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A statistical tool to assess uncertainty in hydrological forecasting

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Prediction of extreme floods has always been a daring challenge since the beginning of the hydrological sciences. The main reason is that hydrologic processes exhibit highly non-linear behaviour, partly due to the chaotic and highly non-linear nature of atmospheric forcing. For operational purposes, hydrologic forecasting requires an assessment of uncertainty.

Uncertainty assessment in hydrology involves the analysis of multiple sources of error. The contribution of these latter to the formation of the global uncertainty cannot be quantified independently, unless (a) one is willing to introduce subjective assumptions about the nature of the individual error components or (2) independent observations are available for estimating input error, model error, parameter error and state error.

An alternative approach, that is applied in this study and still requires the introduction of some assumptions, is to quantify the global hydrological uncertainty in an integrated way, without attempting to quantify each independent contribution. This methodology can be applied in situations characterized by limited data availability and therefore is gaining increasing attention by end users.

This work aims to propose a statistically based approach for assessing the global uncertainty in hydrological forecasting, by building a statistical model for the forecast error xt,d, where t is the forecast time and d is the lead time. Accordingly, the probability distribution of xt,d is inferred through a non linear multiple regression, depending on an arbitrary number of selected conditioning variables. These include the current forecast issued by the hydrological model, the past forecast error and internal state variables of the model. The final goal is to indirectly relate the forecast error to the

sources of uncertainty, through a probabilistic link with the conditioning variables.

In order to statistically test the proposed approach, both synthetic runoff series and predicted runoff series were considered. As a real world case study some flood events occurred recently in the Toce river basin (north-western Italy) were selected and hindcasted through hydrological simulation, using both raingauge observation and precipitation fields predicted by a mesoscale meteorological model. Results are encouraging and suggest the application of the procedure to different case studies, in order to verify its robustness.