



# Mountain water supply in a changing climate

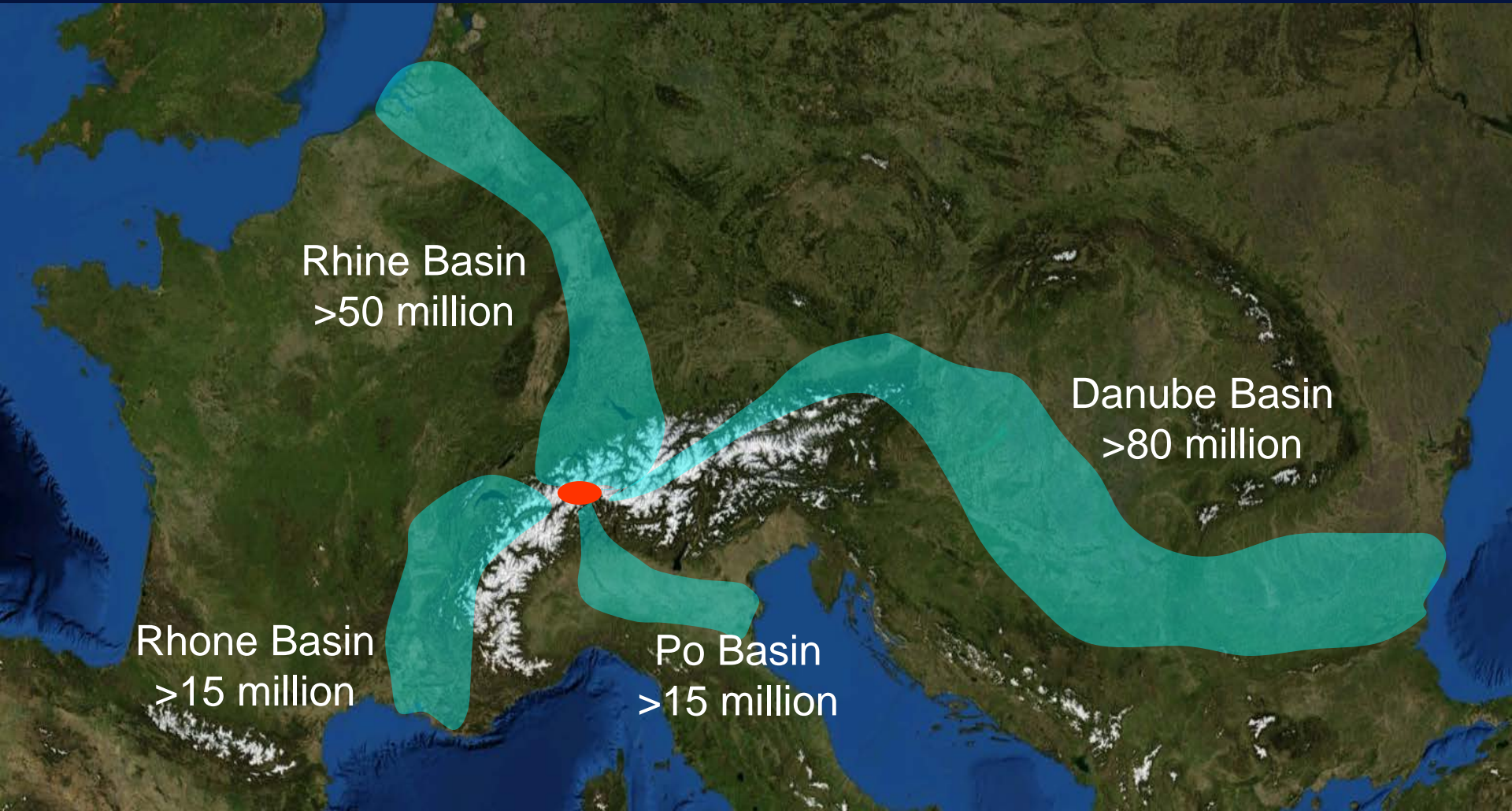
*Martin Beniston  
The University of Geneva  
Switzerland*

# Mountains and water

water

Mountains and

# Upstream-downstream links

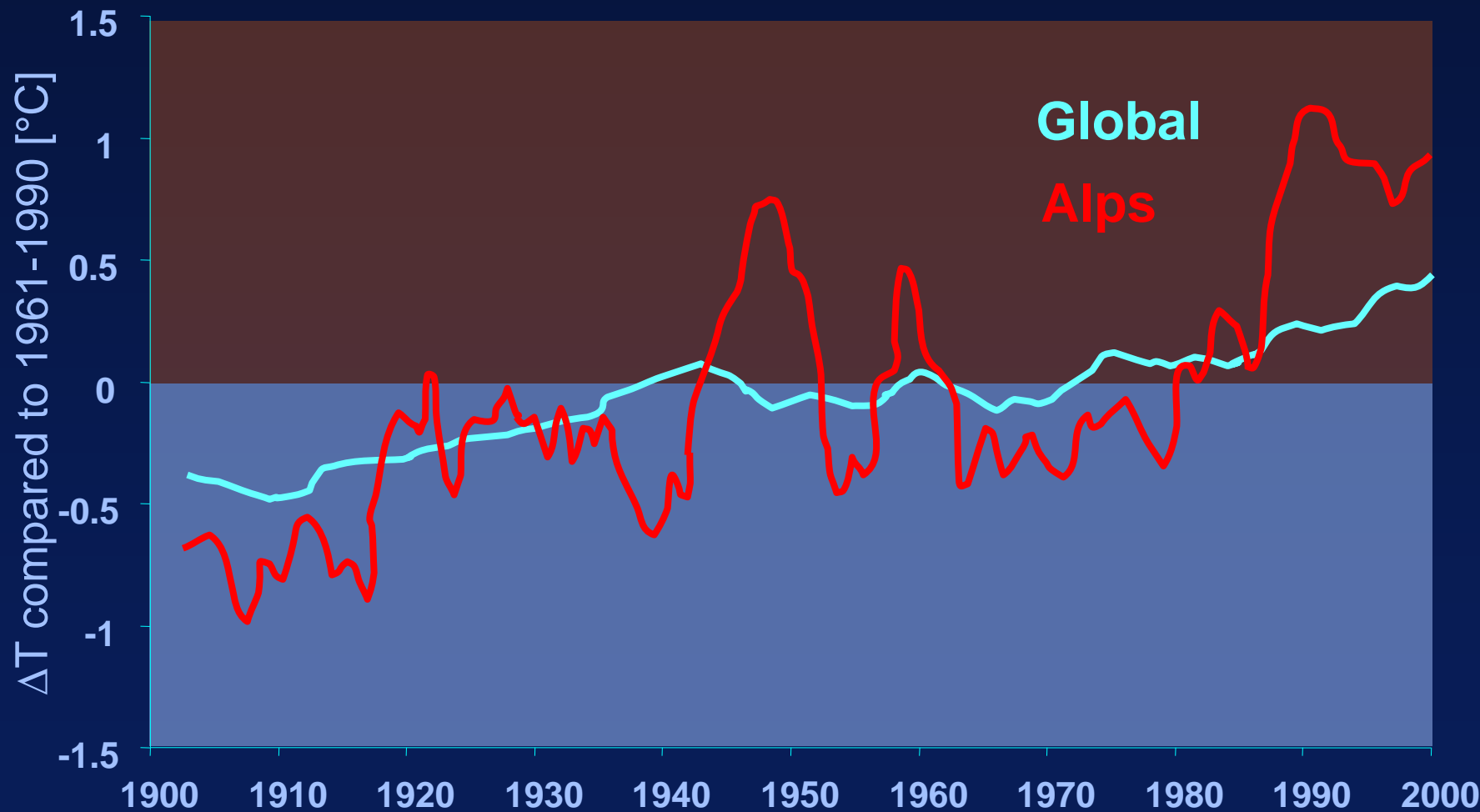


# Observed changes in the Alps

Observed changes in the Alps



# Evolution of global and alpine temperatures, 1901-2000



Beniston, 2000: Environmental Change in Mountains, Arnold, London

# Rhone Glacier retreat: 1870s-2000s

Year 1874.0



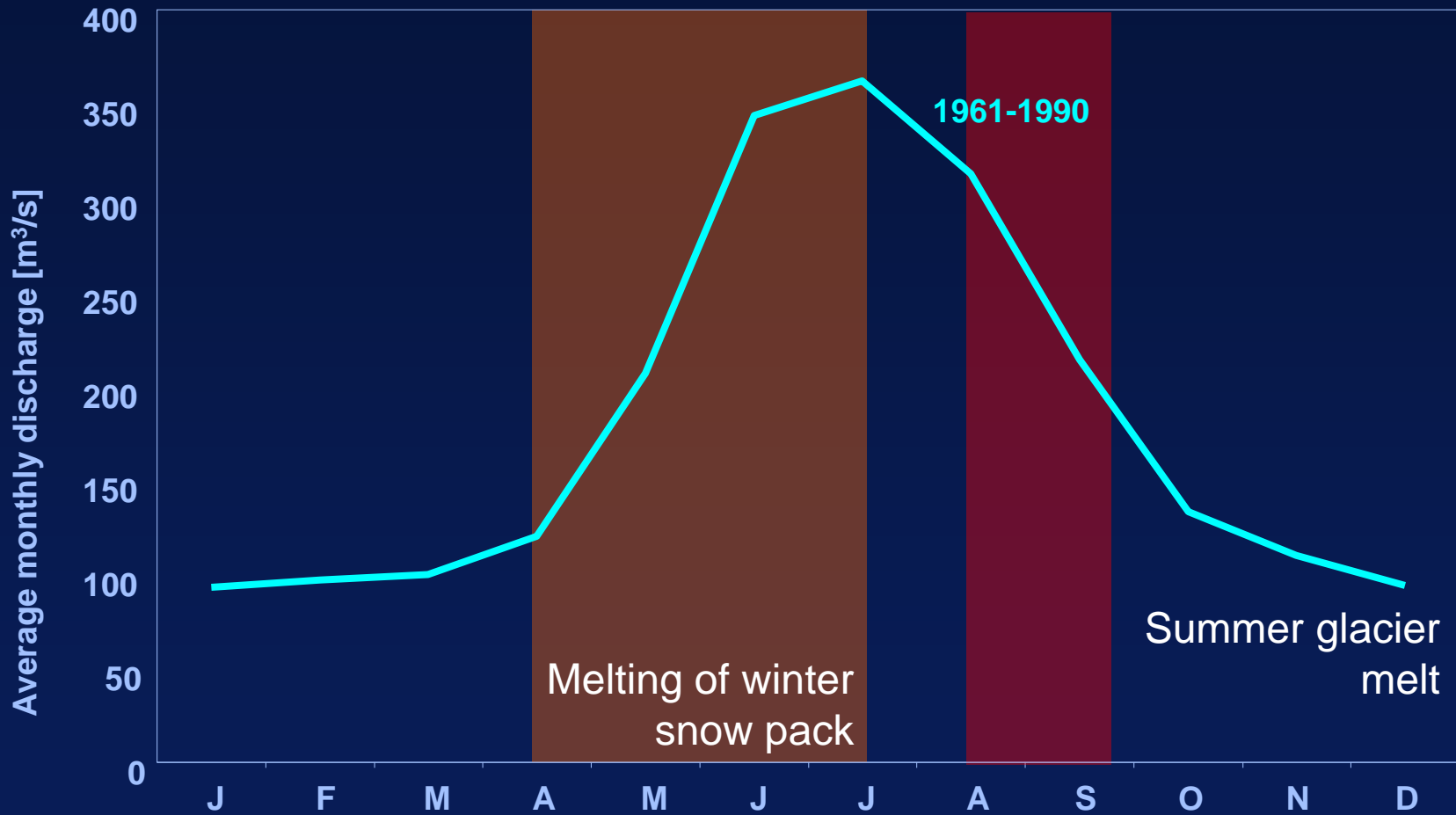
VAW-ETHZ & IACS-EPFL

# Alpine river catchments

Alpine river catchments



# Rhone River discharge in the 1961-1990 reference climate



Beniston, 2010: Journal of Hydrology



# 21st century climate projections for the Alps

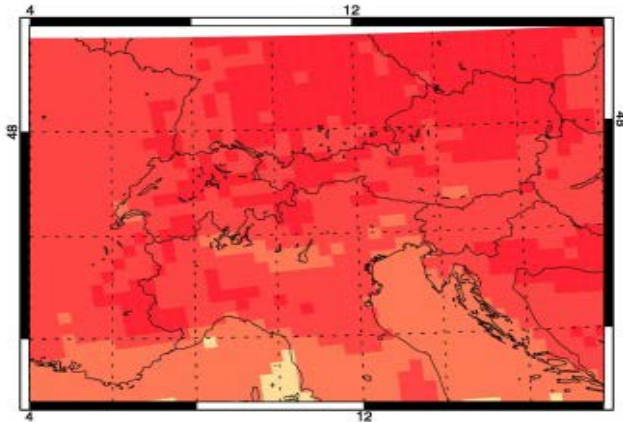
for the Alps

21st century climate projections

# Changing alpine climates

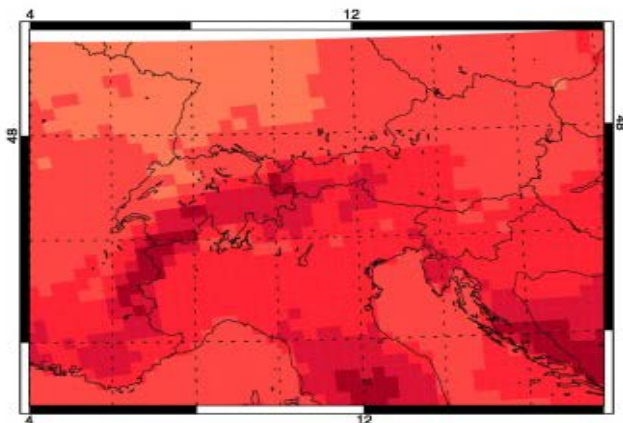
DJF  
Temp

CCS 2-m Air Temp. 1961–90/2021–50  
Ensemble Q.50, season: DJF



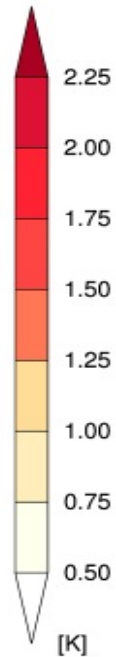
Mean: 1.6 Stand.Dev.: 0.2 Max: 2.0 Min: 1.1

CCS 2-m Air Temp. 1961–90/2021–50  
Ensemble Q.50, season: JJA



Mean: 1.7 Stand.Dev.: 0.3 Max: 2.6 Min: 1.0

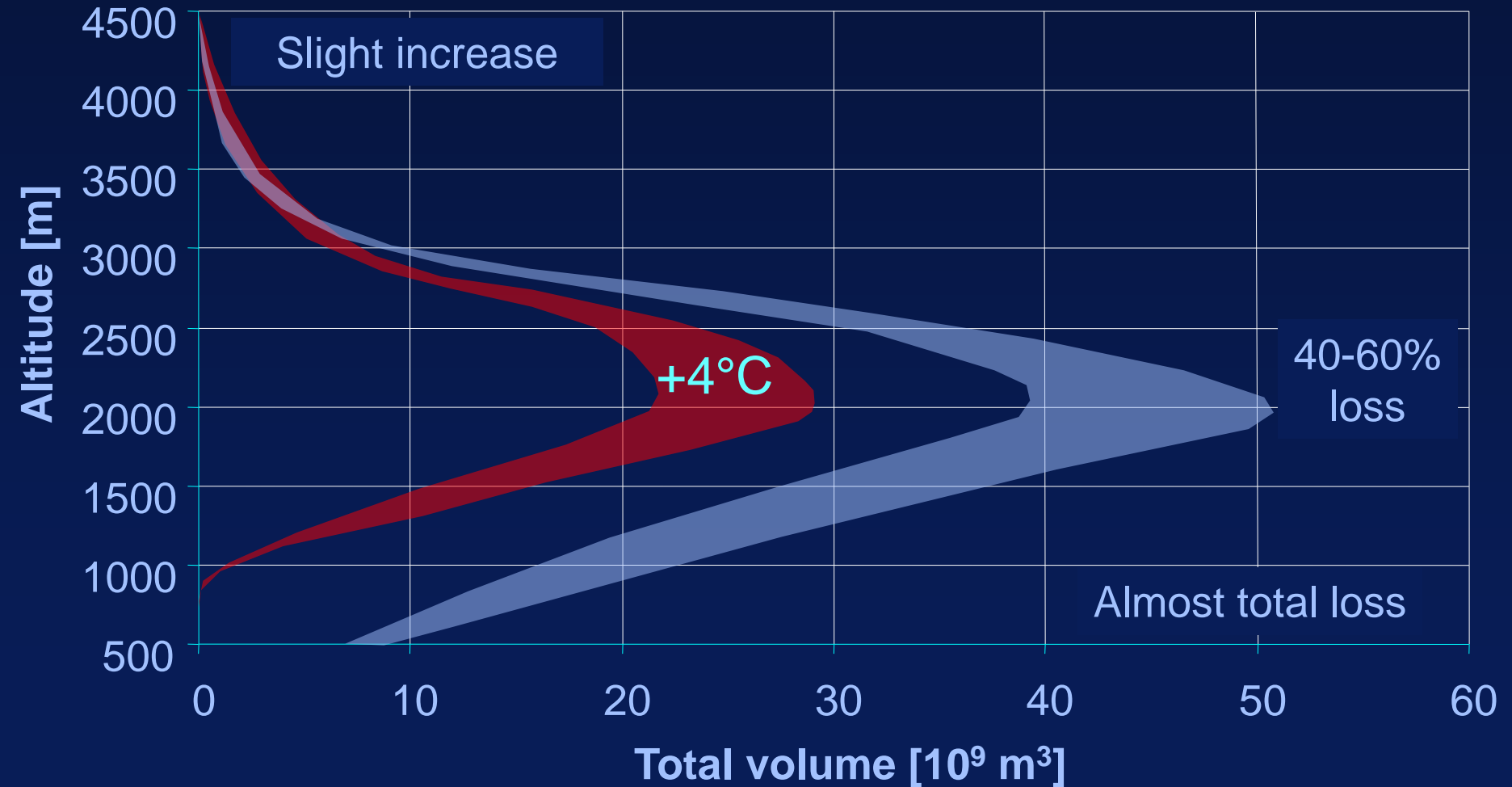
JJA



# Impacts on hydrology

# Shifts in snow volume according to altitude

Beniston et al., 2003:  
Theoretical and Applied Climatology



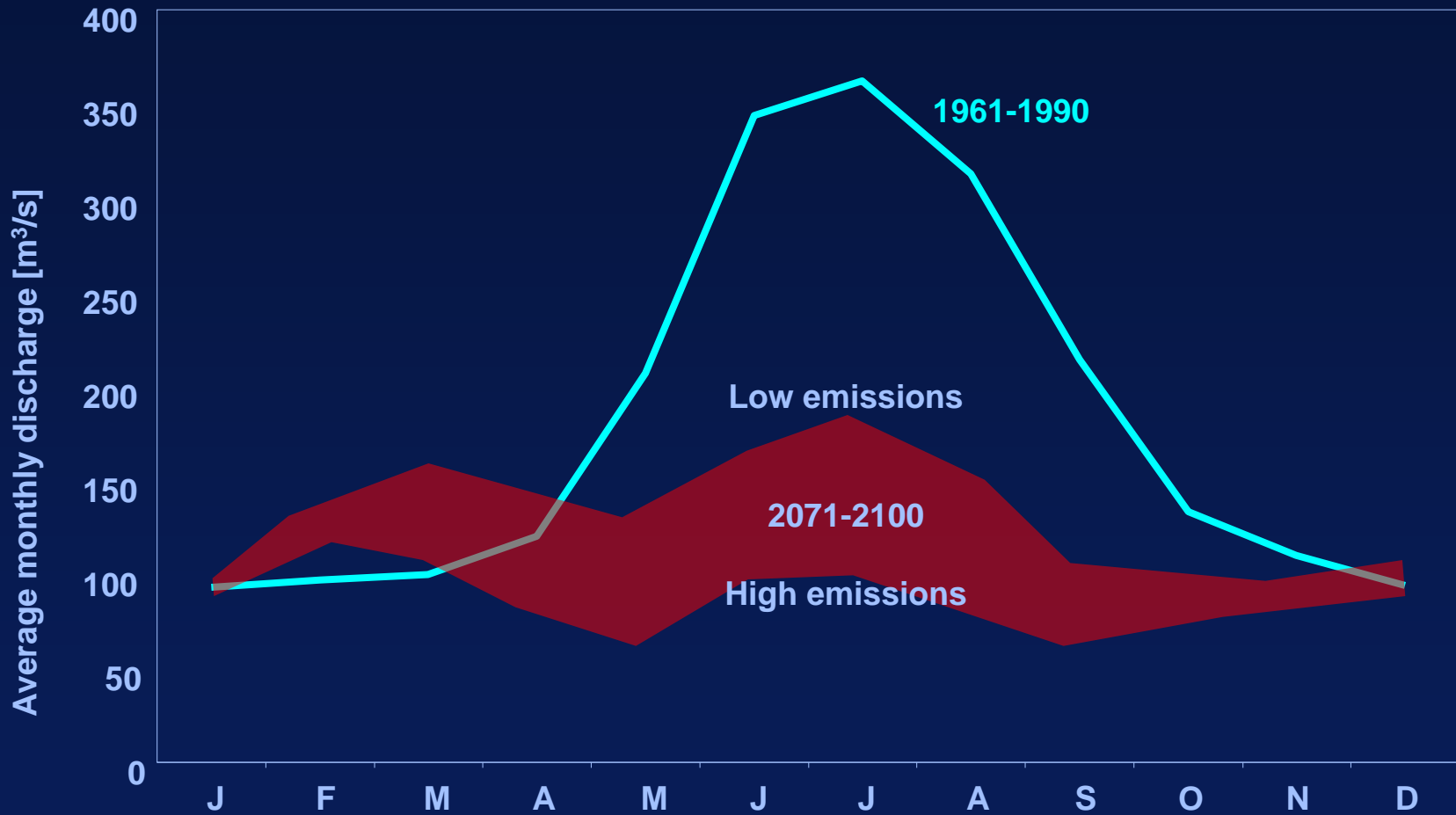
# Rhone Glacier retreat: 2000s-2100

Year 2007.0



VAW-ETHZ & IACS-EPFL

# Possible future discharge by 2100 (m<sup>3</sup>/s, River Rhone)

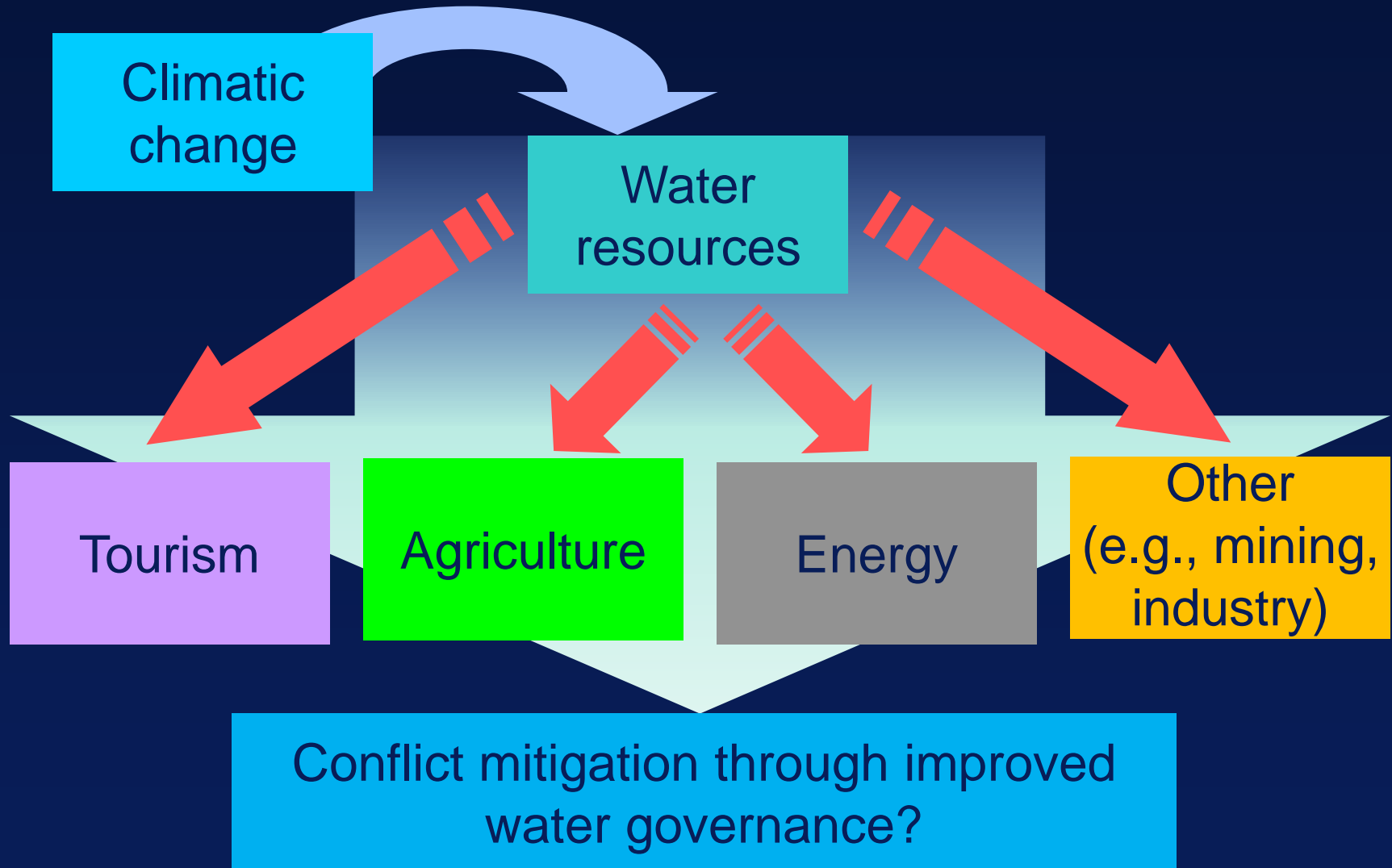


Beniston, 2010: Journal of Hydrology

# Possible economic impacts (example of hydropower) (εχαστηριε οτ μλqιobomeι)

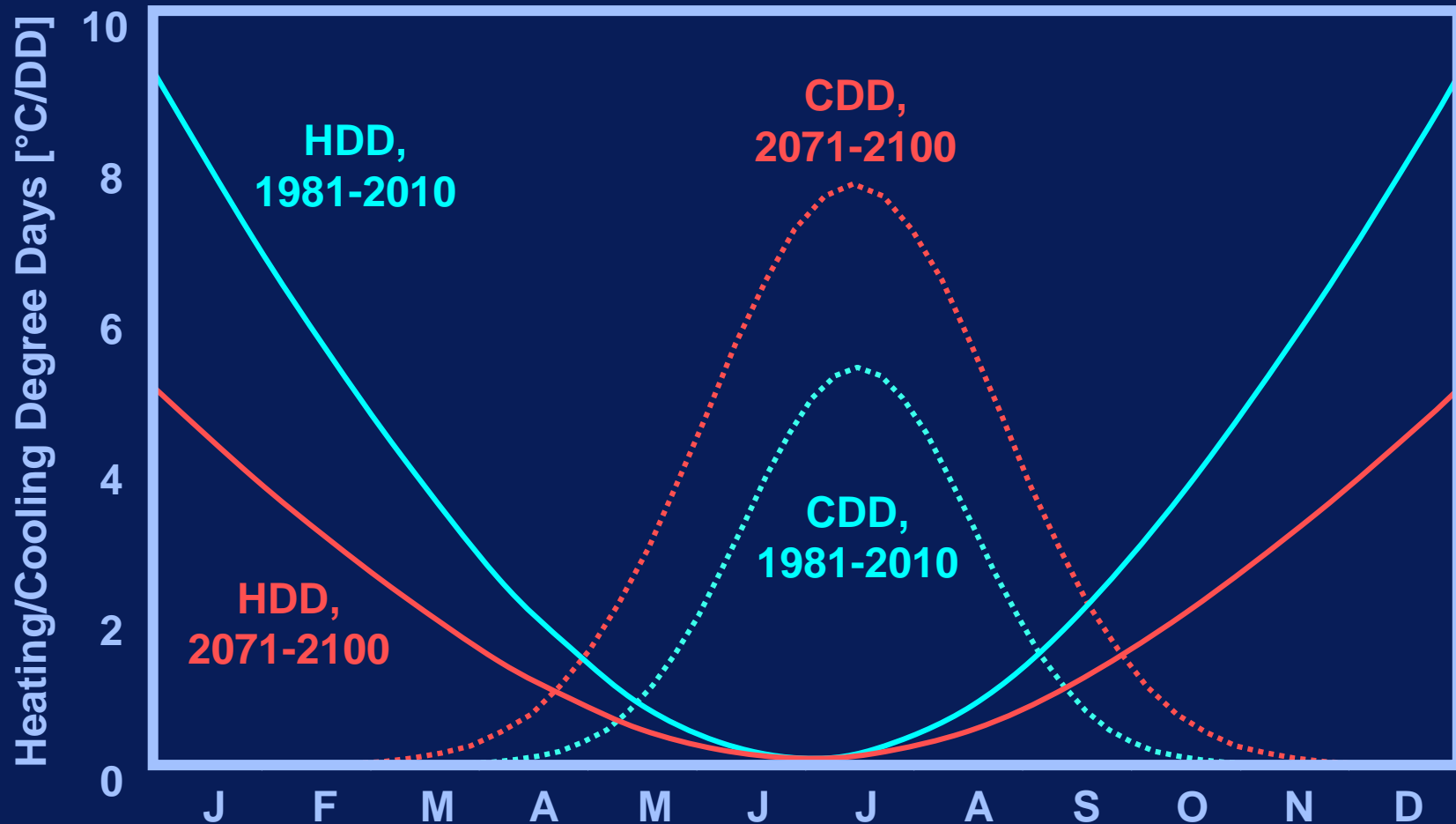
Πossible economic impacts

# Rivalries between economic sectors impacted upon by changing water resources?



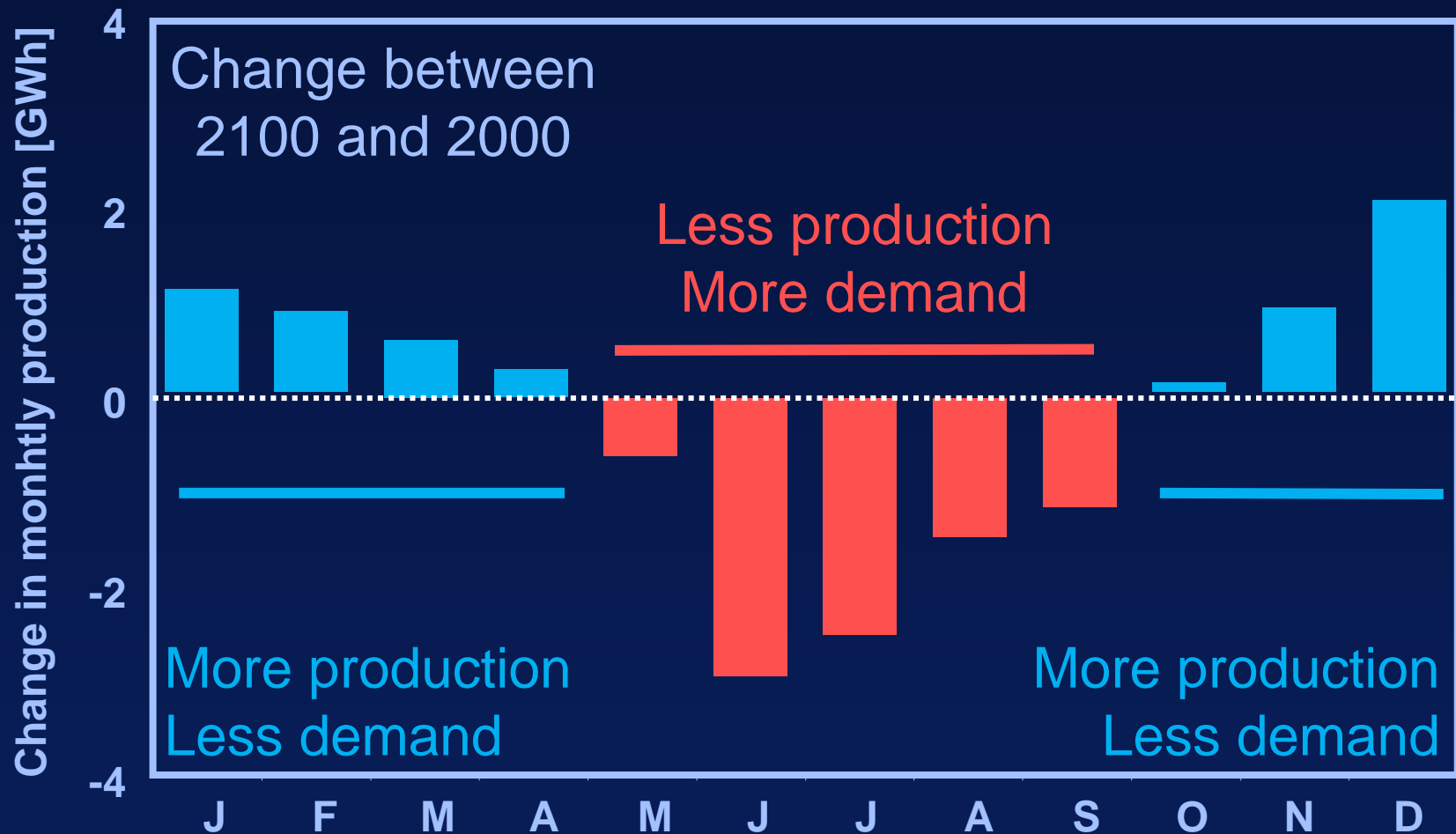


# Possible shifts in electricity demand (Northern Italy)



Maran et al., 2014: Env. Sci. and Policy

# Possible shifts in electricity supply (Mattmark Dam, Switzerland)



Maran et al., 2014: Env. Sci. and Policy



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# ACQWA

ACQWA

Assessing Climate impacts on the Quantity and quality of WAter

A large integrating project under EU R&D Framework Programme 7 (FP7)

Many thanks for  
your attention

Special Issues 2014:  
Science of the Total Environment  
Environmental Science and Policy

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*www.acqwa.ch*