Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

The use of ECMWF forecast products at MeteoSwiss

Forecast Products Users Meeting, 13-15 June, 2007

Paul Della-Marta, Christof Appenzeller, Daniel Baggenstos, David Bolius, Mark Liniger, Andreas Weigel

NCCR CLIMATE
Swiss Climate Research

Overview

- Skill assessments
  - Seasonal multi-model temperature forecasts
  - Monthly temperature forecasts
- Applications
  - Soil moisture (monthly forecasts)
  - European wind storm risk

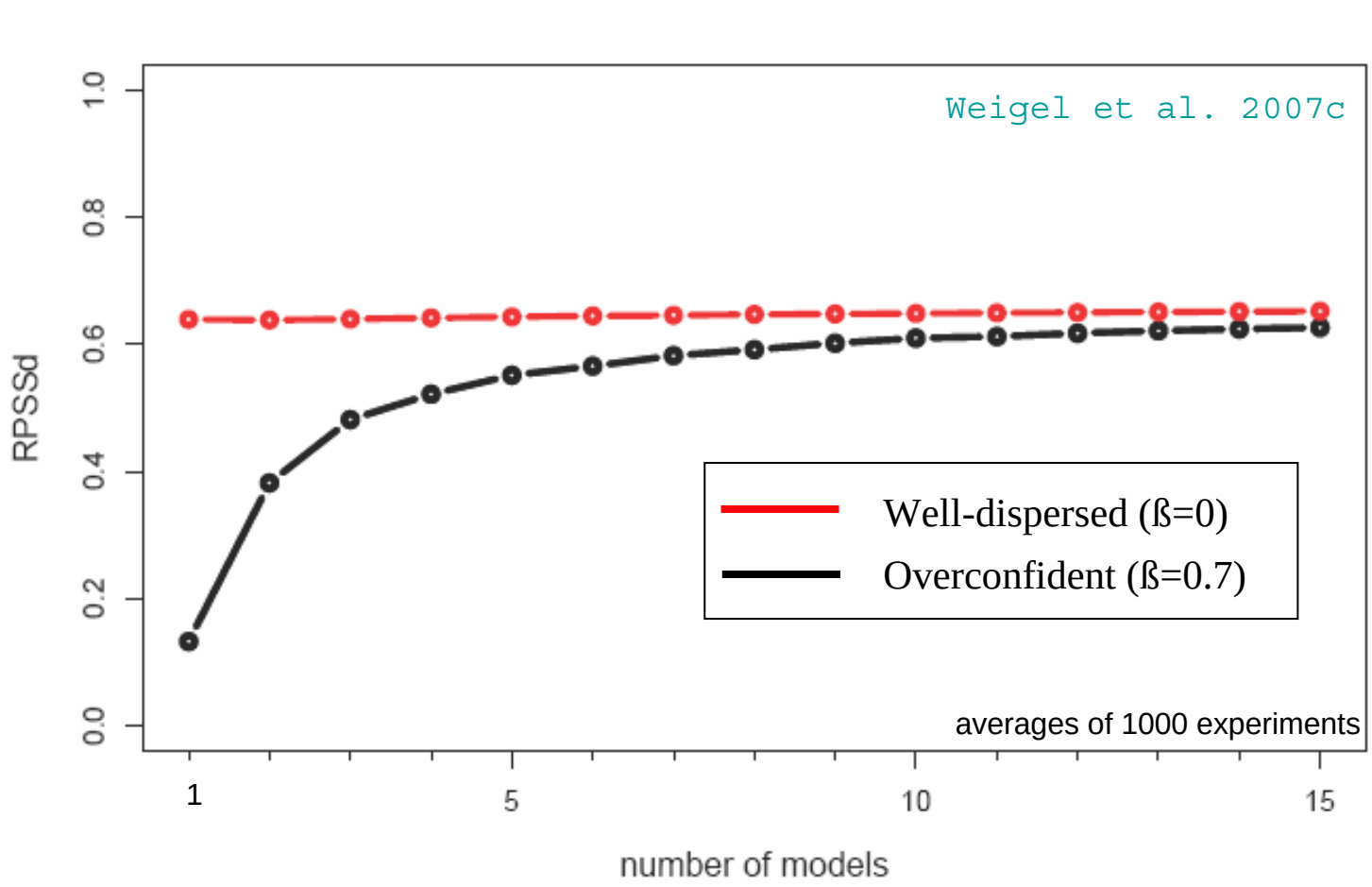
Toy climate model to investigate the mechanics of a multi-model

Artificially generate pairs of random observations and ensemble forecasts with a Gaussian “toy model”.

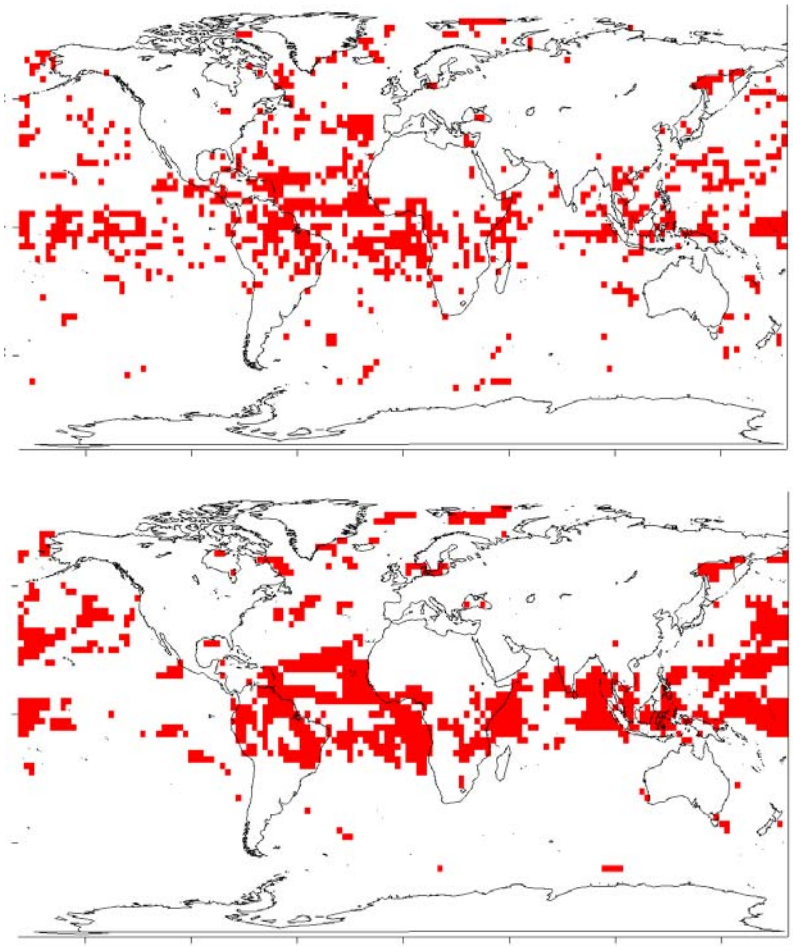
- Gaussian climatology
- observation climatology = forecast climatology
  => forecast climatology perfectly calibrated
- Predictability prescribed by correlation coefficient **α** between observations and forecasts
- Overconfidence prescribed by **ß**
- Verification: RPSSd (insensitive to ensemble size)

Müller et al. 2005
Weigel et al. 2007a,b,c

Multi-model experiments



Application to real data (DEMETER)



multi-model
better than
ECMWF or UKMO

$ß_{ECMWF} > 0.7$
$ß_{UKMO} > 0.7$

Weigel et al. 2007c

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

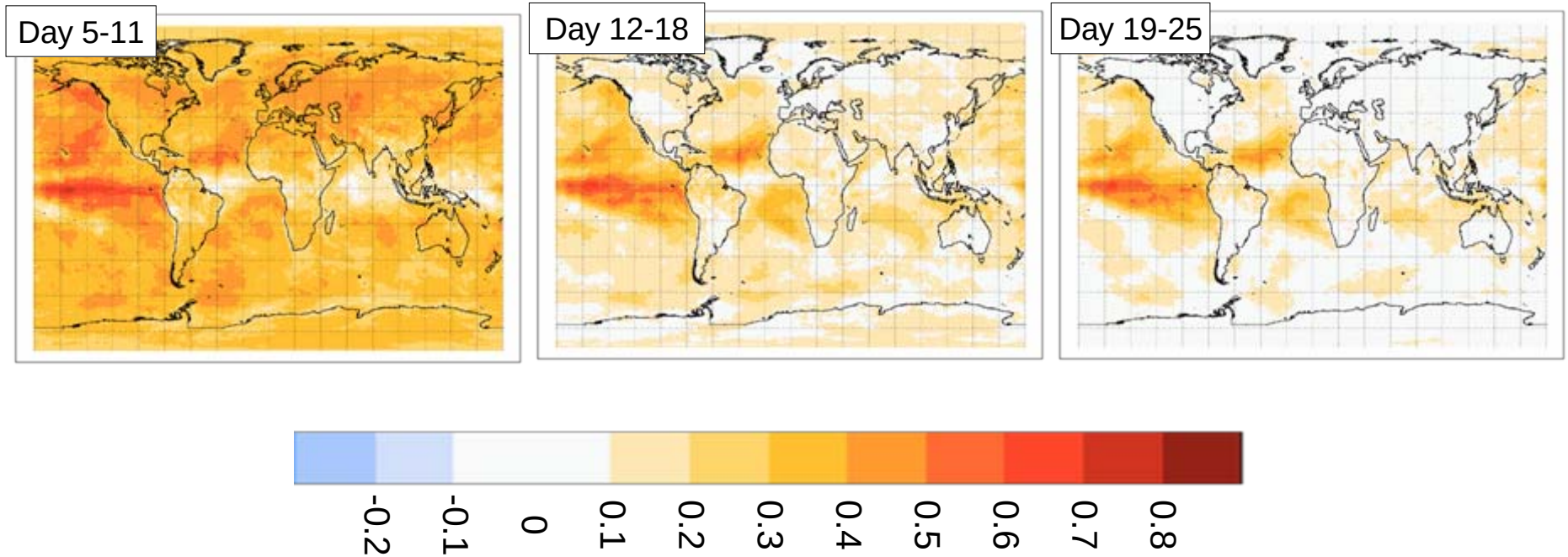
Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Monthly temperature forecasts

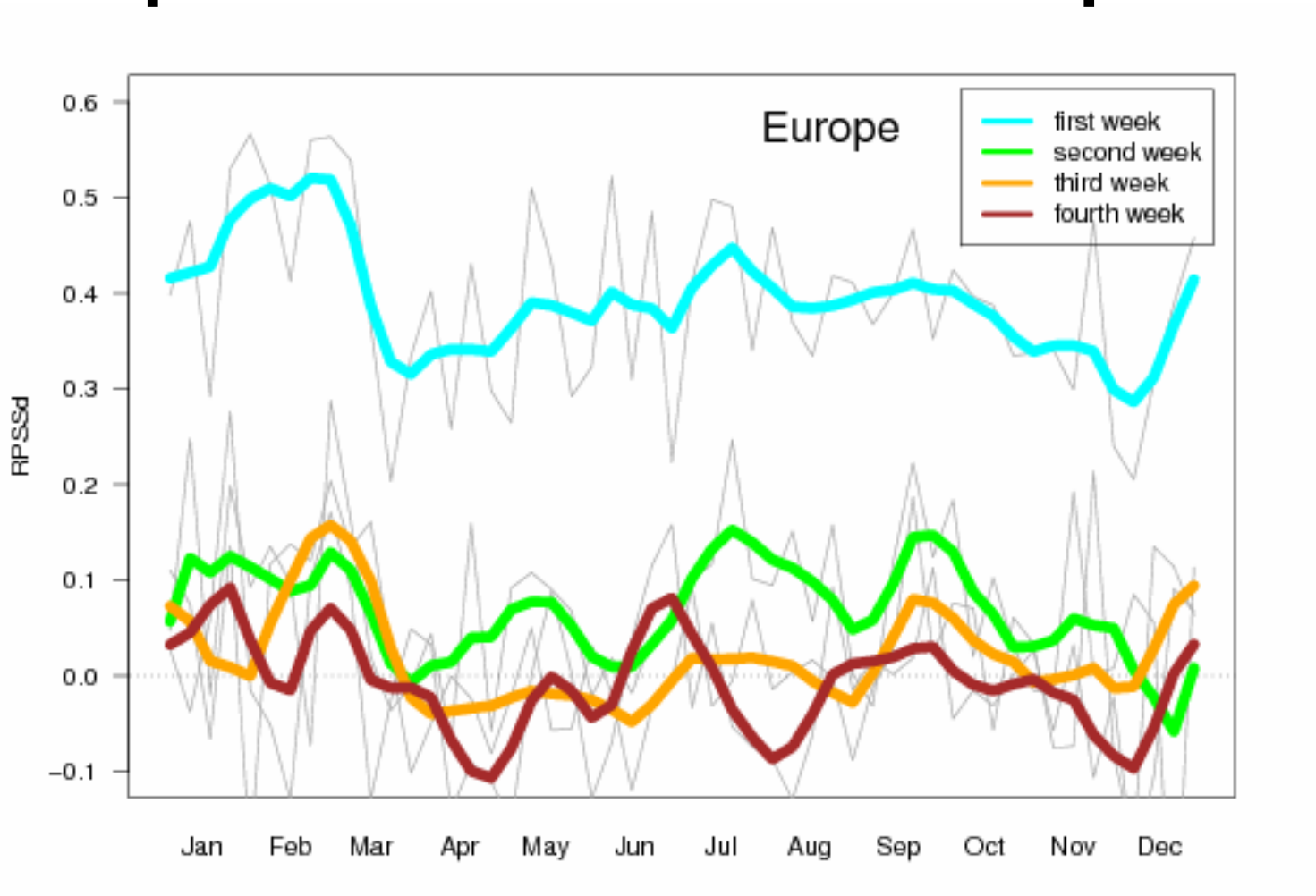
NCCR CLIMATE
Swiss Climate Research

Monthly temperature forecast skill

Results: annual mean $RPSS_D$ for week 1, 2, and 3 monthly forecast.

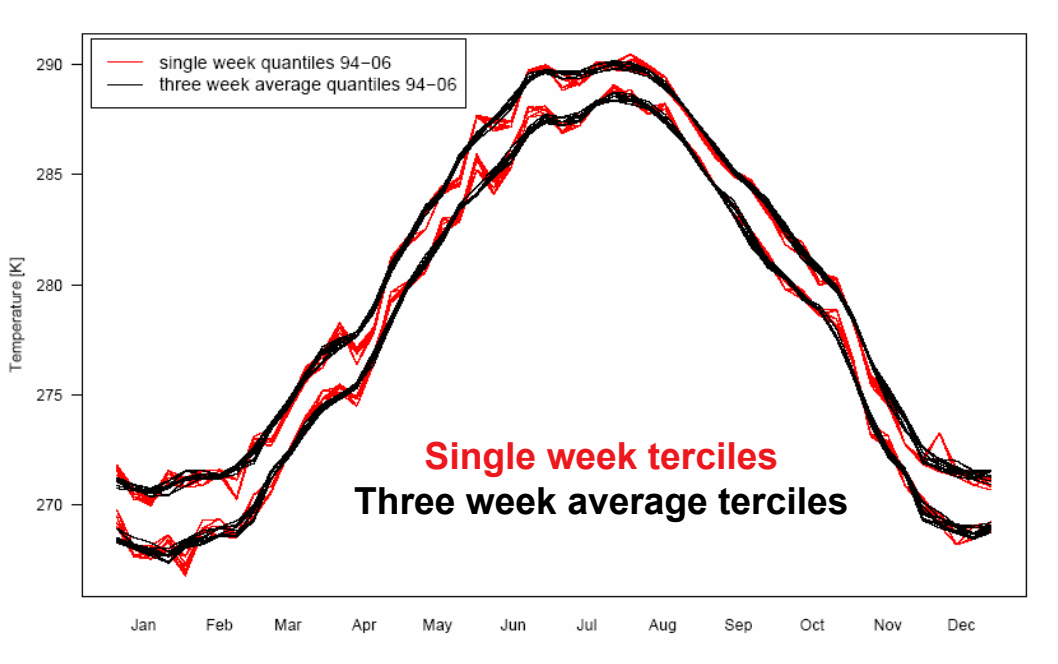


Seasonal variability and lead time dependence of skill for Europe



Model climatology robustness

Seasonal variability of the upper and lower tercile at 8°E 47°N for forecast week 1.



Three week average terciles are more robust than single week terciles therefore likely to improve forecasts.

→ could be implemented easily by calculating hindcast climatology one week in advance → VAREPS?

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

Prediction of moisture availability in agricultural soils using probabilistic monthly forecasts

David Bolius[1], Pier-luigi Calanca[1]
[1]Agroscope Reckenholz-Tänikon ART, Switzerland

NCCR CLIMATE
Swiss Climate Research

Why soil moisture?

- Soil water availability is essential for plant growth
- European heat wave during summer 2003: widespread agricultural losses
- Moisture shortages frequently occur in semi-arid Mediterranean climate
- Soil moisture availability depends on climate, soil type and vegetation
- Can levels of critical soil moisture be anticipated?

Soil moisture model

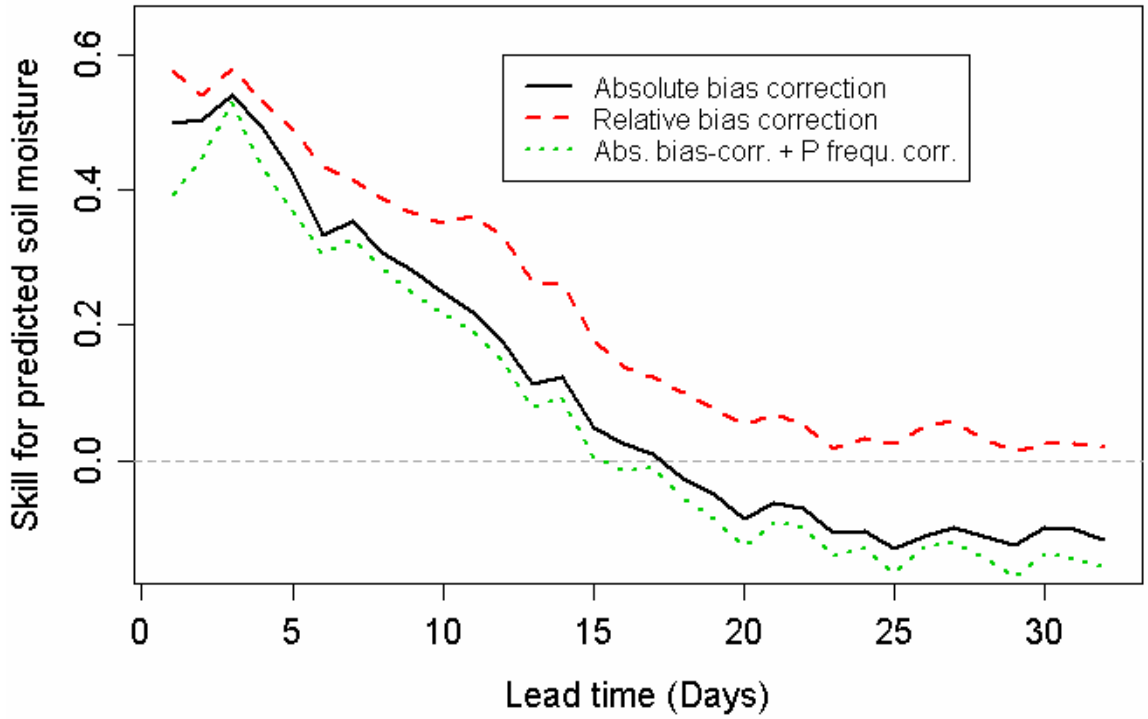
$$nZ\frac{d\Theta}{dt} = P - ET - K$$

Rodriguez-Iturbe et al., 1999

n	porosity	$\frac{m^3}{m^3}$
Z	soil depth	mm
Θ	vol. soil water cont.	$\frac{m^3}{m^3}$
P	precipitation	mm/day
ET	evapo-transp.	mm/day
K	percolation	mm/day

Input variables	Computation of
Temperature	Leakage
Precipitation	Evapotranspiration
Global radiation	➔ Soil moisture
Time step: 1 day	

Skill of soil moisture prediction (preliminary)



Based on predictions

$$\text{Skill: } 1 - \frac{\text{MSE}}{\text{MSE}_{Clim}}$$

Based on climatology

D.S. Wilks, 2006

1 site (Wynau), 1 soil type

CROPFOR Summary

Achievements:

- **Probability estimation for (anticipation of) soil water shortage**
- **Predictions clearly outrange climatology**

To understand better:

- **Precipitation frequency correction**
- **Improved skill of extended dry periods would improve the skill**
- **Persistence? Other locations?**

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

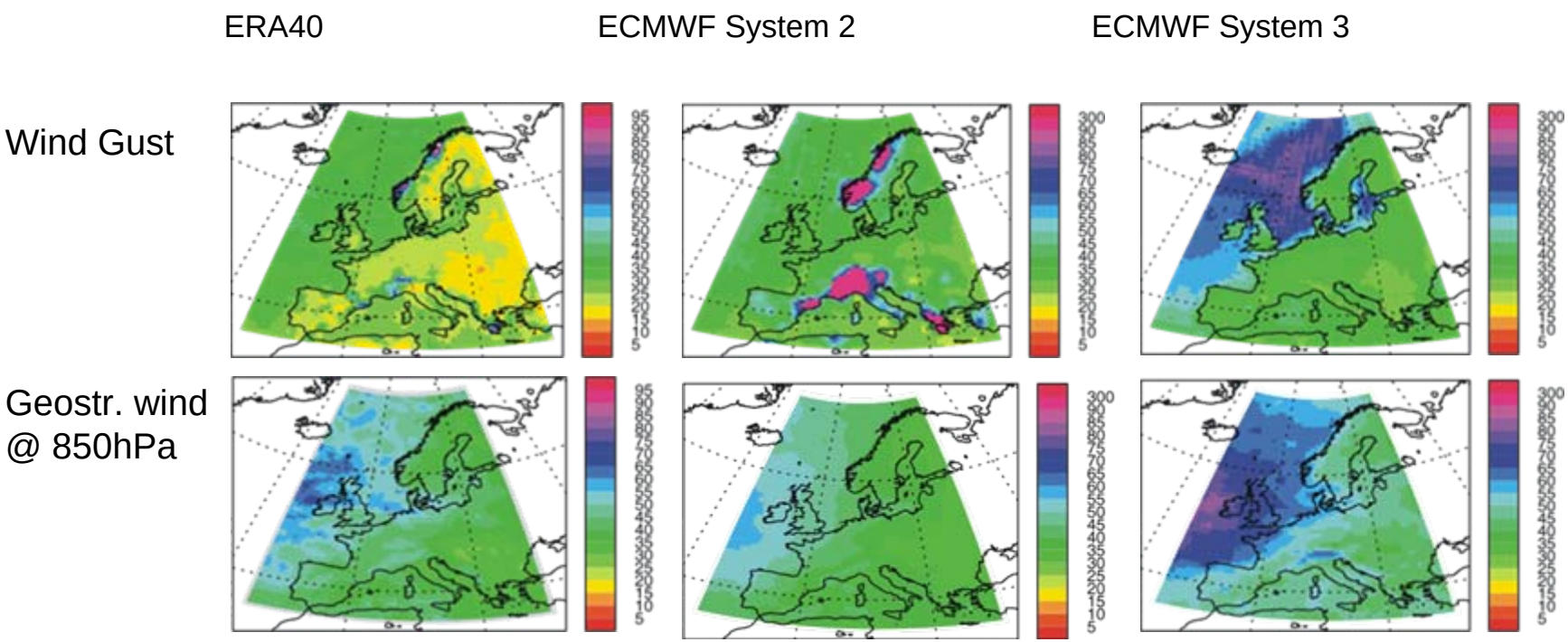
Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

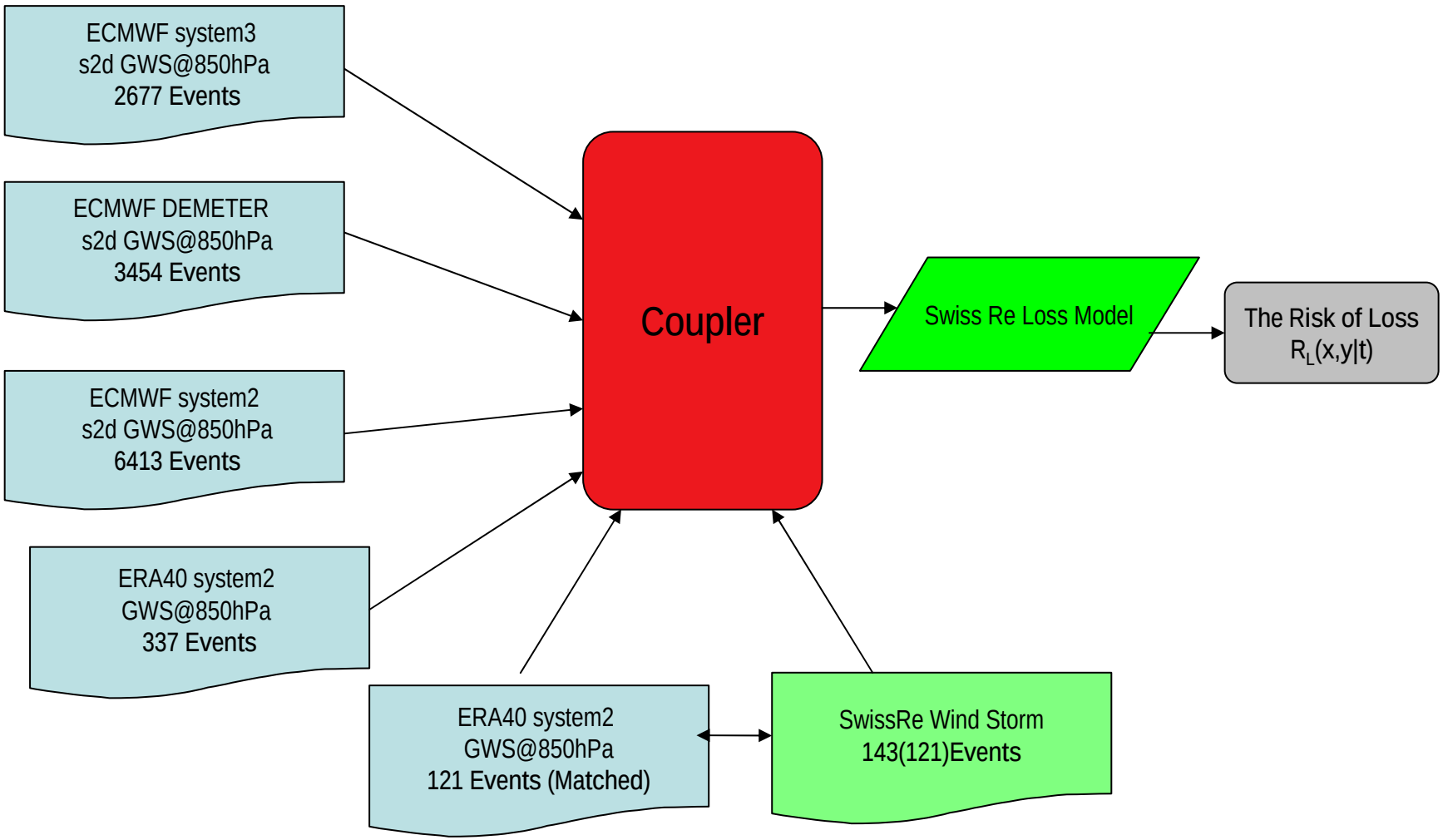
Seasonal forecasts applied to a European wind storm risk loss model

NCCR CLIMATE
Swiss Climate Research

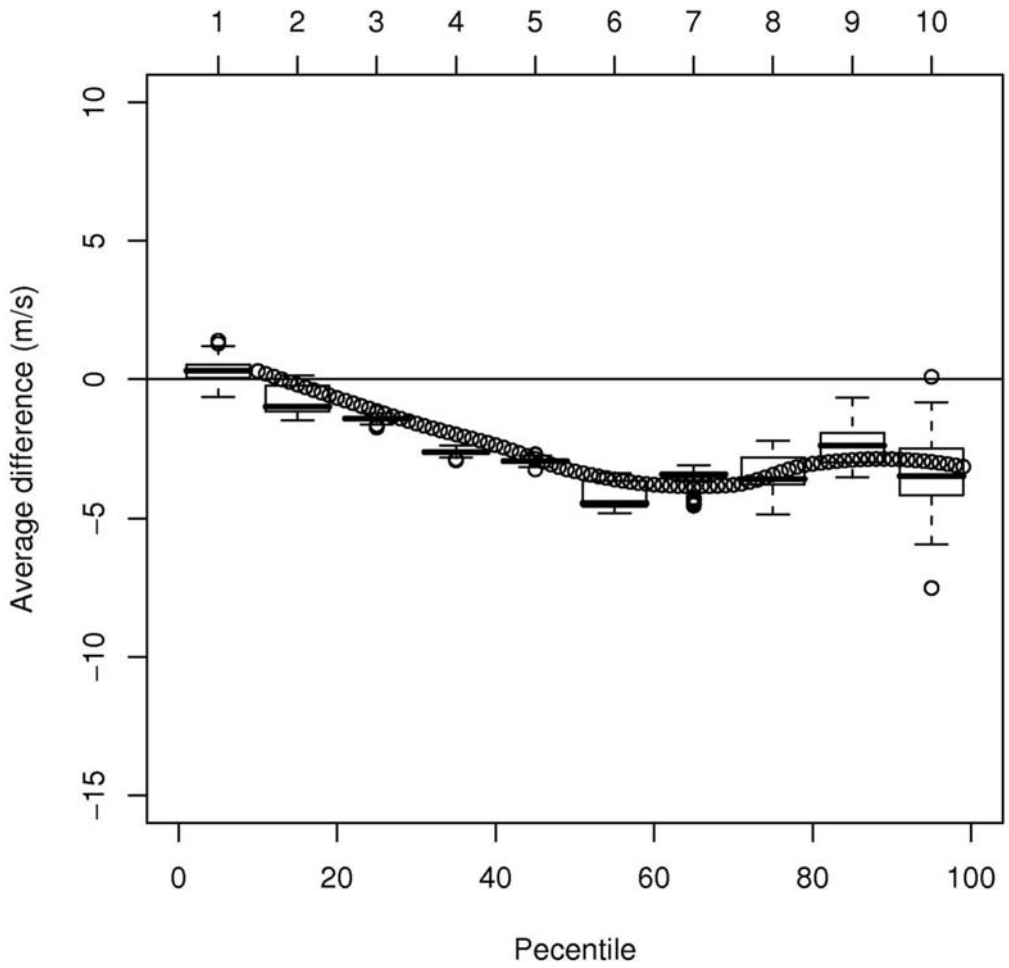
Intercomparison of the 99th %-tile wind climate



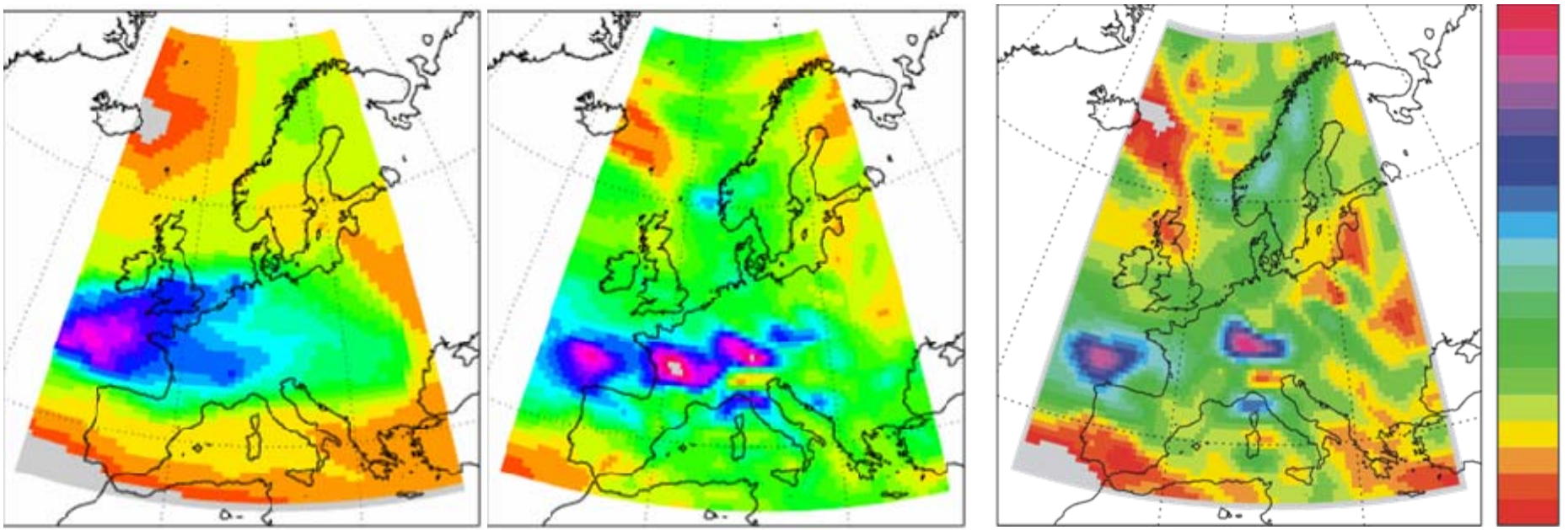
Current status phase 1



CALIB1: A spatial/temporal quantile based calibration (Swiss Re – ERA GWS)



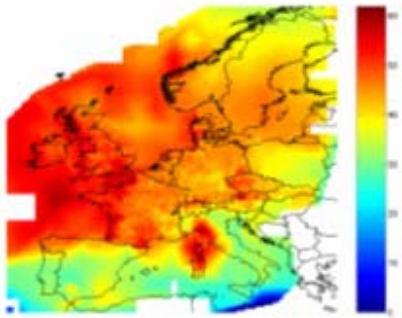
CALIB1: A spatial quantile based calibration, examples

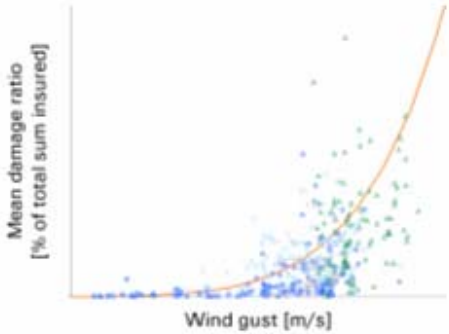


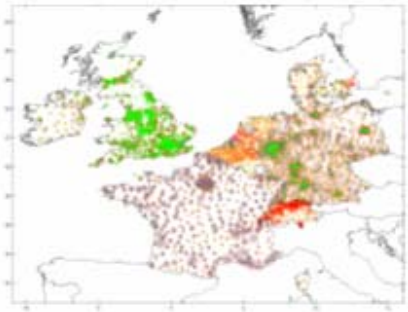
12hourly,
spatially truncated to T95

Swiss Re Wind Storm Loss Model

Hazard	Vulnerability	Value distribution	Cover conditions
How often / how strong?	How well built and protected?	What exactly is covered ... where... and how?	



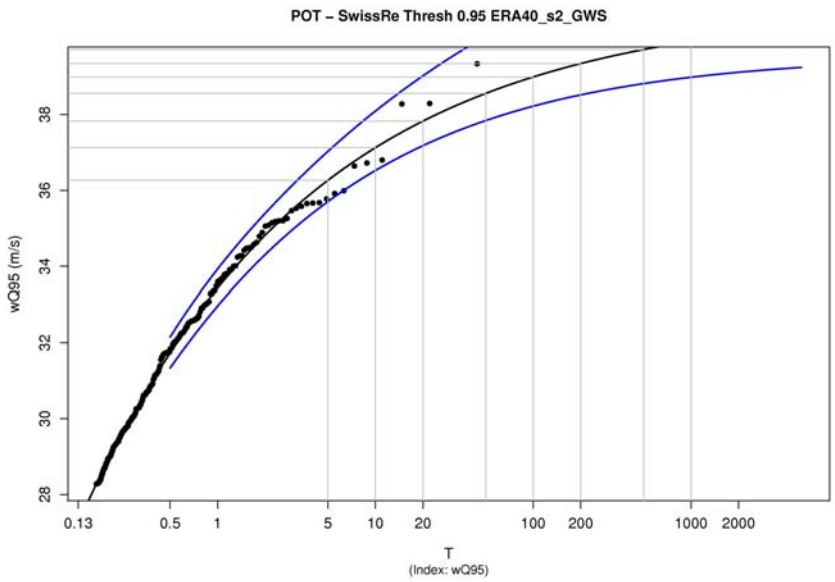




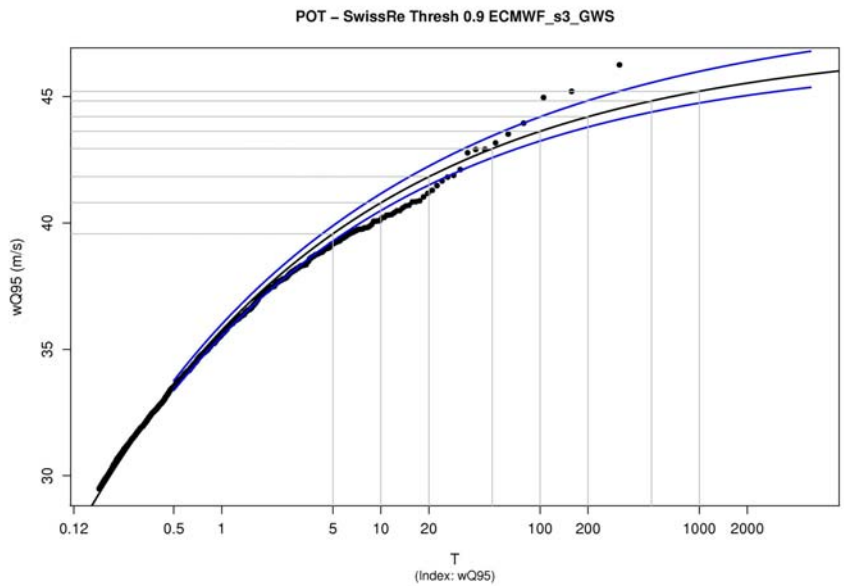
- sums insured
- cover limits
- deductibles
- exclusions
- etc.

A comparison of the wind storm Hazard

ERA40 (337)

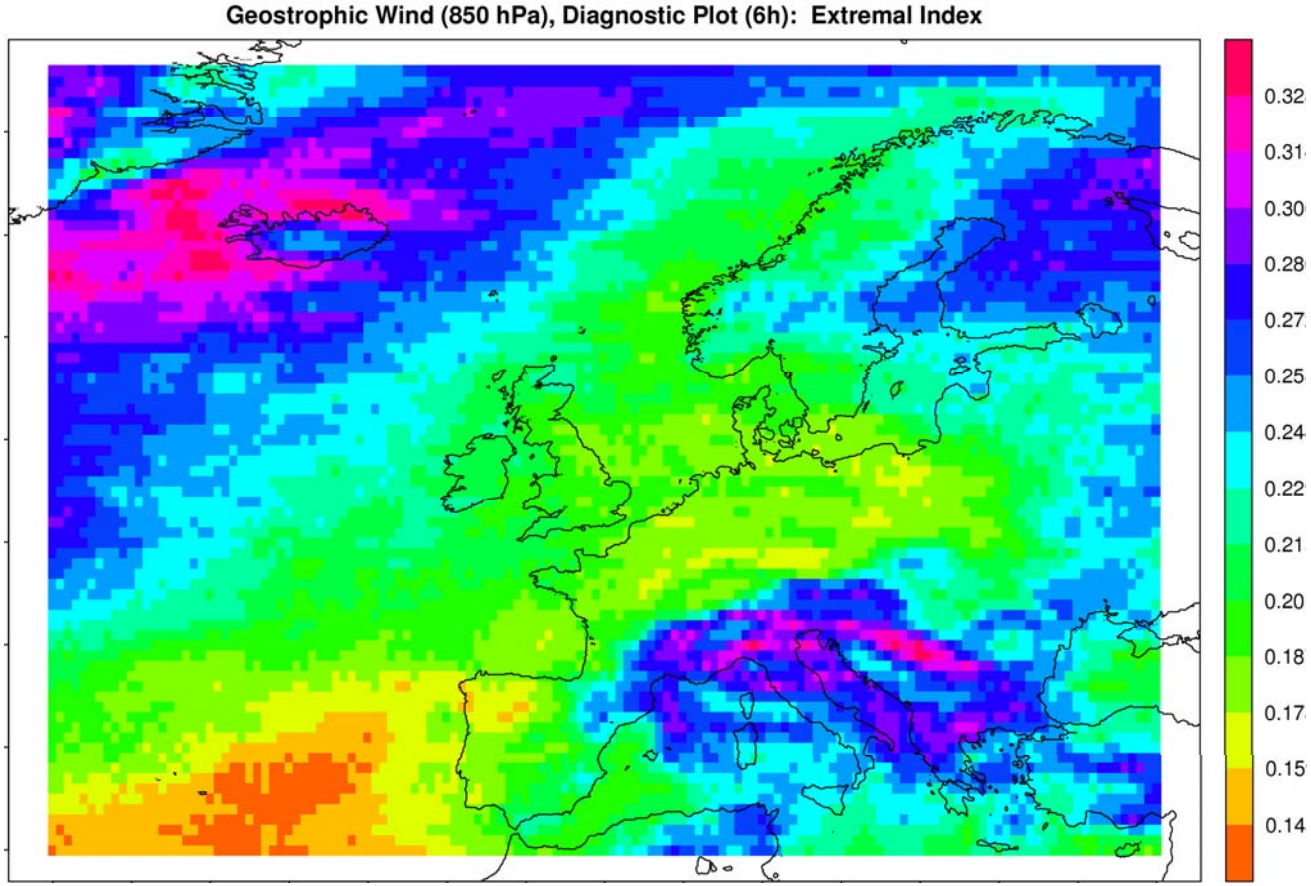


Sys3 (2677)



Serial clustering of ERA40 storms

- Plot of the ‘Extremal Index’, a measure of persistence in Storminess. Lower Extremal Index = greater clustering



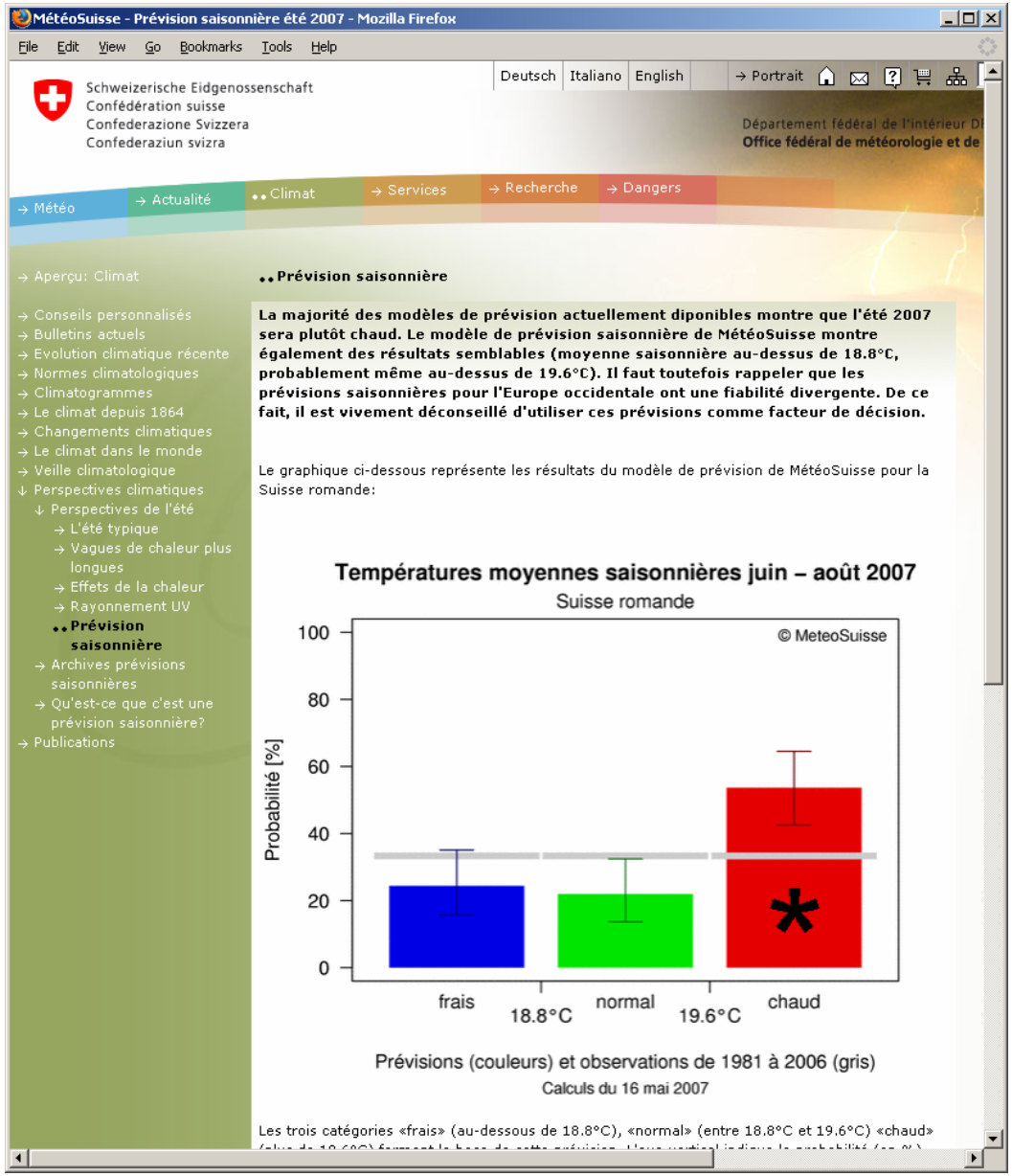
Ferro & Segers (2003)

Climate outlook

Public seasonal forecast for summer in Switzerland

→ 3 languages / regions
→ 2 models

→ temperature only



Conclusions

- Overconfidence reason for success of multi-model
- Detailed skill analysis of monthly forecasts:
  - little skill over Europe, but well calibrated
- Monthly forecasts of potential use in agricultural applications.
- Seasonal forecast very valuable in climate risk assessement. Direct link to operational loss model.

Requests:

- Consider monthly forecast hindcast climatology to be calculated one week ahead.
- Applications needs of temporally high resolution data
  - in System3: Wind gust: 24 hours, geopotential: 12h.
- Climatological characteristics of wind gust in System3 can still be unrealistic. Future improvements in IFS?
- Precipitation day frequency count stored with other monthly output

References

Baggenstos D 2007: Probabilistic verification of operational monthly temperature forecasts, Veröffentlichungen der MeteoSchweiz, 76, 52 pp.

Della-Marta PM et al 2007: Summer heat waves over western Europe 1880-2003, their relationship to large scale forcings and predictability. *Climate Dynamics*, **29**, 251-275.

Della-Marta PM et al 2007: The return period of extreme winds over western Europe. *In Prep*

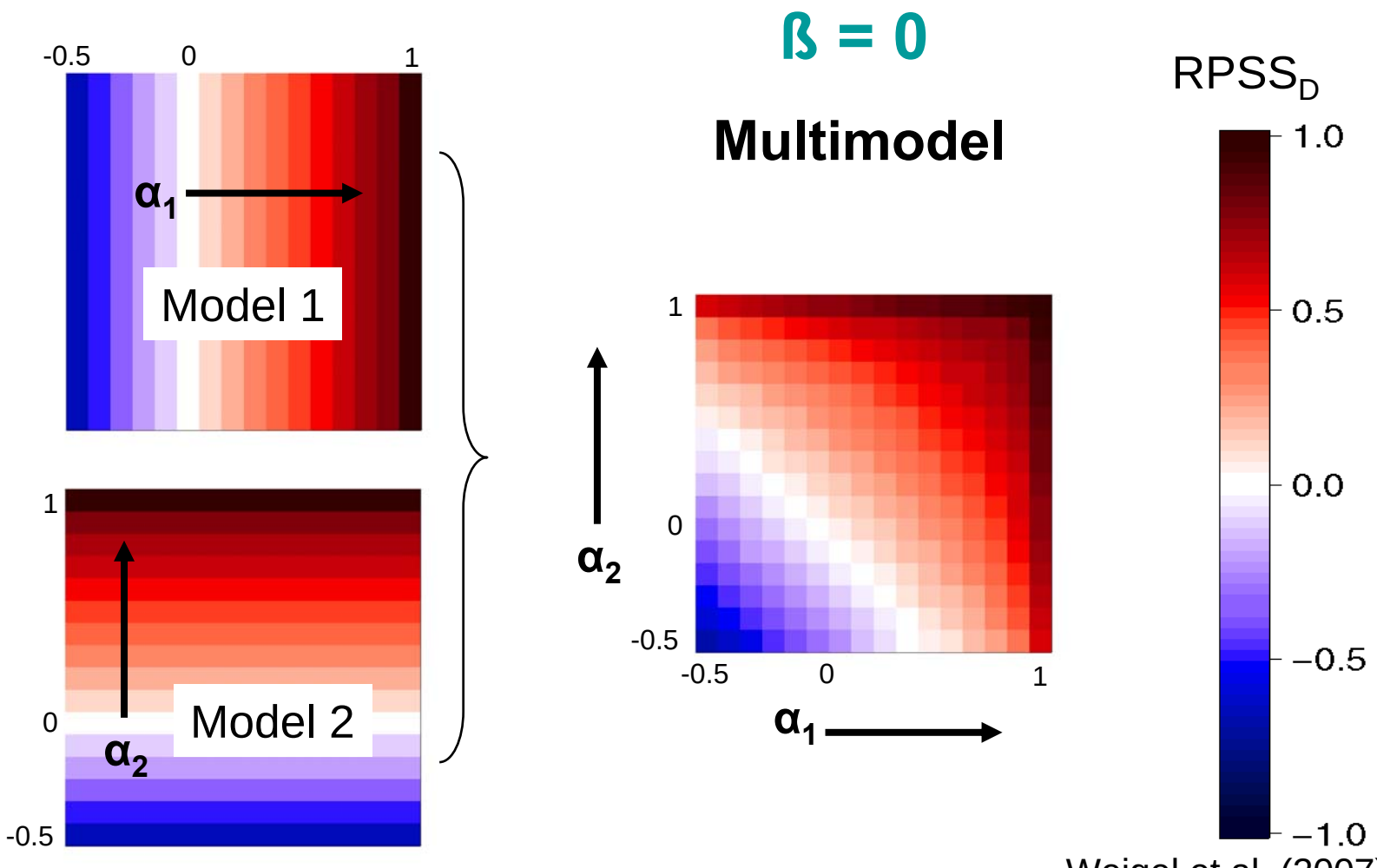
Müller WA et al 2005: A debiased ranked probability skill score to evaluate probabilistic ensemble forecasts with small ensemble sizes. *J.Clim*., **18**, 1513–1523.

Weigel AP et al 2007a: The discrete Brier and ranked probability skill scores. *Mon. Wea. Rev.* **135,** 118–124.

Weigel AP et al 2007b: Generalization of the discrete Brier and ranked probability skill scores for weighted multimodel ensemble forecasts. *Mon. Wea. Rev*. **(in press)**

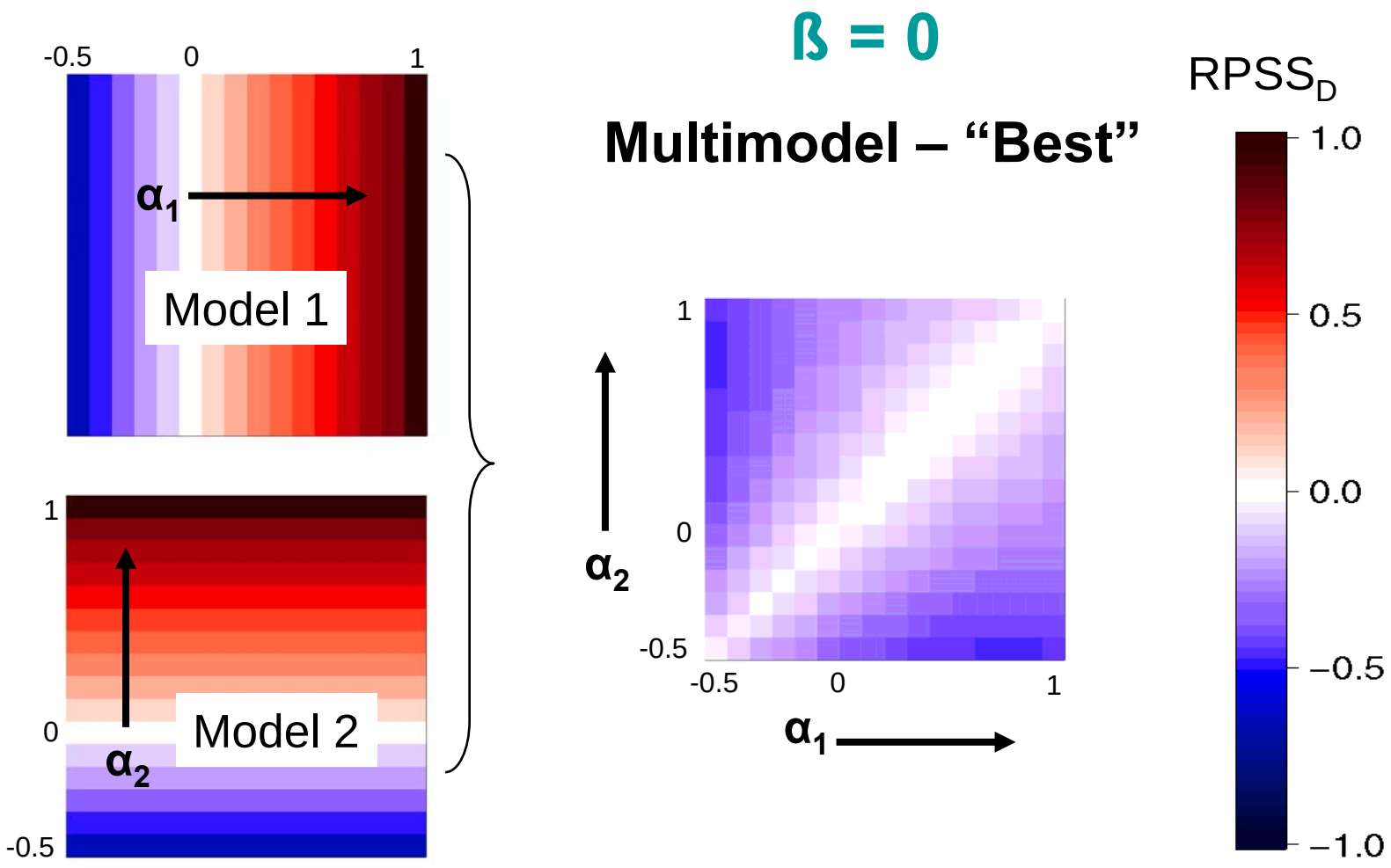
Weigel AP et al 2007c: Can multi-model combination really enhance prediction skill of probabilistic ensemble forecasts? *Quart. J. Roy. Met. Soc.* (submitted)

Toy-model experiments

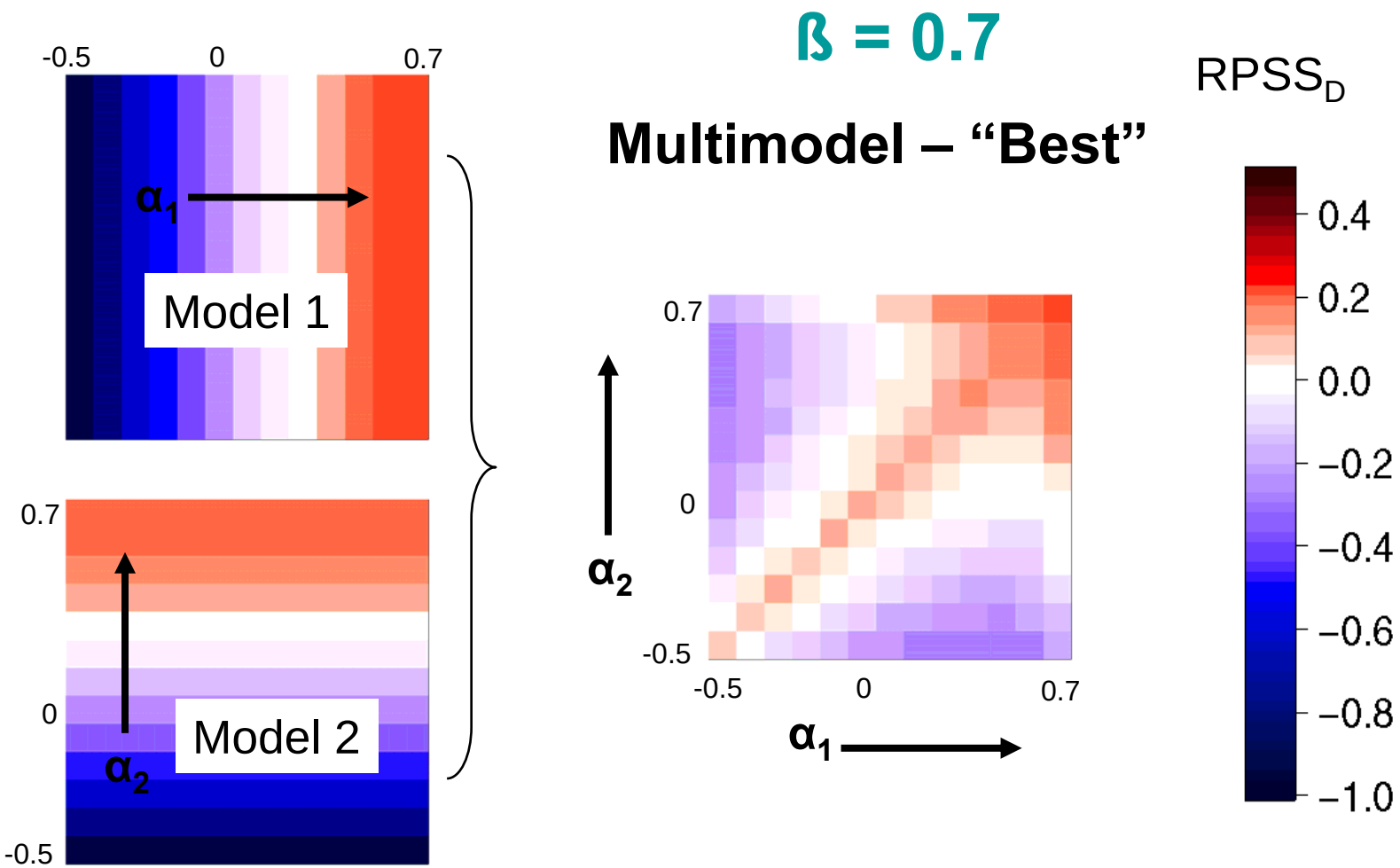


Weigel et al. (2007)

Toy-model experiments



Toy-model experiments



NCCR CLIMATE
Swiss Climate Research