Clara Hauke, Uwe Ulbrich, Henning Rust
c.hauke@fu-berlin.de

1. Motivation

- Under climate-change conditions, droughts and other meteorological extremes are likely to increase in frequency and intensity
- SpreWasser.N investigates the impacts of such extremes on the hydrological system in the region of the river Spree
- To estimate regional risks, the probability of future drought events is assessed
- The results are used to develop strategies for adapting regional water use

2. Drought variables

- Time span: 1980 - 2021
- Mean river study area of precipitation (P) and evapotranspiration (E)
- Calculate "climatic water balance" (P-E) as drought measure

3. Dry days - comparison to observational data

- Set thresholds for "dry days" (simple drought measure) in simple statistical analysis of precipitation: threshold of 0.24 mm/d in ERA5 is equivalent to threshold of 0.1 mm/d in observations

4. Simple drought measures

- Simple statistical drought measures can give some insights, but are not specific enough for most use cases

5. Exemplary application: agriculture

- Negative trend in climatic water balance in April-June
- Yields are negatively correlated with the number of dry days in April-June, which is an important growing season for most crops

6. Drought identification and detection tool

- Input: Time series of climatic water balance
- Tool identifies drought periods based on drought threshold (a percentile of the smoothed daily climatological mean, in this example 25%), allowing a certain number of days where the threshold is not reached as gaps

7. Large-scale weather context

- Objective weather type classification

8. Identification of drought predictors / drought forecast

- Identify meteorological predictors for drought using a machine learning model which automatically selects predictor variables and regions yielding the highest (drought index) forecast skill, taking into account preliminary meteorological conditions and the evolution of meteorological variables (persistence, succession, frequency)
- Forecast drought index, for different forecast lead times

9. Analysis of drought predictability

- Analyze predictability of weather patterns related to drought for forecast lead times from weeks to months
- Assess forecast skill of drought in the Spree region with seasonal forecast system ensemble-hindcasts (DIFS by Deutscher Wetterdienst)
- Examine how lead time affects uncertainty
- Investigate specific situations with above-average predictability w.r.t. weather patterns (persistent weather patterns, successions of weather patterns, ...)

10. Estimate future development

- Estimate future occurrence probabilities of relevant drought events and the associated uncertainties on the basis of available model calculations of decadal climate predictions and climate projections
- Determine dependence on lead time (for decadal predictions)