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Report to the UNFCCC on European Community actions regarding global
climate observing systems

1. COMMON ISSUES

Over the past few decades, Europe has built up considerable experience and technical know-how in the design, production and operation of Earth observing tools. Now, the ad-hoc Group on Earth Observations (GEO), with strong political backing from governments and support from around the world, is working towards an unprecedented level of coordination and harmonisation of Earth Observation Systems at global level, aimed at the creation of the Global Earth Observation System of Systems (GEOSS). On 16 February 2005, over 50 countries and 40 international and scientific organisations signed up to create the GEOSS, at a summit hosted by the European Commission in Brussels.

GEO was launched in response to calls for action by the 2002 World Summit on Sustainable Development and by the G8 (Group of Eight) leading industrialized countries. These high-level meetings recognized that international collaboration is essential for exploiting the growing potential of Earth observations to support decision making in an increasingly complex and environmentally stressed world.

GEO is a voluntary partnership of governments and international organizations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. As of July 2008, GEO's Members include 74 Governments and the European Commission. In addition, 51 intergovernmental, international, and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations.

The strong support of EU in the GEO Committees is sustained by an active involvement in all the four committees. The European Union is also supporting the financial activities of the GEO Secretariat (600,000 EUR for 2008).

The GEOSS will bring together all available information on the state of the global environment, consolidating existing data from disparate sources. Responding to socioeconomic needs, it will facilitate the provision of relevant and meaningful environmental information to policy-makers and the scientific community, improving the decision-making process. During its ten-year implementation period, GEOSS will also provide new impetus for research on earth observation systems and services.

Significant resources of the current EU Framework Programmes FP6 and FP7 (which started in 2007), are devoted to research on Earth observation, and are therefore related to GEO and GEOSS activities. With the issue of the 2009 call for proposals of the FP7 Cooperation Work Programme for the Environment Theme, the EC intends to strengthen the commitment in GEO activities. The 2007 FP7 call covered all Social Benefit Areas foreseen in GEOSS 10-Year implementation plan, while the 2008 call was released with the objective of starting building the Initial GEOSS Common Infrastructure. Now, is time to integrate European activities into GEO. Research and developing activities for the Kopernikus initiative (formerly known as GMES - Global Monitoring for Environment and Security) will play a key role in furthering Earth observation activities, as the main contribution of the EU to GEO. A legal basis for Kopernikus will be presented in 2009 based on a partnership of the relevant European actors including the European Commission, ESA and participating European states.

Research and developing activities for the Global Monitoring for Environment and Security (GMES) initiative (to be renamed "Kopernikus" shortly) will play a key role in furthering Earth

observation activities, as the main contribution of the EU to GEO. Strong co-operation with both the EU's Member States and a range of other countries and organisations around the world will continue to be an important part of the programme.

In terms of direct participation in Global Climate Observation systems, the main responsibility lies with individual EU Member States, although sometimes individual stations will be part of EU actions outside Europe to realize Europe's global responsibility (mainly Africa, the Arctic and the oceans).

1.1. Description of national programmes/actions to introduce and/or enhance national coordination

Under its Kopernikus initiative, the European Community is putting in place operational services that aim to produce long time, consistent data sets for climate derived from observations and their reanalysis. These services will necessitate a sustainable infrastructure regarding both the relevant in situ as well as satellite observations. A European Commission communication outlining the programmatic approach is foreseen for November 2008.

The Kopernikus services are currently being developed as large R&D projects under the EU's 6th (FP6) and 7th framework programmes (FP7) (e.g., MERSEA, GEOLAND, GEMS) that seek to involve existing capacities in Europe and promote their cooperation. Truly operational services are expected to be available from 2011-14 onwards.

The Kopernikus services are arranged on the basis of earth components, namely land, ocean ("marine") and atmosphere. Climate is a cross-cutting theme for these services: Currently, ECVs are included in the scope of the marine and atmosphere services and will be addressed in the course of a global service development for the land monitoring service:

The atmosphere service addresses the themes climate forcing, air quality and UV radiation and will inter alia seek to assure the delivery of data services related to greenhouse gases, reactive gases and aerosols based on a global and a European ensemble model. A primary focus will be to provide information in areas where little or none is available today, e.g., on gridded fields for atmospheric composition.

The marine service provides better information on the 3D state and dynamics of the global ocean through observational data sets reanalysed in state of the art models. It will seek to establish an accurate long-term record of the ocean for climate purposes.

The global component of the land service will strive to provide information on terrestrial ECVs, natural CO₂ stock and budget as well as – together with the atmosphere services- fire impact due to burned biomass.

Across all Kopernikus Earth compartments reanalysis efforts are planned that will help to address problems of inhomogeneity and provide consistent time series of climate observations. The GCOS monitoring principles will be respected in Kopernikus monitoring activities.

The Kopernikus governance is in the process of being developed. The aim of Kopernikus is therefore to coordinate and sometimes consolidate European efforts for Earth observation both in space and with in situ infrastructures in Europe, also with regard to the participation in the international arena.

The Kopernikus services are financed by public funds and their outputs will be considered as public goods. For this reason, the data policy for the Kopernikus services will be based on the principle of full and open access. Kopernikus is a major EU contribution to GEO/GEOSS and will therefore also be compatible with GEO data sharing principles.

The Kopernikus observation infrastructure will draw upon existing capacities in Europe. For space observations, these include research and operational missions provided by ESA, EUMETSAT as well as the EU Member States. National missions are outlined in the reports submitted by Member States.

EUMETSAT is making a significant contribution to operational climate variable monitoring (the Meteosat programme (MSG; MTG), the EUMETSAT Polar Satellites (EPS) with for example, the IASI, GOME-2 and GRAS instruments (post EPS is in phase-0), cooperation on Jason altimetry missions). For operational retrieval of geophysical parameters from satellite data, EUMETSAT operates several satellite application facilities (SAFs), e.g., Climate Monitoring SAF, Ocean and Sea Ice SAF, Land Surface Analysis SAF, Ozone SAF, etc. EUMETSAT will report its contribution to GCOS ECVs in detail separately and via the national report to be submitted by Germany.

Similarly to EUMETSAT, ESA will report its detailed contribution via the CEOS report. Besides ESA R&D satellites (e.g., ENVISAT), ESA is developing dedicated missions for the purpose of GMES/Kopernikus: the Sentinels 1 to 5, which are partially financed through the EC's FP7. Sentinel missions are devised on the basis of user requirements and scope of the Kopernikus services, including global monitoring of climate variables.

With regard to (climate-relevant) in situ data required by Kopernikus, the services will rely on data observed by public bodies in the EU Member States, at the moment often obtained in the frame of research activities or as contributions to international networks, and data exchange in the frame of international networks e.g., through the GEOSS. To consolidate the European efforts for the purpose of operational services, the EU will be mainly focused on a better coordination within Europe, on the filling of existing gaps in observation capacities as well as encouraging a transfer of priority networks to operational status.

1.2. Planning activities for the production and adoption of national implementation plans for observing, archiving and analysing the European Community's national contribution of observations of the ECVs

For a future operational Kopernikus program, planning activities will have to address which observation infrastructures will receive support from European Union resources. The criteria will depend on the available resources. Kopernikus operational costs are to be evaluated in the period 2009-2010.

1.3. Ways to ensure that high-quality climate data records are collected, retained and made accessible for use by current and future generations of scientists and decision-makers.

1.3.1. National policy or guidance relevant to the exchange of ECV data

INSPIRE

The implementation of the INSPIRE Directive (Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)¹ will improve the access and the pan-European harmonization for spatial environmental data. The directive addresses the environmentally relevant data with a spatial reference and aims to make publicly held data interoperable and ease the access to this data. Climate-relevant data such as "atmospheric conditions", "meteorological geographical features", "oceanographic geographical features", "land cover" etc. are explicitly included in the scope of the Directive and reference in the Annexes. INSPIRE envisages a European Spatial Information Infrastructure allowing users to identify and access spatial or geographical information from a wide range of sources, from the local level to the global level, in an interoperable way for a variety of uses.

SEIS (Shared Environmental Information System)

The SEIS communication (Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions Towards a Shared Environmental Information System, COM(2008) 46 final, Brussels, 1.2.2008) will improve the availability of environmental data as provided by the Member States, regional and local authorities, and EU bodies. The SEIS Communication underlines the EU's intention to come forward with legal proposals to set up an information system based on ICT technology providing decision-makers, and in a second step the citizen, with real-time environmental data. SEIS should enable the principle that data is collected once and used many times and replace the currently fragmented systems in Europe with a shared decentralised system open to all.

Revision of Reporting Directive

The European directive of "Reuse of Public Sector Information" Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information addresses the existing barriers in Member State legislations.

European Environment Agency (EEA) and the European Environment Information and Observation Network (EIONET)

EEA and the EIONET are monitoring, holding and providing environmental information according to the reporting obligations of the EU (e.g., air, water quality, biodiversity) and voluntary data flows as agreed with member countries (e.g., CORINE land cover data). Data are either freely available or restricted in access in line with the data policies of the member countries².

1.3.2. Policy-level barriers to the international exchange of climate data and their provision to international data centres

Research observation networks funded under the 5th and 6th EU framework programmes did not have an obligation to release data beyond the project consortia. Data availability was hence often compromised, especially with regard to NRT access.

¹ <http://inspire.jrc.it/>

² <http://eea.europa.eu>; <http://dataservice.eea.europa.eu/dataservice/>; <http://www.eionet.europa.eu/>

The INSPIRE directive does not affect the IPR of data owners and charging for data is permitted. However, the latter must not present an obstacle to data sharing.

1.3.3. Efforts undertaken to ensure that ECV-observing activities adhere to the GCOS climate monitoring principles

Under the Kopernikus initiative, satellite missions are being developed to meet the continuity demand for space based observations in the atmospheric, oceanic and terrestrial domains. The missions involve repeat launches of instruments and to ensure continuity to the extent possible with earlier missions such as that of ENVISAT.

For aerosol properties ECV, the surface based observation capacity for optical depth measurements is rather heterogeneous, while dominated by the NASA sponsored AERONET and partner networks such as PHOTONS in Europe. GAW has therefore put in place a network of precision sunphotometers, co-ordinated by the Physikalisch-Meteorologisches Observatorium Davos World Radiation Center (PMOD-WRC) with the data disseminated by the GAW World Data Centre for Aerosol of DG JRC³. This network of 15 instruments are strategically co-located with instruments from other networks (AERONET, SKYnet, BSRN and individual national networks) in order to provide reference observations to allow the comparison and use of AOD observations from multiple sources, integrating the networks into a single ‘network of networks’ with much improved global coverage.

1.3.4. Difficulties encountered in protecting the integrity of long-term climate data records and steps being taken or required to address those difficulties

ESA and EUMETSAT will report separately on the data records they have built up over the years (see report submitted by CEOS and Germany, respectively).

1.4. Efforts undertaken to ensure that international data centres are established and/or strengthened for all the ECVs (see appendix 4).

All envisaged Kopernikus services target ECVs and the main service is providing NRT or historical data to users.

Further, the FP7 project NESIS attempts to promote the uptake of ICT solutions by public authorities in providing information for the monitoring and reporting of environmental impacts and threats. The running of data centres should then be technologically a simpler task.

1.4.1. Actions undertaken to “establish sustainable systems for the routine and regular analysis of the ECVs ... including measures of uncertainty” (C12)

Kopernikus services for marine and atmosphere use modelling as the production systems for its services. In this service chain the analysis of ECV observations is inherent. Furthermore, multiple modelling systems are combined to form ensemble products to evaluate the uncertainty of atmospheric services. Uncertainty estimates for product quality are required from all Kopernikus services.

³ <http://wdca.jrc.it/>

1.4.2. Steps taken to “establish a sustained capacity for global climate reanalysis and ensure coordination and collaboration between reanalysis centres” (C13)

The development of a sustained Kopernikus Atmospheric Service will provide reanalysis of the greenhouse-gas, aerosol, ozone and surface radiation ECVs, plus consistent reanalysis of the associated meteorological ECVs and some ocean and land ECVs. A first set of reanalysis is being provided by the EC FP6 project GEMS for the period from 2003 onwards.

1.5. Capacity-building activities in least developed countries, small island developing States and countries with economies in transition related to the collection, exchange and/or use of observations of the ECVs, including implementation of the regional action plans developed from the GCOS regional workshop programme.

The provision of key information on the environment is an essential element for policy makers in developing countries to base their decision upon. Therefore, the European Commission in collaboration with EUMETSAT has been supporting two initiatives in this domain:

PUMA Preparation for the Use of Meteosat Second Generation in Africa

The **PUMA** project assists a network of sub-Saharan African countries with equipment for meteorological purposes with the objective of using the EUMETSAT data for weather forecasting (also estimates of rainfall, real-time observation of fires and measurement of sea surface). The project has been executed with the assistance of the JRC-ISPRA. This project has been finalised in 2006. Financing was 11M€ from the EDF8.

AMESD African Monitoring of the Environment for Sustainable Development

AMESD is the follow-up to PUMA and introduces other applications such as land use, soil damage and desertification, deforestation, fresh water resources, agricultural production, prevention and attenuation of the effects of natural disasters. AMESD is being considered as the African component of the European GMES programme and of GEOSS. The AUC has the lead in this project. Financing 21M€ from the 9th EDF.

Following the positive results of PUMA and AMESD, the AUC, the ACP-SEC, the African RECs and the WMO, endorsed the **Maputo Declaration** in which the signatories request: 1) the extension of the European Kopernikus programme to Africa, and 2) the financing of this GMES-Africa by the EDF10. On 6-7 December 2007, the Portuguese Presidency provided an answer to this Maputo Declaration with the conference: **Space for Development: the case of GMES and Africa**. The conference tabled a common EU-AU **Lisbon GMES Declaration** and has started the **Lisbon GMES Process**, which ought to provide by January 2010 an overview of the African Earth Observation demands and the EU answer to these requests. In the course of Spring 2008, DG JRC, the Kopernikus-bureau and DG Development have been working on terms of reference for the drafting of an action plan on Kopernikus and Africa Partnership.

A further project on capacity building as regards Earth observation systems is CarboAfrica.

CARBOAFRICA: Quantification, understanding and prediction of carbon cycle, and other GHG gases, in Sub-Saharan Africa (Project Total Cost: 3.808.758 €, EU Contribution: 2.810.044 €)

The CARBOAFRICA network contributes to the enhancement of an Earth observation system, strengthening the capacity to understand global change process. The scientific and technological

results, in addition to the capacity building activities foreseen by this project, will promote the integration of the environmental dimension in the social and economic context, supporting Sub-Saharan African countries on the path of a sustainable development.

The FP7 projects AMFIC (Air quality monitoring and forecasting in China), DRAGONESS (DRAGON in support of harmonizing European and Chinese marine monitoring for Environment and Security System), MONRUK (Monitoring the marine environment in Russia, Ukraine and Kazakhstan using satellite synthetic aperture radar) and VGT4-Africa (Distribution of vegetation data in Africa through EUMETCAST) all address the international cooperation with transition and developing countries and include some climate-relevant parameters.

1.5.1. Activities undertaken through multilateral and/or bilateral technical cooperation programmes, including participation in the GCOS cooperation.

The European Commission has taken part in the GCOS cooperation mechanism Donor Board meeting in 2008.

1.6. Report from multinational and international projects and organizations conducting climate observations.

The following multi-national bodies are heavily involved in GMES. Their contribution to climate monitoring is reported as follows:

- ECMWF will report its meteorological climate reanalysis activities via the UK national report.
- The ESA contribution (GMES Sentinels) through the CEOS report.
- The EUMETSAT contribution (missions, SAFs) should be submitted via the German national Report.

2. ATMOSPHERIC ESSENTIAL CLIMATE VARIABLES

2.1. Contributions of the atmospheric ECV observations to the international community

The main contribution of the EC in this area relates to the WMO sponsored Global Atmosphere Watch Network. The Joint Research Centre of the EU hosts the GAW World Data Centre for aerosols (<http://wdca.jrc.it/>). The GAW is seen as the core of the GCOS system for the atmospheric composition ECVs including “Aerosol Properties”. The GAW aerosol program prescribes five core measurements: multi-wavelength optical depth; mass in two size fractions; major chemical components in two size fractions; light scattering coefficient and light absorption coefficient to be made at all stations, with measurements of additional aerosol properties recommended for key ‘global’ stations.

Within Europe the activities of the EMEP measurement network and that of the GAW aerosol network are well coordinated, such that the EMEP level 2 and level 3 sites and the stations contributing to the in-situ aerosol measurements of GAW are one and the same. Starting from the FP5 project DAEDALUS (EVK2-CT-2002-00174) and continuing under the ongoing FP6 project EUSAAR (R113-CT-2006-026140) considerable progress has been made in the harmonization and integration of the measurements, data reporting and data quality analysis. Since late 2007 a much simplified data submission protocol has functioned with data being sent first to the EMEP chemical coordinating centre⁴ and from there on to the GAW data centre.

As described in 1.3.3, GAW has put in place a network of precision sunphotometers, coordinated by the Physikalisch-Metrologisches Observatorium Davos World Radiation Center (PMOD-WRC) with the data disseminated by the GAW World Data Centre for Aerosol of DG JRC⁵. This network of 15 instruments are strategically co-located with instruments from other networks (AERONET, SKYnet, BSRN and individual national networks) in order to provide reference observations to allow the comparison and use of AOD observations from multiple sources, integrating the networks into a single ‘network of networks’ with much improved global coverage.

EARLINET (European Aerosol Research Lidar Network to Establish an Aerosol Climatology) was funded by the Commission to build a comprehensive statistical database of the distribution of aerosols across the European continent.

The goals of the CREATE and DAEDALUS projects were to advise on the optimum use of aerosol in-situ, ground-based and satellite remote sensing data to:

- deliver data and information to the users;
- make proposals for aerosol monitoring as part of the European capacity;
- be established for Kopernikus; and
- develop the methodologies necessary for delivering operational aerosol products.

⁴ <http://www.nilu.no/projects/ccc/>

⁵ <http://wdca.jrc.it/>

On-going action is the Preparation for the Use of Meteosat Second generation satellite products in Africa (PUMA).

GEOMON Global Earth Observation and Monitoring (Project Total Cost: 10.450.650 € EU Contribution: 6.621.740 €)

The overall goal of the GEOMON project is to sustain and analyze European ground-based observations of atmospheric composition, complementary with satellite measurements, in order to quantify and understand the ongoing changes. GEOMON is a first step to build a future integrated pan-European Atmospheric Observing System dealing with systematic observations of long-lived greenhouse gases, reactive gases, aerosols, and stratospheric ozone. This will lay the foundations for a European contribution to GEOSS and optimize the European strategy of environmental monitoring in the field of atmospheric composition observations.

ICOS Integrated Carbon Observation System (Project Total Cost: 5.696.669 € EU Contribution: 4.299.996 €)

The ICOS project will build an infrastructure for co-ordinated, integrated, long-term high-quality observational data of the greenhouse balance of Europe and of adjacent key regions of Siberia and Africa. Consisting of a centre for co-ordination, calibration and data in conjunction with networks of atmospheric and ecosystem observations, ICOS is designed to create the scientific backbone for a better understanding and quantification of greenhouse gas sources and sinks and their feedback with climate change. The overarching objectives of ICOS are: To provide the long-term observations required to improve understanding of the present state and future behaviour of the global carbon cycle and greenhouse gas emissions, and the factors that control the changing atmospheric composition in greenhouse gases. To monitor and assess the effectiveness of carbon sequestration and/or greenhouse gases emission reduction activities on global atmospheric composition levels, including attribution of sources and sinks by region and sector at atmospheric and ecosystem level. These objectives will be achieved by: Establishing a central facility, the ICOS-centre, which is responsible for co-ordination, calibration and data handling. Maintaining a co-ordinated, integrated, long-term high-quality network of atmospheric and ecosystem observations. Improving access to existing and future atmospheric and ecosystem data for research, and for political decisions. Improving access to state-of-the-art facilities for ecosystem measurements for the European research community. Providing European terrestrial ground-truth data for the validation of emerging remotely sensed datasets on atmospheric composition and land cover as provided e.g. by GMES. Contributing the European share to a global greenhouse gas observation network under IGCO and UNFCCC.

COCOS Coordination Action Carbon Observation System (Project Total Cost: 1.898.428 € EU Contribution: 1.337.926€)

COCOS will assess the status of harmonization of key carbon cycle variables with international partners. It will improve the interoperability of data sets that are used in global scale carbon cycle studies through joint activities between ecosystem, atmospheric and ocean bottom-up and top down observation communities. COCOS will also perform integrated regional-scale multiple constraint assessments of the land and ocean carbon balance through the use of harmonized data sets. It will identify, narrow down uncertainties and decrease differences in emerging global data sets that are aimed at providing constraints on the vulnerability of the global carbon cycle. COCOS will thus contribute to the implementation and improvement of global observing

systems. It will organize a large international conference to demonstrate the status and way ahead of global carbon observations in light of monitoring requirements for GEO and the implementation of future climate change mitigation commitments. As such, it will contribute to an effective monitoring of the carbon cycle at global level as recommended by GEO and GCOS in supporting the European participation to an international CO₂ research monitoring project. The research and harmonization work developed in this proposal will contribute significantly to building an integrated global approach that promotes close collaboration with the international carbon cycle research community.

IMECC Infrastructure for Measurement of the European Carbon Cycle (Project Total Cost: 8.874.597 € EU Contribution: 6.729.300 €)

The IMECC project aims to build the infrastructure for a coordinated, calibrated, integrated and accessible dataset for characterizing the function of the European terrestrial biosphere. Such an infrastructure is necessary since the critical measurements are spatially dispersed. Their interpretation, however, relies on precise knowledge of the spatial and temporal structures of measured quantities. Thus the measurements must be of the highest quality and precisely calibrated in order to be useful. They should also be well planned, that is subject to some coordinated and targeted experimental design and should be accessible to a wide range of researchers. IMECC will deliver these services to the range of measurements within various European projects. As an added benefit, the improved measurements will also be increasingly compatible with the range of global measurements. IMECC will not only provide these services for the life of the project but will aid the development of strategies and techniques to streamline this coordination into the future.

AirBase is the public air quality database system of the EEA and its network EIONET. It contains QA/QC checked air quality monitoring data and information submitted by the participating countries throughout Europe (SO₂, TSP, PM₁₀, PM_{2.5}, black smoke, O₃, NO₂, NO_x, CO, Pb, Hg, Cd, Ni, As, Benzene)⁶. The database covers geographically all countries from the European Union (Council Decision 97/101/EC), the EEA member and other cooperating countries.

Ozone web: Ozone web provides hourly near-real-time information on ozone pollution across Europe by interpolating data from more than 700 air quality measurement stations across Europe delivered by EIONET members⁷.

Annual inventories of greenhouse gas emissions and removals

Greenhouse gas emission and removal data: Annual data and reports based on data submitted by EU member states under the EU Monitoring Mechanism/ UNFCCC - Council Decision 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol and EEA member countries under UNFCCC and/or Kyoto Protocol (CO₂, CH₄, N₂O, HFCs, PFCs, SF₆)⁸.

⁶ <http://www.eea.europa.eu/themes/air/airbase>

⁷ <http://www.eea.europa.eu/maps/ozone/welcome>

⁸ <http://dataservice.eea.europa.eu/pivotapp/pivot.aspx?pivotid=455;>

http://reports.eea.europa.eu/technical_report_2008_6/en; <http://www.eea.europa.eu/themes/climate/eea-activities>

European Pollutant Emission Register (EPER)⁹ gives access to the annual emissions of approx. 9,200 industrial facilities in the 15 Member States of the EU as well as Norway and Hungary mostly for the year 2001 and approx. 12,000 facilities in the 25 Member States of the EU and Norway for the year 2004. EPER currently covers 50 substances and 56 sectors (GhG and non-GhG). It will be replaced by the E-PRTR (Regulation (EC) No 166/2006 and Council Directives 91/689/EEC and 96/61/EC). The E-PRTR will cover more than 91 substances emitted from 65 sectors of activity. The E-PRTR is due to be published in the autumn of 2009 and will include data updated annually from 2007 onwards.

2.2. Atmospheric elements of the GCOS implementation plan that are less quantifiable, suggested changes and improvements to the climate observing system

While the priority parameter for the aerosol properties has been Aerosol Optical Depth, the importance of high quality in-situ observations of aerosol composition and the optical properties cannot be ignored. The AEROCOM global aerosol model intercomparison (Kinne et al., 2006) found that an ensemble of state of the art models were calculating widely varying fractions (28-79%) of the total global annual average Aerosol Optical Depth due to water vapor associated with the aerosol. This large uncertainty makes difficult to use models to evaluate the impact of anthropogenic aerosol precursor emissions. Concurrent in-situ observations of aerosol composition and optical properties under controlled humidity conditions, together with observation of aerosol hygroscopic growth rates, such as those made within the EUSAAR network, together provide the observational base to reduce these uncertainties. EUSAAR is partly funding the operation of 20 stations of which 6 are GAW stations.

2.3. Plans to ensure availability of past and future data and metadata records of the satellite measurements for the atmospheric ECVs and associated global products contained in table

The EC is promoting the development of a sustained Kopernikus Atmospheric Service which will provide reanalyses of the greenhouse-gas, aerosol, ozone and surface radiation ECVs, plus consistent reanalyses of the associated meteorological ECVs and some ocean and land ECVs. A first set of reanalyses is being provided by the EC FP6 project GEMS for the period from 2003 onwards.¹⁰ In addition to the reanalyses themselves, a number of climate data records based on satellite data retrievals for the composition ECVs are being developed in the EC FP6 project GEMS and the ESA GMES Service Element project PROMOTE. These activities will most likely continue in the EC FP7 project MACC, which provides the pilot core Kopernikus Atmospheric Service.

⁹ <http://eper.eea.europa.eu/eper/flashmap.asp>
¹⁰ gems.ecmwf.int/

3. OCEANIC ESSENTIAL CLIMATE VARIABLES

3.1. National contributions of oceanographic ECV observations to the international community

Euro-Argo

The EURO-ARGO array is the European component of a world wide in situ global ocean observing system, based on autonomous profiling floats. It is estimated that some 3,000 floats are required to reach this objective. The floats are battery powered, so about 800 floats must be deployed per year to maintain the target array. About 250 of these are targeted as a sustained European contribution to the global network.

The data are transmitted in real time by satellite to data centres for processing, management, and distribution. The EURO-ARGO objective is to provide a sustained European contribution to the international ARGO programme. An estimated 6.3 million € per year are required for this.

THOR Thermohaline Overturning - at Risk?

THOR will establish an operational system that will monitor and forecast the development of the North Atlantic THC on decadal time scales and assess its stability and the risk of a breakdown in a changing climate. Together with pre-existing data sets, ongoing observations within the project will allow precise quantitative monitoring of the Atlantic THC and its sources. This will, for the first time, allow an assessment of the strength of the Atlantic THC and its sources in a consistent manner and will provide early identification of any systematic changes in the THC that might occur. The project will contribute to GMES/Kopernikus, to Global Observing Systems such as the GOOS, and to the International Polar Year (IPY).

Ice2sea - estimating the future contribution of continental ice to sea-level rise

The melting of continental ice (glaciers, ice caps and ice sheets) is a substantial source of current sea-level rise, and one that is accelerating more rapidly than was predicted even a few years ago. Indeed, the most recent report from Intergovernmental Panel on Climate Change highlighted that the uncertainty in projections of future sea-level rise is dominated by uncertainty concerning continental ice, and that understanding of the key processes that will lead to loss of continental ice must be improved before reliable projections of sea-level rise can be produced. The ice2sea programme will draw together European and international partners, to reduce these uncertainties. We will undertake targeted studies of key processes in mountain glacier systems and ice caps (e.g. Svalbard), and in ice sheets in both polar regions (Greenland and Antarctica) to improve understanding of how these systems will respond to future climate change. We will improve satellite determinations of continental ice mass, and provide much-needed datasets for testing glacier-response models. Using newly developed ice-sheet/glacier models, we will generate detailed projections of the contribution of continental ice to sea-level rise over the next 200 years, and identify thresholds that commit the planet to long-term sea-level rise. We will deliver these results in forms accessible to scientists, policy-makers and the general public, which will include clear presentations of the sources of uncertainty. The ice2sea programme will directly inform the ongoing international debate on climate-change mitigation, and European debates surrounding coastal adaptation and sea-defence planning. It will leave a legacy of improved understanding of key cryospheric processes affecting development of the Earth System and the

predictive tools for glacier-response modelling, and it will train a new generation of young European researchers who can use those tools for the future benefit of society.

ACOBAR - Acoustic Technology for observing the interior of the Arctic Ocean (Project Total Cost: 4.244.969€ EU Contribution: 3.000.000 € currently under negotiation)

ACOBAR will develop an observing system for the interior of the Arctic Ocean based on underwater acoustic methods including tomography, data transmission and communication to/from underwater platforms, and navigation of gliders. ACOBAR offers alternative methods the ARGO system, which cannot be used in ice-covered seas, based on platforms located under the sea ice, for data collection and transmission from the water column, the seafloor and the subseafloor. ACOBAR will contribute to filling gaps in the global ocean observing system and thereby support the development of GEOSS. ACOBAR will implement field experiments with acoustic sources and receivers in the Fram Strait and the Arctic Ocean basin. Acoustic tomography will be used to obtain integrated 3-D fields of temperature, transports and heat fluxes. Data from tomography arrays and other underwater platforms will be disseminated to users with near real-time capability, including assimilation in ocean models. ACOBAR will extend and improve methods for underwater data collection that are presently tested in DAMOCLES IP.

3.2. Plans to ensure availability of past and future data and metadata records of the satellite measurements for the oceanic ECVs and associated global products contained in table 4

For the satellite ECVs relating to the primary biological variable (i.e. Chlorophyll and ocean colour) there are numerous ongoing activities at the pan-European scale which are ensuring the availability past, present and future data.

The existing initiative based on the products developed by the following European and national projects:

MARCOAST¹¹ (and former Coastwatch) – ESA GMES Service Element: Ocean colour upstream service addressing a wide range of pan-European and regional downstream service providers requirements (Chla, transparency, water-leaving radiances).

MERSEA¹² (current): The MERSEA ocean colour activity distributes global and regional data sets for chlorophyll concentration and primary production. Distribution of other products is upcoming (e.g., diffuse attenuation coefficient) or considered. Additional availability: global and regional time series of normalized water leaving radiances, phytoplankton absorption, CDOM+ non-pigmented particulate absorption, particulate backscattering.

European Commission – JRC Ocean Colour Portal¹³: The European Commission’s Joint Research Centre has an Action that supports environmental, climate and space policies by generating, assessing and analysing ocean satellite-derived climate and environmental products. The core activities of this Action include: generating and delivering products (ECVs) and services in support of policy making and other applications to specific customers such as the

¹¹ <http://gmes-marcoast.com/>

¹² http://w3.mersea.eu.org/html/remote_sensing/oco_products.html

¹³ <http://oceancolour.jrc.ec.europa.eu/>

Directorates-General of the European Commission, the European Environment Agency and Space Agencies. Carrying out the laboratory, field and research activities required to guarantee the quality, reliability and accuracy of these products and services, conduct the scientific R&D necessary to formulate new or improved value-added products and services to address existing and emerging needs and undertaking temporal and spatial analyses of the core Essential Climate Variables. The current ocean colour portal includes a decadal time-series of chlorophyll and ocean colour ECVs, the datasets have pan-European and global scales with a resolution of 2km. The presented archive is maintained with the strictest attentions to the quality and validation of the data presented in accordance with those required for re-analyzed climate data records.

GlobColour¹⁴ (current): The GlobColour service distributes global L3 data sets of chlorophyll concentration, water leaving radiances, diffuse attenuation coefficient, coloured dissolved and detrital organic materials, total suspended matter or particulate backscattering coefficient, turbidity index, quality indicators. Distribution of other products is planned (e.g., transparency, heated marine layer), or considered.

Existing national/regional systems

Mediterranean Sea: The Italian - CNR has produced and distributed Mediterranean ocean colour SeaWiFS data both in realtime (1 hour from the satellite pass) and delayed time (3 days for ancillary data integration) within MFS and ADRICOSM. It is currently producing near realtime (1 hour after the data availability from NASA) and delayed-time MODIS chlorophyll, diffuse attenuation coefficient, normalized water leaving radiances data produced with an ad hoc regional algorithm for the Mediterranean Sea. Within ADRICOSM additional products such as CDOM and non-pigmented particulate absorption, and chlorophyll concentration on the regional model grid are produced for the Adriatic Sea. CNR is currently involved in MERSEA regional product development and operational data supply.

Mediterranean Sea: ACRI-ST in partnership with LOV and Thalès is leading the regional center for Ocean Colour in the Mediterranean Sea – named Regicolour- which benefits from a funding of the PACA region until 2011. The NRT service is operational. Ocean colour Products are generated by LOV with alternative merging methods starting from TOA radiances. Products are generated at regional and global scales.

Northeast Atlantic: PML and University of Dundee provide local reception, NRT and archived/delayed mode regional products for the N. Atlantic, North Sea, Celtic Sea, Iberian Peninsula, Bay of Biscay, western Mediterranean and Baltic Sea (see figure). Ocean colour products including case 1 or case 2 chlorophyll, radiance, visibility, attenuation (K_d490), frontal analyses, inherent optical properties (IOPs) and primary production. SST products (AVHRR and MODIS) are produced on the same projection as full-resolution ocean colour areas. Products are currently used for physics-ecosystem model comparisons. Global NRT coverage of regions of interest (e.g., Southern Ocean south of Chile and Tasmania, Northern Indian Ocean, Tanzania) courtesy of ESA and NASA subscriptions. Other products on demand include: harmful algal bloom likelihood (NRT), high resolution (500m) MODIS chlorophyll. PML also operates an ocean colour/optical cal/val site in the western English Channel.

¹⁴ <http://www.globcolour.info/>

Bay of Biscay: Ifremer provides series of Chla, mineral SPM (Suspended Particulate Matter), attenuation of diffuse descending light, derived from satellite radiance since 1998. The resulting maps are provided to a large community of users (260 registered) through four internet servers covering the western European continental shelf. These servers also present other oceanographic variables, and many in situ measurements of chlorophyll, SPM, SST (CORIOLIS). Ifremer's activity has at high priority the exchange of data and information with users operating monitoring networks involved in the surveillance of the coastal water quality.

3.3. Actions taken in response to the following recommended actions on the oceanic ECVs contained in the GCOS implementation plan

3.3.1. *Implementing a programme for measuring surface pCO₂ (O17)*

CARBOOCEAN IP (Project Total Cost: 19.271.618 € EU Contribution: 14.499.600 €)

The CARBOOCEAN Consortium consists of 47 international groups that have started an integrated research activity on the marine carbon cycle on 1 January 2005. The participating countries are Belgium, Denmark, France, Germany, Iceland, Morocco, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland, United Kingdom and the USA.

One of the five major objectives of the EU CARBOOCEAN IP is the quantification of decadal-to-centennial large-scale Atlantic and Southern Ocean carbon inventory changes. Operationally this implies a need to quantify: “the Atlantic and Southern Ocean carbon sink, and its decadal change, through highest accuracy measurement of the changing inventories of inorganic carbon and carbon-related tracers. Atlantic and Southern Ocean data would then be integrated into a coherent global data base. The ability of prognostic models to represent the observed changes for a reliable now-cast would be assessed against the data-based syntheses.” The science delivery associated with this objective is “a large scale assessment of the ocean carbon storage”.

Over the last three years the number of cruises included in the CARINA collection has increased by a factor of 4 and this growth continues as new cruises are added, additional parameters appended to existing cruises and various edits incorporated. One key feature of the collection is that the various data are in the same units (WOCE standard) and that the formats are comparable (comma separated ascii files with a one line header). All of the common parameters from each cruise have been subjected to 1st level quality control procedures (flag assignment) developed during WOCE. CARINA working groups are now beginning 2nd level quality control procedures similar to those used for GLODAP to assure internal data consistency. Once this is completed a merged data product will be produced and made public.

3.3.2. *Developing capability for systematic measurement of biogeochemical and ecological ECVs (O30)*

The international Argo project, which currently has an array of about 3,000 floats deployed in the world ocean, has proven to be an invaluable tool in modern physical oceanography. It provides, on a routine basis and with great detail, the heat and salt content of the upper ocean, as well as water mass circulation, and more generally it helps ocean monitoring and forecasting systems. The Argo Data Management Committee and the Argo Steering Team have full control of the project.

Recently, about 60 floats have also been instrumented with O₂ sensors, for the benefit of the biogeochemical community (see Argo Oxygen Program - White Paper¹⁵). Bio-optical sensors are now being developed with a reduced size which is compatible for implementation on the Argo floats. Several successful attempts in this direction have already been made in the US. Some discussions are planned on the same topic within the Euro-Argo Group. In summary, an activity is emerging in this domain, and individual researchers as well as Agencies have recognized the fact that a Lagrangian platform array could provide 3-D information not attainable by satellite platforms (the missing vertical dimension), or can even determine near surface properties when cloud cover impedes observations from space, and can also help the validation of satellite data (e.g., Chlorophyll, Kd etc.)

In the context of the IOCCG¹⁶, Dr. Herve Claustre (Laboratoire d'Océanographie de Villefranche) has initiated a working group in the IOCCG called BIO-ARGO which intends to obtain a coherent data set for the validation of ocean-colour satellite-borne sensors, and for the interpretation of optical properties in terms of relevant biogeochemical parameters.

HYPOX - In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies (Project Total Cost: 4.664.282€ EU Contribution: 3.499.712 € currently under negotiation)

Hypoxic (low oxygen) conditions in aquatic ecosystems increase in number, duration and extent due to global warming and eutrophication. Global warming will lead to degassing of oxygen, increased stratification, reduced deep-water circulation and changes in wind patterns affecting transport and mixing. Projected increases in hypoxia (e.g. doubling of “dead zones”) are accompanied by enhanced emission of greenhouse gases, losses in biodiversity, ecosystem functions and services such as fisheries, aquaculture and tourism. A better understanding of global changes in oxygen depletion requires a global observation system continuously monitoring oxygen at high resolution, including assessment of the role of the seafloor in controlling the sensitivity of aquatic systems to and recovery from hypoxia. HYPOX will be monitoring oxygen depletion and associated processes in aquatic systems that differ in oxygen status or sensitivity towards change: open ocean, oxic with high sensitivity to global warming (Arctic), semi-enclosed with permanent anoxia (Black Sea, Baltic Sea) and seasonally or locally anoxic land-locked systems (fjords, lagoons, lakes) subject to eutrophication. The capacity to monitor oxygen depletion globally will be improved by implementing reliable long-term sensors to different platforms for in situ monitoring; and locally by training and implementing competence around the Black Sea. HYPOX can be seen as a contribution to GEOSS tasks in the water, climate, ecosystem and biodiversity work plans, and comply to GEOSS standards by sharing of observations and products with common standards and adaptation to user needs using a state of the art world data centre. The project will be connected to the GOOS Regional Alliances and the SCOR working group and disseminate our knowledge to local, regional and global organisations concerned with water and ecosystem health and management.

¹⁵ http://www.ioccg.org/groups/Oxygen_Argo_whitepaper_15feb07_r.pdf

¹⁶ <http://www.ioccg.org/groups/argo.html>

3.3.3. *Supporting data rescue projects and implementing regional, specialized and global data and analysis centres (O36 and O37)*

The implementation of regional products is a fundamental aspect of the MyOcean Kopernikus project, which succeeds MERSEA (FP6) and is currently under negotiation. Many of the satellite datasets derived as well as the subsequently assimilation of these into operational models will be tailored on a regional basis. This will facilitate the implementation of specific algorithms and parameterization which have a regionally varying dimension. For example in the case of the Ocean Colour activities there will be regional processing centres for the Baltic, Northeast Atlantic, Bay of Biscay and Mediterranean as well as a systematic processing of all ECVs at the global scale as well.

3.3.4. *Developing plans and pilot projects for the production of global products based on data assimilation into models for all possible ECVs, including undertaking pilot projects of reanalysis of ocean data (O24, O41 and O40).*

As mentioned above, the planned MyOcean Kopernikus fast-track project includes, as a central definition of the Service it proposes, the operational assimilation of the satellite data streams in model and forecasting systems on the European and global scale.

4. TERRESTRIAL ESSENTIAL CLIMATE VARIABLES

4.1. National contributions of terrestrial ECV observations to the international community

There are numerous ongoing initiatives both at the European level and in the Member States which promote the generation and archival of satellite derived terrestrial ECVs. Below is a list of some notable examples:

GEOLAND (FP7 Kopernikus project)

The ambition of the GEOLAND consortium is to develop and demonstrate a range of reliable, affordable and cost efficient European geo-information services, supporting the implementation of European directives and their national implementation, as well as European and International policies. Thus, the Kopernikus initiative is considered a unique opportunity to integrate existing technology with innovative and scientifically sound elements into sustainable services.

Two core services have been established within the GEOLAND project. These serve the GEOLAND observatories, providing them with basic geo-information products that the various services can build their individual efforts on:

The Core Service Generic Landcover (CSL) provides the GEOLAND regional observatories with harmonized, topical and geometric correct basic information on landcover.

The Core Service Bio-Geophysical Parameters supplies generic information on bio-geophysical attributes of land surfaces at regional and global scales to the global observatories within GEOLAND.

The Land surface modelling of natural carbon flux relevant parameters have been upgraded into ECMWF and other modelling systems to incorporate Leaf Area Index, soil moisture to provide CO₂ flux information. Successful prototypes of the systems have raised promises for operational systems to emerge shortly.

CARBOEUROPE-IP Assessment of the European Terrestrial Carbon Balance (Project Total Cost: 23.770.780 € EU Contribution: 16.310.000 €)

The overarching aim of the CarboEurope-IP is to understand, quantify and predict the terrestrial carbon balance of Europe and the uncertainty at local, regional and continental scale. This is achieved by (1) executing a strategically focussed set of surface based ecological measurements of carbon pools and CO₂ exchange, (2) further enhancement of an atmospheric high precision observation system for CO₂ and other trace gases, (3) execution of a regional high spatial resolution experiment and (4) integration of these components by means of innovative data assimilation systems and modelling.

CARBO-NORTH Quantifying the Carbon budget in Northern Russia: past, present and future (Project Total Cost: 3.622.074 € EU Contribution: 3.099.822 €)

CARBO-North aims at quantifying the carbon budget in Northern Russia across temporal and spatial scales. Activities address rates of ecosystem change, effects on the detailed monitoring and mapping of vegetation, soil and permafrost. The project will provide input for process-oriented studies (treeline patch dynamics; tundra/forest/river carbon fluxes; ground subsidence, etc) and GIS-based upscaling to regional levels, carbon budget (radiative forcing), and global climate and policy implications (Kyoto).

EC-JRC FAPAR project¹⁷

This project provides access of 10 years of FAPAR datasets at medium resolution over the globe (i.e. 1km- 2km) and delivers global products at various resolution (0.5 degrees to 5 degrees). The retrieval algorithm is physically based and the validation has been made against ground based measurements. The space instrument is SeaWiFS for the historical dataset.

e-SOTER - Regional pilot platform as EU contribution to a Global Soil Observing System
(Project Total Cost: 4.607.986 € EU Contribution: 3.482.601 €)

Soil and land information are often inaccessible, incomplete, or out of date. e-SOTER addresses the felt need for a global soil and terrain database. It will deliver a web-based regional pilot platform with data, methodology, and applications, using remote sensing to validate, augment and extend existing data. Technical barriers include: quantitative mapping of landforms; soil characterization and pattern recognition by remote sensing; standardization of measures to convert legacy data. Major research thrusts involve: 1) improvement of the current SOTER methodology at scale 1:1 million in four windows in Europe, China and Morocco, using optical remote sensing and legacy data; 2) within 1:250 000-scale pilot areas, advanced remote sensing applications. Airborne radiometrics and electromagnetics, and image spectrometry together with field spectrometry will also be applied in a single, data-rich super site to link with field measurements. Advances beyond the state of the art include: transformation of pre-existing data and addition of new information with remote sensing and DEM; interpretations of the e-SOTER database that address threats defined in the EU Soil Thematic Strategy and comparing the results with current assessments; and delivery through a web service of a data portal. e-SOTER will deliver a Pilot Platform and a portal that provides open access to:

- 1) a methodology to create 1:1 million-scale SOTER databases, and an enhanced soil and terrain database at scale 1:1 million for the four windows;
- 2) an artifact-free 90m digital elevation model;
- 3) methodologies to create 1:250000-scale enhanced SOTER databases, and the databases themselves for four pilot;
- 4) advanced remote sensing techniques to obtain soil attribute data;
- 5) validation and uncertainty propagation analysis;
- 6) dedicated applications related to major threats to soil quality and performance.

ESA

MERIS Level 2 products¹⁸

Demonstration FAPAR products processed at the ESA G-POD facility using the EC-JRC algorithm of which allow continuity of the above data sets. Validation has been made against ground-based measurements

ESA GlobCarbon (Global Land Products for Carbon Model Assimilation)¹⁹

¹⁷ <http://fapar.jrc.ec.europa.eu/Home.php>

¹⁸ <http://envisat.esa.int/level3/meris/>

The ESA GlobCarbon consortium is led by the Flemish Institute for Technological Research (VITO). The FAPAR product produced by this consortium is derived from the surface reflectance values for the individual instruments, adopting average LAI values estimated across all sensors. The products are daily and sensor dependent products (1 for VEGETATION, 1 for ATSR, 1 for MERIS).

EUMETSAT LandSaf²⁰

FAPAR and LAI are not operational products. They are based on parametric algorithm originally defined for the historical AVHRR sensor (which does not have the same nominal bands as SEVIRI). These products are also used as inputs the LandSAF albedo products. At present this product is not optimal because of known aerosol issues.

CYCLOPES (POSTEL, France)

This project is funded by EU/FP5, provides global mapping at 1km resolution of biogeophysical variables (leaf area index, the fraction of absorbed PAR, the fraction of vegetation cover, and albedo) derived from data acquired by VEGETATION sensor over the period 1999 - 2003. They are provided in tiles of 10°x10° covering the whole globe in plate-carrée projection. Validation against ground-based measurements made at 50 km.

ESA GlobCOVER²¹

The GEM unit of the JRC has produced a global landcover classification for the year 2000 (GLC2000), in collaboration with over 30 research teams from around the world. The project was carried out to provide accurate baseline landcover information to the International Conventions on Climate Change, the Convention to Combat Desertification, the Ramsar Convention and the Kyoto Protocol.

Furthermore, the GLC2000 land cover database has been chosen as a core dataset for the Millennium Ecosystems Assessment. This means in particular that the GLC2000 dataset is a main input dataset to define the boundaries between ecosystems such as forest, grassland, and cultivated systems.

In contrast to former global mapping initiatives the GLC2000 project is a bottom up approach to global mapping. In this project more than 30 research teams have been involved, contributing to 19 regional windows. Each defined region was mapped by local experts, which guaranteed an accurate classification, based on local knowledge.

Each regional partner used the VEGA2000 dataset, providing a daily global image from the Vegetation sensor onboard the SPOT4 satellite. Each partner also used the Land Cover Classification System (LCCS) produced by FAO and UNEP (Di Gregorio and Jansen, 2000), which ensured that a standard legend was used over the globe. This hierarchical classification system allowed each partner to choose the most appropriate land cover classes which best describe their region, whilst also providing the possibility to translate regional classes to a more generalised global legend.

¹⁹ <http://geofront.vgt.vito.be>

²⁰ <http://landsaf.meteo.pt/>

²¹ <http://ionial.esrin.esa.int/index.asp>

Building on the success of the GLC-2000 project coordinated by the JRC, the European Space Agency (ESA) decided to launch the GLOBCOVER initiative in the framework of its Data User Element (DUE). The GLOBCOVER project was launched 2004 and is now evolving to an international collaboration between ESA, FAO, UNEP, JRC, IGBP and GOCF-GOLD. The objective of GLOBCOVER is to produce a global land-cover map for the year 2005, using as main source of data the fine resolution (300 m) mode data from MERIS sensor on-board ENVISAT satellite, acquired over the full year 2005. This new product intends to complement and update other existing comparable global products, such as the global land cover map for the year 2000 (GLC 2000) with a resolution of 1 km produced by the JRC. Appropriate approaches for the validation of the land cover products are planned to be defined in consultation with CEOS.

The estimate is that up to 20 terabytes of imagery will be needed to mosaic together the final worldwide GLOBCOVER map. The image acquisition strategy is based around regional climate patterns to minimise cloud or snow cover. Multiple acquisitions are planned for some regions to account for seasonal variations in land cover.

The GLOBCOVER classification system is being designed to be compatible with the Global Land Cover map previously produced for the JRC for the year 2000, a one-kilometre resolution map produced from SPOT-4 Vegetation Instrument data and known as GLC 2000.

GLOBCOVER 300m map is produced automatically by mosaicking images together in a standardised way. Currently Version 2 (v2) of the map is available.

4.2. Terrestrial elements of the GCOS implementation plan that are less quantifiable with the aim of making changes and improvements to the climate observing system

The EC is promoting the development of a sustained Kopernikus Atmospheric Service. In addition to the activities for the atmospheric ECVs reported above, the service will include near-real-time analysis and reanalysis of the ECV fire disturbance. A first set of reanalyses is being provided by the EC FP6 project GEMS for the period from 2003 onwards, and GEMS has also started near-real-time processing. These activities will be continued, subject to successful contract negotiation, in the EC FP7 project MACC, which provides the pilot core Kopernikus Atmospheric Service.

A fire-detection capability is provided by the instrument AATSR on ENVISAT (which is used only for backup in GEMS/MACC) and the follow-on instrument on Sentinel 3. Likewise, EUMETSAT provides a Fire Radiative Power product from SEVIRI (which is used in GEMS/MACC). There are plans for a sustained follow-on data provision from MTG.

Water quality data (<http://water.europa.eu/>): The Water Information System for Europe (WISE) coordinated by EEA is providing online information on water quality across Europe. Water quantity (river discharge) will be implemented in WISE in 2009²².

²² <http://www.eea.europa.eu/themes/water>

4.3. Plans to ensure availability of past and future data and metadata records of the satellite measurements for the terrestrial ECVs and their associated global products contained in table 6.

Land-cover data: The Corine land cover database coordinated by EEA contains consistent European land-cover data sets for 1990, 2000 and 2006, currently being updated²³. The update cycle shall be sustained under the Kopernikus program.

4.4. Actions taken in response to the following recommendations on the terrestrial ECVs contained in the GCOS implementation plan

European Commission-JRC: Development of a physically based algorithm for the retrieval of FAPAR using AVHRR data. Contribution to GEO Climate Societal Benefit Analysis Task on data re-analysis (CL-06-01).

²³ http://dataservice.eea.europa.eu/map/clc_download/;
<http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=1>;
<http://www.eea.europa.eu/themes/landuse/eea-activities>

5. ADDITIONAL INFORMATION

5.1. National climate programmes that contribute observations of the ECVs

EEA climate change impact indicators

In the context of reporting EEA is collecting and presenting indicators that are similar to the GCOS essential climate variables (e.g. glaciers, Arctic sea ice, snow cover, SST, river discharge). These are included in the 'climate change indicator report 2008', a joint activity of EEA, JRC and WHO²⁴. The report contains (about 40) indicators in the following categories: atmosphere and climate, glaciers, snow and ice (cryosphere), marine systems and biodiversity, water quantity, freshwater quality and biodiversity, terrestrial ecosystems and biodiversity, soil, agriculture and forestry, and human health.

Furthermore all indicators will be included in EEA's indicator management system (IMS) which will allow easier access to underlying data. So far EEA maintains two core set indicators on climate change (global and European temperature and greenhouse gas concentrations)²⁵.

²⁴ <http://www.eea.europa.eu/themes/climate/reports>

²⁵ <http://themes.eea.europa.eu/IMS/CSI>