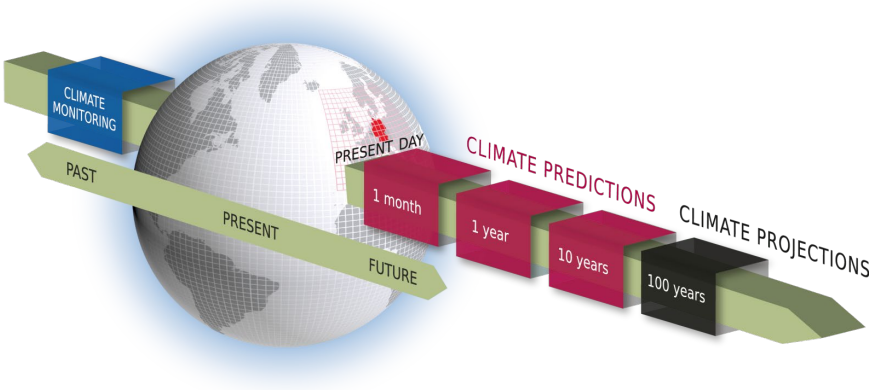
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Climate forecasting techniques at DWD



Kristina Fröhlich
Deutscher Wetterdienst
K. Isensee, J. Wandel, A. Paxian, A. Hoff, B. Früh

Seasonal Forecasting Techniques at DWD

1. Global dynamical coupled model system with data-assimilation in ensemble mode:

   The German Climate Forecast system

1. Statistical downscaling for the region of Germany

MPI-ESM-HR/German Climate Forecast System 2.1 (GCFS2.1)

ECHAM6:

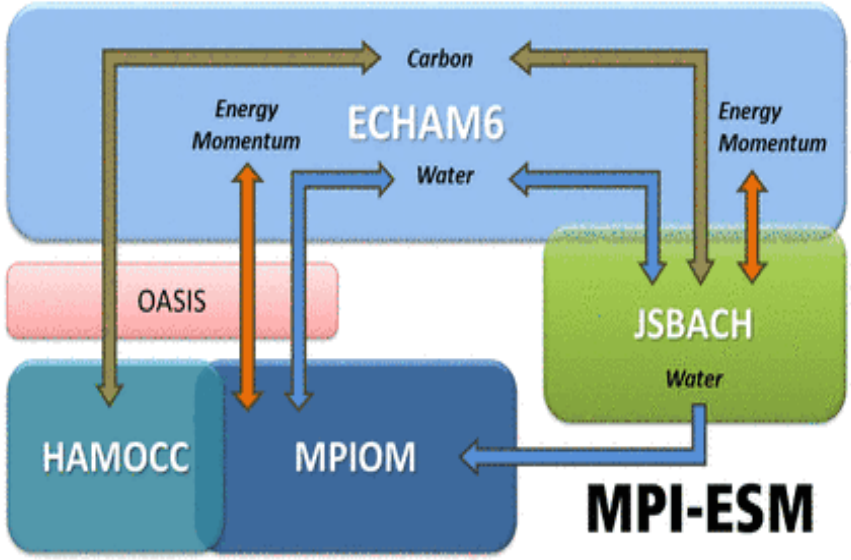
- horizontal resolution T127~ (0.9°x0.9°)
- vertical 95L up to 0.01hPa (80 km)
- Land model: JSBACH
- Run off model
- Transient GHG's, aerosol, ozone, solar irradiance
- Current GHG conditions taken from ssp245

MPIOM:

- horizontal: 0.4°
- vertical: 40 levels
- Sea-ice-Model
- Geo-Bio-Chemical Model

Coupler OASIS3:

- Hourly exchange between ocean and atmosphere



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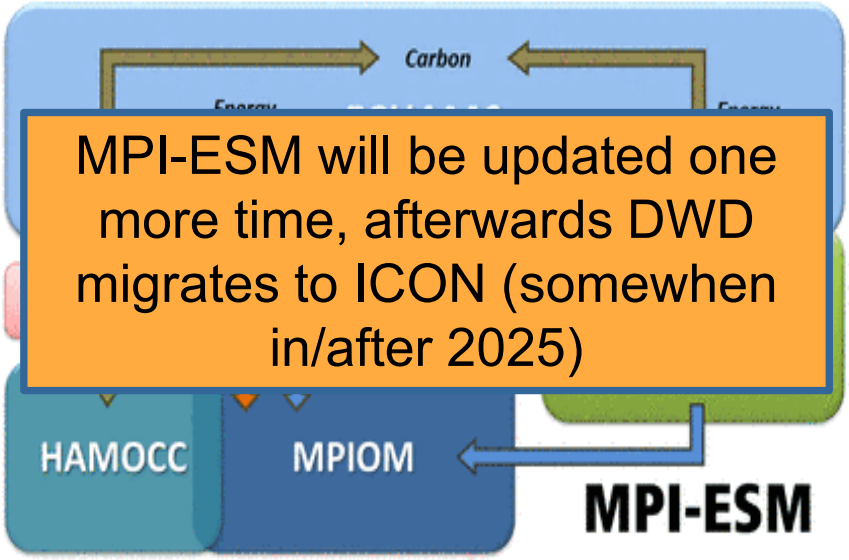
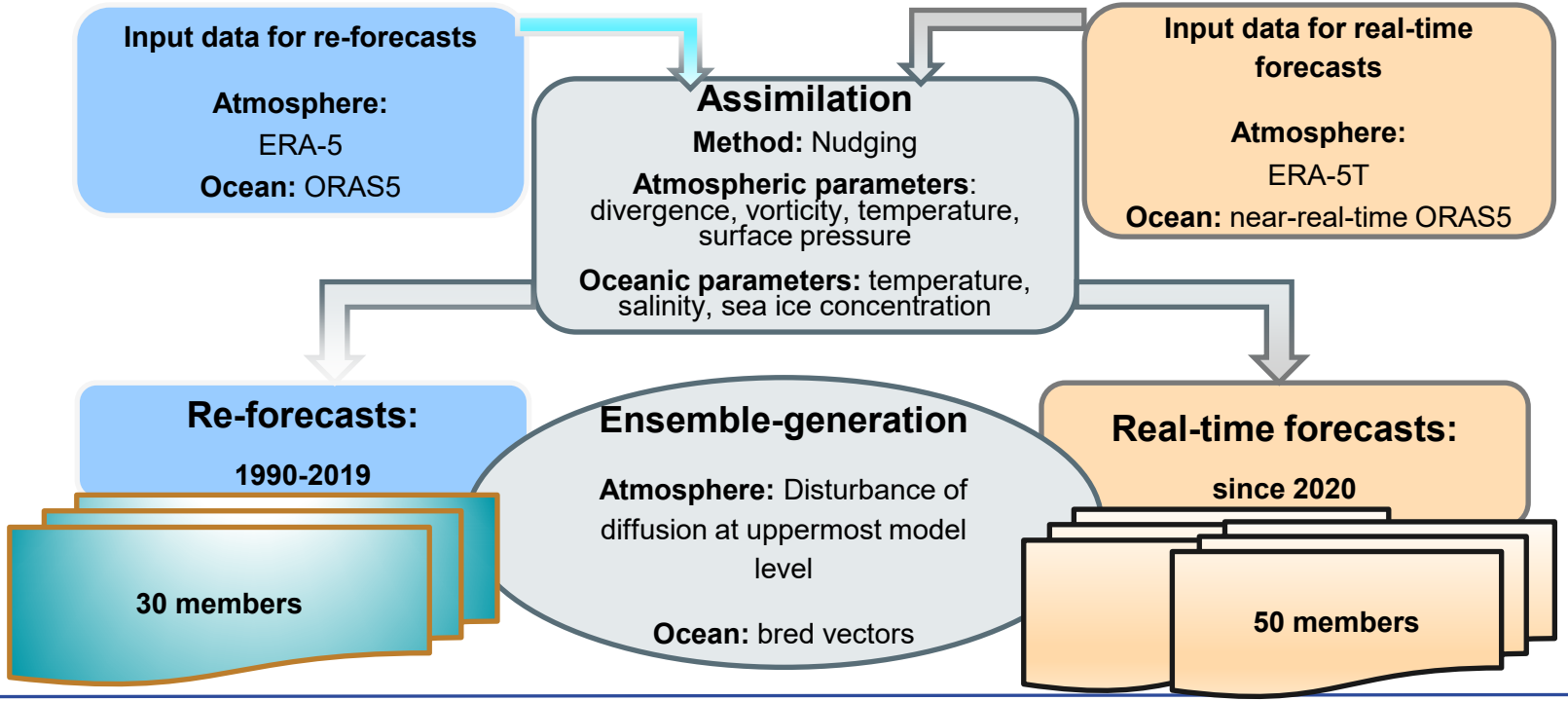
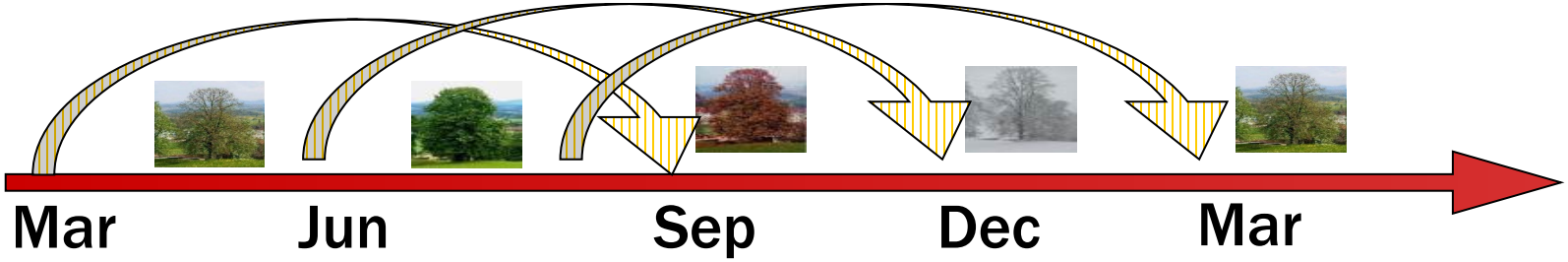


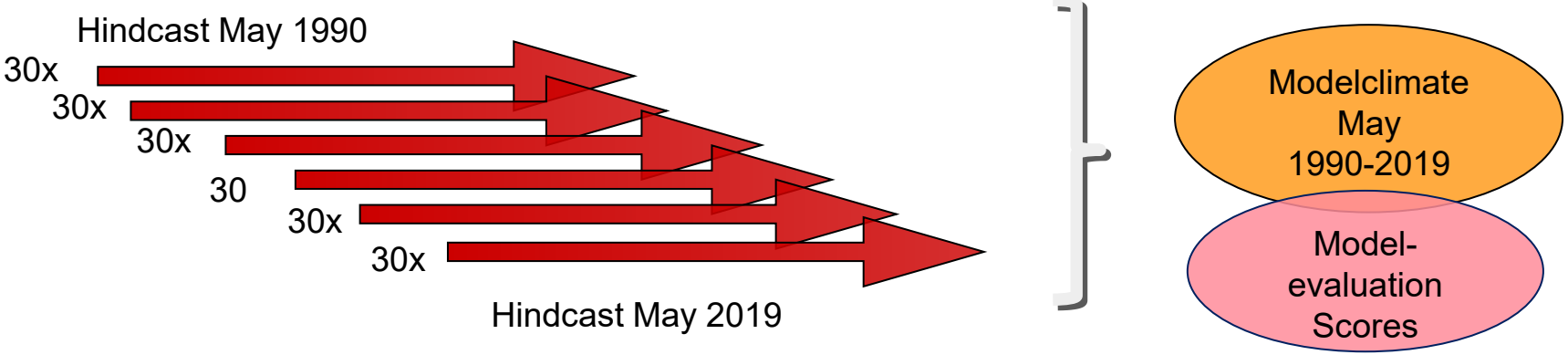
MPI-ESM will be updated one more time, afterwards DWD migrates to ICON (somewhen in/after 2025)

Configuration GCFS2.1



Workflow of Hindcasts GCFS2.1





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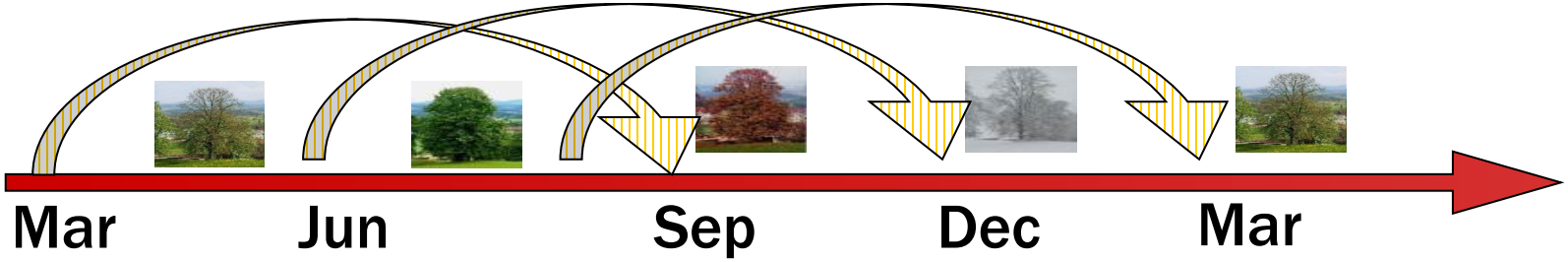


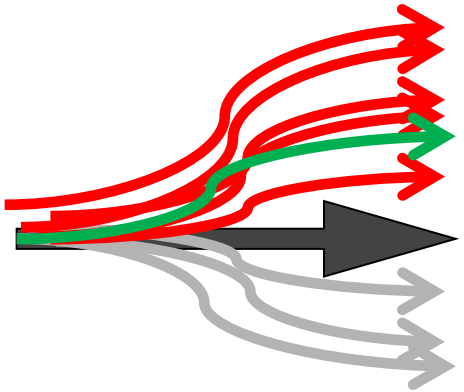
Ensemble-Forecast
May 2023

50x

\-

Modelclimate
May
1990-2019

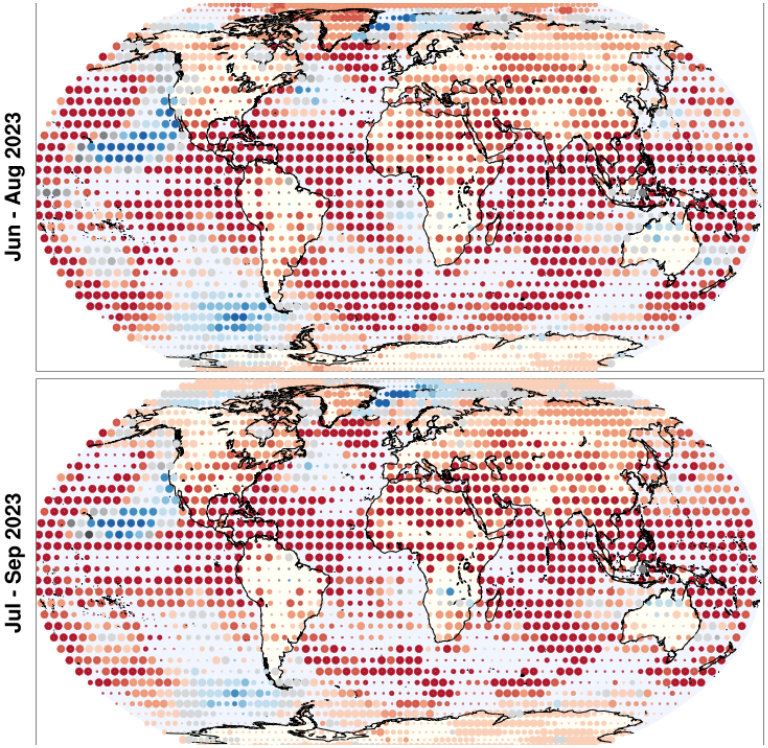
=

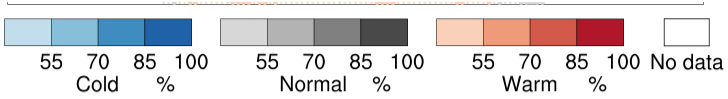


Anomaly-Forecast
May plus lead months 2023

Current summer 2023 prediction

70 Jahre Deutscher Wetterdienst
Wetter und Klima aus einer Hand





Probabilistic prediction for temperature:
The colour represents the most probable category (Cold/Normal/Warm) of the climate prediction (3-month mean) in comparison to the climate characteristics for 1991-2020. The brightness describes the probability of this category.

Prediction skill:
The size of the dots shows the skill in the evaluation period 1991-2020:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

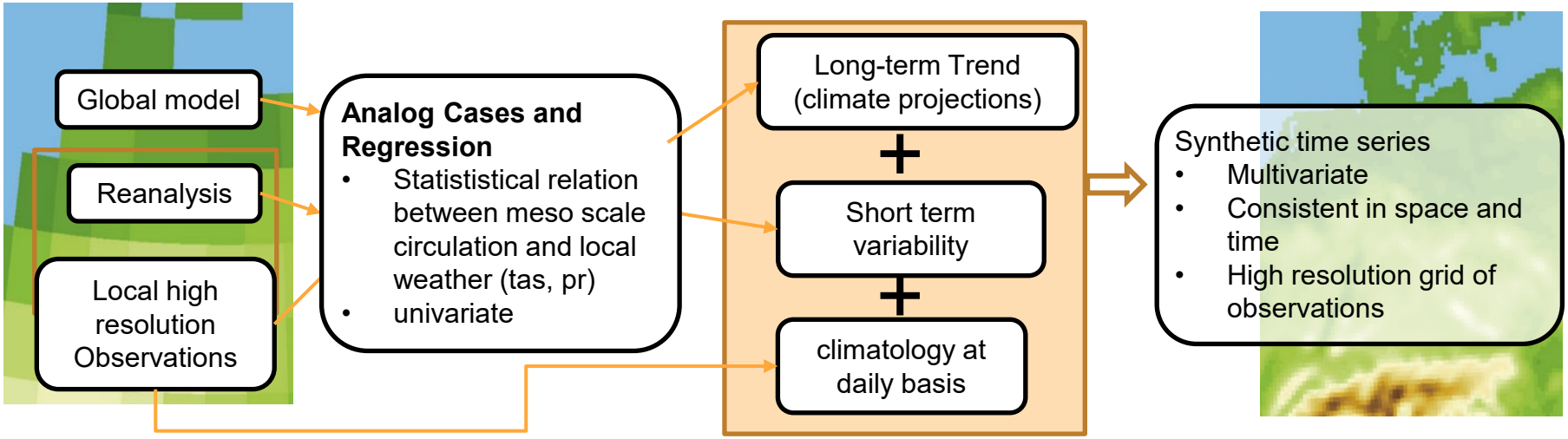
Prediction start on 01 May 2023, generated on 04 May 2023 © DWD

https://www.dwd.de/EN/ourservices/kvhs_en/2_expert/month/monthly.html

Empirical-statistical Downscaling with EPISODES for Germany

70 Jahre Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Method: Perfect-Prog-Approach

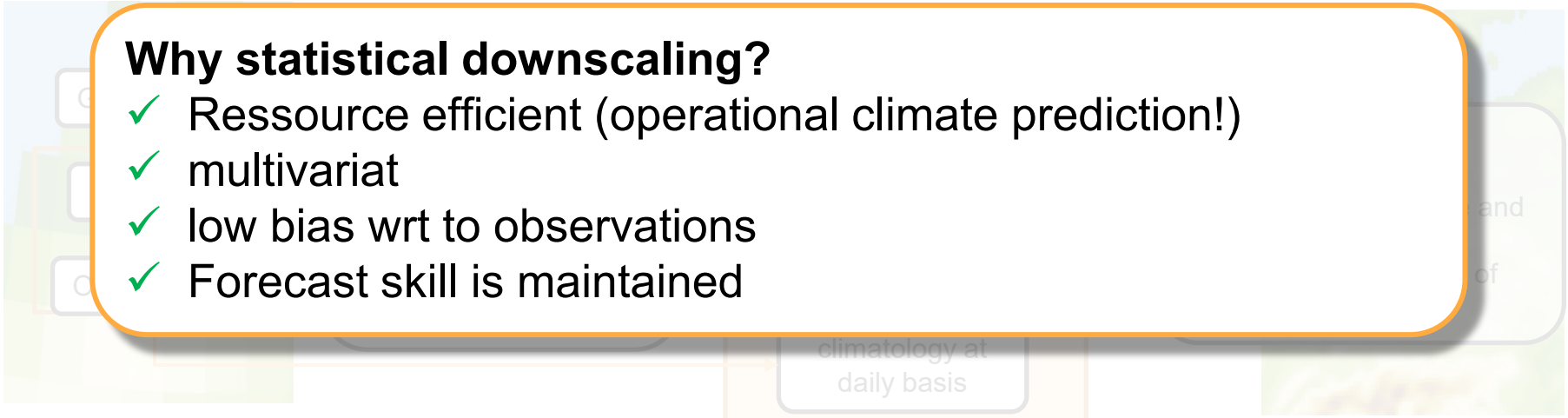


Kreienkamp, F., Paxian, A., Früh, B. et al. Evaluation of the empirical–statistical downscaling method EPISODES. Clim Dyn 52, 991–1026 (2019). https://doi.org/10.1007/s00382-018-4276-2

Method: Perfect-Prog-Ansatz

Why statistical downscaling?

- ✓ Ressource efficient (operational climate prediction!)
- ✓ multivariat
- ✓ low bias wrt to observations
- ✓ Forecast skill is maintained



1st step AFREG

2nd step weather generator

Kreienkamp, F., Paxian, A., Früh, B. et al. Evaluation of the empirical–statistical downscaling method EPISODES. Clim Dyn 52, 991–1026 (2019). https://doi.org/10.1007/s00382-018-4276-2

Why (not) statistical downscaling?

- !! Forecasts represent only already observed events
- !! Only selected variables according to the high-resolution data set in use
- ➢ A local high-resolution data set of observations or reanalysis, where 100m winds can be produced is of extreme help (e.g. COSMO REA6)
- !! Only daily values so far
- ➢ This depends on the algorithm of EPISODES and could be extended in a daily cycle. Other approaches, like ML, again by using a high resolution reanalysis set could help as well

Kreienkamp, F., Paxian, A., Früh, B. et al. Evaluation of the empirical–statistical downscaling method EPISODES. Clim Dyn 52, 991–1026 (2019). https://doi.org/10.1007/s00382-018-4276-2

Current summer 2023 prediction

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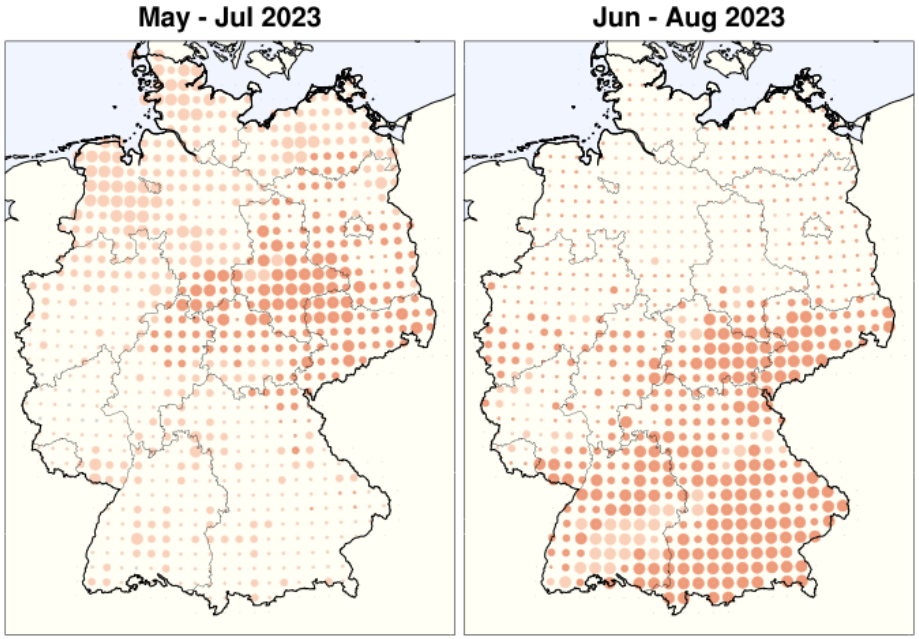

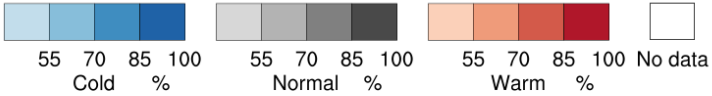

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Climate predictions at DWD

Thank you very much!

Questions??