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Swiss Confederation

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

# **Use of extended range and seasonal forecasts at MeteoSwiss**

Current use and ongoing developments

Christoph Spirig, Irina Mahlstein and Mark Liniger



# Overview

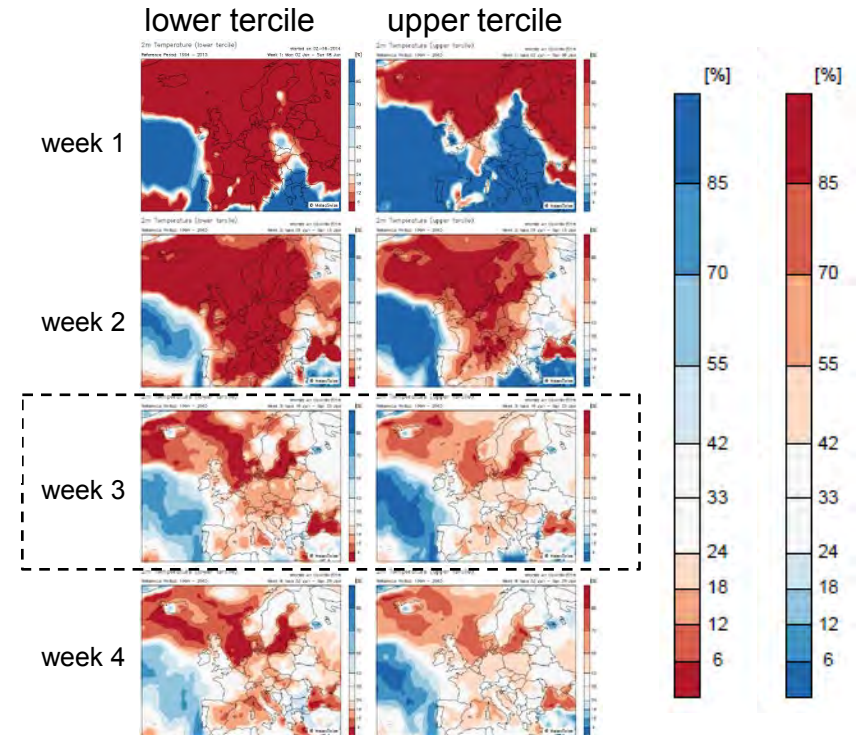
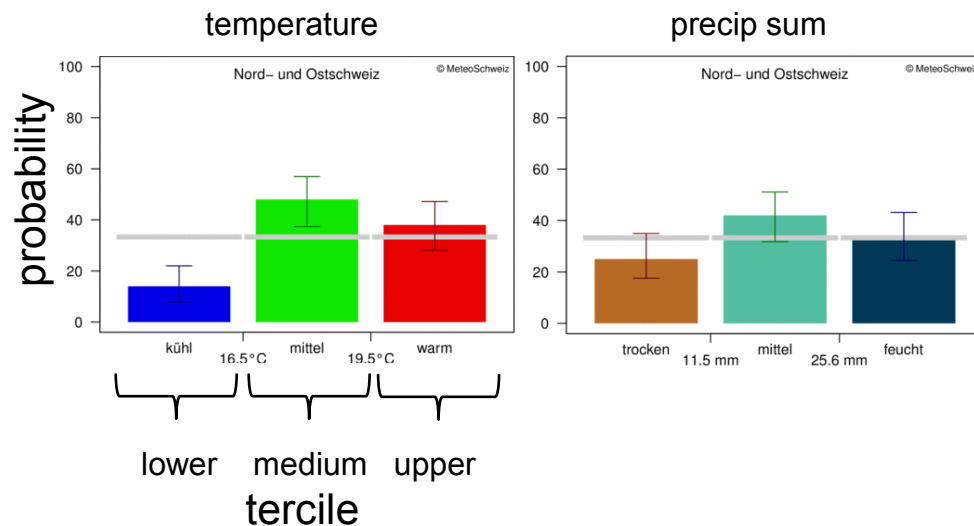
- Current extended range and seasonal forecast services by MeteoSwiss
- Customer feedback and demands
- Development of new services based on daily forecast data
  - post-processing challenges
  - first skill assessments
- Conclusions



# Monthly forecasts

- tercile forecasts for weeks 1-4
  - selected regions and maps (worldwide)

forecast for 16.6.-22.6. :

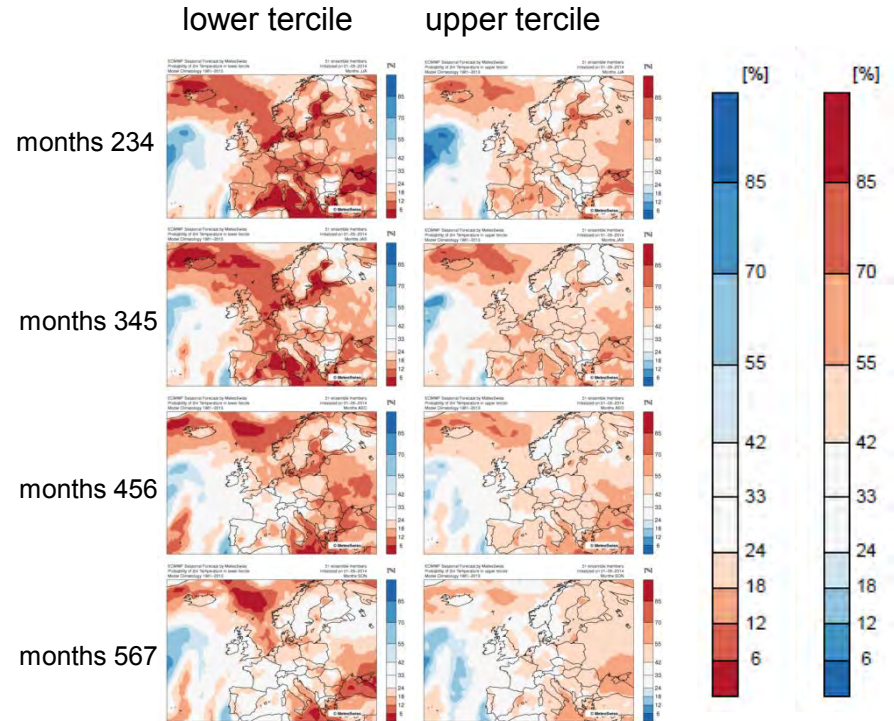
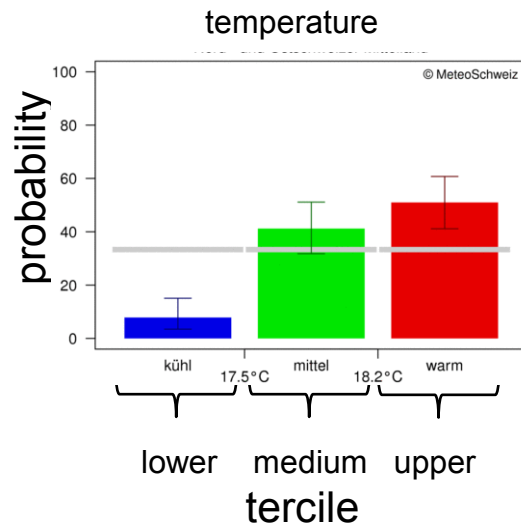




# Seasonal forecasts

- terciles of 3-monthly means for months 1-7
  - selected locations and maps (worldwide)

forecast (2014-5) for JJA :





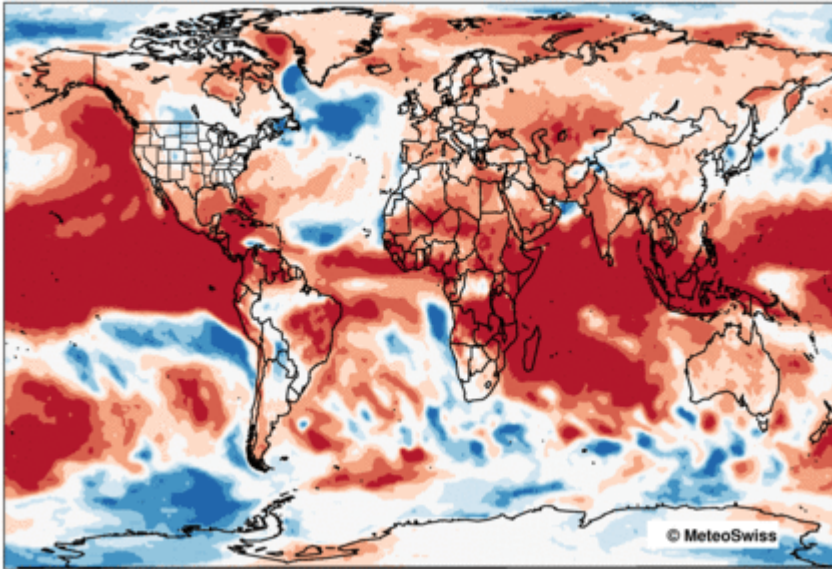
# Conventional and recalibrated forecasts

Temperature: upper tercile probability

conventional

ECMWF Seasonal Forecast by MeteoSwiss  
Probability of 2m Temperature in upper tercile  
Model Climatology 1961–2013

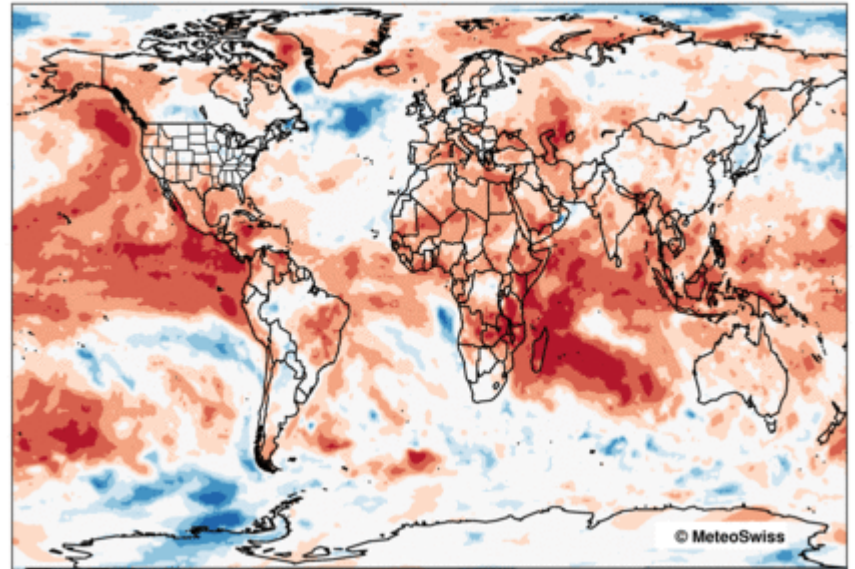
51 ensemble members  
Initialized on 01–05–2014  
Months JJA



recalibrated → «perfect» reliability

ECMWF Seasonal Forecast by MeteoSwiss  
Probability of 2m Temperature (recal) in upper tercile  
Model Climatology 1961–2013

51 ensemble members  
Initialized on 01–05–2014  
Months JJA



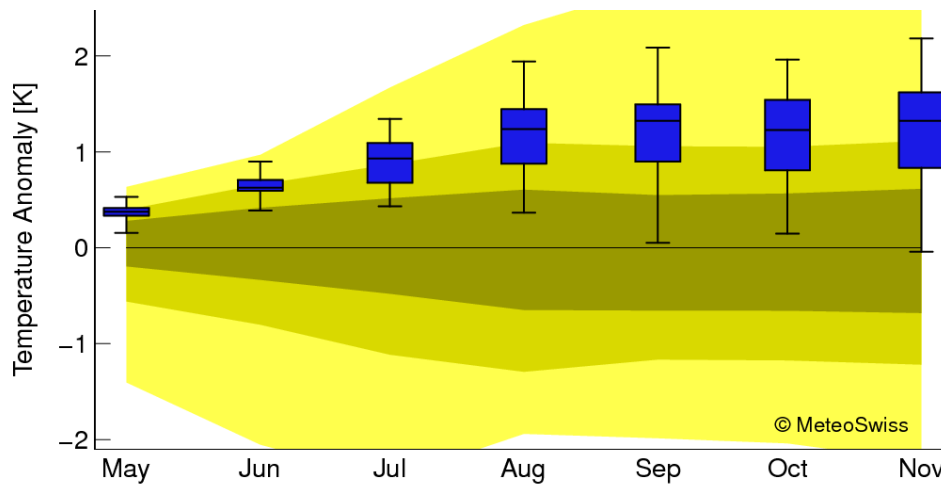
Weigel et al, 2009, Mon. Wea. Rev.



# Conventional and recalibrated forecasts

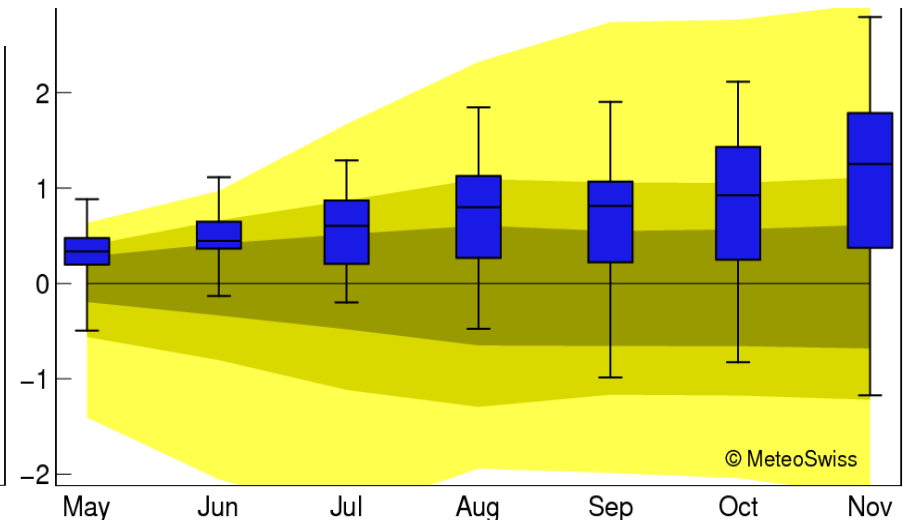
## Climagram for El Niño 3.4 region

conventional



base date: 1.5.2014  
area: -170E : -120E, -5N : 5N (sea)  
ECMWF System 4

recalibrated



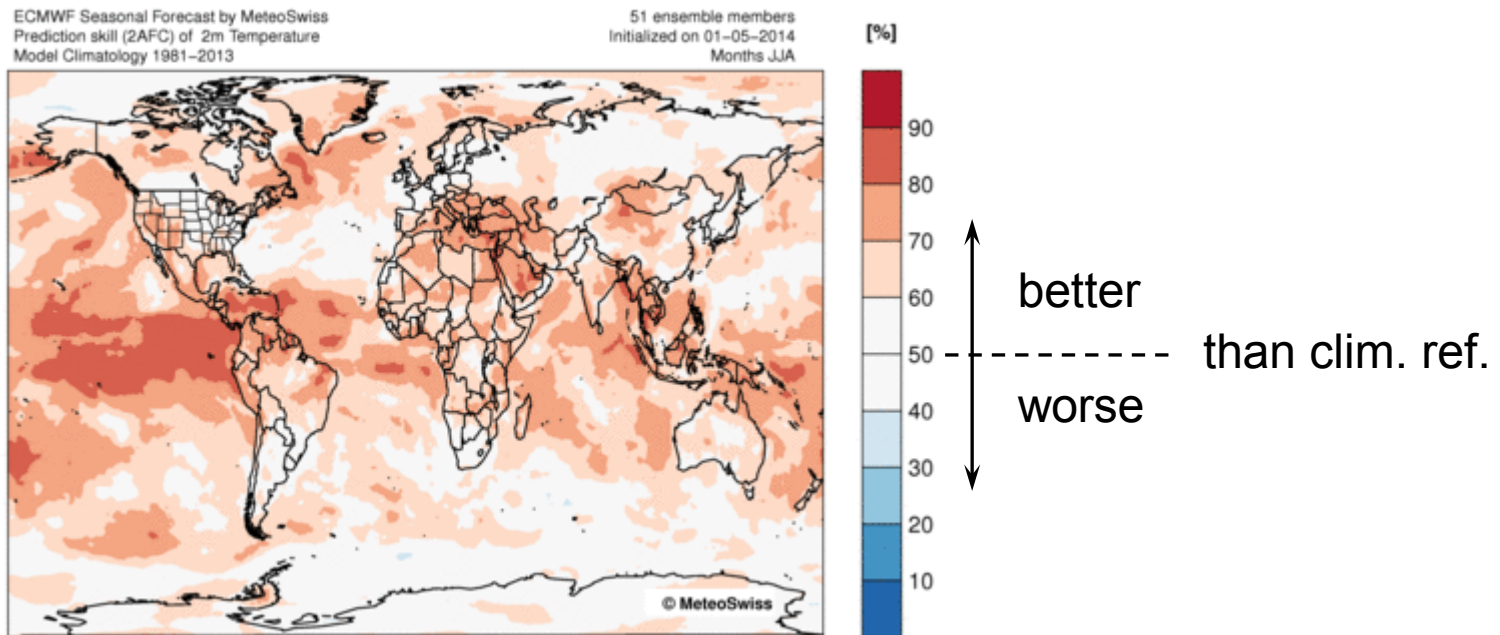
base date: 1.5.2014  
area: -170E : -120E, -5N : 5N (sea)  
ECMWF System 4



# Skill analysis

- operational calculation of generalized discrimination score (Weigel and Mason, 2011)

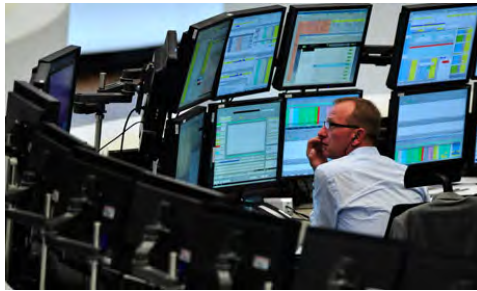
Skill of temperature forecast for months 2-4, May initialization





# Customers of ER and SFC

- commercial customers
  - (re)insurance
  - energy sector
  - global perspective



- general public





# Customers of extended range and seasonal forecasts

- commercial customers: **binary world of decision makers**  
**«buy or sell»**



- general public: **skiing in Switzerland next winter?**





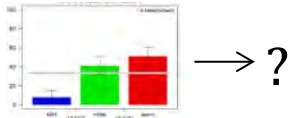
# Customer feedback

- Professional customers
  - graphical format for quick decisions, but as specific as possible (i.e. more than just temperature avg.)
  - location-specific forecasts
  - trend to data rather than graphical services
    - specific post-processing by customer
  - aware of limitations and possibilities
- General public
  - difficult to understand, «3-monthly average?»



# Ongoing developments

graphical  
formats



Improve  
usability of  
long-term  
forecasts

forecast  
indices



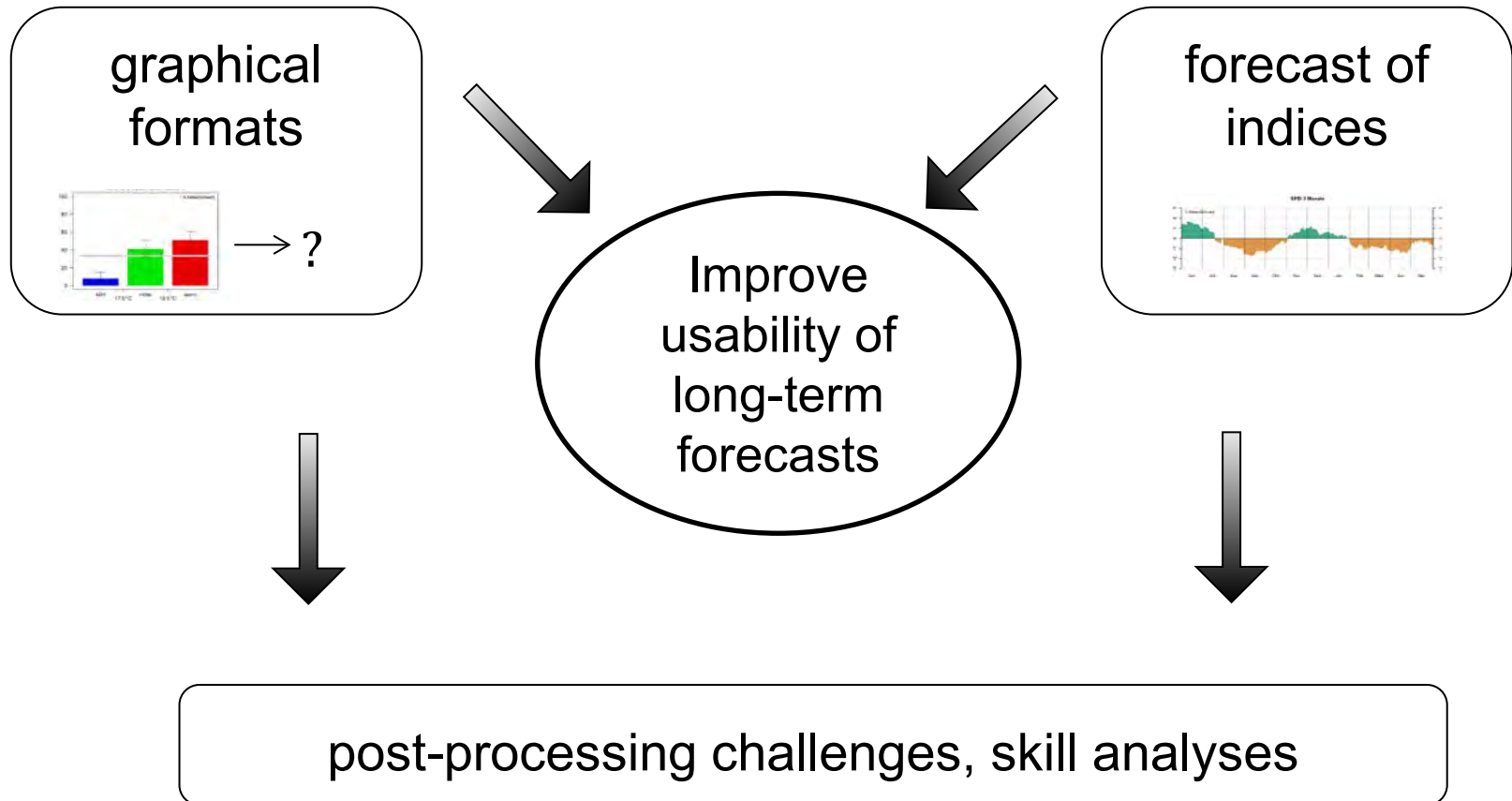
e.g. Heating degree days  
(HDD):  
Index to reflect energy demand  
to heat buildings,  
defined as number of degrees  
that day's avg temperature is  
below 18°C



# Ongoing developments

EUPORIAS

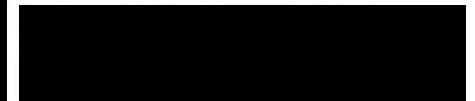
[www.euporias.eu](http://www.euporias.eu)





# Climagrams for monthly forecast?

Weekly distributions of daily  $T_{\max}$  forecasts:



red for upper tercile probs > 40%



blue for lower tercile probs > 40%

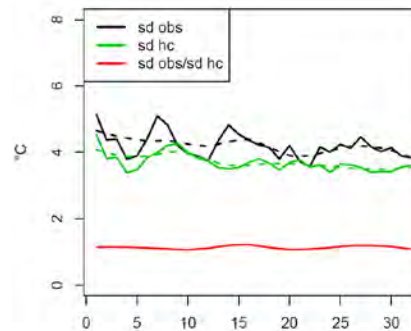
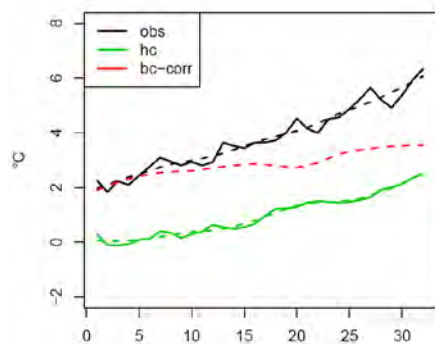
## Objectives

- Provide station-based information
- Absolute scales (here: °C)
- Contrast observed climatology and prediction



# First tests: MOFC since Jan 2014

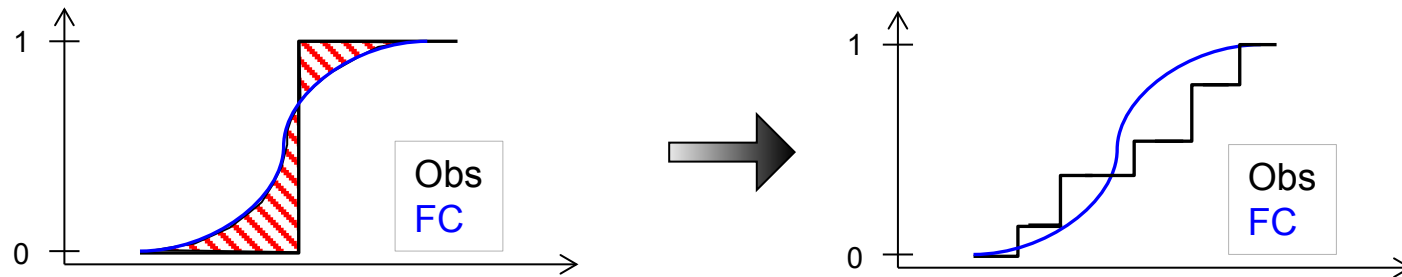
- Downscaling
  - Bilinear interpolation to station coordinates
  - bias/spread correction based on hindcast and observation climatology
    - use 3-week-window centered on forecast week for improved statistics
  - bias- and spread-correction =  $f$  (lead time)





# First skill assessments

- Data base: Monthly forecasts Jan-April 2014
  - 16 initializations
  - full set of hindcasts (20 years, 5 members)
  - 10 locations in Switzerland
- Score: Continuous ranked probability score (CRPS)  
squared diff. between FC- and obs-CDF





# First skill assessments

- Data base: Monthly forecasts Jan-April 2014
  - 16 initializations
  - full set of hindcasts (20 years, 5 members)
  - 10 locations in Switzerland
- Score: Continuous ranked probability score (CRPS)
- CRPSS: climatology as a reference

$$CRPSS = 1 - \frac{CRPS}{CRPS_{ref}}$$





# Skill of temperature forecasts



10 locations in CH,  
16 init times (Jan-Apr)  
20 hindcast years  
51 forecast members  
5 hindcast members

marginal skill  
beyond day 18



# Skill of Temp-based indices



HDD: Heating degree days

FD: Frost days ( $T_{\min} < 0^{\circ}\text{C}$ )



# Skill of underlying variable vs index



CRPSS FD

CRPSS Tmin



# Skill in predicting indices vs. EUPORIAS seasonal average values?

- ECMWF System 4, hindcasts 1981-2010, November and May initializations
- Verified vs ERA-Interim



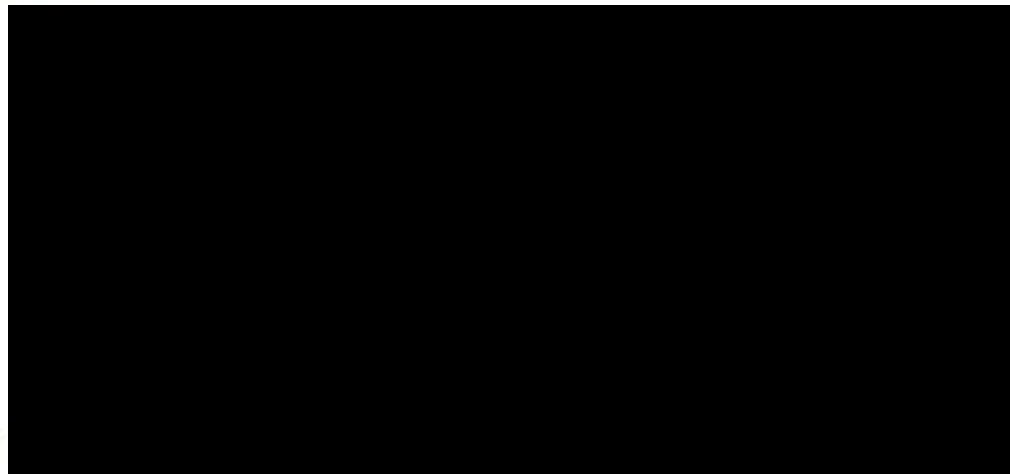
# Skill in predicting indices vs. seasonal average values?

EUPORIAS

TAS



HDD

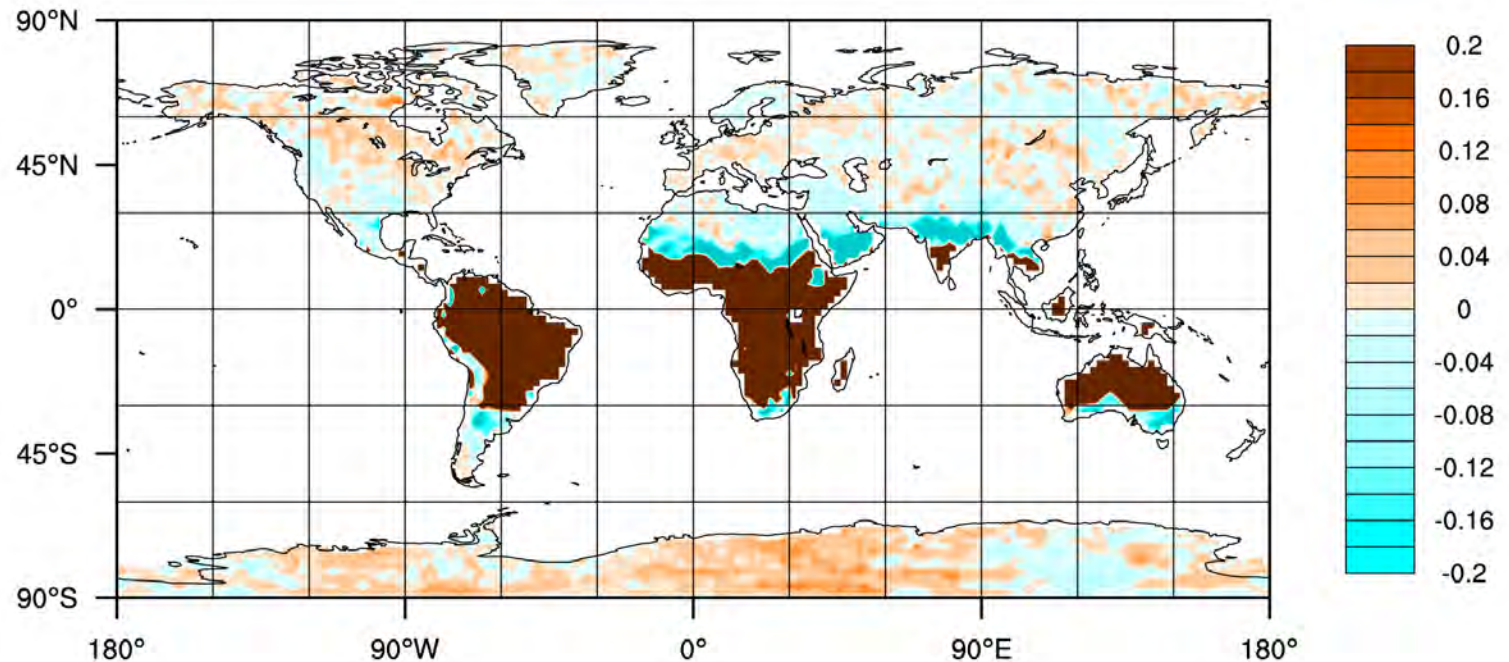


DJF, Nov Initialization, System4



# Improved skill?

## RPSS HDD - RPSS TAS



## DJF, Nov Initialization, System4 vs. ERA-Interim

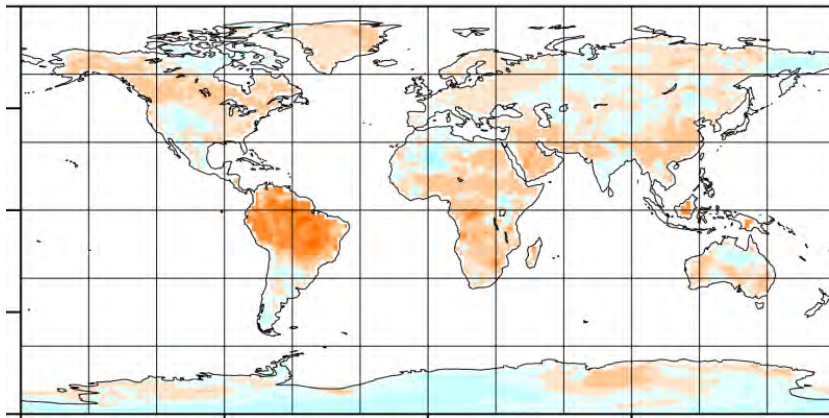


# Skill of Frost Days (FD)

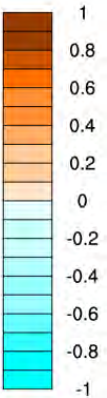
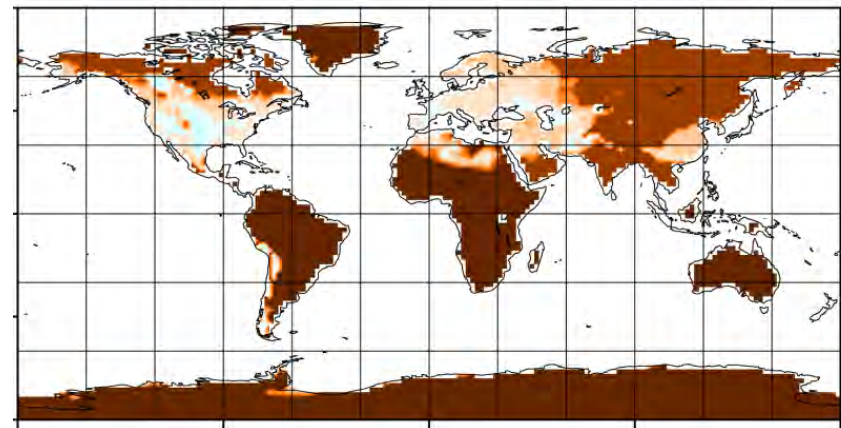
## FD: $T_{min} < 0^{\circ}C$

EUPORIAS

RPSS  $T_{min}$



RPSS FD



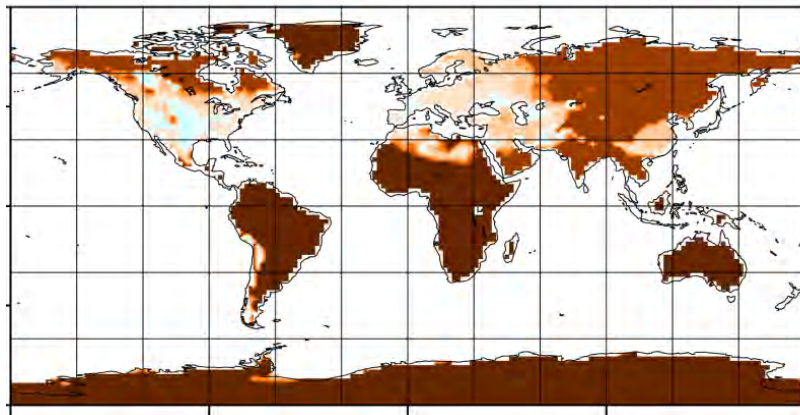
DJF, Nov Initialization, System4 vs. ERA-Interim



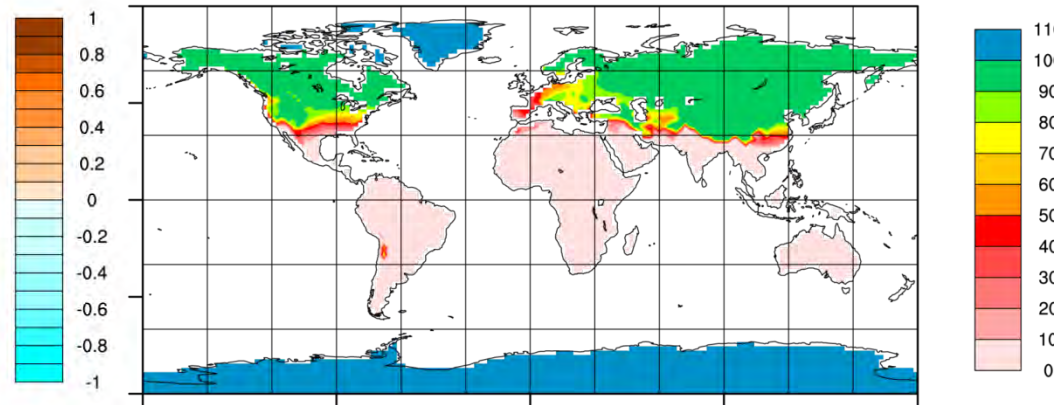
# Skill of Frost Days (FD)

## FD: $T_{min} < 0^{\circ}C$

RPSS FD



FD climatology

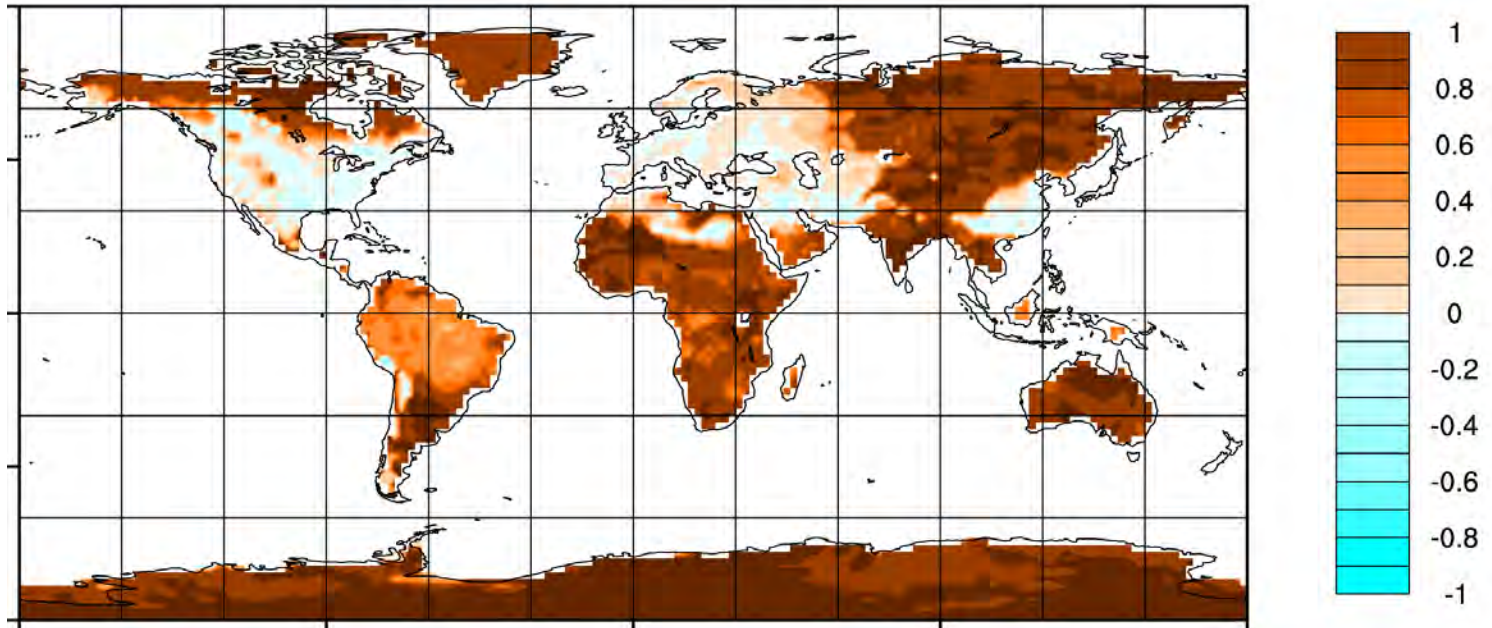


DJF, Nov Initialization, System4 vs. ERA-Interim





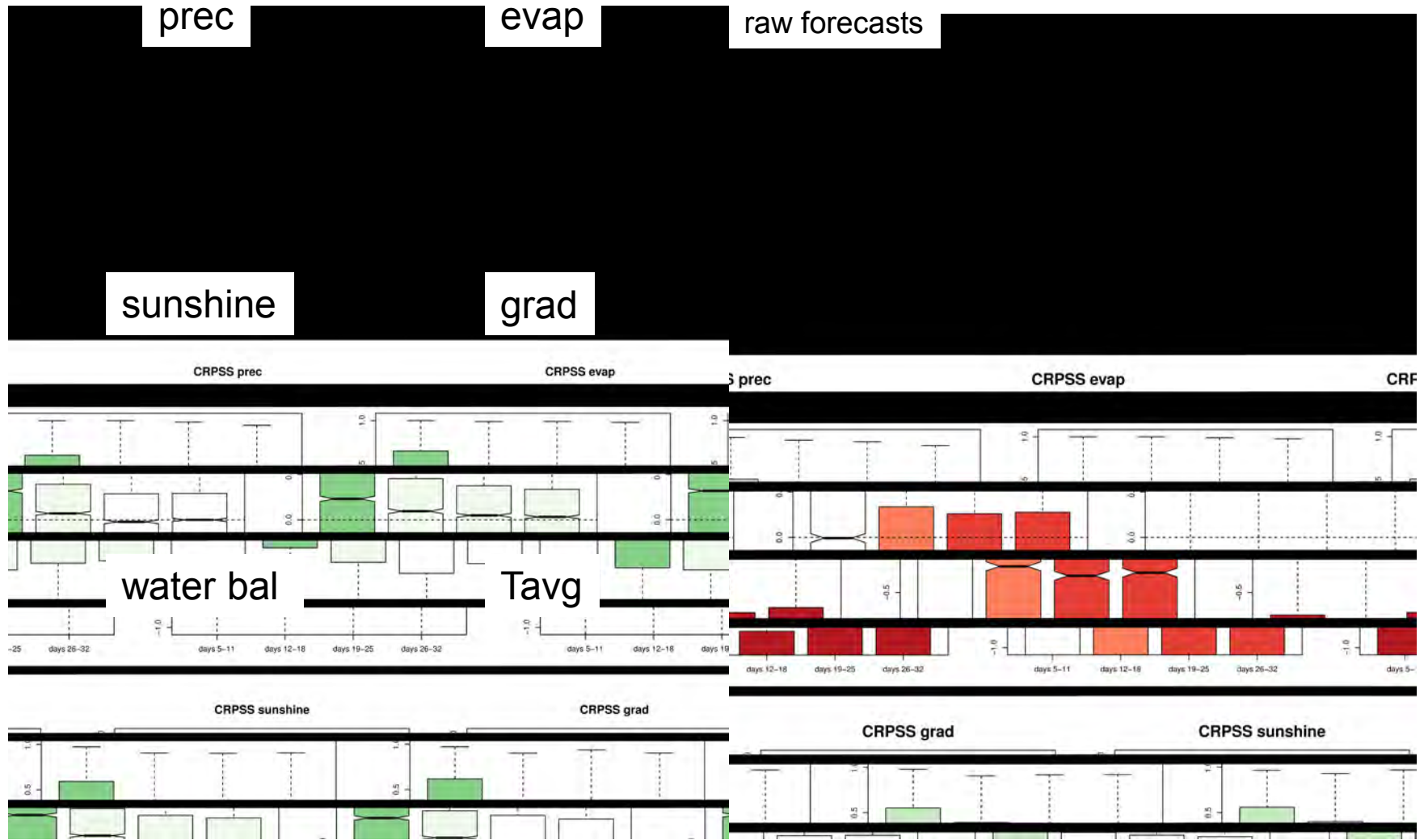
# RPSS Frost Days – RPSS Tmin



DJF, Nov Initialization, System4 vs. ERA-Interim



# Skill for other variables (CRPSS, extended range)





# Conclusions

- Demand for user-specific long-range forecasts
- Indices based on aggregation show same (or slightly better) skill vs. underlying basic climate variables
- Potential of long-range forecasts based on daily data: similar skill but more specific information
- Indices based on 'frequency-count' partially show large improvements in skill & reliability
  - Can be relevant from a user perspective
  - mainly due to bounded value range
  - → Most appropriate measure to be used?



# Thank you



# Outlook

- Investigate large variability of extended range skill
- Extend test data set (Europe, whole year)
- Robustness of skill measures for indices like frost days?