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The role of ensemble post-processing for modeling the ensemble tail

Hans Van De Vyver, Bert Van Schaeybroeck, and Stéphane Vannitsem
Royal Meteorological Institute of Belgium, Research and development, Brussels, Belgium (bertvanschaeybroeck@gmail.com)

The past decades the numerical weather prediction community has witnessed a paradigm shift from deterministic to probabilistic forecast and state estimation (Buizza and Leutbecher, 2015; Buizza et al., 2008), in an attempt to quantify the uncertainties associated with initial-condition and model errors. An important benefit of a probabilistic framework is the improved prediction of extreme events. However, one may ask to what extent such model estimates contain information on the occurrence probability of extreme events and how this information can be optimally extracted.

Different approaches have been proposed and applied on real-world systems which, based on extreme value theory, allow the estimation of extreme-event probabilities conditional on forecasts and state estimates (Ferro, 2007; Friederichs, 2010). Using ensemble predictions generated with a model of low dimensionality, a thorough investigation is presented quantifying the change of predictability of extreme events associated with ensemble post-processing and other influencing factors including the finite ensemble size, lead time and model assumption and the use of different covariates (ensemble mean, maximum, spread...) for modeling the tail distribution. Tail modeling is performed by deriving extreme-quantile estimates using peak-over-threshold representation (generalized Pareto distribution) or quantile regression.

Common ensemble post-processing methods aim to improve mostly the ensemble mean and spread of a raw forecast (Van Schaeybroeck and Vannitsem, 2015). Conditional tail modeling, on the other hand, is a post-processing in itself, focusing on the tails only. Therefore, it is unclear how applying ensemble post-processing prior to conditional tail modeling impacts the skill of extreme-event predictions. This work is investigating this question in details.

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