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Application of a Coupled WRF-Hydro Model for Extreme Flood Events in the Mediterranean Basins

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More accurate simulation of precipitation and streamflow is a challenge that can be addressed by using the Weather Research and Forecasting Model (WRF) in conjunction with the hydrological model coupling extension package (WRF-Hydro).This is demonstrated for the country of Israel and surrounding regions. Simulations from the coupled WRF/WRF-Hydro system were verified against measurements from rain gauges and hydrometric stations in the domain for the 2012-2013 and 2013-2014 winters (wet seasons). These periods were characterized by many punctuated hydrometeorological and hydroclimatic events, including both severe drought and extreme floods events.

The WRF model simulations were initialized with 0.5 degree NOAA/NCEP GFS model data. The model domain was set up with 3 domains, up to 3km grid spacing resolution. The model configuration used here constitutes a fully distributed, 3-dimensional, variably-saturated surface and subsurface flow model. Application of terrain routing and, subsequently, channel and reservoir routing functions, to the uni-dimensional NOAA land surface model was motivated by the need to account for increased complexity in land surface states and fluxes and to provide a more physically-realistic conceptualization of terrestrial hydrologic processes.

The simulation results indicated a good agreement with actual peak discharges for extreme flood events and for full hydrographs. Specifically the coupled WRF/WRF-Hydro model as configured in this study shows improvement in simulated precipitation over one way WRF precipitation simulations. The correlation between the observed and the simulated precipitation using the fully coupled WRF/WRF-Hydro system was higher than the standalone WRF model, especially for convective precipitation events that affect arid regions in the domain. The results suggest that the coupled WRF/WRF-Hydro system has potential for flood forecasting and flood warning purposes at 0-72 hour lead times for large cool season storm events and also for convective storms that impact Israel during the transition seasons.