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User-relevant climate predictions: the path of climate indices

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MeteoSwiss

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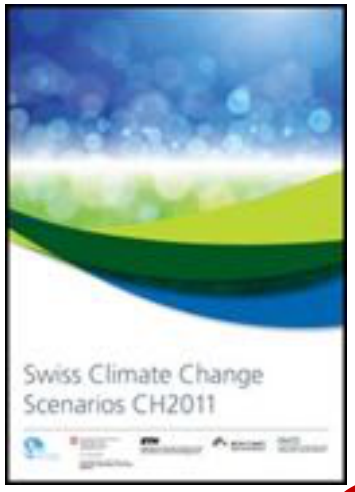
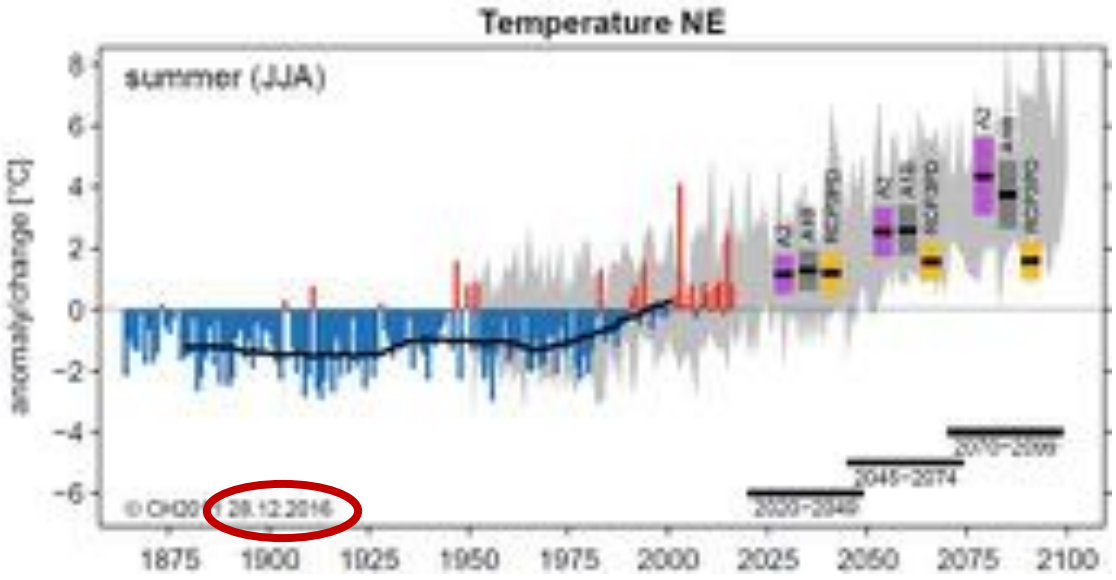
From a climate scenario report towards an operational service: CH2011



Released 28. September 2011
www.ch2011.ch



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ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

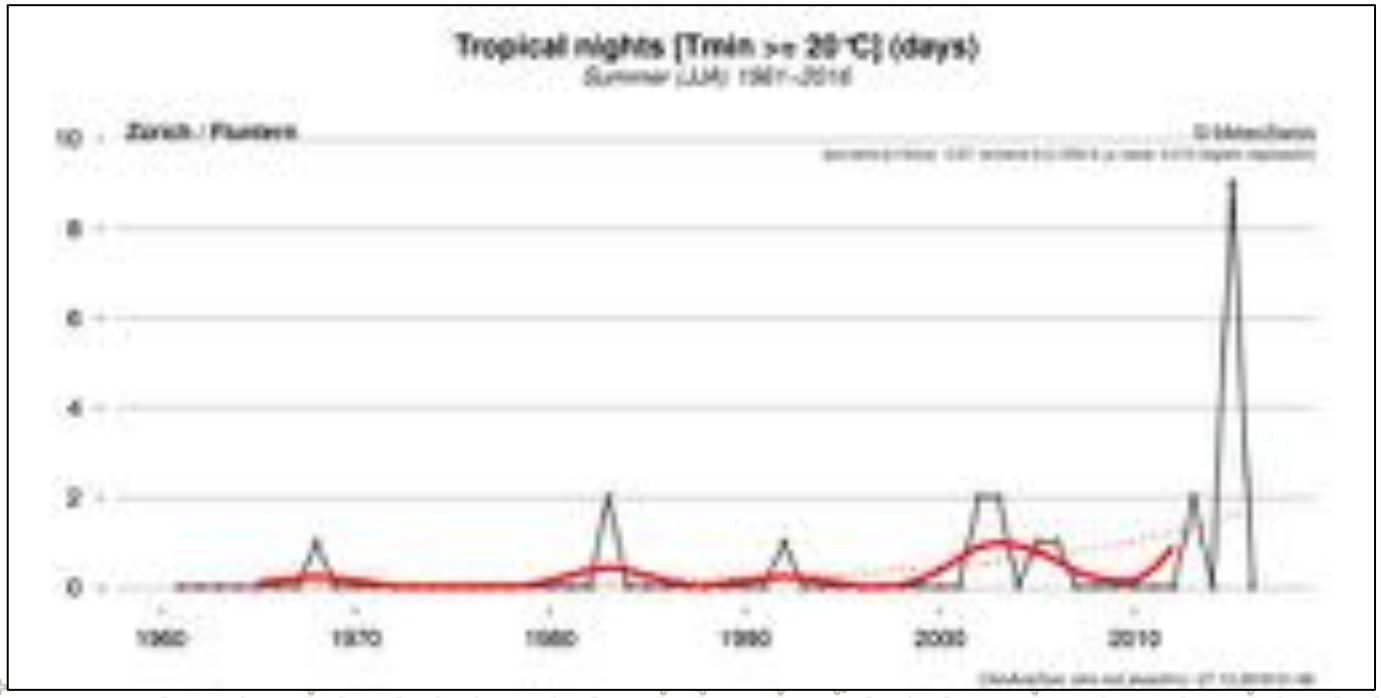
C2SM
Center for Climate Systems Modeling

NCCR CLIMATE
Swiss Climate Research

OcCC
Organe consultatif sur les changements climatiques
Beratendes Organ für Fragen der Klimaänderung

MeteoSwiss

Feel the heat



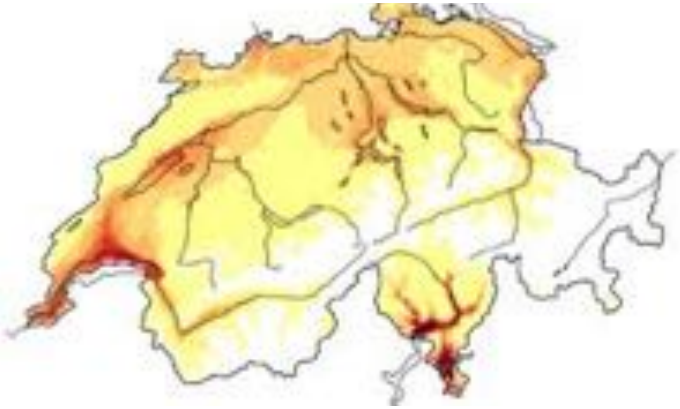
Scherrer SC, Fischer EM, Posselt R, Liniger MA, Croci-Maspoli M, Knutti R (2016) Emerging trends in heavy precipitation and hot temperature extremes in Switzerland. Journal of Geophysical Research: Atmospheres.

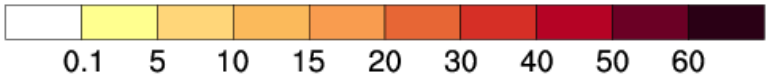
Feel the heat

today
(1980-2009)

A1B-Scenario
(2070-2099)

temporal disaggregation
delta change on
gridded daily obs

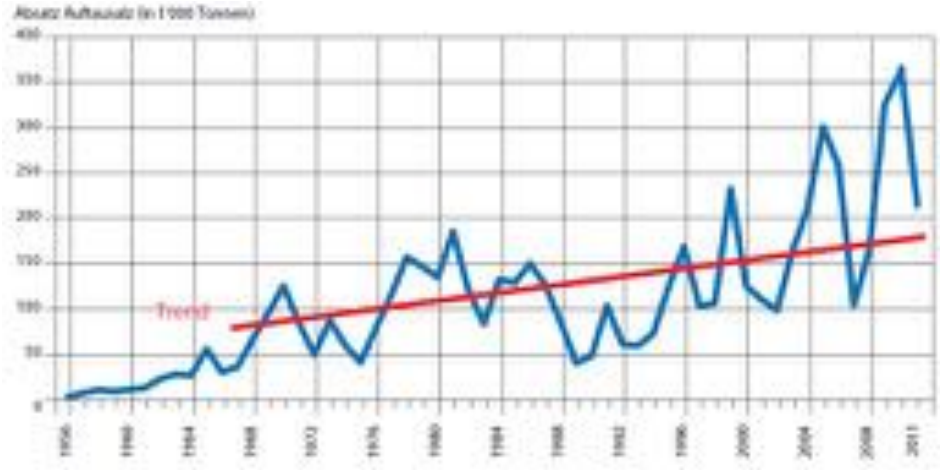




Tropical nights / year
($T_{min} \geq 20°C$)

Zubler EM, Scherrer SC, Croci-Maspoli M, Liniger MA, Appenzeller C. (2014) Key climate indices in Switzerland; expected changes in a future climate. Climatic change. 123(2):255-71.

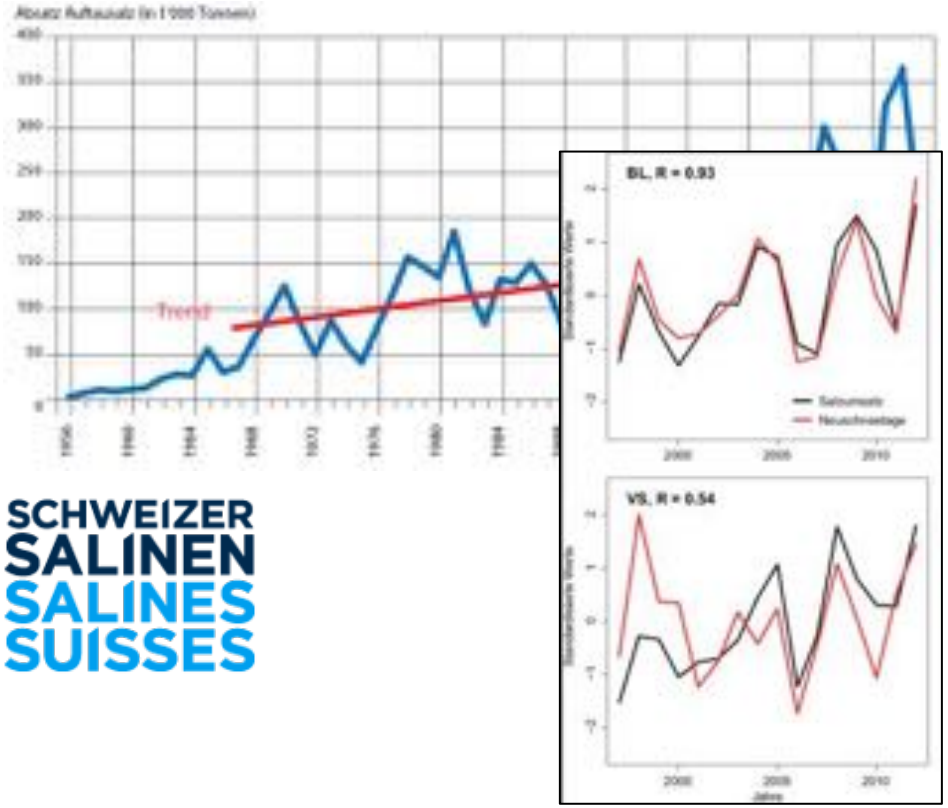
Future road salt use in Switzerland



SCHWEIZER SALINEN
SALINES SUISSES

Zubler, EM, Fischer, AM, Liniger, MA, und Schlegel, T (2015)
Auftausalzverbrauch im Klimawandel,
Technical Report MeteoSwiss, 253, 36pp.

Future road salt use in Switzerland



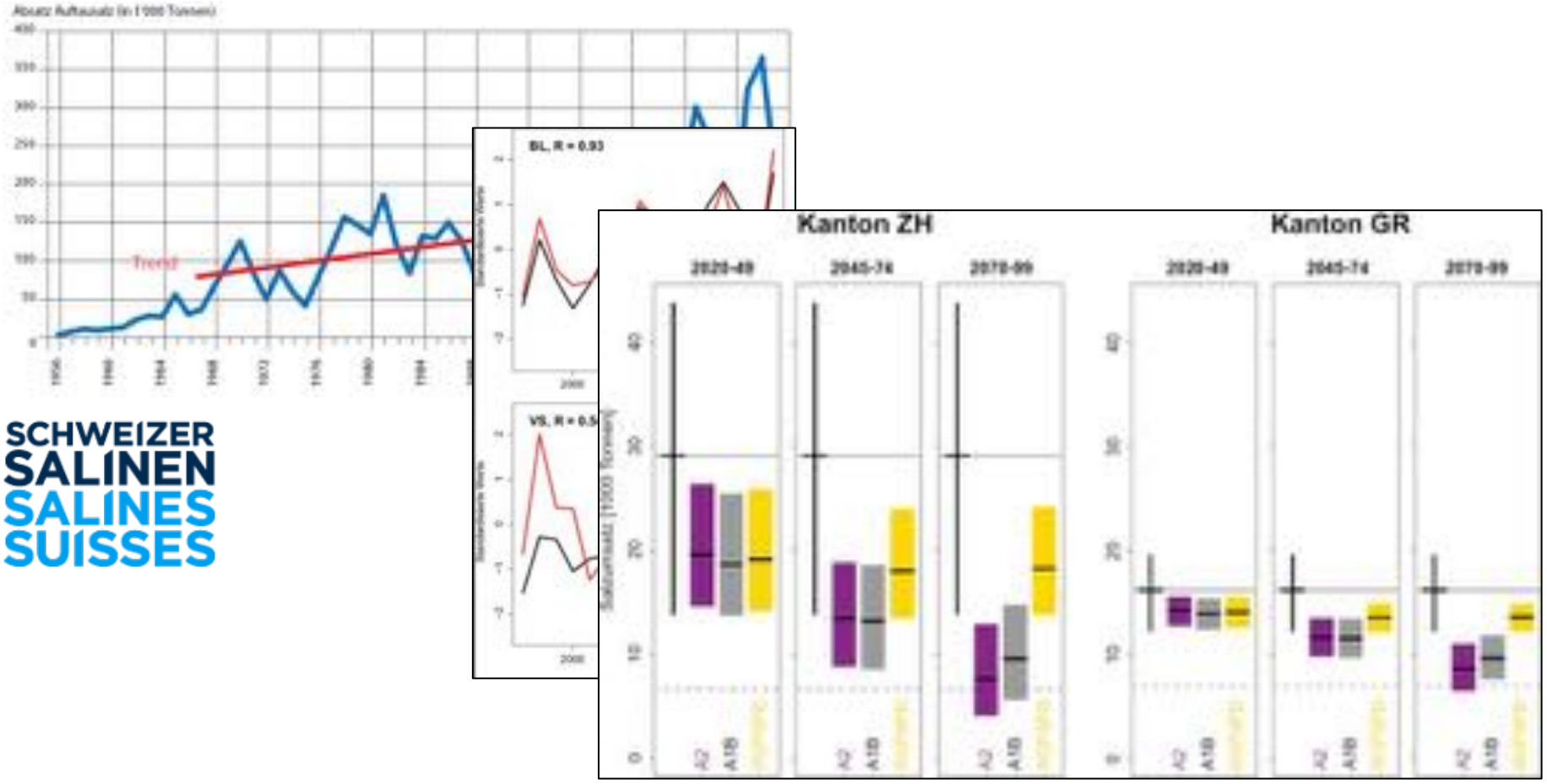
SCHWEIZER SALINEN
SALINES SUISSES

#days with
- precip>1mm
- t2m <2°C

road salt use

Zubler, EM, Fischer, AM, Liniger, MA, und Schlegel, T (2015)
Auftausalzverbrauch im Klimawandel,
Technical Report MeteoSwiss, 253, 36pp.

Future road salt use in Switzerland



SCHWEIZER SALINEN
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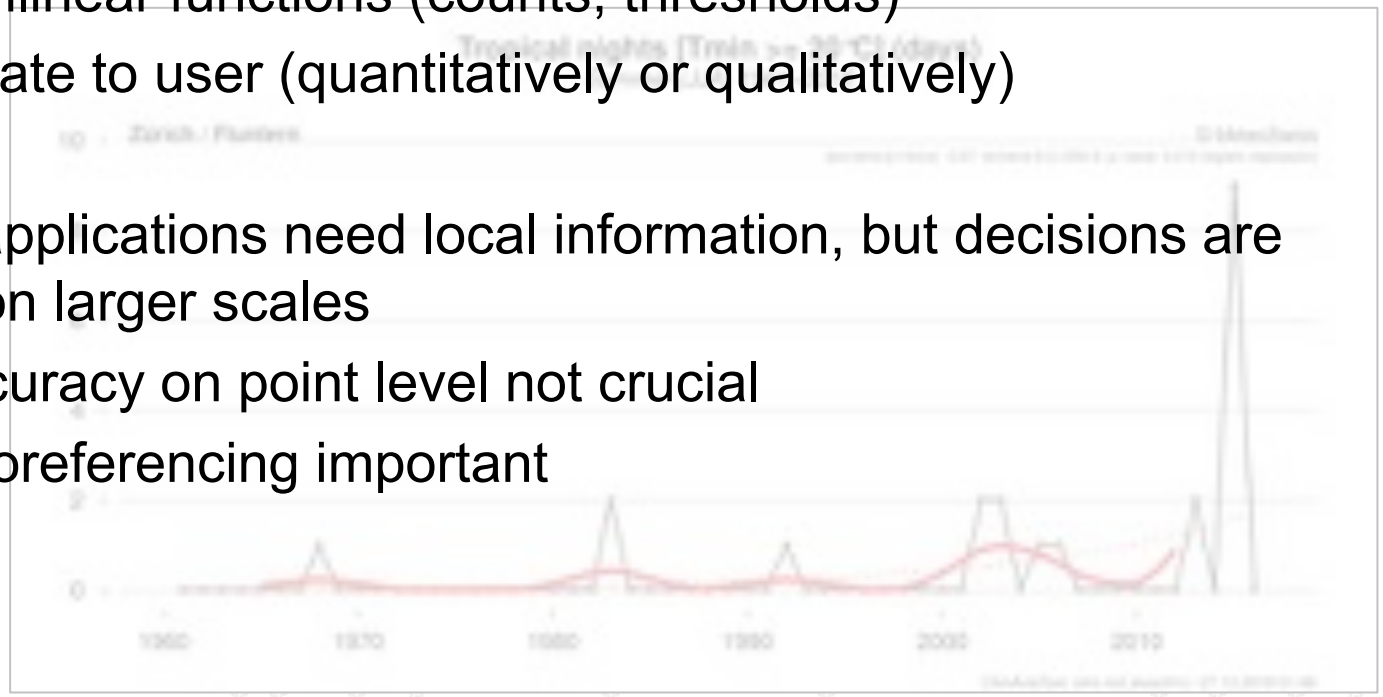
Zubler, EM, Fischer, AM, Liniger, MA, und Schlegel, T (2015)
Auftausalzverbrauch im Klimawandel,
Technical Report MeteoSwiss, 253, 36pp.

User relevance through climate indices

- Indices:
  - scalar values derived from (daily) meteorological variables
  - Nonlinear functions (counts, thresholds)
  - Relate to user (quantitatively or qualitatively)

- Many applications need local information, but decisions are made on larger scales
  - Accuracy on point level not crucial
  - Georeferencing important

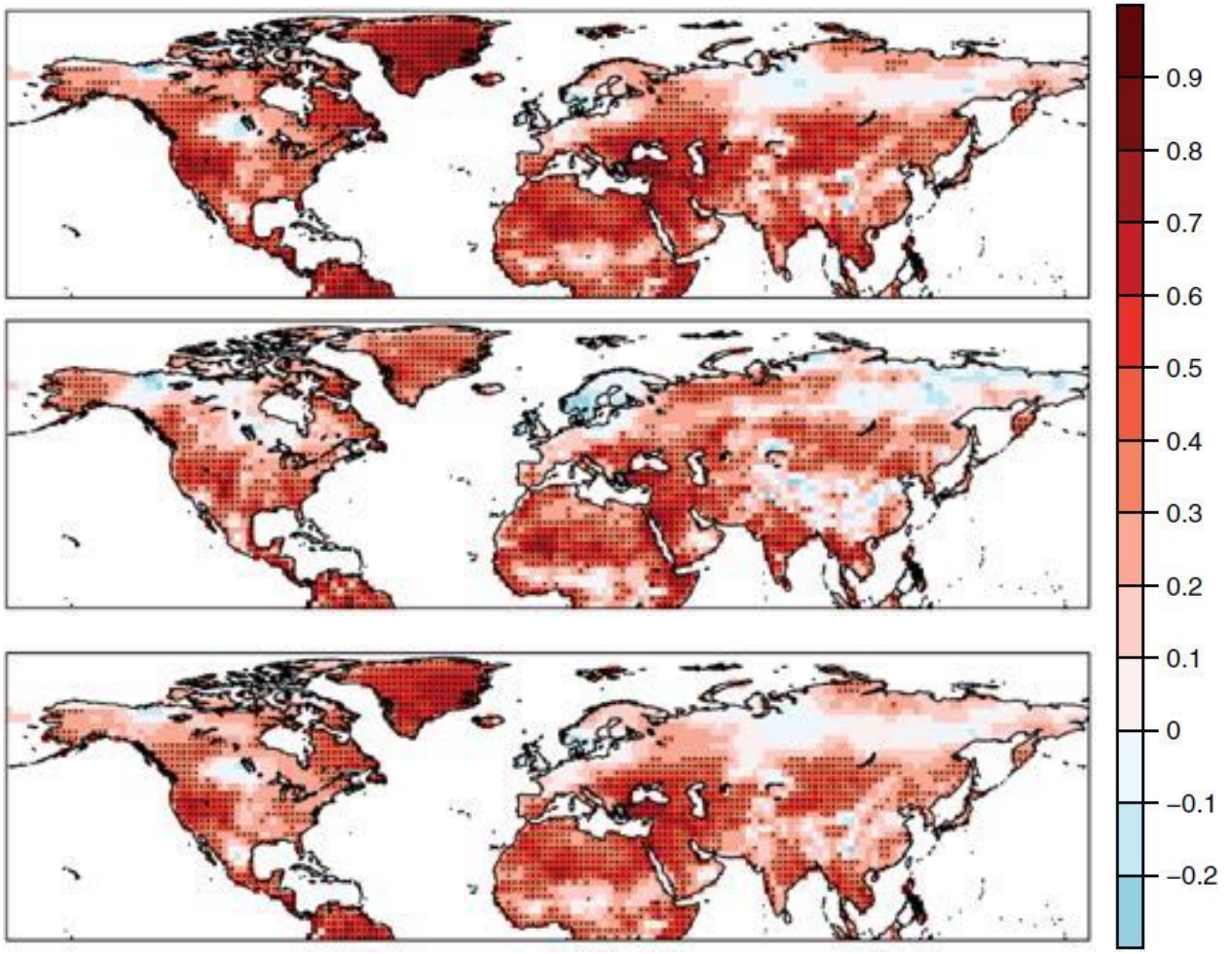


Seasonal forecasts of climate indices

Seasonal mean temperature

DD90
Degree days > 90th

Skill prediction for DD90



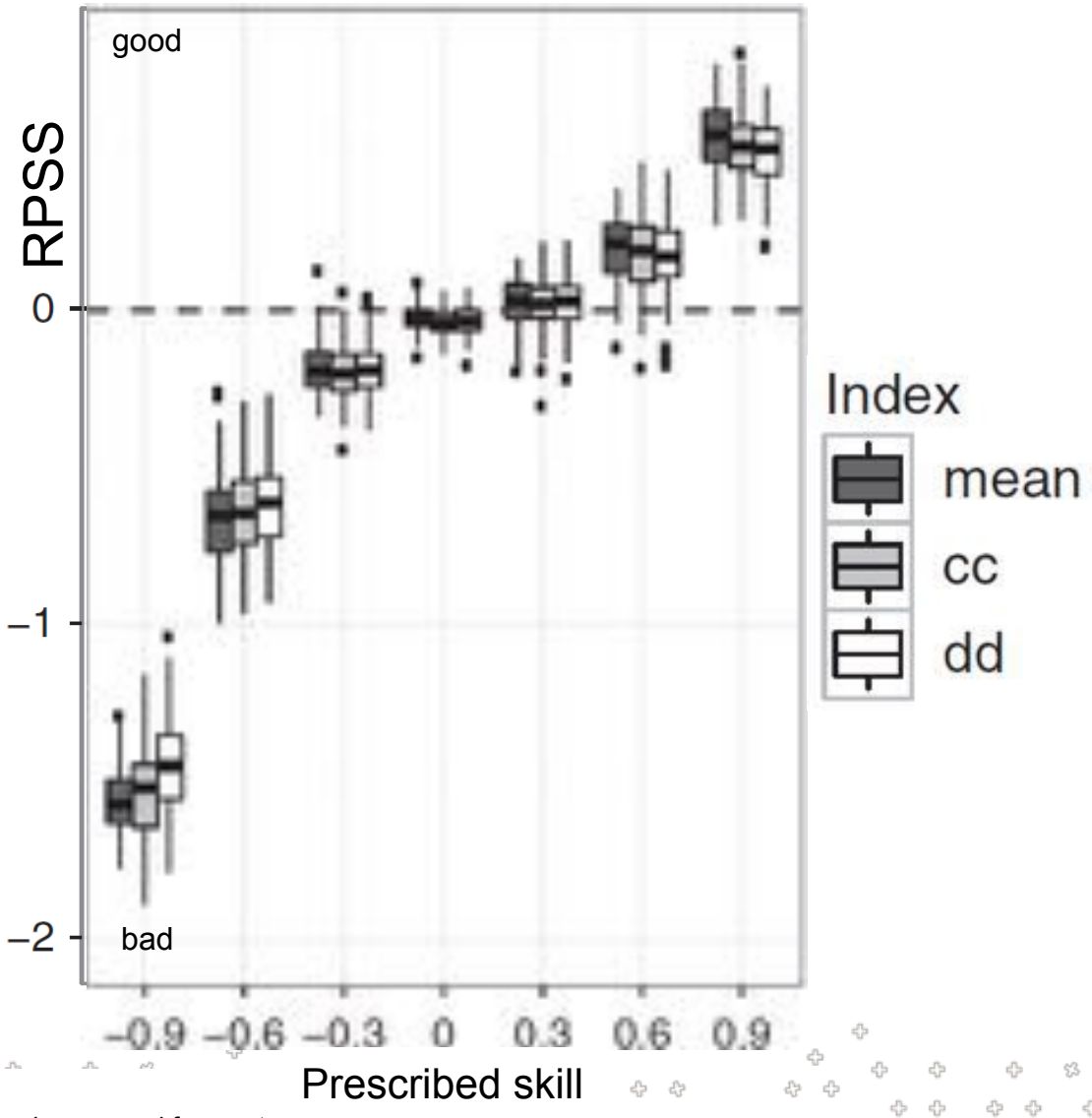
EUPORIAS

Bhend J, Mahlstein I, Liniger MA (2016)
Predictive skill of climate indices compared to mean quantities in seasonal forecasts.
Quarterly Journal of the Royal Meteorological Society.

Skill in mean quantity vs. index

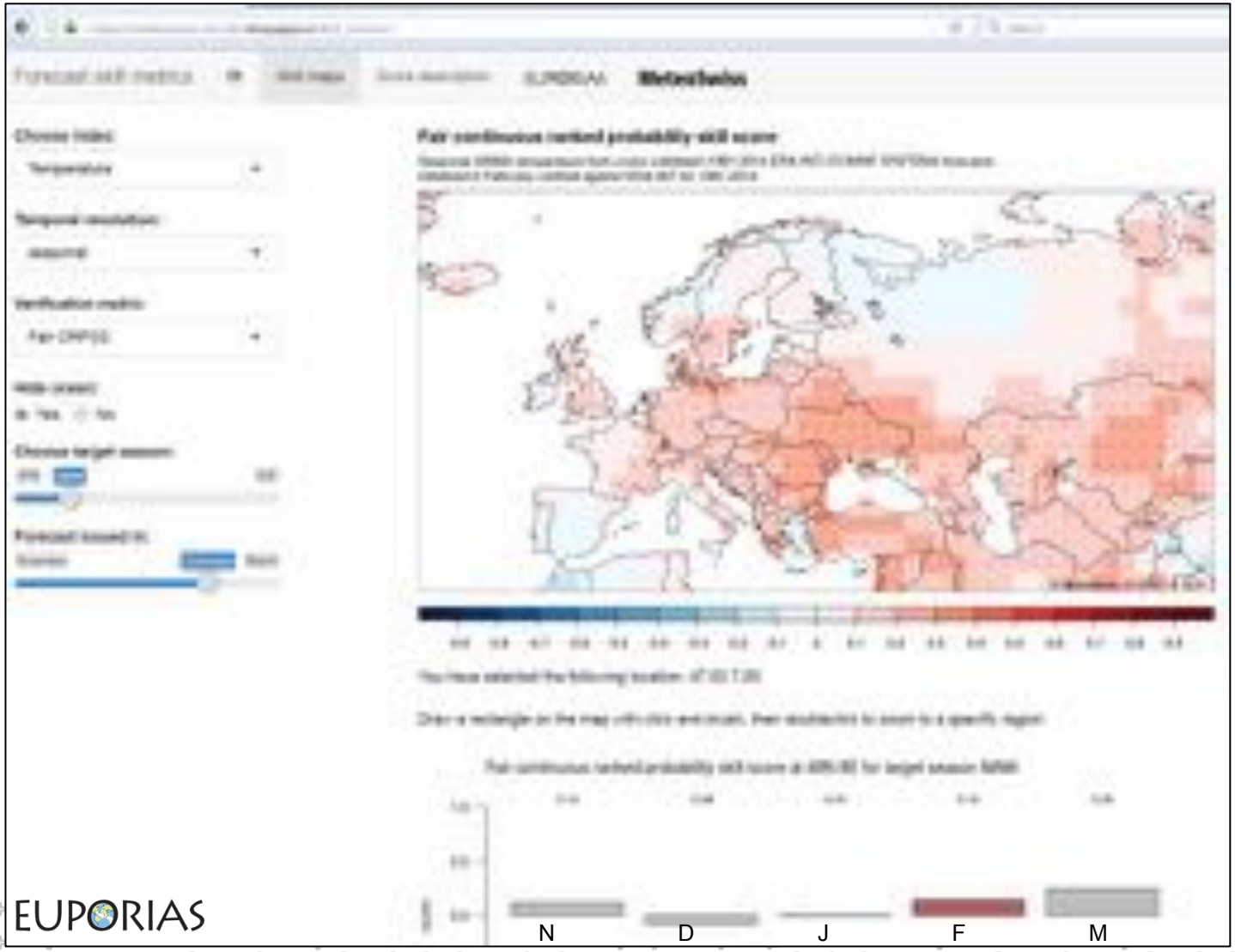
Gaussian toymodel with prescribed correlation skill

Threshold: 75th perc.



Bhend J, Mahlstein I, Liniger MA (2016)
Predictive skill of climate indices compared to mean quantities in seasonal forecasts.
Quarterly Journal of the Royal Meteorological Society.

Exploring the skill of seasonal forecasts



EUPORIAS

ECMWF System 4
vs. ERA-Int

1981 – 2014, T2m, Precip

All starting & all lead times
Monthly, 3-monthly avgs
Global, zoomable

Correlation, discrimination,
RPSS, CRPSS,
spread/error, ROC
(terciles)

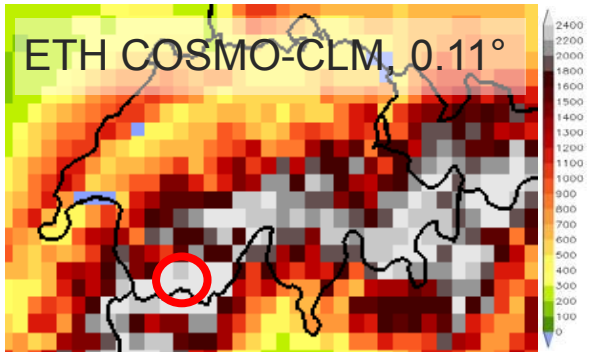
→ C3S QA4seas

https://meteoswiss-climate.shinyapps.io/skill_metrics/

Challenges

Absolute thresholds require bias correction/downscaling

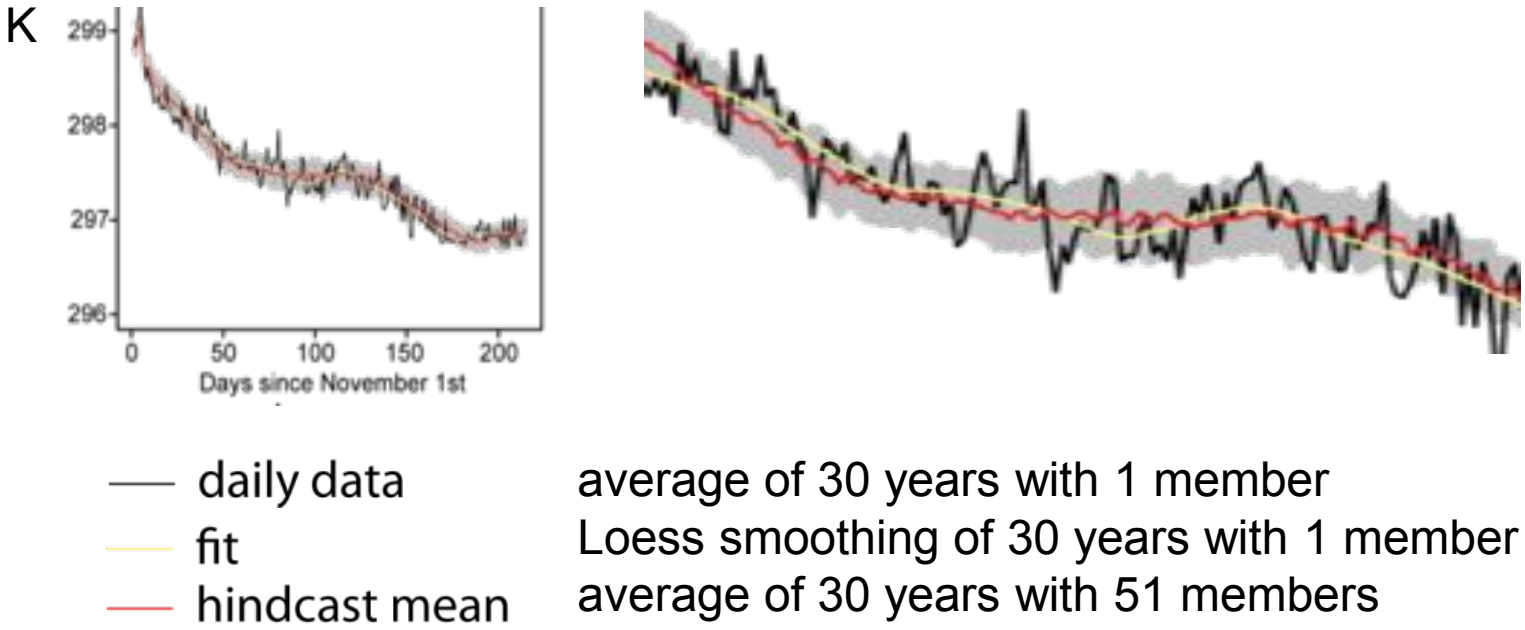
- Not well defined climatology
- Multi-variate indices
- Sub-daily information
- Availability of observations



bias correction of daily data
daily mean temperature

Problem: 30 years of observations not enough to calculate daily climatology

→ Explore smoothing in model world by perfect model approach



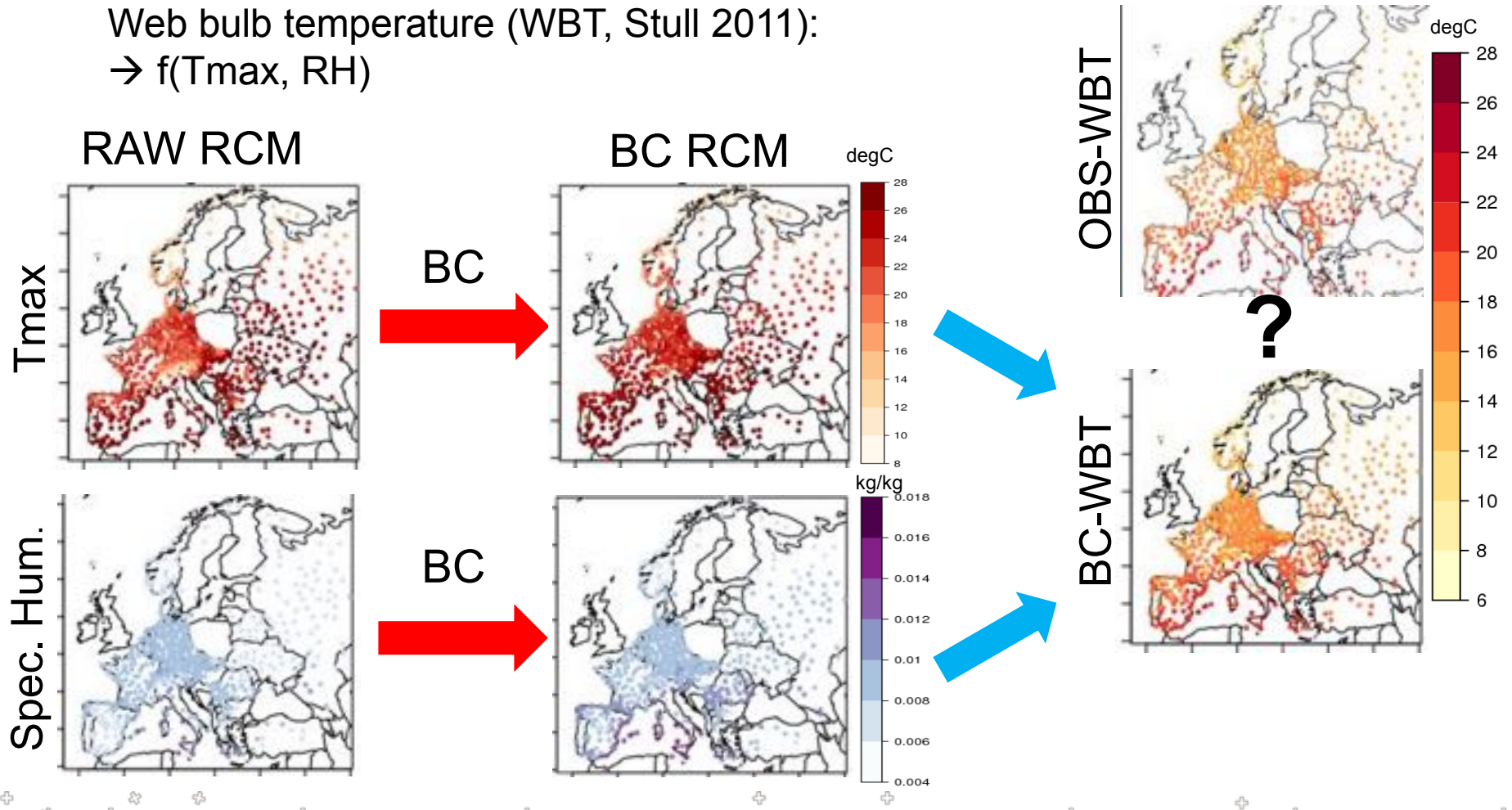
average of 30 years with 1 member
Loess smoothing of 30 years with 1 member
average of 30 years with 51 members

EUPORIAS

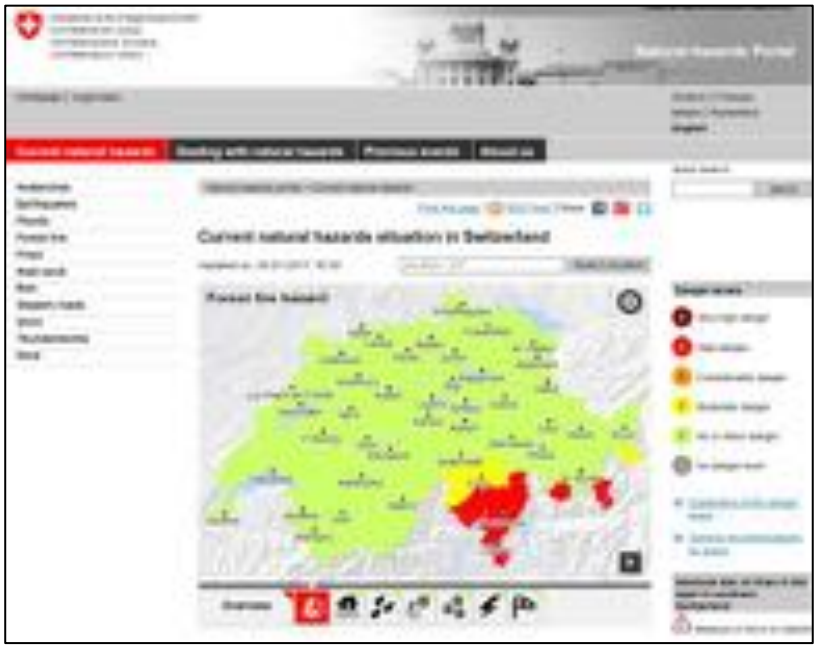
Mahlstein I, Spirig C, Liniger MA, Appenzeller C. (2015)
Estimating daily climatologies for climate indices derived from climate model data and observations.
Journal of Geophysical Research: Atmospheres. 120(7):2808-18.

Multi-variate Bias Correction

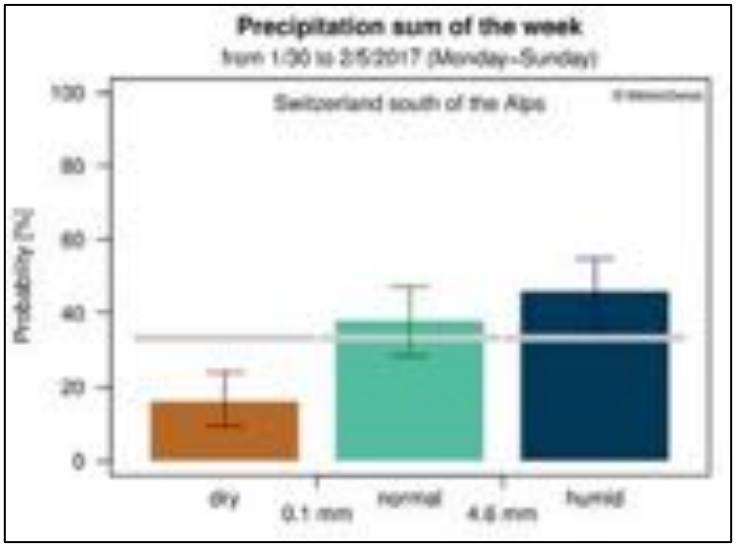
Web bulb temperature (WBT, Stull 2011):
→ f(Tmax, RH)

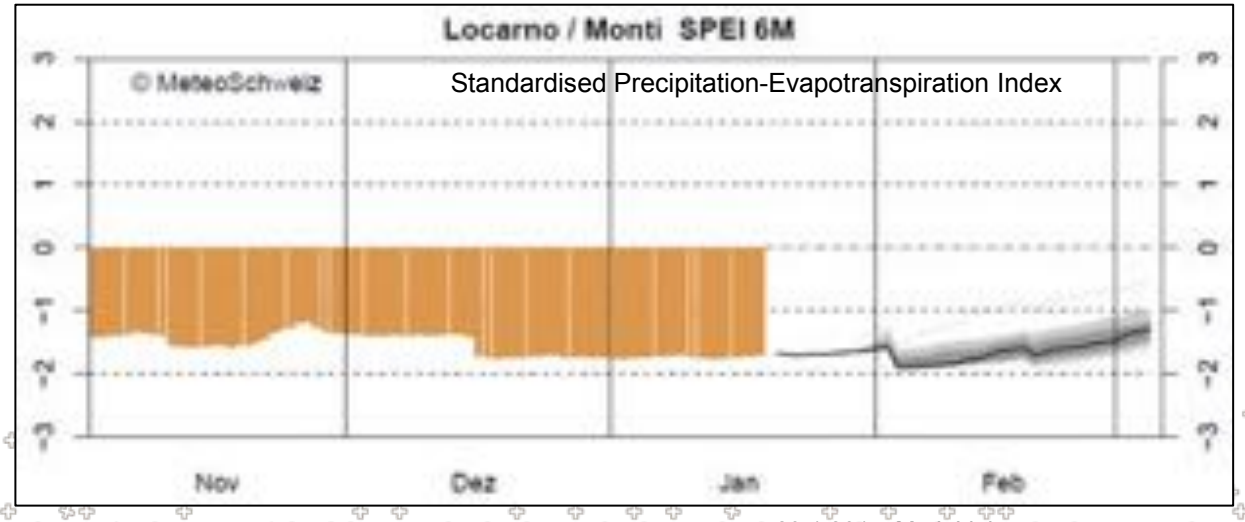


Drought in Southern Switzerland



Forecast issued at the 20.1.2017 (week 2)





Conclusions

- Climate Indices can make climate information more user relevant.
  - Pure meteorological and observable.
- Prediction skill is lower than for mean quantities
  - might be compensated by higher user relevance.
  - Reliability can be improved
- Calculation is expensive
  - Large data amount, bias correction/calibration needed
  - Less complex than running an impact modelling chain
- Concept can be applied in a consistent way to historical data, seasonal forecasts, climate change scenarios.

DISCUSSION QUESTIONS

Q1: Which challenges for climate modelling and observations are raised by climate services?

Q2: What are the barriers that prevent a faster development of a climate services market?

climateurope
Linking science and society

BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

DISCUSSION QUESTIONS

- Q1: Which challenges for climate modelling and observations are raised by climate services?
  - Localized information
  - Technical:
    - Fast delivery (short development phase)
    - high reliability (dissemination,..)
  - Comprehensive (variables, time scales, ..)
  - Simple (for communication, to be integrated, underlying method)
  - Reliability in statistical sense:
    - full uncertainties are included

DISCUSSION QUESTIONS

- Q2: What are the barriers that prevent a faster development of a climate services market?
  - Technical: Data amount and complexity (petabytes, 5D)
  - Openness: Willingness to share data between providers and users (in both directions)
  - "Barriers" between weather forecasting, climate predictions, climate change research.
    - Research field is very wide
  - Fast evolving underlying data sets and scientific methodologies (eg AR4->AR5).
    - "State-of-the-art" is not stationary
  - Climate system is highly complex (scales, subsystems, disciplines),
    - Phase space too large compared to available data
    - knowledge is needed to make meaningful use of data

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