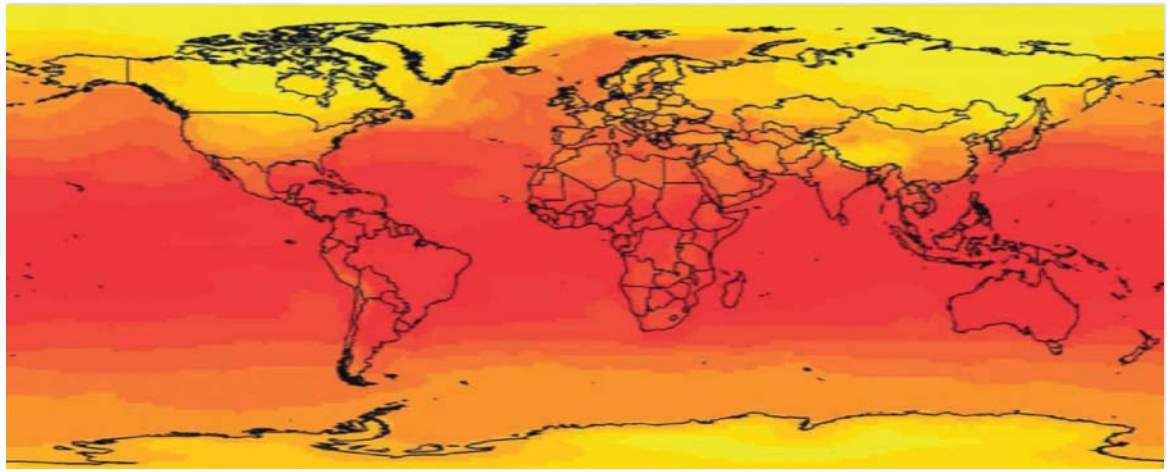


Drought and agriculture - Climate change impacts in Germany

1st Rhine-Mekong Symposium
"Climate change and its influence on water and related sectors"
8-9 May 2014, Koblenz, Germany

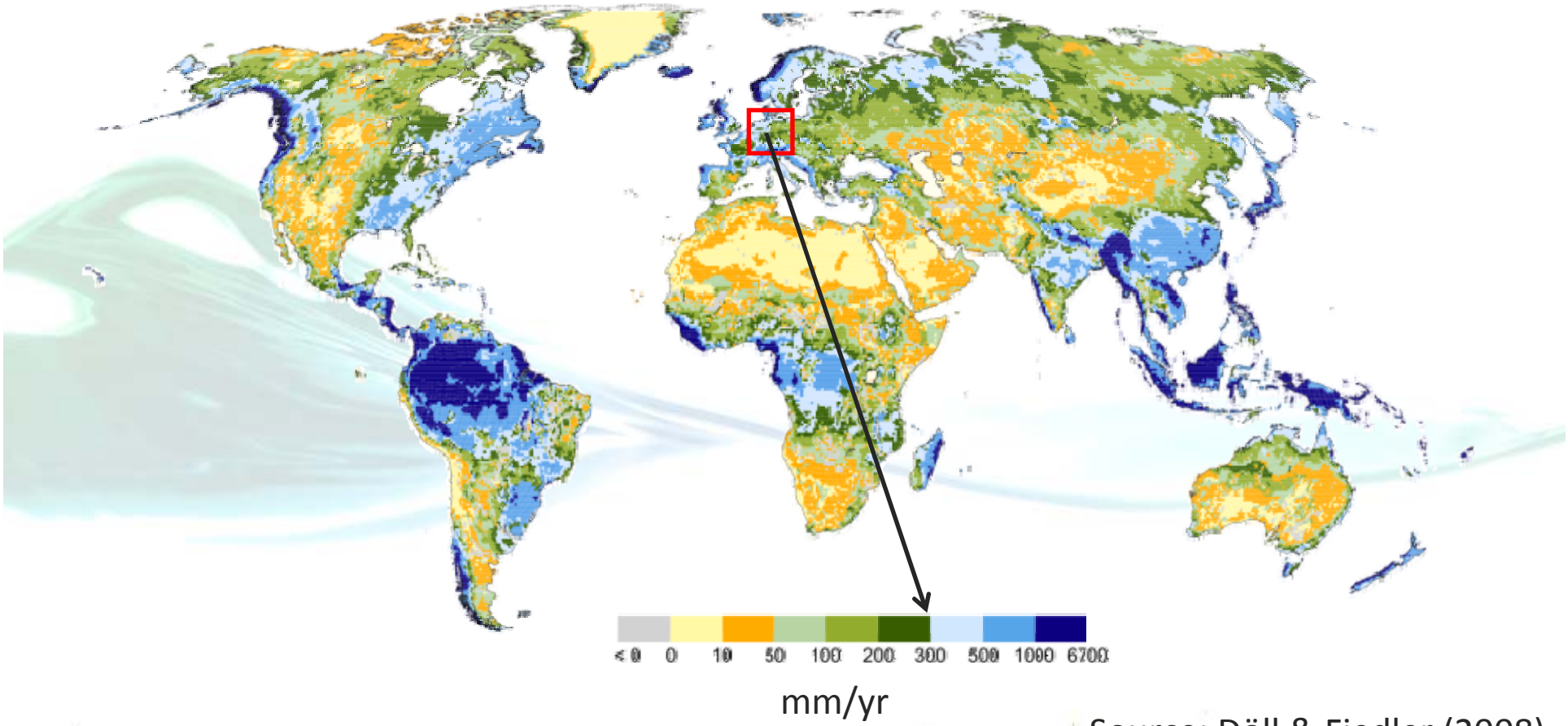
Dr. Enno Nilson
Federal Institute of Hydrology (BfG)

Outline

- Knowledge so far
- Challenges
- Need for cooperation

Global fresh water resources (1961-1990)

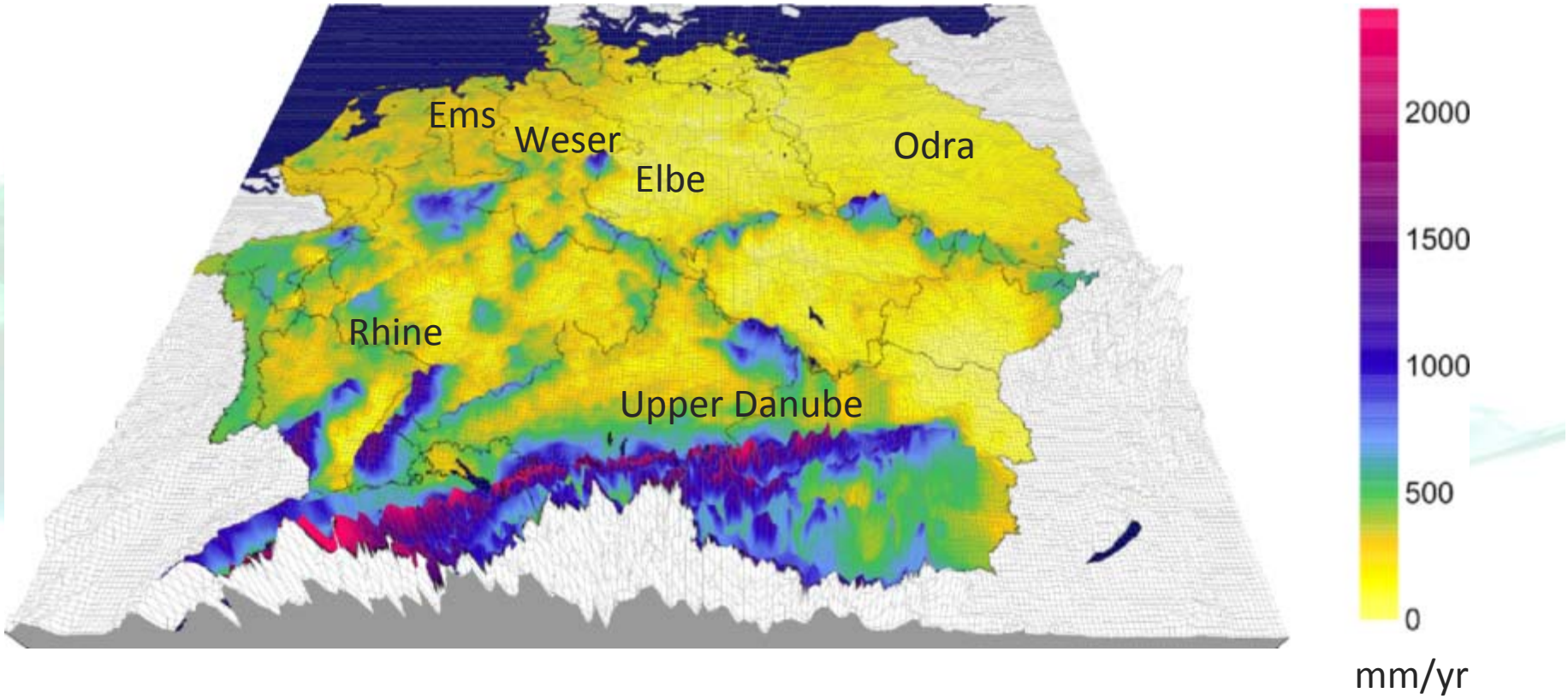
→ Central Europe has a lot of water as compared to other regions of the globe.



Source: Döll & Fiedler (2008)

Central European fresh water resources (1961-1990)

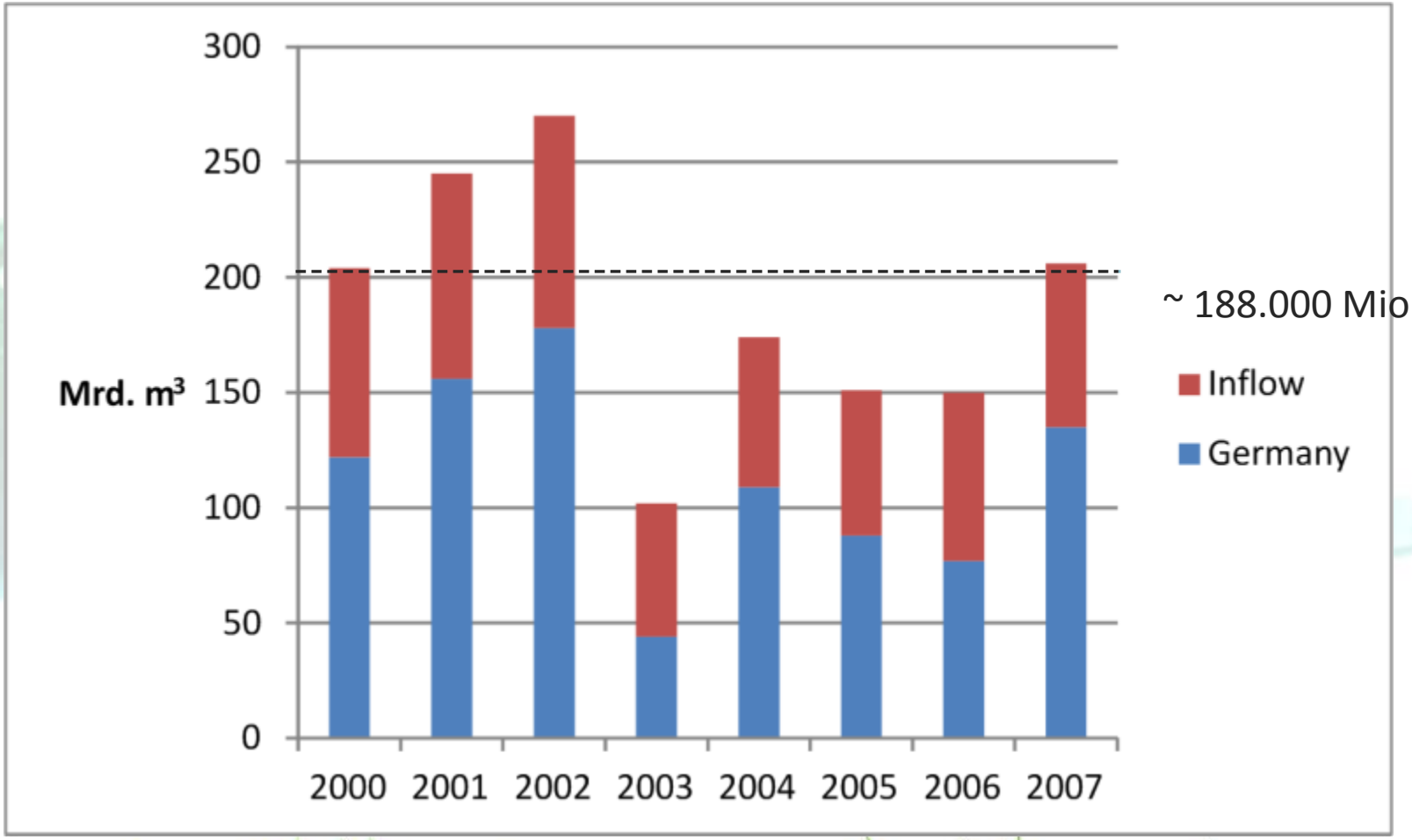
→ Water resources are unevenly distributed in space.



Source: Nilson & Krahe (in prep.)

German fresh water resources (2000-2013)

→ Water resources are unevenly distributed in time.

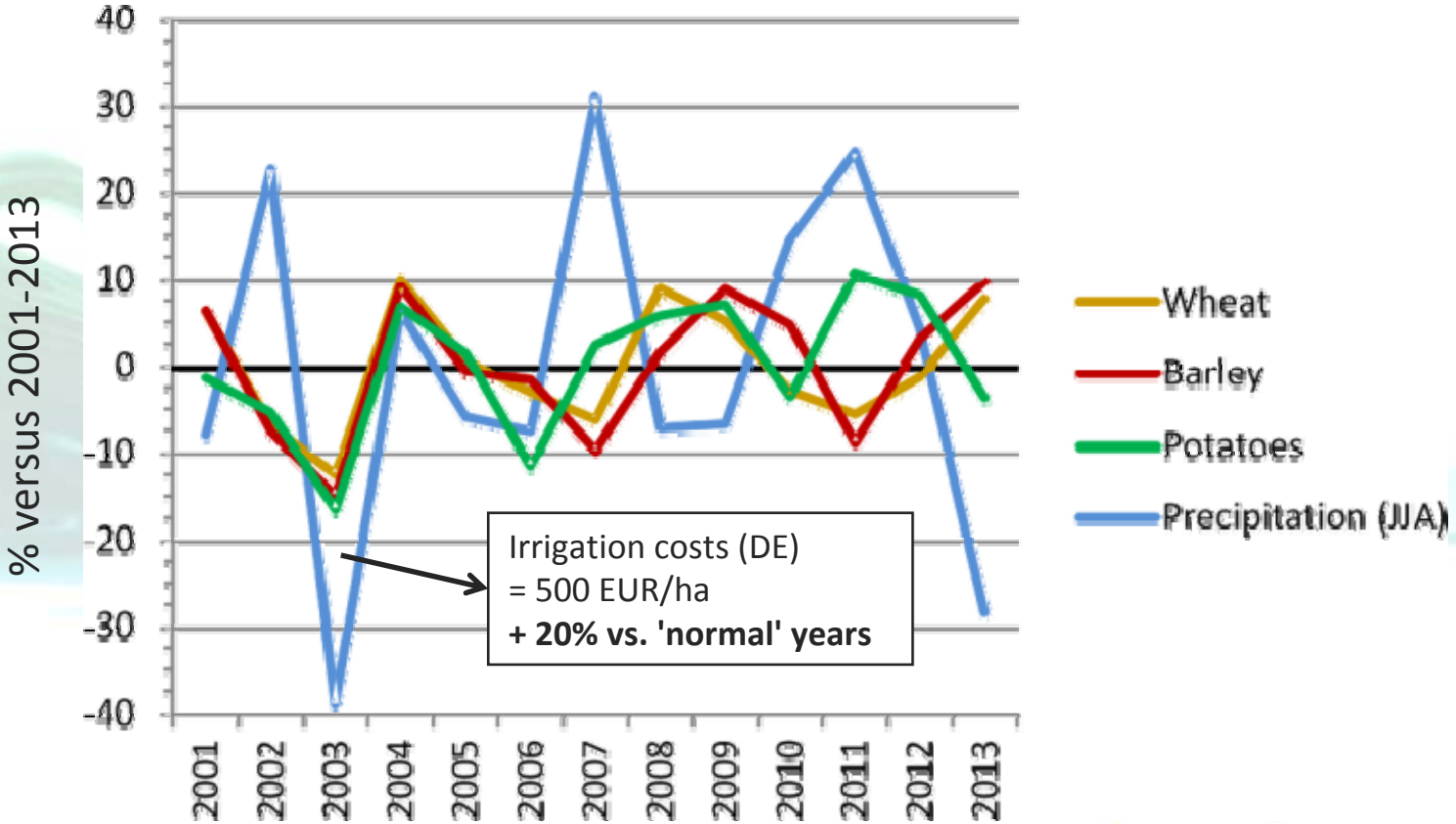


Data: EUROSTAT, DESTATIS, UBA, BfG

Anomalies of precipitation and crop yields in Germany (2001-2013)

→ Agriculture is vulnerable to drought conditions.

→ Relation of met. conditions and crop yields is complex.

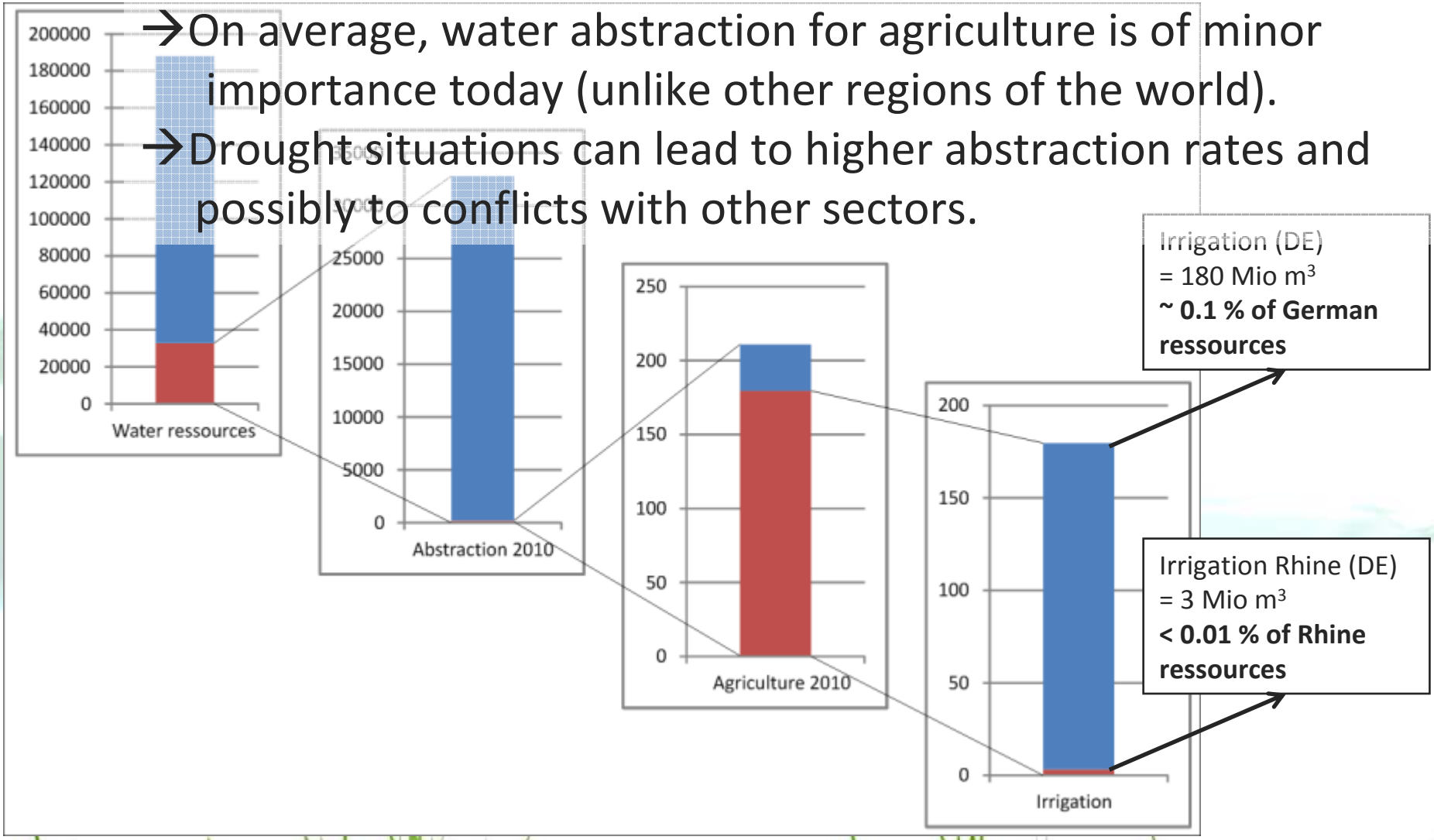


Data: DESTATIS

Water abstraction in Germany (Mio m^3/yr)

→On average, water abstraction for agriculture is of minor importance today (unlike other regions of the world).

→Drought situations can lead to higher abstraction rates and possibly to conflicts with other sectors.

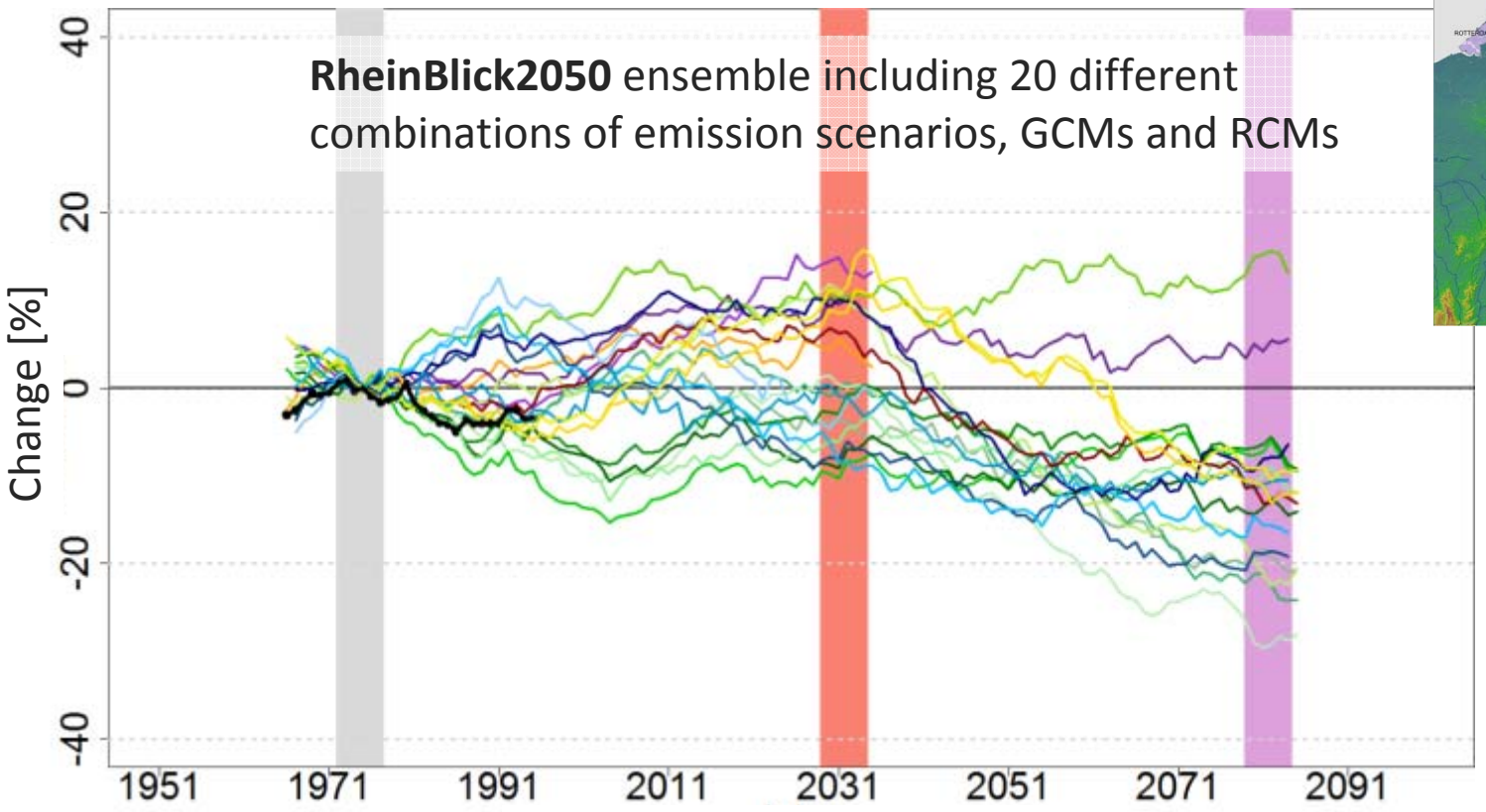


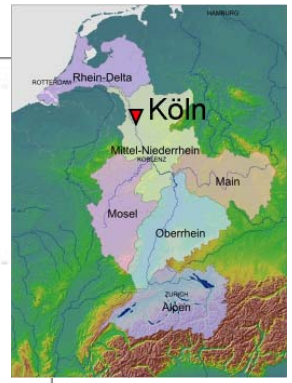
Data: EUROSTAT, DESTATIS

Observed and simulated mean summer flow change at Cologne

→ Hydrological drought situations are projected to increase in the distant future while there is no clear signal in the near future.

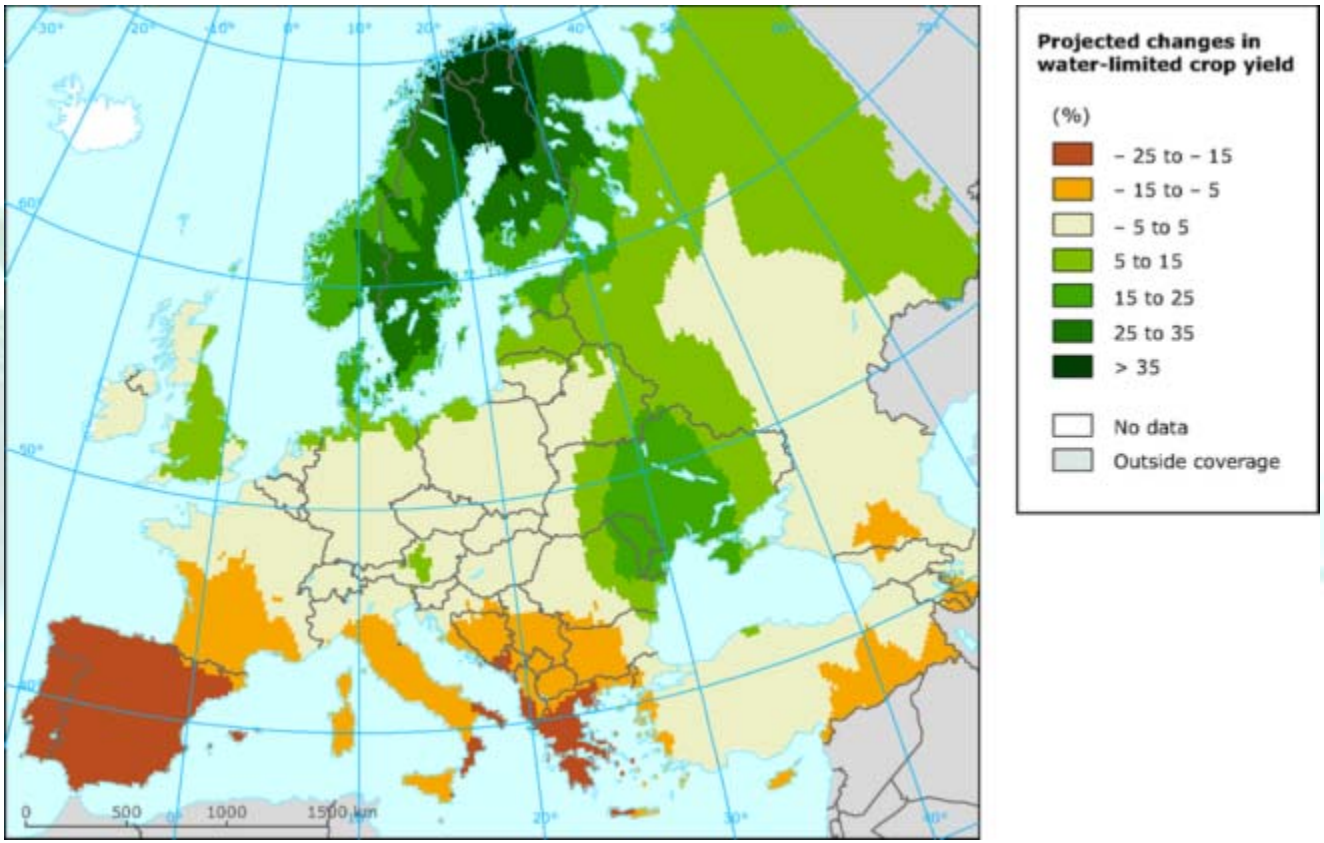
Model chain: ***SRES_GCM_RCM***_LS_EPW_HBV





Projected changes in water-limited crop yield (2050)

→ Consequences of agricultural drought situations in the Rhine catchment are uncertain, but seem limited.



Source: Universidad Politecnica de Madrid, EEA

Knowledge so far
Summary (River Rhine Basin)

- The countries in the River Rhine Basin have a lot of water available as compared to other regions of the globe.
- However, water resources are unevenly distributed in space and time and need to be managed.
- On average, water abstraction for agriculture is of minor importance today (unlike other regions of the world).
- Drought situations can lead to higher abstraction rates and possibly to conflicts with other sectors.
- Agriculture is vulnerable to drought conditions, but the relationship between hydrometeorological conditions and crop yields is complex (soils, individual requirements of crop types, etc.).

- Hydrological drought situations are projected to increase in the distant future (2100) while there is no clear signal in the near future (2050).
- Accordingly, projected changes in agricultural drought situations in the River Rhine Basin are uncertain, but seem limited in near future (2050).

Challenges

IPCC Statements on Soil water change and Droughts

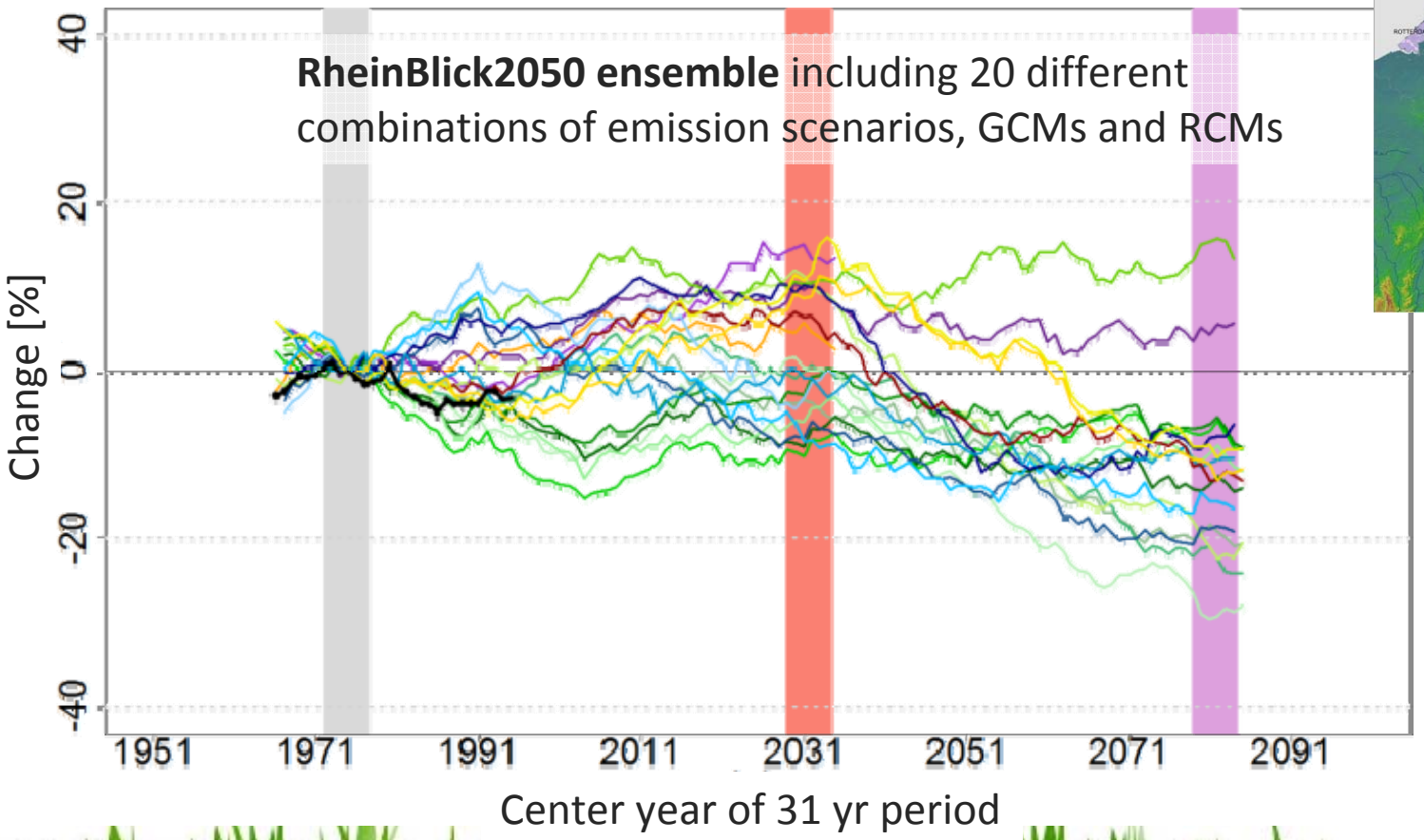
- IPCC SREX: The **type of drought** considered and the **complexities in defining drought** can substantially affect the conclusions regarding trends on a global scale
- IPCC AR5 (WG-I): Regional to global-scale **projections** of soil moisture and drought remain **relatively uncertain** compared to other aspects of the water cycle
  - Potential evapotranspiration model
  - Soil properties, land surface conditions
  - High internal variability

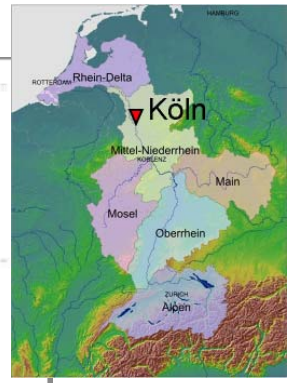
How should we describe droughts?

- prevailing dry and warm weather
  → **meteorological drought (rainfall deficit)**
- decreasing stream flow and groundwater flow
  → **hydrological drought**
- reduced soil water content during the growing season
  → **agricultural drought**
- demand exceeds the supply (incl. storage systems)
  → **socio-economic drought, water scarcity**

How should we describe uncertainty?

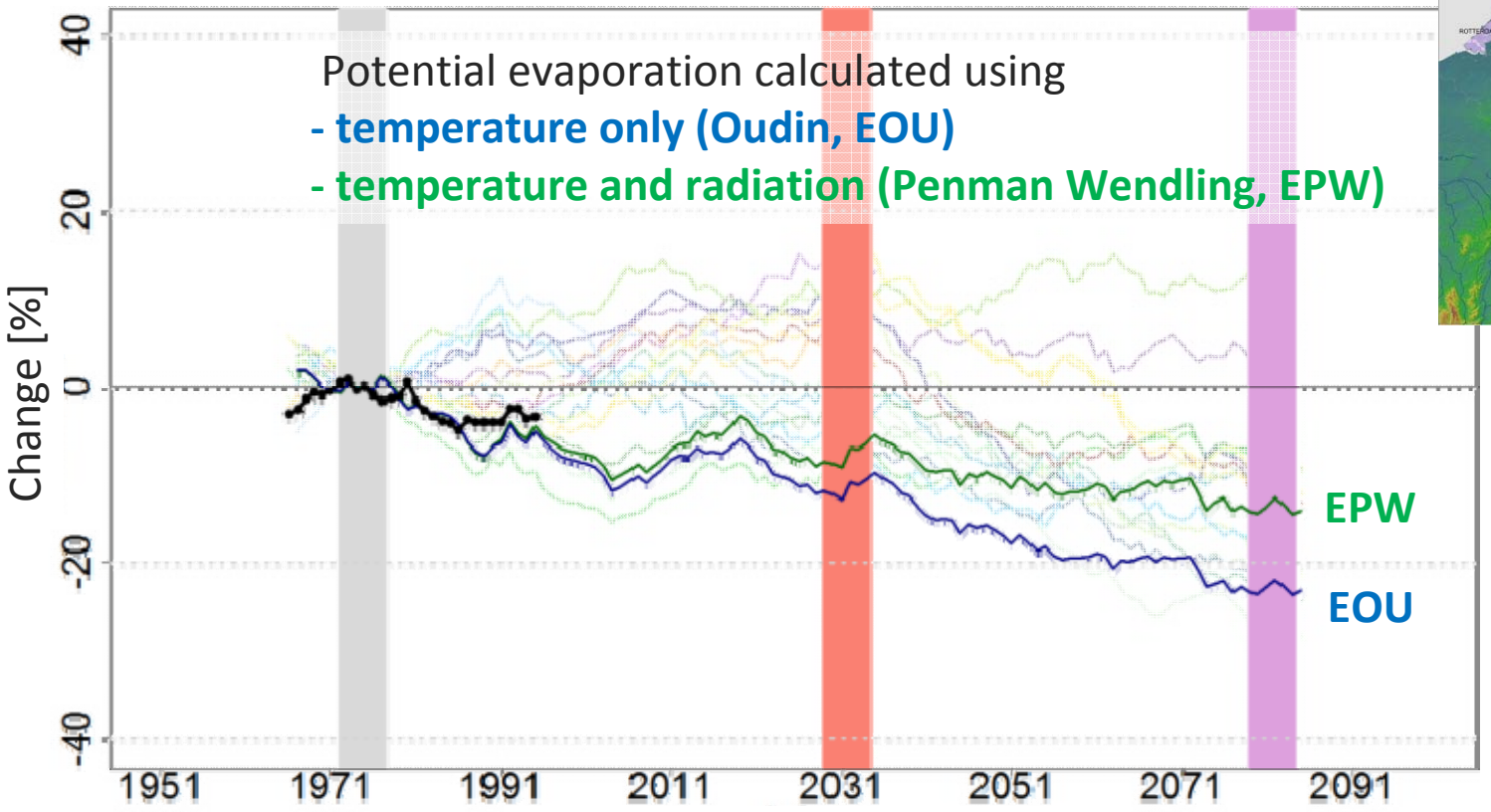
Model chain: ***SRES_GCM_RCM***_LS_EPW_HBV

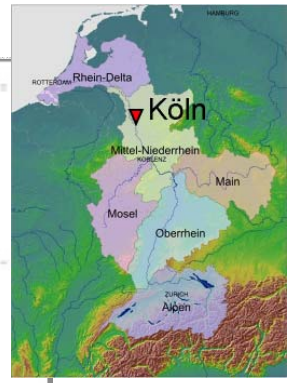




How should we model evaporation?

Model chain: A1B_EH5r3_RE-ENS_LS_***EVAP***_HBV

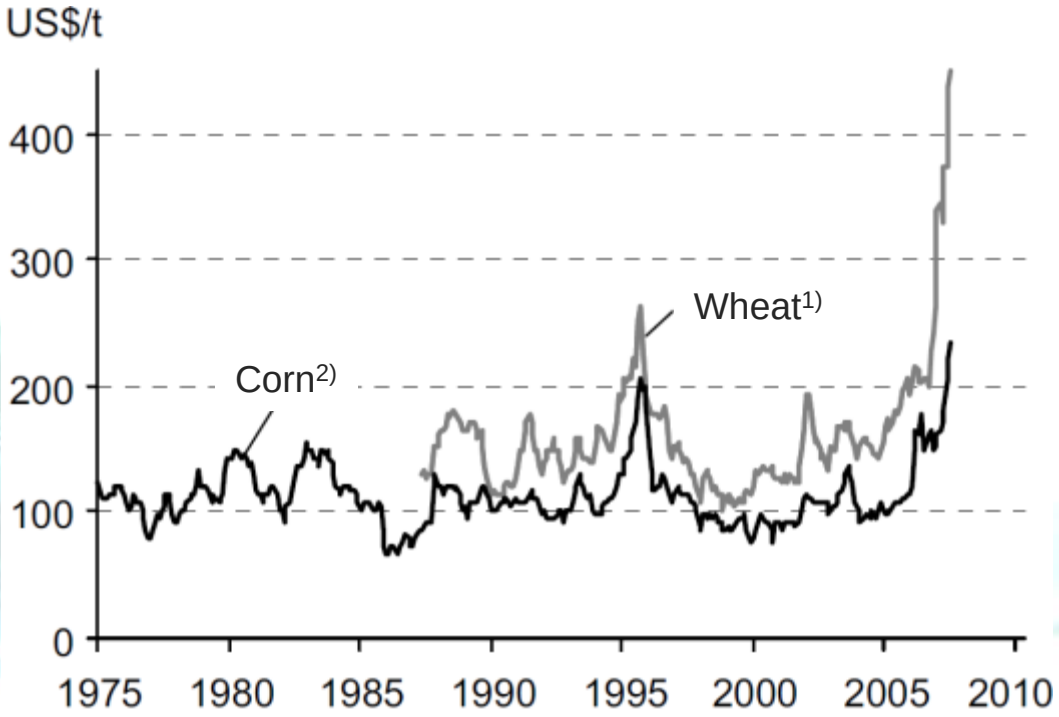




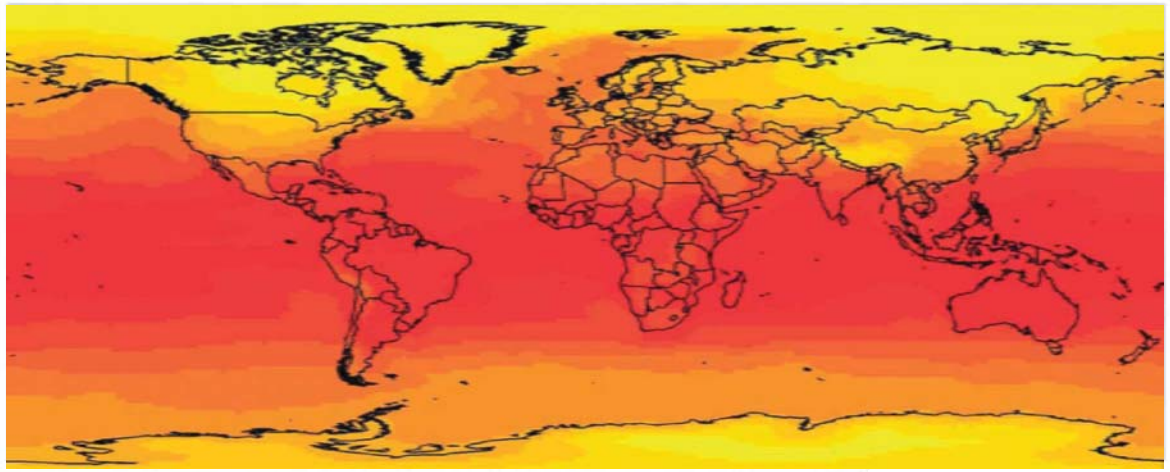
Need for cooperation

- Coordinated selection of drought definitions and indicators.
- Common procedures in generating projections.
  - Technical aspects (model biases, evaporation issues)
- Common procedures in generating scenarios for agriculture.
  - Adaptation scenarios (crop types, precision irrigation)
  - Assumptions, uncertainty assessment, aspects covered

Development of world market prices for grains



1) Hard Red Winter No. 2 fob Gulf. - 2) Corn, No. 2, Yellow fob Gulf.
Quelle: USDA (2008).

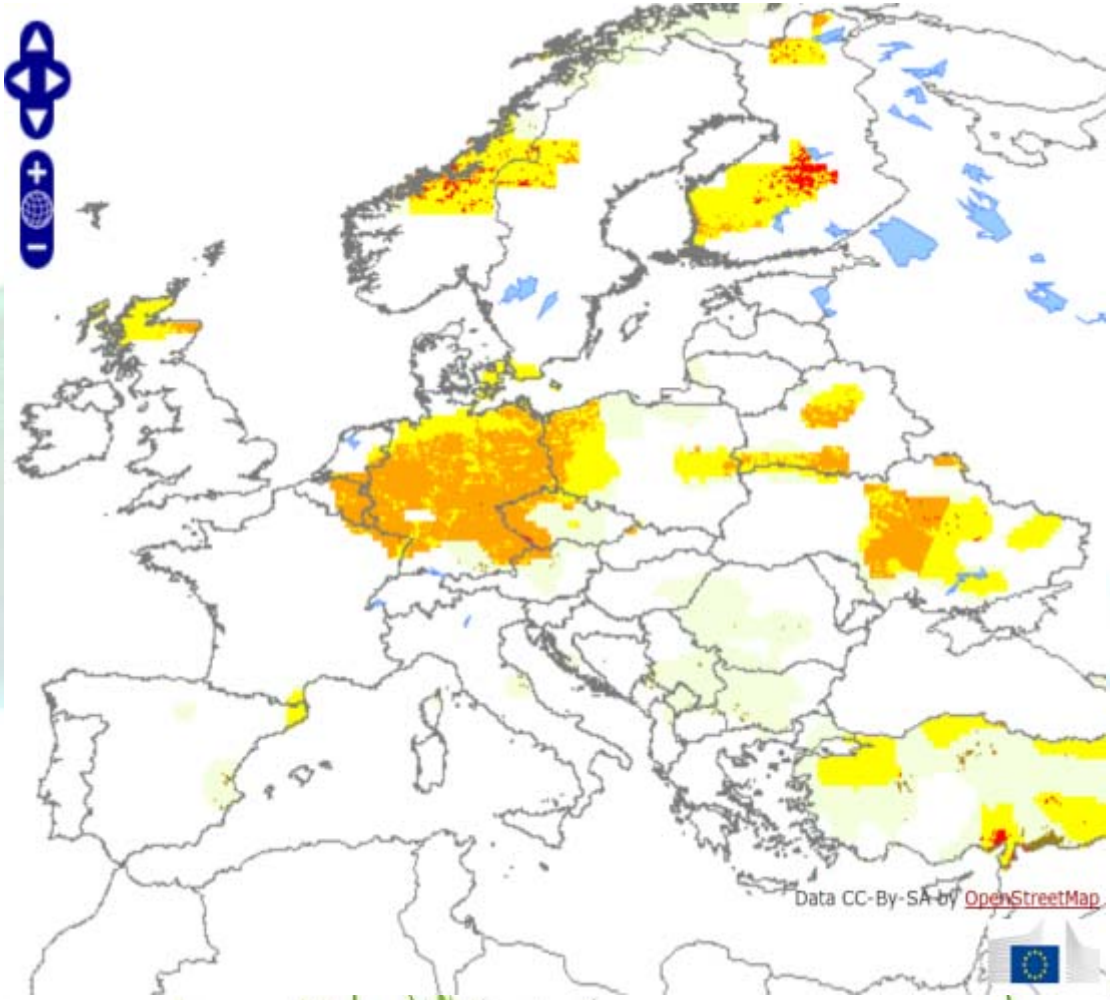


Thank you!

Dr. Enno Nilson
nilson@bafg.de

- Communication on water scarcity & droughts in the European Union 2007: water hierarchy
  - first priority: water demand management
  - alternative supply options only once the potential for water efficiency has been exhausted
- Policy options:
  - Water Price
  - Authorization procedures for water abstraction or use
  - Drought Management Plans
  - additional water supply infrastructures
  - water efficient technologies and practices (e.g. irrigation)
  - awareness raising
  - improving knowledge
  - data collection

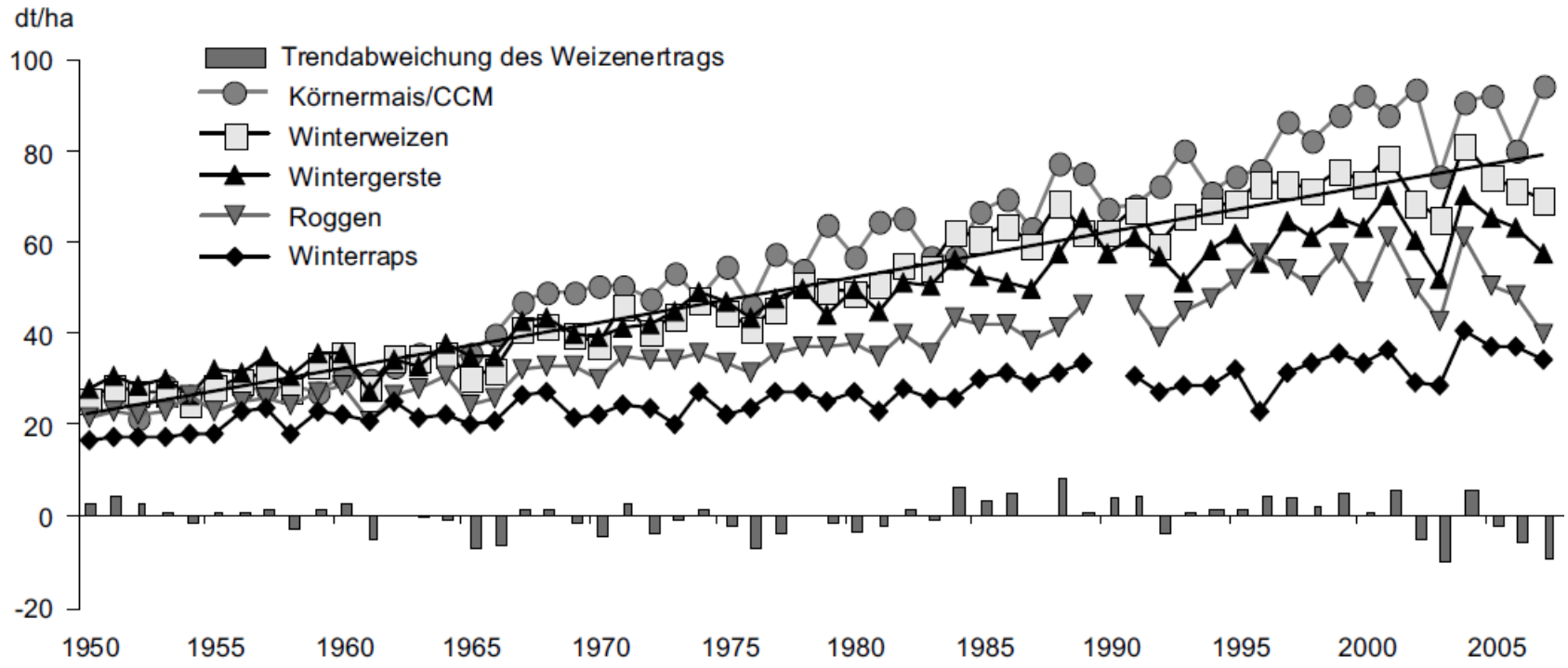
Drought 2014 in Europe



2nd ten-day period
of April 2014

- Watch: rainfall deficit
- Warning: soil moisture deficit
- Alert: vegetation stress following rainfall / soil moisture deficit
- Partial recovery of vegetation
- Full recovery of vegetation to normal conditions

Source:
European drought observatory

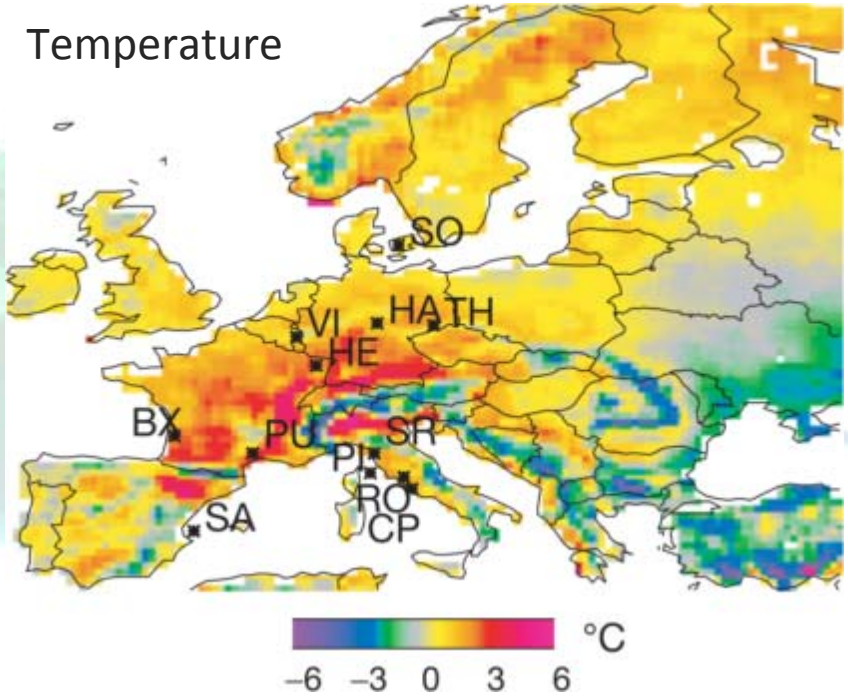


Quelle: BMELV, Statistisches Jahrbuch, versch. Jgg.; eigene Berechnungen.

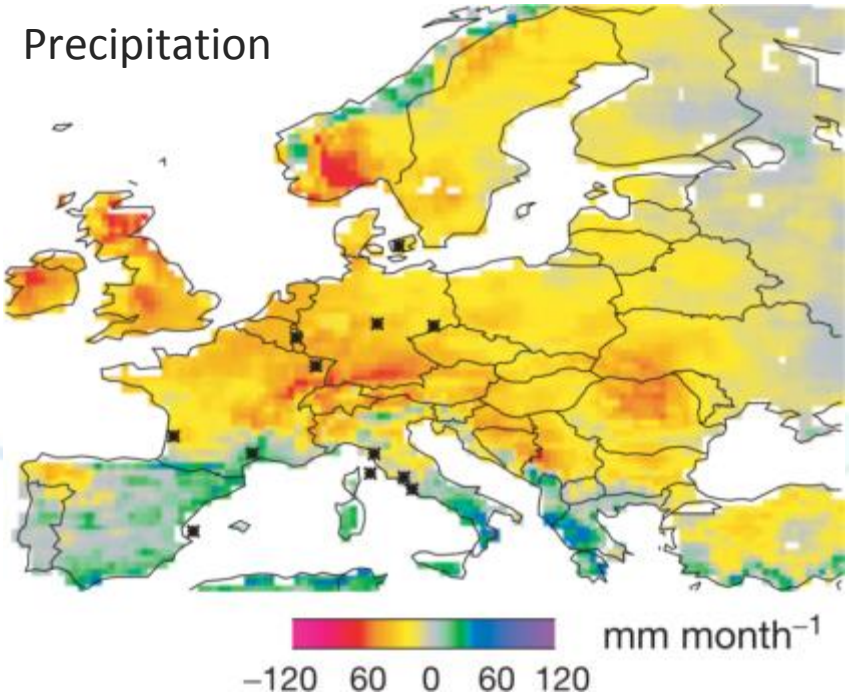
Anter et al. (2009)

Temperature and Precipitation Anomalies during the drought year 2003

Temperature

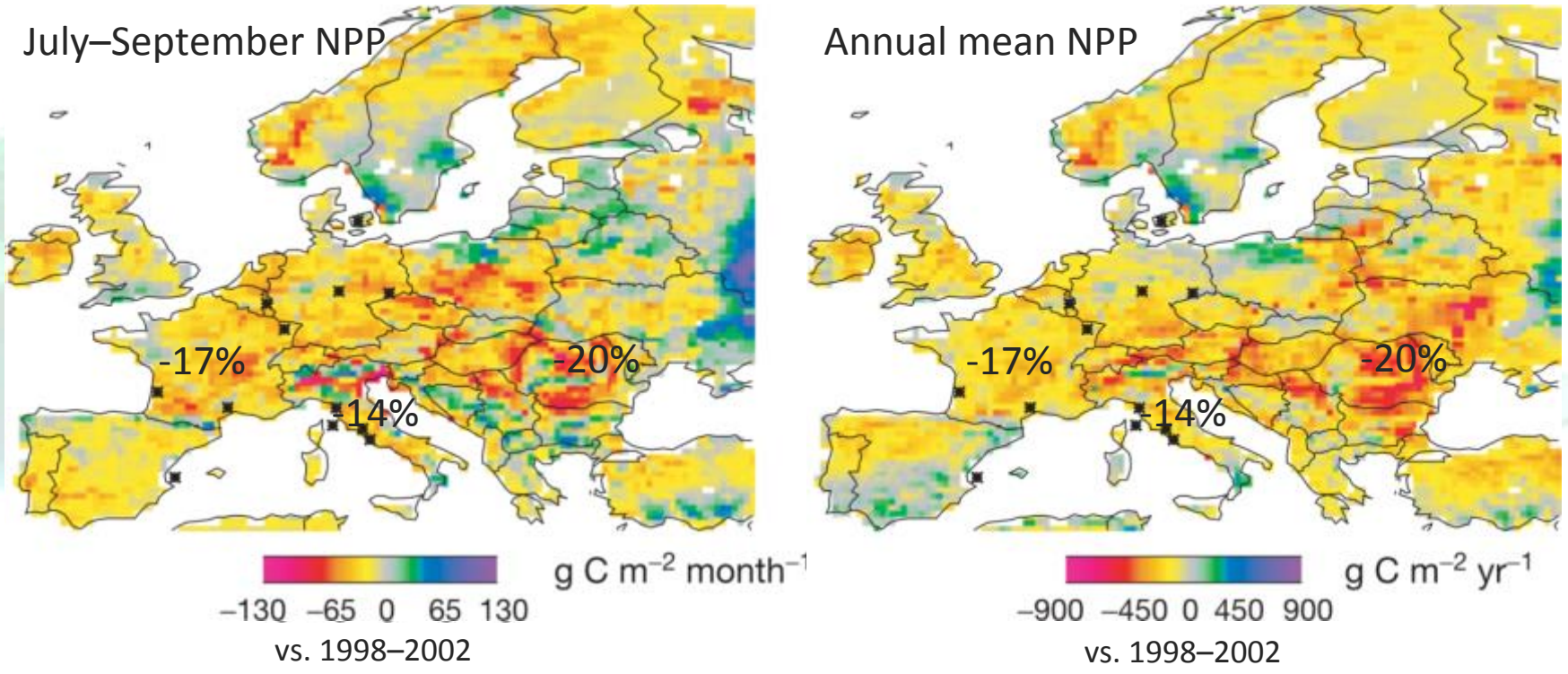


Precipitation



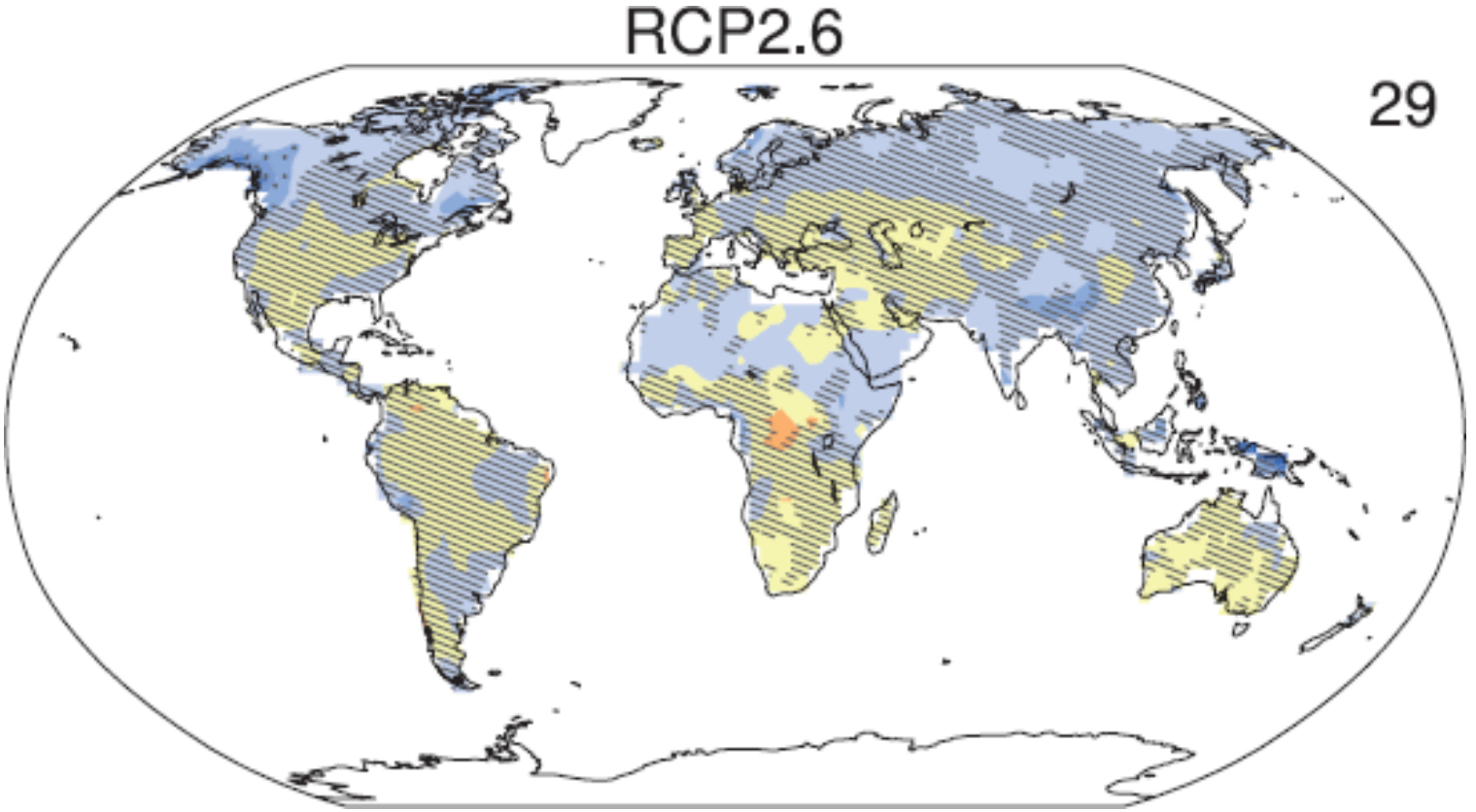
Source: Ciais, P., et al., 2005

Net primary productivity (NPP) during the drought year 2003

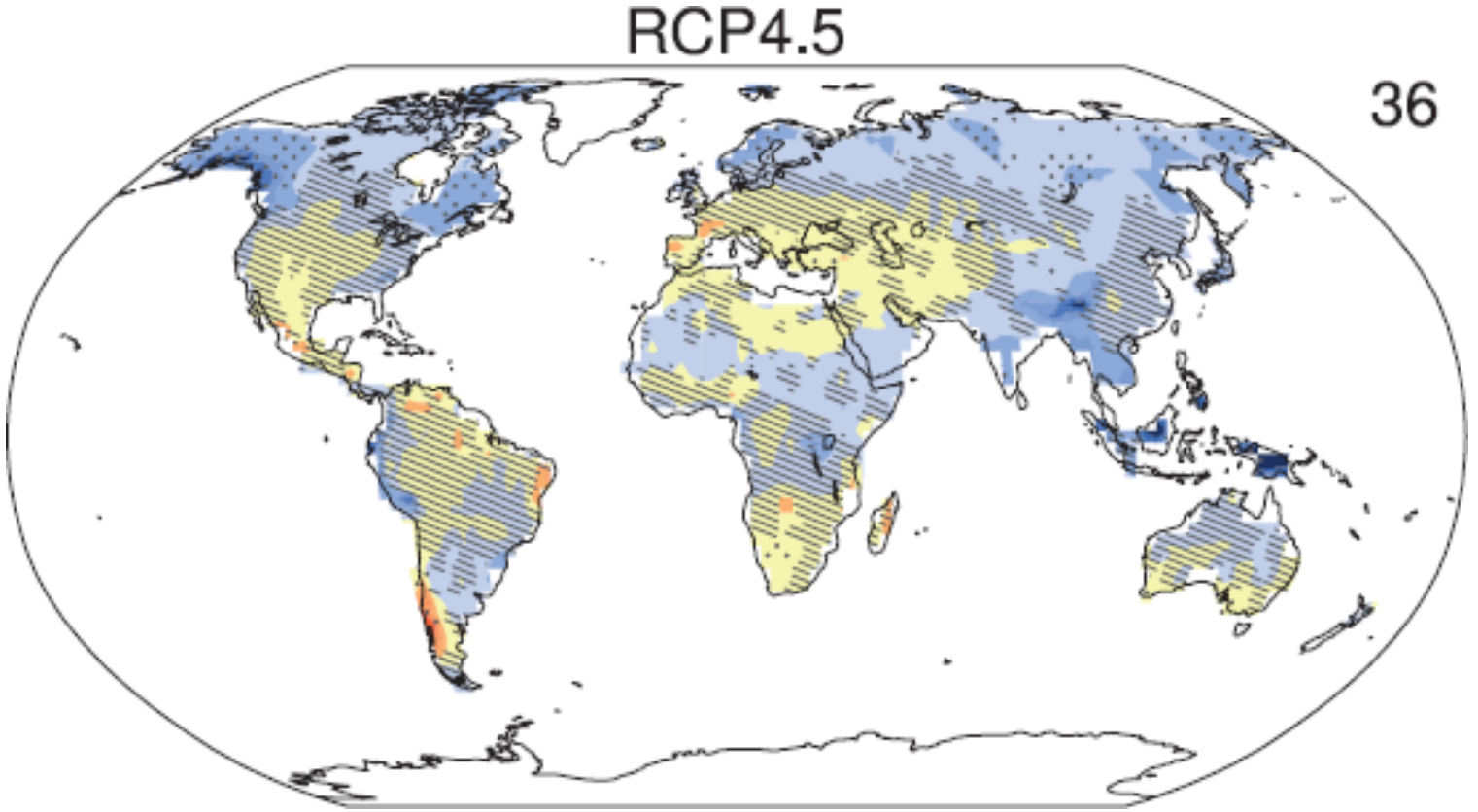


Source: Ciais, P., et al., 2005

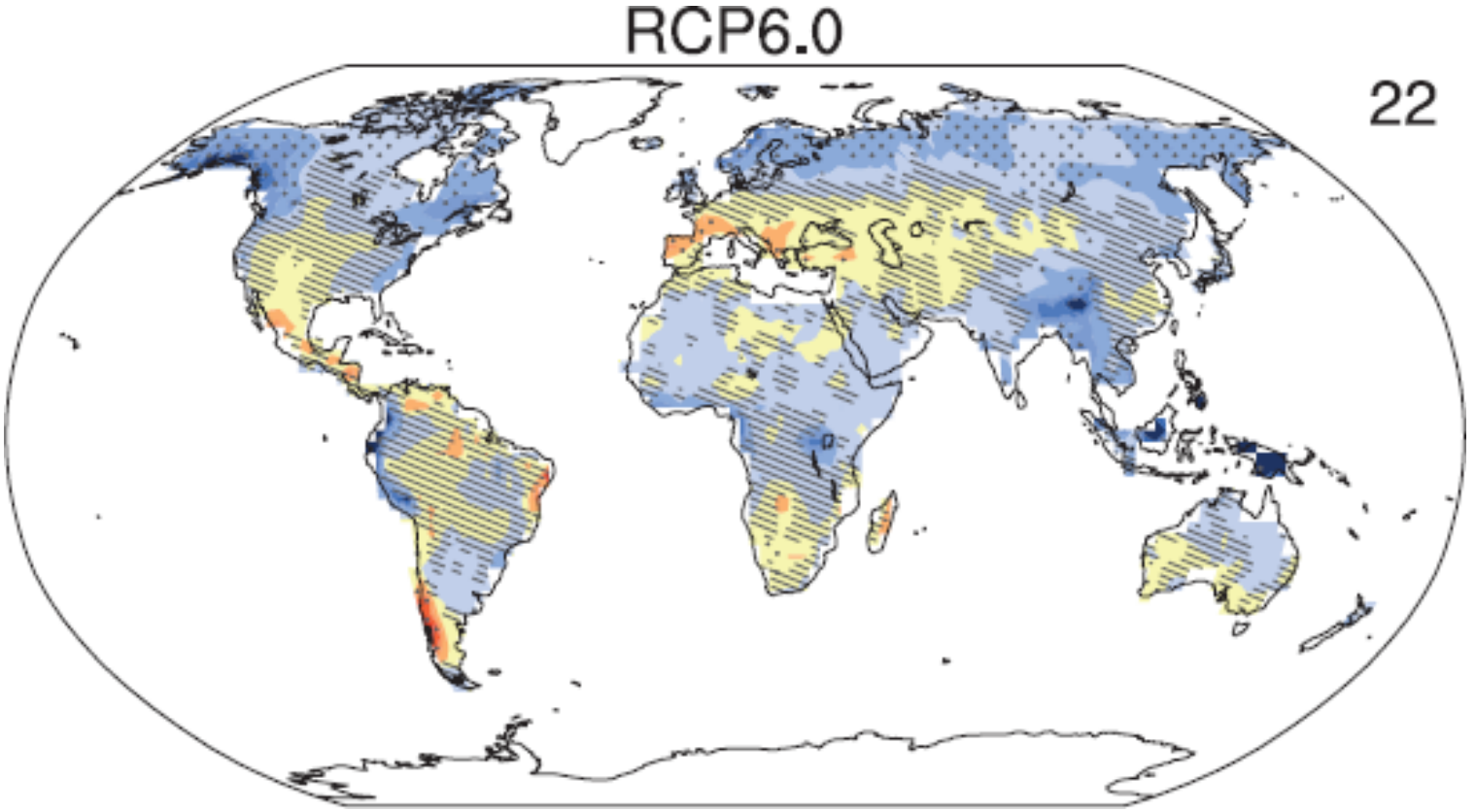
Change in annual mean runoff



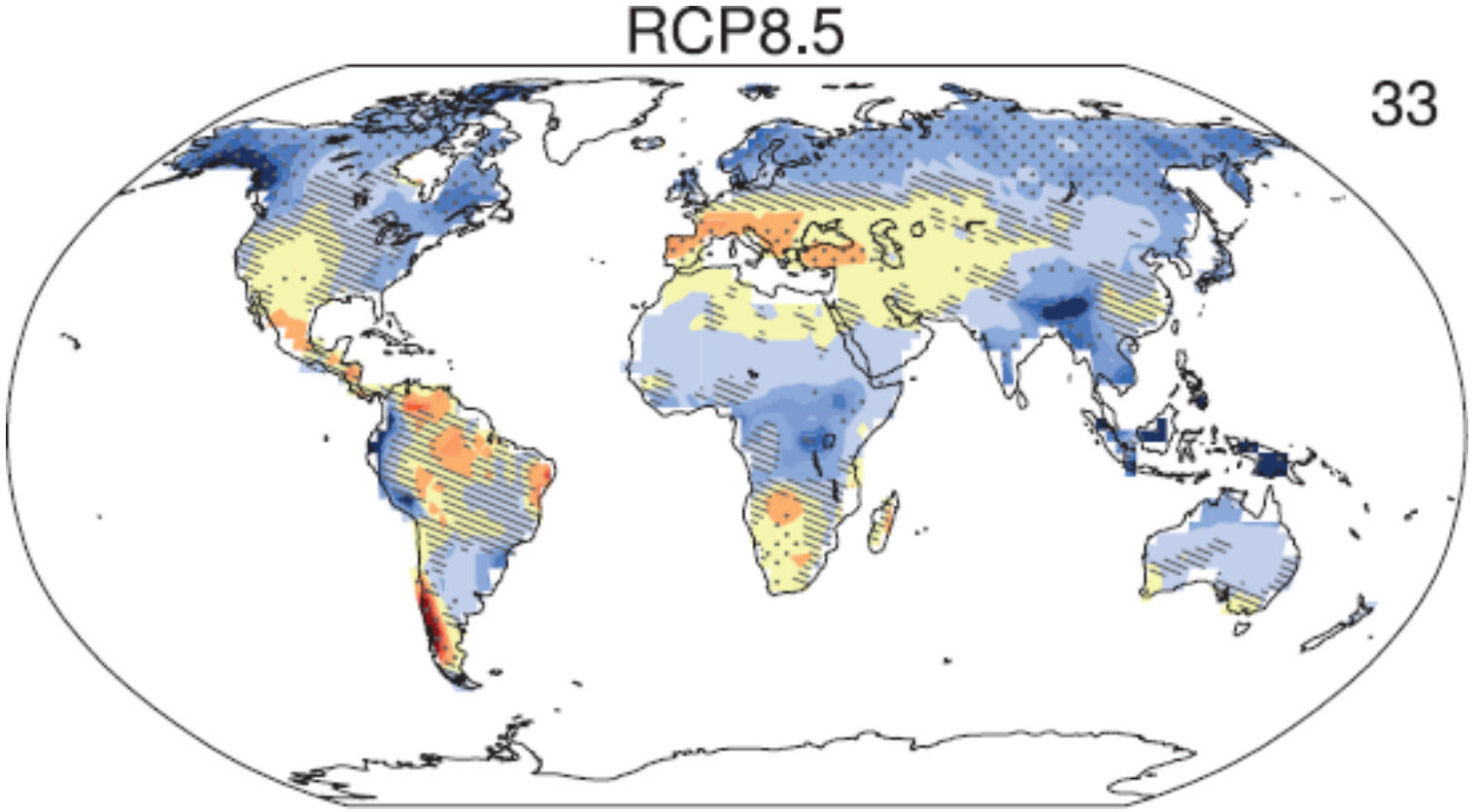
Change in annual mean runoff



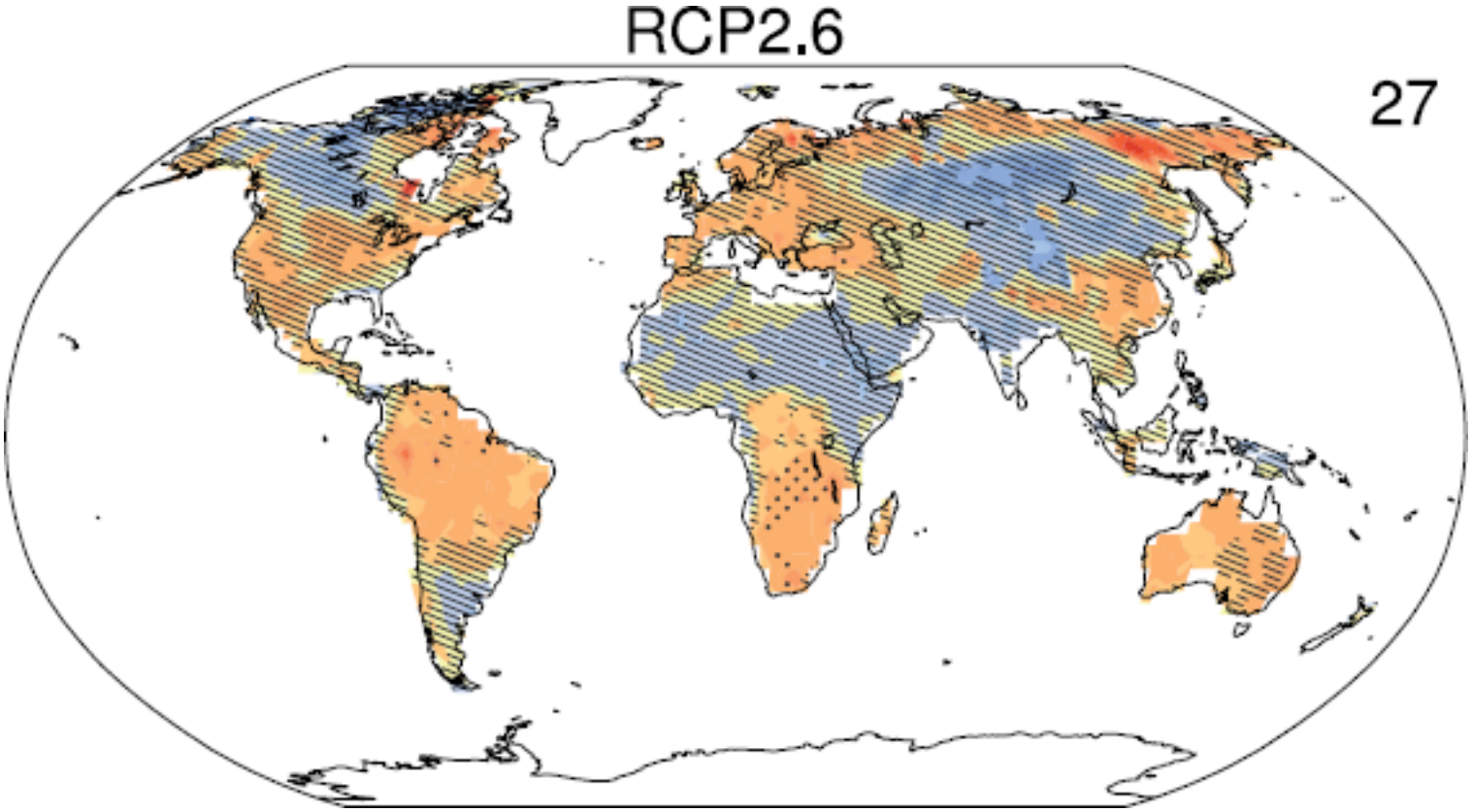
Change in annual mean runoff



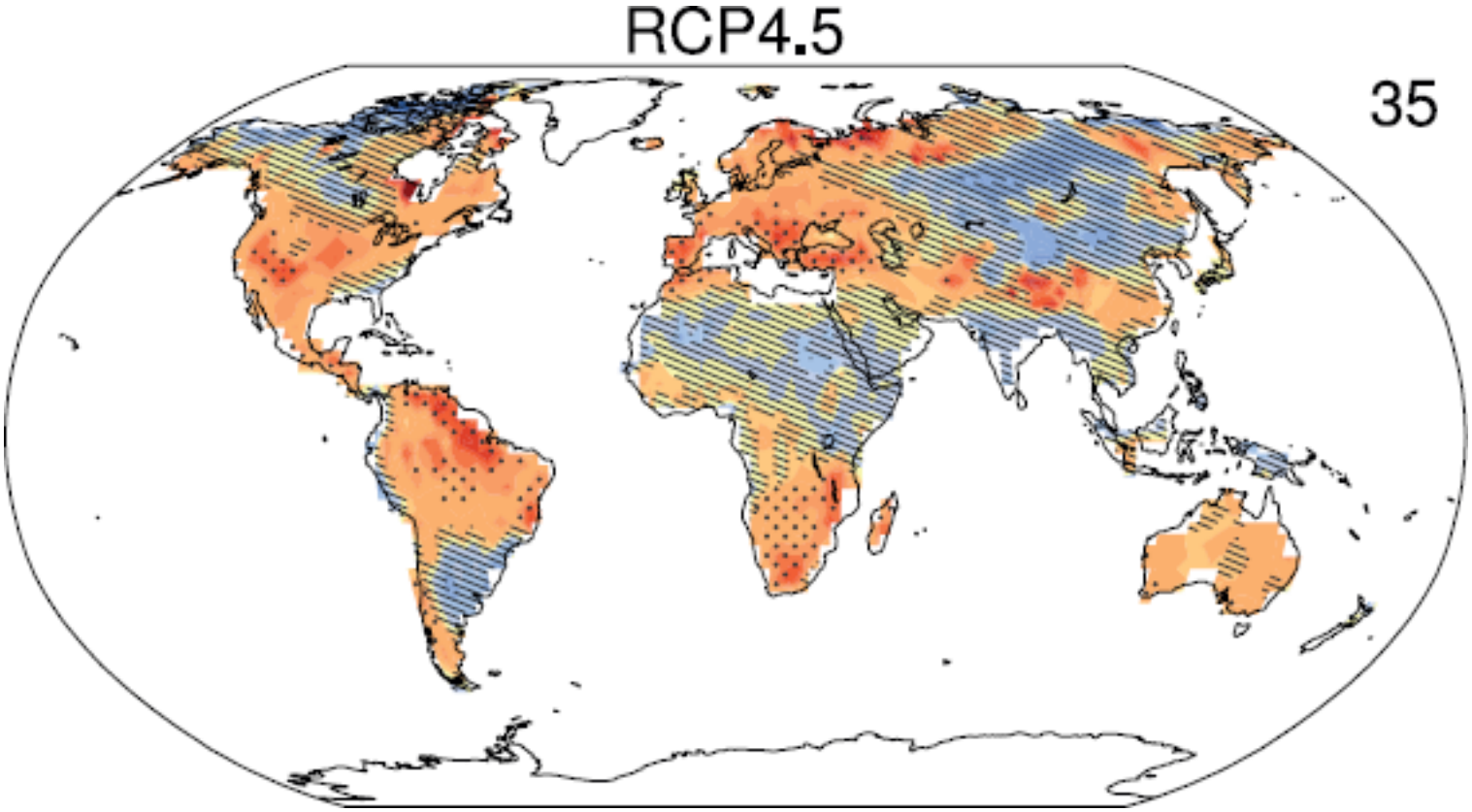
Change in annual mean runoff



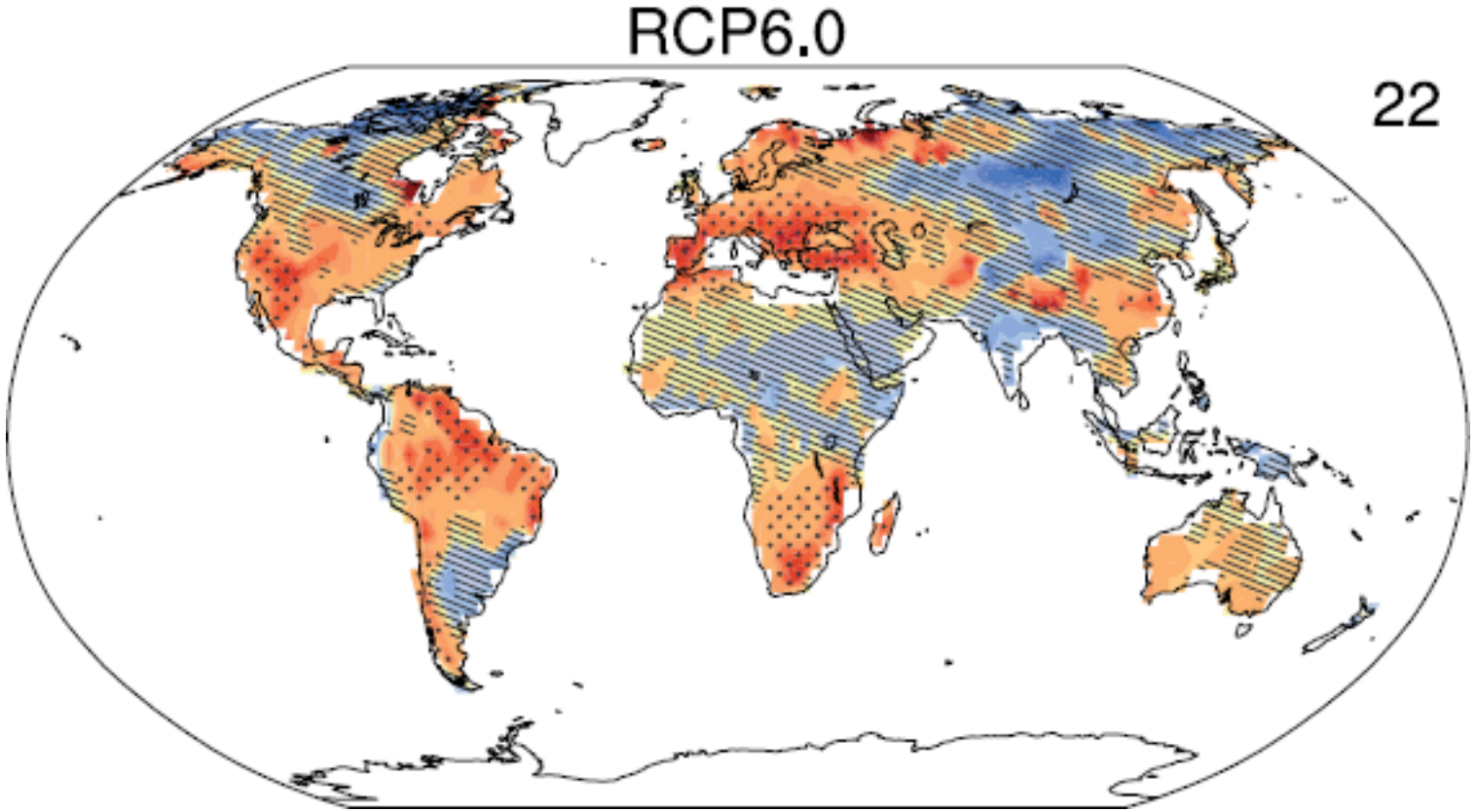
Annual mean changes in soil moisture



Annual mean changes in soil moisture



Annual mean changes in soil moisture



Annual mean changes in soil moisture