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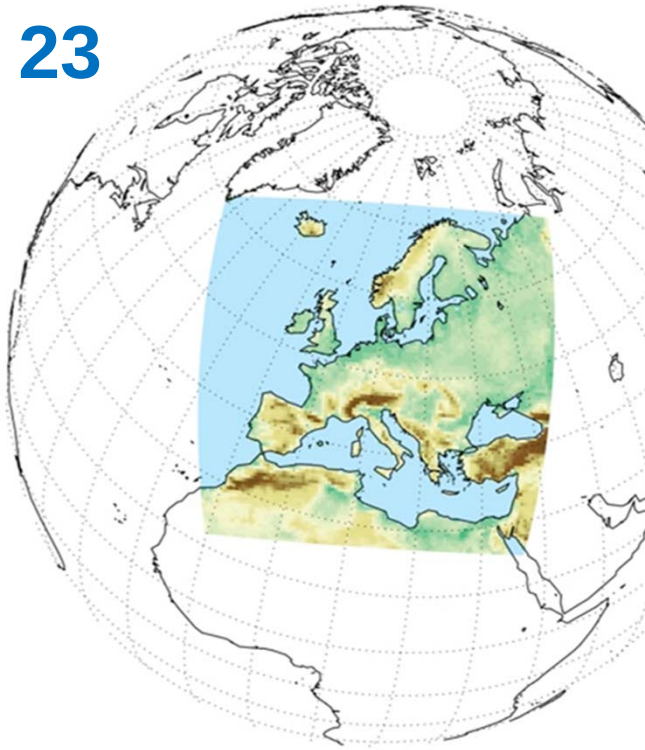
Der 5. Sachstandsbericht des IPCC

Klimawandel in Europa
Kernbotschaften aus Kapitel 23



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Outline

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- **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

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Observed climate trends and future climate projections show regionally varying changes in temperature and rainfall in Europe [***high confidence***]

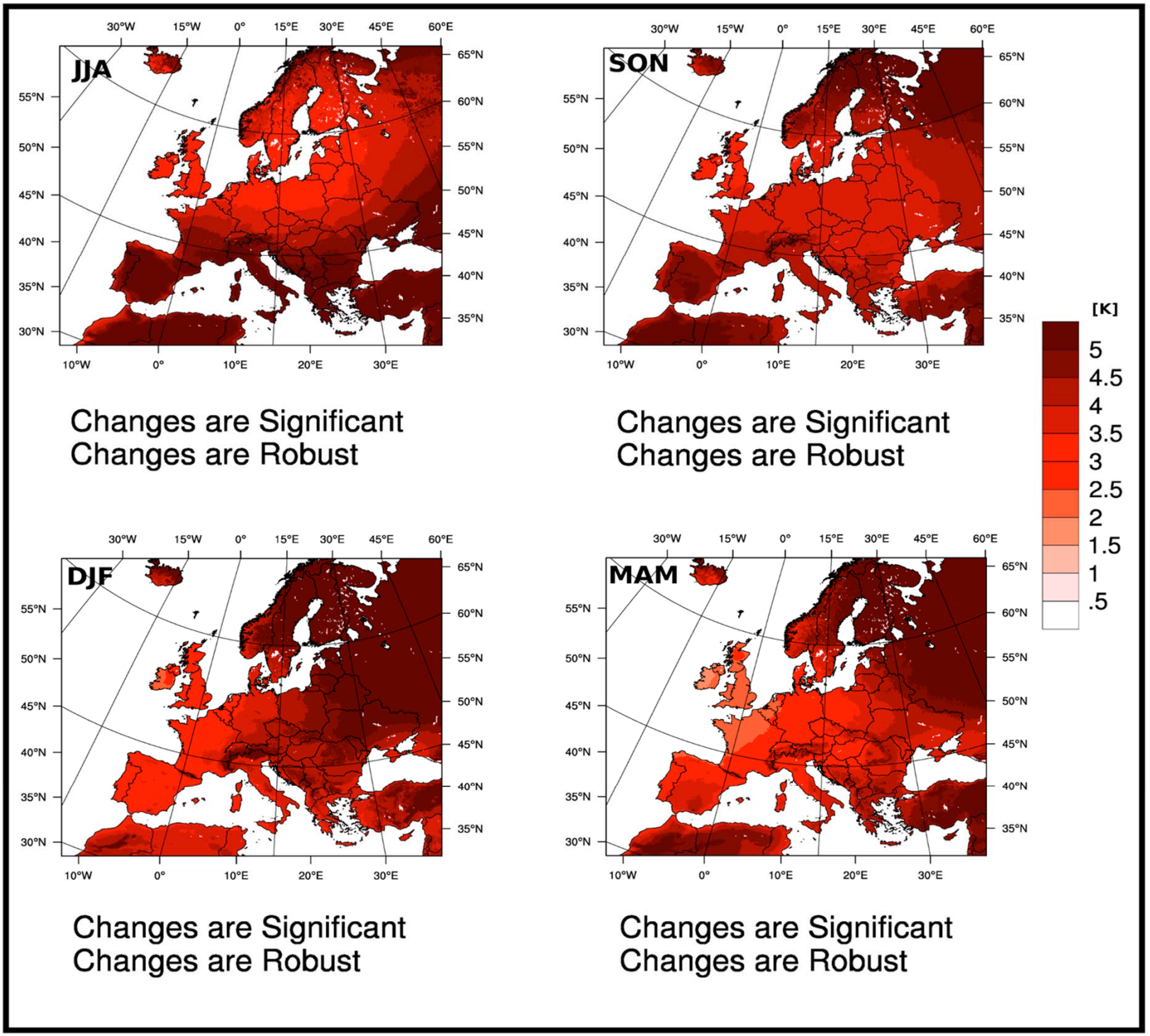
with projected **increases** in **temperature** throughout Europe and
increasing precipitation in Northern Europe and
decreasing precipitation in Southern Europe

In agreement with AR4

Climate projections show

- a marked **increase**
  - in **high temperature extremes** [*high confidence*],
  - **meteorological droughts** [*medium confidence*]
  - **heavy precipitation events** [*high confidence*]

  with variations across Europe and
- Small or no changes in **wind speed extremes** [*low confidence*] except **increases** in **winter wind speed extremes** over Central and Northern Europe [*medium confidence*]



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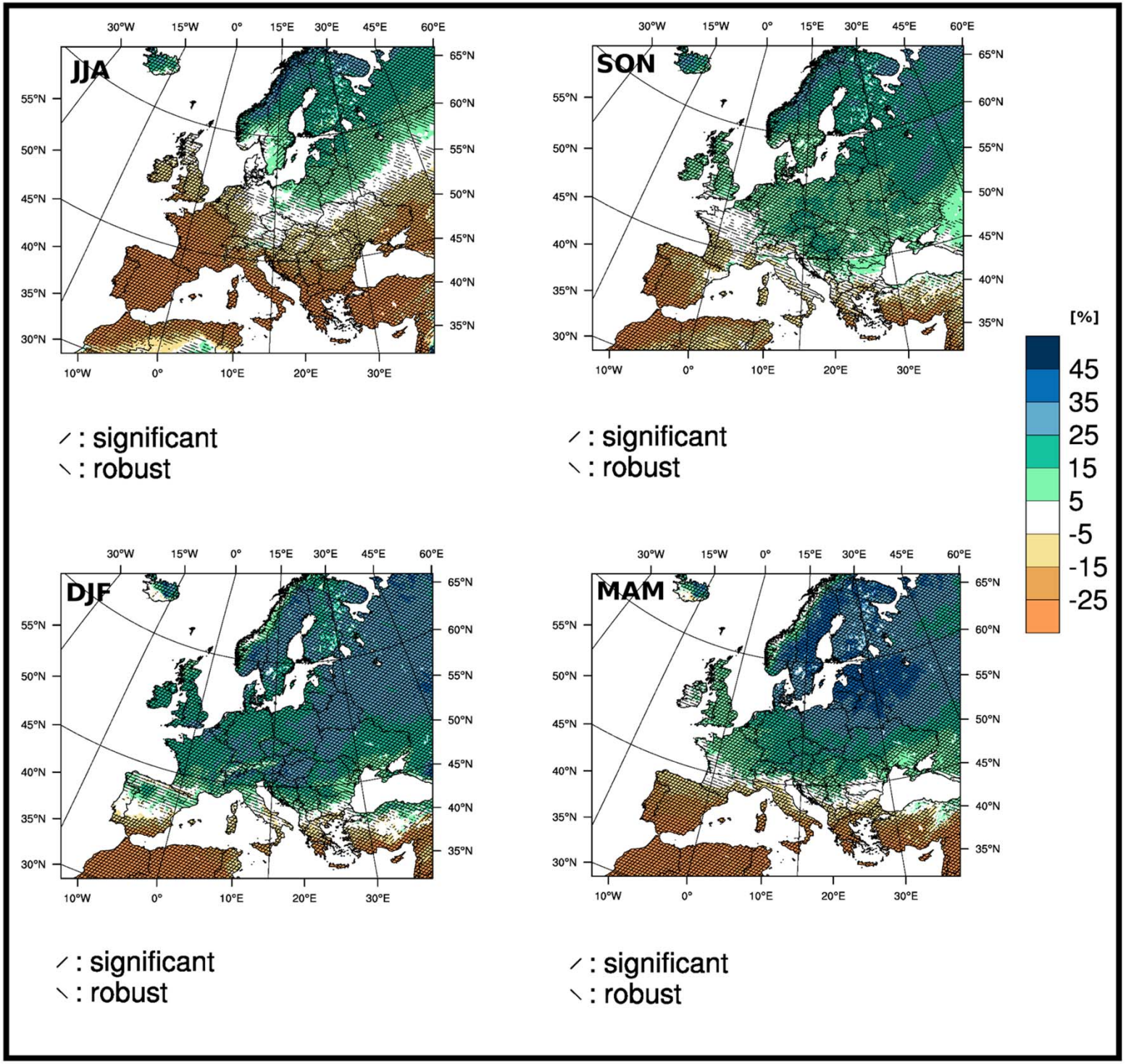
Jacob et al. 2013: Figure s3:

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.



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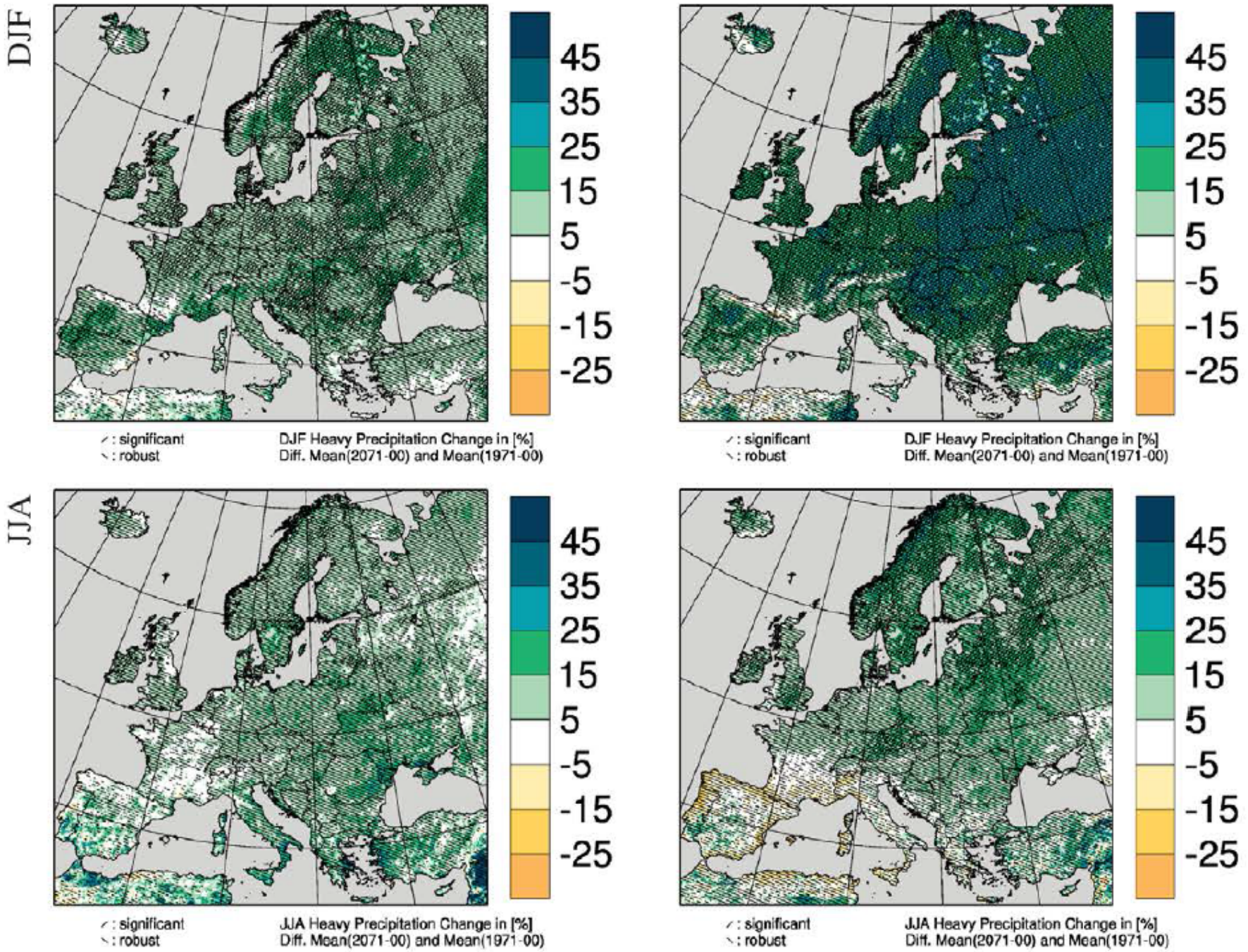
Jacob et al. 2013: Figure s5:

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.


DJF
45
35
25
15
5
-5
-15
-25
/ : significant
\ : robust
DJF Heavy Precipitation Change in [%]
Diff. Mean(2071-00) and Mean(1971-00)
JJA
JJA Heavy Precipitation Change in [%]
RCP4.5
RCP8.5

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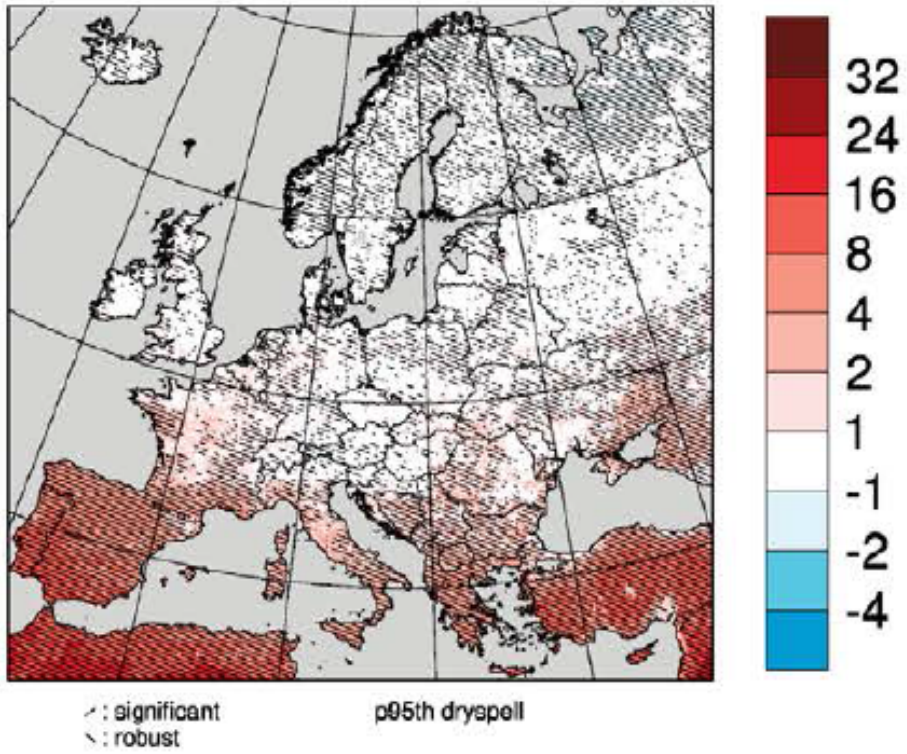
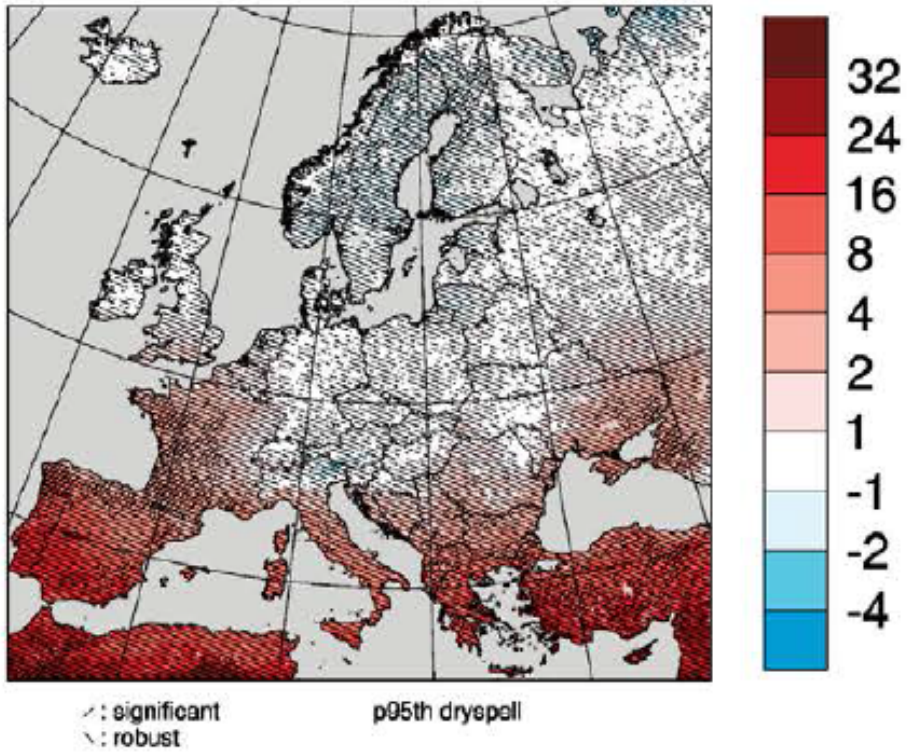
Dry Spells



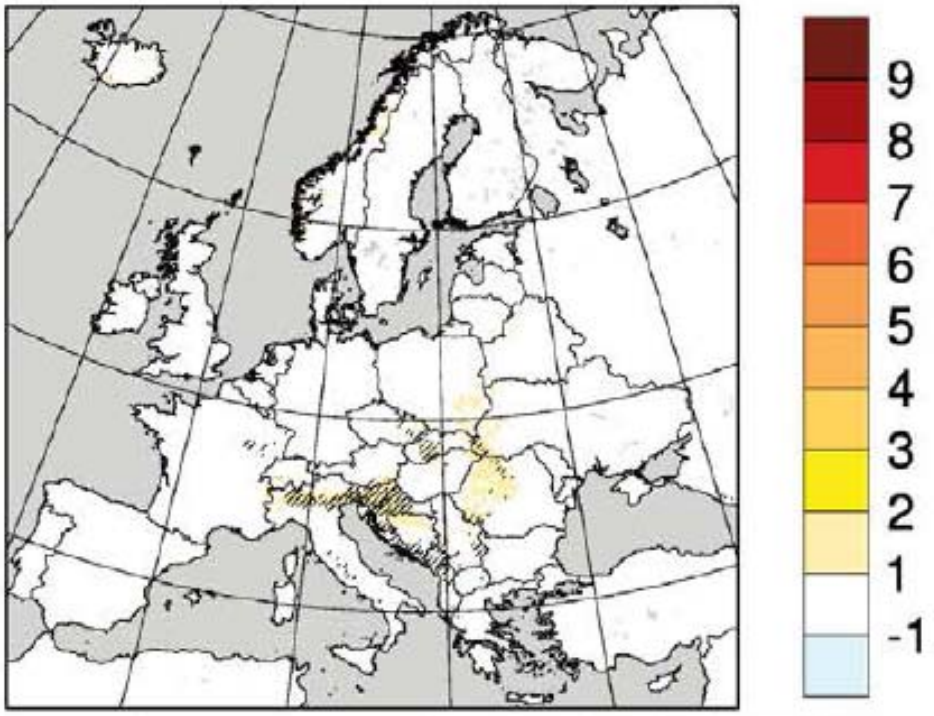


RCP4.5

RCP8.5

Heat Waves

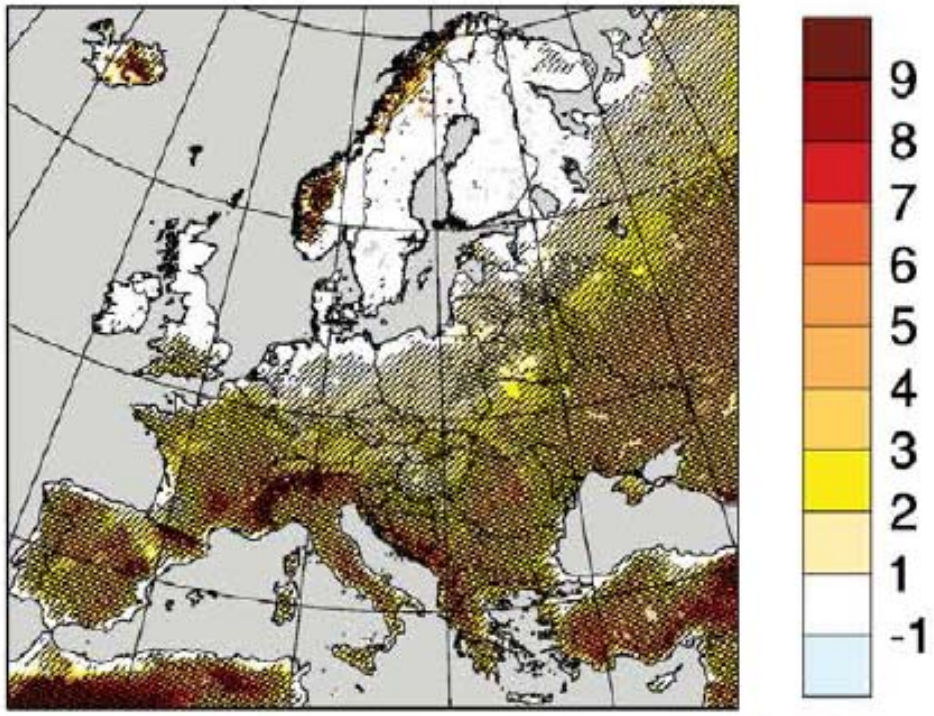
RCP 45



/ : significant
\ : robust

MJJAS Diff. in Mean Number of Heat Waves
Mean(2071-00) and Mean(1971-00)-WMO-tasmax

RCP 85



/ : significant
\ : robust

MJJAS Diff. in Mean Number of Heat Waves
Mean(2071-00) and Mean(1971-00)-WMO-tasmax

Effects of observed climate change impacts

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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*]

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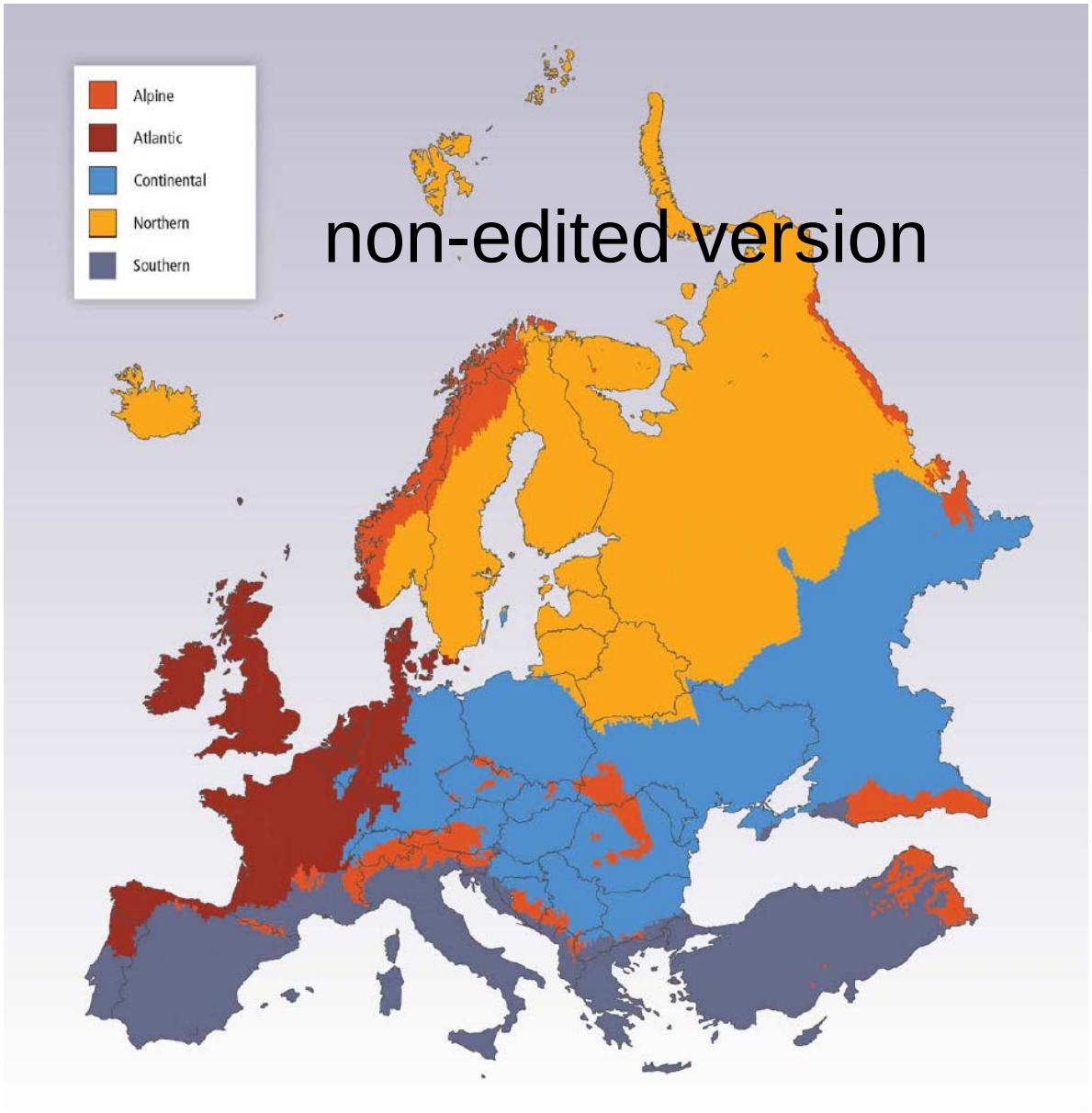

Figure 23-1: Sub-regional classification of the IPCC Europe region. Based on Metzger et al., 2005.

Assessment of Climate Change Impacts on Ecosystem Services by Sub-Region

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	Alpine	Atlantic	Continental	Northern	Southern
Provisioning services:					
Food production	No (1) ∨ (4)	∨ (1)	∨ (1)	∧ (1) ∨ (1)	∨ (1)
Livestock production	No (1) ∨ (1)				
Fibre production	∨ (1)				
Bioenergy production	∧ (1)			∧ (1)	∨ (1)
Fish production		No (1) ∨ (1)	∨ (1)	No (1) ∨ (1)	No (1) ∨ (2)
Timber production	∧ (5) No (2) ∨ (5)	∧ (2) No (3)	∧ (1) No (2) ∨ (1)	∧ (6) No (1)	V (2)
Non-wood forest products				∧ (1) No (1)	∨ (1)
Sum of effects on provisioning services	∧ (6) No (4) ∨ (11)	∧ (2) No (4) ∨ (2)	∧ (1) No (2) ∨ (3)	∧ (9) No (3) ∨ (2)	No (1) ∨ (7)

No = neutral effect

(1) = number in brackets refers to the number of studies supporting the change (increasing, decreasing, neutral) in ecosystem service.

∨ = decreasing impacts

∧ = increasing impacts

Impacts on multiple sectors by extreme events

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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.

Subjects

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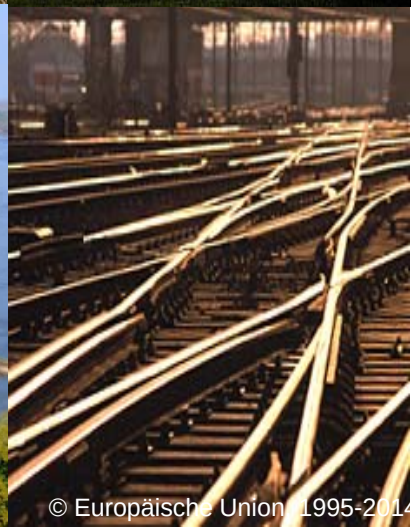
- Coastal and river flood management
- Transport
- Energy production and transmission
- Tourism
- Agriculture
- Irrigation
- Water availability
- Wine grapes
- Forestry
- Fisheries and aquacultures
- Bioenergy production
- Human health
- Cultural heritage
- Environmental quality and biological conservation
- Flora and fauna



Coastal and river flood management

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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*] [

Assessment of climate change impact by sub-region by 2050

medium emission scenario, no planned adaptation

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	Alpine	Southern	Northern	Continental	Atlantic	
Settlements						
River flood damages						23.3.1
Coastal flood damages	n/a					23.3.1
Tourism						
Length of ski season		?			?	23.3.6, 3.5.7
Human health						
Heat wave mortality and morbidity						23.5.1
Food safety						23.5.1

 Beneficial change  Harmful change **?** No relevant literature

Transport

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Climate change is projected to affect the impacts of hot and cold weather extremes on transport leading to economic damage and/or adaptation costs, as well as some benefits (e.g. reduction of maintenance costs) during winter [*medium confidence*]

Climate change is projected

- to **reduce severe accidents** in road transport [*medium confidence*] and
- adversely **affect inland water transport in summer** in some rivers (e.g. the Rhine) after 2050 [*medium confidence*].

Damages to rail infrastructure from high temperatures may also increase *[medium confidence*].

Adaptation through maintenance and operational measures can reduce adverse impacts to some extent.


© Ruhr Nachricht

Energy production and transmission

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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

Tourism

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After 2050, tourism activity is projected to decrease in southern Europe [*low confidence*] and increase in Northern and Continental Europe [*medium confidence*]

No significant impacts on the sector before 2050 in winter or summer tourism except for ski tourism in low altitude sites and under limited adaptation [*medium confidence*]

Artificial snowmaking may prolong the activity of some ski resorts [*medium confidence*]

(c) OÖ Tourismus/Erber

Agriculture

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Climate change is likely to increase cereal yields in Northern Europe [*medium confidence, disagreement*] but decrease yields in Southern Europe [*high confidence*]

Yields of some arable crop species like wheat have been negatively affected by observed warming in some European countries since 1980s [*medium confidence, limited evidence*]

Climate change has contributed to **vector-borne disease in ruminants** in Europe [*high confidence*] and **northward expansion of tick disease vectors** [*medium confidence*]

Irrigation

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Climate change will increase irrigation needs [*high confidence*] but future irrigation will be constrained by reduced runoff, demand from other sectors, and by economic costs

By 2050s, irrigation will **not be sufficient to prevent damage from heat waves** to crops in some sub-regions [*medium confidence*].

System costs will increase under all climate scenarios [*high confidence*]

Integrated management of water, also across countries' boundaries, is needed to address future competing demands between agriculture, energy, conservation and human settlements

Water availability

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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

Wine grapes

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Climate change will change the geographic distribution of wine grape varieties [*high confidence*] and
this will

- **reduce the value of wine products and**
- **the livelihoods of local wine communities in Southern and Continental Europe [*medium confidence*] and**
- **increase production in Northern Europe [*low confidence*].**

Some adaptation is possible through technologies and good practice

Forestry

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Climate warming will

•**increase forest productivity** **in** **northern Europe** **[*medium confidence*]** although

•**damage from pests and diseases** in all sub-regions **will increase** due to climate change [*high confidence*]

•[…]**damages from storms in central Europe** [*low confidence*] may also **increase** due to climate change

Climate change is **likely** to cause **ecological and socio-economic damages** from **shifts in**

•**forest tree species range** (from south-west to north-east) [*medium confidence*],

•and in **pest species distributions** [*low confidence*]

Forest management measures can enhance ecosystem resilience [*medium confidence*]


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Fisheries and Aquacultures

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Observed warming has shifted marine fish species ranges to higher latitudes [*high confidence*] and reduced body size in species [*medium confidence*]

There is limited and diverging evidence on climate change impacts on net fisheries economic turnover.
Local economic impacts attributable to climate change will depend on the market value of (high temperature tolerant) invasive species.

Climate change is **unlikely to entail relocation of fishing fleets** [*high confidence*]

Observed higher water temperatures have **adversely affected both wild and farmed freshwater salmon production** in the southern part of their distribution [*high confidence*]
High temperatures may **increase the frequency of harmful algal blooms** [*low confidence*]

Bioenergy Production

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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

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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*]

Cultural heritage

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Climate change and sea level rise may damage European cultural heritage, including buildings, local industries, landscapes, archaeological sites, and iconic places [*medium confidence*]

and some cultural landscapes may be lost forever [*low confidence*]

Environmental Quality and Biological Conservation

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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*]

Flora and Fauna

Observed climate change is affecting a wide range of flora and fauna, including plant pests and diseases [*high confidence*] and the disease vectors and hosts [*medium confidence*].

Climate change is *very likely*

- to cause changes in habitats and species, with local extinctions [*high confidence*] and
- continental scale shifts in species distributions [*medium confidence]*

The habitat of alpine plants is very likely to be significantly reduced [*high confidence*]

Phenological mismatch will constrain both terrestrial and marine ecosystem functioning under climate change [*high confidence*] with a reduction in some ecosystem services [*low confidence*]

The introduction and expansion of invasive species, especially those with high migration rates, from outside Europe is likely to increase with climate change [*medium confidence*]

Climate change is likely to entail the loss or displacement of coastal wetlands [*high confidence*]

Climate change threatens the effectiveness of European conservation areas [*low confidence*] and stresses the need for habitat connectivity through specific conservation policies

Adaptation

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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

Adaptation costs

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Adaptation will incur a cost, estimated from detailed bottom-up sector-specific studies for coastal defences, energy production, energy use, and agriculture

The **costs of adapting buildings** (houses, schools, hospitals) and **upgrading flood defences increase** under all scenarios relative to no climate change [*high confidence*]

Some impacts will be **unavoidable** due to limits (physical, technological, social, economic or political)

Opportunities and unintended consequences

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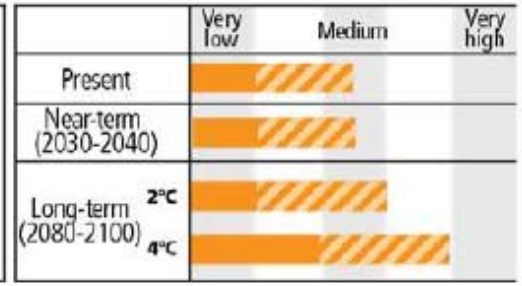
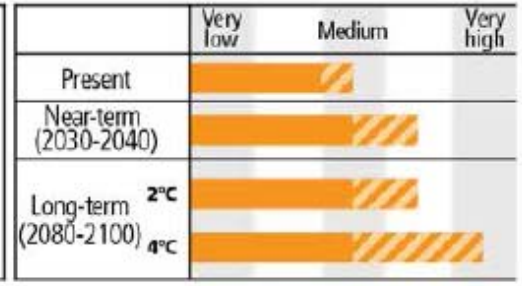
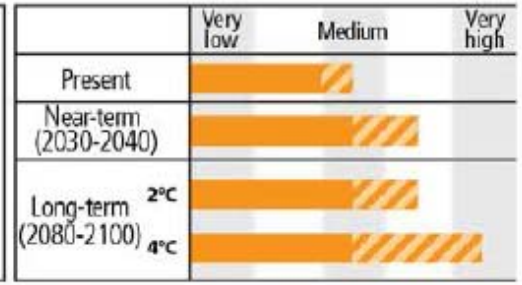
There is also emerging evidence regarding opportunities and unintended consequences of policies, strategies and measures that address adaptation and/or mitigation goals

Some agricultural practices can reduce GHG emissions and also **increase resilience** of crops to temperature and rainfall variability

There is **evidence for unintended consequences of mitigation policies** in the built environment (especially dwellings) and energy sector [*medium confidence*]

Low carbon policies in the transport and energy sectors to reduce emissions are associated with **large benefits to human health** [*high confidence*].

Key risks from climate change in Europe (non-edited version!) and potential for reducing through mitigation and adaptation

Key risk	Adaptation issues and prospects	Climatic drivers	Supporting ch. sections	Timeframe	Risk for current and high adaptation
Increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanisation and by increasing sea-levels and increasing peak river discharges (*high confidence*)	Adaptation can prevent most of the projected damages (high confidence). The experience in hard flood protection technologies is significant. Main issues include the high costs for increasing flood protection demand for land in Europe, and environmental and landscape concerns.		23.2.3, 23.3.1, 23.7		
Increased water restrictions. Significant reduction in water availability from river abstraction and from groundwater resources, combined to increased demands from a range of sectors (irrigation, energy and industry, domestic use) and to reduced water drainage and run-off (as a result of increased evaporative demand) (*high confidence*)	Proven adaptation potential from changes in technologies and adoption of more water efficient technologies and of water saving strategies (irrigation, crop species, land cover, industries, domestic use). Further adaptation possible through solar desalinization (to limit fossil fuel demand).		23.4.3, 23.4.4, 23.7.2		
Increased economic losses and people affected by extreme heat events: impacts on health, welfare (overheating in buildings), labour productivity, crop production, reduced air quality (*medium confidence*)	Implementation of warning systems, adaptation of dwellings and work places, and transport and energy infratructure. Reductions in emissions to improve air quality. Improved wild fire management.		23.3.2, 23.3.4, 23.3.3, 23.5, 23.6.1, 23.6.3, 23.7.4		

Climatic drivers of impacts

Risk & potential for adaptation

FAQs

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

Will climate change introduce new infectious diseases into Europe?

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

Thank you for your attention !

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