Climate change impacts on agriculture in Europe

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Climate change impacts and adaptation

European Environment Agency

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“Climate change is a global problem with grave implications: environmental, social, economic, political and for the distribution of goods. It represents one of the principal challenges facing humanity in our day. Its worst impact will probably be felt by developing countries in coming decades.”

ENCYCLICAL LETTER LAUDATO SI’ OF THE HOLY FATHER FRANCIS, 2015

Important events in 2015

- 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
- COP 21
  - 2 ^{o}C target agreement (150 countries contributing to 90 % global emissions to commit)

European investments into Climate Change Service – Copernicus programme

- **To support mitigation and adaptation policies in Europe**
- **To be an authoritative source of climate information for Europe (evidence based policy making)**
- **To build upon national investments and complement national climate service providers**
- **To support the market for climate services in Europe**
- **Investing of around 250 M€ between 2015 and 2020**

How is the climate changing?

- Observations
- Reanalyses

Will climate change continue, accelerate?

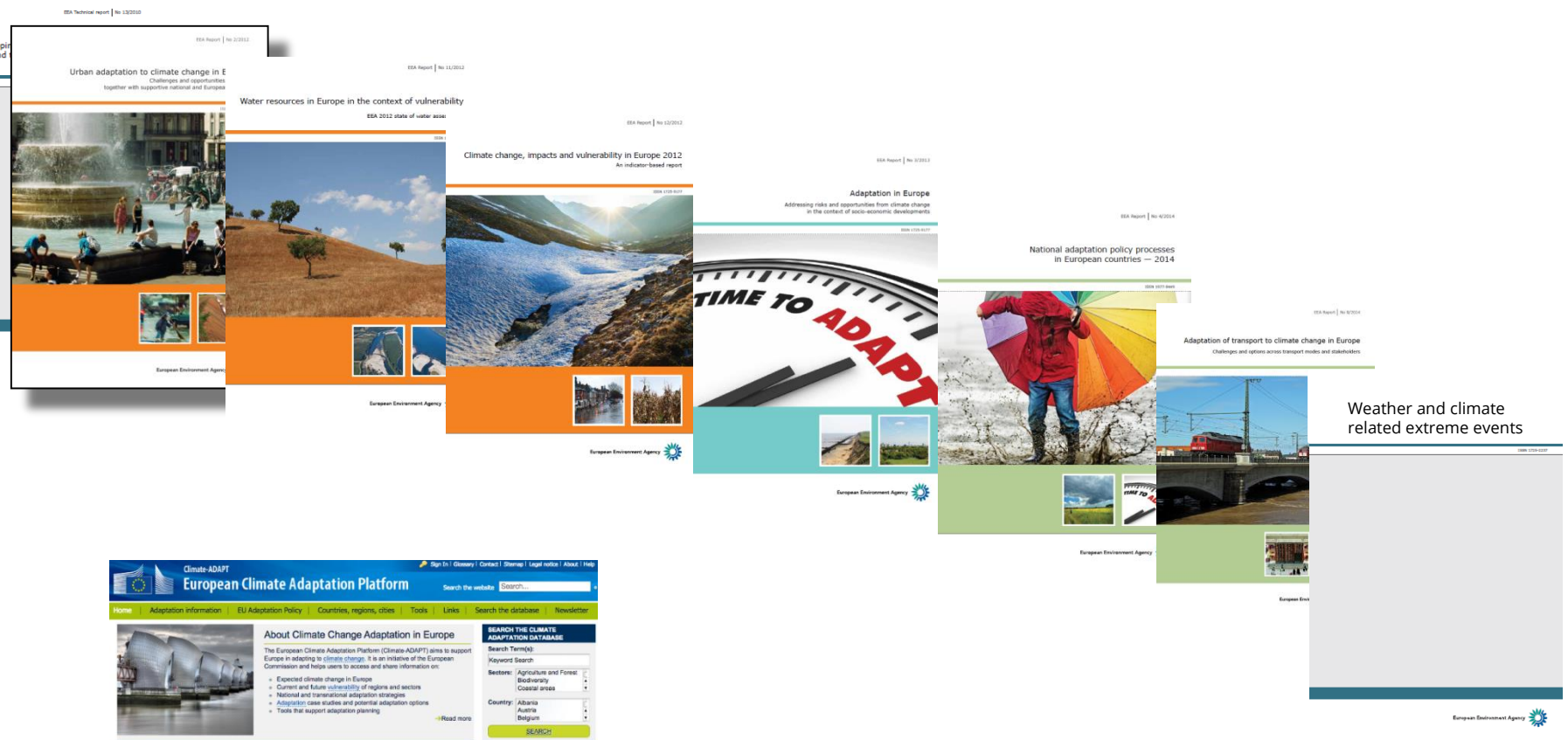
- Predictions
- Projections

What are the societal impacts?

- Climate indicators
- Sectoral information – including Agriculture

Source: ECMWF, 2015

EEA products on Climate Change



Direct support for developing European policies by providing reliable, relevant, timely, and targeted information

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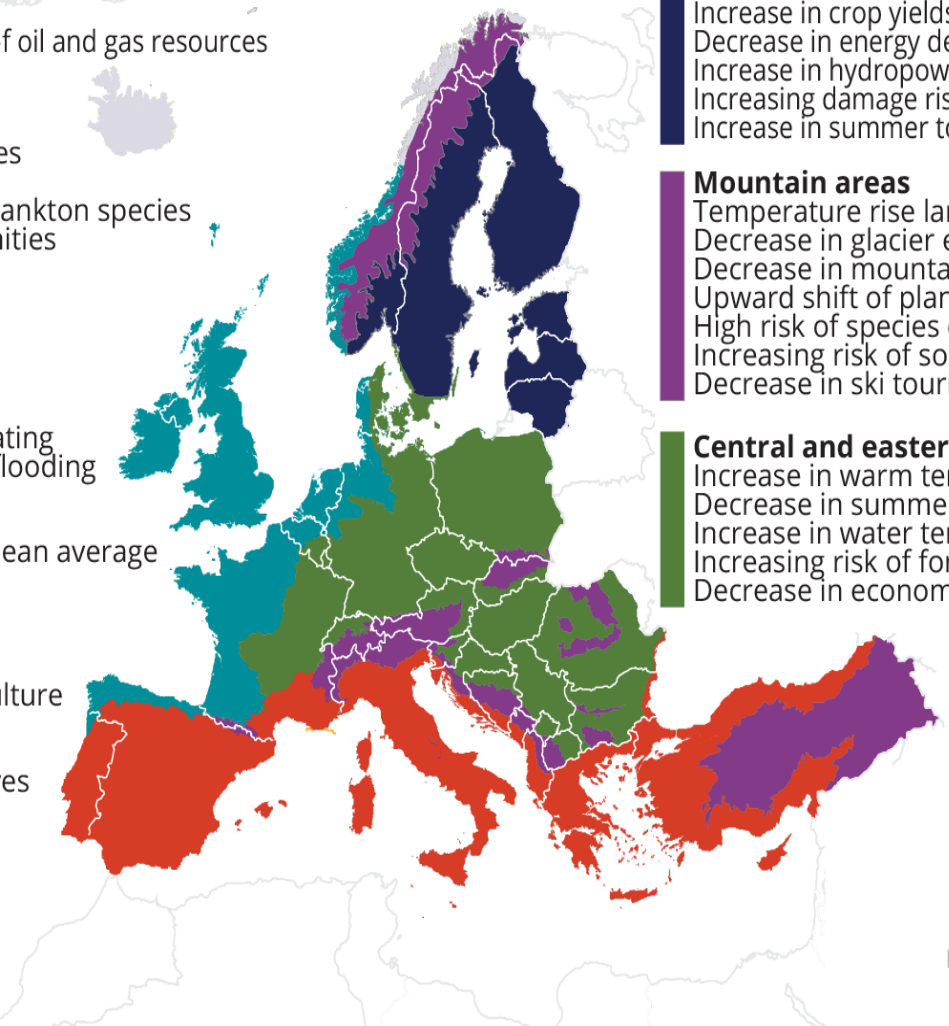
Key observed and projected impacts from climate change for the main regions in Europe- SOER 2015



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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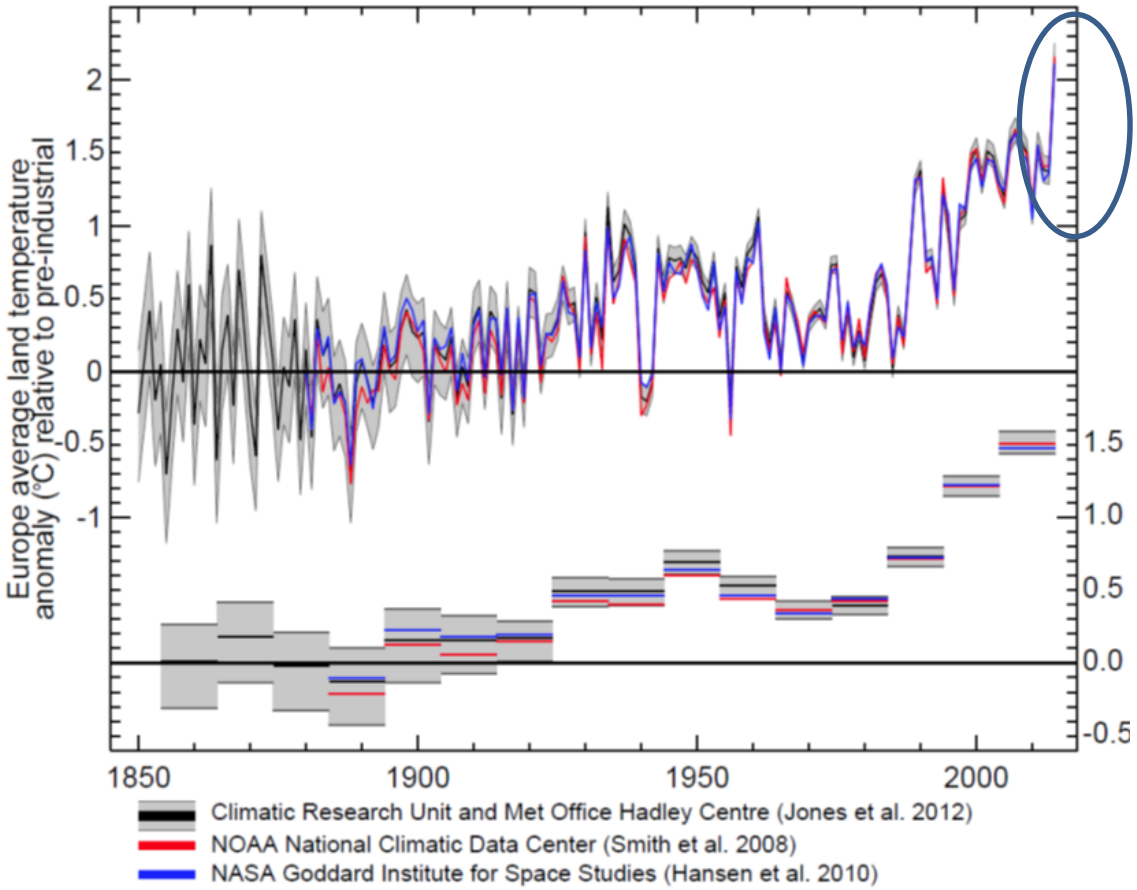
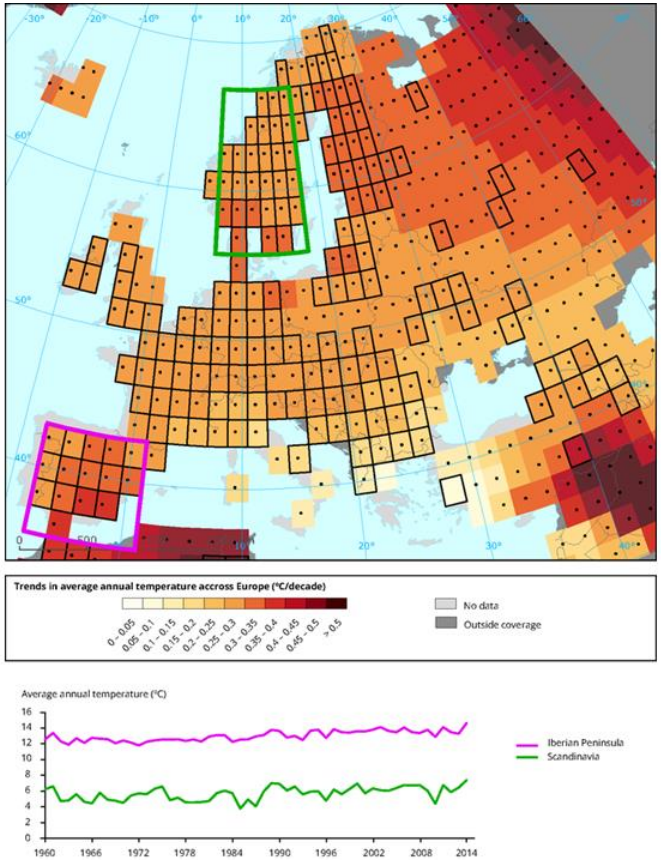
Climate change indicators-European temperature





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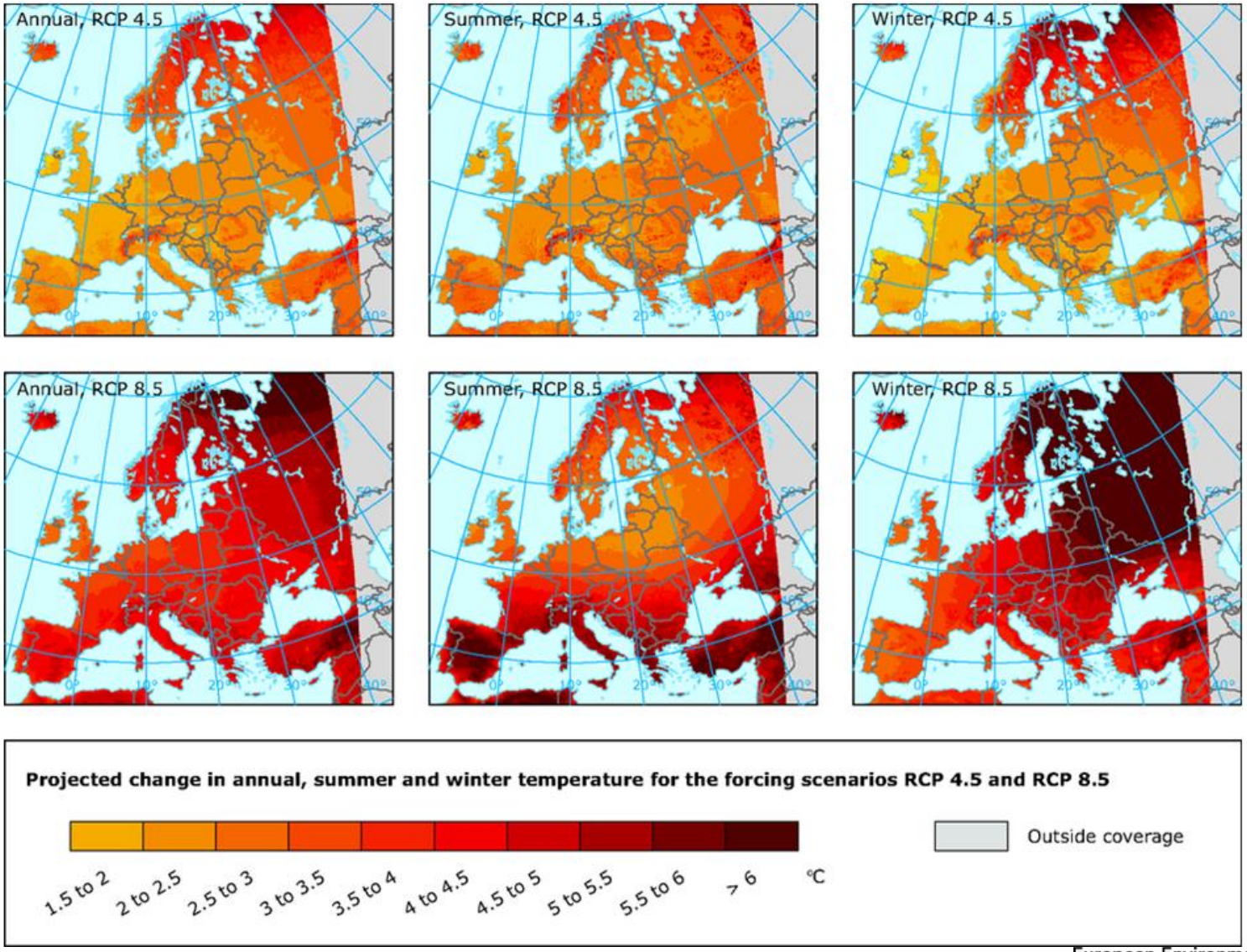
Projected temperature



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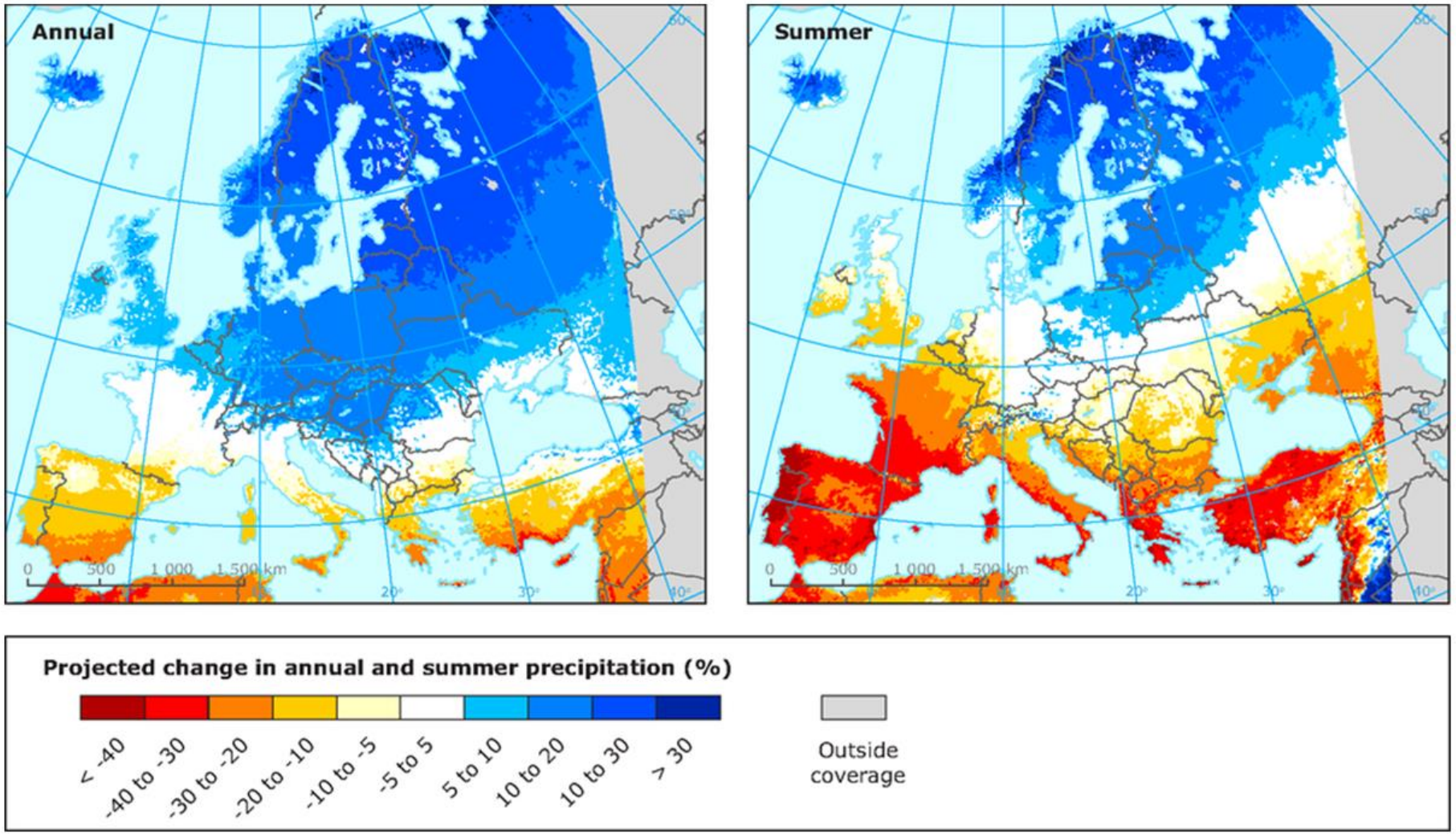
Source: Euro-CORDEX Jacob et el. 2014

Projected precipitation



Source: Euro-CORDEX Jacob et el. 2014

Climate change impacts …

… and agriculture

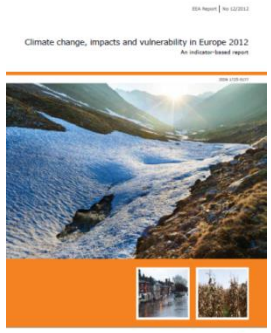
Climate change and agriculture

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

2015 Technical Report on extreme events

- Climate and changes in agriculture – changes in growing season, agrophenology, crop productivity, crop water demand

2016 EEA report on Climate change impacts in Europe



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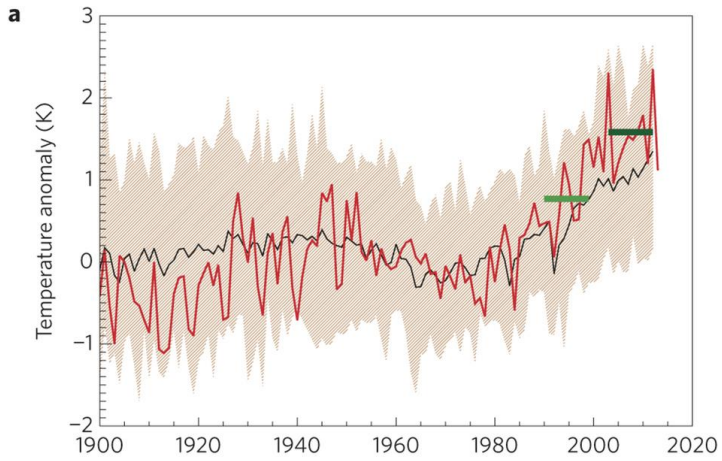
Extremes and agriculture – key findings

Extreme climatic events, including droughts and heat waves, have negatively affected crop productivity during the first decade of the 21st century.

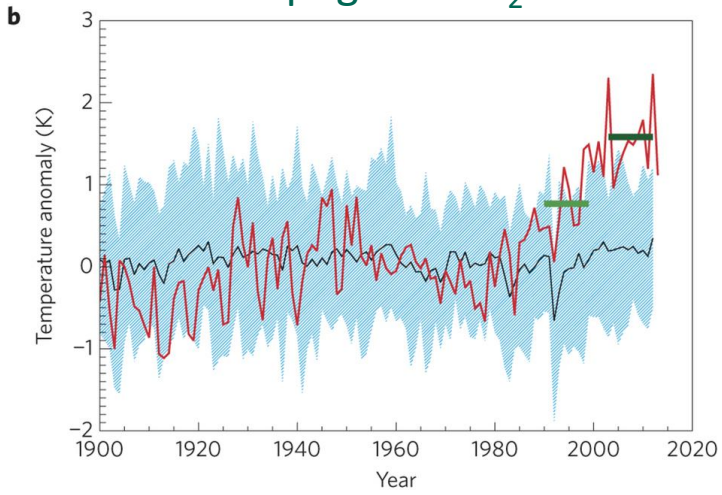
Projected increases in extreme climatic events are expected to further increase yield variability in the future throughout Europe.

Climate change and extreme events

With anthropogenic CO_2 emissions



Without anthropogenic CO_2 emissions



Source: Christidis et al., 2015

Extreme 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.

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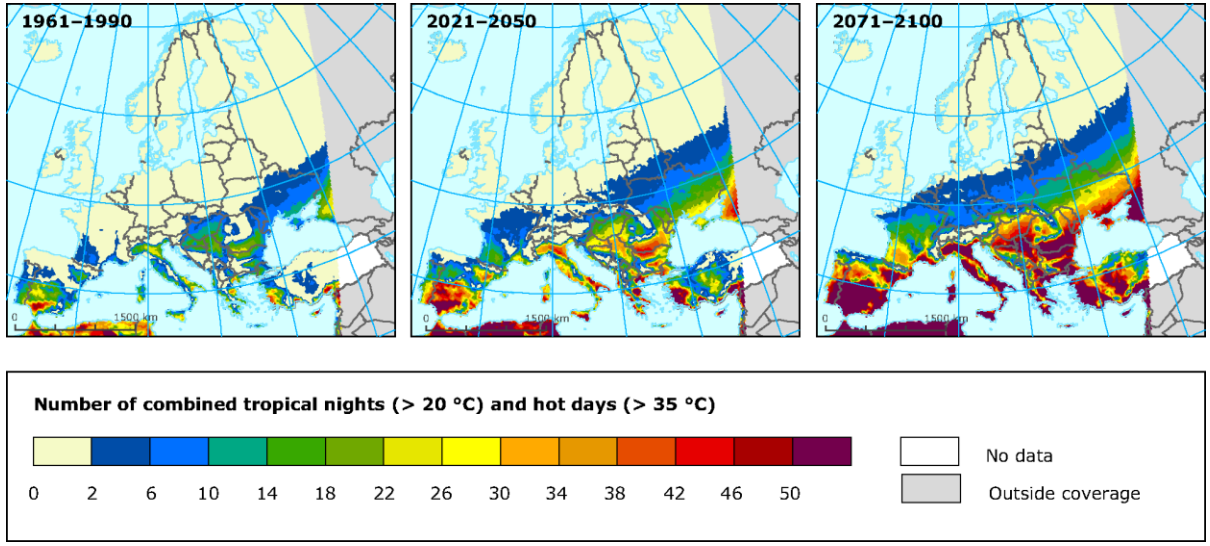
Heat waves and agriculture

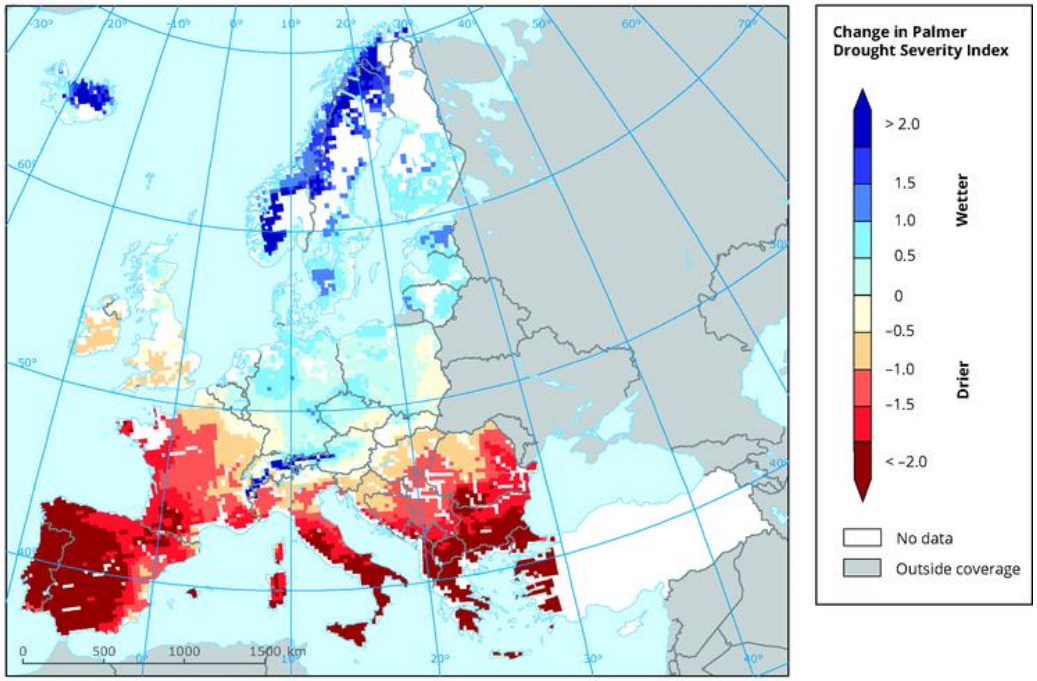


Fischer & Schär, 2010

- Under future climate change the number, duration, and intensity of heat waves is expected **to increase**
- **Summers** like that experienced in 2003 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

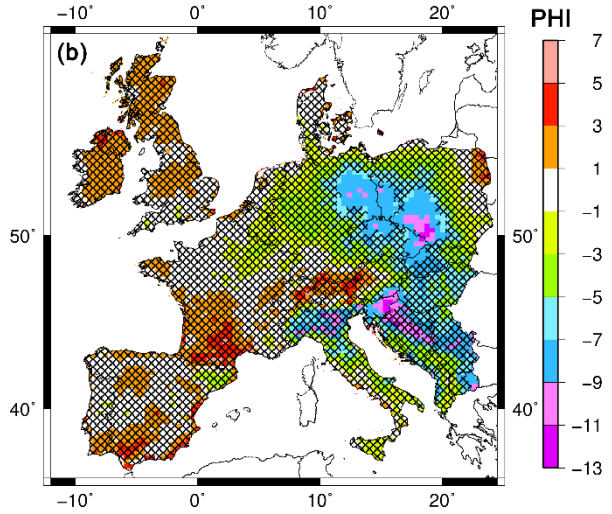


- Drought studies have identified drought hotspots in the **Mediterranean and southern Europe, the Carpathians and the Balkans.**
- Regional climate models for Europe project a decrease in summer soil moisture of **17 % on average, and by 30 % in June** for the period of 2071-2100.
- Dry periods are 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.

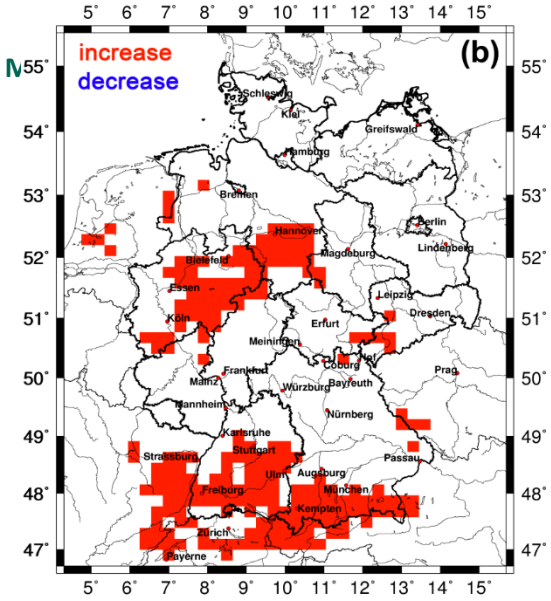
Heinrich and Gobiet, 2011

Hail

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



PHI between 2021-2050 and 1971-2000



- The atmosphere has become more unstable over the last two to three decades in parts of central Europe, south France and Spain
- Hailstorm projection studies, although limited to France, Northern Italy and Germany, show increases in the convective conditions that lead to hail and in some areas an increase in damage days.

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

Climate impact on agriculture

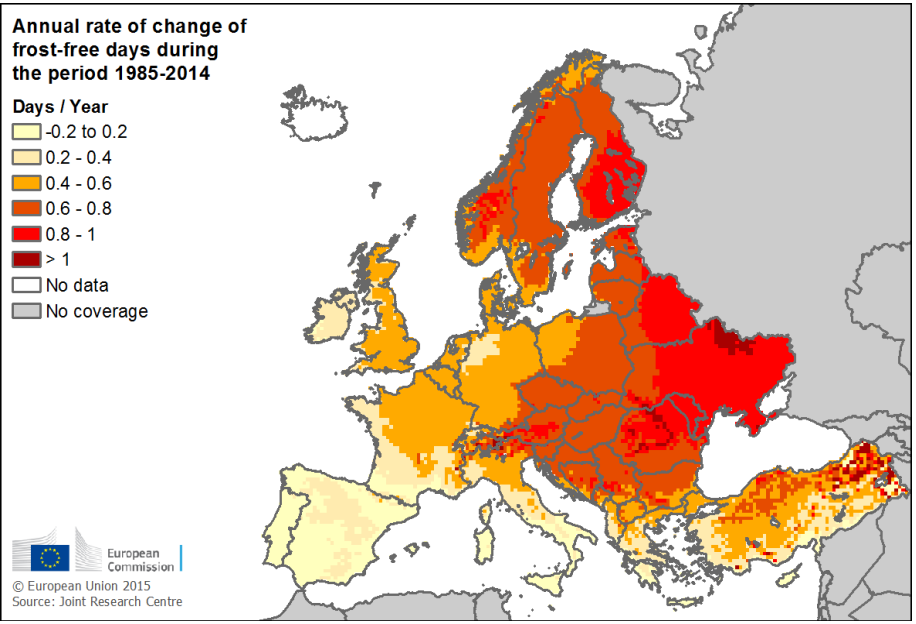
- The cultivation of crops, their productivity and quality, are **directly dependent** on different climatic factors

- 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

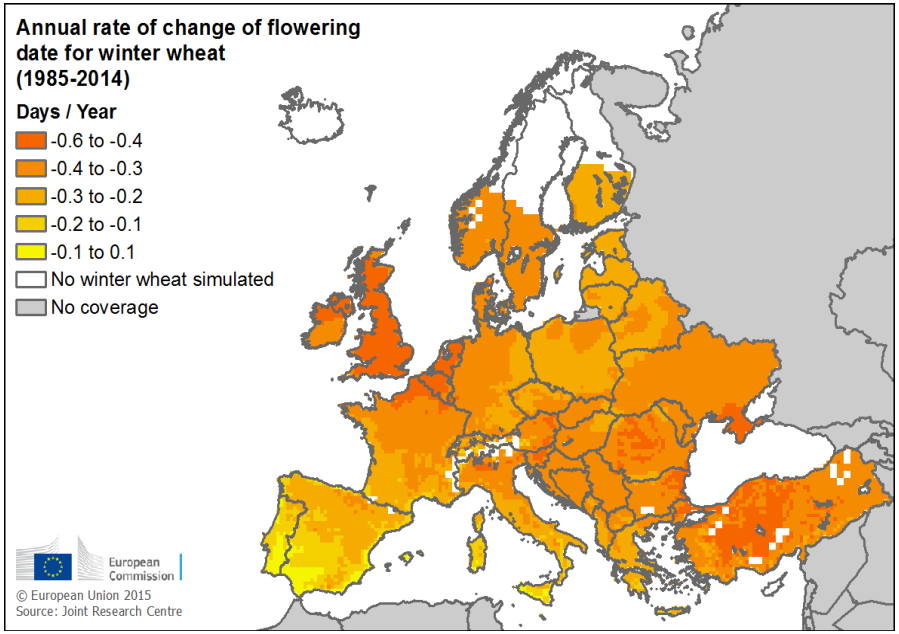
- Climate change is expected **to continue to affect agriculture** in the with effects greatly varying in Europe.

Growing season and phenology for agricultural crops

Trends in length of growing season



Trends in flowering date for wheat

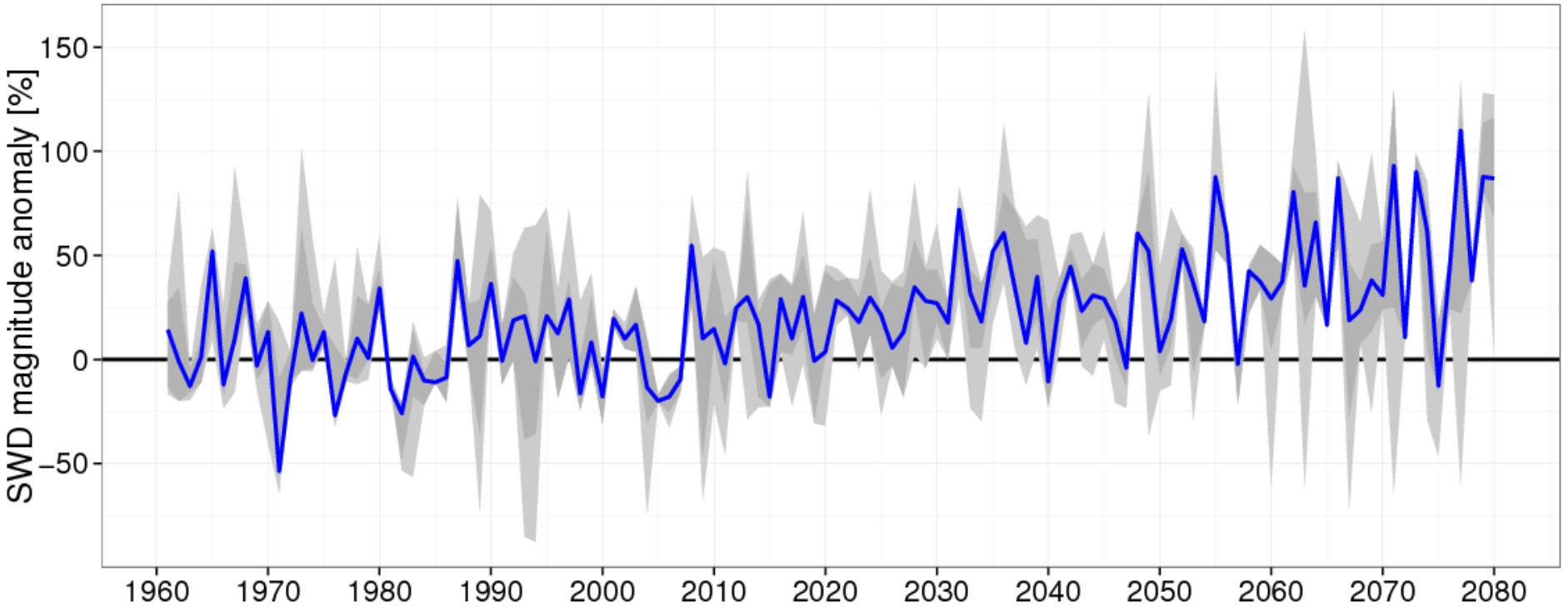


Source: JRC – IES, 2015

Growing season and phenology for agricultural

- Growing season has lengthened by more than 10 days in last 40 years – the most in northern and eastern Europe.
- The growing season is projected to increase further throughout most of Europe.
- The projected lengthening of the thermal growing season would allow a northward expansion of warm-season crops to areas that were not previously suitable.
- Flowering of several annual crops has advanced by about two days per decade in the last 40 years - affecting crop production
- The shortening of crop growth phases in many crops is expected to continue.

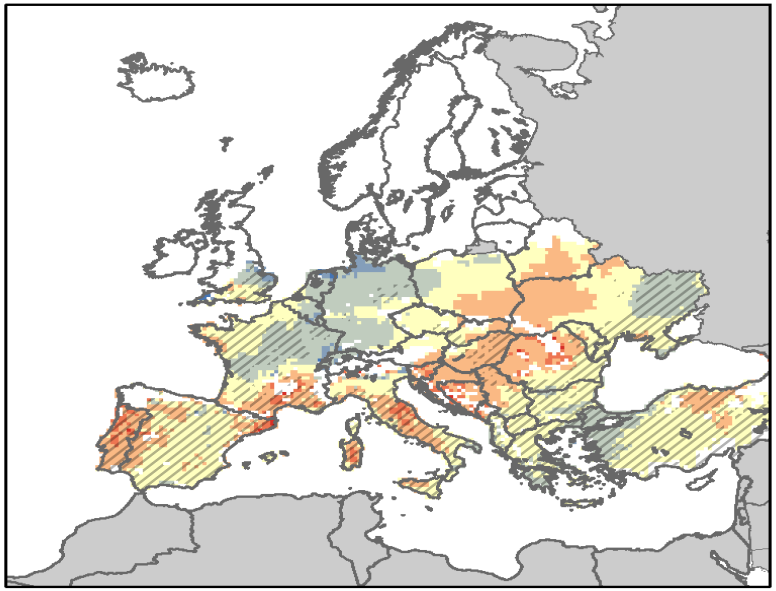
Agriculture water demand – soil water deficit



Ensemble of models based on A1B scenario

Agriculture water demand

HadGEM2



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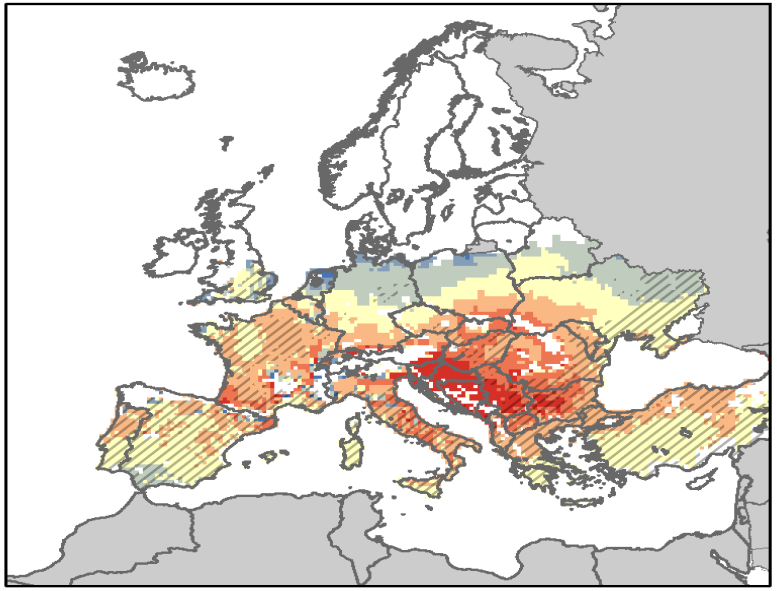

Source: JRC –IES ,2015

WOFOST projections of change in crop water deficit for grain maize growing season in 2030s, as compared to the reference period centred around 2000 for two different global climate models based on RCP8.5

Red: increases in crop water deficit

Blue: decreases in crop water deficit

Agriculture water demand

- **Climate change had led to an increase** in the crop water demand and crop water deficit in large parts of central and southern Europe.

- **The projected increases in temperature** will lead to increased potential evapotranspiration rates → **increasing** crop water demand across Europe.

- The impact of increasing water requirements is expected to be most acute in **southern and central Europe**, where the crop water deficit and irrigation requirements are projected to increase.

Conclusions

- **An increase in the duration** of the thermal growing season has led to northward expansion of areas suitable for several crops.

- **Changes in crop phenology** have been observed, such as advancement of flowering and harvest dates in cereals.

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

- **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. Projections based on different climate models agree on the direction of the change, but with some variation in its magnitude.

Thank you

See for more information:

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

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