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Analysis of spatial variability of extreme rainfall at radar subpixel scale using IDF curves

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Extreme rainfall is quantified in engineering practice using Intensity–Duration–Frequency curves (IDFs) that are traditionally derived from rain-gauges and, more recently, also from weather radars. These instruments measure rainfall at different spatial scales: rain-gauge samples rainfall at the point scale while weather radar averages precipitation over a relatively large area, generally around 1 km2. As such, a radar derived IDF curve is representative of the mean areal rainfall over a given radar pixel and neglects the within-pixel rainfall variability. In this study, we quantify subpixel variability of extreme rainfall by using a novel space-time rainfall generator (STREAP model) that downscales in space the rainfall within a given radar pixel. The study was conducted using a long radar data record (23 years) and a very dense rain-gauge network in the Eastern Mediterranean area. Radar-IDF curves, together with an ensemble of point-based IDF curves representing the radar subpixel extreme rainfall variability, were developed fitting GEV distributions to annual rainfall maxima. It was found that the mean areal extreme rainfall derived from the radar underestimate most of the extreme values computed for point locations within the radar pixel. The subpixel variability of extreme rainfall was found to increase with longer return periods and shorter durations. For the longer return periods, a considerable enhancement of extreme rainfall variability was found when stochastic (natural) climate variability was taken into account. Bounding the range of the subpixel extreme rainfall derived from radar-IDF can be of major importance for applications that require very local estimates of rainfall extremes.