Visualization at ORNL's National Center for Computational Sciences

Presented by

Sean Ahern

Visualization Task Leader
National Center for Computational Sciences

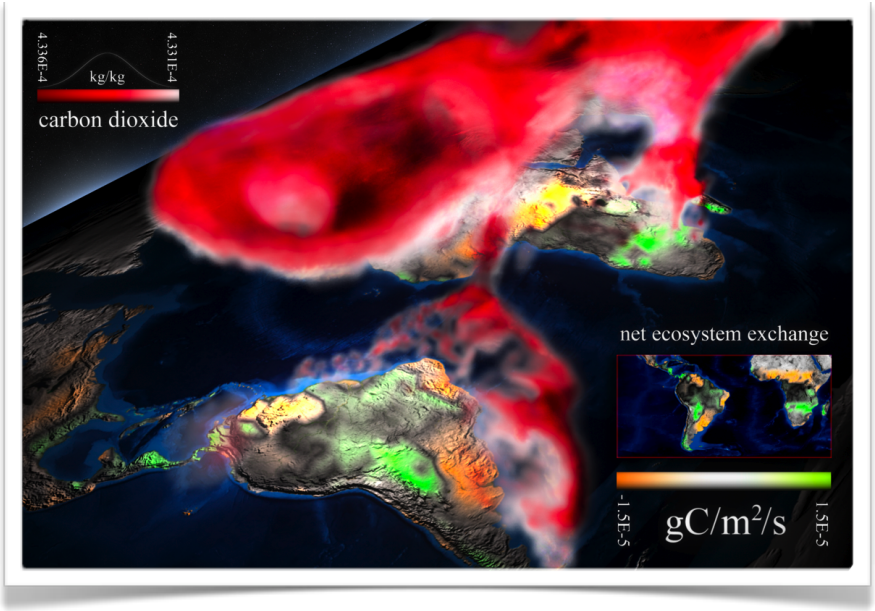
We provide data analysis and visualization for ORNL's HPC users

- Many application domains:
  - Magnetic confinement fusion
  - Climate
  - Bioenergy
  - Material science
  - Nuclear energy
  - Astrophysics
  - Geographic information systems

- Focus on large data:
  - Large, distributed analysis cluster
  - Parallel tools: VisIt, Paraview, EnSight
  - Core competency in remote visualization
- Production visualization development team
  - Custom tools
  - New data exploration techniques
  - Movie/image generation
  - Large display support

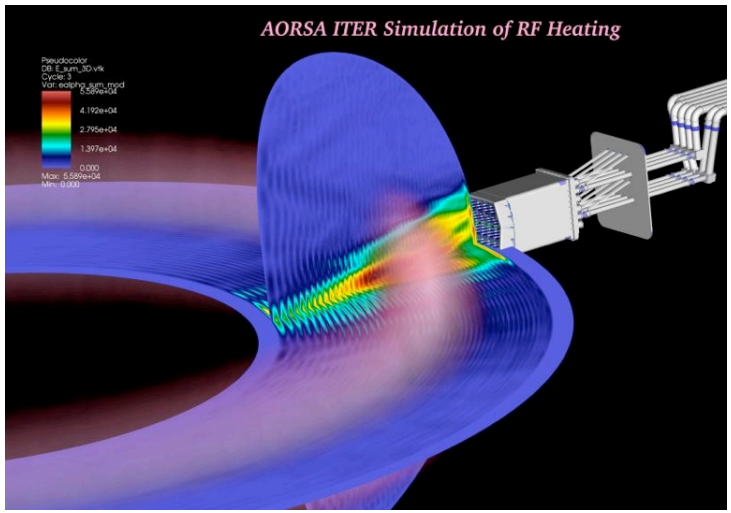
Supporting climate dynamics

- "Embedded" visualization support for the Computational Earth Sciences Group
- Exploring coupled carbon cycle and nitrogen cycle models of long time scale climate systems

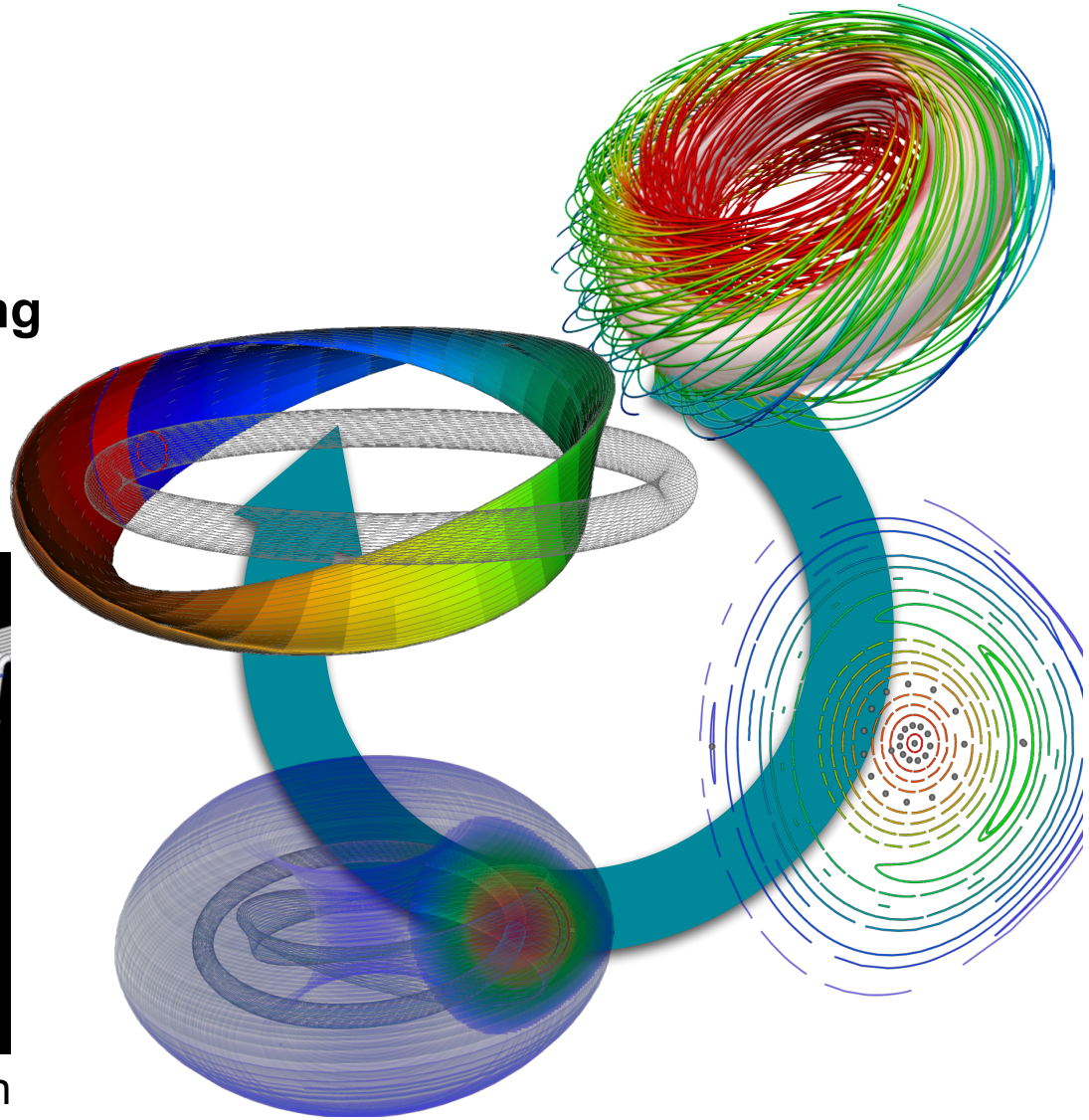


Magnetically confined fusion support

- RF heating of plasmas
- Topological analysis
  - Magnetic field line winding
  - Poincaré plot generation
  - Island extraction

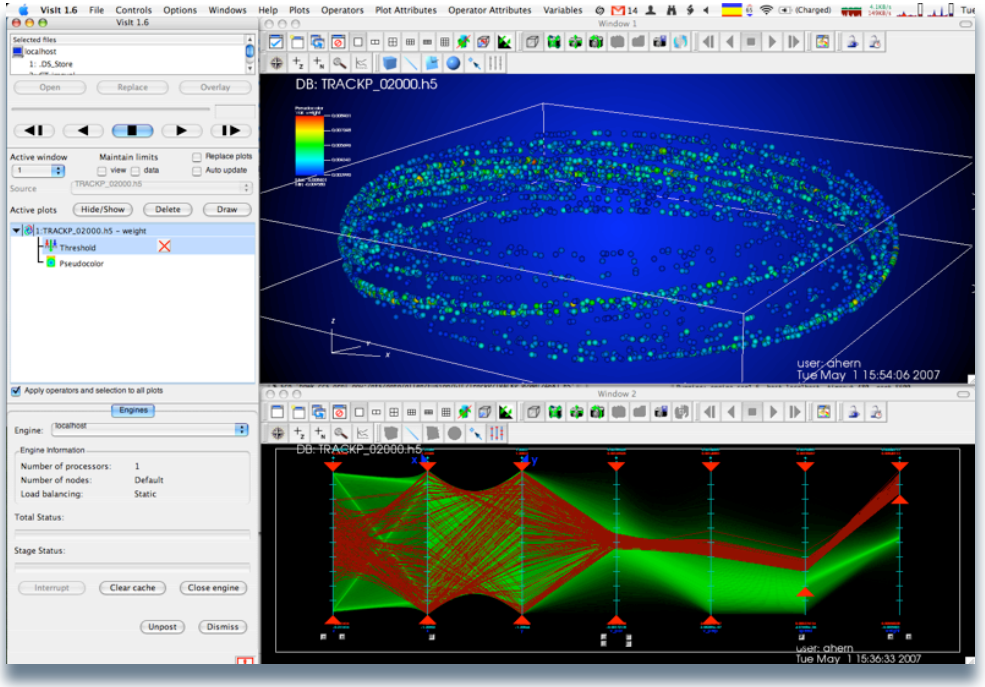


Combined visualization of simulation results and CAD model of ITER



High dimensional filtering

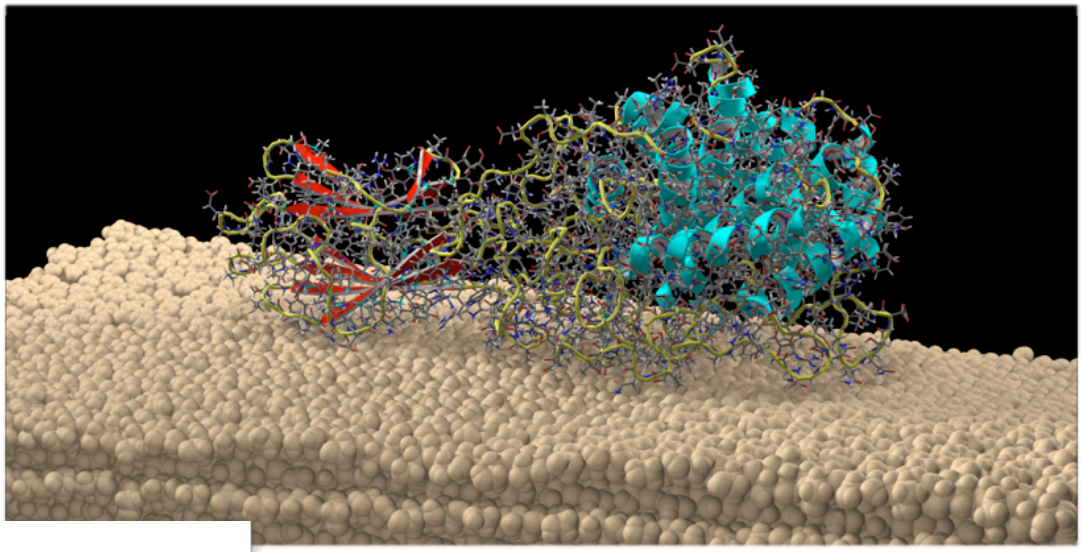
- Information visualization technique (a.k.a. parallel coordinates)
- Consists of three linked capabilities
  - Parallel coordinates plot with summary view for large data
  - Restriction tool
  - Multivariate threshold operator

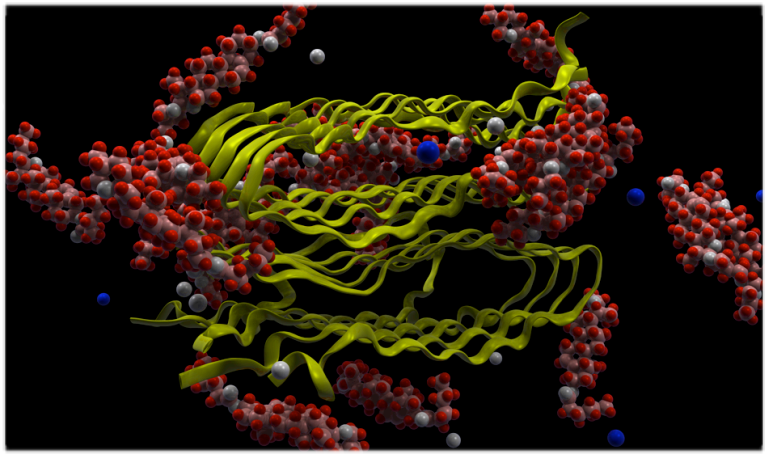


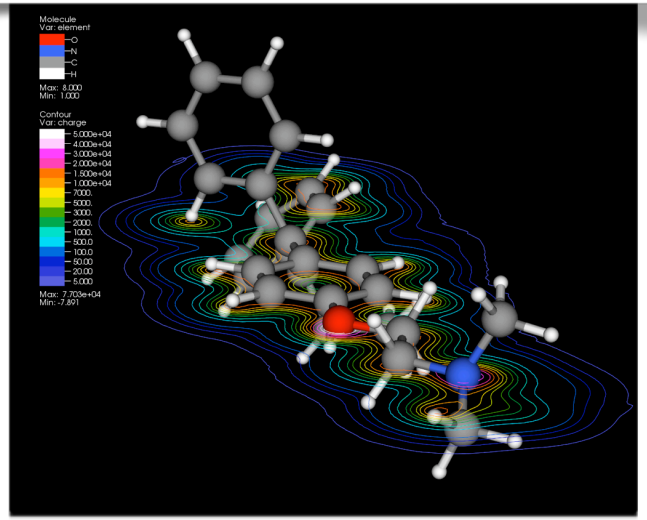
- Used to filter multivariate data from particle-in-cell fusion code
- Implemented in VisIt: http://www.llnl.gov/visit

Molecular dynamics

- Support MD data analysis for
  - Bioenergy
  - Material science
  - Drug modeling
- VisIt “Molecule” plot for data analysis



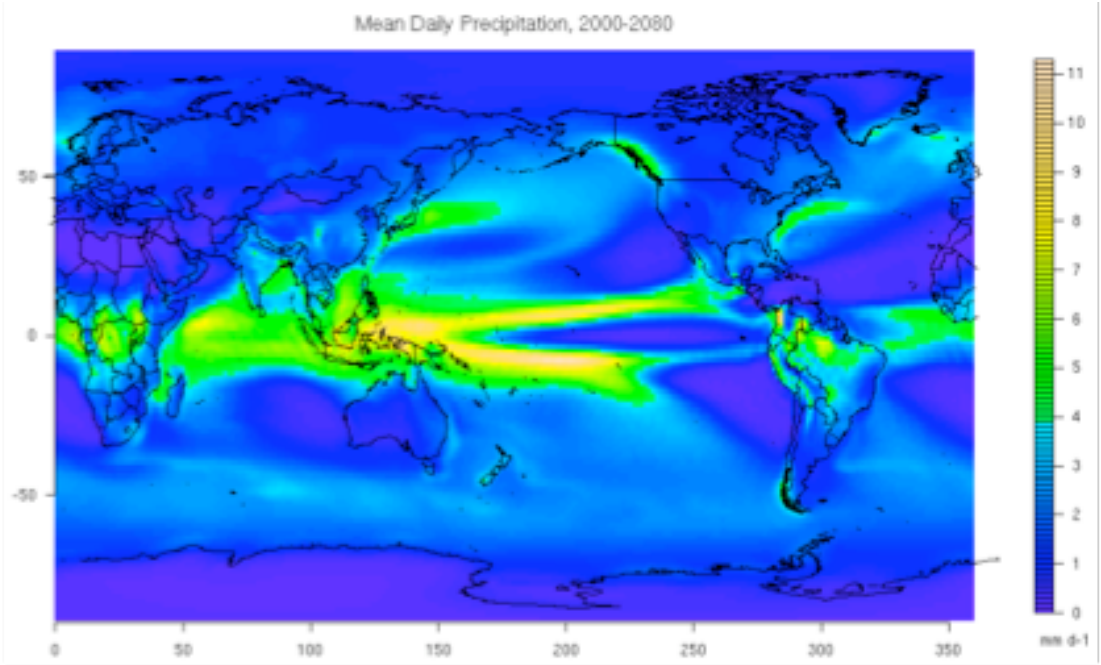




OAK RIDGE National Laboratory

Interactive climate analysis with data-parallel R

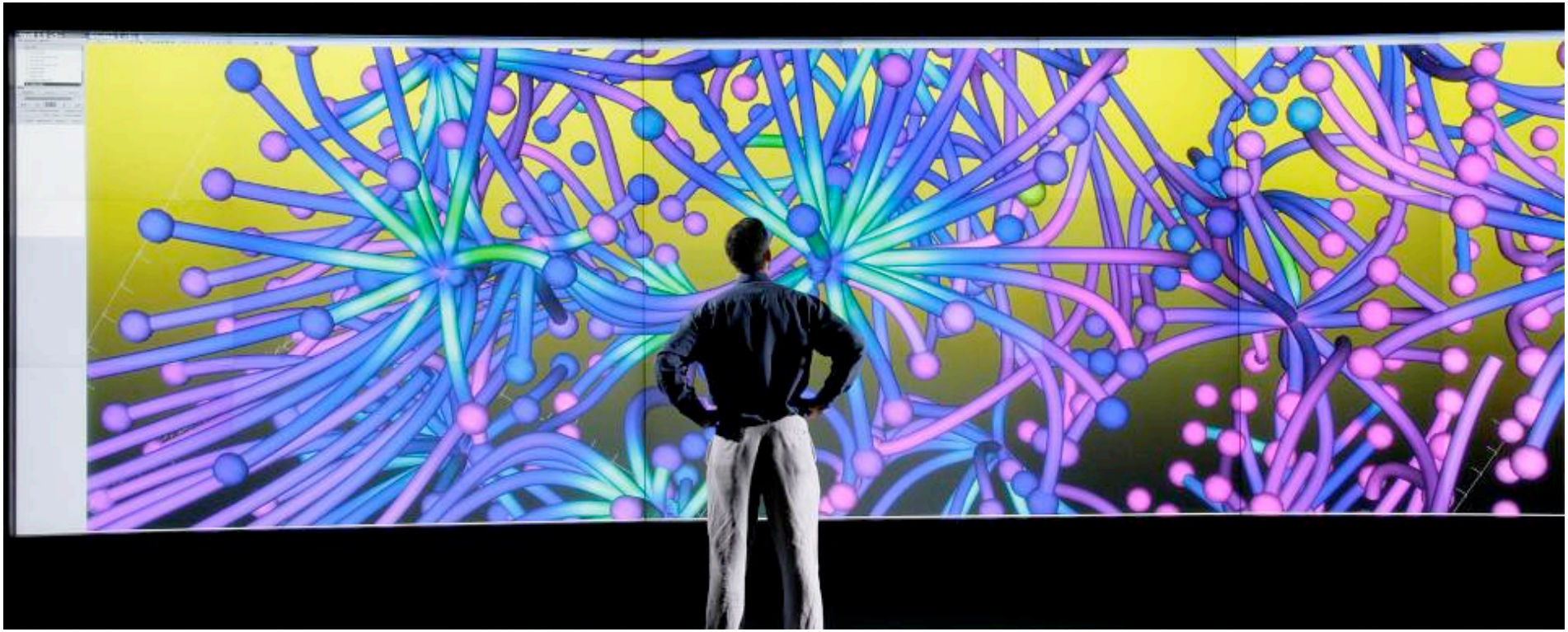
- **Data-parallel R interactive runtime environment:**
  - **NetCDF data-parallel readers**
  - **R/RMPI operations on distributed data**
- **Extremely broad range of analysis methods:**
  - **So far, binning, subsetting, univariate statistics, regression methods, and extreme value methods tested**
  - **Other analyses being tested**



Where it rains and where it doesn't rain

EVEREST facility

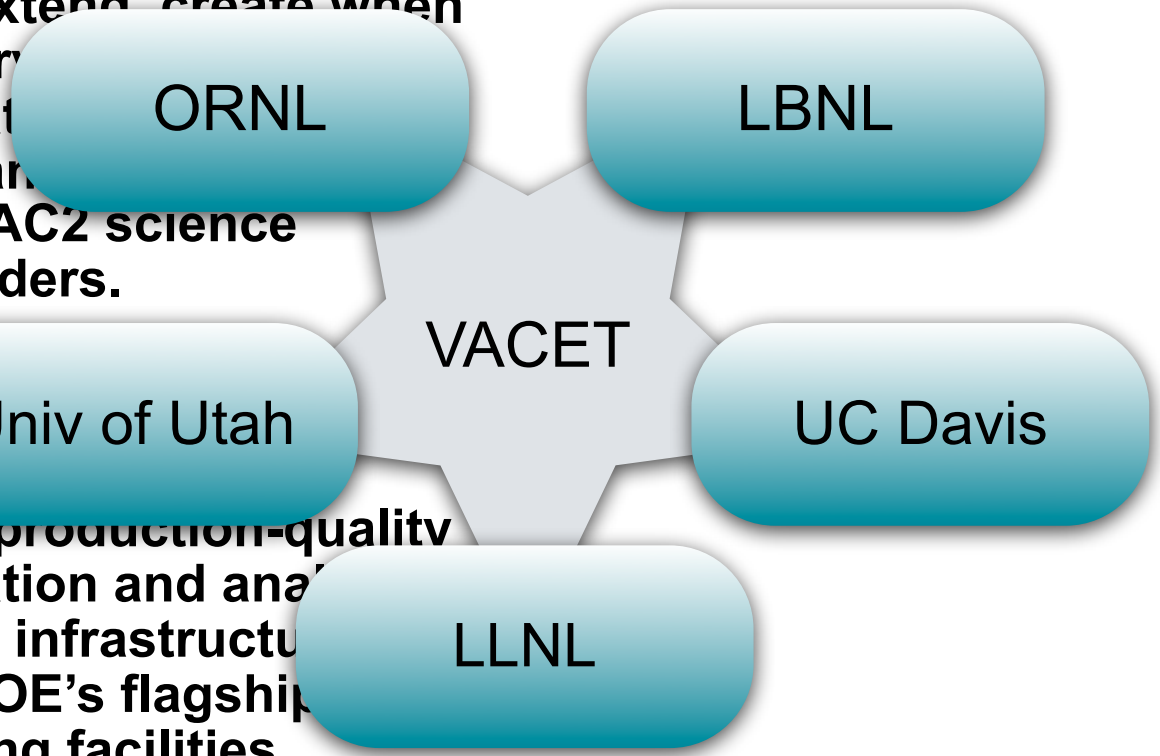
- 35 million pixel, 27-tile PowerWall
- 27 NVIDIA 8800 GTX GPUs, dedicated Linux cluster
- Interactive, large-scale, collaborative data analysis
- 30 feet by 8 feet



One of five institutions making up the SciDAC Visualization Center

- **Meet the data understanding challenge**
  - **Adapt, extend, create when necessary visualization understanding for SciDAC2 science stakeholders.**
- **Produc -capab**
  - **Provide production-quality visualization and ana software infrastructu use at DOE's flagshi computing facilities.**

Visualization and Analytics Center for Enabling Technologies

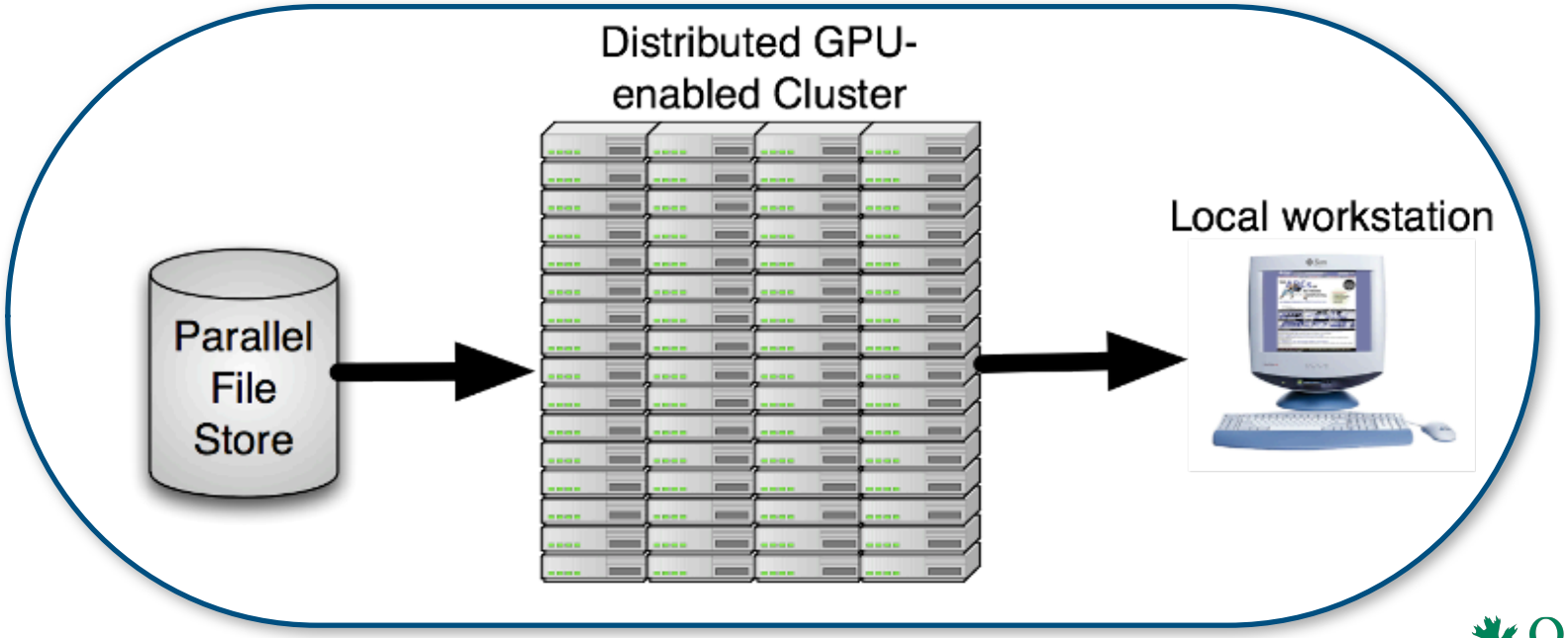


www.vacet.org

OAK RIDGE National Laboratory

Remote visualization for large data

- Largest datasets require use of institutional resources.
- Reduces data movement issues.
- Allows exploitation of multiple GPUs.
- Provides visualization to remote users.
- Exploited by VisIt, ParaView, EnSight.



Contact

Sean Ahern
Visualization Task Leader
National Center for Computational Sciences
(865) 241-3748
ahern@ornl.gov

OAK RIDGE National Laboratory