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Visualization in a Climate Computing Centre

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Today, the extensive numerical simulations of climate models require elaborate visualization for understanding and communicating the results. Typical data sets of climate models are 3-dimensional, multivariate and time dependent, and can hence be very large. Interactive visual data analysis improves and accelerates the comprehension of these vast amounts of data.

At DKRZ, the German Climate Computing Centre, a central high end visualization server, various domain specific visualization applications, and a remote 3D rendering solution enable users to interactively visualize their extensive model results right at their desktops.

The DKRZ's visualization server is a heterogeneous Linux cluster, currently consisting of 10 state of the art visualization nodes equipped with 96 -256 GB RAM and high end NVidia GPUs. Since the parallel file system of the DKRZ's supercomputer is directly mounted over a powerful network, the model data can directly be analyzed and visualized. VirtualGL and TurboVNC are used for utilizing the server's GPUs for 3D rendering, while the TurboVNC client on the user's local computer continuously displays the resulting video stream. By using this central visualization server instead of a local computer, three main benefits are achieved:

- Time consuming transfers of large data sets from the supercomputer to the local computer are not needed.
- The hardware of the user's local workstation doesn't need to be powerful, no expensive GPU is required.
- Users don't have to install or buy visualization software.

On the visualization server, a wide range of visualization software is installed. Avizo Green, a powerful commercial software customized for interactive 3D visualization of climate model data, is available, as well as SimVis and ParaView, which focus more on an exploratory visualization of data. SimVis and ParaView provide techniques like Linking & Brushing to emphasize or de-emphasize portions of the data. Furthermore, some domain specific 2D graphics software packages, like NCL and GrADS, as well as software for processing, manipulating and analyzing the data, such as the CDOs (Climate Data Operators), are also used on the DKRZ visualization server.

This PICO will give an overview on the overall system and the techniques applied at DKRZ for the visualization of climate modeling results. Many examples are given to illustrate the types of applications.