Statistical downscaling of extreme precipitation events under climate change conditions

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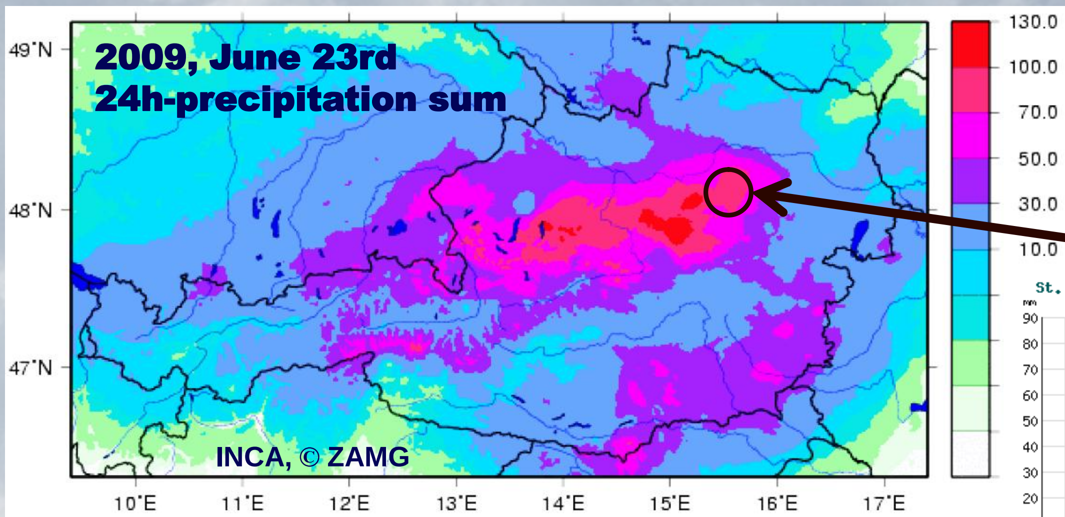
OUTLINE

1. **State the problem & Overview of the study region**
2. **Data (2 slides)**
3. **Method (2 slides)**
4. **RESULTS from Crossvalidation & Climate change signal**
5. **Conclusion**

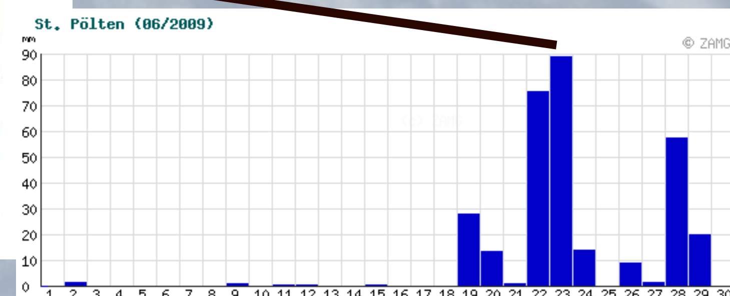
STATE THE PROBLEM

- Extreme precipitation events are relevant for wealth and society (damages and losses)



90mm == 30-year event

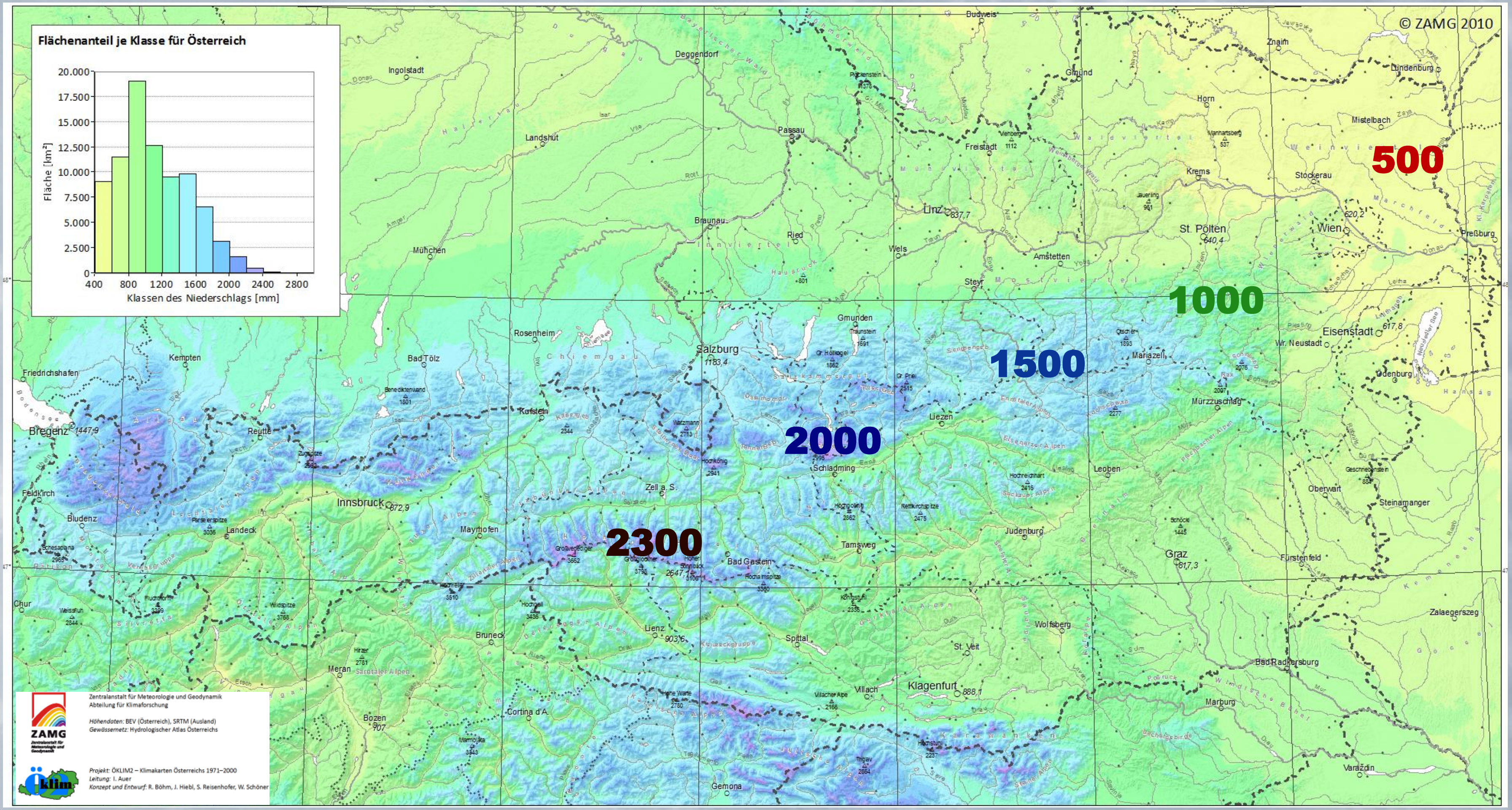
New record groundwater level: +3m aN



- **Key question: How will rare extreme daily precipitation events be altered under changed climate conditions in the next decades ?**

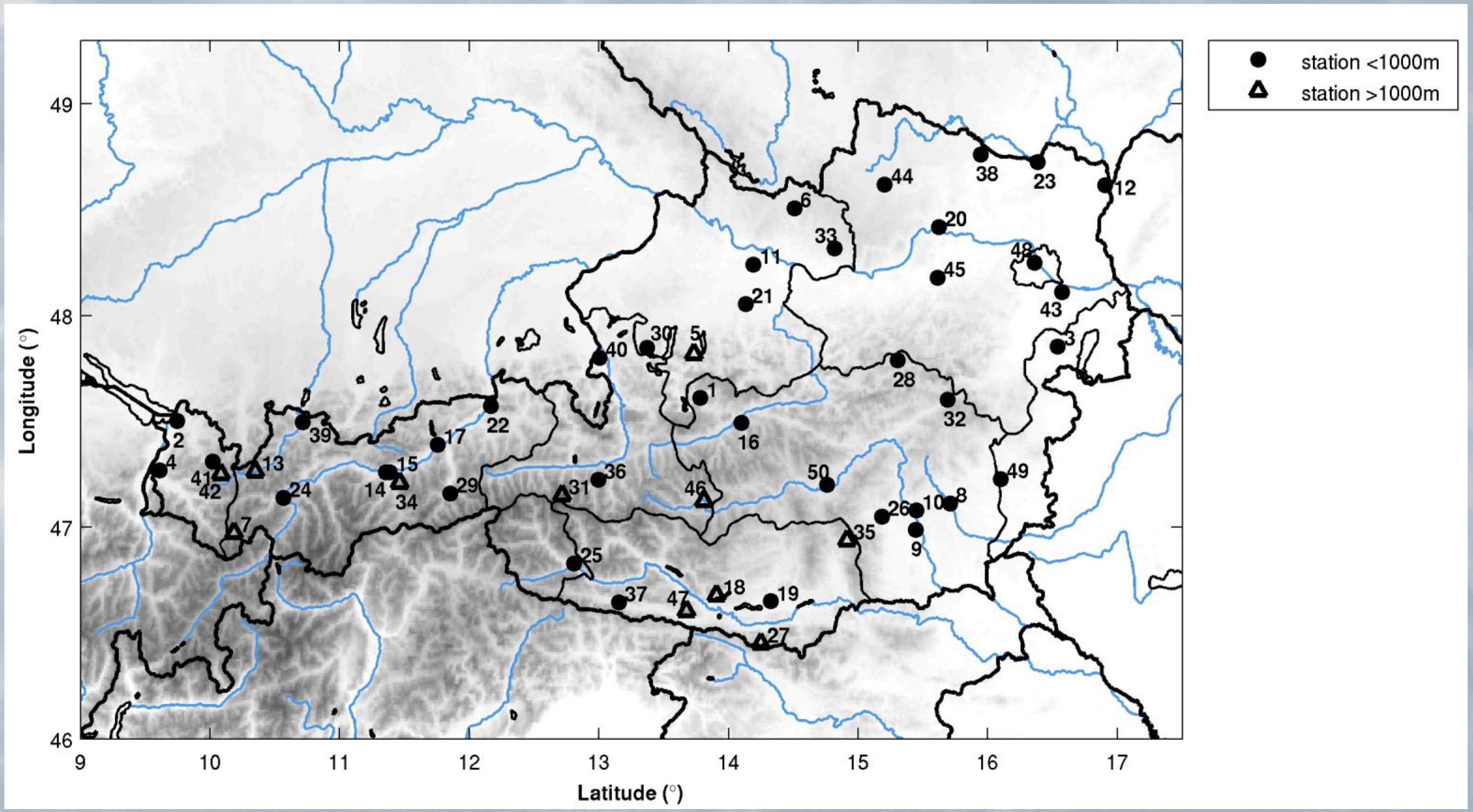
→ Investigate relative changes of **rare strong events**. (10-50y return periods).

STUDY REGION: complex topography, yearly precipitation amounts **mm/YEAR**



OBSERVATIONS: daily precipitation, 50 stations *(Startclim, ZAMG 2003)* covering the **44-year observation and crossvalidation** period 1963-2006.

(quality proofed, < 0.5% missing data)



CLIMATE MODEL DATA: Echam5/MPI-OM: A1b & B1 - 3 realizations each

REANALYSIS DATA: NCAR NCEP1

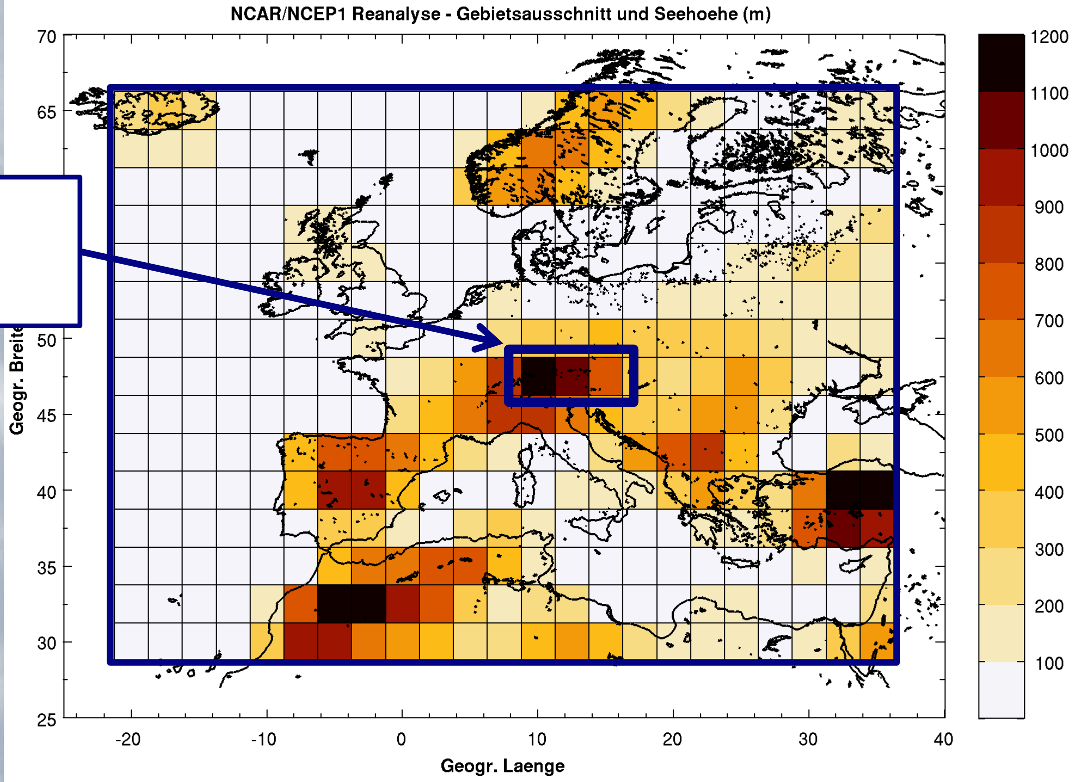
PREDICTOR VARIABLES: **SLP und Q700***

20°W-35°O, 30°S-65°N

***Q700 as an index variable!**

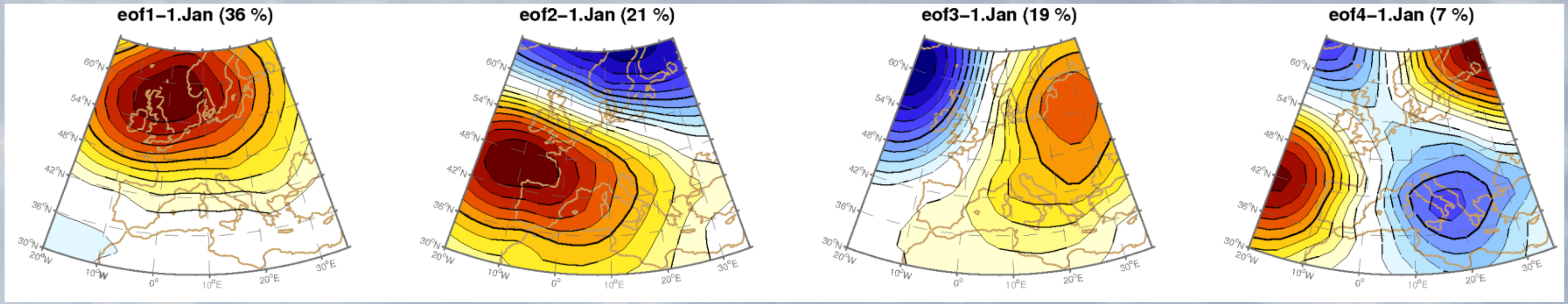
Daily mean over study region

(Precondition for Analog Method)

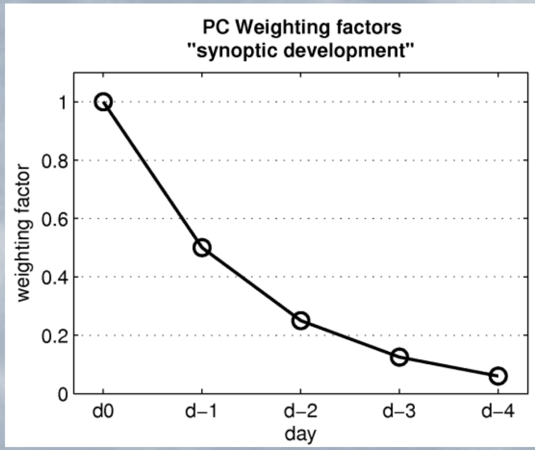


Statistical downscaling: ANALOG METHOD → SLP

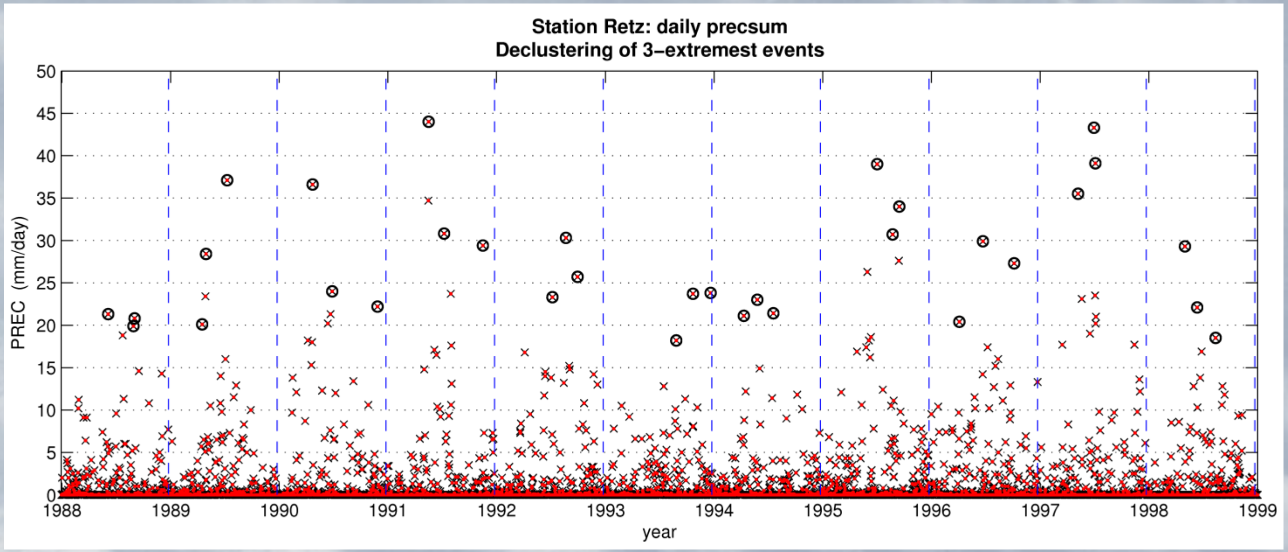
- **Eigenvalue decomposition** for each DOY (1-365), 90-day running window. First 10 EV's !
  Allow for shifts in climate throughout the year (no artif. boundaries due to seasons or months)
- **Search for similar SLP patterns:** Min |euclidian distance(PCs)| → assign according observed prec.



- **Consider synoptic history** from the last 4 days :
- **Q700 "pre-screen"** in the search for analogs
  → Reject 66% of all candidates (largest ΔQ700)



- **Runs de-clustering:** Clusters are seperated by at least 1 observation below threshold (1mm)
- **Block Maxima Approach:** Define the maximum excess within each cluster (seperated by at least 3 days)



- **GEV distribution:** Fitted to 3 largest maxima per year (from independent clusters!)

→ „return level estimates"

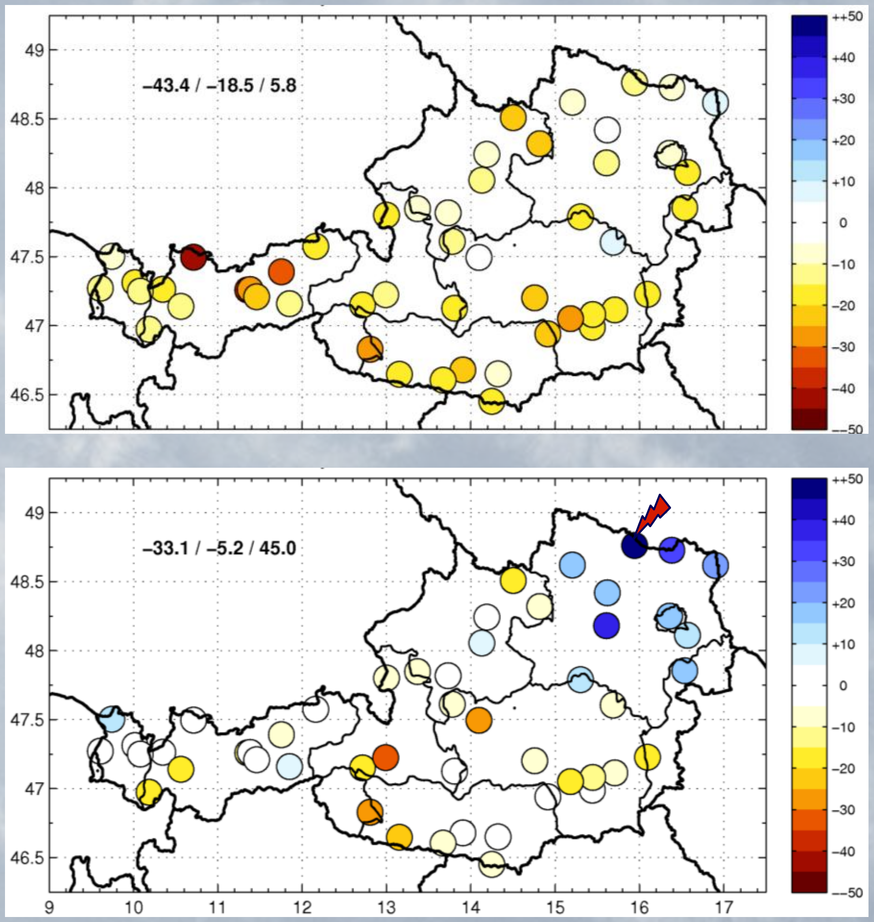
$$G(z) = exp\left[-\left\{1+\xi\left(\frac{z-\mu}{\sigma}\right)\right\}^{-\frac{1}{\xi}}\right]$$

Bias 30y return level estimates (%) (CROSS – OBS, 1963/2006)

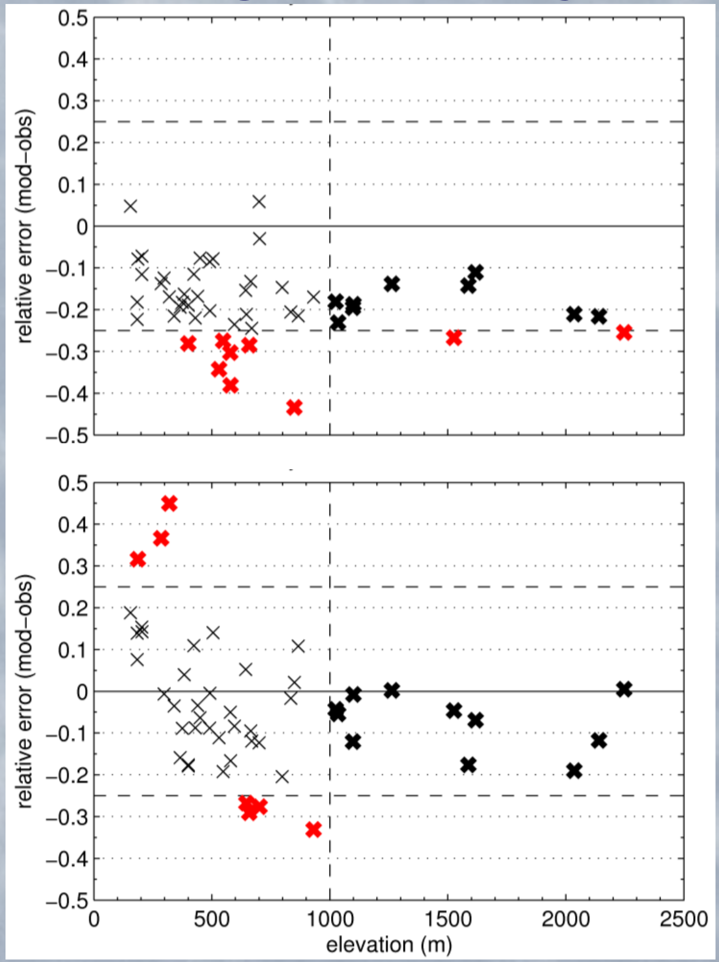
Magnitude / Spacial dependence?

SU (Apr-Sep)

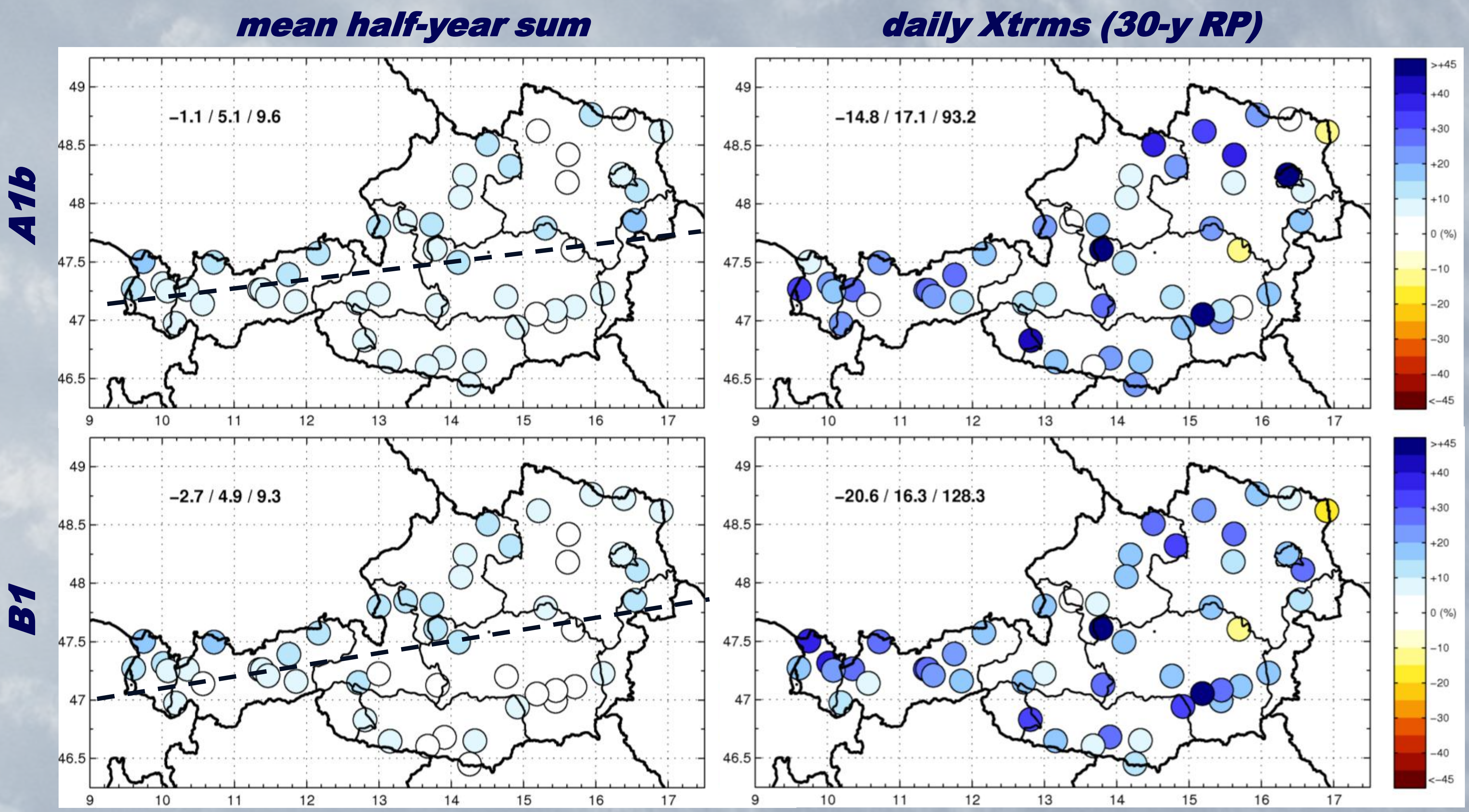
WI (Oct-Mar)



Height dependency ?



SUMMER HJ (Apr-Sep): Relative Change (%) (2007/2051 – 1963/2006)

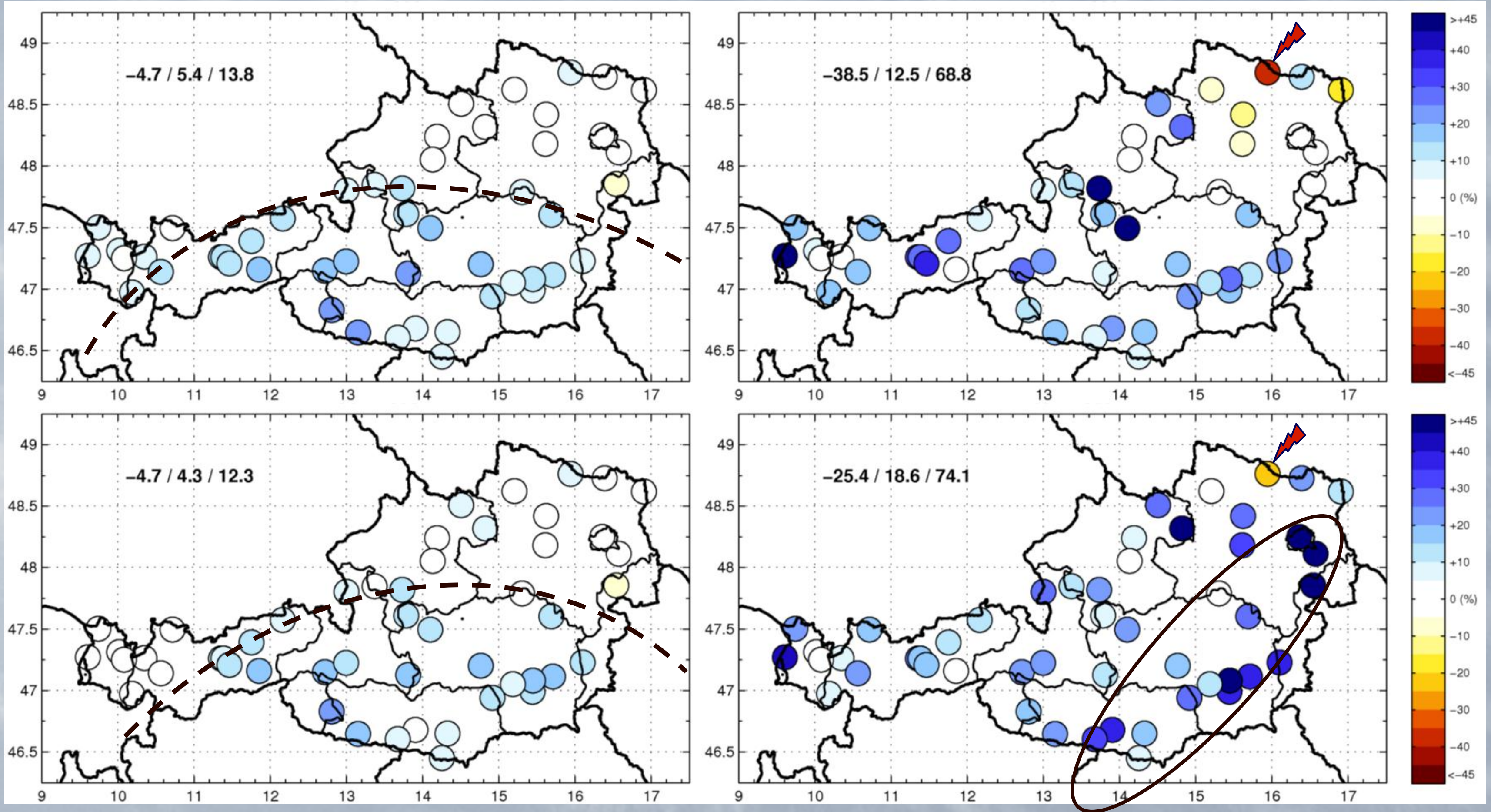


WINTER HJ (Oct-Mar): Relative Change (%) (2007/2051 – 1963/2006)

mean half-year sum ***daily Xtrms (30-y RP)***

A1b

B1



(1) **Downscaled GCM scenario A1b/B1 - Analog Method to derive 10-50 year return level estimates of daily precipitation**

(2) **Interesting things came up:**

- **Changes more pronounced in 30y-xtrms than in the mean (factor 3)**
- ***Mean:* Splitting situation along the alpine chain, splitting reverses from WI to SU**
- ***Xtrms*:**

  General increase of 17% in summer in both scenarios; no spatial structures

  In winter stronger increase in B1 (+17% vs +12%)
  clear differences in the spatial structures, especially in the East !


Thank you for your attention !

Supplement B: Crossvalidation within the 44-year observation period

(1) Split the observation period into 2 sequences (1 & 43 years long)

(2) Derive sets of EOFs from-, and search for Analogons within the 43year episode

(3) Determine the precipitation sequence for the remaining year.

(4) Do this 44 times permutative.

(5) Compare the return level estimates from OBS against those from CROSS