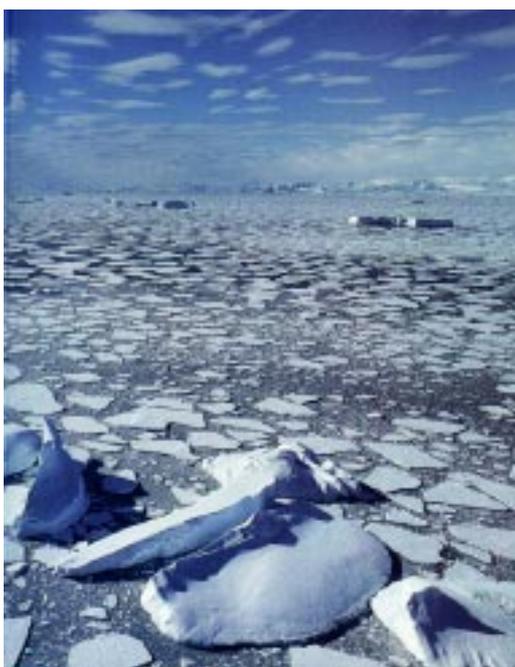


# Norwegian Space Centre and the ENVISAT-programme

As a member of the European Space Agency, ESA, the Norwegian Space Centre started potential participant activities in the ENVISAT-programme in 1991. On behalf of Norway the ENVISAT declaration was signed in 1992. The Norwegian Space Centre has worked with the ENVISAT programme for more than ten years, and Norway has through the Norwegian Space Centre paid approx. 200 MNOK for the participation in the ENVISAT-programme since the start. This is a major investment.



**Monitoring ocean and ice, one of the reasons for the strong Norwegian engagement in the ENVISAT programme.**

For Norway there are several reasons to participate in the programme.

ENVISAT represents:

- continuous measurements, started by the ESA ERS-1 satellite in 1991, giving support to service development for national users
- new measurements, giving new knowledge in understanding and monitoring environment and climate processes for scientific and management purposes
- building knowledge in the industry on space and ground infrastructure.

ENVISAT is equipped with 10 different instruments measuring in the atmosphere and towards the Earth. Several of the instruments are complementary to each other.

## Industrial contribution from Norway

The Norwegian Space Centre has supported three industrial activities in relation with the ENVISAT programme:

*Alcatel Space Norway* has developed and delivered the signal generator for the radar altimeter. The new signal generator is a further development of an equivalent unit on board the ERS satellites. The contract was entered with Alenia Spazio in 1993 and the unit was delivered in 1996. Additionally, Alcatel Space Norway has supplied switches to the SAR antenna transmit/receive modules under a contract with Alcatel Space.

*Kongsberg Defence & Aerospace* delivered the Optical Path Difference Sensor (ODS) electro-optic subsystem for MIPAS instrument, which will measure the concentrations of 20 atmospheric gases. ODS consists of a frequency-stabilized diode laser

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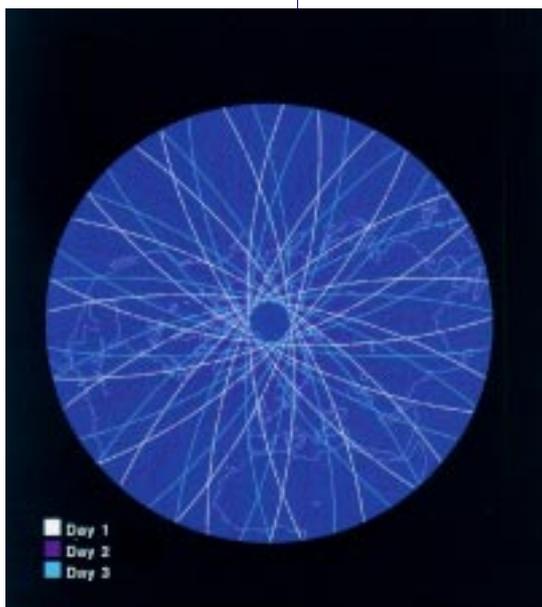
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with an optical fibre and collimator, polarization-sensitive detectors and control electronics. The system is used for precision spectral calibration of MIPAS as well as for generating sampling signals for recording atmospheric spectra.

### *Kongsberg Spaceteq*

has, as subcontractor to Alcatel (France), developed and delivered the Processing Facility Host Structure (PFHS) subsystem, which along with the instrument data processing systems comprises the core of the ENVISAT ground segment. The principal tasks of PFHS are to acquire, process and control the generation of higher-order products as well as to store, distribute and quality assure ENVISAT data. A cost-efficient ASAR processor has been developed and delivered to Tromsø Satellite Station.



**ENVISAT, being a polar orbiting satellite, give very good coverage for the Nordic countries, and explain some of the interest for the programme.**

Figure: ESA.

## Preparations are well under way

Now when the satellite is ready for launch, we are confident that the support Norway has given to the ENVISAT programme is well recognized. The deliverables from Norwegian industry is important for the instruments to work in Space and for handling the data stream being sent to Earth. Further on, many groups around the country are prepared to utilize the data coming from the satellite.

In 1998 20 Norwegian proposals were sent to ESA within the framework of Announcement of Opportunity. After some adjustments and upgrades, they were all accepted.

The projects were grouped in three different categories:

1. Support to calibration/validation of the satellite and ground segment
2. Scientific projects
3. Demonstration projects for application development

The acceptance from ESA includes an agreed amount of data free of charge. All projects accepted by ESA must also deliver results based on the objective and the data involved. There is no financing

from ESA, therefore the projects must find financing elsewhere. The Norwegian Space Centre supports mainly projects in the category 1 and 3. In category 2, the projects receives partly funding from The Norwegian Research Council and from EU's 5 th framework programme.

## Norwegian Space Centre and ESA financing cal./val. activities

For the calibration and validation projects, which will give technical support to ESA in the first phase of ENVISAT, The Norwegian Space Centre has teamed up with ESA to finance key projects. These projects are essential for ESA to execute, and they are part of the Calibration/Validation Plan ESA has made for ENVISAT.

*The Norwegian Institute for Air Research, NILU*, has established a large database that will be used in the comparisons of information from ground instruments and aerial measurements with the information provided by ENVISAT instruments to enhance the reliability of the information. NILU will also perform validation campaigns on the atmospheric instruments specifically related to ozone measurements and utilization of ALOMAR at Andøya.

*The Norwegian Meteorological Institute (DNMI)* is using radar altimeter data in operational wave forecasting today. They will execute validation for the RA-2 on ENVISAT the first six months in order to validate the quality for utilization of the data in models for wave forecasting.

The research institute *NORUT-IT*, a part of ESA's Expert Laboratory for The Advanced Synthetic Aperture Radar (ASAR), has developed software for converting ASAR radar data to information on wind and waves for European users. The ASAR, a radar-imaging instrument, provides images that are equally clear at nights and in daytime, and it can see through cloud cover. In the commissioning phase, the first six months after launch, NORUT-IT will support ESA in the validation of wind and wave information in the ASAR data.

*The Norwegian Institute for Water Research* will use MERIS full resolution data in the assessment of water quality in coastal waters. They will conduct and coordinate validation experiments in the coastal zone to verify these data. There is a considerable need for improved environmental monitoring of coastal waters affected by merchant shipping, fisheries and pollution from land-based industries and agriculture.

*The Nansen Environment and Remote Sensing Center (NERSC)* will also perform validation experiment on the West coast of Norway to validate data coming from several ENVISAT instruments, and perform synergetic studies of the Norwegian coastal waters using ASAR, MERIS and AATSR data.

### Scientific projects

Nordic scientists have studied both the Arctic and Antarctica during the last decade. Norwegian scientists have used satellite data as valuable tools to get updated information from these hostile environments. Important sea ice parameters are ice edge, concentration, drift, type and floe size. These parameters are vital in understanding the mechanisms of the seas surrounding the Poles. Both *the Norwegian Polar Institute (NPI)* and NERSC will work on detecting changes in the Arctic and Antarctic Sea Ice.

NPI will use data from ENVISAT to study the movement of the glaciers. Accurate measurements of the variations in glaciers are important as the glaciers may give early warning of changes in the climate.

NORUT-IT will retrieve near ocean surface wind from SAR under high wind condition and study how to extract more information from the signal under such conditions.

Several groups now take the opportunity ENVISAT provides to work on land. *The Norwegian Defense Research Establishment (FFI)* will analyse ASAR polarization signatures from urban areas using multiple incidence angles and *The Norwegian Computing Center (NR)* will study environmental conditions on land areas using imaging spectrometry – MERIS included. The NERSC will also study refugee camps by synergetic use of SAR and very high resolution optical satellite images.

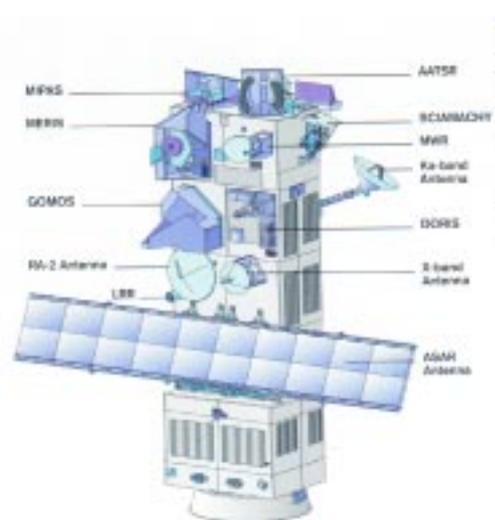
### Demonstrations and service development

FFI has long been working on maritime traffic monitoring systems, in which analyses of radar images are used to determine ship size, position and speed. This information is integrated in the operational system for national fishery enforcement in the Norwegian economic zone and supports utilization of the Coast Guard's ships and aircraft in a cost-effective way. The ASAR instrument will make the service continue, and work will be done to improve this service by studying use of alternating polarizations of ASAR.

*Tromsø Satellite Station* is providing an oil pollution monitoring service based on ERS and RADARSAT SAR. The data are acquired and processed at the station. The ENVISAT ASAR will make the service more robust and reliable by the improvement of the incident angles and coverage.

NR has proposed to conduct further work on automatic detection on oil spills based on ASAR images.

DNMI is utilizing satellite radar altimeter data to support their daily weather forecast. They will improve the assimilation of altimeter wind and wave observations in a coupled weather and ocean-wave



forecast model making progress to further improvements in weather predictions.

NERSC will develop a pre-operational ocean current measurement system using altimetry.

### Ground segment

Svalbard Satellite Station, SvalSat, is located at 79 °N and covers all 14 passes of ENVISAT per day. SvalSat is prepared to provide blind support on a daily basis.

Tromsø Satellite Station, as a national station, will acquire ENVISAT ASAR data with focus on near-real time services for marine applications. The station perform very fast acquisition, processing and distribution of SAR data, and plan to do it for ASAR data as well.

### The role of the Norwegian Space Centre

The role of the Norwegian Space Centre in the ENVISAT-programme is to fund Norwegian participation in the programme, to support projects and activities of importance to national users and industry, and have a coordinating role in execution of the ENVISAT programme.

**ENVISAT's instruments can all give data for better knowledge about our environment, to understand the processes and to monitor these.**

Figure: ESA.