4.1 DESERT PRECIPITATION CHARACTERISTICS AND FLASH FLOOD RESPONSE STUDIED USING WEATHER RADAR DATA

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Precipitation in the desert is scarce, but under distinct conditions can lead to high-magnitude flash floods. In a series of studies focused on the Levant deserts, we aim on: (i) characterizing precipitation space-time patterns, (ii) quantifying their extremes, (iii) identifying precipitation patterns leading to large floods, and, (iv) linking these distinct patterns with meteorological forcing and flooding patterns. Data from weather radar systems are most appropriate for characterizing precipitation, especially in desert regions, due to their typical high space-time resolution matching the high variance and local nature of desert precipitation. Our database includes 24 years of corrected and gauge-adjusted precipitation estimates from a C-band radar used for event-based and climatological analyses.

We analysed case studies from three synoptic patterns: Mediterranean cyclone (MC), active Red Sea trough (ARST) and subtropical jetstream disturbances, also termed tropical plumes (TPs). Significant differences in space-time precipitation patterns and hydrometeorological conditions were identified between these flood-producing synoptic systems: MC storms draw moisture from the Mediterranean and generate moderate rain intensities in the northern and wetter part of the region. ARST and TP storms transfer large amounts of moisture from the south, which is converted to rainfall in the hyperarid southernmost parts of the Levant. ARST rainfall is local and intense, whereas TP rainfall is widespread and prolonged due to high precipitation efficiency and large-scale forcing. Consequently, TP rainfall can generate high-magnitude floods in the largest catchments.

Climatological analysis of precipitation cores ("convective rain cells") has shown that ARST systems produce shorter rain events composed of rain cells with higher rain intensities, longer lifetime, smaller area and lower velocities, compared to MC systems. It was also found that rain cell area is positively correlated with topographic height while cell number is negatively correlated with distance from shoreline. Surprisingly, rain cell intensity is negatively correlated with mean annual precipitation. It was further shown that flash-flood-related events are dominated by rain cells of large size, low velocity, and long lifetime that move downstream with the main axis of the catchments.