



VACE

*Meet the SciDAC Visualization
and Analytics Center for
Enabling Technologies*

E. Wes Bethel (Coordinating PI)

LBNL

23 October 2008



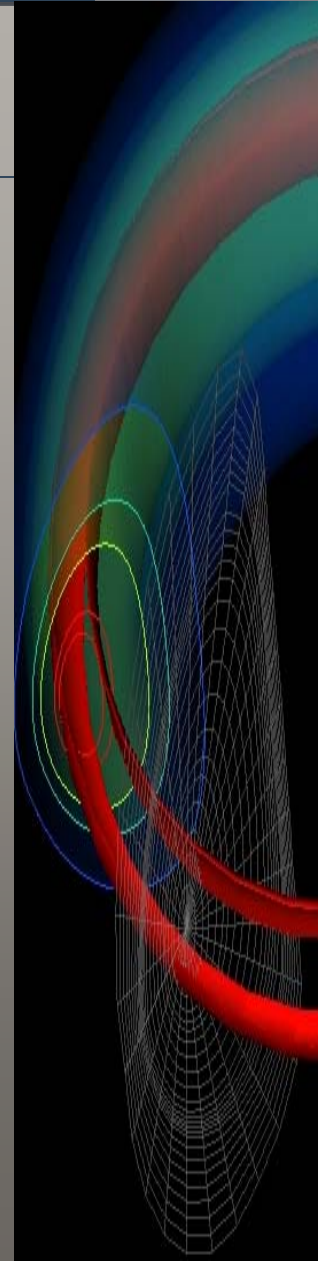
VACET Team

- Lawrence Berkeley National Laboratory
 - Bethel, Weber, Prabhat.
- Lawrence Livermore National Laboratory
 - Childs, Whitlock, Bonnell, Laney.
- Oak Ridge National Laboratory
 - Ahern, Meredith, Ostrouchov, Pugmire.
- University of Utah
 - Johnson, Hansen, Silva, Pascucci.
- University of California, Davis
 - Joy, Hamann.



VACET Motivation

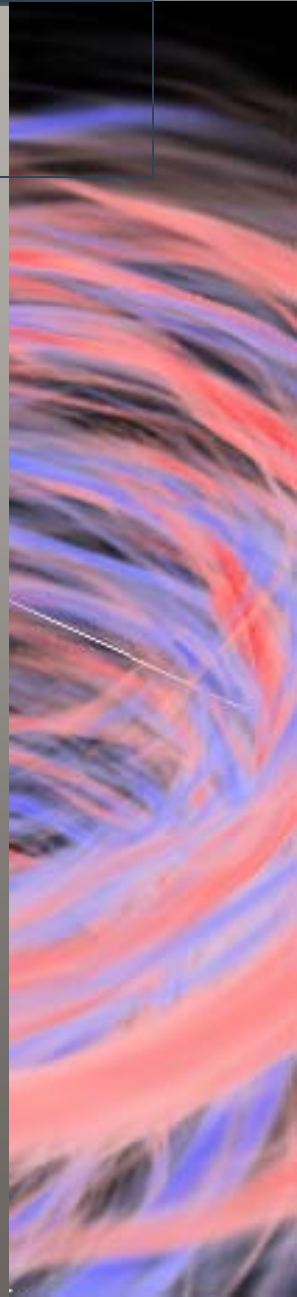
- Visual Data Analysis: plays a central role in the scientific discovery process.
- SciDAC (and other) science efforts have unmet data understanding needs.
 - Domain-specific challenges
 - Large, complex data
 - Emerging computational platforms
 - Training, consulting/partnering, support.





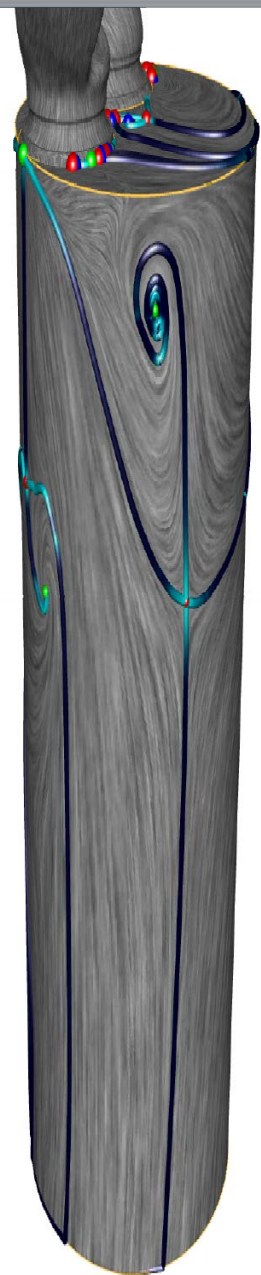
Large Data Visualization Issues

- Existing, traditional algorithms don't work.
 - HPC Challenges
 - Human cognition challenges.
- We listen to our science stakeholders. They want:
 - To see and analyze relevant and scientifically interesting data.
 - To compute and see relationships between fields.
 - Perform these operations on very large data.
 - And on HPC platforms.
 - Want production-quality software, expert help (“fishing instruction”).



VACET Mission Statement

- Meet the Data Understanding Challenge
 - Adapt, extend, create when necessary, and deploy visualization and data understanding technology for SciDAC2 and other DOE science stakeholders.
 - Accelerate scientific knowledge discovery.
- Production-Quality and –Capable Software
 - Provide production-quality visualization and analytics software infrastructure for use at DOE’s open computing facilities.



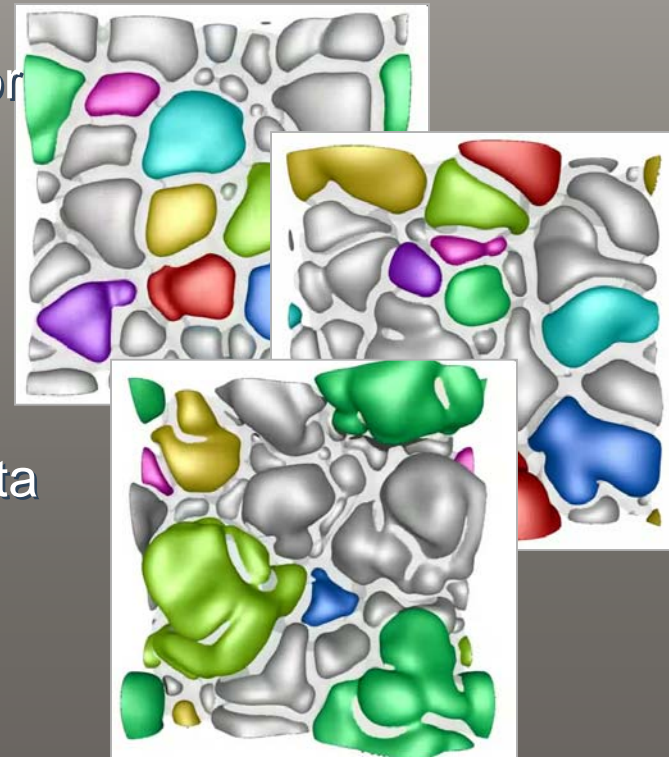
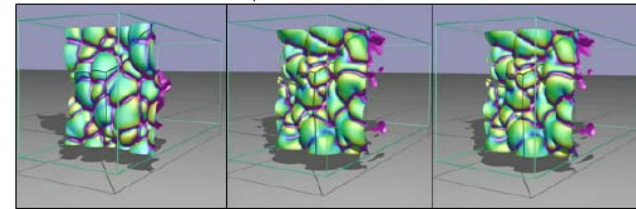
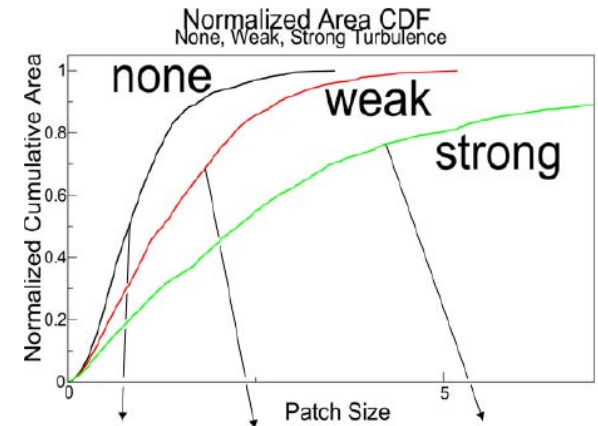
Accomplishments

- Successfully brought multiple “products to market”
 - Science applications adopt VACET technology as community-wide visual data analysis s/w infrastructure.
 - Stakeholders are voting with their feet.
- Award-winning research
 - Dozens of peer-reviewed field-leading journal articles
 - Numerous Best-Paper awards
- High (and positive) visibility within the SciDAC and visualization communities.
- Realizing vision of a successful SciDAC Center



Combustion, Part 1

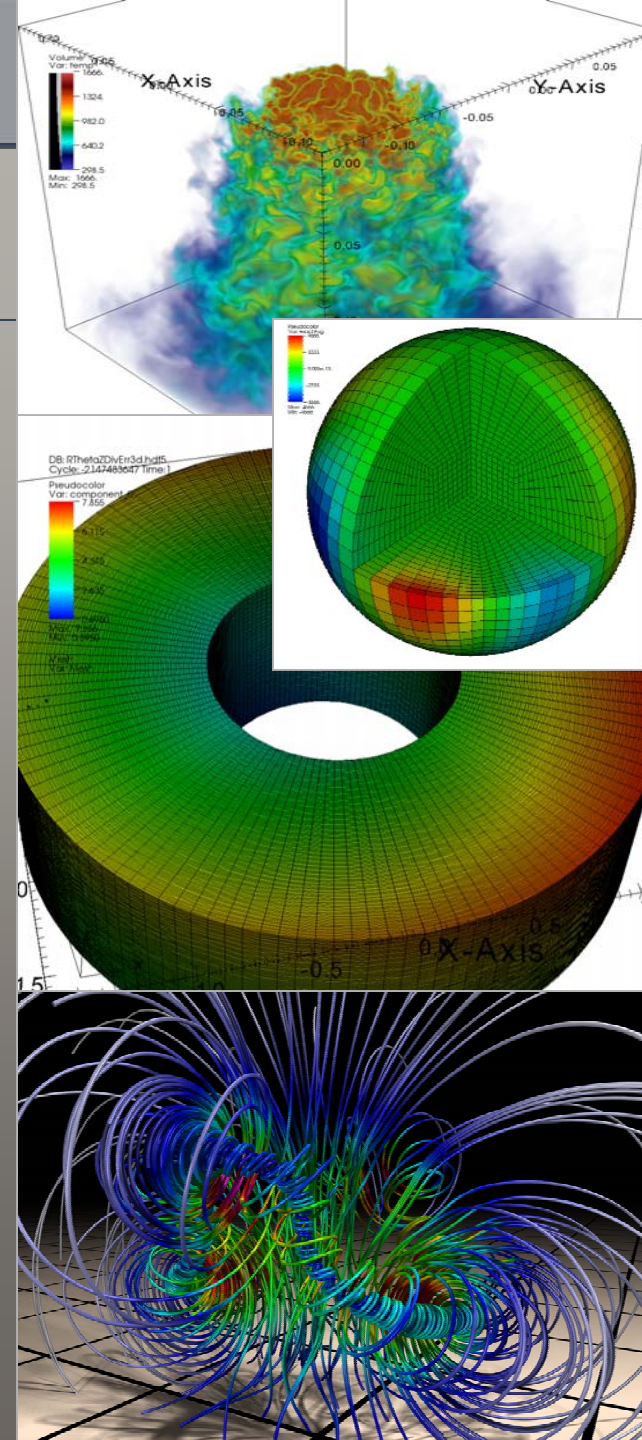
- PI: John Bell (LBNL), SciDAC Community Astrophysics Consortium Partnership, Incite Awardee.
- Accomplishments:
 - New topological analysis techniques for studying relationship between parameters and their effect.
 - Joint publications with stakeholder.
- Science Impact:
 - First-ever quantitative analysis large, time-varying combustion simulation data to study influence of turbulence on size/shape of combustion regions in lean, premixed hydrogen flames.





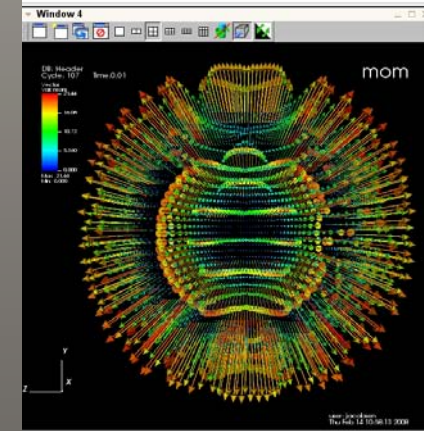
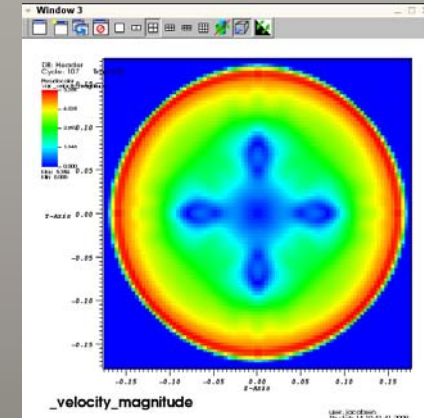
Mathematics

- PI: Phil Colella (LBNL), SciDAC Applied Partial Differential Equations Center
- Accomplishment(s)
 - Software engineering to “bring product to market”. Performance improvements, interface enhancements, file readers, visual data exploration techniques.
- Science Impact
 - Direct cost savings: APDEC no longer uses its own resources (e.g., FTEs) to develop, maintain, and support AMR visualization software.
 - Ability to perform AMR visualization on large, time-varying data, and using parallel platforms.
 - Benefits propagate to all APDEC stakeholders.



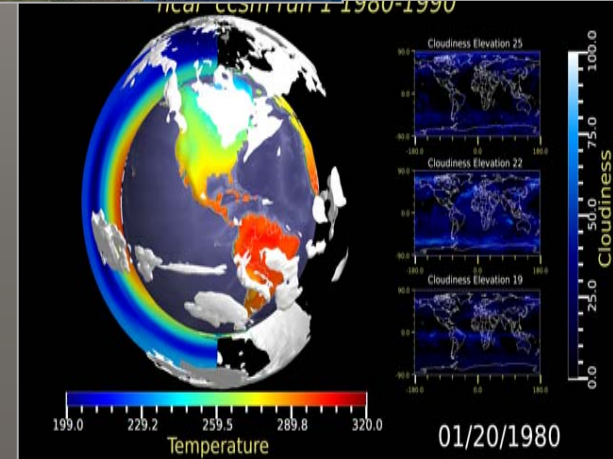
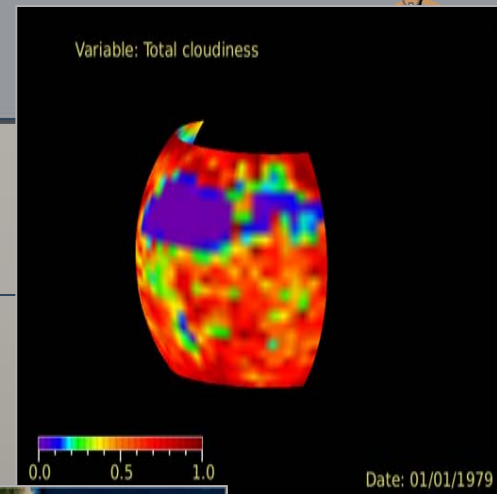
Astrophysics

- PI: Stan Woosley (UCSC), John Bell (LBNL), Adam Burrows (Princeton). SciDAC Community Astrophysics Consortium
- Accomplishment
 - Provide production-quality AMR visualization software, including tutorials and support, to CAC code teams.
- Science Impact
 - Reduced complexity, increase in scientific productivity. A single community-wide visual data analysis application, which addresses needs of SN modeling and spectral analysis, helps eliminate the need to learn and use multiple visual data analysis applications.



Climate, Part 1

- PI: Dean Williams (LLNL), SciDAC Earth Systems Grid.
 - Other beneficiaries:
 - Community Climate System Model Consortium, Phil Jones (LANL), John Drake (ORNL)
- Accomplishments
 - Software engineering to transition research prototype into production code within a climate community standard visual data analysis system (VCDAT).
- Science Impacts
 - New capability: 3D, temporal visual data analysis is now part of a familiar application, offers new dimensions for understanding climate data.





Fusion, Part 1

- PI's/Projects

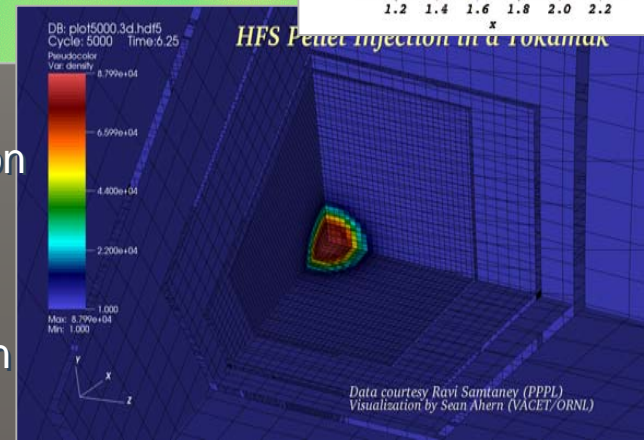
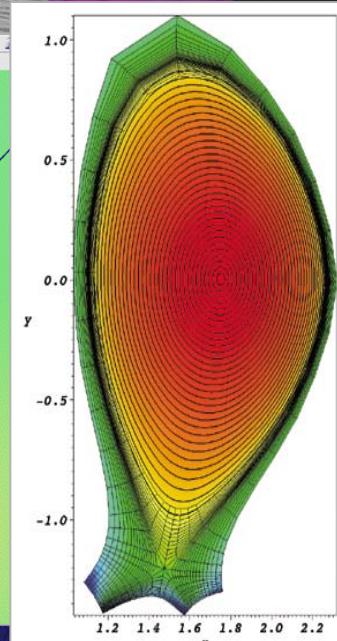
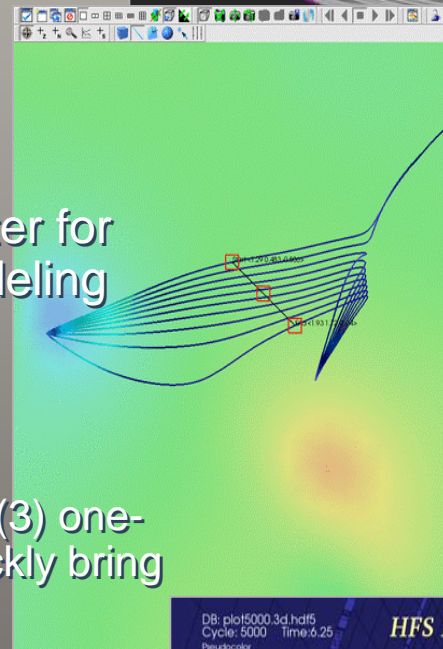
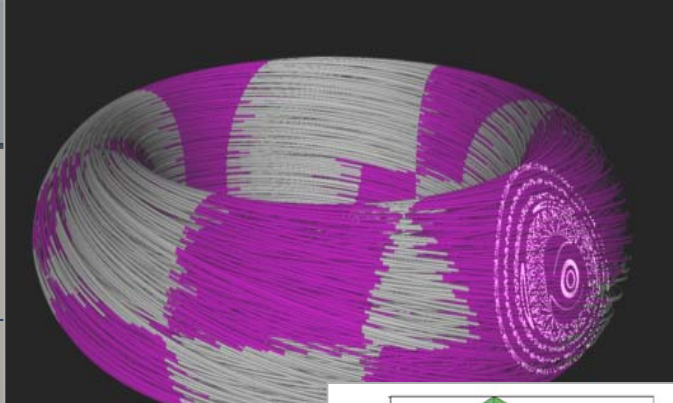
- J. Cary (Tech-X), SciDAC Framework Application for Core-Edge Transport Simulations
- Ravi Semtaney (PPPL), SciDAC Center for Extended Magnetohydrodynamic Modeling

- Accomplishment(s)

- Leverage VACET investment in (1) AMR visualization software and (2) fundamental visualization s/w infrastructure, along with (3) one-on-one work with user communities to quickly bring "product to market."

- Science Impact

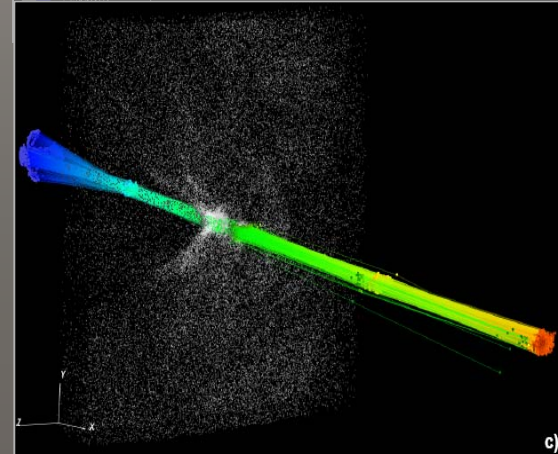
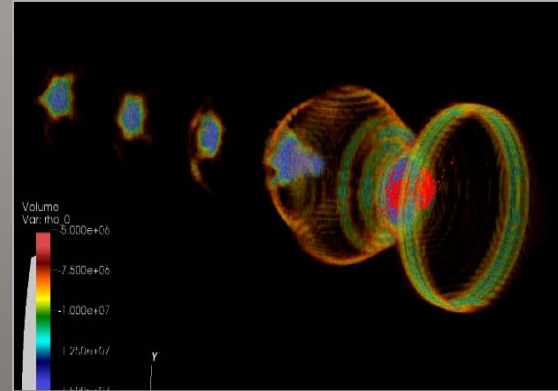
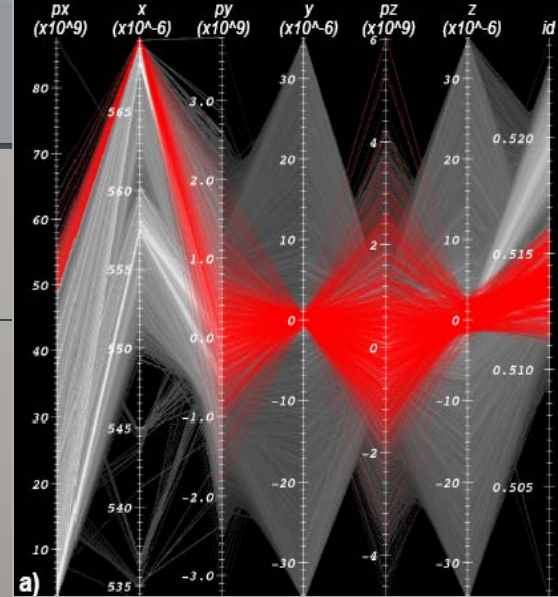
- New capability: production quality AMR visualization software infrastructure.
- Cost savings: community-wide, production-quality visual data analysis software infrastructure helps scientists focus on science rather than visualization s/w development.





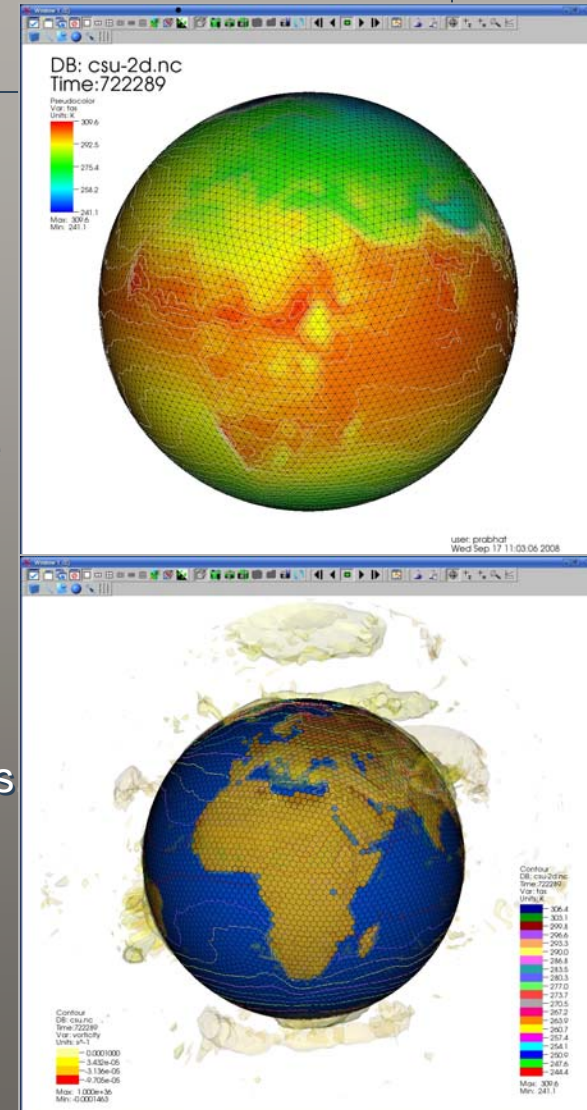
Accelerator Modeling

- PI: C. Geddes (LBNL), part of SciDAC COMPASS project, Incite awardee.
- Accomplishment:
 - Algorithms and production-quality s/w infrastructure to perform interactive visual data analysis (identify, track, analyze beam particles) in multi-TB simulation data.
- Science Impact:
 - Replace serial process that took hours with one that takes seconds.
 - New capability: rapid data exploration and analysis.
- Collaborators:
 - SciDAC SDM Center (FastBit)
 - Tech-X (Accelerator scientists)



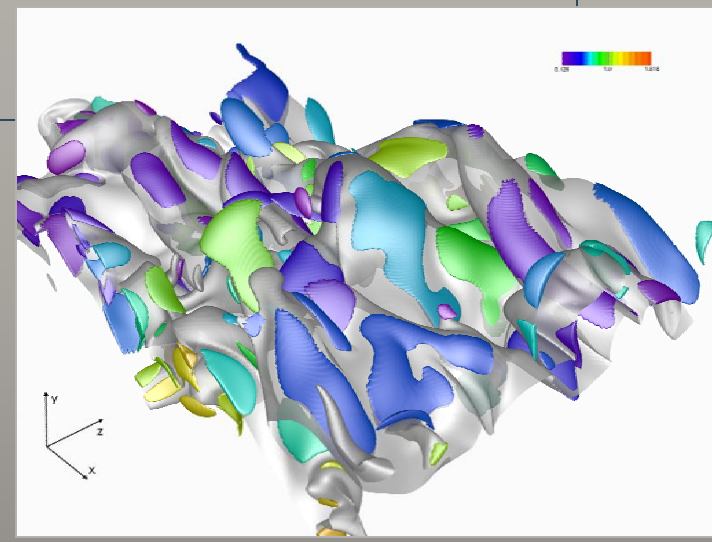
Climate, Part 2

- PI: Dave Randall (CSU). SciDAC Application: Role of Clouds in Global Climate
- Accomplishments
 - Debug and optimize parallel I/O to meet performance objectives.
 - New visualization infrastructure for icosahedral grid.
- Science Impact
 - Enable effective use of INCITE allocation at NERSC
 - Critical s/w infrastructure to enable visualization and analysis of ensemble runs of new global cloud models
- Other Collaborators:
 - NERSC Center staff
 - Karen Schuchardt (PNNL)

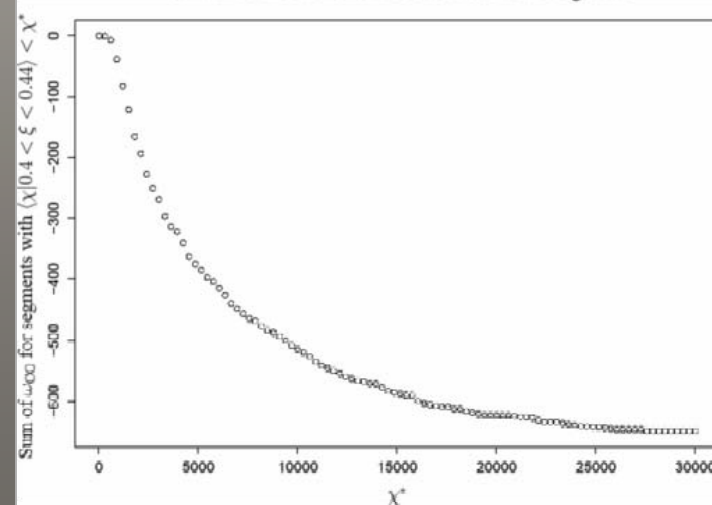


Combustion, Part 2

- PI: Jacqueline Chen (SNL-CA), Incite awardee.
- Accomplishment(s)
 - Algorithms for feature segmentation, tracking, and analysis.
 - Co-authors on multiple papers.
- Science Impact(s)
 - New capability: first-ever ability to see relationship between simulation parameters (e.g., level of turbulence) and scalar dissipation rate.



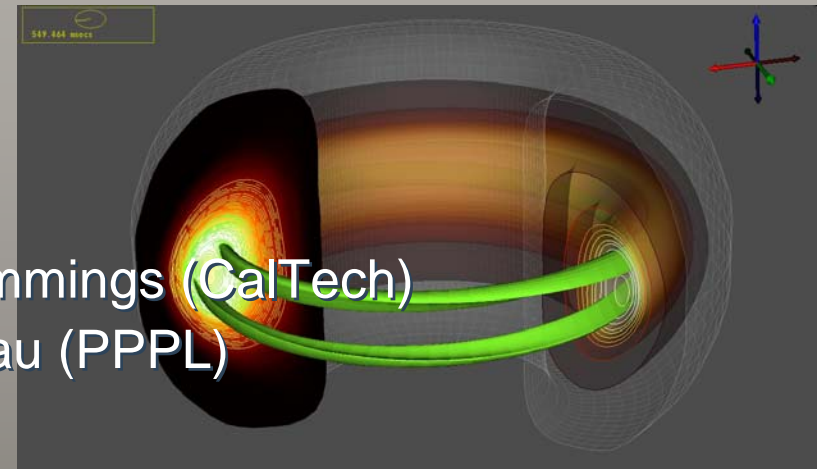
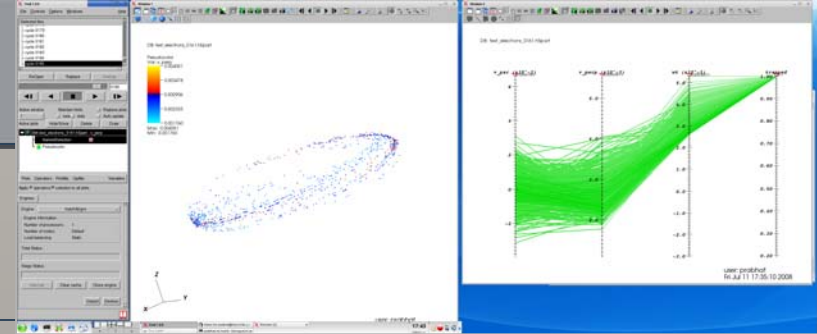
Cumulative carbon monoxide source term inside segments





Fusion, Part 2

- Fusion Partnership
- PI's:
 - Stephane Ethier (PPPL)
 - Seung-Hoe Ku (NTU), Julian Cummings (CalTech)
 - Scott Krger (Tech-X), Josh Breslau (PPPL)
 - Bill Nevins (LLNL)
 - Don Bachelor (ORNL)
- Objective/Approach
 - These diverse groups have many common needs. Our team is developing/deploying new capabilities to meet these needs in production quality visual data analysis s/w.
- Impact
 - Enable new science insights in large, complex data.





Outreach

- Tutorials
 - SciDAC 2008.
 - VisIt, VisTrails
 - Siggraph 2008
 - VisTrails
 - SciDAC 2007
 - VisIt, SCIRun.
 - PPPL, September 2008.
 - CScADS Workshop, Summer 2008.
- Workshops
 - Participation in IUSV-sponsored workshops.



Outreach

- Congressman J. Matheson (Utah) visits VACET AHM to learn about SciDAC and the crucial role played by visualization in scientific knowledge discovery.

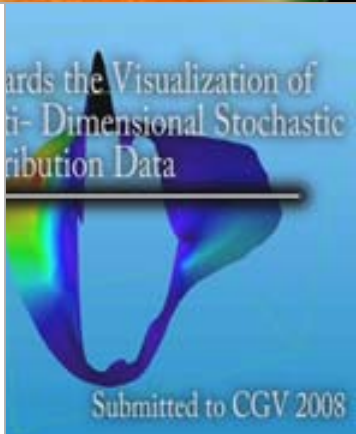
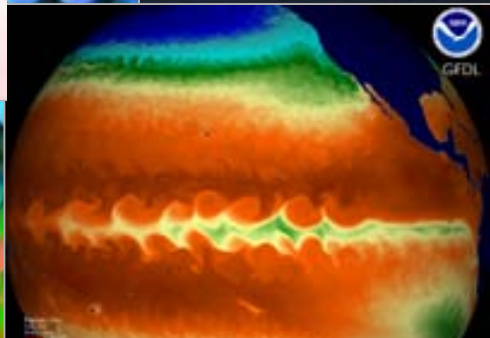
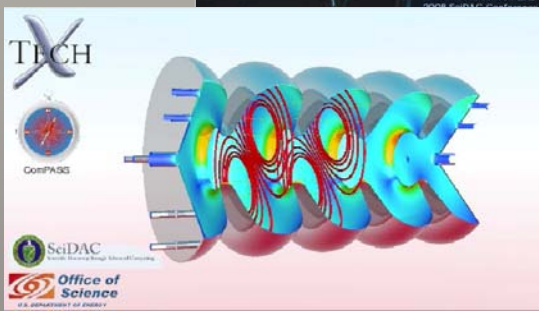




VACET

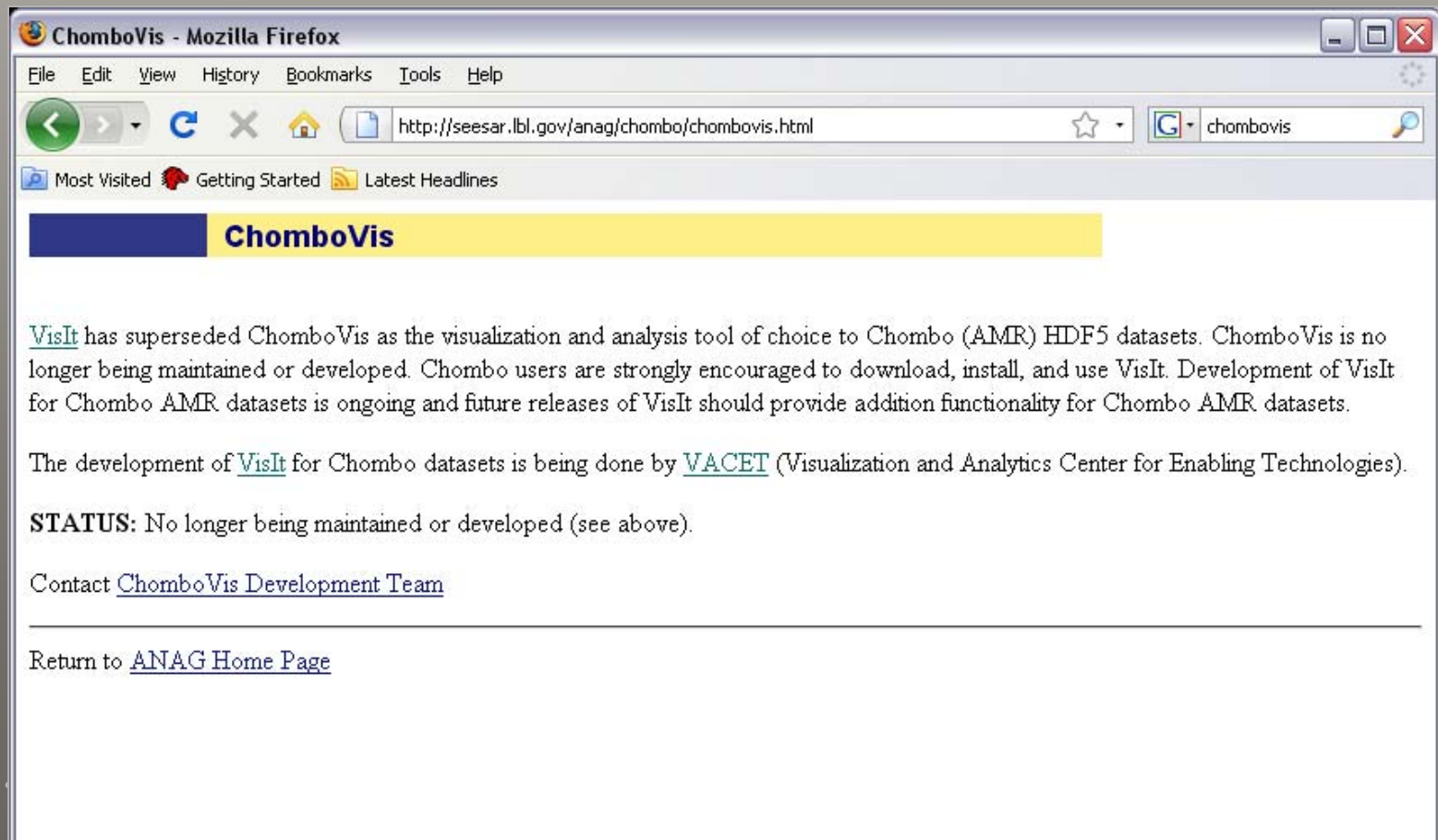
Awards – SciDAC 2008

- SciDAC 2008 “Viz Night”
 - Three “People’s Choice” Awards
 - One Honorable Mention
 - Stakeholder(s) win People’s Choice Awards using VACET s/w:
 - Tech-X: Accelerator
 - LLNL: NIF



Stakeholders Vote with their Feet

- ADPEC adopts VisIt for production-quality AMR visualization



ChomboVis - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://seesar.lbl.gov/anag/chombo/chombovis.html

Most Visited Getting Started Latest Headlines

ChomboVis

[VisIt](#) has superseded ChomboVis as the visualization and analysis tool of choice to Chombo (AMR) HDF5 datasets. ChomboVis is no longer being maintained or developed. Chombo users are strongly encouraged to download, install, and use VisIt. Development of VisIt for Chombo AMR datasets is ongoing and future releases of VisIt should provide addition functionality for Chombo AMR datasets.

The development of [VisIt](#) for Chombo datasets is being done by [VACET](#) (Visualization and Analytics Center for Enabling Technologies).

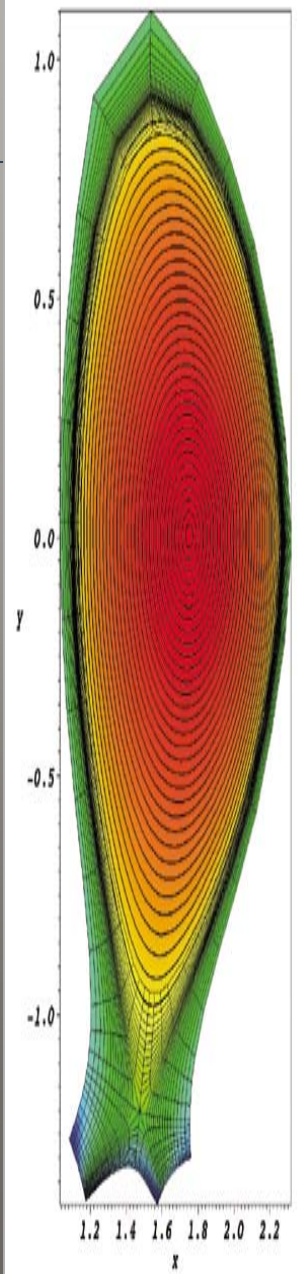
STATUS: No longer being maintained or developed (see above).

Contact [ChomboVis Development Team](#)

Return to [ANAG Home Page](#)

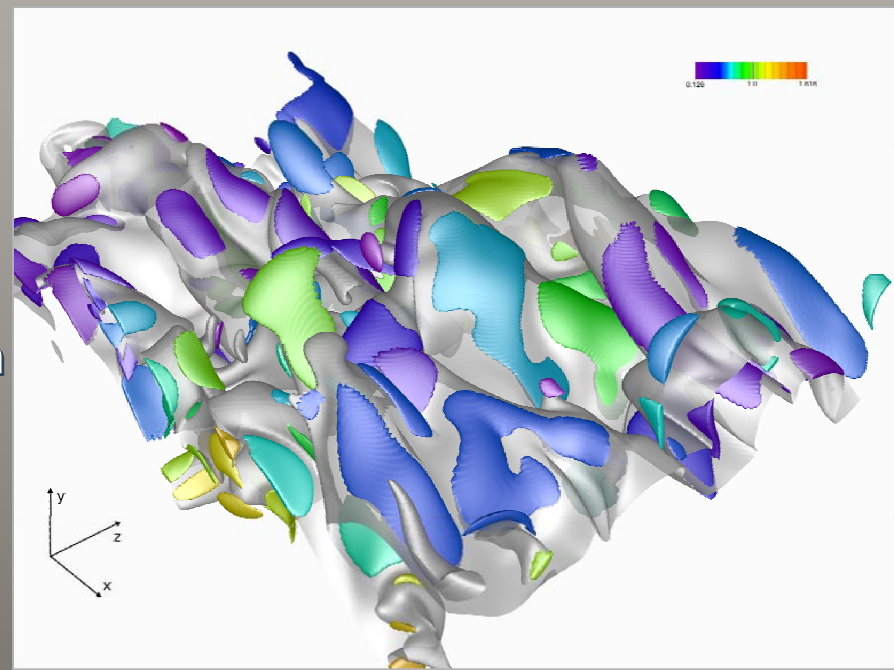
Stakeholders Vote with their Feet

- John Cary (Tech-X)
 - Making concerted effort to migrate FACETS and numerous other Tech-X efforts to VisIt.
 - Generated an animation using VisIt that won an award at SciDAC 2008.
 - Contributing to VisIt in the form of file loaders (VORPAL loader).
 - Using VisIt-generated visuals in day-to-day science activities and for special events (e.g., upcoming review).



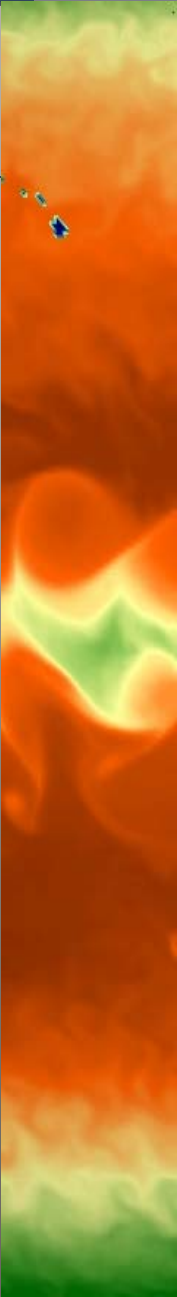
Stakeholders Vote with their Feet

- Jacqueline Chen (SNL-CA)
 - In her SciDAC 2008 presentation: “For the first time, I can see ...”
 - She hires a post-doc from VACET to work exclusively on continuing this project.
- Bronson Messer (ORNL) (Working with Tony Mezzacappa)
 - All visuals in his SciDAC 2008 presentation done using VACET technology.



Exascale Issues

- Lots of data.
 - Where will it be stored?
 - Parallel I/O.
- Data models and formats.
 - “Babel” effect will result in increase in cost, decrease in efficiency.
- Existing visualization and analysis architectures won’t scale.
- Usability: Existing visualization approaches vulnerable to “visual cognition” test.





VACET Summary

- Producing positive scientific impact across many disciplines.
- Strong scientific community support.
- Award-winning research.
- Wildly successful, exemplary performance as a CET.





VACET



The End