Impacts of climate change in Europe

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Above +2°C impacts will be large

**EU 2°C target**
Substantial global GHG emission reduction is needed as well as adaptation

Source: IPCC fourth assessment, 2007 (full uncertainty range for temperature increase is 1.1-6.4ºC)
Why is adaptation important?

- Climate change cannot be totally avoided
- Anticipatory adaptation can be more effective and less costly than “retrofitting” or “emergency adaptation”
- Climate change may be more rapid and pronounced than currently known
- Immediate benefits from adaptation to current climate variability and extreme events
- Avoid maladaptive policies and practices
Coastal zones

- Sea level is projected to rise for centuries (0.2-0.6 m by 2100)
- Future increase in storm frequency and intensity (uncertainties)
- 9% of all European coastal zones is below 5 m elevation potentially vulnerable to sea level rise and related inundations and the exposed population in the main coastal European cities is expected to increase
- Coastal zone ecosystems are threatened

Source: IPCC, 2007; EEA, 2006
European temperature extremes

- Cold extremes are less frequent, the frequency of hot days has almost tripled between 1880 and 2005 and the number of warm extremes doubled.
- Heat waves and droughts will increase in frequency, intensity and duration, the number of cold and frost extremes will further decrease.
- By 2050 every other summer could be as hot as 2003.

Sources: KNMI, ENSEMBLES project 2008; Schär, 2004
European temperature projected to increase most in north and south (Mediterranean)

Source: PESETA project, PRUDENCE; IPCC SRES A2 high emission scenario (change mean annual temperature 2071-2100 relative to 1961-1990)
Precipitation projected to increase in northern, decrease in southern Europe; more frequent droughts and floods likely

Source: PESETA project, PRUDENCE; IPCC SRES A2 high emission scenario (change 2071-2100 relative to 1961-1990)
Glaciers lost 50% of mass between 1850 and 2000, projected to further reduce.
River flow changes

- Annual river flow is projected to decrease in southern Europe and increase in northern Europe.
- Summer flows will decrease and winter/spring flows will increase in most parts of Europe.

Source: JRC, 2008
River flooding events 1998-2005

- About 100 (river) floods: more than 700 fatalities, a million people affected and 25 billion EUR in insured economic losses

Data-source: EEA, 2006
Projected increase in heat-related deaths in Southern Europe

- Hot summer of 2003 resulted in more than 70,000 excess deaths (12 countries)
- 86,000 excess deaths per year are projected in the EU at a global mean temperature increase of 3°C (A2 scenario) without adaptation

Source: PESETA project, PRUDENCE; IPCC SRES A2 high emission scenario (change mean 2071-2100 relative to 1961-1990)
Projected crop yield decrease in Southern Europe, increase in Northern Europe (2 models)

Source: PESETA project, PRUDENCE; IPCC SRES A2 high emission scenario (change mean 2071-2100 relative to 1961-1990)
Projected local extinction of plants in Southern Europe

- By the late 21st Century, distributions of European plant species are projected to have shifted several hundred kilometres to the north and 60% of mountain plant species may face extinction. The rate of change will exceed the ability of many species to adapt.
Key European vulnerable regions and sectors

AT: Increased coastal erosion and flooding; stressing of marine bio-systems and habitat loss; increased tourism pressure on coasts; greater winter storm risk and vulnerability of transport to winds

BO: Water logging; eutrophication of lakes and wetlands; increased coastal flooding and erosion; increased winter storm risk; reduced ski season; severe fires in drained peatland

CE: Increased frequency and magnitude of winter floods; increased variability of crop yields; increased health effects of heat waves

TU: Thawing of permafrost; decreased tundra area; increased coastal erosion and

MT: Glaciers disappearing; reduced snow-cover period; upward shift of tree line; severe biodiversity losses; reduced ski season

ST: Decreased crop yield; increased soil erosion; increased SLR with positive NAO; increased salinity of inland seas

ME: Reduced water availability; increased drought; severe biodiversity losses; increased forest fires; reduced summer tourism; reduced suitable cropping areas; increased energy demand in summer, reduced hydropower; increased land losses in estuaries and deltas; increased salinity and eutrophication of coastal waters

Source: IPCC, 2007; EEA, 2004
Examples of national assessments

- Finland: FINADAPT (Assessing the adaptive capacity of the Finnish environment and society under a changing climate)
- Germany: KomPass (Competence Centre on Climate Change Impacts and Adaptation)
- Hungary: VAHAVA Changing (Változás) Impact (HAtás) Response (VÁlaszadás)
- Netherlands: CcSP (Climate Changes Spatial Planning)
- Portugal: SIAM (Scenarios, Impacts and Adaptation Measures)
- Spain: ECCE (Assessment of the Preliminary Impacts in Spain due to Climate Change)
- Sweden: SWECLIM (Swedish Regional Climate Modelling Programme)
- UK: UKCIP (Climate Impact Programme)
- All countries: communications to UNFCCC
Current national adaptation plans and measures

- Preparation of national adaptation strategies: Denmark, Germany, Finland, France, Hungary, Netherlands, Portugal, Slovakia, Spain, UK, etc.

- Sectoral actions mainly in areas with a long tradition of dealing with climate extremes such as flood defence, water scarcity and droughts (focus of EEA 2007 study)

- Droughts: new water savings standards; recycling; new infrastructure; desalinisation plants; economic instruments

- Floods: emergency responses; improved forecasting; Self-protection and flood awareness; spatial planning and land management; hard and soft engineering
European Adaptation Challenges

- Climate-proof EU policies and Directives (Agriculture, Industry, Energy, Health, Water, Marine, Ecosystems/Biodiversity, Forestry)
- Integrate adaptation into EU’s funding programmes (Structural, Cohesion and Solidarity funds, Agriculture and Rural Development funds)
- Consider new policies, e.g. spatial planning as an integration tool
- Integrate adaptation in EU external relations (developing countries)
- **Enhancing the knowledge base, e.g. regarding regional scale and information on costs**
- Involvement of civil society, business sector organisations and enhanced information exchange
- Exploit opportunities for innovative adaptation technologies

Commission Green Paper, consultation in 2007
White Paper with concrete proposals expected end of 2008
Data and information needs

- Projections of climate change at detailed level (from downscaled climate change models)
- Frequency and intensity of extreme weather events
- Seasonal data (e.g. in agriculture; forestry; water accounts) and projections
- Data across scales, e.g. water balances at river basin level, ecosystem functional units and services
- Economic valuation approaches for accounting ecosystem services in physical and monetary terms
- Information on practical adaptation measures and costs of adaptation
Can ecosystem accounting be used for climate change vulnerability assessments?

### Ecosystem types

**Core accounts of assets & flows**
(by ecosystem types, raw quantities)

**Counts of stocks diversity / integrity**
(by ecosystem types, focus on state, health, resilience)

### Ecosystem Stocks & State Accounts

### Accounts of flows of ecosystem goods and services

**Material/energy flows**
(focus on biomass, water, nutrients, residuals)

**Functions & Services**
- Land use function
- Ecosystem services

### Supply & use of ecosystem goods and services
(Use of resource by sectors, supply to consumption & residuals, accumulation, I-O analysis)

### Natural assets accounts
- Capital consumption & accumulation (physical units, €)
- Natural capital structure, resilience (physical units, by sectors)
- Ecosystem assets wealth (€)

**Natural Capital Accounts/ living & cycling natural capital**

**Economic sectors**

**Spatial integration**

**Economic integration**
**Ecosystem Accounting Framework**

- **Stocks & flows**
  - Spatial systems:
    - **land cover** (units, zones, landscape types)
    - river reaches, rivers, catchments
    - coastal systems
  - Biomass, Productivity (NPP/NEP), Carbon Storage
  - Nutrients (N,P)
  - Water
  - Species
  - Other...
- System interactions
- Services
- Values

➡️ Basic ecosystem stock flows accounts
Ecosystem Accounting Framework

- Stocks & flows
- **System interactions**, integrity & health
  - Spatial interactions (ecotones, distributions, composition / scales)
  - Components interactions
    - Spatial & temporal interactions (water stress, species dynamics...)
  - Bio-chemical-physical cycles
- Human interactions
  - Re-structuring, over-harvesting/over-extraction, deposition of residuals and force-feeding, introduction of species – use of land and the natural capital
- Health – Ecosystem Distress Syndrome
- Services
- Values
Ecosystem Accounting framework

- Stocks & flows
- System interactions

**Ecosystem Services**
- Input/output to/from production, MEFA
- Extracted or harvested products
- Final services to population (non-market, collective or individual)

- Values
**Ecosystem Accounting framework**

- Stocks & flows
- System interactions
- Services
- **Values**
  - Primary goods and ecosystem based market services
  - End use, collective & individual non market services & IDP
  - Additional maintenance/restoration costs & FCGS
  - Inclusive Wealth
**Integration...**

- **Thematic integration:**
  - environmental themes (interactions, ecosystem resilience)
  - environment-economy (ecosystem goods & services, natural capital)
  - environment-human health
- **Spatial integration:**
  - analytical units
  - spatial distribution, neighbourhoods
  - nested scales, natural systems, decision levels
- **Time integration:**
  - change, time series,
  - infra-annual variability
  - now-casting, modelling
- **Data assimilation:**
  - heterogeneous monitoring data and statistics
  - stratification(s), fuzzy logic and probabilities
- **Reporting:**
  - reporting units (administrative, hydrological, biogeographical, zonal (e.g. coasts, rural landscape...))
  - current policies vs. trends assessment...
Spatial Integration of Environmental & Socio-Economic Data Collection

- Mapping
- Socio-Economic Statistics
- Sampling
- Individual Sites Monitoring
Platform for Integrated Spatial Assessment

Ecosystems
- Introduced species
- Species dynamics
- Habitats state and dynamics
- Condition of ecosystems
- Landscape diversity
- Biodiversity of agrosystem

River Basins & Coast
- Water body restructuring, dams
- Hydromorphic change
- Available water resource
- Water stress
- Water quality, quality of coastal & marine waters
- Water abstraction
- Flooding
- Drainage
- Pesticides & fertilizers leakage to rivers, sea
- Waste water discharge
- Water body restructuring
- Water stress

Land Use / Land Cover
- Urbanization
- Transport networks
- Conversion of marginal land
- Pesticides & fertilizers use
- Intensification of agriculture
- Water use
- Intensification of agriculture
- Water use

Platform for Integrated Spatial Assessment
Summary and conclusions

- For **climate change impacts, vulnerability and adaptation** strategies and policies are emerging and **new data** with more details in time and space are needed.
- This requires a **joint effort** by environmental agencies and statistical institutes as well as businesses, and the meteorological and research community, at national, European and global level.
- **EEA works together with Eurostat and member countries to strengthen the links between environment and economic statistics** (ecosystem accounting).
- **Report on climate change impact indicators due in Sep 2008**, jointly with European Commission Joint Research Centre (JRC) and WHO Europe.
- Development of a **clearinghouse** on climate change impacts, vulnerability and adaptation in collaboration with the European Commission (DG Environment).