UNECE Workshop „Water and Climate Change:
HOW TO DEVELOP AN ADAPTATION STRATEGY IN TRANSBOUNDARY BASINS”
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FRESHWATER AND CLIMATE CHANGE

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P I K

1. Introduction

2. Observations

3. Projections

4. Adaptation and concluding remarks

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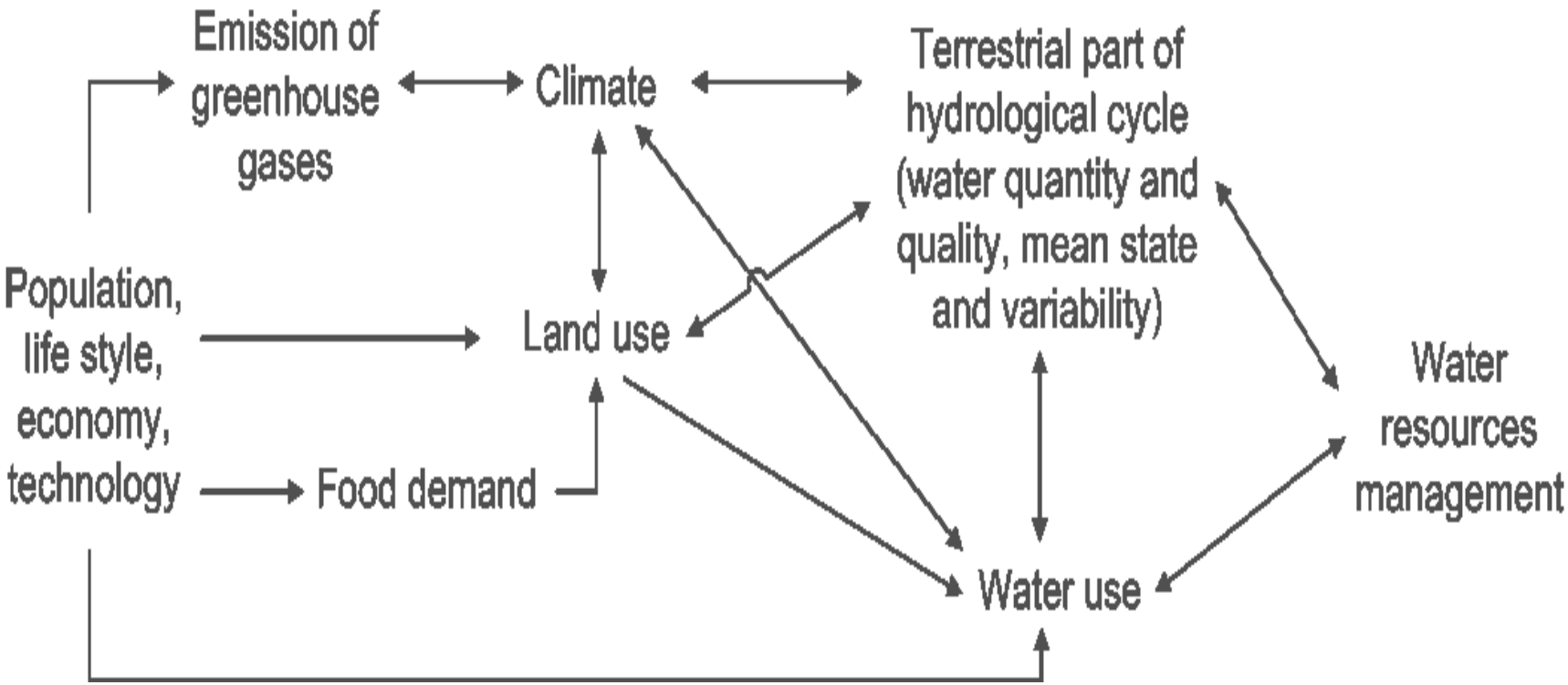
In the global system, everything is connected to everything else. The climate and freshwater systems are interwoven in a complex way so that any change in one of these systems induces a change in the other.



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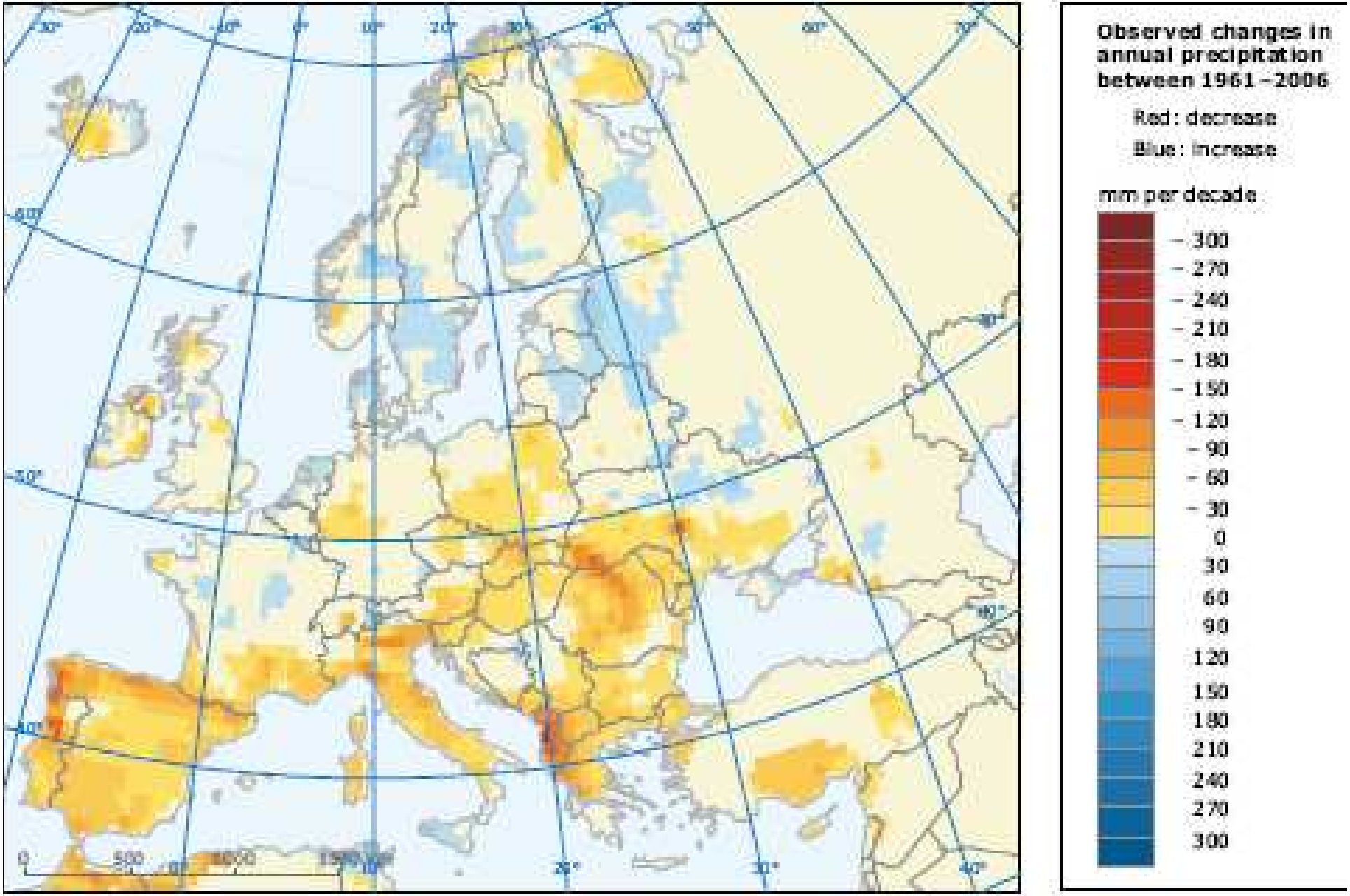
Source: EEA


Observed changes in annual precipitation between 1961–2006
Red: decrease
Blue: increase
mm per decade
– 300
– 270
– 240
– 210
– 180
– 150
– 120
– 90
– 60
– 30
0
30
60
90
120
150
180
210
240
270
300

Pasterze Glacier

Three categories

of water problems:

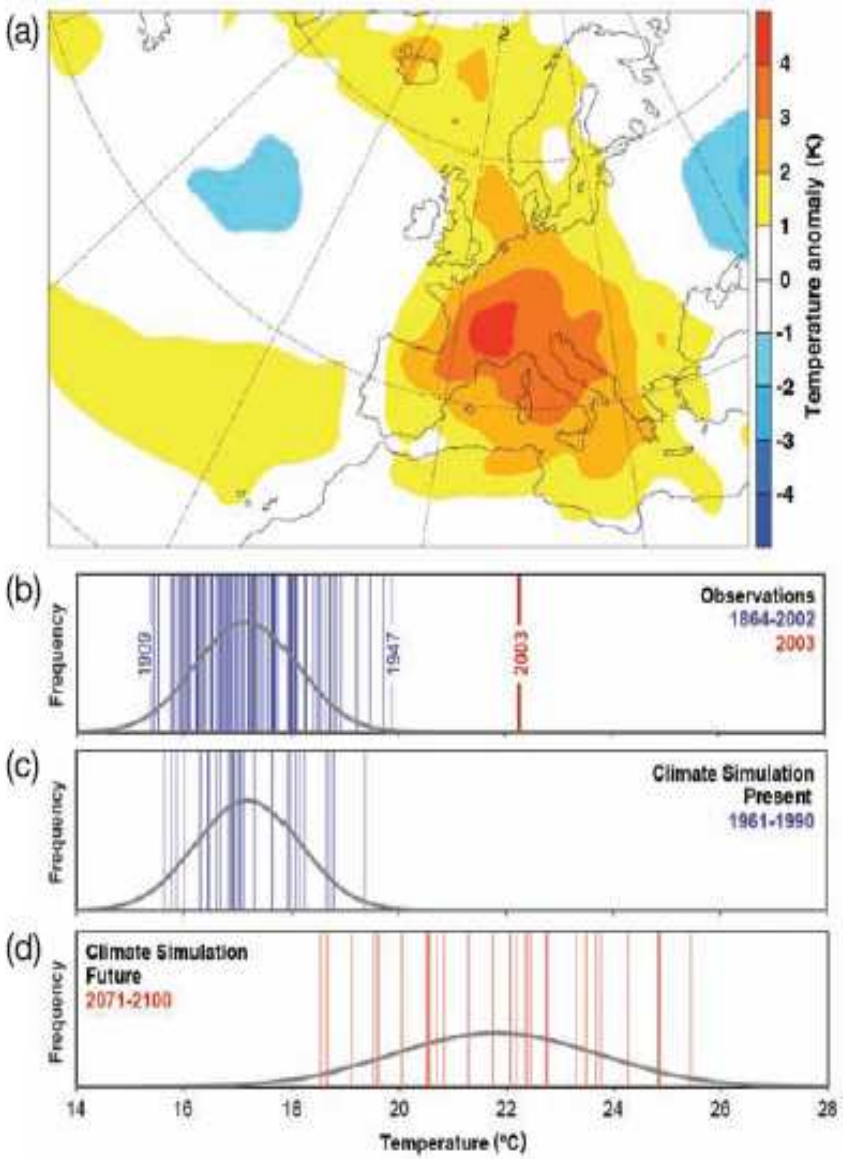
* Too little water

* Too much water

* Polluted water

can be exacerbated

by climate change



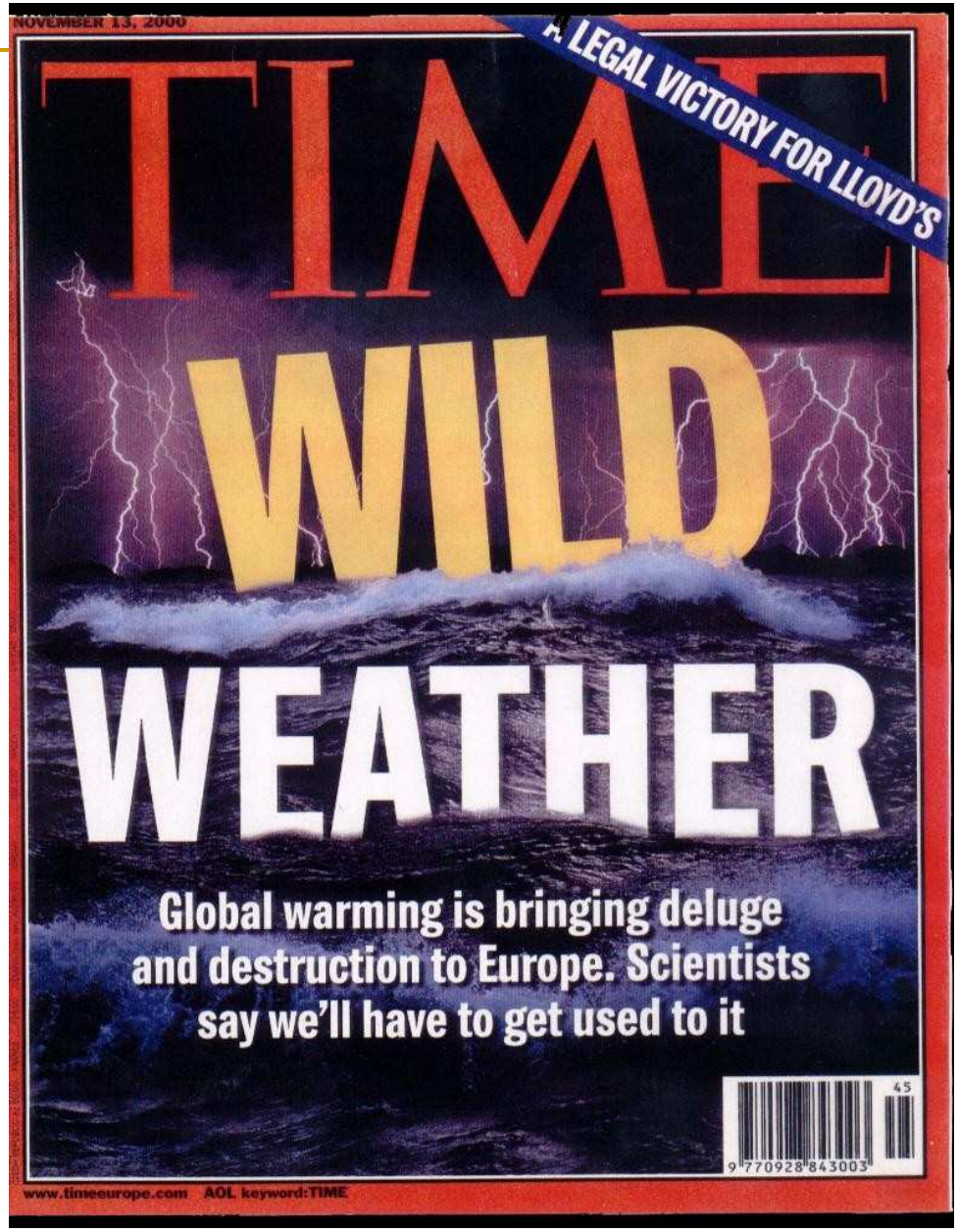
Hot and dry summer 2003 in much of Europe

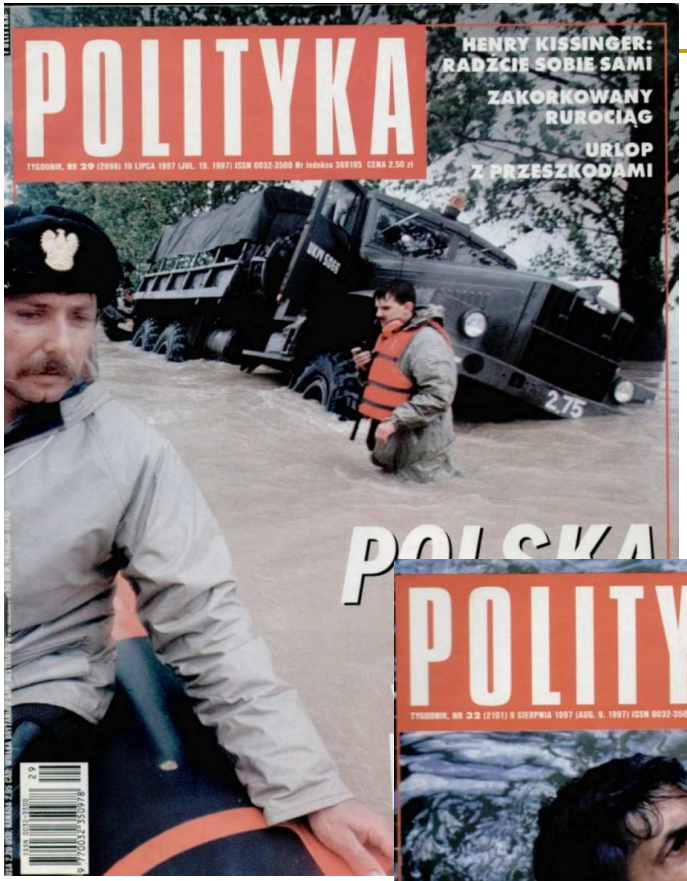
Consequences for energy sector:

- **Little water available for hydropower**
- **Little water available for cooling of power plants**
- **High river water temperatures (water temperatures after the cooling process exceeded environmental safety levels).**

Temperature anomalies in Europe (a) and Switzerland (b), (c), (d). Source *[IPCC AR4, 2007]*

The frequency of heavy precipitation events has increased over most land areas. Further increase in frequency of heavy precipitation events, augmenting flood risk is very likely.





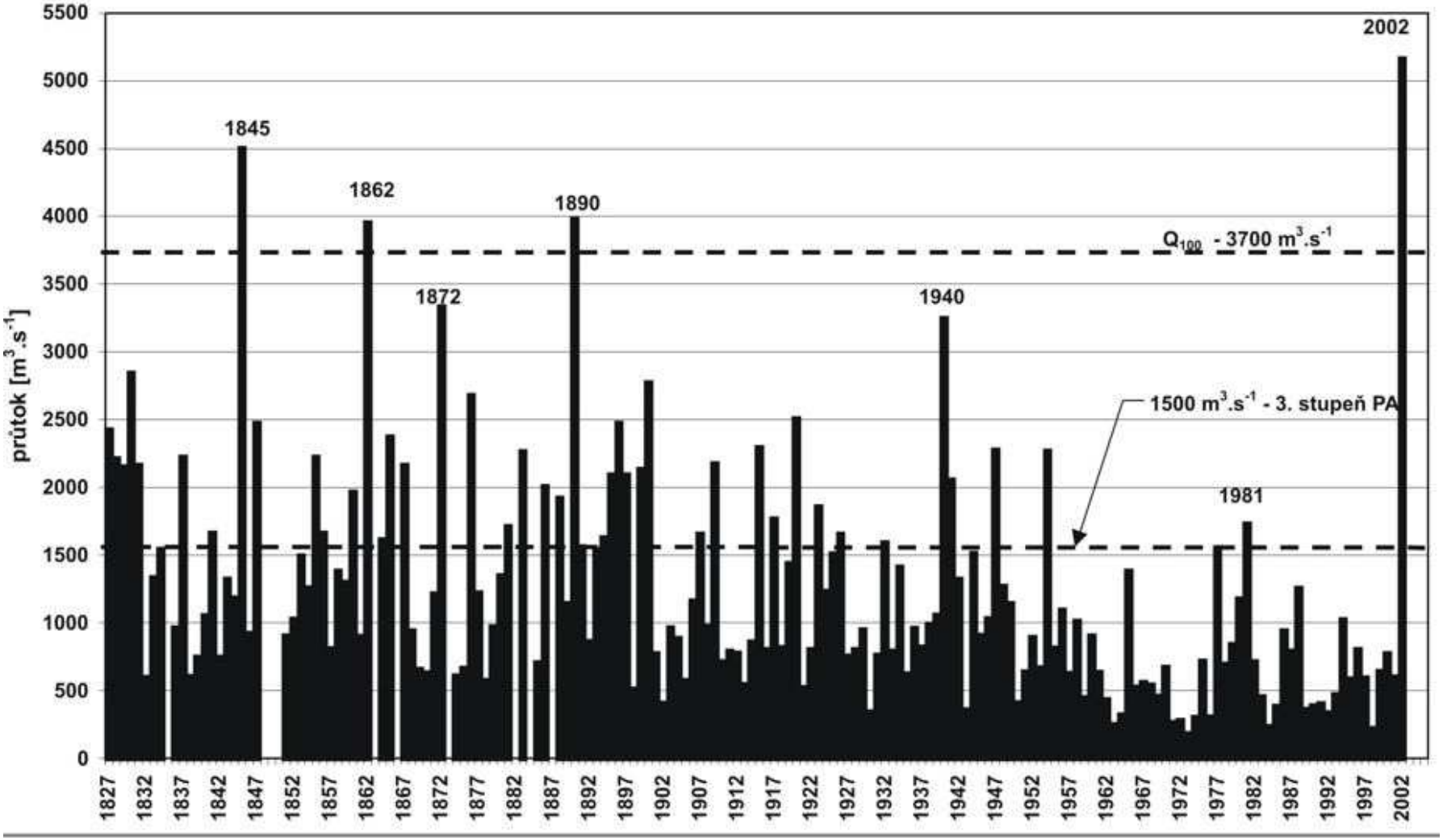
See:

Kundzewicz et al.,

Hydrol. Sci. J.,

1999

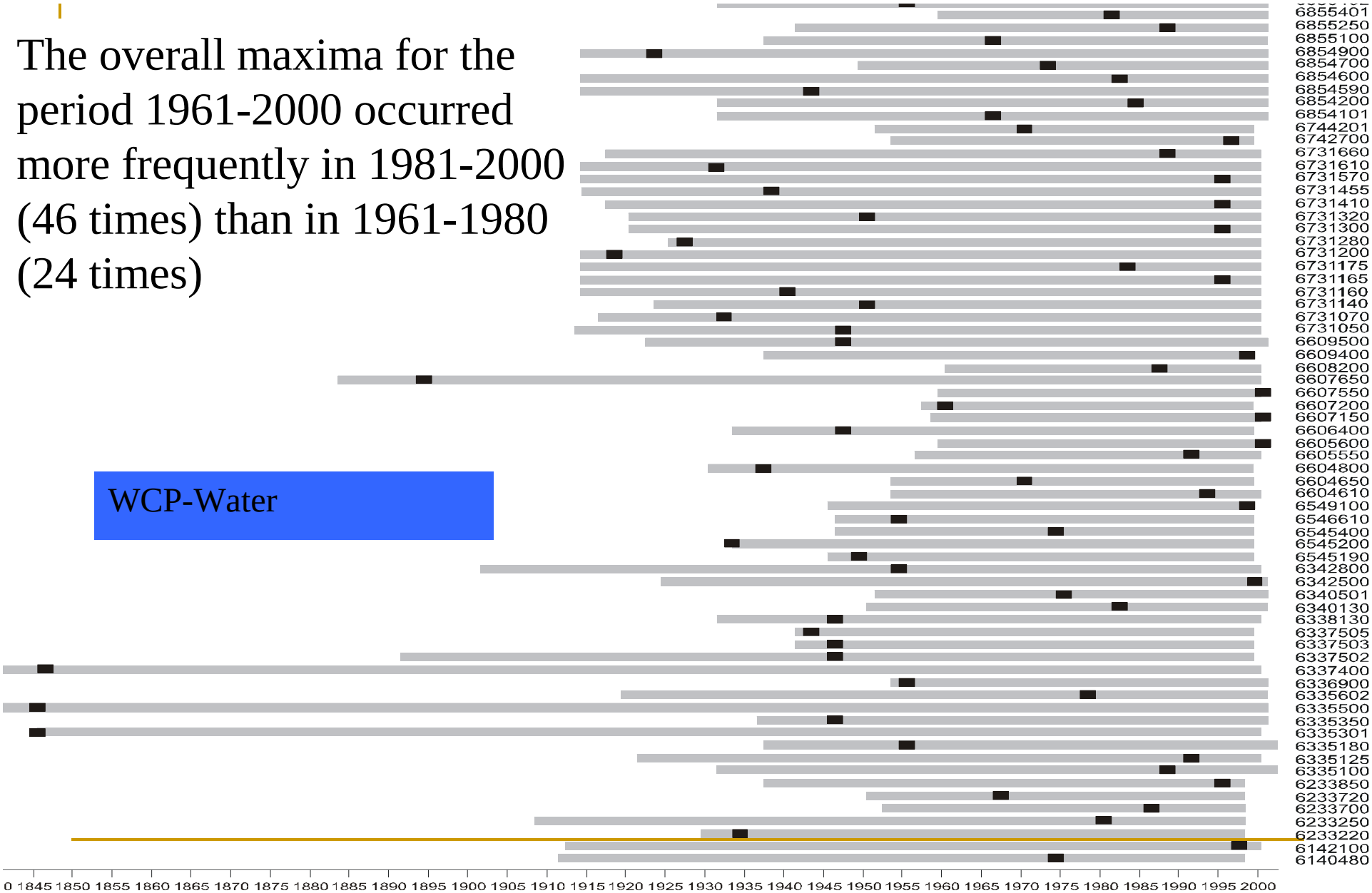
Floods on the Vltava in Prague (Czech Republic)



Source: CHMU

Year of occurrence of maximum flow (Source: Kundzewicz et al., *Hydrol. Sci. J.*, 2005)

The overall maxima for the period 1961-2000 occurred more frequently in 1981-2000 (46 times) than in 1961-1980 (24 times)



WCP-Water

Higher water temperatures, increased precipitation intensity and longer periods of low flows exacerbate water pollution (sediments, nutrients, pathogens, pesticides, salt and thermal pollution), **with impacts on ecosystems, human health, and water system reliability and operating costs.**

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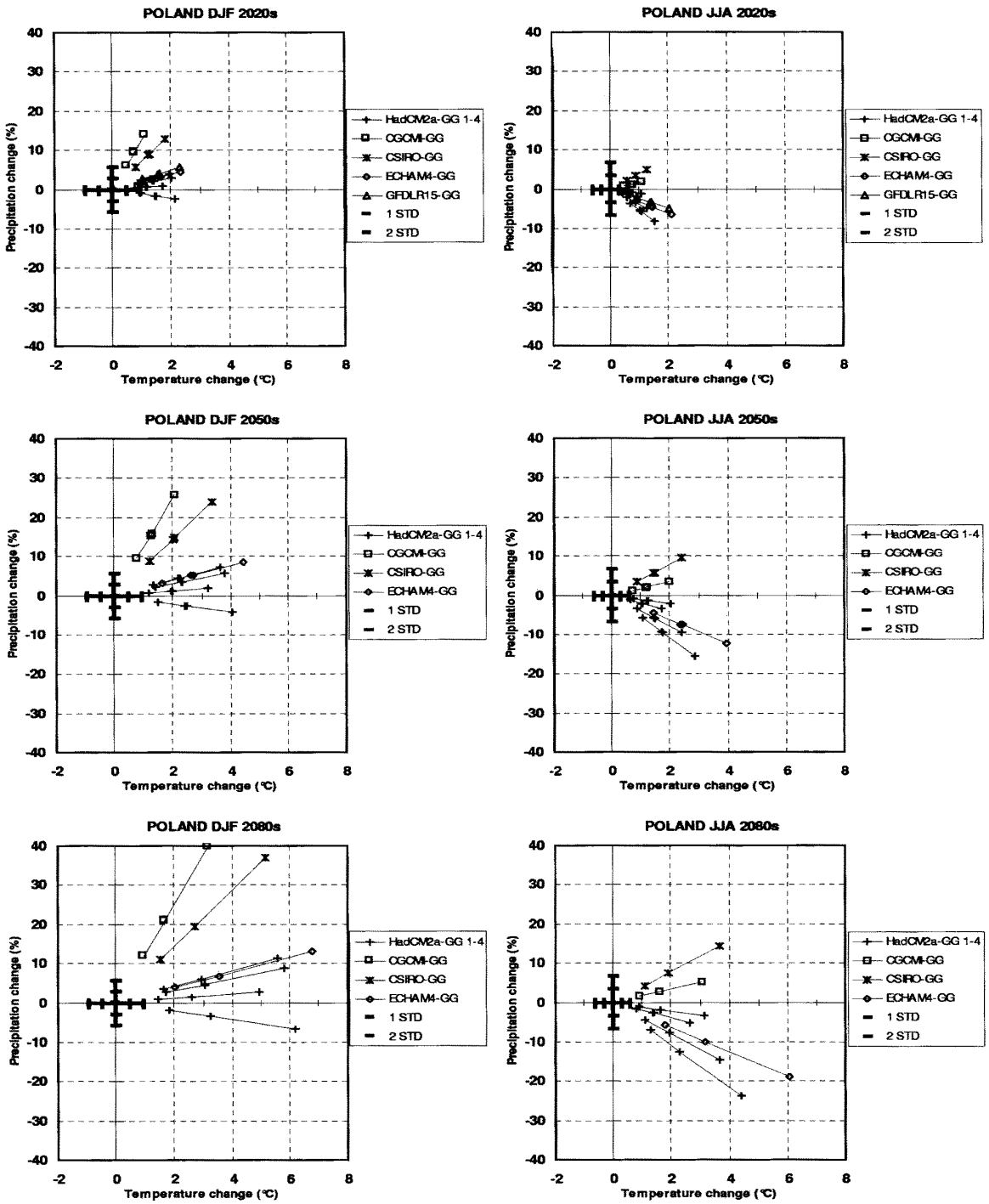
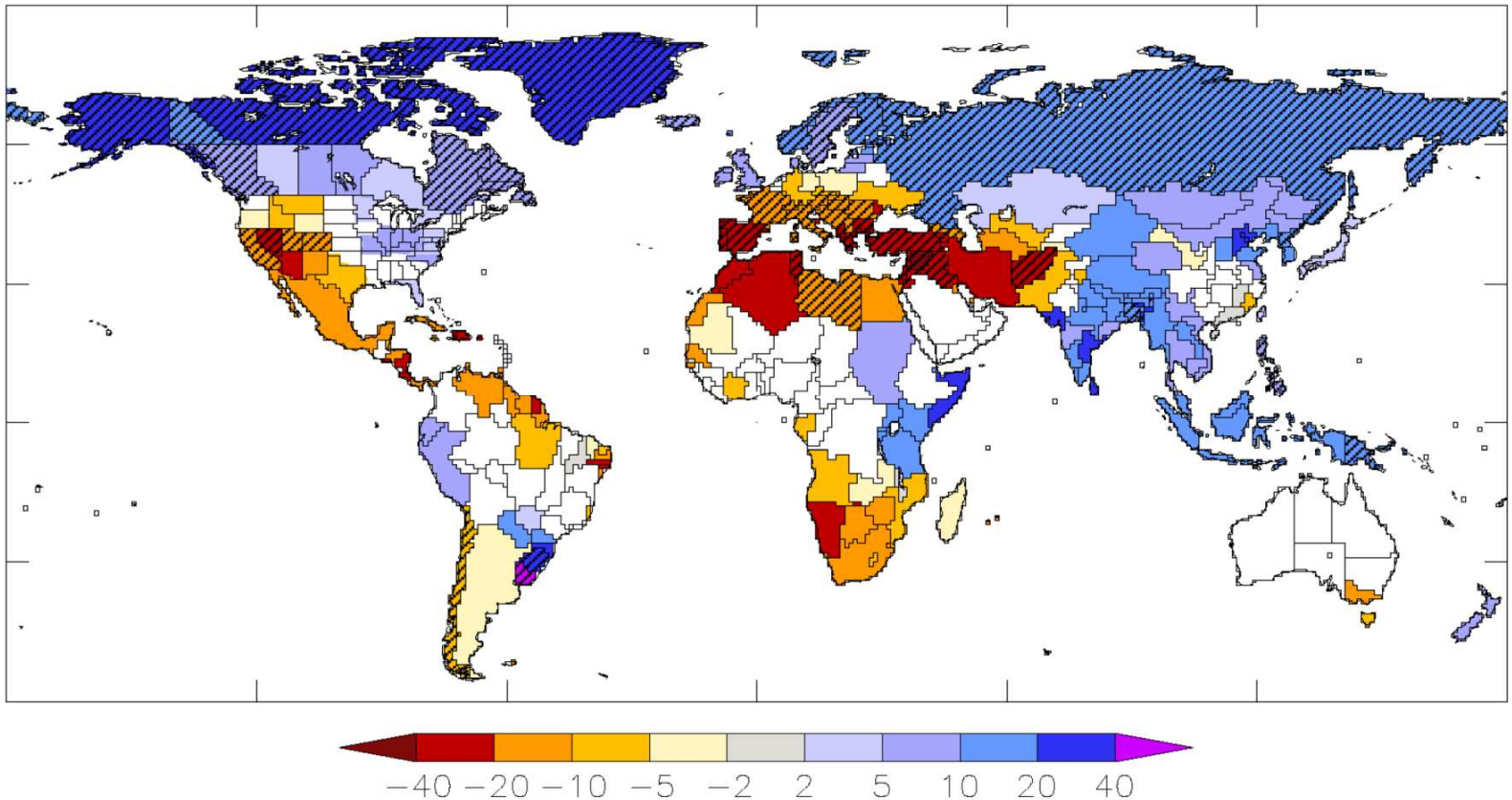


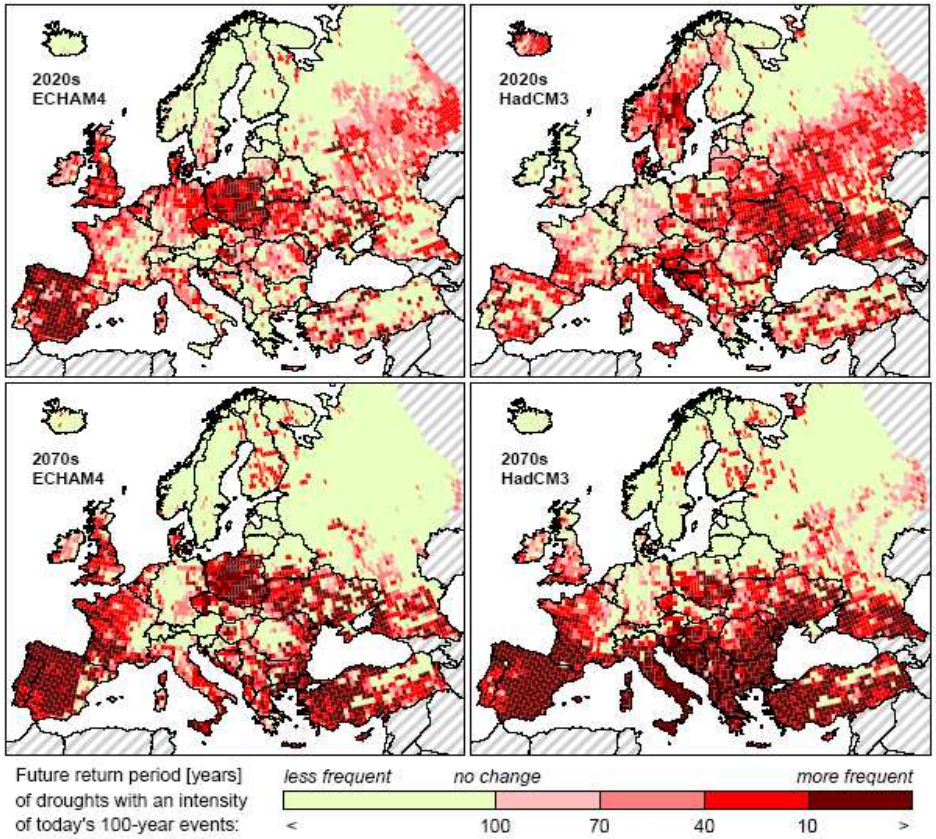
Temperature and precipitation projections for Poland.

Source: Tim Carter

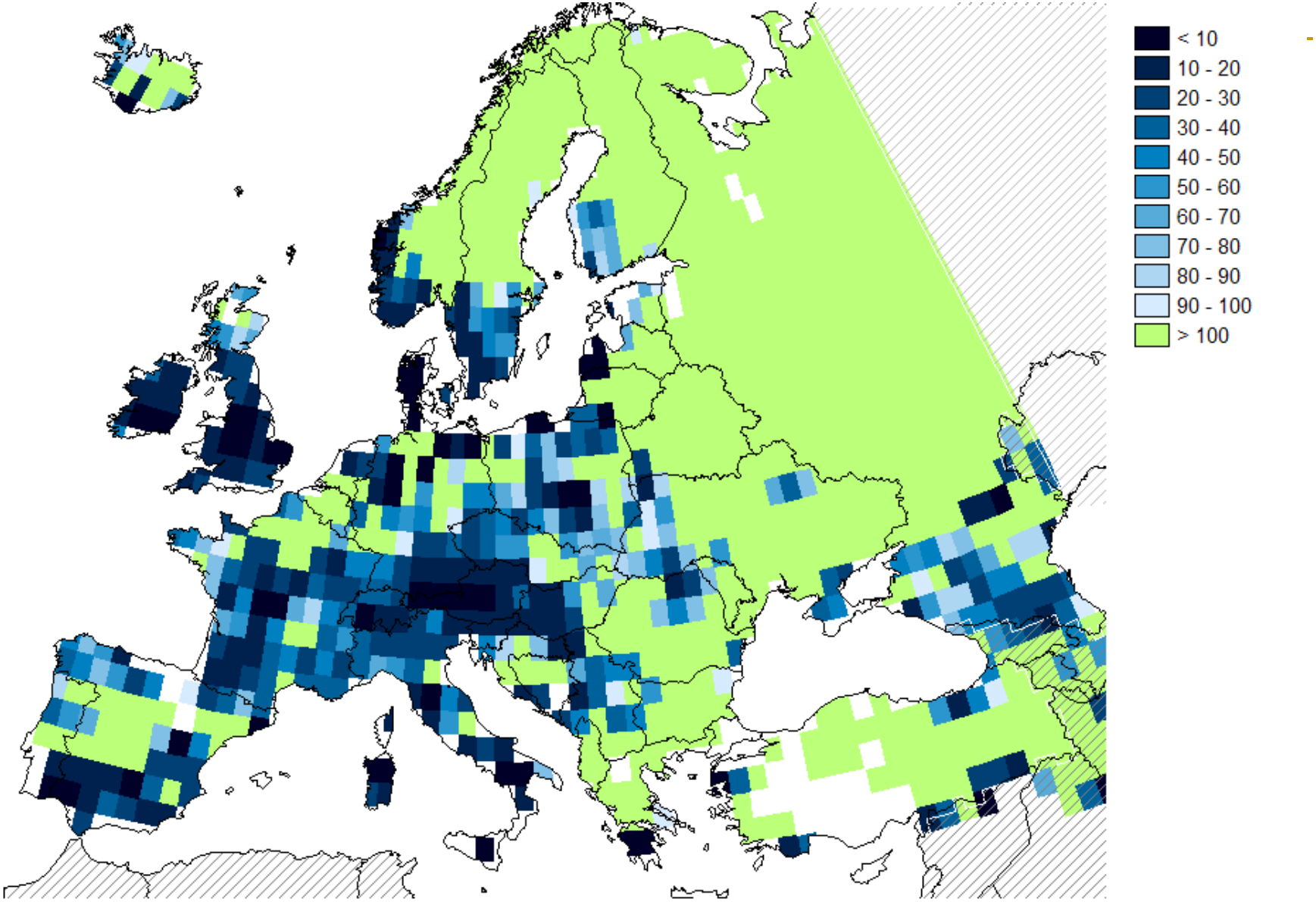
Milly, Betancourt, Falkenmark, Hirsch, Kundzewicz, Lettenmaier & Stouffer
Stationarity is Dead: Whither Water Management? ***Science.*** 1 Feb. 2008



Projection of changes in annual runoff (2041-2060 vs 1900-1970), for SRES A1B. Colour represents a median from 12 models. Presence of colour means that 8 or more models agree as to the direction of change (hatching: agreement of 11 or 12 models).

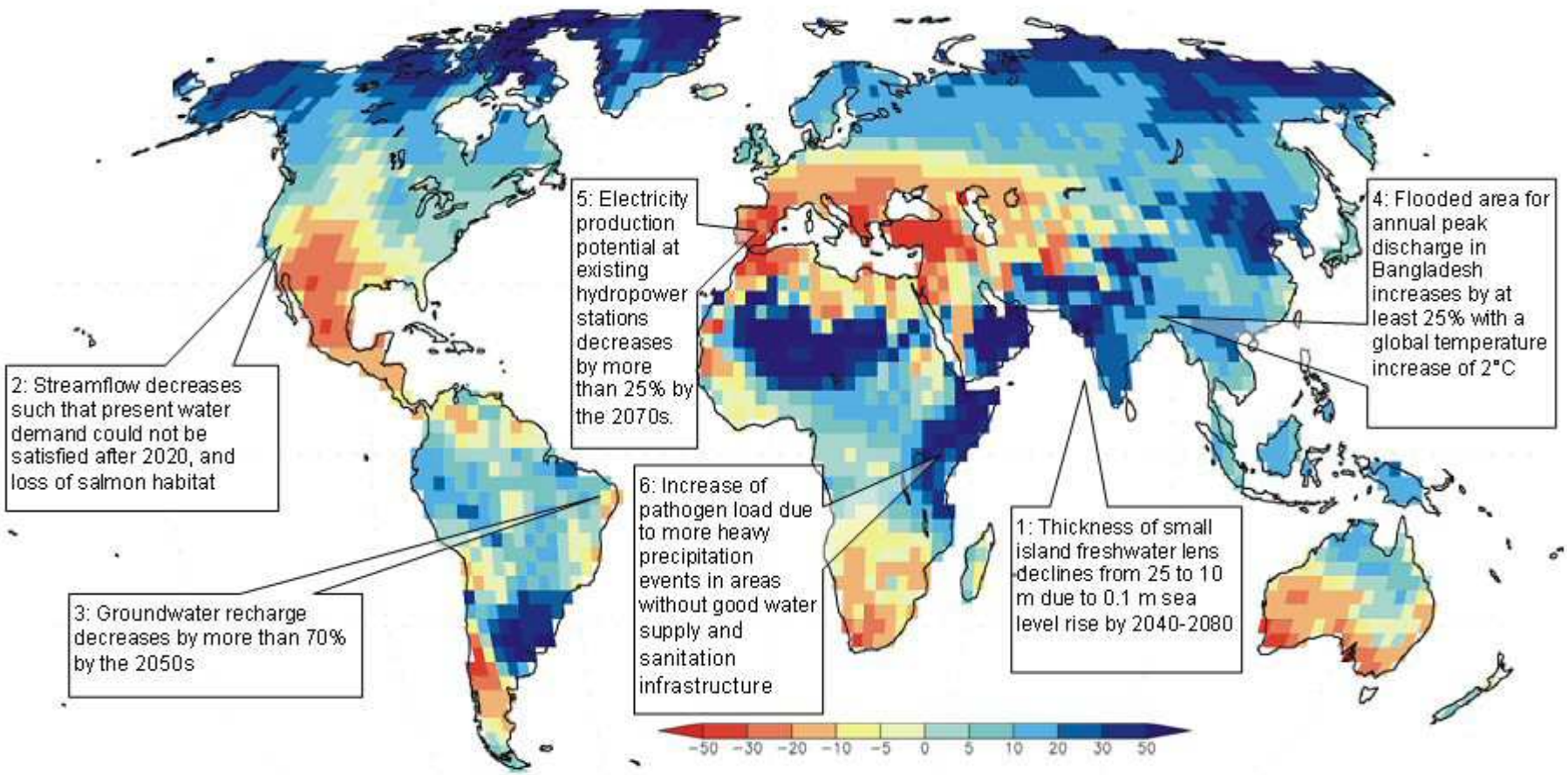


Change in recurrence of 100-year droughts, based on comparisons between climate and water use of 1961-90 and simulations for the 2020s and 2070s (ECHAM4 and HadCM3 climate models, emissions scenario IS92a and a business-as-usual water use scenario). Values calculated with the model WaterGAP 2.1 (Lehner et al., 2005b).



Recurrence interval (return period) of 100-year flood for the control period 1961-1990 at the end of the 21st century (2071-2100), scenario SRES A1B. Based on: **Hirabayashi et al.,** *Hydrol. Sci. J.* **(2008)**

Projected water-related hot spots (boxes) superimposed on map of relative changes in runoff



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Climate change affects the function and operation of existing water infrastructure as well as water management practices.

Adverse effects of climate on freshwater systems aggravate the impacts of other stresses, such as land-use change and urbanization.

Adaptation procedures and risk management practices for the water sector are being developed in some countries that recognize the uncertainty of projections.

• In parts of **Germany** (e.g. Bavaria), flood design values have been increased by a safety margin, based on climate change impact scenarios. The projections for 2050 include an increase of **40-50 %** in small and medium flood discharges and of **15 %** in 100-year floods.

• In the **UK**, the Defra's precautionary allowance includes projection of increase in peak rainfall intensity (up to **20%** by 2085 and **30%** by 2115) and in peak river flow volume (up to **10%** by 2025 and **20%** by 2085), to reflect the possible effects of climate change, based on impact assessments.

• Measures to cope with the increase of the design discharge for the Rhine in **the Netherlands** from **15 000** to **16 000** m^3/s must be implemented by 2015 and it is planned to increase the design discharge to **18 000** m^3/s in the longer term due to climate change.

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Chapter 3: Freshwater Resources and their Management

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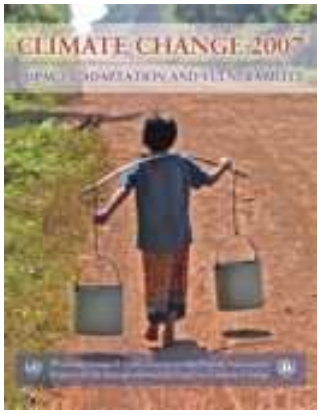

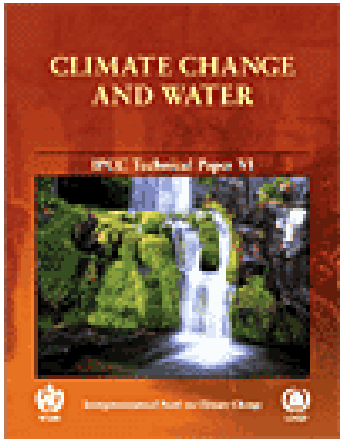

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Publications and Reports

Reports (AR4)

Technical Papers

Acknowledgements:

EU 6FP Integrated Project WATCH