THE ULTRA-SCALE VISUALIZATION CLIMATE DATA ANALYSIS TOOLS

As the need to understand and project climate change becomes increasingly critical, climate model complexity, model resolution and the number of simulations required increases. To keep pace with the growing size and complexity of climate simulations, new software tools are required to enhance and speed manipulation and analysis of the climate data and model output. This creates a challenge for global computational teams to visually and analytically assist scientists in their mission to understand and estimate climate change.

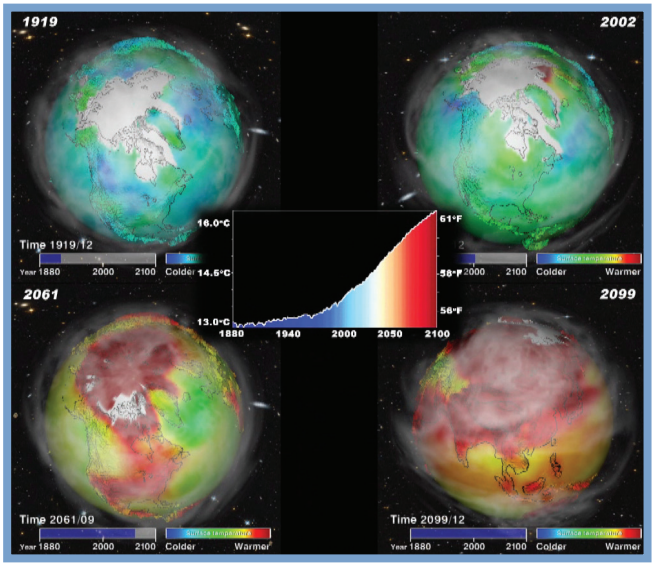
To this end, the Ultra-scale Visualization Climate Data Analysis Tools (UV-CDAT) team is developing new capabilities for visual exploration and analysis of large-scale data collections and uncertainty information. Funded by the U.S. Department of Energy Office of Science, the UV-CDAT consortium, led by Lawrence Livermore National Laboratory, consists of four DOE laboratories (Los Alamos, Lawrence Berkeley, Lawrence Livermore, and Oak Ridge), two universities (University of Utah and the Polytechnic Institute of New York University), NASA, and two private companies (Kitware and Tech-X).

UV-CDAT builds on the following key technologies:

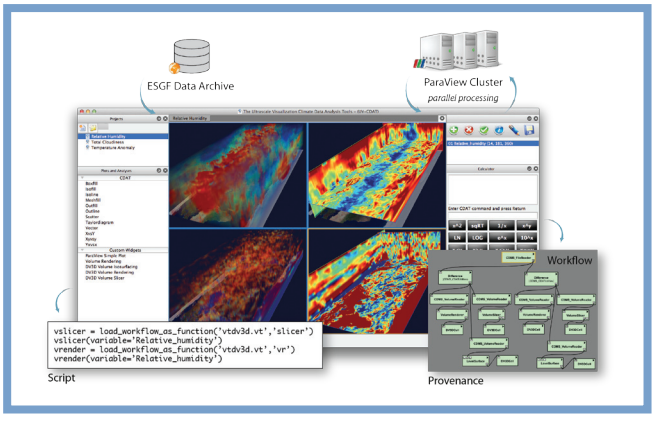
- **Climate Data Analysis Tools (CDAT) framework:** Developed at Lawrence Livermore for the analysis, visualization, and management of large-scale distributed climate data
- **ParaView:** Open-source, multi-platform, parallel-capable visualization tool which recently added capabilities to better support specific needs of the climate-science community
- **VisTrails:** Open-source scientific workflow and provenance management system that supports data exploration and visualization
- **VisIt:** Lawrence Livermore open-source, parallel-capable, visual-data exploration and analysis tool that is capable of running on a diverse set of platforms, ranging from laptops to DOE's largest supercomputers.

These combined tools, along with others such as the R open-source statistical analysis and plotting software and custom packages (e.g., DV3D), form UV-CDAT and provide a synergistic approach to climate modeling, allowing researchers to advance scientific visualization of large-scale climate data sets.

In May 2012, UV-CDAT was officially released to the community for a first look before a final product is issued. As climate modeling is an ever-developing activity of increasing complexity and sophistication, UV-CDAT is working towards a future release that will make better use of modern computational trends, multi-scale processors, parallel I/O readers, user interfaces, and the incorporation of community tools.



The average ensemble surface temperature of 23 climate models over a 100 years time span.



The UV-CDAT reusable software and workflow analysis and visualization graphical user application interface for large-scale DOE climate modeling and measurements archives.

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