Uncertainty investigation and mitigation in flood forecasting

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Abstract

Uncertainty in flood forecasting using a coupled meteorological and hydrological model is arisen from various sources, especially the uncertainty comes from the inaccuracy of Quantitative Precipitation Forecasts (QPFs). In order to improve the capability of flood forecast, the uncertainty estimation and mitigation are required to perform. This study is conducted to investigate and reduce such uncertainty. First, ensemble QPFs are generated by using Monte - Carlo simulation, then each ensemble member is forced as input for a hydrological model to obtain ensemble streamflow prediction. Likelihood measures are evaluated to identify feasible member. These members are retained to define upper and lower limits of the uncertainty interval and assess the uncertainty. To mitigate the uncertainty for very short lead time, a blending method, which merges the ensemble QPFs with radar-based rainfall prediction considering both qualitative and quantitative skills, is proposed. Finally, blending bias ratios, which are estimated from previous time step, are used to update the members over total lead time. The proposed method is verified for the two flood events in 2013 and 2016 in the Yeonguol and Soyang watersheds that are located in the Han River basin, South Korea. The uncertainty in flood forecasting using a coupled Local Data Assimilation and Prediction System (LDAPS) and Sejong University Rainfall - Runoff (SURR) model is investigated and then mitigated by blending the generated ensemble LDAPS members with radar-based rainfall prediction that uses McGill algorithm for precipitation nowcasting by Lagrangian extrapolation (MAPLE). The results show that the uncertainty of flood forecasting using the coupled model increases when the lead time is longer. The mitigation method indicates its effectiveness for mitigating the uncertainty with the increases of the percentage of feasible member (POFM) and the ratio of the number of observations that fall into the uncertainty interval (p-factor).

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