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Uncertainty assessment of spatial estimates of monthly rainfall using sequential Gaussian simulation

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Rainfall data are increasingly being required in gridded formats for many purposes in applied environmental science. Although spatial estimation of rainfall is often hampered by clustered or sparsely distributed rainfall gauges, spatial uncertainty in the gridded rainfall is rarely estimated. One possibility to assess spatial uncertainty in rainfall estimates is provided by the geostatistical technique of stochastic simulation. Unlike deterministic interpolators, stochastic simulation prioritises factors such as texture and sample statistics over local accuracy. The multiple simulations are used to build up a population of estimates at each grid cell location that can be queried with respect to its distribution properties and used to visualise spatial uncertainty.

For the UK, a spatiotemporal stochastic simulation was applied to monthly rainfall over a period of 8 years. In this particular approach, the observed rainfall series are regarded as the sum of a deterministic temporal trend and a stochastic residual component. The parameters of the temporal trend components established at the rain gauges were interpolated in space, accounting for their auto- and cross-correlation, as well as for relationships with ancillary spatial variables. Stochastic simulation was then employed to generate alternative realizations of the spatiotemporal residual component, which were added to the deterministic one to yield realizations of rainfall (after distributional corrections). In total, 40 simulations of rainfall were generated and these formed a model of uncertainty regarding unknown monthly levels of rainfall totals in space and time. The methodology gave reasonably accurate estimates of rainfall but showed some underestimation when the rainfall pattern was characterised by much

higher rainfall in the west and northwest of UK. The strengths of this method are the utilisation of information from the time and space domain, and the ability to provide an assessment of uncertainty due to the estimation method.