CCHydro

Atmospheric data processing and hydrological modelling of large Swiss basins in the frame of the Swiss CCHydro project

Thomas Bosshard, Massimiliano Zappa,
Sven Kotlarski, Tracy Ewen, Christoph Schär

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

C2SM Center for Climate Systems Modeling

u b
UNIVERSITÄT BERN

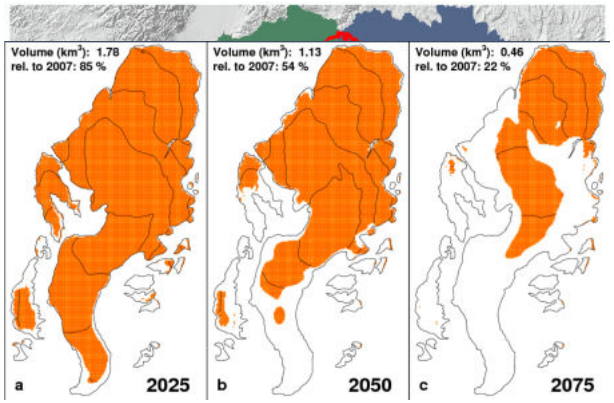
Universität Zürich

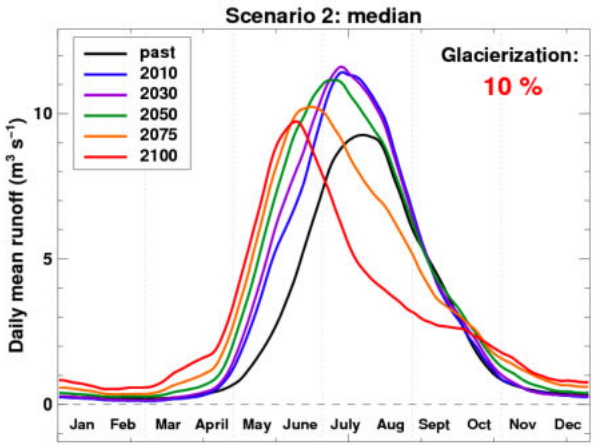
WSL

Overview of the CCHydro-Project

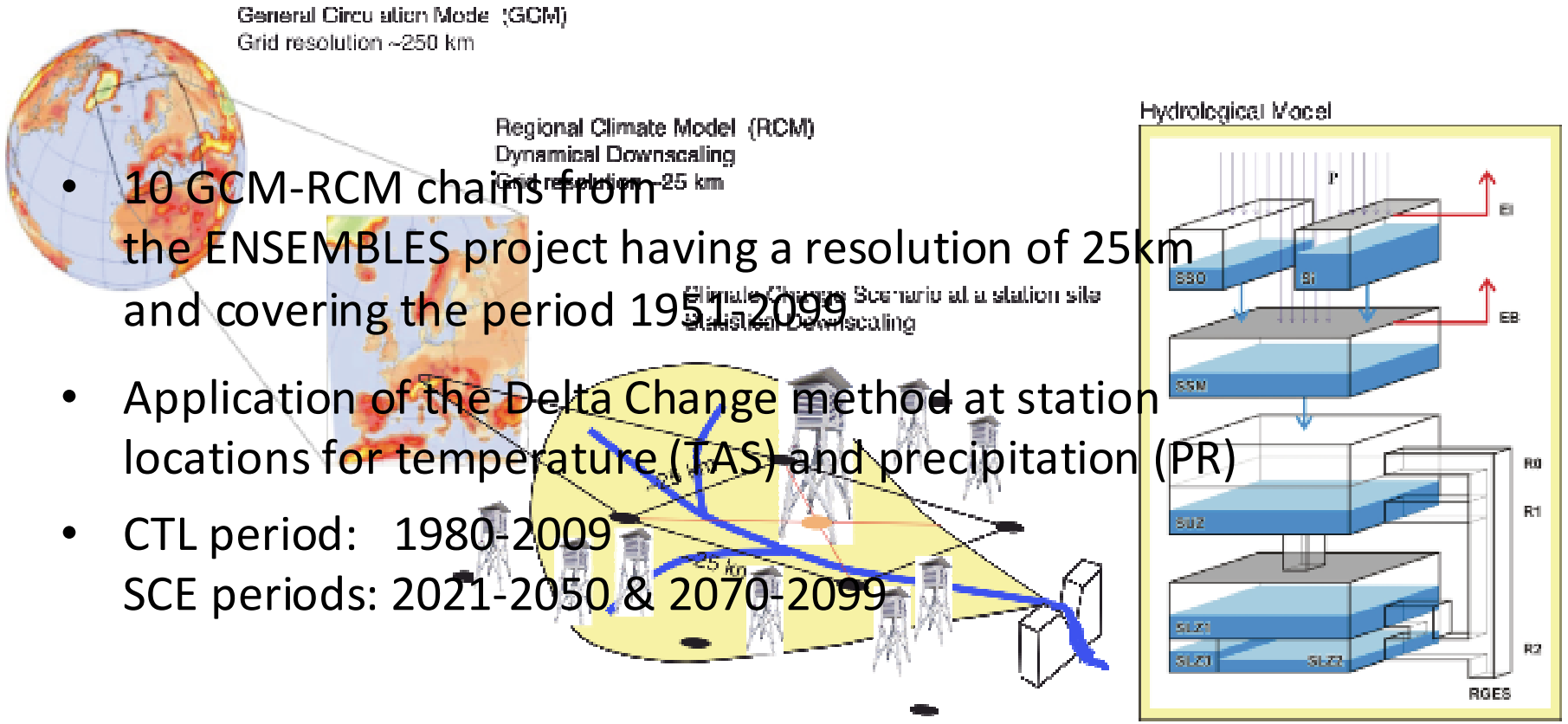
Suite of FOEN projects with the following modules:

- Generation of climate scenarios with a high spatial and temporal resolution for the scenario period 2021-2050
- Assessment of climate impacts on hydrological regimes, low and high flows
- Generation of glacier scenarios
- Assessment of climate impacts on chemical and physical water properties



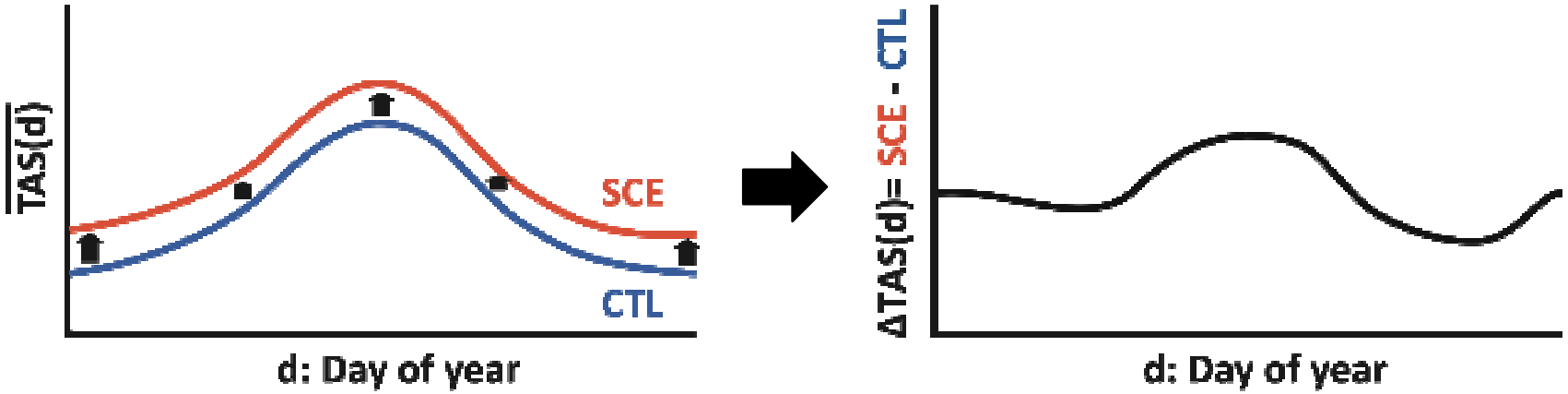


Introduction



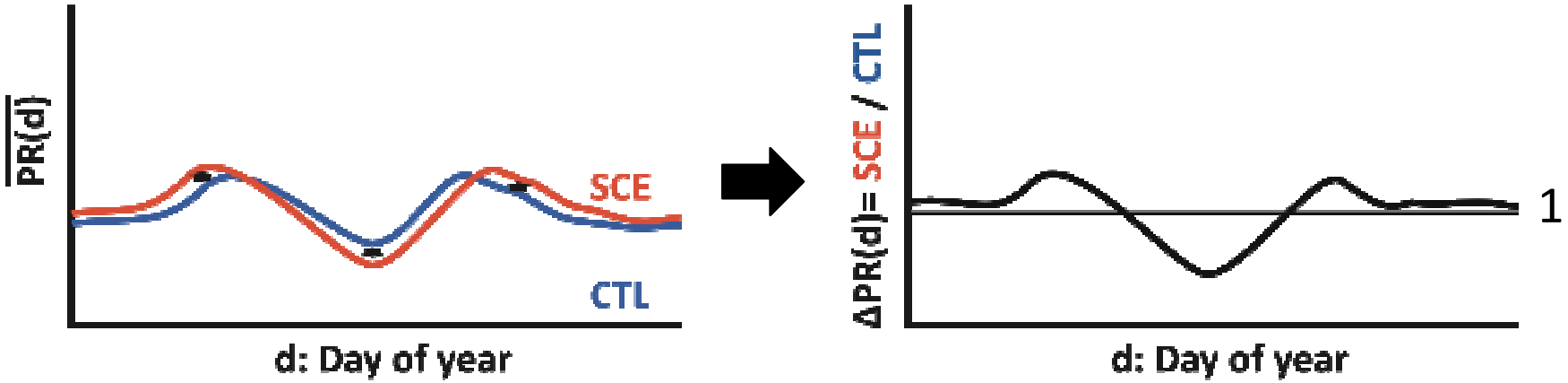
- 10 GCM-RCM chains from the ENSEMBLES project having a resolution of 25km and covering the period 1951-2099
- Application of the Delta Change method at station locations for temperature (TAS) and precipitation (PR)
- CTL period: 1980-2009
  SCE periods: 2021-2050 & 2070-2099

Delta change method: TAS



Estimating the change of the climatological annual cycle is key to the method.

Delta change method: PR

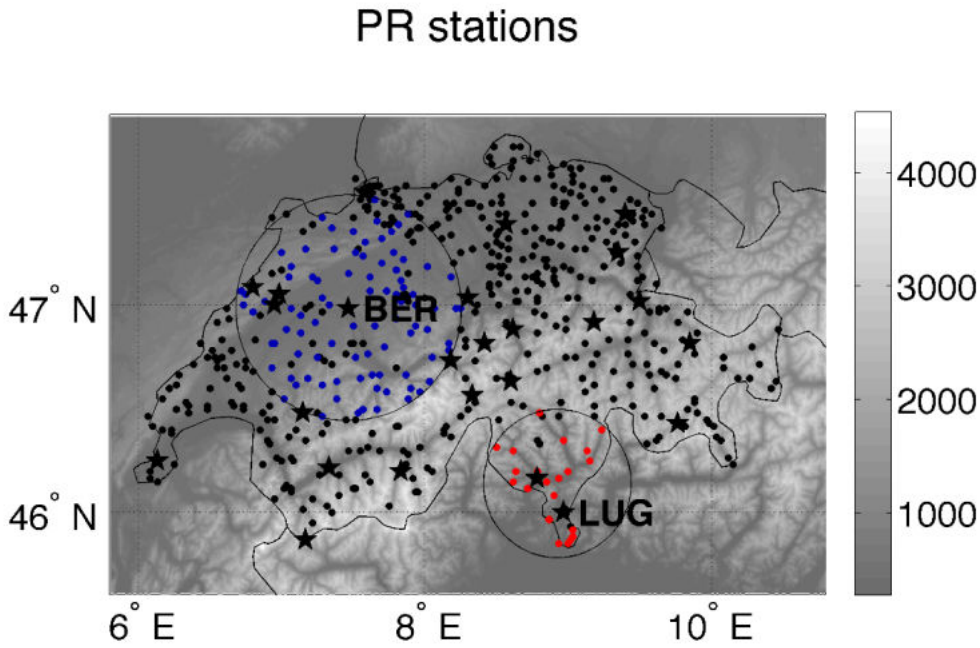


Daily precipitation series are characterized by a strong **natural variability**.

Natural variability influences the estimation of the climatological annual cycle

Effects of precipitation variability

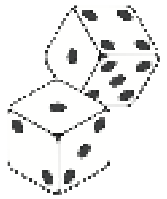
- Derive the rainfall generator parameters from observed daily precipitation
- Sampling twice a 30 year long precipitation series with a rainfall generator
- Derive the multiplicative delta by using moving averages (MA)
- Repeat this 1000 times

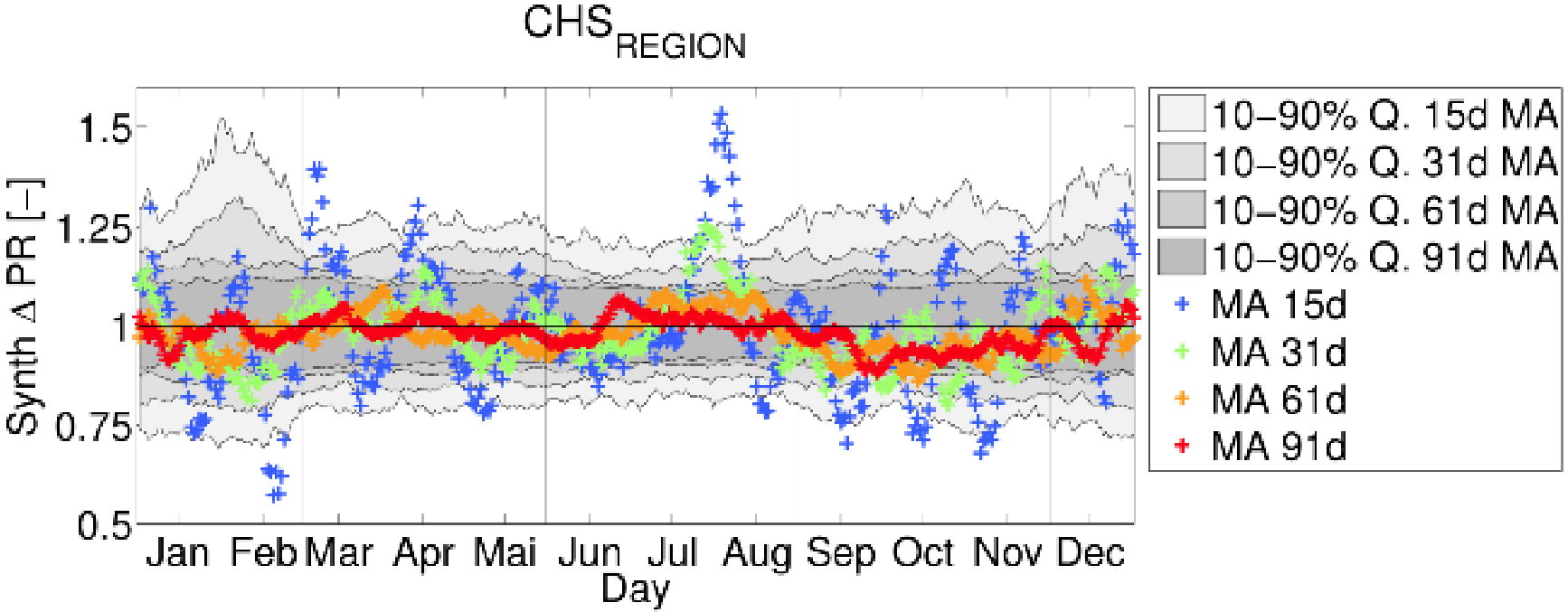


Asymptotic behaviour: Delta is a **horizontal line at 1**

Effects of precipitation variability

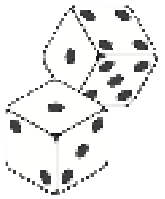
Rainfall generator realizations

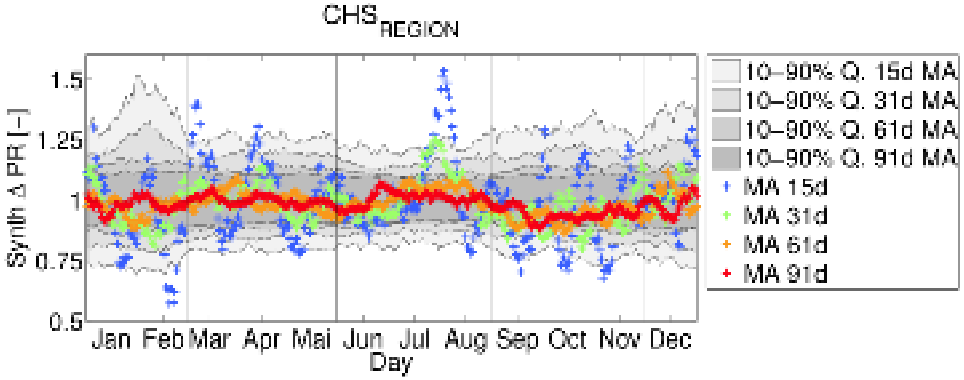




Effects of precipitation variability

Rainfall generator realizations

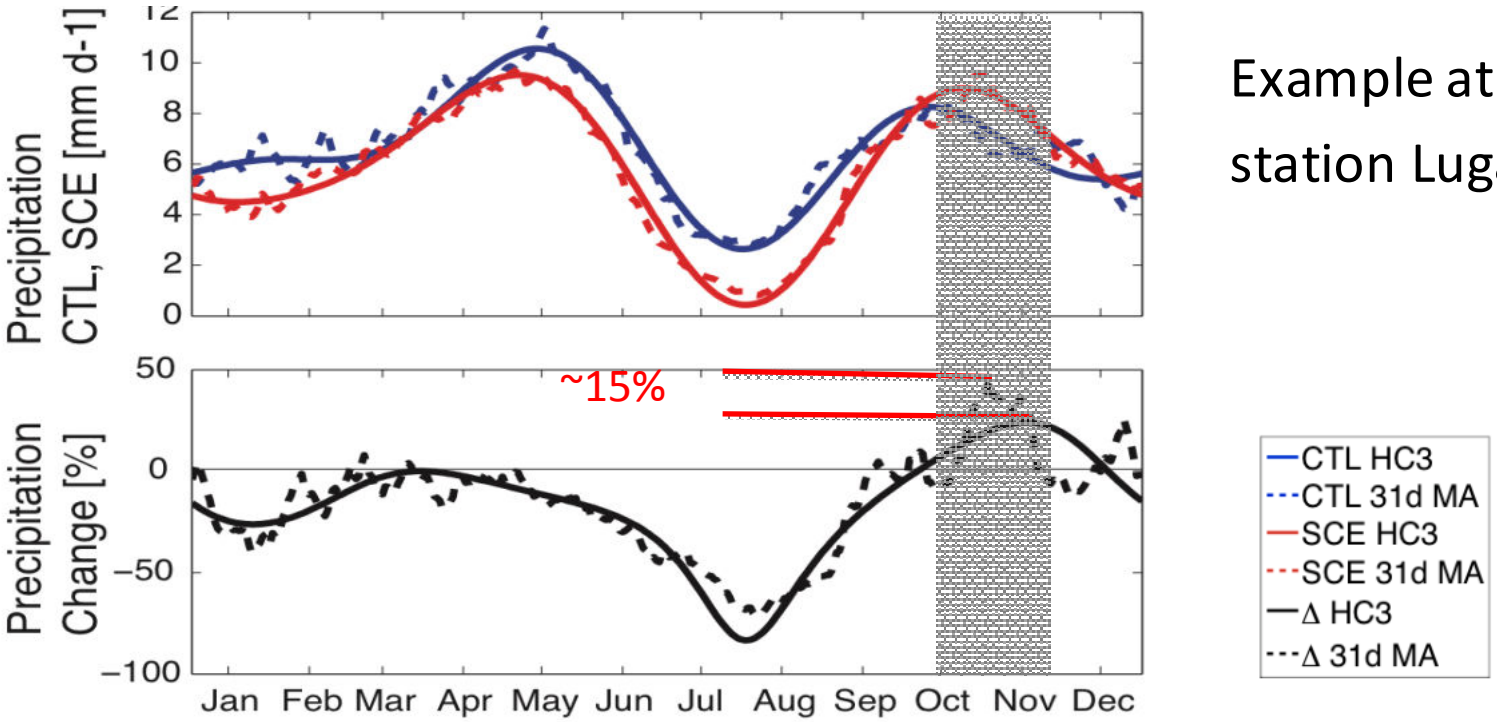




- Large deviations from 1 in the case of the 15d and 31d MA
- High frequency fluctuations occur
- Spikes are as large as +/- 25%

Spectral smoothing filters the high frequency fluctuations

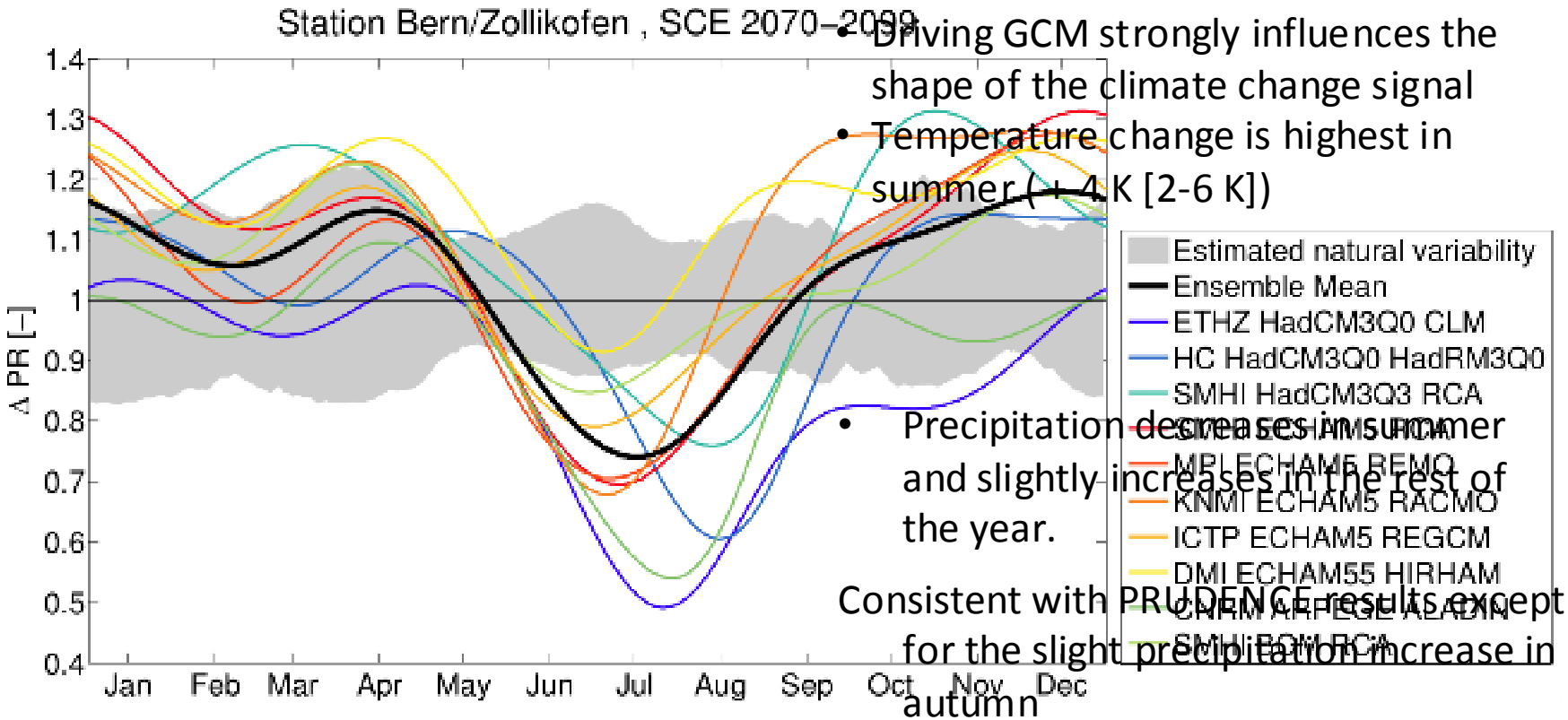
Spectral smoothing



Example at the station Lugano

Spectral smoothing successfully damps high frequency fluctuations

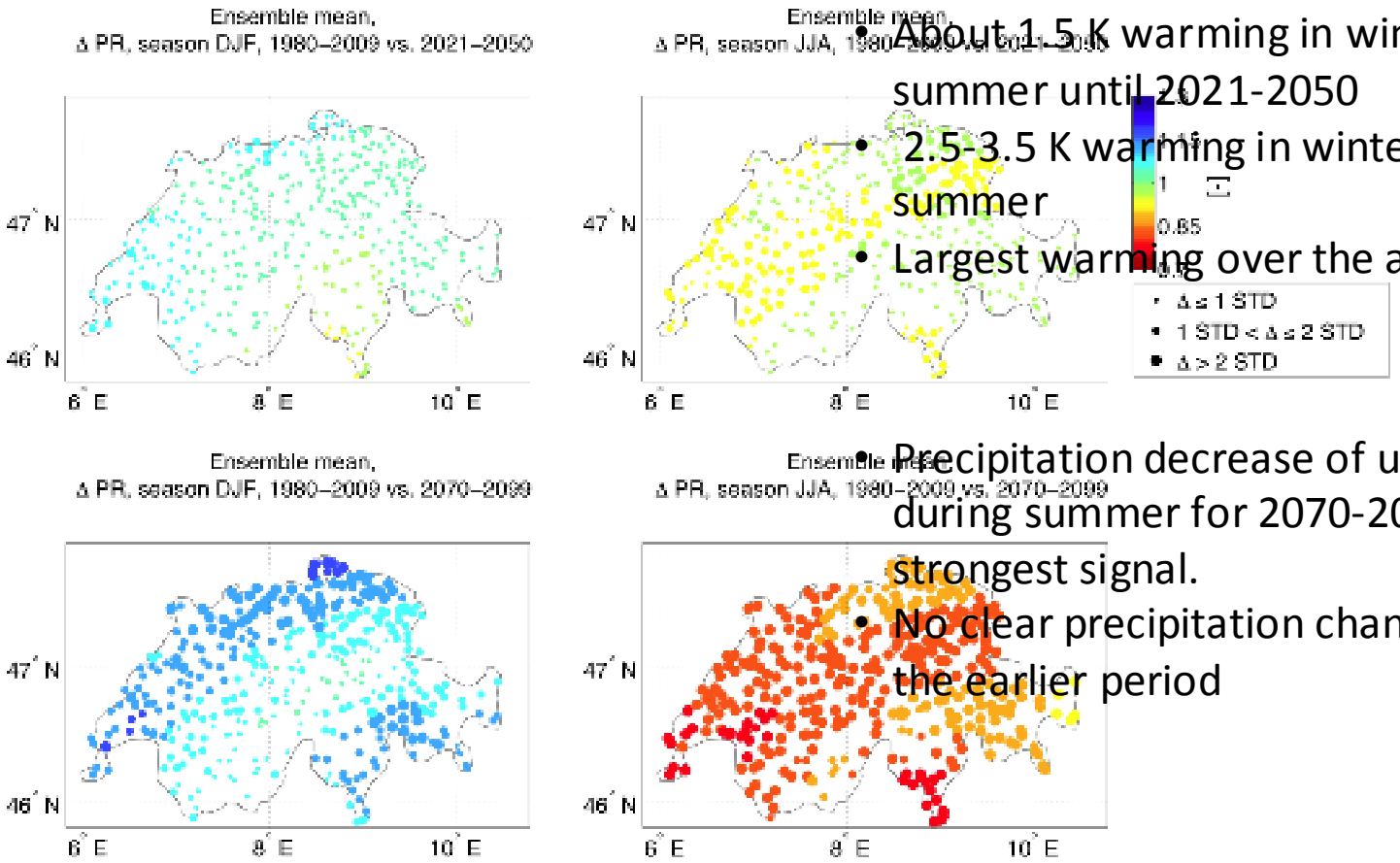
Results at Swiss station sites



- Driving GCM strongly influences the shape of the climate change signal
- Temperature change is highest in summer (+4 K [2-6 K])
- Precipitation decreases in summer and slightly increases in the rest of the year.

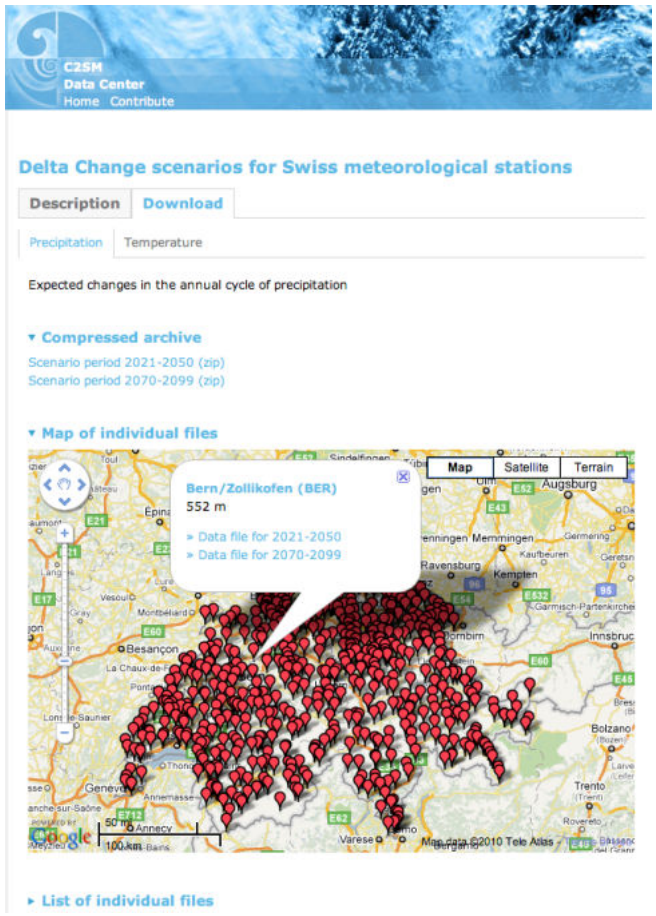
Consistent with PRUDENCE results except for the slight precipitation increase in autumn

Seasonal mean patterns: Ensemble mean

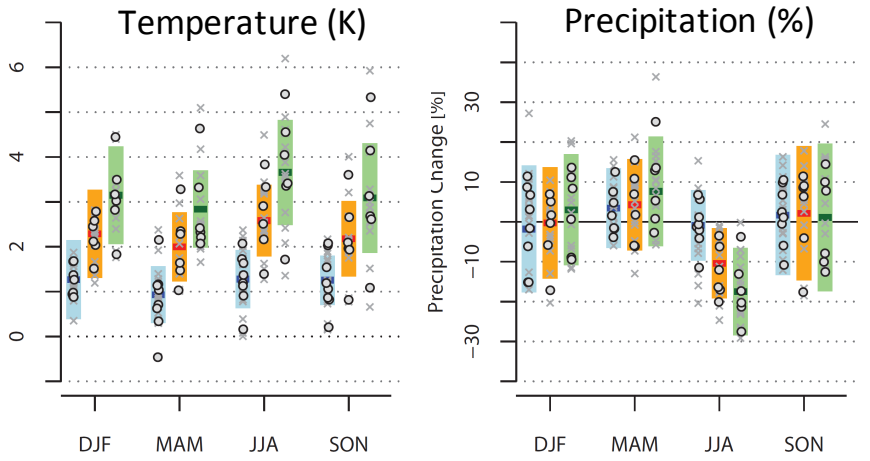


- About 1.5 K warming in winter and 2 K in summer until 2021-2050
- 2.5-3.5 K warming in winter and 3.5-5 K in summer
- Largest warming over the alpine ridge.
- Precipitation decrease of up to -30% during summer for 2070-2099 is the strongest signal.
- No clear precipitation change signal in the earlier period

Upgrade of Swiss Climate Change Scenarios (CH2011)



- Developed by C2SM, ETH, MeteoSwiss, OcCC, NCCR Climate and ART
- Easy access for project partners (e.g. CCHydro)
- Available in Spring at http://www.c2sm.ethz.ch/services/CH2011



by courtesy of A. Fischer

Conclusions

- Natural variability causes artificial fluctuations in the Delta signal if moving averages are used
- Spectral smoothing filters these fluctuations
- In the far future (2070-2099), temperature increase is largest in summer and over the alpine ridge with up to +5K in the ensemble mean.
- In the far future (2070-2099), we expect a strong decrease in summer precipitation.
- The scenario data are easy accessible for impact modellers