Mountain water supply
in a changing climate
Mountains and water
Upstream-downstream links

- Rhone Basin: >15 million
- Rhine Basin: >50 million
- Po Basin: >15 million
- Danube Basin: >80 million
Observed changes in the Alps
Evolution of global and alpine temperatures, 1901-2000

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Rhone Glacier retreat: 1870s-2000s
Alpine river catchments
Rhone River discharge in the 1961-1990 reference climate

- **Melting of winter snow pack**
- **1961-1990**
- **Summer glacier melt**

Average monthly discharge [m$^3$/s]
21st century climate projections for the Alps
Changing alpine climates

Gobiet et al., 2014: Science of the Total Environment

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
Impacts on hydrology
Shifts in snow volume according to altitude

Beniston et al., 2003: Theoretical and Applied Climatology

Slight increase

+4°C

40-60% loss

Almost total loss

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Rhone Glacier retreat: 2000s-2100
Possible future discharge by 2100 (m³/s, River Rhone)

Average monthly discharge [m³/s]

- Low emissions
- High emissions

1961-1990

2071-2100

J F M A M J J A S O N D
Possible economic impacts
(example of hydropower)
Rivalries between economic sectors impacted upon by changing water resources?

Climatic change

Water resources

Tourism

Agriculture

Energy

Other (e.g., mining, industry)

Conflict mitigation through improved water governance?

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Possible shifts in electricity demand (Northern Italy)

- HDD, 1981-2010
- CDD, 2071-2100
- HDD, 2071-2100
- CDD, 1981-2010

Maran et al., 2014: Env. Sci.-and Policy
Possible shifts in electricity supply (Mattmark Dam, Switzerland)

Change between 2100 and 2000

Less production
More demand

More production
Less demand

Change in monthly production [GWh]

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Many thanks for your attention

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

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