Convective rain cells: spatio-temporal characteristics, synoptic patterns and a high resolution synoptically conditioned weather generator

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Information on rain cell features was extracted from high-resolution weather radar data for a total of 191,586 radar volume scans from 12 hydrological years. The convective rain cell features (i.e. cell area, rainfall intensity and cell orientation) were obtained using cell segmentation technique and cell tracking algorithm was used to analyze the changes of those features over time. Three synoptic types were defined for the study area (northen Israel), two extratropical winter lows: deep Cyprus low and a shallow low, and a tropical intrusion: Active Red Sea Trough. Empirical distributions were computed to describe the spatiotemporal characteristics of convective rain cells for these synoptic systems. Those empirical distributions were used for the development of the HiReS-WG (high-resolution synoptically conditioned weather generator). This weather generator is a stochastic model that generates high resolution rainfall fields (5 min and 0.25 km2). The WG is composed of four modules: the synoptic generator, the motion vector generator, the convective rain cell generator and the low-intensity rainfall generator. The weather generator was evaluated for annual rain depth, season timing, wet-/dry-period duration, rain-intensity distributions and spatial correlations using 300 years of simulated rainfall data. It was found that the weather generator well-represented the above properties compared to radar and rain-gauge observations from the studied region. The HiReS-WG is a good tool to study catchments' hydrological responses to variations in rainfall, especially small- to medium-size catchments, and it can also be linked to climate models to force the prevailing synoptic conditions.