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Minimizing uncertainty of daily rainfall interpolation over large catchments through realistic sampling of anisotropic correlogram parameters

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It has been established that daily rainfall gauged network density is not adequate for the level of hydrological modelling required of large catchments involving pollutant and sediment transport, such as the catchments draining the coastal regions of Queensland, Australia, to the sensitive Great Barrier Reef. This paper seeks to establish a link between the spatial structure of radar and gauge rainfall for improved interpolation of the limited gauged data over a grid or functional units of catchments in regions with or without radar records. The study area is within Mt. Stapylton weather radar station range, a 128 km square region for calibration and validation, and the Brisbane river catchment for validation only. Two time periods (2000-01-01 to 2008-12-31 and 2009-01-01 to 2015-06-30) were considered, the later period for calibration when radar records were available and both time periods for validation without regard to radar information. Anisotropic correlograms of both the gauged and radar data were developed and used to establish the linkage required for areas without radar records. The maximum daily temperature significantly influenced the distributional parameters of the linkage. While the gauged, radar and sampled correlogram parameters reproduced the mean estimates similarly using leave-one-out cross-validation of Ordinary Kriging, the gauged parameters overestimated the standard deviation (SD) which reflects uncertainty by over 91% of cases compared with the radar or the sampled parameter sets. However, the distribution of the SD generated by the radar and the sampled correlogram parameters could not be distinguished, with a Kolmogorov-Smirnov test p-value of 0.52. For the validation case with the catchment, the percentage overestimation of SD by the gauged parameter sets decreased to 81.2% and 87.1% for the earlier and later time periods, respectively. It is observed that the extreme wet days' parameters and statistics were fairly widely distributed without a discernible pattern.