



# **Droughts and Climate Change in Austria Implications for Water Resources Management**

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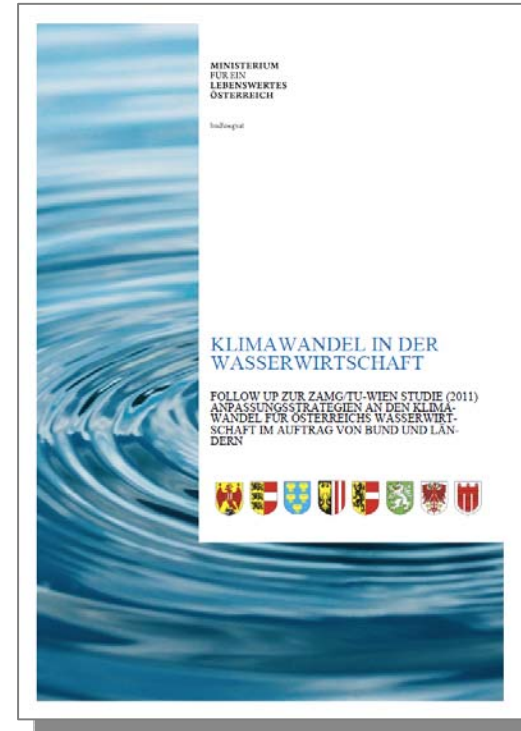
**With contributions from  
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2<sup>nd</sup> Workshop of the Water Platform of the Alpine Convention on  
Drought Risk Management in the Alps  
23 Jan. 2018

# Study on droughts and climate change

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[www.bmnt.gv.at/wasser.html](http://www.bmnt.gv.at/wasser.html)



## Task:

- Assess climate change impacts on floods and droughts (past and future)
- Update of an earlier study on adaptation strategies

# Droughts in the Past

August 2015  
Lower Austria



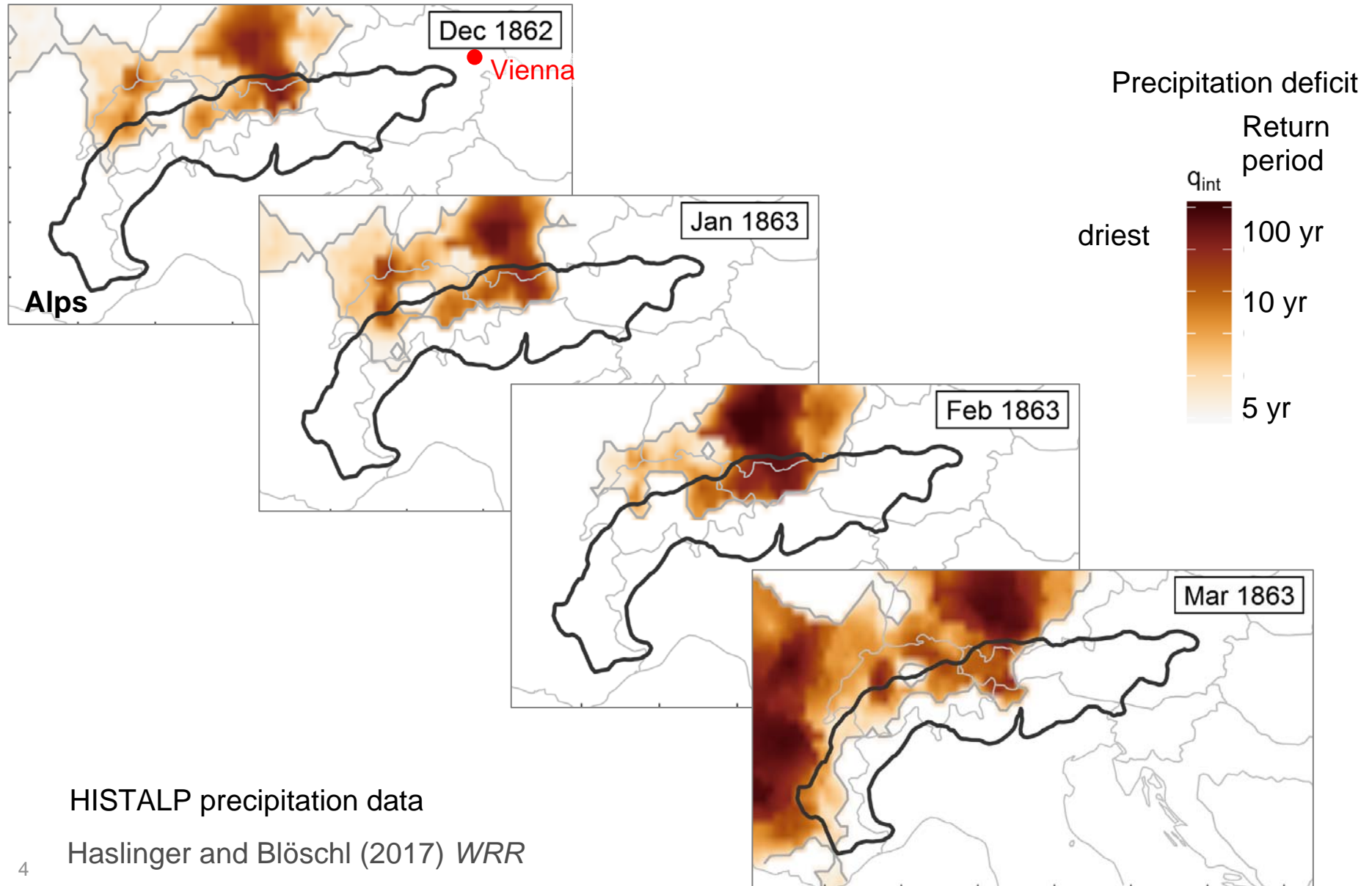
August 2015  
Upper Austria





# Example of meteorological drought event

Dec 1862 - April 1863. Dark colours: least precipitation



HISTALP precipitation data

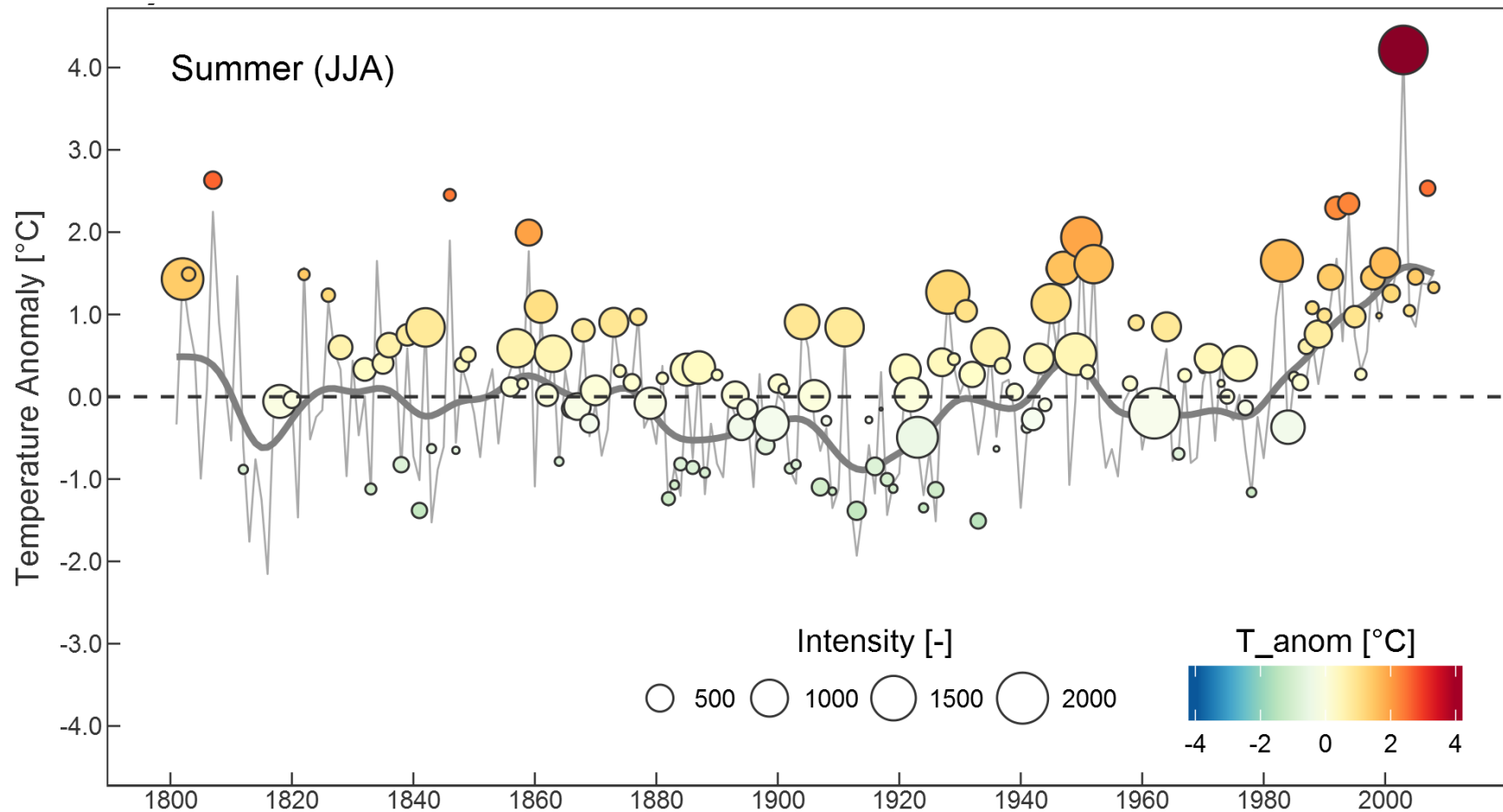
Haslinger and Blöschl (2017) *WRR*

# Drought intensities and air temperatures

## Summer

Size of circles: drought intensity (lack of precipitation)

Colour: air temperature anomaly during drought

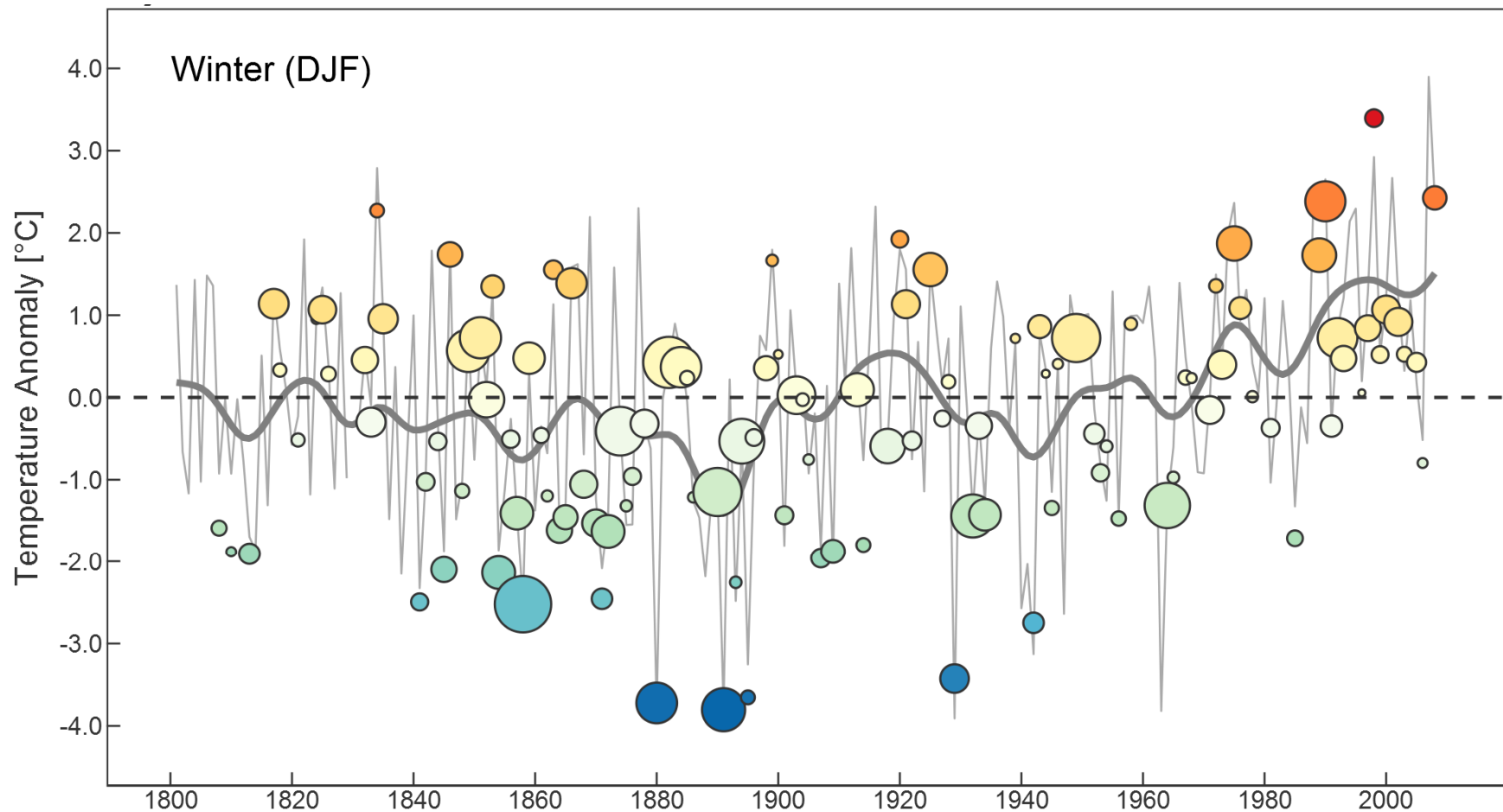


# Drought intensities and air temperatures

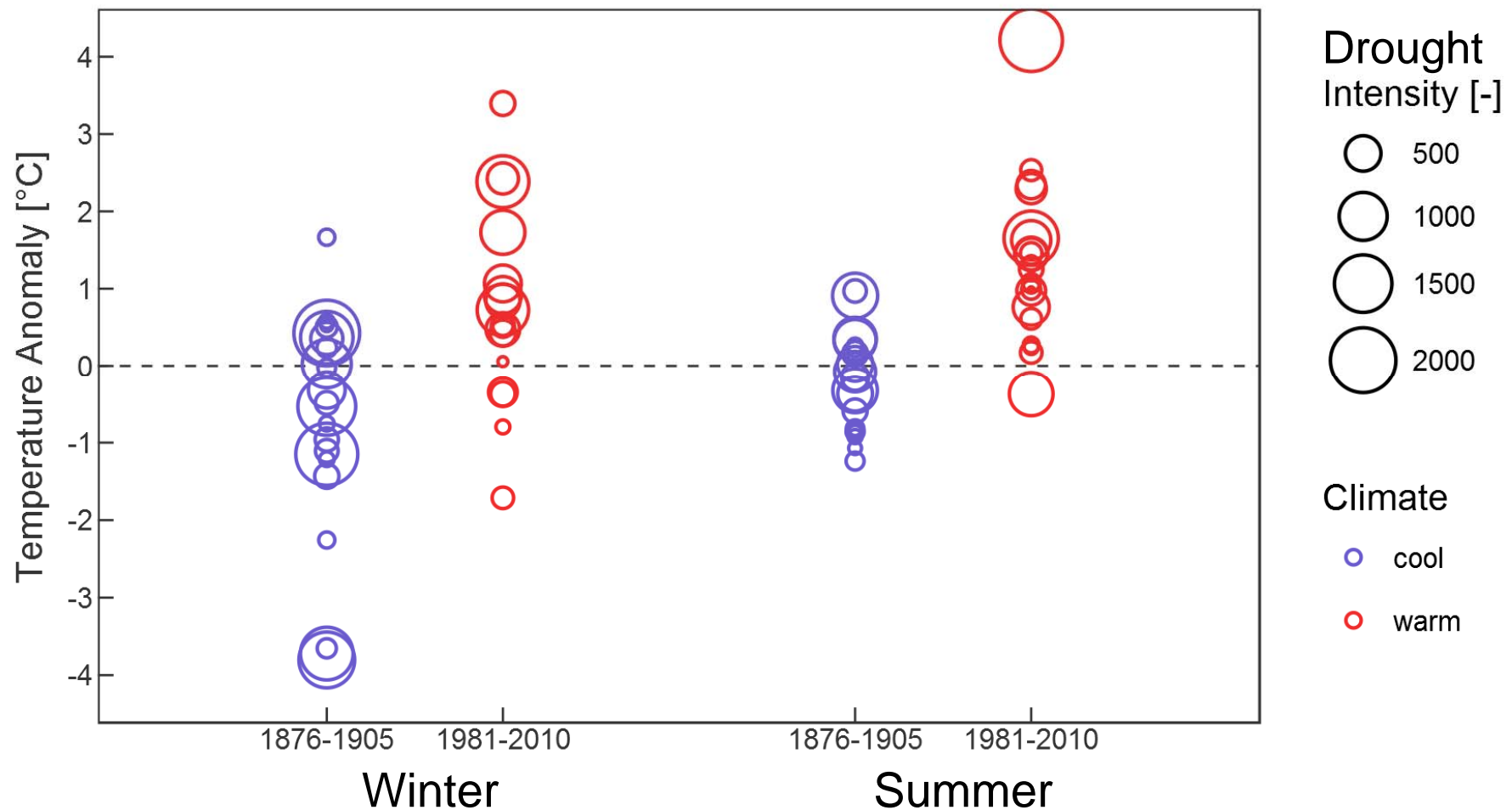
## Winter

Size of circles: drought intensity (lack of precipitation)

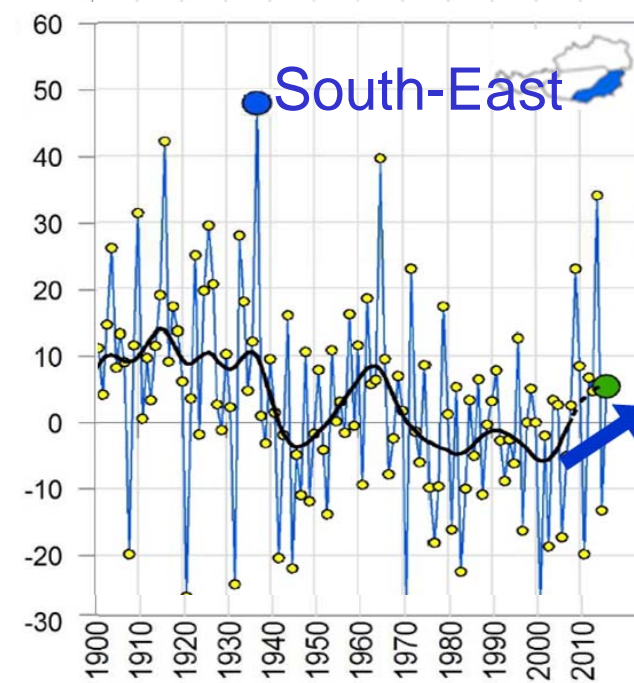
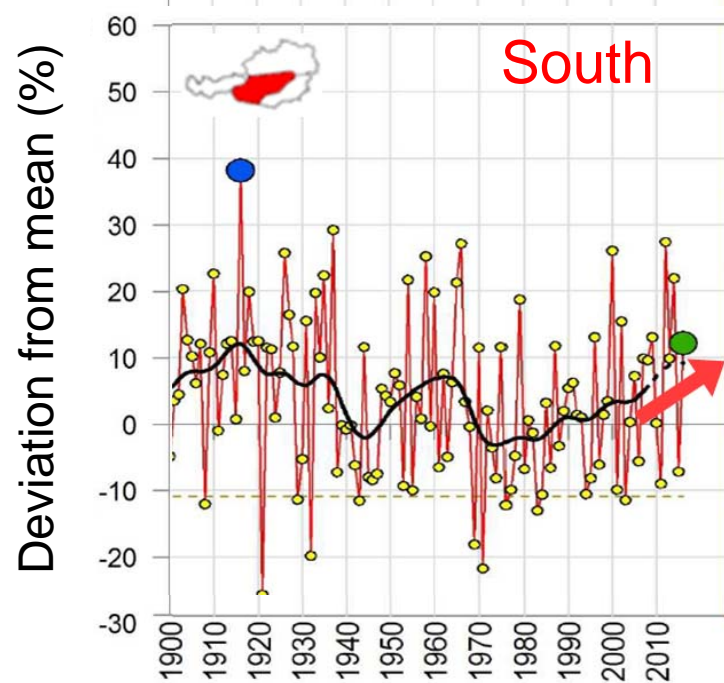
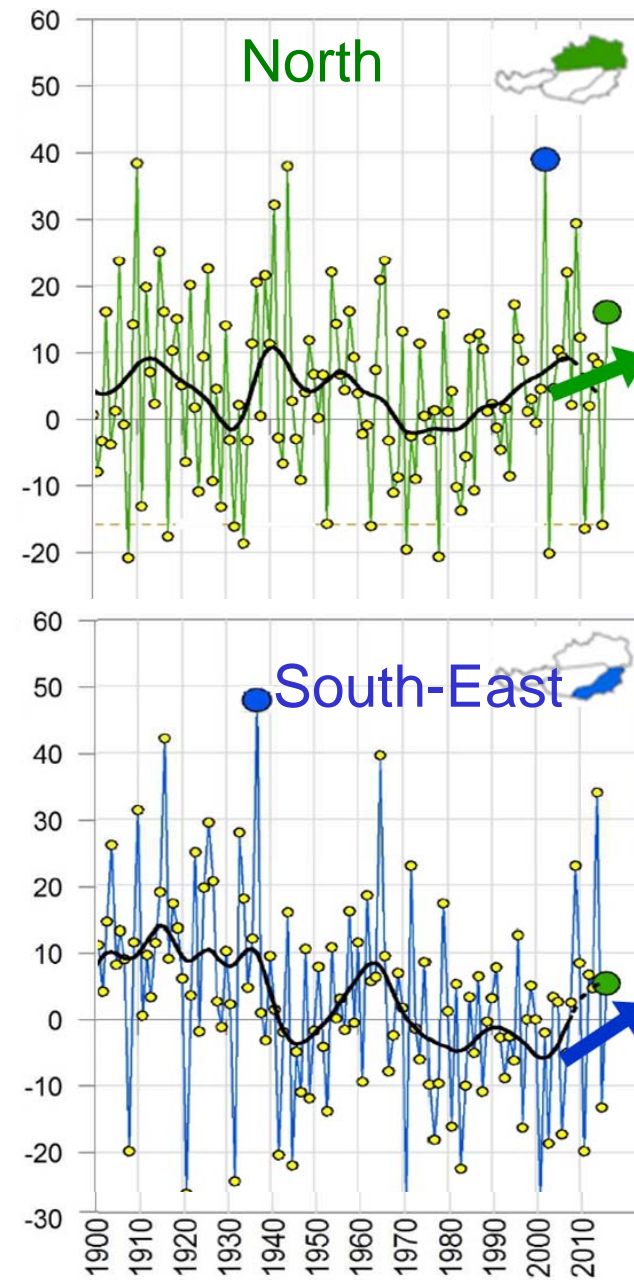
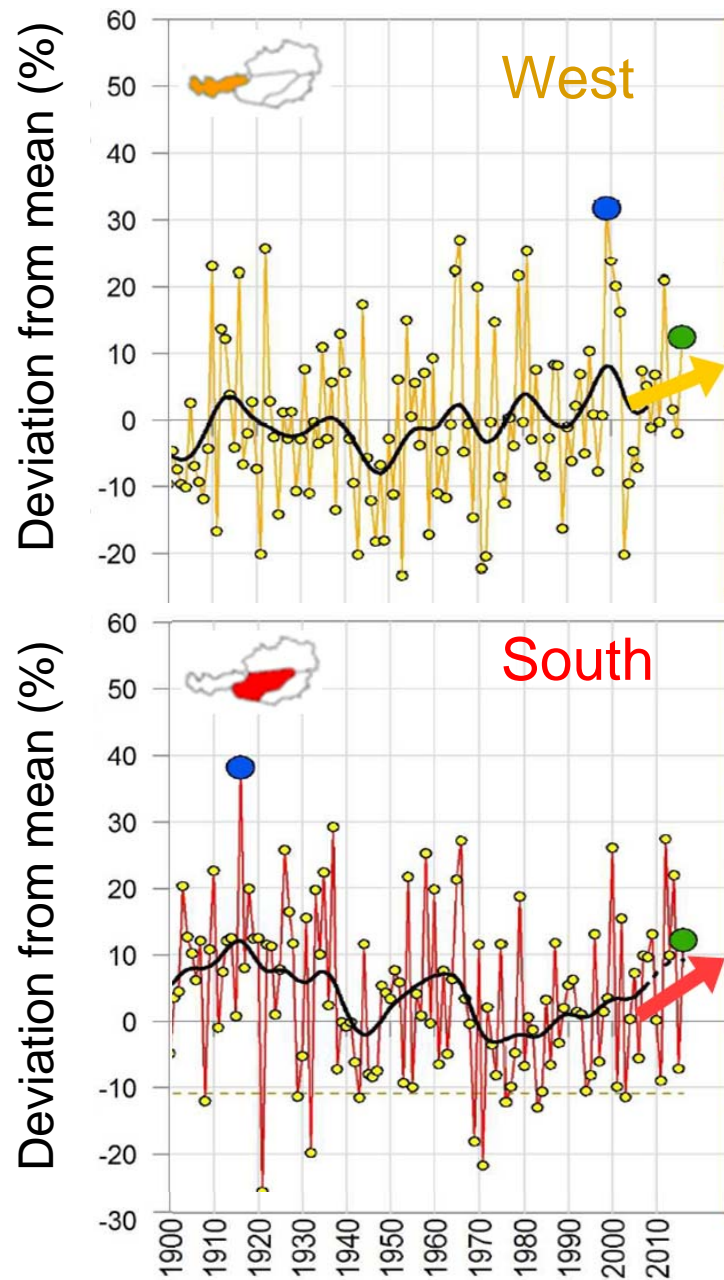
Colour: air temperature anomaly during drought



# Summer droughts have become more frequent, winter droughts less frequent



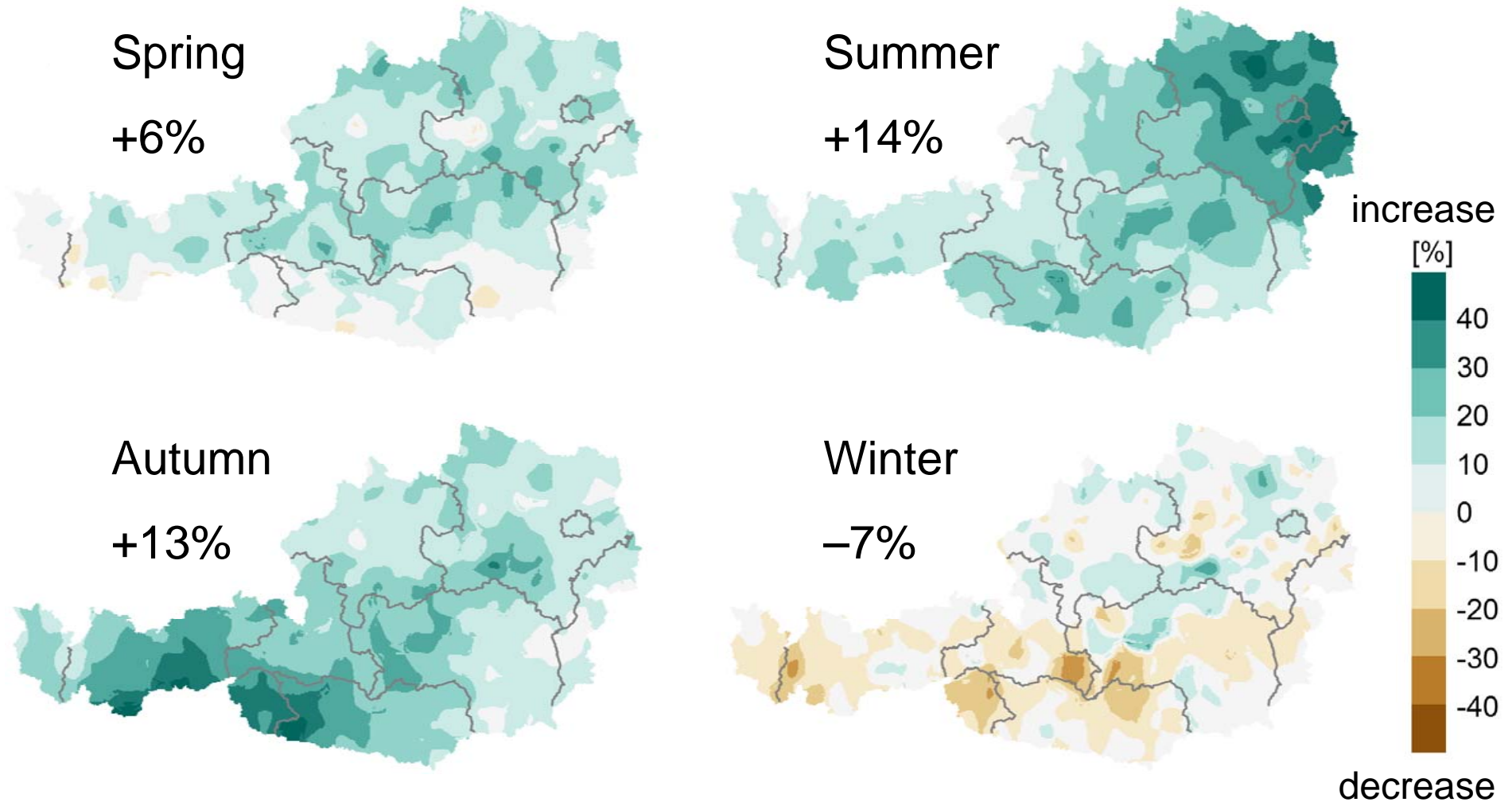
# Annual precipitation in Austria





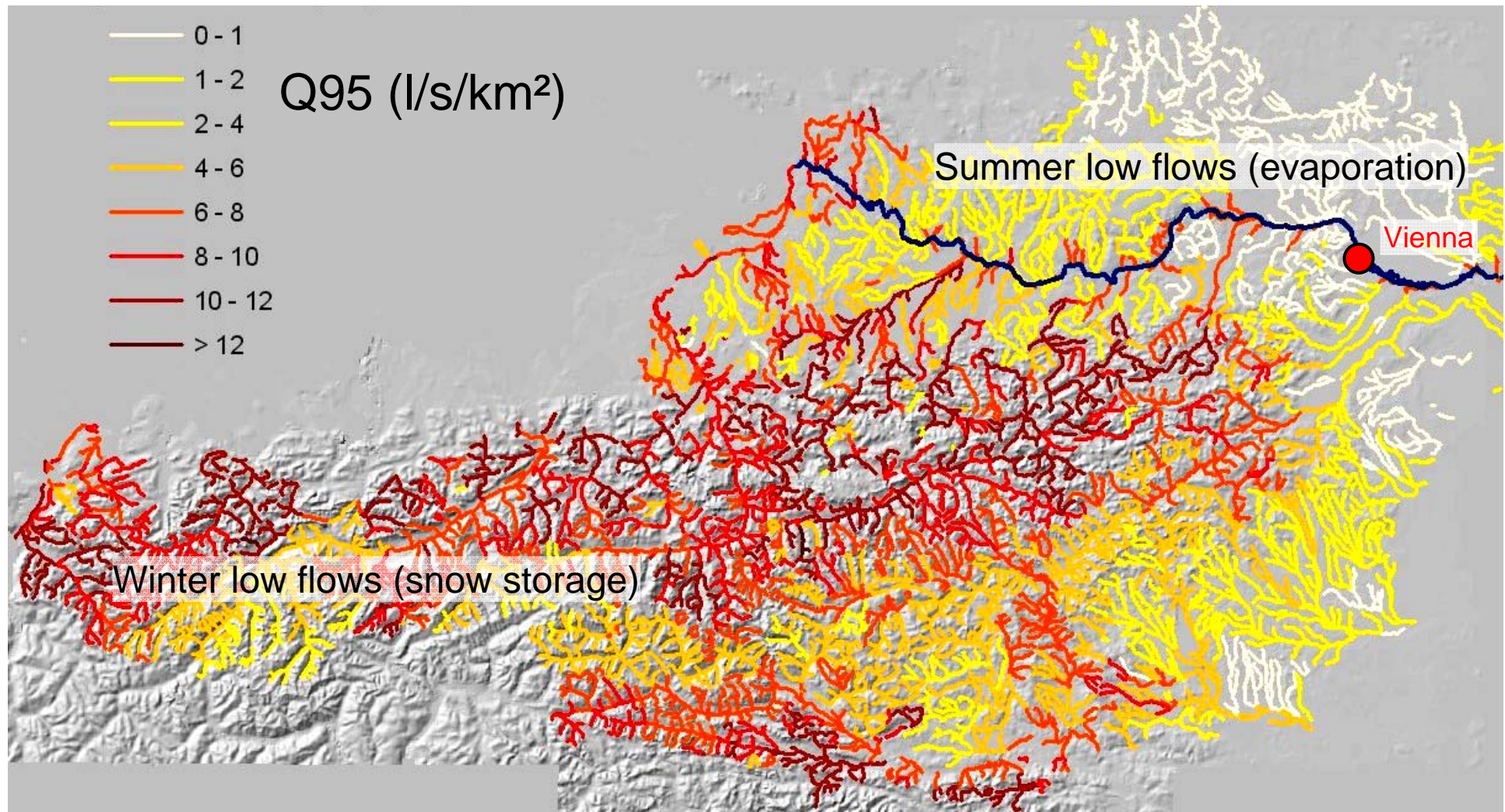
# Precipitation in Austria

1996–2014 minus 1976–1995



# Q95 low flows in Austria

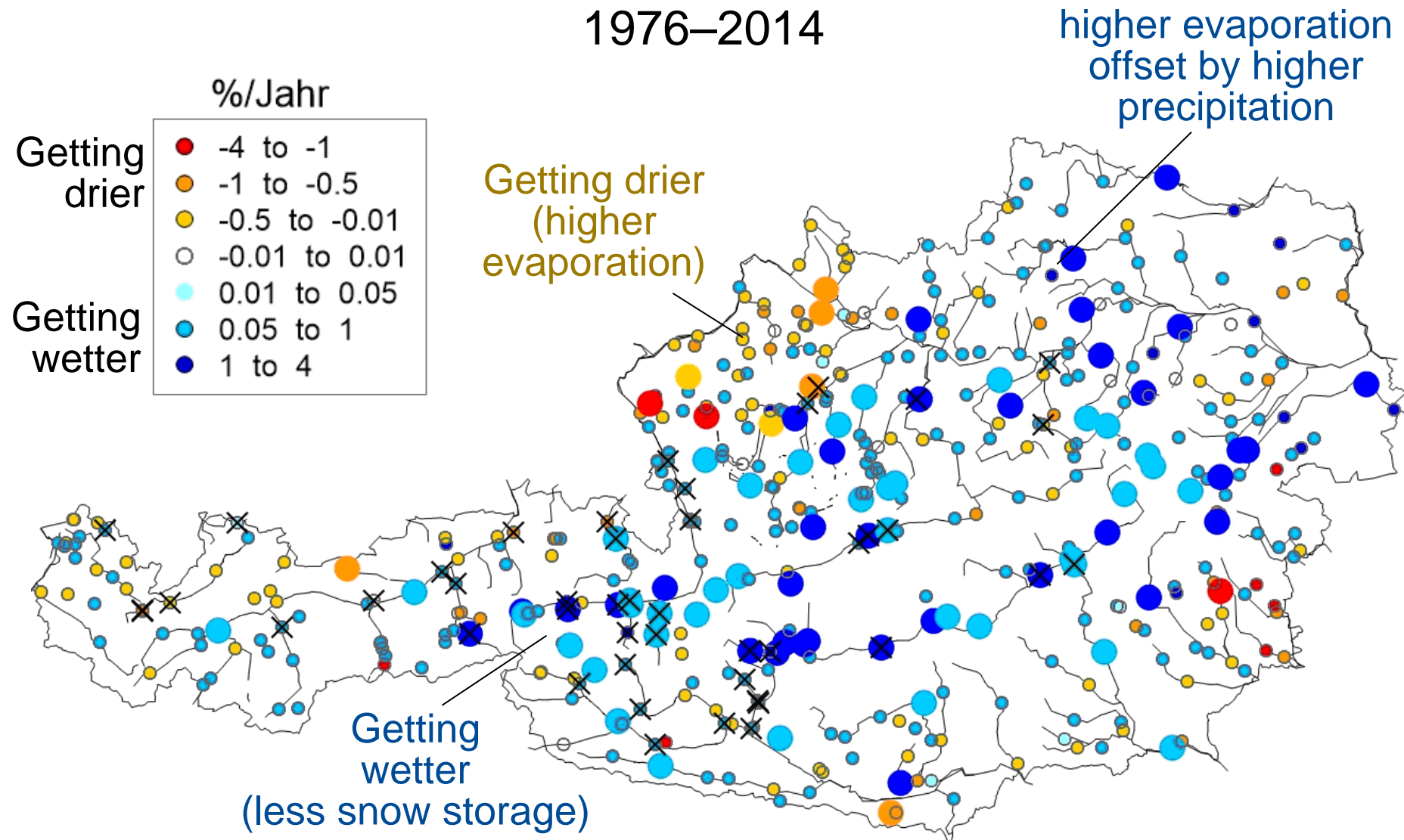
Flow exceeded on 95% of days





# Trends of Q95 low flows in Austria

1976–2014



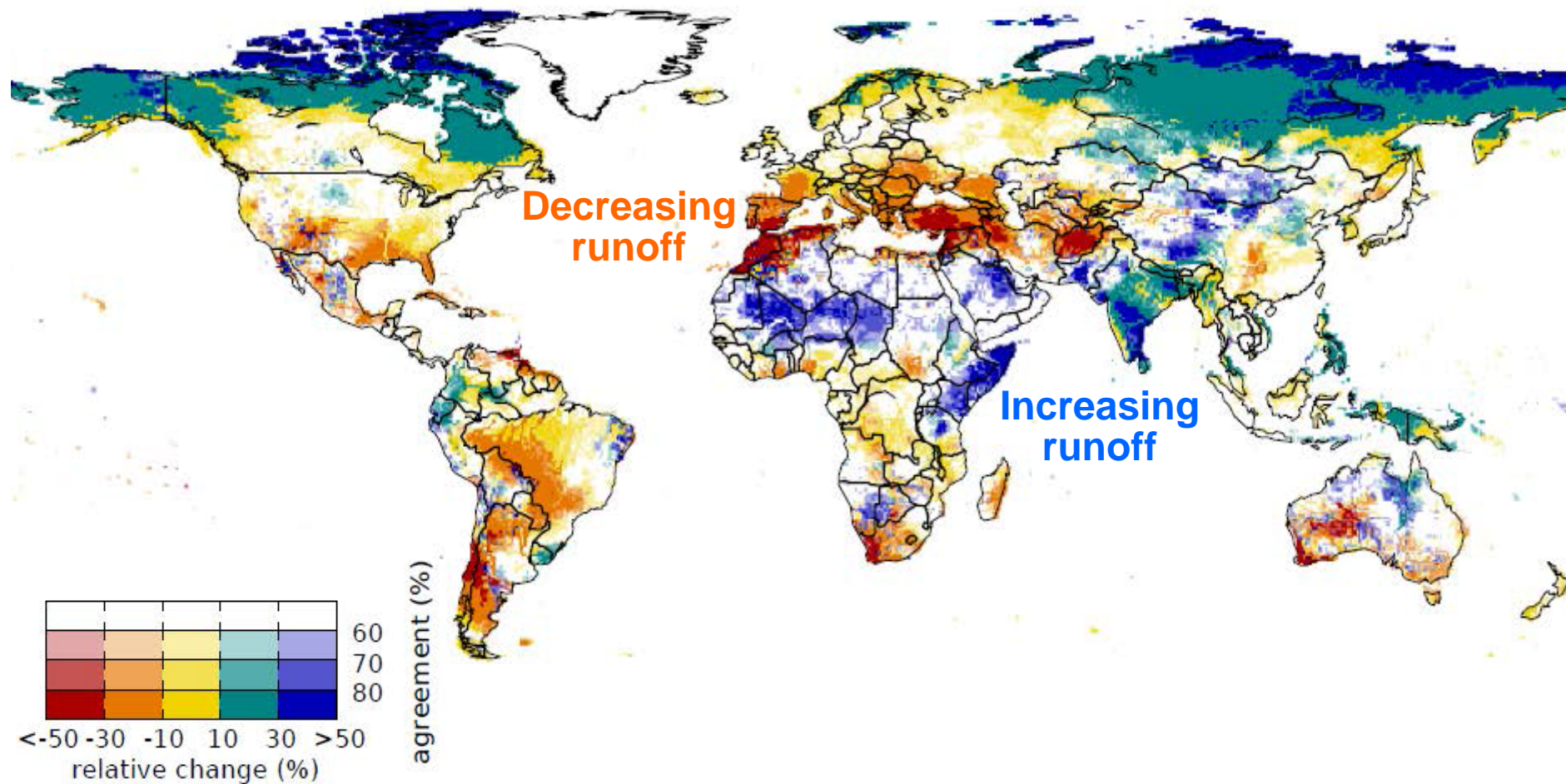
# Droughts in the Future





# Fifth IPCC Assessment Report 2014

Change in mean runoff for a temperature rise of 2°C

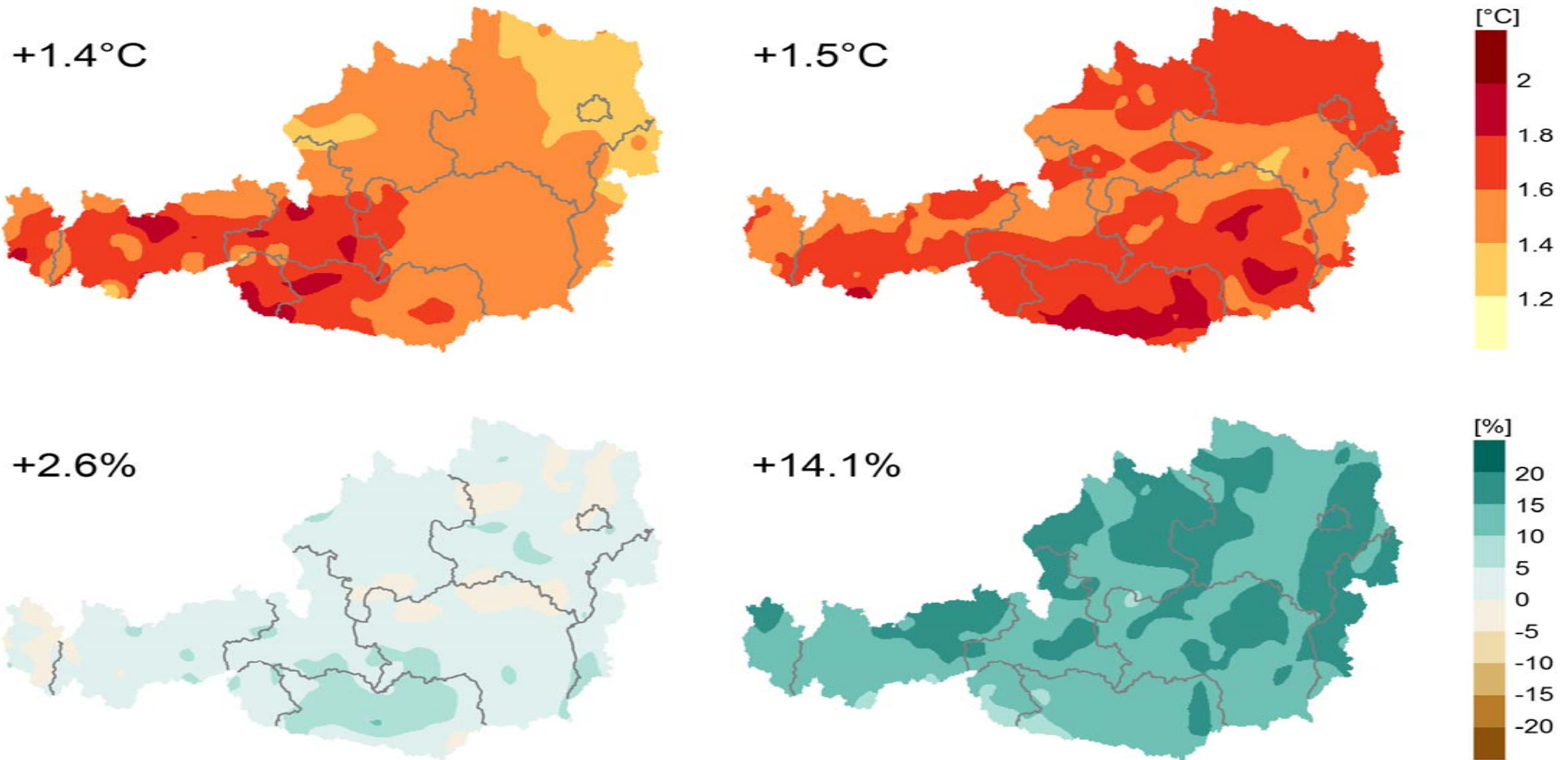


# Temperature, precipitation in the future

2021–2050 minus 1971–2000

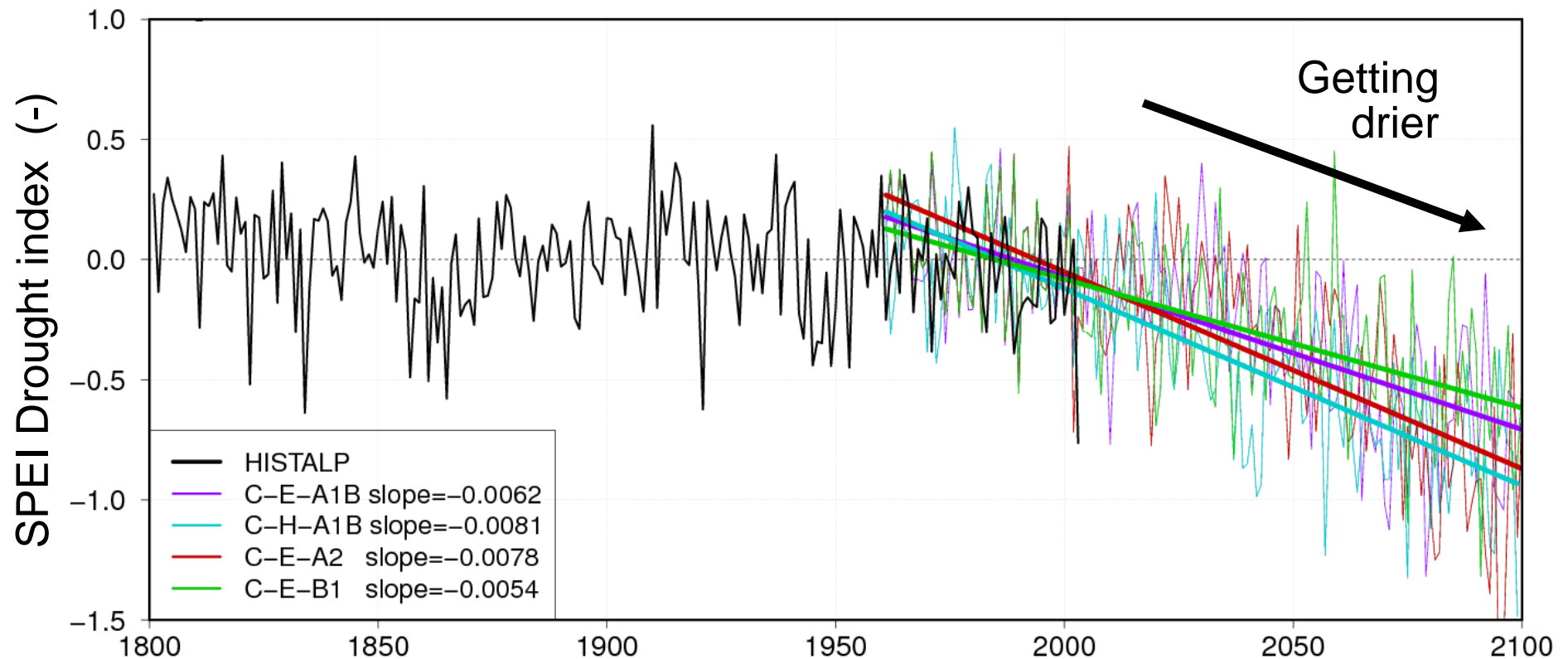
Summer

Winter



# Drought index in the future

Greater Alpine Region  
Based on precipitation, temperature



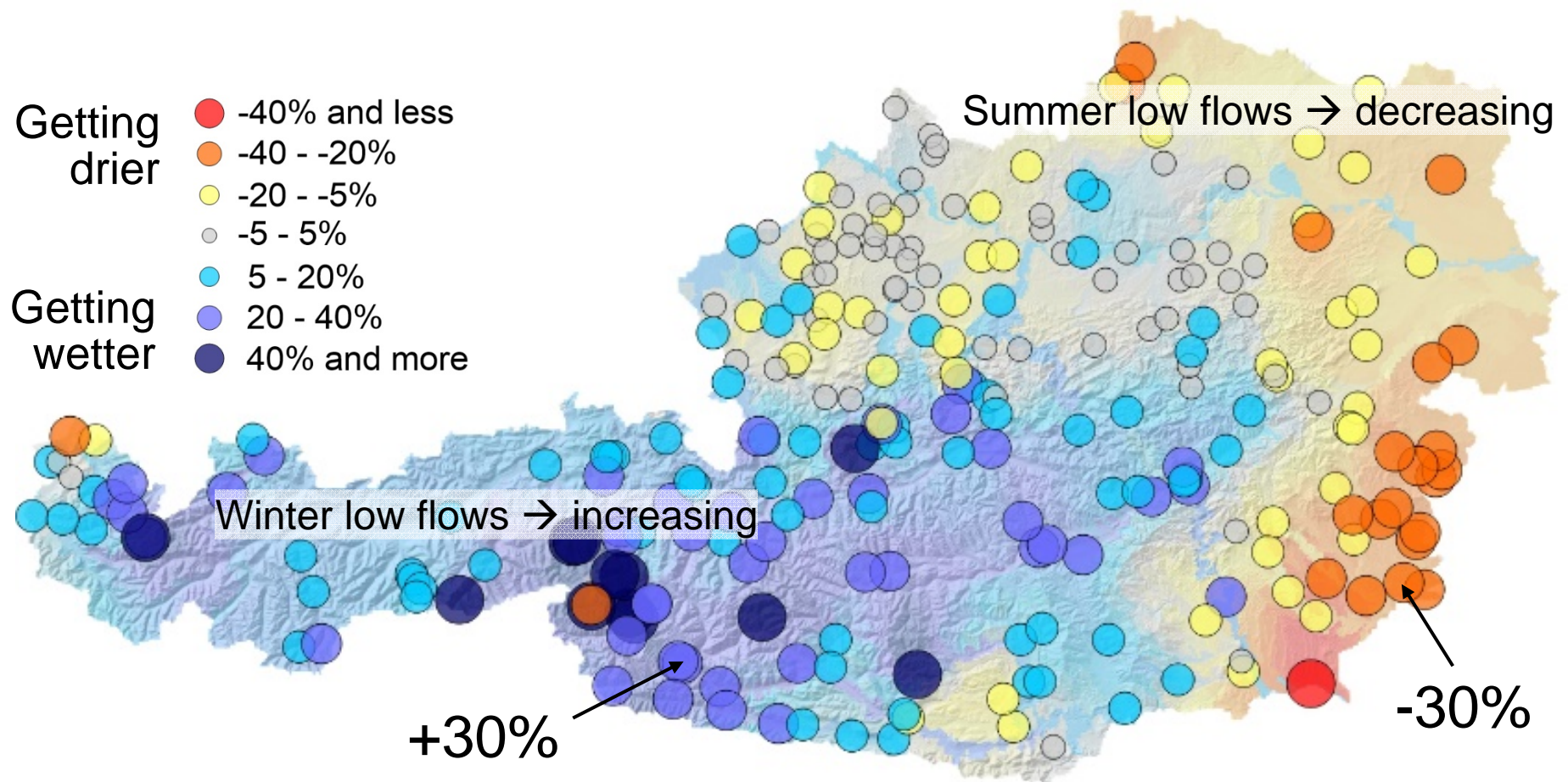
COSMO-CLM with ECHAM5-A1B,  
HadCM3-A1B, ECHAM5-A2, ECHAM5-B1



# Change of Q95 low flows in Austria – Future

2021-2050 vs 1976-2008

AIT\_HADCM3\_A1B

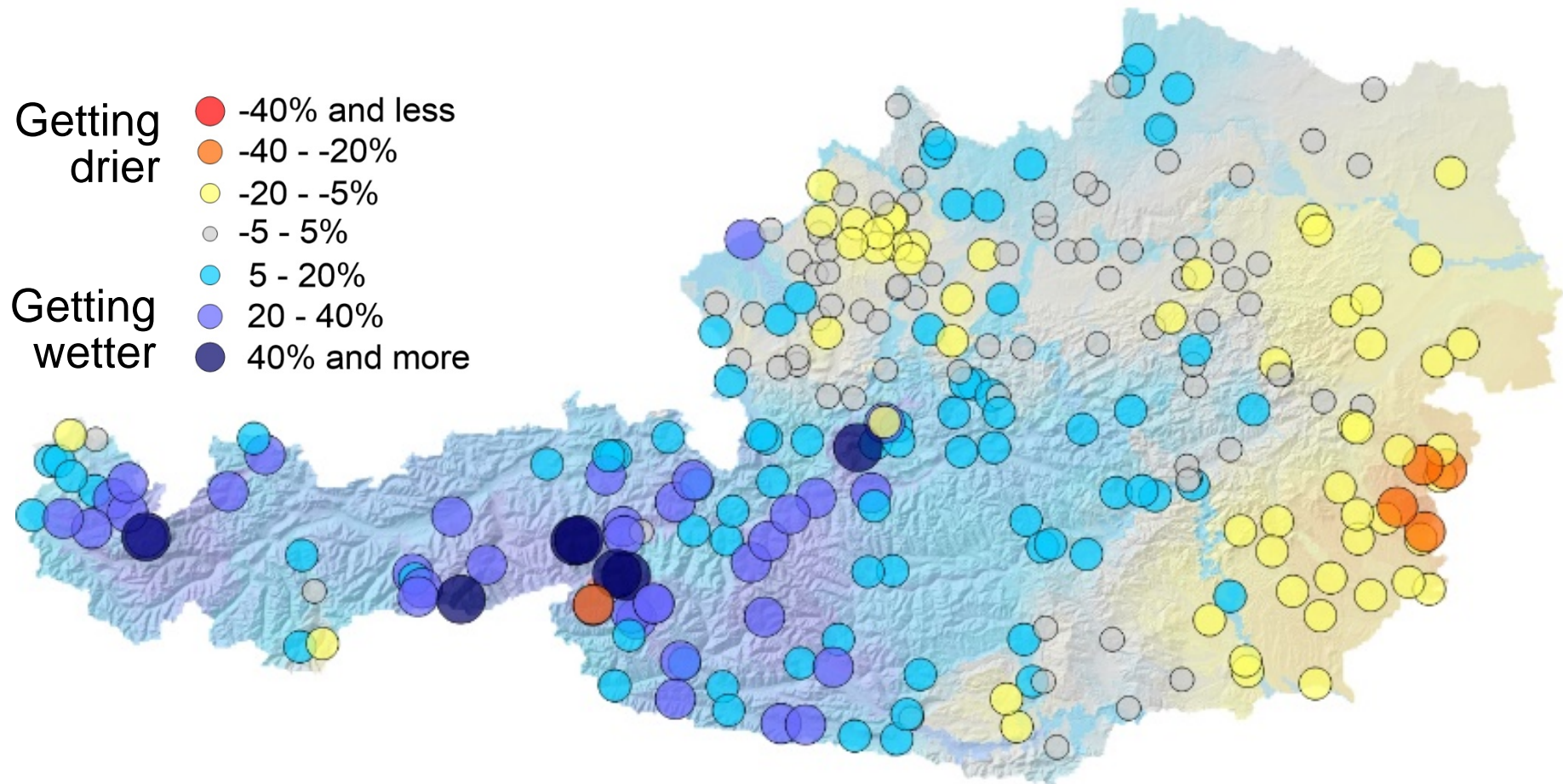




# Change of Q95 low flows in Austria – Future

2021-2050 vs 1976-2008

ZAMG\_ECHAM5\_B1



# Management implications

Observed low flow trends likely to continue into the future

**Alpine areas:** increases in low flows due to warmer air temperatures (less snow retention in catchments)

→ Mostly positive effects (e.g. hydropower)

**Lowlands in the East and Southeast of Austria:**

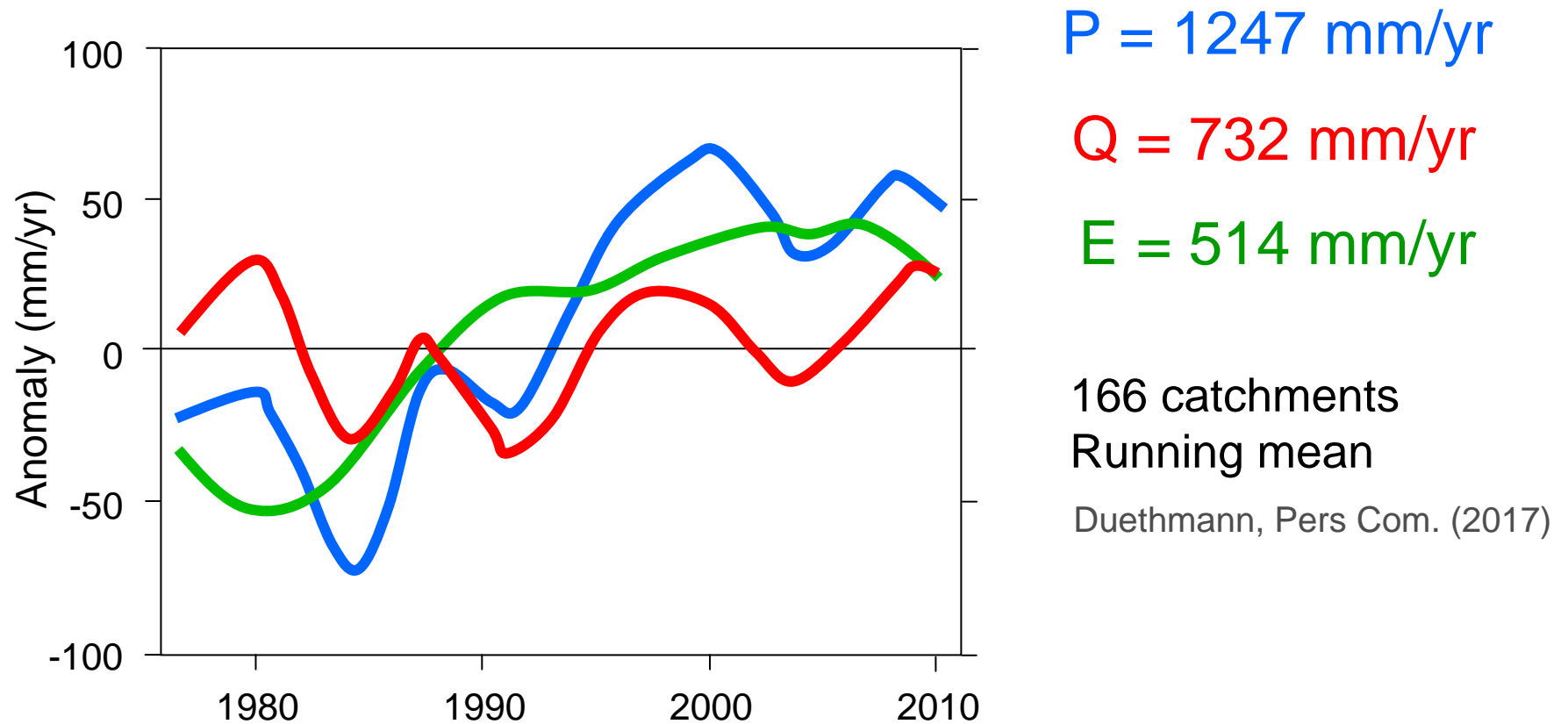
(slight) decreases in low flows likely to continue

→ Probably negative effects (e.g. stream temperatures, water quality, fluvial ecosystems, river bank filtration, ..)

Decadal runoff variability > changes expected for 2021-2050

# What can we expect?

## Water balance of Austria 1975-2015



Precipitation has increased by 7%. Will it increase further?

Runoff has not changed

Evaporation has increased by 16%. Likely to increase further

# Management implications

Shift from winter droughts to summer droughts (more likely)

Prioritisation of climate adaptation measure for droughts / low flows depending on local situation, e.g.

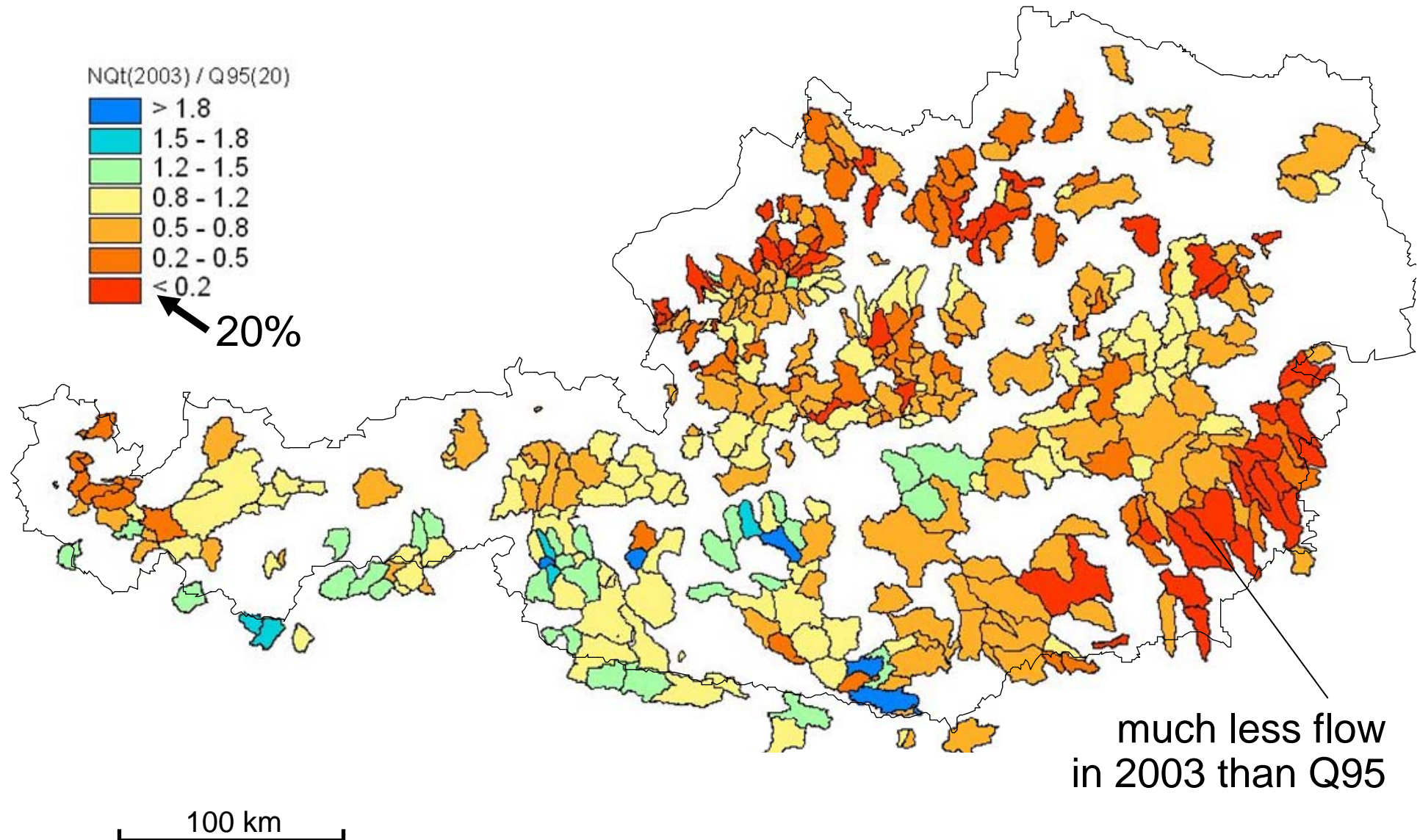
- storage management
- treatment of water from river bank filtration
- Interconnecting local/regional water supply networks

Experience from recent summer droughts (2003, 2015)  
to assist in local adaptation measures



# Summer 2003 drought relative to Q95 low flows

Ratio of low flows in 2003 and Q95 low flows



# Thank you for your attention

Blöschl, Parajka, Blaschke, Hofstätter, Haslinger, Schöner (2017) Klimawandel in der Wasserwirtschaft – Schwerpunkt Hochwasser, Dürre und Trockenheit. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, 1010 Wien.

Haslinger and Blöschl (2017) Space-time patterns of meteorological drought events in the European Greater Alpine Region over the past 210 years. *Water Resources Research*, 53, 9807–9823.

Haslinger, Schöner, Anders (2015) Future drought probabilities in the Greater Alpine Region based on COSMO-CLM experiments, *Meteorologische Zeitschrift*, 25 (2)

Laaha, Parajka, Viglione, Koffler, Haslinger, Schöner, Zehetgruber, Blöschl (2016) A three-pillar approach to assessing climate impacts on low flows. *Hydrology and Earth System Sciences*, 20, 3967–3985.

Parajka, Blaschke, Blöschl, Haslinger, Hepp, Laaha, Schöner, Trautvetter, Viglione, Zessner (2016) Uncertainty contributions to low-flow projections in Austria. *Hydrology and Earth System Sciences*, 20, 2085-2101.