Assessment of bias removal for deterministic medium-range weather forecasts in the Po river basin, Italy, Europe

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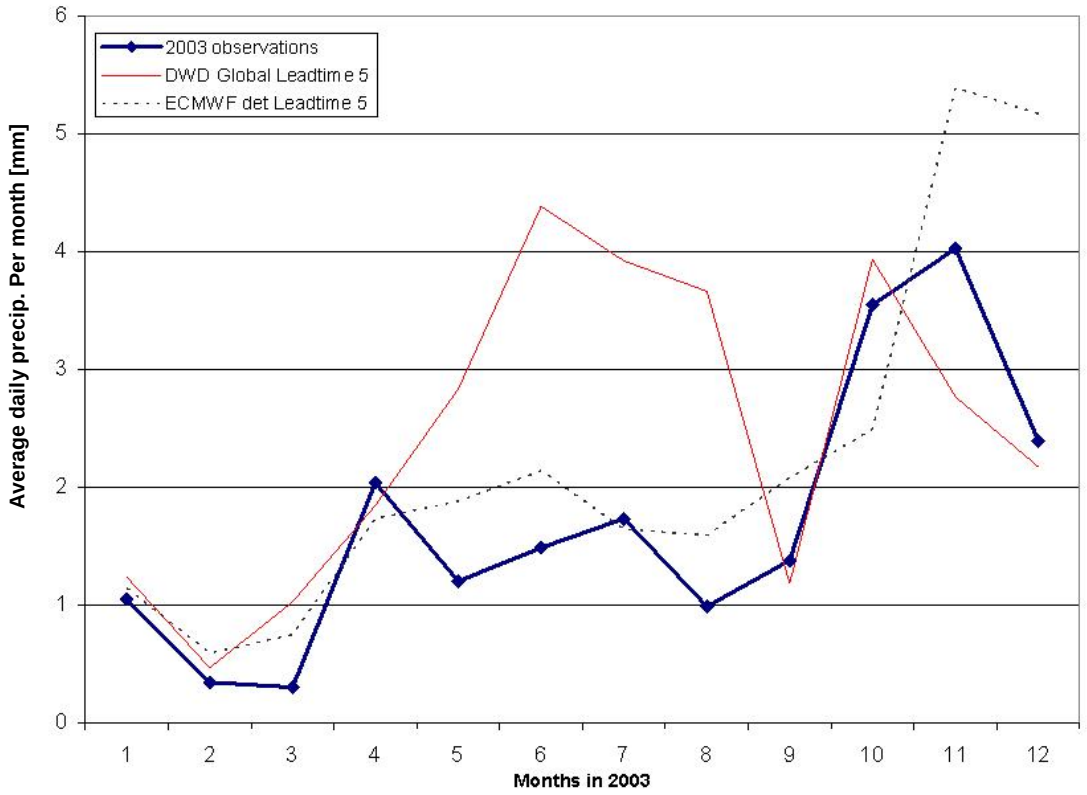
Why Bias removal?

- Medium-range flood forecasting strongly depends on the quality of the precipitation forecasts
- NWP models often have systematic errors due to their coarse grid resolution, temporal scale, simplification of complex physical processes (e.g. precipitation generation)



from HEPEX Testbed Progress Report #1

The focus of this research is based on the applicability of the bias correction method for an operational flood forecasting system (EFAS).

Requirements:

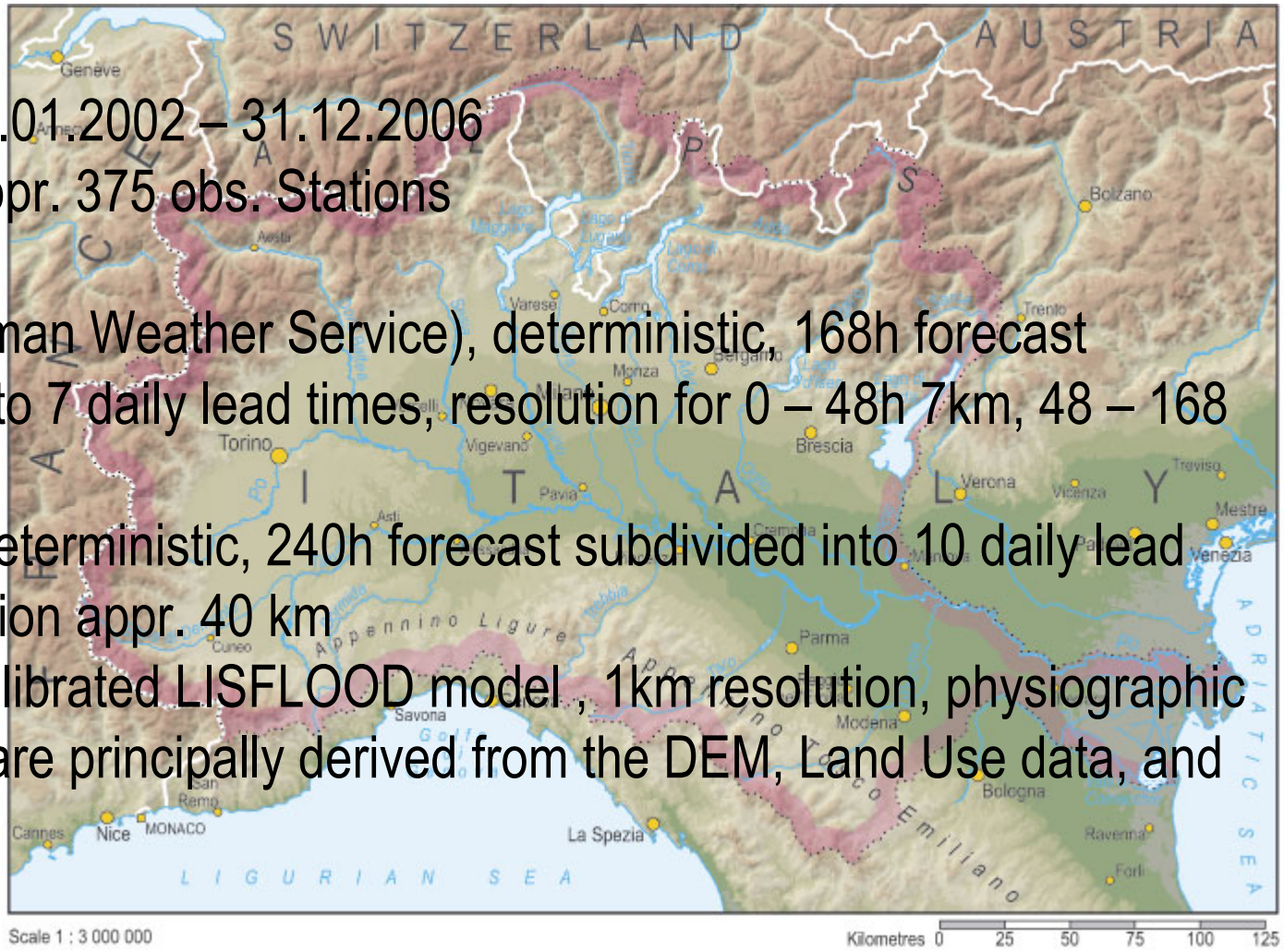
- easy to implement
- computationally efficient
- capable to remove the spatially and temporally variable bias in the precip. input data

Due to the frequent change of the NWPs, the use of bias correction methods employing model climatology is difficult

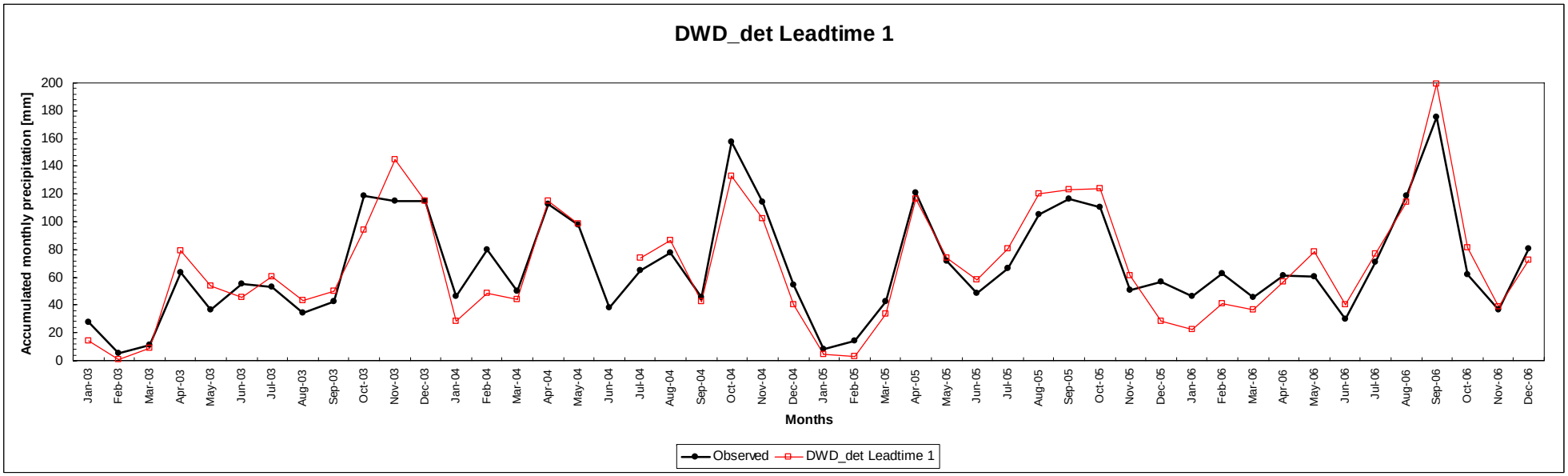
As a first step we will look at the deterministic forecasts used in EFAS

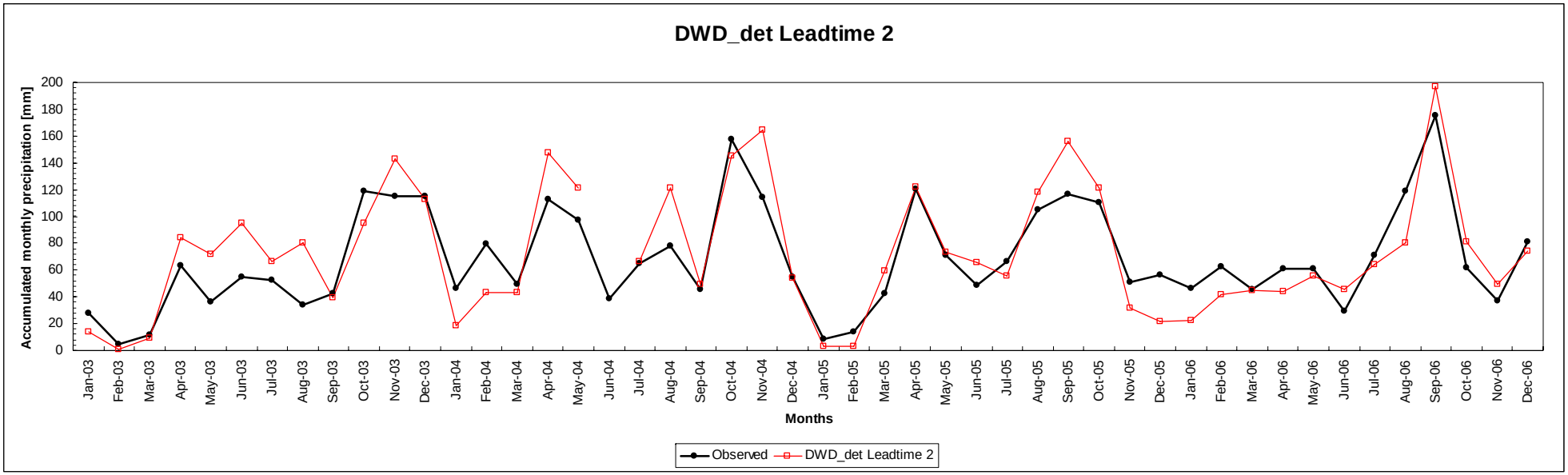
The Po river basin testbed:

- Period of interest: 01.01.2002 – 31.12.2006
- Precipitation data: appr. 375 obs. Stations
- Forecast Data:
  - DWD (German Weather Service), deterministic, 168h forecast subdivided into 7 daily lead times, resolution for 0 – 48h 7km, 48 – 168 appr. 40km
  - ECMWF, deterministic, 240h forecast subdivided into 10 daily lead times, resolution appr. 40 km
- Hydrologic model: calibrated LISFLOOD model , 1km resolution, physiographic basin characteristics are principally derived from the DEM, Land Use data, and Soil properties data



Identification of bias in the precip. forecasts





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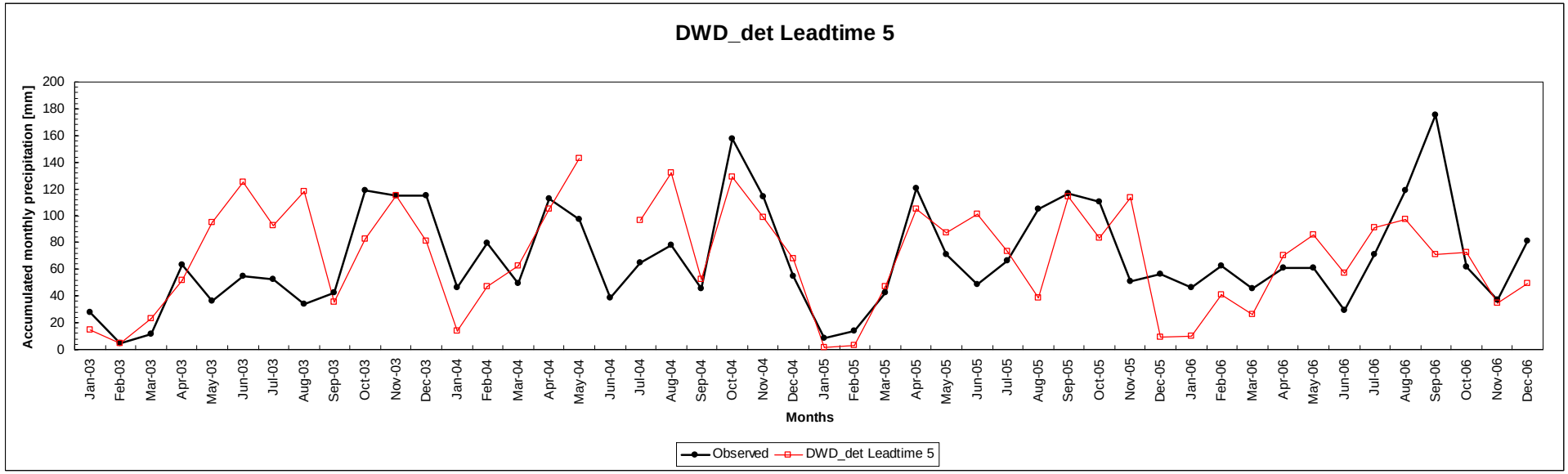

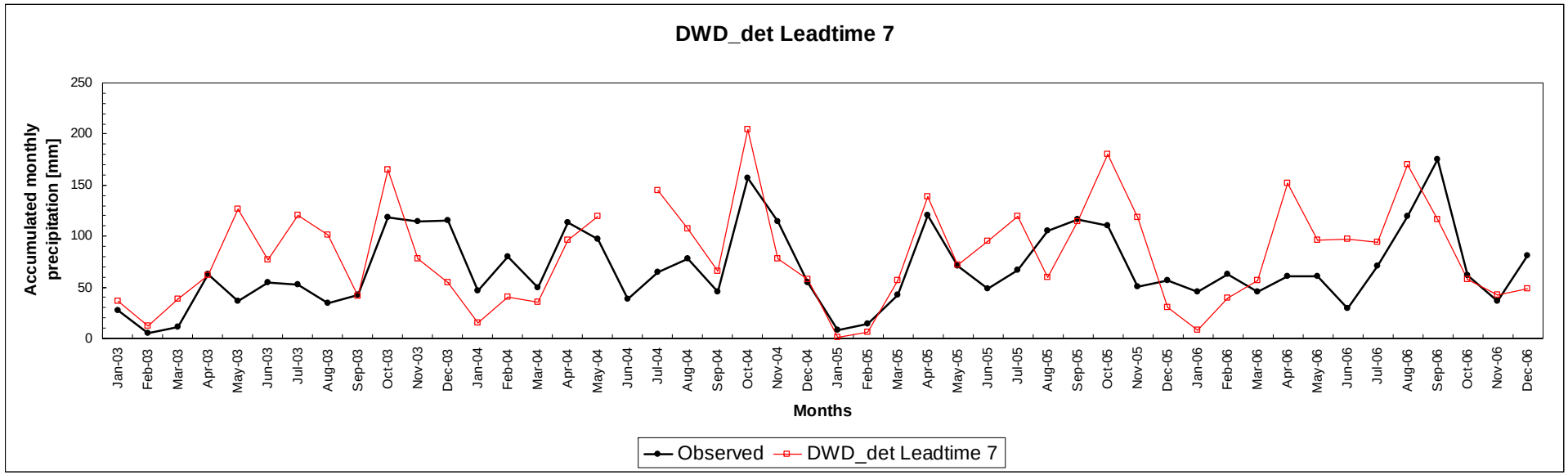

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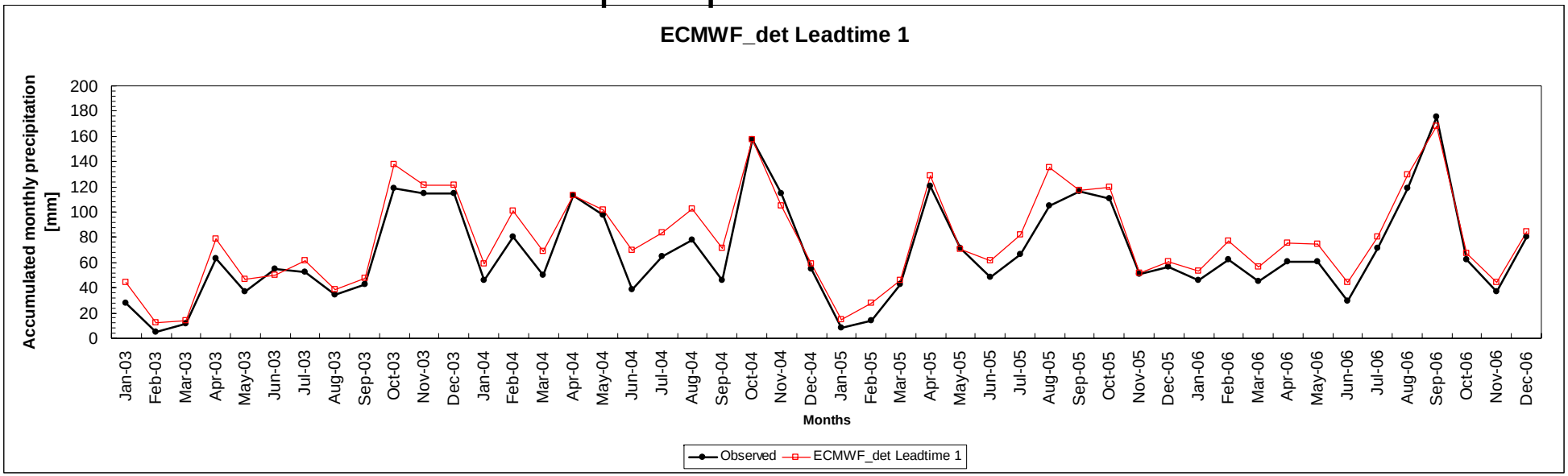

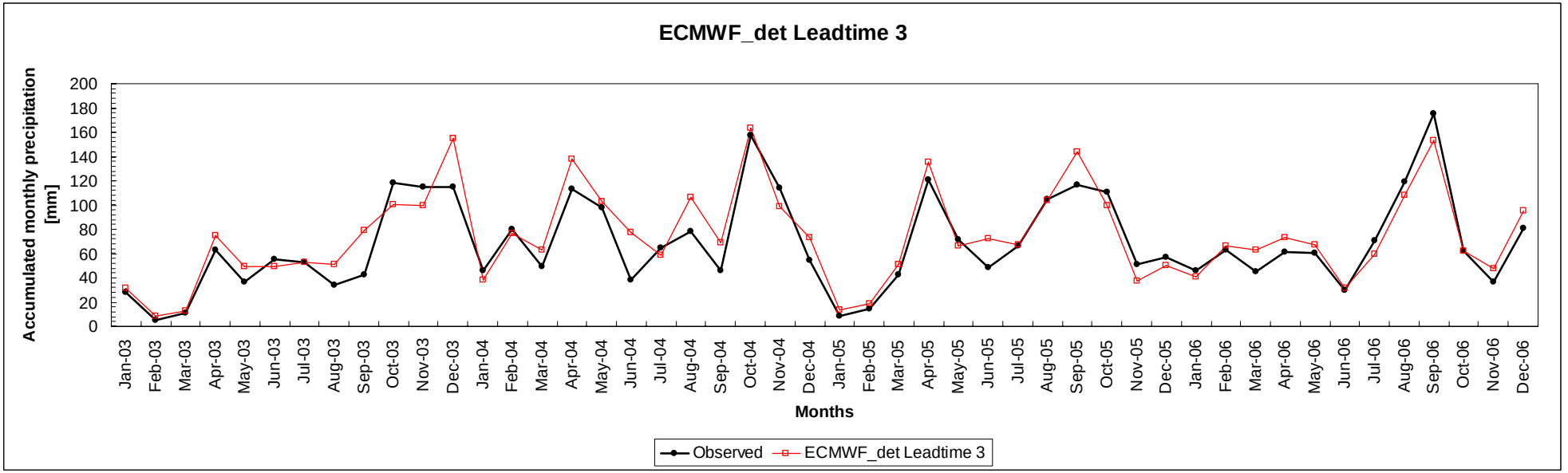

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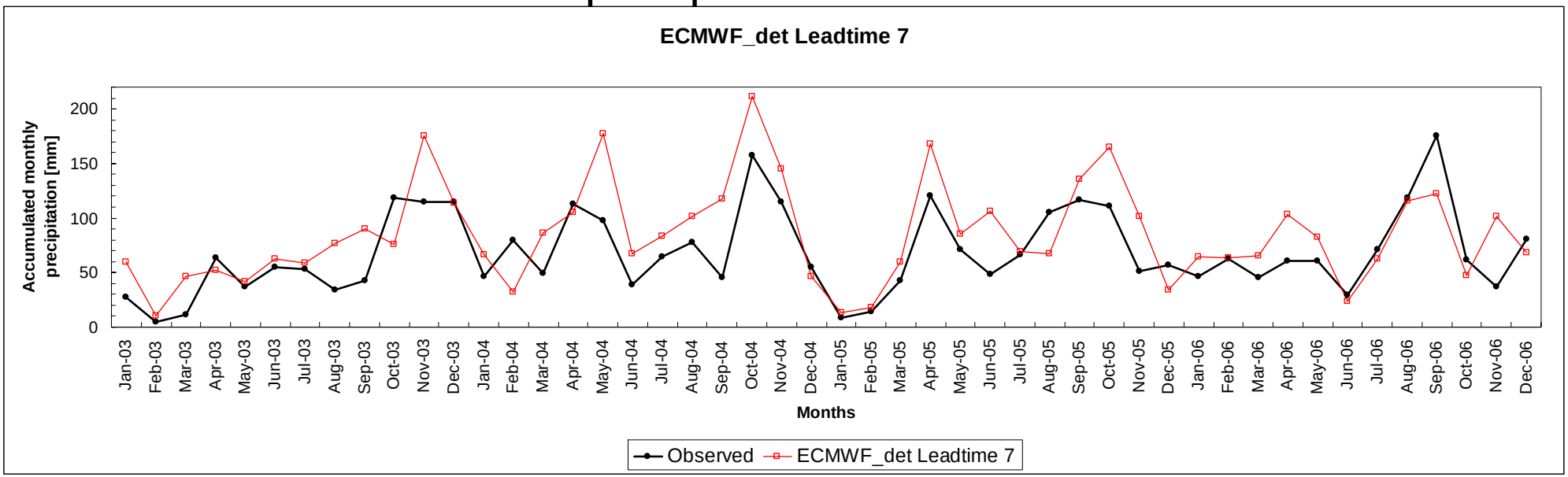
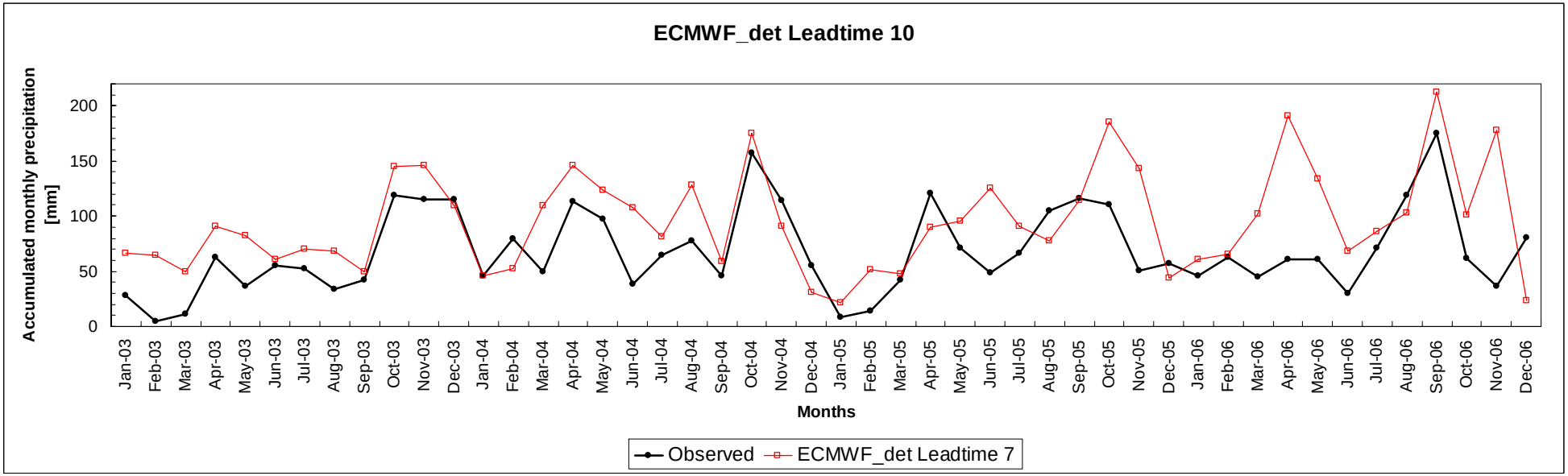
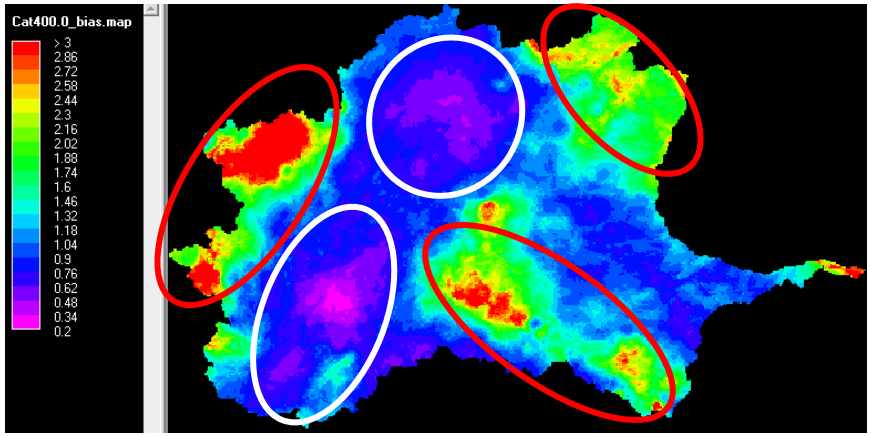




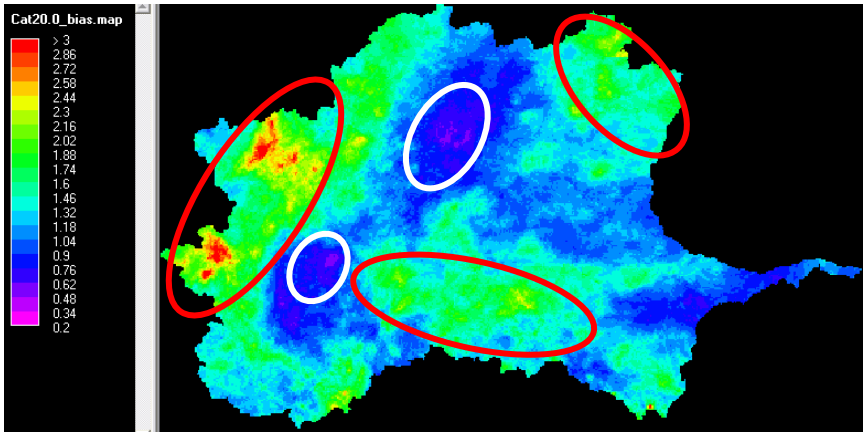
Identification of bias in the precip. forecasts

Frequency bias score BIAS for precip. threshold >20 mm/day

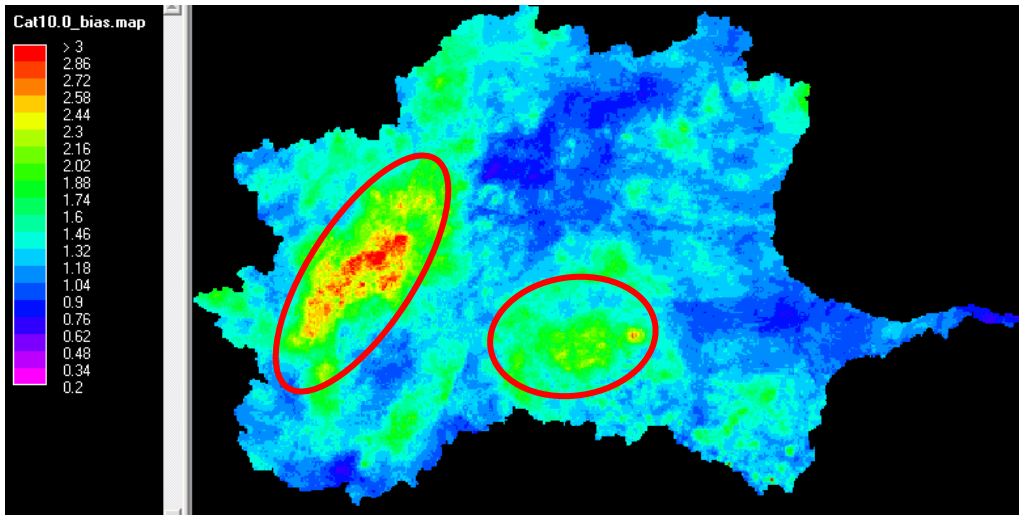
Leadtime 7 days



BIAS score for precip. threshold 10 - 20 mm/day



BIAS score for precip. threshold 5 - 10 mm/day



Red circles show a strong overforecasting of rain events
White circles show a strong underforecasting of rain events

<u>Strong spatial variation of bias in the Po catchment</u>

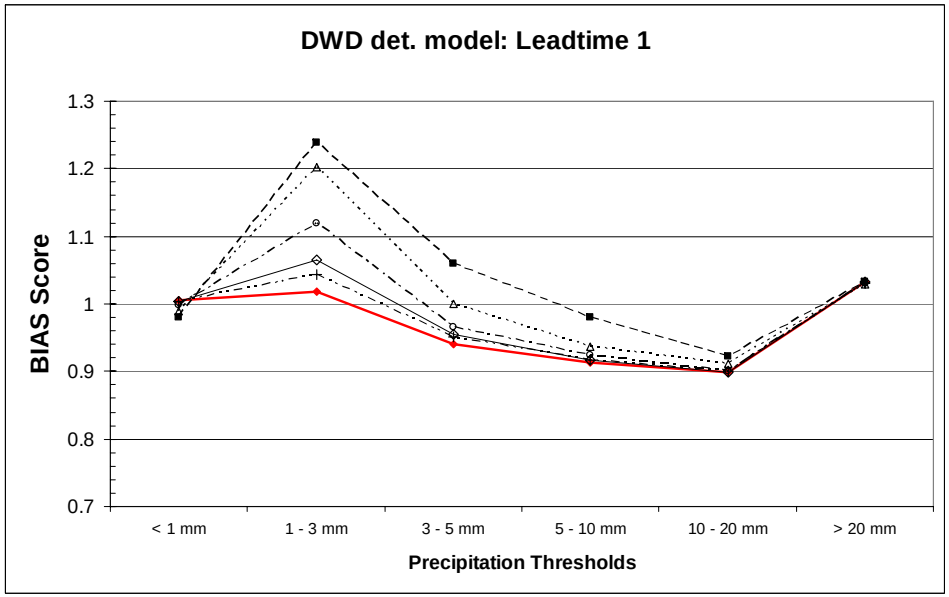
The “running median bias correction” method

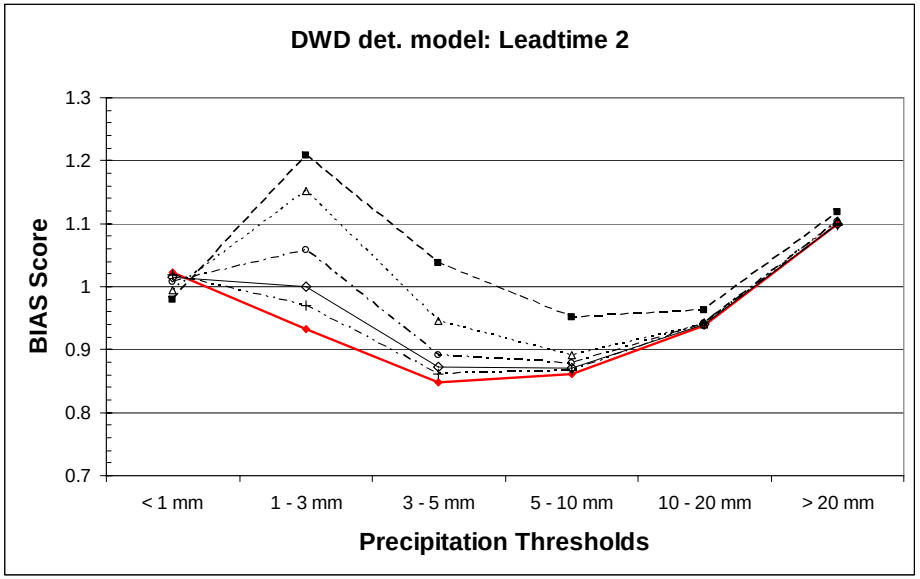
- Has been used in oper. meteorological forecasting (e.g. *Tennant et al., Weather & Forecasting, Vol. 22, 2006*) and research studies (e.g., *Eckel et al., Weather & Forecasting, Vol. 20, 2004*, *Atger, Monthly Weather Review, Vol. 131, 2002*)
- Capable to adress spatial and temporal variability of bias

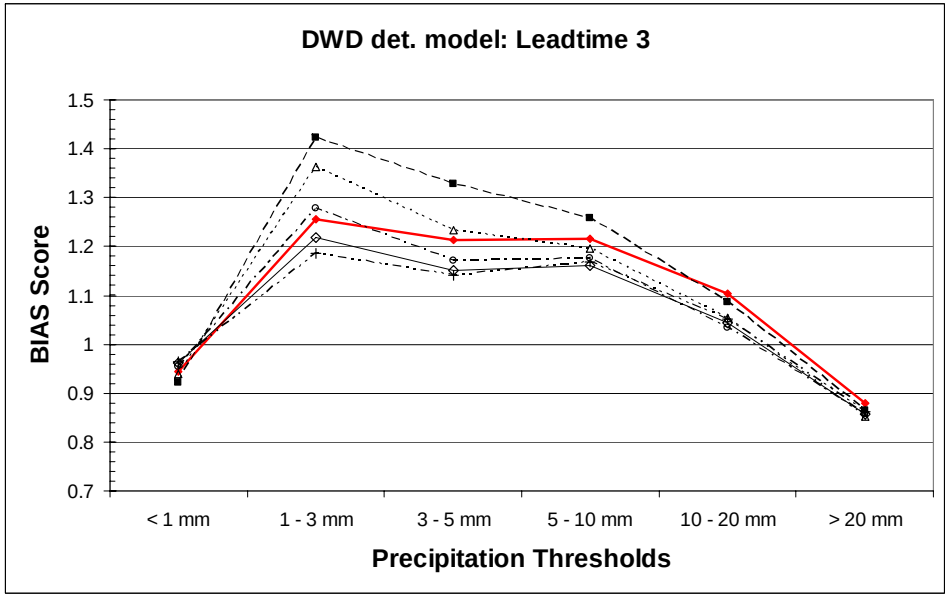
How was the method implemented:

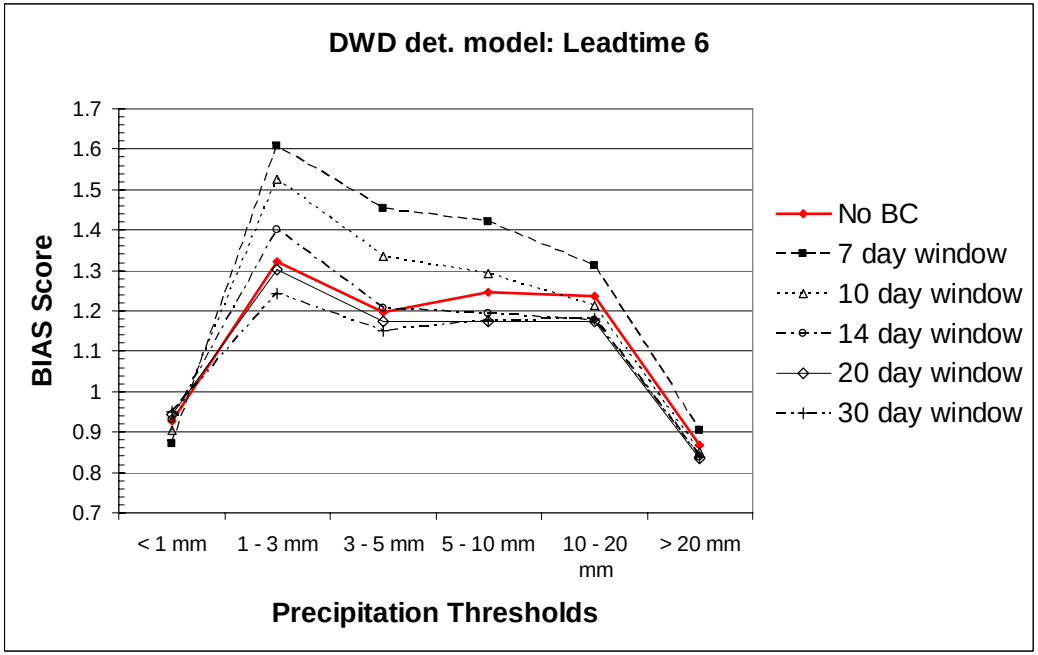
1. Median Error is calculated on a pixel by pixel basis for each forecast lead time using the difference between observed and forecasted value
2. For lead times 2 and higher the preceding bias corrected forecast is used as in the operational system the observed value does not exist
3. The window size for the median error calculation was varied in order to find an optimal size

Assessment of the bias correction method:









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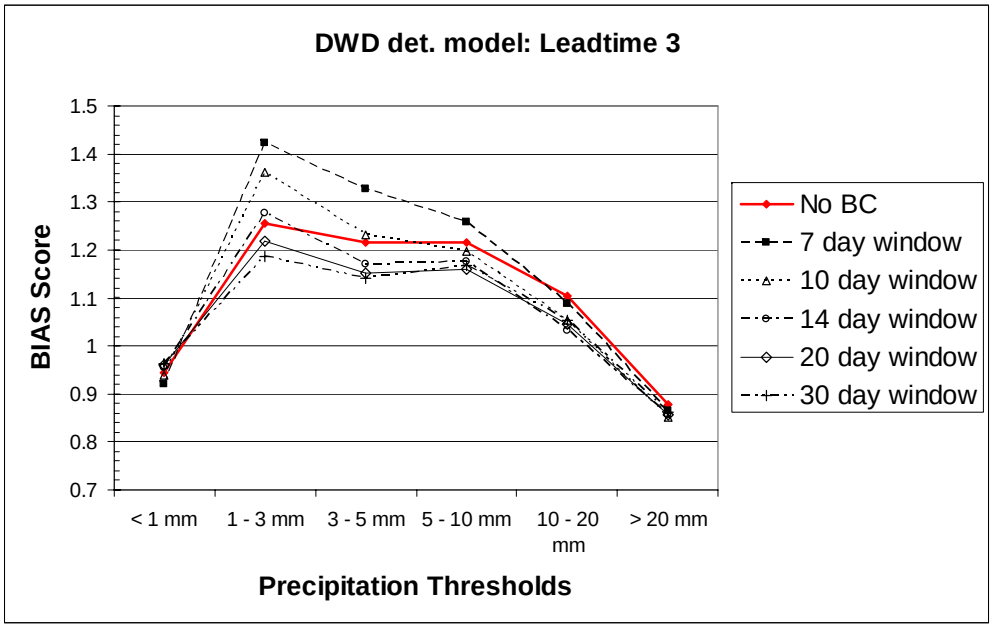

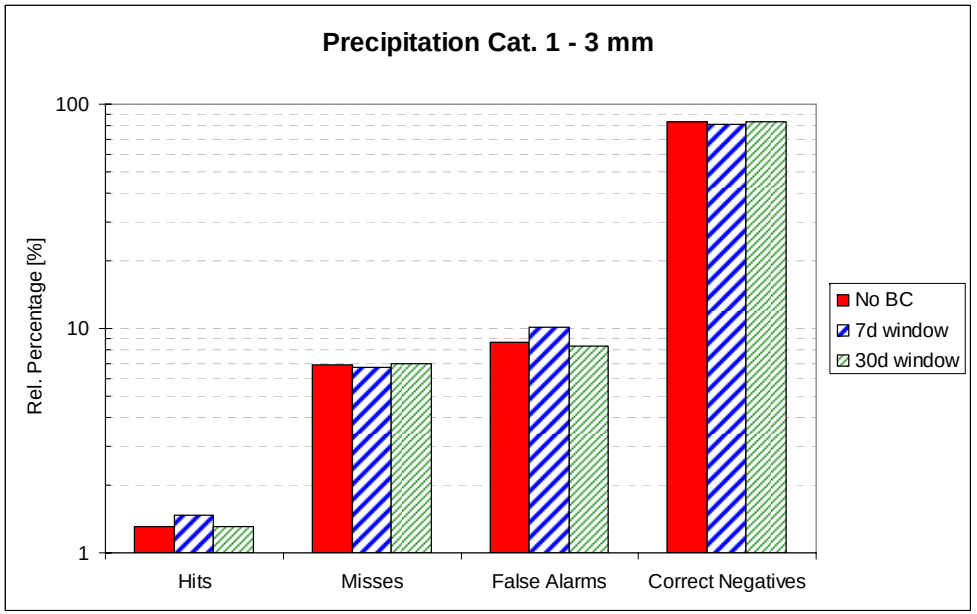

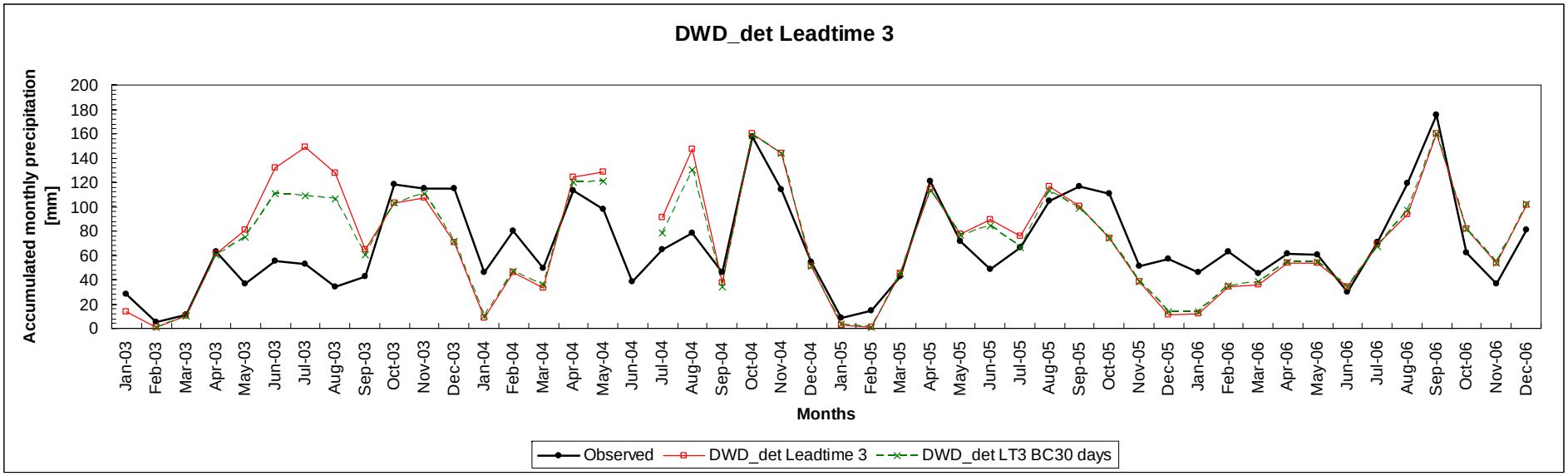

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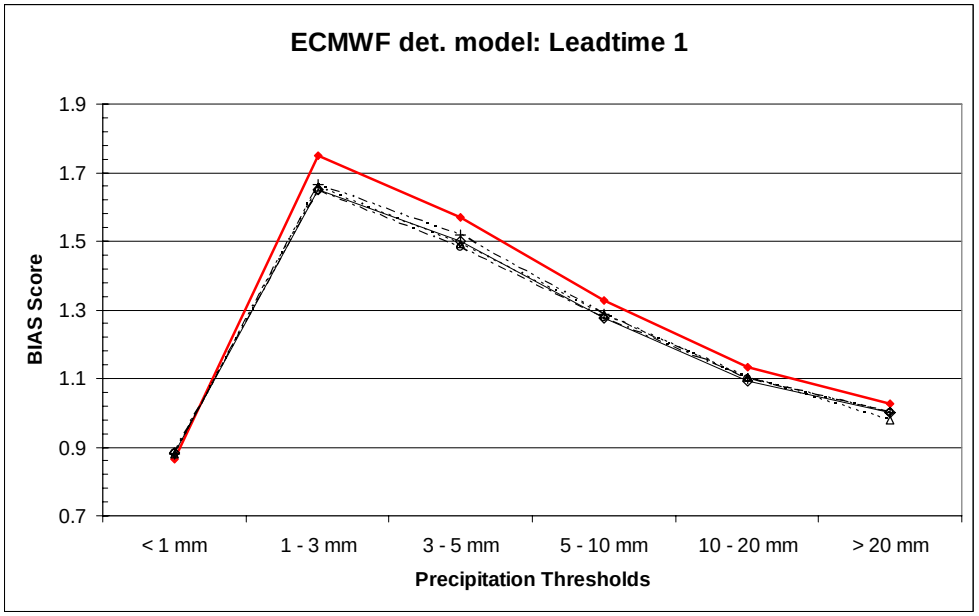

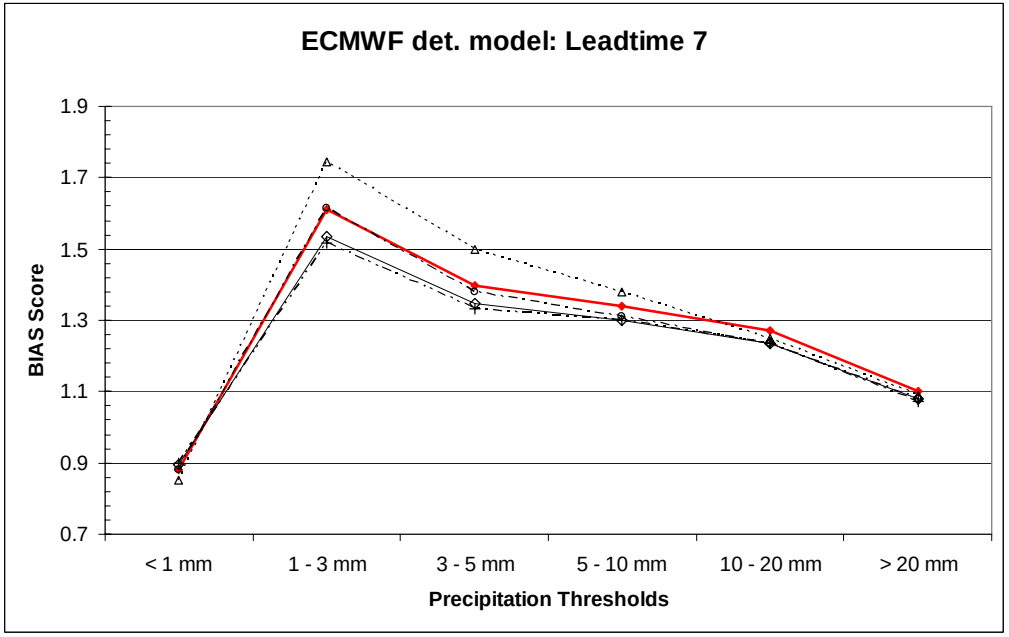

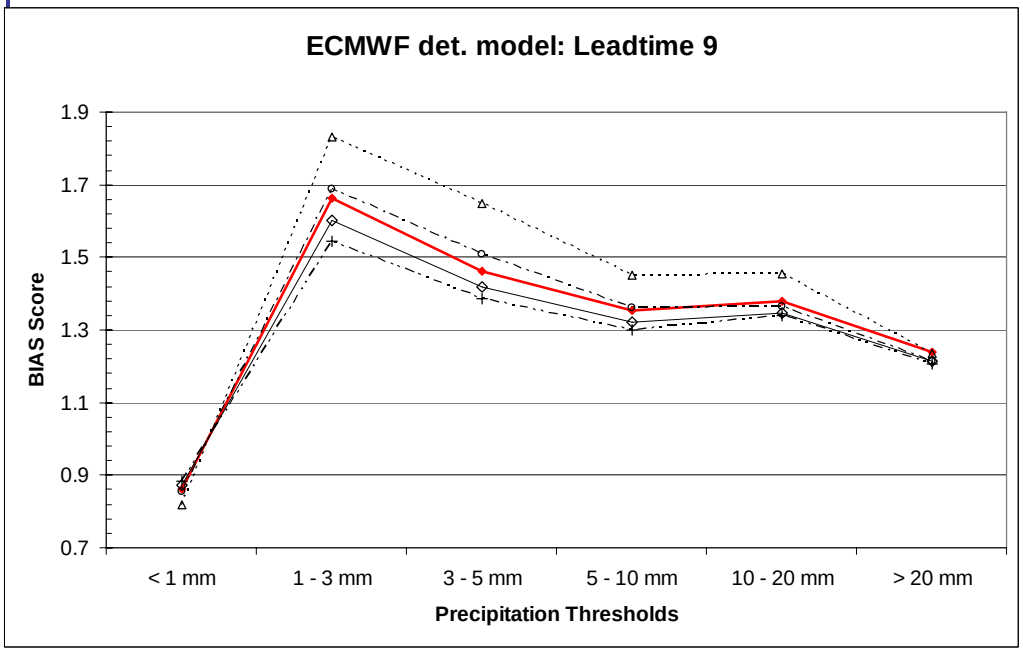

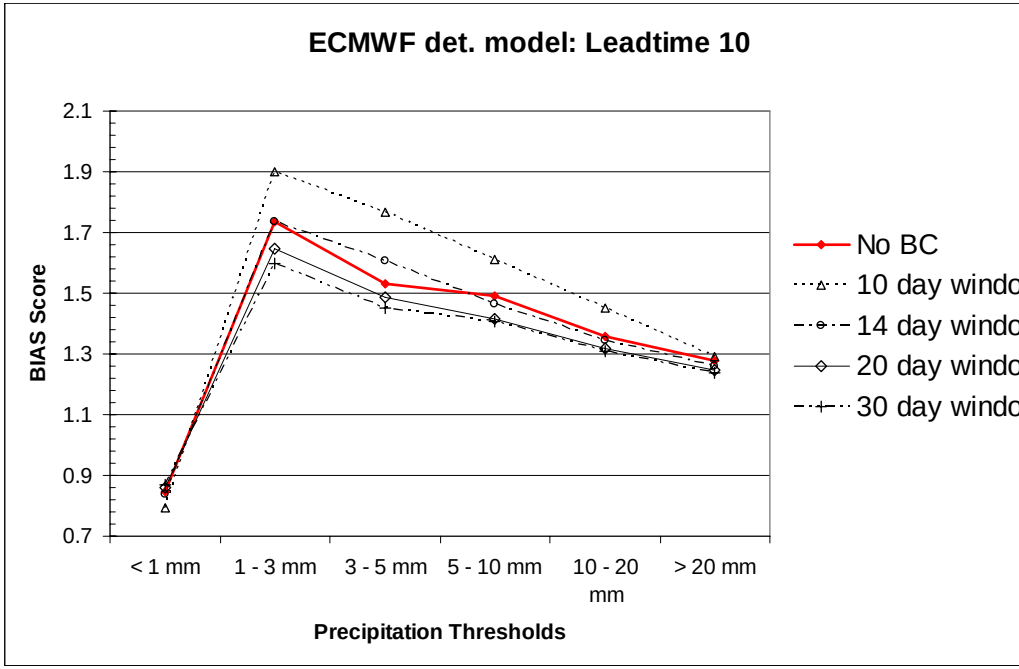

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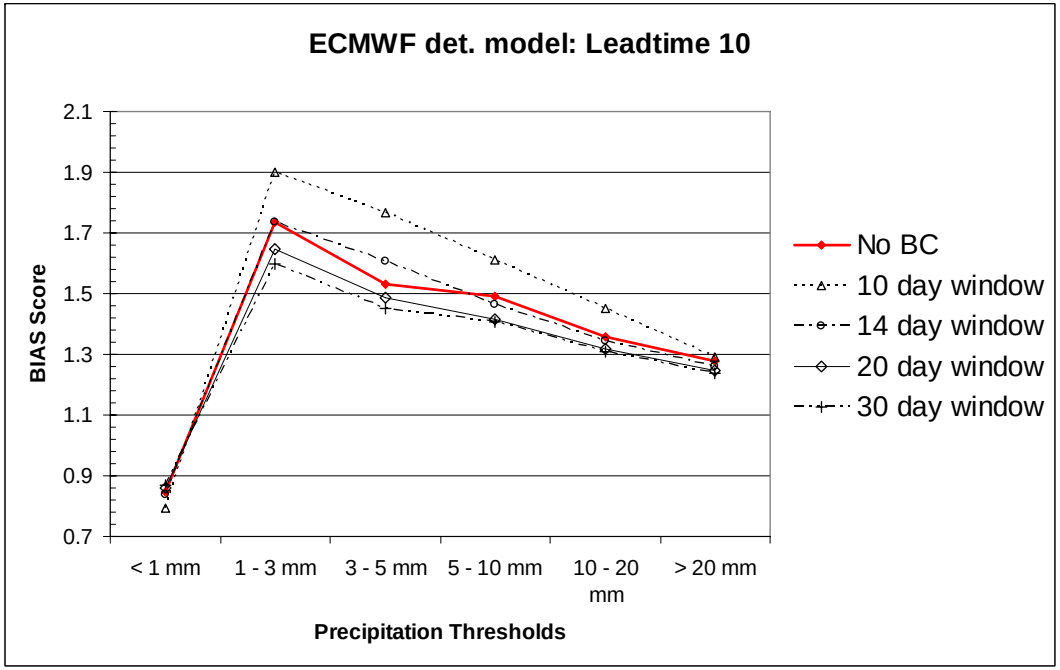

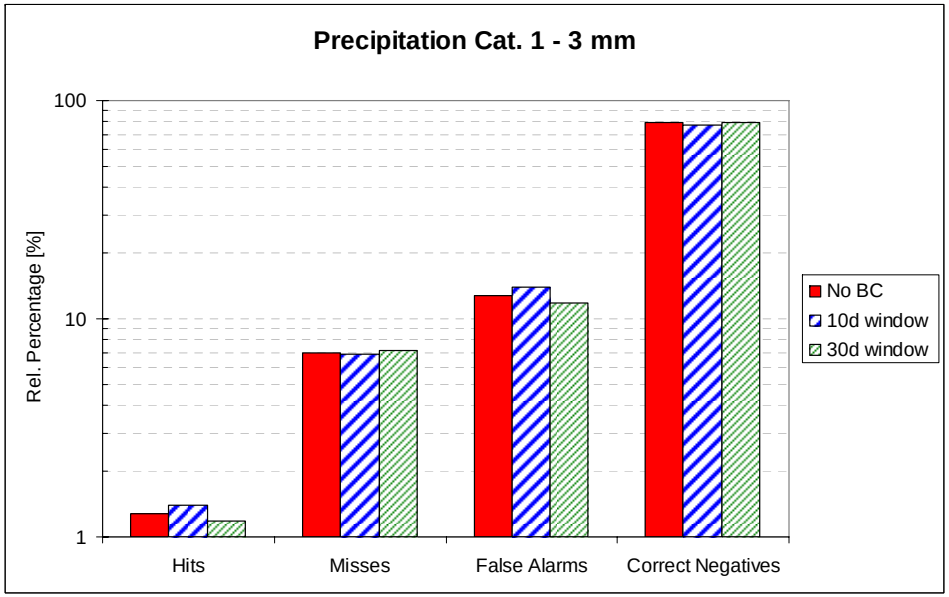

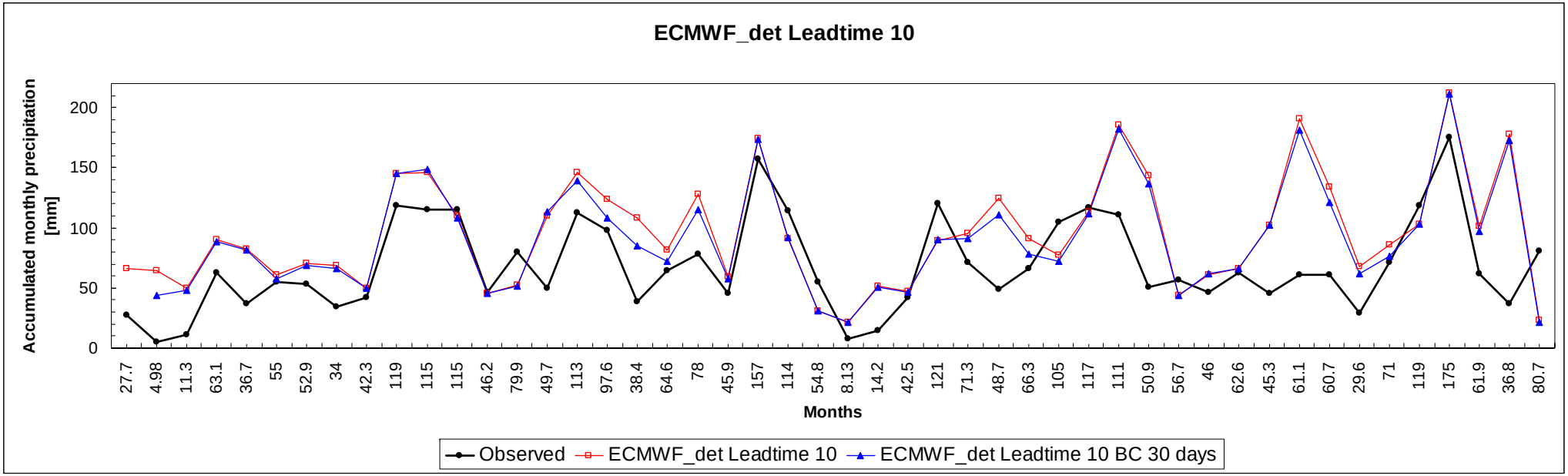

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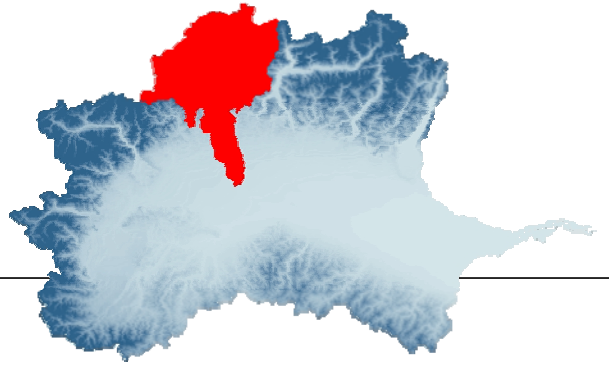

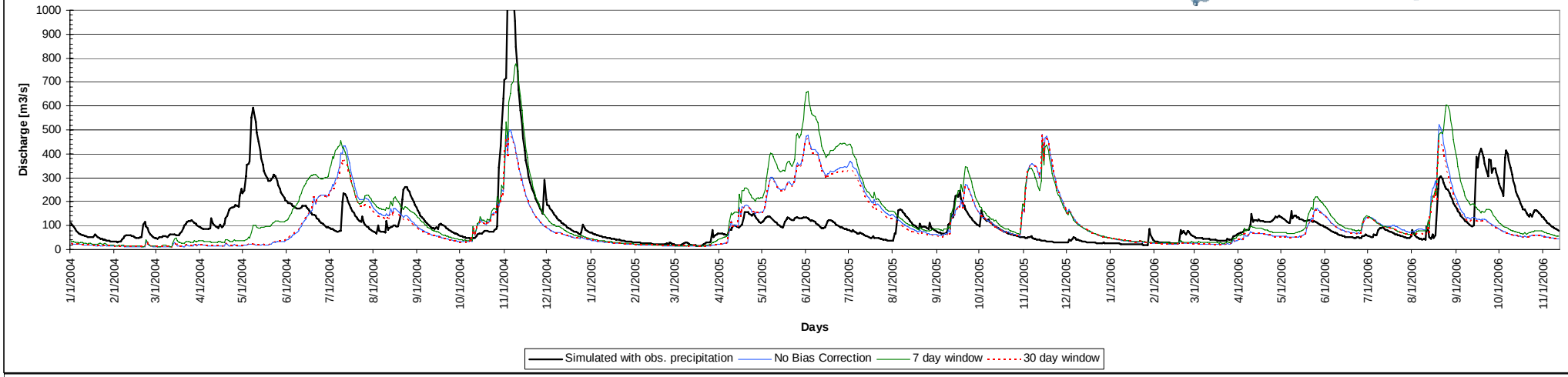

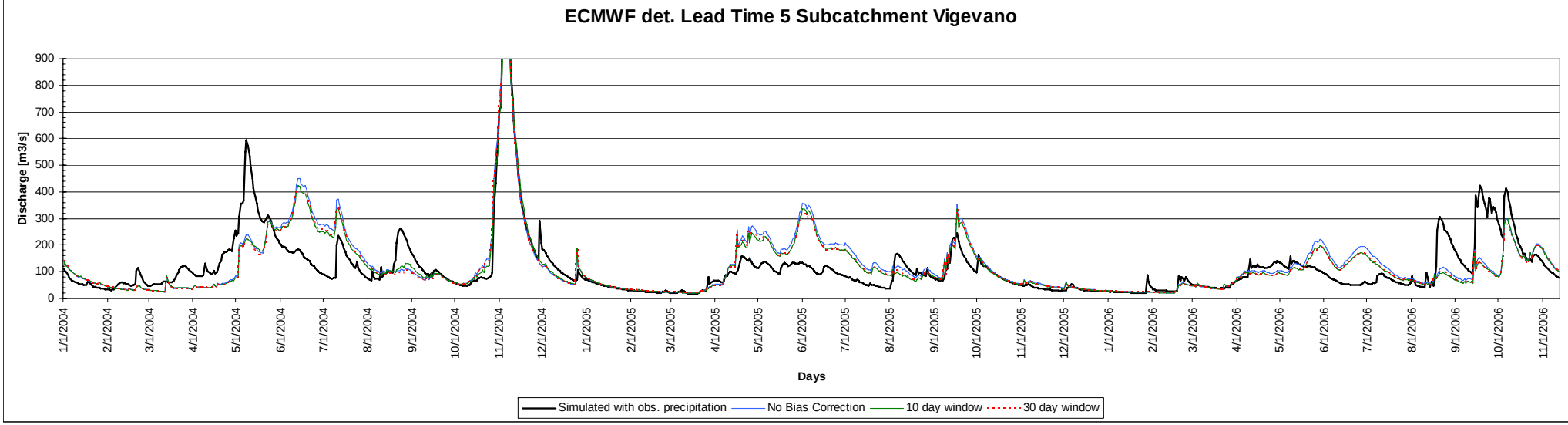

Conclusions

- Bias in both the DWD and ECMWF shows a strong temporal and spatial variability → no general or seasonal trends could be observed
- None of the timeframes for the running median bias correction results in a satisfactory reduction of the bias
- 30 day window illustrate a reduction in the BIAS score but the effect on discharges are minimal
- 7 day window improves the peak discharges but also artificially increases bias for certain times

The failure of the running median bias correction could be based on the different scales between observed and forecasted precipitation

Future work:

- More in depth analysis of the effects of the bias correction method on the discharges
- Effect on upscaling of the observed data to the forecast model grid
- Comparison with the “quantile2quantile” bias correction method developed by Thomas Hopson
- Bias correction methods for ECMWF EPS

Acknowledgements:

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