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SCCER SoE
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Simulation of high-resolution gridded climate variables for present and future climates

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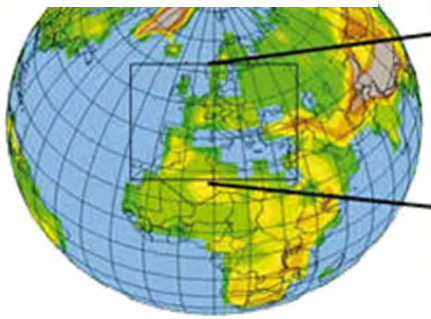
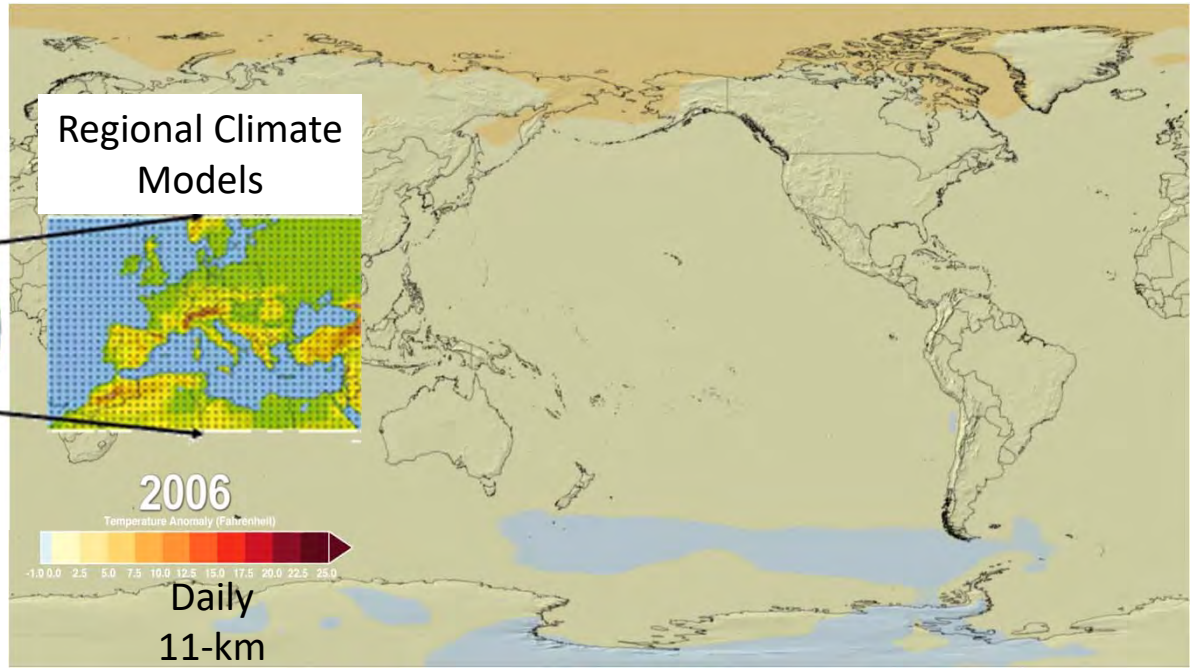
Stochastic climate downscaling

Global Circulation Models



Daily
100-km

Regional Climate Models

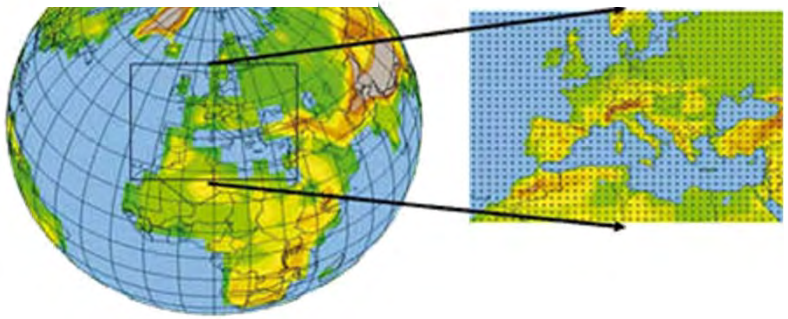


Daily
11-km

Stochastic climate downscaling

Global Circulation Models

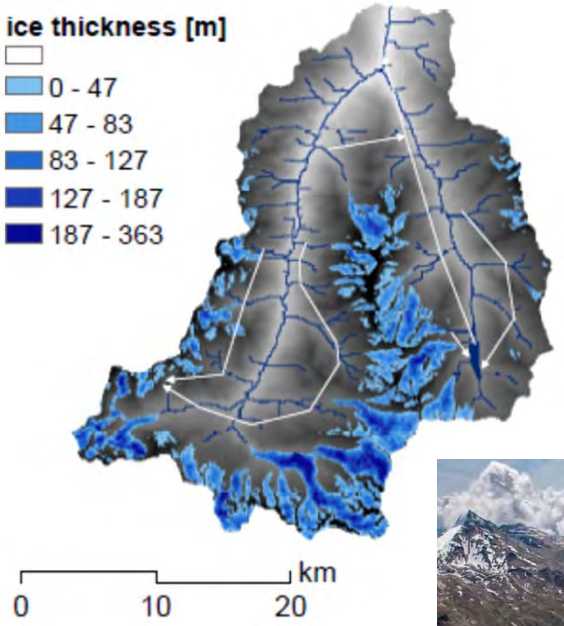
Regional Climate Models



Daily
100-km

Daily
11-km

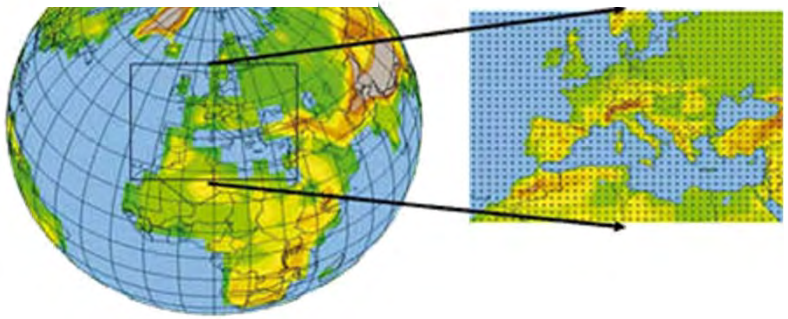
Hourly
1-km



Stochastic climate downscaling

Global Circulation Models

Regional Climate Models

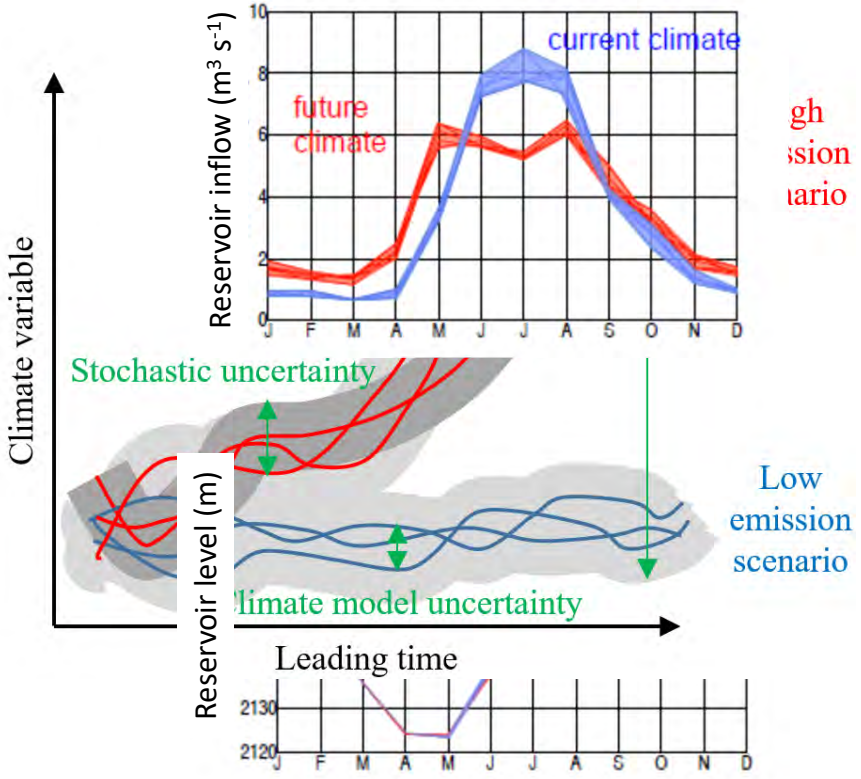


Daily
100-km

Daily
11-km

Stochastic (natural) climate variability

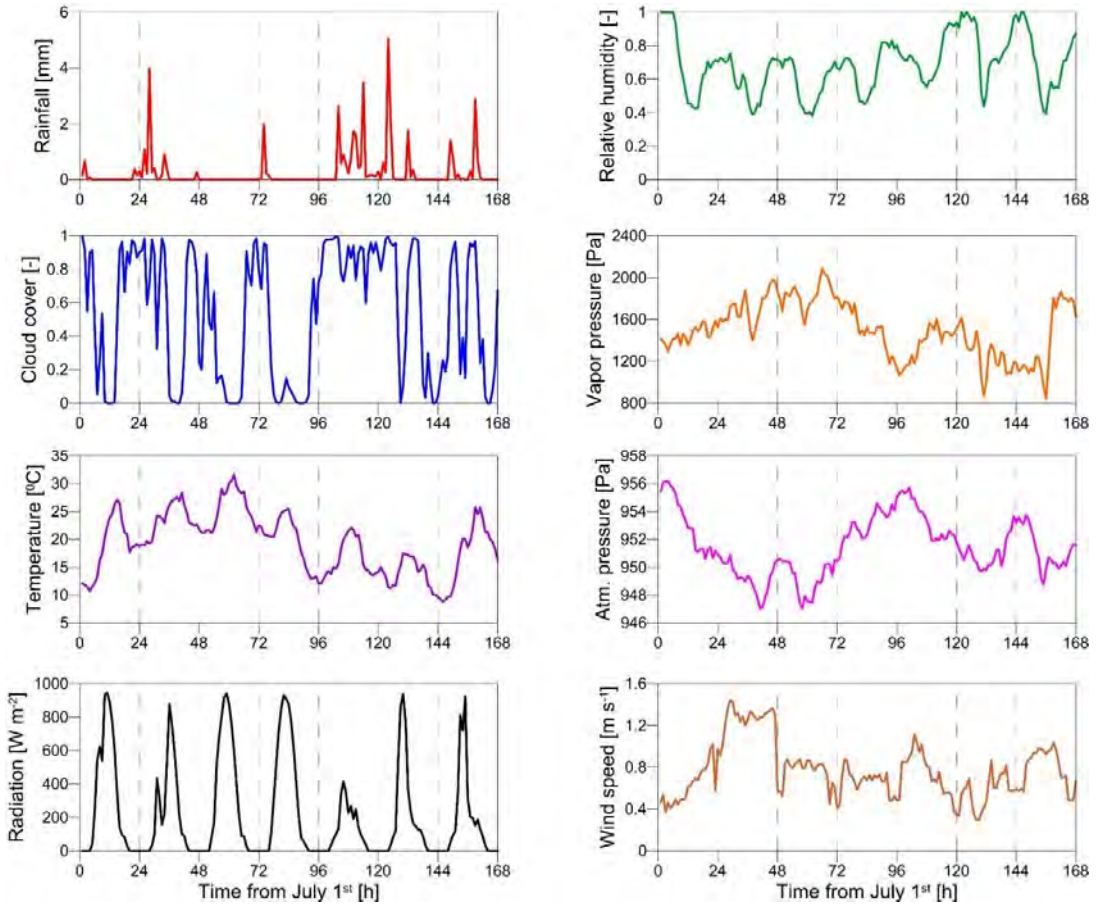
Hourly
1-km



Stochastic climate downscaling

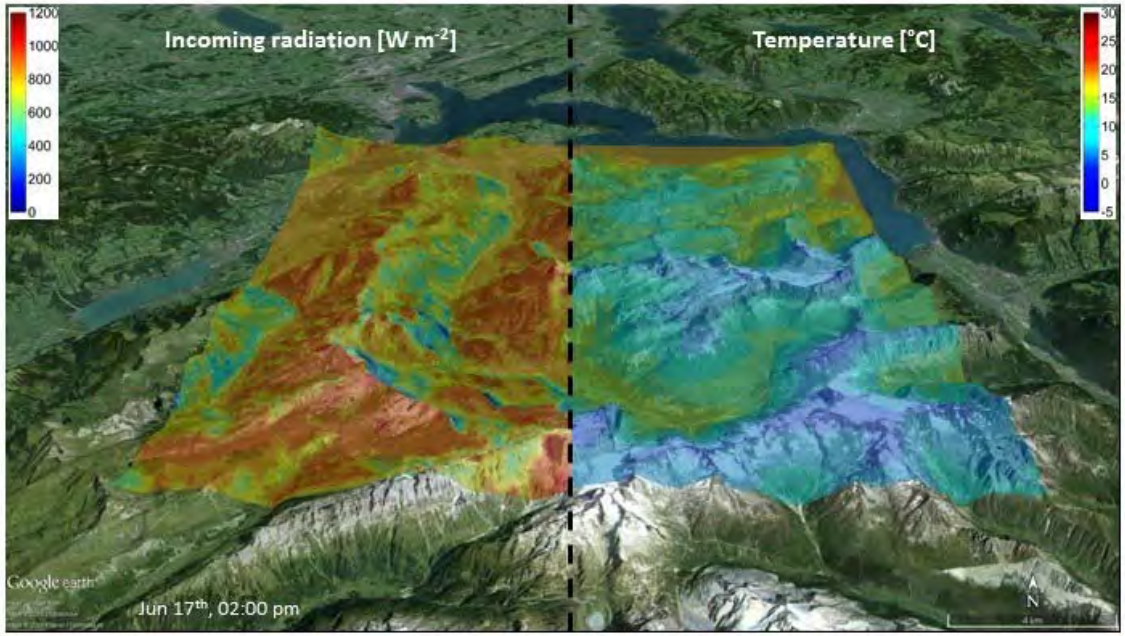
We are looking for a tool that:

- Generate all the climate variables needed for hydrological/morphological/hydropower operation
- Can be use to downscale climate variables to finer spatio-temporal resolution
- Reliably reproduce the present climate
- Can be use to generate multiple realizations of the future climate
- Is fast and computational inexpensive



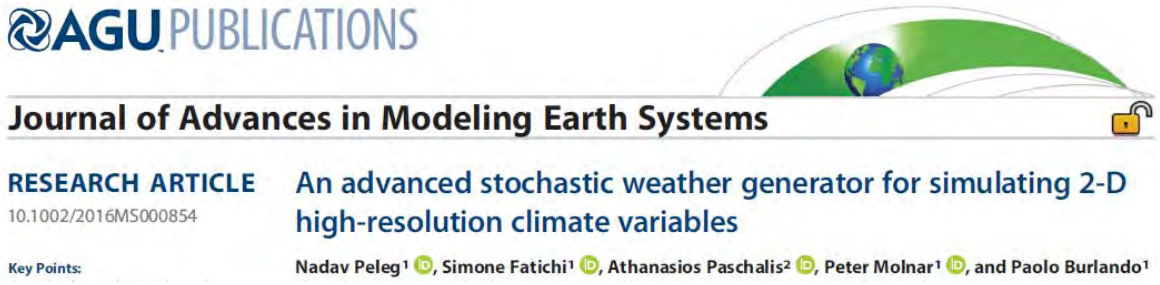
AWE-GEN-2d in a nutshell

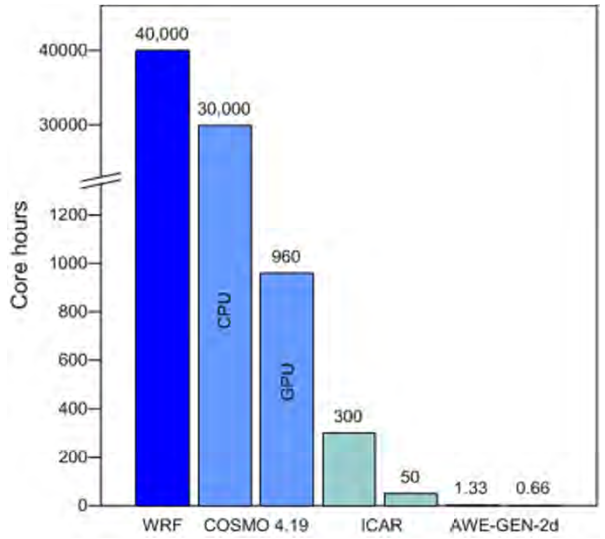
- AWE-GEN-2d (**A**dvanced **WE**ather **GEN**erator for **2-D**imensional grid) follows the philosophy of combining physical and stochastic approaches to generate gridded climate variables in a high spatial and temporal resolution



AWE-GEN-2d in a nutshell

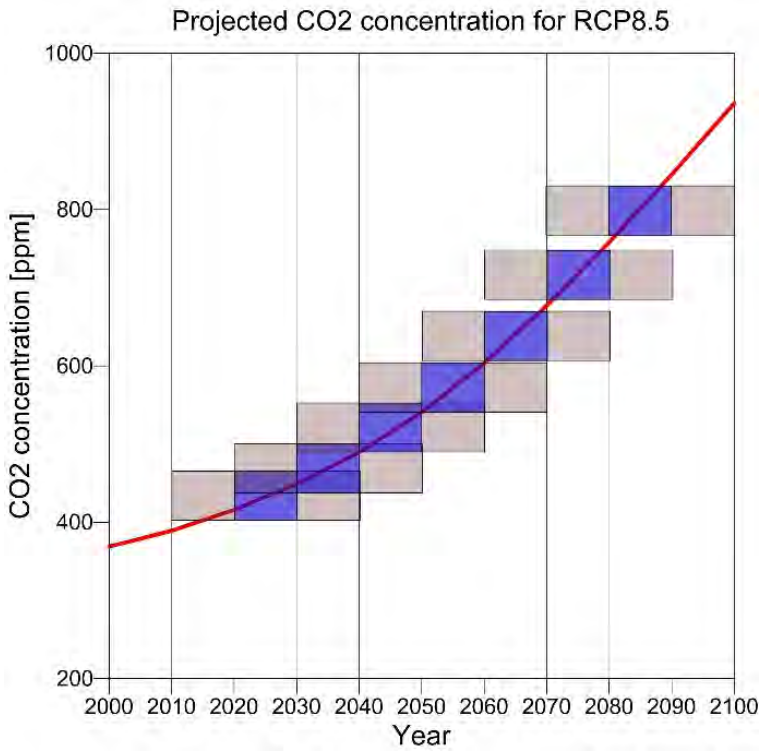
- AWE-GEN-2d (**A**dvanced **WE**ather **GEN**erator for **2-D**imensional grid) follows the philosophy of combining physical and stochastic approaches to generate gridded climate variables in a high spatial and temporal resolution
- It is relatively fast and parsimonious in terms of computational demand
- It allows generating many stochastic realizations of present and future climates





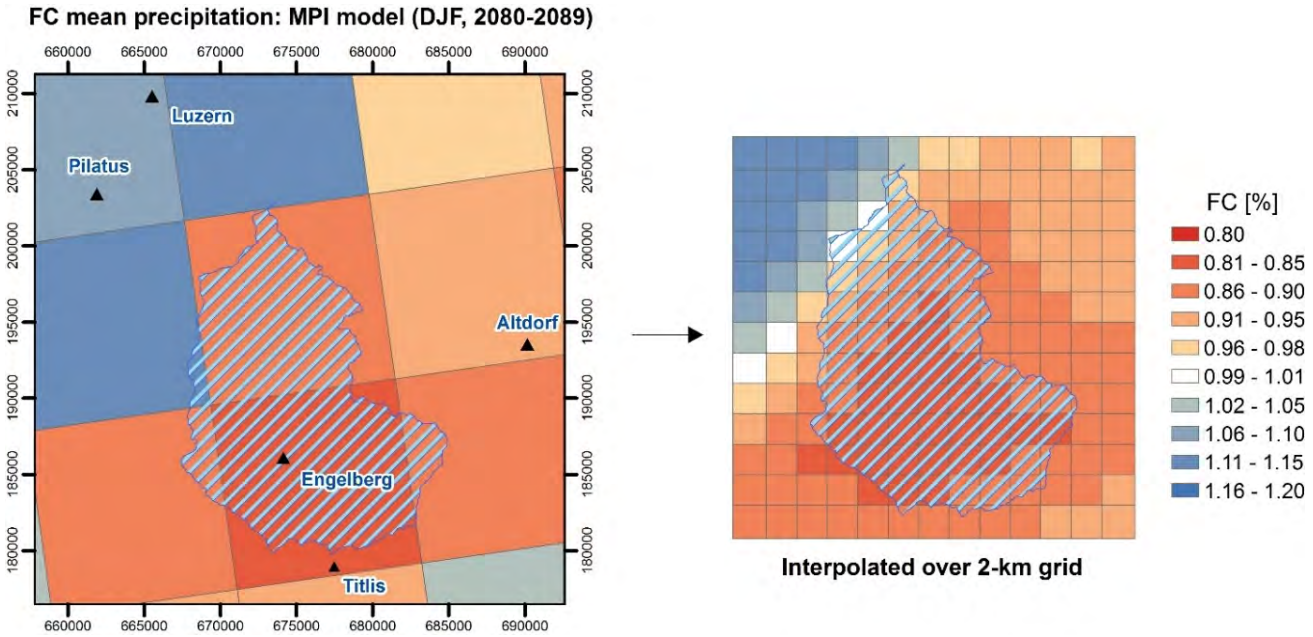
Generating multiple realizations of future climate

- AWE-GEN-2d can be used to generate multiple realizations of future climate by re-parameterizing several of the parameters that were estimated from observed data
- Changes are computed on decadal bases using a 30-year window



Generating multiple realizations of future climate

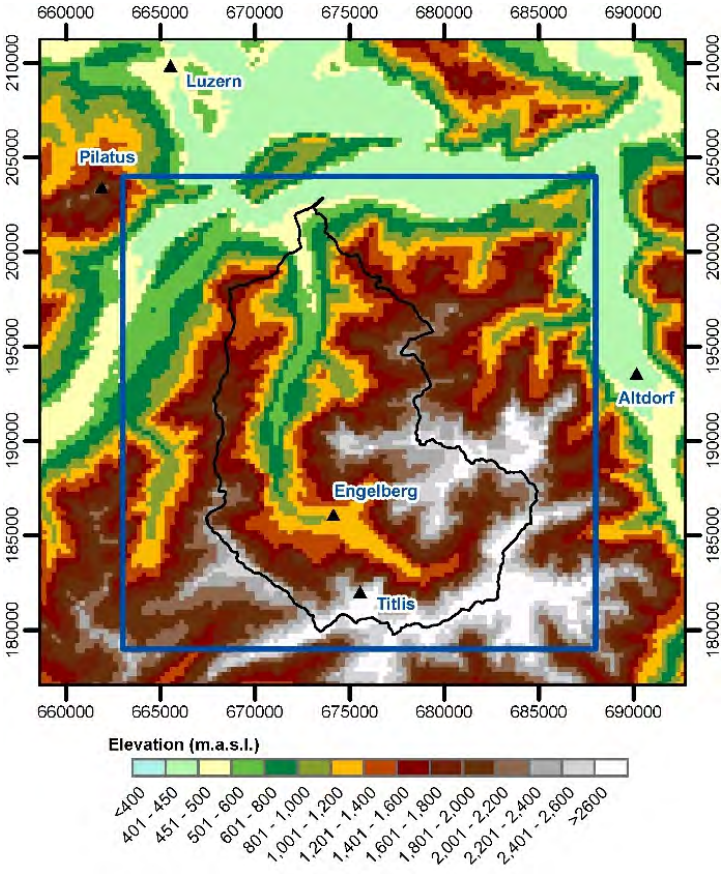
- The “factors of change” (FC) approach is used for the re-parameterization of AWE-GEN-2d
- FC can be a product factor (e.g. for precipitation statistics), or can be an additive factor (also known as Δ-change, e.g. for temperature statistics)



Factors of change: $$S(h)_v^{FUT} = \frac{S(h)_v^{CLM,FUT}}{S(h)_v^{CLM,CON}} S(h)_v^{OBS}$$

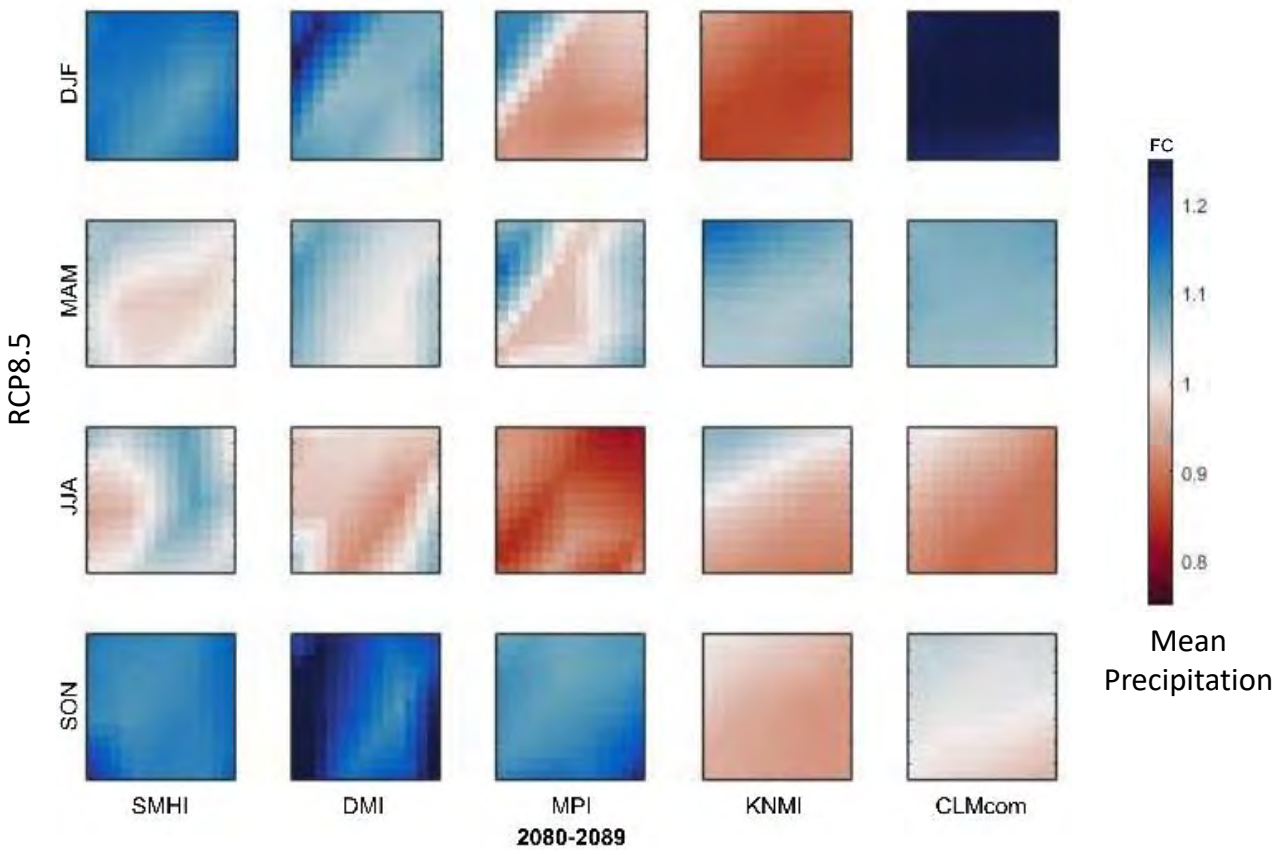
Case study: Engelberg

- Validated for present climate



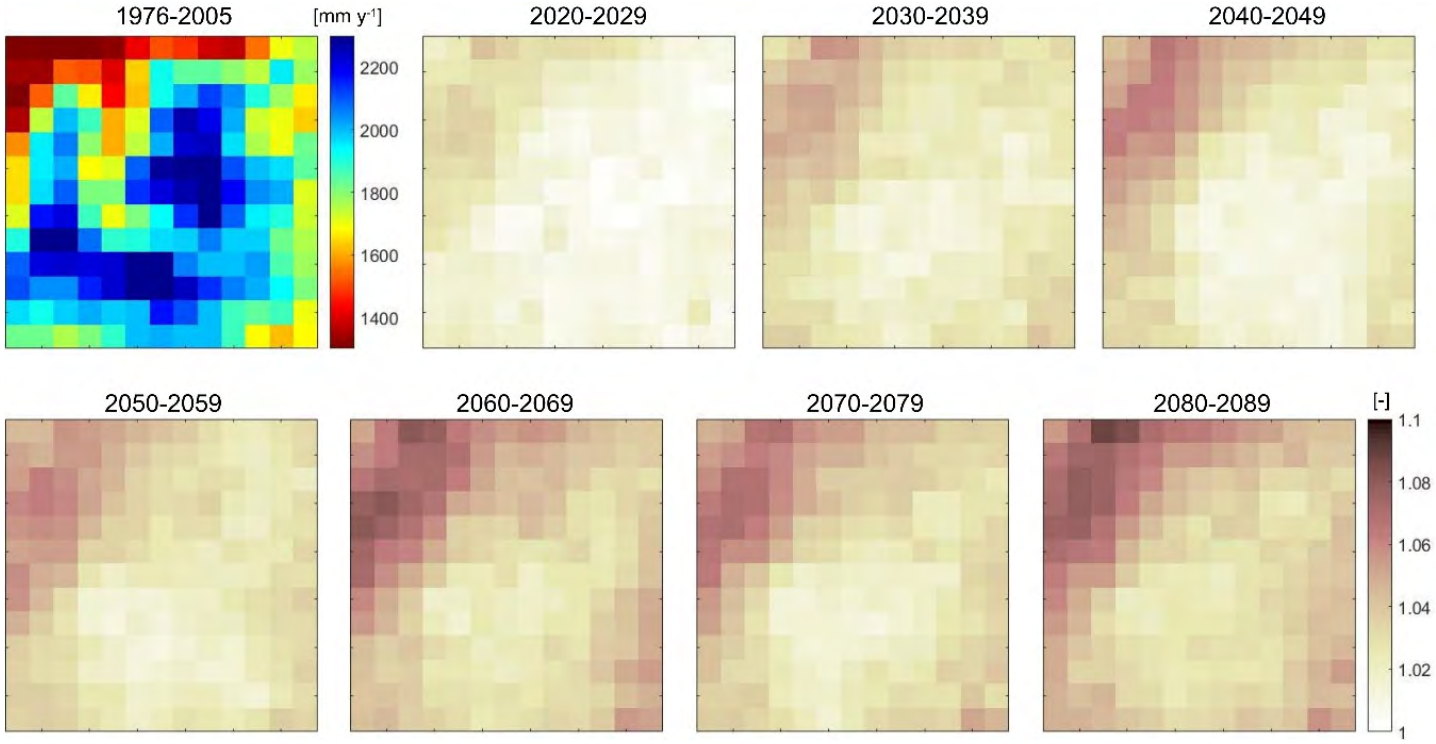
Case study: Engelberg

- Validated for present climate
- FC significantly differ between climate models

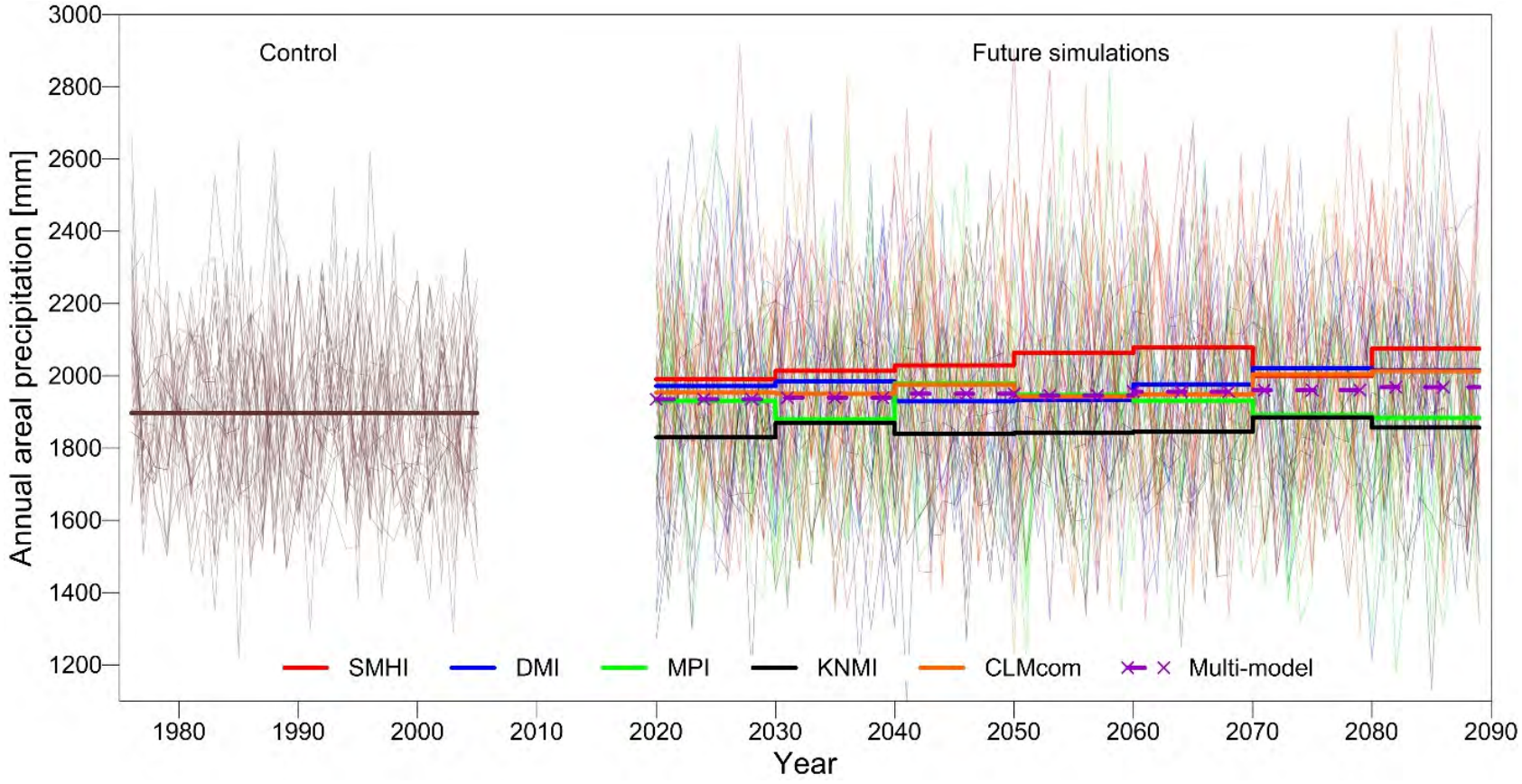


Case study: Engelberg

- Validated for present climate
- FC significantly differ between climate models
- The signal of climate change is nonhomogeneous

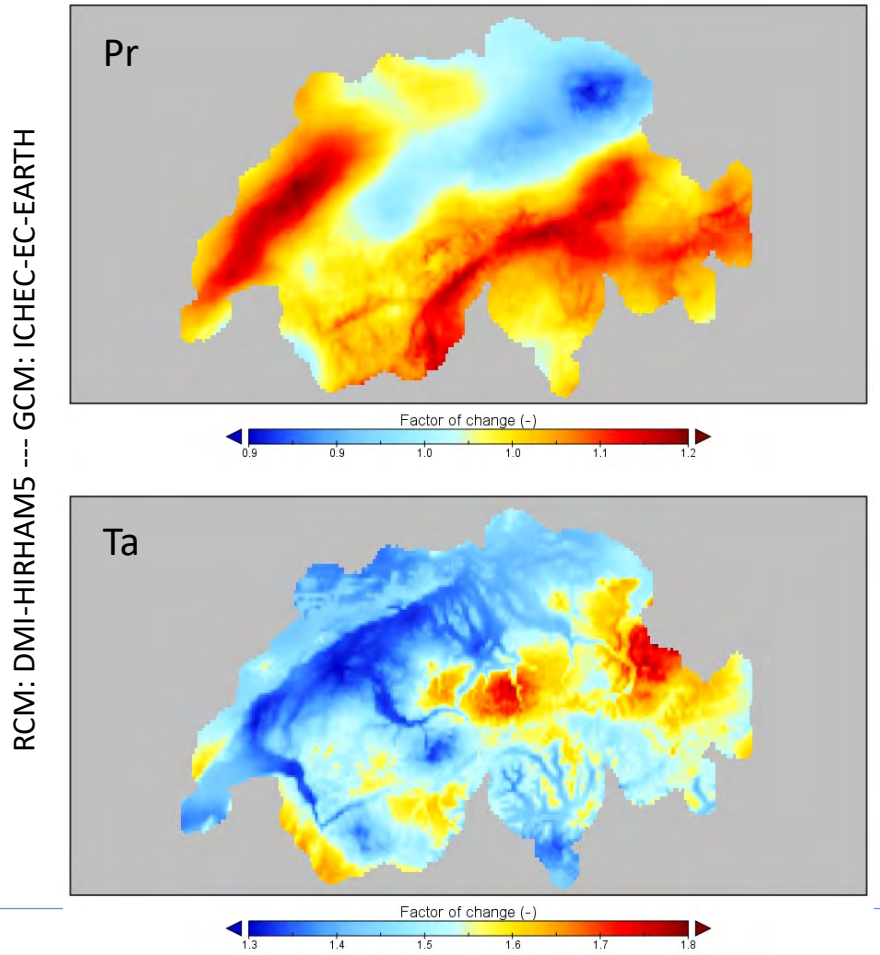


Case study: Engelberg



AWE-GEN-2d: new CH2018 climate scenarios

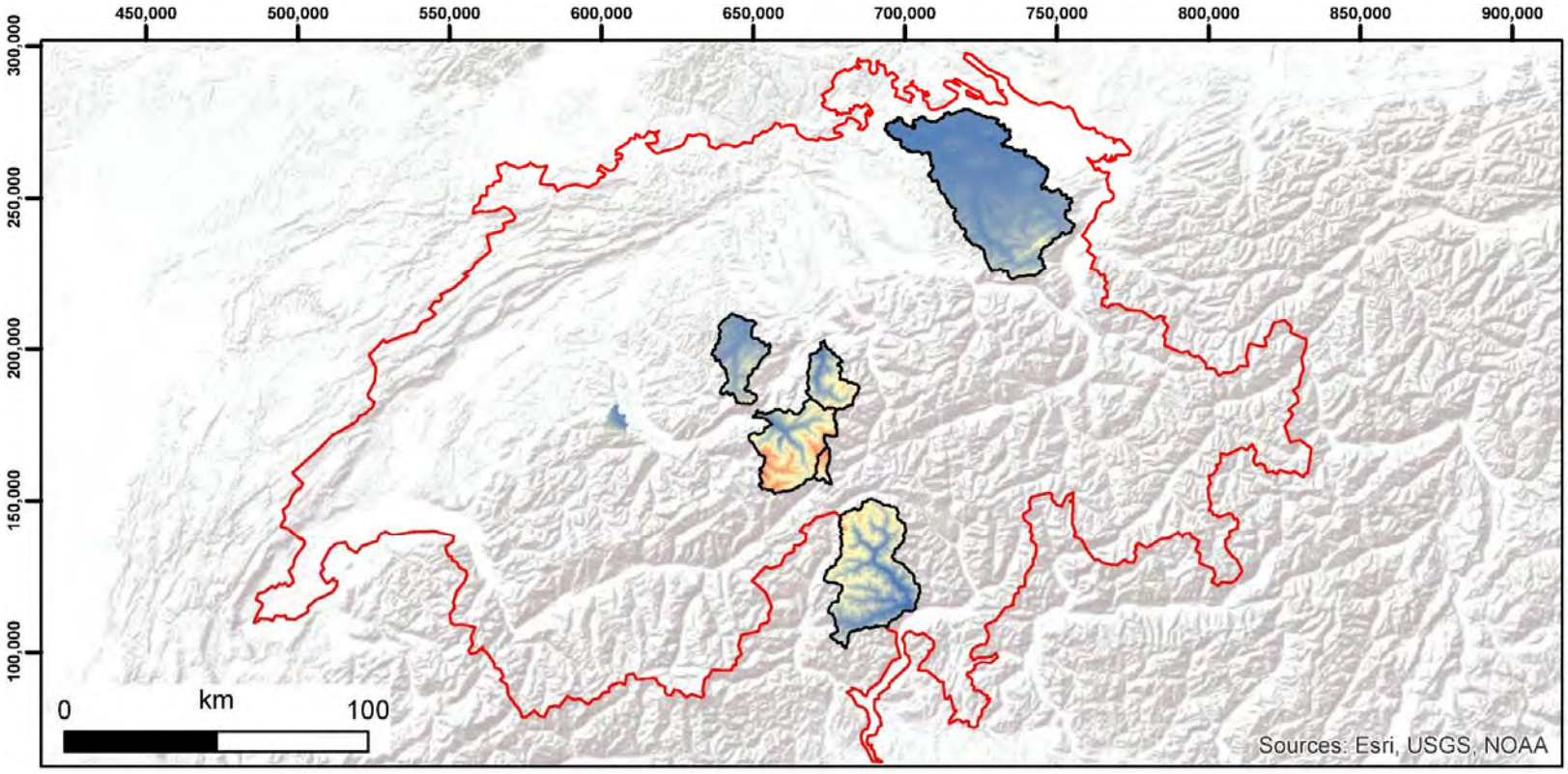
- New CH2018 official climate scenarios are soon to be released (November 2018)
- FC were computed for all RCMs (RCP2.6, RCP4.5 and RCP8.5) on decadal and seasonal basis on a 2-km resolution for the period of 2020-2099
- Pr: mean, standard deviation and occurrence
- T: mean and standard deviation
- Data is available upon request for the SCCER-SoE partners



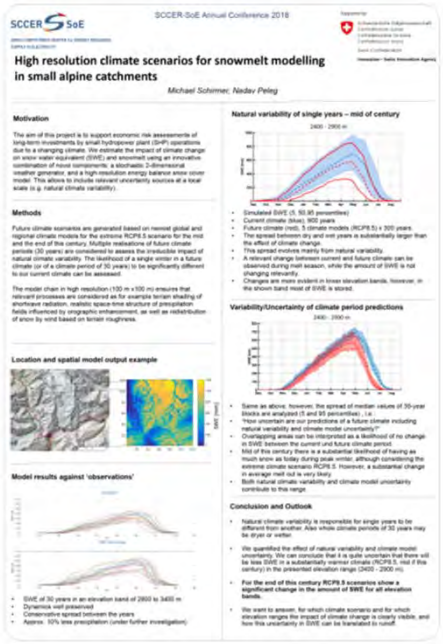
AWE-GEN-2d: calibrated areas in Switzerland

- Engelberg
- Maggia
- Thur
- Kleine Emme
- Gletsch
- Guerbe
- Oberhasli

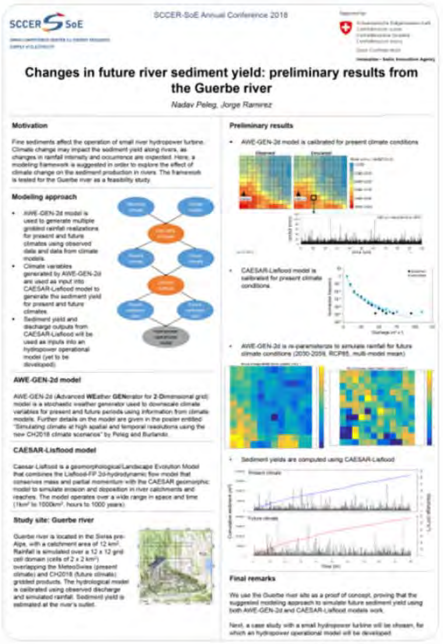
- Mattmark



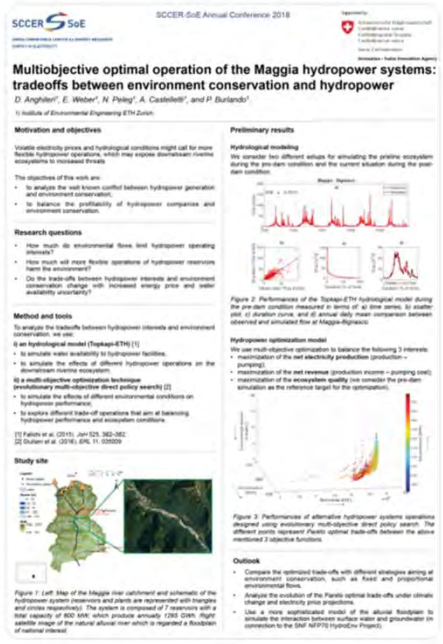
Applications



High resolution climate scenarios for snowmelt modelling
(Schirmer and Peleg)



Changes in future river sediment yield
(Peleg and Ramirez)



Multiobjective optimal operation of the Maggia hydropower systems
(Anghileri et al.)

Thank you for your attention!

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Peleg, N., Fatichi, S., Paschalis, A., Molnar, P., and Burlando, P. (2017)
An advanced stochastic weather generator for simulating 2-D high resolution climate variables
Journal of Advances in Modeling Earth Systems, 9, p. 1595-1627

Peleg, N., Molnar, P., Burlando, P., and Fatichi, S. (under review)
Exploring stochastic climate uncertainty using a gridded hourly weather generator
Journal of Hydrology