Geophysical Research Abstracts, Vol. 9, 02050, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02050

Spatial characteristics of radar-derived convective rain cells over dry climate regimes and their hydrological impacts

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Weather radar data contain detailed information about the spatial structures of rain fields previously unavailable from conventional rain gauge networks. This information is of major importance for enhancing our understanding of precipitation and hydrometeorological systems. This study focuses on spatial features of convective rain cells in southern Israel where the climate ranges from Mediterranean to hyper-arid. Extensive data bases from two study areas covered by radar systems were analyzed. Rain cell features were extracted such as center location, area, maximal rain intensity, spatial integral of rain intensity, major radius length, minor radius length, ellipticity, and orientation. Rain cells in the two study areas were compared in terms of feature distributions and the functional relationships between cell area and cell magnitude, represented by maximal rain intensity and spatial integral of rain intensity. Analytical distribution functions were fitted to the empirical distributions and the log-normal function was found to fit well the distributions of cell area, maximal rain intensity and major and minor radius lengths. The normal distribution fits well ellipticity empirical distribution, and orientation distribution was well-represented by the normal or uniform distribution functions. The effect of distance from the Mediterranean coastline on cell features was assessed. A maximum of cell rain intensity at the coastline and maximum cell density 15 km inland from the coastline were found. In addition, a gradual change of cell orientation was observed with a northwest-southeast orientation 30 km from the coastline at the Mediterranean Sea and to almost a west-east orientation 30 km from the coastline inland.

The effect of the derived spatial rain cell features on the hydrological response of a

drainage basin is examined by utilizing a hydrological model for a case study of an extreme storm in a semi-arid basin. The storm rainfall is fed into the model by a set of convective rain cells according to the derived characteristics. The computed runoff data are analyzed and associated with the convective rain cell properties.