

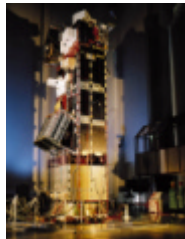
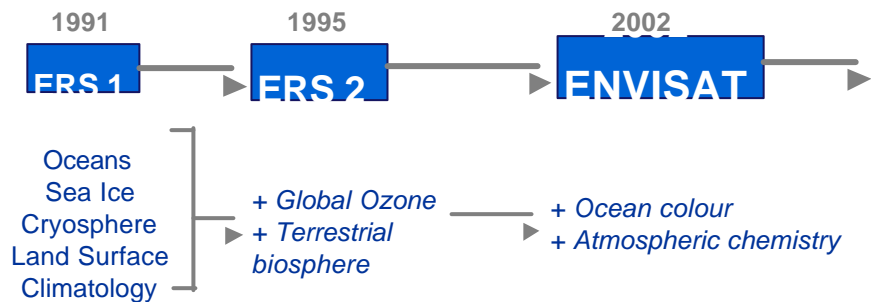
## How Climate Benefits from Space

- Understanding, e.g. modelling for IPCC
- Monitoring, e.g. LULUCF reporting

Please contact ESA help desk for ordering CD-ROM: How can environmental conventions benefit from space?



## ESA Earth Observation Satellites



**esa** EU and ESA GMES services

Coastal Zones

Ocean Monitoring

Ice Monitoring

Northern Dimension

Risk: Fire & Flood

Risk: Geohazards

Soil & Water Quality

Forest Monitoring

Urban Services

Food Security

Humanitarian Aid

Atmosphere

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**esa** Serving the Global Change Users

33 organizations e.g. IPCC, IGBP, WCRP, GODAE, ECMWF, GOFC; participate in projects addressing the monitoring of Global Change on the different elements of the Earth system

**Elements of the Earth System**

Cryosphere

Hydrosphere

Atmosphere

Lithosphere

Biosphere

CLIMATE

GLOBECARBON

GLOBEWETLAND

GLOBECOVER

GLOBECOLOUR

GLOBEROSOL

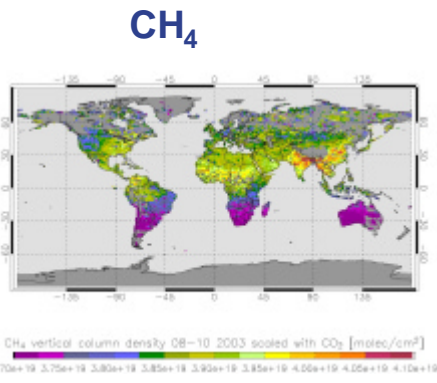
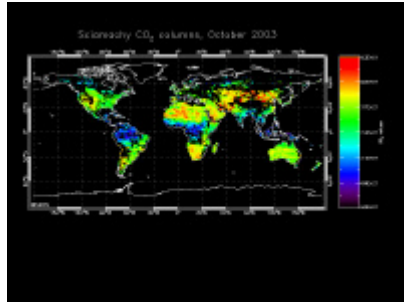
GLOBICE

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**esa** ENVISAT GhGs measurements

**CO<sub>2</sub> research ongoing...**

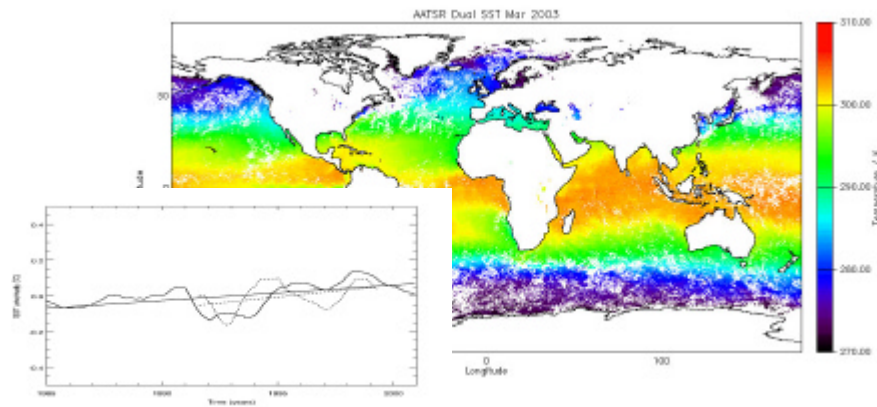


Required accuracy expected with next satellite generation (2013)

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**esa** Sea Surface Temperature

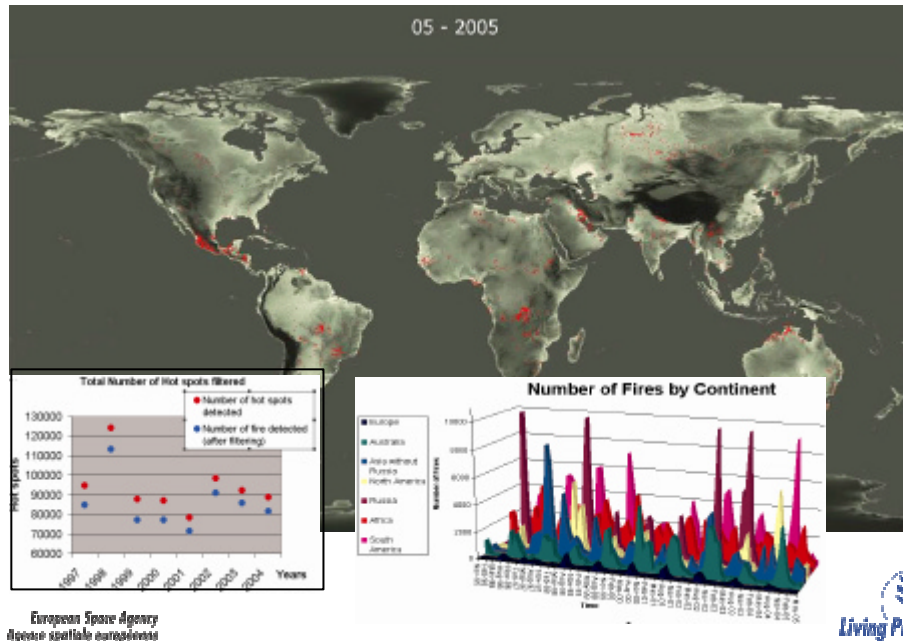


AATSR/AATSR measurements  
Trend  $0.13 \pm 0.03^\circ\text{C/decade}$

Courtesy of David Llewellyn Jones, Univ. Leicester, UK

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IO Data	Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
PAR	2001									
PAR	2002									
PAR	2003									
PAR	2004									
PAR	2005									
PAR	2006									
PAR	2007									
PAR	2008									
PAR	2009									

The GLOBCARBON products and services have been developed by:

- VITO - Flemish Institute for Technological Research - [www.vito.be](http://www.vito.be)
- LEIHA - Laboratorio di Modelli e Applicazioni Ambientali - [www.leiha.it](http://www.leiha.it)
- SATIMAT - [www.satimat.it](http://www.satimat.it)
- GM - Geographic Information Management, Belgium - [www.gim.be](http://www.gim.be)
- Trinity - Belgium - [www.trinity.be](http://www.trinity.be)

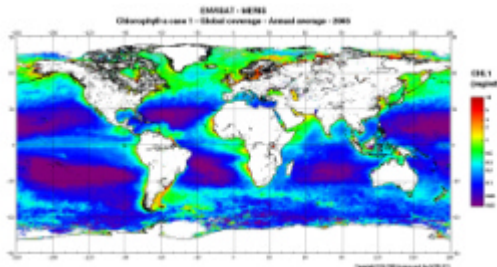
The GLOBCARBON Algorithms have been developed by:

- IGBP - International Geosphere-Biosphere Programme - [www.igbp.org](http://www.igbp.org)
- ESA - European Space Agency - [www.esa.int](http://www.esa.int)
- JRC - Joint Research Centre - [www.jrc.ec.europa.eu](http://www.jrc.ec.europa.eu)
- University of Toronto - [www.jag.utoronto.ca](http://www.jag.utoronto.ca)
- CEISIG - Centre of Earth System & BioSphere - [www.ceisig.org](http://www.ceisig.org)

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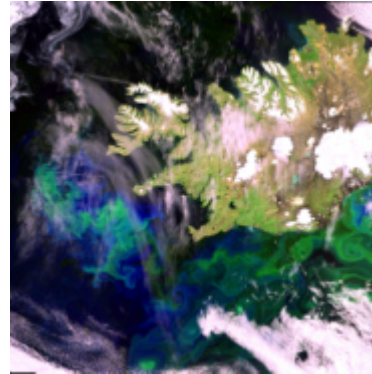
### Services:

- ◆ Global daily ocean colour 1997 to 2007
- ◆ For ocean carbon cycle research
- ◆ Merge SeaWiFS, MERIS, MODIS
- ◆ NRT service demonstration



MERIS chlorophyll (ESA, ACRI)

MERIS image of algal bloom off Icelandic coast (ESA)

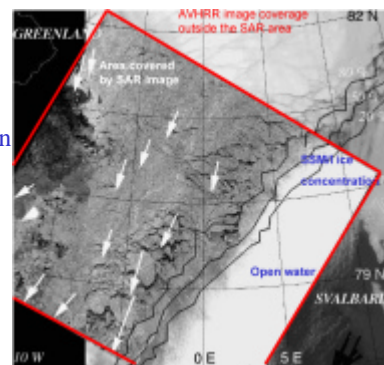
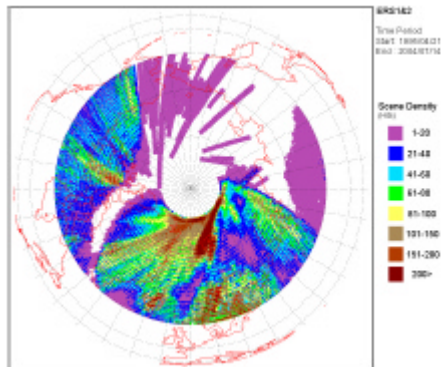


### Users:

- ◆ IOCCG
- ◆ IOCCP

### Services:

- ◆ Sea ice motion and deformation mapping
- ◆ Seasonal cycle of sea ice in the Arctic
- ◆ Long-term changes in the cryosphere e.g. extent, volume and flux of sea ice, based on 15 years archive of ERS and ENVISAT (more than 500 000 SAR scenes)



### Users:

- ◆ CliC (Champion User)
- ◆ IGBP, WCRP and other Climate Research Programmes
- ◆ Scientific communities



# Aerosol Monitoring

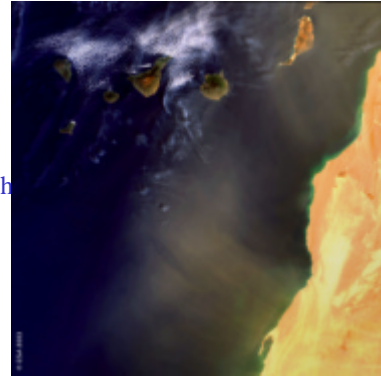


## Services:

- ◆ Global daily aerosol 1995 to 2005
- ◆ For climate and weather prediction research, transboundary pollution assessment and air quality agencies
- ◆ Merge ATSR-2, AATSR, MERIS, SEVIRI
- ◆ Retrieval developed by UniOx and RAL with support from LOA
- ◆ Intercomparison with CTMs



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MERIS image of saharan dust over the Canaries

## Users:

- ◆ ECMWF
- ◆ EMEP
- ◆ Meteo France
- ◆ MPI-Meteorology
- ◆ ARPA Lombardia
- ◆ VMM
- ◆ LUA NRW
- ◆ Min Env, Greece



## CONTRAILS Monitoring

**User:** EUROCONTROL (European Organisation for the Safety of Air Navigation)

### Applications:

Aviation induced climate change: direct effect of contrails and contrail cirrus

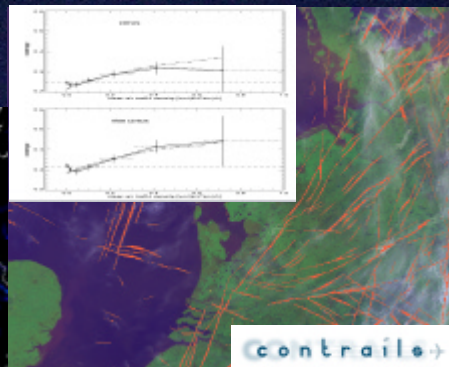
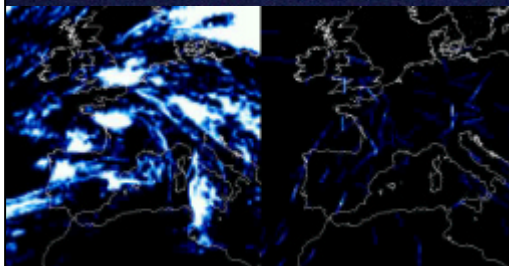
### Products/Activities:

Contrails mapped over Europe and N Atlantic 1985-2004

Quantify correlation between aircraft traffic and cirrus cloud formation

**Input:** Air traffic density information










+ satellite



**esa** Supporting Parties for LULUCF reporting

Which advantages  
1990 data available  
GPG guidelines compliant definitions  
Updating frequency of information increased  
High accuracy systematically assessed

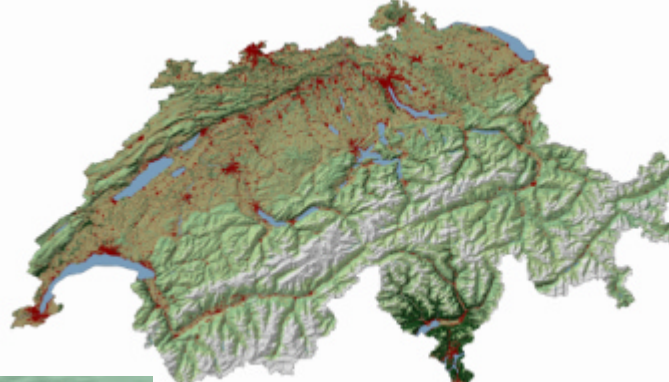
Working with the Parties

 <p><b>SOUTH AFRICA</b> Data from U.S. CO2MEASUREMENTS 243,000 ha reported for each of the following years: 1990-2008</p>	 <p><b>POLAND</b> Data from Ministry of Environment and Natural Resources 130,000 ha reported for each of the following years: 1990-2002</p>	 <p><b>ITALY</b> Data from Ministry of Environment and Ministry of Agriculture 2,200,000 ha reported for each of the following years: 1990-2006</p>	 <p><b>GREECE</b> Data from National Observatory of Athens 2,000,000 ha reported for each of the following years: 1990-2002</p>	 <p><b>GERMANY</b> Data from Federal Ministry of Economic Protection, Transport and Agriculture 2,000,000 ha reported for each of the following years: 1990-2002</p>
 <p><b>FRANCE</b> Data from Ministry of Agriculture 1,000,000 ha reported for each of the following years: 1990-2002</p>	 <p><b>NETHERLANDS</b> Data from Ministry of Agriculture and Fisheries whole country coverage for 1991-1999-2006</p>	 <p><b>SWITZERLAND</b> Data from Ministry of Environment whole country coverage for 1991-1999-2006</p>	 <p><b>SPAIN</b> Data from Ministry of Environment 2,500,000 ha reported for each of the following years: 1990-1999-2002</p>	

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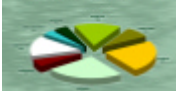
**the Living Planet**

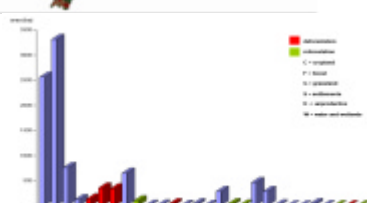
**esa** Baseline Year Map of Switzerland



- coniferous
- deciduous
- mixed forest
- cropland
- grassland
- settlement
- unproductive
- water and wetland

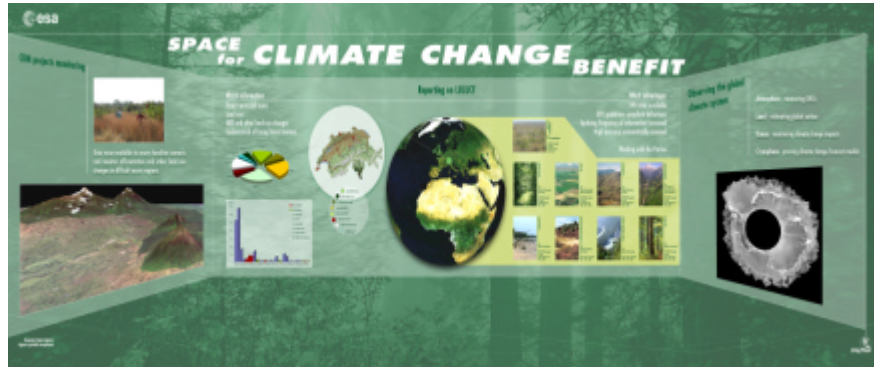
Which information:  
Forest area and types  
Land use  
GHG and other land use changes  
Carbon stock of living forest biomass





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[www.esa.int/eo](http://www.esa.int/eo)  
[www.esa.int/duo](http://www.esa.int/duo)  
[www.esa.int/gmes](http://www.esa.int/gmes)

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