Tail characteristics control the choice of the ordinary distribution in the Metastatistical Extreme Value approach

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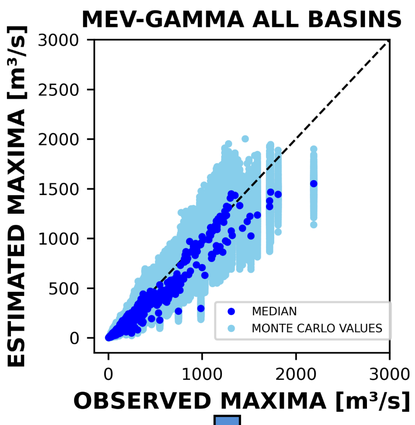
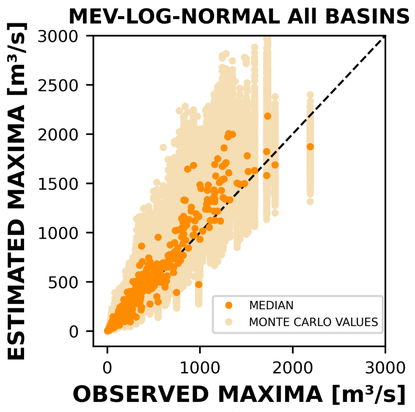
1 Objective

Optimization of the novel Metastatistical Extreme Value (MEV) distribution (rationale: extreme emerge from ordinary events, Marani and Ignaccolo (2015)) to improve the estimation of flood magnitudes across the Germany.



High flood quantiles are underestimated by MEV Gamma



High flood quantiles are overestimated by MEV Log-Normal

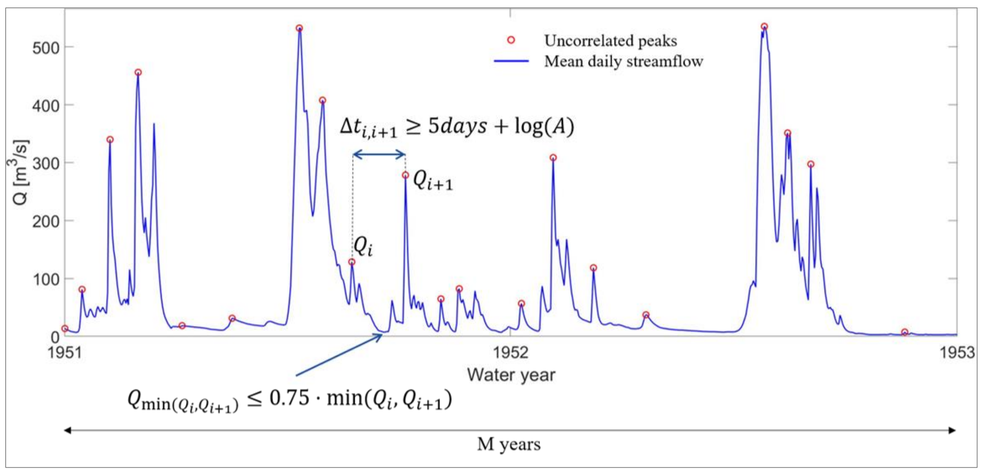
The application of MEV with a single distribution under-estimates or over-estimates the high flood quantiles

2 Hypothesis

The tail properties of the distribution of the ordinary (i.e., all) events should be taken into account for a more accurate estimation of maxima.

3 Study area and Methods

The **Tail Ratio of ordinary peaks** (all independent peaks in hydrograph) is computed to select the best distribution in the MEV framework

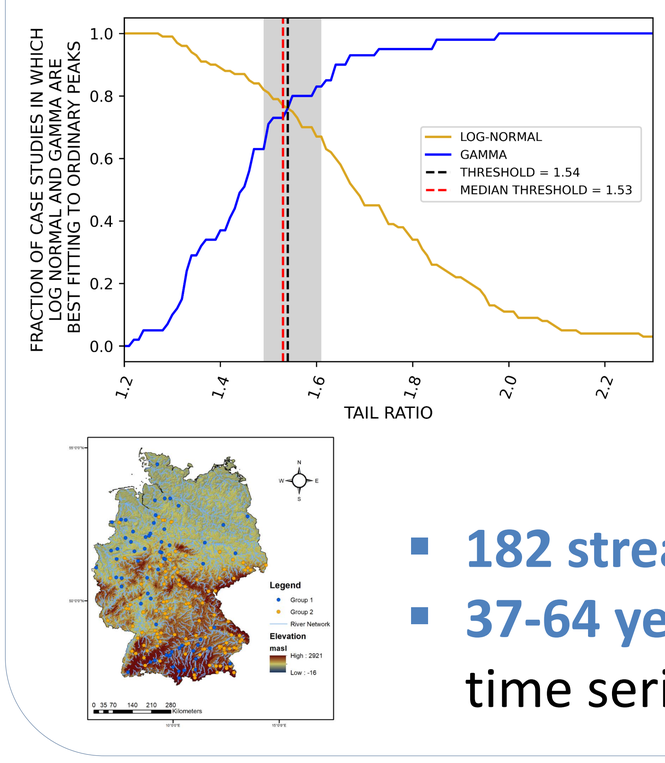


Selection of ordinary peaks

(Miniussi et al., 2020)

$$\text{Tail Ratio} = \frac{99^{th}\ percentile}{95^{th}\ percentile}$$

MEV Gamma (Group 1) ← → MEV Log Normal (Group 2)



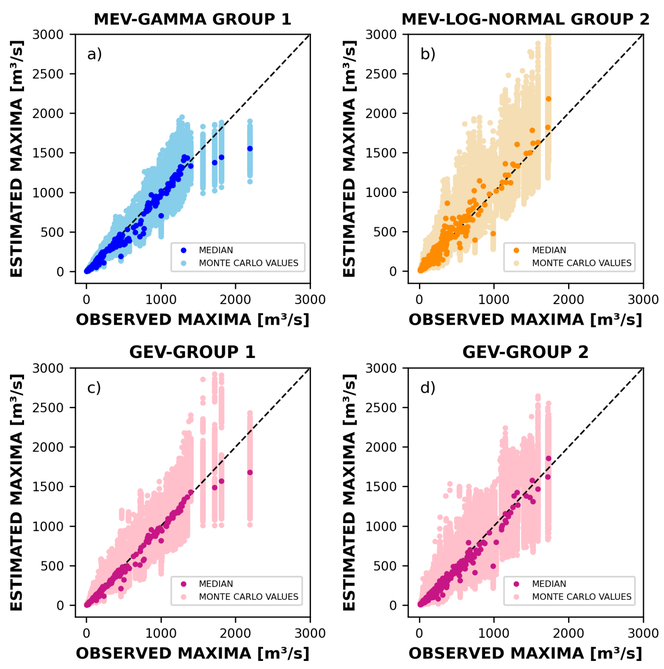
- The **identified Threshold** on the tail ratio is **1.54** to optimize the number of catchments with best fitting distribution
- **Range of thresholds**

1.50 - 1.61

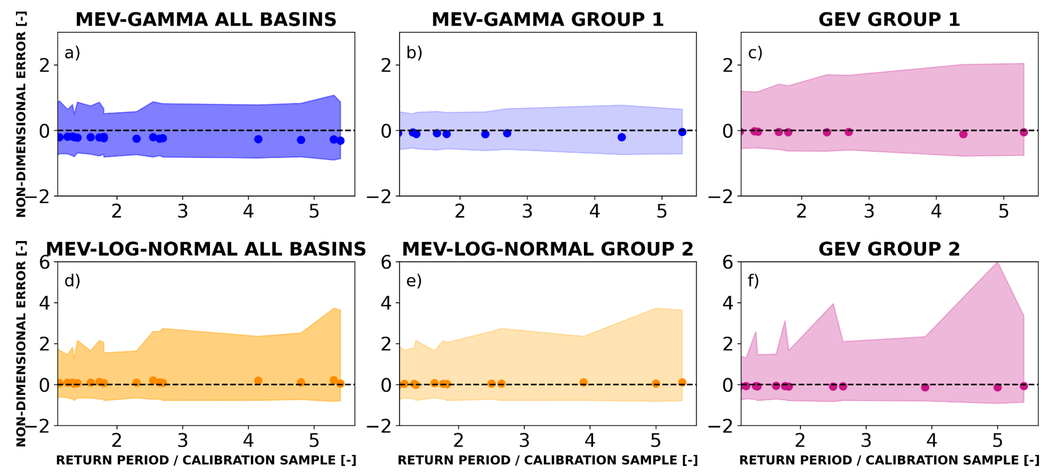
- **182 stream gauges in Germany**
- **37-64 years** of daily streamflow time series

4 Results

Accurate appraisal of high floods



- **The correct choice of the underlying ordinary distribution improves the estimation of maxima.**
- **Estimation uncertainty and relative error decrease in both groups compared to GEV.**



5 Conclusions

- The preliminary selection of the ordinary distribution improves flood appraisal reducing **under and overestimation bias** and **decreasing estimation uncertainty**.
- The proposed methodology is **robust to changes of dataset**, as the identified threshold weakly depends on the catchment selection
- The method correctly identifies the most suitable distribution **in 76% of the case studies**.

Acknowledgment and References

Research project 421396820"Propensity of rivers to extreme floods: climate-landscape controls and early detection (PREDICTED)"

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DFG Deutsche Forschungsgemeinschaft German Research Foundation