

The Pfynwald Irrigation Experiment

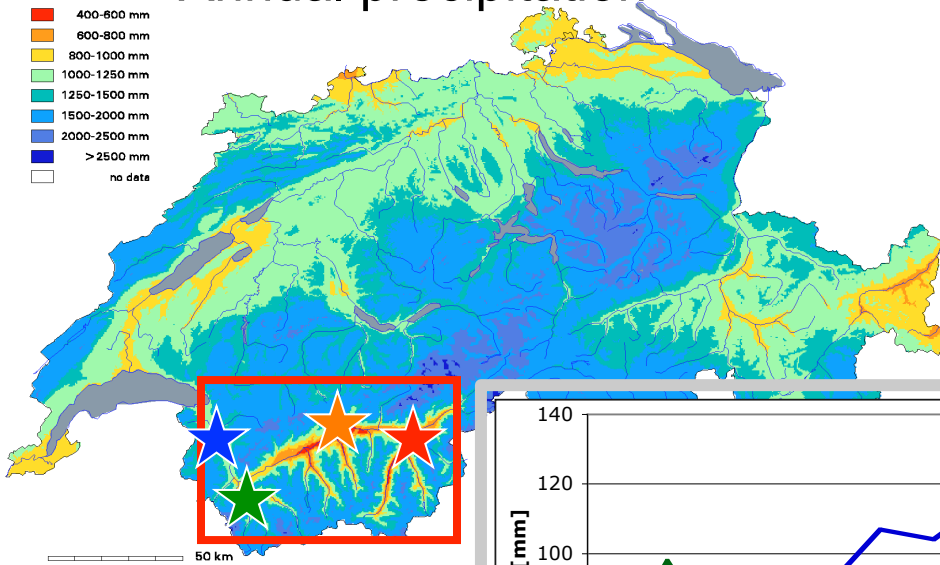
Workshop Dezember 6 2013



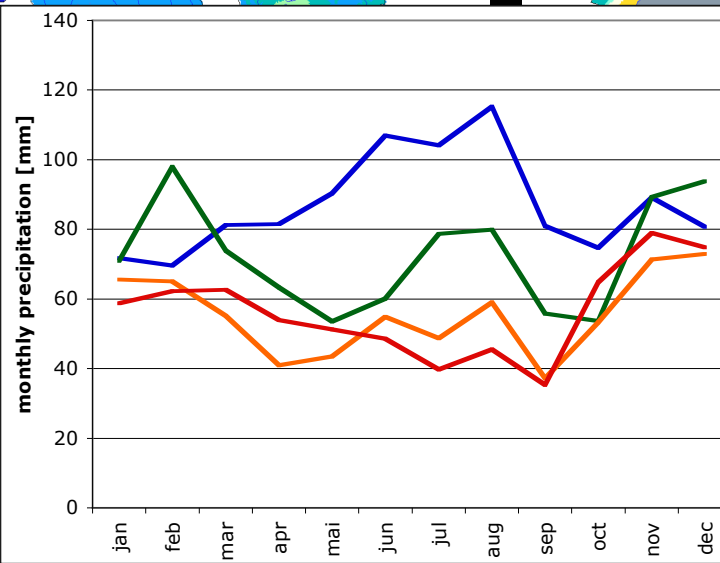
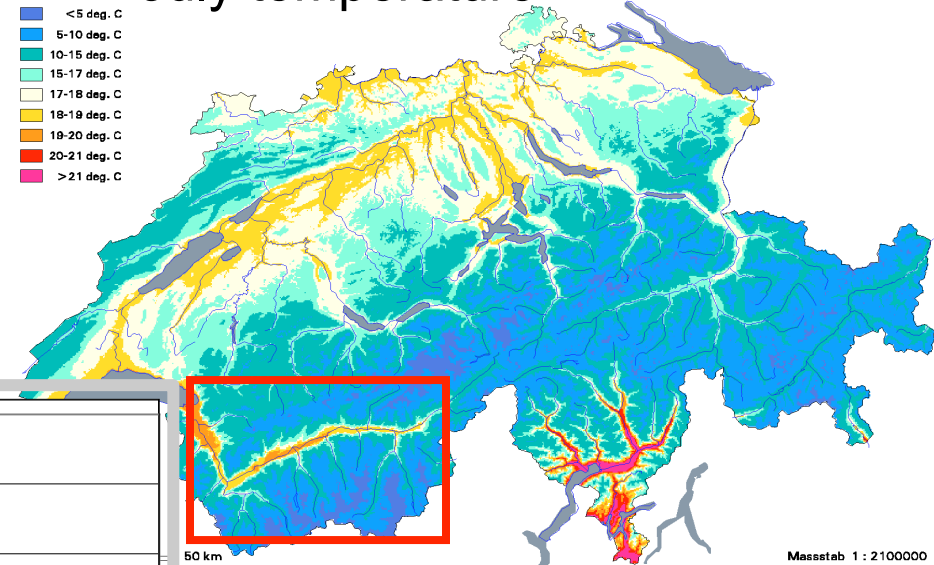
Andreas Rigling, Marcus Schaub, Matthias Dobbertin† et al.

Valais: Inner-Alpine climate

Annual precipitation



July temperature



- 500 - 900 mm
- driest region of Switzerland

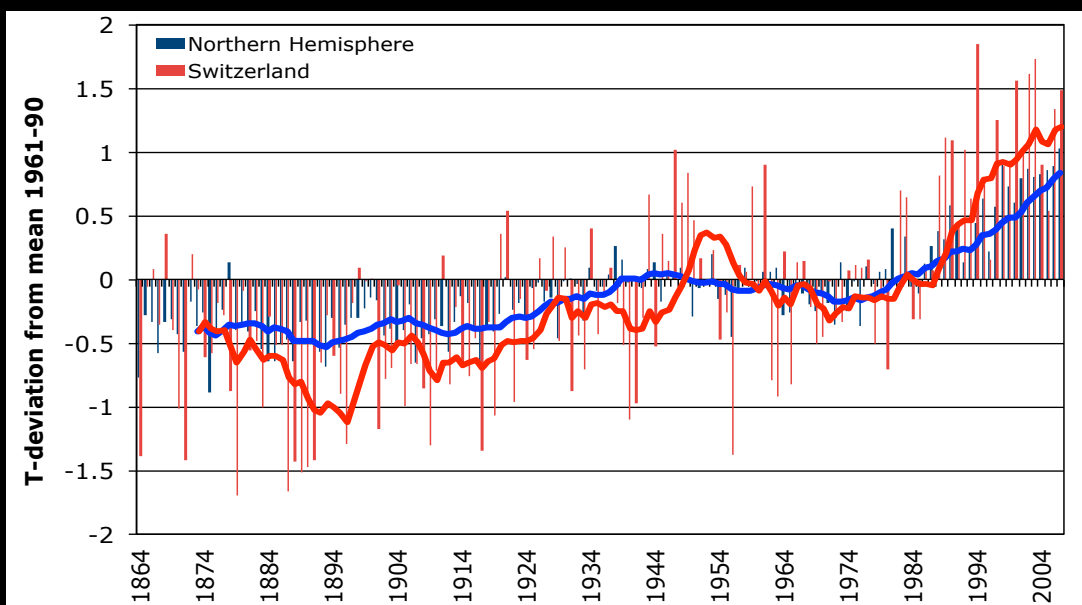
- 18-20° C July temperature
- Annual temperature Sion: 9.2°C (1961-90); 10.4 (1991-2007)

- Oceanic climate in the West (N_{max} in summer)
- Mediterranean-continental climate in the east (N_{max} in winter)

(maps: N. Zimmermann, WSL)

It is getting hotter ...

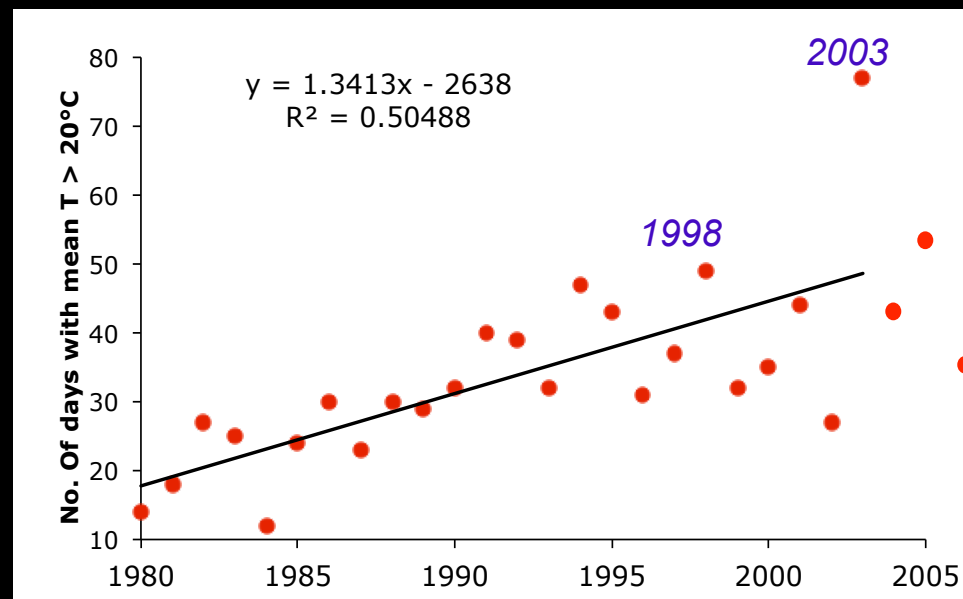
Annual temp. deviations



- Warming is more pronounced in continental mountain areas (Switzerland)
- Within Switzerland, the Valais shows the highest T-increase

(Rebetez & Reinhard 2006: Theor. Appl. Climatol.)

Number of days, mean temp. > 20°C in Visp



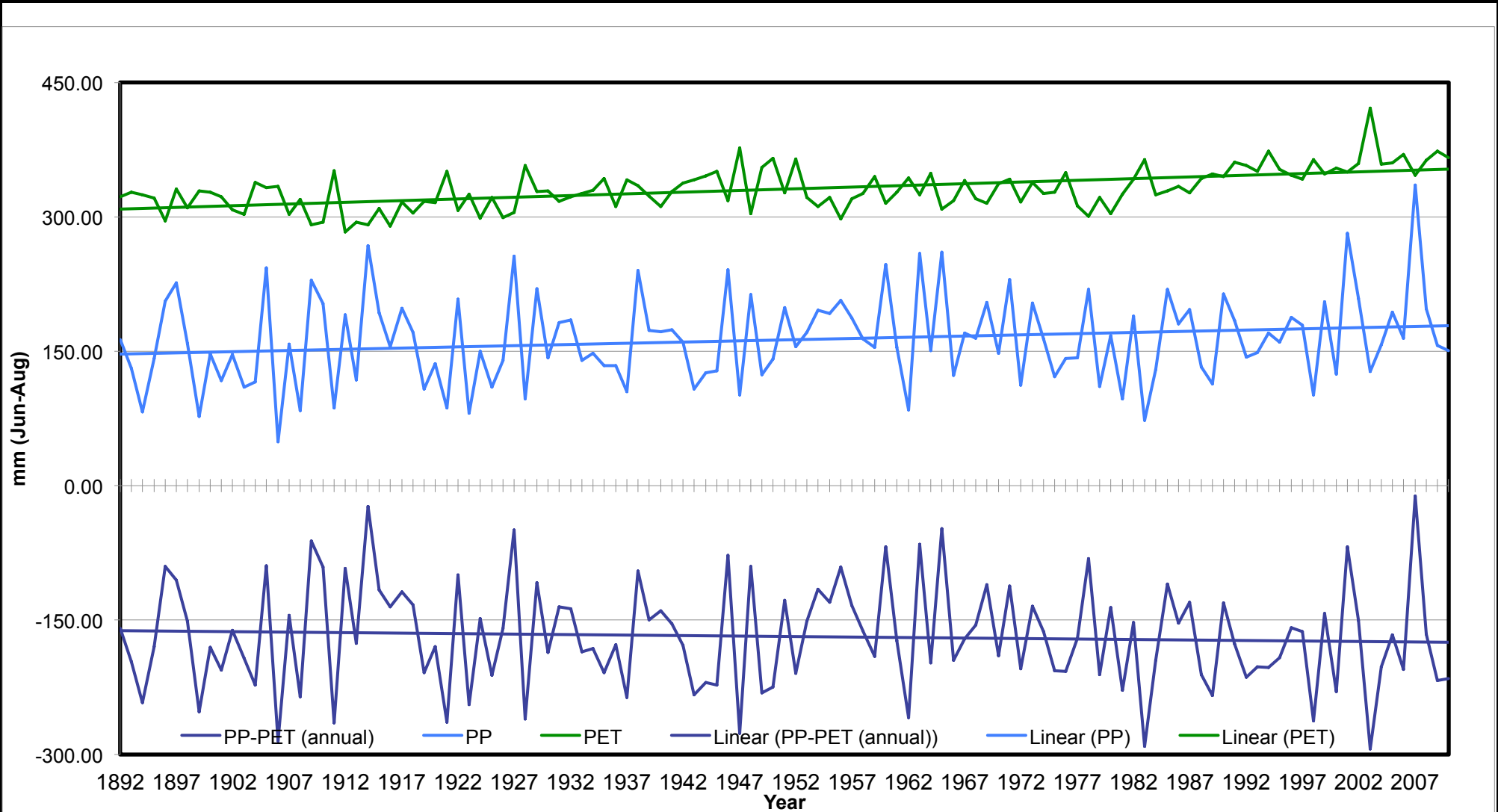
- Number of hot days doubled since 1980
- Consequences for trees and pests?

(Rebetez & Dobbertin 2004: Theor. Appl. Climatol.)

It is getting drier ...

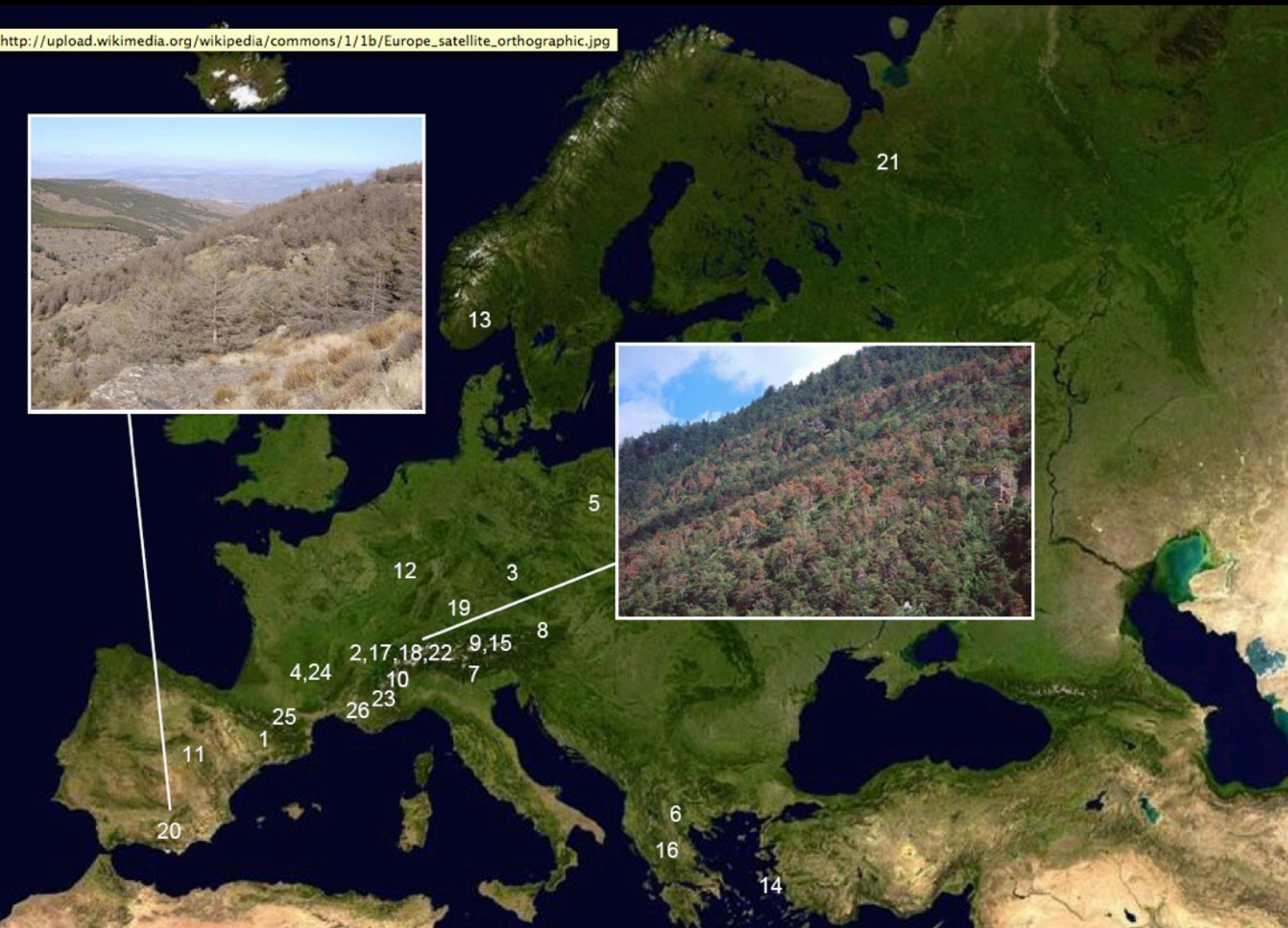


Precipitation PP, Potential Evapotranspiration PET, drought index PP-PET in Sierre (Jun-Aug) 1892-2009



(Giuggiola unpubl.)

Drought and tree mortality: Europe



Pinus sylvestris

- 18: Valais CH
- 22: Chur CH
- 7: Vinschgau I
- 10: Aosta valley I
- 9, 15: Innsbruck A
- 26: Verdon F

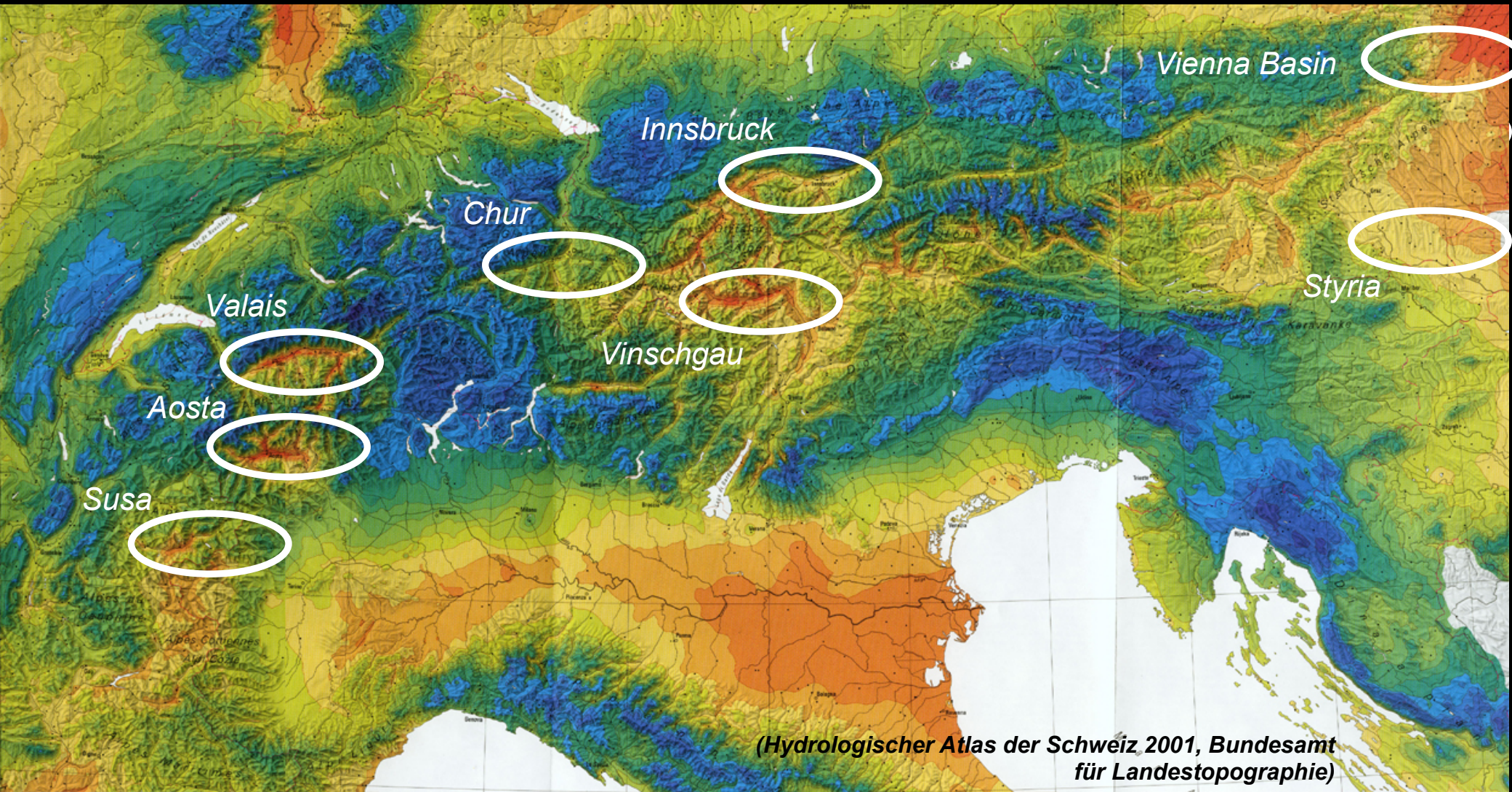
Scots pine decline in the Swiss Rhone valley

20. century - increased since 1990ties



Scots pine decline in inner-Alpine valleys

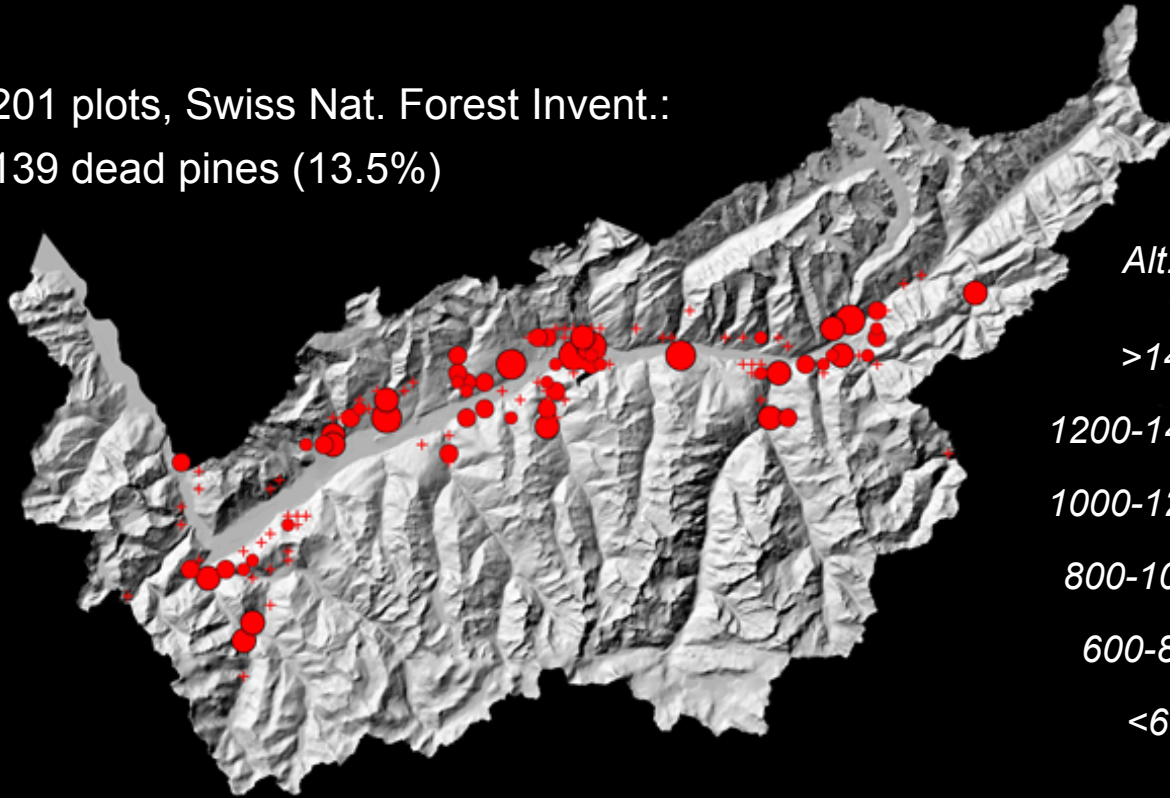
Annual precipitation in the Alps



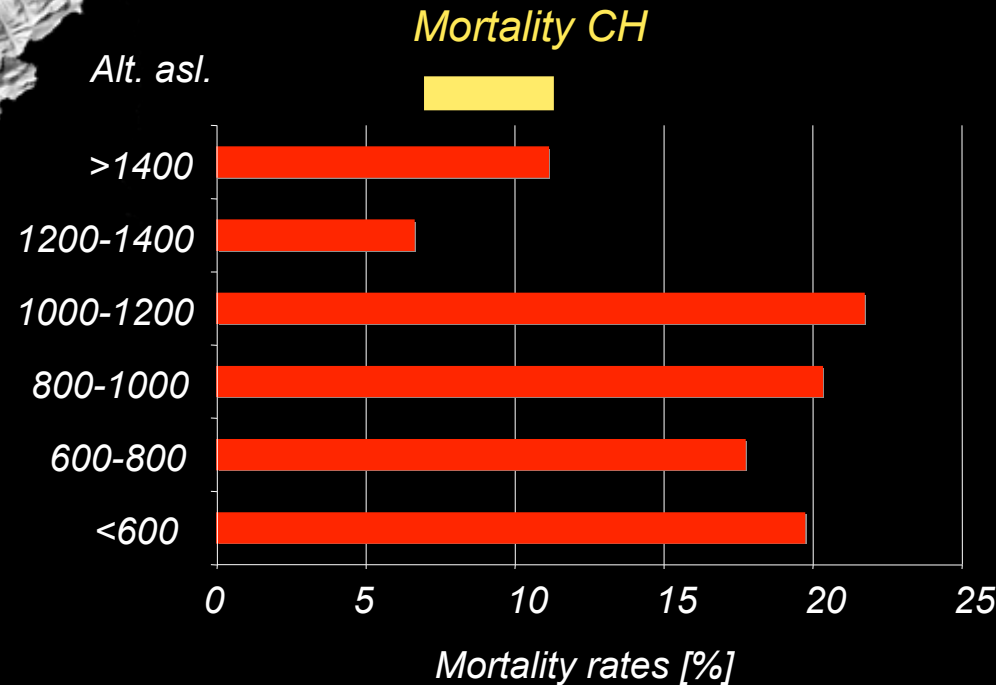
(Hydrologischer Atlas der Schweiz 2001, Bundesamt für Landestopographie)

Where did the pines die?

201 plots, Swiss Nat. Forest Invent.:
139 dead pines (13.5%)



Period of investigations:
1983/85 to 2002/03



- Regression analysis: Significant increase of mortality with:
 - 1) *increasing drought* (Drought index per plot)
 - 2) *stand competition*

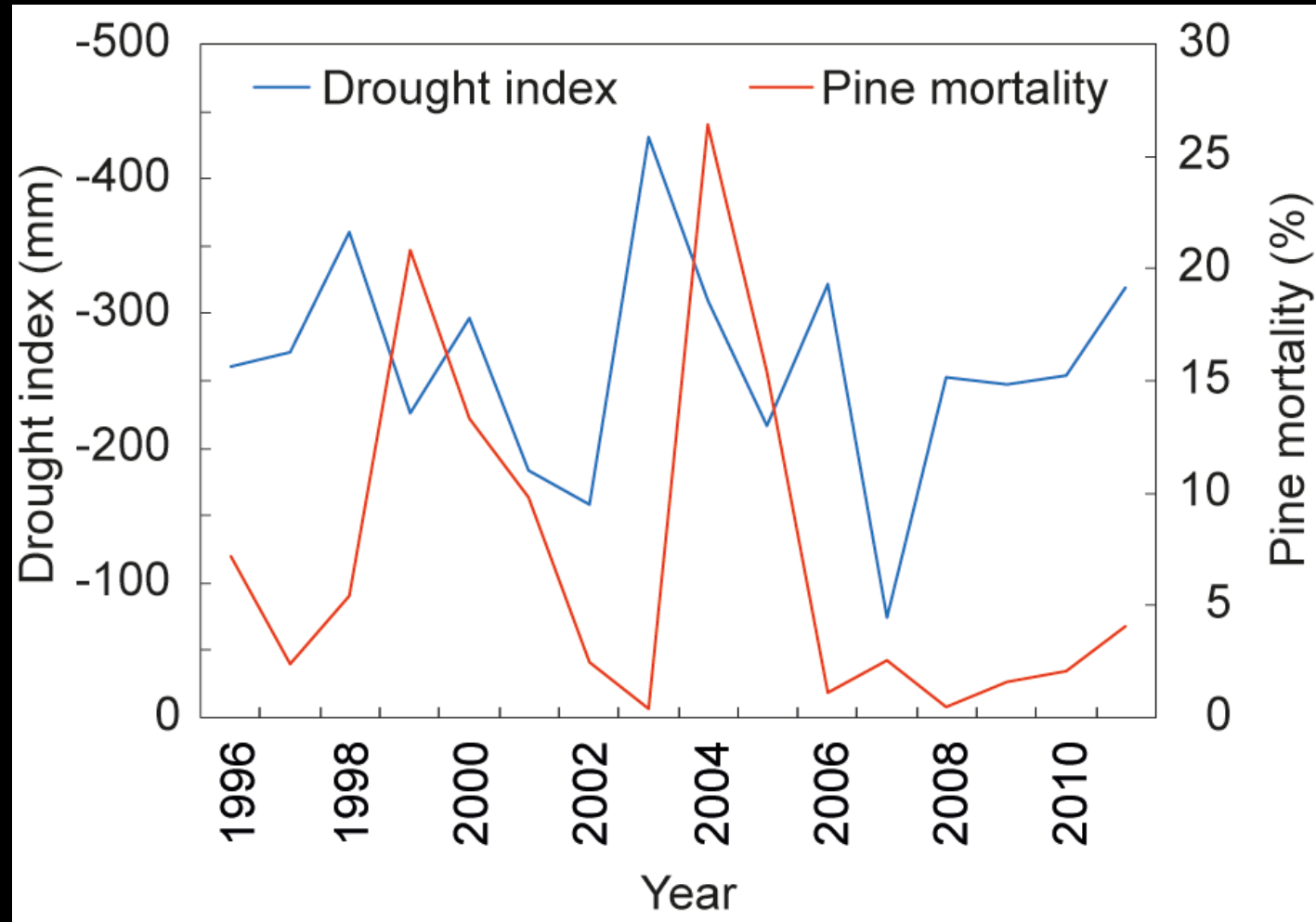
Summer drought and tree mortality



Monitoring plot Visp:

1995-2005:

60% of the pines but
only 15% of the
broadleaves died



- *Pine mortality increased in the year following hot-dry summers*
- *Mortality was highest after multiple drought years*

Irrigation experiment Pfynwald



- Can pines recover from drought stress?

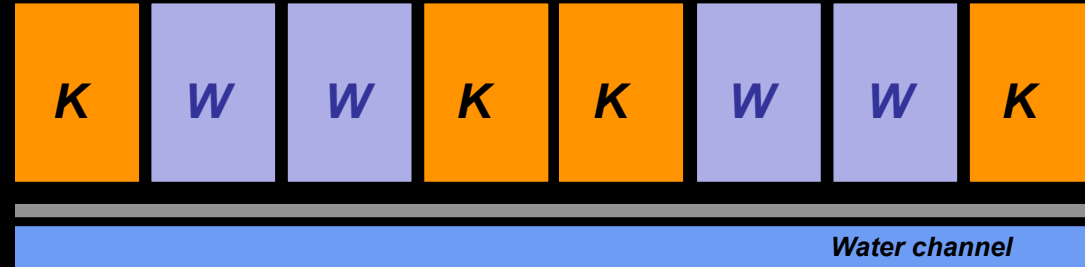


(Dobbertin et al. 2010: Tree Physiology; Brunner et al. 2009: Tree Physiology)

Irrigation experiment Pfynwald



- What is the effect of drought on the functioning of a pine forest?



8 plots (each 40x25 m)

4 blocks: 1x watered and control (ca. 100 trees)

→ In total 800 dominant pines

Irrigation Apr-Oct, during the night

June 2003 - October 2022

An addition of 610 – 790 mm water per year

In memoriam of Matthias Dobbertin



This workshop is dedicated to the memory of our friend and colleague **Matthias Dobbertin** who tragically passed away on October 31 2012.

Matthias Dobbertin was Spiritus Rector of many research activities incl. the irrigation experiment.