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Reproduce Severe October Flood event in Western Norway 2014 by a Fully Coupled Atmosphere-Hydrological Modelling System

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During the last week of October 2014, western Norway suffered major flooding after 4 days of intense rainfall. Voss was one of the main villages, which were severely affected. A large amount of rain saturated the soil and caused severe flooding, which destructed houses, bridges and roads. In Odda houses were flushed out into the roaring river and people in villages on the west coast were isolated for days. The impact of the heavy rainfall and the flooding resulted in damage of hundreds of millions Norwegian kroner.
In this study, we applied a fully coupled WRF-Hydro modelling system at four well-monitored basins in Voss to reproduce this flood event. Due to the traditional separation of hydrological and atmospheric modelling communities, significant gaps exist in our knowledge of the full-chain responses to hydrometeorological extremes, from circulation/transport to discharge. The WRF-Hydro modelling system is a community-based model-coupling framework designed to link multi-scale process models of the atmosphere and terrestrial hydrology, which have been developed to address these gaps (Gochis et al., 2014). The objectives of this study are (1) to understand the meteorological and hydrological dynamical processes that led to this extreme event; (2) to explore the fluxes circulation between atmosphere and land surface by comparing the fully coupled WRF-Hydro mode with the offline WRF-Hydro mode (WRF-only). In order to fulfill the requirement of the complex orography at western Norway, it is downscaled to convection permitting scales at 3 km in a nested domain. Prior to performing the fully coupled WRF-Hydro, the offline WRF-Hydro was calibrated and validated by observed streamflow. The simulations with/without spectral nudging under the coupled/uncoupled model system have also been discussed. The performance of quantitative precipitation estimates and hydrological forecast products were further analyzed. At the end, we compared the results from two model approaches (stand-alone WRF vs. fully coupled WRF/WRF-Hydro). The overall simulations show a good agreement with the observations.