Creating a high temporal and spatial resolution climate reference data set for the modeling of hydrological extreme events

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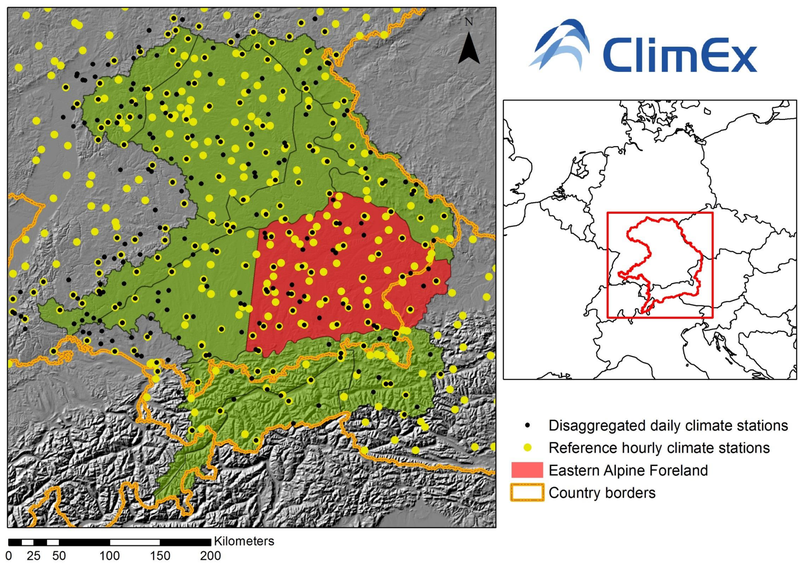
1. Introduction

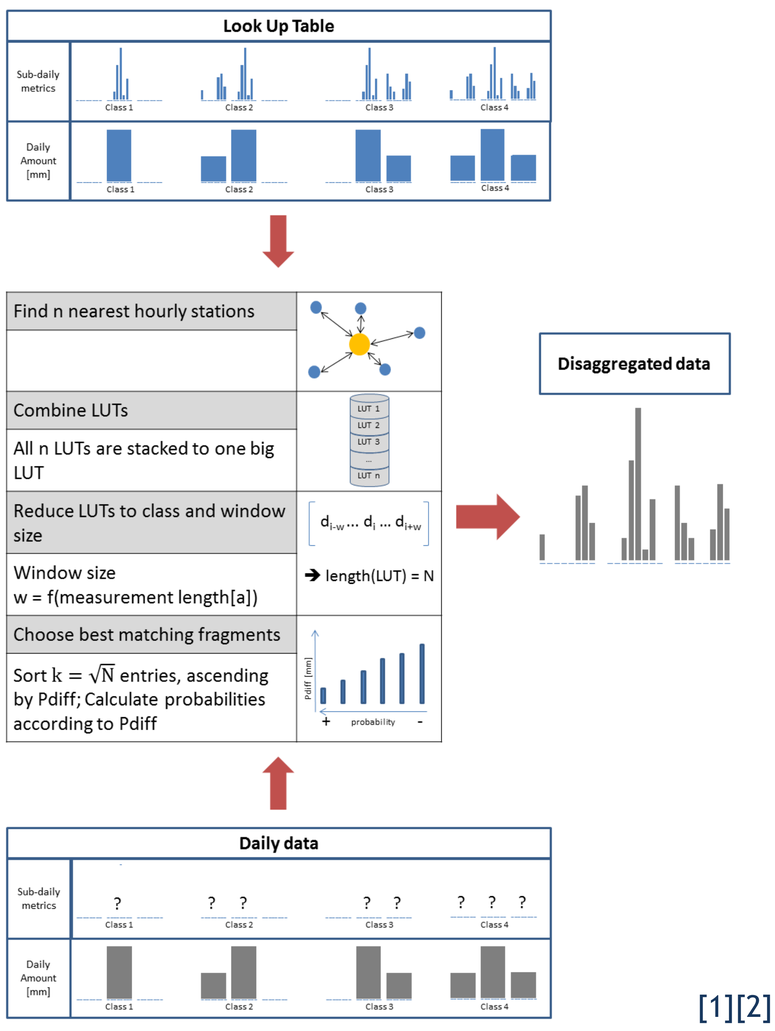
- The ClimEx project focuses on assessing the effects of climate variability and climate change on hydro-meteorological extreme events in Bavaria and Québec
- Analyzing such events for water resources and flood risk management requires high resolution information, both in time and in space, exceeding the capacities of regular observation networks
- This study focuses on
  - the development of a climatological reference data set in high temporal (1h - 6h) and spatial resolution (500m) for 1980-2010
  - extending and distributing sub-daily time series for numerous stations over mesoscale catchments

2. Study area and Data

The hydrological Bavaria: ~100.000 km²



3. Method of Fragments (MOF)



[1][2]

4. Results and Validation of temporal disaggregation

Seasonality

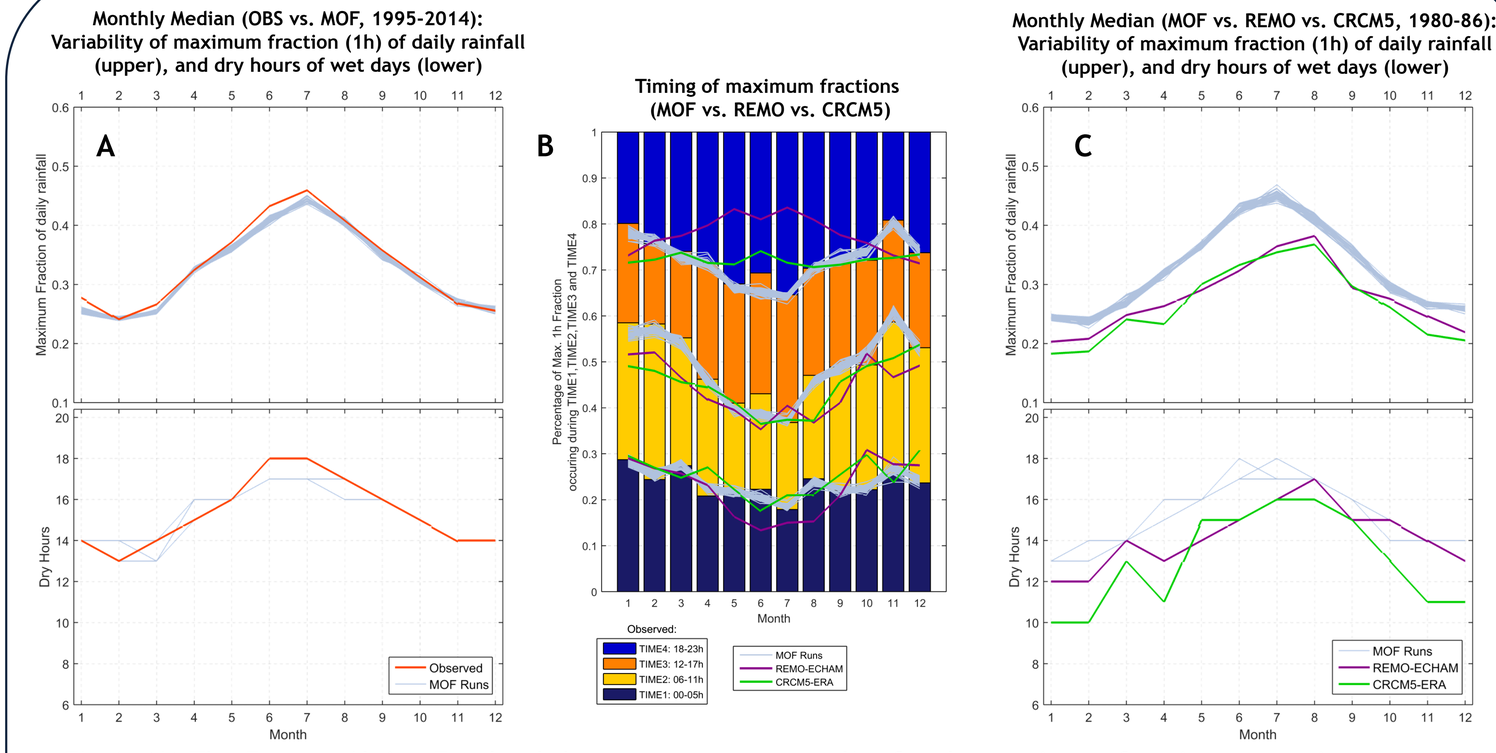


Fig.1: (A) The Eastern Alpine Foreland shows a strong seasonality for the maximum fractions occurring on wet days, with 1h rainfall bursts intensifying in magnitude and duration in summer. 39 Runs of the Method of Fragments (MOF) show a very good representation of the observed data. The Variability in the MOF runs is due to the probability function of the method. (B) The timing of the maximum fractions show an inverse relation between winter and summer, whereby the MOF is again performing very well. (B-C) Comparing two not bias corrected RCM data sets (REMO-ECHAM, CRCM5-ERA) with the observed and modeled (MOF) behavior, reveal shortcomings in the timing, the magnitude of maximum fractions and number of dry hours of the RCM data.

Extremes

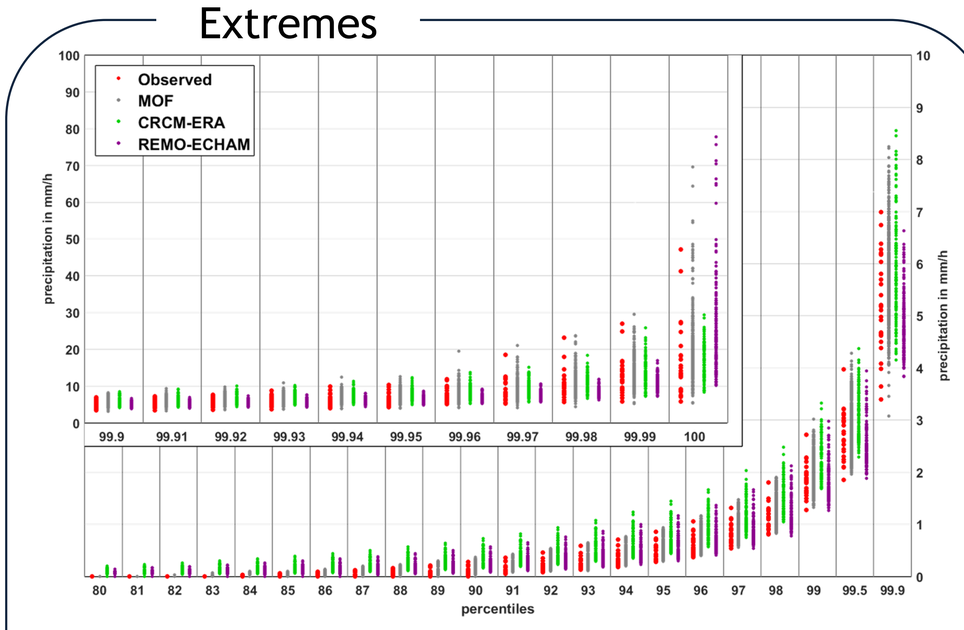


Fig.2: Hourly precipitation values for summer (JJA) in the Eastern Alpine Foreland for 1995-2014: Observations are point measurements of 26 Stations (red) and 39 realizations of MOF for each of these stations (grey). RCMs are represented by 146 tiles of a first test run of the CRCM5 (12km) driven by ERA-interim (only 1980-1986) and by 234 tiles of the REMO (10km) driven by ECHAM5 [3]. In upper percentiles (80-99) an overestimation can be observed, extreme values (>99-Percentile) show higher agreement to observations and MOF.

Runoff

Fig. 3 : Two uncalibrated hydrological model runs, driven by different precipitation data (MOF and uniformly distributed) are compared. Major differences appear in the peak flows. The uniform data weakens the hydrological response of a multi-day rain event.

5. Conclusion & Outlook

- The Method of Fragments is able to reproduce region specific climate characteristics, such as seasonality and timing of maximum fractions
- The 39 realizations of the MOF show a high agreement in hourly precipitation values for the higher percentiles with an overestimation of the absolute extreme values
- The MOF delivers realistic and plausible precipitation distributions and thus can be used as input for hydrological models and for bias correction of sub-daily climate model data
- Next steps are targeted to:
  - provide reliable and consistent results for other climate variables
  - develop and apply suitable spatial interpolation methods

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