7. Space applications after Copenhagen

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7.1. The challenges of a changing world

The vulnerability of society to climate extremes and their consequences, such as rising temperatures, floods, wildfires, etc., has become one of the highest priority issues on the political agenda of world leaders. It is one of the most discussed issues in global economic, social, scientific and political fora. Concern about climate change has now become part of public consciousness and dialogue.

This new dimension and awareness of the global environment and its challenges can be attributed to various factors. One of these is the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) where consensus at scientific level emerged on the fact that "warming of the climate system is unequivocal" and, moreover, that "most of the observed increase in global average temperature since the mid 20th century is likely due to the observed increase in anthropogenic greenhouse gas concentration".[778]

The rate at which global climate change is happening is the most pressing environmental challenge we face today. The consequences of global warming are far reaching, potentially affecting natural resources such as water and, consequently global food production and influencing the sea level and the rate and severity of natural hazards. In the last century mankind has driven greenhouse gases concentrations beyond the maximum reached during the last one million years. We have become responsible for 70% of the nitrogen and 95% of the phosphorus cycle on Earth and have reduced tropical forest areas by 50%.

To determine whether these recent human induced changes could ultimately destabilise the Earth ecosystem, the consequences of human activities have to be fully understood and quantified. Two issues are at stake: sustainability and biodiversity.

Human life draws heavily on the availability of natural resources: fresh water, food, clean air, building materials. In the interest of future generations we must secure ways to ensure that the functioning of our life support system and the ability of the ecosystems to deliver vital goods and services is maintained.

On the biodiversity side, we must ensure the future diversity of species on Earth and the richness of life for future generations. Human impact on the

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ecosystem at a regional level results in widely different patterns, such as deforestation, forest fires, fossil fuel burning, land-use management, use of fresh water, etc. Different local and regional phenomena and different types of regional management have to be considered; the sum of them has a major impact on what can be called the "System Earth".

For all these challenges there is a need at the international level to look for solutions and to monitor the scientific aspects. Space represents an important tool to support such actions.

In 2006, the Stern Review on the Economics of Climate Change, which was prepared for the British Government by the economist Nicolas Stern, was released. It analysed the effects on the world economy of climate change. The conclusions of the Stern Review show that the benefits of strong and early action on climate change considerably outweigh the costs.

It had been suggested that 1% of the annual global gross domestic product (GDP) would have to be invested in order to avoid the worst effects of climate change. In June 2008, Stern increased the estimate to 2% of GDP to account for a faster than expected rate of climate change.[779]

7.2. Copenhagen's accomplishments

The United Nations Climate Change Conference in Copenhagen in 2009 (COP 15) was, perhaps because of excessive expectations, believed to be the moment in history in which humanity would have the opportunity to rise to the challenge and take major decisions related to the climate change debate. Predecessor milestone gatherings were, inter alia, the Bali meeting in 2007 and the 1992 Parties of the UN Framework Convention on Climate Change, where it was agreed by members to launch negotiations in order to strengthen action taken against climate change.

The Copenhagen Climate Summit did not however result in the breakthrough that so many had hoped for. The outcome responded only partially to the high expectations before the Conference. Despite the pessimism of the press and the general feeling that COP 15 fell short of its aspired objectives, the Conference did however provide the world with clear signals that governments would like to see action against global climate change move forward. In addition, some important steps were indeed taken.

In a public Hearing on climate change in Brussels on 14 April 2010, Yvo de Boer, Executive Secretary of the United Nations Framework Convention on Climate Change, said that Copenhagen was an important event "as it raised

climate change policy where it belongs: [at] the highest political level … it advanced negotiations significantly on the infrastructure needed for well functioning global climate change cooperation. Lastly, COP 15 produced the Copenhagen Accord, which is a [statement of] political intent to constrain carbon and to respond to climate change".[780]

The Accord sets a two degrees Celsius temperature limit and includes provisions to review this goal by 2015. It also includes short term financing of 30 billion U.S. dollars with a balanced allocation between adaptation and mitigation planning for developing countries up to 2012.

Much of the credit for this partial success must go to rapidly developing countries like Brazil, China, Indonesia and South Africa. They produced plans to tackle these emissions and to have these plans internationally monitored and verified. For the first time in history there is [now] a voluntary partnership between North and South on climate change cooperation, backed by emission targets and intentions. More than one hundred countries have subscribed to the Copenhagen Accord. Thirty six developing countries have communicated information on their mitigation plans, either in economy wide terms or in specific actions.

Developed countries pledged 30 billion U.S. dollars of climate support to developing economies and said that those funds would possibly lead to 100 billion U.S. dollars by 2020. Although targets and actions by 2020 are insufficient, they represent a clear indication that the world wants to move towards an economic growth path that is more sustainable.

Possibly the best outcome of Copenhagen relates to forestry – up to 20% of global greenhouse gas emissions are linked to forestry. Paying developing countries to conserve rather than to cut down their forests could curb these emissions and generate important benefits to local and national economies. The United Nations Environment Programme (UNEP) and the UN Food and Agriculture Organisation (FAO) are carrying out a UN collaborative programme to reduce emissions from deforestation and forest degradation.

Despite some significant steps forward in terms of emissions, Copenhagen has left a gap between where science says emissions need to be in 2020 (to limit the temperature rise to 2 C or less in 2050) and where they stand today.

The next step is the Convention Meeting in Cancun in December 2010, where what remained incomplete in Copenhagen needs to be completed. Industrialised countries need to make firm commitments to take the lead in establishing legal means to achieve the emission reduction targets. In addition, a fully operational architecture needs to be agreed that makes it possible for developing countries to act on climate change in all key areas: adaptation, mitigation, finance, technology, forests and capacity building.

7.3. The contribution of space to climate

The mapping and understanding of climate change is a complex undertaking. It is essential to provide factual, objective evidence to contribute to the scientific models developed. From that point on, links have to be established to monitoring of the Environmental Conventions, to public debate and to concrete political action. Satellites in this respect deliver data related to environmental monitoring and climate change in a reliable way. Satellite data also helps to find ways to adapt to some of the consequences of climate change.

Satellite data has improved our ability to monitor and understand how atmospheric accumulations of greenhouse gases (GHGs) change over time. The ESA Envisat satellite has produced data on greenhouse gases, CO2 and methane, that detect the evolution of global warming. Data of this type are critical for establishing baselines by which to measure emission reduction programmes. Satellite instruments are also useful for checking CO2 emissions in the atmosphere produced by forest fires. Forest fires are relevant not only because they destroy forests, but also because they are a major cause of global air pollution.

In 1998, the El Nino phenomenon helped to create fires across Borneo that emitted 2.5 billion tonnes of CO2 into the atmosphere, equivalent to Europe's entire carbon emission for that year.

Satellites can also monitor glaciers. Glaciers are the most reliable indicator of climate change due to the major influence they have on water availability. They are thus of great interest to scientists. The ongoing intense political and public debate on how rapidly the Himalayan glaciers are retreating highlights the need to monitor glaciers worldwide.

Measurements from ESA's Envisat satellite have contributed to tackling changes in Greenland's glaciers. Tandem missions (of ESA's ERS-2 and Envisat Satellites) in 2008 and 2009 collected data over the Arctic and Antarctic that showed that polar glaciers are moving faster than previously expected.

Finally, in the field of forest carbon tracking Earth Observation data enables the use of archives of data to analyse the last three decades of forest dynamics. This is important in the context of the Group on Earth Observations (GEO), an international initiative started by several space agencies in order to coordinate the definition, development and validation of robust Earth Observation tools and methodologies to provide periodic evaluations of carbon storage in forests for further operational use.

Measurement of the global deforestation rate via satellite monitoring supports the implementation of the UNFCC/REDD (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries) initiative. In addition to missions that are already operational, such measurements will also be

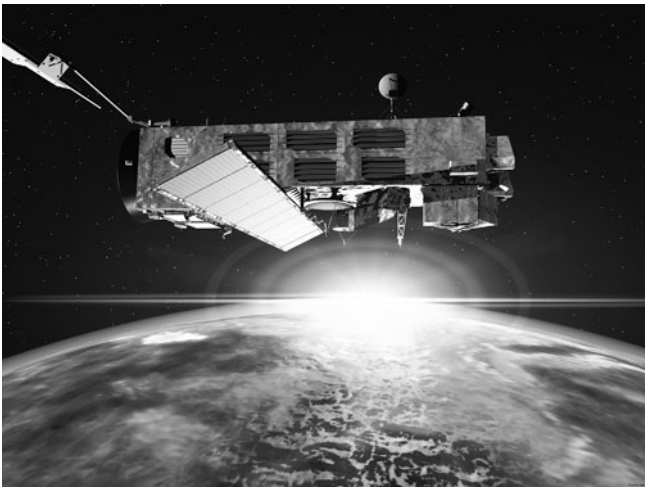

Fig. 8: *Artist's view of Envisat (source: ESA).*

taken in the future by the Sentinel-2 satellite mission currently under development by ESA in the context of the GMES Programme (Global Monitoring for Environment and Security).

In addition, satellite observations have the advantage of going across political borders. The importance of global satellite observations for understanding climate change has also been recognised at an international level.

In the context of the United Nations Framework Convention on Climate Change (UNFCC) and the International Panel of Climate Change (IPCC), the Global Observing System (GCOS) has defined a set of Essential Climate Variables (ECVs) that will be systematically monitored, in order to quantify the state of our climate in an objective and effective way.

The Global Climate Observing System (GCOS) was established in 1992 to ensure that the high quality observations needed to address climate change related issues are obtained and made available to all users. GCOS defined a set of forty-four ECVs.[781] Twenty-five of these variables can be measured by space sensors and can therefore receive major contributions from satellites. Datasets, including historical earth observation data from archives, are essential for measuring key parameters of climate change such as greenhouse gases concentrations, sea ice extent and thickness, sea surface temperature and ocean salinity. The IPCC mentions that "Scientific evidence for warming of the climate system is unequivocal".[782]

Satellites provide key data to the scientific community to improve understanding of the Earth System, detect trends in climate and environment parameters and

help to predict the future climate. At the same time, data from satellites support decision makers in the implementation of relevant environmental policies and in the definition of strategies to adapt and mitigate the effects of climate change.

In 2006, the Committee on Earth Observation Satellites (CEOS) that is the primary international forum for coordination of Earth Observation space based systems provided a coordinated response by space agencies to the data needs expressed through GCOS, identifying more than fifty actions to be performed by space agencies all over the world. In this context ESA made the commitment to contribute to the implementation plan of GCOS.

In this context, in 2008 the European Space Agency initiated "The Climate Change Initiative" (CCI), which aims to systematically generate, preserve and provide access to long term datasets to support the requirements of GCOS in the field of Essential Climate Variables.

The ESA Climate Change Initiative includes recalibration, periodic reprocessing, algorithm development, product generation and validation, and quality assessment of climate records in the context of climate models.

This response by ESA is coordinated with other key partners at the European level such as the European Commission, Eumetsat and the European Centre for Medium range Weather Forecasting (ECMWF). ESA is also contributing to an international effort to coordinate the work of space agencies with respect to climate change in the CEOS context that includes all major space agencies worldwide. This recently set up coordination mechanism on climate change will ensure that activities in this field are carried out coherently, guarantee the best use of the data, and ensure that the best rationalisation of available and planned satellite resources is achieved.

ESA is also cooperating closely with its Member States, using its best resources in the academic field, research institutes and industry to contribute to the programme and is also discussing bilateral collaboration with international partners in this field, such as NASA and NOAA, which have recently initiated a new Climate Services Activity.

ESA recently agreed to retrofit its data policy for Envisat and ERS-2, in order to grant open and free access to data. For the GMES Missions, called Sentinels, a similar data policy was recently agreed by ESA Member States. It should be approved by the European Union by the end of 2010.

A free and open data policy at the European level, similar to the one set up in the United States, has strong relevance for climate change activities. Earth observation data can in fact be used more widely to support environmental climate actions in this context.

On 18 December 2009 in Copenhagen, U.S. President Obama said "The problem actually is not going to be verification in the sense that this international

consultation and analysis mechanism will actually tell us a lot of what we need to know and the truth is that we can actually monitor a lot of what takes place through satellite imagery and so forth. So I think we're going to have a pretty good sense of what countries are doing".[783]

The intervention by President Obama confirms the fact that politics and science are not two separate domains, especially in the climate change debate. This U.S. approach was recently confirmed by the New U.S. Space Policy issued on 28 June 2010.[784] This Policy reflects the 21st century's globalisation of space activities and calls for the expansion of international cooperation, including in the field of climate change. The US government intends to promote policies internationally that will facilitate full, open and timely access to government environment data, while at the same time accelerating the development of new Earth observation missions.

Space can contribute to climate monitoring for assessing and predicting climate change: this can be achieved through systematic observations and, as climate is a global phenomenon, the information required should be of a global scale. Furthermore, as was previously mentioned, space is also essential for the monitoring of emissions mitigation and adaptation procedures; this can be achieved through focussed observations of aspects of local environments in order to gather evidence of the implementation of adopted policies, or of the failure to do so.

7.4. The role of the European Union

Climate change has been a flagship policy of the European Union for a long time, and certainly an area where Europe has acquired a leadership role since 2001 when the United States withdrew from the Kyoto protocol. Europe has in fact imposed itself on the international scene as a "champion" of the fight against climate change.

With the adoption of the "climate – energy" deal in December 2008, Europe committed itself to reducing its gas emissions by 20% by 2020. It also promised to increase such efforts to 30% in view of the Copenhagen summit, provided that an agreement could be reached at COP 15, which unfortunately was not the case.

The new EU climate change policy will be consistent with the so called Europe 2020 strategy of making the EU more competitive. For example, the 2020 strategy seeks to "establish a vision of structural and technological changes required to move to a low carbon, resource efficient economy by 2050".[785]

The linking of EU climate change policy together with other EU policies is important, first because climate change must be embedded in the overall EU strategic approach and secondly because climate change has become an element of the EU's industrialisation and competitiveness strategy. In this respect, EU climate policy is also linked to its energy strategy.

In an intervention at the European Parliament on 10 February 2010, the President of the European Commission José Manuel Barroso mentioned that it is "necessary to build a new economic model based on [a] knowledge and innovation based economy, carbon emissions and high level of employment".

The most convincing sign of leadership the EU could show would be to implement concrete and determined actions towards becoming the most "climate friendly" region of the world. The Europe 2020 strategy has put together "greener" economic growth at the heart of the Union's vision for a resource efficient future Europe that will create new jobs and boost energy security.

Since COP 15, the European Union has taken a number of actions. In March 2010, it approved a post Copenhagen communication[786] and in April 2010 a staff working document on innovative financial tools,[787] as well as a communication on the assessment of costs and options for raising the 2020 GHG emission target from a 20% to a 30% reduction rate[788] were [prepared] [released].

The European Spring Council (25-26 March 2010) agreed on a stepwise approach for setting a Roadmap in Bonn in order to take negotiations forward and arrive at concrete decisions in Cancun.

The European Union retains the ambition of a legally binding agreement, but it has re-examined its overall strategy in post Copenhagen negotiations and the 2020 package of measures in energy and climate change. It has determined as its final objective the COP-17 in South Africa, scheduled to take place at the end of 2011.

7.5. Towards Mexico

A major goal for the Cancun Meeting at the end of 2010 will be to acknowledge the improvement of mechanisms and the new carbon market as a means to generate financial flows to developing countries.

Commitments of a legal nature are needed from industrialised countries in order to capture the emission reduction targets and to meet needs in the areas of adaptation, mitigation, finance and capacity building.

Some of the key remaining issues to be resolved are the need to build a robust and transparent emissions and performance accounting framework and to secure its long term funding.

Fig. 9: *The Copenhagen Summit (source: The Guardian).*

The medium-term goal is to achieve a balanced set of concrete action-oriented decisions in Cancun and to continue work on reaching a legally binding agreement in the South Africa summit, in 2011.

[778] IPCC 4th Assessment Report (2007). www.ipcc.ch/publicationsanddata/publications and datareports.htm.
[779] Stern Review on the Economics of Climate Change, 700 pages by Nicolas Stern, 30 October 2006.
[780] Public Hearing on Climate Change, Brussels, 14 April 2010 Address by Yvo de Boer, Executive Secretary, United Nations Framework Convention on Climate Change (pages 1–5).
[781] http://www.wmo.int/pages/prog/GCOS/index/php.
[782] IPCC 4th assessment Report (See footnote I).
[783] The White House, Office of the Press Secretary, Remarks by the President during press availability in Copenhagen Bella Centre, Copenhagen, Denmark, 18 December 2009.
[784] The National Space policy of the United States of America. 28, June 2010, 8 pages, The White House.
[785] See flagship initiative on "Resource Efficient Europe" in European Commission, Europe 2010. A strategy for smart sustainable and inclusive growth. Communication from the Commission COM (2010) 2020 final of 03 March 2010. Brussels: European Union.
[786] European Commission, International Climate policy post Copenhagen; Acting now to reintegrate global actions on climate chance – SEC (2010) 261 of 09 March 2010. Brussels: European Union.
[787] European Commission, Innovative Financing at global level, Commission Staff Working Document – SEC (2010) 409 final of 01 April 2010. Brussels: European Union.
[788] European Commission, Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage concentration for the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM (2010) 265 final of 26 May 2010. Brussels: European Union.