Schweizerische Eidgenossenschaft
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# Verification of precipitation and drought indices forecasts at subseasonal to seasonal time scales

Christoph Spirig, Jonas Bhend, Samuel Monhart, and Mark Liniger

# Overview

- User tailoring of climate forecasts: prediction of indices
- Verification of monthly forecasts
  - surface temperature and precipitation against ECA&D
  - drought index SPEI in Switzerland
- Verification  of seasonal forecasts
  - precipitation and water balance in E. Africa

# Prediction of indices

- indices: (non-linear) aggregation of meteorological parameter(s) over given period
- direct relevance for users
- forecasts with a user perspective while avoiding complex impact models

# Prediction of drought indices

- Interest from various sectors
  - eg. agriculture, energy, public health

- Ongoing projects:
  - hydrological ensemble predictions for hydropower operations

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Energy Turnaround
National Research Programme NRP 70

©Nant de Drance

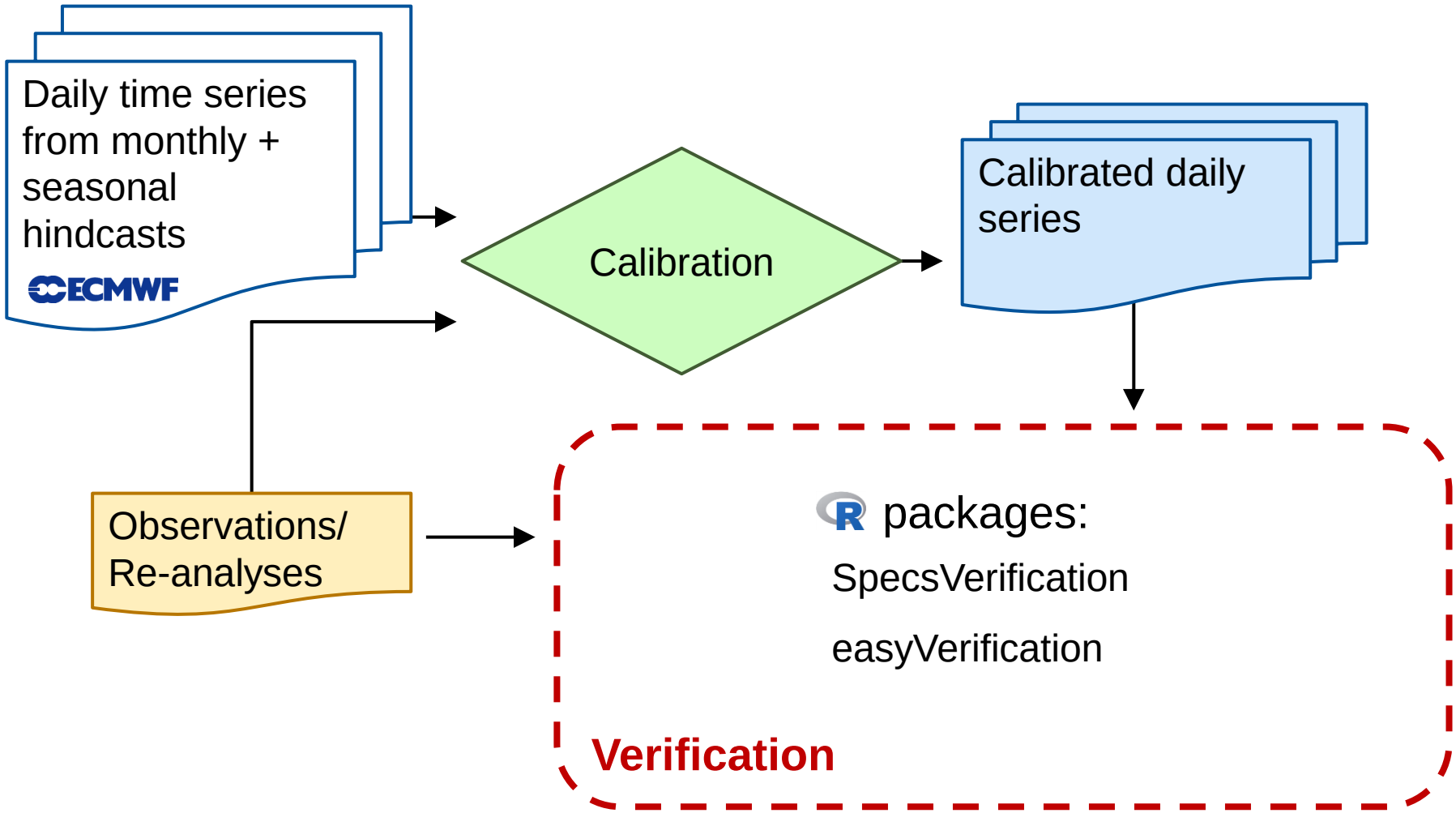
  - Improve usability of seasonal forecasts

EUPORIAS

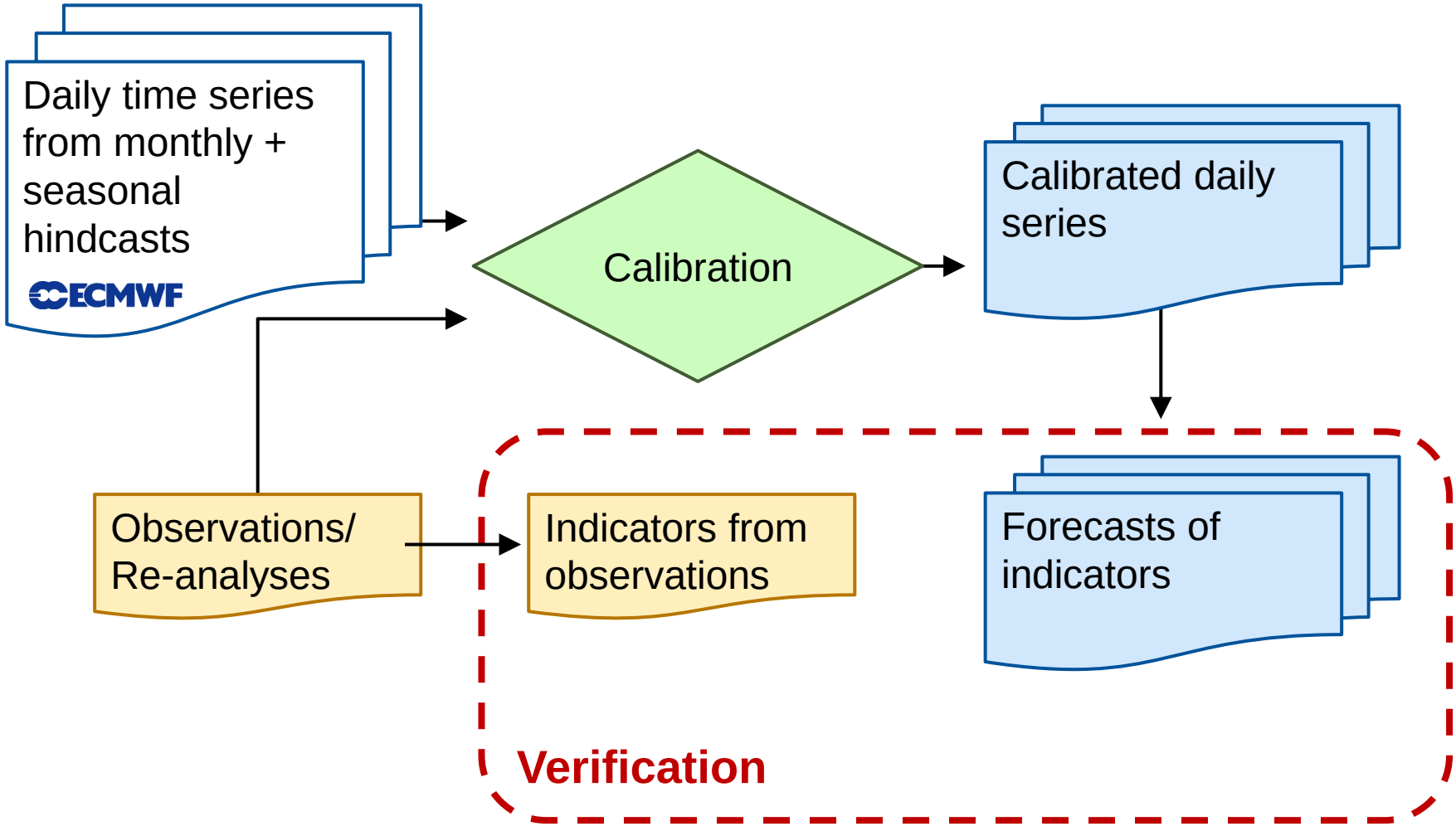
www.euporias.eu

LEAP ETHIOPIA
EARLY WARNING – EARLY ACTION

# Analysis scheme

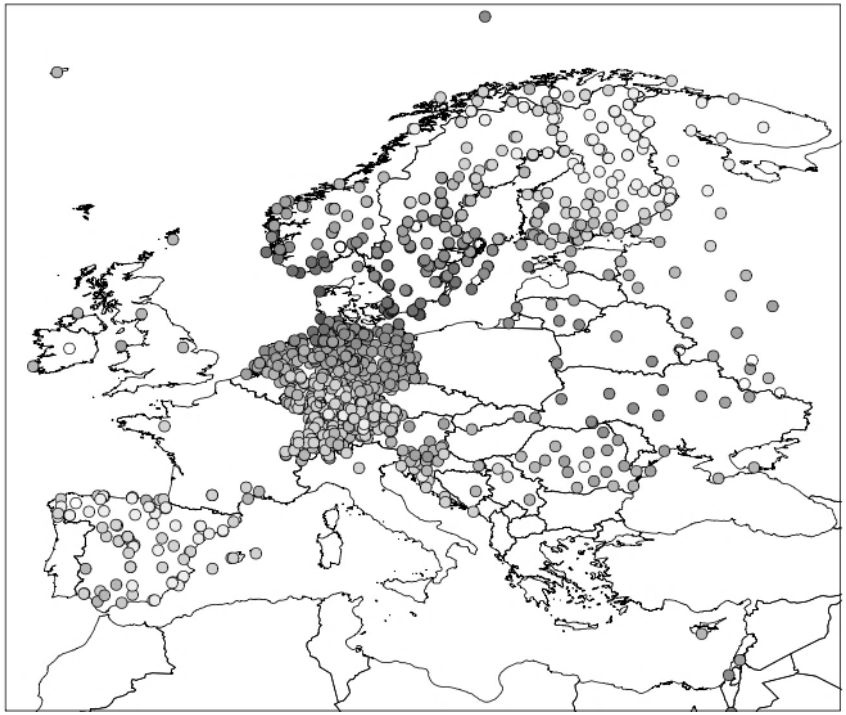


# Analysis scheme

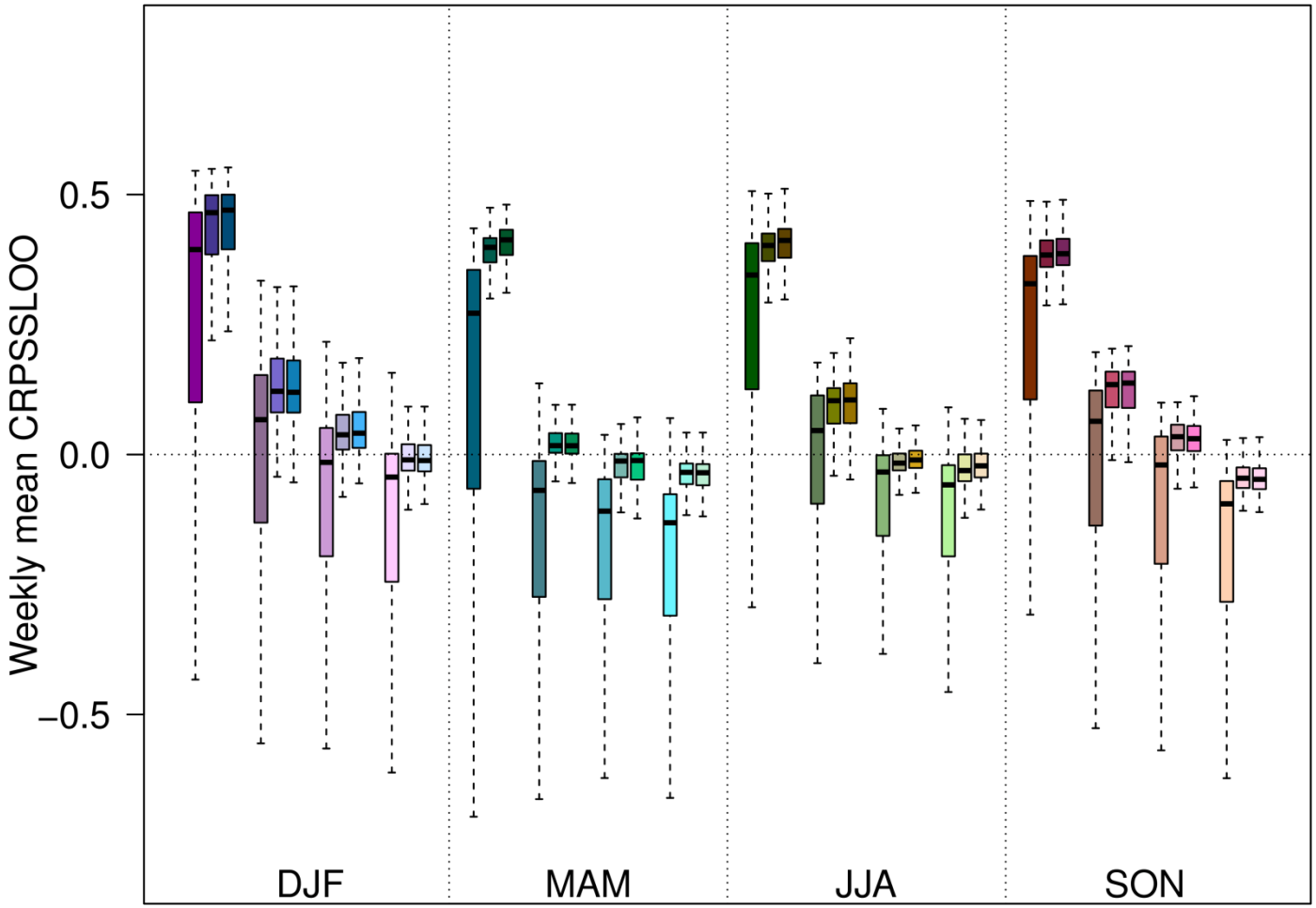


# Verification monthly forecasts

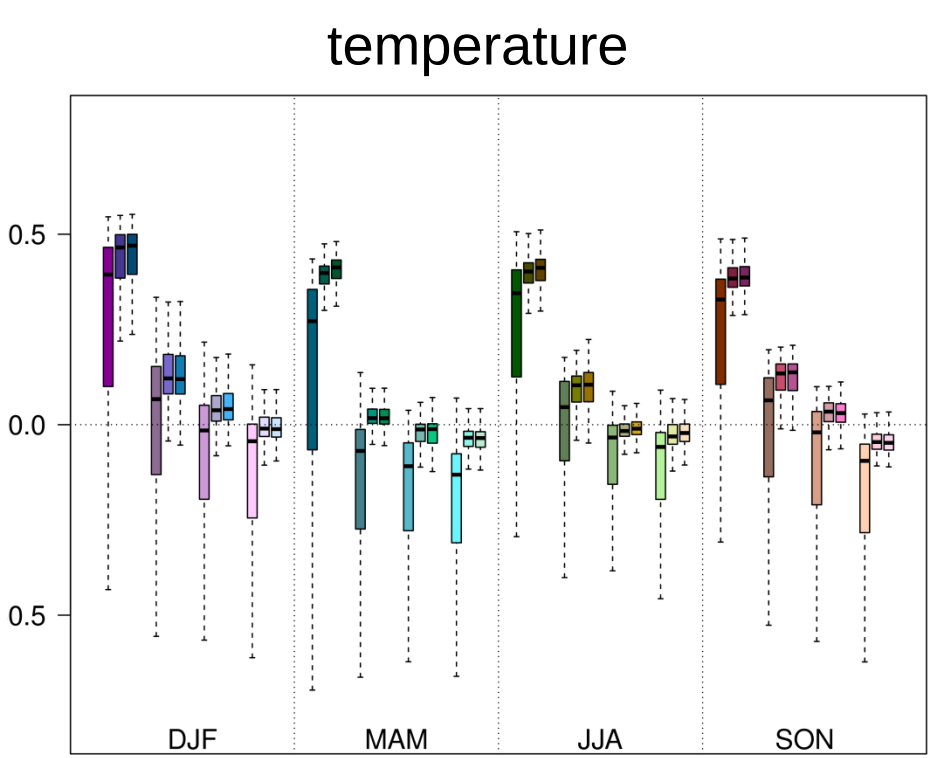
- ECA&D data set (www.ecad.eu)
- ~ 1000 observation sites
- Hindcasts of cycle 40r1, complete yearly cycle

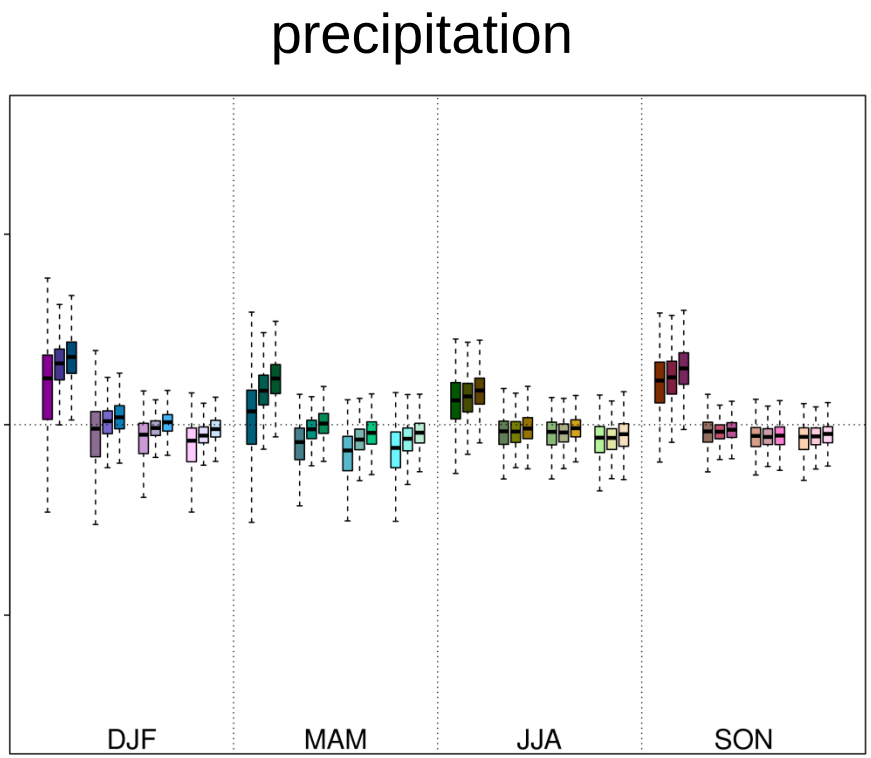


# Skill of raw and bias-corrected hindcasts



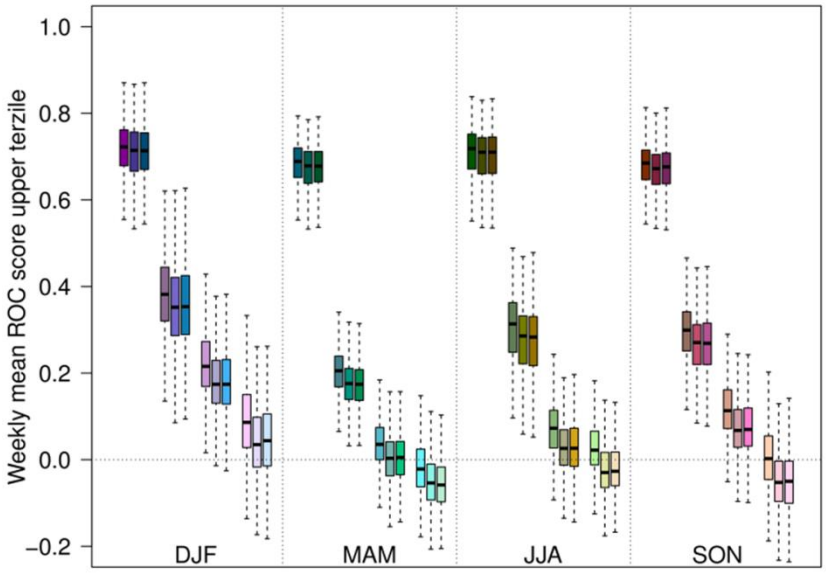
# CRPSS



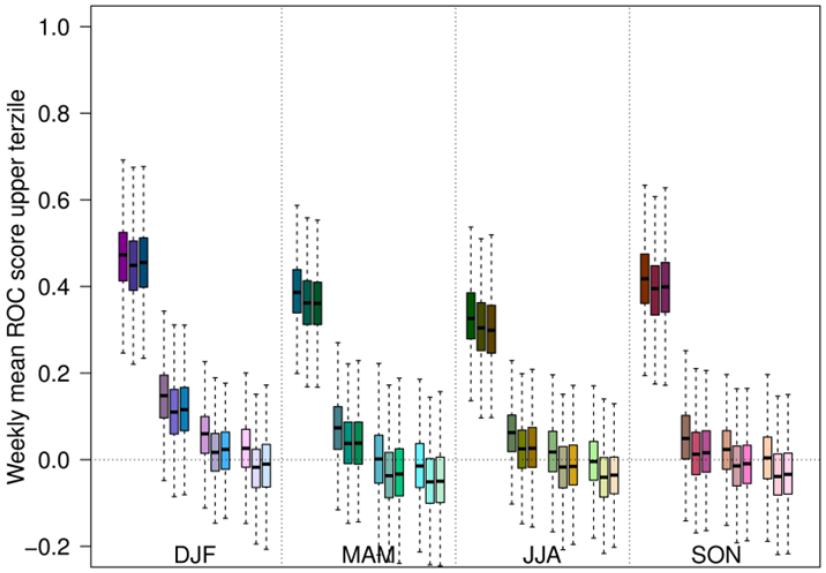



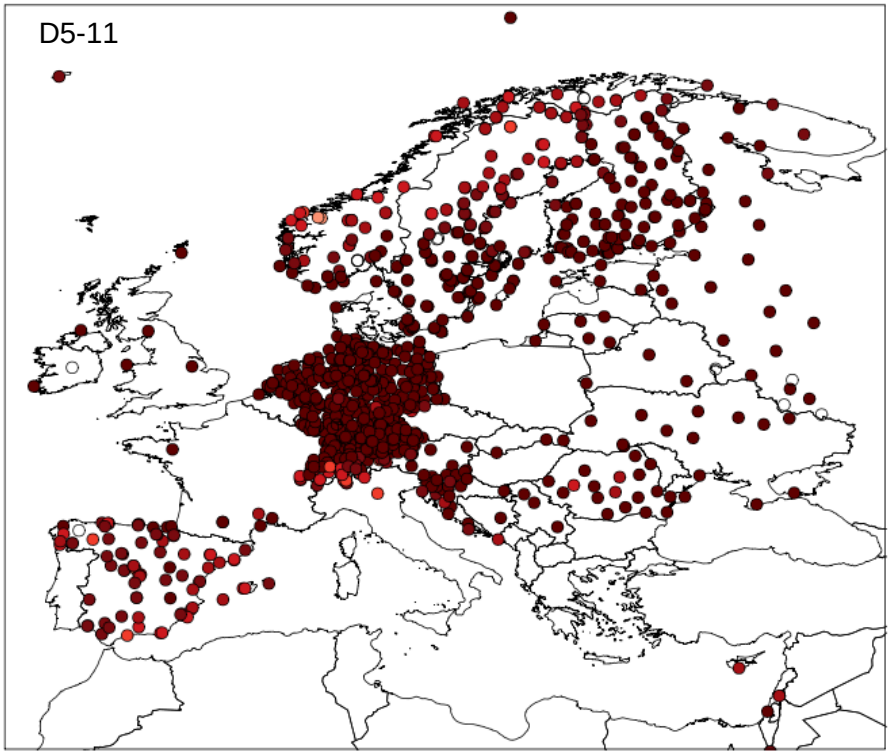
# ROCSS

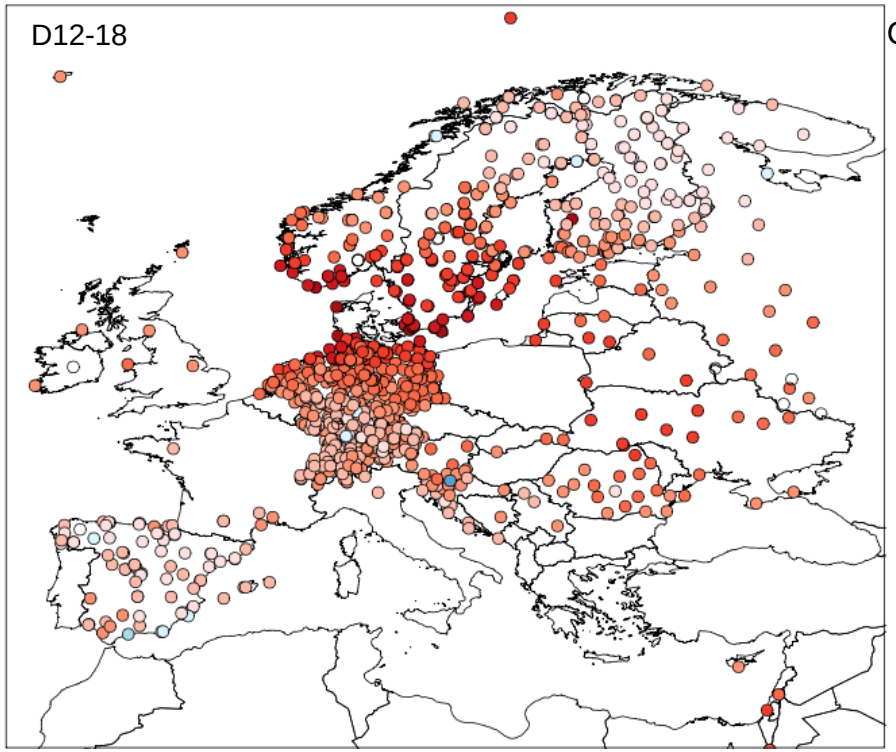
temperature




precipitation

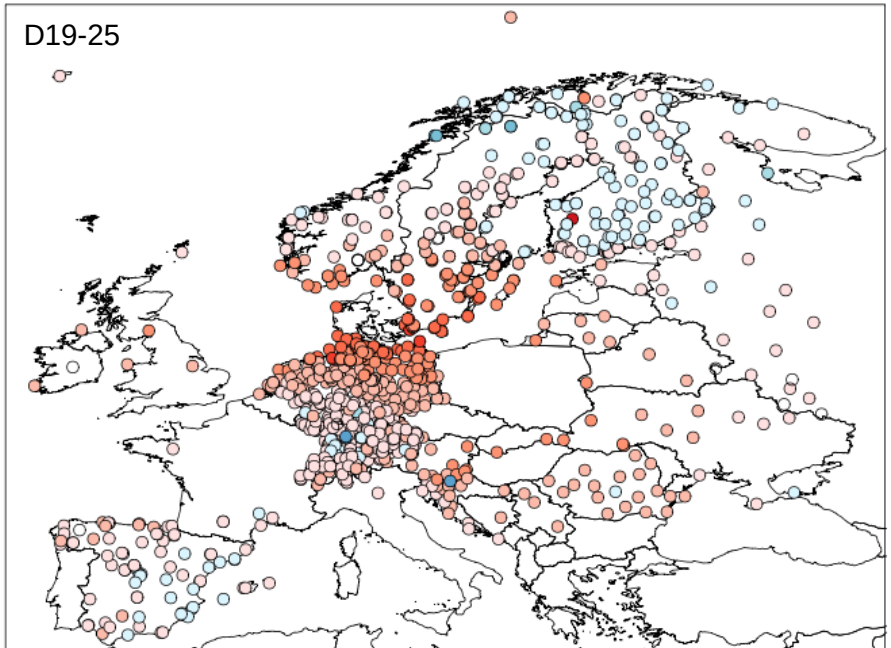


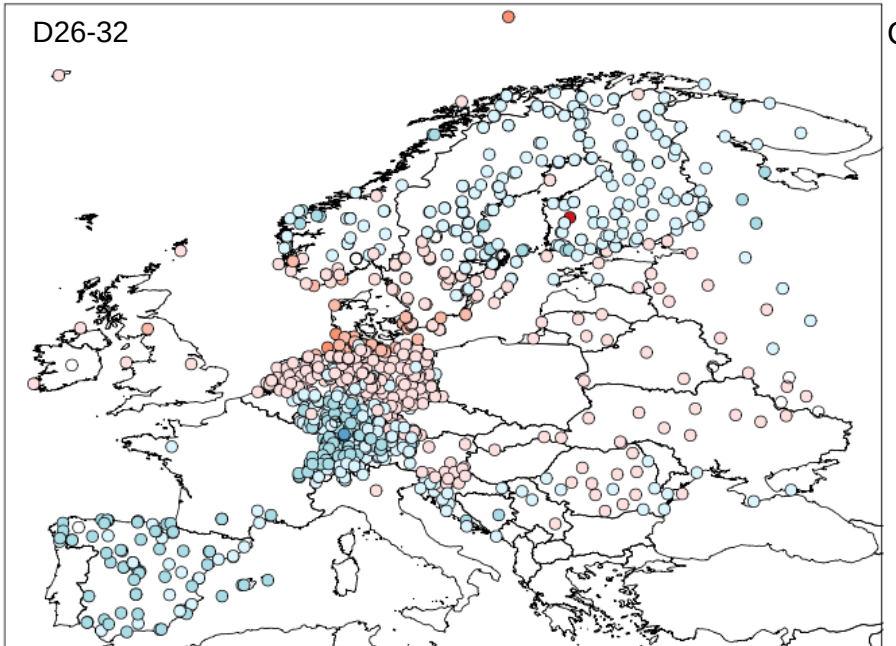



CRPSS
Temp

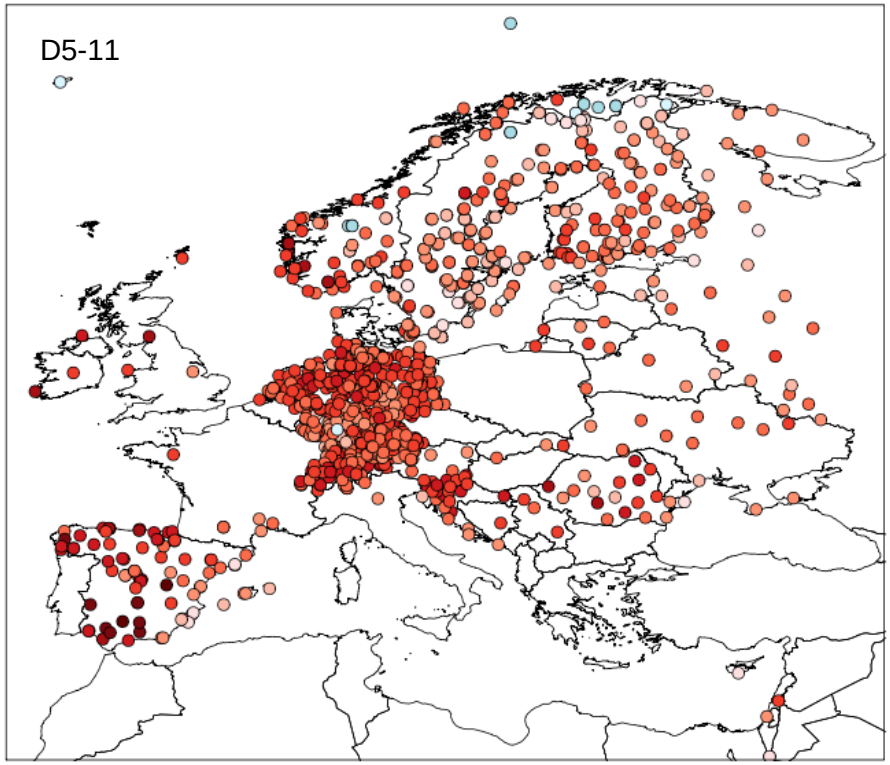
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45

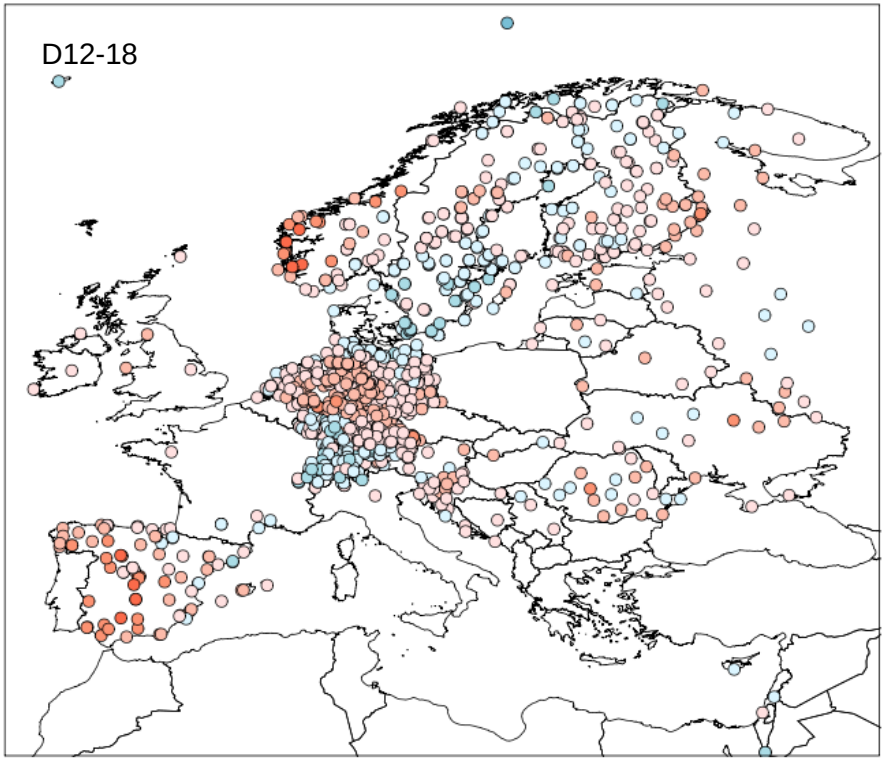



CRPSS
Temp

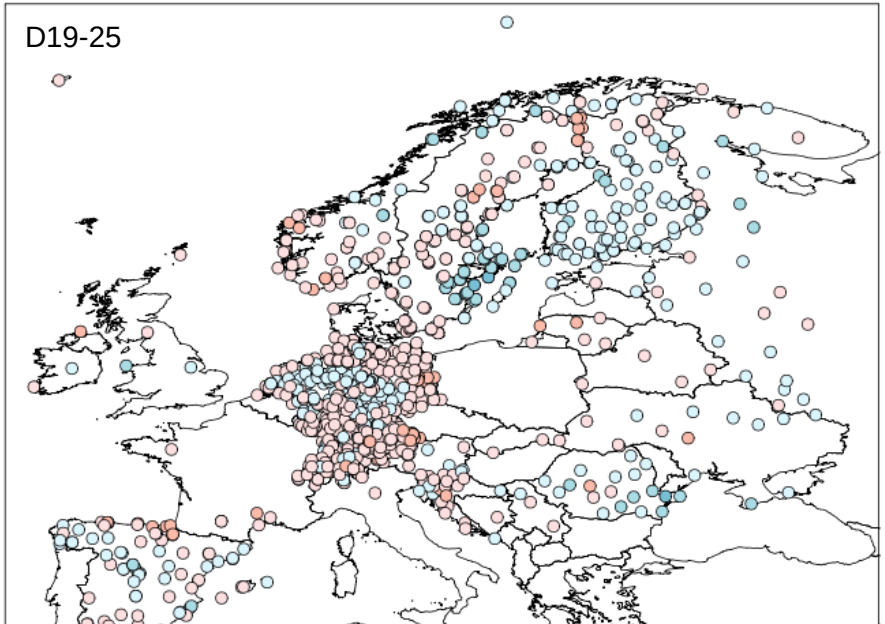
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45

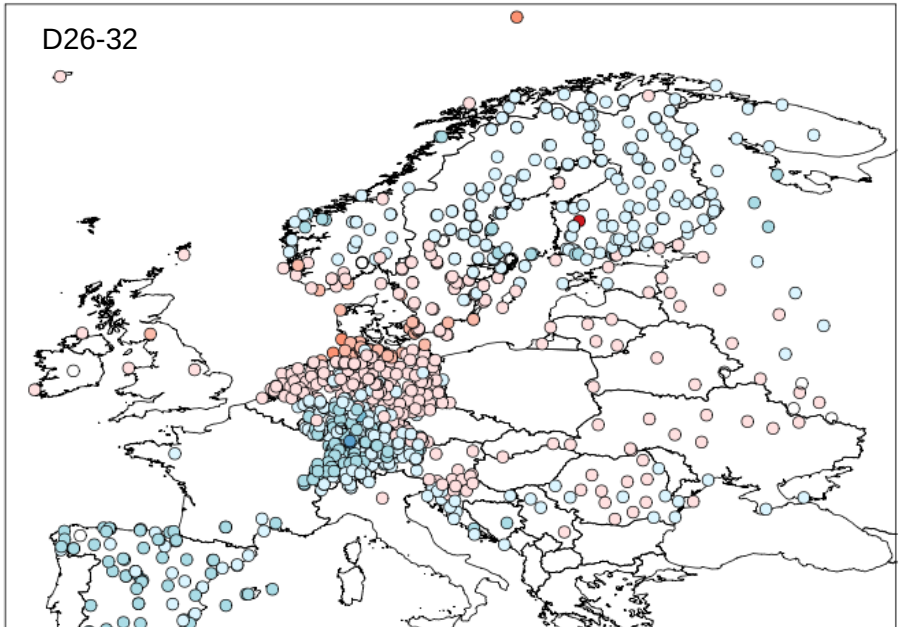



CRPSS
Prec.

0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45




CRPSS
Prec.

0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45

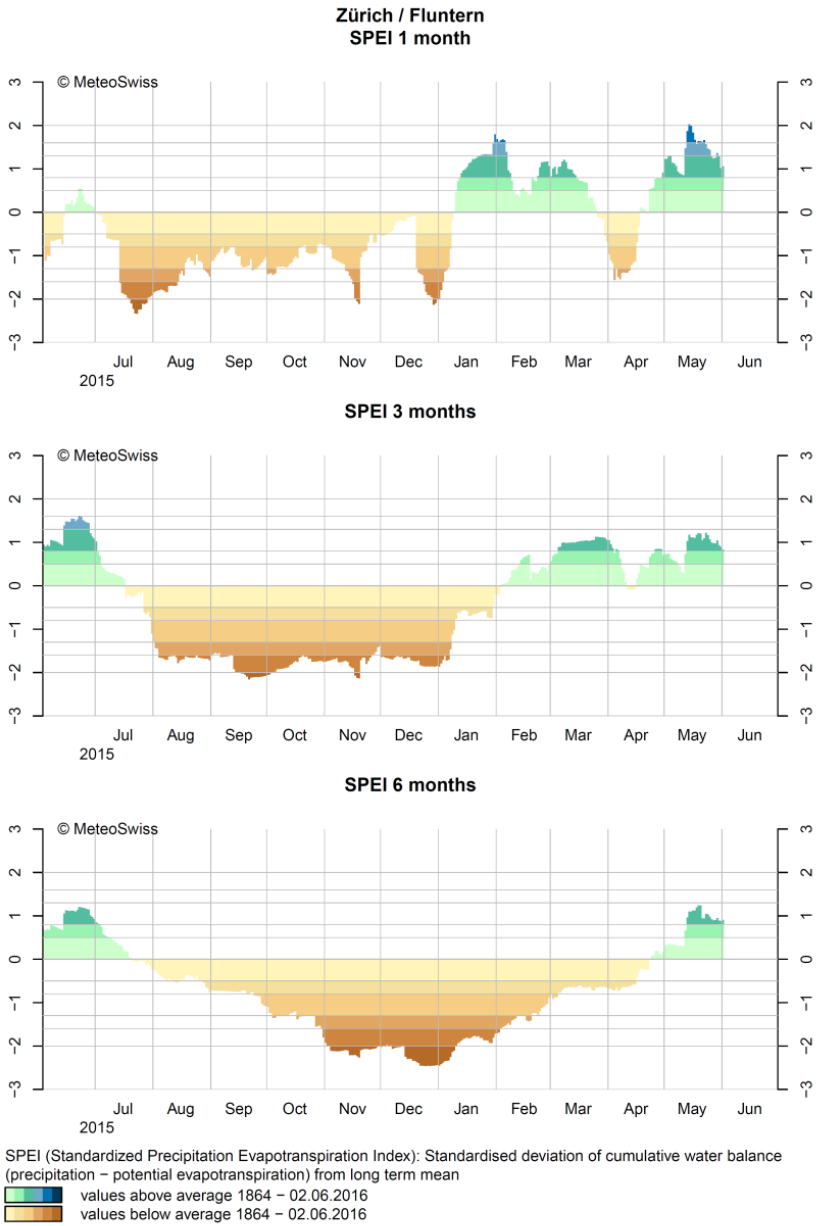
# Skill temperature and precipitation

- Skillful forecasts (T) for up to 4 weeks lead time (discrimination) and up to two weeks (CRPSS)
- Quantile mapping outperforms mean debiasing technique
- Spatial skill patterns quite homogenous
- Winter and autumn with higher skill and with more pronounced regional differences

# SPEI Index

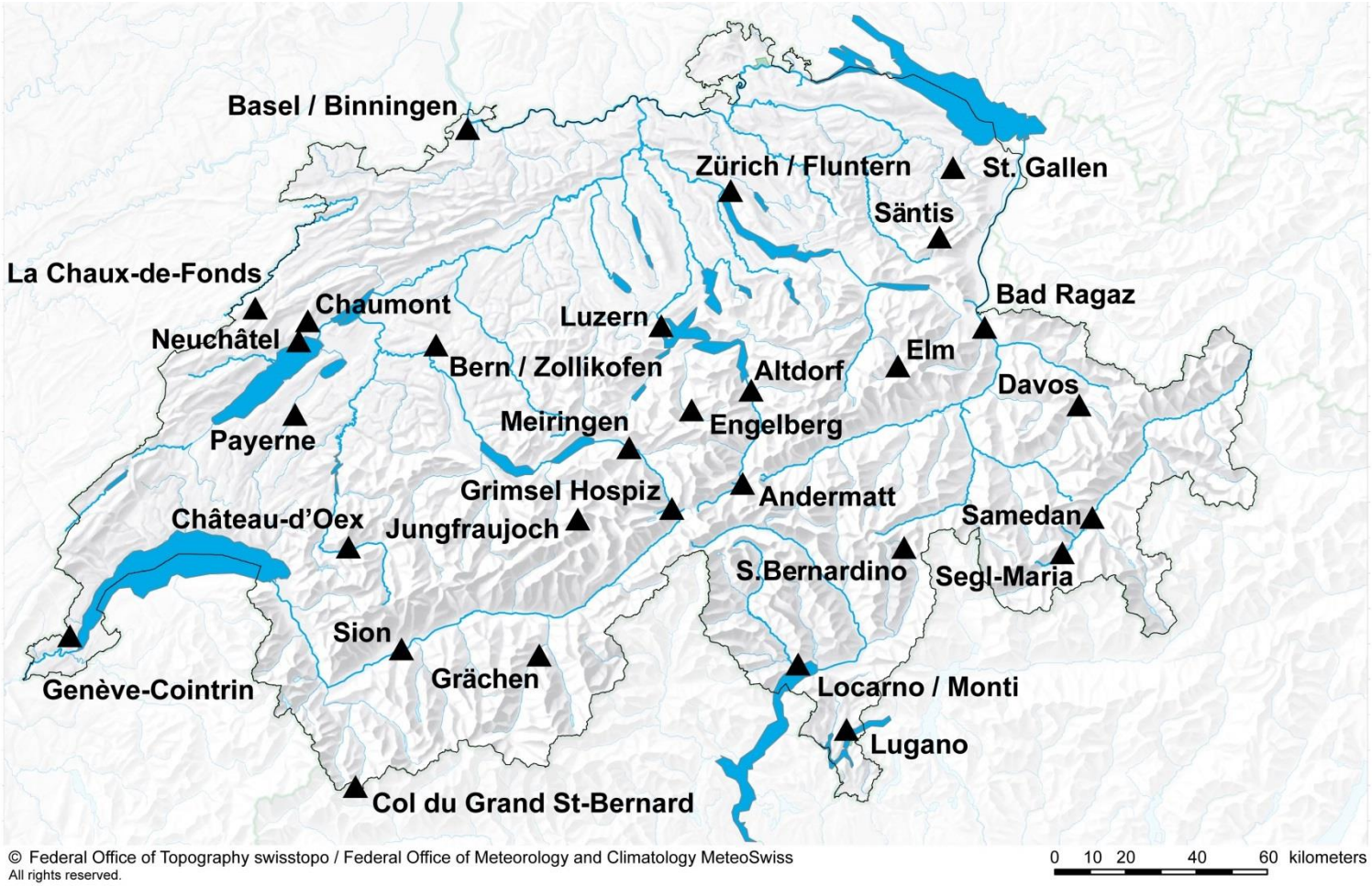
- cumulative water balance (WB)
- different time periods: 1 – 24 months
- index = value of standardized WB, negative values = dryer than norm positve values = wetter than norm
- model case for long term forecasts: system with different degrees of memory

Vicente-Serrano et al., 2010, Buegería et al., 2014

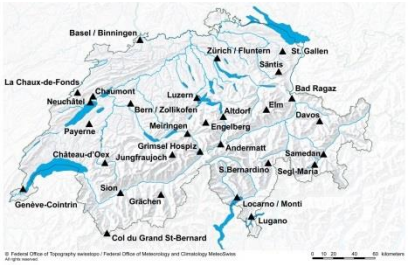



MeteoSwiss

# Climate observation network

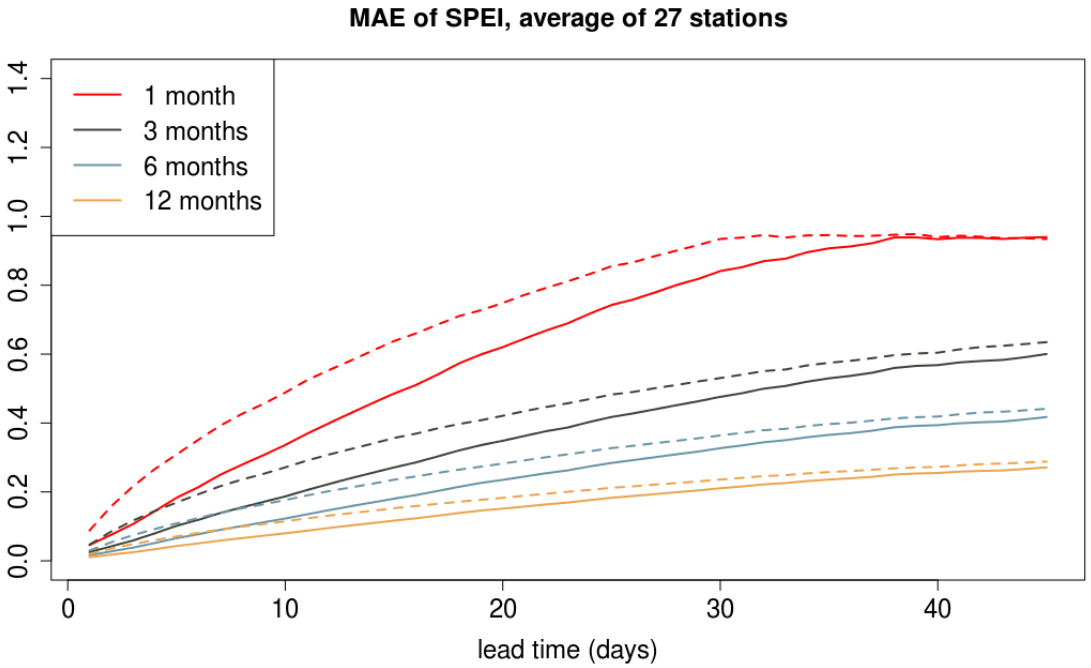


# SPEI verification




- 27 observation sites
- hindcasts of current operational IFS cycle
  i.e. March – April initial dates of 1996-2015

# SPEI verification

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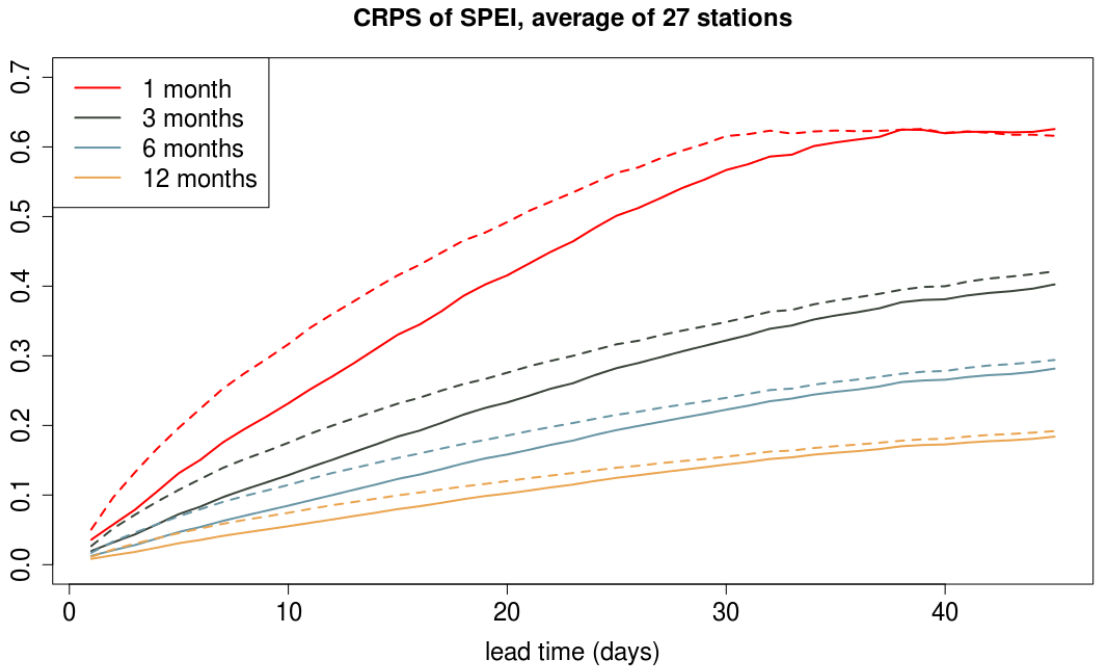
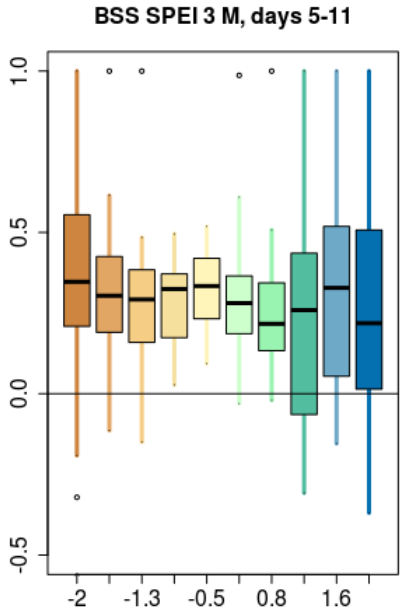
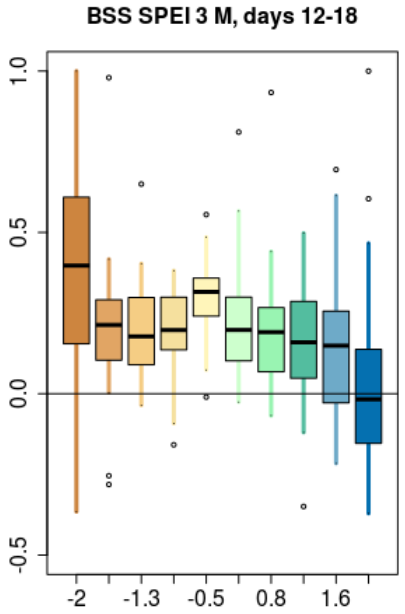
climatological
T/prec forecasts

# SPEI verification




BSS SPEI 3 M, days 5-11
1.0
0.5
0.0
-0.5
-2
-1.3
-0.5
0.8
1.6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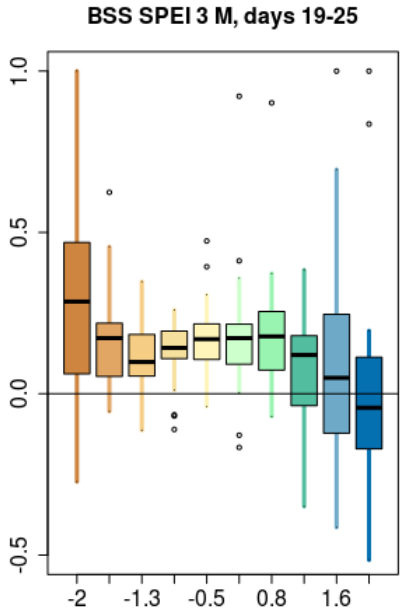
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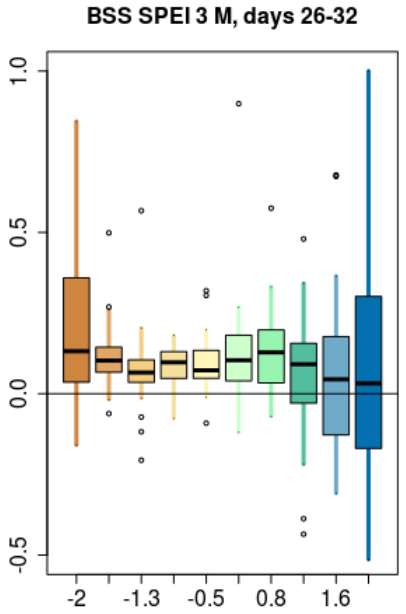
0.8
1.6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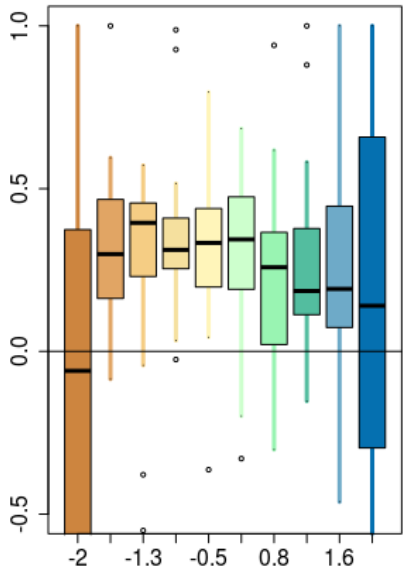
0.8
1.6


BSS SPEI 6 M, days 5-11
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0.0
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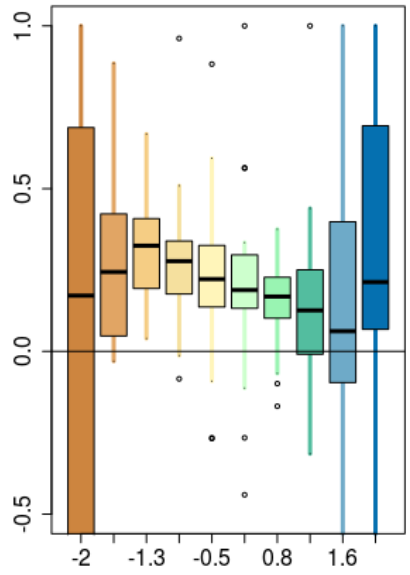
0.8
1.6


BSS SPEI 6 M, days 12-18
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-2
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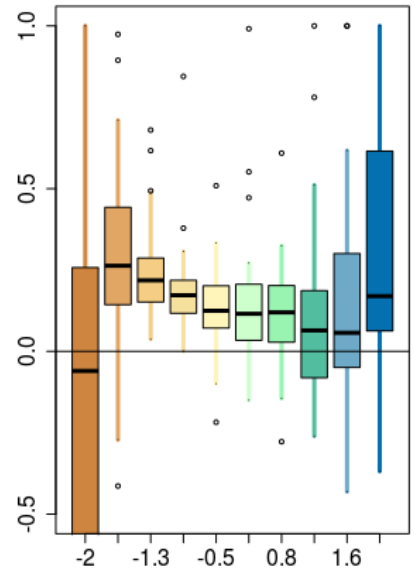
-0.5
0.8
1.6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-2
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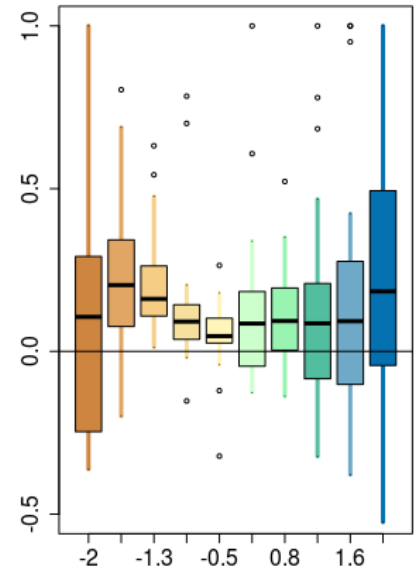
0.8
1.6


BSS SPEI 6 M, days 26-32
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-2
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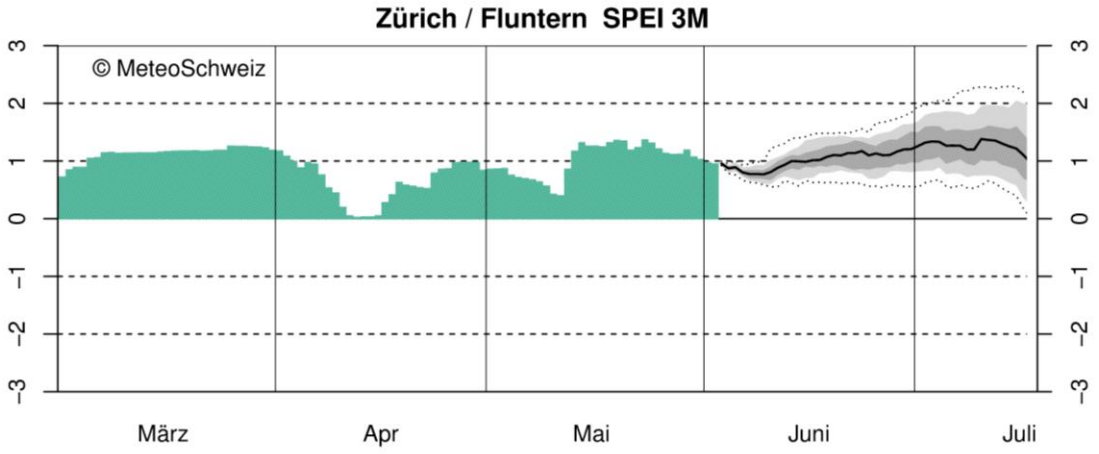
-0.5
0.8
1.6

# SPEI predictions




ECMWF Monatsvorhersagen:

10–90%–Quantil
25–75%–Quantil
2.5–97.5%–Quantil

Stand: 02.06.2016

# Seasonal forecasts in East Africa

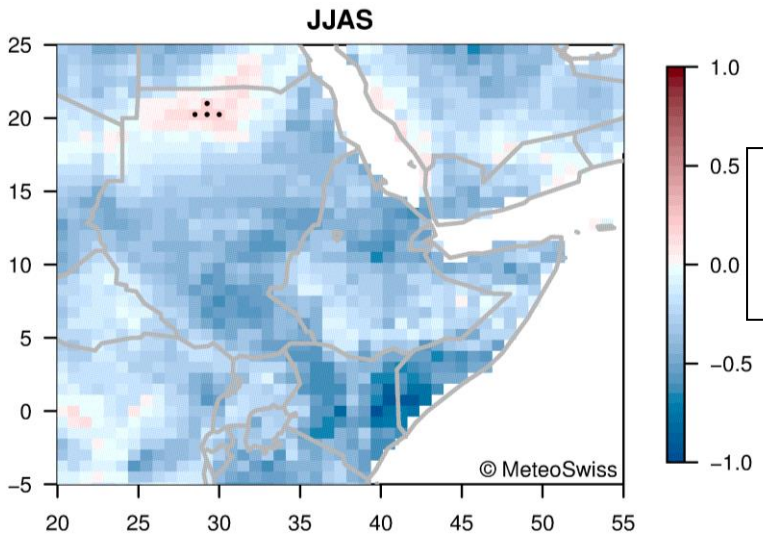
EUPORIAS

- Ethiopia's food security early warning system


- Main cropping season: June-September
- Skill of seasonal forecasts (ECMWF System 4) for predicting precipitation and cumulative water balance?

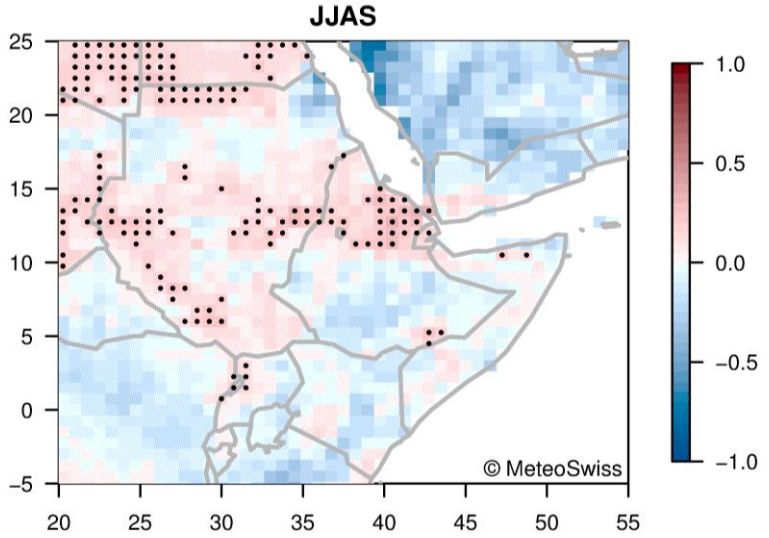
# May forecasts for JJAS

RPSS of cum. water balance
from raw model output



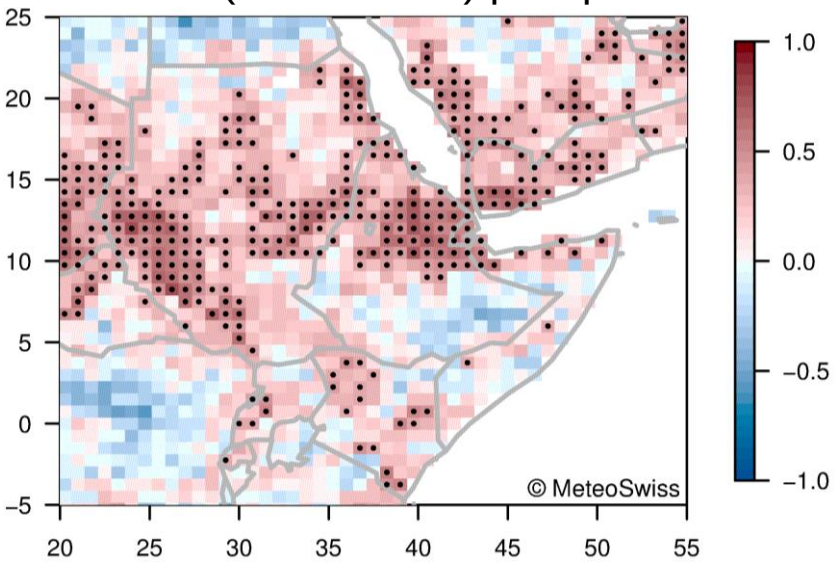

bias-corrrection of $T_{min}$, $T_{max}$, and precipitation

RPSS of cum. water balance
from bias-corrected model output

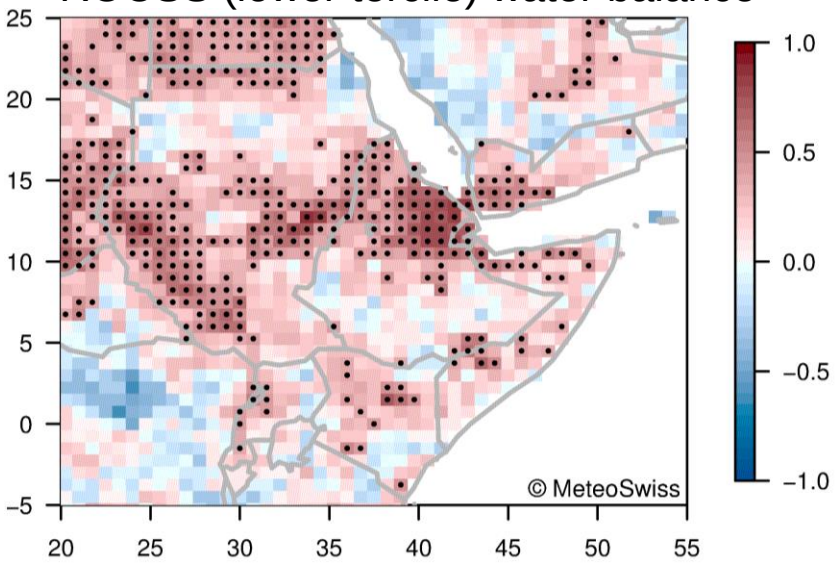


# Resolution

ROCSS (lower tercile) precip sum

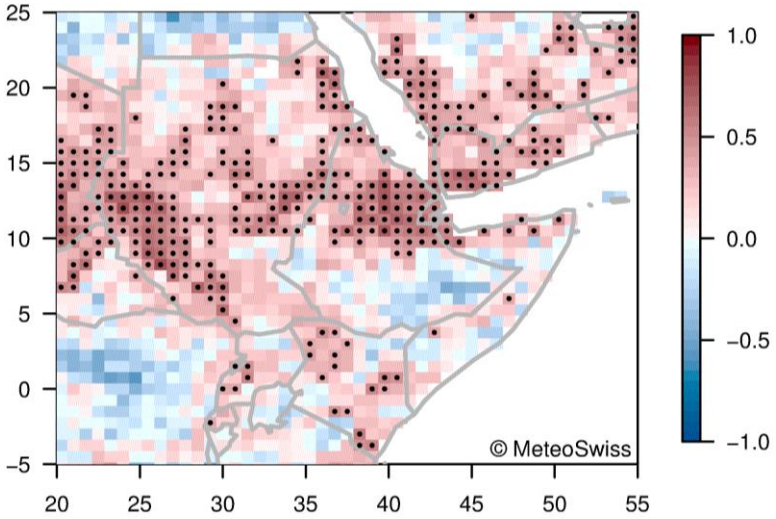



ROCSS (lower tercile) water balance

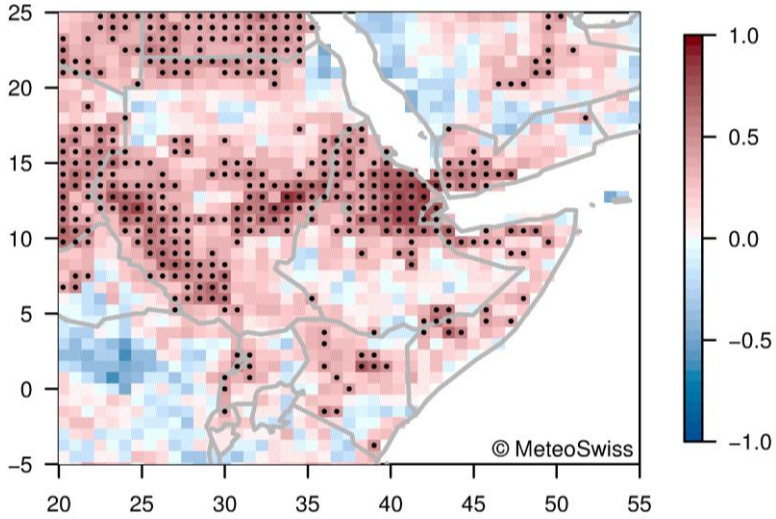


# Precipitation vs water balance

ROCSS (lower tercile) precip sum




ROCSS (lower tercile) water balance




- Similar skill for water balance ($= f\,(T_{min}, T_{max}, prec)$ ) and precip
- Signifcant regional and temporal (skill of ind. months) differences

# Conclusions

- Skill of SPEI monthly forecasts
- Better skill for dry anomalies?
- Water balance seasonal forecast for E Africa with similar or better skill than precipitation
- Indicators with inherent memory call for seamless approaches

# Thank you

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SCHWEIZERISCHER NATIONALFONDS
FONDO NAZIONALE SVIZZERO
SWISS NATIONAL SCIENCE FOUNDATION

EUPORIAS

SEVENTH FRAMEWORK PROGRAMME

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Swiss Confederation

Federal Department of Home Affairs FDHA
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