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Multiscale spatial recorrelation of RCM precipitation downscaling to correct predictions over large areas and small

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In downscaling Regional Circulation Model (RCM) rainfall estimates, it is common to concentrate on the local statistics. To ignore the spatial dependence at large scales may lead to problems in hydrological applications, particularly in estimating/modelling extreme runoff from large areas, due to the wrongly modelled clustering behaviour of storms.

In Bárdossy and Pegram [2011], downscaling of RCM rainfall marginal distributions, dependent on Circulation Patterns (CPs), was successfully achieved over 172 blocks of the Rhine basin at 25 km scale. Uneasy about the spatial statistics of the downscaled RCM rainfall, we calculated the spatial cross correlation coefficients (cccs) of daily rainfalls of the same set. We found that the cccs of the RCM precipitations were significantly lower than those of the observations, especially for large areas aggregated from the elemental block estimates. CP based downscaling led to a slight increase of the cccs but their values remained below those of the observed cccs. We therefore decided to perform a recorrelation treatment to correct the cccs of the RCM estimates back to the observed set, before undertaking the final quantile-quantile (Q-Q) transform.

In this presentation we use a matrix method of recorrelation which was successful in that it recaptured the observed cccs almost exactly. In addition, it was demonstrated that the method coped with problems presented by the high proportion of dry days, when applied to five moderately large and climatologically different South African regions (10 000 to 14 000 sq km) in addition to the large German Rhine basin (108 000 sq km). After recorrelation, the appropriate Q-Q transforms are used to recover the appropriate distributions, and it is demonstrated that the spatial coherence of precipitation over large areas is recovered well enough to closely match that of the gauge-based observations.

Bárdossy, A., and G. Pegram (2011), Downscaling precipitation using regional climate models and circulation patterns toward hydrology, Water Resources Research, 47(W04505), doi:10.1029/2010WR009,689.