses on user needs, technical solutions and system parameters. Agreements that make Norway responsible for search and rescue in the Norwegian sector all the way to the North Pole have also brought about a need for higher capacity.

### Satellite-based AIS

The Automatic Identification System (AIS) satellite AISSat-1 has been successful since it was polar orbited in 2010. Sixteen times a day it gives the Norwegian Coastal Administration updated information on ship traffic in Norwegian waters. Its identical successor AISSat-2 is now ready for orbiting as soon as there's an opportunity for launch. Planning has begun for a further development of a higher-performance AIS receiver that can be used with future satellites such as NORSAT-1.

At the ESA Council meeting at Ministerial level Norway pledged support funding for the Advanced Research in Telecommunications Systems (ARTES) programme in order to take part in the discussions of an envisioned ESA-owned AIS satellite and to gain access to data from it.

### 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.

The ESA membership enabled Norway to influence the shaping of Galileo early on. When the EU assumed ownership, Norway entered an agreement for the 2009-2013 development phase of the system. To date, Norwegian companies have been awarded development phase contracts totalling nearly €50 million. As in 2009, a Parliamentary resolution will be required for further participation in the operative phase from 2014 on.

In October, two Galileo satellites were orbited, so the system now has four operational satellites. In 2012, contracts were entered for delivery of eight more satellites. In all, 26 satellites have been contracted. Plans call for all to be orbited in 2015. A test phase of the operative services is planned before the end of 2014. The EU Commission has put forth a proposal for further extension, development and operation of the system up to its completion in 2020. The seven billion Euro system budget has been put forward for incorporation in the EU budget for the 2014-2020 EU financial period.

Three of the 30 ground stations supporting the Galileo system are on Norwegian lands, in the Arctic on Spitzbergen in the Svalbard archipelago and on Jan Mayen island and in Antarctica on Queen Maud Land. The three stations help ensure signal precision and reliability and the two Arctic stations are particularly important for system accuracy in the high north.

The Public Regulated Service (PRS) is an encrypted Galileo service for

public sector groups with the strict requirement that it always be available. Through 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 satellite navigation programmes also include a support system, the European Geostationary Overlay Service (EGNOS). It aims to ensure the quality and reliability of GPS signals across Europe. In December, Avinor, the State-owned company operating most of the civil airports in Norway, initiated introduction of approach systems based on EGNOS for improved air traffic control safety throughout the country.

### Earth observation

NSC has been the driving force behind ensuring further Norwegian involvement in the EU Global Monitoring for Environment and Security (GMES) programme, now renamed Copernicus. The programme is a large-scale effort to understand natural processes, climate and the environment. Copernicus will require enormous amounts of data from existing and new satellites owned by EU, ESA, Eumetsat and member countries.

The negotiations between Norway and the EU and the subsequent resolution on Norwegian participations in GMES Initial Operations 2011-2013 ensures our being able to influence the programme. It's an active dialog with key Norwegian users including the Norwegian Meteorological Institute, the Geological Survey of Norway, the Norwegian Coastal Administration, the Norwegian Polar Institute, the Norwegian Armed Forces and others, to ensure that needs essential for Norway will be considered in the design of and plans for operation of new European satellites. Key ground station tasks in the first phase of the programme have been assigned to Svalbard.

In 2012, ESA's largest development programme in Earth observation called



for six planned meteorological satellites in the Meteosat Third Generation series, for which Norwegian companies were awarded important tasks. Several Norwegian space-sector companies positioned themselves well for possible future deliveries to the Metop Second Generation satellites, a programme initiated by resolution at the ESA Council of Ministers meeting.

Expansion of the ESA Sentinel satellite ground segment has gone ahead in 2012, with KSAT in a key role. Sentinel 1A will be launched in the autumn of 2013. NSC is cooperating with Norwegian agencies and research communities in developing new applications based on satellite data.

#### Space research

After much uncertainty, the ESA EXoMars programme was clarified at the ESA Council meeting at Ministerial level. In a joint effort with Russia, a new European space exploration probe will be orbited around Mars in 2016 and a rover with a Norwegian-developed ground-penetrating radar will be landed in 2018. The rover will have a two-metre-long drill to facilitate subsurface measurements.

Curiosity, the new Mars rover was launched in 2011 and touched down on Mars in August 2012. The landing was exciting, as Curiosity was lowered on tethers from a sky crane. The landing was successful, and Curiosity was readied for use in the autumn. Several Curiosity instruments were tested during the Arctic Mars Analogue Svalbard Expedition (AMASE).

Svalbard was chosen as a test site because in many places its bedrock resembles that found on Mars.

In 2012, the ESA member countries formally agreed on cooperation in Euclid, a major astronomy project that will bring together European scientists in the search for dark matter and dark energy. The Euclid satellite is scheduled for launch in 2020. Many of the scientists are associated with the Institute of Theoretical Astrophysics at the University of Oslo, so Euclid is one of the largest-ever initiatives in Norwegian space research.

The ESA scientific programme has several orbited space telescopes, space exploration probes orbiting Mars and Venus and a comet probe still on the way to its target. There were no new science programme launches in 2012.

#### Communications and education

In August, NSC joined with the Andøya Rocket Range in celebrating the 50th anniversary of Norway's start as a space nation. The celebration lasted four days and was attended by 5,000 people, including H.M. King Harald and Minister of Trade and Industry Trond Giske.

There was an average of two mentions a day of NSC in the media. This was slightly more than in 2011, but the impact was greater because media coverage of the 50th anniversary celebration was extensive across the country. The anniversary and space activities were highly visible in TV coverage in the Saturday Review on NRK1 and on TV2, major features in

national newspapers and many online news mentions. Moreover, there was good regional coverage in Nordland and Troms Counties. NSC took part in the Oslo Science Fair, an event open to the public that drew 20,000 to 25,000 visitors. In addition, the NSC staff held 220 lectures and some 50 meetings with 1900 participants were held in the NSC premises at Skøyen in Oslo.

In 2006, the AnSat student satellite programme was initiated, in part to interest young people in future careers in technology and science. The programme involves two universities and one college planning, building, testing and launching a satellite that delivers data. To date, the programme has involved 147 students, of which 111 have taken Bachelor's or Master's degrees.

Space travel now is part of the lower secondary school natural science curriculum. Over five years, NSC has offered 8th to 10th year pupils free lectures on space and astronomy that in 2012 were attended by 1300 lower secondary school pupils in Oslo and Akershus Counties.

The romsenter.no website was thoroughly renewed in a preproject in 2011 that led to an invitation to tender for it in 2012. Work on the new website started in September, and the new site is scheduled to be operational in April 2013. In addition to continuation of the focus on astronomy and space travel, the new site also clarifies services for users in administration, businesses and schools.

Oslo, 22.02.2013

  
Kjetil Storaas Hansen

  
Edel Storelvmo, Styreleder

  
Marie Nymark Melle

  
Mats Carlsson

  
Kirsti Lovise Slotsvik

  
Bo Andersen, Adm.dirktør

# Extract of annual accounts for 2012

EXTRACT OF ANNUAL ACCOUNTS (Average exchange rate for 2012: 1€= NOK 7.4744 )	2012
Administrative appropriation from the Ministry of Trade and Industry	48 959 190
Other income*	65 717 270
<i>Operating income</i>	<i>114 676 460</i>
Salaries and social expenses	35 559 971
Other operating expenses	80 723 421
<i>Total operating expenses</i>	<i>116 283 392</i>
<b>Ordinary operating result</b>	<b>1 606 932</b>
Finance income and finance costs	285 762
<b>RESULTS, ORDINARY ACTIVITIES</b>	<b>1 892 694</b>
<p>*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.</p> <p>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.</p>	
<b>ALLOCATION OF APPROPRIATION</b>	
<b><i>Appropriation from the Ministry of Trade and Industry</i></b>	<b>543 631 299</b>
ESA Pension	405 130
ESA Mandatory basic activities	40 191 101
ESA Mandatory CSG Kourou	10 525 673
ESA Mandatory Science Programme	89 407 761
ESA Earth Observation	68 000 406
ESA Microgravity	15 691 828
ESA Navigation	9 499 043
ESA PRODEX	11 927 280
RADARSAT	8 099 072
ESA Space Situational Awareness	4 496 899
ESA Space Station	13 064 711
ESA Technology Development	54 850 580
ESA Telecommunications	123 007 510
ESA Space Transport	29 900 201
Estrange/Andøya Special project	17 664 449
National support schemes	46 899 655
<b>Disbursement of appropriation</b>	<b>543 631 299</b>

# Pictorial review of 2012

## January

### Ariane busy

In 2012 there were seven launches of Ariane 5, the largest European launch vehicle, from the Space Centre near Kourou in French Guiana. The payloads were mostly satellites but Ariane also helped the Automated Transfer Vehicle on its way (see March). Since 2002, Ariane 5 has had 53 successful launches in a row. Several Norwegian companies, including Nammo Raufoss, Kongsberg Defence Systems and Alcatel Space, deliver or have delivered technology to Ariane 5 and Arianespace, the company responsible for launches from the Space Centre near Kourou.

©ESA/Arianespace



©DigitalGlobe

### Clooney's satellite project

The advertising film that actor George Clooney made for Den Norske Bank website dnb.no was much mentioned in the media. Clooney used income from the film to finance a project in which satellite images monitor conflict areas in Sudan. In combination, satellite images, analyses and field observations capture possible threats to civilian populations, observe refugees and find villages that have been bombed. Clooney's Satellite Sentinel Project cooperates with the UN's UNOSAT programme that is experienced in the use of satellite solutions in humanitarian actions.



©Satellite Sentinel Project

## February

### First Vega launch

The initial launch of the European Vega launch vehicle took place on 13 February. Now Europe has a smaller launch vehicle well suited for small payloads, that is, satellites weighing 300 kg to 2000 kg. The launch was from the European Space Centre near Kourou in French Guiana, site of the Ariane launches. While Ariane can orbit two satellites together weighing up to 10 tons, Vega can meet increasing needs for orbiting smaller satellites in orbits from equatorial to polar. The first Vega launch carried nine European small satellites.

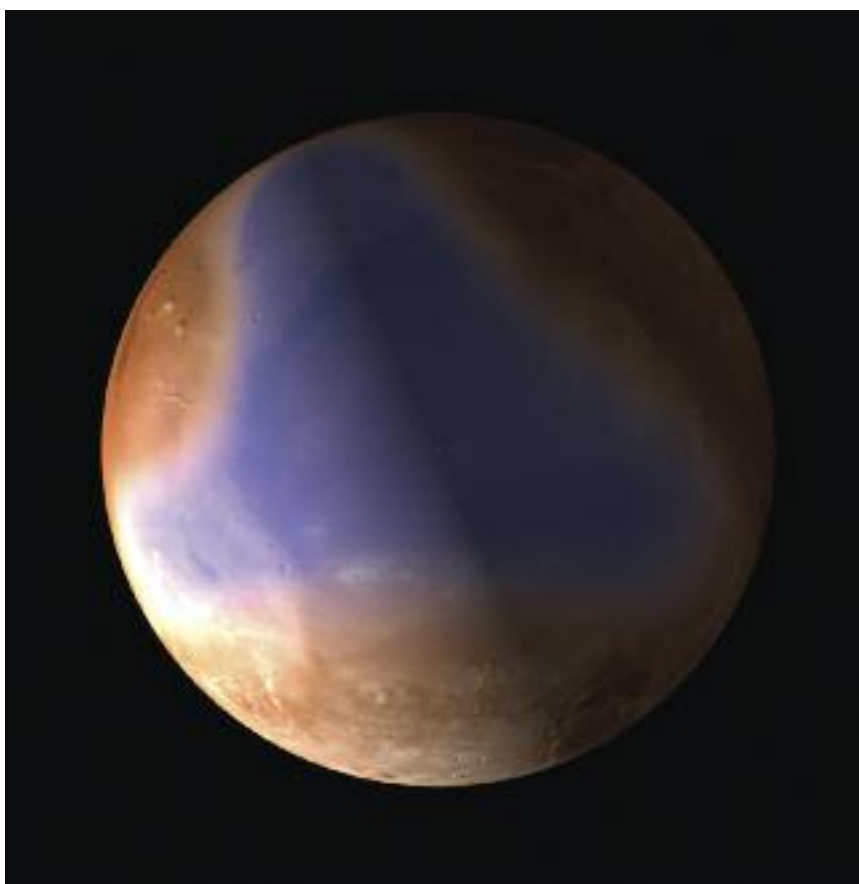
©ESA - S. Corvaja, 2012



### Ancient sea on Mars

The European Mars Express space probe has found remnants of an ancient sea on our red neighbour planet. The radar on board the ESA probe penetrates to a depth of 60 to 80 metres under the surface and has found a large area with ice deposits in the northern hemisphere. The sea existed briefly, for about a million years, three or four billion years ago. That duration was probably too short for life to have evolved. The water probably was absorbed in the ground and froze to ice or was vaporized in the atmosphere.

©ESA, C. Carreau





## March

### More accurate weather forecasting

Europe aims to build a new generation of meteorological satellites that will supply a hundred times more satellite data than the satellite fleet of today. The greater amount of data

will improve the accuracy of weather forecasts. The new generation of meteorological satellites is called Meteosat Third Generation (MTG) and will comprise six satellites in geostationary orbit about the Earth.

In 2018, the MTG satellites will supersede today's Meteosat fleet and ensure continuation of the Meteosat programme that has supplied weather data since the 1970s.

©Bård Gudim



### On autopilot to the Space Station

Operation of the Space Station requires water, food, air, clothing and equipment supplied at intervals for the astronauts on board. ESA's third Automated Transfer Vehicle (ATV)

completed a successful mission to the Space Station, navigating and docking without human intervention. In addition to supplies, the ATV carried research experiment gear and maintenance equipment. Air

resistance continuously lowers the orbit of the Space Station, so one ATV task was to lift it back up in orbit. Once that task was accomplished, the ATV was filled with waste from the Space Station and sent in an orbit back toward Earth to burn up in the atmosphere.

©ESA/CNES/Arianespace/Optique Video du CSG - P.Baudon



©NASA



## April



### Envisat task finished

Just a few weeks after ESA celebrated the tenth anniversary for Envisat, it fell silent. Several attempts to re-establish contact failed, so ESA declared the hard-working Envisat to be a loss. In its ten years in polar orbit, Envisat contributed Earth observation data from the Arctic, monitored the atmosphere, seas, ice, vegetation changes, volcanism (see following) and provided other measurements useful in climate and environmental monitoring. To date, Envisat data have been used in more than 2500 scientific publications, and much unprocessed data remains for future research projects.

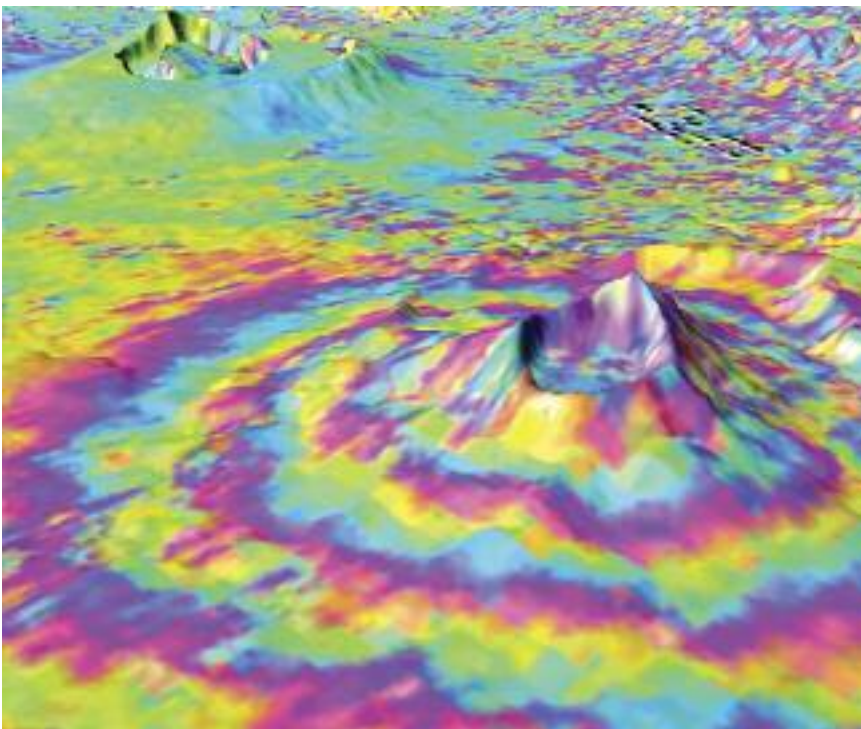
©ESA/Denmann production

### When volcanoes awaken

Satellites can sense imminent action of dormant volcanoes. Forecasting volcanic eruptions can be lucrative, as evidenced by the eruption of Eyafjallajökul on Iceland in 2010 stopping air travel in Europe for many days. Analyses of satellite radar images can reveal movements under volcanoes that may be the precursors

of eruptions. Images of the Longonot Volcano in Kenya are based on satellite data and show that it rose nine centimetres in two years starting in 2004. The ESA Sentinel satellites can deliver the long series of observations necessary before volcanic eruptions forecasting can be realized.

©ESA



### Scottish student satellite won

The finest satellite adventure of the spring took place at Andøya. Young people from 14 European countries were finalists in the CanSat soda can satellite competition. Team Alpha from Scotland won. The Norwegian team from the Heimdal Upper Secondary School had worked hard on the parachute for their satellite, which unfortunately was damaged during launching.

©J. Mäkinen / ESA





## May

### New high north Internet portal

On 30 May, Foreign Minister Jonas Gahr Støre opened the BarentsWatch Internet portal that is a single source for all information on the high north. The portal eases access to information on and services for coasts and sea areas for the general public, authorities and decision-makers. This will improve the exchange of information between various actors.

In all, 27 agencies and research institutes supply data to the portal, and satellite data is an essential part of the information base.



### Jupiter next

ESA has chosen its next major space project. It will be a mission to Jupiter and its large moons to search for water and life. The project is called JUICE (JUperiter ICy moons Explorer). When the probe arrives in 2030, it will explore the volcanically active moon Io, the ice-and-rock moons Ganymedes and Callisto and the ice moon Europa. JUICE also will also investigate Jupiter's atmosphere and magnetic field and how the planet interacts with its moons. Norwegian companies are among the world leaders in making large steerable solar panels of the sort that will be fitted to the probe. So there may be Norwegian deliveries to the probe, which is scheduled for launch in 2022.

©ESA/AOES

## June

### Large rocket launched from Andøya

On 22 June, the largest ever rocket launched from Norway was sent into space from the Andøya Rocket Range. The rocket was used by the German Aerospace Centre (DLR) to test various materials and new approaches to heat shields for use in space shuttles. The seven-ton rocket attained a maximum altitude of 177 km and fell into the sea southwest of Svalbard ten minutes after launch.

©Trond Abrahamsen



### Venus transit across the midnight Sun

On 6 June, Venus passed in front of the Sun. The astronomical high point of the summer was celebrated across the country. The midnight Sun in Northern Norway and on Svalbard permitted the solar transit to be observed for seven hours. Historical transits of Venus observed round the Earth have been used to estimate the distance from the Earth to the Sun and the size of the solar system. In 1769, Vardø in northern Norway was one of the observation sites chosen, and astronomer Maxmillian Hell was sent from Vienna to make observations there. Astronomer Hell's measurements at Vardø along with those of Captian Cook in Tahiti contributed to the accuracy of the estimated distances of the solar system.

©Michel Breitfellner and Miguel Perez Ayucar/ESAC



# July

## Satellite TV jubilee

The first direct transmission of TV images across the Atlantic took place on 23 July 1962. It included images of landmarks such as the Statue of Liberty and the Golden Gate Bridge

sent from a ground station in Maine via the Telstar 1 satellite that had been launched two weeks previously. The signals were received by ground stations in England and in France and distributed across Europe. Later that

evening, the satellite relay direction was reversed, and American TV viewers could view images of the Eiffel Tower and the midnight sun.

©NASA



## Maritime broadband antennas

Fifty years after the first direct TV transmission across the Atlantic, we now can view TV, listen to radio and enjoy telephone and broadband links across the Earth via communications satellites. The challenge for ships at sea is for antennas sufficiently stable for continuous good signal reception. In July, Jotron Satcom of Norway launched a new antenna for higher throughput broadband on board ships. The antenna automatically homes in on the direction of the strongest signal and tracks it as the ship heels or rolls.

©trondur / 123RF Stock Photo

## August

### Curiosity

On 6 August, the Curiosity Mars rover touched down perfectly after being lowered on tethers from a sky crane fitted with four downward-pointing thrusters. The remotely-controlled rover will investigate the geological structure, chemistry and weather of Mars near the landing site at the Gale crater in its northern hemisphere. It is fitted with several instruments, two of which were tested on Svalbard before being mounted on the rover. If all goes well, Curiosity may be operational for 12 to 15 years and may then provide an answer to whether there is or has been microbial life on Mars.

©NASA/JPL-Caltech - ©Kjell Ove Storvik/AMASE



### Norway in space for 50 years

Norway became a space nation with the launch of the Ferdinand 1 rocket from the Andøya Rocket Range on 18 August 1962. In the 50 years since then, thousands of research rockets have been launched from the Range.

The jubilee was celebrated by a royal visit, a scientific conference, a research symposium, a public academy and an art exhibition. The King laid the foundation stone for a new adventure centre due to open in 2014. Space Circus, a gala performance,

was held in a circus tent next door to the control tower. More than three thousand guests visited the Andøya Rocket Range during the four-day celebration of the jubilee.

©FFI

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## September

### Environmental data to Svalbard

SvalSat will be the main downloading station for the Sentinel series of new European environmental satellites. The satellites will monitor environment and climate around the Earth and will ensure continuity of time series of data from today's environmental satellites. KSAT's contract is for NOK 200 million, has a duration of five years and covers downloading data from the first three Sentinel satellites. The first satellite will be launched in 2013. ©KSAT



### New weather satellite orbited

Metop-B is the second satellite in a new series of European meteorological satellites developed by ESA and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). The satellite was launched on 17 September from the Baikonur Cosmodrome in Kazakhstan. It is in polar orbit and delivers meteorological and atmospheric data from around the world, which improves weather forecasting accuracy and supplies useful environmental data for climate research. ©EUMETSAT

### Portrait of the young Universe

The Hubble telescope peers farther out in the Universe and farther back in time than ever before. The image depicts the Universe as it was 13.2 billion years ago. More than five thousand galaxies and galaxy clusters are visible in the collage consisting of thousands of individual images. The most remote, least luminous galaxies are the oldest. They are estimated to have been formed 450 million years after the Big Bang. The Hubble telescope was launched in 1990. After its upgrading and repair, astronomers reckon that it will be operational until 2018 or later.

©NASA; ESA; G. Illingworth, D. Magee, and P. Oesch, University of California, Santa Cruz; R. Bouwens, Leiden University; and the HUDF09 Team



## October

### **Prestigious grant for Norwegian space research**

The University of Bergen and space physics Professor Nikolai Østgaard have been awarded an NOK 18 million grant for research on gamma ray flashes in thunderstorms. Gamma ray flashes are made up of X-ray and

gamma radiation that occurs in thunderstorms. The phenomena are poorly understood, and Professor Østgaard's space physics research group is among the four-five world leaders in the field. The grant was awarded by the European Research Council (ERC) Advanced Grants and

signifies that Professor Østgaard's gamma ray flash project at the University of Bergen is of world rank. The research group is already building an ESA-financed X-ray instrument to be mounted on board the International Space Station to acquire data on the phenomenon.

©plampy - ©Stock Photo



### **Two new Galileo satellites orbited**

Two new Galileo satellites were launched 12 October from Kourou in French Guiana. Together with two equivalent satellites orbited in 2011, they will be used in testing the forthcoming Galileo navigation system. In addition to their navigation technology and extremely accurate clocks, the two satellites are fitted with search and rescue transponders that can rapidly access and forward signals from emergency beacons. Norwegian companies deliver various devices for the satellites and ground stations of the Galileo system, which is scheduled to be completed in 2020.

©ESA - S. Corvaja



## November

### Commits more than a billion

Norway has committed more than NOK 1.1 billion to the ESA optional programmes. The funds will be allocated over several years to programmes that Norway views as advantageous for its industries, administration and research.

As Minister of Trade and Industry Trond Giske remarked after the ESA Council meeting at ministerial level in Italy, "space activities have considerable, increasing benefit for a broad spectrum public sector activities, particularly in the high north where there are few or no

alternatives to satellite-based solutions." In addition to participation in the optional programmes, all ESA member countries pay a membership fee that in part covers ESA scientific programmes. The total ESA budget for the 2013-2017 period is €10 billion.

©ESA-S. Corvaja, 2012



### Aims to settle Mars

Space pioneer Elon Musk seeks new challenges. After having sent Dragon, the first privately-developed spacecraft to the Space Station with supplies in October, Mr. Musk now eyes Mars. He envisions sending a small party to Mars to colonize the planet. With time he envisions the population of the colony to be about 80,000 and the price of a trip to it costing about 500,000 dollars. SpaceX, Mr. Musk's company that developed Dragon and the Falcon launch vehicle, now is testing the next generation of launch vehicles that will be able to take off and land vertically and will be reusable.

©SpaceX



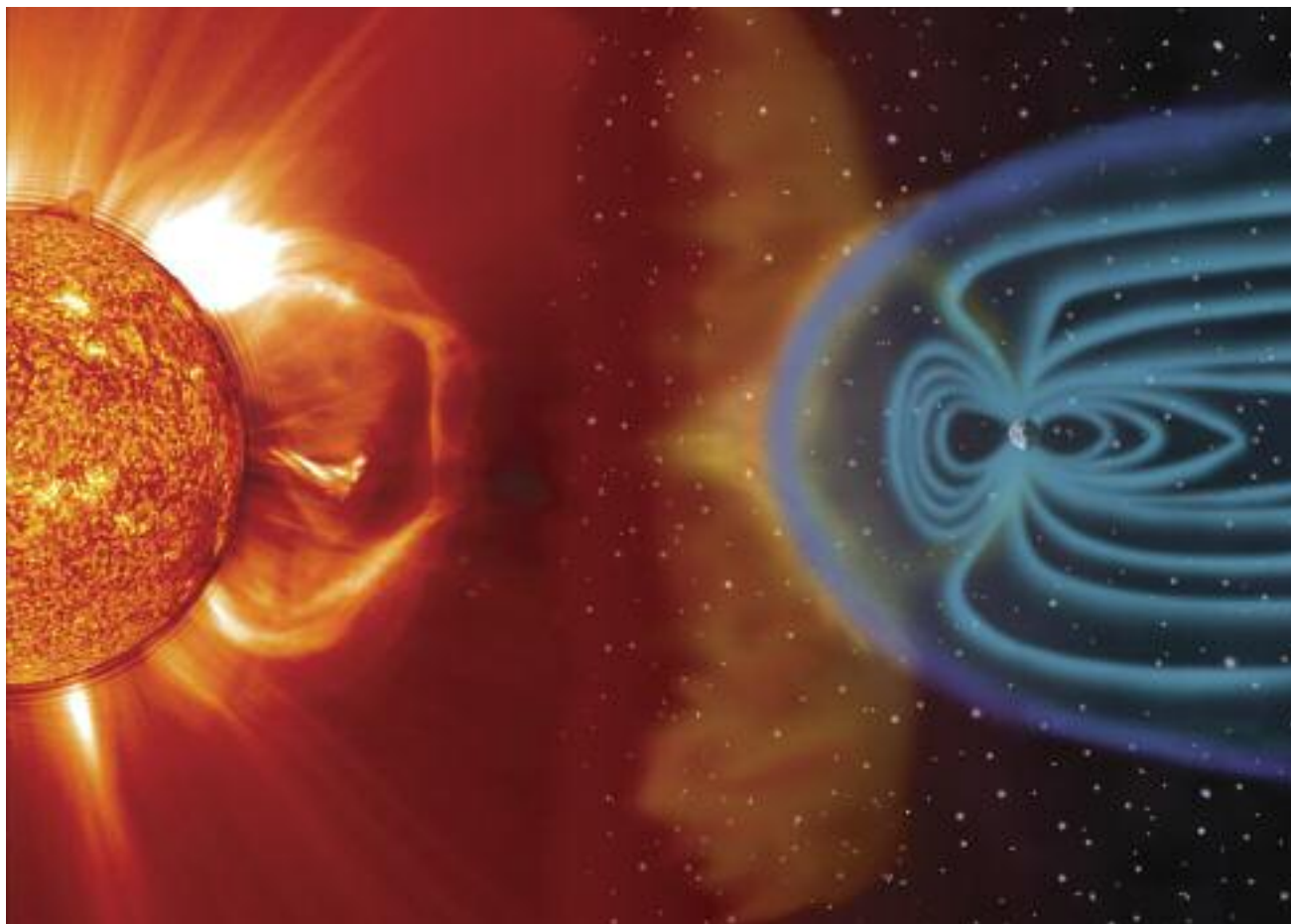
## December

### European space weather forecasting

Starting in 2013, the Norwegian Mapping Authority (NMA) will contribute to ESA space weather forecasting. Severe space weather can disable satellites as well as terrestrial

electronic devices and power grids. Severe space weather events usually is manifested in geomagnetic storms and aurora in northern regions, but during powerful solar storms aurora can spread round the planet. Norway has a long tradition of solar and aurora

research and thereby the expertise for strengthening the space weather service of the ESA Space Situational Awareness Programme. Starting in early 2013, the NMA will deliver ionospheric weather data to the ESA centre for space weather. ©NASA



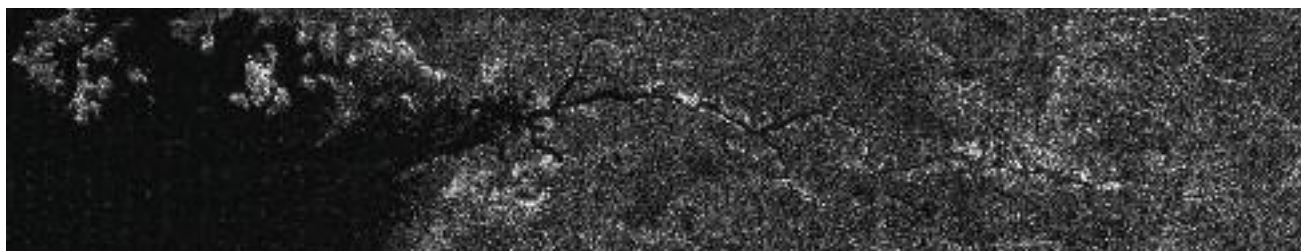
### Miniature Nile on Titan

The Casini probe had discovered a flow that resembles a miniature Nile on Titan, the largest Saturnian moon. The flow is 400 km long and runs from a source region down to a large

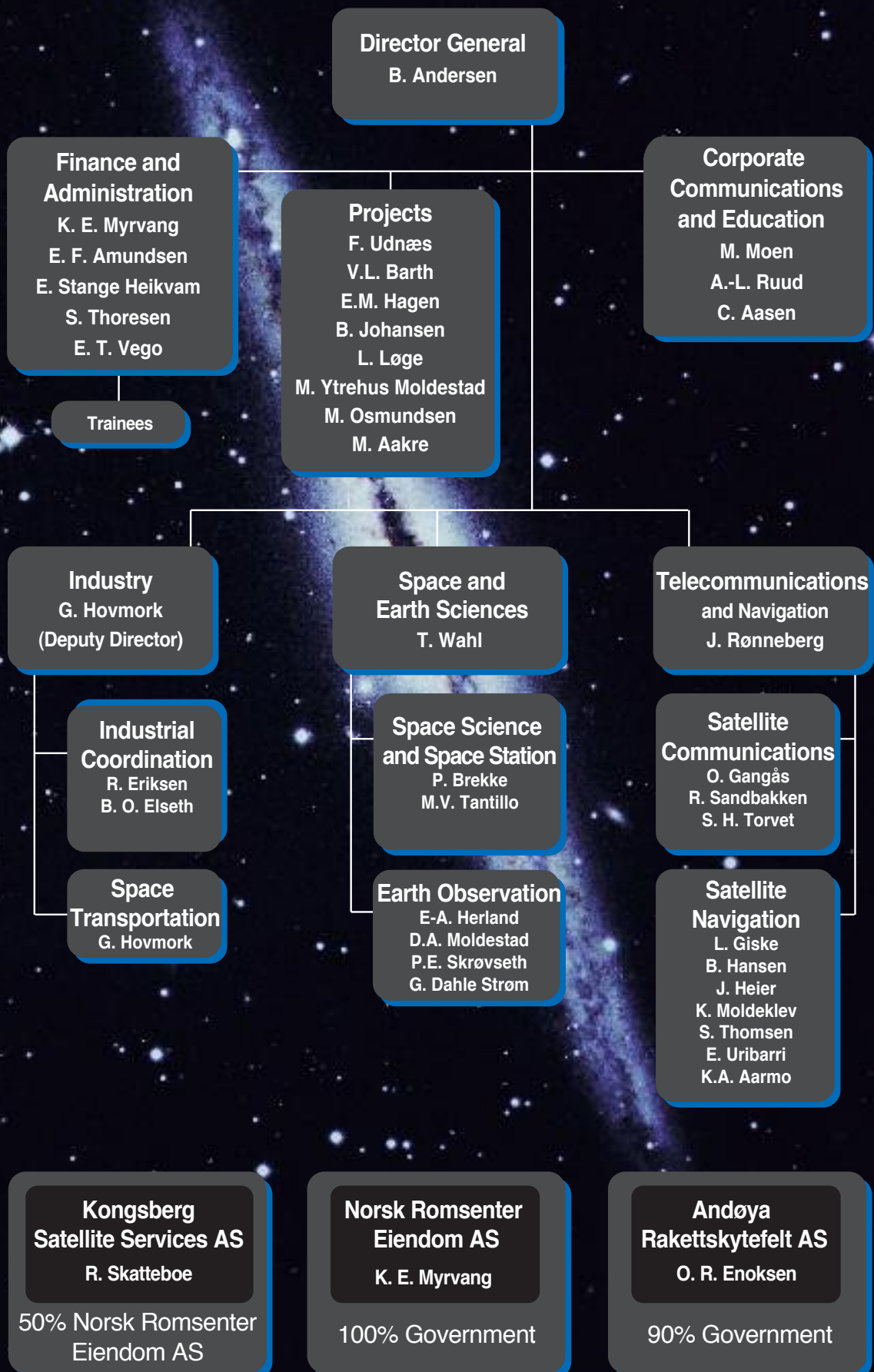
sea. Titan is the only extraterrestrial environment known to support flowing liquids. But it's too cold to have water flow on its surface. So scientists believe that the flow may be of hydrocarbons, such as ethane or

methane, that run in rivers and fill seas on Titan. The Casini probe has orbited Saturn since 2005, and is a part of Cassini-Huygens, a joint space effort of ESA, NASA, and ASI, the Italian space agency.

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# Organization of the Norwegian Space Centre as per 1. september 2013







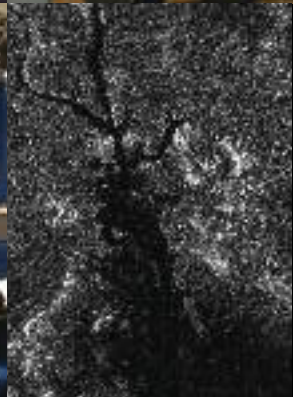
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