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Intensity-Duration-Frequency curves from radar estimates in a range of climatic regimes

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Intensity–Duration–Frequency (IDF) curves are widely used in flood risk management and hydrological design studies to relate the characteristics of a rainfall event to the probability of its occurrence. The usual approach relies on long records of raingauge data providing accurate estimates of the IDF curves for a specific location, but whose representativeness sharply decreases with distance, especially in regions characterized by strong climatological gradients. Weather radars provide high resolution distributed rainfall estimates offering the opportunity to overcome this issue.
The present study explores the use of radar quantitative precipitation estimation for the identification of IDF curves for a region characterized by fundamental climatic transitions (Israel) using a combined physical and empirical adjustment on a unique radar data record (23 yr). Accuracy of the radar archive is assessed with respect to raingauge measurements and is found to be variable in time with correlation coefficient ranging between 0.17 and 0.61 for hourly estimates.
IDF relationships are derived for short durations (20 min, 1h, 4h) by fitting a generalized extreme values distribution to the annual maxima series. Radar IDF are compared to co-located raingauge-based IDF for 14 study cases belonging to arid, semi-arid and Mediterranean climates taking into account the uncertainty related to the fitting method. Radar annual maxima and IDF curves are found to be generally overestimated but, in 70% of the cases, they lay within the confidence interval of raingauge estimates. The observed overestimation increases with return period, especially for arid climates. This finding is mainly associated with the relatively large radar estimation uncertainty, even if other effects, such as the raingauge data temporal resolution, are to be considered. The climatological classification remains meaningful for the analysis of rainfall extremes and weather radar is able to correctly detect it basing on rainfall frequency analysis.