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Exploring the potentials and limitations of flood frequency analysis on water stages

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Motivation of the work

Flood risk assessment and the design of protection measures often require the estimation of high water levels of a given return period, i.e. design flood levels. The **common approach** adopted for this estimation problem involves three main steps. First, a probability distribution model is fitted to a record of annual maximum flows, which are typically derived from a (uncertain) rating curve. The parameterised model is then used to for estimating design floods corresponding to the desired return periods. These design floods are often used as input of a (uncertain) hydraulic model to derive corresponding flood water stages, which are then used for design purposes (e.g. levee height). In this study we compare the common approach with an **alternative approach** based on statistical analysis of annual maximum water levels.

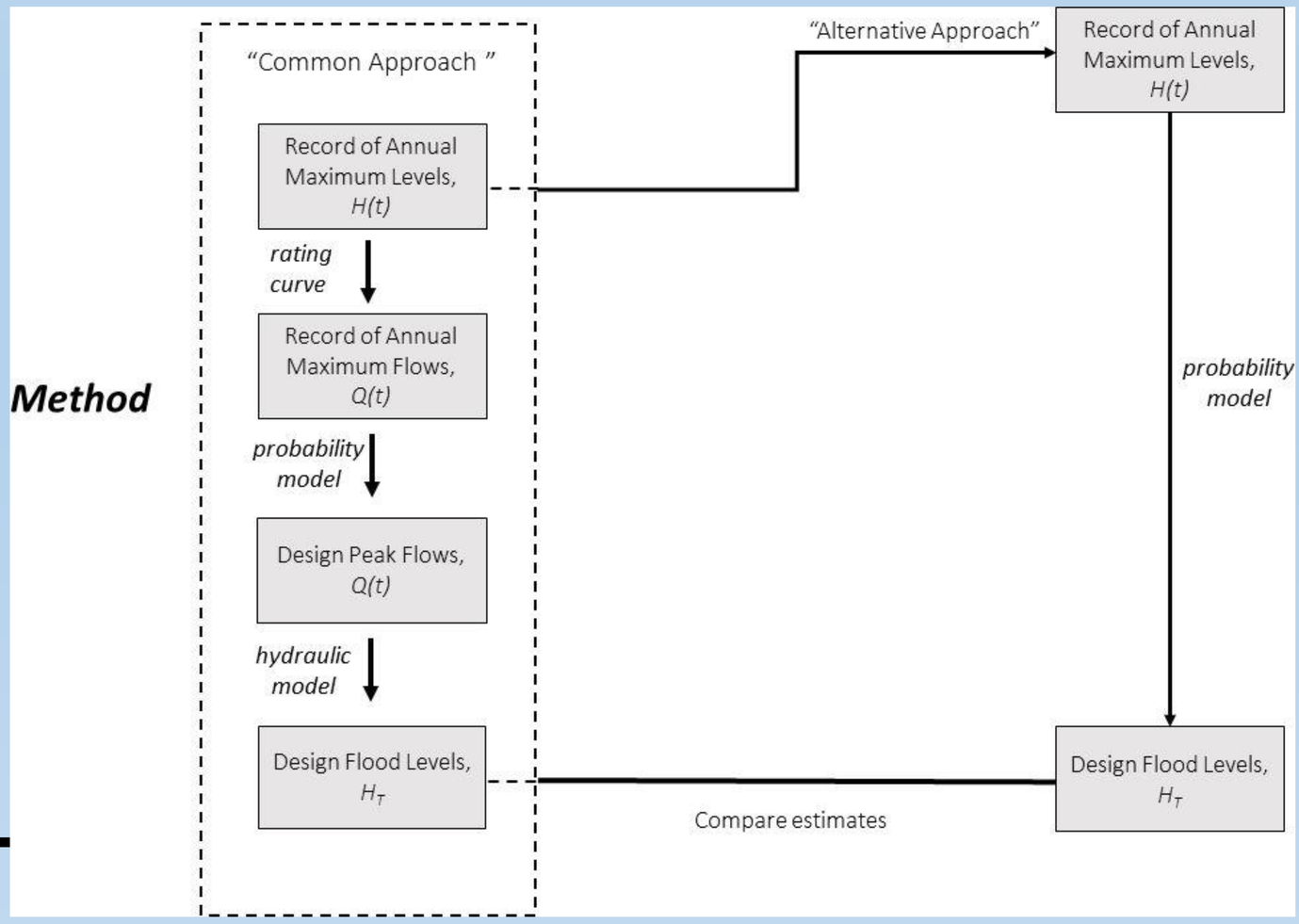

Fig 1. Simulation framework

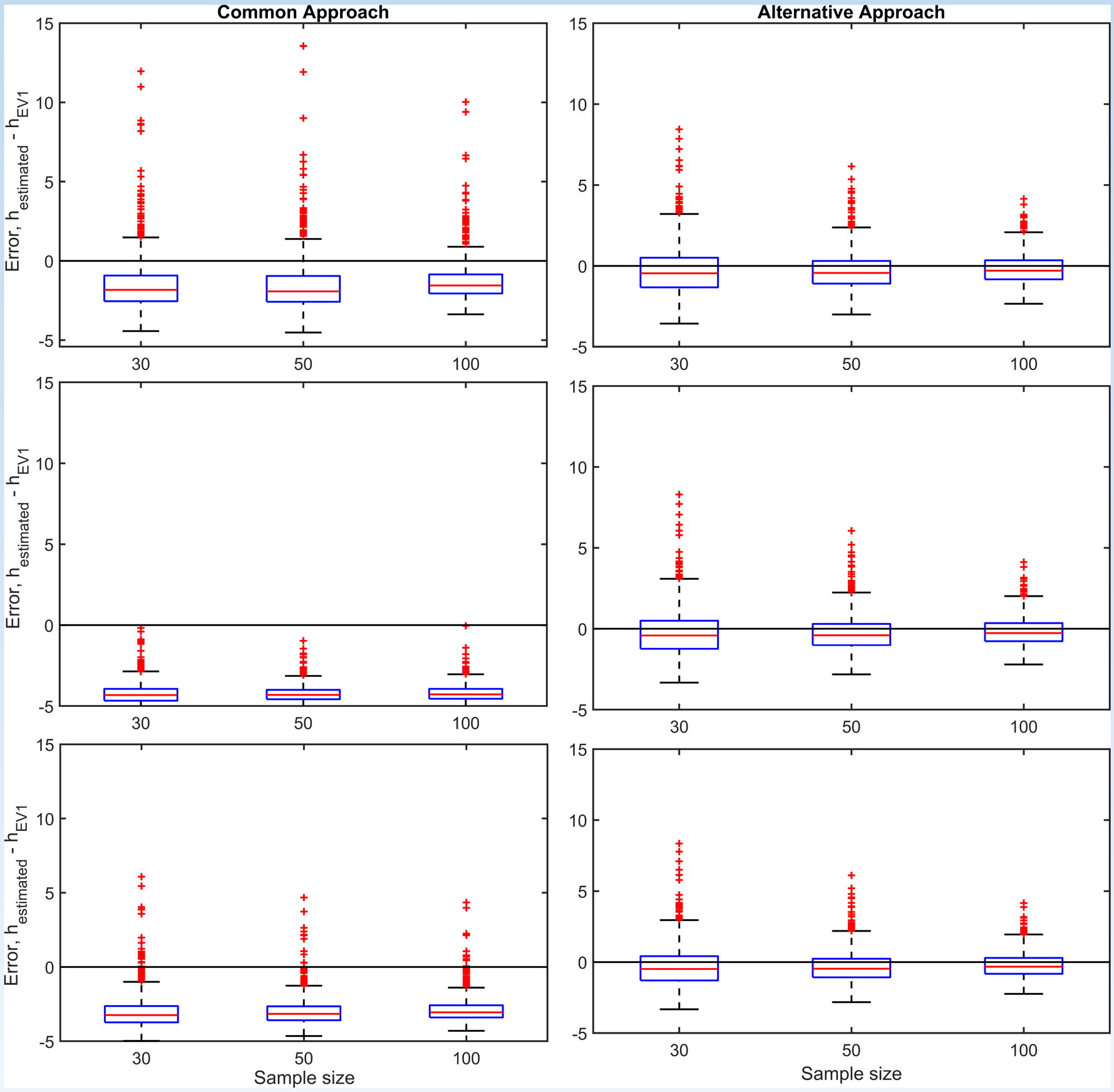

Fig 2. A comparison of the two approaches tested at three locations within a 98 Km reach of the Po River in Italy.

Method

- A parameterised GEV model was used for estimating a "true" design flood and its corresponding design flood level. Synthetic flows were generated (using the fitted GEV model) and used as input into a HEC-RAS to derive water levels.
- The EVI distribution was used for fitting in both approaches.
- For a given sample size, and 1000 model runs, the errors were estimated as a difference between the estimated and the true design flood level.
- The 100-year design flood level is the event of interest in this study.

Conclusion

- Conducting the frequency analysis directly on water levels can improve estimates of the design flood levels when compared to the common approach.
- This approach may be used for rivers with their floodplain geometries relatively stable.

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