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Optimized Flood Forecasts Using a Statistical Enemble

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abstract

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Abstract

The method presented here assembles an optimized flood forecast from a set of consecutive WRF-Hydro simulations by applying coefficients which we derive from straightforward statistical procedures. Several government and research institutions that produce climate data offer ensemble forecasts, which merge predictions from different models to gain a more accurate fit to observed data. Existing ensemble forecasts present climate and weather predictions only. In this research we propose a novel approach to constructing hydrological ensembles for flood forecasting. The ensemble flood forecast is created by combining predictions from the same model, but initiated at different times. An operative flood forecasting system, run by the Israeli Hydrological Service, produces flood forecasts twice daily with a 72 hour forecast period. By collating the output from consecutive simulation runs we have access to multiple overlapping forecasts. We then apply two statistical procedures to blend these consecutive forecasts, resulting in a very close fit to observed flood runoff.

We first employ cross-correlation with a time lag to determine a time shift for each of the original, consecutive forecasts. This shift corrects for two possible sources of error: slow or fast moving weather fronts in the base climate data; and mis-calibrations of the WRF-Hydro model in determining the rate of flow of surface runoff and in channels. We apply this time shift to all consecutive forecasts, then run a linear regression with the observed runoff data as the dependent variable and all shifted forecasts as the predictor variables. The solution to the linear regression equation is a set of coefficients that corrects the amplitude errors in the forecasts. These resulting regression coefficients are then applied to the consecutive forecasts producing a statistical ensemble which, by design, closely matches the observed runoff.

After performing this procedure over many storm events in the Negev region of Israel, we obtain set of consistent, basin-level parameters which will be applied as a post-process after each simulation run to produce more accurate ensemble forecasts.