Accounting for uncertainty in the repair of rain gauge records and their spatial interpolation

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The drastic deterioration of precipitation monitoring networks over South Africa is of great concern. Other regions in the world have also experienced such network decimation. In South Africa during the last decade, more than 30% of good daily rain gauge stations were lost/discontinued over important areas of the country and in 2012, the count of active gauges had reduced to the same number as were reporting in 1920. This deterioration of vital national information has many negative consequences for agriculture and water resources management in the semi-arid region.

To address this problem, we present an application of new techniques, based on space-time Copulas, which can be used for infilling gaps in daily gauge records while simultaneously being used for spatial interpolation to unobserved locations, and hence catchment areas. Both the infilled and interpolated estimates are expressed in the form of distributions [defined by selected quantiles] of possible rainfall values at each unobserved location in space and time. This distributional information provides a direct way to carry out studies that properly account for the uncertainty associated with estimating the missing values. Thus, instead of producing conventional global measures of uncertainty, the method adds valuable information by determining uncertainty estimates of the repaired data that vary in both space and time, depending directly on the number of intact nearby observations.