France-wide application of the RAINSIM rainfield stochastic generator

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Abstract

The RAINSIM stochastic rain field generator is based on weather pattern sub-sampling and meta-gaussian models (Ayar et al., 2020). Observed data at stations are sub-sampled into subsets by seasons and weather types on which most of the statistical models (e.g. point distribution, space-time covariance etc.) are parametrized.
In this study, the RAINSIM generator is parametrized with a dataset from 291 rain gauges covering the whole French continental territory. This large-scale application challenges a key assumption of RAINSIM: the stationarity of its spatial covariance model (here an anisotropic powered-exponential model). At the scale of France, the diversity of climatology-and potentially of the spatial structures of rain fields-is significant, thus questioning this hypothesis.

To tackle this, the approach presented in Monestiez et al (2007) has been tested. As stated in this paper, "a deformation of the geographic plane (is computed) so that the spatial covariance structure can be considered stationary in terms of a new spatial coordinate system. This provides a non-stationary model for the spatial covariances between sampled locations and prediction locations". This approach has been implemented by Youngman in the R-package *deform* (Youngman, 2023).

Thus, RAINSIM parametrizations and simulations with exponential covariance functions based on deformed spatial coordinates are presented here. The deformations are computed independently for each subset, thanks to the *deform* package, illustrating that the spatial covariance structure of the rain fields depends on the weather, and to a lesser extend to the season. Comparisons to observed data with suitable metrics are presented to score this use of covariance-oriented deformations of space.

References:

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