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Copula-based Investigation of Dependency Structures of Wet refractivity in Central Europe

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Understanding, modeling, and predicting hydrometeorological extreme events are major topics in geoscience. But since, in particular, extreme events depend on various factors and hydrometeorological parameters as well as their interactions and feedbacks, it is crucial to analyze and understand their spatial and temporal dependencies. However, simple metrics like spatial correlation coefficients only consider the linear relationship between variables and therefore neglect significant non-linear dependencies. Therefore, we propose Copula-based dependency-metrics, with which we can analyze the full dependency structure of variables, including the statistical relationship of extreme events. In this study, we use the proposed approach for analyzing the spatial dependency structures of atmospheric wet refractivity, which is a key parameter in GNSS-tomography and hence the reconstruction of a local tropospheric model. Therefore, the Weather Research and Forecast (WRF) model has been applied, with which high-resolution fields of atmospheric pressure, temperature and water vapor were simulated. We used the model results for deriving pixel-based wet refractivities on multiple pressure levels in high spatial and temporal resolution. The model was run with a spatial resolution of 3km for a domain in Central Europe during the period April to October 2016. The dynamic patterns and spatial correlations of pixel-based hourly wet refractivity on different pressure levels were then evaluated using several Copula-based dependency measures. While we currently focus on the analysis of wet refractivity, the dependency measures can be easily applied to other hydrometeorological quantities and therefore provide an innovative approach for analyzing spatial correlations including the spatial dependencies of extreme events. In our presentation, we show the different steps for deriving the dependency measures as well as first results which show the advantages compared to classical correlation-based analyses.