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Combination of radar and daily precipitation data to estimate meaningful sub-daily point precipitation extremes

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The use of radar measurements for the space time estimation of precipitation has for many decades been a central topic in hydro-meteorology. In this presentation we are interested specifically in daily and sub-daily extreme values of precipitation at gauged or ungauged locations which are important for design. The purpose of the presentation is to develop a methodology to combine daily precipitation observations and radar measurements to estimate sub-daily extremes at point locations. Radar data corrected using precipitation-reflectivity relationships lead to biased estimations of extremes. Different possibilities of correcting systematic errors using the daily observations are investigated. Observed gauged daily amounts are interpolated to un-sampled points and subsequently disaggregated using the sub-daily values obtained by the radar. Different corrections based on the spatial variability and the sub-daily entropy of scaled rainfall distributions are used to provide unbiased corrections of short duration extremes. In addition, a statistical procedure not based on a matching day by day correction is tested. In this last procedure, as we are only interested in rare extremes, low to medium values of rainfall depth were neglected leaving 12 days of ranked daily maxima in each set per year, whose sum typically comprises about 50% of each annual rainfall total. The sum of these 12 day maxima is first interpolated using a Kriging procedure. Subsequently this sum is disaggregated to daily values using a nearest neighbour procedure. The daily sums are then disaggregated by using the relative values of the biggest 12 radar based days in each year. Of course, the timings of radar and gauge maxima can be different, so the new method presented here uses radar for disaggregating daily gauge totals down to 15 min intervals in order to extract the maxima of sub-hourly through to daily rainfall.

The methodologies were tested in South Africa, where an S-band radar operated relatively continuously at Bethlehem from 1998 to 2003, whose scan at 1.5 km above ground [CAPPI] overlapped a dense [10 km spacing] set of 45 pluviometers recording in the same 6-year period. This valuable set of data was obtained from each of 37 selected radar pixels [1 km square in plan] which contained a pluviometer, not masked out by the radar foot-print. The pluviometer data were also aggregated to daily totals, for the same purpose. The extremes obtained using disaggregation methods were compared to the observed extremes in a cross validation procedure. The unusual and novel goal was not to obtain the reproduction of the precipitation matching in space and time, but to obtain frequency distributions of the point extremes, which we found to be stable.

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