Plinius Conference Abstracts,
Vol. 11, Plinius11-41, 2009
11th Plinius Conference on Mediterranean Storms

Assessing the propagation of uncertainty associated with ensemble quantitative precipitation forecasts into streamflow response

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Evaluating the propagation of errors associated with ensemble Quantitative Precipitation Forecasts (QPFs) into the ensemble streamflow response is important to reduce uncertainty in operational flow forecasting. In this study, we created a large set of synthetic hydrometeorological events over the Baron Fork basin (OK, USA) by using (i) a multifractal downscaling model to generate the high-resolution rainfall input and (ii) a distributed hydrological model to simulate the streamflow response. These events were assumed as "observations". Next, for each "observed" event, we generated three ensemble QPFs with different characteristics (one reliable and the other two affected by different kinds of precipitation forecast errors) and simulated the correspondent ensemble streamflows. A verification framework based on the verification rank histogram and the continuous ranked probability score was then applied to evaluate the characteristics of the ensemble forecast. Results revealed that the most accurate forecasts are obtained when the reliable ensemble QPFs are utilized. In addition, analyses allowed us to underline a series of requirements and challenges that need to be considered when hydrologic ensemble forecasts are evaluated, including: (i) the importance of hindcasting to create an adequate set of data that span a wide range of hydrometeorological conditions; and (ii) the sensitivity of the ensemble streamflow verification to the effects of basin initial conditions and the properties of the ensemble precipitation distributions.