Improved Hydrometeorological Forecasting through Physically-based Distributed Models

Enrique R. Vivoni, New Mexico Institute of Mining and Technology (NMT)
David J. Gochis, National Center for Atmospheric Research (NCAR)

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1. ABSTRACT

Advances in coupled meteorological and hydrological modeling are needed for improvements in the National Weather Service (NWS) operational flood forecasting. Our proposed approach is based on the use of physically-based, distributed models that capture spatiotemporal dynamics in a complete hydrometeorological forecasting chain. We focus on fusing quantitative precipitation forecasts from radar nowcasting and numerical weather prediction models as input to distributed flood forecasts in operational scale basins within the Colorado Front Range. This intensively-observed study area is a challenging environment for hydrometeorological forecasts due to the complex basin properties and meteorological regimes. Enhanced hydrologic predictions in this region will be transferred to local and national NWS forecasting efforts.

In this proposed work, we will address two fundamental science questions related to quantifying the flood forecast skill achievable with the combined use of quantitative precipitation forecast and distributed hydrological models. The primary science questions are: (1) *Can precipitation forecasts (from multiple sources) with lead-time dependent errors improve flood forecasting skill in light of modeling uncertainties?*, and (2) *Are floods at certain catchment scales more predictable due to the physically-based integration occurring in distributed hydrologic models?* Both of these questions require advanced forecasting tools that are yet to become operational, but which are available in the hydrometeorological research community. In this study, we propose to address these questions as a means for guiding national decisions on the appropriate use of quantitative precipitation forecasts with distributed flood forecasting systems.

To address the science questions outlined above, we propose the following project activities: (1) Fuse quantitative precipitation estimates and forecasts to generate forcing ensembles in the Colorado Front Range region which account for lead-time dependent inaccuracies in the forecast generation, (2) Utilize distributed hydrological models to generate streamflow forecast ensembles for selected operational basins in the Colorado Front Range and their interior ungauged locations, and (3) Quantify the flood forecast skill achievable from the distributed models as a function of precipitation forecast lead time, prediction/modeling methodology and catchment area. In this effort, we will also focus on the methodological developments of an ensemble-based forecasting chain in order to derive generalized conclusions applicable to other precipitation

forecast products and hydrological simulations. We anticipate that the project results will impact future directions in the NWS on spatially-distributed operational flood forecasting.