Climate Change and Alpine Water

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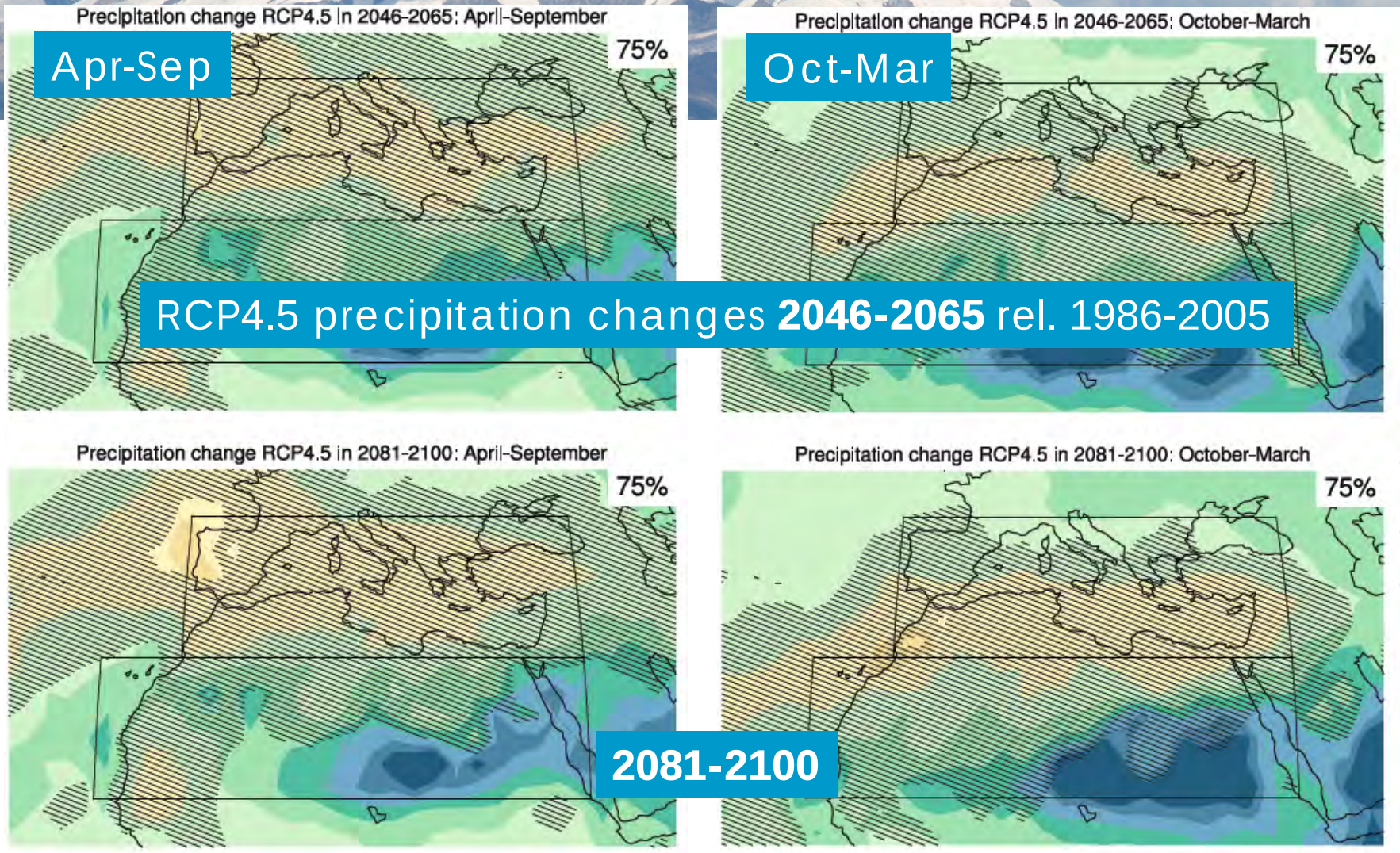
$$Q = P - E \pm \Delta S$$

Runoff = Precipitation – Evaporation ± ΔStorage

Drivers: Precipitation + Temperature

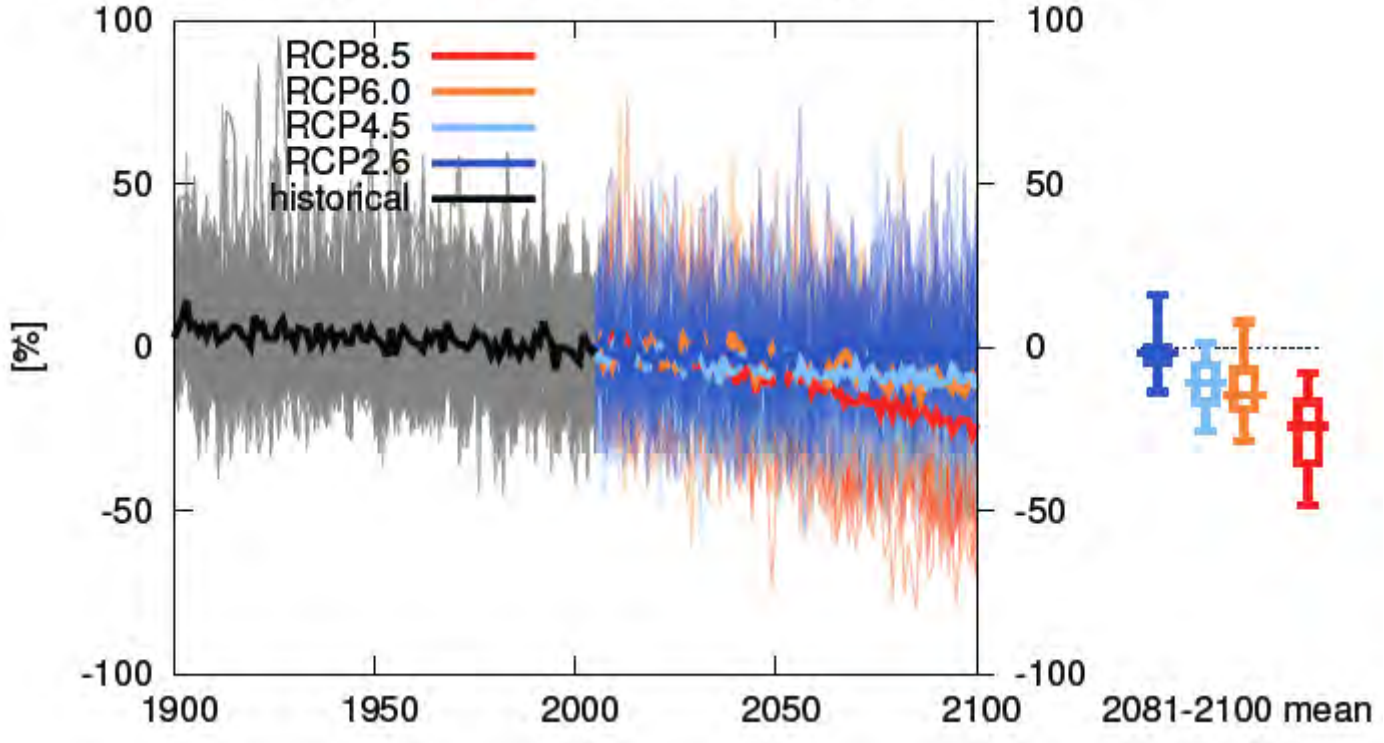
time scales of interest:
< hourly peaks * seasonal variations * annual sums

RCP4.5 precipitation changes **2046-2065** rel. 1986-2005



IPCC **AR5 WG1 Atlas** (2013)

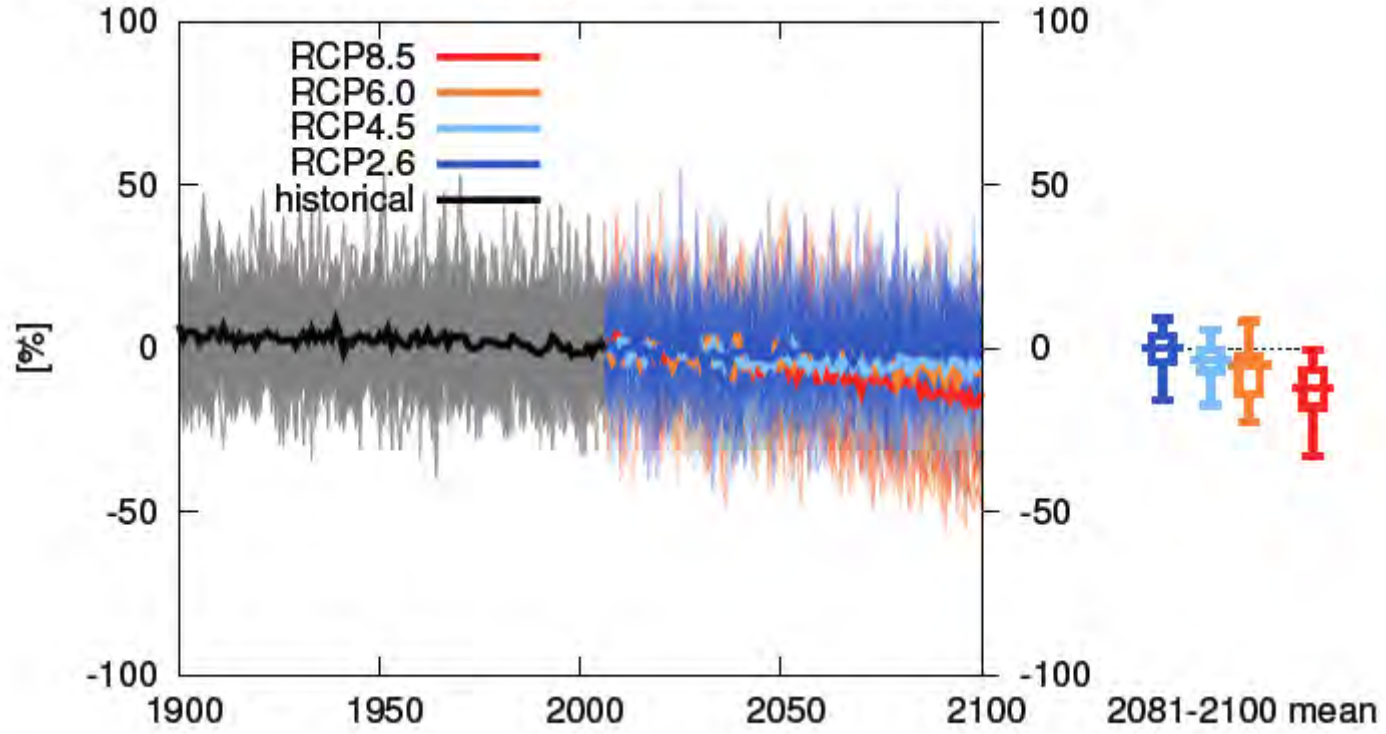
Precipitation changes **Apr-Sep**



IPCC **AR5 WG1 Atlas** (2013)

www.climatechange2013.org

Precipitation changes **Oct-Mar**



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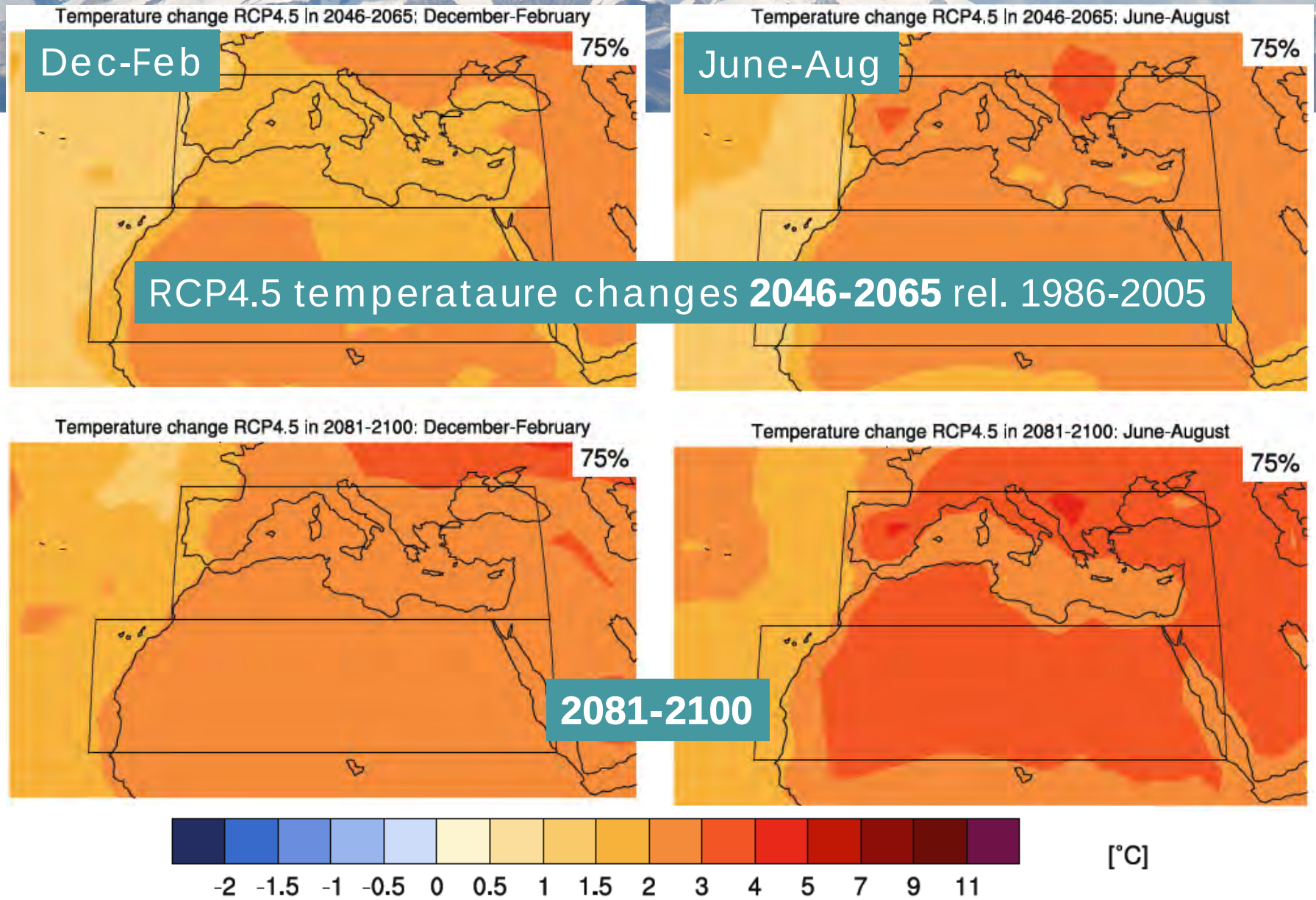
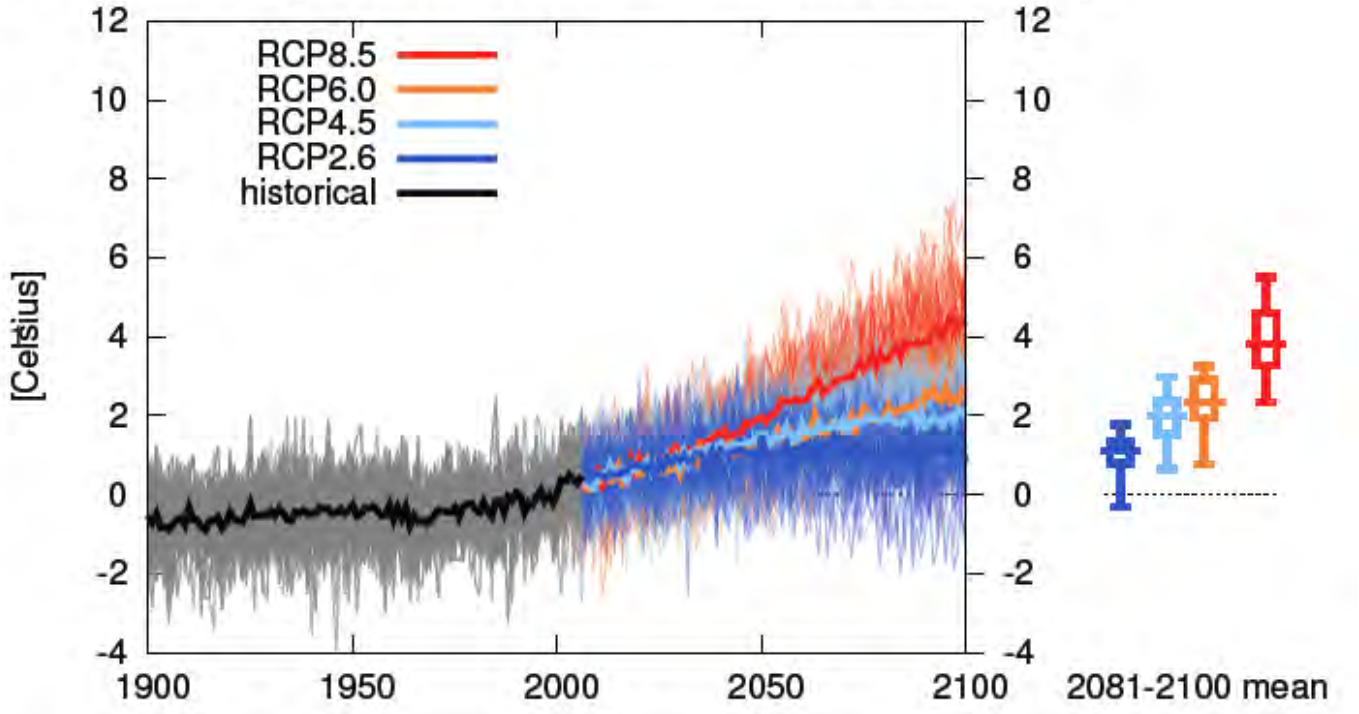


IPCC **AR5 WG1 Atlas** (2013)

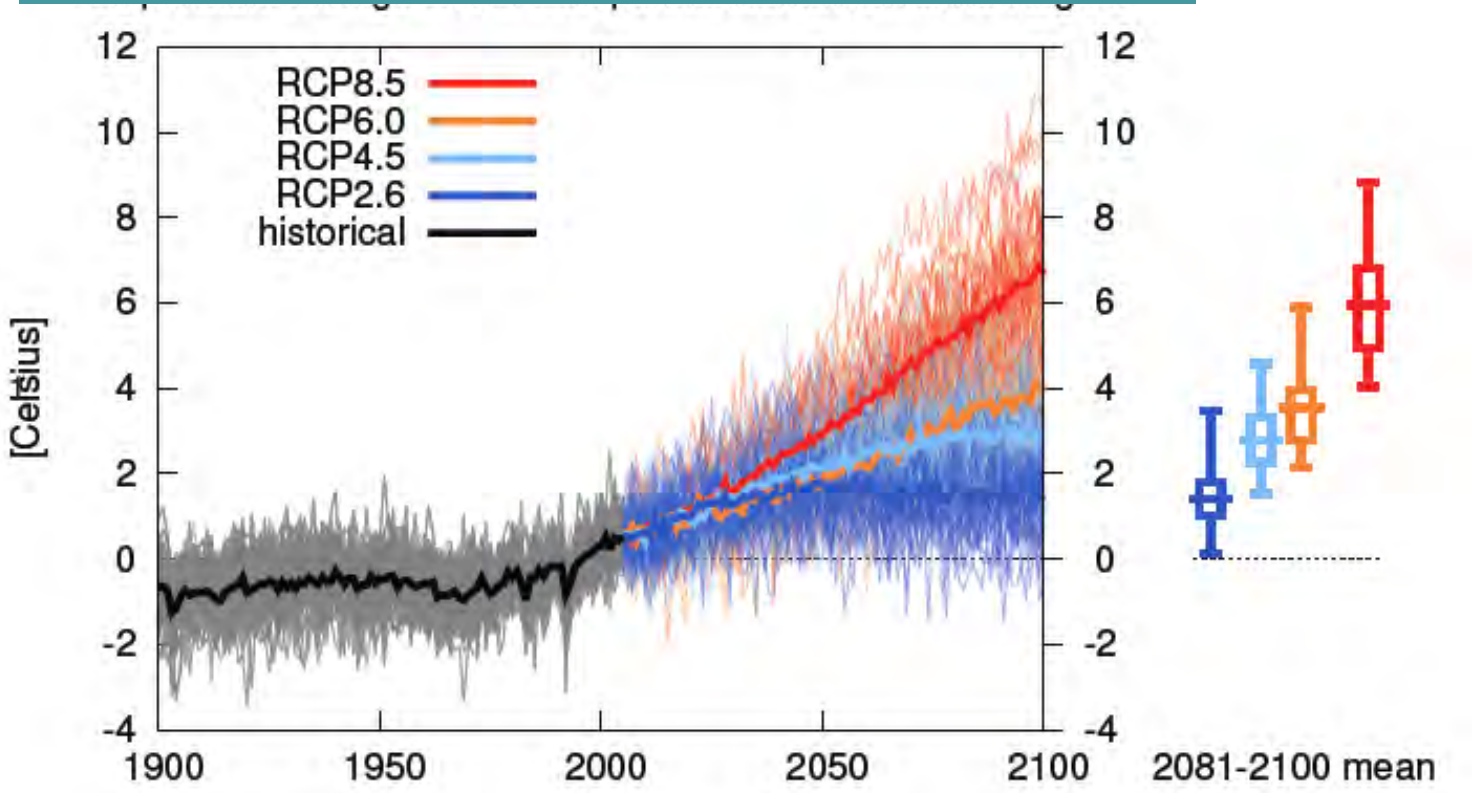
Temperataure changes **Dec-Feb**



IPCC **AR5 WG1 Atlas** (2013)

+1°C » +170 m freezing level

Temperataure changes **Jun-Aug**

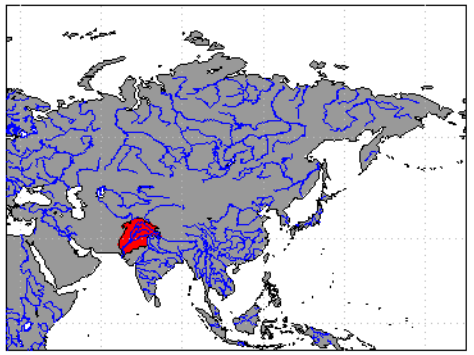


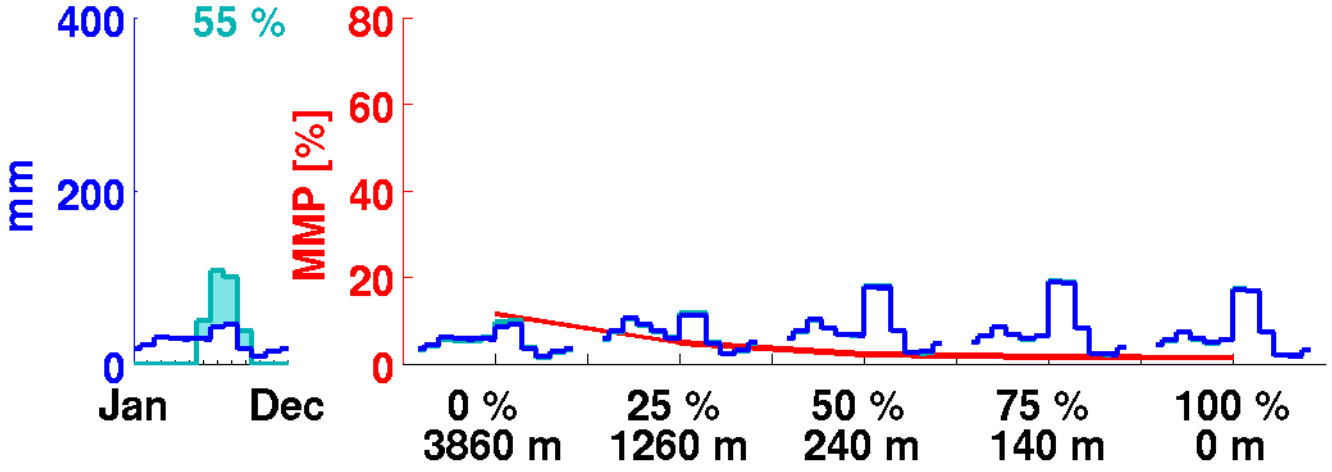
IPCC **AR5 WG1 Atlas** (2013)

Present **glaciers' contribution to water availability** (steady state)

Indus

Total basin area:	1139814 km^2
Total glacier area:	20325 km^2 (1.78 %)
Mean precipitation:	405 mm/year
Total population	211.28 Mio. people
Total PIX	4.82 Mio. people





Kaser, Marzeion, Großhauser **PNAS** *(2010)*

Present **glaciers' contribution to water availability** (steady state)

population impact index (PIX)
=
population x MMP

a measure of seasonally delayed glacier melt
as a resource for human water consumption

Kaser, Marzeion, Großhauser **PNAS** *(2010)*

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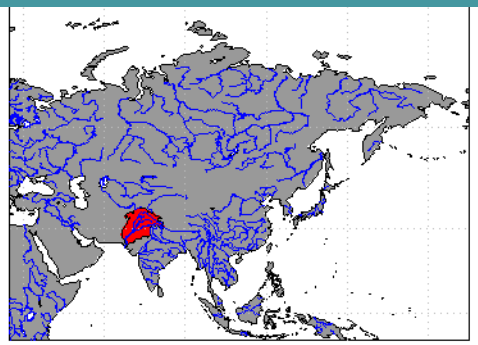
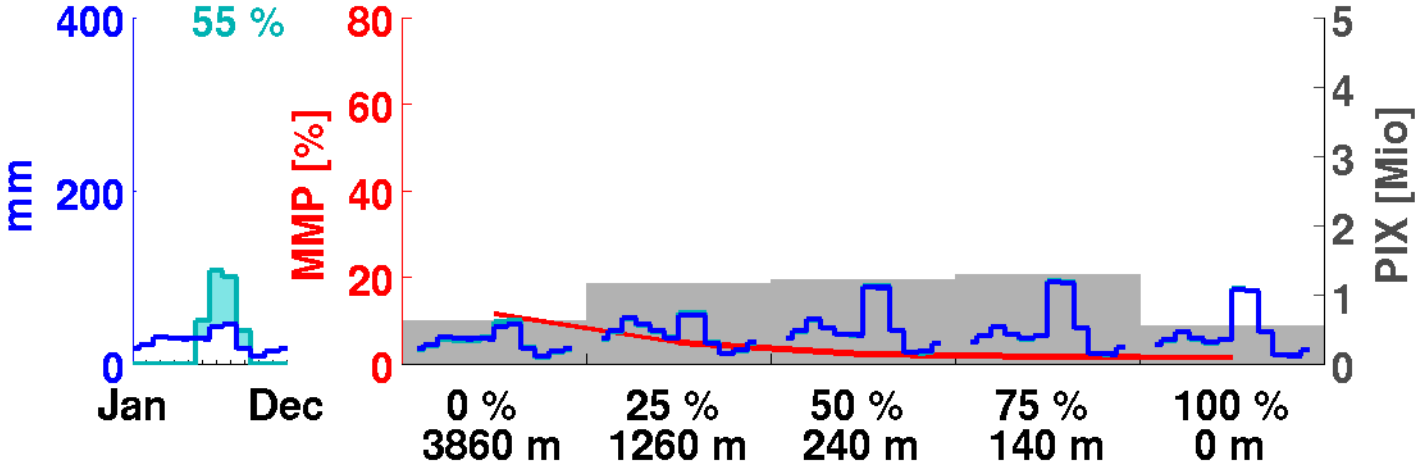


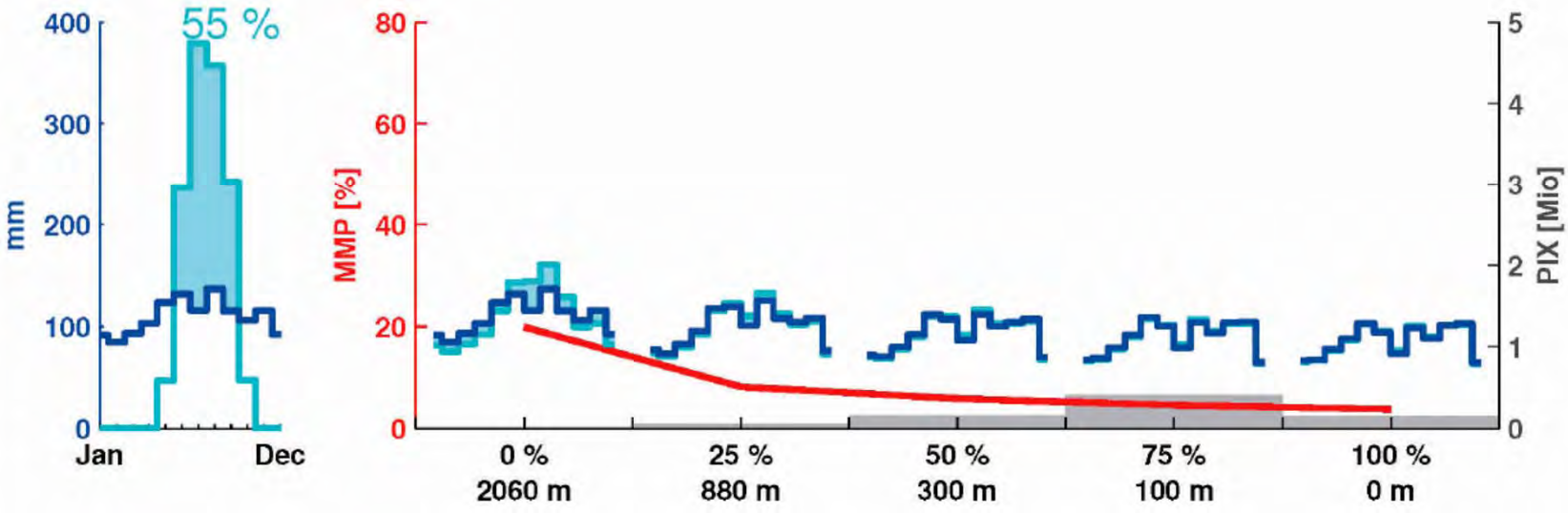


Kaser, Marzeion, Großhauser **PNAS** *(2010)*

Present **glaciers' contribution to water availability** (steady state)

Po

Total river basin area:	73297 km^2
Total glacier area:	818 km^2 (1.12 % of total river basin area)
Mean annual precipitation:	1028 mm
Total population	16.55 Mio. people
Total PIX	0.81 Mio. people

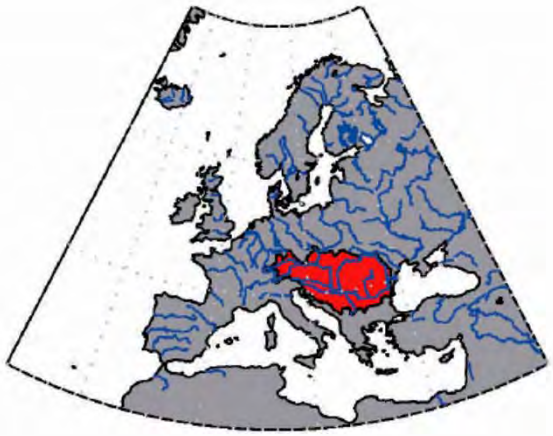


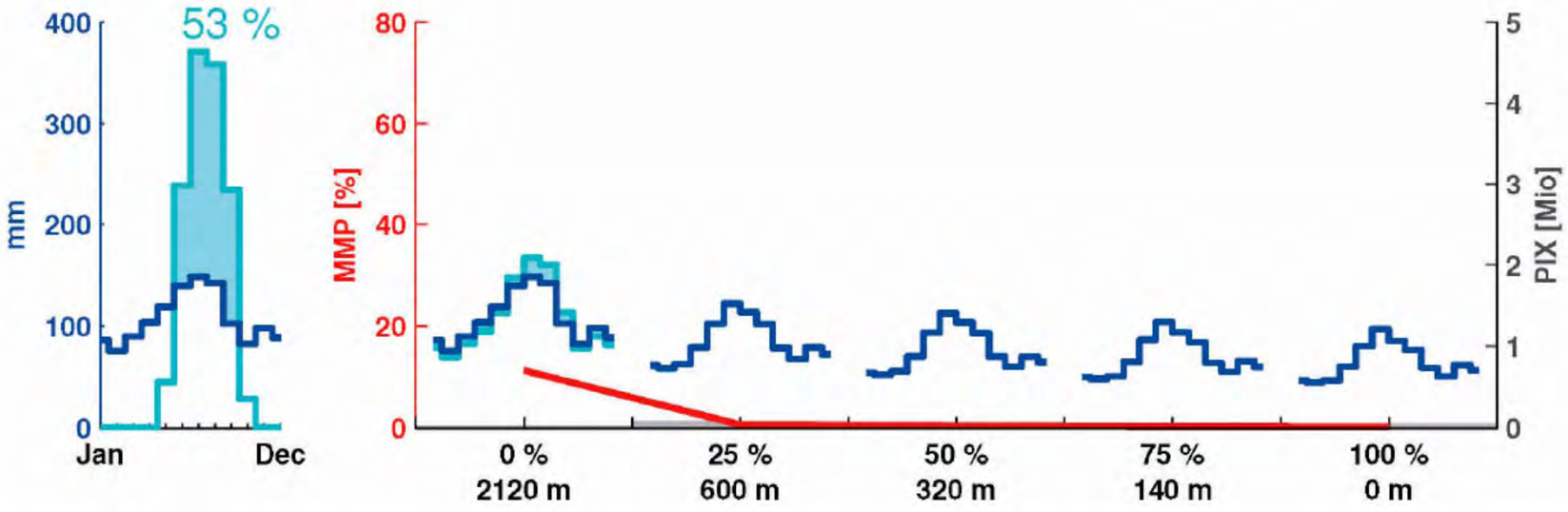
Kaser, Marzeion, Großhauser **PNAS** *(2010)*

Present **glaciers' contribution to water availability** (steady state)

Danube

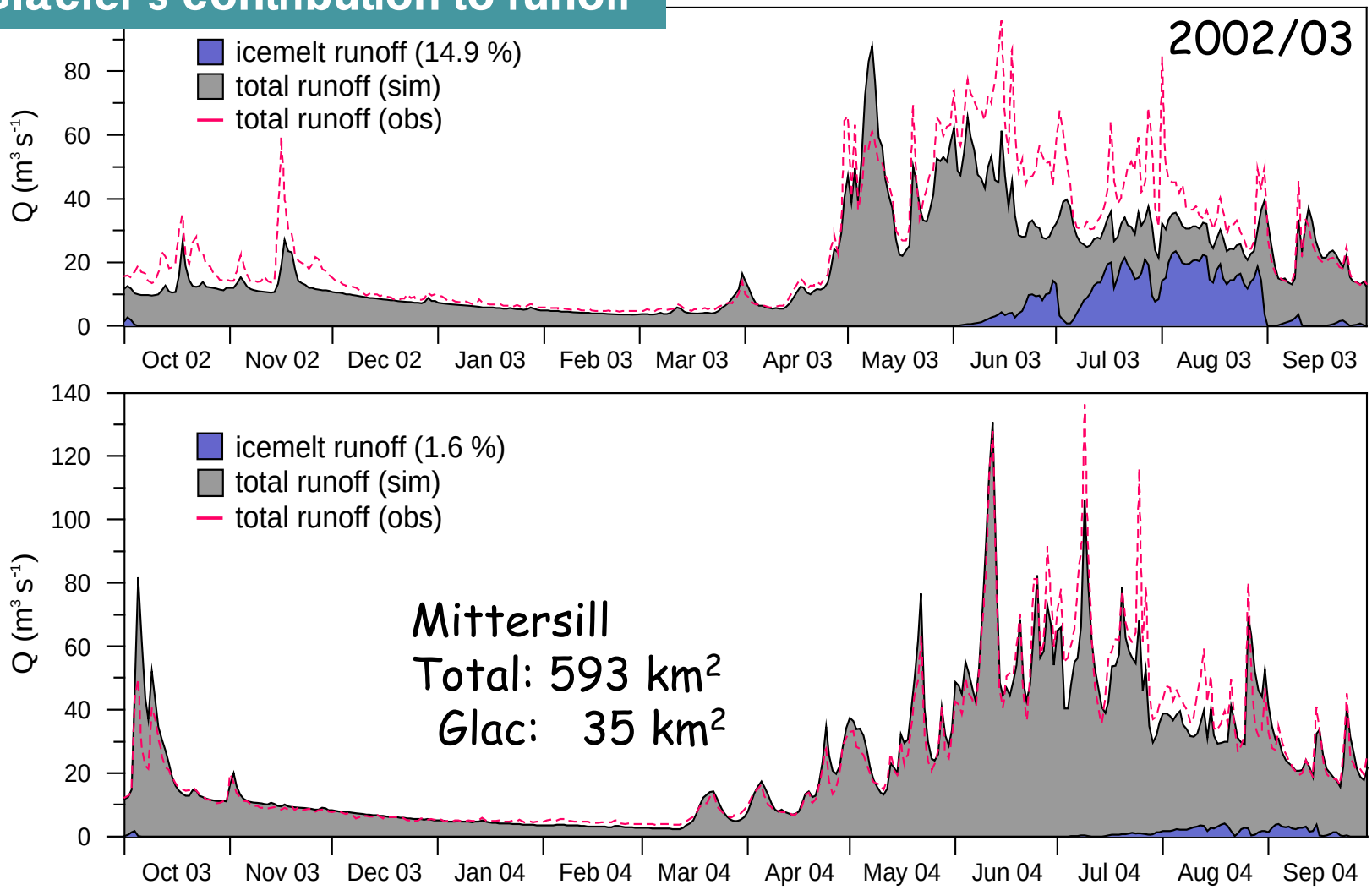
Total river basin area:	794133 km^2
Total glacier area:	617 km^2 (0.08 % of total river basin area)
Mean annual precipitation:	765 mm
Total population	81.38 Mio. people
Total PIX	0.31 Mio. people





Kaser, Marzeion, Großhauser **PNAS** *(2010)*

A Glacier's contribution to runoff



Koboltschnig (2007) – **PhD Thesis**, *BOKU, Vienna*

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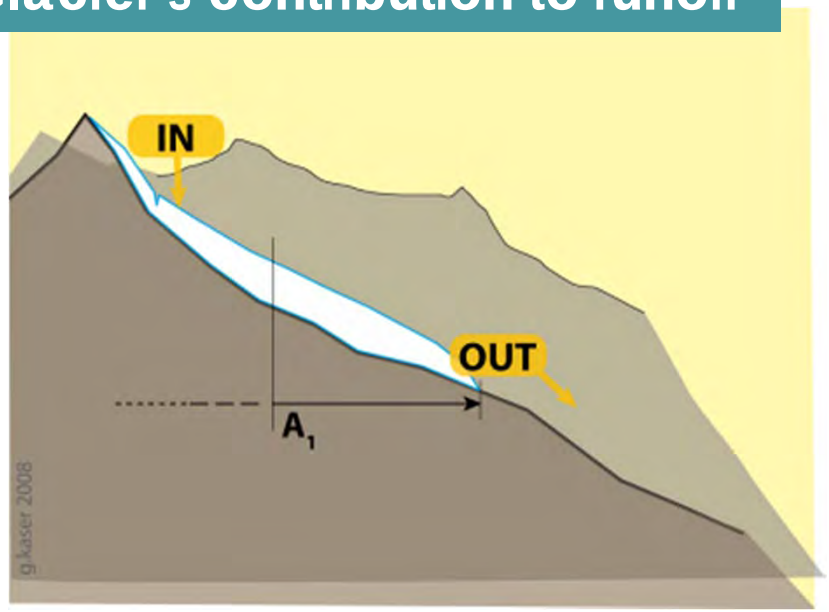
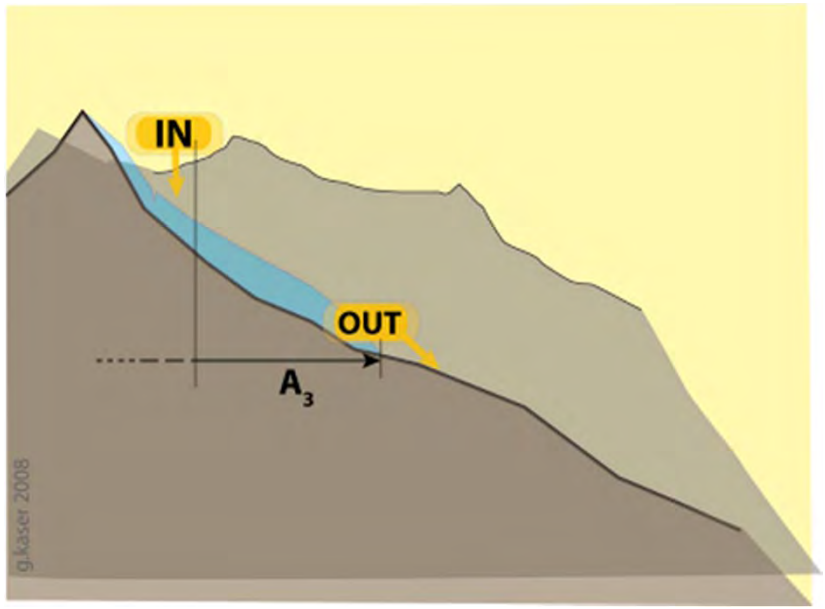




1. Melt water runoff (A_1)

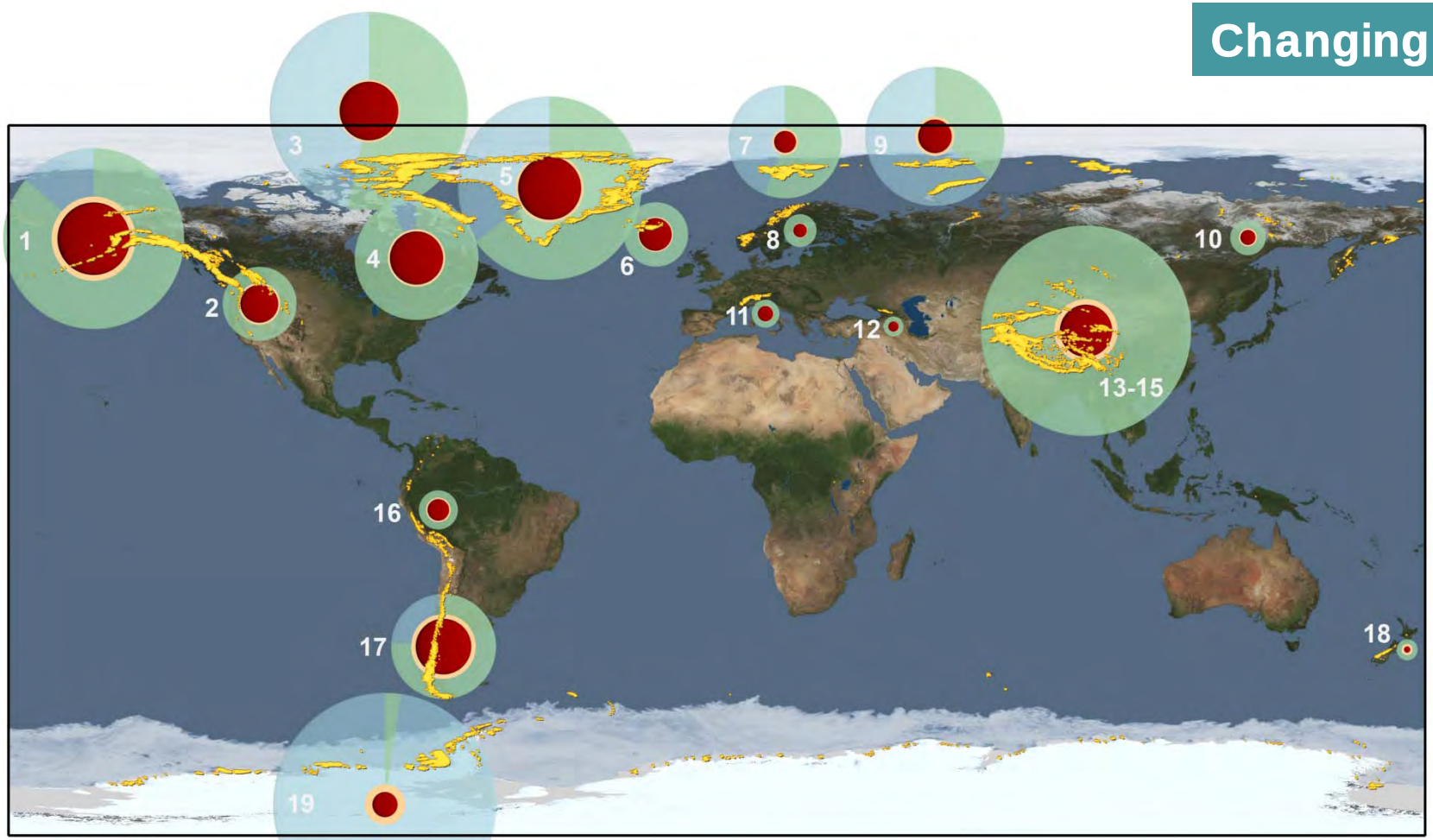
2. $A_2 > A_1$

3. Increasing runoff

4. A3 < A2 < A1

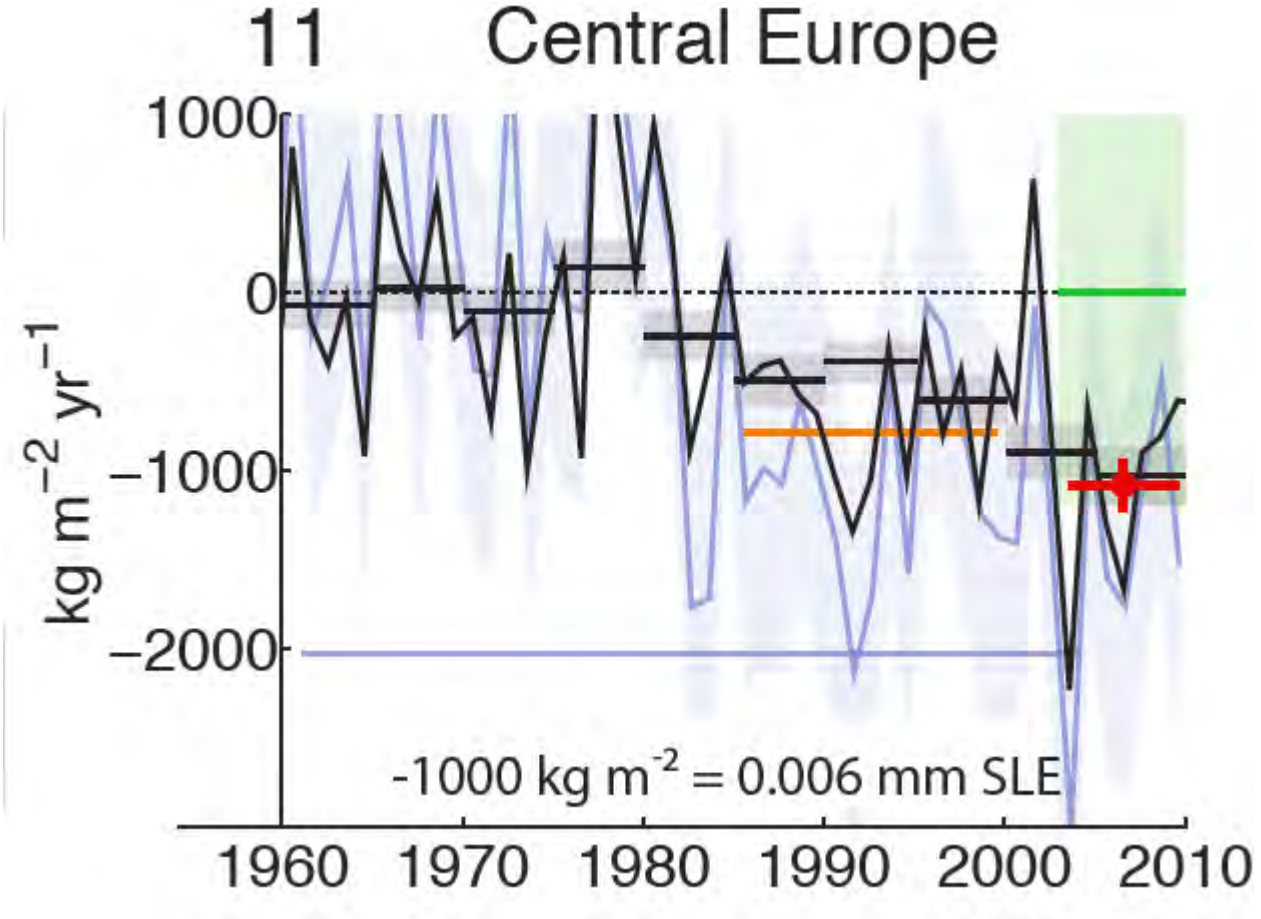
5. Decresing runoff

Changing Glacies



Gardner et al. **Science** 2013
IPCC **AR5 WG1** *2013*

Changing Glacies



IPCC **AR5 WG1** *2013*

$$Q = P - E \pm \Delta S$$

SUMMARY:

Precipitation: moderate changes

Seasonal snow cover: rise of freezing level

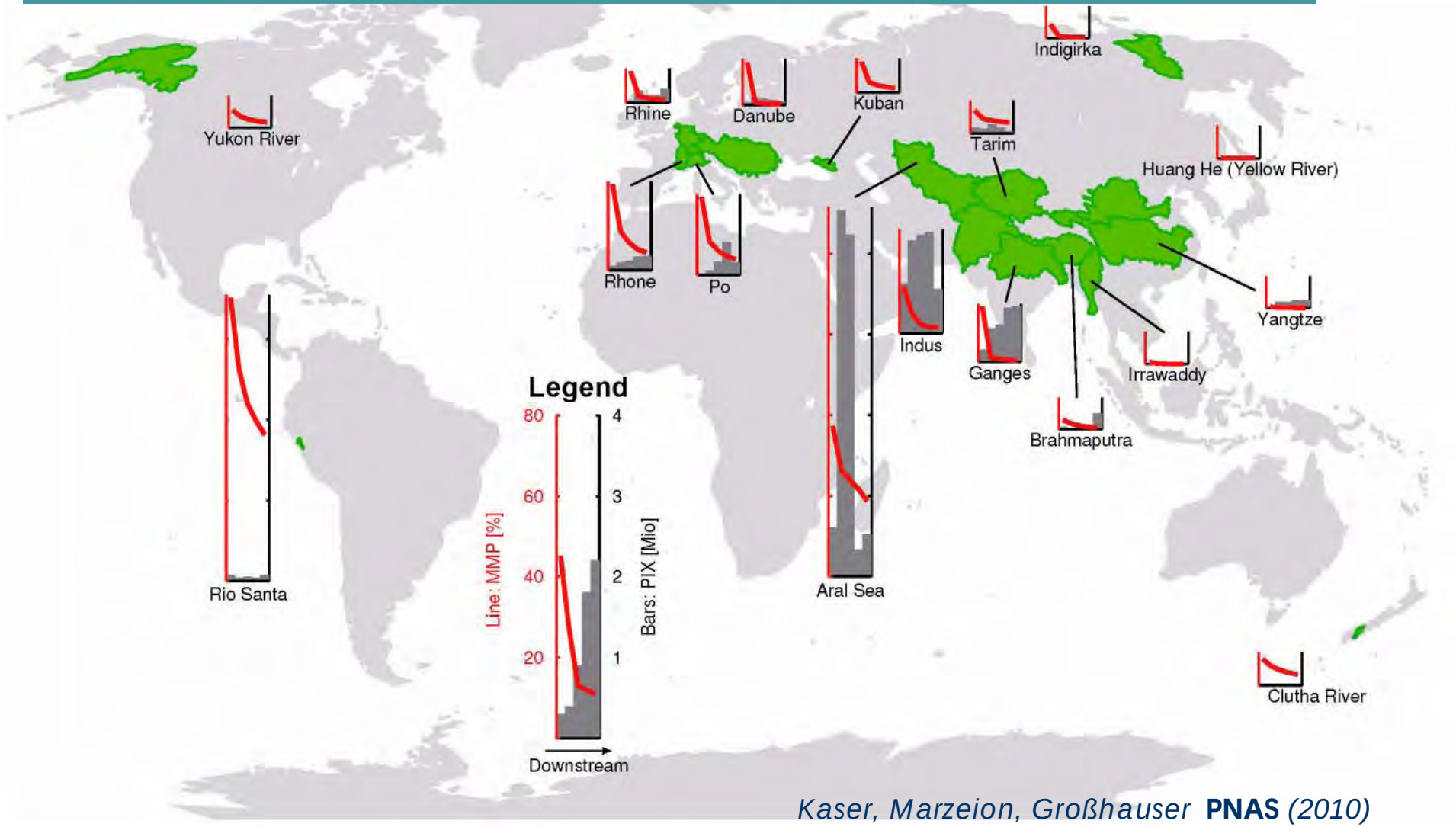
Evaporation: increase

Glaciers: will widely loose their contribution

TOTAL:

less water, particularly during vegetation period

Present **glaciers' contribution to water availability** (steady state)



Kaser, Marzeion, Großhauser **PNAS** *(2010)*


Thank you very much
Foto: B. Marzeion