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Radar QPE for hydrological design: Intensity-Duration-Frequency curves

Francesco Marra and Efrat Morin
Hebrew University of Jerusalem, Department of Geography, Jerusalem, Israel (marra.francesco@mail.huji.ac.il)

Intensity-duration-frequency (IDF) curves are widely used in flood risk management since they provide an easy link between the characteristics of a rainfall event and the probability of its occurrence. They are estimated analyzing the extreme values of rainfall records, usually basing on raingauge data. This point-based approach raises two issues: first, hydrological design applications generally need IDF information for the entire catchment rather than a point, second, the representativeness of point measurements decreases with the distance from measure location, especially in regions characterized by steep climatological gradients. Weather radar, providing high resolution distributed rainfall estimates over wide areas, has the potential to overcome these issues. Two objections usually restrain this approach: (i) the short length of data records and (ii) the reliability of quantitative precipitation estimation (QPE) of the extremes. This work explores the potential use of weather radar estimates for the identification of IDF curves by means of a long length radar archive and a combined physical- and quantitative-adjustment of radar estimates.
Shacham weather radar, located in the eastern Mediterranean area (Tel Aviv, Israel), archives data since 1990 providing rainfall estimates for 23 years over a region characterized by strong climatological gradients. Radar QPE is obtained correcting the effects of pointing errors, ground echoes, beam blockage, attenuation and vertical variations of reflectivity. Quantitative accuracy is then ensured with a range-dependent bias adjustment technique and reliability of radar QPE is assessed by comparison with gauge measurements. IDF curves are derived from the radar data using the annual extremes method and compared with gauge-based curves. Results from 14 study cases will be presented focusing on the effects of record length and QPE accuracy, exploring the potential application of radar IDF curves for ungauged locations and providing insights on the use of radar QPE for hydrological design studies.