# FOREWORD

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Ladies and gentlemen,

The Envisat Symposium 2007 is the largest ESA science conference of the year. In a nutshell: 1000 participants have come to Montreux. We have received 800 abstracts submitted by 2040 authors from over 40 countries, which will be presented and discussed in 54 thematic sessions over the next five days.

## I. WHERE WE COME FROM

Let me remind that Envisat, the subject of this conference, is the biggest environmental satellite ever built. In the beginning it was used to be nicknamed a dinosaur, because of its sheer size carrying ten different instruments on its platform. Then it was called a workhorse, because it served and is still serving many thousand users around the world. Today we can add the notion of a flagship, because of its outstanding results, its meanwhile 78 different data products, and as reference for the continuation of its heritage. Envisat finished its nominal mission after five highly successful years: It demonstrated the capacity of the European Space Industry to build the biggest and one of the most complex Earth observation satellites ever. It demonstrated ESA's capacity to operate it, in a fully decentralised way, with many Ground Segment facilities spread across Europe, and reducing operations costs by 50% over the years.

But what makes Envisat such an outstanding mission is the huge user response: users in Earth sciences, but also providers and users of operational and pre-operational services, ranging from the provision of NRT UV indices to monitoring of illegal fisheries in the Indian Ocean. Over 1200 scientific projects are presently making use of Envisat data, and this figure implies several thousands of researches worldwide.

During the past five years, Envisat has delivered as many remarkable results. To name just a few highlights:

a) In November 2002, Envisat revealed the extent of the oil slick after the "Prestige" tanker accident.

b) As mentioned, the satellite was called a dinosaur, but the synergy of measurements is one of the advantages of a multi-instrument platform like Envisat. It was demonstrated during the Hurricane Katrina in summer of 2005: Wind field measurements derived from the Envisat ASAR could be combined with temperature and altimetry data. Altimeter measurements revealed the warm water body in the Gulf of Mexico feeding the hurricane with energy: The water was warmer than 27°deg and extended down to 125m depth – these data explain the strength of Katrina.

c) MERIS Full Resolution data are the basis for a new global land cover map to a resolution three times sharper than any previous satellite map (the Globecover Project).

d) The ASAR Background Mission revealed the blind fault of the Bam earthquake. It provides, besides others, subsidence measurements which form the basis of applications such as urban planning.

e) Envisat helps our understanding of anthropogenic greenhouse gases. Recently, discovery of high amounts of methane over tropical rain forests point to the possibility of a not yet known source of methane (or to a significantly underestimated known source). The measurements of NO2 show an NO2 concentration increase by 50% over China during last 8 years (in combination with ERS-2 data).

f) Envisat ASAR reveals ice loss such as exemplified with the Larsen B ice shelf over the past years. In 2005, the Arctic sea ice covered 5.3 Million km2; the lowest ever recorded extent by satellites.

These examples are just a reflection of the broad scientific topics fed with Envisat data during the first five years. (You will hear more about these important topics later today.) Yet the success story of Envisat is a continuation of a way that started much earlier. Besides the Earthnet programme running since almost three decades, and the most successful series of Meteosat missions, meanwhile in the second generation, the two smaller and older sisters of Envisat, our ERS satellites, have shaped the ESA Earth observation programme. Since 1991, thanks to ERS-1, ERS-2 and Envisat, we have 16 years of data continuity which allow important scientific observations. Such, to name just one more example, the global trends in sea surface temperature and mean sea level rise have become visible. The results of more than a decade of ERS and Envisat observations of the Earth show a global sea level rise of ~3.2mm/year compared to 1.6mm/year in the past. Two thirds of this is thermal expansion. The sea surface temperature increase amounts to 0.13°deg. per decade. These are measured values, not model calculations. Such results have fed the recently published UN climate change assessment report.

*Proc. 'Envisat Symposium 2007', Montreux, Switzerland*
*23–27 April 2007 (ESA SP-636, July 2007)*

ERS-2 is operating since 12 years in space – if you call Envisat a flagship mission, you might call ERS-2 the veteran mission. The production throughput for ERS High Resolution data increased to meanwhile some 27000 SAR products distributed per year, compared to some thousands in the first years. And it seems that ERS-2 could be operated for several more years, assuming that measures compensating for aging are being applied.

Envisat and ERS have significantly shaped the Earth observation science and application environment. They are the means providing a constant stream of data to all of you.

## II. WHERE WE STAND: OUR PROGRAMMES

### Global change and the symbiosis of science and politics

Ladies and gentlemen, it was difficult to oversee during the last months: The notion of "global change" has arrived in the life of citizens around the globe. It has arrived on the desks of opinion makers, in front of TV cameras and it appeared in the agendas of politicians. Why? Because it is nothing abstract any more, it is concerning this generation in this century.

I'd like to stress that this momentum is also your work. I don't need to tell you the predictions of the IPCC report 2007, parts one and two, which have brought global change back to the headlines. I don't need to explain you that the report expects the Arctic to be ice-free as of the second half of this century, that the sea level is expected to rise by 48cm until 2100, that w up to 90 percent of permafrost are predicted to melt around the world, freeing high amounts of methane gas, that less but significantly enhanced storms and surges will happen, that precipitation will decrease in arid areas but increase in humid regions, and that a weakening of the Gulf stream is foreseen – bearing in mind that the mechanisms and the effects are not fully understood yet. But I can tell you that these scientific predictions have a strong impact on economic and political issues, henceforth on decision-makers. For the first time ever climate change was discussed in the UN Security Council last Tuesday. I consider these are important developments.

The recently published STERN report (Nicolas Stern is a former director of World Bank) calls the climate change the "greatest and widest ranging market failure ever seen". The same report forecasts that we will loose about 20% of GDP within this century if we are not willing to spend at least 5% of GDP now to reduce the effects. We should be clear about it: Global Change is not a scientific exercise any more but a highly economic and therefore political question, which requires continued research and observation and appropriate response. I recall the new EU study as part of the strategy package for a common energy and climate policy. I recall the last Council of the European Union where it was decided to reduce the emission of greenhouse gases by 20% until 2020 and augment the percentage of renewable energies in the European energy portfolio from today 6.5% to 20% in the same time frame. Such ambitions have been significantly influenced by the observation capacities we have created over the last decades and by your work, and there is much evidence that this influence will continue to shape political decisions, not only in Europe, but globally.

In order to prepare the right decisions for mitigation of and adaptation to climate change, Europe needs to have continuous and independent capabilities as well as continuous research, not at last to have competitive advantages as economy.

Since ESA established its Living Planet Programme in the mid-nineties, a close cooperation with the scientific community for mission definition, development and operation was established. A recently renewed Earth Observation science strategy was formulated by the science community, which has resulted in the selection and development of meanwhile six Earth Explorer missions covering a broad range of science issues.

### The ESA Earth Explorers

Let's start with GOCE, the next science mission to be brought into space early next year. GOCE shall improve our knowledge of the gravity field. We need a more accurate geoide e.g. to extract ocean current data from altimetry measurements, but also to look into the Earth's interior and to investigate other effects connected to mass distribution on our planet.

Soon after GOCE we will launch SMOS in 2008: The Soil Moisture and Ocean Salinity mission shall demonstrate the observation of two key variables of the Earth System from space, namely the soil moisture content over land surfaces and the amount of salt dissolved in the oceans.

In 2009, CryoSat 2 will be brought into space to improve our understanding of thickness and mass fluctuations of the Earth's continental ice shields and marine ice cover, and to quantify rates of thinning and thickening of ice due to climate variations. I am proud that it was possible to get a decision within six months to rebuild this important mission and to secure 150 Million Euro for this purpose. This is an example how flexible the scheme of the ESA Earth Observation Envelope Programme is.

ADM Aeolus will follow in 2009, built to provide the first ever measurements of wind profiles from space. These data are expected to substantially advance numerical weather prediction, applied especially to extreme weather events.

In 2010, we will continue the suite of Explorers with SWARM. The primary aim of the Swarm mission is to provide the best survey ever of the geomagnetic field and its temporal evolution. SWARM will consist of three small satellites at different points of the magnetosphere.

After SWARM, EarthCare shall quantify and improve our understanding of cloud-aerosol-radiation interactions, in order to include such parameters correctly and reliably in climate and weather prediction models.

The seventh Earth Explorer is under selection. After having received 24 proposals for this new mission –demonstrating the strong interest of the European scientific community in ESA's Earth observation programme – evaluations by scientific, technical and programmatic panels resulted in a recommendation of ESAC, our Earth Science Advisory Committee, to commence assessment studies for six mission concepts in parallel.

It is without exaggeration when we summarise this suite of highly focussed science missions as unique in the world. Their data will enhance our understanding of the Earth system as a whole.

**The new ESA science strategy**

The implementation of our programmes relies on continuous and close interaction with you, the scientific community. The Earth Science Advisory Committee (ESAC) is hereby our primary advisory body. In 2005, we asked six external scientists and six ESAC members to support ESA in developing an updated science strategy for the Earth Observation Envelope Programme. The strategy underwent a wide consultation with the scientific community. Particular emphasis is put on the system approach, where links between different parts of the Earth System are considered. Such, the document addresses Earth science through the five topics oceans, atmosphere, cryosphere, land and solid Earth and identifies the challenges for each of these. The need for synergetic and interdisciplinary research holds therefore a special significance, as do near real time data and long-term monitoring also for science. Only satellites provide us at the same time with a global and regional, long-term and near-real view of our planet.

To answer some of the fundamental questions and help managing these challenges, for the benefit of future generations, is and must remain the fundament of our mutual efforts through the means of scientific Earth observation.

**The ESA Earthnet Programme**

The strength of Earth observation also lies in the diversity of systems. The amount and complementarities of Earth observation missions around the world make it imperative to use synergies between one another. With our Earthnet programme, we give harmonised access to currently 26 different missions and instruments to more than ten thousand users worldwide. As example, the Japanese ALOS satellite with its optical and an active L-band microwave sensor payload is one of the latest entries in the portfolio. Scientists worldwide can access the large pool of ESA Third Party missions according to their needs. The data access is implemented through a unified gateway to enable effective mission exploitation.

**The ESA-EUMETSAT cooperation on meteorological missions**

Let's turn to meteorology. The first successful transfer of scientific Earth Observation results into an operational system was set already three decades ago with the launch of the first Meteosat satellite. Meteorology was the forerunner and the model for an operational service; so much that nowadays it has become an integral part of the life of citizens around the world. The meteorological missions of ESA, in close cooperation with EUMETSAT, are an important pillar of our Earth observation programme. ESA's role is to develop the satellites and bring them into orbit, after which they are transferred to EUMETSAT. Meteosat is meanwhile operating in second generation, with two MSG satellites already in space and successfully working, two more waiting for launches in 2011 and 2015 respectively. The geostationary

network of f European meteorology satellites is complemented by the first European Polar System EPS. Metop, with its 800km polar orbit, carries a suite of European and American instruments. Metop A was launched in October 2006; one month ago it passed the in-orbit verification review and is now with EUMETSAT for operation. Again, two more satellites are waiting in storage for their subsequent launches in 2011 and 2015.

In fully operational systems you have to begin the work on the next generation of satellites when the actual one has become operational. We have therefore started, again in close cooperation with EUMETSAT, to define the third generation of the Meteosat systems. MTG, a three-axis stabilised satellite, will have four instruments most likely on two platforms, a clear evolution with respect to the current system. MTG will be one of the proposals for the coming ESA Ministerial Council end of 2008.

## III. WHERE WE WILL GO: GMES

Envisat will not live forever. Its specified life time has already expired and currently we estimate that as of 2010 we will not have enough fuel to continue nominal Envisat operations. At the same time, there is a growing demand for Earth Observation data. As the IPCC and Stern reports show to us, we need the best possible environmental information to enable correct decisions with regard to climate change. In global competition, only prepared societies and industries will be competitive on the markets. Europe wants to have independent access to data for decision making, but at the same time contributing to a global environmental monitoring system.

With GMES we are about to open a new chapter of Earth observation in Europe. GMES, the second flagship project of the cooperation between the European Union and ESA, will start its first services next year. The provision of Earth observation-based services to European administrations is indeed a new quality of long-term satellite applications in our domain. We try to achieve for operational environment and security applications what we reached 30 years ago for meteorology.

GMES has not started with satellites, however. For the past five years, EU and ESA have developed pilot services with more than 330 operational users to prepare the system. Those users had to report back about experiences and demands. ESA has undertaken, together with its partners, a thorough survey of missions covering the entire spectrum of observation needs. For the gaps found in this spectrum, we have defined new missions: the Sentinels. The Sentinels will range from SAR and superspectral imaging capacities to ocean and atmospheric monitoring capacities. They will provide data continuity as of 2012, leaving nevertheless a short gap after Envisat which we have to bridge. As important as the Sentinels are the contributing missions; missions of Member States and EUMETSAT, as well as commercial missions. Only through them we realise a synergetic and complete operational system in Europe.

Let me add another important thought: Even if GMES is an operational system, I am personally convinced that the scientific community will profit from the capacities, because science in and for this system is indispensable.

## IV. CONCLUSION

Ladies and gentlemen, after this “par force” ride across the ESA Earth Observation Programme, let me summarise some observations which I would like to share with you.

Earth Observation is the fastest growing space programme in Europe, and Europe has the most ambitious Earth Observation programme worldwide. Until 2015 not less than seventeen satellites are planned to be launched by ESA. More than ten thousand users all over the world are currently being provided with satellite data. The European Space Policy puts its emphasis on space applications; with GMES, we are close to lead another part of Earth Observation into operations, after having successfully demonstrated this transition with meteorology in Europe.

Envisat is a symbol for this success in many ways: It shows what can be achieved with common will and efforts. It reflects the complexity and variety of today’s scientific challenges. It proves the possibility to provide data for these challenges. It reminds that we have to keep and deepen its capacities, as demands are growing. Looking at the impressive statistics of the Envisat symposium we are opening today, it confirms that the imperative of Earth observation is well understood – and that we are prepared for the coming years.

Thank you.