

GEOSS for Climate

The GEO Climate Societal Benefit Area



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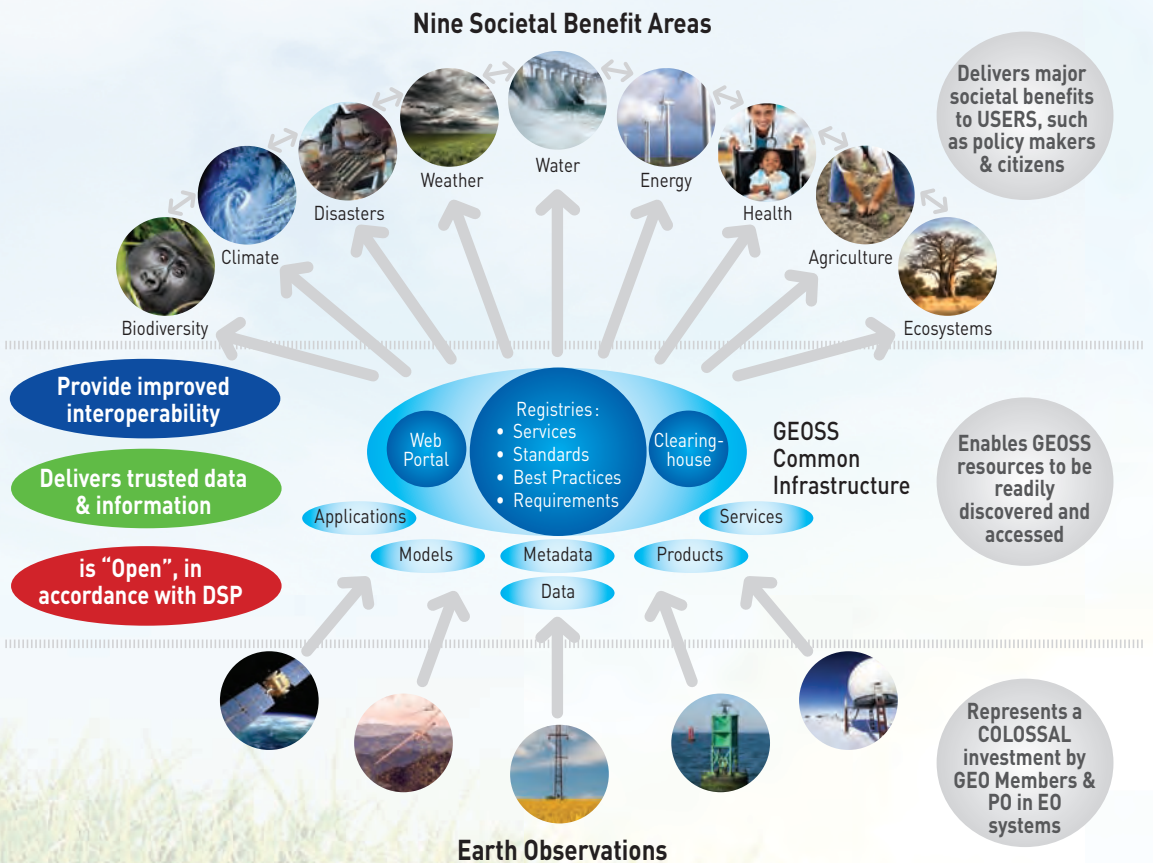


GROUP ON
EARTH OBSERVATIONS

GEOS - A GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS

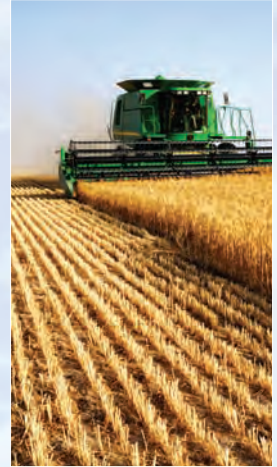
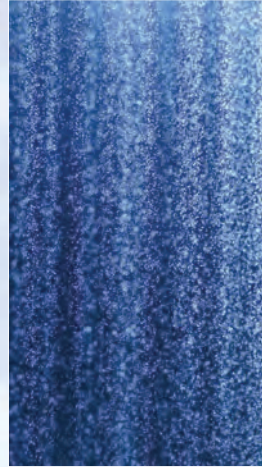
The Group on Earth Observations (GEO) is coordinating efforts to build a Global Earth Observation System of Systems (GEOS). GEO was established in February 2005 by the Third Earth Observation Summit in Brussels in response to calls for action by the 2002 World Summit on Sustainable Development and the Group of Eight (G8) leading industrialised countries. GEO is a voluntary partnership of governments and international organisations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments.

www.earthobservations.org.



The vision for GEOS is to realise a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information.

GEOS will work with and build upon existing national, regional, and global systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide and to transform the data they collect into vital information for society.



GEOSS will simultaneously address nine Societal Benefit Areas (SBA) of critical importance to people and society. It aims to empower the international community to protect itself against natural and human-induced **disasters**, understand the environmental sources of **health** hazards, manage **energy** resources, respond to **climate** change and its impacts, safeguard **water** resources, improve **weather** forecasts, manage ecosystems, promote sustainable **agriculture** and conserve **biodiversity**. GEOSS coordinates a multitude of complex and interrelated issues simultaneously.

This **cross-cutting approach** avoids unnecessary duplication, encourages synergies between systems and ensures substantial economic, societal and environmental benefits.

Many efforts are oriented towards **solving the standardisation of data and interoperability issues** within GEO.

GEO is also **building on its Data Sharing Principles (DSP)** agreed by its members to develop a consistent data sharing implementation plan at international level.

THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS



Target 2015

The **GEOS Strategic Target for Climate** is the following :

Before 2015, GEO aims to :

Achieve effective and sustained operation of the global climate observing system and reliable delivery of the climate information needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle.

This will be demonstrated by :

- Improved scientific understanding, modelling and prediction of climate.
- Accessibility of all the observational data needed for climate monitoring and services in support of adaptation to climate variability and change.
- Development and facilitation of a comprehensive (atmosphere, ocean, land) global carbon observation and analysis system in support of monitoring based decision-making and related environmental treaty obligations.
- Availability of all Essential Climate Variables needed by the WCRP, the IPCC and the UNFCCC.



GEOS FOR CLIMATE

GEO Work Plan 2009-2011

Under the current GEO Work Plan 2009-2011, the Climate issue is addressed in four main tasks:

CL-06-01 A Climate Record for Assessing Variability and Change

Extend and improve the quality of the past climate record through advanced data reanalysis and reconstruction in the atmosphere, ocean, land and sea ice domains. Generate high-quality temporally-homogeneous estimates of the past climate to support analyses of climate variability and change.

CL-09-01 Environmental Information for Decision-making, Risk Management and Adaptation

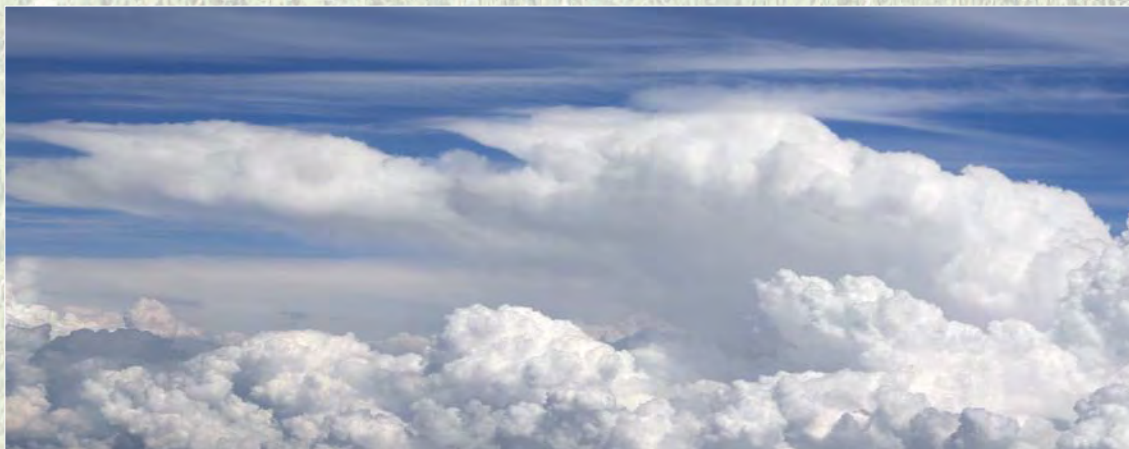
Support the integration of climate and environmental risk management into adaptation processes. Coordinate and drive the development of tailored climate products and services. Encourage the use of this information by policy and decision makers (at all levels), and initiate user oriented activities to do both increase the demand, and foster the supply, of climate and environmental services for development.

CL-09-02 Accelerating the Implementation of the Global Climate Observing System

Accelerate the implementation of the Global Climate Observing System (GCOS) through enhanced support for the component systems of GCOS: The WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW), the IOC-led Global Ocean Observing System (GOOS), the FAO-led Global Terrestrial observing System (GTOS), and the global hydrological networks and all relevant satellite systems.

CL-09-03 Global Carbon Observation and Analysis System

Implement a global carbon observation and analysis system addressing the three components of the carbon cycle (atmosphere, land and ocean) and integrating them with satellite data. Provide high-quality regional information on CO₂ and CH₄ concentrations and emission variations useful for decision makers. Combine observations, reanalysis and product development to develop tools for carbon tracking and carbon storage evaluation. Build upon internationally accepted strategies and the work of the WMO Global Atmospheric Watch (GAW) to implement the atmospheric component of those strategies.

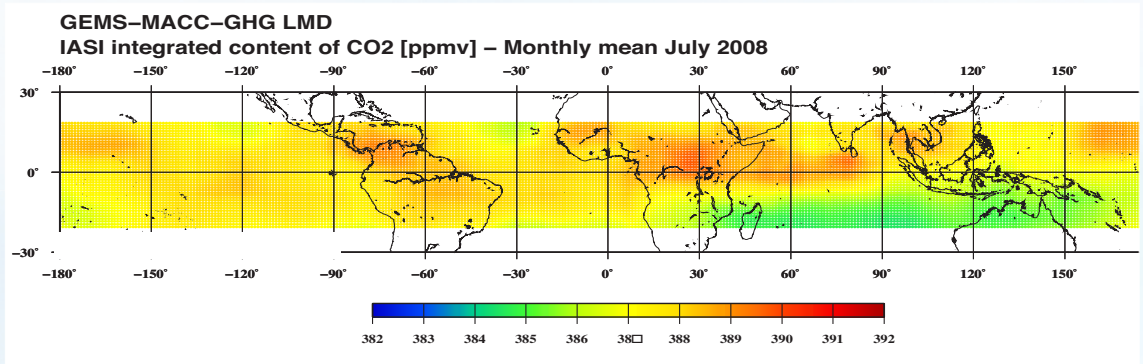


Examples of the European Projects contributing to the Climate SBA



The project **MACC** (Monitoring Atmospheric Composition and Climate) is led by the European Centre for Medium-Range Weather Forecasts (ECMWF). It is the current pre-operational atmospheric service of the European **GMES (Global Monitoring for Environment and Security)** programme. MACC provides

data records on atmospheric composition for recent years, data for monitoring present conditions and forecasts of the distribution of key constituents for a few days ahead. MACC combines state-of-the-art atmospheric modelling with Earth observation data to provide information services covering European Air Quality, Global Atmospheric Composition, Climate, and UV and Solar Energy. (www.gmes-atmosphere.eu).



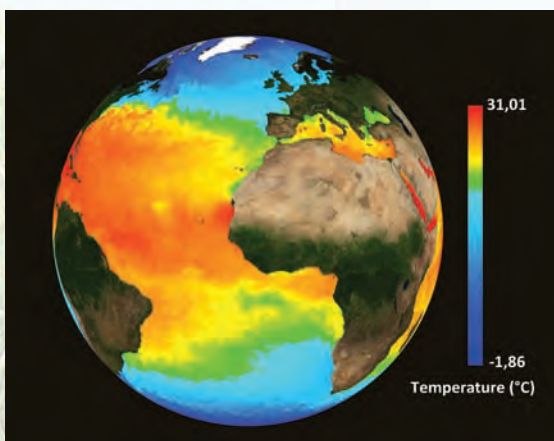
Mid-to-upper tropospheric integrated content of CO₂ derived from the hyperspectral infrared observations of MetOp/IASI (monthly map for July 2008) at LMD in the framework of the Greenhouse Gases subproject of MACC.



To satisfy both public and private users' operational needs, **MyOcean** implements a major component of the **GMES Marine Service** (Global Monitoring for Environment and Security Initiative) by depicting the state of the global ocean and European regional seas today and tomorrow with physical variables



and primary ecosystems data. MyOcean delivers reliable and robust data to the European and national meteorological services. Ocean surface conditions impact atmospheric storms. Changes in sea ice extent, concentration and volume are monitored to detect signals connected with global warming. (www.myocean.eu.org).



MyOcean - Global Sea Surface Temperature
/Mean Sept 17th 2009.



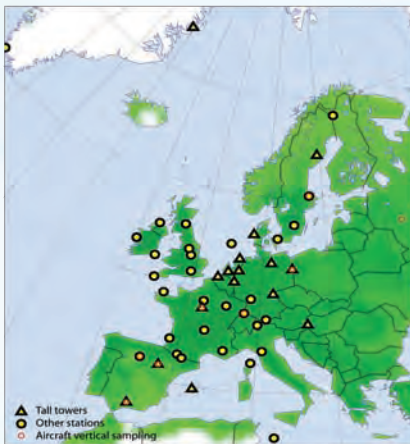


ICOS is a recently-launched, world-class **research infrastructure** dedicated to the monitoring and improved understanding of **carbon sources and sinks**. It consists of complementary, harmonised networks of long-term ecosystem monitoring stations, atmospheric greenhouse gases measurement stations, and ship-based oceanic

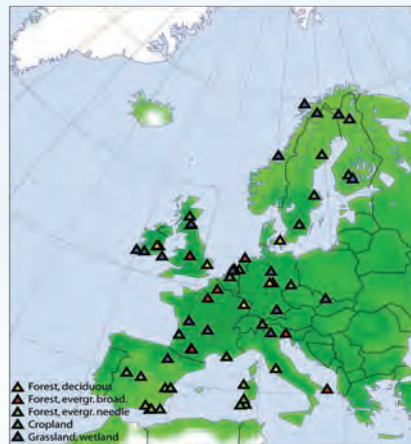
measurements. The atmospheric and ecosystem **networks** focus on Europe and adjacent regions. The networks will be coordinated through a set of central facilities: three Thematic centers for the atmosphere, ecosystems and the ocean, and a Central analytical lab.

ICOS will provide the essential **long-term observations** required to understand the present state and predict future behaviour of the global **carbon cycle** and greenhouse gases' emissions.

ICOS will provide key data for the monitoring and assessment of the impact 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. (www.icos-infrastructure.eu).



Atmospheric network



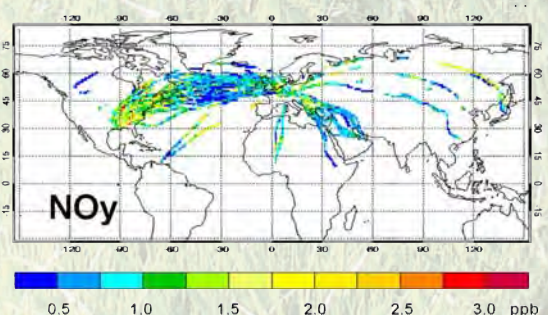
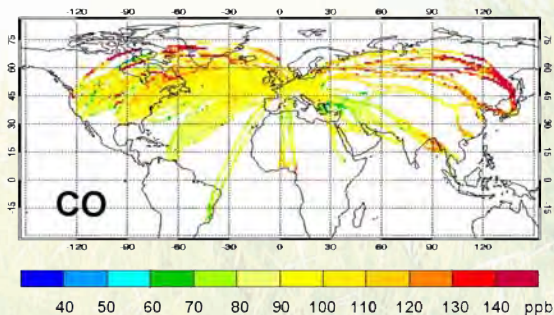
Ecosystem network



MOZAIC (Measurements of OZone and water vapour by Airbus In-service Aircraft) is a research programme coordinated by Laboratoire d'Aérodologie (CNRS), Toulouse for high quality monitoring of trace gases (O₃, H₂O, CO, NO_y) relevant to air quality and climate

change from commercial airliners. Data are available since 1994 from more than 30.000 longhaul flights (mozaic.aero.obs-mip.fr).

IAGOS (In-service Aircraft for a Global Observing System), a new European infrastructure coordinated by Research Centre Jülich, expands this platform into sustainable operation with global coverage and enhanced capabilities for GHGs, aerosol and cloud particles. (www.iagos.org).



MOZAIC data demonstrate the strong influence of biomass burning, convection and lightning on the concentrations of carbon monoxide and nitrogen oxides in the upper troposphere.

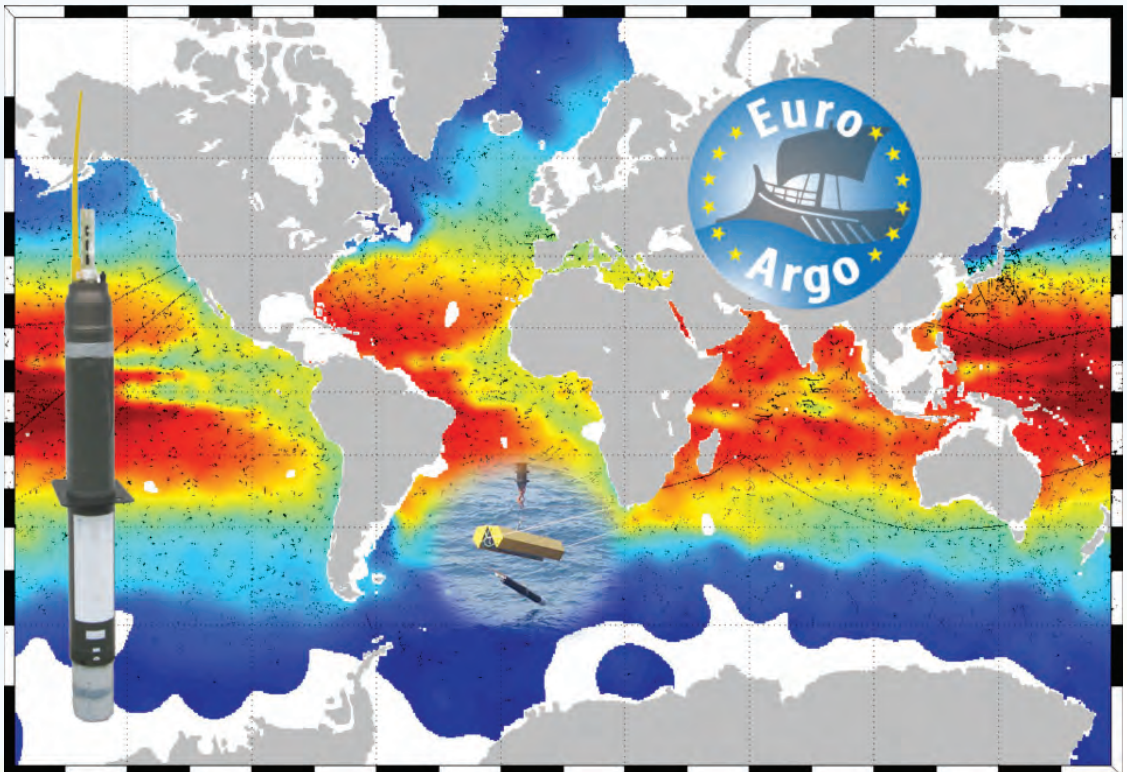


The oceans have a fundamental influence on our climate and weather. They store, transport and exchange with the atmosphere large amounts of heat. These exchanges dramatically affect world and regional climates on time scales ranging from days (storms and hurricanes), to seasons (monsoons), to years (El Niño) and centuries (climate change).

Understanding and predicting the evolution of our weather and climate thus requires long term, high quality global ocean observations. Argo is a global ocean observing system for the 21st century. It is **an international array of 3000 profiling floats that measure temperature and salinity throughout the deep global oceans, down to 2,000 metres.**

Argo is the first-ever global, in-situ ocean-observing network in the history of oceanography, providing an essential complement to satellite systems.

Euro-Argo will develop and consolidate the European component of the global network. (www.euro-argo.eu).



CarboAfrica was a 3.5 years international project funded by EC under FP6. CarboAfrica contributed to the task CL-09-03a Integrated Global Carbon Observation (IGCO) of the GEO 2009-2011 Work Plan, by **improving the current global carbon observing network in an underrepresented region such as Africa.** The project coordinated a standardised Sub-Saharan observation system of old, current and future carbon data. The monitoring network has been expanded and new or improved data on carbon stocks and fluxes, ecosystems

processes, and fire emissions, were produced. The project highlighted that Sub-Saharan Africa plays a key role in the global carbon cycle and could have a significant potential for carbon sequestration and emission reduction, even if still highly uncertain. The data produced are freely available on the website: www.carboafrika.net



CarboAfrica: "Solar panel and scientific instruments above the canopy of the African tropical forest, in Ghana"



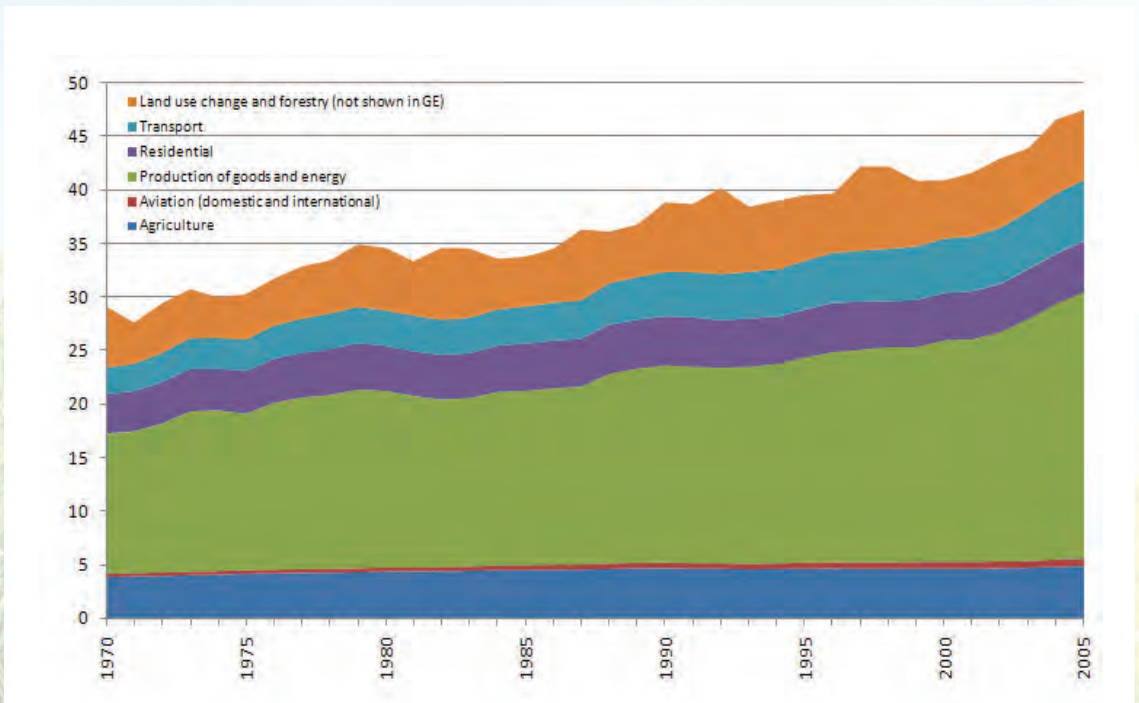
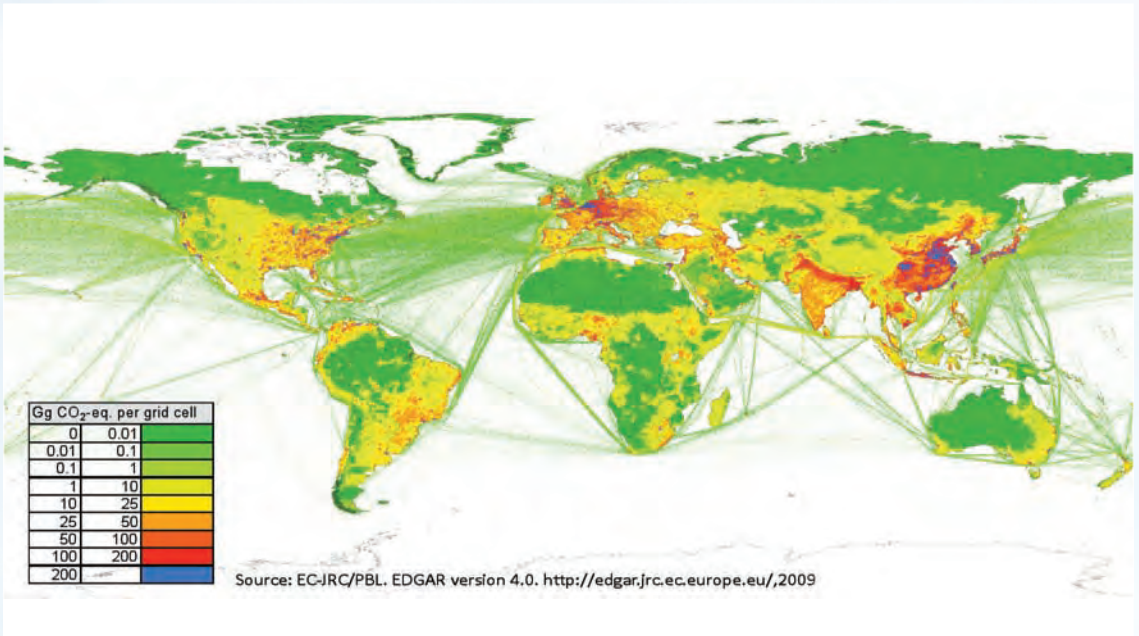
To determine the CO₂ balance of European regions various approaches are taken. They range from detailed process studies, meteorological methods, to satellite support and data assimilation models. How are these approaches best combined? What background information is available and useful? What needs to be improved? These

are the questions that **COCOS (Coordination Action Carbon Observing System)** wants to answer aiming to design a reliable European Carbon Observation System. (www.cocos-carbon.org).



The Emissions Database for Global Atmospheric Research (EDGARv4), developed at the EC Joint Research Centre provides global past and present day anthropogenic emissions of greenhouse gases and air pollutants by country and on spatial grid. Measures are available since 1970. High resolution digital maps of man-made green house gas

(GHG) emissions can be easily visualised as add-on layers to Google Earth. The download from http://edgar.jrc.ec.europa.eu/kml_files_intro.php represents the global annual distribution of GHG emissions from 1970-2005 and by main emission sources for the year 2005 on 0.1 degree by 0.1 degree.



These grid maps are constructed from independent estimates of national total emission inventories for all world countries from the EDGARv4 database. Priority is given to a technology-based methodology that is consistently applied to all countries for the period 1970 – 2005 and confined by a global sum in agreement with atmospheric measurements. A consistent approach for calculating emissions from both Annex I and Non-Annex I Parties of the UNFCCC is increasingly relevant as sums of their contribution to the total emissions shown in Fig. 1 are becoming equally important. Contact: edgar-info@jrc.it.

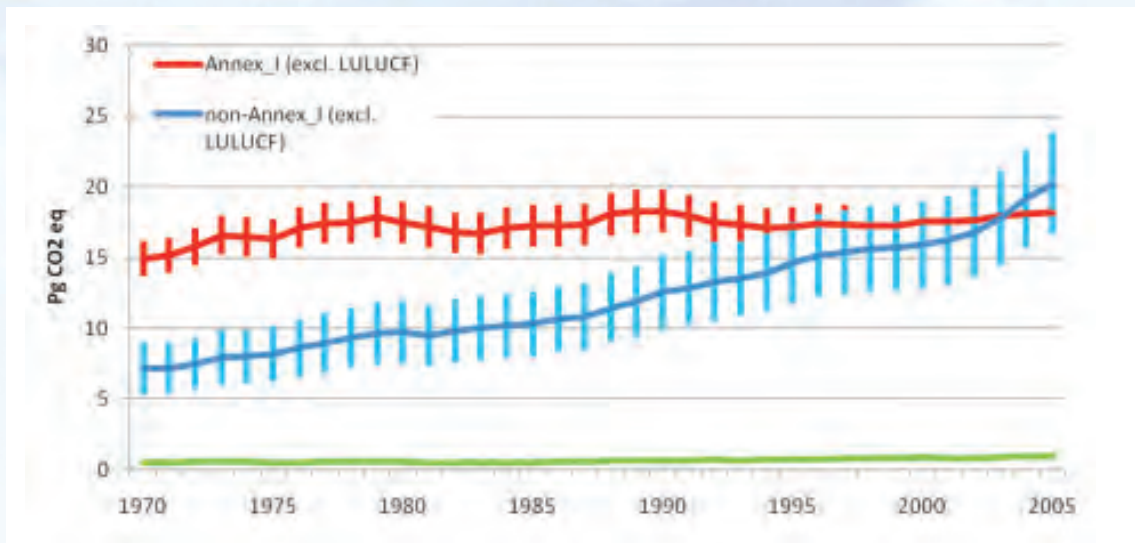
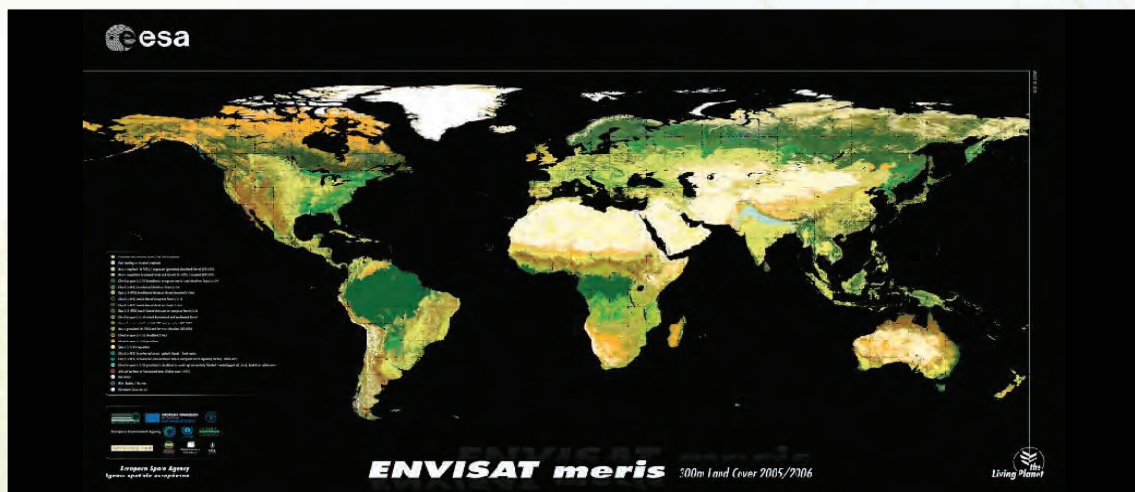


Fig. 1: Total Emission trends from 1970-2005 for Annex I versus Non-Annex I parties of the UNFCCC.



MERIS (Medium Resolution Imaging Spectrometer) flies since 2002 on the ENVISAT satellite, developed and operated by the European Space Agency (ESA), and is **the most advanced spectrometer, imaging the planet in 15 spectral bands, accurately calibrated.** MERIS land cover is widely used for applications falling in many GEO Societal Benefit Areas including Climate. It is easily available to all

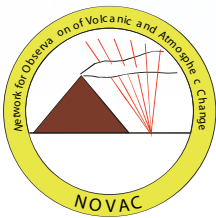
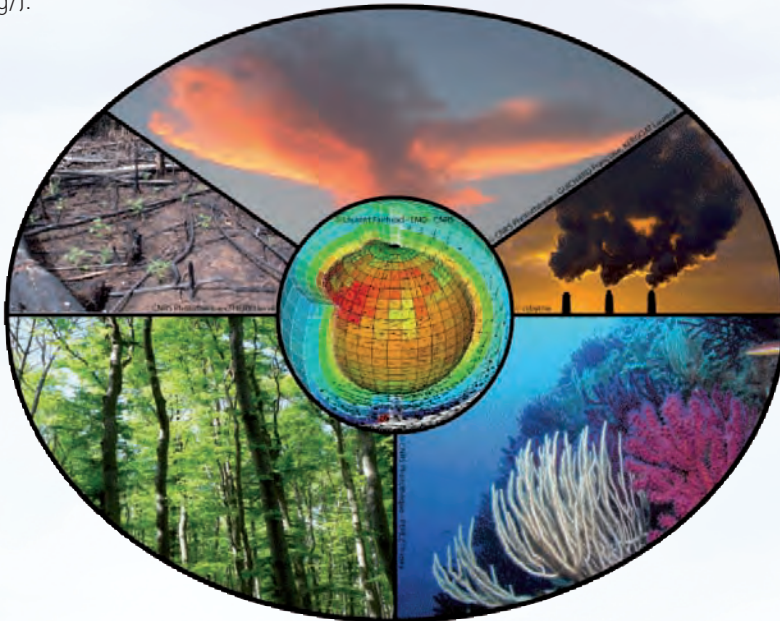
GEO users. The GMES Sentinel-2 and Sentinel-3 missions will support land cover with improved data streams.





Climate Earth system models are key tools to understanding climate change and its effects on society and are at the basis of the International Panel on Climate Change (IPCC) projections and EU policy on climate change. The EU funded project **IS-ENES (Infrastructure for the European**

Network for Earth System Modelling) aims to promote the development of a common distributed modelling research infrastructure in Europe in order to facilitate the development and exploitation of climate models and better fulfil the societal needs with regards to climate change issues. (<http://is.enes.org/>).



NOVAC (Network for Observation of Volcanic and Atmospheric Change) is an EC project set to establish a global network of stations on volcanoes in Europe, Africa, South and Central America for the quantitative measurement of volcanic gas emissions by UV absorption spectroscopy making use of a novel type of instrument, the Scanning mini-DOAS, developed within the EU-project DORSIVA.

The instruments provide new parameters for risk assessment, gas emission estimates and geophysical research on the local scale. In addition data are exploited for global estimates of volcanic gas emissions, large scale volcanic correlations, studies of climate change, studies of stratospheric ozone depletion, etc. (www.novac-project.eu)



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Recognising the need to improve our understanding of the Earth system and enhance our ability for informed decision making for the benefit of our planet and the sustainability of our societies, over 130 governments and leading international organisations are participating in the Group on Earth Observations, or GEO, to coordinate the construction of a Global Earth Observation System of Systems (GEOSS) by the year 2015.

This series of brochures provides a snapshot of the process developed by the GEO to build the GEOSS taking advantage of the international framework of cooperation and of the common vision to share and integrate information with a view to serving nine Societal Benefit Areas.

Examples of contributions from European and the European Commission-funded projects benefiting to the specific societal area or to the GEOSS building blocks are presented in each thematic brochure

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