Climate change impacts on agriculture in Europe

Blaž Kurnik

Climate change impacts and adaptation

European Environment Agency

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EEA networking with member countries (Eionet)

EEA coverage

Member countries

Cooperating countries

*Kosovo under UNSCR 1244/99

- **33 member** and six collaborating **countries** (ministries and **environment agencies**)
- Main target audience: **policymakers** at European and national levels
- Supporting and informing policy development and implementation by **data, indicators and assessments**
- **Networking:** annual Eionet workshop, expert meetings
- Supported by **European Topic Centres**, e.g. on adaptation see: http://cca.eionet.europa.eu/

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2016-2020: EEA content priorities

- Circular economy and Natural Capital
- **EU Climate and Energy package**
- Sustainable Development Goals, Paris agreement, and Sendai Framework
- EU Copernicus programme (monitoring the environment)
  - land monitoring service and in-situ coordination
  - climate change service (important European user)

- **State of Environment Report (SOER 2020)**

Important global agreements

- Sendai Framework on DRR 2015-2030
  - Links between Disaster risk reduction and Climate Change Adaptation
- Sustainable Development Goals (SDG)
  - Strengthen resilience and adaptive capacity
  - Integrate climate change measures into national policies, strategies and planning
  - Implement the commitment of mobilising $100 billion by 2020
- Paris agreement
  - in force since 4 November 2016
  - Global warming below 2 (1.5) ^{o}C target
  - Investment into adaptation to climate change and resiliency to extreme events

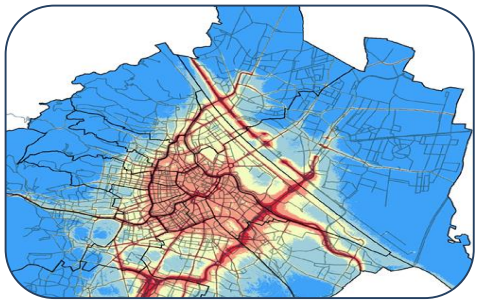
EU Strategy on Adaptation to Climate Change (2013)

Priority 1: Promoting action by Member States

- Action 1. Encourage MS to adopt Adaptation Strategies and action plans
- Action 2. LIFE funding, including adaptation priority areas
- Action 3. Promoting adaptation action by cities along the Covenant of Mayors initiative

Priority 2: Better informed decision-making

- Action 4. Knowledge-gap strategy
- Action 5. Climate-ADAPT



Priority 3: Key vulnerable sectors

- Action 6. Climate proofing the Common Agricultural Policy, Cohesion Policy, and the Common Fisheries Policy
- Action 7. Making infrastructure more resilient
- Action 8. Promote products & services by insurance and finance markets

Copernicus Climate Change Service (C3S)

…. “access to information for monitoring and predicting climate to support adaptation”

How is the climate changing?

- Observations
- Reanalyses

Will climate change continue, accelerate?

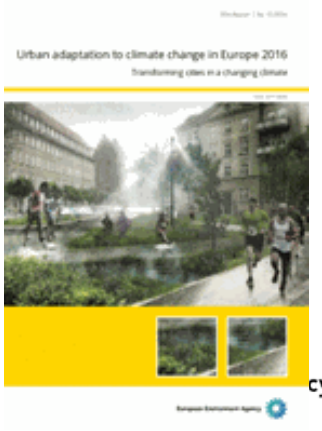
- Predictions
- Projections

What are the societal impacts?

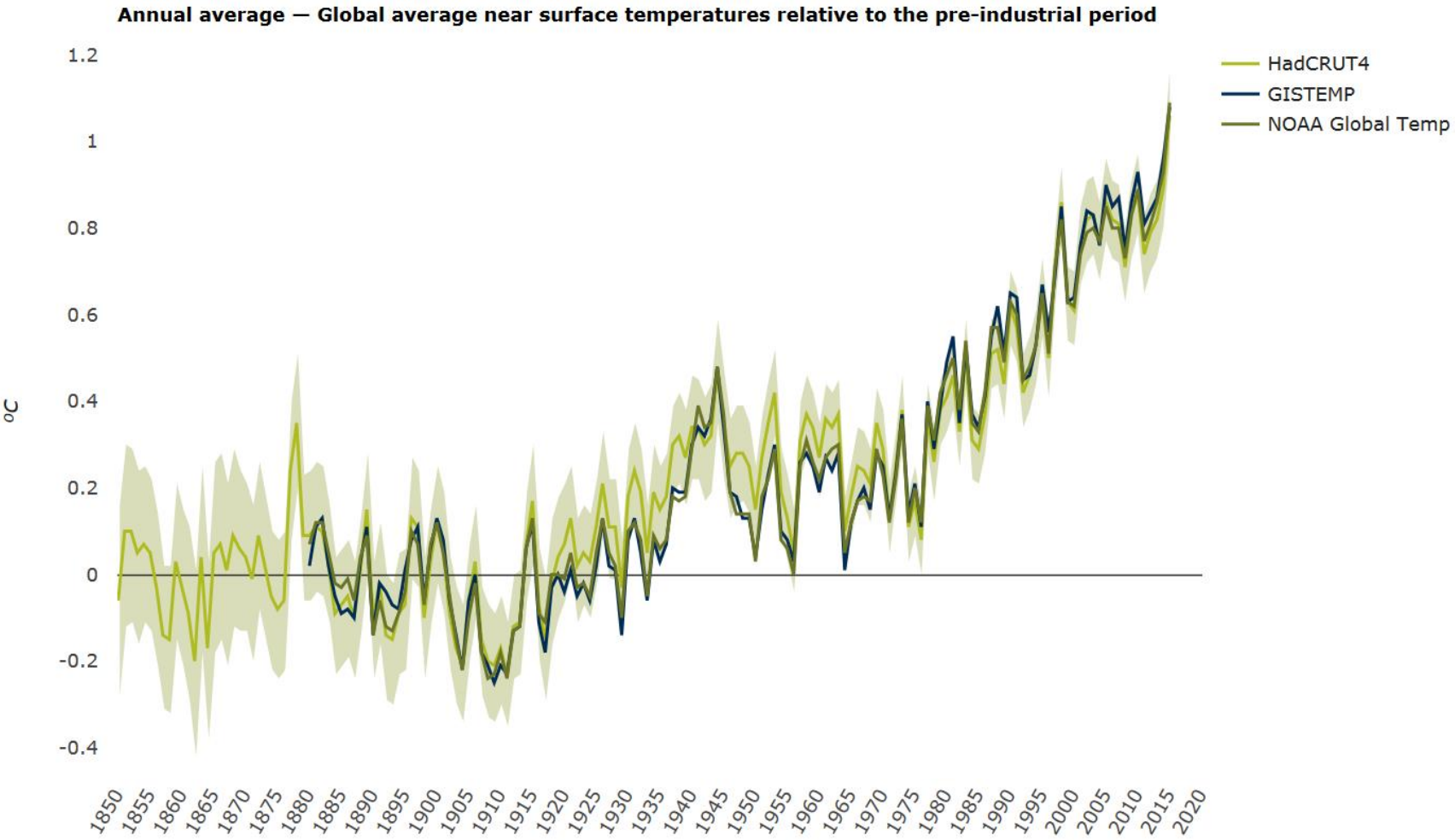
- Climate indicators
- Sectoral information – including Agriculture

Climate change impacts and adaptation products in 2016

- *Climate change impacts indicators*
- *Climate – ADAPT*
- *Urban adaptation to climate change*, 2016 report
- *Climate change impacts and vulnerability report in Europe*, 2016 report



Global temperature – 2015 the warmest year



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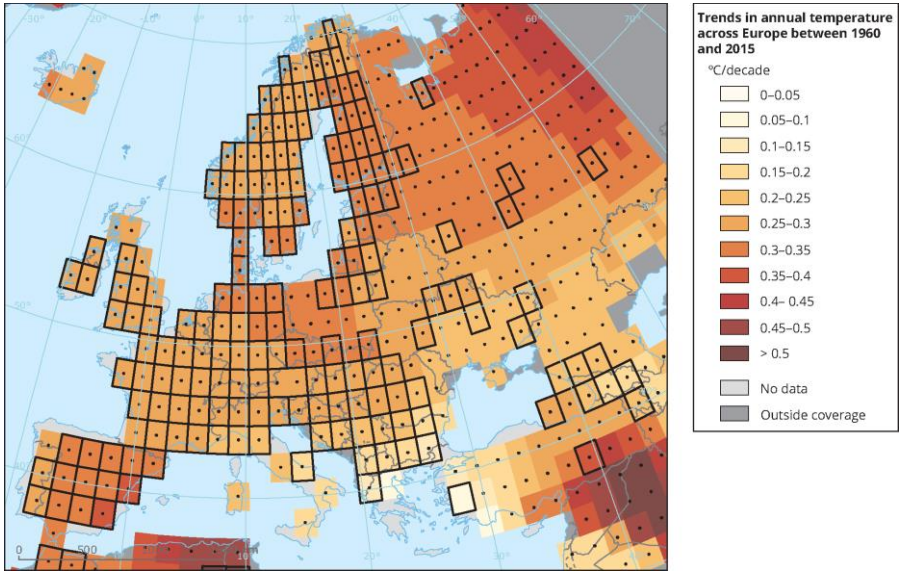
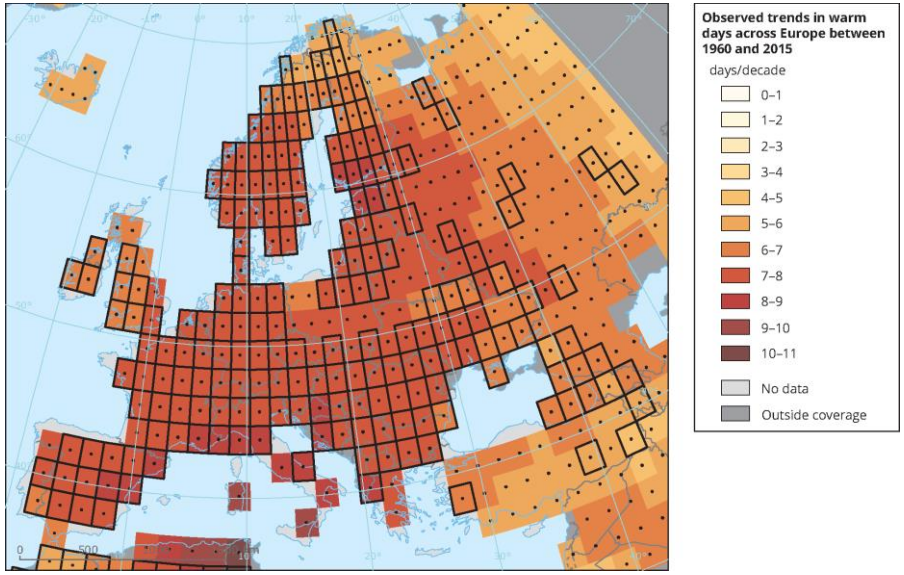
Trends in European temperature

Trends in annual temperature



Trends in number extreme warm days



Trends for 1961-2015 based on E-OBS

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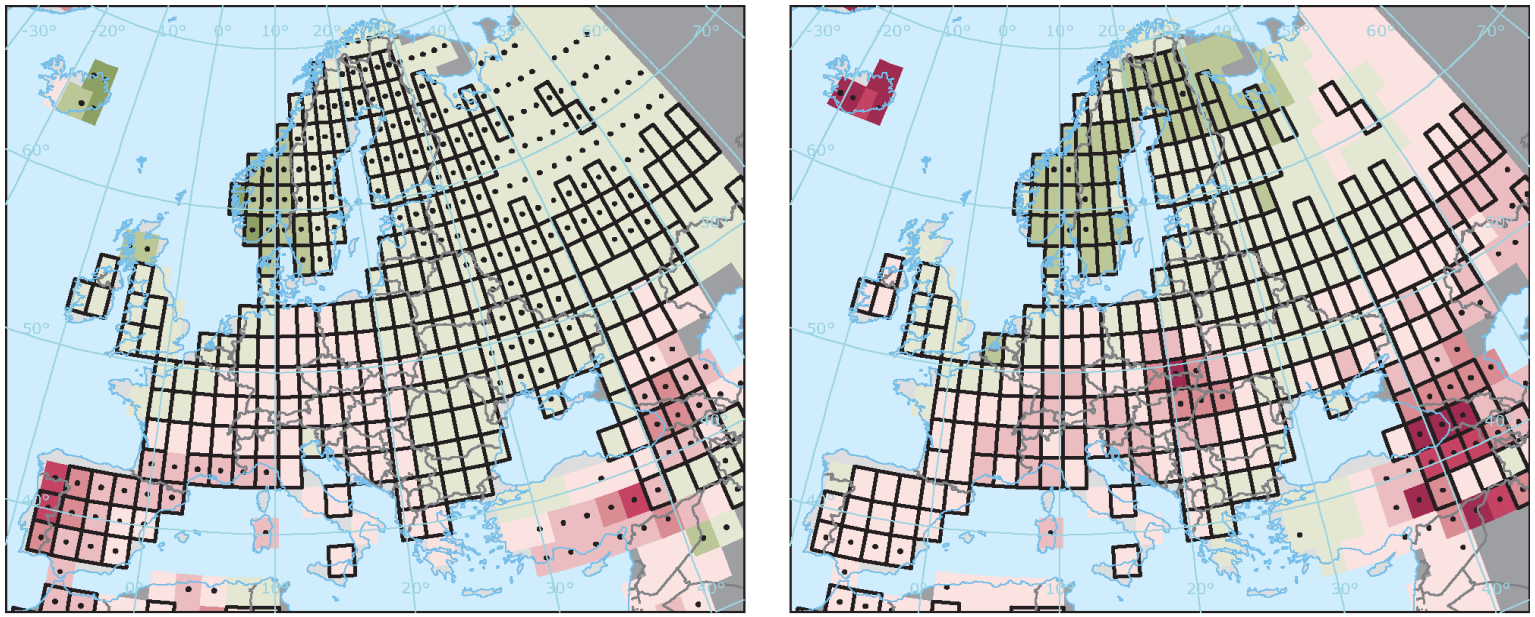
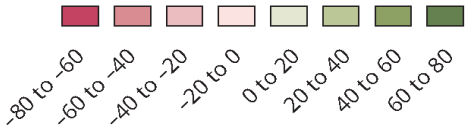
Trends in European precipitation

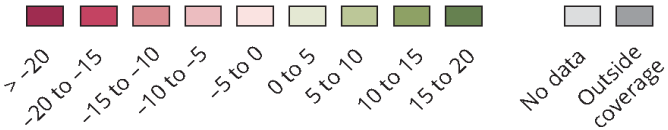


Trends in annual (left) and summer (right) precipitation across Europe between 1960 and 2015

Annual precipitation (mm/decade)



Summer precipitation (mm/decade)



Trends for 1961-2015 based on E-OBS

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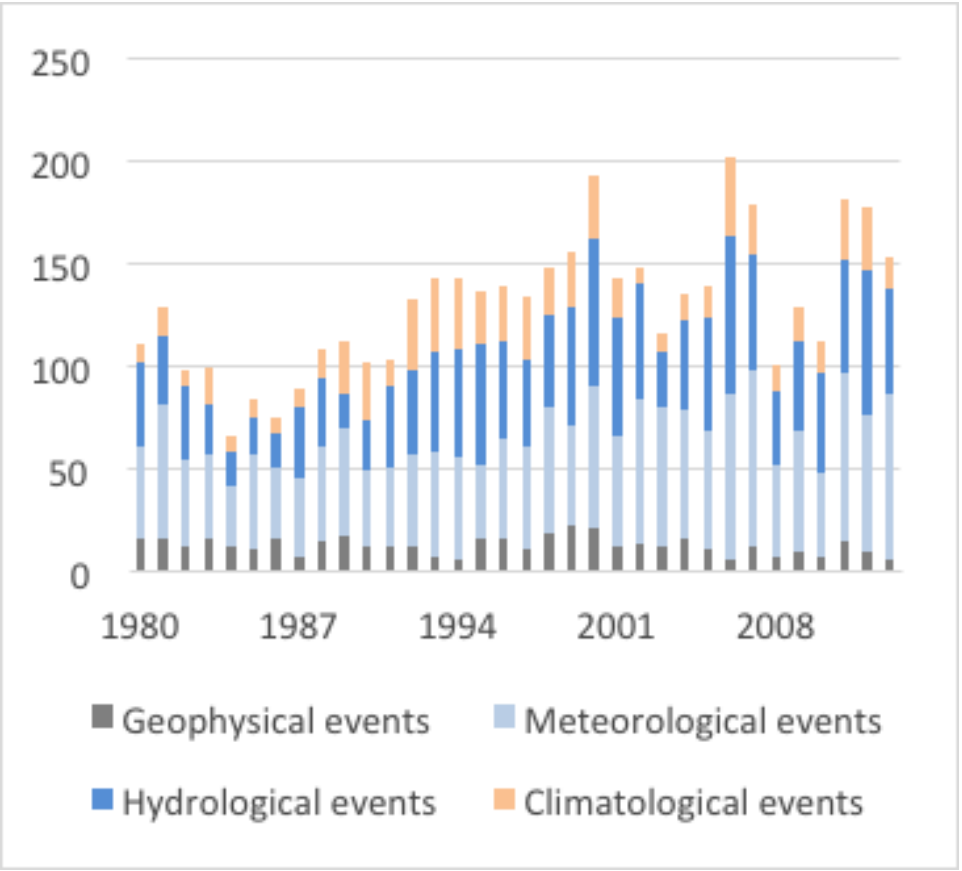
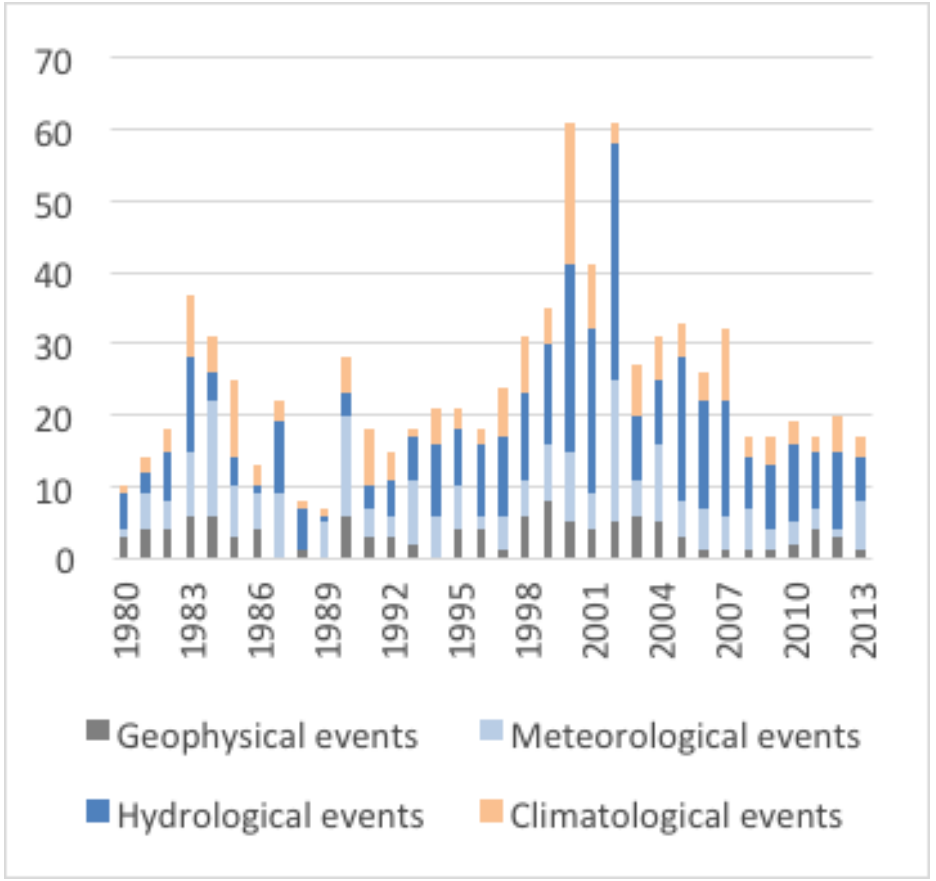
Number of recorded extreme events





Left: Munich RE NatCatSERVICE (data received under institutional agreement)
Right: CRED EM-DAT (data received based on a Letter of Understanding).

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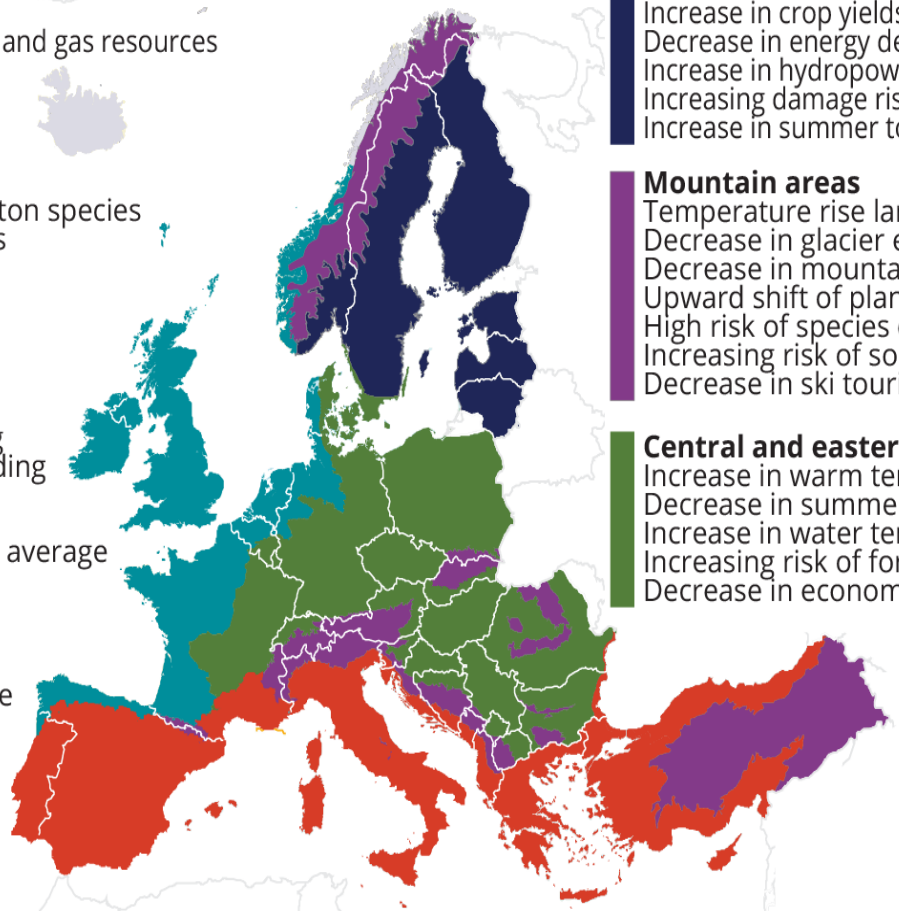
Key observed climate change impacts for the main regions in Europe- SOER 2015

Arctic
Temperature rise much larger than global average
Decrease in Arctic sea ice coverage
Decrease in Greenland ice sheet
Decrease in permafrost areas
Increasing risk of biodiversity loss
Intensified shipping and exploitation of oil and gas resources

Coastal zones and regional seas
Sea-level rise
Increase in sea surface temperatures
Increase in ocean acidity
Northward expansion of fish and plankton species
Changes in phytoplankton communities
Increasing risk for fish stocks

North-western Europe
Increase in winter precipitation
Increase in river flow
Northward movement of species
Decrease in energy demand for heating
Increasing risk of river and coastal flooding

Mediterranean region
Temperature rise larger than European average
Decrease in annual precipitation
Decrease in annual river flow
Increasing risk of biodiversity loss
Increasing risk of desertification
Increasing water demand for agriculture
Decrease in crop yields
Increasing risk of forest fire
Increase in mortality from heat waves
Expansion of habitats for southern disease vectors
Decrease in hydropower potential
Decrease in summer tourism and potential increase in other seasons



Northern Europe
Temperature rise much larger than global average
Decrease in snow, lake and river ice cover
Increase in river flows
Northward movement of species
Increase in crop yields
Decrease in energy demand for heating
Increase in hydropower potential
Increasing damage risk from winter storms
Increase in summer tourism

Mountain areas
Temperature rise larger than European average
Decrease in glacier extent and volume
Decrease in mountain permafrost areas
Upward shift of plant and animal species
High risk of species extinction in Alpine regions
Increasing risk of soil erosion
Decrease in ski tourism

Central and eastern Europe
Increase in warm temperature extremes
Decrease in summer precipitation
Increase in water temperature
Increasing risk of forest fire
Decrease in economic value of forests

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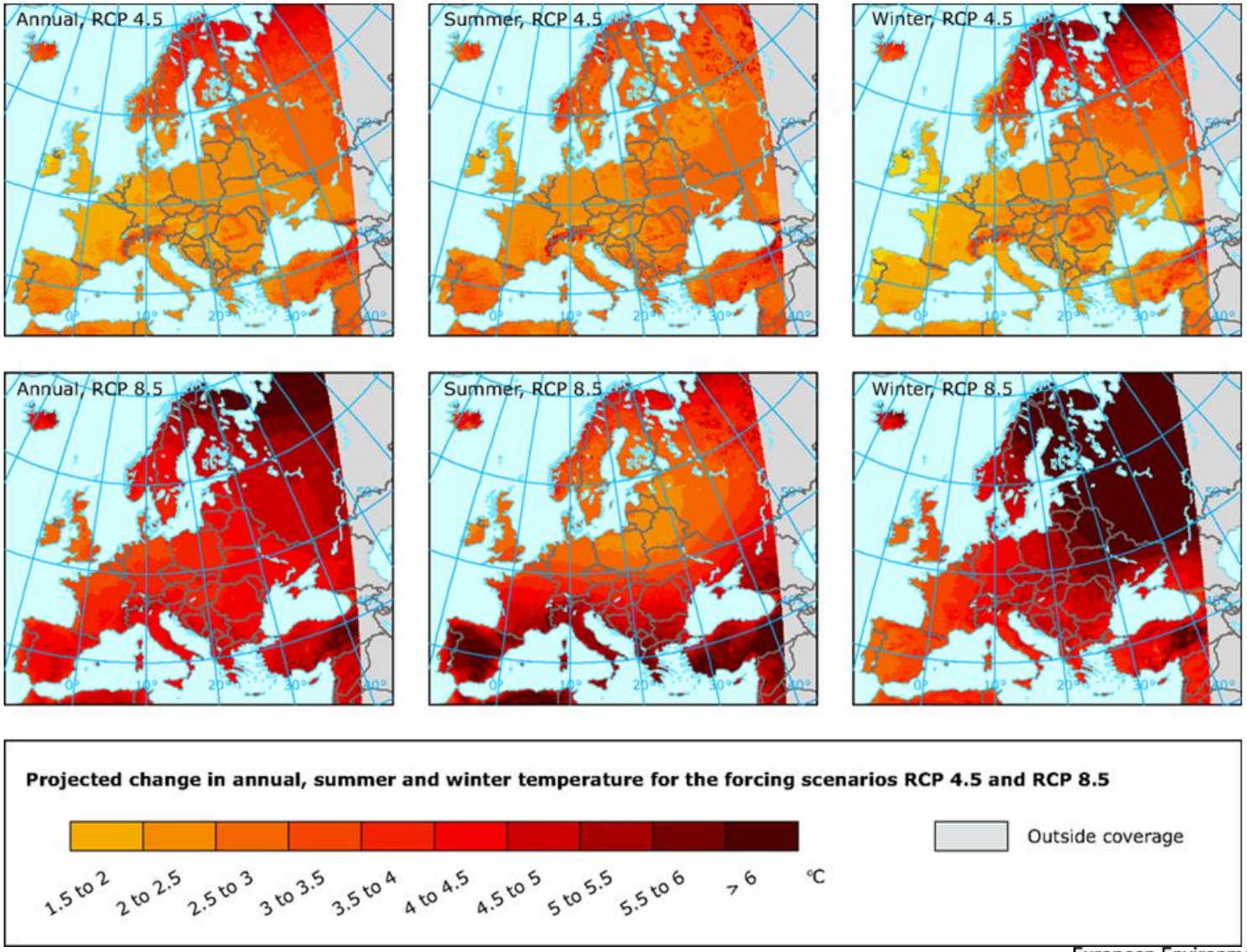
Projected temperature



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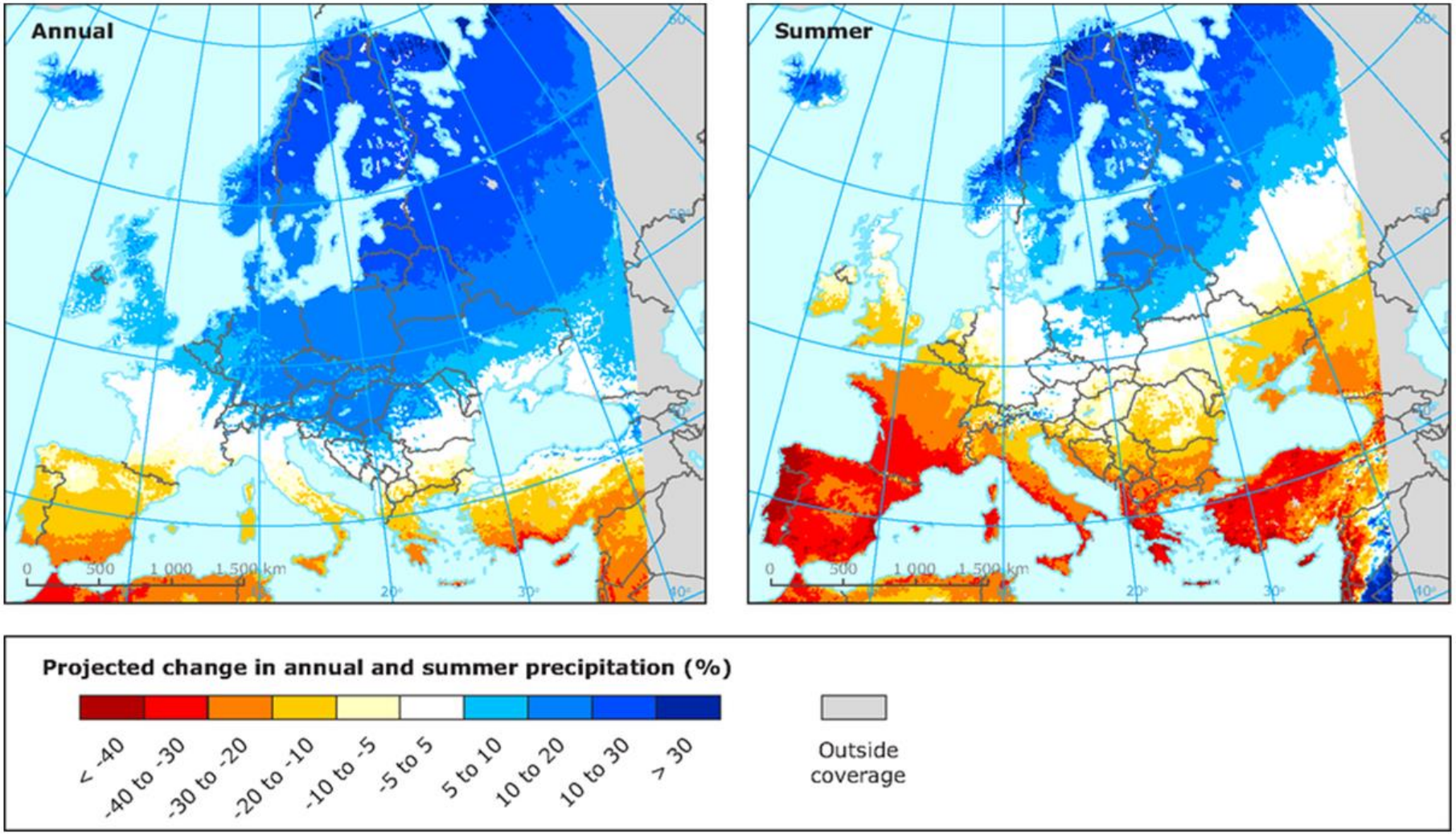
Source: Euro-CORDEX Jacob et el. 2014

Projected precipitation



Source: Euro-CORDEX Jacob et al. 2014, RCP8.5

Agriculture and climate change

1) Agriculture contributes to climate change through the release of GHGs, land cover changes, …

2) Agriculture is highly exposed to climate change, since it directly depends on climatic conditions

Climate change impacts and agricultural sector

- Extreme weather and climate events – droughts, heat waves, hail, frost, …

2015 Technical Report on extreme events

2017 report on CCA and DRR

- Climate and changes in agriculture –

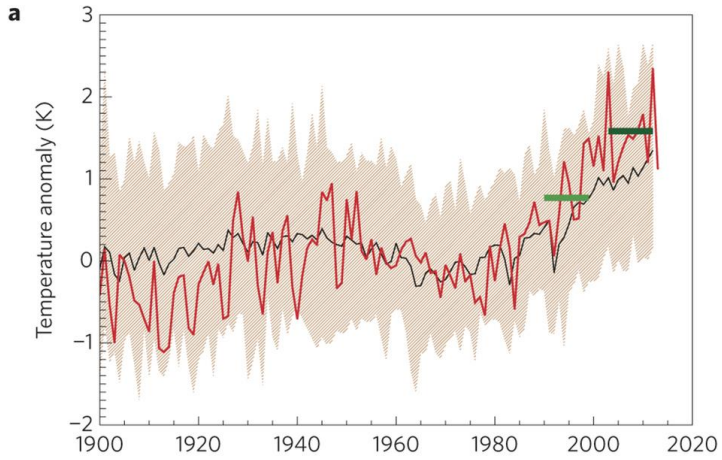
  changes in growing season, agrophenology, crop productivity, crop water demand

2016 EEA report on Climate change impacts in Europe

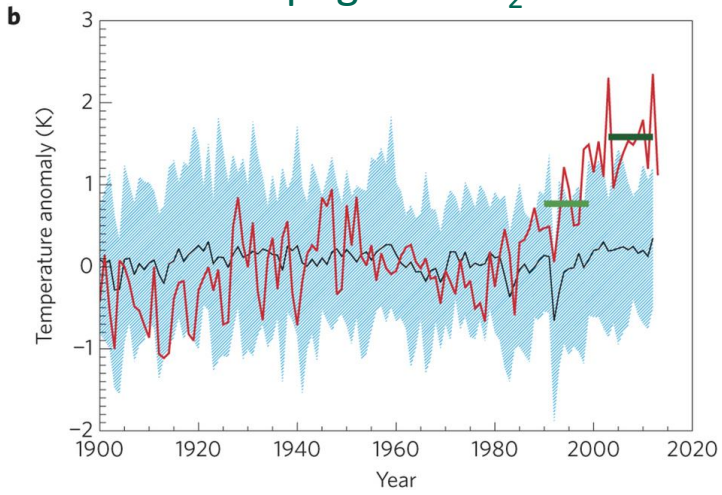
2018 EEA report on Climate change impacts and adaptation in agriculture sector

Climate change and extreme heat events

With anthropogenic CO_2 emissions



Without anthropogenic CO_2 emissions

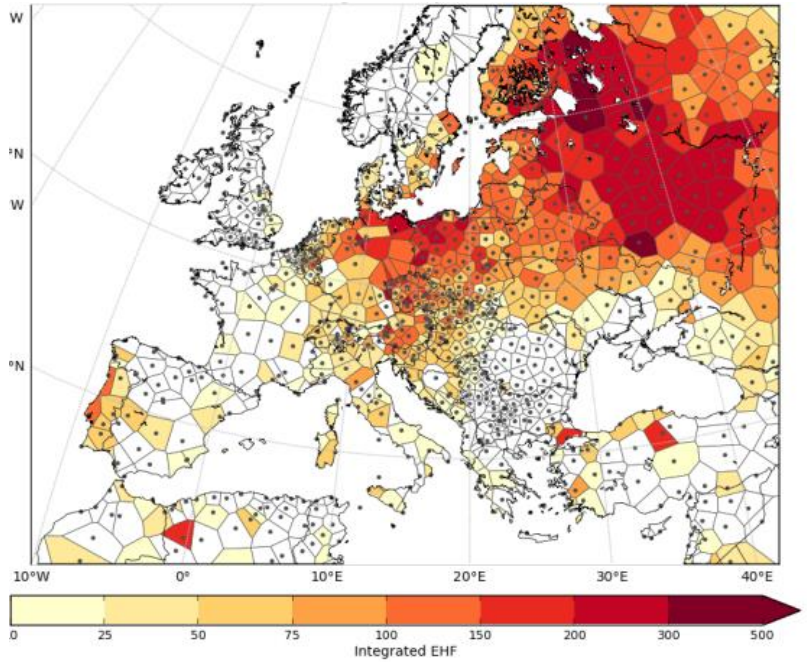


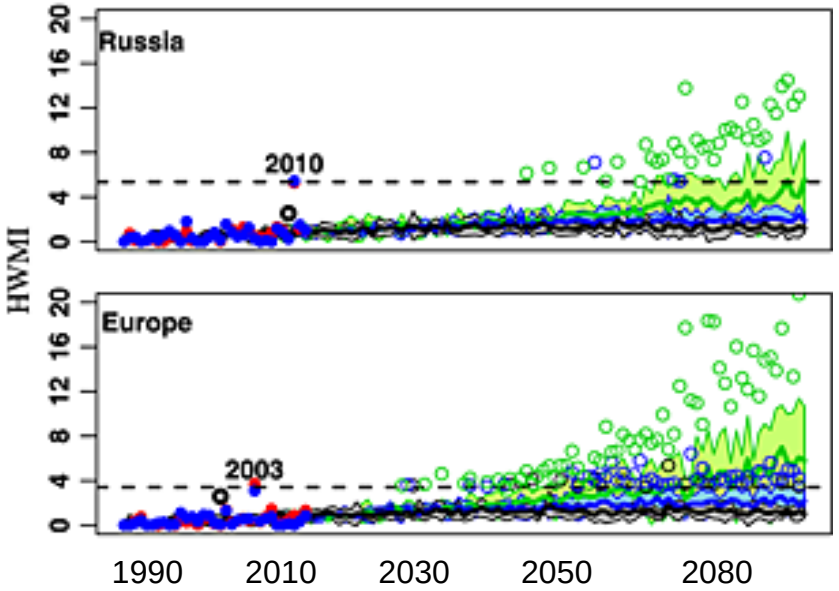
Source: Christidis et al., 2015

Extreme heat events can be attributed to anthropogenic climate change.

About 75% of the present day moderate daily hot extremes over land are attributable to human influence.

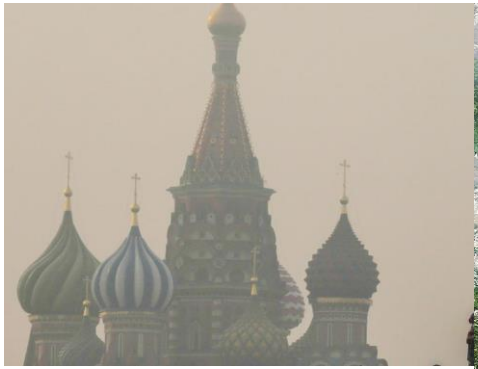
Extreme events and agriculture



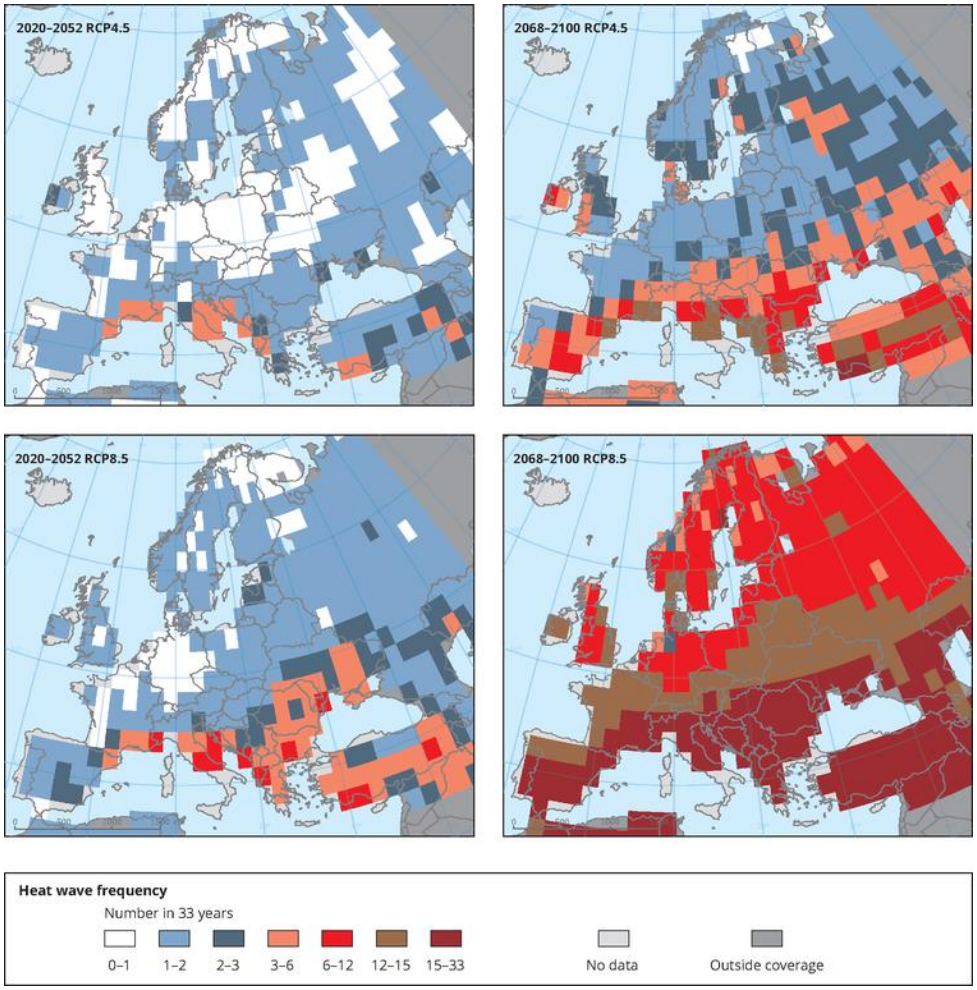


Russo et al., 2014

Russian heat wave in 2010, have had negative economic consequences for Europe.



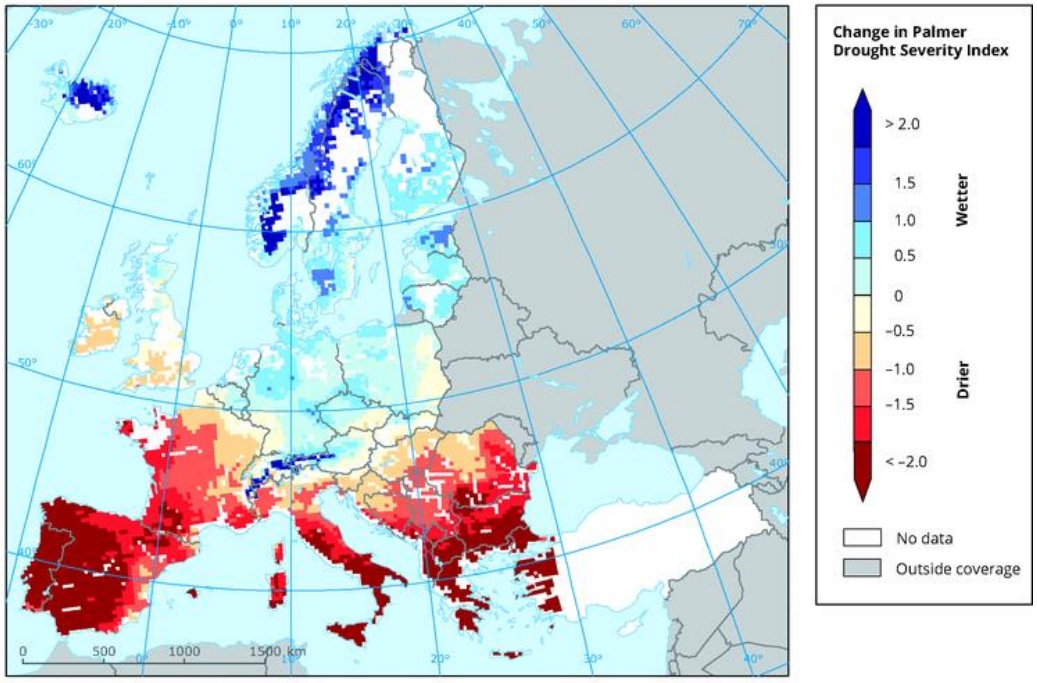
Heat waves and agriculture



- **Summers** like that experienced in 2003 or 2010 will become commonplace by the 2040s
- Prolonged high, or extreme summer temperatures lead to **reduced** crop yields
- **Heat waves** are also more persistent when there are **soil moisture deficits**

Droughts and agriculture

Changes in summer soil moisture between the periods 1961 to 1990 and 2021 to 2050



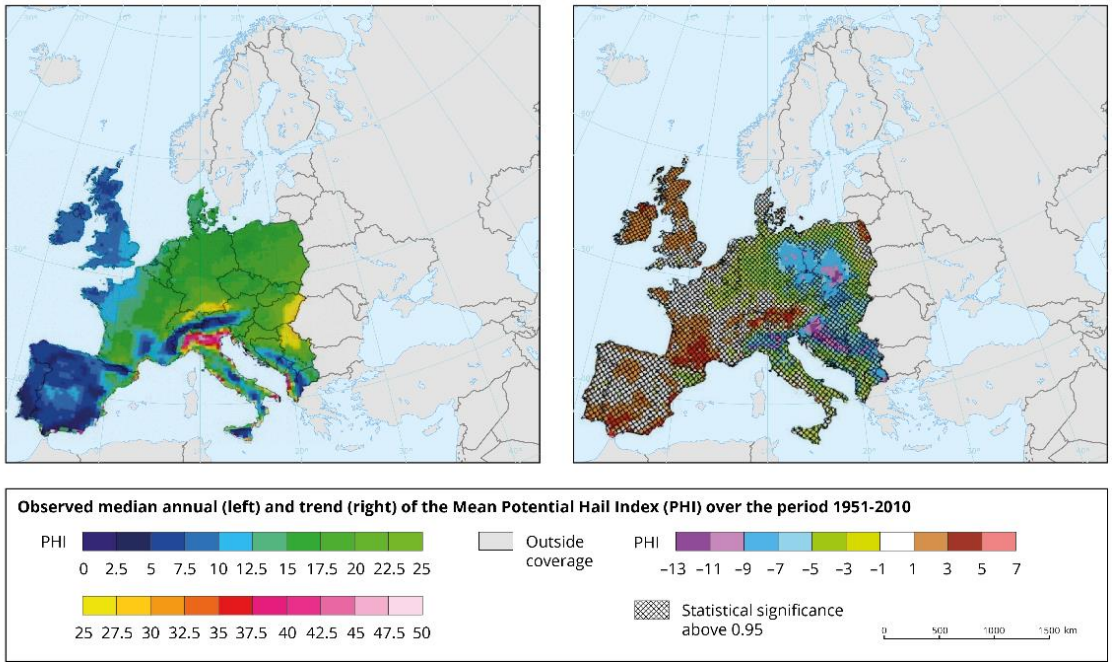
- Drought studies have identified drought hotspots in the **Mediterranean and southern Europe, the Carpathians and the Balkans.**

- Dry periods are expected to **occur 3 times more often** at the end of the current century and to last longer by 1 to 3 days compared to the period of 1971-2000.

Heinrich and Gobiet, 2011

Hail storms

Trends in Probabilistic Hail Index (PHI) between 1951 and 2010



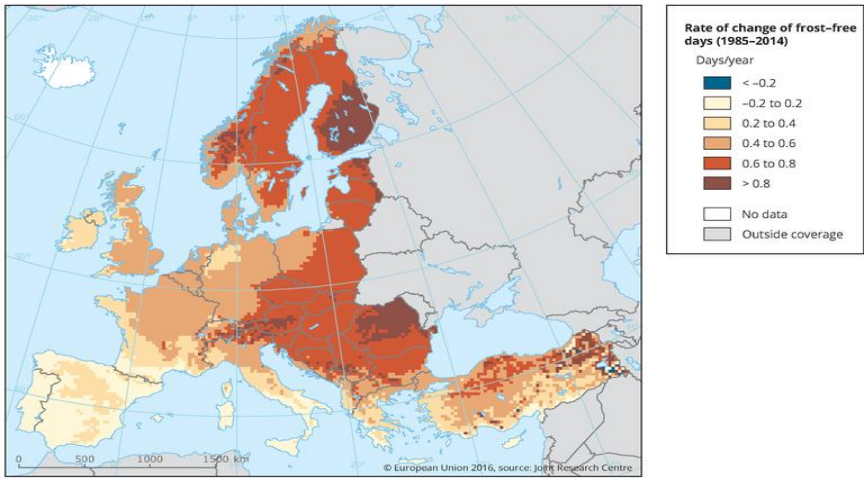
The atmosphere has become **more unstable over the last two to three decades** in parts of central Europe, south France and Spain

Increases in the convective conditions can lead to hail and in some **areas an increase in damage days**.

Source: KIT (Mohr, Kunz, and Geyer, 2015)

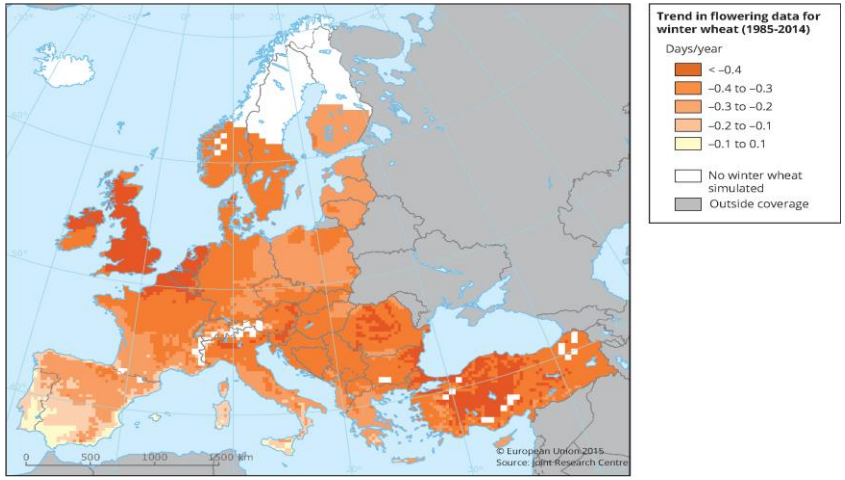
Growing season and phenology for agricultural crops

Trends in length of growing season



- Growing season has **lengthened by more than 10 days in last 40 years** – the most in northern and eastern Europe. To increase further throughout most of Europe.

Trends in flowering date for wheat



- Flowering and harvesting of several annual crops has advanced by about t**wo days per decade in the last 40 years**.
- The shortening of crop growth phases in many crops is expected to continue – **affecting quality.**

Source: JRC , 2015

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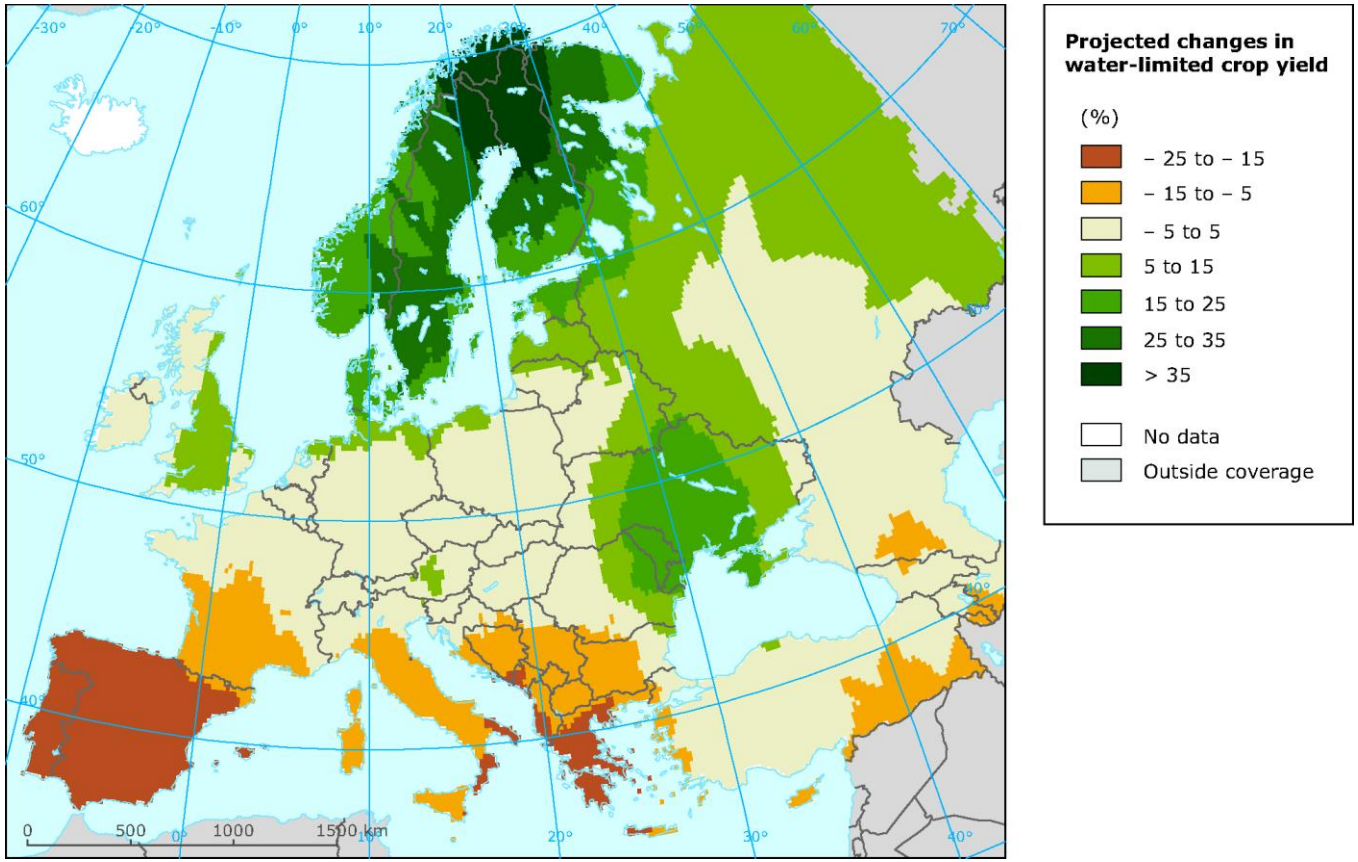
Projected change in water-limited crop yields



Source: Adapted from Iglesias et al. (2012), Ciscar et al. (2011).

A1B Scenario, 12 RCMs, 2050s.

Climate change impacts and agriculture

- The cultivation of crops, their productivity and quality, are **directly dependent** on weather and climate.

- Climate change is already having an impact on agriculture and it is one of the factors **contributing to stagnation** in wheat yields in parts of Europe despite continued progress in crop breeding

- **Recent heat waves, droughts, frost and hail** can greatly reduce the yield of some crops. The projected increase in the occurrence of such events is expected to increase risk of crop losses.

- **Climate change leads to changes in crop phenology and growing season,** advancements of flowering and harvest dates in cereals have been observed.

- **Climate change is projected to improve the suitability** for growing crops in northern Europe and to reduce crop productivity in large parts of southern Europe.

Thank you

See for more information:

http://www.eea.europa.eu/themes/climate
http://climate-adapt.eea.europa.eu/

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