

Science of  
**today**  
for the  
**environment** of  
**tomorrow**



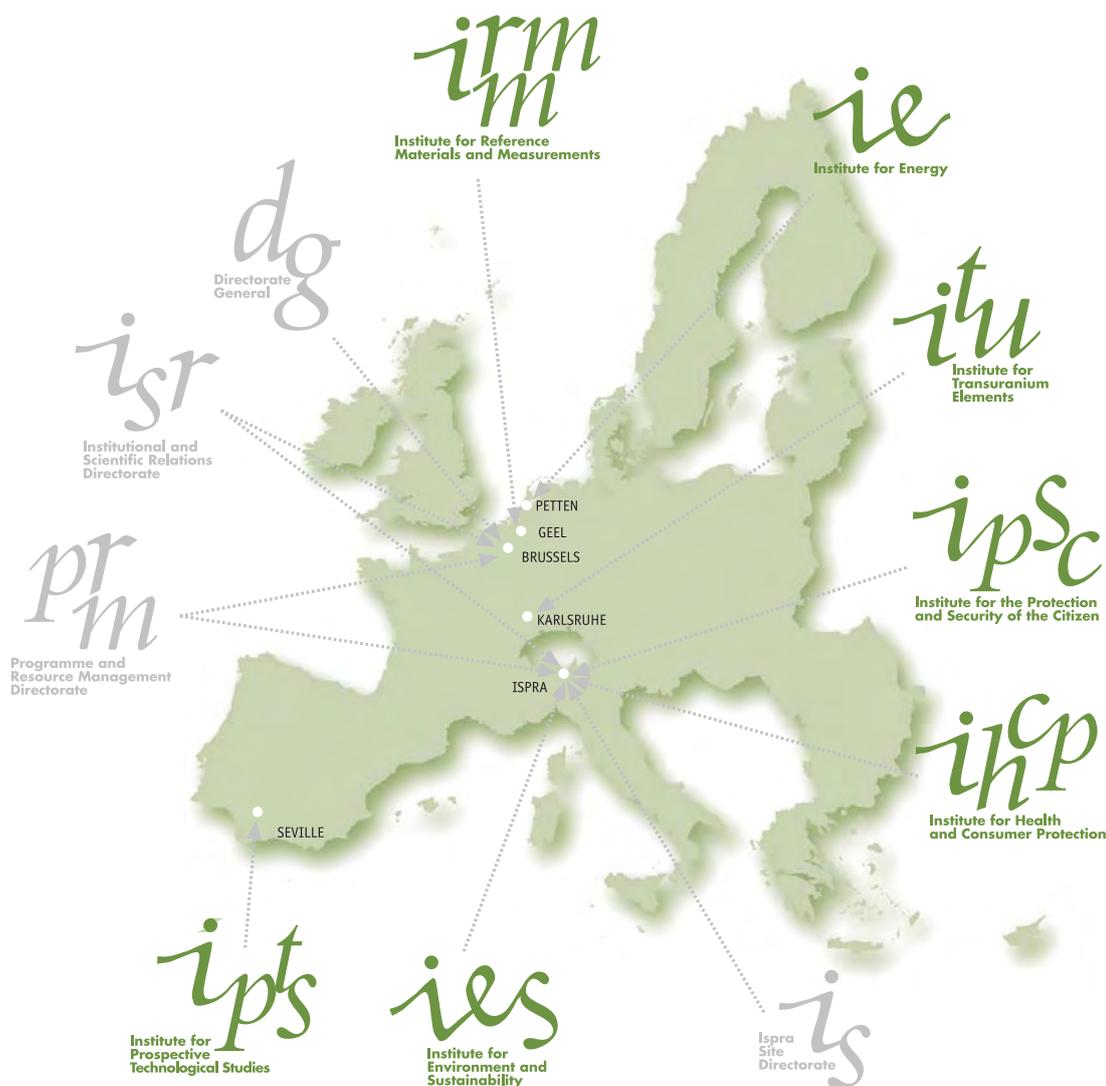
**An insight to the JRC Institute for  
Environment and Sustainability**

2004 2005 2006 **2007** 2008 2009 2010



**EUROPEAN COMMISSION**  
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Roland Schenkel  
JRC Director-General

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Anneli Pauli  
JRC Deputy Director-General

*Robust science  
for  
policy making*

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for the  
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## The IES Mission

The mission of the Institute for Environment and Sustainability is to provide scientific-technical support to the European Union's Policies for the protection and sustainable development of the European and global environment.

*1500 Collaborations*

*800 Partners*

*470 Staff*

*300 Publications per year*

*72 Competitive Projects*

*26 Institutional Research Actions*

*7 Scientific Units*

*1 Goal:*

***Environmental Sustainability***

***A small step for science,  
a giant leap for the environment***

*IES staff member Arianna Farfaletti-Casali, Italian National Champion in Pole Vaulting 2006*

A healthy environment is one of the cornerstones of the European model of sustainable development. Moreover, our natural and cultural heritage defines our common European identity and thus its preservation for present and future generations is one of our utmost responsibilities.



Since its creation in 2001, the Institute for Environment and Sustainability (IES) of the European Commission's Joint Research Centre (JRC) has been at the forefront in providing high quality research-based support to the development and implementation of European environmental policies.

This publication highlights the Institute's achievements during the execution of the JRC's Multi-Annual Work Programme 2003-2006 and the delivery of our commitments under the 6<sup>th</sup> EU Research Framework Programme. You will find an overview of the activities carried out by the IES in this period, the major results achieved, an insight into selected projects, and links to further reading.

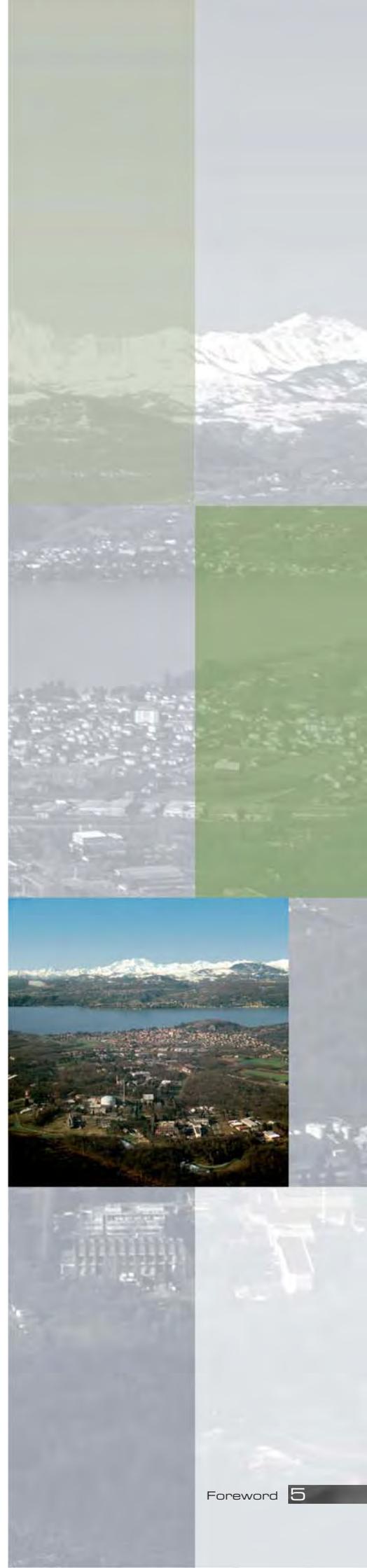
At the same time, this publication provides an outlook on the major challenges awaiting us in the context of the 7<sup>th</sup> EU Research Framework Programme (2007-2013). Together with its research partners in the JRC, in EU Member States and beyond, the IES is ready to face these challenges with the aim to satisfy its customers and thus to help in safeguarding a healthy environment for us and our children.

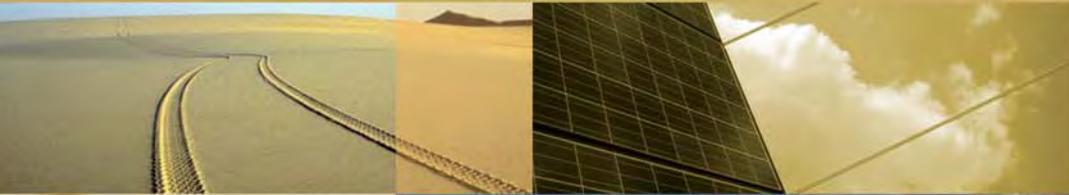
Four priorities will drive our research in the years to come.

- **First, environment and prosperity.** We are firmly convinced that environmental concerns are no obstacle for European competitiveness, but on the contrary are a key for achieving Europe's aim to become the most competitive knowledge-based society in the world.
- **Second, environment and solidarity.** We support the common goal of providing equal access to a healthy environment to all European citizens. At the same time, we perceive solidarity as intergenerational justice, allowing future generations to choose their own priorities for development.
- **Third, environment and security.** Many people are concerned about potential threats to the integrity of their lives and belongings. It is our commitment to contribute to a reduction of environmental risks, no matter whether these are related to natural hazards or the result of human activities.
- **And fourth, the global perspective.** Europe is exporting pressure on natural resources worldwide and is facing the consequences of environmental conflict in other parts of the world. We help Europe to take up responsibility for the environmental well-being of the entire planet.

A lot has been achieved. Still more lies ahead.  
Enjoy your reading!

Manfred Grasserbauer  
*Director, Institute for Environment and Sustainability*





Environment  
and  
**Prosperity**

## Fostering economic growth whilst ensuring environmental sustainability

In the so-called Lisbon Strategy the European Union has committed itself to become the most competitive knowledge-based society in the world. The JRC's Institute for Environment and Sustainability supports this ambitious goal by developing concepts for decoupling economic growth from environmental deterioration. In fact, environmental protection should not be seen as an obstacle for competitiveness, but as a prerequisite for it - and even more: an opportunity. The environmental sector has become a job creator itself, environmental technologies being among Europe's fastest growing industries. An outstanding example is the photovoltaic industry, where Europe has gained worldwide leadership. The same refers to energy generation from wind, as well as to a large range of other environmental technologies, e.g. bioremediation and environmental information systems.

IES research seeks identifying win-win situations, where both economy and ecology profit from a holistic approach. Automotive fuels are a good example: cars that need less fuel save money and have less impact on the environment. But which are the fuels that save most money while having the best performance in terms of minimising greenhouse gas emissions? And which is the impact on the environment when assessing the whole life cycle, e.g. taking into consideration the growth of crops for use in biofuels and bioenergy? These are some of the questions the IES tries to answer, together with partners from policy, industry and the scientific community.

Examples of IES support to European competitiveness include:

- The IES is at the forefront of developing the Infrastructure for Spatial Information in Europe (INSPIRE) which will revolutionise the way we use and exchange geographic information. INSPIRE will streamline reporting obligations and avoid generation of data that is existing already, thus saving tax payer's money.
- One of the key challenges in Europe is how to ensure sustainable cities and transport systems. The IES monitors urban sprawl and develops concepts for greener transport. In particular, the Institute supports the development of vehicle emissions standards, both in Europe and globally, and assesses the options for alternative fuels and power-trains with respect to their contribution to climate change.
- The IES has a major task in fostering sustainable production and consumption by co-ordinating the "European Platform for Life Cycle Assessment" and developing relevant databases. Close collaboration with major players from industry ensures a wide acceptance of life cycle thinking.
- The Institute serves as a reference in the field of renewable energies, in particular photovoltaics. On the one hand, the IES hosts the Scientific-Technical Reference System for Renewable Energy and End-use Efficiency, on the other hand it provides certified reference for solar cells through the European Solar Test Installation.

*"The most urgent issue facing Europe today is the lack of growth and job creation that safeguards the standard of living and social protection Europeans have grown used to."*

José Manuel Barroso  
European Commission President





## CONTACT

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IES Research Action INSPIRE – Infrastructure  
for Spatial Information in Europe:  
<http://ies.jrc.ec.europa.eu/inspire.html>  
IES Research Action COSIN – Community  
Spatial Information Network:  
<http://ies.jrc.ec.europa.eu/cosin.html>  
Infrastructure for Spatial Information in  
Europe (INSPIRE):  
<http://inspire.jrc.it>  
European Geo-Portal:  
<http://eu-geoportal.jrc.it>

## CUSTOMERS

DG Environment  
DG Eurostat  
DG Regional Policy  
DG Agriculture and Rural Development  
DG Information Society  
DG Enterprise and Industry  
Member State Legally Mandated Organisations  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Proposal for a Directive establishing the  
Infrastructure for Spatial Information in  
the Community – COM (2004) 516  
United Nations Aarhus Convention on Access  
to Information, Public Participation in  
Decision-making and Access to Justice in  
Environmental Matters  
Decision laying down the 6th Community  
Environment Action Programme 2001-2010  
– 1600/2002/EC  
Communication on Global Monitoring for  
Environment and Security (GMES): From  
concept to reality – COM (2005) 565



Monica Mestre  
*IES Staff Member from Cittiglio, Italy*  
*"I like to work for the JRC because  
it allows me to be in contact with a  
stimulating pan-European dimension."*

# Building the Infrastructure for Spatial Information in Europe

Consider travelling by train across Europe and having to change train at every national border because the distance between railway tracks is different from one country to the next. Fortunately, these differences have now been overcome and since 2001 we also have technical agreements backed by European law on other important aspects related to communications, operations, and maintenance that help create an integrated European railway infrastructure and facilitate the free and safe movement of people and goods across the Union. Unfortunately, not all activities affecting our lives can rely on the existence of a similar infrastructure. For example, environmental phenomena such as natural disasters do not stop at national boundaries. In order to tackle them on the European level we need a shared knowledge base that is currently missing.



*INSPIRE will facilitate the  
access to geographic and  
environmental information  
all over Europe*

Therefore, the European Commission has proposed the establishment of an Infrastructure for Spatial Information in Europe (INSPIRE) to facilitate the exchange of environmental and geographic information. Central to INSPIRE is a concern to make better use of the data that is already available across Europe, but that it is often difficult to find, access, and use. The IES is playing a critical role in the development and implementation of INSPIRE, together with DG Environment and the European Statistical Office Eurostat. In particular, the IES is responsible for the scientific and technical co-ordination of INSPIRE, including the preparation of the technical rules that will facilitate its coherent implementation. Furthermore, the IES supports the development of the European Commission's own Spatial Data Infrastructure. This will make it possible to search, access, and use more effectively the data resources developed within the Commission services, starting with the Joint Research Centre itself.

*Did you know that the vertical  
reference systems of Germany and  
Belgium differ by more than 2 meters?*

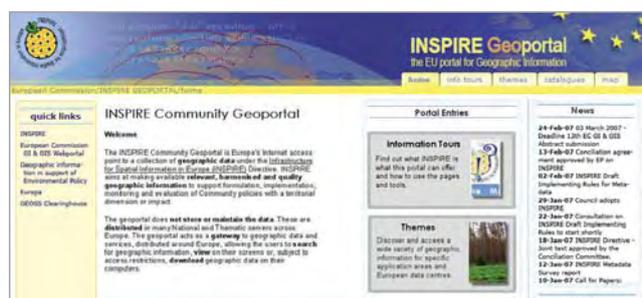
## Results achieved

- The INSPIRE Directive has been adopted by the European Commission in 2004 with major technical input from the IES, and agreed by the Council and Parliament in early 2007.
- The IES contributed to the creation of a broad community of INSPIRE stakeholders in Europe, who are adopting its principles even before the Directive is finalised.
- Development of key technical specifications including the European spatial reference system, map projection systems, and reference grid now adopted by all major European organisations.
- Confirmed international recognition of the IES as centre of scientific excellence for spatial data infrastructures, speaking for Europe in major international standardisation and spatial data infrastructure initiatives.



## Development of the EU Geo-Portal

The IES is responsible for the development of the EU Geo-Portal which is specifically required by the INSPIRE Directive. The portal is an internet-based facility providing a single point of entry to the environmental and geographic infrastructures maintained by the Member States, and the information held by the Commission services or related organisations. The Geo-Portal does not store or maintain the data. These are distributed in many national and thematic servers across Europe, maintained by the organisation responsible for the data, and conforming to agreed standards. The Geo-Portal allows users to search and discover geographic information, services, and applications provided by government, commercial, and non-commercial organisations. Its development is important to increase public access to information, and to test the operational effectiveness of existing standards, specifications, and technologies.



Highlight

*The European Geo-Portal hosted by the IES is the main entry to geographic information in Europe*

In particular, the EU Geo-Portal allows local and distributed search and discovery of metadata for geographic data and services. Thanks to extensive use of open standards, the EU Geo-Portal permits searches to be performed real-time against catalogues from Member States and European Organisations and Institutions. Harvesting is another facility that at scheduled intervals collects metadata records from other remote catalogues. It also provides a map viewer interface that allows retrieval of visual “layers” from remote servers, their transformation to a common co-ordinate reference system and subsequently to overlay and display them under a single view. The viewer includes tools for navigation, zoom in/out, pan and display of legend.

## KEY PUBLICATIONS

Bernard L., Kanellopoulos I., Annoni A., Smits P. (2005): The European Geoportal - One step towards the Establishment of a European Spatial Data Infrastructure. *Computers, Environment and Urban Systems* 29 (1): 15-31.

Craglia M., Annoni A. (2006): INSPIRE: An innovative approach to the development of spatial data infrastructures in Europe. In: Onsrud H. (Ed.): *Research and Theory in Advanced Spatial Data Infrastructures*. E.S.R.I. Press: Redlands.

Craglia M., Annoni A. (2003): *The Spatial Impact of European Union Policies*. EUR 20121 EN, Office for Official Publications of the European Communities, Luxembourg.

Annoni A. (Ed.) (2005): *European Reference Grids*. EUR 21494 EN, Office for Official Publications of the European Communities, Luxembourg: 189 pp.

Senkler K., Voges U., Einspanier U., Kanellopoulos I., Millot M., Luraschi G., Bernard L., Smits P. (2007): *Software for Distributed Metadata Catalogue Services to support the EU Portal*. EUR 22337 EN, Office for Official Publications of the European Communities, Luxembourg: 61 pp.

Smits P., Friis-Christensen A. (2007): Resource discovery in a European spatial data infrastructure. *IEEE Transactions on Knowledge and Data Engineering* 19 (1): 85-95.

## MAIN RESEARCH PARTNERS

Natural Resources Canada, Ottawa, Canada  
Federal Geographic Data Committee,  
Reston (VA), USA  
United Nations Food and Agriculture Organisation (FAO), Rome, Italy  
Regione Lombardia, Milan, Italy

## Challenges ahead

- Development of an Infrastructure for Spatial Information in Europe that is well linked to other initiatives worldwide.
- Maintaining the engagement and commitment of all the stakeholders that are involved in developing the infrastructure.
- Supporting an integrated approach to policy-making across different sectors so that the full impact on the environment can be assessed.
- Helping to develop a culture of information sharing in Europe within and across organisations, disciplines, and boundaries.

## Benefit for Europe

Policy and governance must be based on sound knowledge and dedicated infrastructures to access and share relevant information: the IES helps to make it happen.



Emile De Saeger  
IES Staff Member from Pamel, Belgium

*“The JRC brings science closer to the people.”*



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<http://ies.jrc.ec.europa.eu/inspire.html>  
IES Research Action COSIN – Community  
Spatial Information Network:  
<http://ies.jrc.ec.europa.eu/cosin.html>  
International Journal of Spatial Data Infra-  
structure Research:  
<http://ijsdir.jrc.it>  
Image2000 Satellite Mosaic:  
<http://image2000.jrc.it>

## CUSTOMERS

DG Environment  
DG Eurostat  
DG Information Society  
DG Enterprise and Industry  
European Environment Agency (EEA)  
European Space Agency (ESA)

## POLICIES SUPPORTED

United Nations Aarhus Convention on Access  
to Information, Public Participation in  
Decision-making and Access to Justice in  
Environmental Matters  
Directive on the re-use of public sector infor-  
mation – 2003/98/EC  
Decision laying down the 6th Community  
Environment Action Programme 2001-2010  
– 1600/2002/EC  
Directive establishing a framework for Com-  
munity action in the field of water policy –  
2000/60/EC  
Lisbon Strategy for Economic, Social and  
Environmental Renewal

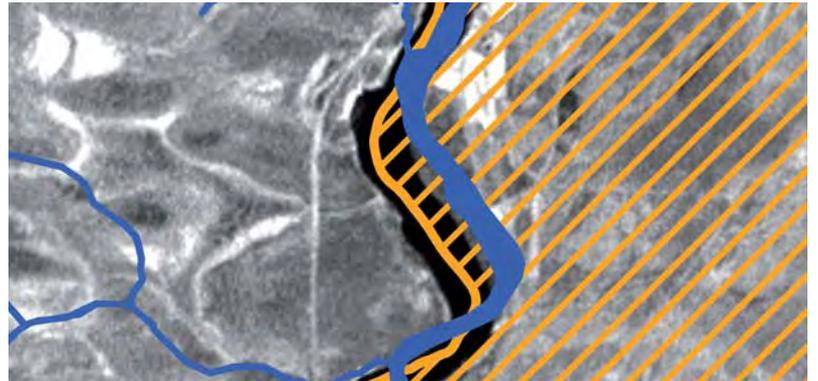


Bernd Gawlik  
IES Staff Member from Saarbrücken, Germany

*“When going on mission as a JRC researcher,  
I am an ambassador of the European Union.”*

## Leading the research effort on spatial data infrastructures

In the last 30 years we have seen major improvements in the availability and quality of information systems handling geographic and environmental information. The internet has opened new ways to share this information with decision-makers and the general public. Nevertheless, there are still major barriers that make it difficult to share and use this information. For this reason there is a need to develop dedicated infrastructures for spatial information that make it possible to find data relevant to a specific problem, understand their structure, content and quality across multiple languages, administrative systems, and scientific disciplines, process the data into relevant information, and communicate this information to the interested parties in a timely manner. The Infrastructure for Spatial Information in Europe (INSPIRE) provides the regulatory framework and technical standards to enable this.



*Interoperability is a major challenge: The map shows the different ways in which protected areas are defined in Member States, and the inconsistencies in position between the same features when mapped by separate organisations*

However, research is needed to ensure that the infrastructure is well tested and open to new technological and policy developments, and that it delivers the expected positive social and economic impacts. One of the major challenges is interoperability, moving from the transmission of raw data to the exchange of the rich semantic information that allows other systems and services to understand automatically the structure, content, meaning, and relevance of data. Further research of the IES is dedicated to the development of methods for finding, extracting, and integrating data from distributed and dynamic sources, assuring their quality, even across different geographical scales, and harmonising heterogeneous data structures so that they can be integrated without changing the original source data. Finally, the IES also addresses the social and economic impacts of spatial data infrastructures in terms of costs and benefits.

*Did you know that 25% of the European  
research effort is spent in finding  
data that already exists?*

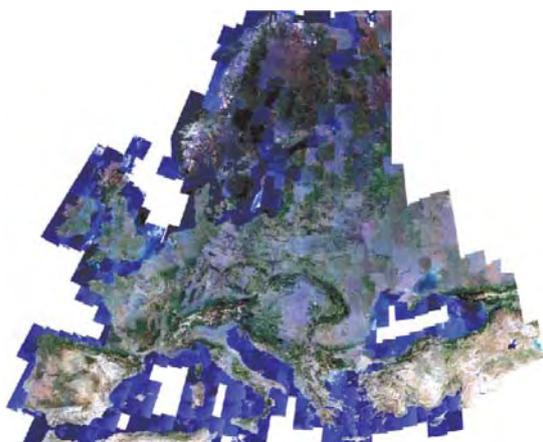
## Results achieved

- The IES designed and tested software architectures that make it easy to combine services for a variety of environmental applications.
- Ability to cut hundreds of satellite images automatically covering the entire EU and produce a seamless mosaic minimising cloud cover, and provision of this mosaic through the IMAGE2000 Data Dissemination Service with free public access.
- Launch of the International Journal of Spatial Data Infrastructure Research, acting as point of reference for the scientific community in this emerging research field.



## Advanced methods to create large mosaics of satellite images

Satellites are an important and useful source of information to monitor the environment, but the vast quantities of information they provide also carries the problem of handling it quickly and efficiently. For example, it took 722 Landsat satellite images to mosaic the whole of Europe in 2000. This is equivalent to 45 million pages of data! To produce such a mosaic it is necessary to identify the areas with clouds, find alternative images that are cloud-free, cut the relevant parts, and join them together to create a complete and clear picture. Given the enormous amount of work, it is obvious that such a mosaic can only be created automatically. Scientists at the IES are carrying out ground-breaking research to develop advanced methods to extract key features, segment images and collate the mosaic.



Highlight

*More than 700 satellite images have been used to create a satellite mosaic of Europe*

The outcome of this research is being applied to create a new mosaic giving an updated snapshot of Europe from space for 2006, known as IMAGE2006. With the same images used to update the European land cover database, a pan-European mosaic covering 38 countries will be produced for 2006. The images have been acquired within a period useful to discriminate differences in vegetation, taking into account the diversity of vegetation conditions in Europe. A key challenge in this process is to develop and test automatic methods for creating a seamless and cloud-free pan-European mosaic from images provided by three different satellites and sensors.

## KEY PUBLICATIONS

Blakemore M., Craglia M. (2006): Access to public sector information in Europe: Policy, rights, and obligations. *The Information Society* 22 (1): 13-24.

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Friis-Christensen A., Jensen C., Nytnun J., Skogan D. (2005): A conceptual schema language for the management of multiple representations of geographic entities. *Transactions on GIS* 9 (3): 345-380.

Lutz M., Klien E. (2006): Ontology-based retrieval of geographic information. *Journal of Geographical Information Science* 20 (3): 233-260.

## MAIN RESEARCH PARTNERS

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EuroGeoSurveys, Brussels, Belgium  
University of Zaragoza, Spain  
University Jaume I, Castelló de la Plana, Spain  
University of Münster, Germany

## Challenges ahead

- Creating an infrastructure for spatial information in Europe that works well across languages, cultures, and technologies.
- Shifting the emphasis from delivering data to an audience of experts, to delivering information to citizens and decision-makers.
- Becoming the recognized centre of excellence for spatial data infrastructure research in Europe.

## Benefit for Europe

In a global economy, research and innovation are crucial investments for Europe's future. The spatial data infrastructure research of the IES helps to spend less money on finding data, thus allowing research money to be spent more effectively.



Magda Moner i Girona  
IES Staff Member from Barcelona, Spain  
"I wanted to use my scientific background to make an impact on society – so I joined the JRC."



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#### WEB SITES

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<http://ies.jrc.ec.europa.eu/lmnh.html>  
IES Research Action NAHA – Natural Hazards:  
<http://ies.jrc.ec.europa.eu/naha.html>  
MOLAND Database:  
<http://moland.jrc.it/>

#### CUSTOMERS

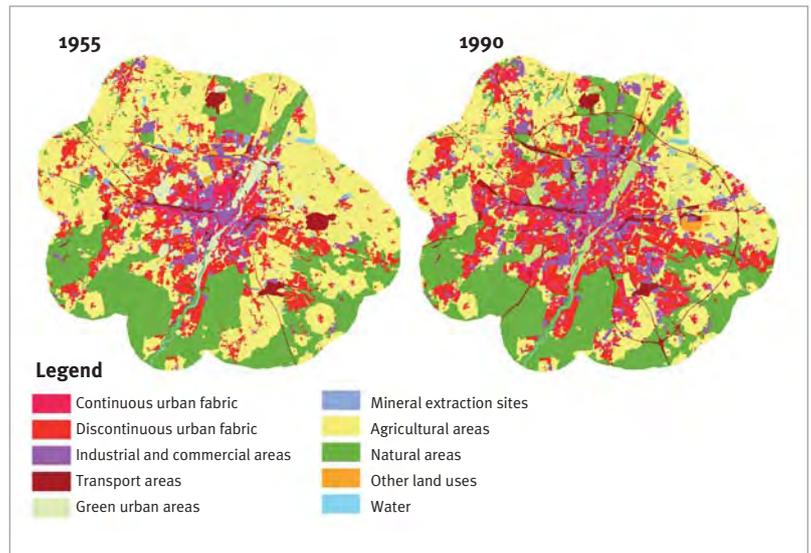
DG Regional Policy  
DG Environment  
European Environment Agency (EEA)

#### POLICIES SUPPORTED

Thematic Strategy on the Urban Environment – COM (2005) 718  
Regulation on the European Regional Development Fund – 1080/2006/EC

## Towards sustainable cities: Monitoring urban sprawl in Europe

The expansion of urban areas, which is often referred as urban sprawl, causes many negative impacts both in urban areas and in the surrounding countryside. Scattered urban structure increases energy, land and soil consumption, raises greenhouse gas emissions that cause climate change and increases traffic and consequently also air and noise pollution. Urban sprawl has also severe socio-economic consequences. It generates and triggers social segregation based on income leading to the emergence of dual cities with poor and degenerated inner areas and wealthier suburbs. The economic costs are linked to the construction and maintenance of urban infrastructure, increased transport needs and congestion costs. Since the mid-1950's urban areas in Europe have expanded on average by 78 %, but population has grown only by 33 % during the same period. As a consequence, European cities have become much less compact.



Urban development of Munich between 1955 and 1990

The IES has developed a large land use database (MOLAND) containing detailed historical and present day land use information on more than 30 European urban areas and larger regions. This data is used for analysing changes in urban land use from the mid-1950's to the present day. The degree of sprawl in various areas is evaluated on the basis of indicators measuring the compactness of residential, commercial, industrial and transport structures and their change in time. With the aid of the MOLAND land use model, future land use scenarios are projected under different driving force combinations and policy options.

**Urban areas in Europe**  
expanded from 1990 to 2000  
by 8 000 km<sup>2</sup>  
which is equivalent to the size  
of the whole country of Luxembourg!

#### Results achieved

- Completion of the MOLAND database and indicator framework.
- Development of the MOLAND land use model.
- Publication of the joint JRC-EEA Report "Urban Sprawl in Europe: The ignored challenge" (EEA Report No. 10/2006).



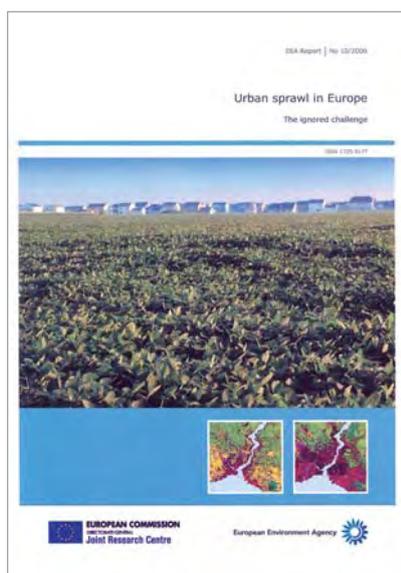
Joanna Nowak  
IES Staff Member from Warsaw, Poland

*"Working at the JRC gives me the chance to explore a new dimension of research."*



## Urban Sprawl in Europe – The ignored challenge

The IES is a co-author of the recent EEA report “Urban Sprawl in Europe - The ignored challenge”. The report is the first European level analysis dealing with urban sprawl. It analyses the extent of urban sprawl, the driving forces behind it, its impacts and finally the ways of countering the problem. A set of land use indicators based on the MOLAND database was developed to support the sprawl analysis. The indicators were calculated for 24 European urban areas (from the mid-1950’s up until the late 1990’s). The indicators describe the built-up area and population growth rates, denseness of residential areas, growth of residential area versus industrial and commercial areas and loss of agricultural and natural areas.



Highlight

*The report “Urban Sprawl – The ignored challenge” summarises the main facts about urban sprawl in Europe*

On the basis of this analysis it is clear that historically very compact European cities are sprawling to a smaller or greater extent. The future simulations of the Dublin region, the Dresden-Prague corridor, the Madrid region and Istanbul show that the risk of even greater sprawl is real if decision-makers at local, regional, national and European level do not take necessary decisions to prevent this from happening. As urban sprawl is an issue which has very far-reaching and complex impacts, its monitoring and prevention should be tackled in an integrated way.

### Challenges ahead

- Development and calculation of new indicators linked to urban sprawl.
- Improvement of urban modelling capacities.
- Addition of a transport module to the MOLAND model.

### Benefit for Europe

Urban sprawl monitoring provides European, national and local authorities and institutions with up-to-date information on the extent of urban growth and sprawl, driving forces and ways to combat it in a European context.

### KEY PUBLICATIONS

European Environment Agency and Joint Research Centre (Eds.) (2006): Urban Sprawl in Europe – The ignored challenge. EEA Report No. 10/2006: 60 pp.

Kasanko M., Barredo J.I., Lavalle C., McCormick N., Demicheli L., Sagris V., Brezger A. (2006): Are European cities becoming dispersed? A comparative analysis of 15 European urban areas. *Landscape and Urban Planning* 77: 111-130.

Barredo J.I., Kasanko M., Lavalle C., McCormick N. (2003): Modelling dynamic spatial processes: simulation of urban future scenarios through cellular automata. *Landscape and Urban Planning* 64: 145-160.

### MAIN RESEARCH PARTNERS

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Flemish Institute for Technological Research (VITO), Mol, Belgium  
Austrian Research Centres (ARC), Vienna, Austria  
Finnish Environment Institute (SYKE), Helsinki, Finland  
Helmholtz Centre for Environmental Research (UFZ), Leipzig, Germany



Matej Kapus  
IES Staff Member from Ljubljana, Slovenia

*“The JRC cares for the social well-being of its staff.”*



## CONTACTS

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IES Renewable Energies Unit:  
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IES Research Action SUSTRANS  
– Sustainable Transport:  
<http://ies.jrc.ec.europa.eu/sustrans.html>  
IES Research Action BioF – Quality and  
Performance of Biofuels:  
<http://ies.jrc.ec.europa.eu/biof.html>

## CUSTOMERS

DG Environment  
DG Transport and Energy  
DG Enterprise and Industry  
DG Agriculture and Rural Development  
European Environment Agency (EEA)  
International Energy Agency (IEA)

## POLICIES SUPPORTED

White Paper: European transport policy for  
2010: Time to decide – COM (2001) 370  
Communication “Keep Europe moving: Sus-  
tainable mobility for our continent” –  
COM (2006) 314  
Green Paper: Towards a European strategy for  
security of energy supply – COM (2000) 769  
Directive relating to the quality of petrol and  
diesel fuels – 98/70/EC and 2003/17/EC  
Directive on the promotion of the use of  
biofuels or other renewable fuels for  
transport – 2003/30/EC



Dimitar Marinov  
IES Staff Member from Sofia, Bulgaria

*“The feedback from customers shows  
that the JRC is on the right track.”*

## Sustainable mobility: The greener approach

The IES is providing input to transport policy decision-makers with the ultimate aim to find a sustainable balance between different transport modes. The IES has started a major case study to assess in a holistic way the environmental impacts and other implications of different transport modes – such as short sea shipping, rail and road transport and their combinations – along the so-called Corridor V which runs from Lisbon to Kiev. The impacts will be assessed per unit of the carried goods, thus allowing a direct comparison of different transport modes. This will be complemented by a series of measurement campaigns in major cities along the Corridor in order to evaluate the impact of transport on air pollution levels. The final expected result of the study is a framework for a modal shift from unsustainable road transport to inter-modal solutions which take into account the three pillars of sustainability. The study will also identify and analyse economics and social barriers for such a shift.



*The IES plays a leading role in developing solutions for greener transport*

The transition to sustainable transport can possibly be founded on hydrogen-based energy systems. This transition depends among other factors on non-technical barriers such as technical regulations for assessment and homologation purposes as well as public acceptance. Technical regulations will contribute to an open market if they are harmonised and globally accepted, whilst at the same time contributing to the acceptance of the new technology by the public. It is for this reason that the IES participates in international working groups aiming at the development of a Global Technical Regulation for hydrogen and fuel cell vehicles. The IES is also involved in the development of a European Directive on type approval of this class of vehicles.

*A hydrogen fuel cell car,  
although zero-emission on the road,  
produces more greenhouse gas than a conventional car  
if the hydrogen comes from coal or electrolysis from mains!*

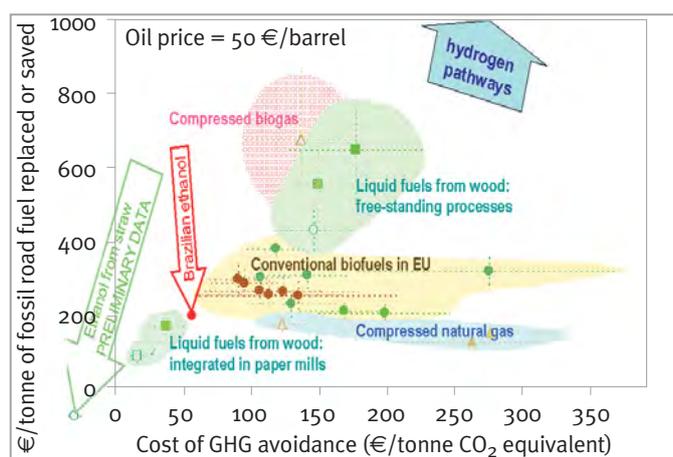
## Results achieved

- The “Well-to-Wheels” study on alternative fuels and power-trains was completed in 2003 and updated in 2006. DG Transport and Energy based the impact assessment of the Biofuels Directive review to a large extent on the results of the study, while other Commission Directorates-General used the cost calculations of the IES in fact sheets on the environmental impacts of biofuels.
- Testing facilities for hydrogen vehicles’ evaporative emissions and fuel consumption have been completed. Furthermore, battery electric vehicles have been tested and homologated.
- The IES contributed to the ZERO-REGIO project aiming at the demonstration of the use of hydrogen as an alternative fuel via an automobile fleet field test in the German Rhein-Main region and the Italian Lombardia region.



## Assessing the sustainability of alternative fuels and power-trains

There is no sustainable means of transport without considering its full impact on the environment. For this reason, the IES has embarked with important partners from industry (CONCAWE and EUCAR) on the so-called Well-to-Wheels study (see <http://ies.jrc.ec.europa.eu/WTW>). The main aims of the study are to establish, in a transparent and objective manner, a consensual well-to-wheels energy use and greenhouse gas emissions assessment of a wide range of automotive fuels and power-trains relevant to Europe in 2010 and beyond, to consider the viability of each fuel pathway and estimate the associated macro-economic costs, and to have the outcome accepted as a reference by all relevant stakeholders.



Highlight

*IES research seeks for win-win situations aiming at avoiding greenhouse gases at the lowest cost*

Particular attention has been given to the numerous hydrogen potential production routes as well as to biofuels. For instance, the unique range of environmental expertise in the IES is exploited in the new calculation of average N<sub>2</sub>O emissions from the soils of crops for biofuels in the European Union. N<sub>2</sub>O emissions are the greatest uncertainty in greenhouse gas balances of biofuels. So far, no one could say with sufficient precision whether any biofuel has a positive or negative greenhouse gas balance. The Well-to-Wheels study reduced the error range to less than 30% exploiting models and databases developed within the IES.

## Challenges ahead

- To assess the environmental, economic and social impacts of the Corridor V.
- To further extend the time horizon of the Well-to-Wheels study.
- To investigate the Well-to-Wheels performance of other alternative fuels, such as fossil fuels from unconventional oil, biogas from crops and biodiesel from alternative sources (palm oil, etc.).

## Benefit for Europe

The work done by the IES shows the cost of greenhouse gases reduction and of the fossil fuel replacement for many alternative fuels and car options. This contributes to the overall aim of the IES to foster sustainable transport in Europe.

## KEY PUBLICATIONS

Edwards R., Rouveirrolles P., Larivé J.-F., Mahieu V. (2006): Well-to-wheels analysis of future automotive fuels and power-trains in the European context. EUR 22342 EN, Office for Official Publications of the European Communities, Luxembourg: 88 pp.

Edwards R., Mahieu V., Larivé J.-F., Ryckearld D., Rouveirrolles P., Hass H. (2006): Availability and Cost of Biomass for Road Fuels in EU. Proceedings of an Expert Workshop, 2-4 May 2006, Brussels, Belgium. EUR 22345 EN, Office for Official Publications of the European Communities, Luxembourg: 23 pp.

## MAIN RESEARCH PARTNERS

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 Ludwig-Bölkow-Systemtechnik GmbH (LBST), Ottobrunn, Germany  
 FIAT Research Centre, Orbassano, Italy  
 Luigi Bocconi University, Milan, Italy  
 Interuniversity Research Centre for Sustainable Development (CIRPS), Rome, Italy



Sasa Gligorijevic  
 IES Staff Member from Belgrade, Serbia  
 "The JRC plays a key role in helping Balkan Countries to meet the criteria for membership to the EU."



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IES Research Action TRANSTECH  
– Transport Technologies:  
<http://ies.jrc.ec.europa.eu/transtech.html>

## CUSTOMERS

DG Environment  
DG Transport and Energy  
DG Enterprise and Industry

## POLICIES SUPPORTED

Directive relating to the quality of petrol and diesel fuels – 98/70/EC and 2003/17/EC  
Directive on the promotion of the use of biofuels or other renewable fuels for transport – 2003/30/EC  
Directive on certain components and characteristics of two or three-wheel motor vehicles – 97/24/EC  
Directive on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in nonroad mobile machinery – 97/68/EC  
Directive relating to measures to be taken against air pollution by emissions from motor vehicles – 98/69/EC  
Directive on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from ignition engines for use in vehicles – 1999/96/EC  
Communication on the implementation of the Community Strategy for Dioxins, Furans and Polychlorinated Biphenyls – COM (2004) 240



Madeleine Rizzi  
*IES Staff Member from Hettange-Grande, France*  
*“The JRC provides a fascinating working environment.”*

## Testing vehicle emissions for cleaner technology

The Vehicle Emissions Laboratory (VELA) of the IES, equipped with the most advanced facilities and instrumentation, allows the physical/chemical and toxicological characterisation of the emissions from all types of transport means. Tests are conducted on engines, from small hand-held to large heavy-duty engines, and on full vehicles such as mopeds, motorbikes, passenger cars, 4WD cars, heavy-duty trucks and buses. Test bench and laboratory analysis of tailpipe emissions is accomplished by innovative research activities on combustion engines’ real-world emissions. The so-called Portable Emission Measurement Systems (PEMS) are already tested by the IES since some time on heavy-duty trucks driving their normal working shift. Similar systems are also used with passenger cars, working machinery, ships and locomotives, to investigate the proper functioning of their engines and after-treatment systems under real-world operation conditions.



*The IES operates the Vehicle Emissions Laboratory (VELA), testing the emissions of different automotive fuels and power-trains*

The research lines of VELA cover all environmental aspects related to advanced technologies, new engines and after-treatment systems, on-board diagnostic systems, new or reformulated fuels, biofuels and gaseous fuels. It also comprises the chemical analysis of particulate matter and volatile organic compounds speciation for transport means fingerprints used for source apportionment. Further to classical combustion engine emission testing, the IES carries out cost-benefit analysis of cleaner transport technology options and technology foresight through the life cycle analysis of transport fuels, and the testing of electrical, hybrid, hydrogen and fuel cell vehicles’ energy efficiency.

*Emissions and fuel consumption of vehicles depend on technologies – but also on individual driving style and traffic conditions!*

## Results achieved

- New emission limits (Euro-5) for particle mass and particle number emitted from diesel-driven vehicles were derived from the “Particle Measurement Programme” (PMP) carried out by the IES.
- New emission limits (Stage 3) for motorbikes tested under the worldwide harmonised motorbike test cycle WMTC were derived by the IES on the basis of extensive 2-wheelers testing.
- A test protocol for the in-use compliance testing of trucks with Portable Emission Measurement Systems (PEMS), as requested by the Heavy-Duty Directive, has been developed.
- Within the Fuels Quality Directive review process, open questions regarding biofuels, additives, detergents and the introduction of low sulfur diesel fuels were investigated.
- Within a large co-operative research programme the impact of bio-ethanol blending on evaporative emissions was studied.



## On-road testing of truck emissions

In January 2004, the IES launched in co-operation with DG Enterprise and Industry a co-operative research programme studying Portable Emission Measurement Systems (PEMS) with a view to their application in Europe for in-use conformity checking of heavy-duty vehicles. The introduction of field measurements in the regulations is widely recognised as a major step towards more transparency and a much better control of the homologation for combustion engines, since it provides both emission data and activity data under a wide range of operating conditions. Tests have been conducted in the heavy-duty dynamic test facility of the IES to evaluate the performance of the candidate portable systems, in order to check how the portable systems compare with the high quality lab systems for emissions and also how they compare against each other.



*The IES equips heavy-duty trucks with Portable Emission Measurement Systems to get real-world emissions data*

Highlight

The on-road evaluation of the Portable Emission Measurement Systems was based on collected real-world emissions data at different locations and for a panel of vehicles typical for the various engine families and technologies currently existing on the European market. Seven test campaigns with trucks provided by all European truck manufacturers were conducted. The data collected showed sufficient test-to-test repeatability for a given instrument and vehicle load. The performance of the core measurements was therefore satisfactory for the purposes of in-use conformity checking.

## Challenges ahead

- Hydrogen, fuel cell and electric vehicles will be tested in the now modified VELA test cells, testing energy efficiency, leakage losses and driveability, as well as the development of testing procedures.
- Portable Emission Measurement Systems will in future also be used for the real-world assessment of emissions from construction machinery and may also be extended to rail cars, ships and passenger cars.
- Maritime emissions become more and more important due to the reduction of emissions in other sectors, thus requiring research on abatement technologies.
- With a new facility for full-scale truck and bus testing, VELA will be able to test trucks from road under controller conditions, and the efficiency of their after-treatment systems, be it the original ones or retrofitted systems.

## Benefit for Europe

Vehicles emit on-road at different levels compared to the controlled type approval tests. With on-road exhaust measurements the major polluting vehicles and drive patterns can be identified, allowing measures to be taken against these.

## KEY PUBLICATIONS

Farfaletti A., Astorga C., Martini G., Manfredi U., Müller A., Rey Garrote M., De Santi G., Krasenbrink A., Larsen B. (2005): Effect of Water/Fuel Emulsions and a Cerium-based Combustion Improver Additive on HD and LD Diesel Exhaust Emissions. *Environmental Science and Technology* 39: 6792-6799.

Hak C., Pundt I., Trick S., Kern C., Platt U., Dommen J., Ordóñez C., Prevot A., Junkermann W., Astorga C., Larsen B., Mellqvist J., Strandberg A., Yu Y., Galle B., Lörzer J.C., Braathen G., Volkamer R. (2005): Intercomparison of Four Different in-situ Techniques for Ambient Formaldehyde Measurements in Urban Air. *Atmospheric Chemistry and Physics* 5: 2881-2900.

Bonnel P., Krasenbrink A., Martini G. (2005): EURO 3 Stage for motorcycles: Derivation of equivalent limits for the WMTC driving cycle. EUR 22163 EN, Office for Official Publications of the European Communities, Luxembourg.

## MAIN RESEARCH PARTNERS

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European Council for Automotive R&D (EUCAR), Brussels, Belgium

Association for Emissions Control by Catalyst (AECC), Brussels, Belgium

Association of European Motorcycle Constructors (ACEM), Brussels, Belgium

European Biodiesel Board (EBB), Brussels, Belgium

European Association of Internal Combustion Engine Manufacturers (Euromot)

French Petroleum Institute (IFP), Rueil-Malmaison, France

TÜV Nord AG, Hanover, Germany

Polytechnical University of Milan, Italy

Bern University of Applied Sciences, Biel, Switzerland

US Environmental Protection Agency – Office of Transportation and Air Quality, Washington D.C., USA

National Traffic Safety and Environment Laboratory (NTSEL), Tokyo, Japan

Vehicle Emission Control Centre (SEPA-VECC), Beijing, China

California Air Resources Board (CARB), Sacramento (CA), USA



Wim Zaaiman  
IES Staff Member from Veldhoven,  
The Netherlands  
“You can trust in the independent  
expertise of the JRC.”



## Life cycle thinking in support of European business and public administrations

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<http://ies.jrc.ec.europa.eu/ensure.html>  
LCA Information Hub:  
<http://lca.jrc.ec.europa.eu>

### CUSTOMERS

DG Environment  
DG Research  
DG Enterprise and Industry  
DG Transport and Energy  
DG Eurostat  
United Nations Environment Programme (UNEP)

### POLICIES SUPPORTED

Thematic Strategy on the Prevention and Recycling of Waste – COM (2005) 666  
Thematic Strategy on the Sustainable Use of Natural Resources – COM (2005) 670  
Communication on Integrated Product Policy – COM (2003) 302  
Directive establishing a framework for the setting of ecodesign requirements for energy-using products – 2005/32/EC

Life cycle thinking is a core commitment for achieving sustainable consumption and production of resources, as laid down in the European Commission's Thematic Strategies on the Sustainable Use of Natural Resources and on the Prevention and Recycling of Waste, as well as in the Communication on Integrated Product Policy. Life cycle thinking is complementary to conventional assessment techniques, being essential for the consideration of all the stages in a product's life cycle, from the extraction of raw materials, manufacture, use, recycling operations, through to the ultimate disposal of remaining wastes created at each stage of the life cycle. Differences amongst options for goods and services (products), hence trade-offs, can occur due to emissions and resources consumed in different life cycle stages, between different environmental and health impact categories (e.g. climate change, eutrophication, toxicological effects, land use), as well as in different regions. Life Cycle Assessment (LCA) facilitates the quantification of such regional and global effects in a single, coherent framework.



*The increasing pressure on natural resources requires more life cycle thinking and intelligent waste management strategies*

The IES is complementing conventional methods with the development of recommended approaches, indicators, reference data, and case studies to facilitate life cycle thinking in European business and public administrations. The focus is on increased awareness and acceptance, achieved through scientific robustness and consensus building. Activities include the European Platform on Life Cycle Assessment, which is developing the European Reference Life Cycle Data System (ELCD) and recommended Handbooks on Life Cycle Assessment, including focused pilot studies on life cycle based indicators for monitoring progress towards sustainability. The life cycle activities of the IES are carried out working closely with other Commission services and Member State representatives, as well as European business associations, and other stakeholders.

***Consumption expenditure for products increased by 25% and waste production by 20% in the last ten years: a new way of thinking is needed!***

### Results achieved

- The European Reference Life Cycle Data System (ELCD) launched by the IES provides life cycle data for key materials, inorganic chemicals, and services.
- The LCA Information Hub provides a detailed directory of Life Cycle Assessment services, tools, databases, and providers facilitating knowledge exchange among practitioners in governments, industry, research, and consultancy.
- A series of international workshops and pilot studies with Member States have supported life cycle thinking in waste management, with European guidance documents being developed.

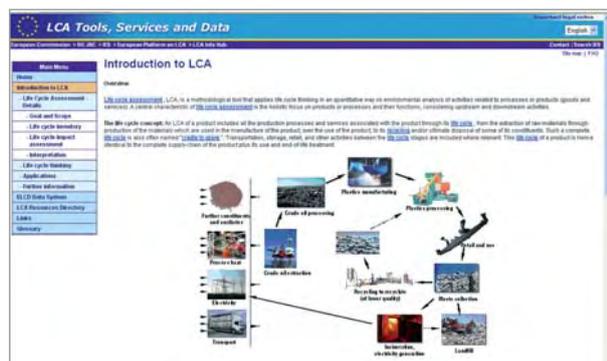


Luigi Rogora  
IES Staff Member from Gallarate, Italy  
*"I love to work for the JRC because of its multisocial environment, combining high culture with advanced technologies."*



## The Life Cycle Assessment Information Hub

In support of the European Platform on Life Cycle Assessment, the IES provides reference data and recommended methods for more reliable life cycle assessment studies, sector-specific guidance, and sustainability indicators. These activities promote improved environmental performance and increased competitiveness. A key element in this context is the so-called LCA Information Hub (<http://lca.jrc.ec.europa.eu>), which has been set up by the IES to provide a comprehensive and detailed directory of life cycle assessment services, tools, databases, and providers to ease access to data and methods and to facilitate knowledge exchange.



Highlight

*The Life Cycle Assessment Information Hub promotes sustainable production and consumption*

Among other features, this web site provides access to the European Reference Life Cycle Data System (ELCD), containing core life cycle inventory data from European business associations for key materials energy carriers, transport, and waste management, as well as life cycle impact assessment factors for calculating impact indicators for resource consumption and pressures on the environment. Furthermore, the LCA Information Hub offers technical guidance documents with best attainable consensus on life cycle assessment practice in data collection, modelling, analysis, interpretation, documentation, and review. Finally, a wealth of information can be found on life cycle based sustainability indicators to facilitate planning and help monitor progress towards sustainable consumption and production at all levels of public administration in Europe.

## KEY PUBLICATIONS

Pennington D.W., Margni M., Payet J., Jolliet O. (2006): Risk and regulatory hazard based toxicological effect indicators in life cycle assessment. *Human and Ecological Risk Assessment* 12: 450-475.

Koneczny K., Pennington D.W., Dragusanu V. (2007): Environmental Assessment of Municipal Waste Management Scenarios: Part I – Data collection and preliminary environmental assessments for life cycle thinking pilot studies. Office for Official Publications of the European Communities, Luxembourg.

Koneczny K., Pennington D.W. (2007): Environmental Assessment of Municipal Waste Management Scenarios: Part II – Detailed Life Cycle Assessments. Office for Official Publications of the European Communities, Luxembourg.

## MAIN RESEARCH PARTNERS

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- European Copper Institute (ECI), Düsseldorf, Germany
- European Confederation of Iron and Steel Industries (EUROFER), Brussels, Belgium
- Association of the Plastics Manufacturers in Europe (PlasticsEurope), Brussels, Belgium
- European Federation of Corrugated Board Manufacturers (FEFCO), Brussels, Belgium

## Challenges ahead

- Development and maintenance of reference life cycle data, recommended life cycle impact assessment indicators and methodological guidance, for building consensus and improving scientific credibility and acceptance of life cycle assessment.
- Development of a series of European guidance documents to support life cycle thinking in different sectors.
- Development of life cycle based indicators to monitor and assess sustainability in Europe, Member States and Regions.

## Benefit for Europe

Guidance, indicators, approaches, and data are essential to ensure life cycle thinking in the development of knowledge-based policies in the move towards sustainable consumption and production.



Silvia Calvo Iglesias  
IES Staff Member from Ribadeo, Spain  
“The JRC provides me the unique opportunity to do research close to European policy-making.”



# Monitoring renewable energies development and energy efficiency in an enlarged Europe

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<http://ies.jrc.ec.europa.eu/refree.html>  
Energy End-use Efficiency web site:  
<http://energyefficiency.jrc.ec.europa.eu>

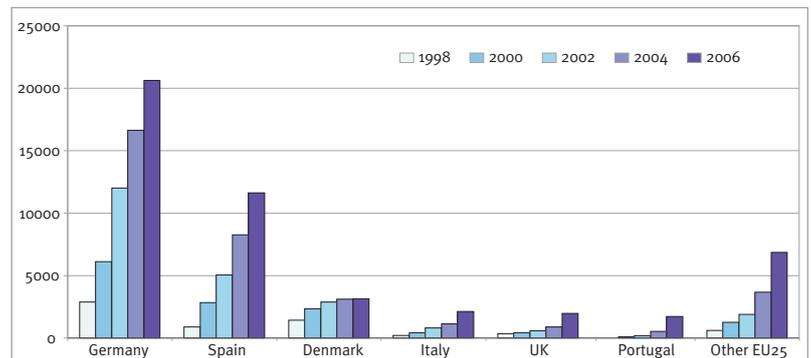
## CUSTOMERS

DG Transport and Energy  
DG Research  
DG Environment  
DG Development  
International Energy Agency (IEA)  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Directive on the Promotion of Electricity  
produced from Renewable Energy Sources  
in the Internal Electricity Market –  
2001/77/EC  
Directive establishing a Framework for the  
Setting of Eco-design Requirements for  
Energy-using Products – 2005/32/EC  
European Energy Star Programme  
European Climate Change Programme

Electricity generation is one of the largest sources of CO<sub>2</sub> emission in Europe. In addition, the EU is importing more than 50% of its energy needs, and even up to 70% by 2030, under current trends. Renewable energy coupled with end-use energy efficiency are solutions to both challenges: in order to properly react to climate change, to enhance the security of energy supply, and at the same time to create jobs and boost the competitiveness of European enterprises. In the past decade, renewable and end-use energy efficiency technologies have made significant progress in terms of performance, cost-effectiveness and reliability, thanks to research and development, demonstration and market introduction programmes, and accompanying policies at European, national and also regional level. The coming years will be crucial for the larger deployment of Renewable Energy technologies in order to reach the needed target share of 20% for renewable energies in the European Union.



Development of the cumulated installed capacity of wind energy in the EU (in Megawatt)

The IES supports this goal by mapping out renewable energy and energy efficiency data and indicators in close collaboration with the European and national statistical offices as well as other data providers. Ongoing policies and support schemes are monitored, together with their environmental and socio-economic impact, in order to help the setting of future targets. In collaboration with expert networks, information is constantly being updated, quality checked and harmonised in a practical format, in order to judge whether Europe is “on track” with respect to renewable energy and energy end-use efficiency.

*Did you know that up to 50%  
of the European electricity needs in 2020  
could be supplied by renewable energy sources  
if these were implemented intensively and effective energy  
efficiency measures were to be put in place?*



Jennifer Rundle  
IES Staff Member from Edinburgh, UK  
“My dream was to work with people from  
different cultures, and after so many years in  
the Commission I have never regretted it.”

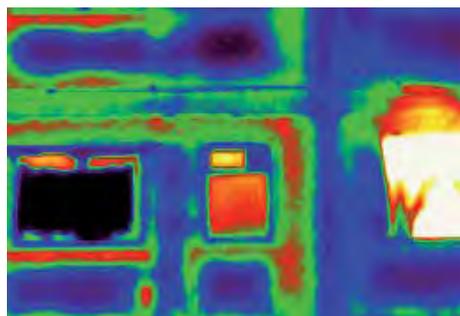
## Results achieved

- Comprehensive Annual Reports on Renewable Energy and Energy Efficiency as well as specifically on Photovoltaics.
- Fact-finding on Renewables Development and Energy Efficiency in the new Member States.
- Contribution to the understanding and reduction of stand-by losses.
- Report on the Status of Energy Service Companies in Europe.
- Organisation of the International Conference on Energy Efficiency in Residential Appliances and Lighting (EEDAL).



## Save what you waste!

End-use energy efficiency focuses on electricity use, where large, cost-effective efficiency gains are possible in households, offices, public buildings and enterprises. In electric lighting, the IES contributed substantially to a Quality Charter for household Compact Fluorescent Lamps, and for offices with advanced designs, by boosting the GreenLight Programme. A lot of equipment consumes energy when not in use (so-called “stand-by losses”). This is typical of consumer electronics (TVs, DVD players, etc.) and office equipment (computers, printers, etc.). New technologies dramatically reduce each stand-by load from around tens of Watt to a few milli-Watt.



*Thermal images help to spot where energy is wasted in buildings*

Highlight

In co-operation with industry at technical and regulatory level, the IES paved the ground for voluntary agreements on better, energy-efficient products. The Institute contributed substantially to European and national policies for the reduction of stand-by losses via the so-called Code of Conducts, and within the EU Energy Star Programme. However, the data analyses carried out by the IES indicate that Europe can go beyond that: Minimum efficiency requirements can be introduced to ban poorly performing equipment. In public procurement, Europe could pioneer demand for the most efficient equipment. In collaboration with experts from all over the EU, and in support of European energy efficiency policies, test methods were developed, and techno-economic analysis of existing and future products performed – ensuring that energy savings are cost-effective.

## KEY PUBLICATIONS

Bertoldi P., Rezessy S., Vine E. (2006): Energy Service Companies in European Countries: Current status and a strategy to foster their development. *Energy Policy* 34 (14): 1818-1832.

Bertoldi P., Huld T. (2006): Tradable Certificates for Renewable Electricity and Energy Savings. *Energy Policy* 34 (2): 212-222.

Jäger-Waldau A., Ossenbrink H. (2004): Progress of Electricity from Biomass, Wind and Photovoltaics in the European Union. *Renewable and Sustainable Energy Reviews* 8: 157-182.

Jäger-Waldau A., Šúri M., Dunlop E., Ossenbrink H., Huld T., Cebecauer T. (2006): Challenges to Realise 1% Electricity from Photovoltaic Solar Systems in the European Union by 2020. In: Proceedings of the 4th World Conference on Photovoltaic Energy Conversion, USA, 8-12 May 2006.

## MAIN RESEARCH PARTNERS

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Jozef Stefan Institute, Ljubljana, Slovenia  
Italian National Agency for New Technologies, Energy and the Environment (ENEA), Rome, Italy  
Institute for Building, Mechanisation and Electrification in Agriculture (BREC/IBMER), Warsaw, Poland  
Swedish Energy Agency (STEM), Eskilstuna, Sweden  
Risø National Laboratory, Roskilde, Denmark

## Challenges ahead

- To track the development of renewable energies in Europe, including effects on Europe’s job-market, export chances, and its commitments to the Kyoto Protocol.
- To analyse and describe the challenges, but also the drive from large take-up of renewable electricity for the modernisation of the European electricity grid.
- To provide ideas for the design of new policies that combine renewable energies with end-use efficiency measures.
- To improve the monitoring and understanding of electricity consumption and quantify real, cost-effective saving potentials without service loss.

## Benefit for Europe

The IES supports the creation of a new industry providing at least 2 million jobs in 2020, it assists in developing cost-effective solutions to climate change, and it contributes to reduce citizen and business energy expenditures maintaining at least the same level of comfort and service.



Peter Bergamaschi  
IES Staff Member from Kirchzarten, Germany

*“The JRC is a dynamic, internationally recognised research centre.”*



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Photovoltaic Solar Electricity:  
<http://ies.jrc.ec.europa.eu/solarec.html>  
Photovoltaic Geographical Information  
System:  
<http://re.jrc.ec.europa.eu/pvgis/>

#### CUSTOMERS

DG Transport and Energy  
DG Development  
DG Enterprise and Industry  
International Electrotechnical Commission  
(IEC)  
European Committee for Electrotechnical  
Standardisation (CENELEC)  
International Energy Agency (IEA)  
Photovoltaic Industry

#### POLICIES SUPPORTED

Green Paper: A European Strategy for Sustainable, Competitive and Secure Energy – COM (2006) 105  
Communication on Global Monitoring for Environment and Security (GMES): From concept to reality – COM (2005) 565  
Directive on the Promotion of the Electricity produced from Renewable Energy Source in the Internal Electricity Market – 2001/77/EC

## Photovoltaic solar energy – Clean and unlimited electricity

Photovoltaic devices convert light directly into electricity by semiconductor effects and provide a particularly elegant and convenient method of solar energy utilisation. Over the last ten years substantial progress has been made in reducing costs, improving technology and increasing market penetration. A sustained average growth rate of 35% per year over the last decade has not only created a multi-billion Euro industry, but provides also peak-day electricity production. Even though the technology is cost-effective already in many applications, there are still numerous options to exploit which will still further decrease costs.



*The IES uses solar trackers for the type approval tests of photovoltaic devices*

Consequently, the photovoltaic research activity at the IES is focusing on the one hand on the cost-determining factors, such as available solar resources and the energy production of solar cells over their expected life-time, and on the other hand on future technologies, such as thin films, low-cost polymers and ultra-high efficiency concepts. The laboratories of the European Solar Test Installation (ESTI), located at the IES, serve both customers from research and industry, and provide tools and equipment for the experimental assessment of prototypes. As conversion efficiency and product life-time determine the cost of the electricity produced, the ESTI facilities are also used to develop test methods and to establish reliable and precise reference data. For industrial customers, the accredited ESTI laboratory performs the “Type Approval Tests”, which are a requirement in most European markets and enable the photovoltaic industry to offer product warranties of up to 20 years. Most of the measurement and test protocols developed at the IES serve International Standards Organisations in establishing world-wide agreed and applied standards which help to reduce trade barriers.

***Electricity from Sunlight:  
Technology for sustainable energy supply  
with the highest growth rate of all industries***

#### Results achieved

- The uncertainty of the photovoltaic calibration measurements of the IES has been reduced to  $\pm 1.5\%$ , which can influence world-wide product sales of a value of plus or minus 60 million Euro for the year 2006.
- The feasibility of producing low-cost polymer solar cells based on electrochemical polymerisation was demonstrated.
- Procedures to determine the electricity generation of second generation photovoltaic products (thin film) have been developed.
- The publicly accessible Photovoltaic Geographical Information System (PV-GIS) has been developed to determine solar radiation for any place and any time in Europe, allowing not only to select the most suitable sites for solar energy use, but also to calculate the photovoltaic electricity price achievable for a particular situation.



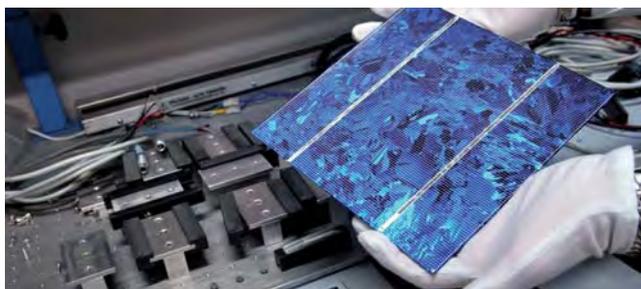
Bo Larsen  
*IES Staff Member from Copenhagen,  
Denmark*

*“There is no other place like Ispra.”*



## Polymer Solar Cells

Solar cells made from semi-conducting plastics could be much cheaper than crystalline silicon ones. However, state-of-the-art plastic solar cells last only a few weeks in air without perfect sealing because they are made using solvent-evaporation techniques that require soluble polymers. Exploratory research at the IES aims at producing an entire polymer solar cell by electrochemistry, depositing plain polymer chains which are much more stable than the ones currently used.



*Classical silicon solar cells may someday be replaced by cheaper polymer solar cells*

By understanding the mechanism of the polymerisation, IES researchers have found how to make a much higher quality layer of polymer than previous electro-polymerised layers. With the technology developed at the IES, polymerisation and doping, i.e. the enhancement of the photoelectric effect by increasing the number of electrically-charged carriers, can be done with only one electrochemical bath. The solvent evaporation techniques have been verified as an alternative method for polymerisation to produce an entire plastic photovoltaic cell, which is cheap to make, does not require vacuum or high-temperature processing, and above all, avoids expensive encapsulation. This ground-breaking research could help to make photovoltaics much cheaper and thus even more competitive with respect to other energy sources.

Highlight

## KEY PUBLICATIONS

Müllejans H., Ioannides A., Kenny R.P., Zaaiman W., Ossenbrink H., Dunlop E.D. (2005): Spectral Mismatch in Calibration of Photovoltaic Reference Devices by Global Sunlight Method. *Measurement Science and Technology* 16: 1250-1254.

Vignali M., Edwards R.A.H., Serantoni M., Cunnane V.J. (2006): Electropolymerized Polythiophene Layer extracted from the Interface between two Immiscible Electrolyte Solutions: Current time Analysis. *Journal of Electroanalytical Chemistry* 591: 59-68.

Šúri M., Huld T.A., Dunlop E.D. (2005): PVGIS: A Web-based Solar Radiation Database for the Calculation of PV Potential in Europe. *International Journal of Sustainable Energy* 24 (2): 55-67.

Kenny R.P., Dunlop E.D., Ossenbrink H., Müllejans H. (2006): A Practical Method for the Energy Rating of c-Si PV Modules based on Standard Tests. *Prog. Photovolt. Res. Appl.* 14: 155-166.

## MAIN RESEARCH PARTNERS

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Energy Centre Netherlands (ECN), Petten, The Netherlands  
National Institute for Solar Energy (CEA/INES), Chambéry, France  
Research Centre for Energy, Environment and Technology (CIEMAT), Madrid, Spain  
TÜV Rheinland, Cologne, Germany,  
University of Loughborough – Centre for Renewable Energy Systems Technology, United Kingdom  
European Photovoltaic Industry Association (EPIA), Brussels, Belgium

## Challenges ahead

- Further increase of photovoltaic electricity in Europe will have impacts on local distribution grids. The utility value, in particular of summer peak demand, needs to be quantified.
- Thin Film technology will increase market shares, as crystalline silicon feedstock availability will continue to be a cost factor in conventional, wafer-based photovoltaic products. Measurement and test procedures need to be developed in order to establish robust confidence levels.
- The Photovoltaic Geographical Information System needs to be enhanced to take into account 3rd Generation ultra-high efficiency cells, which need very high levels of concentrated sunlight.
- With the rapid increase of photovoltaic deployment, recycling of photovoltaic products at the end of their service life becomes an issue which needs to be addressed.

## Benefit for Europe

The IES helps to ensure fair, transparent markets and reduced trade barriers for the European photovoltaic industry by being a reliable, professional reference for solar cell research, data provision and product quality.



Rita Van Dingenen  
IES Staff Member from Gent, Belgium  
“Working for the JRC gives me the feeling to do something for today’s and future generations.”



# Environment and **Solidarity**

## Seeking for a sustainable management of natural resources

Despite the fact that the European Union has one of the most advanced bodies of environmental legislation in the world, our environment is still under pressure. This refers to both, terrestrial and aquatic ecosystems. One example is the eutrophication of our regional seas, lakes and rivers. In the summer months, the media report frequently about algal blooms and dying fish, leading to economic losses in tourism and fisheries. One of the major sources of eutrophication in Europe is the use of fertilizers in agriculture. Therefore, there is not only the need for a “mainstreaming” of environmental policies, but moreover the necessity to develop integrated management concepts that take into consideration ecological needs as well as socio-economic concerns across different policy fields.

Together with its partners, the JRC’s Institute for Environment and Sustainability (IES) is firmly committed to the development of such holistic management tools that enable our economies and society to live in harmony with nature. By doing so, the IES helps to ensure a healthy environment for all citizens of the European Union – those living today, but also the generations to come. The challenge of global climate change reminds us that intergenerational justice remains a promise we must fulfil for the sake of our future.

Examples of IES support to environmental solidarity include:

- The IES develops concepts for integrated monitoring and assessment of the marine environment in the European regional seas, with particular focus on the Baltic Sea and the Black Sea.
- Key input is delivered to the implementation of the Water Framework Directive by co-ordinating the intercalibration exercise which seeks for joint standards of good ecological water quality.
- The IES develops major environmental information systems for policy-making, such as the Water Information System for Europe (WISE) and the European Land Information System for Agri-Environment (ELISA).
- Major support is provided to the Common Agricultural Policy through the development of agri-environmental indicators.
- Following an agreement with DG Environment, Eurostat and the European Environment Agency (EEA), the IES is setting up European Data Centres for Soils and Forests, building on a broad expertise in soil and forest research.
- The Institute supports the UN Framework Convention on Climate Change through carrying out research on greenhouse gas emissions and sinks and developing independent verification systems for greenhouse gas reporting.

*“Environmental protection remains a key duty we have towards future generations.”*

José Manuel Barroso  
*European Commission President*





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IES Research Action PROCAS – Protection  
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<http://ies.jrc.ec.europa.eu/procas.html>  
Environmental Marine Information System:  
<http://emis.jrc.it>

## CUSTOMERS

DG Environment  
DG Fisheries and Maritime Affairs  
Baltic Marine Environment Protection  
Commission (Helsinki Commission)  
OSPAR Commission for the Protection of the  
Marine Environment of the North-East  
Atlantic  
Black Sea Commission  
United Nations Environment Programme  
(UNEP) – Mediterranean Action Plan  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Thematic Strategy on the Protection and  
Conservation of the Marine Environment –  
COM (2005) 504  
Green Paper: Towards a future Maritime  
Policy for the Union – A European vision for  
the oceans and seas – COM (2006) 275  
Directive establishing a framework for  
Community action in the field of water  
policy – 2000/60/EC  
Directive concerning urban waste-water  
treatment – 91/271/EEC  
Communication on Integrated Coastal Zone  
Management: A strategy for Europe –  
COM (2000) 547



Sandra Poikane  
IES Staff Member from Jūrmala, Latvia  
“Who better than the JRC addresses the  
pan-European dimension of environmental  
research?”

# Supporting the recovery of European regional seas

Marine eutrophication, i.e. the over-enrichment of water by nutrients producing undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned, is a major issue of concern in European regional seas. Marine eutrophication is considered to be the cause of various biological effects such as green tides, phytoplankton blooms, deep-water anoxia and fish population changes. In order to tackle the problem, satellite remote sensing of chlorophyll concentration is used by the IES to provide estimates of the biological productivity, being complemented by *in-situ* measurements for validation purposes. Long-time series of chlorophyll concentration help in evaluating the impact of nutrient reduction (or increase) in coastal and marine waters. In addition, the numerical modelling of the physical and biological processes is used by the IES to better understand and assess the specificities of the different European regional seas in relation to the eutrophication phenomena.



*The Acqua Alta Oceanographic Tower in the Northern Adriatic Sea is a key element for the validation of the ocean colour products of the IES*

Through its marine research activities, the IES is building a comprehensive knowledge base in support of European policies related to the marine environment and the intergovernmental marine regional seas bodies, such as the Helsinki Commission and Black Sea Commission. Specific emphasis is given to the Baltic Sea and Black Sea because these are suffering particularly from high nutrient loads in their coastal waters. Restoring the ecological health of these endangered ecosystems will not only help the environment, but also bring economic benefits, e.g. in fisheries and tourism.

***Did you know that about 1 million tons of nitrogen  
and more than 30,000 tons of phosphorus  
enter the Baltic Sea every year  
either as waterborne or airborne inputs?***

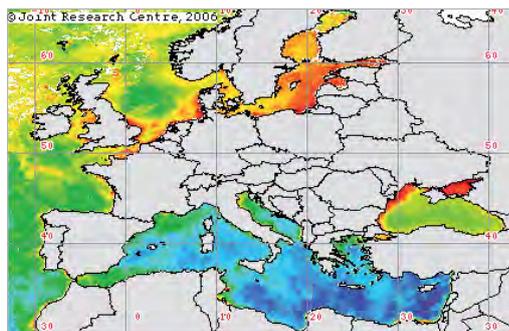
## Results achieved

- Completion of a European Environmental Marine Information System with navigation and query capabilities.
- Successful measurement campaigns in the Baltic Sea, Black Sea and Mediterranean Sea to support the validation of products derived from satellite remote sensing.
- Comparative assessment of satellite remote sensing products from the SeaWiFS, MODIS and MERIS sensors.
- Autonomous radiometer systems operational in the Baltic Sea to support satellite ocean colour validation activities.
- Coupled physical-biochemical model for carbon and oxygen dynamics in the Baltic Sea completed.



## Development of indices for marine eutrophication

Spatial indices using satellite and numerical model data provide decision-makers as well as the general public with easily understandable information about the risks associated with eutrophication. These indices must take into account the different physical and biological condition of Europe's regional seas. In this context, two spatial indices addressing specific aspects of the eutrophication of coastal marine ecosystems (oxygen depletion risk and physical vulnerability) have been further developed by the IES to include temporal variability on a European scale.



Monthly average of chlorophyll concentration in European Seas in June 2005: the red colour indicates very high concentrations

The so-called OXYRISK and PSA indices blend hydro-dynamical model data with remote sensing data to provide a temporal distribution of the risk of oxygen depletion near the sea-bed in European coastal seas (depth < 100 m). The indicators provide large-scale maps, which can help European policy managers to identify problematic areas ("hot spots") where a more detailed analysis through *in-situ* sampling should be performed. The OXYRISK and PSA map products are made available by the IES on a monthly basis, and therefore offer a synoptic and dynamic view of the oxygen depletion risk and physical vulnerability in European coastal areas. Both indices show that some regions of the Baltic Sea, the Belt Sea, the Kattegat and the North-Western Adriatic Sea, among others, are particularly sensitive to these eutrophication risks.

Highlight

## KEY PUBLICATIONS

Druon J.N., Schrimpf W., Dobricic S., Stips A. (2004): Comparative assessment of large-scale marine eutrophication: North Sea area and Adriatic Sea as case studies. *Marine Ecology Progress Series* 272: 1-23.

Helsinki Commission (2004): Thematic Report on Validation of Algorithms for Chlorophyll a Retrieval from Satellite Data of the Baltic Sea Area (Editor W. Schrimpf). *Baltic Sea Environ. Proc.* 94: 44 pp.

Mélin F., Berthon J.F., Zibordi G. (2005): Assessment of apparent and inherent optical properties derived from SeaWiFS with field data. *Remote Sensing of the Environment* 97: 540-553.

Zibordi G., Holben B., Hooker S.B., Mélin F., Berthon J.F., Slutsker I., Giles D., Vandemark D., Feng H., Rutledge K., Schuster G., Al Mandoos A. (2006): A Network for Standardized Ocean Color Validation Measurements. *EOS Transactions of the American Geophysical Union* 87 (30): 293-304.

Lilover M.J., Laanemets J. (2006): A simple tool for the early prediction of the cyanobacteria *Nodularia spumigena* bloom biomass in the Gulf of Finland. *Oceanologia* 48 (5): 213-229.

## MAIN RESEARCH PARTNERS

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Bulgarian Academy of Science – Institute of Oceanology, Varna, Bulgaria  
National Environment Research Institute (NERI), Roskilde, Denmark  
Swedish Meteorological and Hydrological Institute, Norrköping, Sweden  
French Research Institute for Exploitation of the Sea (IFREMER), Issy-les-Moulineaux, France  
National Institute for Geophysics and Vulcanology (INGV), Rome, Italy  
Tallinn University of Technology, Estonia  
University of Plymouth, United Kingdom  
Hellenic Centre for Marine Research (HCMR), Athens, Greece

## Challenges ahead

- Operational production of marine eutrophication risk indices for all European regional seas.
- Implementation of a coupled physical-biochemical model for carbon and oxygen dynamics for the North Sea and Mediterranean Sea.
- Calibration of satellite remote sensing products in all European regional seas.
- Identification of nutrient thresholds in European marine and coastal waters with regard to eutrophication.

## Benefit for Europe

The marine research activities at the IES help to monitor progress in the restoration and recovery of the European regional seas by developing and applying advanced tools using satellite remote sensing and numerical modelling and hence, improving our knowledge and understanding of marine ecosystem functioning.



Ioannis Kanellopoulos  
IES Staff Member from Athens, Greece

"JRC is a great multicultural, multilingual environment to work for."



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Ecological Water Quality Assessment:  
<http://ies.jrc.ec.europa.eu/eewai.html>  
WFD Intercalibration Documents:  
[http://forum.europa.eu.int/Public/jrc/  
jrc/jrc\\_eewai/library](http://forum.europa.eu.int/Public/jrc/jrc/jrc_eewai/library)

## CUSTOMERS

DG Environment  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Directive establishing a framework for  
Community action in the field of water  
policy – 2000/60/EC  
European Union Strategy for Sustainable  
Development – COM (2001) 264

# Towards a better quality of Europe's rivers, lakes and coastal waters

A core concept of the EU Water Framework Directive (WFD) is that the structure and functioning of aquatic ecosystems is used to assess the ecological status of surface waters. The WFD classification scheme for water ecological quality includes five status categories: high, good, moderate, poor and bad. The general objective of the Water Framework Directive is to achieve at least good status for all surface waters by 2015. Assessment of quality is based on the extent of deviation from the reference conditions, defined as the biological, chemical and morphological conditions associated with no or very low human pressure. Good status means “slight” deviation from reference conditions, providing a sustainable ecosystem and acceptable conditions for human uses.



*By 2015 all surface waters in the EU shall have a good ecological quality*

According to the Water Framework Directive, the Member States should develop and harmonise ecological status assessment systems for all surface water categories (lakes, rivers, coastal waters) and all biological quality elements (phytoplankton, macrophytes, benthic fauna and fish). In order to ensure comparability of the ecological classification scales and to obtain a common understanding of the good ecological status of surface waters, the Directive requires an “Intercalibration Exercise”. This poses complex problems to which environmental research must contribute answers. The IES tackles this challenge by co-ordinating and facilitating the intercalibration of ecological water quality objectives and developing WFD-compliant bioindicators and classification tools for ecological water quality assessment.

*Did you know that 20% of  
all surface water in the European Union  
is seriously threatened  
by pollution?*



Vladimir Stolbovoy  
IES Staff Member from Moscow,  
Russian Federation  
*“At the JRC I get everything I need to do  
good research.”*

## Results achieved

- Intercalibration Register: The final Intercalibration Register for the implementation of the Water Framework Directive was established in October 2004 containing 1500 surface water sites from 27 countries illustrating the concept of “good water quality”.
- Lake Intercalibration: The first Lake Intercalibration exercise co-ordinated by the IES has set the reference conditions and class boundaries for chlorophyll-a values for all lake intercalibration types and all geographical regions of the European Union.
- River Intercalibration: The first River Intercalibration exercise co-ordinated by the IES provided harmonised river assessment systems based on benthic fauna across the European Union, ensuring the common understanding of good status of rivers and streams.

## Assessing the water quality of European lakes

The Lake Intercalibration exercise steered by the IES has brought together experts from all over Europe with the aim to set harmonised boundaries for the ecological assessment of lake water quality across the European Union. This exercise is carried out within five so-called ecoregions consisting of Member States sharing common lake types with similar geological, morphological and hydrological features. This regionalised approach is necessary to take into account the different climatic and ecological natural conditions. The exercise is focusing on the biological quality elements considered to be the most relevant for the major pressures: phytoplankton and macrophytes for eutrophication, macroinvertebrates and fish for acidification.



*The growth of algae due to eutrophication poses a serious threat to European lakes*

In a first step, 19 common lake types were defined for the intercalibration exercise based on altitude, size, depth and the catchment's geology. After this, 360 reference lakes, i.e. lakes with no or minor human impact, were identified within the European Union. In a second step, reference conditions for chlorophyll-a values were defined providing the benchmark against which the current condition is compared. Based on these reference conditions, good-moderate quality boundaries were set based on impact-response curves along pressure gradients. For this, the probability of undesirable disturbance to the aquatic ecosystem was evaluated, e.g. a decrease of abundance of submerged macrophytes and an increase of proportion of blue green algae. The resulting harmonised and science-based pan-European lake assessment scheme will be used to achieve a good ecological quality of European lakes.

Highlight

## KEY PUBLICATIONS

Heiskanen A.-S., van de Bund W., Cardoso A.C., Nöges P. (2004): Towards good ecological status of surface waters in Europe – Interpretation and harmonisation of the concept. *Water Science and Technology* 49 (7): 169-177.

Nöges P., van de Bund W., Cardoso A.C., Heiskanen A.-S. (2005): Setting ecological quality class boundaries for the Water Framework Directive: the lake intercalibration network. *Verh. Internat. Verein. Limnol.* 29 (1): 265-267.

Nöges P., Toth G., van de Bund W., Cardoso A.C., Haastrup P., Wuertz J., de Jager A., MacLean A., Heiskanen A.-S. (2005): The Water Framework Directive Final Intercalibration Register for lakes, rivers, coastal and transitional waters: Overview and analysis of metadata. EUR 21671 EN, Office for Official Publications of the European Communities, Luxembourg.

Nöges P., Poikane S., Cardoso A.C., van de Bund W. (2006): Water Framework Directive - The way to water ecosystems sustainability in Europe. *Lakeline* 37: 36-43.

## MAIN RESEARCH PARTNERS

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Natural Environment Research Council – Centre for Ecology and Hydrology (CEH), Wallingford, United Kingdom  
French Centre for Agricultural and Environmental Engineering Research (CEMAGREF), Antony, France  
Institute for Inland Water Management and Waste Water Treatment (RIZA), Lelystad, The Netherlands  
Water Research Institute (CNR-IRSA), Rome, Italy

## Challenges ahead

- New biological quality elements, such as benthic fauna and fish for lakes, as well as aquatic vegetation and fish for rivers need to be addressed.
- Other pressures such as acidification and hydromorphological modifications need to be studied further.

## Benefit for Europe

The research of the IES lays the foundations for sustainable water management aiming at clean and healthy rivers, lakes, and coastal waters that are suitable habitats for fish and other species while providing safe water suitable for drinking and bathing.



Elena Testa  
IES Staff Member from Gallarate, Italy

*“Working for the JRC is a stimulating job.”*



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<http://ies.jrc.ec.europa.eu/iwqis.html>  
IES Research Action AGRI-ENV – Integration of Environment Concerns into Agriculture:  
<http://ies.jrc.ec.europa.eu/agrienv.html>  
Water Information System for Europe:  
<http://wise.jrc.it>  
CCM River and Catchment Database:  
<http://agrienv.jrc.it/activities/catchments/>

## CUSTOMERS

DG Environment  
DG Agriculture and Rural Development  
DG Eurostat  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Directive establishing a framework for Community action in the field of water policy – 2000/60/EC  
Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources – 91/676/EEC



Stephen Peedell  
IES Staff Member from Oxford, UK  
*“The JRC integrates and consolidates cutting-edge knowledge to make it fit to the needs of the policy-maker.”*

# Developing environmental information systems for water

The IES has a strong expertise in developing water-related information systems. These include the Water Information System for Europe (WISE), the European Land Information System for Agri-Environment (ELISA) and the European River and Catchment Database, the latter being part of the Catchment Characterisation and Modelling (CCM) activity. While WISE is an information system with the aim to collect and harmonise a wide range of water-related information as reported by the EU Member States under the Water Framework Directive, CCM covers the entire European continent (including non-EU countries), providing information on rivers and their drainage basins. For the first time, WISE provides facilities for electronic reporting under a Directive and for handling geographically referenced information, following the specifications set out in the related Guidance Document under the Water Framework Directive.



The IES developed the Water Information System for Europe (WISE), now being used by Member States for their reporting under the Water Framework Directive

Complementary to the data delivered by the Member States in WISE, CCM provides a hierarchically structured river network linked to drainage basins and including a set of attributes per river and catchment, which makes it highly relevant for hydrological modelling. The information from CCM, together with information coming from ELISA (e.g. on agricultural land use types, fertilizer use, or protected areas) serves, for example, as input for modelling the environmental impact of agricultural practices and for identifying pressures related to water resources. Results of these models provide scenario-based information to policy-makers.

*Did you know that the Danube River Basin includes the territory of 19 European countries and that Finland has about 190,000 lakes?*

## Results achieved

- With the CCM River and Catchment database, the IES has shown that it is possible to develop a database of rivers and catchments for the whole pan-European continent using innovative algorithms and techniques.
- The integrated electronic Water Information System for Europe (WISE) has been developed and tested, becoming fully operational in 2007.
- New algorithms for the automatic delineation of rivers and catchment boundaries from Digital Elevation Data have been developed.



## Developing a pan-European River and Catchment Database

Detailed information on rivers and lakes and on the characteristics of their drainage basins is important for analysing pressures on water resources and for monitoring the impact of water-related policies. Relevant information systems that allow analysing spatial relationships between different types of water bodies (e.g. rivers, lakes, coastal waters), and between water bodies and environmental characteristics (e.g. terrain types, land cover and land use, population densities, industrial activities) are however lacking on the international level. While detailed information systems may exist for individual countries, no information system for the European Union or even the European continent as a whole has been available to date. Different projection systems, different levels of detail, and different ways of organising the data prevent the easy generation of harmonised European-wide information systems.



*Major European River Systems and their Drainage Basins: a unique map produced by the IES*

In support to several Commission Directorates-General and the European Environment Agency (EEA), the IES has developed the CCM River and Catchment Database for Europe. Rivers and catchment boundaries have been derived at a 100 meter spatial resolution using advanced algorithms. A digital elevation model and a landscape stratification based on climate data, land cover data, and soil served as major input data. By modelling the flow of water across the surface, fully connected river systems could be automatically mapped across the entire continent and their drainage basins subsequently derived from the elevation data. While national data will generally provide more cartographic detail, CCM has the advantage of a seamless coverage of the whole continent.

Highlight

## KEY PUBLICATIONS

Haastrup P., Wuertz J. (Eds.) (2007): Environmental Data Exchange Network for Inland Water. Elsevier: Amsterdam, 313 pp.

Vogt J.V., Bouraoui F., Bidoglio G. (2005): Climate Change and Water Use in Agriculture. In: Eisenreich S. (Ed.): Climate Change and the European Water Dimension. A Report to the European Water Directors. EUR 21553 EN, Office for Official Publications of the European Communities, Luxembourg: 143-150.

Vogt J.V., Colombo R., Paracchini M.L., de Jager A., Soille P. (2003): CCM River and Catchment Database, Version 1.0. EUR 20756 EN, Office for Official Publications of the European Communities, Luxembourg: 30 pp.

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Podmaniczky L., Vogt J.V., Schneller K., Ángyán J. (2005): Land suitability assessment methods for developing a European Land Information System for Agriculture and Environment (ELISA). In: Mander Ü., Helming K., Wiggering H. (Eds.): Multifunctional Land Use: Meeting Future Demands for Landscape Goods and Services. Springer: Berlin, Heidelberg, New York.

## MAIN RESEARCH PARTNERS

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Leibniz-Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany  
Research Institute for Knowledge Systems (RIKS), Maastricht, The Netherlands

## Challenges ahead

- Further integration of systems like WISE, CCM and ELISA for providing up-to-date science-based information to policy-makers, scientists, and the public.
- Linking the available information systems and modelling activities into sophisticated Decision Support Systems.
- Developing tools and indicators for analysing the available information across a range of scales from regional to European level.

## Benefit for Europe

Europe needs detailed and accurate information on the state and trend of its water resources. Relevant information is made available by the IES to policy-makers, experts and the general public through state-of-the-art information systems.



Jutta Thielen-del Pozo  
IES Staff Member from  
Mühlscheider Hof, Germany  
“I appreciate that the JRC is committed to carrying out exploratory research.”



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## CUSTOMERS

DG Agriculture and Rural Development  
DG Environment  
DG Eurostat  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Regulation on Support for Rural Development – 1698/2005/EC  
Communication on the development of agri-environmental indicators for monitoring the integration of environmental concerns into the Common Agricultural Policy – COM (2006) 508  
Decision laying down the 6th Community Environment Action Programme 2001-2010 – 1600/2002/EC  
Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources – 91/676/EEC  
Directive establishing a framework for Community action in the field of water policy – 2000/60/EC

## Integrating environmental concerns into agriculture

Through the recent reforms of the Common Agricultural Policy, rural development is playing an increasingly important role in helping rural areas to meet the economic, social and environmental challenges of the 21<sup>st</sup> century. The new legal framework for rural development 2007-2013 aims at improving sustainability through the right balance between competitive agricultural production and the respect of nature and the environment. However, the integration of agriculture and environment policies is challenging as it requires the introduction of measures seeking environmental protection into the Common Agricultural Policy, in particular the development of agricultural practices that preserve the environment and safeguard the countryside.



*Agricultural policies have a big impact on the environment*

The above mentioned rural development regulation also sets strategic guidelines for a common monitoring and evaluation framework of the new policies based on objectives and indicators. Therefore, common methodologies and indicators need to be developed to carry out *ex-ante* and *ex-post* evaluations of the EU programmes. The IES helps the European Union to assess properly the relevance of farming practices and their impacts on the environment. Furthermore, the maintenance of the multi-functionality of the land in very diversified European rural areas is supported by developing spatially targeted assessments underpinned by geo-spatial modelling and a robust scientific basis.

*Approximately 90% of the European Union territory is rural area – turning agricultural practices into a key factor for environmental protection!*

## Results achieved

- The IES has demonstrated the feasibility of compiling agri-environmental indicators at a pan-European level, such as on High Nature Value Farmland and Soil Erosion, providing relevant input for the Common Monitoring and Evaluation Framework for the Rural Development Programmes 2007-2013.
- The IES contributed to the development of methodologies, e.g. with the pilot study on “High Nature Value (HNV) Farmland Identification in France” which has been tested by the French Ministry for Ecology and Sustainable Development.
- The IES provided important elements for a new Communication from the Commission to the Council and the European Parliament prepared in July 2006 in order to review the progress made with the development of agri-environmental indicators.
- The IES contributed to the identification of necessary improvements of the European statistical system for reporting on agri-environmental issues, which will feed into future agricultural surveys.



Robert Kenny  
IES Staff Member from Kildare, Ireland

*“The JRC cares for the environment: in research and practice.”*



## Developing agri-environmental indicators

The IRENA project (Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy) was carried out jointly by several European institutions, to develop methodologies describing the interface between agriculture and environment in the former 15 EU Member States on the basis of 35 agri-environmental indicators. This activity contributed to the assessment, quantification and monitoring of impacts of agriculture on the environment, supporting both, the implementation of the environmental aspect of agricultural policies and the land management component of the Rural Development Policy.



*Agri-environmental indicators help to assess the success of new rural development policies*

Indicators were derived on the basis of a range of existing European-wide data sources, such as farm censuses, land cover from remote sensing, pan-European environmental databases, modelling activities and administrative data. Some of these indicators were then used to analyse issues of agricultural water use, water quality, land use and soils, climate change and air quality, biodiversity and landscape for the period 1990 to 2000. A scoring scheme was established to evaluate the performance of individual agri-environmental indicators according to the following criteria: policy relevance, responsiveness, analytical soundness, data availability and measurability, ease of interpretation, and cost-effectiveness.

Highlight

## KEY PUBLICATIONS

Campling P., Terres J.-M., Van de Walle S., Van Orshoven J., Crouzet P. (2005): Estimation of Nitrogen balance from agriculture for EU15, spatialisation of estimates to river basins using CORINE Land Cover. *Physics and chemistry of the Earth* 30 (1-3): 25-34.

Grizzetti B., Bouraoui F., de Marsily G., Bidoglio G. (2005): A statistical method for source apportionment of riverine nitrogen loads. *Journal of Hydrology* 304: 302-315.

Bouraoui F., Grizzetti B., Mulligan D., Galbiati L. (2005): Where do fertilizers go? EUR 21748 EN, Office for Official Publications of the European Communities, Luxembourg.

Vogt J.V., Bouraoui F., Bidoglio G. (2005): Climate Change and Water Use in Agriculture. In: Eisenreich S. (Ed.): Climate Change and the European Water Dimension. A Report to the European Water Directors. EUR 21553 EN, Office for Official Publications of the European Communities, Luxembourg: 143-150.

Biala K., Paracchini M.L., Terres J.-M., Pointereau P., Pezet J. (2006): Biodiversity serving agriculture. EUR 22550 EN, Office for Official Publications of the European Communities, Luxembourg.

## MAIN RESEARCH PARTNERS

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ALTErrA - Wageningen University and Research Centre, Wageningen, The Netherlands  
Leibniz-Centre for Agricultural Landscape Research (ZALF), Müncheberg, Germany  
SOLAGRO - Initiatives for Energy, Environment, Agriculture, Toulouse, France  
French National Institute for Agricultural Research (INRA), Paris, France  
Institute of Soil Science and Plant Cultivation (IUNG), Pulawy, Poland  
Catholic University of Leuven, Belgium  
Szent István University, Gödöllő, Hungary

## Challenges ahead

- To improve conceptually and develop technically the indicator on land abandonment, as there is hardly any data providing information on the importance of this phenomenon.
- To develop indicators characterising landscape diversity and change because landscape features are very difficult to capture and to communicate to the public and decision-makers.
- To build a conceptual and modelling framework that allows consistent and robust assessments of the risk of contamination from agriculture to water bodies at different scales.
- To study the increasing pressure of farming activity on groundwater, especially (but not only) in the Mediterranean area, with the aim to develop concepts for aquifer management in stressed agricultural areas.

## Benefit for Europe

The work of the IES delivers key input for the design, implementation, monitoring and evaluation of agricultural policies with the aim to achieve sustainable agro-ecosystems that serve both, food and feed production as well as an ecologically sound management of the countryside.



Nadine Gobron  
IES Staff Member from Moulins, France  
"Thanks to the JRC I can work with the most important international organisations around the world."



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<http://ies.jrc.ec.europa.eu/soil.html>  
European Soil Portal:  
<http://eussoils.jrc.ec.europa.eu>

## CUSTOMERS

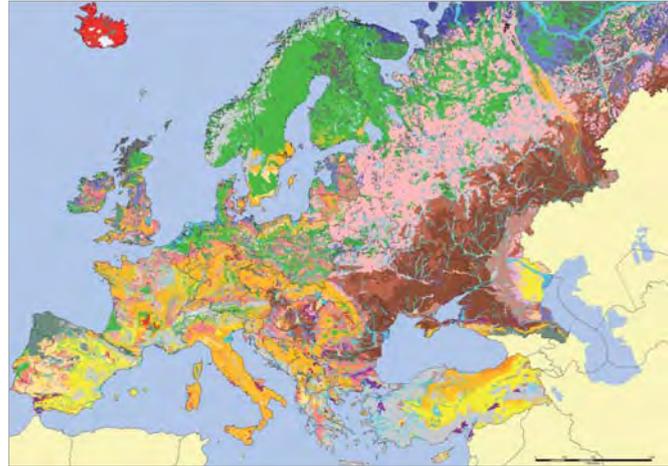
DG Environment  
DG Agriculture and Rural Development  
European Environment Agency (EEA)  
United Nations Food and Agricultural Organisation (FAO)

## POLICIES SUPPORTED

Thematic Strategy for Soil Protection – COM (2006) 231  
Proposal for a Directive establishing a framework for the protection of soil – COM (2006) 232  
United Nations Convention to Combat Desertification (UNCCD)

# Be down to earth: Protecting soil in the European Union

Within the European Union, the major driving force to safeguard soil resources is the Community's Thematic Strategy for Soil Protection, adopted by the Commission in 2006. The IES is actively supporting policies to protect soil resources through research aimed at improving our understanding of the state of soil and the various threats to the way that soil functions. Furthermore, the IES provides decision-makers with policy relevant information on the state or quality of soil.



Map showing the distribution of the major soil types across Europe

One of the key assets of the IES in this domain is its comprehensive European-scale soil database (the Soil Geographical Database of Europe). This knowledge base was established through the development of the European Soil Bureau Network which has evolved into a strong working relationship between IES staff and leading soil science experts across Europe and beyond. The Soil Geographical Database of Europe provides researchers with the necessary data to generate regional scale assessments of the state of soil. Examples include European-wide maps of potential soil erosion, soil organic matter (a crucial component for controlling the way soil functions), crop yield estimates and drivers within flood prediction systems. These derived datasets can then be used in various scenarios to assess the impact of policies on soil quality and the wider environment (e.g. land cover change arising from the Common Agricultural Policy, soil nutrient levels associated with an expansion of biofuel crops, role of soils in climate change).

*Natural processes  
can take more than 500 years  
to create 2 cm of topsoil!*

## Results achieved

- Release of the Soil Atlas of Europe.
- Soil Database of Europe at a scale of 1:1 million: a unique resource and source of knowledge on the soils of Europe, publicly available through the EU Soil Portal (<http://eussoils.jrc.ec.europa.eu/>).
- Soil Resources of Europe Report: This volume provides the most comprehensive summary of the current position detail and availability of soil information at national and European levels.
- Common Criteria for Risk Area Identification according to Soil Threats: This document supports the Soil Thematic Strategy by presenting an overview of common criteria and approaches to identify risk areas for the threats of soil organic matter decline, soil erosion, soil compaction, salinisation and landslides.



Katalin Tóth  
IES Staff Member from Budapest, Hungary  
*"The JRC shows that enlargement was not just a simple act of widening the circle: it increased Europe's scientific potential."*



## Raising public awareness of the need for soil protection

An important element within the Soil Thematic Strategy is the realisation of the need to increase public awareness of the need to protect soil. There is virtually no perception by the general public of the role that soil plays within the environment and of the importance for soil protection measures. It is in this context that the IES has produced the first ever “Soil Atlas of Europe”. This striking, high quality and informative reference publication, aimed at the European Citizen, uses a comprehensive pan-European soil database compiled through several years of collaboration between the IES and soil scientists across Europe to produce a series of maps showing the distribution of major soil types across Europe. The maps are supplemented by a wealth of educational material.



*Soil erosion is a serious problem in Europe: Poor land management practices can lead to the complete removal of soil*

Another mechanism developed by the IES for improving access to soil related information is the European Soil Portal, a comprehensive web site that functions as a single reference point for soil data and information at European level. The Soil Portal provides access to a range of datasets, documents and internet mapping services that allow users to add soil information to their own maps. The success of the Soil Portal can be seen by the thousands of daily users from all over the world. Over the coming years, the European Soil Portal will be further developed to become the European Soil Data Centre (ESDAC), the prime node for soil related data in Europe.

Highlight

## KEY PUBLICATIONS

Eckelmann W., Baritz R., Bialousz S., Bielek P., Car-ré F., Houskova B., Jones R.J.A., Kibblewhite M., Kozak J., Le Bas C., Tóth G., Tóth T., Várallyay G., Yli Halla N., Zupan M. (2006): Common Criteria for Risk Area Identification according to Soil Threats. European Soil Bureau Research Report No.20, EUR 22185 EN, Office for Official Publications of the European Communities, Luxembourg: 94 pp.

Hollis J.M., Jones R.J.A., Marshall C.J., Holden A., Renger van de Veen J., Montanarella L. (2006): SPADE-2: The Soil Profile Analytical Database for Europe (version 1.0). EUR 22127 EN, Office for Official Publications of the European Communities, Luxembourg: 52 pp.

Jones R.J.A., Houskova B., Bullock P., Montanarella L. (2005): Soil Resources of Europe, 2nd edition. EUR 20559 EN, Office for Official Publications of the European Communities, Luxembourg: 420 pp.

Jones A., Montanarella L., Jones R.J.A. (Eds.) (2005): Soil Atlas of Europe. EUR 21676 EN, Office for Official Publications of the European Communities, Luxembourg: 128 pp..

## MAIN RESEARCH PARTNERS

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Szent István University, Gödöllő, Hungary  
Mediterranean Agronomic Institute (CIHEAM-IAMB), Bari, Italy  
University of Copenhagen, Denmark  
University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria

## Challenges ahead

- The establishment of the European Soil Data Centre (ESDAC) as a single focal point for all soil data and information in Europe.
- The development of quality assured procedures for data collection, management, storage and distribution to all users that comply with the Infrastructure for Spatial Information in Europe (INSPIRE).
- The development of advanced modelling techniques, indicators and scenario analyses in relation to the major threats to soil as identified in the Thematic Strategy for Soil Protection.

## Benefit for Europe

The research of the IES helps to ensure that soil continues to provide us with food and raw materials, serving as a platform for human activities, an archive of heritage, a habitat and gene pool, a body for storing, filtering and transforming water, nutrients and carbon, and as the biggest carbon store in the world.



Wouter van de Bund  
IES Staff Member from Bennekom,  
The Netherlands  
“Every day at the JRC is different:  
Every day there is a new challenge.”



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<http://ies.jrc.ec.europa.eu/forest.html>

## CUSTOMERS

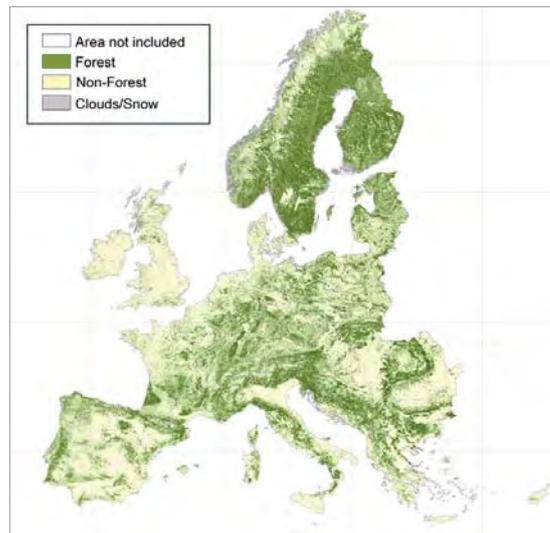
DG Environment  
DG Agriculture and Rural Development  
DG Regional Policy  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Regulation concerning monitoring of forests and environmental interactions in the Community (Forest Focus) – 2152/2003/EC  
EU Forest Strategy (1999/C 56/01) and EU Forest Action Plan for the implementation of the EU Forest Strategy – COM (2005) 84  
Directive on the conservation of natural habitats and of wild fauna and flora – 92/43/EEC  
Communication on halting the loss of biodiversity by 2010 and beyond – COM (2006) 216

# Monitoring the forest in Europe

Since the 1980's, several EU regulations have been aimed at monitoring European forests and environmental interactions. During the last years, the IES has supported these activities by acting as scientific-technical co-ordinator of the Forest Focus regulation, e.g. developing a comprehensive European database (EU Forest Focus Database) which provides up-to-date information on forest damage caused by atmospheric pollution, forest fires, forest biodiversity and forest soil parameters. In the future, the IES will serve as the focal point for forest information in the European Union through the European Forest Data Centre (EFDAC) which will be hosted by the IES. The data centre is expected to foster provision of available data, information tools and to offer possibilities to plug this data into relevant modelling systems. The concept of the European Forest Data Centre will be compliant with the envisaged Shared Environmental Information System.



*The European Forest Map produced by the IES shows the forest cover in Europe in unrivalled detail*

Among the achievements is the development of the first forest map of Europe at very detailed spatial resolution on the basis of satellite imagery. The production of the 25 m spatial resolution map of the year 2000 will be used as the basis for monitoring forest area and forest fragmentation changes with respect to the forests in the 1990's and with respect to their current status in 2006. The habitats of many endangered species in Europe are closely linked to the status of the forests, as increased fragmentation of our forests may trigger the extinction of these species. The IES' activities on forest monitoring are thus essential to the implementation of indicators related to the monitoring of forest spatial pattern and forest fragmentation, these being of key importance for the European Union policy to halt the loss of biodiversity by 2010.

*Did you know that **over 25%** of the global forest area is located in Europe?*

## Results achieved

- Development of the first high-spatial resolution (25 m) forest map of Europe.
- Development and implementation of methods for assessing the forest spatial pattern of European forests.
- Implementation of a unique database on forest condition in Europe.
- Development of the European Forest Information and Communication Platform.
- Development of the first prototype of the European Forest Data Centre (EFDAC).

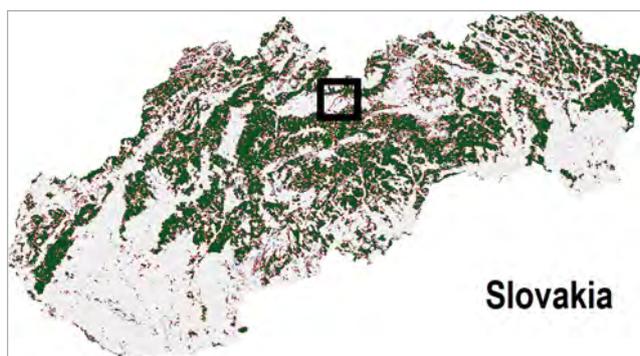


Marcel Šúri  
IES Staff Member from Trnava, Slovakia  
"I enjoy the interdisciplinary JRC team work and the possibility to transfer scientific results into our daily lives."



## Monitoring the biodiversity of European forests – halting forest fragmentation

Urban sprawl, increase of infrastructure, conversion to agriculture, and clear cuts lead to forest fragmentation which has an impact on forest biodiversity. Today, more and more species are endangered or even at risk of extinction. The amount, distribution, and status of forests is very diverse among EU Member States. Policy-makers, environment agencies, and local forest management authorities require tools and methods to monitor the state and evolution of forest spatial patterns. Statistical analysis and maps of forest spatial pattern are the pre-requisite for efficient planning and quality assessment of forest management and related political programmes.



Highlight

*The spatial pattern of forests is of key importance for biodiversity*

The IES is providing these tools to assess forest spatial pattern from local to European scale for operational use. The Institute provides statistics and maps of forests classified in a series of classes such as core-, edge-, patch-, and perforated forests, including connectivity features like green corridors which may be crucial for movement pathways and the survival of endangered species. The ongoing research project to analyse forest spatial pattern has led to innovative approaches which have been published, acknowledged and accepted for implementation by the European Environment Agency and other actors.

## KEY PUBLICATIONS

Baraldi A., Puzolo V., Blonda P., Bruzzone L., Tarantino C. (2006): Automatic spectral rule-based preliminary mapping of calibrated Landsat TM and ETM+ images. *IEEE Transactions on Geosciences and Remote Sensing* 44 (9): 2563-2586.

Fassio A., Giupponi C., Hiederer R., Simota C. (2005): A decision support tool for simulating the effects of alternative policies affecting water resources: an application at the European scale. *Journal of Hydrology* 304: 462-476.

Gabban A., San-Miguel-Ayaz J., Viegas D.X. (2006): On the suitability of the use of NOAA-AVHRR NDMI data for forest fire risk assessment. *International Journal of Remote Sensing* 27 (22): 5095-5102.

Kozak J., Estreguil C., Vogt P. (2007): Forest cover and pattern changes in the Carpathians over the last decades. *European Journal of Forest Research* 126: 77-90.

Vogt P., Riitters K., Estreguil C., Kozak J., Wade T.G., Wickham J.D. (2007): Mapping Spatial Patterns with Morphological Image Processing. *Landscape Ecology* 22: 171-177.

Vogt P., Riitters K., Iwanowski M., Estreguil C., Kozak J., Soille P. (2007): Mapping Landscape Corridors. *Ecological Indicators* 7: 481-488.

## MAIN RESEARCH PARTNERS

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University of Molise, Campobasso, Italy  
University of Tuscia, Viterbo, Italy

## Challenges ahead

- Establishment of the European Forest Data Centre (EFDAC) as a focal point for forest information in Europe.
- Contribution to the future European Forest Monitoring System.
- Linking forest spatial pattern with species habitats and migration patterns.
- Characterisation of the protective functions of forests in relation to human well-being.
- Scenario modelling of forest trends in the EU in relation to Climate Change.

## Benefit for Europe

Forests are the reservoir of most of the plant and animal biodiversity in Europe. They act as filters for air and water, and contribute to the reduction of the greenhouse effect. The IES helps to maintain the quality of European forests, and thus to preserve them as one of the primary sources of recreation for the European population.



Bianca D'Alimonte  
IES Staff Member from Angera, Italy

*“At the JRC the best brains of Europe meet to create European added value.”*



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<http://ies.jrc.ec.europa.eu/afolu.html>  
AFOLU DATA Tool Box:  
<http://afoludata.jrc.it>  
CARBOEUROPE Integrated Project:  
<http://www.carboeurope.org/>  
NITROEUROPE Integrated Project:  
<http://www.nitroeuropa.eu/index.html>

## CUSTOMERS

DG Environment  
DG Agriculture and Rural Development  
European Environment Agency (EEA)  
Intergovernmental Panel on Climate Change (IPCC)

## POLICIES SUPPORTED

Decision concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol – 280/2004/EC  
Regulation concerning monitoring of forests and environmental interactions in the Community (Forest Focus) – 2152/2003/EC  
Decision concerning the approval of the Kyoto Protocol to the UNFCCC and the joint fulfilment of commitments thereunder – 2002/358/EC  
United Nations Framework Convention on Climate Change (UNFCCC)  
United Nations Convention on Long-range Transport of Transboundary Air Pollution



Niina Kautto  
IES Staff Member from Jyväskylä, Finland

*“The JRC provides me the chance to make my PhD in an exceptional environment.”*

# Monitoring greenhouse gases in terrestrial ecosystems

Terrestrial ecosystems are closely linked to all major aspects of climate change: causes, impacts and solutions. For example, tropical deforestation is a major cause of climate change, contributing to about 20% of greenhouse gases emitted every year. At the same time, terrestrial ecosystems are experiencing climate change, with mixed effects: in Europe, plants are generally growing faster because of extended growing seasons, atmospheric CO<sub>2</sub> and nitrogen fertilization, but more frequent droughts, thunderstorms and heat waves may reverse these positive effects in the future. The relevance of these linkages make changes in terrestrial ecosystems a central issue in any policy aimed at combatting climate change. However, due to the high complexity of ecosystems, the better quantification of these relationships and their role in climate change, their vulnerability and their mitigating potential represents an extraordinary scientific challenge.



*The IES used a poplar plantation in Parco Ticino near Pavia (Italy) for the monitoring of ecosystem greenhouse gas fluxes (left) and a detailed inventory of biomass stocks after logging (centre-right)*

This is of particular importance in the context of the United Nations Framework Convention on Climate Change and its Kyoto Protocol, which requires Parties – among them the European Union – to monitor impacts of their policies through annual inventories of greenhouse gases. The IES supports the compilation of a European greenhouse gas inventory by investigating the biogeochemical cycles of carbon and nitrogen and providing for the Agriculture, Forestry and Other Land Uses sector both, quality assessment and control of the estimates and harmonisation of the methodologies used by Member States, including the development of EU-wide reference data sets. The overall aim is to improve the robustness, completeness and comparability of the inventories, as well as to prepare the bases for their independent verification.

*Did you know that European forests absorb about 10% of greenhouse gas emissions from fossil fuels use in Europe?*

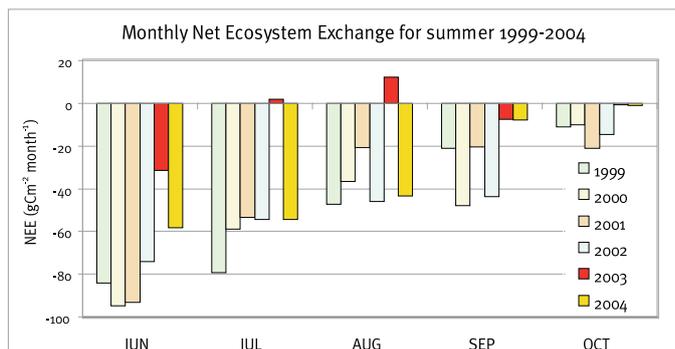
## Results achieved

- Support provided to the annual EU greenhouse gas inventory and other reports due under the EU Monitoring Mechanism, including data quality assessment for the Agriculture, Forestry and Other Land Uses (AFOLU) sector.
- Delivery of the web-based toolbox AFOLU DATA (<http://afoludata.jrc.it>) estimating European greenhouse gas fluxes and carbon stock changes in the AFOLU sector.
- Publication of a paper in *Nature* on the effects of the 2003 heat and drought on vegetation (see Key Publications).
- Development of a detailed agricultural land use map of Europe for the year 2000.



## Summer 2003: a taste of future climate effects on ecosystems

What will be the impact of climate change on terrestrial ecosystems? The exceptional heat wave and drought of the summer of 2003 provided the opportunity to answer this question. During this year the IES, through its test sites for long-term ecosystem research in a poplar plantation (close to Pavia/Italy) and a Mediterranean pine forest (close to Pisa/Italy), has documented an unprecedented reduction in primary productivity due to heat and water stress. These findings were published in *Nature* along with similar data from many other sites of the CarboEurope project on a wide range of ecosystems across Europe.



Highlight

*Greenhouse gas fluxes in a pine forest measured at the San Rossore site near Pisa (Italy): In the hot and dry summer of 2003 the forest became a source of CO<sub>2</sub>, instead of being a sink*

CarboEurope, and its complementary NitroEurope, are European projects aimed at quantifying and understanding the carbon and nitrogen cycle through a complex integration of different methodological approaches. The IES is participating to both projects covering the whole chain “from the plot to the continent” with its experimental sites instrumented to perform long-term monitoring of greenhouse gases in different land uses, with datasets and models to allow the up-scaling of the gained insight, and with the distillation of the knowledge obtained into simple methodologies to estimate national greenhouse gas emissions.

## Challenges ahead

- To improve and simplify the monitoring and reporting of greenhouse gases from agriculture and forestry.
- To help in establishing a systematic monitoring system for greenhouse gas concentrations and fluxes in Europe and the world.
- To contribute process understanding and tools to separate impacts of climate, air pollution or management on terrestrial ecosystems.
- To expand the web-based toolbox AFOLU DATA to other world regions to help future regimes for monitoring and reporting of avoiding deforestation in Developing Countries.

## Benefit for Europe

Establishing EU-wide data sets in the agriculture and forestry sectors allows the assessment of the vulnerability of terrestrial ecosystems to climate change, to develop options for mitigating climate change through land use activities, and to increase the EU-wide capacity for the verification of greenhouse gas emissions and removals.

## KEY PUBLICATIONS

Ciais P., Reichstein M., Viovy N., Seufert G., Matteucci G., Manca G., et al. (2005): Europe-wide reduction in primary productivity caused by the heat and drought in 2003. *Nature* 437: 529-533.

Leip A., Dämmgen U., Kuikman P., van Amstel A.R. (2005): The quality of European (EU-15) greenhouse gas inventories from agriculture. *Environmental Sciences* 2 (2-3): 177-192.

Bergamaschi P., Behrend H., Jol A. (2004): Inverse modelling of national and EU greenhouse gas emission inventories - Report of the workshop “Inverse modelling for potential verification of national and EU bottom-up GHG inventories” under the mandate of the Monitoring Mechanism Committee WG-1, 23-24 October 2003, JRC Ispra. EUR 21099 EN, Office for Official Publications of the European Communities, Luxembourg.

Bergamaschi P., Frankenberg C., Meirink J.F., Krol M., Dentener F. et al. (2007): Satellite cartography of atmospheric methane from SCIAMACHY on board ENVISAT. *Journal of Geophysical Research* 112: 26 pp.

## MAIN RESEARCH PARTNERS

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- University of Milano Bicocca, Milan, Italy
- Natural Environment Research Council – Centre for Ecology and Hydrology (CEH), Edinburgh, United Kingdom
- ALTErrA – Wageningen University and Research Centre, Wageningen, The Netherlands
- International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
- Research Centre Karlsruhe (FZK) – Institute for Meteorology and Climate Research, Garmisch-Partenkirchen, Germany
- Risø National Laboratory, Roskilde, Denmark



Paulo Barbosa  
IES Staff Member from Lisbon, Portugal

“The expertise of the JRC helps to shape Europe.”



# Environment and **Security**

## Managing environmental risks

The quality of life of European citizens is threatened by multiple risks related to the environment. These range from natural hazards to the man-made pollution of air, water and soils. Given the fact that most of these threats cross borders and thus have EU-wide implications, the European Union has an important role to play at all stages: risk reduction and prevention, early warning, crisis management, and damage assessment. The JRC's Institute for Environment and Sustainability (IES) develops monitoring, forecasting, information and assessment tools that help to reduce and manage environmental risks.

The IES tackles in particular the following areas in the field of environmental security:

- Under the EURATOM Treaty, the IES is in charge of the radioactivity environmental monitoring in Europe, providing accurate and validated information under routine and emergency conditions. This activity is complemented by research concerning the atmospheric dispersion of radioactive agents and, increasingly, the risk assessment of environmental radioactivity.
- The IES supports the EU Environment and Health Action Plan by investigating environmental risk factors with the aim to develop tools that make it possible to quantify environment and health interactions. Particular emphasis is given to the health effects of climate change and of emerging technologies.
- The Institute has long standing expertise in air pollution studies in urban areas. While in past years scientists have been looking mainly into the personal exposure of citizens, in the future the research of IES will move more and more towards integrated assessments of air pollution and health effects.
- The fate of pollutants in terrestrial and aquatic ecosystems is an issue of major concern in Europe. This is because the focus has shifted from point-source pollution (e.g. originating from industry) to diffuse pollutants that need to be addressed on a river catchment scale. The IES develops concepts to solve this complex challenge.
- The IES is at the forefront of developing early-warning and damage assessment systems related to weather-driven natural hazards. These events seem to become increasingly frequent and extreme under the conditions of a changing climate. The IES has gained international recognition through the development of the European Flood Alert System (EFAS) and the European Forest Fire Information System (EFFIS).

*“The European institutions must tackle the risks faced by citizens in their daily life. The protection of the life and the property of citizens is a core task giving legitimacy to public power and public policies.”*

José Manuel Barroso  
European Commission President





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European Radiological Data Exchange  
Platform (EURDEP):  
<http://eurdep.jrc.it/>  
ENSEMBLE Project:  
<http://ensemble.jrc.it/>  
European Forum on Radon Mapping:  
<http://radonmapping.jrc.it/>

## CUSTOMERS

DG Transport and Energy  
DG Information Society  
DG External Relations  
International Atomic Energy Agency (IAEA)  
Competent Authorities of the EU Member  
States and Candidate Countries

## POLICIES SUPPORTED

Euratom Treaty, Art. 35-36  
Directive laying down basic safety standards  
for health protection of workers and the  
general public against the dangers arising  
from ionizing radiation – 96/29/EURATOM  
Recommendation concerning the monitoring  
of the levels of radioactivity in the environ-  
ment for the purpose of assessing the  
exposure of the population as a whole –  
2000/473/EURATOM  
Decision on Community arrangements for  
the early exchange of information in the  
event of a radiological emergency –  
87/600/EURATOM

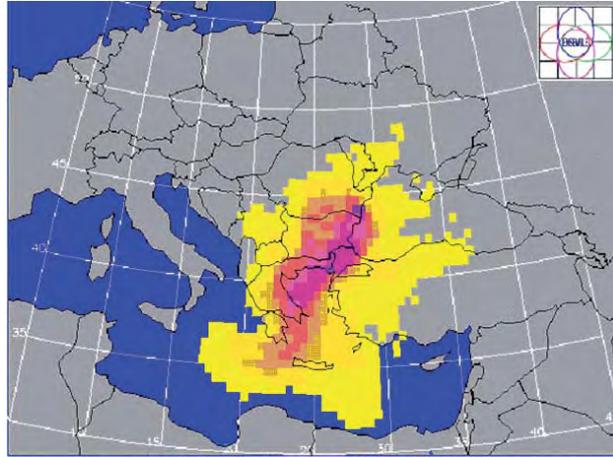


Niels Jensen  
IES Staff Member from Kolding, Denmark

*“The JRC is a catalyst of European  
integration.”*

## Monitoring radioactivity in Europe's environment

The Radioactivity Environmental Monitoring Action of the IES was started shortly after the Chernobyl nuclear power plant accident (26 April 1986) to support the European Commission in its responsibility to provide qualified information on the levels of radioactive contamination of the various compartments of the environment (air, water, soil). This role of the European Commission is laid down in EU legislation, in particular the Euratom Treaty and the Council Decision 87/600.



*The ENSEMBLE system compares different atmospheric dispersion models*

Hence, the main line of the IES' activities concerns the improvement of procedures for the collection, evaluation and harmonisation of environmental radioactivity concentration data and the modelling of the migration of radioactivity in the environment under routine and emergency conditions, as well as making this information available to the general public. The IES ensures the availability of tools for the inter-communication and access to this information. Specific attention is given to further integrate the new Member States into the existing information exchange systems and to assist Candidate Countries in fulfilling these obligations in view of their potential membership of the EU. Underpinning research consists of the development and intercomparison of real-time atmospheric dispersion models, development and implementation of advanced statistical tools, radioecological assessment and the continued development of decision support systems.

*Did you know that the IES hosts the data centre for  
environmental radioactivity  
measurements in the EU?*

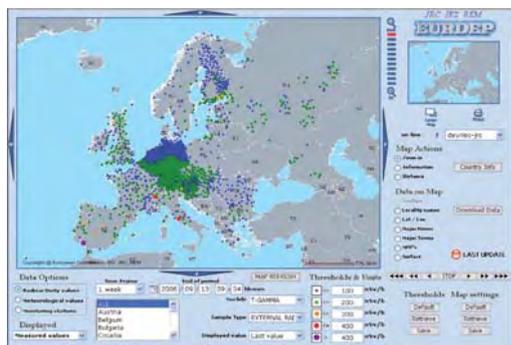
## Results achieved

- A new web interface has been developed and implemented for the EURDEP Network to report radioactivity monitoring information to the general public.
- The ENSEMBLE modelling system has been coupled with the EURDEP database, allowing the direct consultation of model predictions and real-time monitoring data in case of emergency.
- The international ConvEx-3 exercise (May 2005) simulated an accident in the Cernavoda Nuclear Power Plant in Romania. During the 48 hours of the exercise, IES staff gave scientific and technical support, and the EURDEP, ECURIE and ENSEMBLE networks were operated successfully.
- An overview of national radon surveys (indoor and soil gas) has been completed as well as a detailed summary on gamma dose-rate and airborne concentration measurements for most European countries.



## Nuclear emergency support

A crucial part of the IES' work programme is dedicated to the maintenance and development of international information exchange systems for decision support in case of a large nuclear accident with transboundary release to the atmosphere. Over the past few years, the functionality of the exchange systems for notification (ECURIE), monitoring data (EURDEP) and atmospheric model evaluation (ENSEMBLE) has been further improved. This was demonstrated on several occasions through successful participation to international emergency exercises. Currently 30 countries have joined the EURDEP network, continuously exchanging radiological monitoring data in almost real-time from some 4100 stations making the network applicable for emergency management.



The EURDEP web site (<http://eurdep.jrc.it/>) provides environmental radioactivity monitoring data all over Europe

Together with the International Atomic Energy Agency (IAEA) and DG Transport and Energy, the IES developed a common data format for exchanging information during radiological accidents, allowing EU Member States to fulfil their legal obligations to both the IAEA and the European Commission through a single procedure. The collaboration is further enhanced by IES staff participating in the IAEA Expert Groups dealing with the harmonisation and improvement of international data and information exchange during radiological accidents and atmospheric modelling activities.

Highlight

## KEY PUBLICATIONS

Bianconi R., Galmarini S., Bellasio R. (2004): Web-based System for Decision Support in Case of Emergency: Ensemble Modelling of Long-range Atmospheric Dispersion of Radionuclides. *Journal of Environmental Modeling and Software* 19 (4): 401-411.

De Cort M., Naegele J., Doherty B., Tollefsen T. (Eds.) (2005): Environmental Radioactivity in the European Community 1996-2000. EUR 20765 EN, Office for Official Publications of the European Communities, Luxembourg: 184 pp.

Dubois G. (Ed.) (2005): Automatic mapping algorithms for routine and emergency monitoring data. EUR 21595 EN, Office for Official Publications of the European Communities, Luxembourg: 150 pp.

Dubois G. (2005): An Overview of Radon Surveys in Europe. EUR 21892 EN, Office for Official Publications of the European Communities, Luxembourg: 168 pp.

Galmarini S. (2006): One Year of <sup>222</sup>Rn Concentration in the Atmospheric Surface Layer. *Atmos. Chem. Phys.* 6: 2865-2887.

## MAIN RESEARCH PARTNERS

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- University of British Columbia, Vancouver (BC), Canada
- Ecole Nationale des Ponts et Chaussées, Paris, France
- Polytechnical School of Lyon, France
- Czech Geological Survey, Prague, Czech Republic
- Federal Office of Public Health, Bern, Switzerland
- Dutch National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands
- University of Utrecht, The Netherlands
- Institute for Nuclear Research and Nuclear Energy – Bulgarian Academy of Sciences, Sofia, Bulgaria
- Federal Agency for Radiation Protection – Institute for Atmospheric Radioactivity, Freiburg, Germany

## Challenges ahead

- Adapt the ECURIE and EURDEP systems to the standards agreed with the International Atomic Energy Agency (IAEA).
- The ENSEMBLE system will be further developed and tested by means of model intercomparisons and participation to international emergency exercises.
- The feasibility of mapping indoor radon at the European level will be explored in view of a possible preparation of a European Atlas on Natural Radiation.

## Benefit for Europe

The IES collects, compares and evaluates the environmental radioactivity data submitted by the Member States for normal and emergency situations all over Europe and provides it to a wide audience.



Vittoria Lacovara  
IES Staff Member from Grünstadt, Germany

*"I have never heard so many languages in one single place as in Ispra."*



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## WEB SITES

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<http://ies.jrc.ec.europa.eu/envihealth.html>

## CUSTOMERS

DG Environment  
DG Health and Consumer Protection  
DG Research  
World Health Organisation (WHO)  
United Nations Environment Programme (UNEP)  
European Environment Agency (EEA)  
European Centre for Disease Control (ECDC)

## POLICIES SUPPORTED

European Environment and Health Action Plan 2004-2010 — COM (2004) 416

# Environmental quality and human health

Environmental risk factors have an impact on human health and well-being. Sometimes they even cause disease and pre-mature deaths. For example, it is commonly known that air pollution can cause respiratory diseases, that UV radiation from the sun increases the risk for skin cancer and that exposure to industrial chemicals could lead to infertility or change the normal development of the nerve system during childhood. We are annoyed by noise from traffic or ventilation systems disturbing our sleep and affecting our performance at work and at home. Also new types of environmentally related health risks are appearing on the horizon. People are concerned about how climate change may affect human health, due to increasing temperatures and more frequent extremes. New technologies, like nanotechnology, may cause risks to human health and the environment at scales that we are not yet able to discover.



*Environmental problems such as air pollution and noise particularly affect the population in urban areas*

The European Environment and Health Action Plan for the period 2004-2010 has the ambition to tackle all these issues in a comprehensive way. The IES supports this Action Plan by providing scientifically grounded information needed to help the EU and the Member States to reduce adverse health impacts from environmental factors and to better enhance cooperation between actors in the environment, health and research fields. The IES has developed elegant systems to collect, analyse and store information about environmental quality. This information is now framed into a human health context with the overall aim to unveil environment and health interactions. This work includes the development and application of informatics tools, harmonisation through geo-referenced database management as well as information mining of health statistics.

***Are you aware that negative health effects of environmental factors are seriously affecting European productivity?***

## Results achieved

- “Environment and Health in Europe 2005”: Report produced jointly by the JRC and the European Environment Agency, giving an overview of the current environment and health situation in Europe.
- Development of a roadmap for integrating monitoring and information systems for environment and health assessments in the Member States.
- Contributions to the “Belgrade Report 2007” of the European Environment Agency on late effects of early exposure as well as on long-term health effects of the Chernobyl accident.
- Contribution to the UNEP Report on the impact of nanotechnologies on our environment.



Pam Kennedy  
IES Staff Member from Beckenham,  
United Kingdom  
*“The JRC is networked with the best institutions in the Member States and beyond.”*



## Quantifying the impact of environmental factors on our health

In 2004, an expert panel of the World Health Organisation Europe estimated that air pollution causes 100.000 pre-mature deaths in the EU (15 Member States) every year. Using basically the same background information, another expert panel within the Clean Air For Europe Programme of the European Commission came up with a number of 350.000 pre-mature deaths, while at the launch event of the European Environment Agency's State of the Environment Report 2005, the number of 200.000 Europeans dying pre-maturely because of air pollution in the 25 EU Member States was mentioned. What is right, what is false, which numbers do we believe? Unfortunately, this is the reality which decision-makers are facing and it is on this type of information they have to make decisions with up to multi-billion Euro consequences. Policy-makers clearly need reliable information in a field which by its very nature is plagued by a high degree of uncertainty.



*Environment and health interactions are very complex and difficult to communicate*

The IES is analysing and comparing different quantitative models for estimating health impacts, with the ambition to develop and refine them, paving the way towards a European consensus approach. In particular, the IES is looking into how to optimally apply the "Environmental Burden of Disease" (EBD) concept developed by the World Health Organisation and the World Bank quantifying health effects of environmental factors. The idea is to develop this concept not only into a methodology for delivering more accurate environment and health estimates, but also into a tool for communication, providing a simple way to raise awareness of environmental health impacts.

Highlight

## KEY PUBLICATIONS

European Environment Agency and Joint Research Centre (Eds.) (2005): Environment and Health. EEA Report No.10/2005: 40 pp.

Goldstein B., Aguar P., Bech S., Cortie M., da Silva C.G., Rickerby D., Savage N., Vacek J., Yu L., Zhao Y. (2007): The impact of new nanotechnologies in our environment. In: United Nations Environment Programme (Ed.): Geo Yearbook 2007.

Baklanov A., Hänninen O., Slørdal L.H., Kukkonen J., Bjergene N., Fay B., Finardi S., Hoe S.C., Jantunen M., Karppinen A., Rasmussen A., Skouloudis A., Sokhi R.S., Sørensen J.H. (2006): Integrated systems for forecasting urban meteorology, air pollution and population exposure. *Atmospheric Chemistry and Physics Discussions* 6: 1867-1913.

## MAIN RESEARCH PARTNERS

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Institute of Health Carlos III, Madrid, Spain  
Peninsula Medical School, Universities of Exeter and Plymouth, United Kingdom  
Society for Chemical Engineering and Biotechnology (DECHEMA), Frankfurt, Germany  
National Institute for Environmental Studies (NIES), Tsukuba, Japan  
National Institute for Scientific Research (INRS), Québec, Canada  
Marmara Research Centre (TÜBITAK), Gebze, Turkey  
University of Crete, Heraklion, Greece  
International University of Venice, Italy

## Challenges ahead

- Development of methodologies to cross environmental quality and health information.
- Development of the "Environmental Burden of Disease" concept to quantify environment and health interactions and use it as a communication tool.
- Study of human health impacts of climate change as well as of new and emerging technologies.

## Benefit for Europe

**A cleaner environment means healthier citizens leading to higher productivity and lower costs for health care.**



Peeter Nõges  
IES Staff Member from Tartu, Estonia

*"The JRC allows me to make a difference."*



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IES Research Action APE – Air Pollution and Effects:  
<http://ies.jrc.ec.europa.eu/ape.html>

## CUSTOMERS

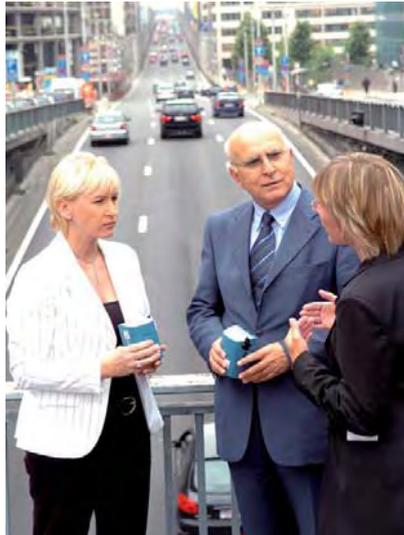
DG Environment

## POLICIES SUPPORTED

Thematic Strategy on Air Pollution – COM (2005) 446  
Proposal for a Directive on ambient air quality and cleaner air for Europe – COM (2005) 447  
Directive on ambient air quality assessment and management – 1996/62/EC  
Directive relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air – 1999/30/EC  
Directive relating to limit values for benzene and carbon monoxide in ambient air – 2000/69/EC  
Directive relating to ozone in ambient air – 2002/3/EC

## Air pollution assessment in European cities

In support to the Air Quality Policy of the European Union, the IES contributes to the provision, the compilation and the critical analysis of scientific evidence for the preparation of new legislation or the revision of existing legislation related to air pollution. The IES addresses the problems of toxic emissions, the resulting air quality and their impacts on human health with an integrated approach that includes the in-depth physical and chemical study of the pollutants emitted by various human activities, with a particular emphasis on transport. It develops methodologies for the identification of the sources of air pollution and for the use of dispersion models in support to the implementation of air quality policies.



*The IES provided Commission Vice-President Margot Wallström and Environment Commissioner Stavros Dimas with mobile personal samplers to monitor their personal exposure to air pollutants*

The IES activities have been designed in close collaboration with DG Environment in the framework of the “Clean Air For Europe (CAFE)” programme. In order to offer the policy-makers an adequate support to develop appropriate emission reduction strategies including cost-benefit considerations, the IES co-ordinates these activities with relevant scientific partners in Europe and worldwide. The European Reference Laboratory for Air Pollution (ERLAP), located at the IES, plays a key role in this context through the co-ordination of *ad-hoc* measurement campaigns and intercomparisons. Particular priority is given to the integration of the new EU Member States and Candidate Countries by providing guidance on the correct implementation of air quality directives.

*Despite significant improvements in Europe's air quality thanks to European legislation and other factors, air pollution continues to be a serious problem for human health and the environment.*

## Results achieved

- The PEOPLE project studying the exposure of citizens to urban air pollution in different European cities has contributed significantly to the understanding of the relation between ambient air quality, exposure to air pollutants and impacts on health.
- The intercomparison exercises of the European Reference Laboratory for Air Pollution (ERLAP) have made important contributions to the comparability and quality of European air pollution data.
- The validation of alternative measurement techniques like diffusive samplers have led to an increase in measurement capabilities in EU networks.



Jan Kučera  
IES Staff Member from České Budějovice, Czech Republic  
*“I appreciate that the JRC actively supports gender equality.”*



## The Krakow Project: An integrated approach to toxic emissions

In the years 2004-2006, the IES carried out the “Krakow Project - From toxic emissions to health effects” for testing an innovative integrated approach to air pollution. The objective of the project was to develop a methodology supporting the decision-making process at local, state and EU level to design appropriate air quality and emission reduction strategies. The area selected for the case study was the Malopolska region (Poland) where the European limits for the suspended particulate matters were significantly exceeded. The use of source apportionment techniques for the understanding of air pollution origins was crucial to identify the relative contributions of different source types to ambient air pollutant concentrations.



*The Krakow Project was characterised by a participatory approach involving the local population*

The study revealed that the chemical composition of the particulate matter in the ambient air of Krakow shows a high level of toxic organic compounds, such as Benzo-(a)-Pyrene. However, the values of toxic metals (Pb, As, Cd, Ni) were found to be below the EU limits. A major finding was the fact that the size of the particles is inferior to the average in Europe. An accompanying health impact study revealed the evidence of a negative impact on health in population exposed to higher levels of this particulate matter such as the inhabitants of the old districts of the town where the presence of coal-heated apartments prevails. The methodology developed and applied in the Krakow study will now be applied and further developed to other European areas where air pollution is of big concern, e.g. the Italian Lombardy Region.

Highlight

## KEY PUBLICATIONS

Gerboles M.O., Lagler F., Rembges D., Brun C. (2003): Assessment of Uncertainty of NO<sub>2</sub> Measurements by the Chemiluminescence Method and Discussion of the Quality Objective of the NO<sub>2</sub> European Directive. *Journal of Environmental Monitoring* 5: 529-540.

Cieslik S.A. (2004): Ozone uptake by various surface types: a comparison between dose and exposure. *Atmospheric Environment* 38 (15): 2409-2420.

Pérez Ballesta P. (2005): The uncertainty of averaging a time series of measurements and its use in environmental legislation. *Atmospheric Environment* 39 (11): 2003-2009.

Pérez Ballesta P., Field R.A., Connolly R., Cao N., Baeza Caracena A., De Saeger E. (2006): Population exposure to benzene: One day cross-sections in six European cities. *Atmospheric Environment* 40 (18): 3355-3366.

Gerboles M., Buzica D., Amantini L., Lagler F., Hafkenscheid T. (2006): Feasibility study of preparation and certification of reference materials for nitrogen dioxide and sulfur dioxide in diffusive samplers. *Journal of Environmental Monitoring* 8: 174-182.

## MAIN RESEARCH PARTNERS

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University of Stockholm, Sweden  
Institute of Health Carlos III, Madrid, Spain  
Austrian Environment Agency, Vienna, Austria  
National Environmental Research Institute (NERI), Roskilde, Denmark  
Finnish Meteorological Institute (FMI), Helsinki, Finland  
Czech Hydrometeorological Institute, Prague, Czech Republic  
Slovenian Environment Agency, Ljubljana, Slovenia  
Estonian Environmental Research Centre, Tallinn, Estonia

## Challenges ahead

- To better understand the relation between ambient air quality and its impact on human health, the environment and climate change.
- To follow-up measures for the reduction of fine particle concentrations.
- To quantify the contributions of different sources to air pollution.
- To develop and validate new sensors in the field of air pollution assessment techniques.
- To enhance the use of space-based remote sensing tools for air quality assessment.

## Benefit for Europe

The IES helps the European policy-maker to develop adequate emission abatement strategies, based on state-of-the-art scientific knowledge.



Linda Gazzea  
IES Staff Member from Caravate, Italy

*“The IRC combines creativity with professionalism.”*



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City-Delta Model Intercomparison:  
<http://aqm.jrc.it/citydelta/>  
Euro-Delta Model Intercomparison:  
<http://aqm.jrc.it/eurodelta/>  
Task Force on Hemispheric Transport of Air  
Pollution – Co-ordinated Model Studies:  
<http://aqm.jrc.it/HTAP/>

#### CUSTOMERS

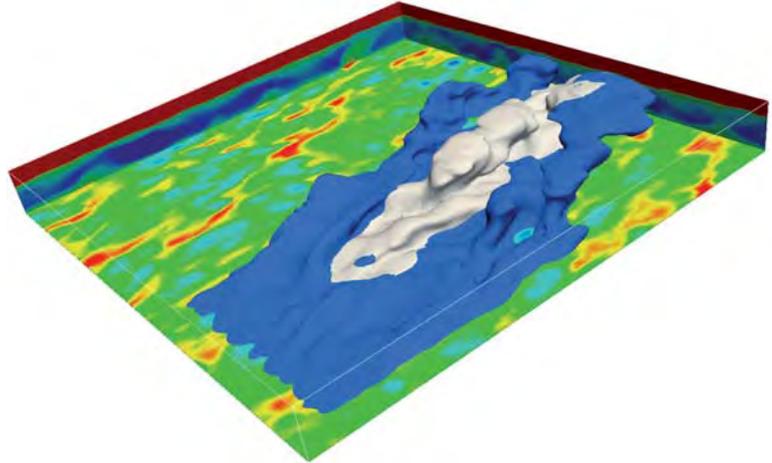
DG Environment  
DG Research  
Member State and Regional Competent  
Authorities

#### POLICIES SUPPORTED

Thematic Strategy on Air Pollution –  
COM (2005) 446  
Directive on ambient air quality and cleaner  
air for Europe – COM (2005) 447  
Directive on national emission ceilings for  
certain atmospheric pollutants –  
2001/81/EC  
Directive on ambient air quality assessment  
and management - 1996/62/EC  
United Nations Convention on Long-range  
Transboundary Air Pollution

## Modelling air pollution in urban areas

During the past five years, the IES has taken a leading role in air quality modelling in Europe by organising intercomparison exercises for atmospheric dispersion models, with the aim to give support to existing or upcoming European legislation related to emission reduction and air pollution, such as the National Emission Ceilings Directive. In particular, the City-Delta and the Euro-Delta exercises give input to the definition of the legislation for the limit of emission ceilings and the quality of air. Emphasis is being placed on the modelling of particulate matter and ozone as these have strong impacts on health. Moreover, the IES is now expanding its activities into the area of modelling of urban emission “hot spots”, developing a new approach to address the spatial distribution of emission sources and how it affects the results of air quality modelling.



*Simulation of the atmospheric dispersion from an area source*

Work in support to the National Emission Ceilings Directive and the United Nations Convention on Long-range Transboundary Air Pollution is also focusing on the improvement of the way of modelling emission inventories, with strong emphasis on the transport sector. New models are under development which will make use of real-world data for the calculation of vehicle emissions. Finally, assistance is given by the IES to the integration of the new EU Member States and Candidate Countries into the European Union by providing guidance on the correct implementation of air quality directives through the use of modelling tools and emission inventories.

### *Can computer models accurately predict the changes in emissions and their impact on air quality in 10, 20, 30 years from now?*

#### Results achieved

- The City-Delta and Euro-Delta intercomparison exercises organised by the IES have provided key input to the integrated assessment underpinning the Clean Air For Europe (CAFE) programme and the revision of the National Emission Ceilings Directive.
- A network of modellers was created to work towards the harmonisation of atmospheric dispersion modelling for regulatory purposes.
- Work is continuing on the improvement of emission inventories, currently focused on emissions from transport, both on their spatial distribution as well as on their accuracy and influence on air quality modelling.
- Many scientists from the new Member States and Candidate Countries were trained at the IES in the field of atmospheric dispersion modelling.



Sibylle Dueri  
*IES Staff Member from Locarno, Switzerland*  
*“It’s a big opportunity to work for a European  
research institution – especially as a Swiss  
citizen.”*



## The City-Delta model intercomparison exercise

City-Delta is an open model intercomparison exercise organised by the IES in collaboration with several partners from research and industry, in order to explore the changes in urban air quality predicted by different atmospheric chemistry transport dispersion models, in response to changes in urban emissions. City-Delta concentrates on ambient air levels of ozone and particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), with particular emphasis on health-related aspects. Among the main objectives are to assess the performance of the participating models and to compare them against available observational data, to identify the range of model responses towards emission reductions (the “Deltas”), and to provide information on the effectiveness of Europe-wide emission controls against local measures.



Highlight

*The City-Delta model intercomparison gathered experts from all over Europe*

Furthermore, City-Delta seeks to provide quantitative information in relation to legal obligations, e.g. whether a certain trend in emissions will achieve air quality limit values, and to provide guidance on how urban air quality could be included in a European-wide evaluation of the cost-effectiveness of emission control strategies. Results from the various phases of the City-Delta exercises have led, for instance, to the formulation of functional relationships for primary PM<sub>2.5</sub>. These relations allow the calculation of urban PM<sub>2.5</sub> increments (defined as the difference between an averaged background value and a value representative of the city area), based on emissions and annual wind speed. These urban PM<sub>2.5</sub> increments have been implemented into cost-effectiveness analyses allowing the development of suitable policy measures.

## KEY PUBLICATIONS

Cuvelier C. et al. (2007): CityDelta: A model inter-comparison study to explore the impact of emission reductions in European cities in 2010. *Atmospheric Environment* 41 (1): 189-207.

Vautard R. et al. (2007): Evaluation and intercomparison of Ozone and PM<sub>10</sub> simulations by several chemistry transport models over four European cities within the CityDelta project. *Atmospheric Environment* 41 (1): 173-188.

Thunis P. et al. (2007): Analysis of model responses to emission-reduction scenarios within the CityDelta project. *Atmospheric Environment* 41 (1): 208-220.

Vinuesa J.-F., Galmarini S. (2007): Characterization of the <sup>222</sup>Rn family turbulent transport in the convective atmospheric boundary layer. *Chem. Phys.* 7: 697-712.

Galmarini S. et al. (2004): Ensemble Dispersion Forecasting, Part I: Concept, Approach and Indicators. *Atmospheric Environment* 38 (28): 4607-4617.

Kubica K., Paradiz B., Dilara P., Klimont Z., Kakareka S., Debski B. (2004): Charter on small combustion installations. In: European Environment Agency (Ed.): Joint EMEP/CORINAIR Atmospheric Emission Inventory Guidebook, Third Edition.

## MAIN RESEARCH PARTNERS

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The European Oil Companies' European Association for Environment, Health and Safety in Refining and Distribution (CONCAWE), Brussels, Belgium  
Regione Lombardia, Milan, Italy  
European Centre for Medium-range Weather Forecasts (ECWMF), Reading, United Kingdom  
Aristotle University of Thessaloniki, Greece

## Challenges ahead

- To take the quality assessment and quality control of atmospheric modelling one step forward, in order to assist the Member States in the use of models for the implementation of the Air Quality Directive.
- To address the problem of “hot spots” and urban air quality.
- To further improve emission inventories by developing a model for emission estimation, based on the real-world emissions from vehicles.

## Benefit for Europe

The IES helps the European policy-maker and the Member States to develop adequate emission abatement strategies for the improvement of the air quality by using modelling to predict the changes to the air with the introduction of new policy measures.



Jean-Luc Widlowski  
IES Staff Member from Flaxweiler, Luxembourg

*“Working at the JRC means contributing to Europe’s future.”*



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IES Research Action ENSURE – Environmental Assessment of European Wastes and the Sustainable Management of Resources:

<http://ies.jrc.ec.europa.eu/ensure.html>

IES Research Action AGRI-ENV – Integration of Environment Concerns into Agriculture:

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## CUSTOMERS

DG Environment  
DG Agriculture and Rural Development  
European Environment Agency (EEA)  
United Nations Environment Programme (UNEP)

## POLICIES SUPPORTED

Directive establishing a framework for Community action in the field of water policy – 2000/60/EC

Directive on the protection of groundwater against pollution and deterioration – 2006/118/EC

Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources – 91/676/EEC

Directive on the management of waste from the extractive industries – 2006/21/EC

Thematic Strategy on the Sustainable Use of Pesticides – COM (2006) 327

Strategy for Dioxins, Furans and Polychlorinated Biphenyls – COM (2001) 593

Environment Strategy for the Mediterranean – COM (2006) 475

Stockholm Convention on Persistent Organic Pollutants

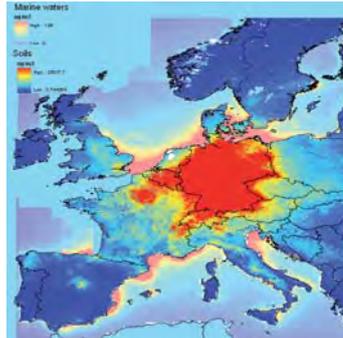


Nicolas Hoepffner  
IES Staff Member from Epernay, France

*“The JRC is a well-respected partner in competitive activities.”*

## Fate and impacts of pollutants in terrestrial and aquatic ecosystems

Human activities are undeniably related to the uncontrolled or accidental release of pollutants into the environment. Contaminants spread across different environmental media through atmospheric deposition, leaching from soil to groundwater, accumulation in rivers and lakes, and discharge into the sea. The understanding of the fate and impact of pollutants on the functioning of the terrestrial/aquatic interface is a scientific challenge that requires a combination of several disciplines, tools and datasets. The IES has taken up this challenge by launching the FATE project, aiming to answer policy questions arising from a number of environmental Directives, EU Thematic Strategies and International Conventions. The adopted tiered approach links modelling and monitoring for a multi-scale impact assessment in a risk-based framework.



*Modelling of PCB concentrations in soil and sea water arising from atmospheric deposition from inland emission sources in Europe (as reported by EMEP; reference year 1998)*

The FATE project addresses the fate and impacts of pollutants across a range of temporal and spatial scales depending on the policy question and making the best use of available data. The results are pollution risk and vulnerability maps, which are very useful to assess the impact of EU policies, raise public awareness and facilitate planning of management scenarios. At the scale of continental Europe the focus is on identifying “hot spots”, spatial trends and general pathways of pollutants; at the catchment/coastal zone scale the interest is more on the apportionment of mass inventories and aggregated in and out fluxes; at local scale attention is eventually paid to the prediction of concentrations in different compartments, generating input information for exposure assessments of ecosystems to potential pollutant risks, which is the information requested by decision-makers for implementing environmental management strategies.

### *Where do all pollutants released in Europe end up in the environment?*

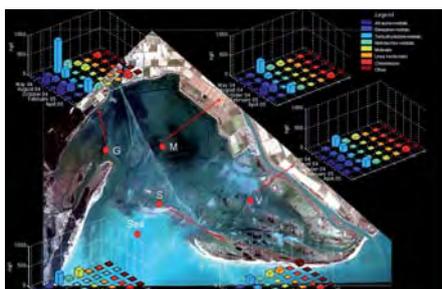
#### Results achieved

- Publication of an atlas giving a clear view of nutrient levels in ecosystems across the continent and offering the European public and researchers the opportunity to pinpoint total nutrient loads in European river and land habitats.
- Creation of a robust spatially explicit continental scale model accounting for exchange and partitioning of pollutants among environmental media, suitable to locate over large areas “hot spots” of pollutant concentrations from emission sources in Europe.
- Delivery of a dataset of landscape and climate parameters providing spatially resolved insights of ecosystems exposure at pan-European scale.
- A validated methodology for the assessment of the spatial and temporal variability of herbicides of agricultural origin in coastal lagoons and their impacts on aquaculture.
- Development of a set of analytical techniques for the identification of emerging pollutants, contributing to the harmonisation of monitoring strategies in the EU Member States.



## Pilot studies to highlight challenges and provide testing grounds for new methodologies

In the multi-scale FATE mapping of environmental pollution risks in Europe, a network of case study regions and coastal sites provide a snapshot of impacts of decisions taken at sub-national and national levels, and act as testing ground of methodologies for the identification of priority risk sources and most vulnerable end points. One example are the analyses of ecosystem effects of lagoon fluid-dynamics, river run-off influence, nutrients cycles, macro-algal blooms, as well as the economical implications of different scenario analyses which have been conducted using Southern European lagoon-estuarine systems exhibiting a range of pollutant pressures (agriculture, industry and tourism).



Summary of concentration of herbicides detected in water samples in the Sacca di Goro lagoon (Italy)

Highlight

Integrated watershed and 3D biogeochemical models have been developed and validated by the IES. Scenario analysis of nutrient impacts on primary production, e.g. shellfish farming activities, have been carried out taking into account the impacts of nutrients from the watershed due to change in agricultural practices as well as climatic variability. A management tool has been developed that will allow to choose the appropriate time-scale to monitor the relevant river-basin-coastal lagoon processes, develop early warning detection systems and help assess the effectiveness of measures designed to achieve good quality status of waters, as described in the Water Framework Directive.

## Challenges ahead

- To develop vulnerability and risk maps providing spatially and temporally resolved insights of trends in concentrations of pollutants such as fertilizers, pesticides, pharmaceuticals and industrial chemicals.
- To predict the effects of changes in climate, land use, habitats and demography on loads and environmental exposure of multiple pollutants, sensitivity of biotic communities and their responses.
- To assess discharge flows of potentially emerging pollutants by the main European rivers and the contribution of major European cities by promoting EU-wide monitoring and regional monitoring.
- To extend to the Mediterranean region the spatial mapping of environmental pollution risks and scenarios screening, in order to support the monitoring of impacts of the Horizon 2020 initiative in the context of the Euro-Mediterranean partnership.

## Benefit for Europe

Working across policies and environmental media, the FATE project provides answers to key questions such as how climate and lifestyle changes affect pollutant release. The IES supports the development of more cost-effective measures for emission control at Community level.

## KEY PUBLICATIONS

Mulligan D., Bouraoui F., Grizzetti B., Aloe A., Dusart J. (2006): An Atlas of Pan-European Data for Investigating the Fate of Agrochemicals in Terrestrial Ecosystems. EUR 22334 EN, Office for Official Publications of the European Communities, Luxembourg.

Grizzetti B., Bouraoui F. (2006): Nitrogen and Phosphorous Environmental Pressure at European Scale. EUR 22526 EN, Office for Official Publications of the European Communities, Luxembourg.

Pistocchi A., Vizcaino Martinez M.P., Pennington D.W. (2006): Analysis of Landscape and Climate Parameters for Continental Scale Assessment of the Fate of Pollutants. EUR 22624 EN, Office for Official Publications of the European Communities, Luxembourg.

Caraffa R., Marinov D., Dueri S., Wollgast J., Ligthart J., Canuti E., Viaroli P., Zaldivar J.M. (2006): A 3D hydrodynamic fate and transport model for herbicides in Sacca di Goro coastal lagoon (Northern Adriatic). *Marine Pollution Bulletin* 52:1231-1248.

Plus M., Jeunesse I.L., Bouraoui F., Zaldivar J.M., Chapelle A., Lazure P. (2006): Modelling water discharges and nitrogen inputs into a Mediterranean lagoon - Impact of the primary production. *Ecological Modelling* 193: 69-89.

Sommer S., Bidoglio G., D Alessandro M., Hamor T., Jordan G., Puura E., Panagiotis P., Van Liedekerke M., Vijdea A.M. (2004): Options for Compiling an Inventory of Mining Waste Sites throughout Europe. EUR 21186 EN, Office for Official Publications of the European Communities, Luxembourg: 21 pp.

## MAIN RESEARCH PARTNERS

- University of Stockholm, Sweden
- Radboud University Nijmegen, The Netherlands
- National Environmental Research Institute (NERI), Silkeborg, Denmark
- Institute of Chemical and Environmental Research (IIQAB-CSIC), Barcelona, Spain
- French Research Institute for Exploitation of the Sea (IFREMER), Issy-les-Moulineaux, France
- Norwegian Institute for Water Research (NIVA), Oslo, Norway
- Institute for Ecology of Industrial Areas, Katowice, Poland
- University of Montpellier, France



Joanna Niedzialek  
IES Staff Member from Krakow, Poland  
"The JRC allows me to contribute with my knowledge and experience to the improvement of the environment in Europe."



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European Flood Alert System:  
<http://efas.jrc.it/>

#### CUSTOMERS

DG Environment  
DG Regional Policy  
International Commission for the Protection of the Danube River  
International Commission for the Protection of the Elbe River  
National Water Authorities and River Basin Services

#### POLICIES SUPPORTED

Proposal for a Directive on the assessment and management of floods – COM (2006) 15  
Decision establishing a Community mechanism to facilitate reinforced co-operation in civil protection assistance interventions – 2004/277/EC  
Directive establishing a framework for Community action in the field of water policy – 2000/60/EC  
ICPDR Flood Action Plan – IC/o82

## Early warning and monitoring of floods in Europe

In the last decade Europe has experienced a number of unusually long-lasting rainfall events that produced severe floods, e.g. in the Netherlands, Belgium, France and Germany (1993, 1995), the Czech Republic, Poland and Germany (1997), in Northern Italy (1994, 2000), and in the United Kingdom (1998, 2000). The new millennium started up equally disastrous. The Elbe experienced a 100-year flood in 2002 – just to have the same river flooding again four years later in the spring floods in 2006. And also in the Danube repeatedly wide-spread flooding has taken place with again another record high during the snowmelt driven floods in spring 2006.



*Flooding causes severe damage to European economies every year*

The IES is providing policy support on flood issues, especially focused on cross-border river basins. The Institute is developing harmonised European-wide methodologies and information systems for the prevention and prediction of weather-driven natural hazards, complementing national activities. One of the initiatives to improve the preparedness for floods is the development of a European Flood Alert System. This system, which is aiming at providing information about the possibilities of floods to happen up to 10 days in advance, is currently under testing and validation. This is done in close collaboration with the National Water Authorities to ensure that the new system is useful for both obtaining a European overview as well as providing relevant information for local flood forecasters. As prevention and forecasting studies on transnational floods and related disasters have to take into account complete river basins, independent of administrative boundaries, the IES works closely with international river commissions such as for the Danube, Elbe, and Oder.

***Floods are a major natural disaster, forcing on average more than 10000 people a year in Europe to leave their homes – not knowing what they will find when coming back!***

#### Results achieved

- Collaboration with competent national hydrological authorities in Europe: 22 Collaboration Agreements signed until January 2007.
- More than 130 flood alert reports sent out in 2006 only, of which 85% correctly forecasted the flood event with four or more days in advance.
- Positive feedback from the national hydrological services: several countries reported an earlier crisis response thanks to EFAS flood alerts.



Anne Lyche Solheim  
IES Staff Member from Oslo, Norway  
*“The JRC facilitates researchers to answer crucial questions related to water management at the European level.”*





## CONTACTS

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IES Research Action NAHA – Natural Hazards:

<http://ies.jrc.ec.europa.eu/naha.html>

IES Research Action SOLO – Systematic

Observations of the Land and Oceans:

<http://ies.jrc.ec.europa.eu/solo.html>

Fraction of Absorbed Photosynthetically Active Radiation (FAPAR):

<http://fapar.jrc.it/>

## CUSTOMERS

DG Environment  
DG Regional Policy  
National Water and Environmental Authorities

## POLICIES SUPPORTED

Directive establishing a framework for Community action in the field of water policy – 2000/60/EC

Cohesion Policy (Structural Funds 2007-2013)

Communication on Winning the Battle Against Global Climate Change – COM (2005) 35

Communication on Limiting Global Climate Change to 2 degrees Celsius: The way ahead for 2020 and beyond – COM (2007) 2

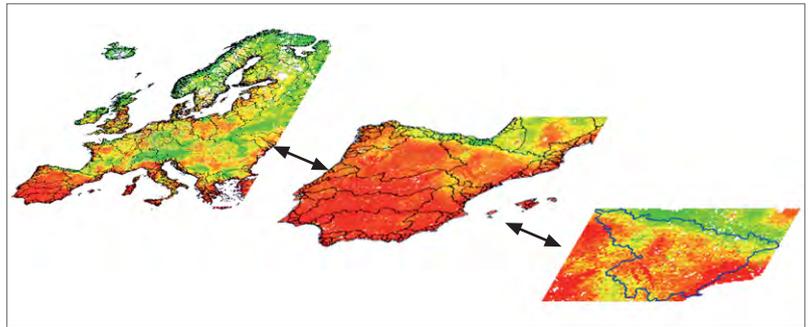


Frank Dentener  
IES Staff Member from Utrecht,  
The Netherlands

*“At the JRC I can make research relevant for Europe and the World.”*

## Towards a European Drought Observatory

Results of climate change studies show a trend towards an increasing variability of climate in Europe that will likely lead to more frequent droughts in the future. Droughts impact various economic sectors and geographical regions, and affect society and nature in many ways. Agricultural production is reduced, leading to increased prices of agricultural products, a decrease of income in this sector, and postponed investments due to lack of capital. Not only the risk for forest fires is increased considerably, but also trees are weakened by an increased susceptibility to pests. Persistently low water levels in rivers damage aquatic flora and fauna, hinder transport of goods on water-ways, and reduce energy production of hydro-, thermal and nuclear power plants. Decreasing groundwater tables and empty reservoirs can lead to restrictions in drinking and process water supply. Opposite to other natural hazards such as floods or wind storms, drought impacts develop gradually over time and are thus difficult to identify and to quantify.



*The European Drought Observatory will allow for studying a drought event from the European to the regional scale*

The IES is developing a European Drought Observatory in close collaboration with the European countries that have been frequently affected by droughts. Methodologies and monitoring systems are developed to observe water deficits in soils and vegetation, using advanced modelling techniques and satellite imagery. Recent advances in long-range meteorological forecasting will be exploited to strengthen preparedness and early warning for droughts in Europe. The European Drought Observatory complements national activities on drought monitoring with the European dimension, presenting a timely and consistent picture of ongoing and emerging drought situations. At the same time, more detailed information on the regional and local level will be directly accessible, provided by collaborating national and regional authorities.

*Droughts can affect regions anywhere  
and anytime in Europe,  
from Scandinavia to the Mediterranean,  
summer to winter!*

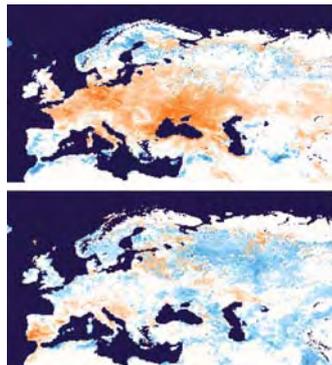
### Results achieved

- Development of an algorithm to retrieve the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), which is an indicator of the state and productivity of vegetation.
- Daily monitoring of soil moisture conditions in Europe, including a one week outlook.
- First version of a European drought hazard map as a basis to drought risk mapping.



## Monitoring of Vegetation Stress

The Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) is an indicator of the state of vegetation and a fundamental surface parameter for environmental studies. It represents the fraction of the solar energy absorbed by vegetation and plays the role of a battery during the plant photosynthetic process. FAPAR can be used to document the spatial variability and temporal evolution of the vegetation cover over large areas and long periods of time, and in particular monitor the seasonal and inter-annual changes. The IES developed mathematical algorithms to retrieve this fundamental quantity from space remote sensing data.



*Anomalies of vegetation productivity in spring for the year 2003 (top) and 2005 (bottom), respectively, compared to the reference period 1998-2005. Lower than normal activity appears in orange/red, higher than long-term average activity appears in blue/green.*

Highlight

The 2003 drought event had a catastrophic effect on crop growth. Using the FAPAR product, it is clearly detectable as early as March 2003. The FAPAR anomaly patterns correlate strongly with those of independently derived surface wetness indicators, and show that the water stress preceded the vegetation response by as much as (but not more than) a month in various places. By contrast, the FAPAR products for the 2005 spring season indicate back to normal conditions of the terrestrial environment in Central-Western Europe, while the impact of drought on the Iberian Peninsula is visible much stronger in 2005 than in 2003. This kind of analysis is being pursued by the IES on a regular basis.

## Challenges ahead

- Development of a European Drought Observatory in close collaboration with Member State authorities.
- Integration of drought information on various spatial scales.
- Exploitation of long-term meteorological forecasts for drought forecasting.
- Creation of consistent European FAPAR datasets to observe the state of vegetation, through a re-analysis of data archives from early and recent instruments, to provide a historical background for the understanding of the impact of recent drought events.
- Evaluation and quantification of direct and indirect impacts of droughts at European and regional scale (risk mapping).

## Benefit for Europe

Combining regional, national and European data, the European Drought Observatory will provide timely and consistent information on ongoing and upcoming drought events in Europe for improved preparedness and early warning of the affected population.

## KEY PUBLICATIONS

Gobron N., Pinty B., Mélin F., Taberner M., Verstraete M.M., Belward A., Lavergne T., Widlowski J.-L. (2005): The state of vegetation in Europe following the 2003 drought. *International Journal of Remote Sensing* 26: 2013-2020.

Gobron N., Pinty B., Aussenat O., Chen J.M., Cohen W.B., Fensholt R., Gond V., Huemmrich K.F., Lavergne T., Mélin F., Privette J.L., Sandholt I., Taberner M., Turner D.P., Verstraete M.M., Widlowski J.-L. (2006): Evaluation of Fraction of Absorbed Photosynthetically Active Radiation products for different canopy radiation transfer regimes: Methodology and results using Joint Research Centre products derived from SeaWiFS against ground-based estimations. *Journal of Geophysical Research* 111: D13110.

Lavalle C., Barredo J.I., De Roo A., Niemeyer S., San Miguel-Ayaz J., Hiederer R., Genovese E., Camia A. (2005): Towards an European integrated map of risk from weather driven events - A contribution to the evaluation of territorial cohesion in Europe. EUR 22116 EN, Office for Official Publications of the European Communities, Luxembourg: 52 pp.

## MAIN RESEARCH PARTNERS

Natural Environment Research Council – Centre for Ecology and Hydrology (CEH), Wallingford, United Kingdom  
Vienna University of Technology, Vienna, Austria  
University of Catania, Italy  
Wageningen University and Research Centre, The Netherlands



Aisling Naughton  
IES Staff Member from Ennis, Ireland

*“Working in the JRC I can have it all: a challenging career and time for my family.”*



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## WEB SITES

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IES Research Action FOREST – Forest Data and Information Systems:

<http://ies.jrc.ec.europa.eu/forest.html>

European Forest Fire Information System:

<http://effis.jrc.it>

## CUSTOMERS

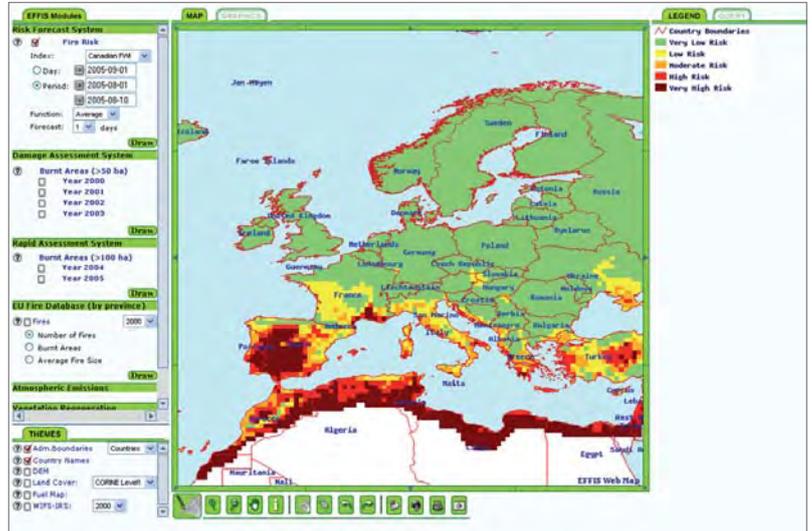
DG Environment  
DG Regional Policy  
United Nations Economic Commission for Europe (UN-ECE)  
United Nations Food and Agricultural Organisation (FAO)  
Civil Protection Authorities and Forest Services in the EU Member States

## POLICIES SUPPORTED

Regulation concerning monitoring of forests and environmental interactions in the Community (Forest Focus) – 2152/2003/EC  
Communication on Global Monitoring for Environment and Security (GMES): From concept to reality – COM (2005) 565

# The European Forest Fire Information System

Over the last years, the IES has developed the European Forest Fire Information System (EFFIS), which is part of the European Forest Focus Regulation on the monitoring of forests and environmental interactions since 2003. All the EFFIS activities are co-ordinated with DG Environment to reach the final users in the Member States: Civil Protection Authorities and Forest Services. The aim of EFFIS is to provide relevant information for the protection of forests against fire in Europe addressing both pre-fire and post-fire conditions.



The EFFIS web site (<http://effis.jrc.it>) provides daily forest fire risk forecasts

On the pre-fire phase, EFFIS is focused both on the development of systems, to provide forest fire risk forecast based on existing fire risk indices which are available on a daily basis from the 1<sup>st</sup> of February until the 31<sup>st</sup> of October of each year, and on the development of new integrated forest fire risk indicators permitting the harmonised assessment of forest fire risk at the European scale. They may be used as tools for the assessment of risk situations in cases of which international co-operation in the field of civil protection is needed. On the post-fire phase, EFFIS is focused on the estimation of annual damage caused by forest fires in the Southern part of the European Union. All burned areas that are larger than 50 ha, which account for around 75 % of the total area burnt in Southern Europe, are mapped every year using satellite imagery. An EU Fire Database is also included in EFFIS. This database currently contains the forest fire information compiled by 16 EU Member States. This information is useful in order to understand which forest fire prevention measures could be implemented in order to reduce the number of forest fires and their impact.

*Did you know  
that more than half a million hectares  
of forest land burn every year  
in the European Union?*

## Results achieved

- Implementation of the EFFIS Web Mapping Interface.
- Extension of EFFIS to the new Member States.
- Development and implementation of the EFFIS Rapid Damage Assessment.
- Production of the annual reports “Forest Fires in Europe”.
- Production of EFFIS Newsletters during the summer fire season.



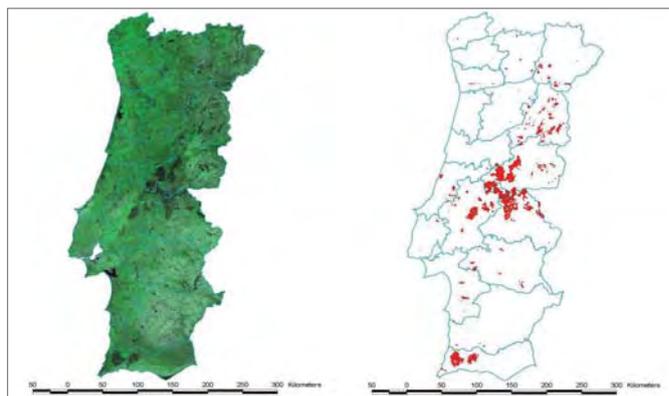
Ana Gallego Romero  
IES Staff Member from Logroño, Spain

*“I enjoy being part of a driving force of European integration.”*



## Forest Fires Rapid Damage Assessment

The 2003 European summer fire campaign was characterised by extreme weather conditions that resulted in one of the most severe fire seasons experienced during the last decades in Southern Europe. This campaign was not only exceptional in terms of damage in some countries, but also on the number of casualties resulting from these fires. Over 40 people amongst civilians and fire fighters died in the 2003 summer fires.



Damage Assessment of burnt areas in Portugal 2003 using satellite imagery

The critical level of fire risk reached during the summer of 2003 in many areas, estimated with the EFFIS Risk Forecast tool, and a number of exceptionally large uncontrolled fires that destroyed important parts of the land resources, led the European Commission to activate the EFFIS Damage Assessment module before the end of the fire season, as it would have been normally expected. Evaluation of forest fire damages were therefore performed in near realtime during the 2003 fire campaign leading to the initial development of the EFFIS Rapid Damage Assessment (RDA) module. This module has been improved since then and it has been run successfully from 2004 to 2006 allowing quick response to the different requests of the Member States in situations of emergency (e.g. forest fires in Portugal 2005, forest fires in Galicia 2006).

Highlight

## KEY PUBLICATIONS

Gabban A., San-Miguel-Ayaz J., Barbosa P., Libertà G. (2006): Analysis of NOAA-AVHRR NDVI inter-annual variability for forest fire risk estimation. *International Journal of Remote Sensing* 27 (8): 1725-1732.

San-Miguel-Ayaz J., Ravail N., Kelha V., Ollero A. (2005): Active Fire Detection for Fire Emergency Management: Potential and Limitations for the Operational Use of Remote Sensing. *Natural Hazards Journal* 35 (3): 361-376.

Gimeno M., San-Miguel-Ayaz J. (2004): Evaluation of RADARSAT-1 data for identification of burnt areas in Southern Europe. *Remote Sensing of Environment* 92: 370-375.

Gimeno M., San-Miguel-Ayaz J. (2004): Identification of burnt areas in Mediterranean forest environments from ERS-2 SAR time series. *International Journal of Remote Sensing* 25 (22): 4873-4888.

Lioussé C., Andreae M.O., Artaxo P., Barbosa P., Cachier H., Grégoire J.M., Hobbs P., Lavoué D., Mouillot F., Penner J., Scholes M., Schultz M.G. (2004): Deriving global quantitative estimates for spatial and temporal distributions of biomass burning emissions. In: Granier C., Artaxo P., Reeves C. (Eds.): *Emissions of Atmospheric Trace Compounds*, 77-120. Kluwer Academic Publishers: Dordrecht.

## MAIN RESEARCH PARTNERS

Spanish Ministry of the Environment, Madrid, Spain  
University of New Brunswick, Fredericton (NB), Canada  
University of Coimbra, Portugal  
Infoterra France, Toulouse, France  
Météo-France, Paris, France

## Challenges ahead

- Implementation of an EFFIS module on forest fire emissions.
- Implementation of an EFFIS module on post-fire risk (soil erosion).
- Development of an EFFIS module on socio-economic damages caused by forest fires.
- Development of a European forest fire fuel map on the basis of the European Forest Map and additional information.
- Development of a standard methodology for the use of MODIS satellite data on vegetation regeneration studies.

## Benefit for Europe

The European Forest Fire Information System allows for a better understanding of the forest fire phenomenon in the European Union, having the reduction of forest fire damages as ultimate aim.



Hans-Jürgen Stibig  
IES Staff Member from Freiburg, Germany

“Working for the JRC means working within a global network of partners.”



# Global Environmental Partner

## Supporting Europe's responsibility for the well-being of the planet

Our planet is at a crossroads. Climatic extremes as a consequence of global warming and boat people stranded on Europe's beaches trying to escape from environmental conflict at home show us that many environmental problems cannot be solved on a national or even continental scale any longer. The environmental performance of countries in other parts of the world has a direct impact on Europe, e.g. through the long-range transport of pollutants. At the same time, and despite its recognised leadership in sustainable development, Europe is still exporting considerable environmental pressures to other world regions – be it indirectly through its contribution to climate change, or directly through the import of natural resources such as coal and timber.

Being aware of its responsibility, the European Union has taken a firm commitment to improve the global environment. The EU is not only a driving force behind many international agreements, but it acts also as the largest donor of development aid in the world. The research of the JRC's Institute for Environment and Sustainability (IES) contributes to this commitment by monitoring the state of the global environment, assessing the relevant policies and helping to understand the complex interaction between man and the biosphere on both a continental and global scale.

The IES tackles in particular the following areas related to the global environment:

- The Institute contributes to the effort of creating a Global Soil Information System by providing the European window and helping Developing Countries to archive their soil data.
- The IES monitors the development of air pollution at the regional and global scale, helps to identify trade-offs between climate change and air pollution policies, and develops concepts for the mitigation of and adaptation to climate change.
- Contributing to the Global Monitoring for Environment and Security (GMES), the IES monitors the state of the global environment, both in the terrestrial and the marine domain, ensuring high data quality.
- Particular emphasis is given to the monitoring of the tropical and boreal forest resources with the aim of delivering reliable deforestation estimates on a global scale.
- Jointly with the JRC's Institute for the Protection and Security of the Citizen, the IES has set up the "ACP Observatory" for monitoring the sustainable development of the African, Caribbean and Pacific countries. The sustainable use of natural resources in Africa is a key priority in this context.
- The IES helps to enhance the use of solar resources in Developing Countries through assessing the implementation of renewable energies, in particular of photovoltaics.

*"Europe must promote stable international growth founded on sustainable development and remain true to its commitment to human rights. It must also target effective implementation of key goals in the area of environmental protection. It must share the responsibility with key partners to this end."*

José Manuel Barroso  
*European Commission President*





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European Soil Portal:

<http://eusoils.jrc.ec.europa.eu>

European Digital Archive of Soil Maps:

[http://eusoils.jrc.it/esdb\\_archive/EuDASM/EuDASM.htm](http://eusoils.jrc.it/esdb_archive/EuDASM/EuDASM.htm)

## CUSTOMERS

DG Environment

DG Development

United Nations Food and Agricultural Organisation (FAO)

United Nations Environment Programme (UNEP)

ISRIC – World Data Centre for Soils

## POLICIES SUPPORTED

Thematic Strategy for Soil Protection – COM (2006) 231

Proposal for a Directive establishing a framework for the protection of soil – COM (2006) 232

United Nations Convention to Combat Desertification (UNCCD)

United Nations Convention on Biological Diversity (CBD)

United Nations Framework Convention on Climate Change (UNFCCC)

## The global dimension of soil

Soil degradation is a serious problem in many parts of the world. It is mainly caused by inadequate or inappropriate agricultural and forestry practices, industrial activities, tourism, and urban development. Such activities have a negative impact that prevents the soil from performing its broad range of functions and services to humans and ecosystems. This results in a loss of soil fertility, a decrease in carbon stocks, a decline in biodiversity, lower water-retention capacity leading to flooding, disruption of gas and nutrient cycles and reduced filtering and degradation of contaminants. The challenge posed by these intricate relationships on the social, economic and environmental conditions in many countries can be exemplified in the images of famine and desertification in Africa, showing the failure of soil as a result of mismanagement of the land.



*Desertification is one of the most urgent environmental problems in many parts of the world*

A growing awareness of this problem within the international community has led to a number of initiatives that consider the issue of soil protection. Of particular relevance are the United Nations Conventions on Climate Change (UNFCCC), Desertification (UNCCD) and Biological Diversity (CBD), all of which note the importance of the need for soil protection. It is in this context that the IES is active not only in research to model water and wind erosion, land degradation in drylands and the role of permanently frozen soil in the Arctic, but also through collaborating with other major players to develop a fully operational Global Soil Information System (GLOSIS) that provides relevant soil information for the implementation of multilateral environmental agreements and initiatives such as the Global Monitoring for Environment and Security (GMES).

*Poor land management practices can lead to the removal of organic matter from soil, often the first step towards desertification!*

## Results achieved

- Northern Circumpolar Soils Map at a scale of 1:10 million.
- Integration of Eurasia and North Africa into the European 1:1 million Soil Database of Europe.
- European Digital Archive of Soil Maps on the World: an initiative to protect soil information for future generations by scanning paper soil maps that are slowly degrading.
- Contribution to the Beirut 2006 conference on managing natural resources in the Mediterranean through the implementation of sustainable policies.



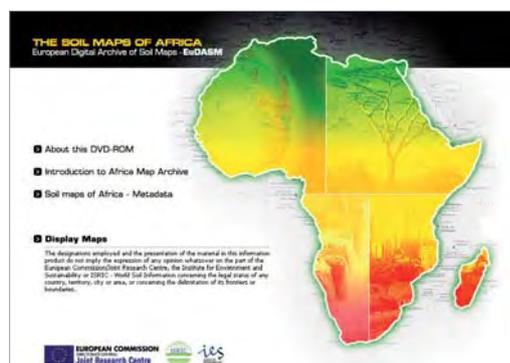
Philippe Mayaux  
IES Staff Member from Strépy-Bracquegnies, Belgium

*“By monitoring the sustainable use of natural resources, the JRC contributes to poverty reduction.”*



## Creating and preserving soil maps of the world

Global warming in the northern latitudes of Eurasia will cause Cryosols (frozen soils) to melt, thus releasing large volumes of methane from the decomposition of vegetation currently frozen in the soil. A widespread thawing of Cryosols could have a dramatic impact on global climate. For this reason, the IES has participated in a major international project to develop a digital northern circumpolar soil map, at a scale of 1:10,000,000, covering the United States, Canada, Greenland, Iceland, Northern Europe, Russia, Mongolia, and Kazakhstan, that can be used to assess climate change scenarios.



*The IES helps to preserve the soil maps of Developing Countries*

Highlight

In many countries soil maps are being lost because of a lack of proper attention to storage, often compounded by the disappearance of institutions that were responsible for the acquisition and maintenance of soil and land resources data. This problem is particularly acute in many Developing and Transitional Countries where valuable data, currently only available on paper, must be saved before they are lost forever. To preserve this valuable resource, the IES has collaborated with the World Data Centre for Soils (ISRIC) to develop the European Digital Archive of Soil Maps (EuDASM), preserving paper soil maps by transferring them into digital format. To date, several hundred soil maps of Africa, Asia and Latin America have been digitised and made accessible on DVD or on the web ([http://eusols.jrc.it/esdb\\_archive/EuDASM/EuDASM.htm](http://eusols.jrc.it/esdb_archive/EuDASM/EuDASM.htm)).

## KEY PUBLICATIONS

Tarnocai C., Kimble J.M., Swanson D., Goryachkin S., Naumov Y.M., Stolbovoy V., Jakobsen B., Broll G., Montanarella L., Arnoldussen A., Arnalds O., Yli-Halla M. (2002): Northern Circumpolar Soils. 1:10,000,000 scale map. Agriculture and Agri-Food Canada, Research Branch, Ottawa. Distributed by the National Snow and Ice Data Center/World Data Center for Glaciology, Boulder, CO.

Selvaradjou S.-K., Montanarella L., Spaargaren O., Dent D. (2005): European Digital Archive of Soil Maps (EuDASM) - Soil Maps of Africa: DVD-ROM version. EUR 21657 EN, Office for Official Publications of the European Communities, Luxembourg, 386 pp.

Selvaradjou S.-K., Montanarella L., Spaargaren O., Dent D. (2005): European Digital Archive of Soil Maps (EuDASM) - Soil Maps of Asia: DVD-ROM version. EUR 21823 EN. Office for Official Publications of the European Communities, Luxembourg.

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## MAIN RESEARCH PARTNERS

ISRIC - World Soil Information, Wageningen, The Netherlands  
The Earth Institute at Columbia University, New York, USA  
University of Sydney, Australia

## Challenges ahead

- Extension of the coverage of the European Soil Information System towards a fully operational Global Soil Information System, contributing to the ground segment of the Global Monitoring for Environment and Security (GMES).
- Development of a sampling procedure for the verification of organic carbon levels in soils in support of the Kyoto Protocol implementation process.
- Production of a Soil Atlas of Africa.
- Production of a Northern Circumpolar Soil Atlas.

## Benefit for Europe

Soil degradation is a serious problem in many parts of the world, often closely related to the onset of desertification, failure of agriculture and famine. In parallel, soil acts as a major store of carbon and other greenhouse gases and is a major factor in climate change studies. Therefore, the protection of soils around the world must be a primary concern for Europe.



Maria Luisa Paracchini  
IES Staff Member from Borgo Ticino, Italy

*"The JRC fosters a culture of dialogue and respect."*



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## WEB SITES

IES Climate Change Unit:  
<http://ies.jrc.ec.europa.eu/ccu.html>  
IES Research Action GAPCC – Global Air  
Pollution and Climate Change:  
<http://ies.jrc.ec.europa.eu/gapcc.html>  
WMO World Data Centre for Aerosols:  
<http://wdca.jrc.it>

## CUSTOMERS

DG Environment  
UN-ECE Programme for Monitoring and  
Evaluation of the Long-range Transmission  
of Air Pollutants in Europe (EMEP) - Task  
Forces Hemispheric Transport of Air  
Pollution (TFHTAP) and Measurements  
and Modelling (TFMM)  
Intergovernmental Panel on Climate Change  
(IPCC)  
United Nations Environment Programme  
(UNEP)  
World Meteorological Organisation (WMO)  
European Environment Agency (EEA)

## POLICIES SUPPORTED

Future EU Climate Change Policy  
Thematic Strategy on Air Pollution –  
COM (2005) 446  
United Nations Convention on Long-range  
Transport of Transboundary Air Pollution  
United Nations Framework Convention on  
Climate Change (UNFCCC)

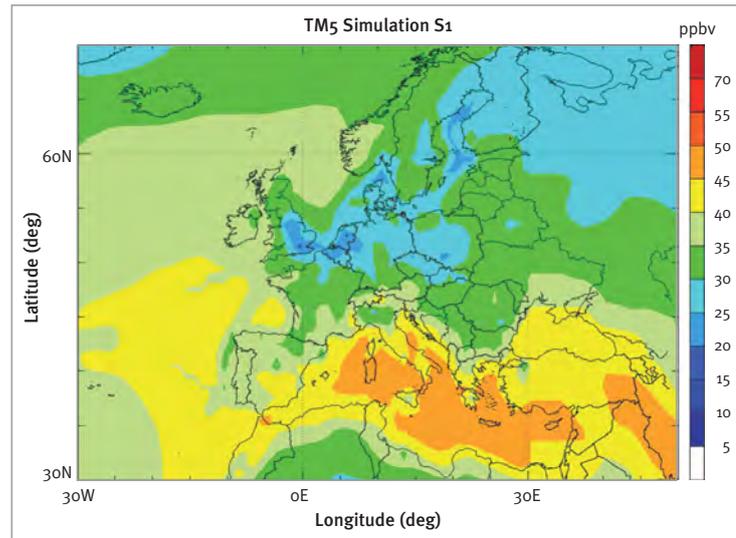


Elif Eker Develi  
IES Staff Member from Mersin, Turkey

*"I appreciate that the JRC permits flexible  
working hours."*

## Assessment of air pollution in different world regions

Climate change and air pollution are intimately linked through emissions from common sources, primarily those related to the use of fossil fuels. The IES performs scientific research on the linkages between air pollution and climate change to make policy-makers aware of potential synergies and trade-offs that are imposed by the way the atmosphere and the climate system work. The research is focused especially on those regions where climate change and air pollution are different priorities for policy-makers, e.g. in China, India and Russia. It also looks at the interconnectedness of these regions through intercontinental hemispheric transport of air pollutants, providing the European Commission with comparative assessments of air pollution and its impact on the environment and climate in these regions.



*Calculated ozone concentration over Europe using the JRC atmospheric chemistry model TM5*

Models, ground and space-based monitoring systems are used to produce the assessments. For instance, the JRC's global chemistry transport model TM5 is used to assess the impact of air pollution emissions on ozone and particulate matter concentrations worldwide. Likewise, the ECHAM-HAM climate model is used to provide assessments of the climate impacts of sector and region-based emission reduction strategies on climate. These modelling studies are systematically underpinned by observations, including the JRC's own EMEP superstation at the Ispra site, measuring long-term records of air pollutants and climate gases.

## *Emissions in China will have an impact on air pollution in Europe, but how much?*

### Results achieved

- More than 100 peer-reviewed publications linking air pollution and climate issues during the 6<sup>th</sup> EU Research Framework Programme.
- Key contributions to three major scientific assessments (Aerocom, Photocomp, Intergovernmental Panel on Climate Change).
- Build-up of measurement capacities at the JRC Ispra site (EMEP superstation) and onboard the "Costa Fortuna" ship.
- Increased capacity of communicating science to policy and the public in general, especially through a leading role in the Network of Excellence ACCENT.



## Using cruise ships for air pollution monitoring

Predictions on future climate and atmospheric conditions bear considerable uncertainties, particularly at the regional level. The need for more reliable model calculations as well as the lack of existing measurements of ozone over the Mediterranean region motivated the IES to install measurement devices for ozone and particles on-board a cruise ship through an innovative public-private partnership with the Italian Shipping Line Costa Crociere. The automated monitoring station has been mounted on the cruise ship “Costa Fortuna” – with 105.000 Gross Registered Tons the largest ocean liner operating under an Italian flag. Following a regular route in the Western Mediterranean basin during spring, summer and autumn, the on-board monitoring station provides rarely taken, continuous over-sea measurements, resulting in a unique dataset for atmospheric studies.



The cruise ship “Costa Fortuna” has been equipped with an automated air pollution monitoring station

Preliminary results indicate that concentrations of air pollution (ozone and aerosols) are high over the Mediterranean, and thus provide high “background” concentrations on top of which countries and regions in the Mediterranean add their local pollution, which leads to frequent exceedances of air pollution limit values. Even more important, however, could be the effect of ozone on the Mediterranean climate since ozone is a strong greenhouse gas.

Highlight

## KEY PUBLICATIONS

Lelieveld J. et al. (2002): Global Air Pollution Crossroads over the Mediterranean. *Science* 298: 794-799.

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Van Dingenen R. et al. (2004): A European Aerosol Phenomenology 1: Physical characteristics of particulate matter at kerbside, urban, rural and background sites in Europe. *Atmospheric Environment* 38: 2561-2577.

Putaud J.-P. et al. (2004): A European Aerosol Phenomenology 2: Chemical characteristics of particulate matter at kerbside, urban, rural and background sites in Europe. *Atmospheric Environment* 38: 2579-2595.

Stier P. et al. (2005): The aerosol-climate model ECHAM5-HAM. *Atmospheric Chemistry and Physics* 5: 1125-1156.

Dentener F. et al. (2006): The global Atmospheric Environment for the Next Generation. *Environmental Science and Technology* 40: 3586-3594.

## MAIN RESEARCH PARTNERS

Max Planck Institute for Atmospheric Chemistry, Mainz, Germany

Max Planck Institute for Meteorology, Hamburg, Germany

Institute for Atmospheric and Climate Sciences (CNR-ISAC), Bologna, Italy

University of Utrecht, The Netherlands

University of Stockholm, Sweden

Centre for Mediterranean Environmental Studies (CEA), Valencia, Spain

## Challenges ahead

- To combine atmospheric modelling, remote sensing from space and *in-situ* measurements from international networks to assess the role of air pollution on climate change (and vice versa) in various world regions.
- To assess how emissions in one region affect air pollution and climate in other regions through hemispheric transport.
- To enhance the scientific understanding on how emission reduction policies do impact on levels of air pollution and greenhouse gases.
- To estimate the source strengths and the potential to reduce the emissions of, in particular, black carbon/organic carbon aerosols and methane, as these compounds have a profound effect on both air pollution and climate.

## Benefit for Europe

In regions of strong economic development such as China or India local air pollution is considered a more urgent problem than climate change, although both are closely linked. The work of the IES helps the EU to develop and propose effective policies that address both problems.



Konrad Bogner  
IES Staff Member from Gmunden, Austria  
“The peer-reviewed publications record of the JRC can easily compete with other research centres.”



## CONTACT

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## WEB SITES

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<http://ies.jrc.ec.europa.eu/ccu.html>  
IES Research Action ICPA-EEI – Integrated  
Climate Policy Assessment: Emissions and  
Environmental Impacts:  
<http://ies.jrc.ec.europa.eu/icpa.html>  
EDGAR Database:  
<http://edgar.jrc.it>

## CUSTOMERS

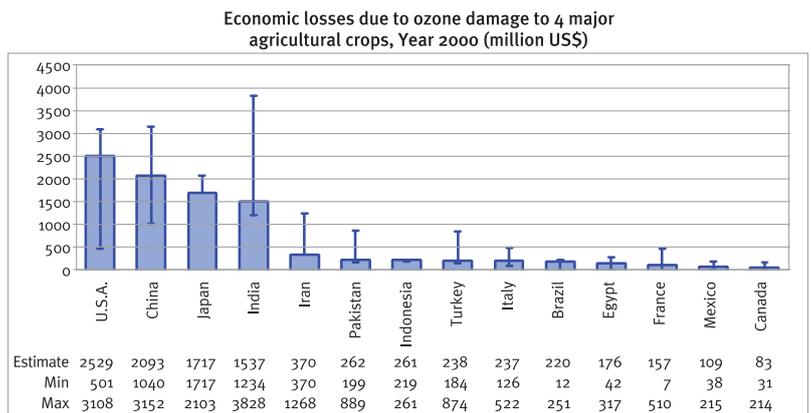
DG Environment  
UN-ECE Programme for Monitoring and  
Evaluation of the Long-range Transmis-  
sion of Air Pollutants in Europe (EMEP) –  
Task Forces Hemispheric Transport of Air  
Pollution (TFHTAP) and Emissions and  
Projections (TFEIP)  
Intergovernmental Panel on Climate Change  
(IPCC)

## POLICIES SUPPORTED

Future EU Climate Change Policy  
United Nations Convention on Long-range  
Transport of Transboundary Air Pollution  
United Nations Framework Convention on  
Climate Change (UNFCCC)

# Environmental and economic impacts of a changing climate

In order to tackle the climate change problem, the EU climate change policy will have to implement policies that reduce the amount of greenhouse gases and air pollutants released to the atmosphere (mitigation) as well as policies that aim at reducing the exposure of people and ecosystems to the effects of climate change (adaptation). The IES has started in 2005 to perform assessments of environmental impacts and benefits of climate policy on the European and global climate and environment. An example of such an impact study is the calculation of economic losses due to ozone damage on agricultural crops such as maize, soybean, rice and wheat in various world regions. To perform such an impact assessment, the IES has integrated global present and future emissions of greenhouse gases and air pollutants contained in the Emission Database for Global Atmospheric Research (EDGAR) with a global atmospheric chemistry model (TM5).



*Economic losses due to ozone damage for maize, soybean, rice and wheat in the year 2000 (in million US\$) based on daily averaged ozone concentrations modelled globally with the TM5 model (Note: The blue columns indicate “best estimates”, while the error bars show the range of total damage from the available range of parameters and their dose-response functions)*

Currently, the IES is developing capacity to extend the research into regional climate modelling and modelling to assess the impacts on ecosystems and carbons stocks so that the biogenic response to climate change can also be analysed. This work is closely linked to other research throughout the Joint Research Centre such as the assessment of economic impacts and benefits of the EU climate policy done at the JRC’s Institute for Prospective and Technological Studies (IPTS). Results from the climate and environment impact studies will be used in the POLES model to perform assessments of socio-economic costs of climate change and environmental impacts.

*Currently humans release per year about  
100,000,000,000 kg of the ozone  
precursor NO<sub>2</sub> into the atmosphere and  
27,000,000,000,000 kg of the  
greenhouse gas CO<sub>2</sub>!*

## Results achieved

- Release of a global emission inventory of air pollutants and greenhouse gases (EDGAR FT2000).
- Coupling of global energy scenarios (POLES) with the global emission inventory (EDGAR).
- Calculation of economic losses due to ozone damage on agricultural crops such as maize, soybean, rice and wheat in various world regions.

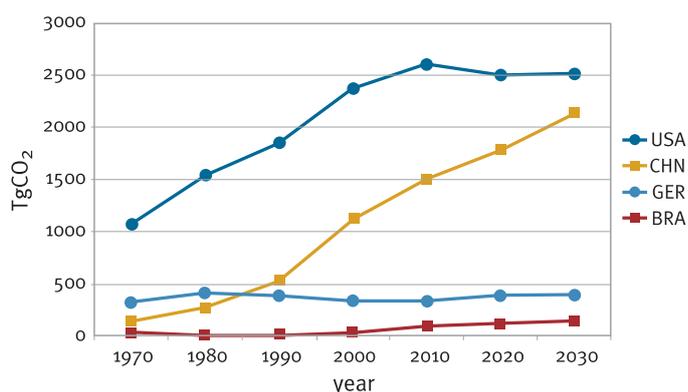


Peter Pärt  
IES Staff Member from Uppsala, Sweden  
“It is fascinating to be the bridge between science on the one side and policy-making on the other: this is the JRC.”



## Global emission inventory of past, present and future greenhouse gases and air pollutants

In collaboration with the Dutch Environmental Assessment Agency (MNP) and the German Max Planck Institute for Chemistry, the IES developed the Emission Database for Global Atmospheric Research (EDGAR). In 2005, a global emission inventory of greenhouse gases and air pollutants has been released representing emissions in the year 2000 for 240 countries and territories in the world on a 1x1 degree grid. Currently, EDGAR contains anthropogenic emissions of the “Kyoto Protocol” greenhouse gases CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and F-gases (HFCs, PFCs and SF<sub>6</sub>) as well as the air pollutant gases CO, NMVOC, NO<sub>x</sub>, SO<sub>2</sub> and the aerosols black carbon and organic carbon.



Highlight

*Past, present and future emissions of CO<sub>2</sub> from fossil fuel and biofuel combustion in the power plants of the USA, China, Germany and Brazil based on the EDGAR database and the POLES model*

The emission data per country provides policy-makers with an overview of the importance of different economic activities to the emissions of specific components in different world regions. This allows an assessment of which sectors current and future policies might be most efficient in reducing these emissions. The results show, for instance, that in Europe the transport sector is the largest source of NO<sub>2</sub>. In the USA the power plant sector is as important as transport, while in East Asia (including China) the power plant sector is the most important emission source. In the less developed countries of Africa residential biofuel combustion is the largest emission source.

### Challenges ahead

- Implementation of a regional climate model to provide uniform meteorological data to different European impact models.
- Setting up of a modelling framework to study climate change and impacts on ecosystems.
- Integration of different disciplines to perform an integrated assessment of environmental and economic impact of climate change policies.
- Integration of country emission inventories into the EDGAR database.

### Benefit for Europe

The IES calculates present values and future emission trends in various world regions. Through climate and ecosystem modelling, possible future environmental impacts of these emissions in Europe are calculated and an assessment of the (cost-)effectiveness of EU policies is made.

### KEY PUBLICATIONS

Olivier J.G.J., Van Aardenne J.A., Dentener F., Pagliari V., Ganzeveld L.N., Peters J.A.H.W. (2005): Recent trends in global greenhouse gas emissions: regional trends 1970-2000 and spatial distribution of key sources in 2000. *Environmental Science* 2 (2-3): 81-99.

Eyring V., Koehler H.W., Van Aardenne J.A., Lauer A. (2005): Emissions from international shipping: The last 50 years. *Journal of Geophysical Research* 110: D17305.

Dentener F., Stevenson D.S., Amann M., Mechler R., Cofala J., Derwent R., Bergamaschi P., Raes F. (2005): The impact of air pollutant and methane emission controls on tropospheric ozone and radiative forcing: CTM calculations for the period 1990-2030. *Atmospheric Chemistry and Physics* 5: 1731-1755.

Raes F. (Ed.) (2005): Research at JRC in support of EU climate change policy making. EUR 21855 EN, Office for Official Publications of the European Communities, Luxembourg: 40 pp.

Raes, F. (2006): Climate and air pollution – research and policy. *Global Change Newsletter of the International Geosphere-Biosphere Programme (IGBP)*, March 2006.

### MAIN RESEARCH PARTNERS

Dutch Environmental Assessment Agency (MNP), Bilthoven, The Netherlands  
 Tyndall Centre for Climate Change Research, Norwich, United Kingdom  
 Max Planck Institute for Atmospheric Chemistry, Mainz, Germany  
 International Institute for Applied System Analysis (IIASA), Laxenburg, Austria  
 Swiss Federal Institute of Technology (ETH), Zürich, Switzerland



Marilena Muntean  
 IES Staff Member from Bucharest, Romania  
 “The JRC gives me the possibility to carry out excellent research with partners all over Europe.”



## CONTACT

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## WEB SITES

IES Global Environment Monitoring Unit:

<http://ies.jrc.ec.europa.eu/gem.html>

IES Research Action SOLO – Systematic

Observations of the Land and Oceans:

<http://ies.jrc.ec.europa.eu/solo.html>

Global Land Cover 2000 Database:

<http://www-gem.jrc.it/glc2000/defaultglc2000.htm>

Ocean Colour Portal:

<http://marine.jrc.ec.europa.eu/frames/OceanColourPortal.htm>

Radiation Transfer Model Intercomparison

(RAMI):

<http://rami-benchmark.jrc.it/>

## CUSTOMERS

DG Environment

DG Enterprise and Industry

DG Development

European Environment Agency (EEA)

European Space Agency (ESA)

EUMETSAT

United Nations Food and Agriculture  
Organisation (FAO)

United Nations Environment Programme  
(UNEP)

Global Climate Observing System (GCOS)

## POLICIES SUPPORTED

Communication on Global Monitoring for  
Environment and Security (GMES): From  
concept to reality – COM (2005) 565

Communication on Climate Change in the  
Context of Development Cooperation –  
COM (2003) 85

United Nations Convention to Combat  
Desertification (UNCCD)

United Nations Framework Convention on  
Climate Change (UNFCCC)

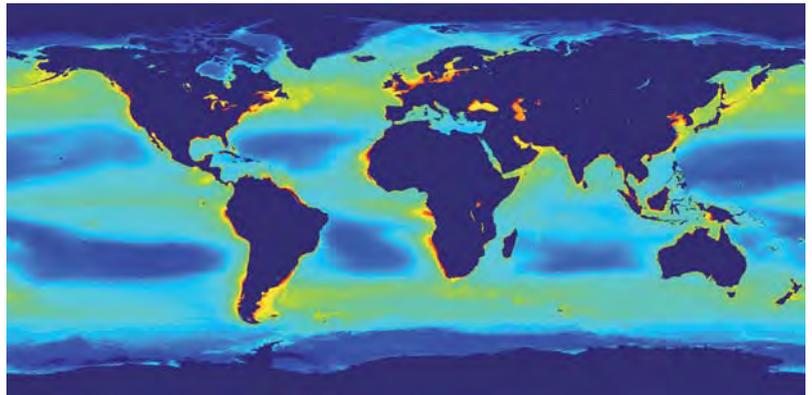


Agne Dobranskyte  
IES Staff Member from Klaipeda, Lithuania

*“There are so many fields in which the JRC sets the reference or even the standard.”*

## Monitoring the state of the global environment

Ever since the first civilian Earth observing satellite was launched in 1972, the IES has been developing methods to harness these technologies for monitoring the global environment. IES activities have grown from monitoring cropping and cattle ranching in West Africa to pan-tropical measurements of deforestation through to the preparation of global maps of land cover. In addition, the IES has developed a capacity for the assessment and monitoring of the coastal and marine environment at scales from highly detailed localised measurements in the Adriatic Sea to measurements of global ocean colour. Major efforts have been made to ensure the quality and reliability of the products, for instance through model benchmarking exercises and validation campaigns such as the Radiation Transfer Model Intercomparison (RAMI), which since its launch in 1999 has established itself as the sole platform for the benchmarking of the performance of canopy reflectance models.



*The IES assesses the state of the marine environment, e.g. through global ocean colour retrieval*

The IES' work on global environmental monitoring is helping reduce uncertainty in the output of climate change models, which in turn helps focus climate change impact and adaptation work – tasks of particular importance in the poorest countries where the effects will be felt strongest, and the capacity for action is weakest. Likewise, changes in ocean colour can indicate changes in marine productivity and thus global carbon cycling with attendant consequences for the climate system, having as well direct impacts on fishing and thus on food, employment and marine biodiversity.

*Did you know that Europe has only 0.01% of the planet's permanent snow and ice – and 10% of the Alpine glaciers disappeared in 2003 alone!*

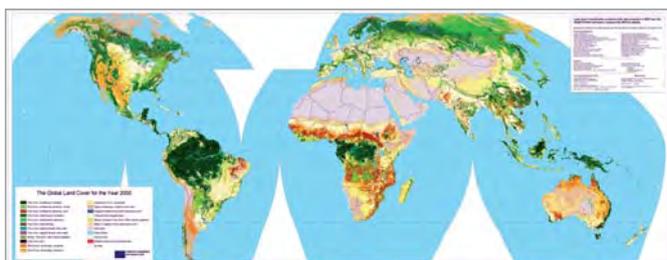
## Results achieved

- Production and delivery of regional and global land cover maps as well as associated online digital databases documenting the year 2000 conditions.
- Global archive of ocean colour data sets from the SeaWiFS and MODIS instruments displaying several parameters such as chlorophyll-a concentration and photosynthetically active radiation, being used to compute global primary production.
- Advancement of our knowledge on the radiative transfer in forested environments with particular emphasis on assessing the impact of canopy structure on remote sensing quantities across a range of spatial resolutions, as well as *in-situ* measurements.



## Global Land Cover Map 2000

Since 1993, when the first global land cover data set has been assembled, our planet's land cover has changed quite considerably, e.g. losing 6,000,000 hectares of humid tropical forest each year. At the same time newer and better sensors have been put into space, and we have learned more about ways of analysing the data they provide to create land cover maps. In this context, the IES took the challenge to co-ordinate the Global Land Cover Map 2000 (GLC2000), which has been published in 2003.



*The Global Land Cover Map 2000 is a unique product co-ordinated by the IES*

GLC2000 mapping used daily observations of the planet's land surface as seen in the year 2000 by the VEGETATION sensor flying on the SPOT-4 satellite. Under the leadership of the JRC, regional partners all over the world mapped their regions in the way that best described the local land cover. All partners used a system developed by the UN Food and Agriculture Organisation (FAO) and the United Nations Environment Programme (UNEP) to classify land cover in such a way that the detailed regional maps could be aggregated into a consistent global product. The new Global Land Cover Map 2000, highlighted in the TIMES Atlas of the World and National Geographic, documents in unrivalled detail 22 land cover types, ranging from the boreal forests of the north through agricultural land, cities and deserts to tropical forests, wetlands and permanent snowfields.

Highlight

## Challenges ahead

- To map and measure global land cover and land cover change at fine resolutions.
- To re-analyse data archives with the aim of providing a consistent historical background for the understanding of recent and current events, as well as for setting a baseline against which to evaluate current trends over Europe and at global scale.
- To integrate ocean and land surface processes in global carbon models to reduce the uncertainty in our knowledge of the global carbon cycle.
- To establish benchmarking procedures assessing the quality of all elements involved in the extraction of information from Earth observation data, i.e. models, algorithms, remote sensing products and *in-situ* validation schemes, in an effort to ensure the accuracy of space-derived information to the highest possible metrological standards.

## Benefit for Europe

The IES uses satellites to provide global environmental information in a consistent, unbiased and uniform manner, underpinning the EU's strive to be a leading exponent of good environmental stewardship and a promoter of global sustainable development.

## KEY PUBLICATIONS

Mayaux P., Strahler A., Eva H.D., Herold M., Shefali A., Naumov S., Dorado A., Di Bella C., Johansson D., Ordoyne C., Kopin I., Boschetti L. (2006): Validation of the Global Land Cover 2000 Map. *IEEE Transactions on Geoscience and Remote Sensing*, 44 (7): 1728-1739.

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Zibordi G., Mélin F., Berthon J.-F. (2006): Comparison of SeaWiFS, MODIS and MERIS radiometric products at a coastal site. *Geophysical Research Letters* 33: L06617.

Mélin F., Berthon J.-F., Zibordi G. (2005): Assessment of apparent and inherent optical properties derived from SeaWiFS with field data. *Remote Sensing of Environment* 97: 540-553.

Bartholomé E.M., Belward A.S. (2005): GLC2000: A new approach to global land cover mapping from Earth Observation data. *International Journal of Remote Sensing* 26: 1959-1977.

Pinty B. et al. (2004): RAdiation transfer Model Intercomparison (RAMI) exercise: Results from the second phase. *Journal of Geophysical Research* 109: D06210.

## MAIN RESEARCH PARTNERS

- Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa
- Indian Institute of Remote Sensing, Dehradun, India
- Institute for Remote Sensing Applications (IRSA), Beijing, China
- Russian Academy of Science - Space Research Institute, Moscow, Russian Federation
- Catholic University of Louvain, Belgium
- US Geological Survey, Sioux Falls, USA
- Institute of Marine Sciences (CNR-ISMAR), Venice, Italy
- Finnish Institute of Marine Research (FIMR), Helsinki, Finland
- Goddard Space Flight Center - National Aeronautics and Space Administration (NASA), Greenbelt (MD), USA
- Laboratory for Geophysical and Oceanographic Spatial Studies - National Centre for Scientific Research (CNRS), Toulouse, France



Arwyn Jones  
IES Staff Member from Bangor, United Kingdom  
"By supporting Neighbouring Countries around Europe, the JRC helps to make Europe a safer place."



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IES Research Action TREES-3 – Global Forest  
Resource Monitoring:  
<http://ies.jrc.ec.europa.eu/trees.html>

## CUSTOMERS

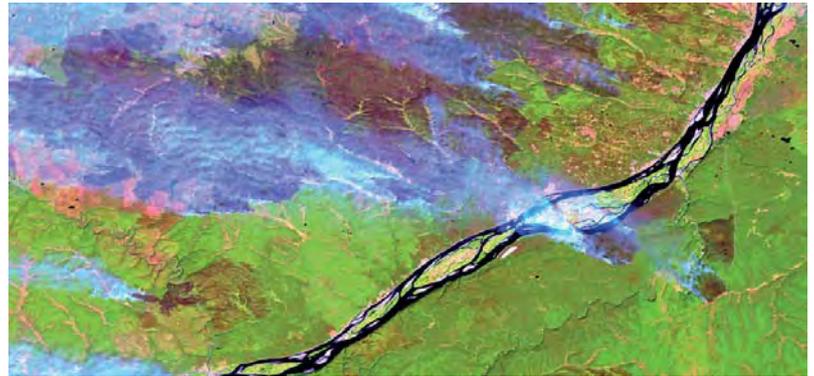
DG Environment  
DG Development  
DG External Relations  
European Commission Delegations  
Regional multilateral organisations, e.g. the  
Amazon Co-operation Treaty Organisation  
(ACTO)  
United Nations Food and Agricultural  
Organisation (FAO)  
United Nations Environment Programme  
(UNEP)  
Intergovernmental Panel on Climate Change  
(IPCC)

## POLICIES SUPPORTED

Communication on Climate Change in the  
Context of Development Cooperation –  
COM (2003) 85  
Communication on Forest Law Enforcement  
of Governance and Trade (FLEGT) – Pro-  
posal for an Action Plan – COM (2003) 251  
Communication on Global Monitoring for  
Environment and Security (GMES): From  
concept to reality – COM (2005) 565

# A fresh look on tropical and boreal deforestation

Despite much public attention towards global deforestation, very little accurate, verifiable information exists on the actual magnitude and location of this process. Deforestation in the tropics and in the boreal zone is thought to be a major contributor to greenhouse gases, but by how much is not known. The impacts on biodiversity and on indigenous people's livelihoods are also of major concern, as is the illegal exploitation of forest reserves. To monitor global deforestation, the TREES project has been set up to provide quantitative measurements and mapping of changes in forest resources in support of EU policies related to global environmental and forestry issues, notably the EU commitments to international agreements.



*Forest fires are widespread across the Siberian forests in summer.*

In recent years, the IES has provided estimates for tropical deforestation rates between 1990 and 1997 and mapped the forest cover of the major tropical regions, in particular Central Africa, South America and South-East Asia. In the forthcoming years the IES will take a fresh look at deforestation issues in a global perspective. The work will generate regional forest maps, track areas of rapid forest change and produce statistically valid estimates of cover change for the current and previous decades (from the mid 1970's up to 2005-2010). The drivers of deforestation will be identified at the regional levels, with a focus on Eurasian boreal forests and tropical forests. The results of this research will provide input into future climate change impact scenarios and, through close co-operation with DG Environment, give support to the Kyoto Protocol process.

*Every year over 60,000 km<sup>2</sup> of  
humid tropical forests are deliberately destroyed:  
How does this affect our planet's health?*



Kabindra Adhikari  
IES Staff Member from Devnagar, Nepal

*"While doing something for Europe at the  
JRC, I do something for my home country."*

## Results achieved

- Maps of the tropics and of Eurasia were produced from satellite data, showing the extent of major forests for the year 2000.
- A radar mosaic of Siberia covering nearly 20 million km<sup>2</sup> was made from over 400 image strips, taken by the Synthetic Aperture Radar on the JERS-1 spacecraft, provided by the Japan Agency for Space Exploration in a collaborative project.
- IES research, published in *Nature*, showed that increases in boreal forest fires are not only due to climate anomalies, but also to human activities – opening the question whether such fires should be considered as "natural" under climate change conventions.
- Side event presentations by IES scientists at the Global Climate Change Conferences in Milan (COP 9), Montreal (COP 11) and Nairobi (COP 12), have had major influences in demonstrating the technical capacities of remote sensing data for forest monitoring issues.



## Providing a scientific basis for the geographic definition of Amazonia

The term “Amazonia” is used frequently in the popular press, in scientific papers and in political spheres. It is intrinsically understood by this term that one is talking about the huge expanse of the South American tropical rainforest that bridges the equator. Despite this widespread usage it is surprising to know that the actual geographical limits of Amazonia have never been “officially” defined. Indeed the different countries that surround the Amazon forest all have their own, independent view of what Amazonia is. These views are based on different criteria: hydrological basins, land cover, administrative boundaries. While each country’s own definition perfectly suits its own particular purposes, the lack of a common supra-national definition is a handicap towards defining common transnational spatial databases and development programmes.



*The IES facilitated a consensus opinion of top European Amazon experts on the geographical borders of Amazonia*

With this in mind, the Amazon Co-operation Treaty Organisation (ACTO), which brings together the countries that share the Amazon rainforest, asked the JRC to act as a neutral facilitator of a consensus-building process for developing a practical solution to overcome this problem. In this context, the IES organised a workshop in June 2005, bringing together some of Europe’s leading experts on Amazonia. The experts presented current thinking on the limits of Amazonia from different scientific perspectives. The outcome of this exercise provided a consensus proposal, along with a cartographic product created by the IES, which now serves as an independent starting point for further discussions within South America, eventually leading towards an operational management tool.

Highlight

## KEY PUBLICATIONS

Achard F., Eva H.D., Mayaux P., Stibig H.-J., Belward A.S. (2004): Improved estimates of net carbon emissions from land cover change in the tropics for the 1990s. *Global Biogeochemical Cycles* 18: GB2008, doi:10.1029/2003GB002142.

Eva H.D., Huber O. (Eds.) (2005): A Proposal for Defining the Geographical Boundaries of Amazonia / Proposição para Definição dos Limites Geográficos da Amazônia / Una Propuesta para la Definición de los Límites Geográficos de la Amazonia. EUR 21808, Office for Official Publications of the European Communities, Luxembourg: 40 pp..

Mayaux P., Holmgren P., Achard F., Eva H.D., Stibig H.-J., Branthomme A. (2005): Tropical Forest Cover Change in the 1990’s and Options for Future Monitoring. *Phil. Trans. R. Soc. B* 360: 373-384.

Mollicone D., Eva H.D., Achard F. (2006): Human role in Russian wild fires. *Nature* 440: 436-437.

Stibig H.-J., Achard F., Fritz S. (2004): A new forest cover map of continental Southeast Asia derived from SPOT-VEGETATION satellite imagery. *Applied Vegetation Science* 7: 153-162.

## MAIN RESEARCH PARTNERS

- Brazilian Agricultural Research Corporation – National Centre for Satellite Monitoring Research (EMBRAPA-CNPQ), Campinas, Brazil
- Forest Research Institute, Zvolen, Slovakia
- Global Forest Watch Russia, Moscow, Russian Federation
- Indian Institute of Remote Sensing (IIRS), Dehradun, India
- Venezuelan Institute of Scientific Investigations (IVIC), Caracas, Venezuela
- Institute for Climate and Water (CIRN-INTA), Buenos Aires, Argentina
- Japan Aerospace Exploration Agency (JAXA), Tokyo, Japan
- Max Planck Institute for Biogeochemistry, Jena, Germany
- Catholic University of Louvain, Belgium
- VTT Information Technology, Espoo, Finland

## Challenges ahead

- To demonstrate that we can reduce uncertainty in the calculation of carbon fluxes arising from deforestation at global levels.
- To effectively support EU policy on reducing greenhouse gas emissions through the process of avoiding deforestation.
- To engage effectively in transferring technology on forest monitoring using remote sensing to partners throughout the world.

## Benefit for Europe

By playing a leading role in monitoring tropical and boreal forests, the IES helps to highlight areas where deforestation is occurring and to come up with reliable deforestation rates, allowing Europe to target climate policy and international environmental co-operation.



Lucia Reithmaier  
IES Staff Member from Traunstein, Germany

*“I love to work for the JRC because of its unique multicultural atmosphere.”*



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## WEB SITES

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<http://ies.jrc.ec.europa.eu/gem.html>  
IES Research Action MONDE – Monitoring  
Natural Resources for Development Co-  
operation:  
<http://ies.jrc.ec.europa.eu/monde.html>  
PASTIS database on EU-funded environmen-  
tal projects in Africa:  
<http://pastis.jrc.it/>  
Burned area products:  
[http://www.grid.unep.ch/activities/  
earlywarning/preview/ims/gba/](http://www.grid.unep.ch/activities/earlywarning/preview/ims/gba/)

## CUSTOMERS

DG Development  
DG EuropeAid – Co-operation Office  
Governmental institutions in African partner  
countries  
European and National Space Agencies  
United Nations Environment Programme  
(UNEP)  
United Nations Food and Agricultural Organi-  
sation (FAO)

## POLICIES SUPPORTED

European Consensus on Development: Joint  
statement by the Council and the repre-  
sentatives of the governments of the  
Member States meeting within the Coun-  
cil, the European Parliament and the Com-  
mission on European Union Development  
Policy – 2006/C 46/01  
Communication on Forest Law Enforcement  
of Governance and Trade (FLEGT) – Pro-  
posal for an EU Action Plan – COM (2003) 251  
Communication on Climate Change in the  
Context of Development Cooperation –  
COM (2003) 85  
EU Strategy for Africa: Towards a Euro-  
African pact to accelerate Africa's develop-  
ment – COM (2005) 489



Raffaella Del Grande  
IES Staff Member from Laveno, Italy

*“The international character of the JRC allows  
the exchange of ideas from all over the world.”*

# Monitoring natural resources for reducing poverty in Africa

Europe needs to define, target, implement and evaluate its development aid strategies and programmes. In order to do this properly, it requires dynamic information on the location, condition and evolution of environmental resources, on food availability demand, and on crisis situations. The main role of the IES in this strategic area is to develop tools for the monitoring of ecosystems and agrosystems and contribute to the understanding of the interactions between development, environment, and security issues. This analysis relies heavily on data from Earth Observing satellites, but needs to be combined with advanced geospatial analysis, socio-economic models and *in situ* information. The African, Caribbean and Pacific countries are the main target area of the activities.



*Satellite mosaic for the African  
continent acquired by the SPOT  
VEGETATION instrument  
throughout the year 2000.*

In order to promote the sustainable management of natural resources, the research of the IES pays particular attention to land cover and land use dynamics, fresh water availability (in dry areas), land degradation and desertification, forest resources (deforestation, illegal logging), coastal zone management (degradation), marine resources, threats to biodiversity (in protected areas and in specific ecosystems) and the urban ecological footprint. Country and region specific environmental diagnostics are produced by the IES, as well as reports for the United Nations Conventions on Climate Change, Biological Diversity and Desertification.

*Guess how much natural vegetation  
has been converted to agricultural lands  
in Africa over the last 25 years?  
Over 50,000 km<sup>2</sup> each year!*

## Results achieved

- Burned area estimates for the African continent have been assessed for the first time at a 1 km resolution: over 2.5 million km<sup>2</sup> of burned areas were detected for the year 2000, accounting for 65% of the area burned globally.
- Land cover change in Sub-Saharan Africa has been assessed from the 1970's to the year 2000, showing an increase of agricultural lands of more than 50%.
- A new land cover map of Africa for the year 2000 has been created at a spatial resolution of 1 km, presenting the most detailed view published at this scale so far.
- A procedure was developed for monitoring water bodies in dry regions using imagery from the SPOT VGT system: tested over West Africa, the methodology is robust enough to be considered pre-operational.
- The PASTIS database of EU-funded environmental projects in Africa since 1995 has been developed, containing administrative information as well as reports and spatial datasets.



#### KEY PUBLICATIONS

Mayaux P., Bartholomé E., Fritz S., Belward, A.S. (2004): A new land cover map of Africa for the year 2000. *Journal of Biogeography* 31: 861-877.

Gond V., Bartholomé E., Ouattara F., Nonguierma A., Bado I. (2004): Surveillance et cartographie des plans d'eau et des zones humides et inondables en régions arides avec l'instrument VEGETATION embarqué sur SPOT 4. *International Journal of Remote Sensing* 25 (5): 987-1004.

Tansey K., Grégoire J.-M., Binaghi E., Boschetti L., Brivio P.A., Ershov D., Flasse S., Fraser R., Graetz D., Maggi M., Peduzzi P., Pereira J.M.C., Silva J.M.N., Sousa A., Stroppiana D. (2005): A global inventory of burned areas at 1 km resolution for the year 2000 derived from SPOT VEGETATION data. *Climatic Change* 67 (2): 345-377.

Clerici N., Bodini A., Eva H.D., Grégoire J.-M., Dulieu D., Paolini C. (2006): Increased isolation of two biosphere reserves and surrounding protected areas (WAP Ecological Complex, West Africa). *Journal for Nature Conservation*: doi: 10.1016/j.jnc.2006.08.003.

#### MAIN RESEARCH PARTNERS

Centre for Ecological Monitoring, Dakar, Senegal  
French Agricultural Research Centre for International Development (CIRAD), Paris, France  
BirdLife International, Cambridge, United Kingdom  
Catholic University of Louvain, Belgium  
Centre AGRHYMET, Niamey, Niger  
Institute for Electromagnetic Sensing of the Environment (CNR-IREA), Naples, Italy  
Tropical Research Institute (IICT), Lisbon, Portugal  
University of Leicester, United Kingdom

### Monitoring threats to biodiversity in national parks of West Africa

The European Commission is supporting a conservation project aiming at improving the environmental management and the level of biodiversity in the W Regional Parks, the first African trans-boundary biosphere reserve, located at the frontiers of Burkina Faso, Niger and Benin. The IES supported this project by training local park managers on the use of satellite data and providing them with information on bush fires derived from satellite observations. Information on the timing and location of fires is in fact an essential part of management in African parks. The information is required to monitor prescribed burning, to identify illegal activities (e.g. poaching) and to limit catastrophic fires.



Highlight

Satellite image showing the peculiar W shape of the Niger River which gave its name to the Park W

The support for fire management was complemented by an analysis of land cover change in a 30 km peripheral buffer around the Park and an assessment of the level of isolation of the ecological complex. Based on high-resolution satellite imagery for the period 1984-2002, it was evaluated that 15% of the savanna habitat was converted to agricultural land in the peripheral area, while 0.3% was converted inside the complex. The study has also shown a drastic increase in the degree of fragmentation of remnant savanna habitat. Despite the effectiveness of the park conservation programme, it was found that its capacity to conserve species richness is decreasing.

### Challenges ahead

- The long-term monitoring of natural resources in Africa depends of the continuous availability of satellite data and its processing, for which the IES will work hand in hand with space agencies.
- Biophysical parameters on natural resources need to be crossed with socio-economic data in order to become really meaningful for development policies.
- The IES will further enhance the access to scientific information on the trends in natural resources to the European Commission services in charge of development and environment policies.
- A sound management of natural resources in Africa can contribute to poverty reduction only when a proper capacity-building and technology transfer involving local stakeholders is ensured.

### Benefit for Europe

Sustainable development constitutes the primary objective of the EU's development policy. As natural resources are crucial in this context, the EU and African countries will profit from dynamic information on the management of soil, water and forests, provided by the IES.



Jean-Philippe Putaud  
IES Staff Member from Villejust, France  
"For me the most important asset of the JRC is its independence of private or national interests."



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IES Research Action SOLAREC – Photovoltaic  
Solar Electricity:  
<http://ies.jrc.ec.europa.eu/solarec.html>  
Photovoltaic Geographical Information  
System:  
<http://re.jrc.ec.europa.eu/pvgis/>

## CUSTOMERS

DG External Relations  
DG Development  
DG Transport and Energy  
DG EuropeAid - Co-operation Office  
European Commission Humanitarian Aid  
Office (ECHO)  
United Nations Environment Programme  
(UNEP)

## POLICIES SUPPORTED

Green Paper: A European Strategy for Sustainable, Competitive, and Secure Energy – COM (2006) 105  
Communication on mobilising public and private finance towards global access to climate-friendly, affordable and secure energy services: The Global Energy Efficiency and Renewable Energy Fund – COM (2006) 583  
Communication “Towards a global partnership for sustainable development”, in particular the Energy Initiative for Poverty Eradication and Sustainable Development (EUEI) – COM (2002) 82

# Renewable energies: A key to sustainability in Developing Countries

Large parts of the world’s population lack access to electricity and are unlikely to have it in the near future through traditional grid extensions. Moreover, Developing Countries have large and impoverished rural populations, where the grid will not be extended because of low consumption and economic barriers. Decentralised photovoltaic (PV) Systems are a solution to bring cost-effective electricity to the population of rural zones in Developing Countries. For instance, Africa has 95% of the world’s best daily winter sunshine, yielding a yearly energy of more than 2300 kWh/m<sup>2</sup>. Ironically, very little of this free energy is being exploited: in rural and peri-urban Africa the overall level of electrification is less than 15%, even levels of below 2% are common.



*Solar electrification of a school in Gumulu, Burkina Faso*

The proper and cost-effective configuration of a stand-alone PV system depends on the knowledge of solar resources, their considerable geographical and seasonal variation and the needs and consumption of the end-users. The IES proposes to explore the optimisation of the energy-service performance of stand-alone PV systems through a combination of irradiation data, laboratory testing, field measurements, and interviews with end-users and key actors in the industry. Furthermore, the IES has contributed with technical expertise to the definition and approval of international standards such as on PV Stand-Alone System-Design Verification, thus supporting market penetration. These activities improve the design of stand-alone power systems, helping to make rural energy programmes in Developing Countries a success.

*Did you know  
that nearly two billion people  
lack access to electricity?*

## Results achieved

- The IES is involved in the Global Approval Programme for Photovoltaics (PV-GAP) as a member and secretary of its Technical Committee. The Technical Committee is empowered to take any action necessary to ensure proper and global standards for the photovoltaic industry and procurement agencies, such as the World Bank and the United Nations Development Programme.
- The IES contributed to the definition and approval of the PV Stand-Alone System Design Verification Standard (IEC 62124), published in 2004.
- A solar radiation database has been developed for Africa which through the coupling of a Geographical Information System enables users to calculate the performance of solar energy systems in Africa.
- The IES participates in the European Photovoltaic Technology Platform and contributes to new policies, including financial schemes, for the implementation of renewable energies in Developing Countries.



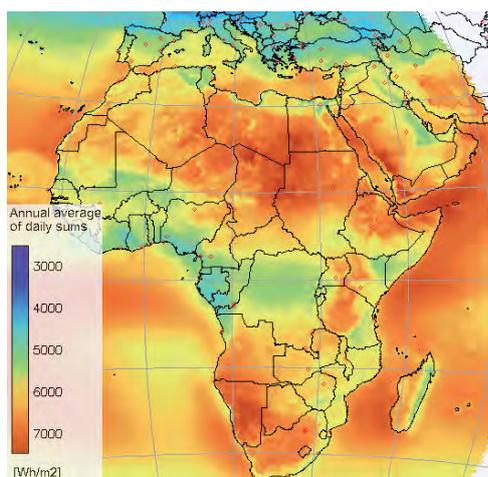
César Carmona Moreno  
IES Staff Member from Almería, Spain

*“The JRC cares for the needs of the  
Developing World.”*



## The Photovoltaic Geographical Information System (PVGIS)

For small stand-alone photovoltaic systems (not grid connected) the performance depends strongly on how much the solar radiation varies from day to day and between seasons. This is because the energy must be stored in the system itself, normally in a battery. If there are long periods with bad weather and little sunlight, the battery must be larger to store enough energy while the system is not generating enough power. Here the Photovoltaic Geographical Information System (PVGIS) developed by the IES comes into play, which determines the amount of solar radiation available at a given location, using a database that has daily values of radiation for over 20 years.



Map of solar radiation for the African continent.

To assess solar radiation available in rural Africa, the PVGIS was used and extended to cover Africa and the Middle East. The web applications developed by the IES use the radiation data to calculate the performance for a system of a given size and assumed power consumption. Using these interactive tools, local system developers, e.g. in Africa, are able to optimise the design and use-factor of stand-alone photovoltaic systems to give better reliability and to reduce costs.

### Challenges ahead

- The EU's development co-operation needs support regarding the assessment of the implementation of renewable energies and energy-end-use efficiency in Developing Countries.
- Technical Guidelines need to be written with the aim of improving the design of renewable energy systems in Developing Countries using locally manufactured energy-efficient applications.
- Technical problems linked to the social acceptance of rural electrification with renewable energy need to be identified, investigating the real usage energy patterns under different geographical, socio-cultural and political frameworks.

### Benefit for Europe

Renewable energies in rural areas reduce CO<sub>2</sub> emissions and help to eliminate the disastrous consequences on the environment from deforestation caused by wood burning and pollution from traditional fuels. Moreover, renewable energies are enabling poverty alleviation. The IES helps Europe to fulfil its global responsibility.

Highlight

### KEY PUBLICATIONS

Kaiser R., Svodoba V., Wenzl H., Baring-Gould I., Wilmot N., Mattera F., Tselepis S., Nieuernhout F., Rodrigues C., Perujo A., Ruddell A., Lundsager P. (2004): Development of Test Procedures for Benchmarking Components in Renewable Energy Systems Applications, in particular Energy Storage. In: Proceedings of the 5<sup>th</sup> ISES European Solar Conference, Freiburg. Germany, 20-23 June 2004, Vol. 3: 197-205.

Azzam M., Jacquemart M., Kay R., Ossenbrink H., Perujo A., Varadi P.F. (2004): Raising the Standard Global PV Standardisation and Specification. *Renewable Energy World* 7 (4).

Huld T., Šúri M., Dunlop E., Albuissou M., Wald L. (2005): Integration of Helioclim-1 Database into PVGIS to Estimate Solar Electricity Potential in Africa. In: Palz W., Ossenbrink H., Helm P. (Eds.): Proceedings of the 20<sup>th</sup> European Photovoltaic Solar Energy Conference and Exhibition, Barcelona, Spain, 6-10 June 2005: 2989-2992.

Šúri M., Huld T.A., Dunlop E.D., Albuissou M., Wald L. (2006): Online Data and Tools for Estimation of Solar Electricity in Africa: the PVGIS Approach. In: Proceedings of the 21<sup>st</sup> European Photovoltaic Solar Energy Conference and Exhibition, Dresden, Germany, 4-8 October 2006.

Dunlop E.D., Wald L., Šúri M. (Eds.) (2006): Solar Energy Resource Management for Electricity Generation from Local to Global Scale. Nova Science Publishers: Hauppauge, 205 pp.

### MAIN RESEARCH PARTNERS

Ecole des Mines de Paris - Centre for Energy and Processes, Sophia Antipolis, France  
 University of Prešov, Slovakia  
 Fraunhofer Institute for Solar Energy Systems, Freiburg, Germany  
 Energy Centre Netherlands (ECN), Petten, The Netherlands  
 Research Institute for Sustainable Energy (RISE), Murdoch, Australia  
 Risø National Laboratory, Roskilde, Denmark  
 National Renewable Energy Laboratory, Golden (CO), USA  
 Centre for Solar Energy and Hydrogen Research (ZSW), Stuttgart, Germany  
 Centre for Renewable Energy Systems (CRES), Pikerini, Greece



Iris De Oliveira  
IES Staff Member from Cambé, Brazil  
"The JRC gives me the opportunity to make new friends in a stimulating cosmopolitan working environment."



The JRC Institute  
for Environment  
and Sustainability

## Delivering robust environmental science fit to the needs of the European policy-maker

Located in Ispra (Lago Maggiore, Italy), the Institute for Environment and Sustainability (IES) is one of seven institutes that constitute the Joint Research Centre (JRC), which is a Directorate-General of the European Commission providing customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies.

The IES was created in 2001 through a merger of the former Environment Institute of the JRC with the Space Applications Institute, giving life to a scientific structure covering the entire environmental sciences with particular competences in the field of earth observation and remote sensing. With 470 staff, the IES is one of the largest interdisciplinary environmental research institutes in Europe. Its institutional budget of approx. 45 million Euro per year (staff costs and research credits) stems from direct funding through the EU Framework Research Programme and competitive income.

Being structured into seven scientific Units, the Institute at present is engaged in eight main fields of activity:

- Sustainable Use of Natural Resources: Water, Soils, Forests
- Sustainable Agriculture and Rural Development
- Climate Change Mitigation and Adaptation
- Environmental Risks and Natural Hazards
- Sustainable Transport and Air Quality
- Renewable Energies
- Environmental Dimension of Development Co-operation
- Environmental Monitoring and Information Systems: GMES and INSPIRE

Through its research actions, the IES supports a large number of European policies and programmes related to the environment including, among others, the Water Framework Directive, the Thematic Strategies of the 6th Environment Action Programme, the Global Monitoring for Environment and Security (GMES) and the Infrastructure for Spatial Information in Europe (INSPIRE).

The main customers of the work of the IES are the Policy Directorates-General of the European Commission and other European bodies, such as the European Environment Agency (EEA) and the European Space Agency (ESA), as well as global organisations such as the United Nations Environment Programme (UNEP) and the United Nations Food and Agricultural Organisation (FAO). The IES works in close collaboration with research partners in the Member States of the European Union and beyond. Since 2002, the Institute participates in the Partnership for European Environmental Research (PEER), which combines Europe's largest environmental research centres.

The IES runs several large-scale research infrastructures and hosts a large number of unique pan-European and global databases. The Institute actively supports the enlargement and integration process of the European Union through targeted activities. Being a European reference centre for environmental science and technology, it is also engaged in international standardisation efforts and provides calibration services to the private sector and the scientific community at large.

The IES puts strong emphasis on the public dissemination of its research results through publications and media activities, thus strengthening the link between EU policies and the European citizen.



# Structure of the Institute for Environment and Sustainability

## Units and Research Actions in the 7<sup>th</sup> EU Research Framework Programme (Status 2007)

Director: Manfred Grasserbauer

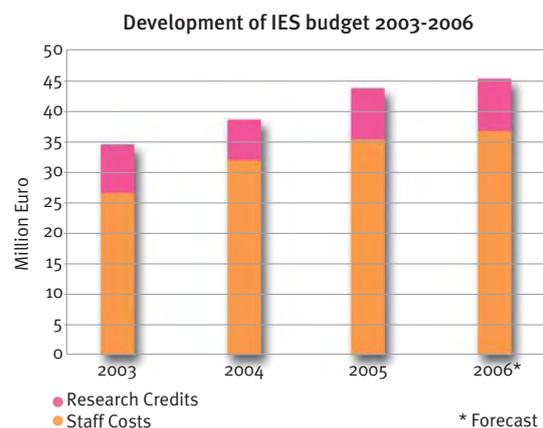
- ① **Directorate Unit (Unit Head: Manfred Grasserbauer)**
  - Office of the Director (Head: Pam Kennedy)
  - Action ENVIHEALTH - Health Impact Assessment of Environmental Risk Factors (Leader: Peter Pärt)
- ② **Management Support Unit (Unit Head: Neil Hubbard)**
- ③ **Climate Change Unit (Unit Head: Frank Raes)**
  - Action GAPCC - Global Air Pollution and Climate Change (Leader: Frank Dentener)
  - Action GHG-AFOLU - Greenhouse Gases in Agriculture, Forestry and other Land Uses (Leader: Günther Seufert)
  - Action ICPA-EEI - Integrated Climate Policy Assessment: Emissions and Environmental Impacts (Leader: John van Aardenne)
- ④ **Global Environment Monitoring Unit (Unit Head: Alan Belward)**
  - Action PROCAS - Protection and Conservation of European Seas (Leader: Wolfram Schrimpf)
  - Action SOLO - Systematic Observations of Land and Oceans (Leader: Mark Dowell)
  - Action MONDE - Monitoring Natural Resources for Development Co-operation (Leader: Philippe Mayaux)
  - Action TREES-3 - Global Forest Resource Monitoring (Leader: Frédéric Achard)
- ⑤ **Transport and Air Quality Unit (Unit Head: Giovanni De Santi)**
  - Action SusTrans - Sustainable Transport (Leader: Adolfo Perujo)
  - Action TransTech - Transport Technologies and Emissions (Leader: Alois Krasenbrink)
  - Action APE - Air Pollution and Effects (Leader: Annette Borowiak)
  - Action AIRMODE - Air Quality and Transport Modelling (Leader: Panagiota Dilara)
  - Action REM - Radioactivity Environmental Monitoring (Leader: Marc De Cort)
- ⑥ **Rural, Water and Ecosystem Resources Unit (Unit Head: Giovanni Bidoglio)**
  - Action IWQIS - Integrated Water Quality Information System (Leader: Palle Haastrup)
  - Action AGRI-ENV - Integration of Environment Concerns into Agriculture (Leader: Jean-Michel Terres)
  - Action ATEAM - Aquatic and Terrestrial Ecosystems Assessment and Monitoring (Leader: José Zaldívar)
  - Action EEWAI - European Ecological Water Quality and Intercalibration (Leader: Anna-Stiina Heiskanen)
  - Action ENSURE - Environmental Assessment of European Waste and the Sustainable Use of Resources (Leader: David Pennington)
- ⑦ **Spatial Data Infrastructures Unit (Unit Head: Alessandro Annoni)**
  - Action COSIN - Community Spatial Information Network (Leader: Stephen Peedell)
  - Action INSPIRE - Infrastructure for Spatial Information in Europe (Leader: Paul Smits)
- ⑧ **Land Management and Natural Hazards Unit (Unit Head: Guido Schmuck)**
  - Action FOREST - Forest Data and Information Systems (Leader: Jesús San-Miguel-Ayanz)
  - Action SOIL - Soil Data and Information Systems (Leader: Luca Montanarella)
  - Action NAHA - Natural Hazards (Leader: Ad De Roo)
- ⑨ **Renewable Energies Unit (Unit Head: Heinz Ossenbrink)**
  - Action BioF - Quality and Performance of Biofuels (Leader: Jean-François Dallemand)
  - Action SOLAREC - Photovoltaic Solar Electricity (Leader: Ewan Dunlop)
  - Action REFREE - Scientific Technical Reference System for Renewable Energy and End-Use Efficiency (Leader: Arnulf Jäger-Waldau)



④ ② ⑨ ③ ① ⑥ ⑦ ⑧ ⑤

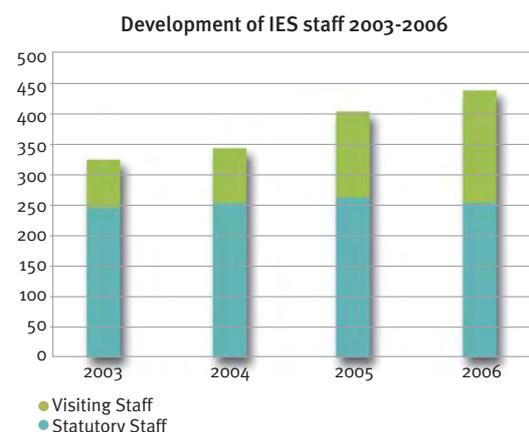
### Budget

The IES budget is principally subdivided into staff costs and research credits, with a budget in 2006 amounting to approx. 45 million Euro. Most of this budget is made available through the EU Research Framework Programme (Funding period of the 6th Framework Programme: 2003-2006), and relates to the institutional work programme of the Institute. In addition, an increasing part of the IES income derives from the Institute's participation in competitive activities, with signed contracts during the 6th Framework Programme exceeding 40 million Euro. The competitive work has three main components: participating with partners to open calls for research projects, performing work directly in a policy support role to Commission services, and contract work for third parties such as regional authorities or industry.



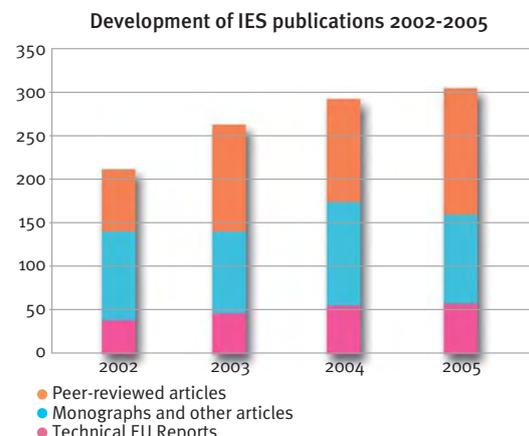
### Human Resources

IES staff numbers have increased throughout the 6th Framework Programme in response to the increased workload of the Institute. While the number of statutory staff positions has remained more or less stable, the number of visiting staff has increased. This is especially a consequence of the growth in competitive projects, the JRC Enlargement and Integration Programme and the active Institute policy of hosting doctoral and post-doctoral students as well as seconded national experts.



### Publications

The most important indicator for the scientific performance of the IES is the number of publications. In particular, the number of peer-reviewed journal articles reflects the high scientific recognition the IES gained since its foundation in 2001. The annual number of IES publications in peer-reviewed journals has more than doubled between 2002 and 2005 and will further increase in the future. Despite its strive for scientific excellence, the IES also aims to grow at the same time its policy support efforts, as can be shown in the increasing number of Technical EU Reports, which are mainly targeted at customer Directorates-General of the European Commission.



### A new building for the IES

As many buildings on the Ispra site, the laboratory buildings of the IES are 40 or more years old and no longer correspond to the requirements of a modern research organisation. To address this problem, a strategic plan for the development of the Ispra site has been prepared which foresees the construction of new research premises, including a new laboratory building for environmental research offering space for 180 staff. This facility, expected to host the IES' activities in the field of climate change, natural resources and environment monitoring, will not only provide state-of-the-art laboratory space, but will also enhance the interaction between the various research groups who are presently spread out in a large number of old buildings.



Architecture proposal for the new IES building

## Research facilities

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EMEP super-site at the JRC Ispra  
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In order to deliver high-class research and targeted policy support, the JRC's Institute for Environment and Sustainability (IES) hosts unique research facilities. Among the most prominent ones are the following:

### European Solar Test Installation (ESTI)

The European Solar Test Installation (ESTI) is a European centre of excellence in the field of solar energy, and specifically in photovoltaics, the direct conversion of sunlight into electrical energy. The primary objective is to provide the technological basis for a sound and credible assessment of all aspects of photovoltaic energy, assisting both policy-makers and industry, but also standards organisations and national agencies. In the past 20 years ESTI developed into one of the world's leading laboratories for photovoltaic reference measurements. In 2004, ESTI became the world's first laboratory obtaining the accreditation for the calibration of photovoltaic devices.

### Vehicle Emissions Laboratory (VELA)

The Vehicle Emissions Laboratory (VELA) is equipped with the most advanced instrumentation, allowing the physical, chemical and toxicological characterization of the emissions from all types of transport fleet. Tests are conducted on engines, from small hand-held to large heavy-duty engines, and on full vehicles such as mopeds, motorbikes, passenger cars, 4WD cars and small trucks. In addition, a new truck and bus roller bench will allow simulating the on-road emissions of heavy-duty vehicles. The research lines of VELA cover all environmental aspects related to advanced technologies, new engines and after-treatment systems, on-board diagnostics, new or reformulated fuels, biofuels, gaseous fuels and technology foresight.

### European Reference Laboratory for Air Pollution (ERLAP)

The need to refer to an independent laboratory on the development and the correct implementation of Air Quality Directives in Europe led to the creation of the European Reference Laboratory for Air Pollution (ERLAP), based at the IES. The highly specialised laboratory works on the harmonisation and standardisation of measurement techniques, carries out measurement campaigns with mobile laboratories in sites of particular interest, analyses the chemical composition of toxic and carcinogenic compounds in air pollution and develops reference and equivalent measurement methods.

### EMEP super-site at the JRC Ispra

The IES runs one of only two stations based on Italian territory in the framework of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP). The concentrations of carbon monoxide (CO), ozone (O<sub>3</sub>) and secondary aerosol precursors (SO<sub>2</sub>, NO<sub>x</sub>) are continuously monitored. Daily aerosol samples are collected to determine PM<sub>10</sub> and PM<sub>2.5</sub> concentrations and chemical compositions. The aerosol measurement programme is being enhanced turning the JRC-EMEP station into a super-station where all the parameters needed to understand the interplay of ozone, aerosol and greenhouse gases are measured.

# Key information systems and databases

The JRC's Institute for Environment and Sustainability (IES) hosts a large number of unique pan-European and global environmental information systems, data centres, databases and related web portals. Most of these are accessible through web applications. Among the most important ones are:

## European Geo-Portal

The European Geo-Portal is Europe's internet access point to the Infrastructure for Spatial Information in Europe (INSPIRE). Hosted by the IES, the Geo-Portal is established on internationally agreed standards and provides access to geographic information stored and maintained on national and thematic servers across Europe.

## European Forest and Soil Data Centres (EFDAC / ESDAC)

Following an agreement of DG Environment, DG Eurostat, the European Environment Agency and the JRC, the IES has been made responsible for the development and maintenance of the European Data Centres for Forests and Soils. Once operational, these will become the focal points for forest and soil information at the European level.

## World Data Centre for Aerosols (WDCA)

The World Data Centre for Aerosols, operated by the IES, is one of five recognised World Data Centres which are part of the Global Atmosphere Watch programme of the World Meteorological Organisation (WMO). The purpose of this Data Centre is to provide data on the spatio-temporal distribution of aerosol properties.

## Water Information System for Europe (WISE)

The IES supports the development and realisation of the Water Information System for Europe (WISE). This system will implement the reporting requirements of the Water Framework Directive, being filled gradually with data uploaded by the Member States. WISE allows zooming to any area in Europe, providing information on the status of water bodies.

## Image 2000 & CORINE Land Cover 2000

Being a joint project of the European Environment Agency (EEA) and the IES, Image 2000 & CORINE Land Cover 2000 provides a snapshot of Europe for the year 2000 as a multi-purpose spatial reference. It integrates European and national satellite mosaics as well as a land cover database of the European continent.

## Global Land Cover 2000 Database (GLC2000)

The Global Land Cover 2000 Database shows for the first time ever the land cover of the entire planet with a 1km resolution. The project was carried out in collaboration with over 30 research teams from around the world, under the co-ordination of the IES. Each region was mapped by local experts, which guaranteed an accurate classification based on local knowledge.

### WEB SITES

European Geo-Portal:  
<http://eu-geoportal.jrc.it/>

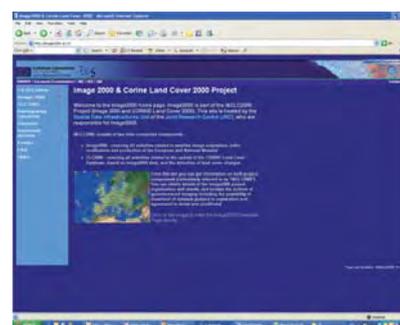
World Data Centre for Aerosols:  
<http://wdca.jrc.it/>

Water Information System for Europe (WISE):  
<http://wise.jrc.it>

Image 2000 & CORINE Land Cover 2000:  
<http://image2000.jrc.it/>

Global Land Cover 2000 Database:  
<http://www-gem.jrc.it/glc2000/defaultglc2000.htm>

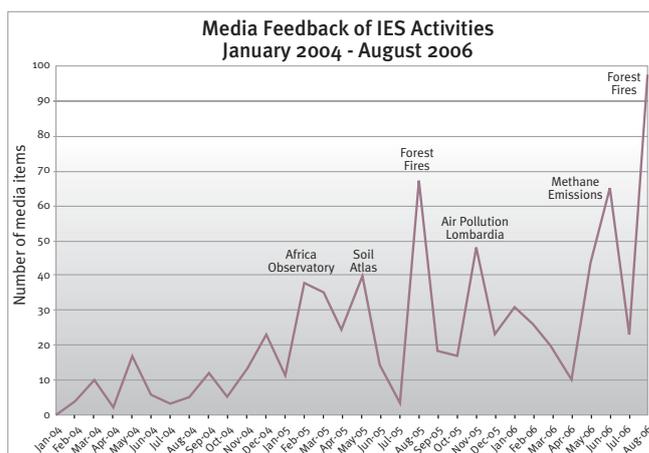
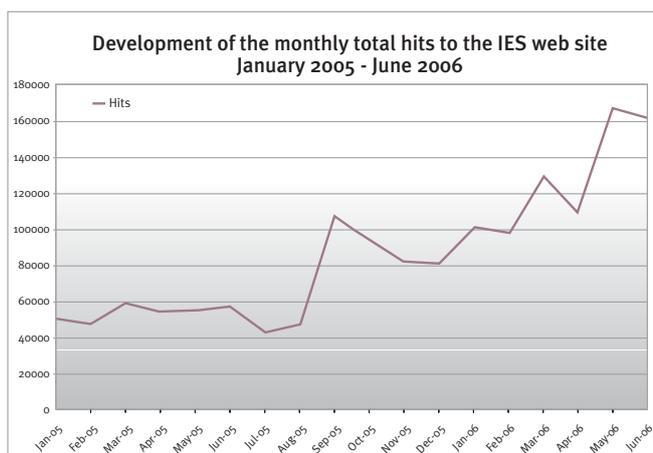
These and more information systems and databases operated by the IES can be found on:  
<http://ies.jrc.ec.europa.eu/dbanks.html>





The IES web <http://ies.jrc.ec.europa.eu>

The European Commission has identified the communication with the citizen as one of its key priorities, as can be demonstrated with the Action Plan “Communicating Europe” and the White Paper on a European Communication Policy. But this is not the only reason why the JRC’s Institute for Environment and Sustainability (IES) has always put a strong emphasis on communicating its work and results to the public. Raising awareness for environmental problems – and environmental opportunities – is of key importance for safeguarding a healthy environment for future generations. On these pages you will find some of the ways the IES uses to communicate with the public.



BBC interview with Ad De Roo on the European Flood Alert System

## Web Sites

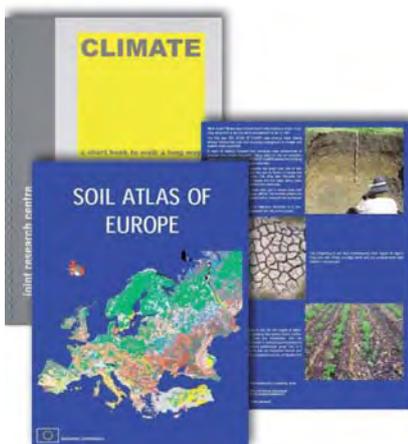
The IES hosts a large number of web sites that provide useful information to policy-makers, the scientific community, and the general public. The main portal to the wealth of environmental information hosted by the IES is the Institute web site (<http://ies.jrc.ec.europa.eu>). The number of hits to the web site increased three-fold within 18 months after the re-launch of the IES web portal.

## Mass Media

The IES has substantial interactions with mass media from all EU Member States and beyond, including key dailies and popular science magazines as well as TV and radio stations. In 2006 alone, the IES has been mentioned in 453 newspaper articles and audiovisual broadcasts. This included key print media like the Financial Times, Le Monde, Die Welt, El Pais, and Corriere della Sera as well as TV stations like BBC and RAI. The amount of media feedback has strongly increased since 2004, showing a higher concern of the public for environmental issues.

## Publications

Besides the large number of scientific publications which the IES is producing as a result of its research, the Institute is actively engaged in developing publications aimed at a broader public. The most prominent example of these is the Soil Atlas of Europe which is the first of its kind, being the product of a joint effort of the European Soil Bureau Network under the co-ordination of the IES. But also in other areas, in particular climate change, the Institute offers books that can be used for didactic purposes.



Examples of IES Publications

## Institute Visits

The IES receives a large amount of visitors every year, ranging from school classes and student groups, over scientific and industrial partners, to high-level visitors such as European Commissioners. Some of the high-level visits in the recent past included Commission Vice President Siim Kallas, Commissioner Louis Michel, the Secretary-General of the Amazon Co-operation Treaty Organization Rosalía Arteaga Serrano, Nobel Prize Winner Paul Crutzen, and the Industry, Research and Energy Committee of the European Parliament.

## Exhibitions

The IES participates to information stands at exhibitions and information days organised by the Joint Research Centre in European institutions and in the Member States. Recent examples include a JRC exhibition in the European Parliament in Brussels, the European Science Open Forum (ESOF), and the European Photovoltaic Solar Energy Conference, the latter being co-organised by the IES. These are important fora in which scientists can interact directly with the general public.

## Photo Competitions

The IES regularly organises photo competitions amongst its staff, dealing with environmental subjects. Besides being an instrument for social cohesion of staff, these competitions provide the opportunity to generate visual material that can be used for public relations and awareness-rising purposes. In fact, some of the photos which you will find in this brochure, including the one on the front cover, are the result of these activities.

## Awards

The Joint Research Centre gives annual excellence awards to selected staff members, the IES being successful in repeated occasions. In addition, IES scientists and achievements have won several international awards. These recognitions are being used to disseminate to a broader public the research results for which the awards have been granted.

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## Examples of IES press releases issued by the European Commission during the 6th Research Framework Programme:

- JRC releases report on plight of European coastal and sea waters (14 February 2007)
- European researchers call for wider use of existing eco-technology in the fight against global warming (15 November 2006)
- Research shows huge potential energy savings through light-bulbs and household goods (19 October 2006)
- Commission launches innovative air pollution monitoring station (3 November 2005)
- European Commission - working to combat fire and drought in the EU (10 August 2005)
- First Soil Atlas of Europe shows importance of protecting this vital resource (28 April 2005)
- Breakthrough in environmental monitoring from space (16 December 2004)
- Europe, the bright spark in converting sunlight into electricity: First ever calibration laboratory accreditation (8 September 2004)



*European School visit to the IES in June 2006*



*The IES at the JRC stand in the European Parliament (April 2005)*



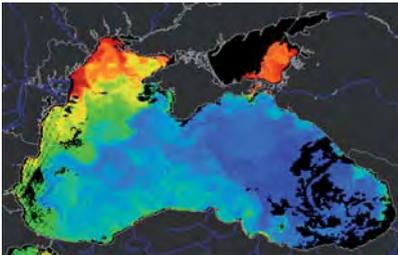
*Winning Picture of the IES Photo Competition 2006 (Elena Testa)*



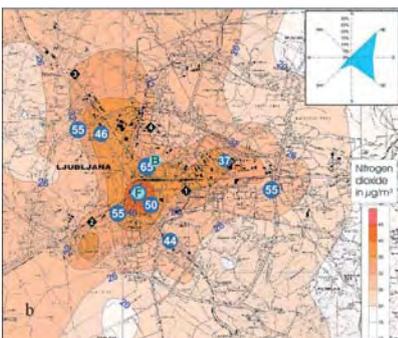
*Nadine Gobron, Best Young JRC Scientist 2004, with Research Commissioner Janez Potočnik and JRC Director-General Roland Schenkel*



*Participants of the JRC Summer School on Soil Survey*



*Monitoring of chlorophyll concentrations in the Black Sea*



*Assessment of NO<sub>2</sub> concentrations in the ambient air of Ljubljana*



*PECOMINES Report on mining waste in the new Member States*

The pull of the European Union has helped to transform the countries of Central and Eastern Europe into modern, well-functioning democracies that encourage peace, stability, prosperity, human rights and the rule of law across Europe. More recently, the process has inspired far-reaching reforms in the Western Balkans, Turkey and the Ukraine.

The Joint Research Centre (JRC) is playing an important role in providing scientific and technological support to the enlargement process by actively supporting the Candidate Countries towards their accession to the Union while promoting the integration of the new Member States which joined the EU in 2004 and 2007.

The JRC Enlargement and Integration Action aims to accelerate the uptake of scientific and technical aspects of European legislation in these countries through a range of measures that includes participation in workshops, specific training courses and collaboration in projects within the JRC work programme that reflect priority enlargement needs.

Since 2000, the number of experts from the new Member States and Candidate Countries hosted by the IES has risen constantly from 5 persons in 2000 to more than 60 in 2006. Since the launch of the Call for Visiting Scientists and Detached National Experts issued by the JRC, the IES has consistently attracted the highest number of applicants throughout all the JRC Institutes. In 2006, the IES organised more than 20 workshops and advanced training courses under its Enlargement and Integration Action involving around 600 participants.

In addition, the IES has been recently developing and strengthening co-operation with scientific organisations from potential Candidate Countries of the Western Balkans with the objective of anticipating and addressing pre-accession priority needs. Furthermore, there is an increasing collaboration with other countries in the European Union Neighbourhood, e.g. the Russian Federation and Northern Africa.

Examples of activities carried out by the IES to support the integration and enlargement process include:

- Ecosystem Health Assessment of the Black Sea and Baltic Sea;
- Guidance on the implementation of the Water Framework Directive in the new Member States;
- Flood forecasting in the Danube River Basin;
- Support to soil protection policies in South-Eastern Europe;
- Assessment of mining waste in the new Member States;
- Air quality and population exposure in the new Member States;
- Integration of European monitoring networks for environmental radioactivity;
- National Information Days on the Infrastructure for Spatial Information in Europe (INSPIRE);
- Assessment of sustainable energy resources in the new Member States, Candidate and Neighbourhood Countries.

Further details of the JRC enlargement and integration programme can be found at <http://www.jrc.ec.europa.eu/enlargement/>.

For more information please contact the IES Enlargement Officer: [arwyn.jones@jrc.it](mailto:arwyn.jones@jrc.it).

## Satisfying the needs of our customers

The science of the JRC's Institute for Environment and Sustainability (IES) delivers tailor-made solutions to a large variety of customers.

### European Commission

The Directorates-General of the Commission are the primary target group for the policy support provided by the IES. Among these, the most important customer is DG Environment, being supported in the entire spectrum of environmental research. Strong policy support is also delivered, for instance, to DG Agriculture and Rural Development, DG Transport and Energy, DG Enterprise and Industry, and DG Regional Policy. The increasing global component of the IES is reflected in a strong relationship with the so-called "External Relations family" (DG External Relations, DG Development and DG EuropeAid).

### European Parliament

The expertise of the IES is more and more requested by the European Parliament. The support delivered by the Institute ranges from answers to parliamentary questions through the participation in expert panels to directly requested research activities.

### European Organisations

The second most important customer of the IES is the European Environment Agency (EEA) in Copenhagen, the multi-area collaboration being organised through a joint Annual Work Programme. In addition, the IES is working closely with a number of other European organisations, including the European Space Agency (ESA), the European Centre for Medium-range Weather Forecasts (ECMWF), and the European Committee for Standardisation (CEN).

### Global Organisations

The increasing global focus of the IES portfolio comes along with a close working relationship with a number of global organisations. These include especially the United Nations bodies, such as the UN Environment Programme (UNEP), the UN Food and Agricultural Organisation (FAO), the UN Economic Commission for Europe (UN-ECE), the World Meteorological Organisation (WMO) and the World Health Organisation (WHO).

### Member States

While respecting the subsidiarity principle, the IES expertise is also requested by Member States. The IES co-ordinates several networks, in which official Member State representatives are participating. Moreover, the collaboration with national, regional and even local authorities is of key importance for the IES to develop tools that can be applied across Europe. One such example is the collaboration of the IES with the Italian Regione Lombardia on air pollution abatement strategies.

### Industry

The IES would not be able to provide tailor-made policy support without partners from industry. In particular, the Vehicle Emissions Laboratory (VELA) and the European Solar Test Installation (ESTI) of the IES have gained worldwide recognition as mediators between science, industry and policy-makers.



*Visit of Commissioner Louis Michel*



*Commission Secretary-General Catherine Day visiting the IES stand*



*Visit of Jacqueline McGlade, Executive Director of the European Environment Agency (EEA)*



*European Parliament Vice-President Alejo Vidal Quadras studying the Soil Atlas of Europe*

## The Partnership for European Environmental Research: Teaming up with the key players



<http://www.peer-environment.eu>

In 2002, the JRC's Institute for Environment and Sustainability (IES) joined the Partnership for European Environmental Research (PEER), a strategic alliance of the major European environmental research centres. PEER has the goal to strengthen the knowledge base for sustainable development, fostering innovative interdisciplinary research and cross-cutting approaches in support of national and European policy-makers, industry and society.

### The PEER members are:

- ALTERRA – Wageningen University and Research Centre (The Netherlands)
- CEH – Centre for Ecology and Hydrology (United Kingdom)
- CEMAGREF – Centre for Agricultural and Environmental Engineering Research (France)
- JRC-IES – Institute for Environment and Sustainability (European Commission)
- NERI – National Environmental Research Institute (Denmark)
- SYKE – Finnish Environment Institute (Finland)
- UFZ – Helmholtz Centre for Environmental Research (Germany)



<http://www.alterra.wur.nl>



<http://www.ceh.ac.uk>



<http://www.cemagref.fr>

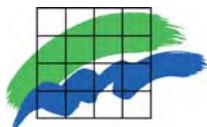


<http://ies.jrc.ec.europa.eu>

With a total staff of 4700 and a combined budget of 360 Million Euro per year, the seven research centres constituting PEER are a driving force in the development of a European Research Area in the environmental sciences. The common asset of the PEER members is that they address complex environmental challenges across all environmental compartments as well as spatial and temporal scales, integrating natural sciences, social sciences and engineering, and linking basic with applied research.

Major projects that were developed within the framework of PEER are the Network of Excellence ALTERNET (A long-term Biodiversity, Ecosystem and Awareness Research Network), the Integrated Project NOMIRACLE (Novel methods for integrated risk assessment of cumulative stressors in Europe), and the Marie Curie Training Series METIER (Methods in Interdisciplinary Environmental Research).

PEER gives advice to DG Research, DG Environment, and the European Environment Agency (EEA), and organises regularly conferences on environmental topics that are high on the political agenda. The PEER members actively support the exchange of staff and the creation of training opportunities for young researchers. In the long term, PEER members aim at aligning their research programmes in fields that are considered to be of strategic importance.



<http://www.dmu.dk>



<http://www.ymparisto.fi>



<http://www.ufz.de>



*The PEER Directors 2006 (left to right): Patrick Lavarde (Cemagref), Pat Nuttall (CEH), Wim van Vierssen (Alterra), Georg Teutsch (UFZ), Henrik Sandbeck (NERI), Lea Kauppi (SYKE), Manfred Grasserbauer (JRC-IES).*

## Networking with the best

In order to fulfil its mission, the JRC's Institute for Environment and Sustainability (IES) is working in close collaboration with a multitude of research partners in the Member States of the European Union, and beyond. Find below some of the major institutional networks and competitive activities in which the IES is involved:

### INSTITUTIONAL NETWORKS (EXAMPLES)

#### ESBN – European Soil Bureau Network

With its Secretariat being hosted by the IES, the European Soil Bureau Network was created in 1996 as a network of national soil science institutions. Its main task is to collect, harmonise, organise and distribute soil information for Europe. The members of the network aim at supporting European and national policy-makers in the field of soil protection.

#### AQUILA – Network of European Air Quality Reference Laboratories

Co-ordinated by the IES, the main objectives of AQUILA are to provide technical support to the development and implementation of EU air quality directives, by providing expert judgment on matters regarding the measurement strategy. Particular focus is given to the chemical and physical processes of air pollution and impact assessments of air pollutants on human health.

#### EURAQUA – European Network of Freshwater Research Organizations

The specific objectives of EurAqua are to better integrate European research resources through joint actions and initiatives, to promote the collaboration and efficient transfer of knowledge between scientific institutions and researchers, to provide expert advice to EU institutions and other stakeholders and to increase the competitiveness of the European water sector on a global scale.

### COMPETITIVE PROJECTS (EXAMPLES)

- ACCENT – Atmospheric Composition Change: The European Network of Excellence (Network of Excellence 2004-2009)
- CARBOEUROPE-IP – Assessment of the European Terrestrial Carbon Balance (Integrated Project 2004-2008)
- NITROEUROPE-IP – The nitrogen cycle and its influence on the European greenhouse gas balance (Integrated Project 2006-2011)
- ADAM – Adaptation and Mitigation Strategies: Supporting European climate policy (Integrated Project 2006-2009)
- ENSEMBLES – ENSEMBLE-based Predictions of Climate Changes and their Impacts (Integrated Project 2004-2009)
- SENSOR – Sustainability Impact Assessment: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions (Integrated Project 2004-2008)
- NOMIRACLE – Novel Methods for Integrated Risk Assessment of Cumulative Stressors in Europe (Integrated Project 2004-2009)
- FLOODSITE – Integrated Flood Risk Analysis and Management Methodologies (Integrated Project 2004-2009)
- EURANOS – European approach to nuclear and radiological emergency management and rehabilitation strategies (Integrated Project 2004-2009).



#### WEB SITES INSTITUTIONAL NETWORKS

European Soil Bureau Network:

[http://eusoils.jrc.it/esbn/Esbnet\\_overview.html](http://eusoils.jrc.it/esbn/Esbnet_overview.html)

Network of European Air Quality Reference Laboratories:

<http://ies.jrc.ec.europa.eu/Units/eh/Project/Aquila/>

European Network of Freshwater Research Organizations:

<http://www.euraqua.org/>

#### WEB SITES COMPETITIVE PROJECTS

Atmospheric Composition Change: The European Network of Excellence:

<http://www.accent-network.org/>

Assessment of the European Terrestrial Carbon Balance:

<http://www.carboeurope.org/>

The nitrogen cycle and its influence on the European greenhouse gas balance:

<http://www.nitroeuropa.eu/>

Adaptation and Mitigation Strategies: Supporting European climate policy:

<http://www.adamproject.eu/>

ENSEMBLE-based Predictions of Climate Changes and their Impacts:

<http://www.ensembles-eu.org/>

Sustainability Impact Assessment: Tools for Environmental, Social and Economic Effects of Multifunctional Land Use in European Regions:

<http://www.sensor-ip.org/>

Novel Methods for Integrated Risk Assessment of Cumulative Stressors in Europe:

<http://nomiracle.jrc.it/>

Integrated Flood Risk Analysis and Management Methodologies:

<http://www.floodsite.net/>

European approach to nuclear and radiological emergency management and rehabilitation strategies:

<http://www.euranos.fzk.de/>

## Feedback from our partners



*“Good and efficient environmental policy in Europe needs to be based on a thorough understanding and knowledge of environmental issues. The JRC’s Institute for Environment and Sustainability has grown into a credible and well recognised partner to the Directorate-General Environment of the European Commission, providing a wide range of input and services for developing better policies.”*

**Timo Mäkelä**

*Director Sustainable Development and Integration, DG Environment*



*“The JRC’s Institute for Environment and Sustainability has given scientific support to the European Environment Agency in many areas: Global Spatial Environmental Monitoring, Climate and Energy, and Environment and Health are only a few examples.”*

**Jacqueline McGlade**

*Executive Director, European Environment Agency*



*“The IES plays a key role in European environmental research by creating and providing pan-European databases and assessments, which Member State institutions would never be able to do alone. The IES makes sure that the best expertise from scientific partners across Europe is channeled into EU policy-making.”*

**Georg Teutsch**

*Scientific Director*

*Helmholtz Centre for Environmental Research UFZ, Leipzig (Germany)*

*Chairman Partnership for European Environmental Research (PEER)*



*“The Amazon Co-operation Treaty Organisation appreciates the support given by the JRC’s Institute for Environment and Sustainability to its mission of preserving and promoting the sustainable development of the Amazon region, one of the richest natural heritages of the world.”*

**Rosalía Arteaga Serrano**

*Secretary-General*

*Amazon Co-operation Treaty Organisation (ACTO)*

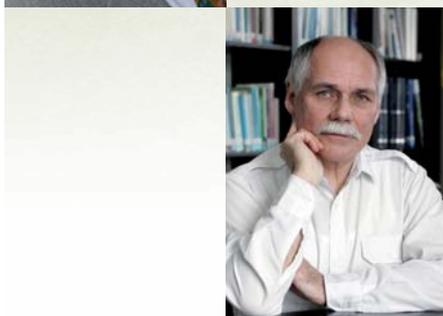


*“Very few Europeans know about the crown jewel of European public research: the JRC. The environmental and health research of the JRC reflects the best and the brightest of the European Union.”*

**David Hammerstein Mintz**

*Member of the European Parliament*

*Committee on Industry, Research and Energy*



*“I am impressed by the broad programme of the JRC’s Institute for Environment and Sustainability and the academic excellence of its results. Its work represents an extremely valuable contribution to achieving the so much needed harmony between social and economic development on one hand and nature and environment on the other.”*

**Bedřich Moldan**

*Senator of the Czech Parliament*

*Director of the Environment Centre at the Charles University of Prague*

*Former Minister of the Environment of the Czech Republic*

*Former Chairman of the UN Commission for Sustainable Development*

*Martina Sarti, European citizen from Italy, was born on the 15 May 2006.*



*Will she love nature?*

*Will she enjoy biodiversity?*

*Will she see glaciers on the Alps?*

*Will she live safe from natural hazards?*

*Will she have access to clean air, water and soil?*

*Will she count on a reliable and affordable energy supply?*

*Will she experience the richness of ecosystems around the world?*

*Will she have the possibility to pass on a healthy environment to her children?*

*Will she be able to fulfil her dreams?*

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## **ABSTRACT**

“Science of today for the environment of tomorrow” presents the Institute for Environment and Sustainability of the European Commission’s Joint Research Centre. The brochure gives an insight to the Institute’s achievements throughout the 6<sup>th</sup> Research Framework Programme of the European Union and provides an outlook on the challenges ahead.





*“The ultimate test of a moral society is the kind of world that it leaves to its children”.*  
*Dietrich Bonhoeffer, German Theologian (1906-1945)*

