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Modeling spatial dependencies using spatial vine copula approaches

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Classical approaches for the modeling of spatial dependency mostly assume Gaussian dependency structures. Although this assumption may simplify the modeling process, it is not always met in practice. In this talk, I will introduce two new approaches for spatial dependency modeling, based on the flexible class of vine copula distributions, which are able to capture non-Gaussian spatial dependencies. One approach enhances the regular vine copula for spatial applications; the other is a composite-likelihood-based inference technique combining local, 4-dimensional, canonical vine copulas. Vine copulas are a class of flexible multivariate probability distributions that are built from bivariate copulas. For each of these bivariate building blocks we can choose among a variety of different dependency structures (copula families), which are well understood and easy to compute. The proposed "spatial R-vine copula model" and the composite likelihood approach for the modeling of spatial dependencies ("spatial local C-vine composite likelihood approach") combine the flexibility of vine copulas with the geostatistical idea of modeling the extent of spatial dependencies using the distances between the variable locations. Maximum likelihood estimation techniques will be presented. Both approaches allow for spatial prediction at unobserved locations. To illustrate the model development process, I will consider daily mean temperature time series taken from 54 monitoring stations across Germany. A validation data set comprising of 19 additional station time series will be used for adequate model validation and comparison.

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