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Use of High Spatial Resolution Remote Sensing for Hydro-Geomorphologic Analysis of Medium-sized Arid Basins

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Arid environments are often remote, expansive, difficult to access and especially vulnerable to flash flood hazards due to the poor understanding of the phenomenon and the lack of meteorological, geomorphological, and hydrological data. For many years, catchment characteristics have been observed using point-based measurements such as rain gauges and soil sample analysis; on the other hand, use of remote sensing technologies can provide spatially continuous hydrological parameters and variables. The advances in remote sensing technologies can provide new geo-spatial data using high spatial and temporal resolution for basin-scale geomorphological analysis and hydrological models.

This study used high spatial resolution remote sensing for hydro-geomorphologic analysis of the arid medium size Rahaf watershed (76 km^2), located in the Judean Desert, Israel. During the research a high resolution geomorphological map of Rahaf basin was created using WorldView-2 multispectral satellite imageries; surface roughness was estimated using SIR-C and COSMO-SkyMed Synthetic Aperture Radar (SAR) spaceborne sensors; and rainstorm characteristics were extracted using ground-based meteorological radar.

The geomorphological mapping of Rahaf into 17 classes with good accuracy. The surface roughness extraction using SAR over the basin showed that the correlation between the COSMO-SkyMed backscatter coefficient and the surface roughness was very strong with an R^2 of 0.97. This study showed that using x-band spaceborne sensors with high spatial resolution, such as COSMO-SkyMed, are more suitable for surface roughness evaluation in flat arid environments and should be in favor with longer wavelength operating sensors such as the SIR-C. The current study presents an innovative method to evaluate Manning's hydraulic roughness coefficient (n) in arid environments using radar backscattering. The weather radar rainfall data was calibrated using rain gauges located in the watershed. The quantitative precipitation estimations had an error of 38.6–47.9%, which is considered fairly good in comparison to previous studies. The radar-based rainstorm extracted characteristics are used to create accumulated and intensity rain maps.

Finally, all the remotely sensed data were used as inputs for the Kinematic Runoff and Erosion Model (KINEROS2) through the Automated Geospatial Watershed Assessment (AGWA) tool. The model-simulated peak flow and volume were then compared to runoff measurements from the watershed's pouring point.