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Analysis of Climate Data using Interactive Visual Exploration Methods Compared with Classical Statistics

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The field of geophysics frequently deals with large datasets, increasingly so with extending the spatial domain of climate change detection to using satellite observations and global climate model simulations. Classical statistical concepts are commonly used to deal with these datasets. Interactive visual exploration can support getting a grip on the huge amount of information collected. Visual exploration methods use the abilities of the human vision to detect visual patterns, and to extract useful information from the datasets. These methods in the context of more general data mining concepts have become feasible even for personal computers only recently.

Using the concepts of visual data exploration such as “brushing” (selecting) the data items in different “linked views” it is shown how to readily get an overview on the characteristics of the dataset or how to detect data deficiencies. The visual data exploration approach does not presume any assumptions on the data or any preselections beforehand. It is well suited to come up with hypotheses about the data which can then be analyzed further using the methods of classical statistics.

In this study the interactive visual field exploration tool SimVis (*Sim*ulation *Vis*ualization) is used to explore atmospheric datasets of ECHAM5 global climate model runs and the ERA-40 reanalysis. We present exemplary visual exploration processes with a focus on climate trend detection in the upper troposphere/lower stratosphere region for geopotential height and temperature fields, being key climate indicators which are accessible by radio occultation observations. The thus extracted hypotheses are then compared with results from classical statistical trend analysis.