THE WORKING GROUP II
CONTRIBUTION TO THE IPCC'S FIFTH ASSESSMENT REPORT
CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY
Socioeconomic Pathways
Adaptation and Mitigation Actions
Governance

CLIMATE
- Natural Variability
- Anthropogenic Climate Change

EMISSIONS and Land-use Change

RISK
- Hazards
- Vulnerability
- Exposure

IMPACTS

SOCIOECONOMIC PROCESSES
- Socioeconomic Pathways
- Adaptation and Mitigation Actions
- Governance
WIDESPREAD OBSERVED IMPACTS
A CHANGING WORLD
WIDESPREAD OBSERVED IMPACTS
A CHANGING WORLD
INCREASING MAGNITUDES OF WARMING INCREASE THE LIKELIHOOD OF SEVERE AND PERVERSIVE IMPACTS
### Diskussionsforum IPCC

#### Risks with Current Adaptation

**Very Low**

**Med**

**Very High**

**Unprecedented Challenges, Especially from Rate of Change**

**Risk Level with High Adaptation**

**Potential for Additional Adaptation to Reduce Risk**

**Risk Level with Current Adaptation**

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#### NORTH AMERICA

- **Increased Risks from Wildfires**
- **Heat-Related Human Mortality**
- **Damages from River and Coastal Urban Floods**

#### EUROPE

- **Increased Flood Losses and Impacts**
- **Increased Losses and Impacts from Extreme Heat Events**

#### ASIA

- **Increased Flood Damage to Infrastructure, Livelihoods, and Settlements**
- **Heat-Related Human Mortality**
- **Increased Drought-Related Water and Food Shortage**

#### AFRICA

- **Compounded Stress on Water Resources**
- **Reduced Crop Productivity and Livelihood and Food Security**
- **Vector- and Water-Borne Diseases**

#### CENTRAL AND SOUTH AMERICA

- **Reduced Water Availability and Increased Flooding and Landslides**
- **Reduced Food Production and Quality**
- **Coastal Inundation and Habitat Loss**

#### SMALL ISLANDS

- **Loss of Livelihoods, Settlements, Infrastructure, Ecosystem Services, and Economic Stability**
- **Vector- and Water-Borne Diseases**
- **Risks for Low-Lying Coastal Areas**

#### THE OCEAN

- **Reduced Fisheries Catch Potential at Low Latitudes**
- **Increased Mass Coral Bleaching and Mortality**
- **Coastal Inundation and Habitat Loss**

#### POLAR REGIONS

- **Risks for Ecosystems**
- **Risks for Health and Well-Being**
The diagram illustrates the maximum speed at which species can move from 2050 to 2090, categorized by different groups such as trees, herbaceous plants, split-hoofed mammals, carnivorous mammals, rodents, primates, plant-feeding insects, and freshwater mollusks.

Key points:
- The x-axis represents the maximum speed in kilometers per decade, ranging from 0 to 100.
- The y-axis lists various groups of species.
- Each group is shown with horizontal bars indicating the upper bound, median, and lower bound for their average climate velocity.
- The groups are color-coded to distinguish RCP2.6, RCP4.5, RCP6.0, and RCP8.5 scenarios.

Legend:
- Upper Bound
- Median
- Lower Bound

AVERAGE CLIMATE VELOCITY 2050-2090
CHANGE IN MAXIMUM CATCH POTENTIAL (2051-2060 COMPARED TO 2001-2010, SRES A1B)

CHANGE IN pH (2081-2100 COMPARED TO 1986-2005, RCP 8.5)

CRUSTACEANS

MOLLUSK

Mollusk and Crustacean Fisheries
Present-day annual catch rate ≥0.005 tonnes km²

Cold-Water Corals

Warm-Water Corals

Positive Effect

No Effect

Negative Effect

SPECIES (%)
Risks of climate change increase with continued high emissions.
The diagram illustrates the yield impact (% change per decade) for different crop types: Wheat, Soy, Rice, and Maize. The yield impact is measured across various percentiles:

- 90th Percentile
- 75th Percentile
- Median
- 25th Percentile
- 10th Percentile

Wheat shows a yield impact ranging from the 10th to the 25th percentile, with a median yield impact around -2%. Soy has a yield impact close to zero, with the 10th percentile yield impact slightly negative. Rice and Maize have yield impacts close to zero as well, with the 10th percentile yield impact slightly positive.
CLIMATE CHANGE
REDUCING AND MANAGING RISKS
**SCOPING**

- Identify Risks, Vulnerabilities, and Objectives
- Establish Decision-Making Criteria

**IMPLEMENTATION**

- Review and Learn
- Implement Decisions
- Monitor

**ANALYSIS**

- Identify Options
- Assess Risks
- Evaluate Tradeoffs

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Diskussionsforum IPCC-Bericht AG 2
EFFECTIVE CLIMATE CHANGE ADAPTATION
A MORE VIBRANT WORLD
Outline

• Introduction
• Current and Future Trend
• Implications of Climate Change for *Production Systems* and *Physical Infrastructure*
• Implications of Climate Change for *Agriculture, Fisheries, Forestry*, and *Bioenergy Production*
• Implications of Climate Change for *Health* and *Social Welfare*
• Implications of Climate Change for the *Protection of Environmental Quality* and *Biological Conservation*
• *Cross-Sectoral Adaptation Decision-making and Risk Management*
• *Co-Benefits and Unintended Consequences of Adaptation and Mitigation*
• *Synthesis of Key Findings*
Observed and projected climate trends

Observed climate trends and future climate projections show regionally varying changes in temperature and rainfall in Europe \([\text{high confidence}]\) with projected increases in temperature throughout Europe and increasing precipitation in Northern Europe and decreasing precipitation in Southern Europe.

Climate projections show

- a marked increase
  - in high temperature extremes \([\text{high confidence}]\),
  - meteorological droughts \([\text{medium confidence}]\)
  - heavy precipitation events \([\text{high confidence}]\)

- with variations across Europe and

- Small or no changes in wind speed extremes \([\text{low confidence}]\) except increases in winter wind speed extremes over Central and Northern Europe \([\text{medium confidence}]\)
Jacob et al. 2013: Figure s3:

Projected seasonal changes of temperature [K] based on the RCP8.5 scenario for the period 2071-2100 compared to 1971-2000. Changes are robust and significant across the entire European continent.
Jacob et al. 2013: Figure s5:

Projected seasonal changes of precipitation [%] based on the RCP8.5 scenario for the period 2071-2100 compared to 1971-2000. Hatched areas indicate regions with robust and/or statistical significant change.
Diskussionsforum IPCC-Bericht AG 2

Dry Spells

RCP4.5

RCP8.5
Effects of observed climate change impacts

Observed climate change in Europe has had wide ranging effects throughout the European region including:
• distribution, phenology, and abundance of animal, fish and plant species [high confidence]
• stagnating wheat yields [medium confidence, limited evidence] and forest decline in some sub-regions [medium confidence]

Climate change has affected both
• human health (from increased heat waves) [medium confidence]
• animal health (changes in infectious diseases) [high confidence]

There is less evidence of impacts on social systems attributable to observed climate change, except in pastoralist populations [low confidence]
Impacts on multiple sectors by extreme events

Climate change will increase the likelihood of systemic failures across European countries caused by extreme climate events affecting multiple sectors [medium confidence]

Extreme weather events currently have
• significant impacts in Europe in multiple economic sectors [high confidence] as well as
• adverse social and health effects [high confidence]
There is limited evidence that resilience to heat waves and fires has improved in Europe [medium confidence],

while some countries have improved their flood protection following major flood events.

Climate change is very likely to increase the frequency and intensity of heat waves, particularly in Southern Europe [high confidence] with mostly adverse implications for health, agriculture, forestry, energy production and use, transport, tourism, labour productivity, and the built environment.
Impacts of climate change and regional differences

Climate change is expected to impede economic activity in Southern Europe more than in other sub-regions [medium confidence], and may increase future intra-regional disparity [low confidence].

There are also important differences in vulnerability within sub-regions, for example, plant species and some economic sectors are most vulnerable in high mountain areas due to lack of adaptation options [medium confidence].

Southern Europe is particularly vulnerable to climate change [high confidence] as multiple sectors will be adversely affected (tourism, agriculture, forestry, infrastructure, energy, population health) [high confidence].
Coastal and river flood management

Sea level rise and increase in extreme rainfall are projected to further increase coastal and river flood risk in Europe and, without adaptive measures, will substantially increase flood damages [*high confidence*]

Adaptation can prevent most of the projected damages [*high confidence – based on medium evidence, high agreement*] but there may be constraints to building flood defences in some areas

Direct economic river flood damages have increased over recent decades [*high confidence*] but this increase is due to development in flood zones and not due to observed climate change

Some areas in Europe show changes in river flood occurrence related to observed changes in extreme river discharge [*medium confidence*] [
Energy production and transmission

Climate change is expected to affect future energy production and transmission

Hydropower production is likely to decrease in all sub-regions except Scandinavia [high confidence]
Climate change is
• unlikely to affect wind energy production before 2050 [medium confidence] but will have a negative impact in summer and a varied impact in winter after 2050 [medium confidence].
• likely to decrease thermal power production during summer [high confidence]
Climate change will increase the problems associated with overheating in buildings [medium confidence]
• Although climate change is very likely to decrease space heating demand [high confidence], cooling demand will increase [very high confidence] although income growth mostly drives projected cooling demand up to 2050 [medium confidence]
More energy efficient buildings and cooling systems as well as demand-side management will reduce future energy demands
As a result of increased evaporative demand, climate change is likely to significantly reduce water availability from river abstraction and from groundwater resources [*medium confidence*],

in the context of increased demand (from agriculture, energy and industry, and domestic use) and cross-sectoral implications which are not fully understood

**Some adaptation is possible** through uptake of more water efficient technologies and water saving strategies
Climate change will affect bioenergy cultivation patterns in Europe by shifting northward their potential area of production [medium confidence]

Elevated atmospheric CO2 can improve drought tolerance of bioenergy crop species due to improved plant water use, maintaining high yields in future climate scenarios in temperate regions [low confidence]
Human health

Climate change is likely to affect human health in Europe.

Heat-related deaths and injuries are likely to increase, particularly in Southern Europe [medium confidence]

Climate change may change the distribution and seasonal pattern of some human infections, including those transmitted by arthropods [medium confidence],

And increase the risk of introduction of new infectious diseases [low confidence]
Environmental Quality and Biological Conservation

Climate change may adversely affect background levels of tropospheric ozone \([low confidence, limited evidence, low agreement]\), assuming no change in emissions, but the implications for future particulate pollution (which is more health-damaging) are very uncertain.

Higher temperatures may have affected trends in ground level tropospheric ozone \([low confidence]\).

Climate change is likely to

- decrease surface water quality due to higher temperatures and changes in precipitation patterns \([medium confidence]\)
- increase soil salinity in coastal regions \([low confidence]\)

Climate change may also increase soil erosion (from increased extreme events) and reduce soil fertility \([low confidence, limited evidence]\).
Adaptation

The capacity to adapt in Europe is high compared to other world regions, but there are important differences in impacts and in the capacity to respond between and within the European sub-regions.

In Europe, adaptation policy has been developed at international (European Union), national and local government level including the prioritisation of adaptation options.

There is limited systematic information on current implementation or effectiveness of adaptation measures or policies.

Some adaptation planning has been integrated into coastal and water management, as well as disaster risk management.

There is limited evidence of adaptation planning in rural development or land-use planning.
### Key risks from climate change in Europe and potential for reducing through mitigation and adaptation

<table>
<thead>
<tr>
<th>Key risk</th>
<th>Adaptation issues &amp; prospects</th>
<th>Climatic drivers</th>
<th>Timeframe</th>
<th>Risk &amp; potential for adaptation</th>
</tr>
</thead>
</table>
| Increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanization, increasing sea levels, coastal erosion, and peak river discharges *(high confidence)* | Adaptation can prevent most of the projected damages *(high confidence).*  
• Significant experience in hard flood-protection technologies and increasing experience with restoring wetlands  
• High costs for increasing flood protection  
• Potential barriers to implementation: demand for land in Europe and environmental and landscape concerns | ![Cloud, Wave] | Present | Very low | Medium | Very high |
| ![Cloud, Wave] | Near-term (2030-2040) | Very high | Medium | Very low | |
| ![Cloud, Wave] | Long-term (2080-2100) | 2°C | High | Very high | Very low | Medium | |
| ![Cloud, Wave] | | 4°C | High | Very high | Very low | Medium | |
| Increased water restrictions. Significant reduction in water availability from river abstraction and from groundwater resources, combined with increased water demand (e.g., for irrigation, energy and industry, domestic use) and with reduced water drainage and runoff as a result of increased evaporative demand, particularly in southern Europe *(high confidence)* | • Proven adaptation potential from adoption of more water-efficient technologies and of water-saving strategies (e.g., for irrigation, crop species, land cover, industries, domestic use)  
• Implementation of best practices and governance instruments in river basin management plans and integrated water resources management | ![Sun] | Present | Very low | Medium | Very high |
| ![Sun] | Near-term (2030-2040) | Very high | Medium | Very low | |
| ![Sun] | Long-term (2080-2100) | 2°C | High | Very high | Very low | Medium | |
| ![Sun] | | 4°C | High | Very high | Very low | Medium | |
| Increased economic losses and people affected by extreme heat events: impacts on health and well-being, labor productivity, crop production, air quality, and increasing risk of wildfires particularly in southern Europe and in Russian boreal region *(medium confidence)* | • Implementation of warning systems  
• Adaptation of dwellings and workplaces and of transport and energy infrastructure  
• Reductions in emissions to improve air quality  
• Improved wildfire management  
• Development of insurance products against weather-related yield variations | ![Sun] | Present | Very low | Medium | Very high |
| ![Sun] | Near-term (2030-2040) | Very high | Medium | Very low | |
| ![Sun] | Long-term (2080-2100) | 2°C | High | Very high | Very low | Medium | |
| ![Sun] | | 4°C | High | Very high | Very low | Medium | |
FAQ:

Will Europe need to import more food because of climate change?

Will climate change introduce new infectious diseases into Europe?

Will I still be able to live on the coast in Europe?