



## **Multi-scale model analysis and hindcast of the 2013 Colorado Flood**

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While the generation of most flood and flash flood events is fundamentally linked to the occurrence of heavy rainfall, the physical mechanisms responsible for translating rainfall into floods are complex and manifold. These runoff generation processes evolve over many spatial and temporal scales during the course of flooding events. As such robust flood and flash flood prediction systems need to account for multitude of terrestrial processes occurring over a wide range of space and time scales. One such extreme multiscale flood event was the 2013 Colorado Flood in which over 400 mm of rainfall fell along the Rock Mountain mountain front region over the course of a few days. The flooding impacts from this heavy rainfall event included not only high, fast flows in steep mountain streams but also included large areas of inundation on the adjacent plains and numerous soil saturation excess impacts such as hillslope failures and groundwater intrusions into domestic structures. A multi-scale and multi-process evaluation of this flood event is performed using the community WRF-Hydro modeling system. We incorporate several operational quantitative precipitation estimate and quantitative precipitation forecast products in the analysis and document the skill of multiple configurations of WRF-Hydro physics options across a range of contributing area length scales. Emphasis is placed on assessing how well the different model configurations capture the multi-scale streamflow response from small headwater catchments out to the entire South Platte River basin whose total contributing area exceeds 25,000 sq km. In addition to streamflow we also present evaluations of event simulations and hindcasts of soil saturation fraction, groundwater levels and inundated areas as a means of assessing different runoff generation mechanisms. Finally, results from a U.S. national-scale, fully-coupled hydrometeorological hindcast of the 2013 Colorado flood event using the combined WRF atmospheric model and WRF-Hydro system will be shown.