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A radar-based hydrological model for flash flood prediction in the dry regions of Israel

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Flash floods are floods which follow shortly after rainfall events, and are among the most destructive natural disasters that strike people and infrastructures in humid and arid regions alike. Using a hydrological model for the prediction of flash floods in gauged and ungauged basins can help mitigate the risk and damage they cause. The sparsity of rain gauges in arid regions requires the use of radar measurements in order to get reliable quantitative precipitation estimations (QPE). While many hydrological models use radar data, only a handful do so in dry climate. This research presents a robust radar-based hydro-meteorological model built specifically for dry climate. Using this model we examine the governing factors of flash floods in the arid and semi-arid regions of Israel in particular and in dry regions in general.

The hydrological model built is a semi-distributed, physically-based model, which represents the main hydrological processes in the area, namely infiltration, flow routing and transmission losses. Three infiltration functions were examined – Initial & Constant, SCS-CN and Green&Ampt. The parameters for each function were found by calibration based on 53 flood events in three catchments, and validation was performed using 55 flood events in six catchments. QPE were obtained from a C-band weather radar and adjusted using a weighted multiple regression method based on a rain gauge network. Antecedent moisture conditions were calculated using a daily recharge assessment model (DREAM).

We found that the SCS-CN infiltration function performed better than the other two, with reasonable agreement between calculated and measured peak discharge. Effects of storm characteristics were studied using synthetic storms from a high resolution weather generator (HiReS-WG), and showed a strong correlation between storm speed, storm direction and rain depth over desert soils to flood volume and peak discharge.