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Analysis and modeling of an extreme desert rainstorm: rainfall, flashfloods, and forecast

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Flash floods are one of the most devastating and lethal natural hazards. In 2018, flashflood events in the deserts of Israel and Jordan alone resulted in 45 casualties. Improving our forecasting of such extreme events is crucial. It is important to characterize spatiotemporal properties of extreme rainfall and intra-basin flashflood patterns, and to test the current forecast capabilities. The hydrometeorological analysis of a substantial storm (25-27 April, 2018) that occurred in the Zin basin ($\sim$1400 km^2, southern Israel) is presented. The analysis focuses on three main aspects: characterization of the observed extreme precipitation, modeling of the flood response, and integration of weather forecasts in the hydrological modeling chain.

Spatially distributed rainfall intensity-duration-frequency maps for the storm are produced from weather radar archive (24 years) using the novel MEV approach, allowing the identification of spatial distribution of extreme rain intensities at a resolution of 1 km^2. A grid based hydrological distributed runoff model (GB-HYDRA) is used to study flashflood magnitudes at 57 sub-basins. Finally, the model is used to examine the intra-basin hydrological response for different forecast scenarios produced by the COSMO numerical prediction model, currently operational within the Israeli Meteorological Service.

Only a small portion of the Zin basin (1-20%) experienced precipitation intensities exceeding 75-100 year return period for duration of 3-24 hours. Local extreme rainfall intensities resulted in a rapid hydrological response characterized by maximal return periods of 10-50 years. The forecast does not improve as the event approaches and the use of a deterministic forecast scenario leads to incorrect flashflood prediction. The use of forecast ensembles and/or radar based nowcasting methods is recommended.