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Application of high-resolution short-range ensemble NWP in flood forecasting

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Advances in meso-scale numerical weather predication make it possible to provide rainfall forecasts along with many other data fields at increasingly higher spatial resolutions. It is currently possible to incorporate high-resolution NWP's directly into flood forecasting systems in order to obtain an extended lead time. It is recognized, however, that direct application of rainfall outputs from the NWP model can contribute considerable uncertainty to the final river flow forecasts as the uncertainties inherent in the NWP are propagated into hydrological domains and can also be magnified by the scaling process. As more and more 'modern' flood forecasting systems are adopting this integrated approach, it is necessary to study uncertainty propagation and interaction between the NWP and hydrological model cascade which comprises the decision support system in the context of real-time flood forecasting.

In this study, a meso-scale short-range ensemble NWP system is set up to generate rainfall forecasts with different realizations of perturbed initial conditions and model physics. Ensemble rainfall predictions are then incorporated into a hydrodynamic based flood forecasting system in which a semi-distributed hydrological model is used to produce discharge forecasts coupled with a hydrodynamic model. The river flow forecast ensembles based on each individual NWP ensemble member are compared with the ensemble mean rainfall prediction in order to investigate the uncertainty-propagation process. Finally, the effects due to the scale difference existing between the NWP domain and the hydrological domain are examined by using a resolution-varied rainfall ensemble which can account for finer resolved topography for NWP as well as spatial rainfall disaggregation within the hydrological model. Some remarks based on experiment results are proposed for guiding future research on application

of NWP’s within flood risk management systems.