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Joint Research Centre

Joint Research Centre

The Challenge of Climate Change for Europe.

Manfred Grasserbauer

Vienna University of Technology
Chemistry Department

Institute for Environment and Sustainability
Joint Research Centre
European Commission

The Issue of Climate Change.

Under baseline scenarios CO_2 emissions will increase till 2050 by 70 % in industrialised countries and by 250 % by countries in development.

IPCC predicts a temperature increase of 1,4 – 5,8 degrees by 2100.

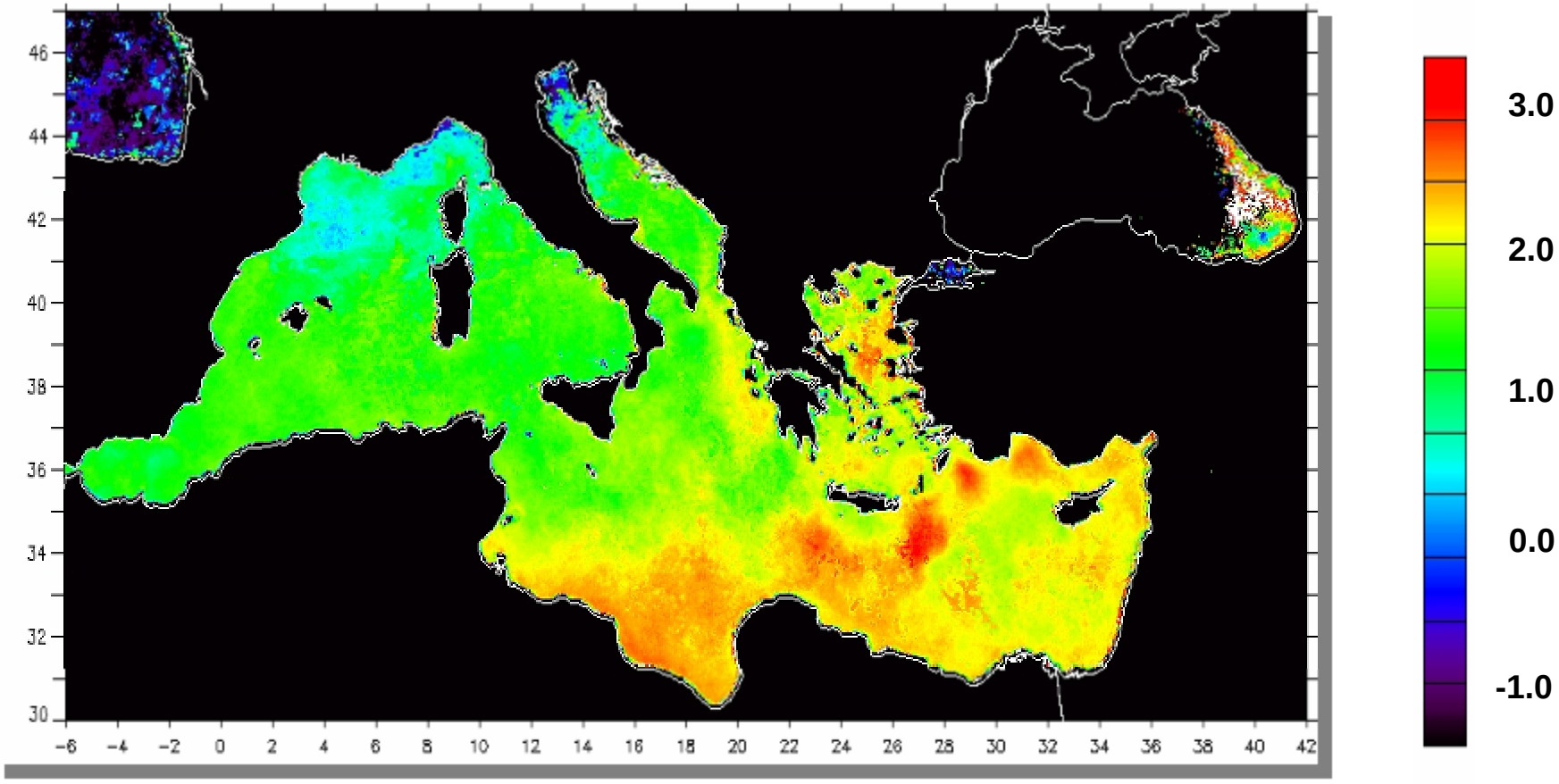
UNFCCC, IPCC4

⇨**Development of mitigation and adaptation strategies.**

Morteratsch-Glacier (Pontresina, Engadin)

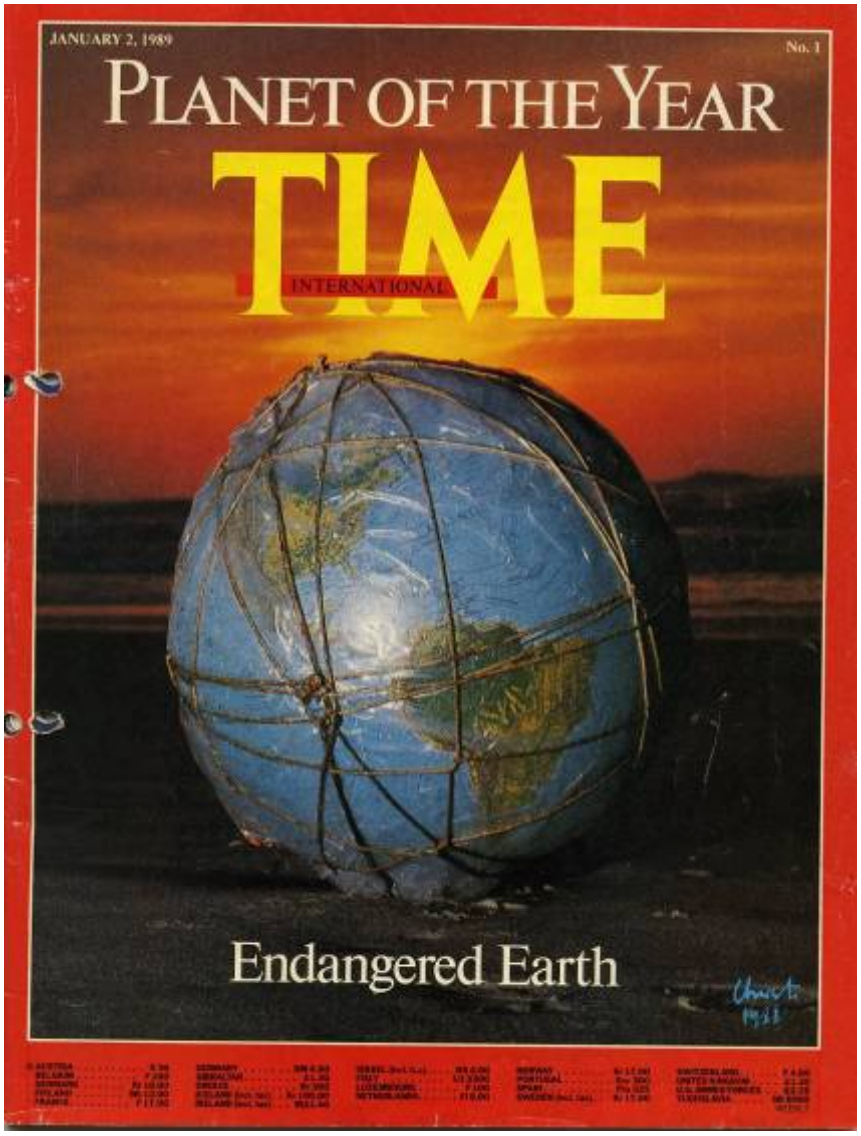
Glacier retreated 2000 m since 1900

Trends in Mediterranean Sea Surface Temperature



Total SST change in degrees Celsius between 1982 and 2003.

Source: JRC-IES



January 1989

April 2007

EU Climate Change Policy

Reducing Climate Change Risk **by** **MITIGATION** **+** **ADAPTATION**

Reducing & Avoiding GHG emissions

Reducing Exposure & Vulnerability

at the lowest cost & greatest benefit.

Targets for EU Climate Policy

Limitation of global temperature increase to +2°C (compared to pre-industrial times)

Spring Council 2007

- **GHG emission reduction targets:**

  20 (30) % in EU till 2020

- **Energy targets for 2020:**

  20 % renewable energies (binding)

  10 % biofuels (binding)

  20 % energy efficiency savings

Climate Change Research Challenges:

To assess the exposure, vulnerability and adaptation potential to Climate Change of EU ecosystems.

Knowledge base still quite limited.

⇒European Inland and Marine Waters

⇒European Soils, Agriculture and Forests

Climate Change

Inland and Marine Waters

- 20 % of all European surface water bodies seriously threatened by pollution (nitrate and pesticides).
- European seas threatened by eutrophication.
- Wide-spread over-consumption of water, particularly in the South of Europe.
- Water scarcity affects now already 100 million people in Europe.

EU: Water Framework Directive 2000/60EC
Marine Thematic Strategy 2006

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Information Gathering and Data Collection

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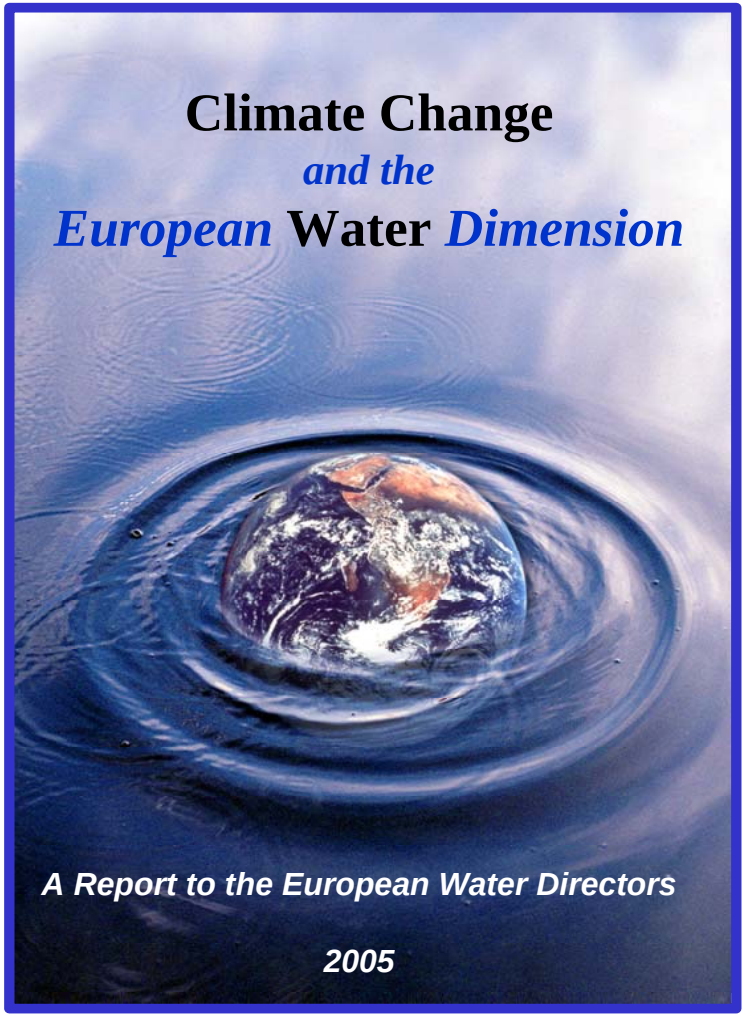
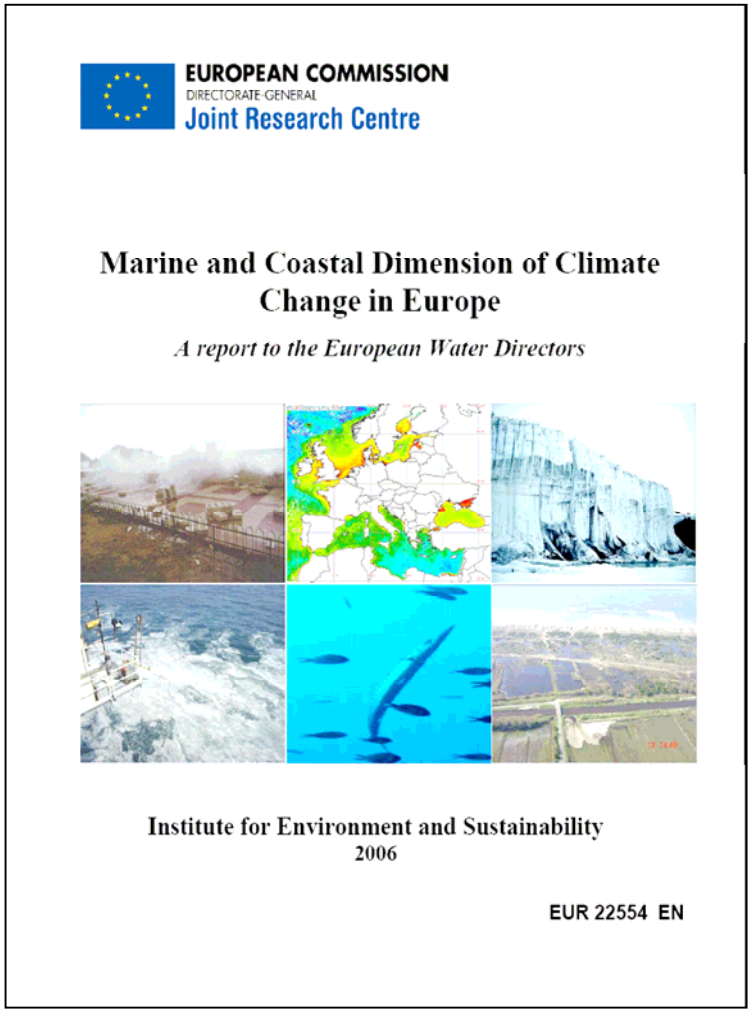
JRC Reports to the European Water Directors





Preparation of EEA-JRC Report on "Impacts of Climate Change in Europe" (2008)

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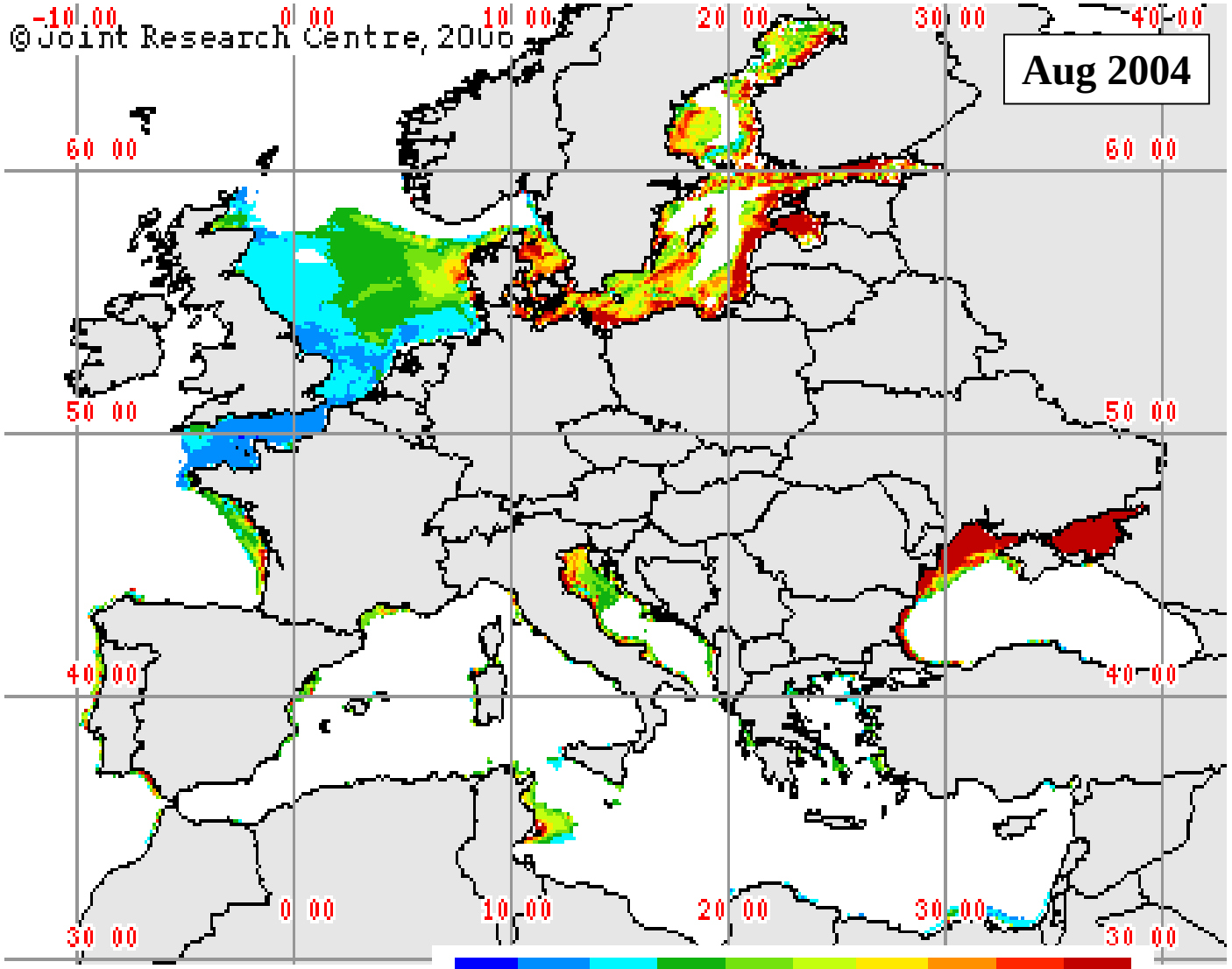
EMIS

Ecological Indicators to Assess Vulnerability of Coastal Areas



Oxygen Depletion/ Eutrophication Risk Index

Useful tool to monitor the impact of climate change variability

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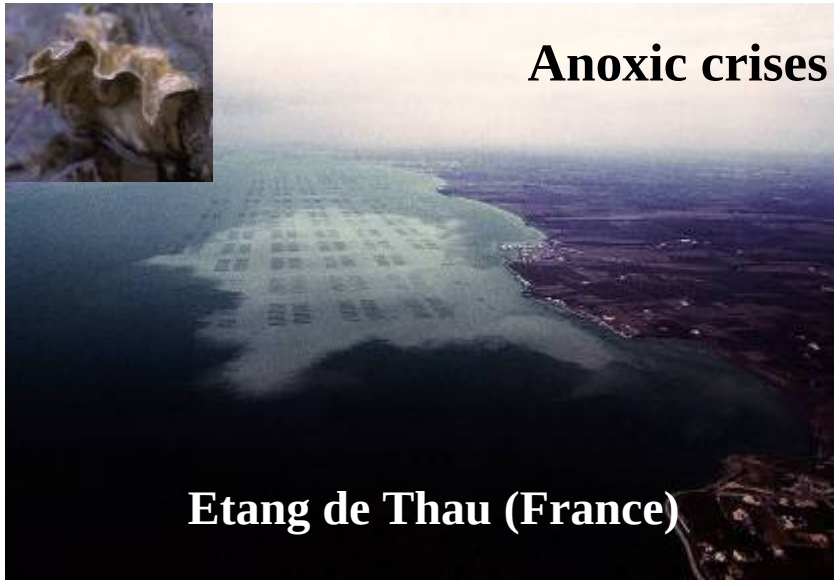
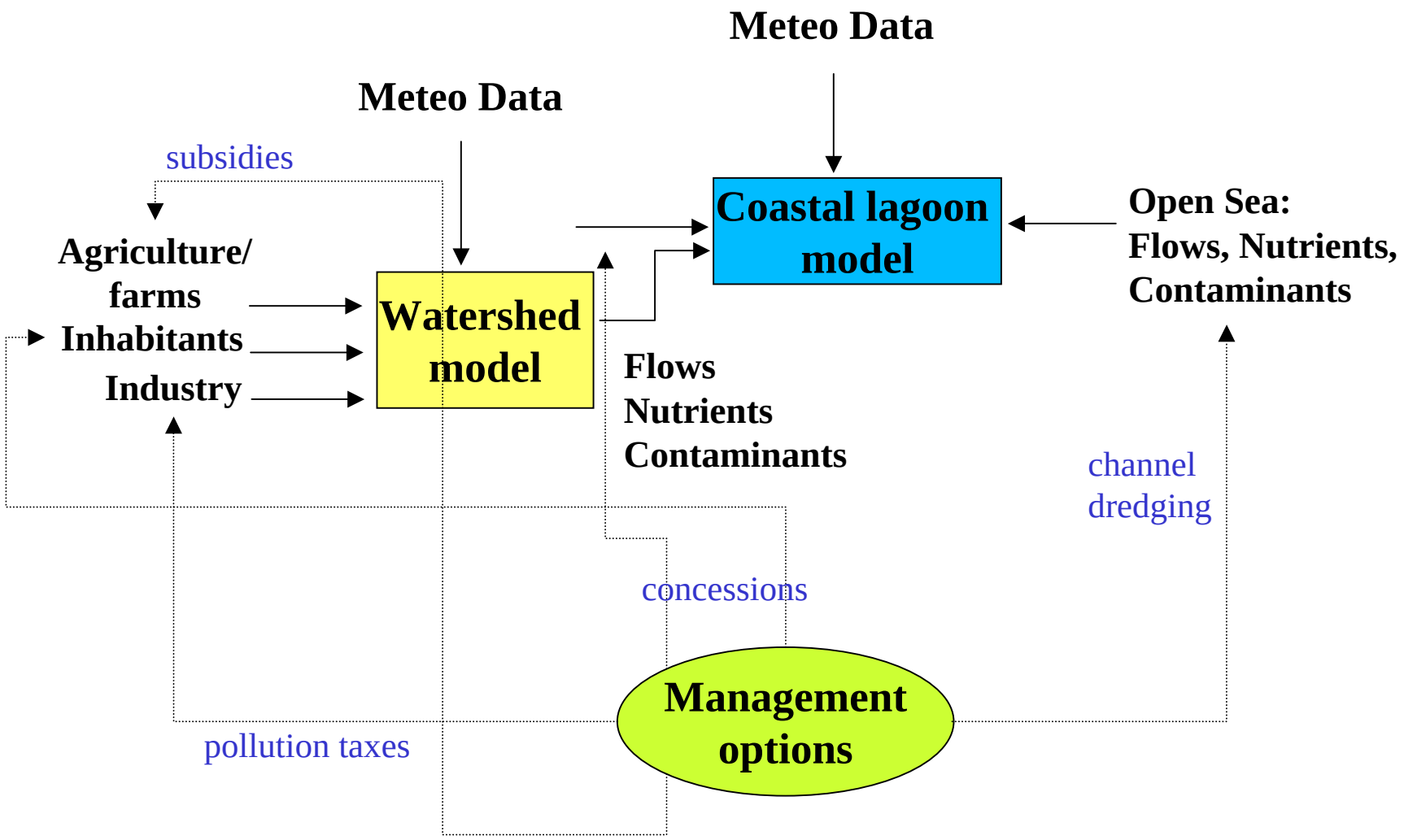
Coastal Zone Management

- Strong anthropogenic pressures: freshwater inputs rich in pollutants, land use changes, fish and shellfish farming, tourism, etc.

- Ecosystem functioning disruptions: anoxic crises, algal blooms, etc.



Modelling of Processes in Coastal Zones



behaviour of complex systems

Our Endangered Soil

- Soil erosion by water affects 12 % of Europe's surface and by wind 5 %
- 45 % of European soils have a reduced organic carbon content (particularly in Southern Europe)
- The number of contaminated soil sites is estimated at 3,5 million.
- Major land use changes: between 1990 and 2000 2,8 % of area changed in use causing widespread sealing (Corinne 2000).

"Versiegelt, versauert und vom Winde verweht"- Presseinformation BGR/NLfB 29. Nov. 2005

Climate Change is expected to enhance pressures on soil.

Source: JRC-IES/EEA

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European Soil Data Center ESDAC Configuration

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JRC Datasets and Catalogues

Data and metadata providers

ESTAT
EEA
FAO
UNECE
EFI
MS-NFI
…

Data

Metadata Catalogues

DG AGRI
DG RTD
GMES Projects

ESDAC

Metadata Catalogue

Data Repository

Tools

Information

Common architecture to ensure DC interoperability

INSPIRE
European Geo-Portal

Users

EC Services (DG ENV)

Member States

International Org. (FAO, UNECE..)

Source: JRC-IES

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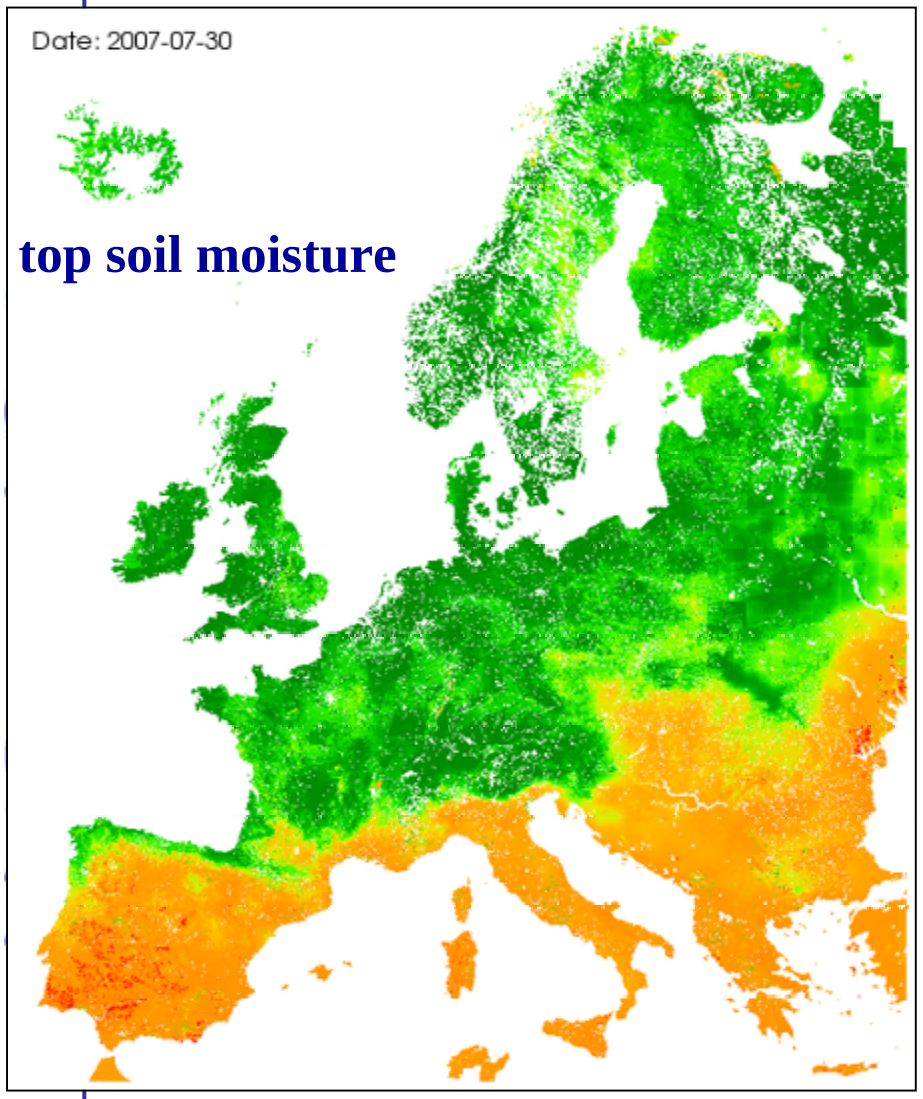
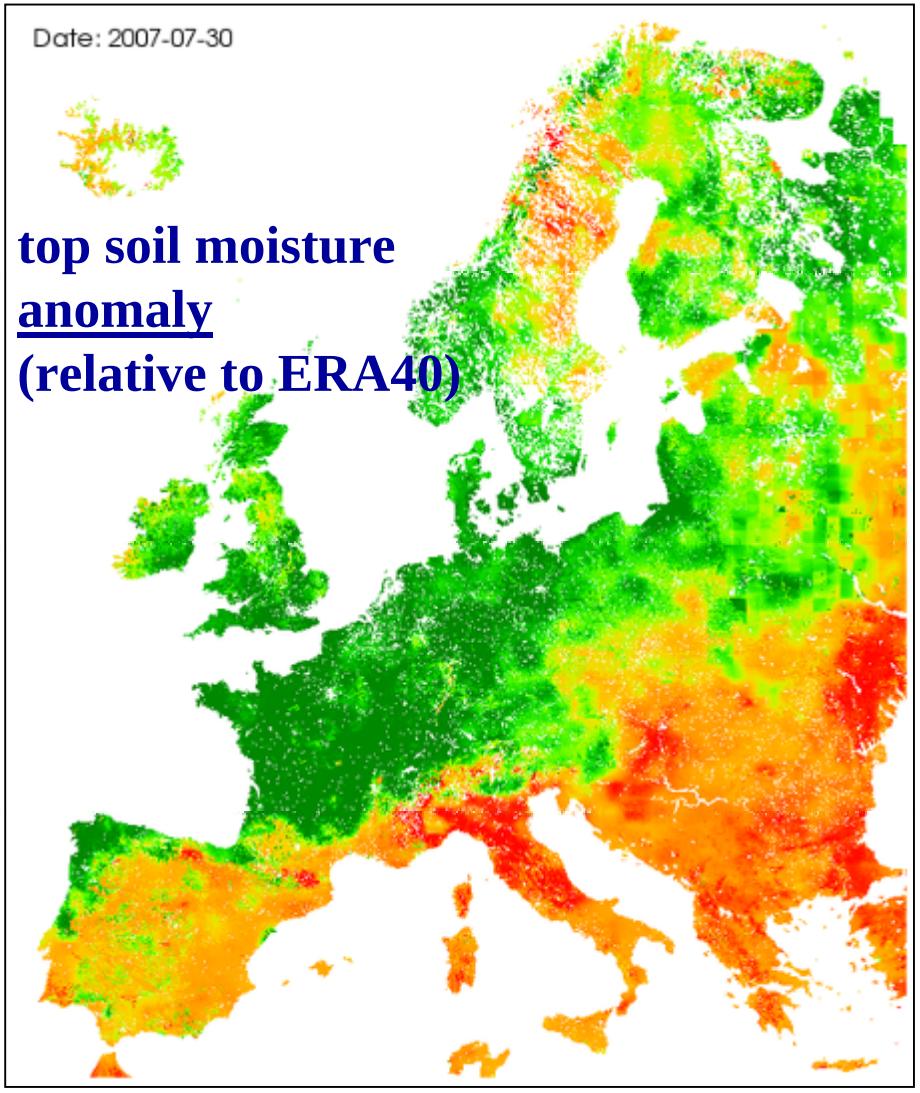
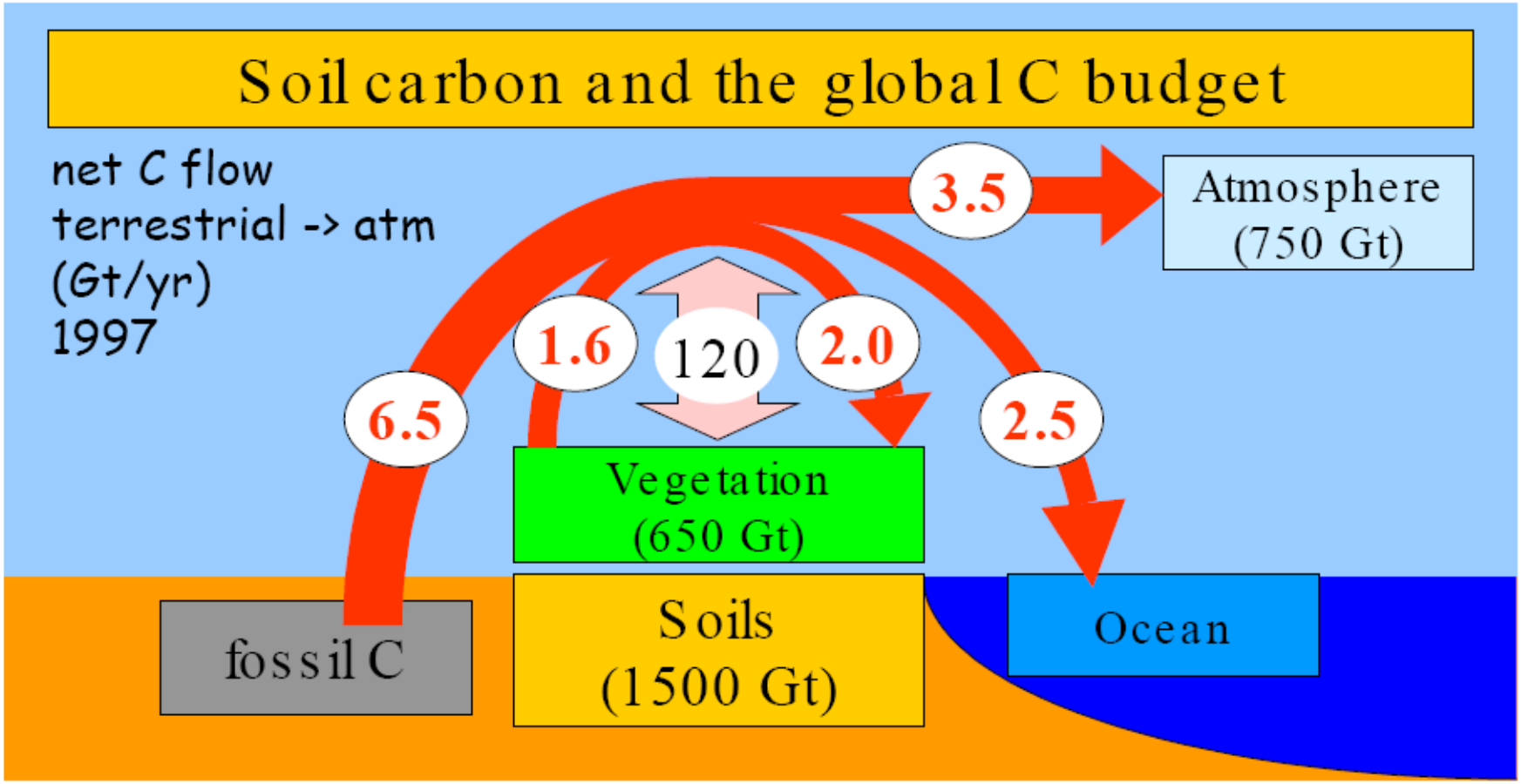
European Soil Moisture Maps





Source: JRC-IES/ECMWF

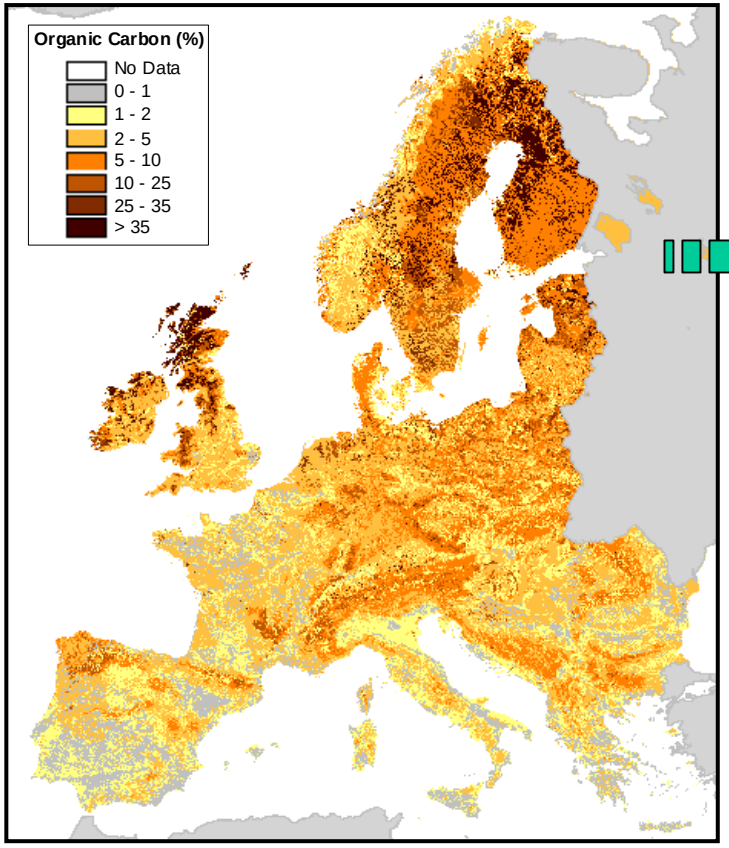
Climate Change and Soil Research Challenges



Source: M. Robert, 2004

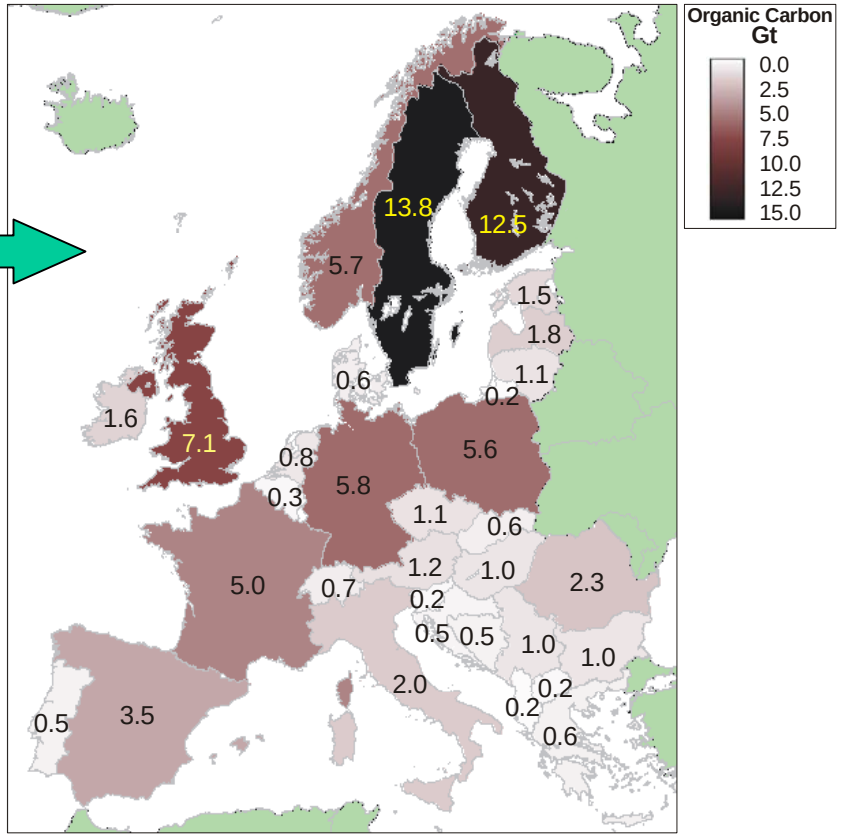
Soil Organic Carbon Stocks
Assessment

Model output



Organic carbon content (%) in the surface horizon (0-30 cm) of soils: total 71 GtC in EU

Aggregated results

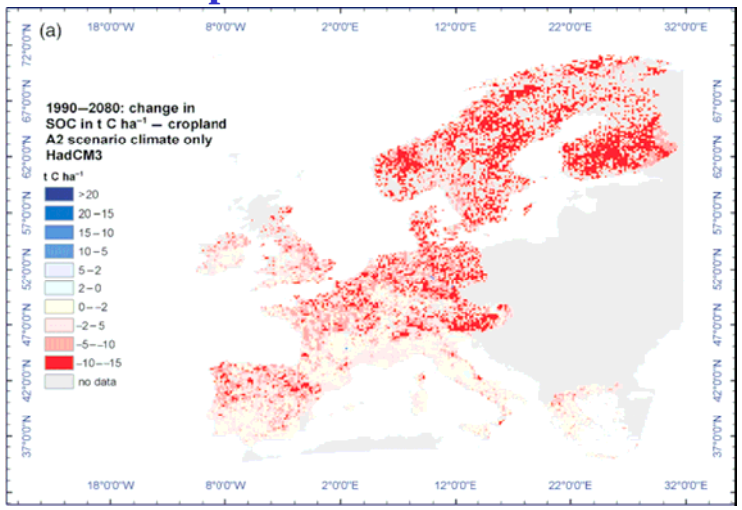


National Soil Organic Carbon stocks (0-30cm) in Gt.

Source: JRC-IES

Modelling of Decline of Soil Organic Carbon

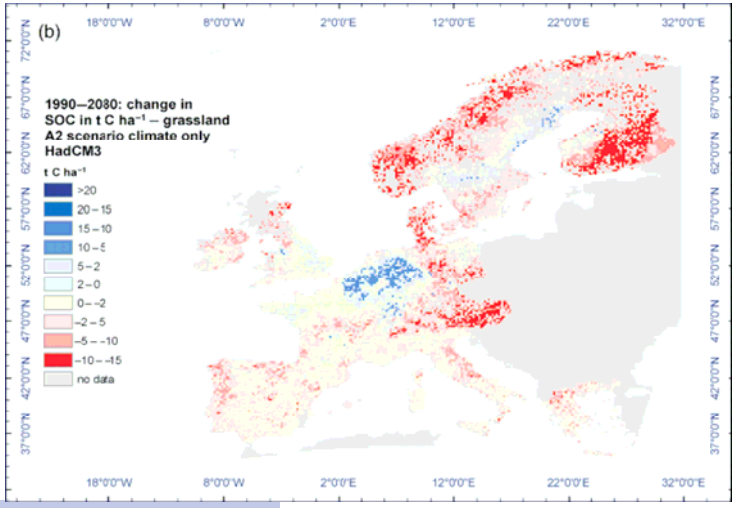
Climate-cropland



Finding

The model shows that climate change will stimulate further loss of SOC from cropland of the EU. For most of the Member States the loss can reach from 5 to 15 tC ha.

Climate-grassland



Finding

For most of the Member States the grassland soil will be turned into CO_2 sources. It is modeled that pasture soils in Germany remains to be a sink.

Source: Smith et al., 2005

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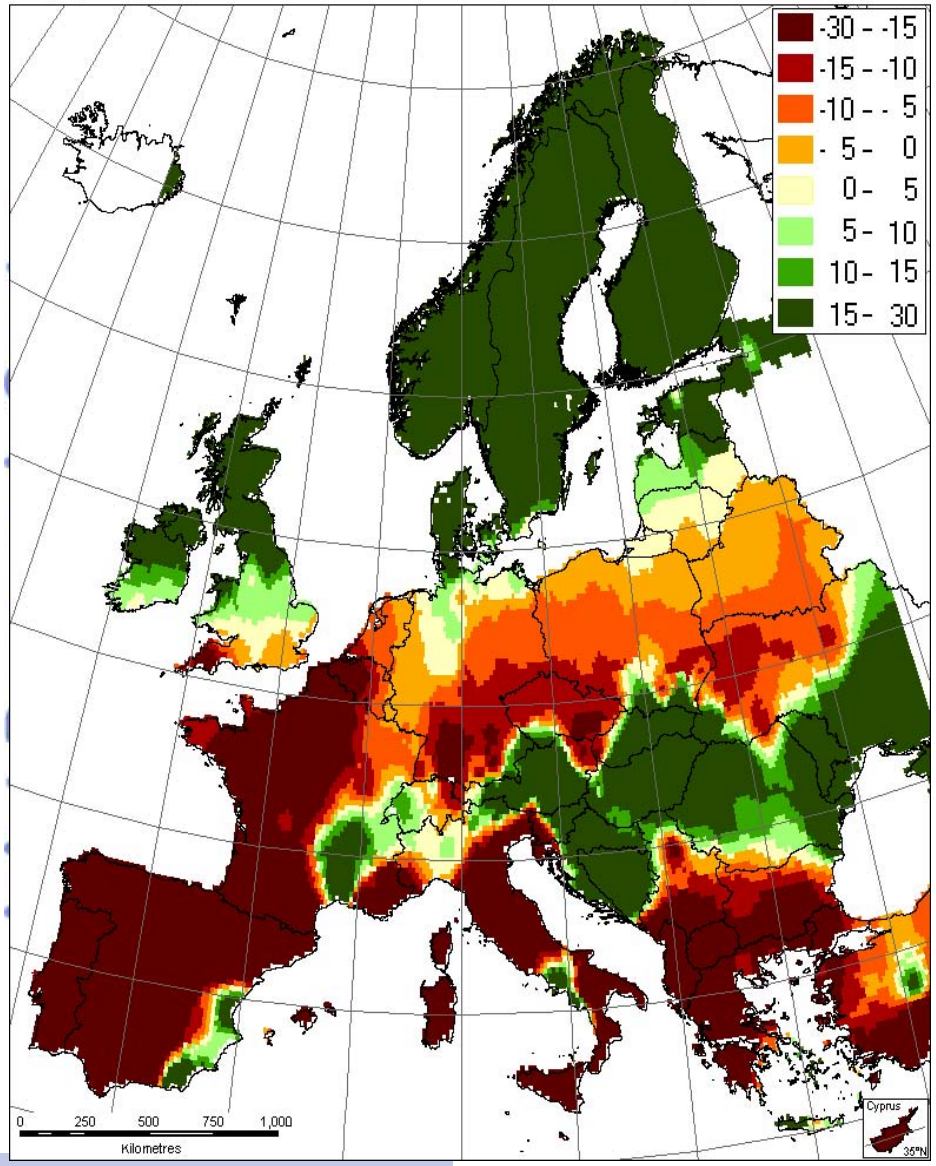
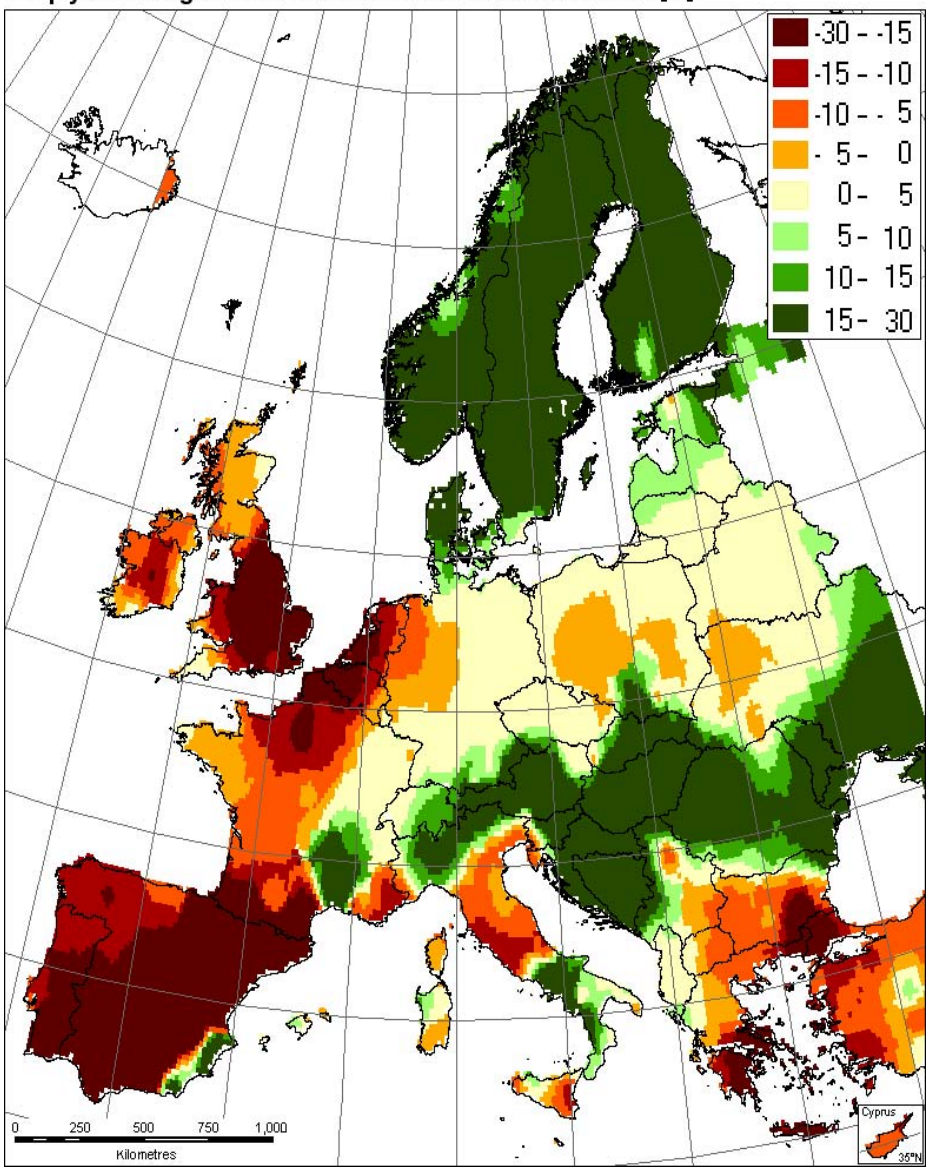
Possible Crop Yield Changes Changes under IPCC A2 Scenario (2 different models)

Crop yield changes under the ECHAM4/ RCA3 A2 scenarios [%]



Crop yield changes under the HadCM3/HIRHAM A2 scenario [%]



Source: Prudence Project

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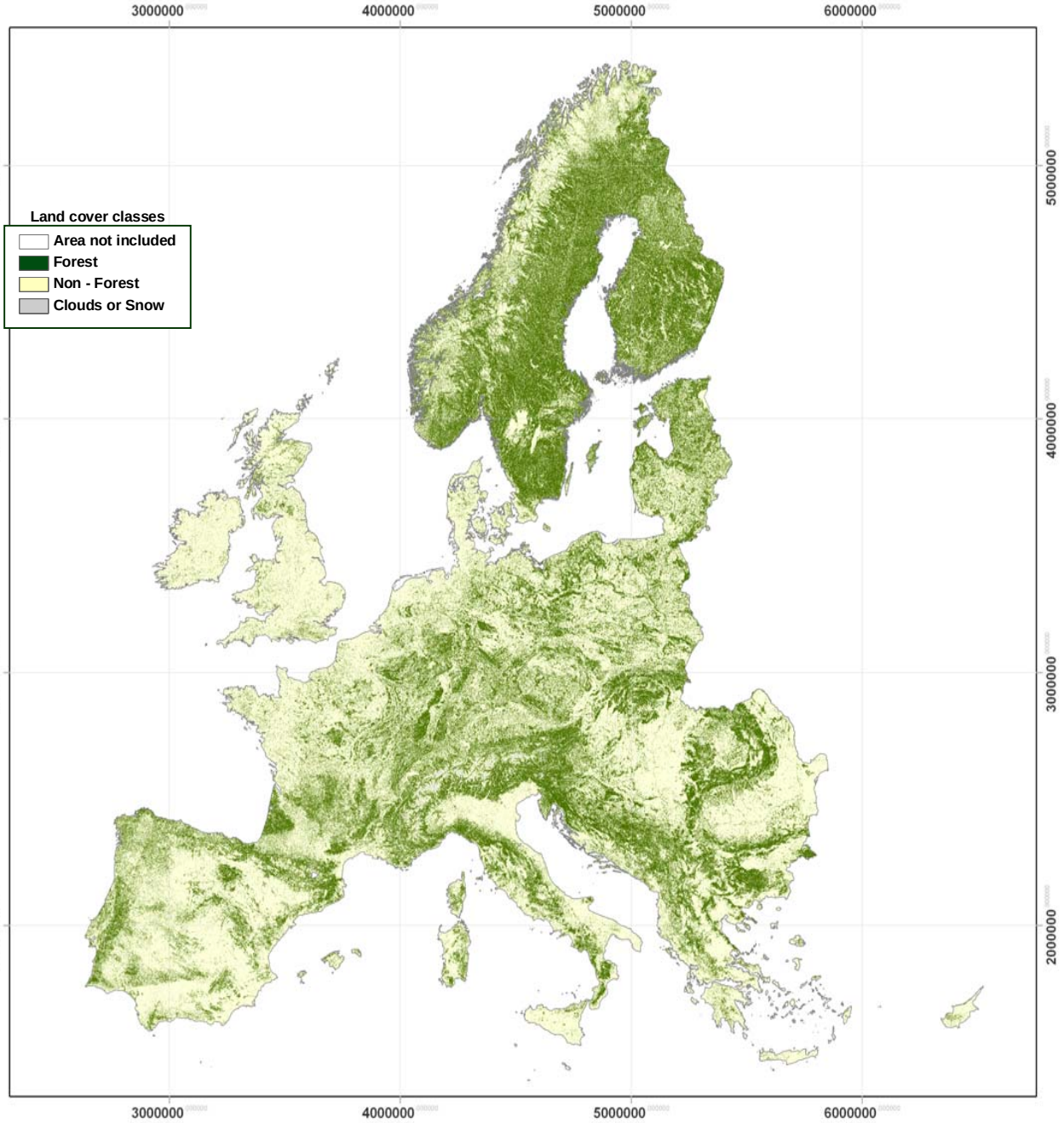
European Forest Data Centre (EFDAC)



Pan-European Forest Map JRC 2006

25 m resolution

Source: JRC-IES

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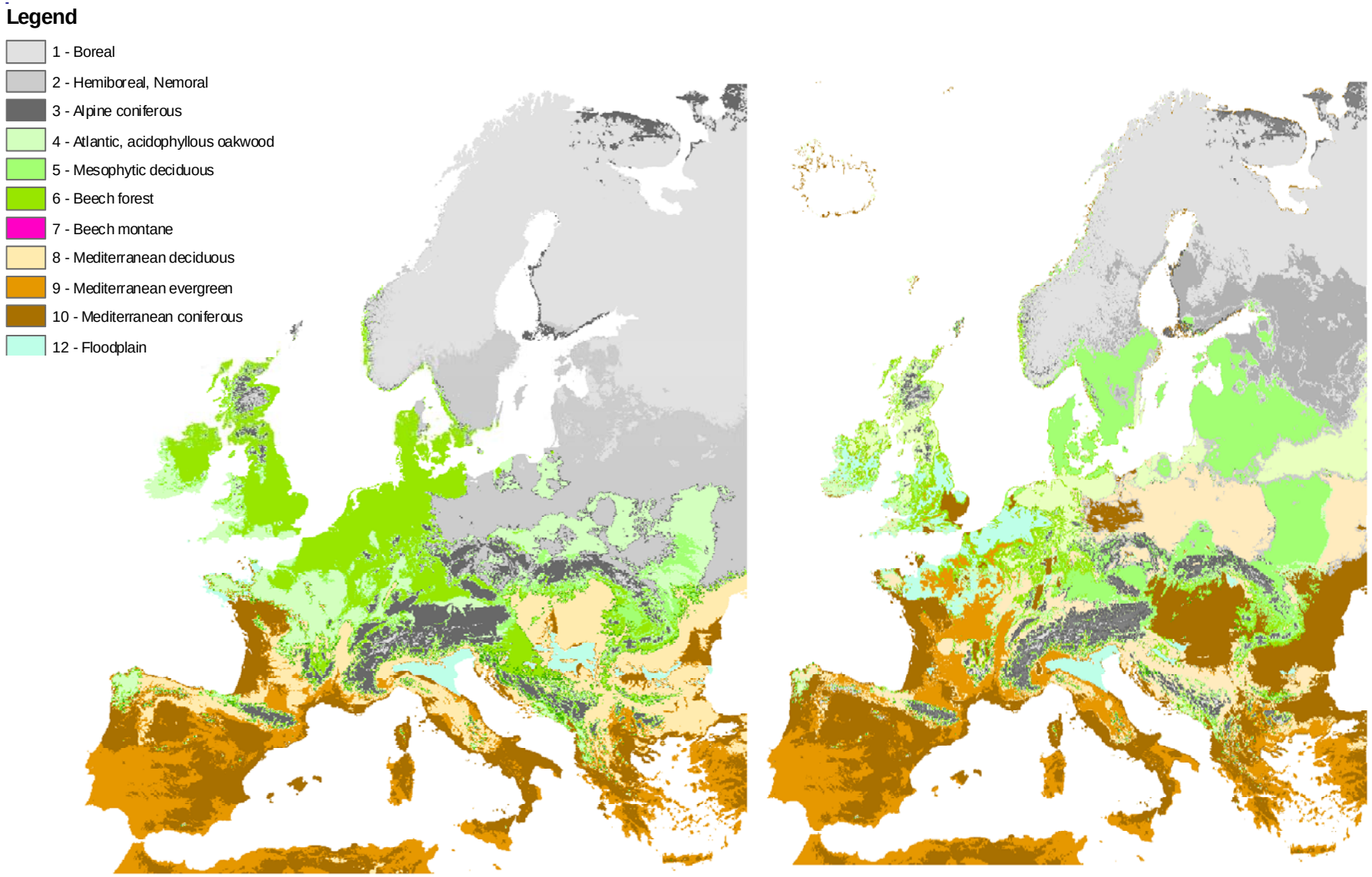
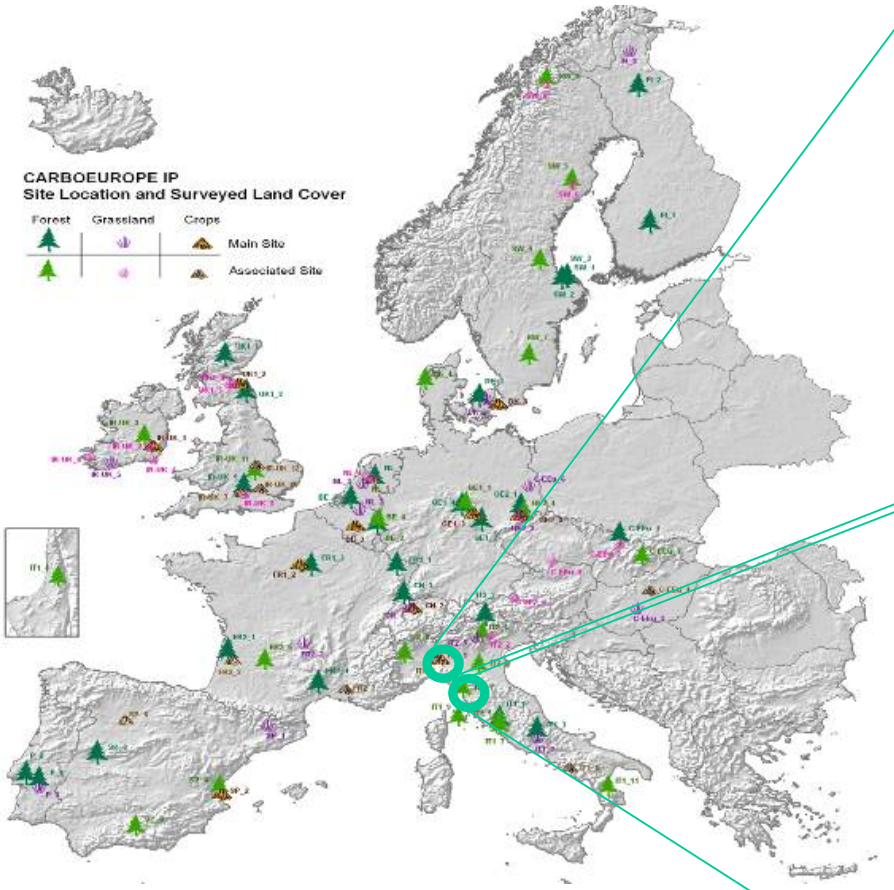
Forest Monitoring and Modeling



Simulation of the impact of Climate Change under A2 scenario on forest type.

Changes in CO_2 Capture Capacity of Vegetation

Carbon uptake in EU forests = 10% of EU emissions



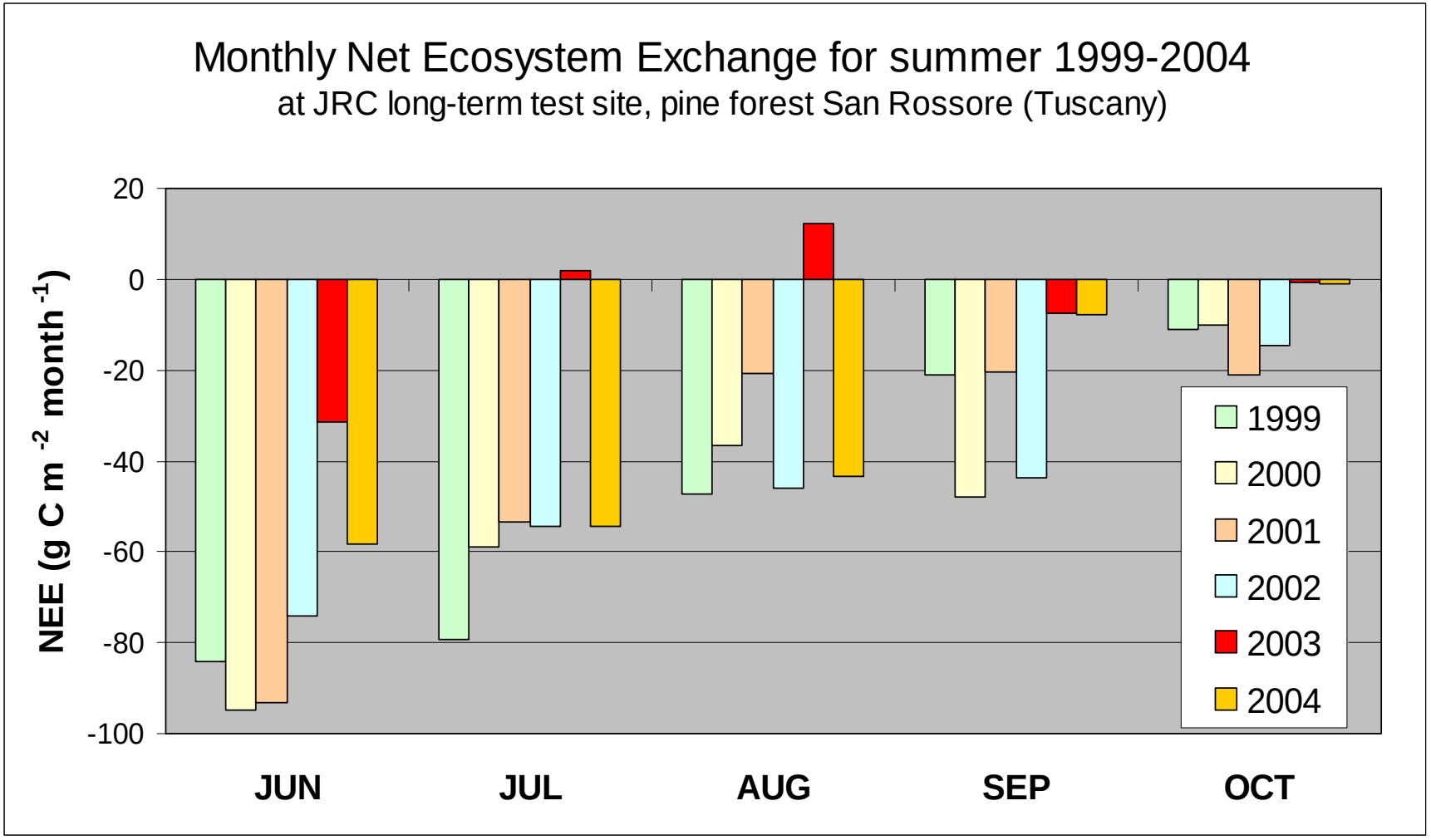
Zerbolò (Parco Ticino)
Poplar Plantation

San Rossore (Pisa)
Mediterranean Pine Forest

Source: JRC-IES/IP Network CarboEurope

Changes in CO_2 Capture Capacity of Vegetation

Forests can turn from sinks into emitters under conditions of heat and drought as evidenced in summer 2003.



Source: JRC-IES/IP Network CarboEurope; Nature 437, 529 – 533 (2005)

Climate Change Research Challenges:

To develop risk assessment and risk reduction tools in the context of adaptation measures to Climate Change.

Water scarcity will affect large regions of Europe.
Extreme weather events likely to increase.

⇒European Drought Hazard Maps

⇒European Forest Fire Information System (EFFIS)

⇒European Flood Risk Maps

⇒European Flood Alert System (EFAS)

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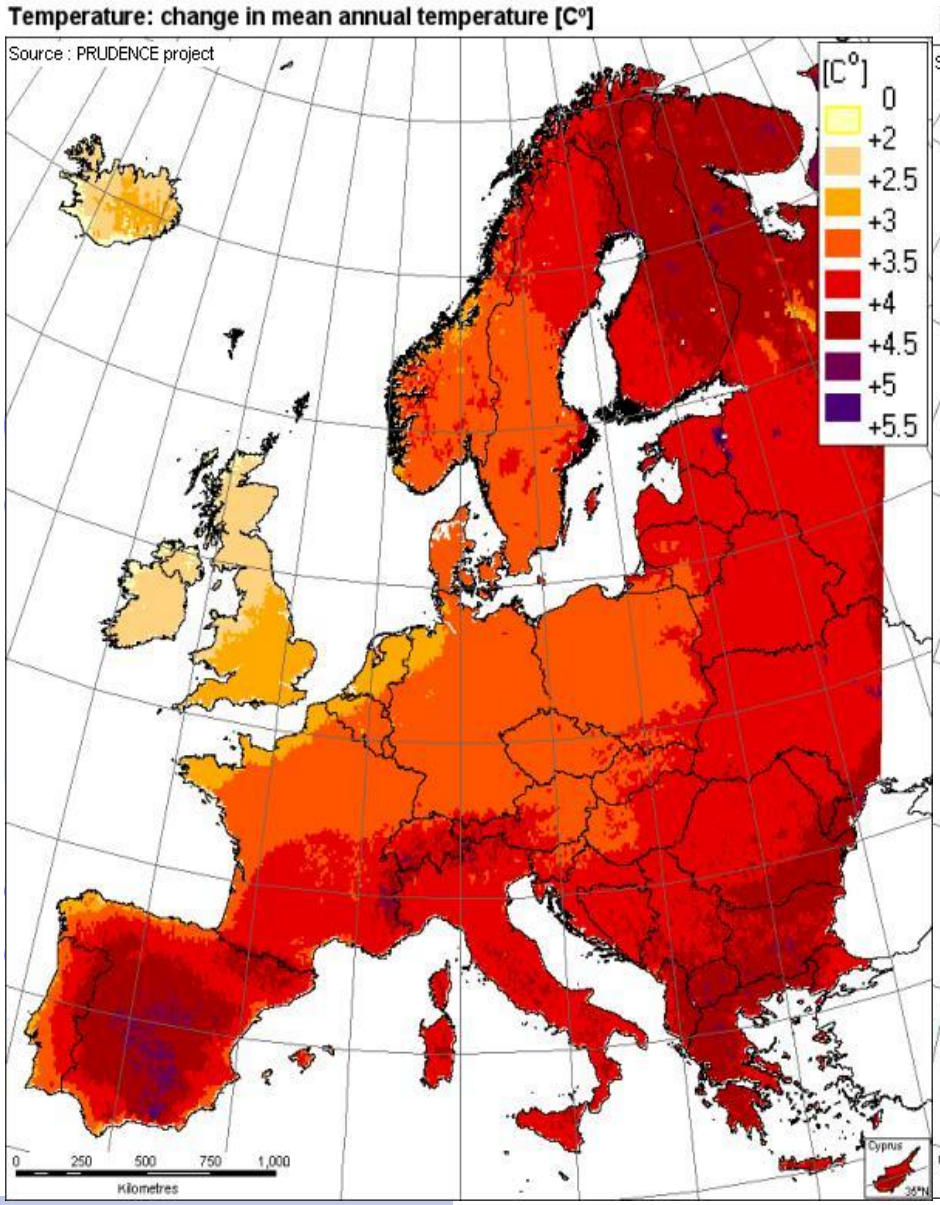
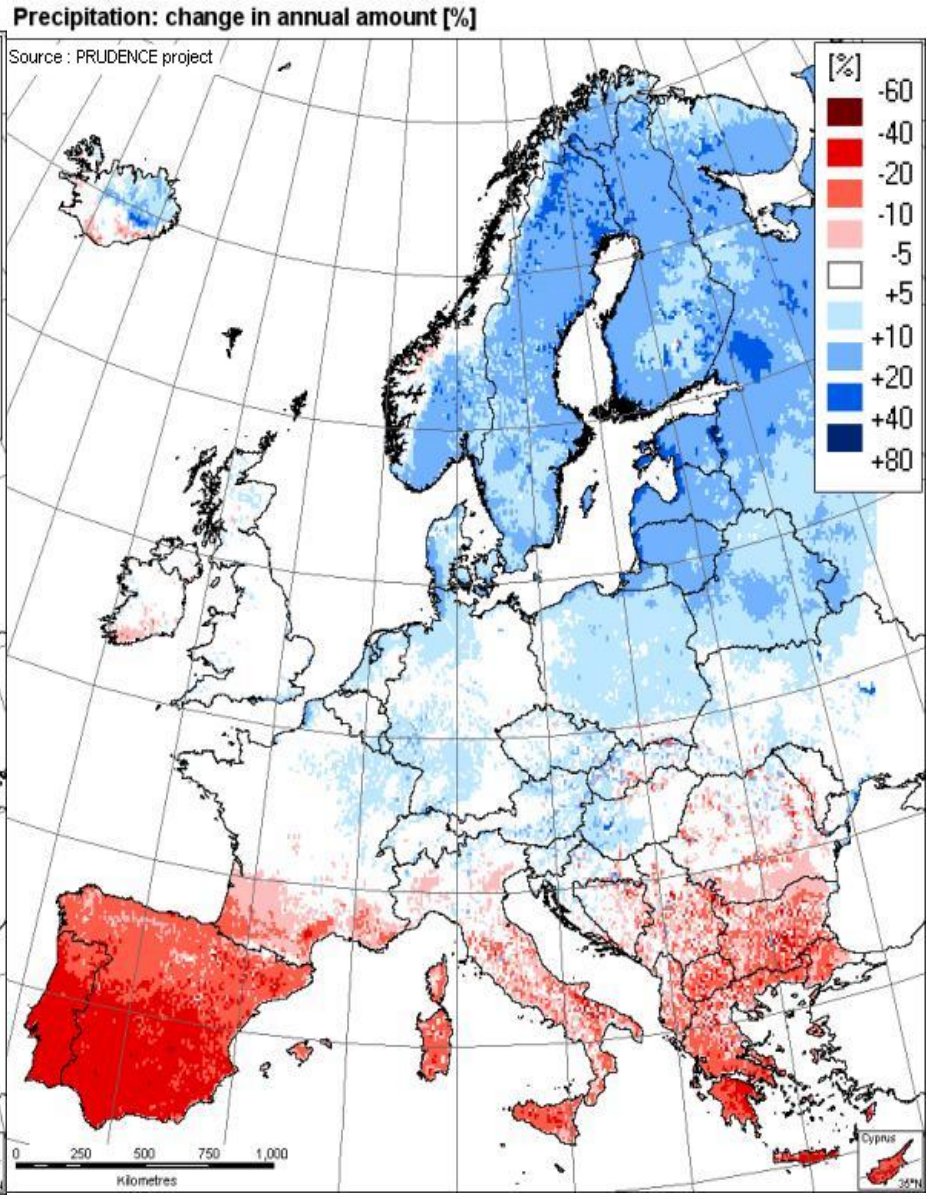
Possible Temperature and Precipitation Changes under IPCC A2 Scenario





Source: Prudence Project

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European Drought Hazard Maps

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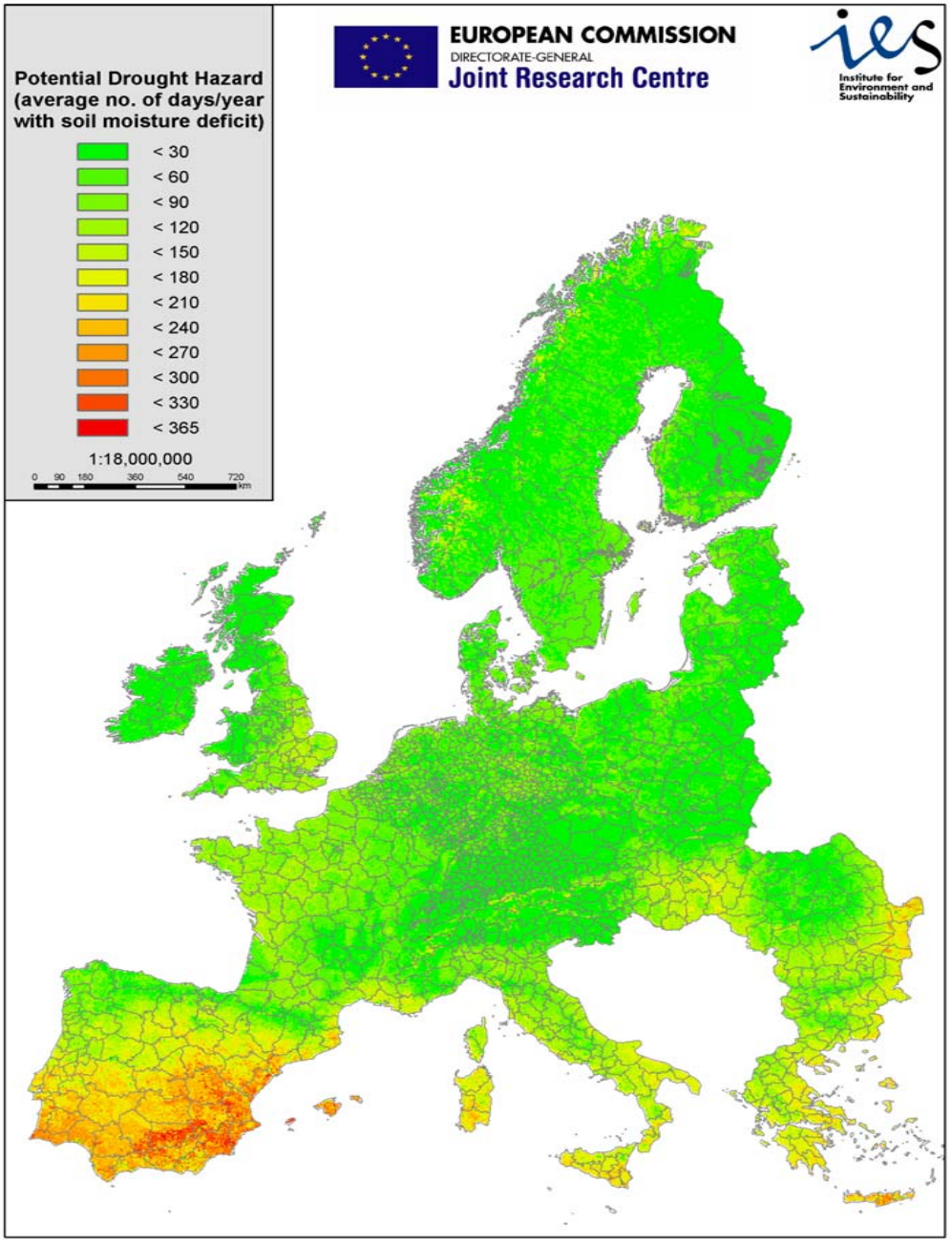
Potential Drought Hazard Based on Soil Water Stress Maps

LISFLOOD
model run
on 44 years
07/1957 – 06/2002
of
ECMWF ERA40
meteorological data



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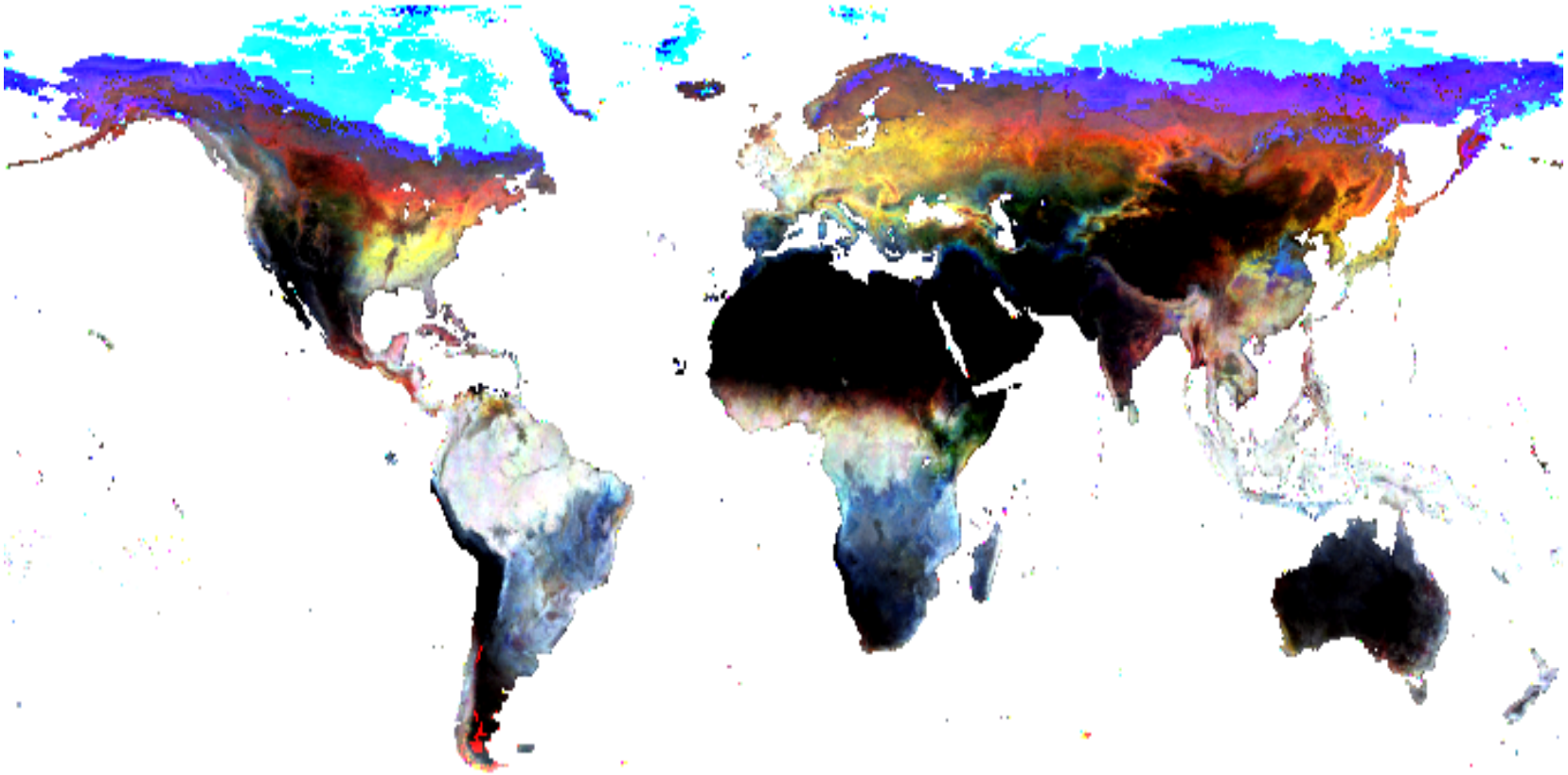
Development of Earth Observation Techniques for Measuring Variables in the Climate System



FAPAR = Fraction of Absorbed Photosynthetically Active Radiation
for measuring vegetation productivity

Source: JRC-IES

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GMES: Global Monitoring for Environment and Security

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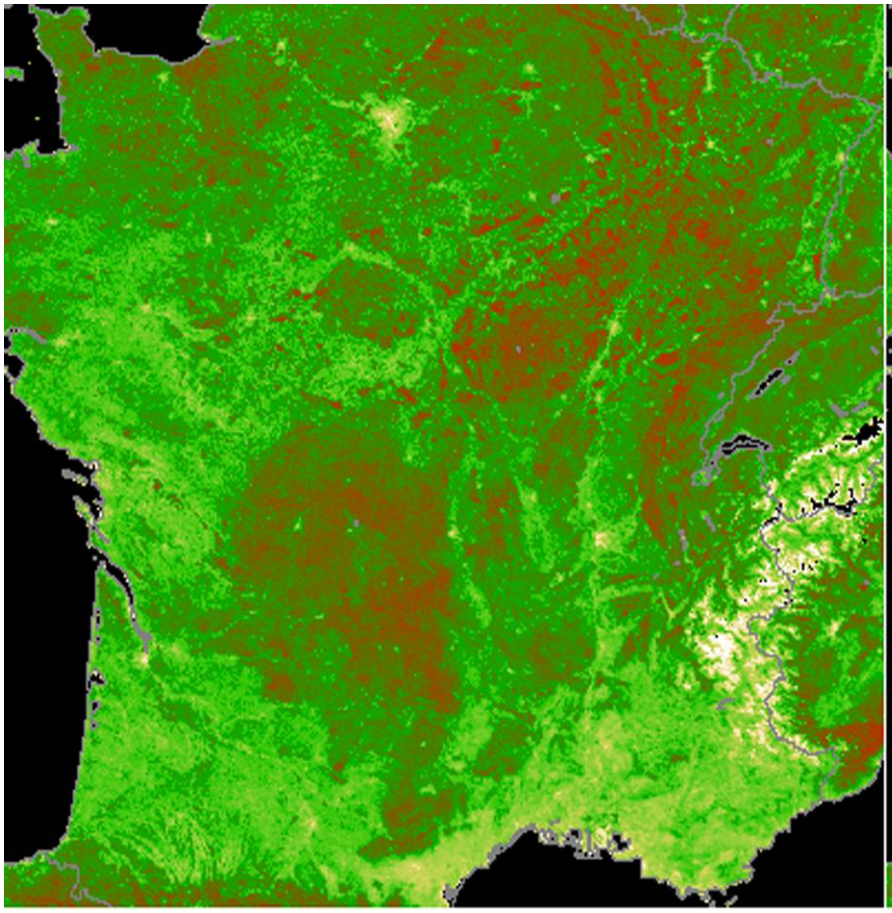
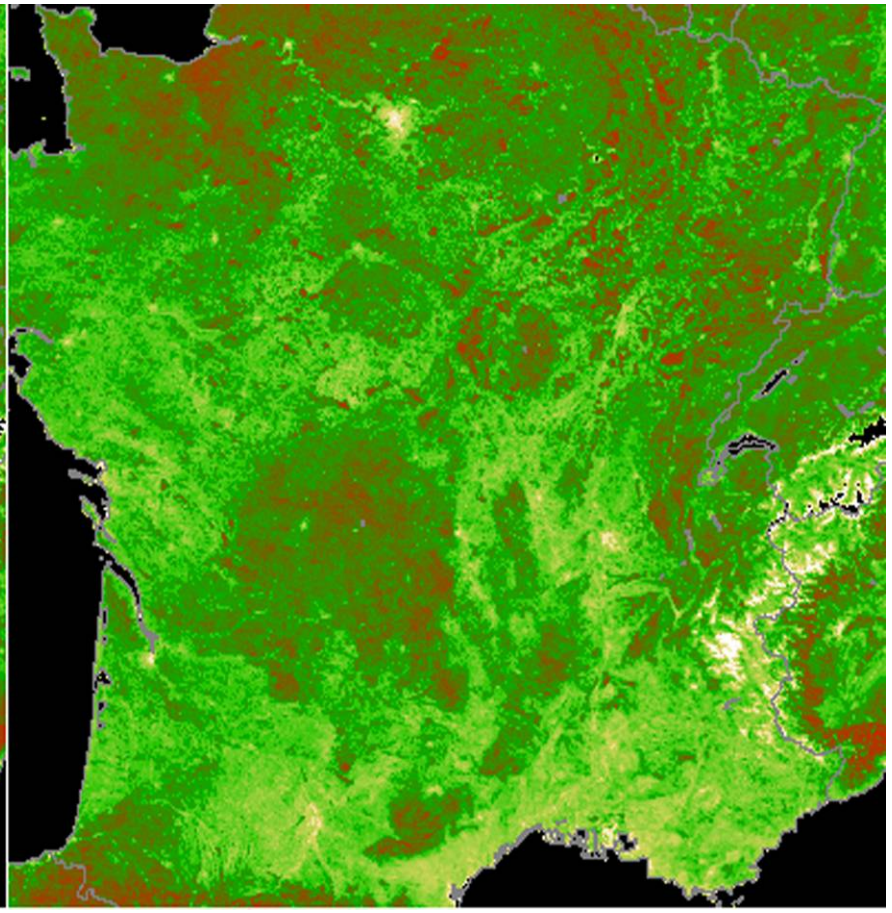
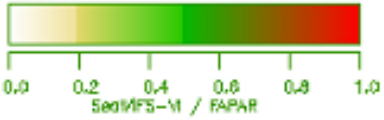
Productivity of Land Surfaces under Different Metrological Conditions



June 2002 – normal summer



June 2003 – hot and dry summer



FAPAR images

Source: JRC-IES

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EFFIS
European Forest Fire Risk Forecasting System

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DG ENV

Civil Protection

PORTUGAL SPAIN FRANCE ITALY GREECE GERMANY FINLAND AUSTRIA SWEDEN U. K. LITHUANIA

CZECH REP.

LATVIA

HUNGARY

SLOVENIA

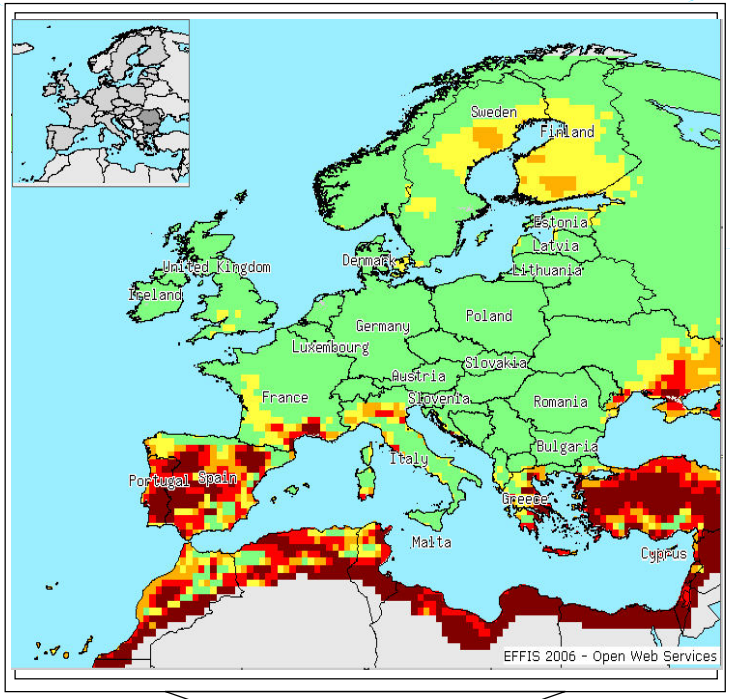
SLOVAKIA

CYPRUS

BULGARIA

ROMANIA

TURKEY



daily message 1 Apr – 31 Oct
prognosis up to 10 days
res. 7 km (2007)

European Forest Fire Information System

Risk Forecasting System
Index: Canadian FWI
Day: 2006-08-08 (1 Day Forecast)

Levels of Risk
Very Low
Low
Moderate
High
Very High

Meteorological Data from MeteoFrance
Administrative Boundaries from EUROSTAT - GISCO
Application by DG JRC - Inforest Action

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DG Environment - B1 / A3
DG Joint Research Center - IES

FIRE RISK MODELS

Data
Data
ata
DATABASES

RESEARCHERS

METEOROLOGICAL MODELS

CC Water Danube 3 Dec 07

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European Forest Fire Information System EFFIS

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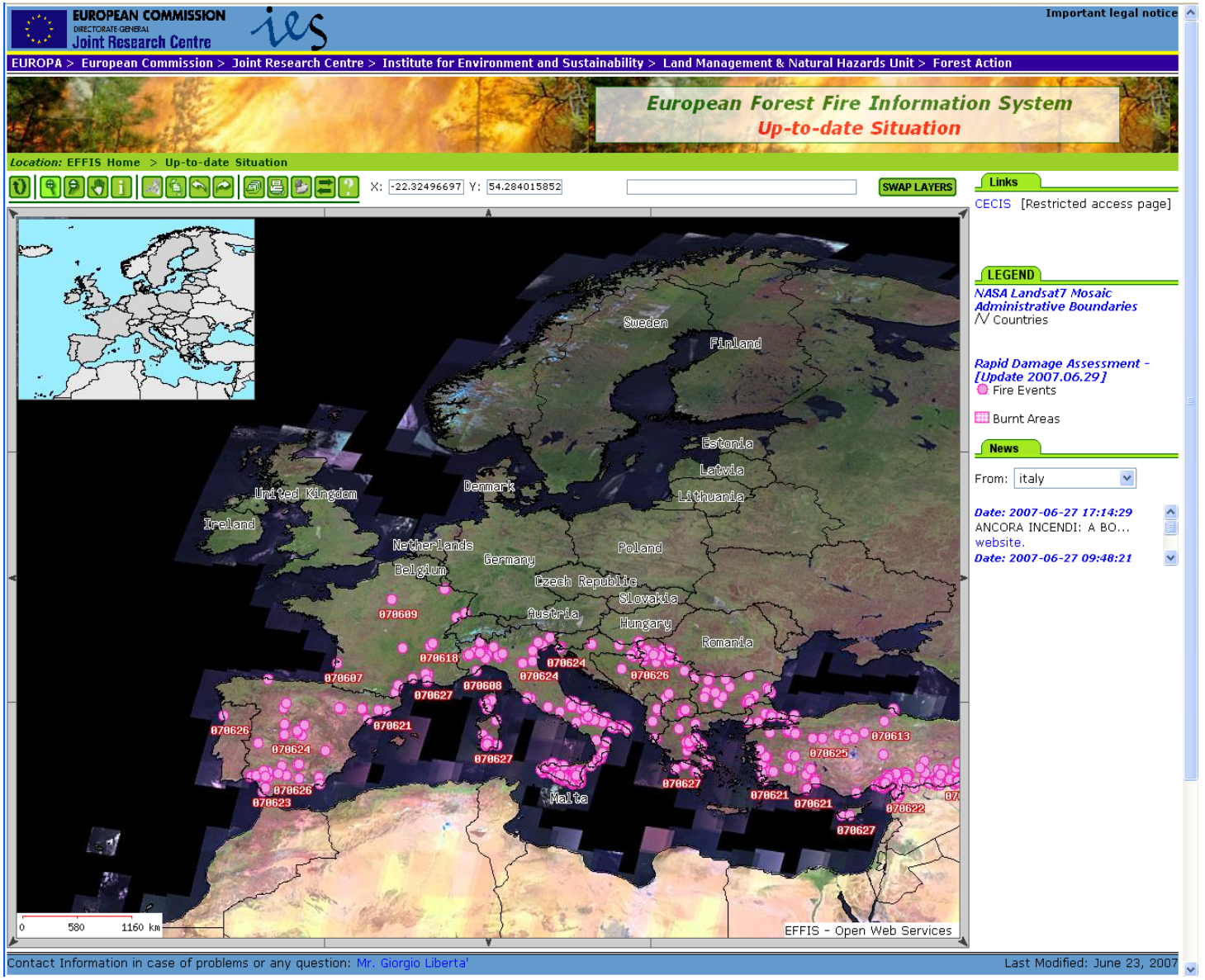

Map of forest fires 2007 with areas burnt in the different countries: total 600.000 ha.

Source: JRC-IES

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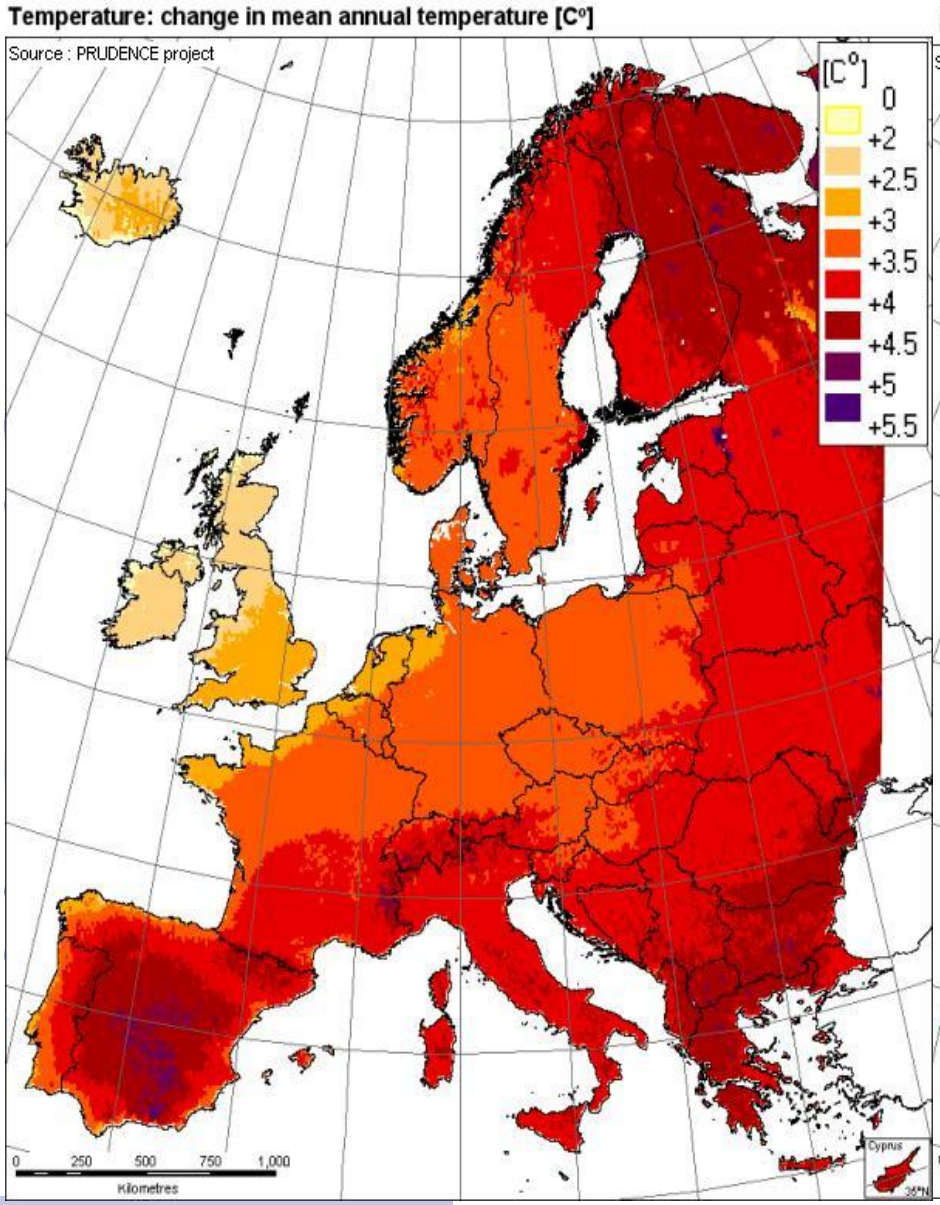
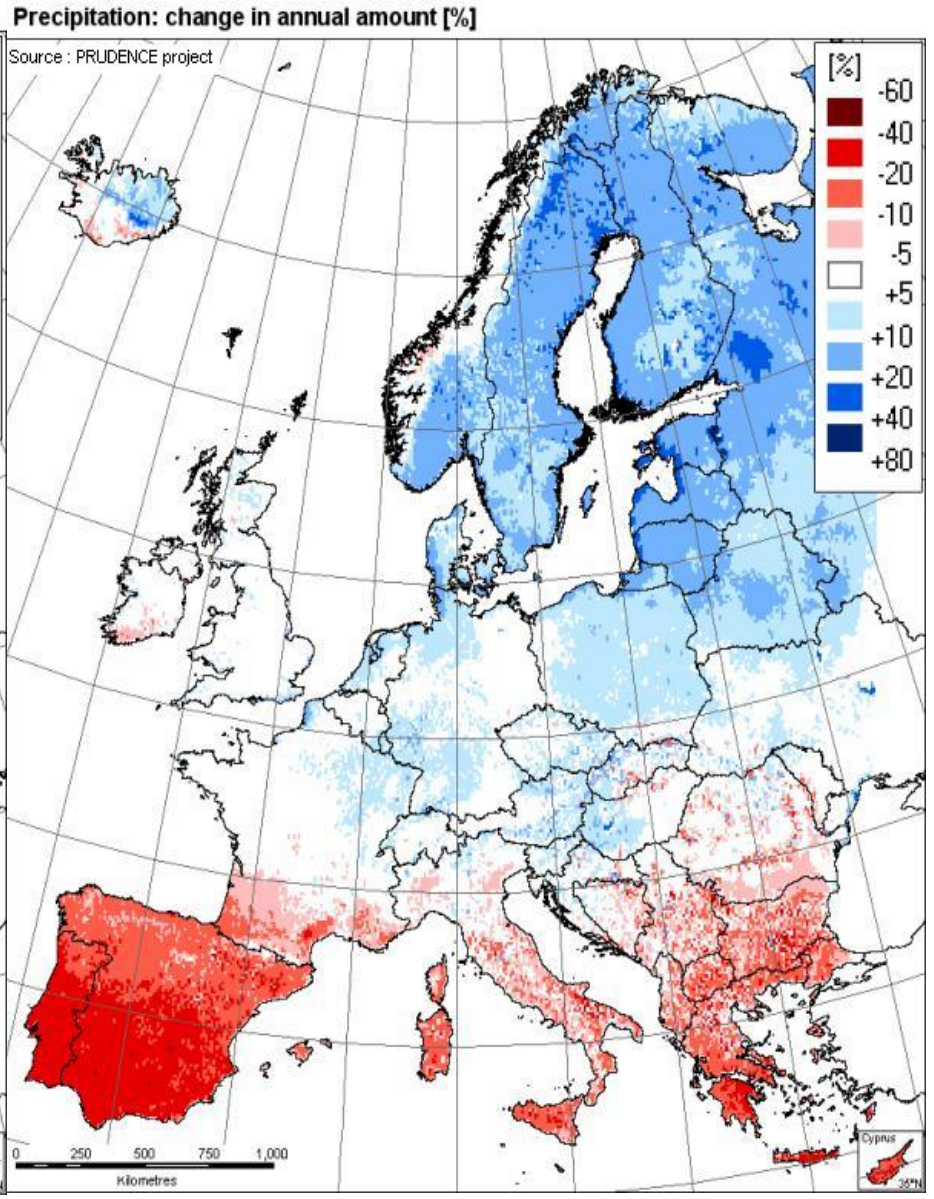
Possible Temperature and Precipitation Changes under IPCC A2 Scenario





Source: Prudence Project

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Changes in River Discharge for Extreme Floods

Joint Research Centre

DMI-HIRHAM A2 scenario (12km) with 5km LISFLOOD model

Increased flooding:
Almost everywhere

Decreased extreme floods:
Southern Sweden, Finland, Russia, Lower Danube (decreased snowmelt?)

Change in HQ_{100} river discharge of a once in 100 years flood

Source: JRC-IES/DMI

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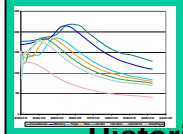
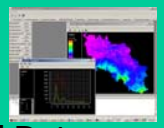
European Flood Alert System (EFAS)

Joint Research Centre

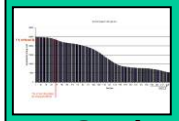
EU Flood GIS

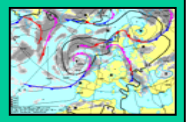
Realtime H-Q data



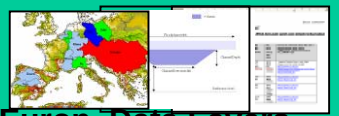


Historical Data



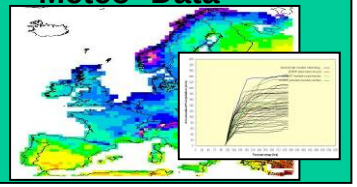


Static Data

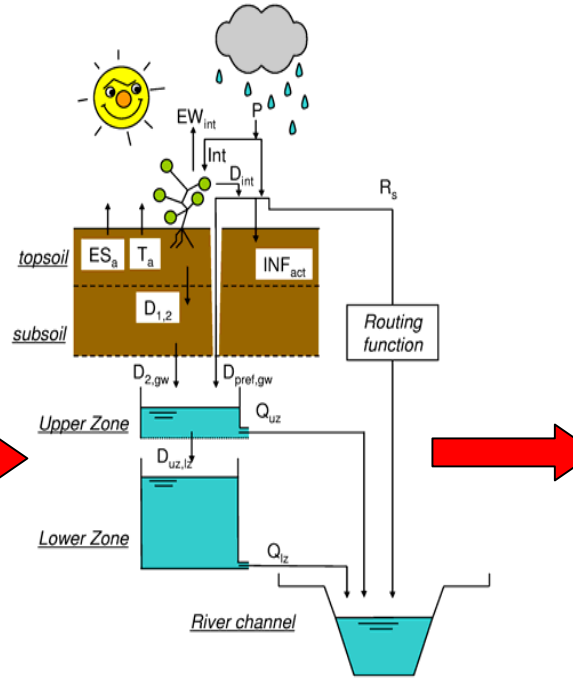


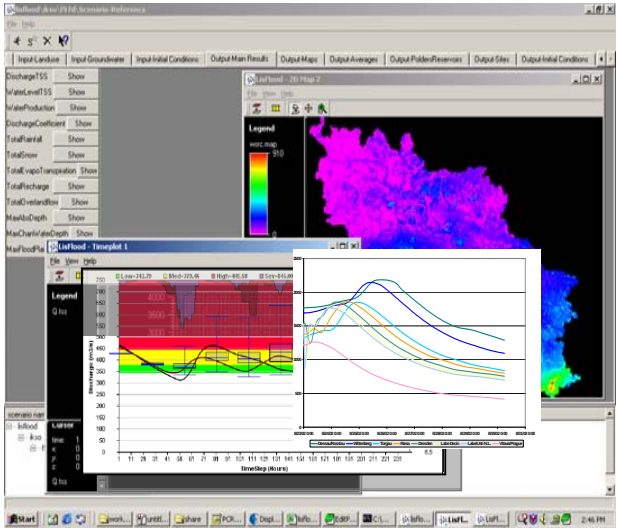
Europ. Data Layers

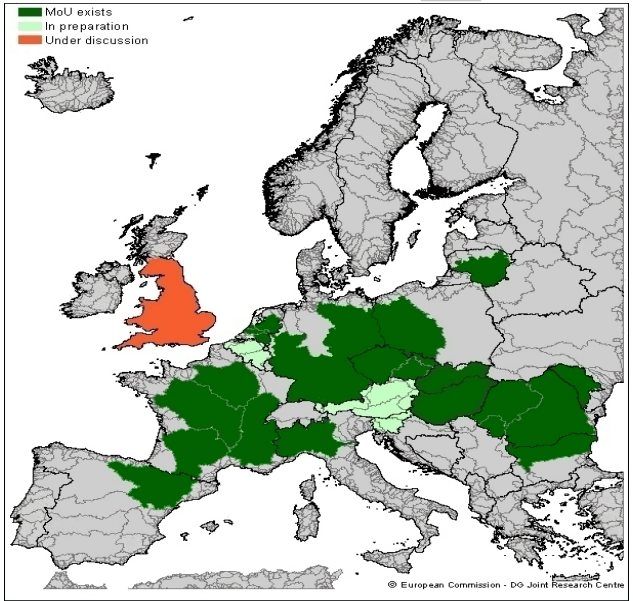
Meteo -Data

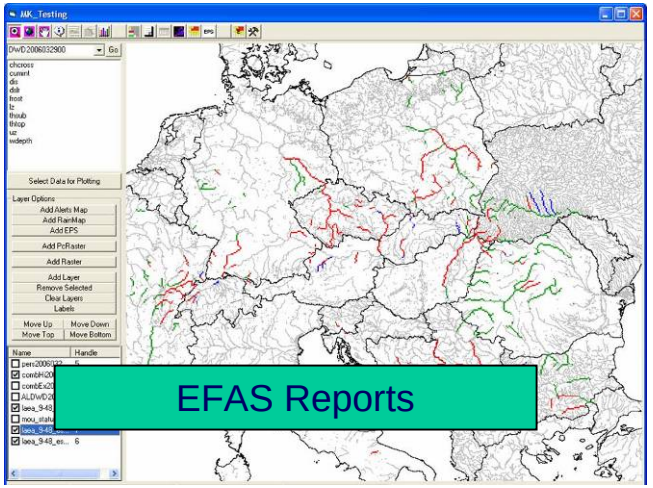


Expert Knowledge of Member States









min area = 50 km²

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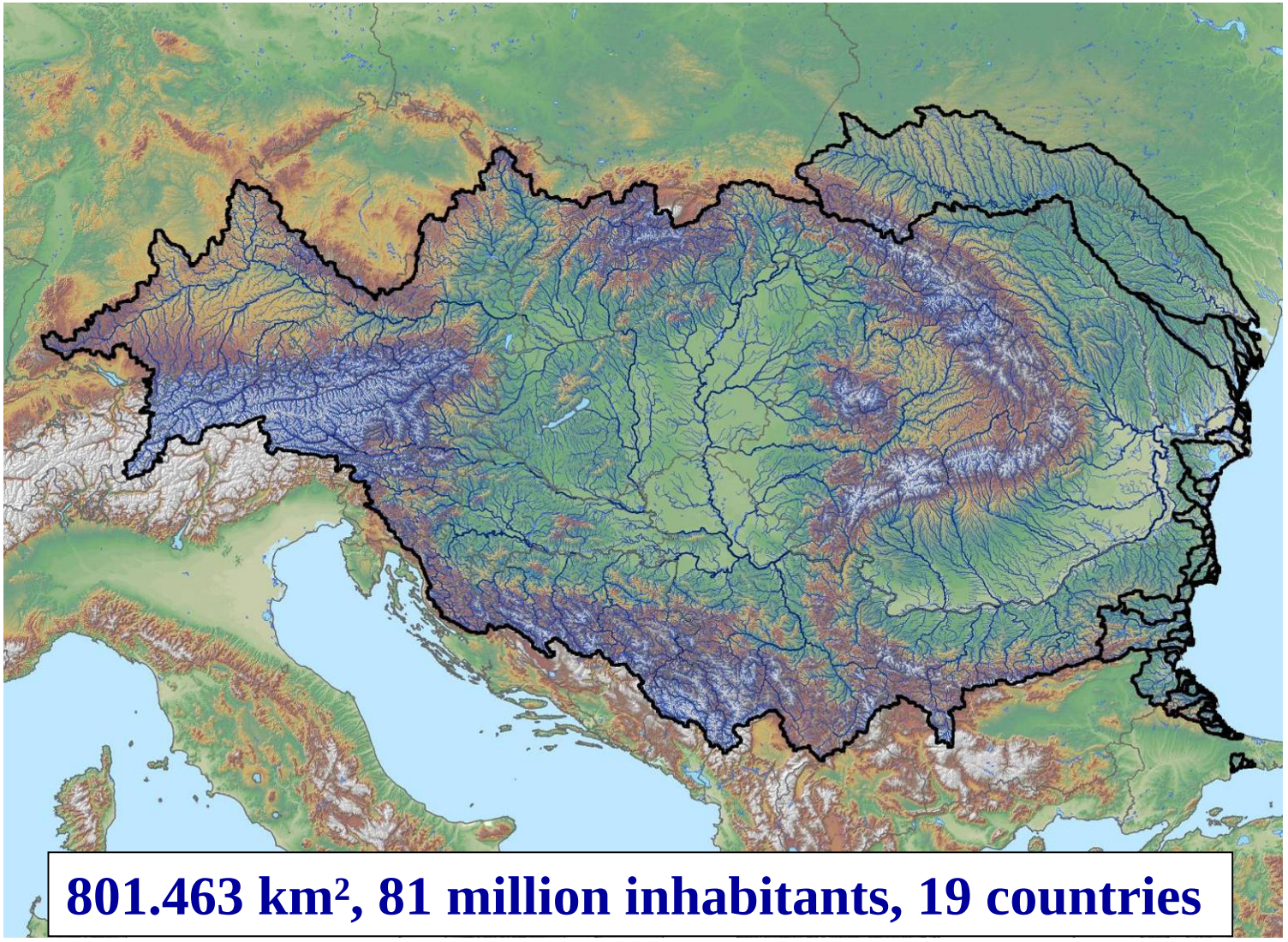
Flood Management for Danube River Basin

EFAS selected as forecasting and alert system by International Commission for the Protection of the Danube River (ICPDR).



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Climate Change Research Challenges:

Linking the climate change policy agenda with the development agenda of European Union.

Climate Change will have the strongest impact in developing countries.

Strong population growth and food shortage.

Water resources are continuously shrinking.

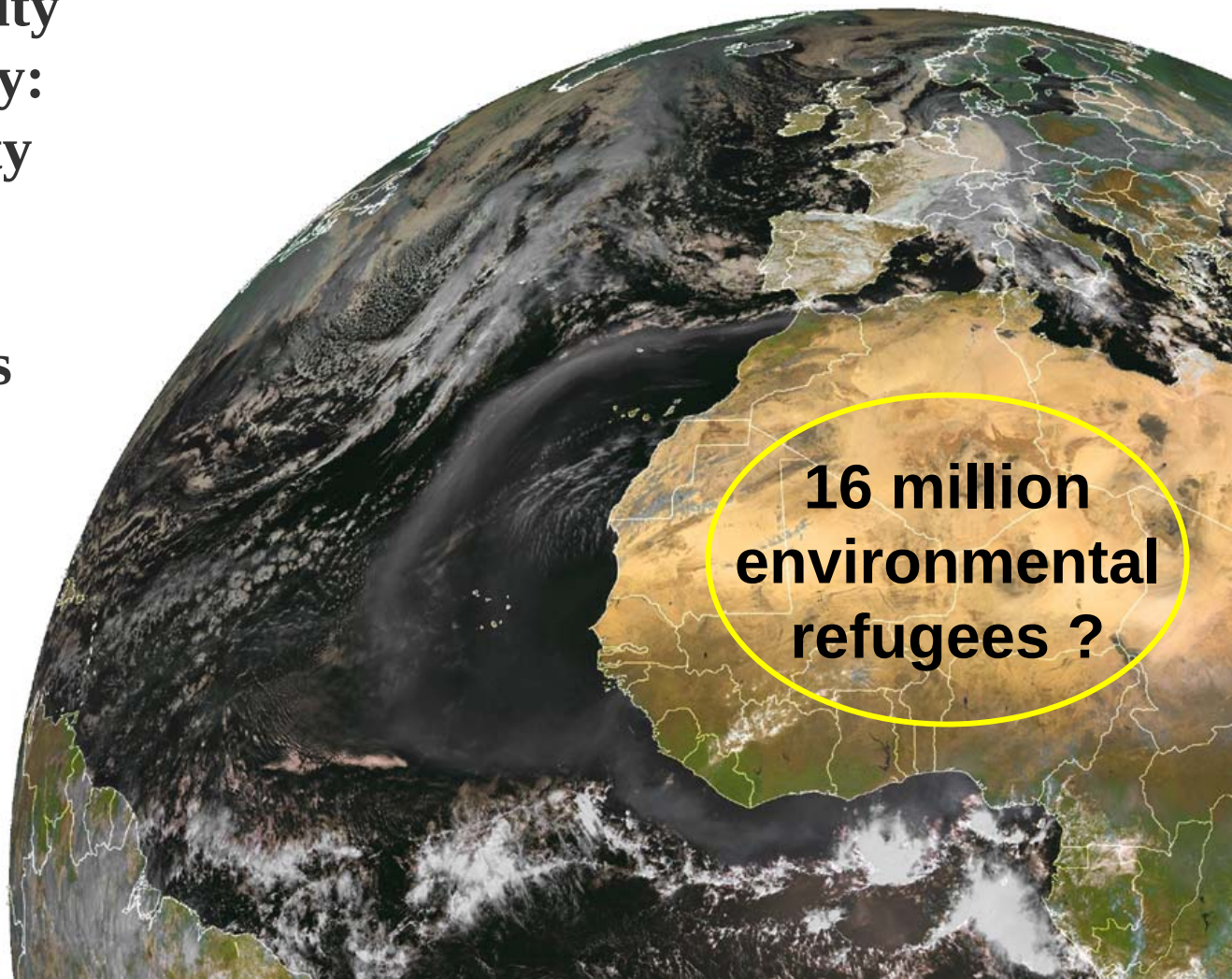
Massive deforestation in tropical zones.

European Union is largest donor of development aid.

⇒ACP (African-Caribbean-Pacific) Observatory

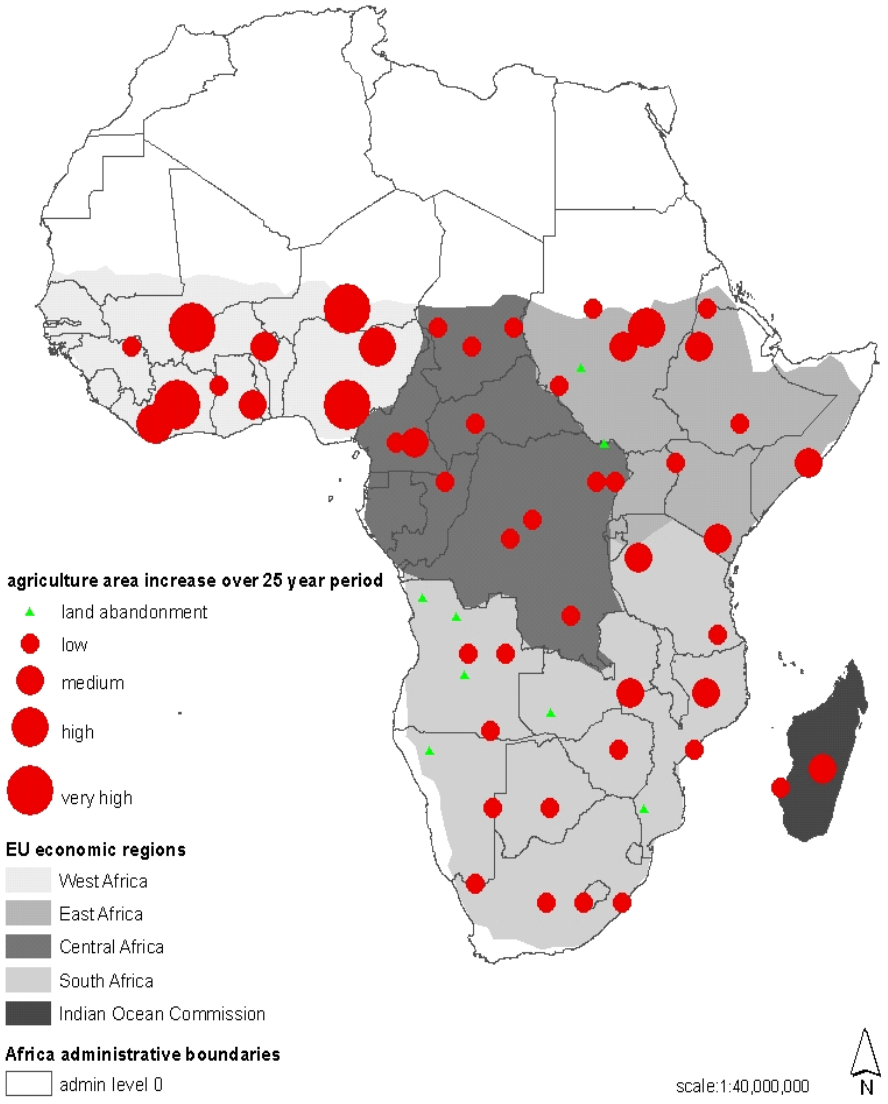
The ACP Observatory: Major Issues for Africa.

- Water availability
- Food availability:
- Land availability
- Deforestation
- Desertification
- Biodiversity loss
- Floods
- Pollution
- Urbanisation



Population Growth and Food Security

- Since 1970 50 % increase in agricultural production area
- But population has doubled since 1970
  - less land per person
  - Increasing pressure on environment *and* population
  - conflict and migration
- Africa has now ca 1 billion people, but 2 billion in 2050

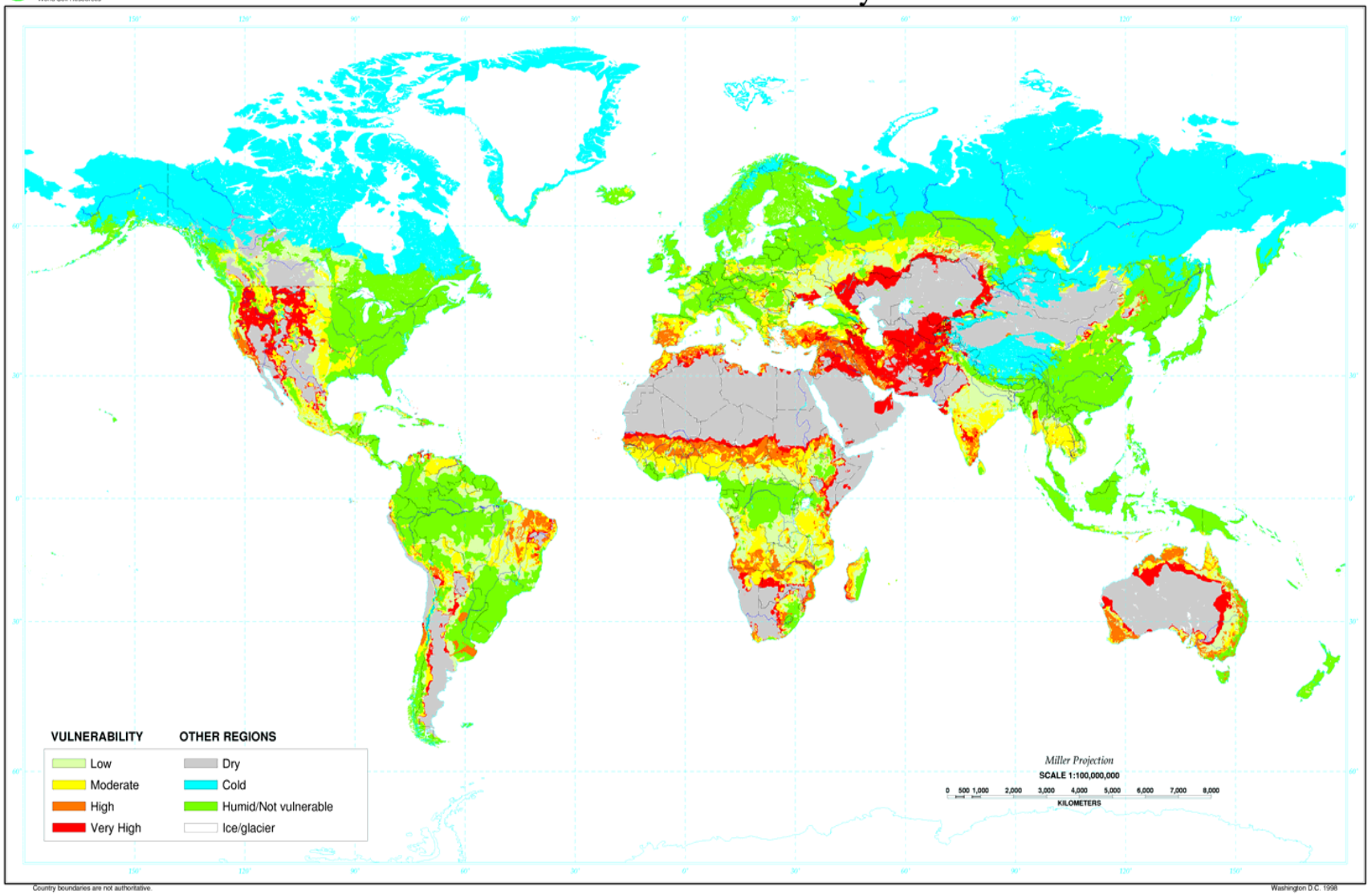


Assessment of Tropical Deforestation in Africa

From 1975 to 2000 Africa lost 16 % of its forests and 5 % of its woodlands and greenlands.

Annual loss of natural vegetation = 50.000 km^2

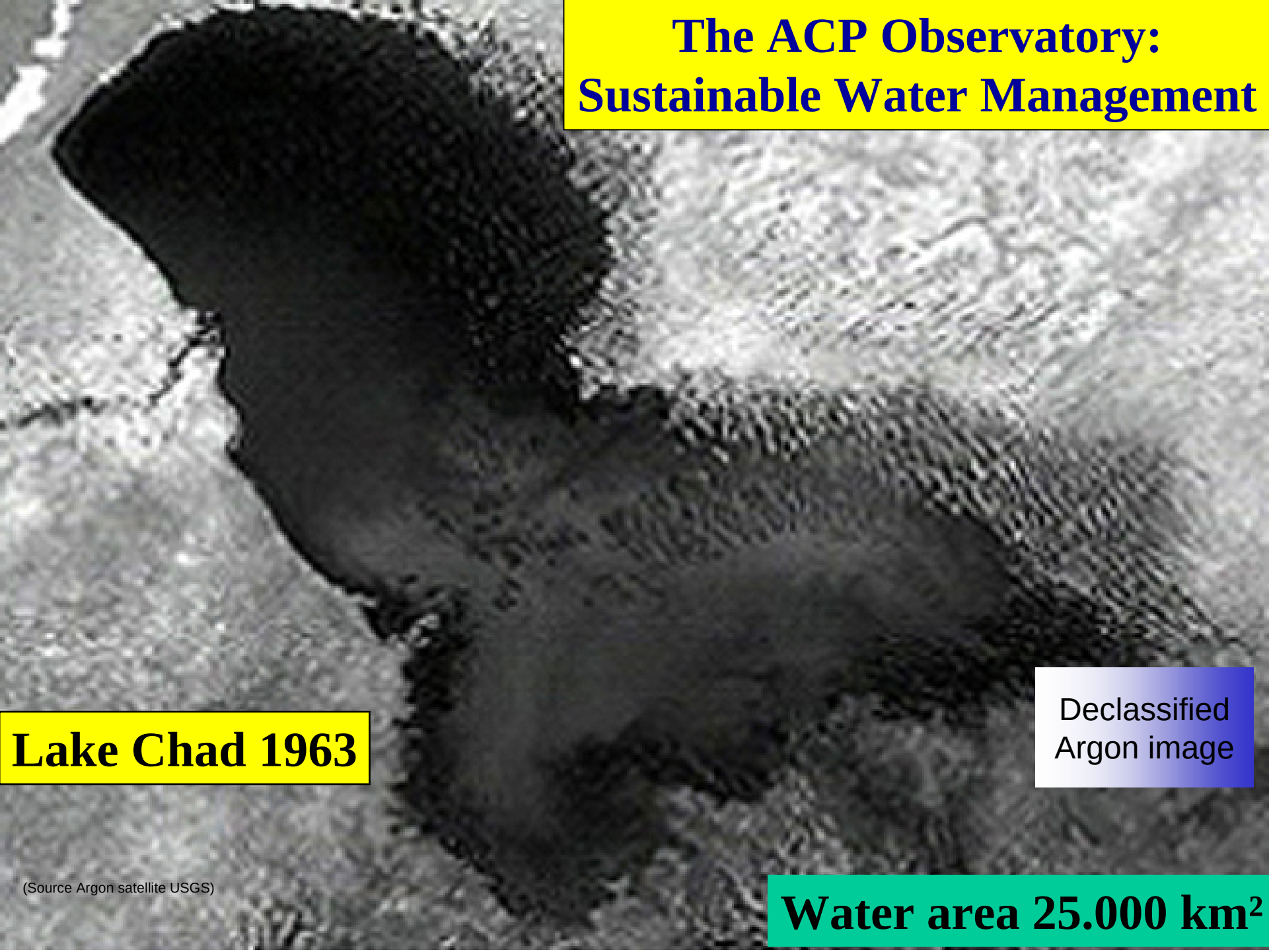
Desertification: Vulnerable Zones



United Nations Convention to Combat Desertification (UNCCD)

Source: USDA

The ACP Observatory: Sustainable Water Management



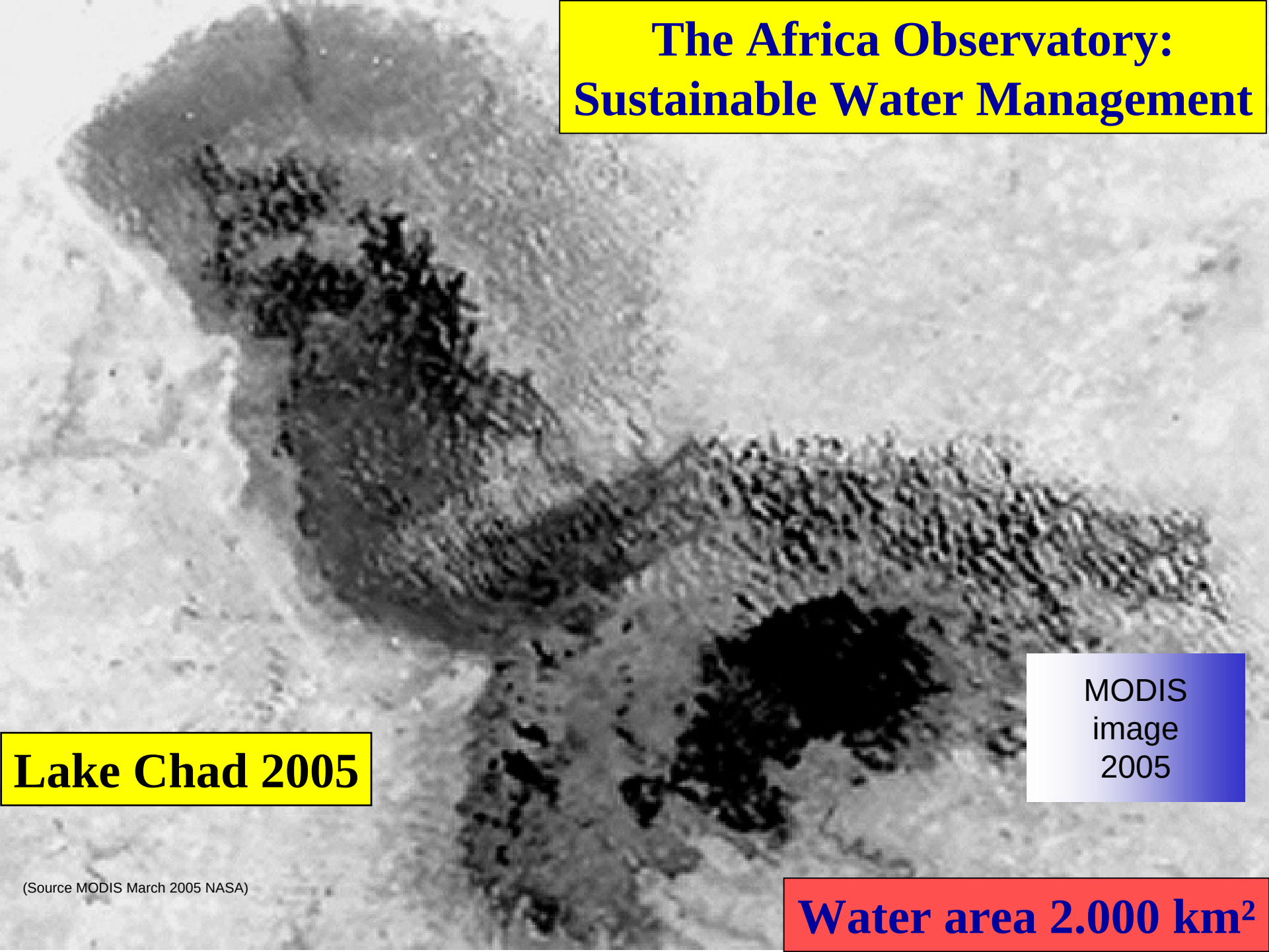
Lake Chad 1963

Declassified Argon image

(Source Argon satellite USGS)

Water area 25.000 km²

The Africa Observatory: Sustainable Water Management



MODIS image 2005

Lake Chad 2005

(Source MODIS March 2005 NASA)

Water area 2.000 km²

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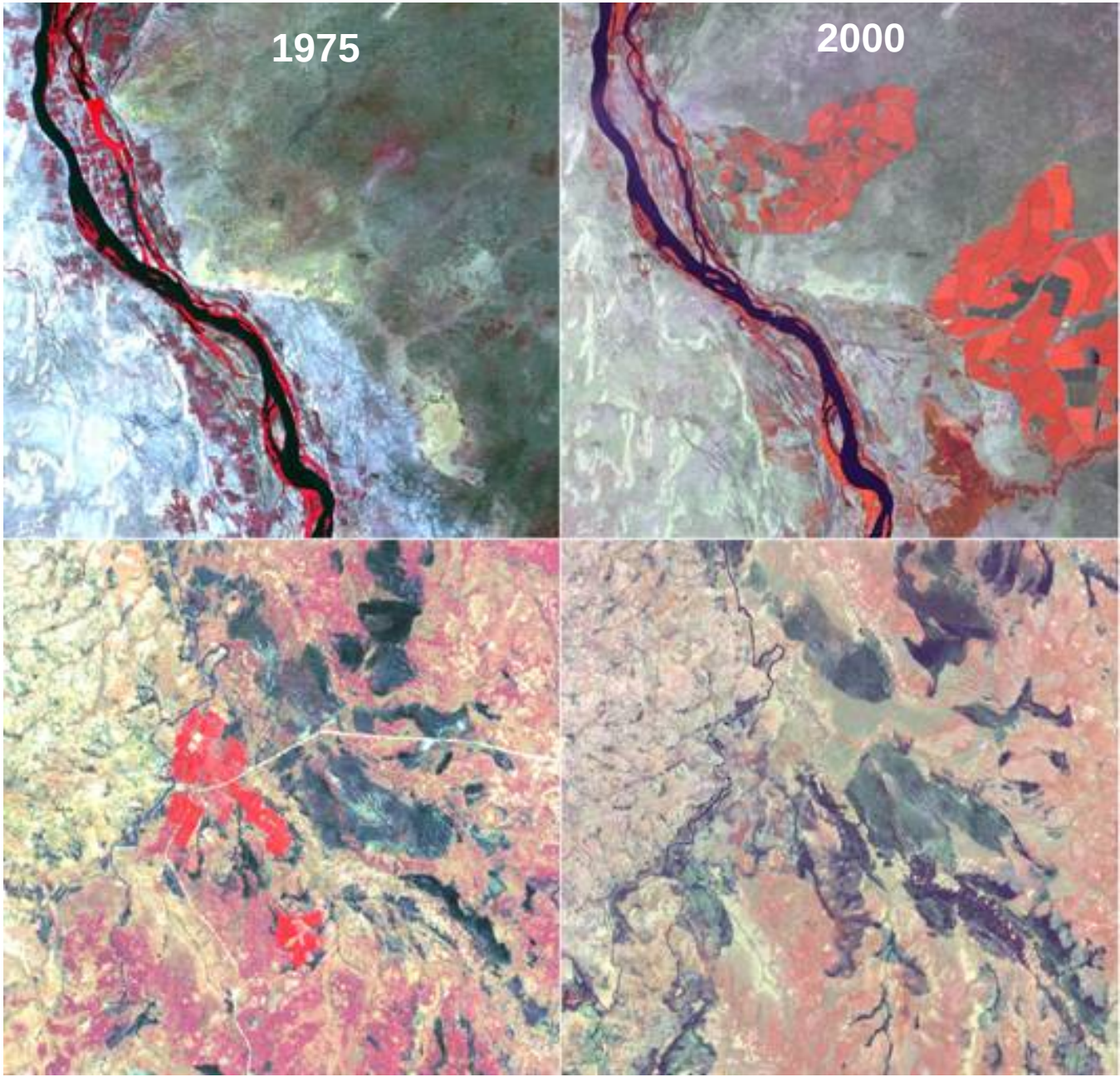
Monitoring of Irrigation in Africa

Joint Research Centre

- Less than 10% of the cultivated land is irrigated
- Irrigation in Africa increases at a rate of less than 1.2% per year



Source: JRC-IES/ Landsat/FAO

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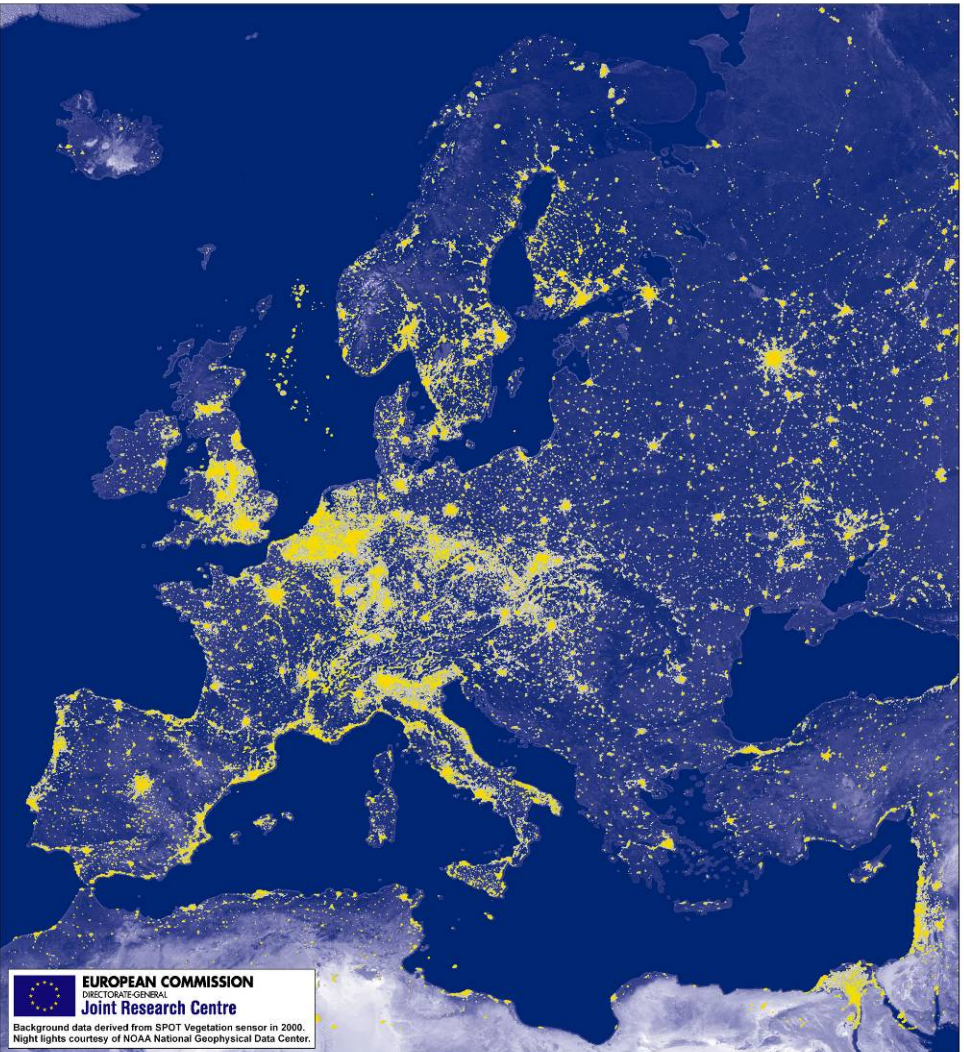
Joint Research Centre

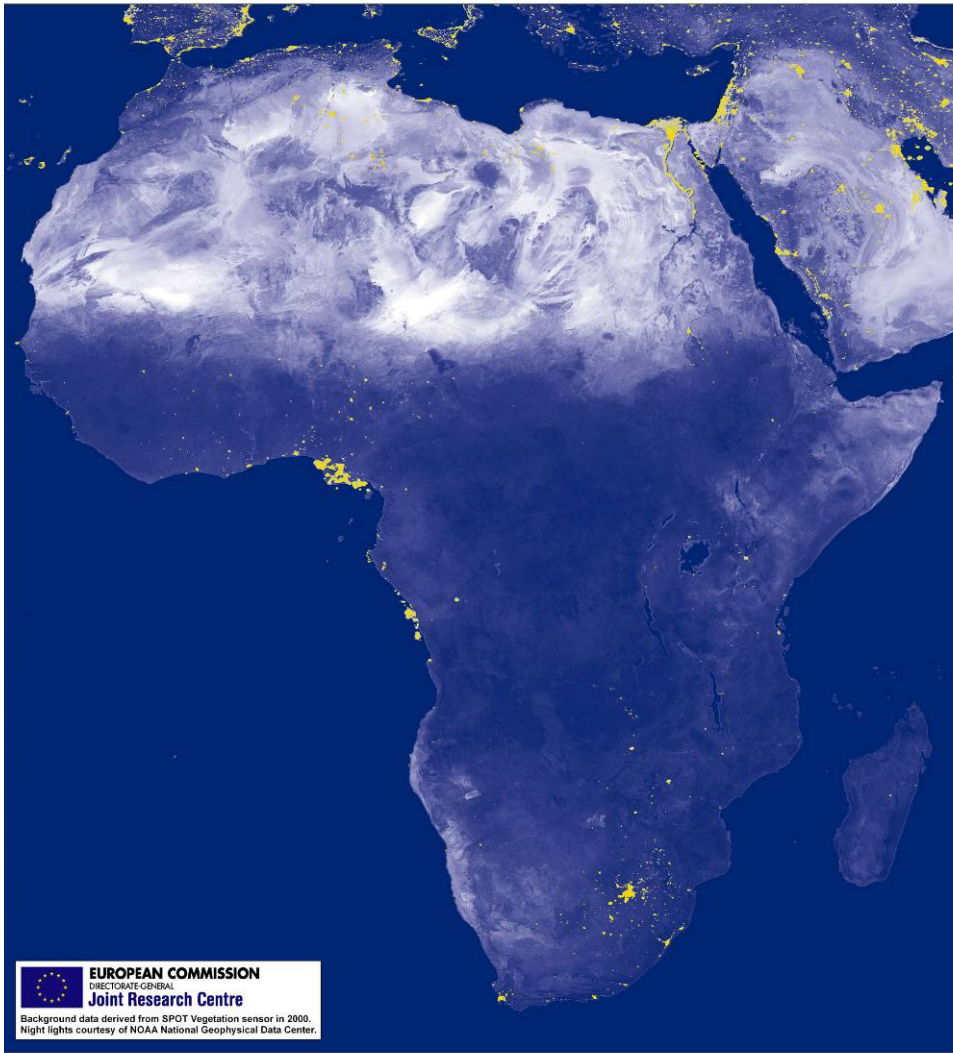
The Issue of Energy Consumption:

Night-Lights over Europe and Africa

5000 Watt per capita

<1000 Watt per capita





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Solar Electricity Potential of Africa

Joint Research Centre

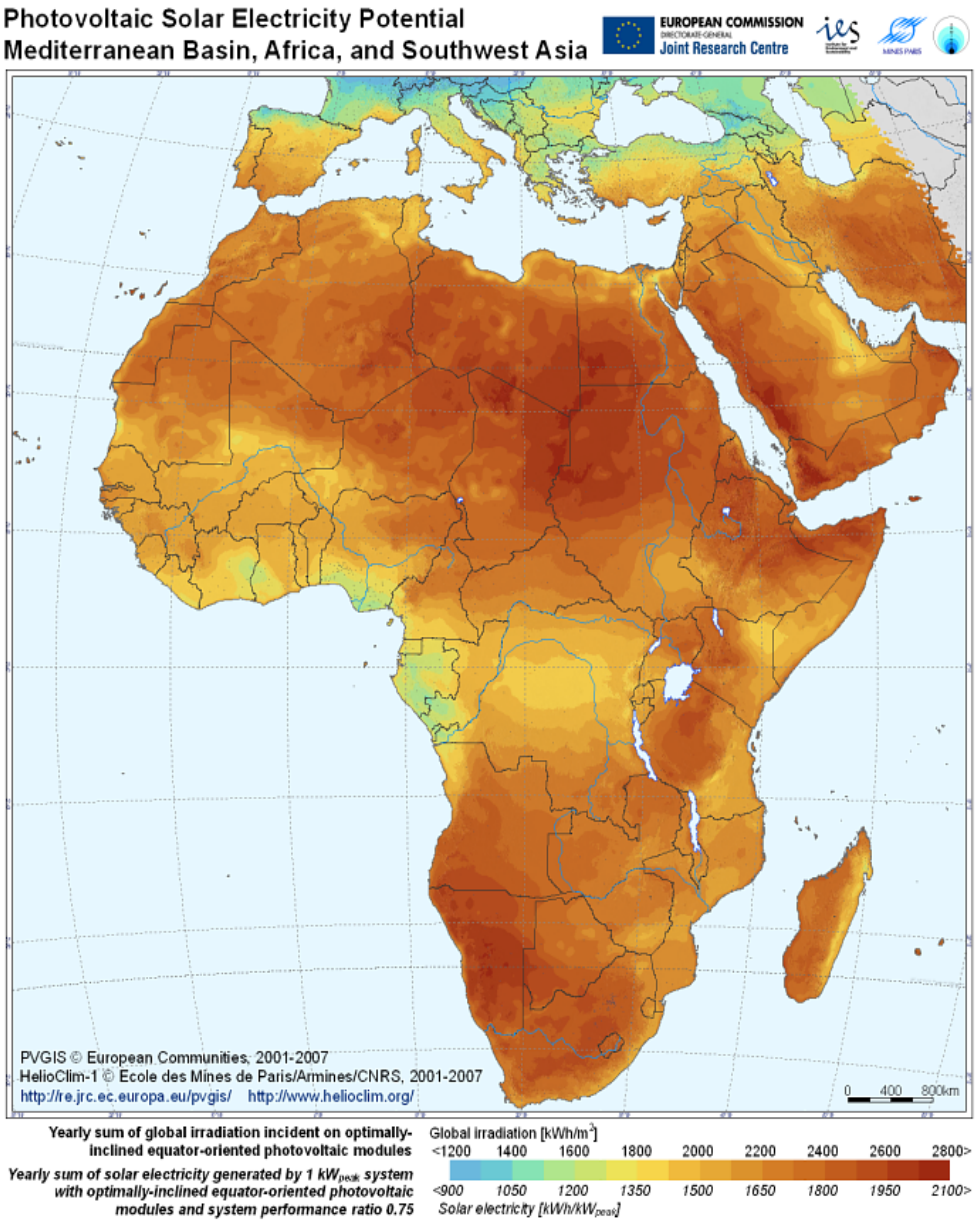
PVGIS provides

- Geographic analysis of solar resource
- Assessment of photovoltaic electricity generation
- Web access to data and tools
- Maps of countries and regions

Community of users

- EC and international organisations
- Universities & research
- PV industry
- Interested individuals

http://re.jrc.ec.europa.eu/pvgis/



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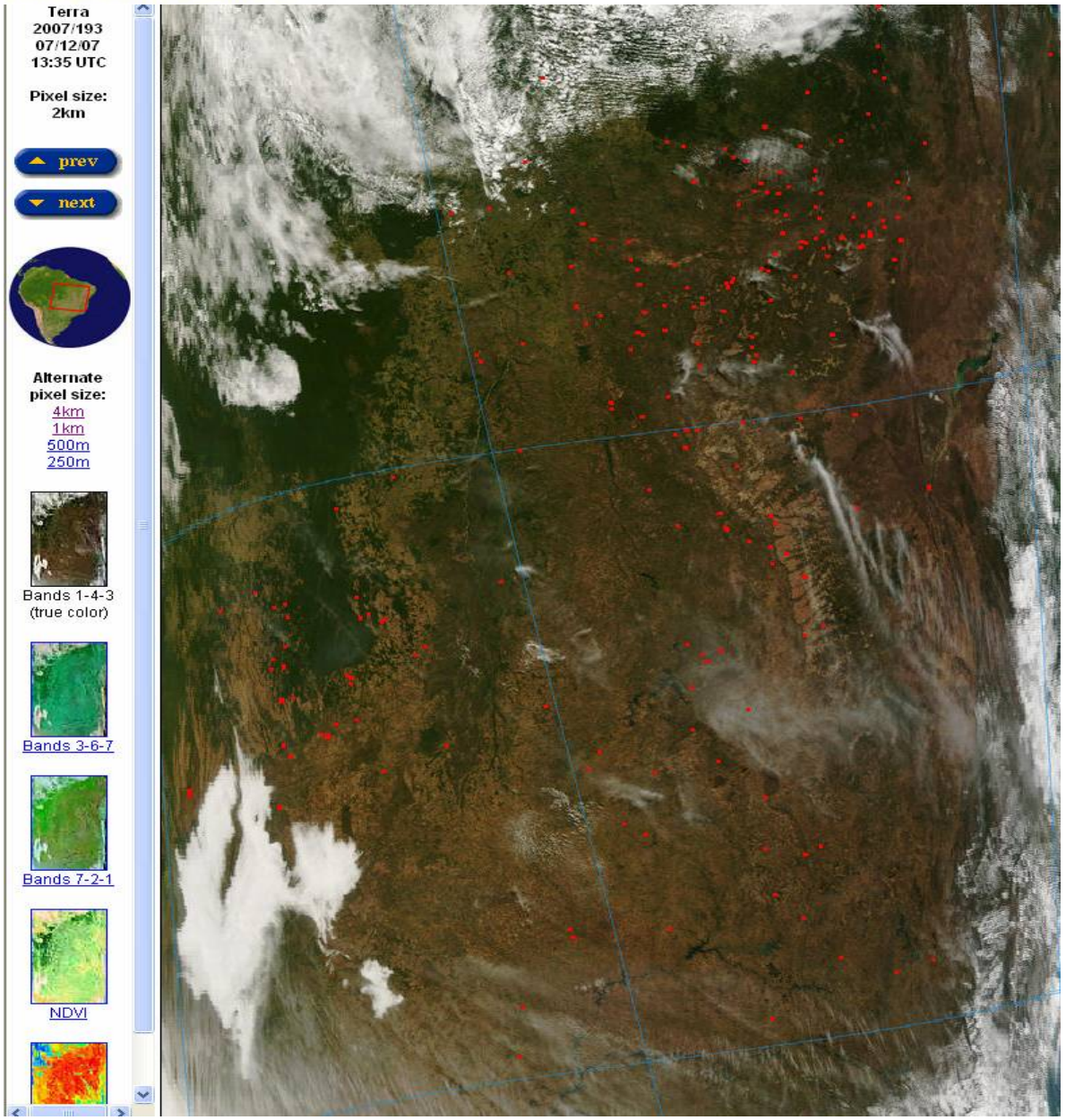
Monitoring of Deforestation in Amazonia

Joint Research Centre



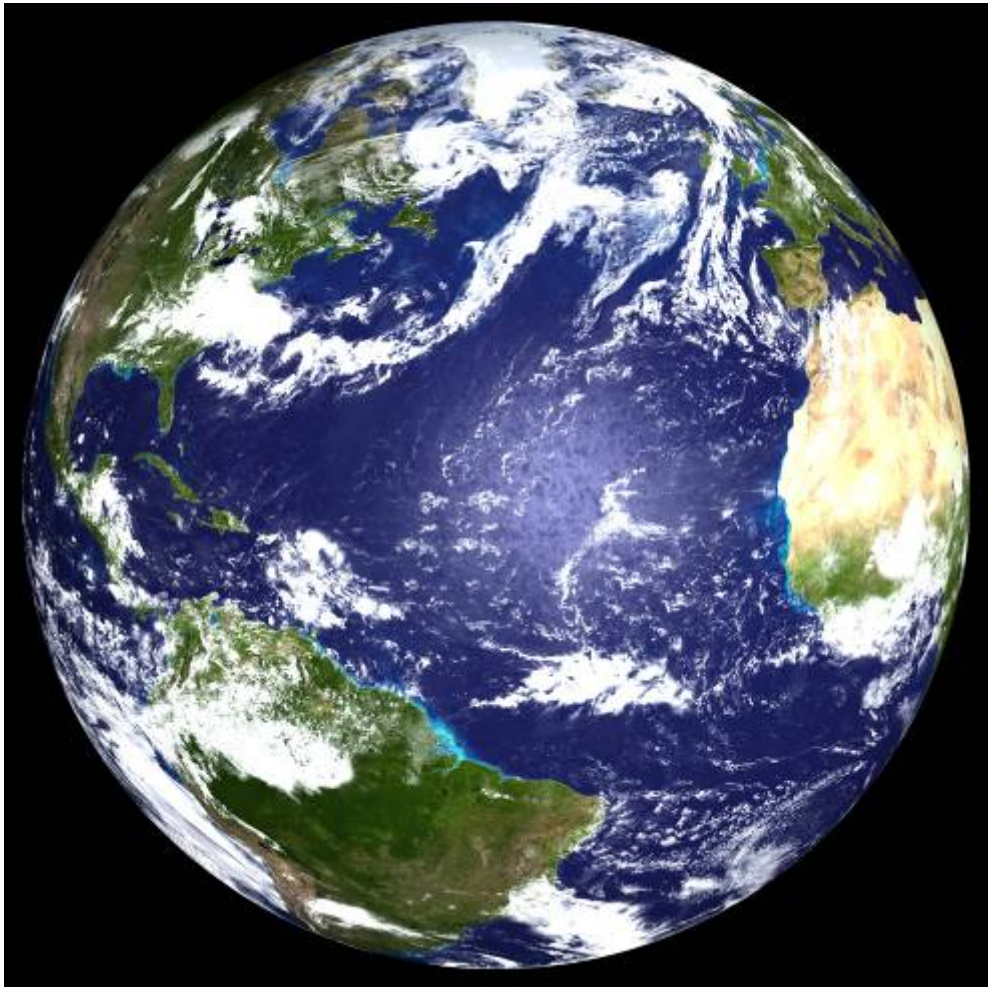
Fires around the Xingu National Park (west of image) Amazonia and in northeast Brazil, 12th July 2007

Source: JRC-IES with data from MODIS instrument on board Terra

Major Challenge for Future of the Planet Earth

How to move towards a sustainable global system ?

6,7 billion people, 1000 nations, 200 countries



Source: 3DNWorld web-site

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Thank you for your attention!

Institute for Environment and Sustainability