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Joint Generalized Neural Models and Censored Spatial Copulas for Probabilistic Rainfall Forecasting

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This work develops a novel method for generating conditional probabilistic rainfall forecasts with temporal and spatial dependence. A two-step procedure is employed. Firstly, marginal location-specific distributions are modelled independently of one another. Secondly, a spatial dependency structure is learned in order to make these marginal distributions spatially coherent.
To learn marginal distributions over rainfall values, we propose a class of models termed Joint Generalised Neural Models (JGNMs). These models expand the linear part of generalised linear models with a deep neural network allowing them to take into account non-linear trends of the data while learning the parameters for a distribution over the outcome space.
In order to understand the spatial dependency structure of the data, a model based on censored copulas is presented. It is designed for the particularities of rainfall data and incorporates the spatial aspect into our approach. Uniting our two contributions, namely the JGNM and the Censored Spatial Copulas into a single model, we get a probabilistic model capable of generating possible scenarios on short to long-term timescales, able to be evaluated at any given location, seen or unseen. We show an application of it to a precipitation downscaling problem on a large UK rainfall dataset and compare it to existing methods.