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A workflow for the 3D visualization of meteorological data

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In the future, climate change will strongly influence our environment and living conditions. To predict possible changes, climate models that include basic and process conditions have been developed and big data sets are produced as a result of simulations. The combination of various variables of climate models with spatial data from different sources helps to identify correlations and to study key processes. For our case study we use results of the weather research and forecasting (WRF) model of two regions at different scales that include various landscapes in Northern Central Europe and Baden-Württemberg. We visualize these simulation results in combination with observation data and geographic data, such as river networks, to evaluate processes and analyze if the model represents the atmospheric system sufficiently. For this purpose, a continuous workflow that leads from the integration of heterogeneous raw data to visualization using open source software (e.g. OpenGeoSys Data Explorer, ParaView) is developed. These visualizations can be displayed on a desktop computer or in an interactive virtual reality environment. We established a concept that includes recommended 3D representations and a color scheme for the variables of the data based on existing guidelines and established traditions in the specific domain. To examine changes over time in observation and simulation data, we added the temporal dimension to the visualization.

In a first step of the analysis, the visualizations are used to get an overview of the data and detect areas of interest such as regions of convection or wind turbulences. Then, subsets of data sets are extracted and the included variables can be examined in detail. An evaluation by experts from the domains of visualization and atmospheric sciences establish if they are self-explanatory and clearly arranged. These easy-to-understand visualizations of complex data sets are the basis for scientific communication. In addition, they have become an essential medium for the evaluation and verification of models. Particularly in interdisciplinary research projects, they support the scientists in discussions and help to set a general level of knowledge.