

# EU action against climate change



research and development  
to stimulate climate-friendly  
technologies



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## The crucial role of research and development in addressing climate change



Climate change is a subject of enormous complexity and magnitude. Thanks to a focused research effort, we are continuously improving our understanding of the drivers and the options we have to reduce its impact.

Research has helped us to find out about the causes, manifestations and effects of climate change. Our knowledge is advancing rapidly, thereby reducing uncertainty. Research combined with economic analysis has enabled us to identify the most cost-effective measures to mitigate climate change. Research focusing on technological development plays an important role in preparing the low-carbon society of the future by improving existing climate-friendly technologies and devising those of tomorrow. Lastly, we need research to be able to predict climate-related changes, at global, regional and local levels, so we can take adaptation measures.

The European Union (EU) has financed research into climate change and technological development (R&D) since the 1980s, facilitating the formulation of realistic policy objectives. The EU's current R&D programme 2002-2006 allocates roughly €2 billion to research that directly or indirectly deals with climate change. Another €1.2 billion is being spent on nuclear research. These sums complement the financial resources that the 25 Member States commit nationally to climate change-related R&D.

In response to the need for greater efforts to deal with climate change in the future, it is proposed to increase EU funding for climate-relevant research approximately three-fold from 2007 onwards.



## EU priorities

In broad terms, EU-funded research supports the following priorities:

- ⇒ *Understanding, observing and predicting climate change and its impacts*
- ⇒ *Providing tools to analyse the effectiveness and costs & benefits of different policy options for mitigating climate change and adapting to its impacts*
- ⇒ *Improving, demonstrating and deploying existing climate-friendly technologies and developing the technologies of the future.*



The EU's main instrument for R&D funding in Europe is the multi-annual framework programme. It brings together scientists from all 25 Member States and is also open to scientists from third countries. The current sixth framework programme runs from 2002 to 2006 and has a budget of €17.5 billion. Climate change falls under 'Sustainable Development, Global Change and Ecosystems' with a budget of almost €2.2 billion.

- ▶ €900 million are allocated to 'sustainable energy systems,' covering the development, dissemination and adoption of innovative technologies and sustainable solutions in energy production and consumption. This involves in the increased use of renewable energies, energy efficiency, clean burning of fossil fuels, use of alternative fuels, carbon capture and storage, and hydrogen and fuel cell technology.
- ▶ €700 million are allocated to 'global change and ecosystems.' Among other things, this covers operational forecasting and modelling of climate change, its impact on ecosystems and biodiversity, research into reducing greenhouse gas emissions, the evaluation of carbon sinks, ozone layer depletion and the creation of new management tools.
- ▶ €600 million are allocated to 'sustainable surface systems,' covering the development and introduction of environment-friendly, efficient and safe transport systems for passengers and goods by road, rail and sea.

The European Commission's Joint Research Centre, which provides research support for EU policymaking and is funded under the R&D framework programmes, is involved in climate modelling, adaptation and mitigation technologies, and scenario-building. The Commission is also actively participating in international technology partnerships, such as the International Partnership for the Hydrogen Economy and the Carbon Sequestration Leadership Forum.

The budget of the sixth framework programme represents around 5% of all public, non-military research spending in the EU. As most projects are only partially financed



by the EU, it mobilises additional funds. EU R&D programmes also signal to national research communities and the private sector what the European research priorities are, triggering additional research.

## Looking to the future



In early 2005, the EU agreed on the need to scale up domestic and global efforts to fight climate change in the future, as proposed in the European Commission's policy document, "Winning the Battle against Global Climate Change". The report advocates a major push for innovation based on stronger and better focused research and on policies that spur the uptake of climate-friendly technologies at an early stage of their commercialisation.

In line with this, the Commission's proposal for the 7th R&D framework programme, to run from 2007 to 2013 with an overall budget of approximately €72 billion, roughly triples funding for climate change-related research. It includes three relevant thematic areas: energy (€2.9 billion), environment (€2.5 billion) and transport (€5.9 billion). Another €4.2 billion is proposed for nuclear fusion energy research, fission and radiation protection.

Additional funding will come from other activities and specific programmes. For example, the European Commission's Joint Research Centre will increasingly support EU climate change policies, and the Commission has proposed a 'Competitiveness and Innovation Framework Programme' (€4.2 billion) that will help enterprises and industry innovate.

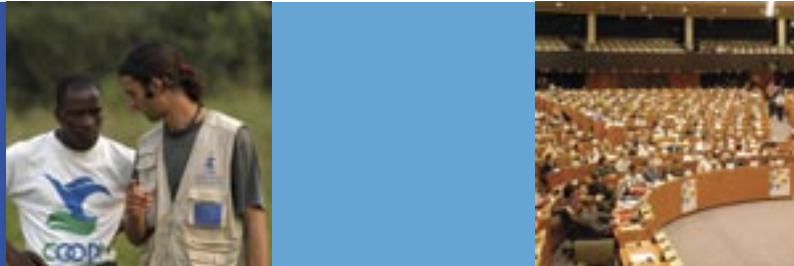
The proposals will be discussed and adopted by the EU Council of Ministers and the European Parliament.

The three major institutions of the EU are the European Commission, the Council of Ministers and the European Parliament. The European Commission is the sole body that has the right of initiative in proposing and drafting EU legislation, and it is responsible for ensuring its correct implementation after adoption. Most legislation must be adopted by the Council of Ministers, which represents the 25 EU Member States, and the European Parliament, which is made up of 732 directly elected deputies from all Member States.



## International cooperation - a key aspect of EU R&D

International cooperation has been an integral part of the EU R&D framework programmes. Under the 6th framework programme, €600 million are allocated to funding scientists from third countries so they can participate in EU-supported research projects, and to projects aimed at establishing international cooperation in specific fields.



As regards climate change, international research activities are explicitly encouraged by the United Nations Framework Convention of Climate Change (UNFCCC), which was agreed in 1992, and its 1997 Kyoto Protocol. The two agreements call on their signatories to promote, and to cooperate in, scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives.

European researchers in the field of climate change are therefore actively cooperating with their counterparts in third countries and disseminating the results of European research projects. The results also feed into the work of the Intergovernmental Panel on Climate Change (IPCC). Established in 1988 by the United Nations, the IPCC brings together more than a thousand scientists from across the world to assess and synthesise existing knowledge. So far, it has published three major reports. Many European researchers directly contribute to the work of the IPCC by making available their research, providing expert knowledge and peer-reviewing studies.



## The 'push and pull' approach to ensure the uptake of new technologies

On its own, the development of climate-friendly technologies will not bring about the changes in our energy systems and economies that are necessary to limit climate change. The technologies must also be put to use. Their introduction in the market makes it possible to exploit the technological 'learning curve', which describes a



steady fall in costs and the continuous improvement of the technologies under real-life conditions. This virtuous circle in turn fosters deployment on a wider basis.

Studies indicate that the development and uptake of low-carbon technologies requires a complementary approach – 'technology push' through R&D and 'market pull' through incentives and the appropriate regulatory framework.

In this respect, market-based instruments are useful. For example, the EU emissions trading scheme, which began operating on 1 January 2005, encourages the use of emission-saving technologies by capping CO<sub>2</sub> emissions from some 11,500 energy-intensive installations in the EU. Other examples are green certificate schemes and fiscal incentives for renewable energy sources, which exist in several Member States.

As a result of focused research and policies 'pulling' wind power onto the market, particularly in Germany, Spain and Denmark, wind turbine power has increased by a factor of 100 in the last 20 years, while wind power generation costs have declined by some 80%. From units of 20-60kW in the early 1980s with rotor diameters of around 20m, generators of single wind turbines have increased to 5,000kW with rotor diameters of over 100m.





When all cost elements (including investment, operation and maintenance costs) are considered together, the cost of wind power generation in the EU has come down to approximately 4-5 €cents/kWh at sites with very good wind speeds, and to 6-8 €cents/kWh at sites with low wind speeds. These figures were calculated for 2003 when the wholesale cost of electricity produced by conventional power plants was around 3 €cents/kWh. Due to recent increases in electricity prices, wind power is now approaching competitiveness in locations with high average wind speeds.

What is more, European companies supply 90% of the global market for wind turbines - a market that is worth around € 8 billion and has been growing at 30% per year.

Other renewable energy sources and low-carbon technologies are ready to be used more widely if the right mix of policies is put in place. Renewables, carbon capture and storage techniques, and nuclear fission can decarbonise electricity production and reduce the combustion of fossil fuels to produce energy. Other existing technologies can improve the energy efficiency of buildings, power plants and vehicles. There are also techniques to manage forests and agricultural soil that can enhance the function of natural sinks.

At the same time, research remains crucial to devising the technologies that will play a role in the medium to long-term future. In this regard, hydrogen & fuel cell technology are promising options.



## Clean, clever, competitive: the Environmental Technologies Action Plan

The EU's Environmental Technologies Action Plan (ETAP), launched in January 2004, seeks to improve the development and promote the wider use of eco-technologies in the EU, including climate-friendly technologies.

It is based on the recognition that many new environmental technologies have great potential to help resolve environmental problems and, at the same time, boost competitiveness and contribute to economic growth in Europe since the global market for environmental technologies is growing at 5% per year.

ETAP has identified 25 actions to overcome barriers that slow down the development and introduction of eco-technologies. These barriers include economic obstacles (distorting market prices and subsidies, the need for initial investments, the complexity of switching to a new technology), unfavourable regulations and standards, lack of targeted research, inadequate availability of risk capital, and lack of market demand.

The key priority actions under ETAP focus on three themes:

**Getting from research to markets:** a stronger and more focused research effort including demonstration projects and dissemination; the establishment of technology platforms bringing together researchers and business on specific issues to build long-term visions on research needs and future market developments; European networks for testing, performance verification and standardisation to provide business and consumers with the information they need.

**Improving market conditions:** development of performance targets for key products, processes and services to improve their performance and stimulate competition; mobilisation of finance to share the risks of investing in new technologies; review of state aid guidelines and subsidies to ensure they do not discriminate against new technologies; green public procurement to use the purchasing power of the public sector as a market driver; awareness-raising among business and consumers; training in the use of new technologies.

**Acting globally:** promotion of responsible investments in, and use of, environmental technologies in developing countries and countries in economic transition.

ETAP is being implemented by the European Commission, national and regional governments, industry and other stakeholders. By the end of 2005, Member States have to prepare national roadmaps for its implementation. While many of the actions are long-term, initial progress includes the establishment of technology platforms (on hydrogen & fuel cell technology, photovoltaics, manufacturing technologies, aeronautics, construction and steel), the establishment so far of three networks of validation centres, increased funding for eco-innovation in the proposed 7th R&D framework and competitiveness programmes for 2007-2013, the publication of a handbook on green public procurement with many practical tips for public authorities, and a recommendation to standardisation bodies in the EU to consider environmental aspects when setting standards.

More information is available at: [www.europa.eu.int/comm/environment/etap/index.htm](http://www.europa.eu.int/comm/environment/etap/index.htm)



## Examples of EU-funded research projects

The following are examples of research projects funded by the EU under the 5th (1998-2002) and 6th framework programmes (2002-2006).

### *Connecting models to policy needs*

*In recent years, the focus has moved from developing large-scale climate models to linking these models to policy needs. EU-funded projects are now facilitating decision-making by providing a sound scientific base including estimates of uncertainties.*

#### **ENSEMBLES (2004-2009)**

This UK-led project brings together 70 partners from the EU, Switzerland, Australia and the US, with EU funding of €15 million. The project aims to develop and test an ensemble prediction system for climate change, simultaneously using several models, and to quantify and reduce uncertainty in the representation of feedbacks in the Earth system. (Feedbacks describe the interlinkages between different components of the Earth System.)

[www.ensembles-eu.org](http://www.ensembles-eu.org)

#### **CarboEurope (2004-2009)**

Funded with €16.3 million from the EU and another €16 million from national governments, CarboEurope is a large integrated project with 61 partners from 17 European countries. It seeks to understand and quantify the present terrestrial carbon balance between uptake and return of CO<sub>2</sub> to the atmosphere of Europe and the associated uncertainty at local, regional and continental scale.

[www.carboeurope.org](http://www.carboeurope.org)



## **Evaluating the impacts and costs of climate change**

*Theoretical knowledge, observations, experimental results and newly developed tools are brought together under the EU umbrella to generate better understanding of the environmental and socio-economic impacts of climate change as well as the impacts and costs of mitigation and adaptation policies.*

### **Scale and effects of climate change in Europe - ACACIA (1997-2000)**

ACACIA is so far the biggest European attempt to assess the scale of climate change in Europe, its effects and options for adaptation. Over a three-year period, it harnessed the knowledge of 39 top experts on climatology, the environment and the human sciences from 12 EU countries and produced four future scenarios for Europe based of different levels of temperature increase. Acacia's forecast table is now the most comprehensive reference on the subject and represents a major European contribution to the work of IPCC.

<http://europa.eu.int/comm/research/success/en/env/0336e.html>

### **Economic effects of climate change policies - GECS (2000-2002)**

With €700,000 from the EU, the project prepared economic assessments of climate change policies related to the Kyoto Protocol's flexible mechanisms up to 2030.

[www.upmf-grenoble.fr/iepe/GECS](http://www.upmf-grenoble.fr/iepe/GECS)

### **Vulnerability of human health - cCASHh (2001-2004)**

Funded by the EU with €1.4 million, this project focused on the vulnerability of human health to adverse effects of climate change, such as heat waves and diseases, and analysed possible adaptation measures.

[www.euro.who.int/ccashh](http://www.euro.who.int/ccashh)

### **Coastal vulnerability - DINAS-COAST (2001-2004)**

This project, funded with €1.4 million from the EU, combined state-of-the-art science and data from a range of different disciplines to help policy makers interpret and evaluate coastal vulnerability to climate change and sea-level rise in Europe.

[www.dinas-coast.net](http://www.dinas-coast.net)

### **Vulnerability of freshwater eco-systems - EURO-LIMPACS (2004-2009)**

The project is bringing together around 40 partners and will receive €12 million in EU funding. It is addressing the impacts of climate change on freshwater eco-systems.

[www.eurolimpacs.ucl.ac.uk](http://www.eurolimpacs.ucl.ac.uk)

### **Technology transfer under the Kyoto flexible mechanisms - TETRIS (2006-2007)**

Supported with €700,000 from the EU, TETRIS seeks to explore the economic and industrial impacts of, as well as the prospects for achieving technology transfer with, the Kyoto flexible mechanisms.

<http://www.zew.de/en/forschung/projekte.php3?action=detail&nr=486>



## Lessons from the ice: EPICA

The polar ice sheets are unique and very precious archives of changes in past climate and in the atmosphere's composition. Tiny air bubbles trapped in the ice provide clues to the composition of the Earth's atmosphere thousand of years ago, while the relationship between the levels of atmospheric CO<sub>2</sub> found in the bubbles and the temperature at which the ice formed reflects the extent of the greenhouse effect at that time.

EPICA (1996-2005) is an ambitious multinational European project for deep ice-core drilling in Antarctica. It is a joint project of the European Commission and the European Science Foundation, and has received EU funding of €8.5 million.

The aim of the project is to predict more accurately how global climate is likely to respond to increased emissions of greenhouse gases as a result of human activities. Some of the questions that EPICA seeks to answer are: is the relatively stable warm climatic period of the last 10,000 years an exception in the last 500,000 years? Were the rapid climatic changes of the last ice age cycle global events or restricted to the northern hemisphere, and are the climates of the two hemispheres linked? Which patterns do the transitions from the glacial to warmer periods, and vice versa, follow?

As part of the EPICA project, two new deep ice cores have been drilled in Antarctica. Drilling at one of the sites - Concordia Station, Dome C - was completed in December 2004, reaching a drilling depth of 3270.2 m, 5 m above bedrock. The retrieved core will extend the record back to around 890,000 years ago.



## **Achieving more sustainable energy systems**

*Sustainable energy systems are based on improvements in energy efficiency as well as the production of cleaner energy and/or renewable energy. Sustainable energy systems not only reduce greenhouse gas emissions, but produce ancillary benefits such as cleaner air, greater energy security of supply and lower vulnerability to oil price fluctuations.*

### **Energy systems - DISPOWER (2002-2006)**

The Dispower project – a consortium of 37 industry players and academic institutions, funded by the EU with €9.5 million – is supporting the transition from today's energy supply structures based on the traditional electricity grid design to a more market-oriented and decentralised supply structure that encompasses renewable energy sources and small generating plants.  
[www.dispower.org](http://www.dispower.org)

### **Photovoltaics - CRYSTAL CLEAR (2004-2008)**

The main objective of the CRYSTAL CLEAR integrated project (16 partners) is to allow photovoltaic modules to be produced at low costs while improving their environmental profile by 20%. The EU is supporting this project with €16 million.  
[www.ipcrystalclear.info](http://www.ipcrystalclear.info)

### **Biofuels - RENEW (2004-2008)**

RENEW is an integrated project with 31 partners and EU funding of €10 million. It will develop and evaluate processing technologies for the synthesis of liquid fuels from biomass with a view to producing cost-effective premium fuels for current and future combustion engines.  
[www.renew-fuel.com](http://www.renew-fuel.com)

### **Geological storage of carbon - CO2SINK (2004-2008)**

This project, which will receive €8.7 million from the EU, aims to explore geological storage of CO<sub>2</sub>. It will investigate a former natural gas storage site and a deeper aquifer and, if safe, inject them with 100,000 tonnes of CO<sub>2</sub>. The effects of the injections will be monitored with special monitoring techniques.  
[www.co2sink.org](http://www.co2sink.org)

### **Hydrogen - HYWAYS (2004-2007)**

HyWays is an integrated project to develop the European Hydrogen Energy Roadmap. Funded with €4 million from the EU, it will carry out a comparative analysis of regional hydrogen supply options and energy scenarios for the periods until 2020, 2030 and 2050.  
[www.hyways.de](http://www.hyways.de)

### **Fuel cells - FURIM (2004-2008)**

The integrated project FURIM (EU funding: €4 million) is devoted to further developing fuel cell technologies, particularly the development of polymer membranes for operation above 100°C. This will support the commercialisation of the fuel cell technology.  
[www.furim.com](http://www.furim.com)



### **Effects of enhancing carbon sinks in agriculture and forestry - INSEA (2004-2006)**

With EU funding of €1.5 million, INSEA seeks to develop an analytical tool to assess the economic and environmental effects of enhancing carbon sinks in agriculture and forestry.  
[www.iiasa.ac.at/Research/FOR/INSEA](http://www.iiasa.ac.at/Research/FOR/INSEA)

### **Shift to a hydrogen-based economy - CASCADE MINTS (2004-2006)**

This tool, being developed with €1 million in EU support, will analyse the prospects for a shift to a hydrogen-based economy and build scientific consensus on the impacts of policies aimed at promoting sustainable energy systems.  
[www.energytransition.info/cascade-mints](http://www.energytransition.info/cascade-mints)

### **Analytical tools, models and databases developed with EU support**

**PRIMES** - a large-scale model of the energy systems of EU Member States that allows for forecasting, scenario construction and policy impact analysis covering a wide range of energy, environmental and technological policies;

**POLES** - a world simulation model for the energy sector that allows for regional long-term projections of demand, supply and prices, analyses of the impacts of emission trading systems and the costs of CO<sub>2</sub> abatement policies, and technology improvement scenarios;

**GEM-E3** - a model providing details on the macro-economy of EU countries or world regions and their interaction with the environment and the energy systems; allowing for a consistent evaluation of climate change policy measures;

**NEMESIS** - an econometric macro-sectoral model for EU countries to assess the impacts of economic, environmental and R&D policies in the short to medium term;

**MURE** - a database on policies and measures for the rational use of energy and renewables in the EU as well as their ex-ante evaluation;

**GREEN-X** - a tool box with a database calculating potential and costs of climate-friendly energy sources and technologies and the corresponding reductions in greenhouse gases. It uses a dynamic computer model linking and simulating different



## ***Coordinating and harmonising Earth observation systems***

*Through space, meteorological, atmospheric, oceanic and terrestrial observation centres, European scientists are constantly monitoring the effects of human activities on the global atmosphere and water, as well as land use and ecosystems changes. This provides the necessary scientific background for solid policies. The EU has built up considerable experience in the design, production and operation of Earth observing tools.*

### **Global Earth Observation System of Systems - GEOSS (2005-2015)**

As part of the Group on Earth Observations, the EU is working on the ground-breaking Global Earth Observation System of Systems (GEOSS) project, which was launched by 50 countries and 40 international and scientific organisations in February 2005. GEOSS will bring together and make available information on the state of the global environment.  
[http://europa.eu.int/comm/research/environment/geo/article\\_2450\\_en.htm#4](http://europa.eu.int/comm/research/environment/geo/article_2450_en.htm#4)

### **Global Monitoring for Environment and Security - GMES (2002-2008)**

Global Monitoring for Environment and Security (GMES) is a joint EU and European Space Agency programme. It represents a concerted effort to collate environmental and security-related data and link information providers with users.  
[www.gmes.info](http://www.gmes.info)

### **Oceanic observation - MERSEA (2004-2008)**

MERSEA aims to develop a European system for operational monitoring and forecasting on global and regional scales of the ocean physics, biogeochemistry and ecosystems. This integrated system will be the ocean component of the future GMES system.  
[www.mersea.eu.org](http://www.mersea.eu.org)

### **Oceanic observation - CarboOcean (2005-2010)**

The CarboOcean project focuses on large-scale observation of the carbon cycle in oceans, in particular the Atlantic and southern oceans. It will receive €14.5 million in EU funding.  
[www.carboocean.org](http://www.carboocean.org)

### **Space-based observation**

The EU has provided a comprehensive set of operational space missions with permanent and continuous observing capacities of the Earth's system. The European Commission's Joint Research Centre is developing methods to extract the information from space observations and to assist space agencies in meeting the needs of climate science.

### **Atmospheric observation - World Data Centre for Aerosols**

The Joint Research Centre operates the World Data Centre for Aerosols, one of six World Data Centres set up in the framework of Global Atmosphere Watch, a programme of the World Meteorological Organisation.  
<http://rea.ei.jrc.it/netshare/wilson/WDCA/>



## ***International cooperation***

*Climate change is a global issue, and international co-operation has been an integral part of the priority thematic areas of all EU framework research programmes.*

### **Climate change & African monsoons - AMMA (2005-2009)**

The project, which will receive €11.7 million in funding from the EU, aims to reinforce regional environmental monitoring systems and to improve the ability to predict the impact of climate change on West African Monsoon variability.

[www.amma-eu.org](http://www.amma-eu.org)

### **Europe/South America cooperation on climate change - CLARIS (2004-2007)**

The CLARIS project provides for the transfer of knowledge and expertise in Earth System models between Europe and South America and the creation of a high-quality climate database for South America. The EU supports the project with €500,000.

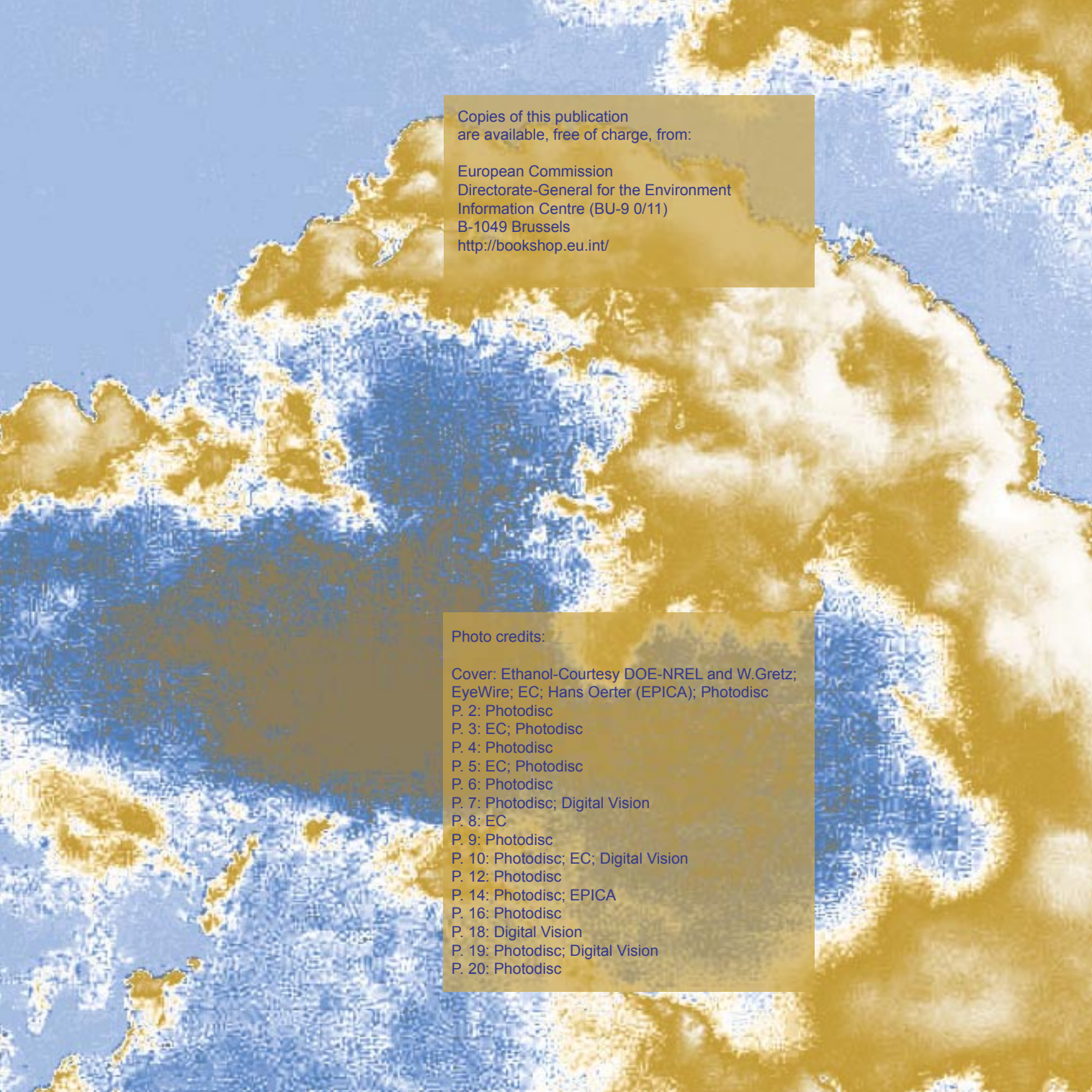
[www.claris-eu.org](http://www.claris-eu.org)

### **The Amazon ecosystem - PAN-AMAZONIA (2004-2007)**

The project, supported by the EU with €400,000, aims to build and strengthen European cooperation with Latin American partners in building critical mass of human resources and techniques for monitoring and understanding the role of the Amazon ecosystem in climate change and biodiversity.

[www.geog.ox.ac.uk/research/projects/panamazonia](http://www.geog.ox.ac.uk/research/projects/panamazonia)



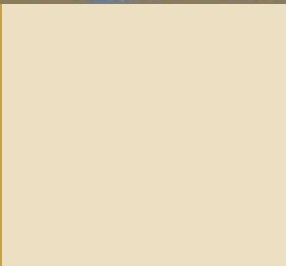
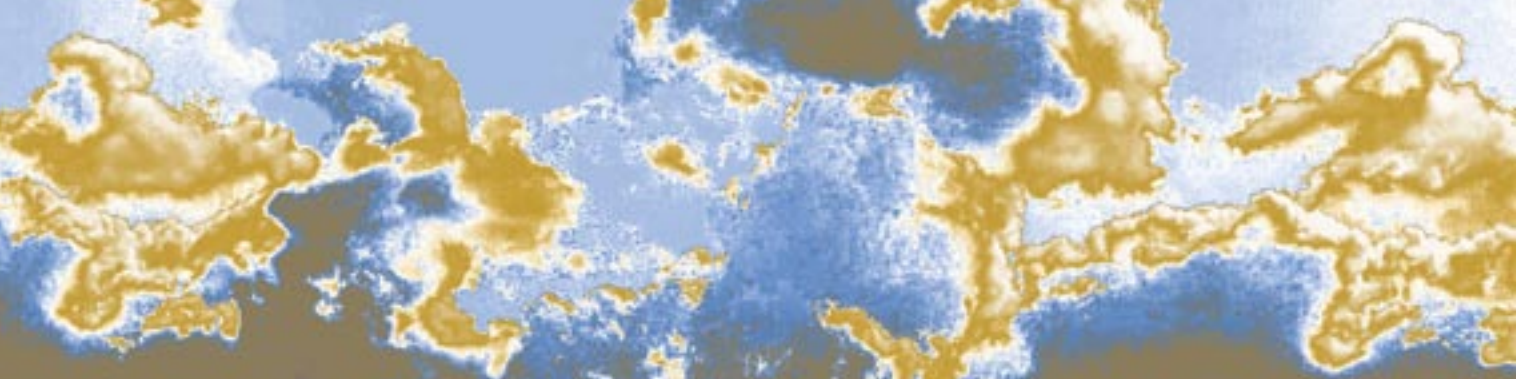


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