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Radar-based quantitative precipitation estimation over Mediterranean and dry climate regimes

E. Morin (1) and M. Gabella (2)

(1) Hebrew University of Jerusalem, Jerusalem, Israel, (2) Politecnico di Torino, Torino, Italy (msmorin@mscc.huji,ac,il / Fax: +972 2-5820549 / Phone: +972 2-5883020)

Quantitative precipitation estimation based on meteorological radar data potentially provides continuous, high-resolution, large-coverage data that are essential for meteorological and hydrologic analyses. While intense scientific efforts have focused on precipitation estimation in temperate climatic regimes, relatively few studies examined radar-based estimates in dry climatic regions. The paper examines radar-based storm rain depth estimation for Israel, where the climate ranges between Mediterranean to dry. Two radar gauge-adjustment methods are compared: a 1-coefficient bulk-adjustment, which simply removes the mean bias and a 4-coefficient weighted multiple regression (WMR), which assumes a locally varied correction factor. The latter method has been previously applied in the Alps of Europe but was adjusted here to fit the unique precipitation conditions of the region. Adjustment coefficients have been derived for twenty-eight storms using 60 independent gauges of the quality-checked training data set. The validation was based on an independent data set composed of gauges located in eleven 20X20 squared km validation areas, which are representative of different climate, topography and radar-distance conditions. The WMR method was found preferable in all cases. Furthermore, a novel approach has been adopted in this study, whereby radar estimates are considered useable if they provide information that is better than gauge-only estimates. The latter was derived by spatial interpolation of the gauges belonging to the training data set. Note that these gauges are outside the validation areas. As for the radar-adjusted estimates, gauge-derived estimates were assessed against gauge data in the validation areas. It was found that radar-based estimates are better for the eight validation areas within 100 km range. At larger distances, the radar underestimation becomes too large in the two northern validation areas, while in the southern one radar data are still better than gauge interpolation.

It is concluded that in ungauged areas of Israel it is preferable to use WMR-adjusted radar echoes inside rather than conventional gauge-interpolated values (isohyets, kriging) derived from point measurements, which are obviously outside the areas themselves. The WMR-adjustment method provides useful storm rain depth estimates for the examined areas but within the limitation stated above.