

GLACIERS IN A CHANGING CLIMATE

A GLOBAL PERSPECTIVE



Georg **Kaser**

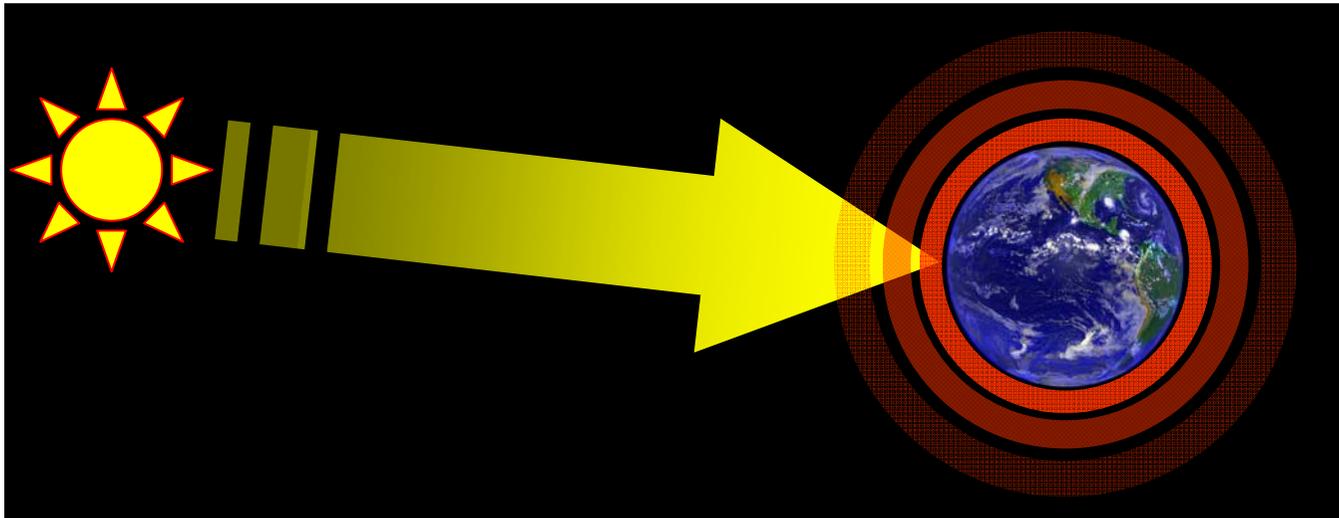
Institut of Meteorology and Geophysics Innsbruck



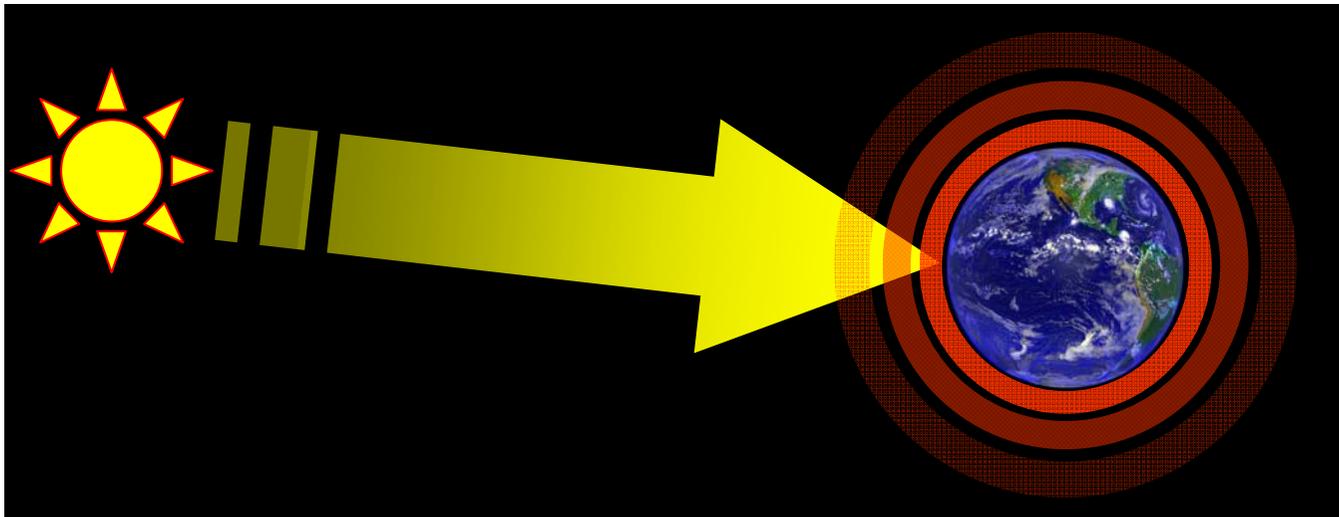
Former President of **IACS** 

The average energetic state of the climate system Earth

balance: $\Phi_{\text{in}} = \Phi_{\text{out}}$

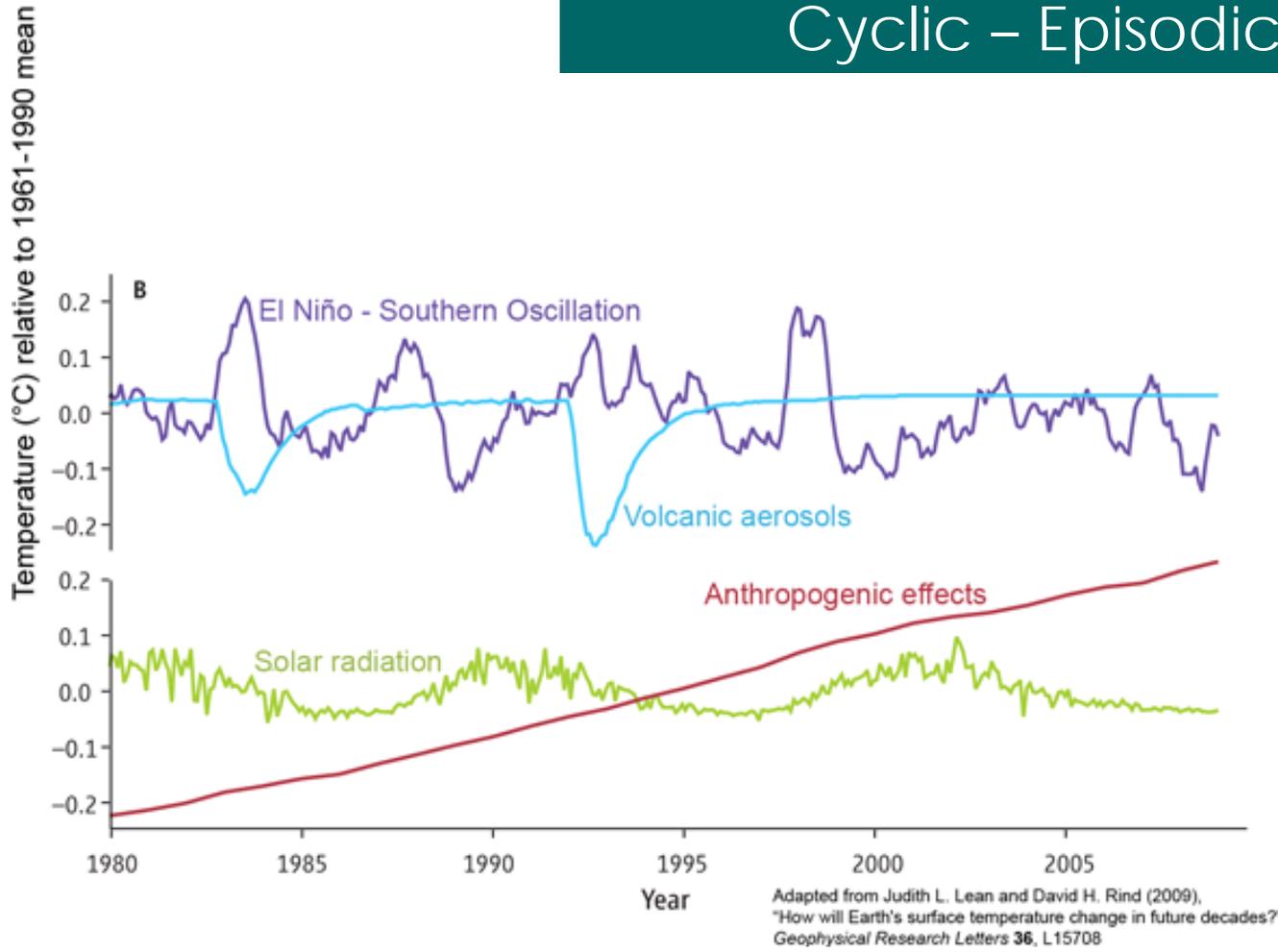


inbalance: $\Phi_{in} \neq \Phi_{out}$



If persitent:.....changes the enegetic state

Cyclic – Episodic - Persistent

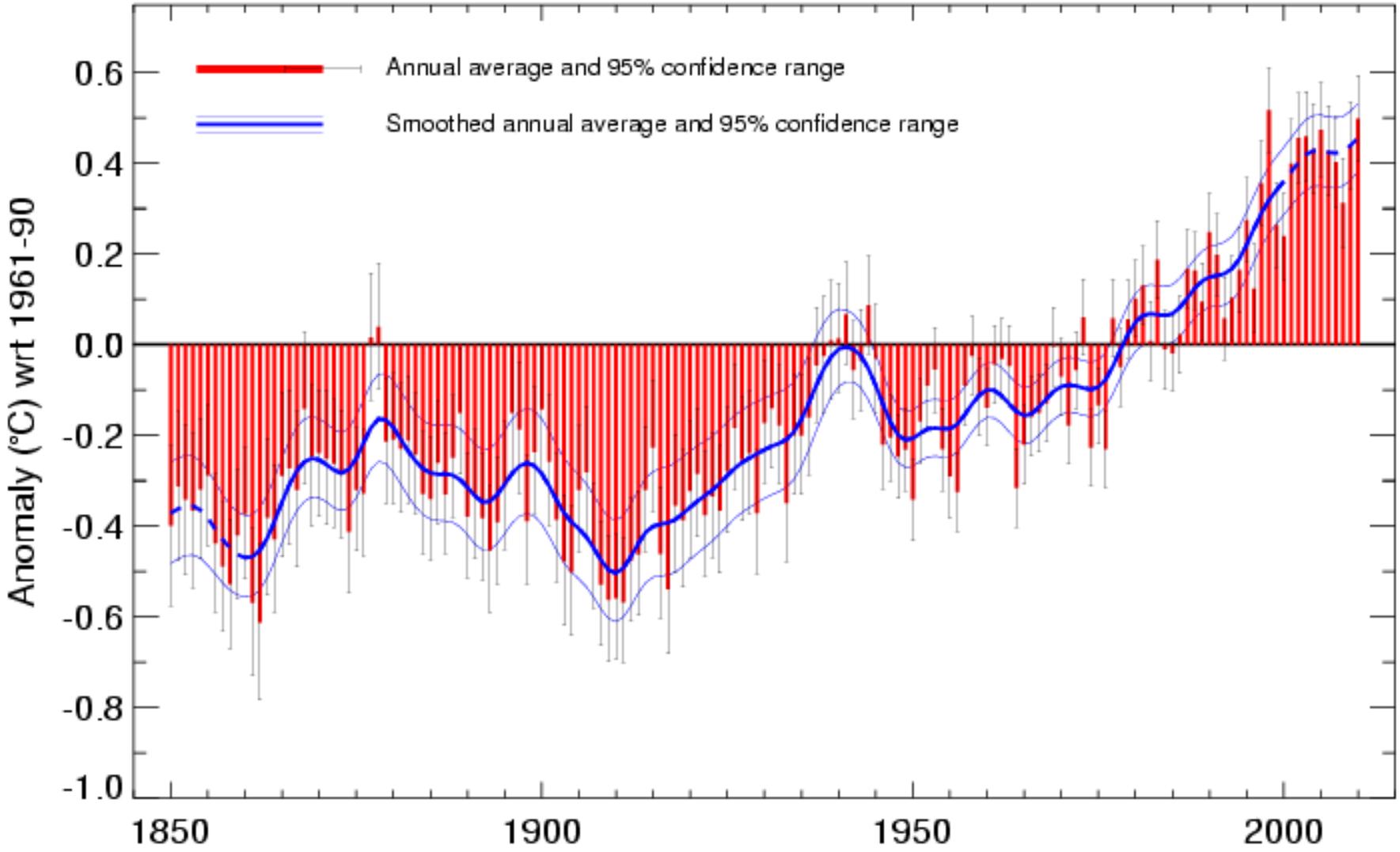


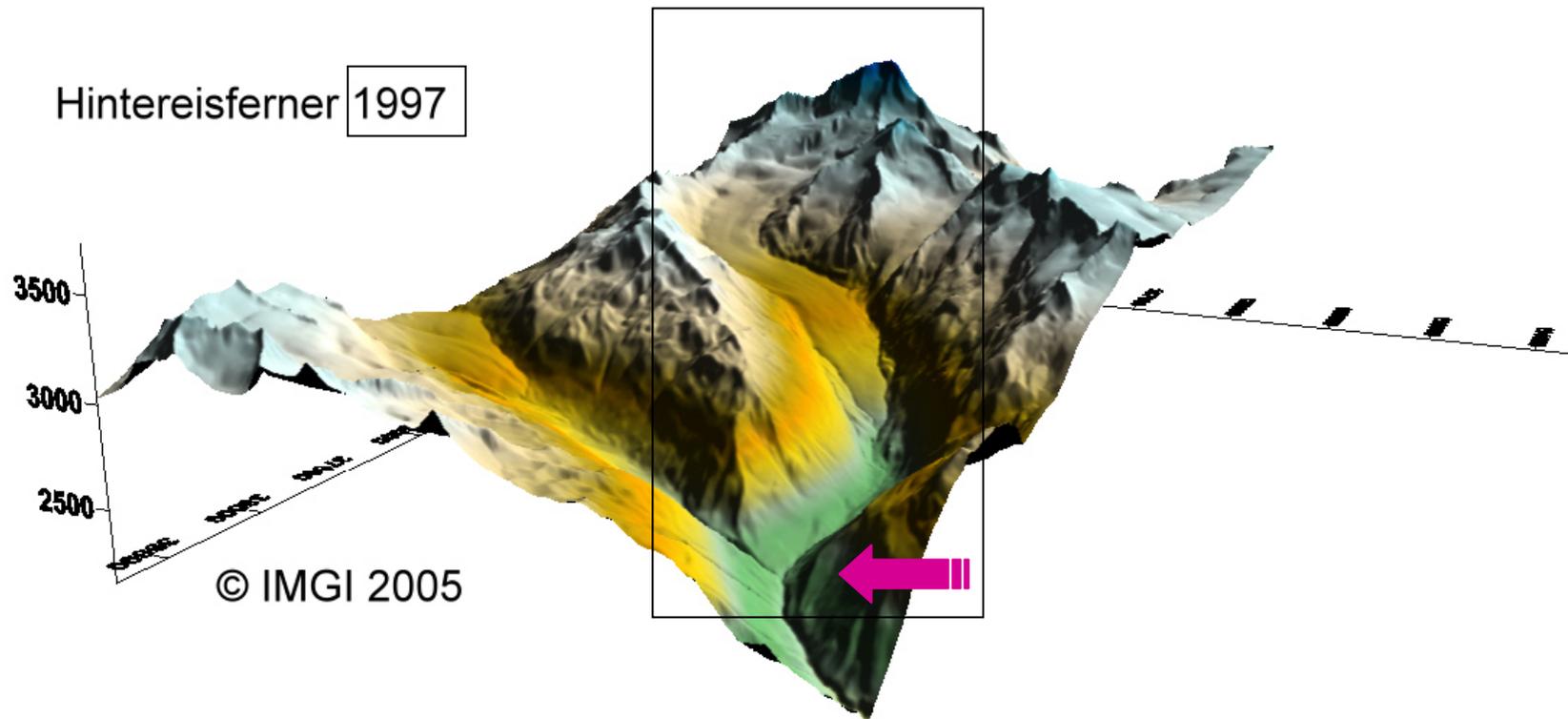
presently: 1.6 W m^{-2}

Temperatures



Global average temperature 1850-2010 Based on Brohan et al. 2006

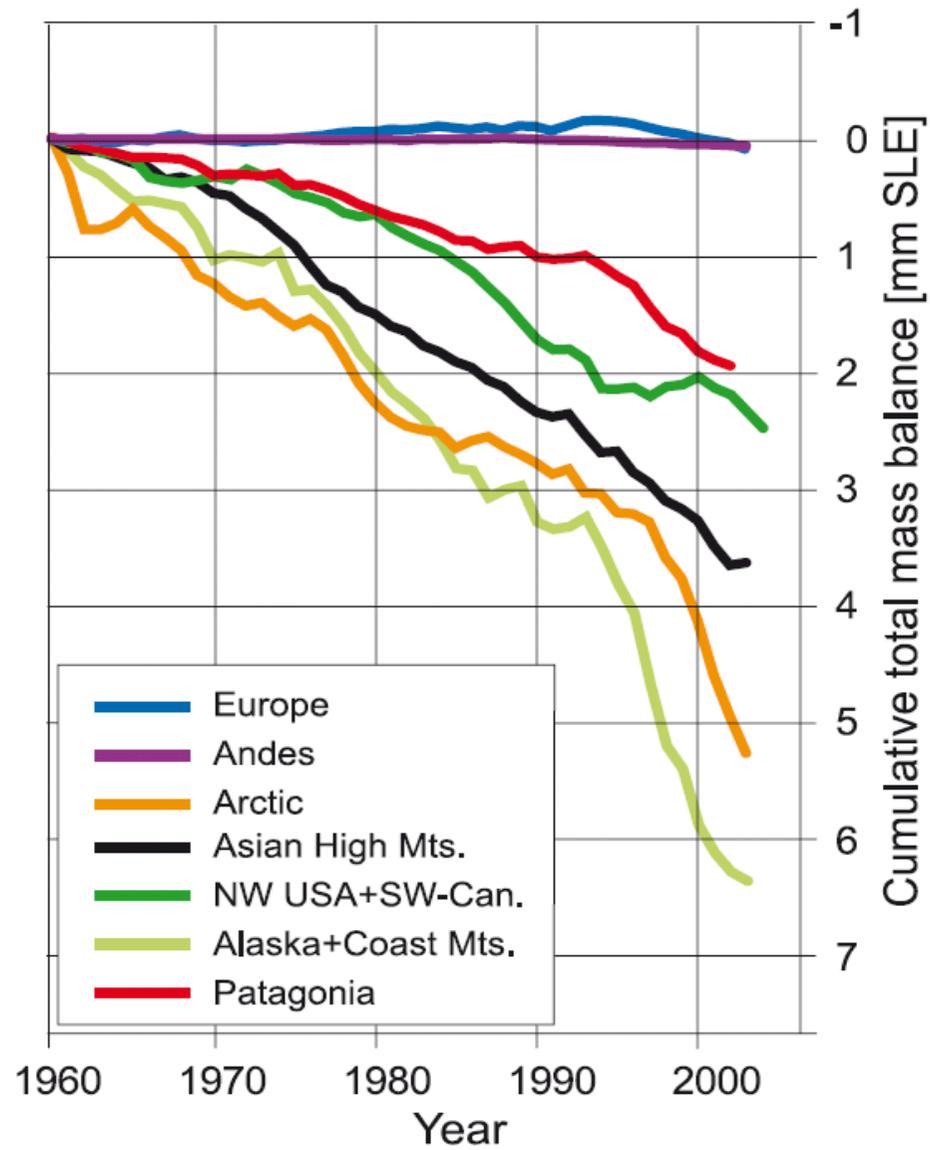




**HINTEREISFERNER – AUSTRIAN ALPS
1884 – 1997**

Inst. f. Meteorologie & Geophysik Innsbruck

Glaciers



Lemke et al. (2007) - **IPCC 2007** - AR4 WG I, Ch. 4

Glaciers

Glaciers (all, excluding the two ice sheets):
~**60 cm of Sea Level Equivalent.**

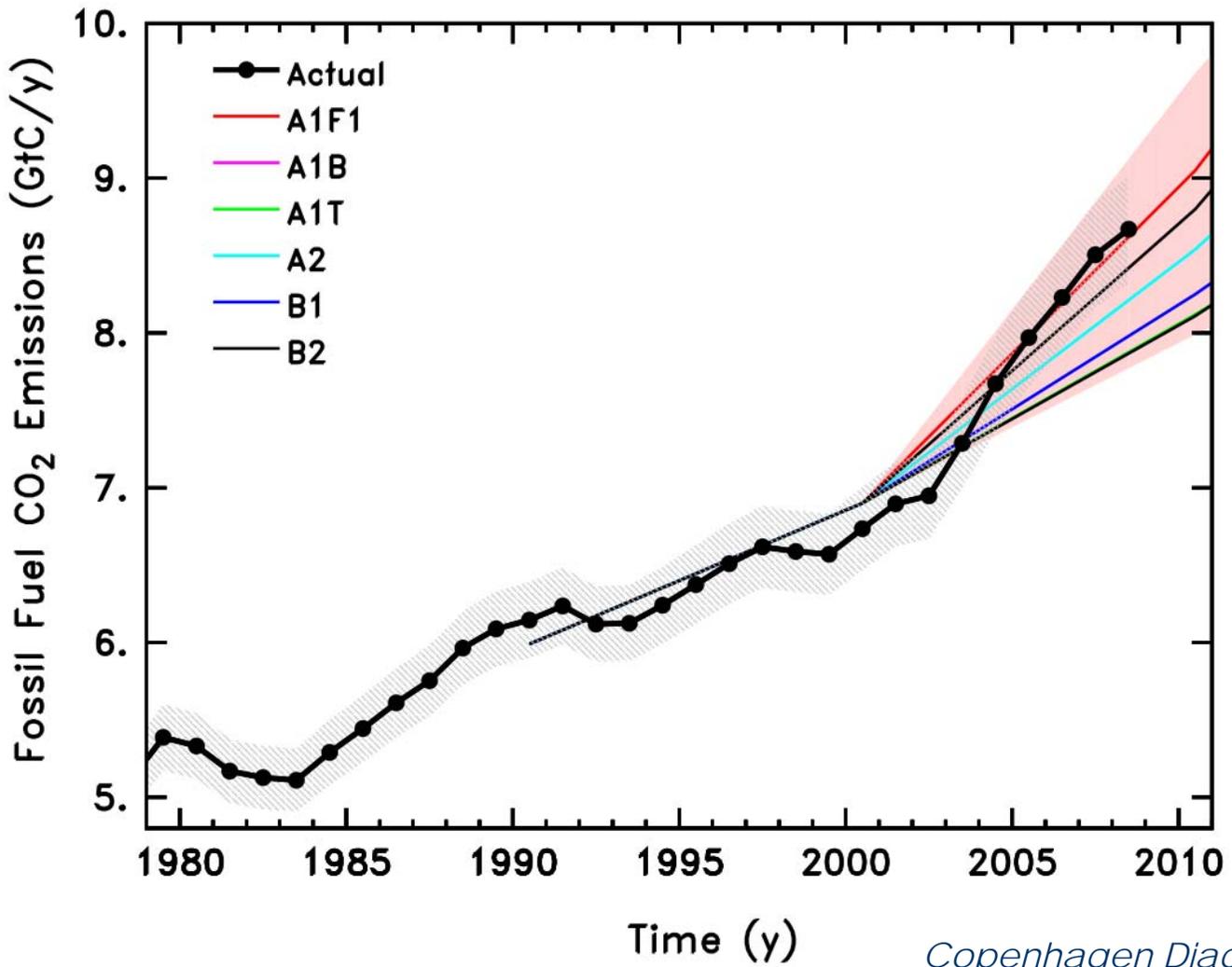
(Radic and Hock, 2010)

Glaciers react slow

The adjustment of glaciers and ice caps to present climate alone is expected to raise sea level by ~**18 centimeters.** *(Bahr et al, 2009)*

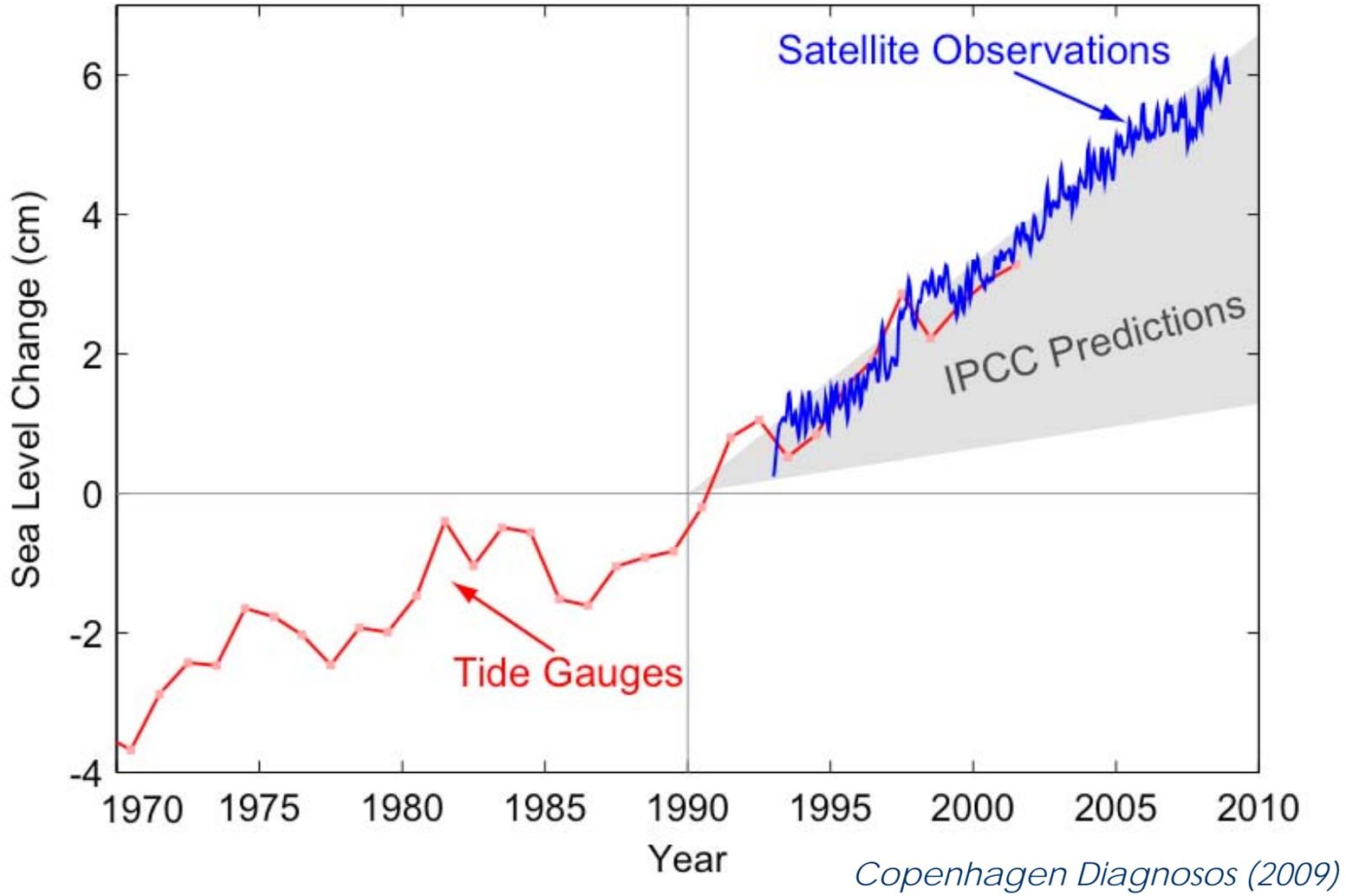
Committed!

CO₂ Emissions

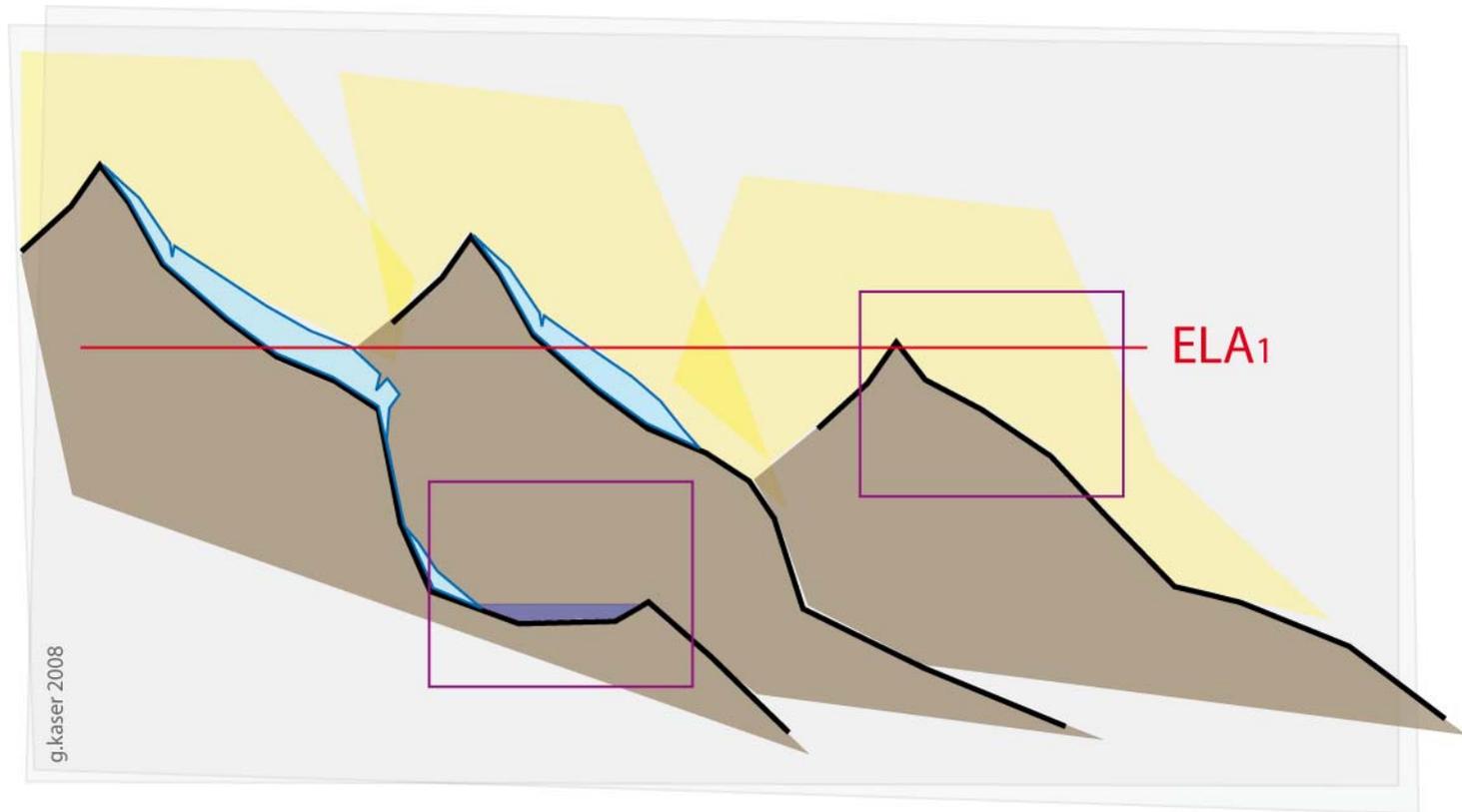


Copenhagen Diagnostics (2009)

Sea Level Rise



... in the high mountains



Changing Glaciers



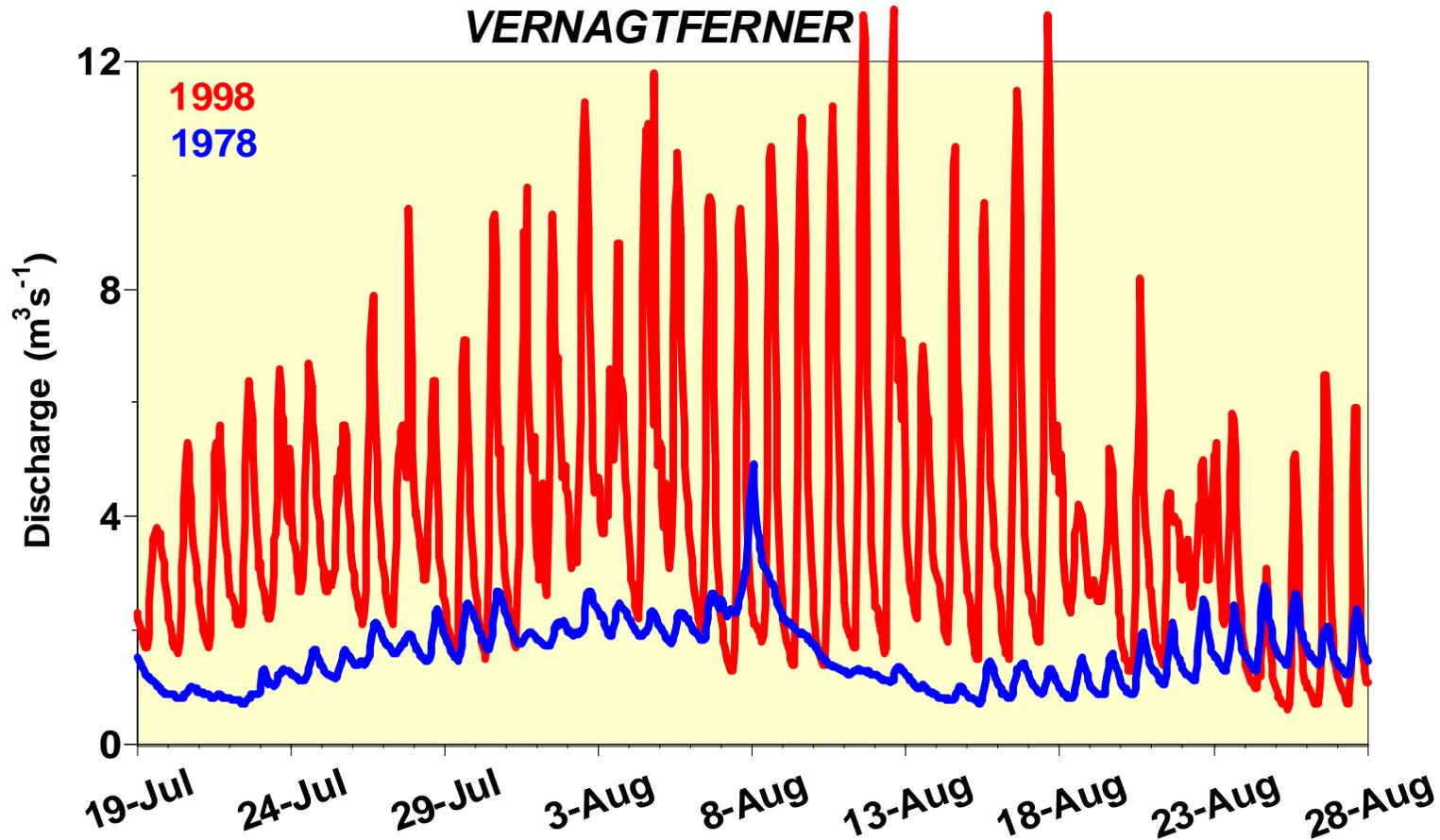
Cordillera Blanca, 2010 (B. Marzeion)

Impacts

1. **landscape**
2. **culture**/spirituality
3. regional **water availability**
4. global **sea level**
5. **climate** indicators (instruments)

Who cares?

tourism, safety
mountain **societies**
systems downriver
costal societies/**infrastructures**
science → **society**

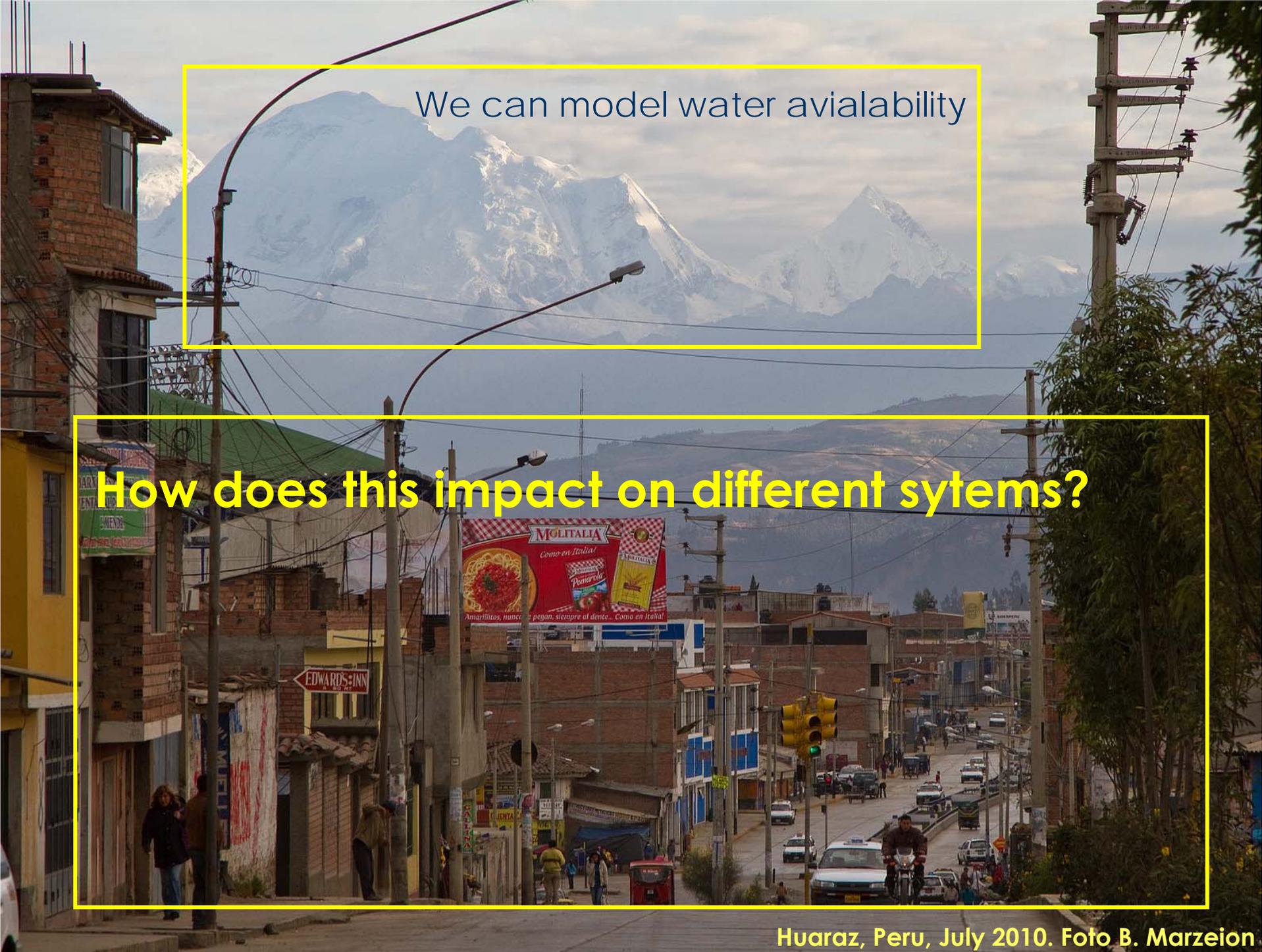


Quelle: Bayerische Akademie der Wissenschaften, Glaziologische Kommission

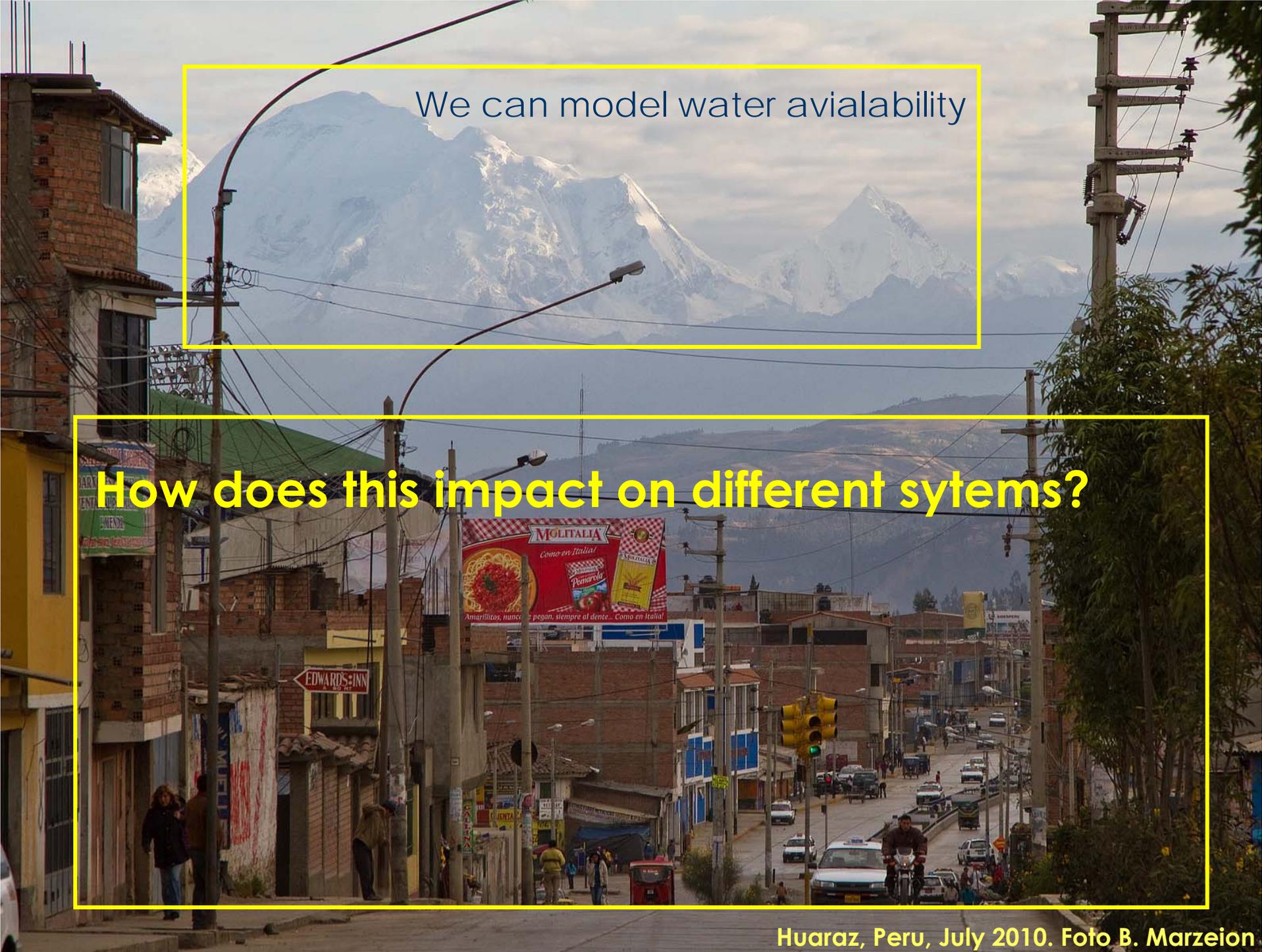
We have the **expertise** and the tools to model glacier contributions to seasonal water availability.

It must be applied case by case in order to obtain regional **knowledge**.

Future projections are based on **climate projections**.

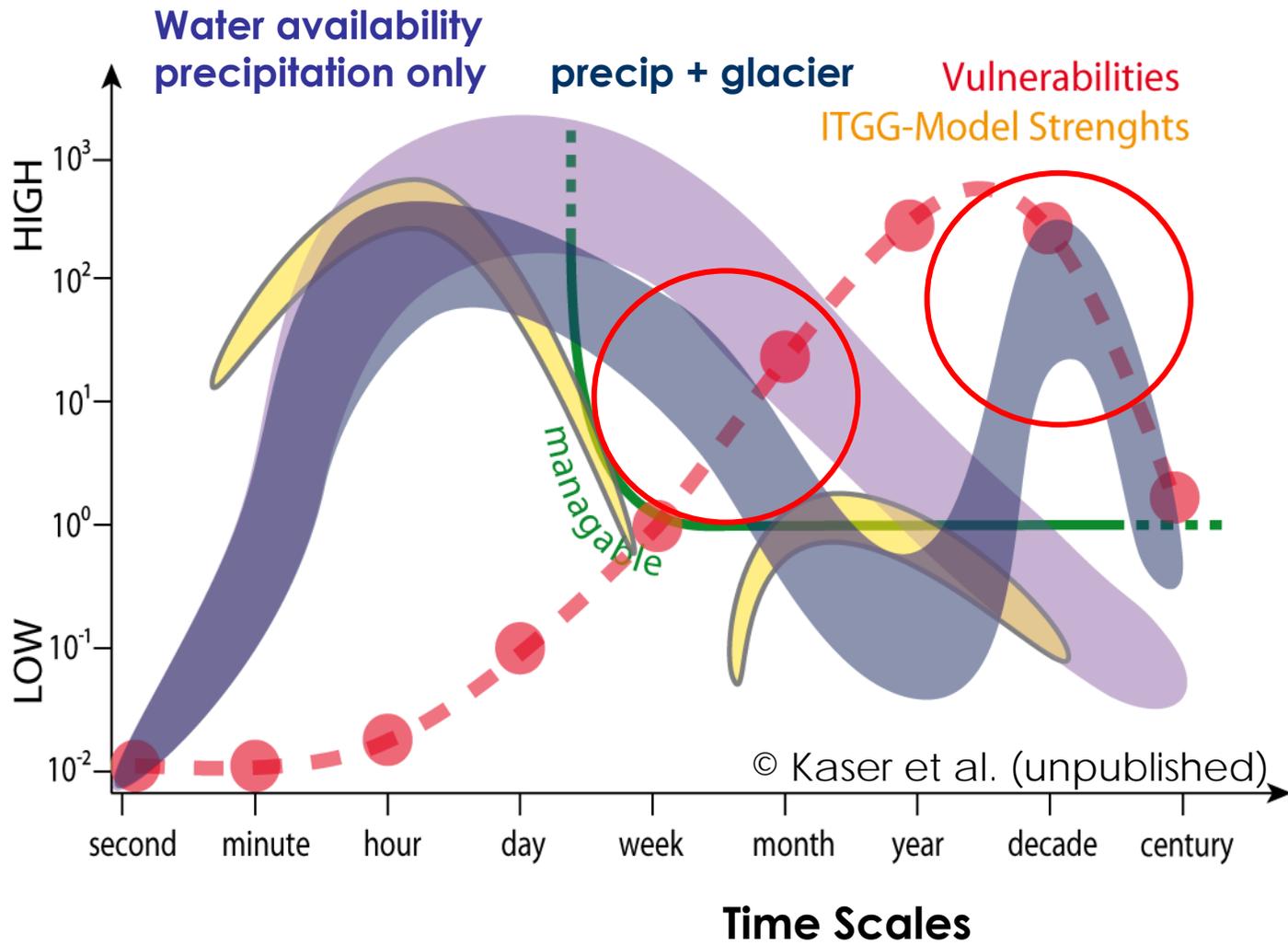


We can model water availability



How does this impact on different systems?

Huaraz, Peru, July 2010. Foto B. Marzeion



Summary

Climate is warming

Glaciers are losing mass

Many glaciers will disappear (committed)

Variety of impacts

Physics are understood (but need to be applied)

Linking knowledge (interdisciplinary)