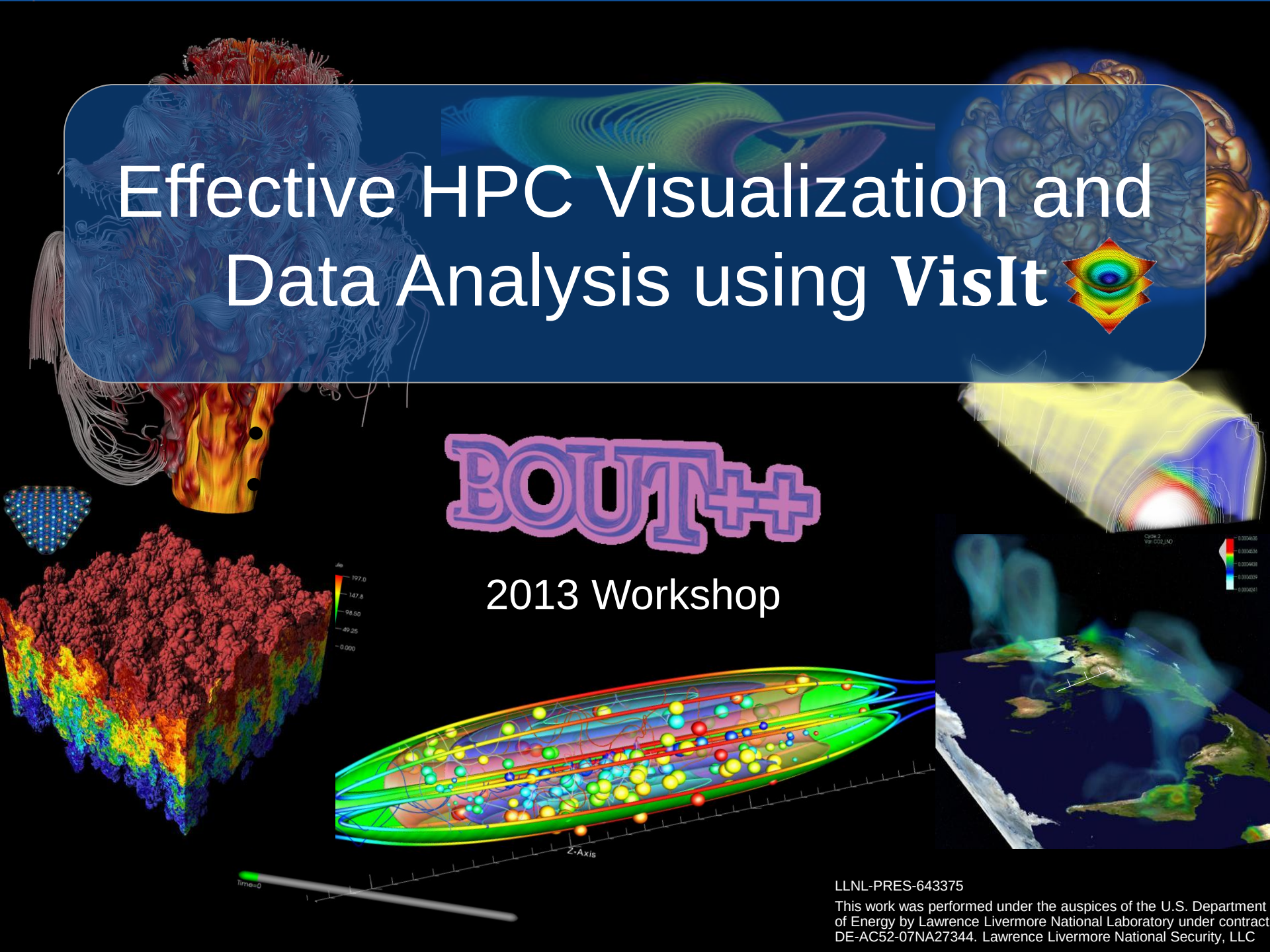
Effective HPC Visualization and Data Analysis using **VisIt**

BOUT++

2013 Workshop



LLNL-PRES-643375

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Tutorial Speakers

Eric Brugger

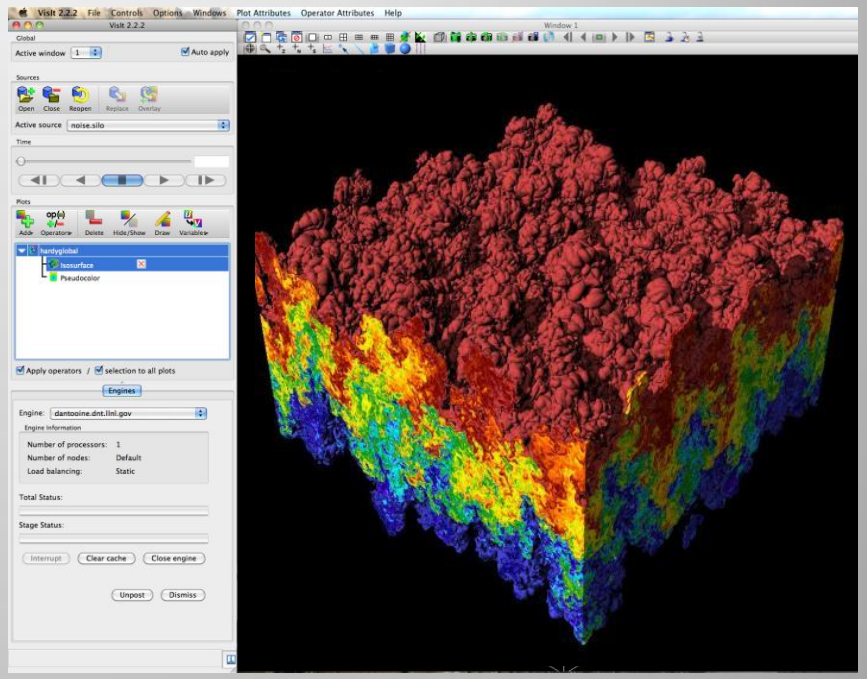
Cyrus Harrison

Outline

- **Overview of VisIt** (10 min)
- **VisIt and BOUT++** (5 min)
- **VisIt setup help for attendees** (15 min)
- **Guided tour of VisIt** (55 min)
- **Closing Remarks and Questions** (5 min)

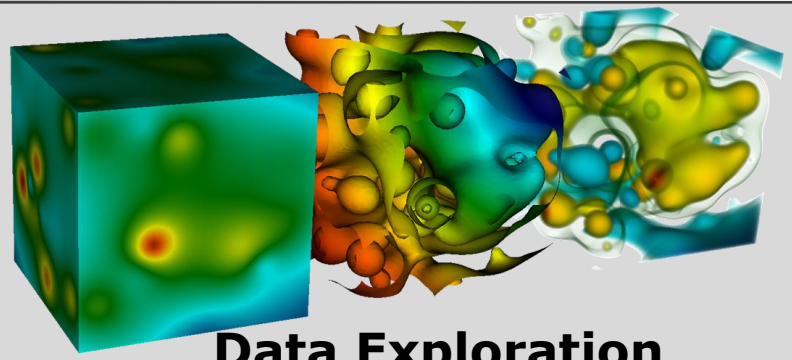
VisIt is an open source, turnkey application for data analysis and visualization of mesh-based data.

- Production end-user tool supporting scientific and engineering applications.
- Provides an infrastructure for parallel post-processing that scales from desktops to massive HPC clusters.
- Source released under a BSD style license.

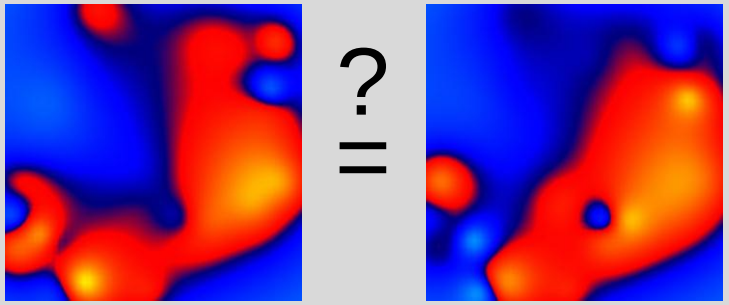


Density Isovolume of a 3K^3 (27 billion cell) dataset

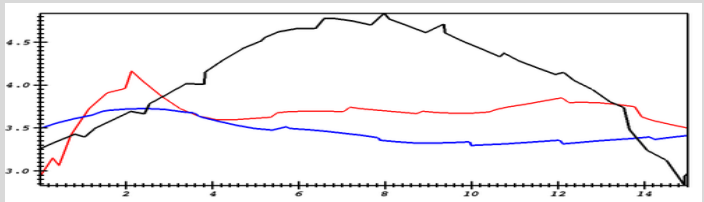
VisIt supports a wide range of use cases.



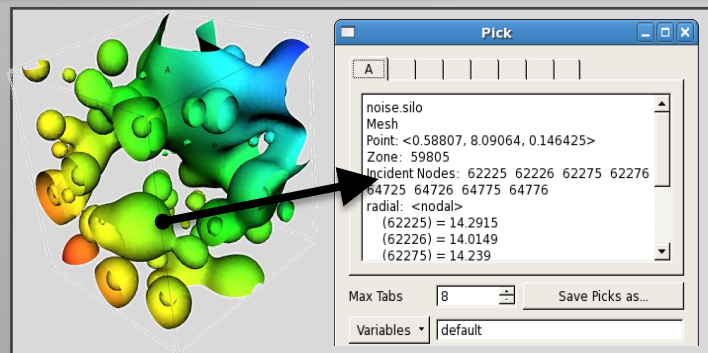
Data Exploration



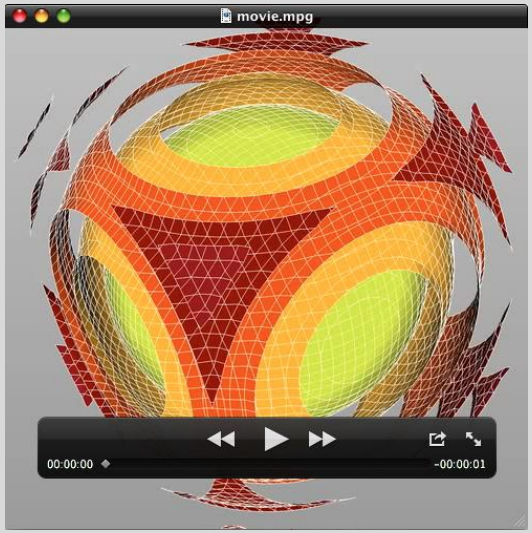
Comparative Analysis



Quantitative Analysis

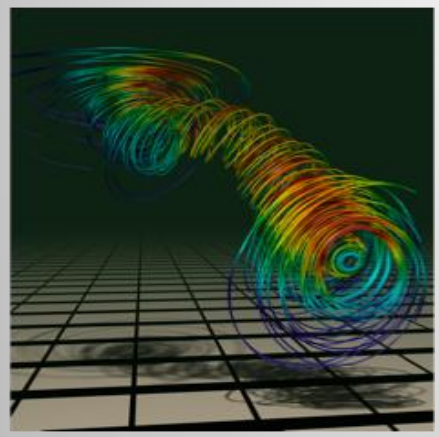


Visual Debugging

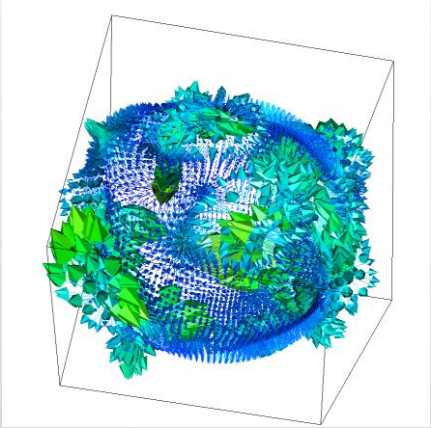


Presentation Graphics

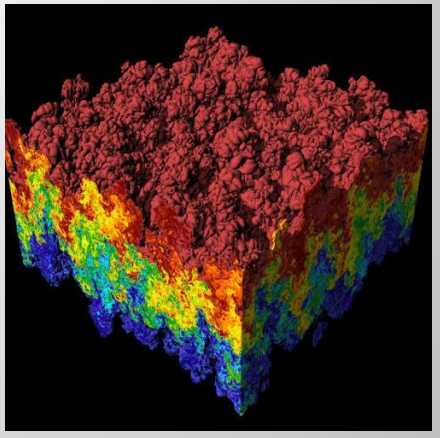
Examples of VisIt's visualization capabilities.



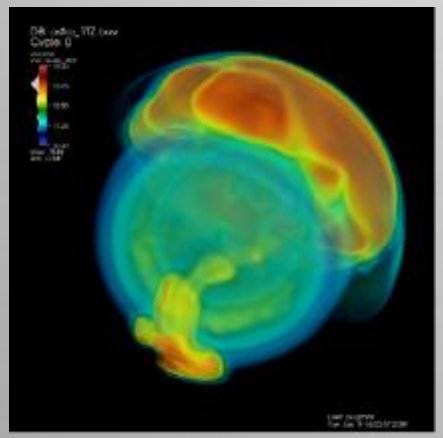
Streamlines



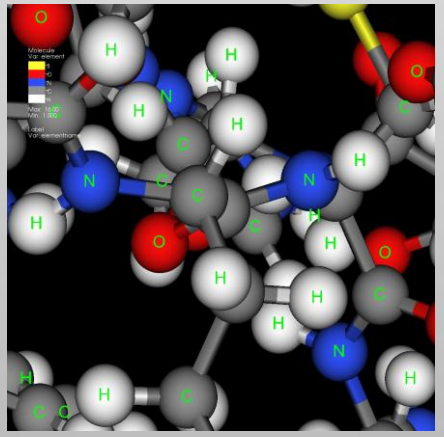
Vector / Tensor Glyphs



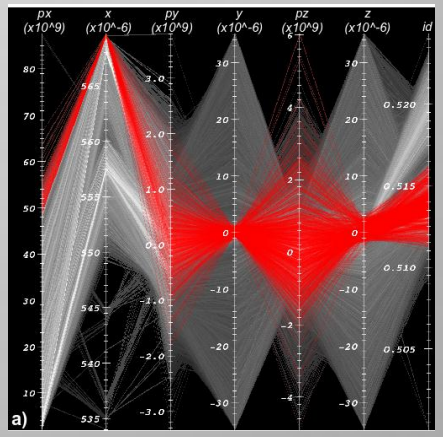
Pseudocolor Rendering



Volume Rendering

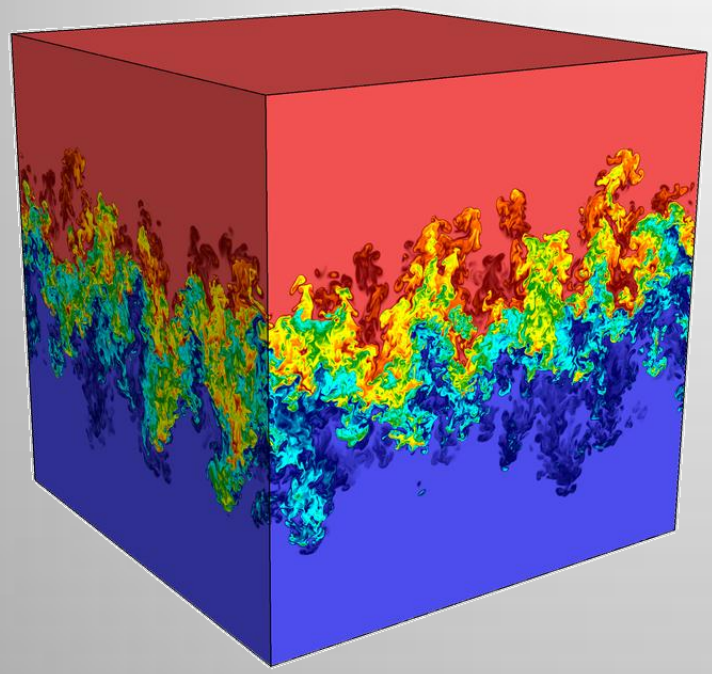


Molecular Visualization

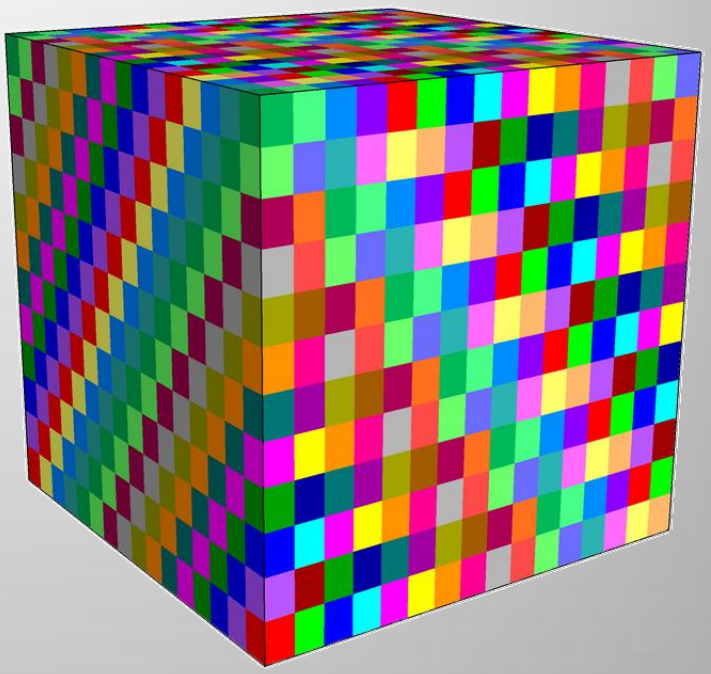


Parallel Coordinates

VisIt uses MPI for distributed-memory parallelism on HPC clusters.



Full Dataset
(27 billion total cells)



3072 sub-grids
(each 192x129x256 cells)

We are enhancing VisIt's pipeline infrastructure to also support threaded processing.

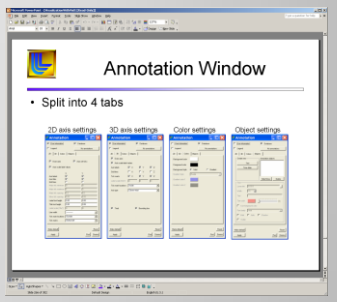
VisIt is a vibrant project with many participants.

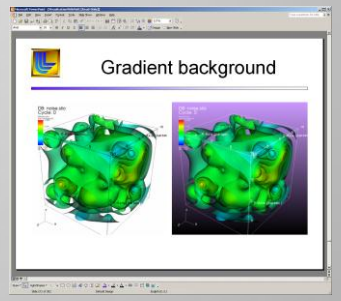
- The VisIt project started in 2000 to support LLNL's large scale ASC physics codes.
- The project grew beyond LLNL and ASC with research and development from DOE SciDAC and other efforts.
- VisIt is now supported by multiple organizations:
  - LLNL, LBNL, ORNL, UC Davis, Univ of Utah, Intelligent Light, …
- Over 75 person years of effort, 1.5+ million lines of code.

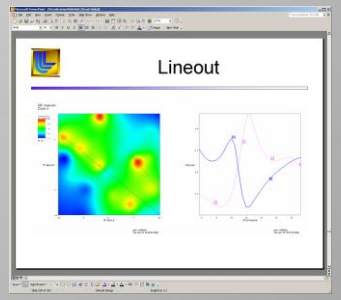
Project Started	LLNL ASC users transitioned to VisIt	2005 R&D 100	VACET Funded	Transition to Public SW repo	VisIt 2.0 Release	SDAV Funded
2000	2003	2005	2006	2008	2010	2012

The VisIt team focuses on making a robust, usable product for end users.

- Regular releases (~ 6 / year)
  - Executables for all major platforms
  - End-to-end build process script ``build_visit''
- Customer Support and Training
  - visitusers.org, wiki for users and developers
  - Email lists: visit-users, visit-developers
  - Beginner and advanced tutorials
  - VisIt class with detailed exercises
- Documentation
  - "Getting data into VisIt" manual
  - Python interface manual
  - Users reference manual

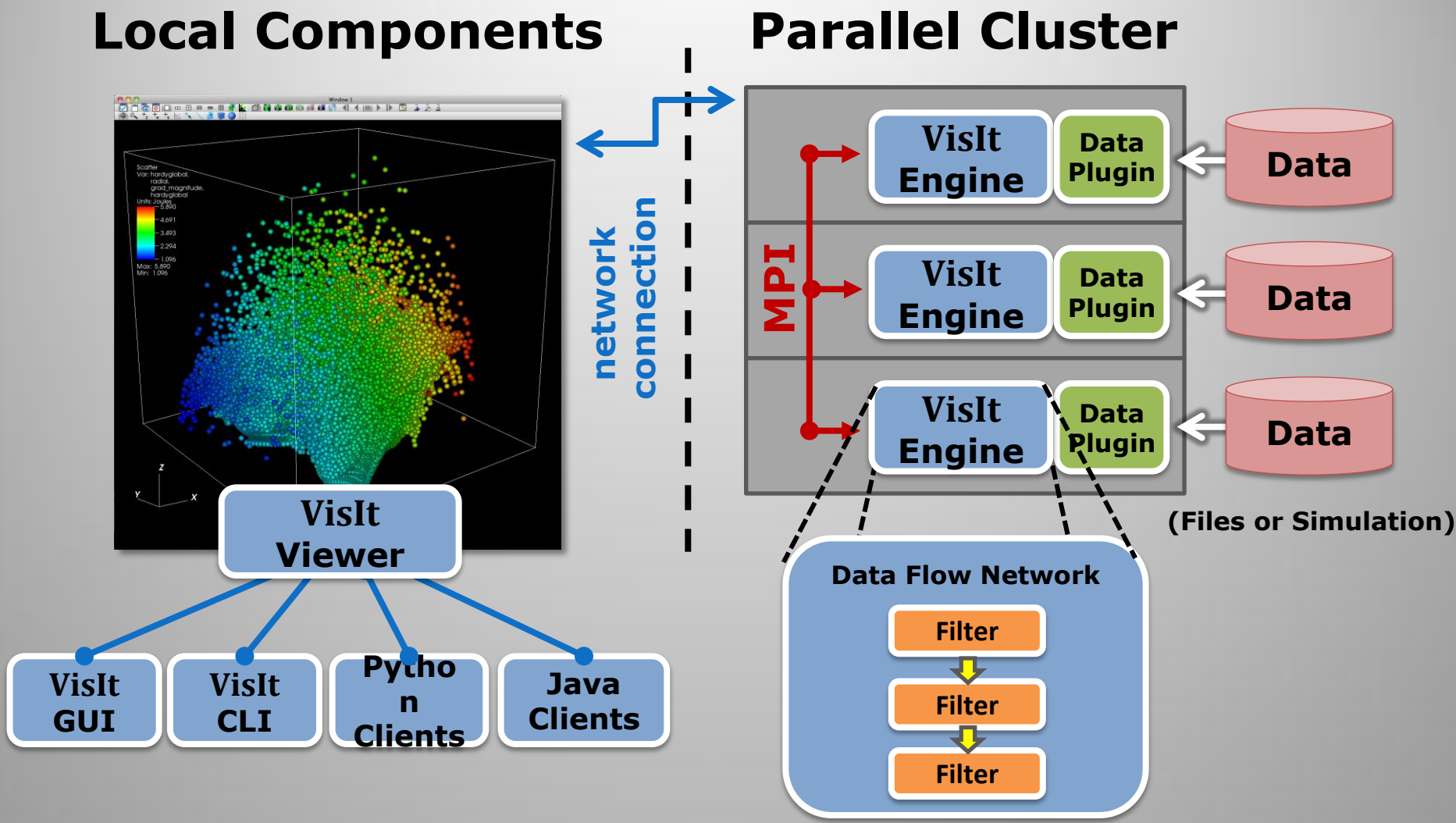






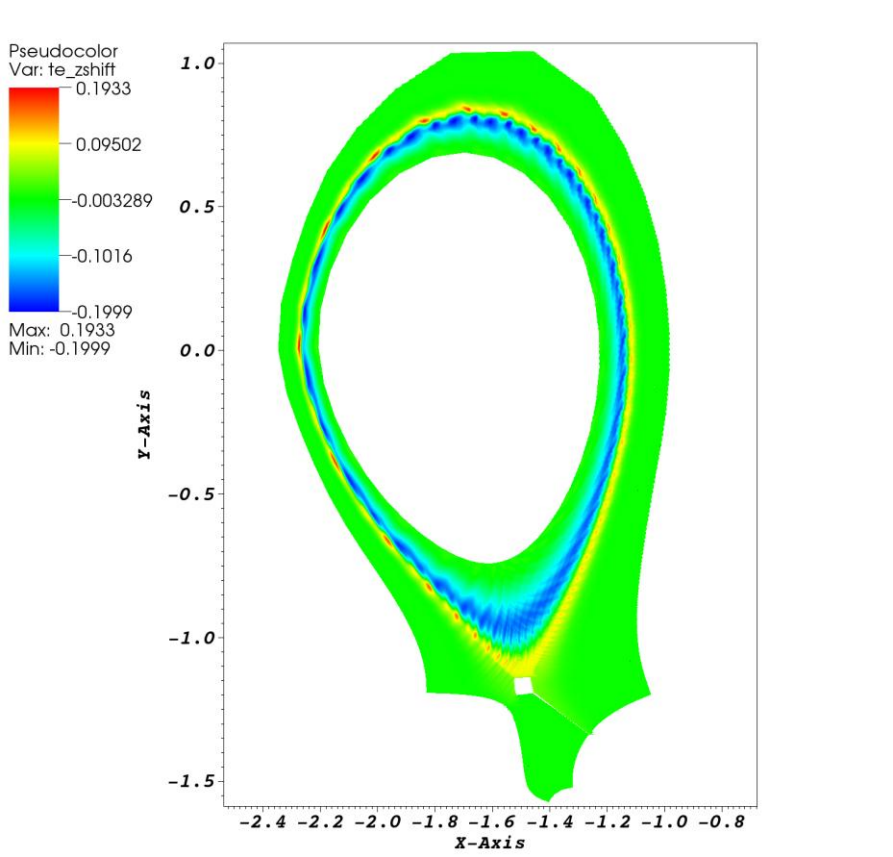
Slides from the VisIt class

VisIt employs a parallelized client-server architecture.



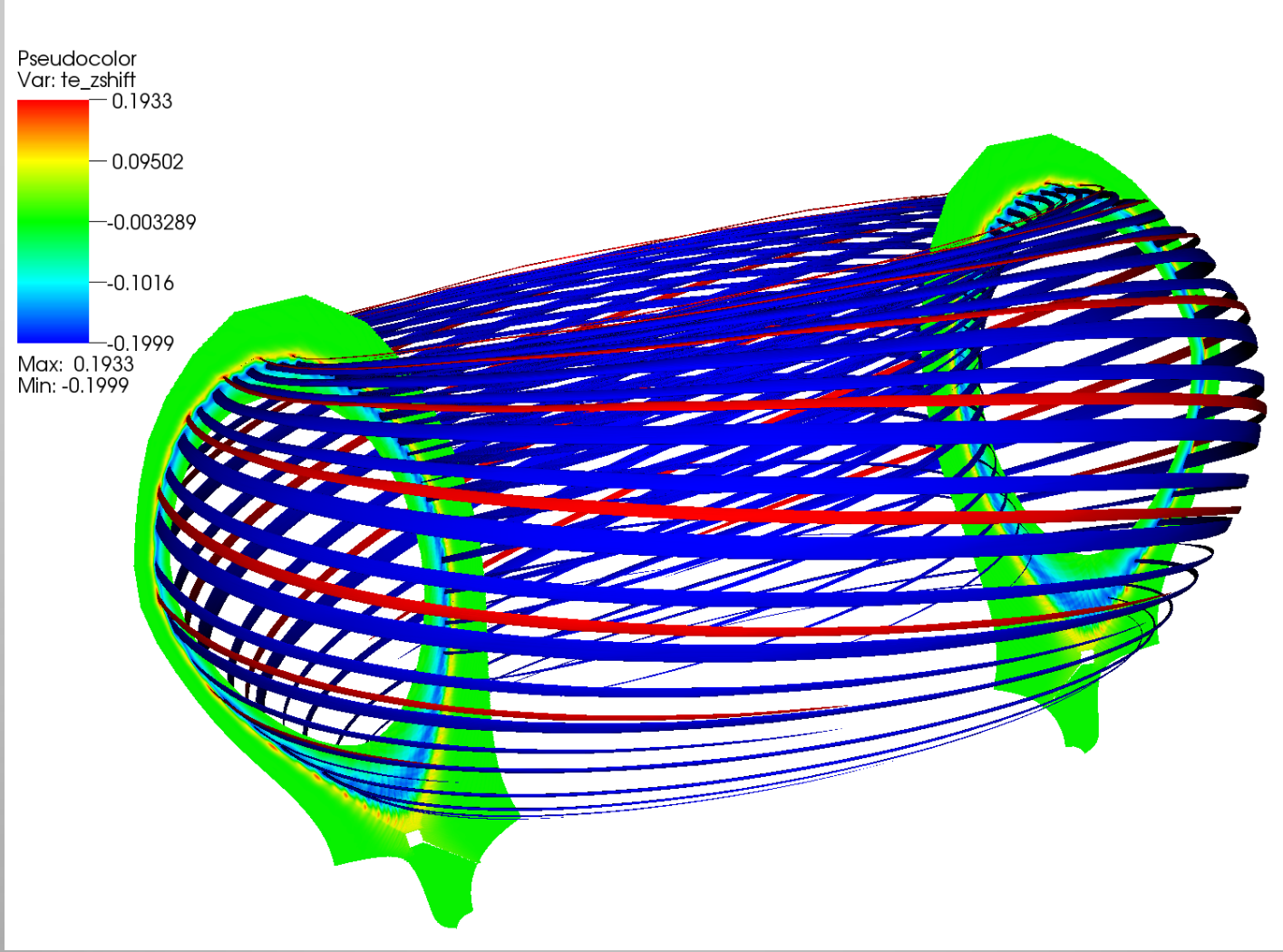
VisIt and BOUT++

- Currently implementing a reader for BOUT++ netcdf output
  - Reader will allow display of 2D and 3D BOUT++ data
  - Reader will automatically decompose data for running in parallel
  - It will be released in VisIt 2.7, to be released in about a month



Te from a BOUT++ simulation

VisIt and BOUT++

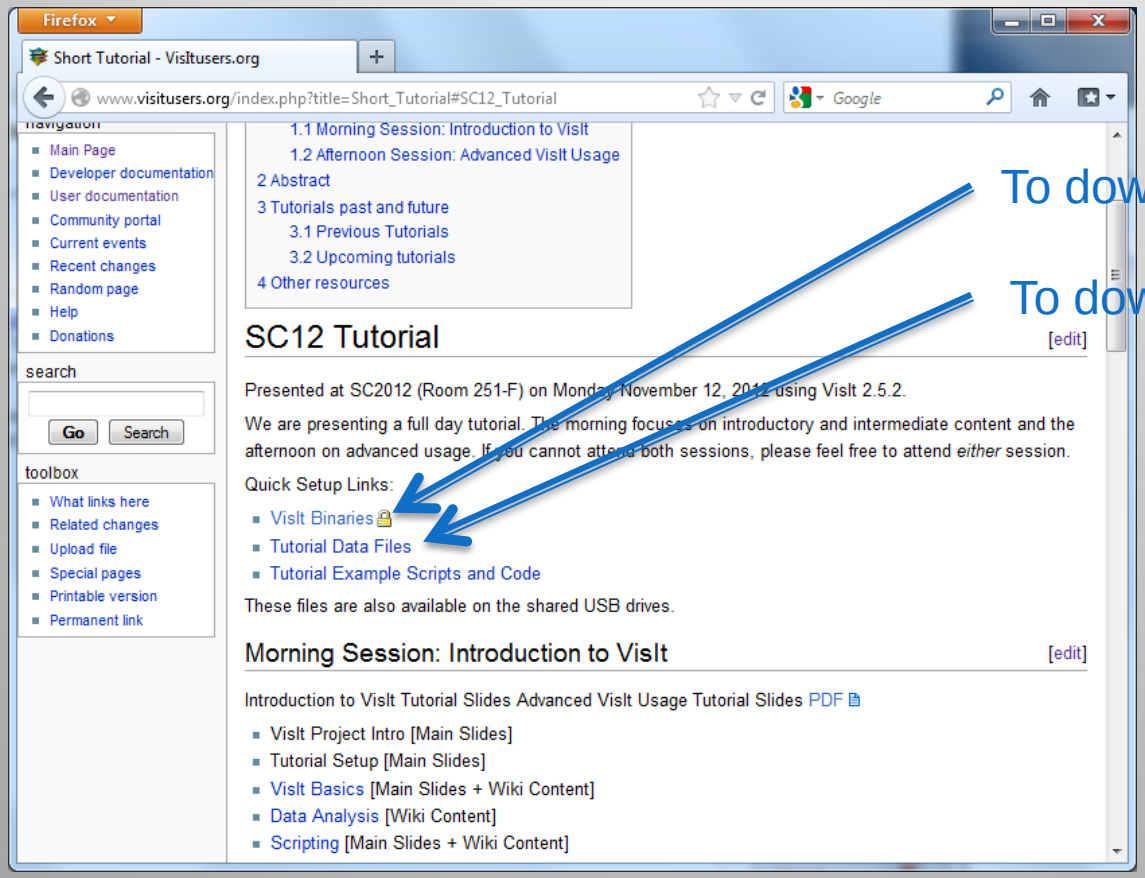


Te from a BOUT++ simulation

Guided tour of VisIt

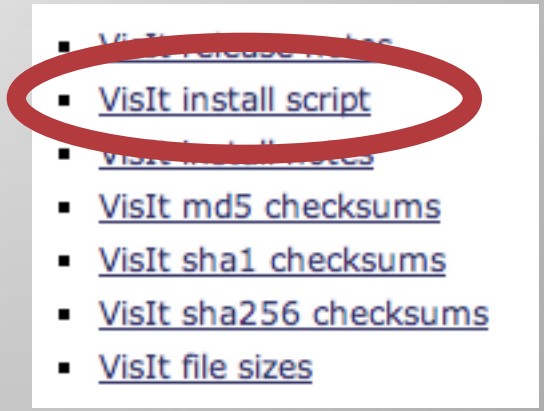
Download and install the software

- VisIt wiki: http://www.visitusers.org/index.php?title=Short_Tutorial



Using Release Binaries

- https://wci.llnl.gov/codes/visit/executables.html
- Windows:
  - Run installer & select NERSC profiles.
- Linux:
  - Install using “visit-install”.

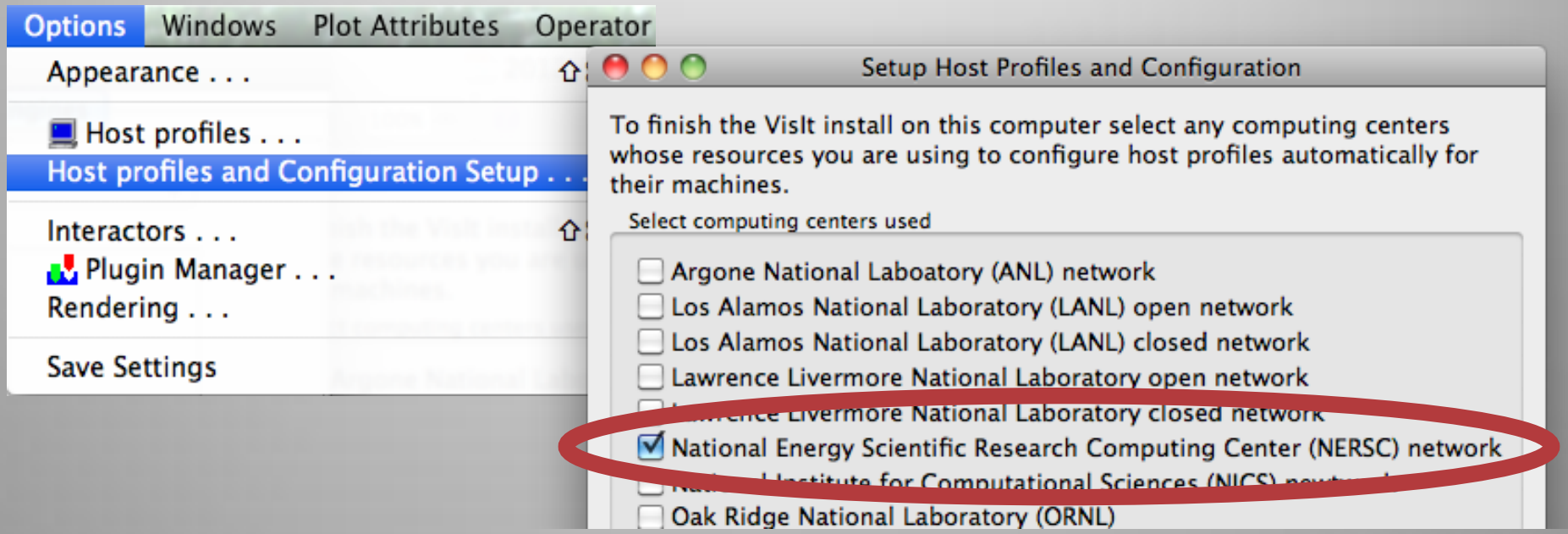


**>./visit-install2_6_3 –c nersc **

2.6.3 linux-x86_64-rhel6 <dest_path>

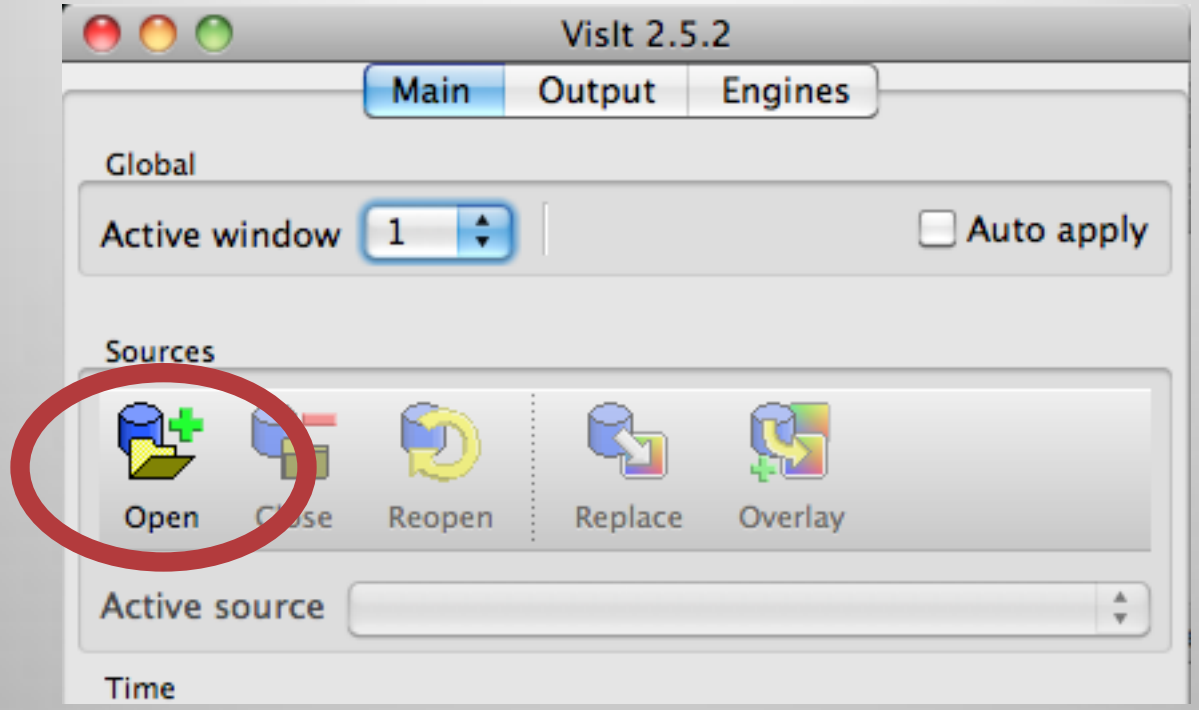
Using Release Binaries

- https://wci.llnl.gov/codes/visit/executables.html
- OSX:
  - Open DMG & drag VisIt to desktop.
  - Select NERSC profiles:

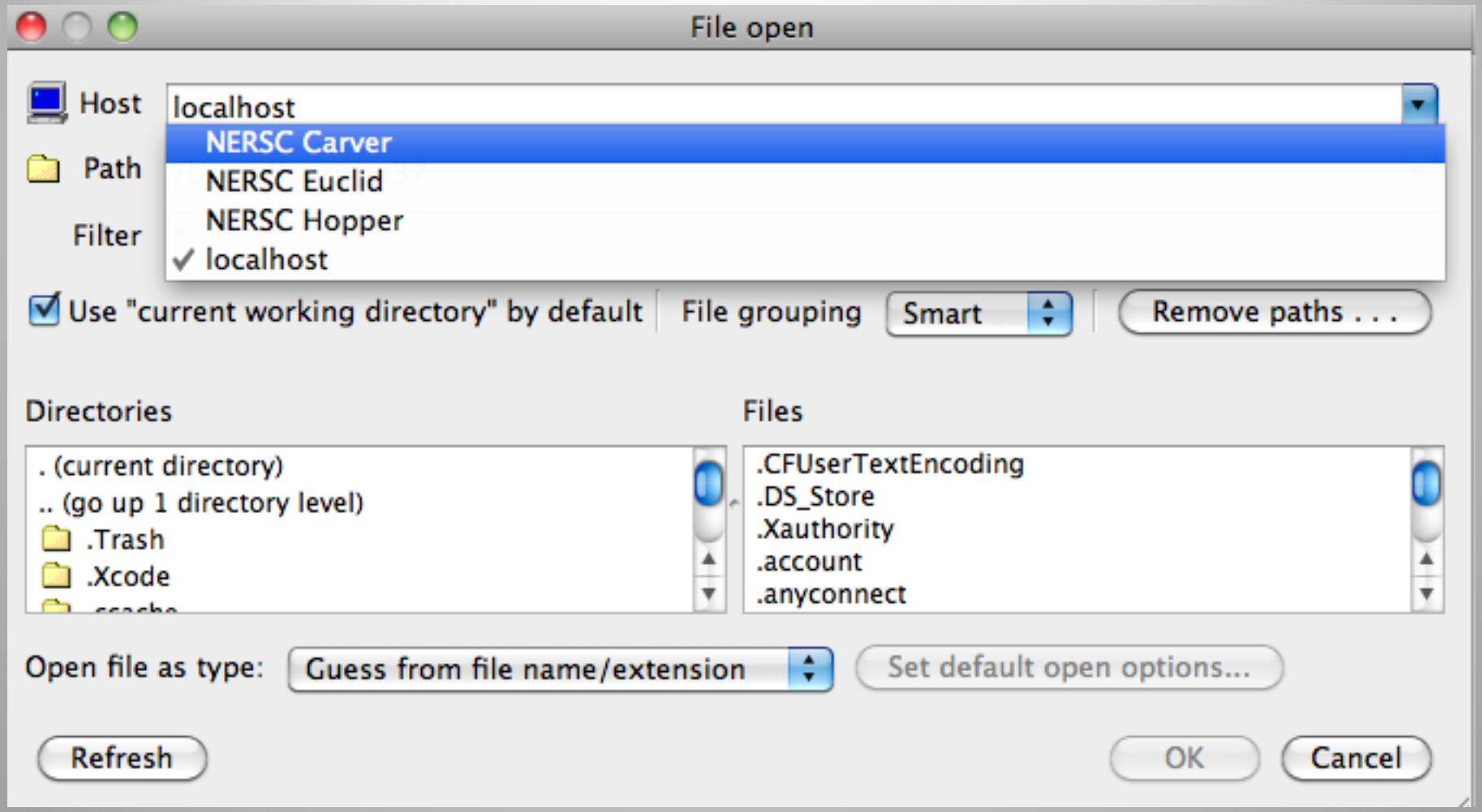


VisIt Client / Server Demo

Connecting to NERSC's Carver Cluster



Connecting to NERSC's Carver Cluster



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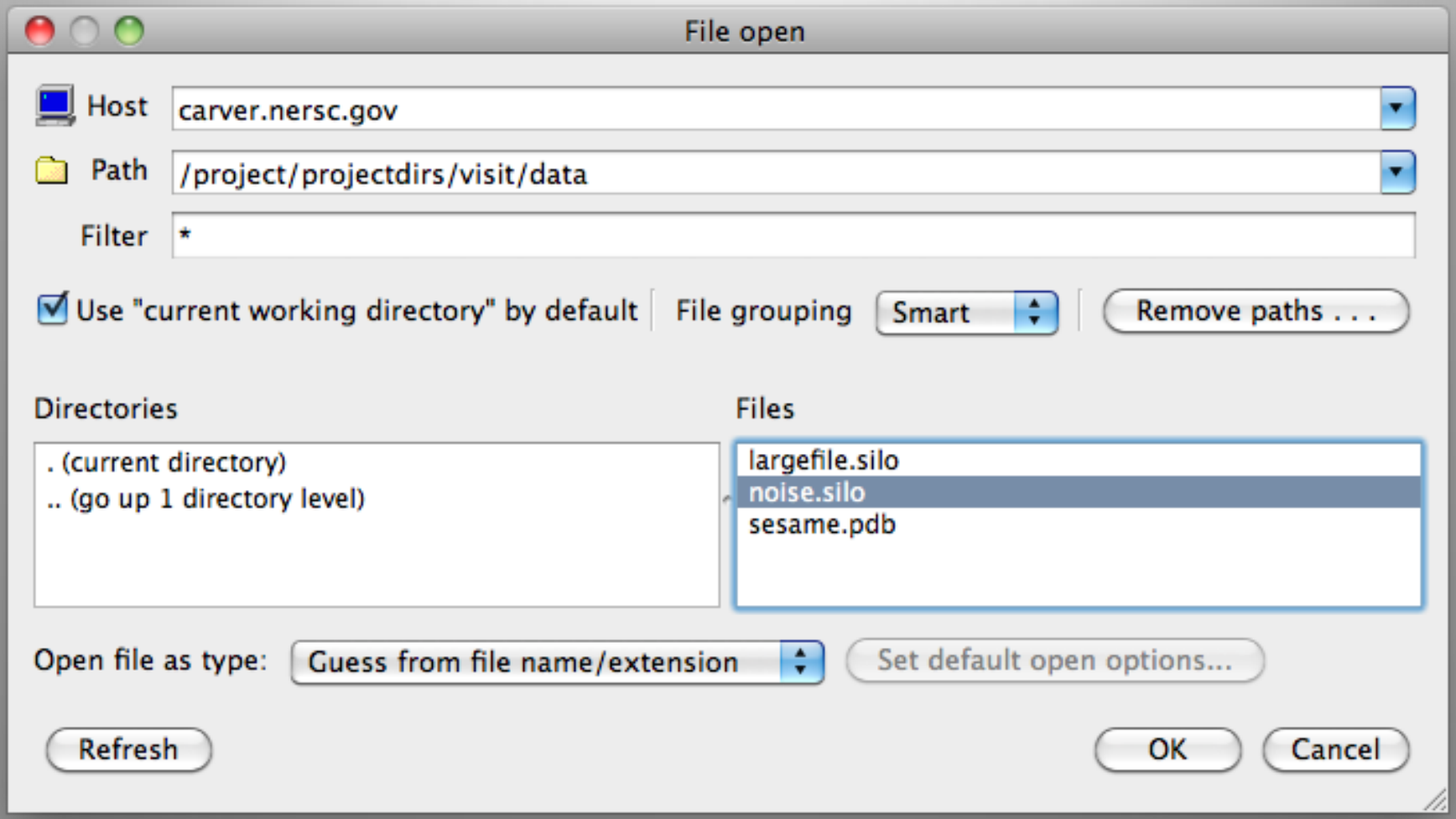
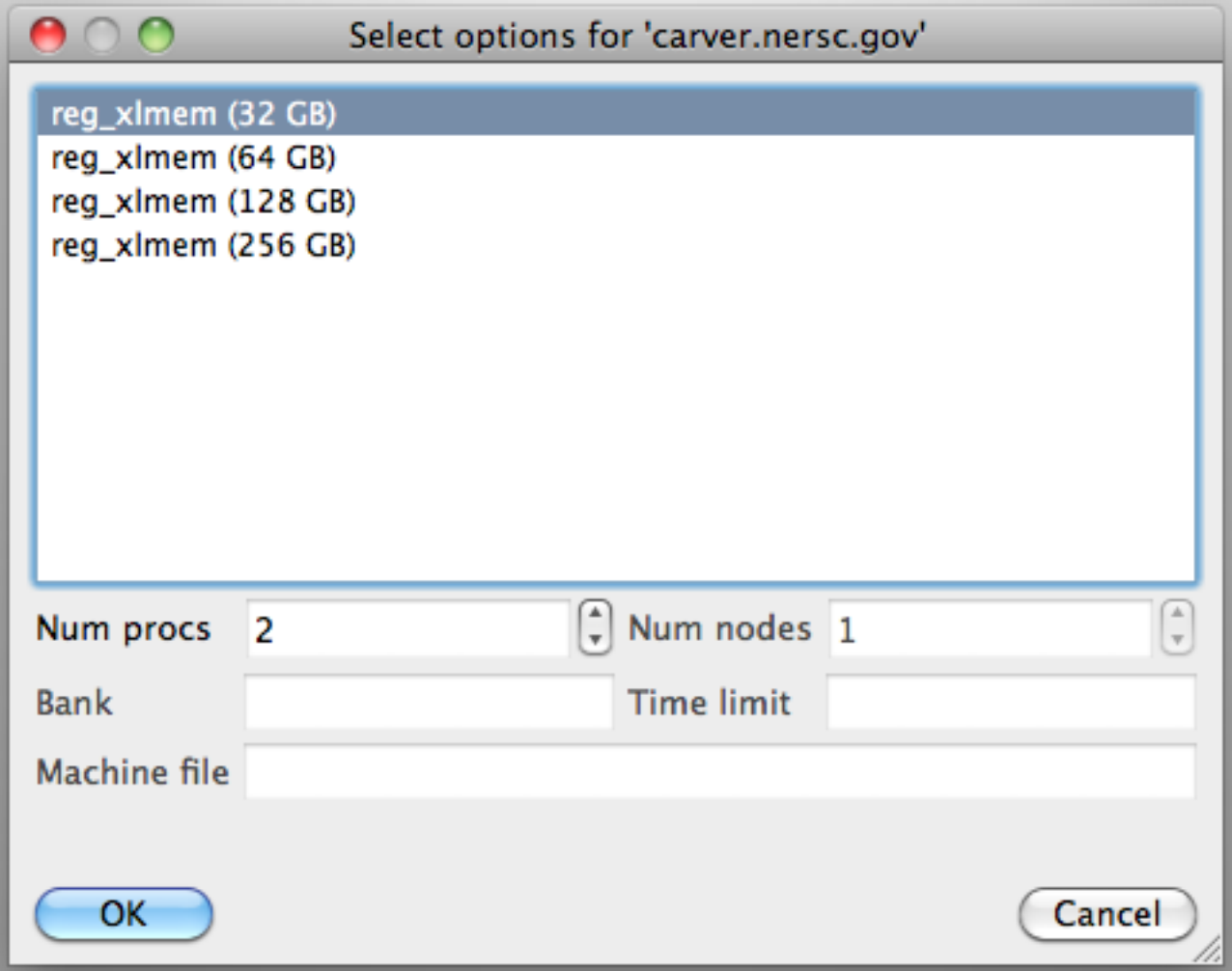


Connecting to NERSC's Carver Cluster



There are several ways to access VisIt's Python Client Interface.

- Launch VisIt's CLI binary:
  - **visit –cli**
- Launch for windowless batch processing:
  - **visit -nowin –cli –s <script_file.py>**
- Control VisIt from a Python interpreter:
  - `import visit'
  - http://visitusers.org/index.php?title=Python_Module_Support
- Record GUI actions in to Python snippets:
  - Macro Recording provides a quick path to learn VisIt's Python Client API.

How to get help when you run into trouble

- FAQ
  - http://visit.llnl.gov/FAQ.html
- VisIt Users Mailing List
  - Address: visit-users@elist.ornl.gov
  - Info: https://elist.ornl.gov/mailman/listinfo/visit-users
  - Archive: https://elist.ornl.gov/pipermail/visit-users/
- VisIt Users Wiki
  - http://www.visitusers.org
- VisIt Users Forum
  - http://visitusers.org/forum/YaBB.pl
- Reference Manuals
  - https://wci.llnl.gov/codes/visit/manuals.html

FAQ: http://visit.llnl.gov/FAQ.html

Frequently Asked Questions

https://wci.llnl.gov/codes/visit/FAQ.html

Home | Downloads | Documentation | What's New | Index | Contact

Frequently Asked Questions

1. Contact information
2. Supported platforms
3. Optimal hardware/software
4. Debugging problems starting VisIt or opening files
5. Stereo rendering
6. VisIt won't run on Linux
7. Slow performance on Linux
8. Slow performance Using SSH
9. No output in visualization window
10. Accessing data on remote machine
11. Running VisIt in parallel
12. Supported data file formats
13. Getting your data into VisIt
14. Making a movie of your data
15. Setting your user name to connect to a remote machine
16. Cannot connect to a remote computer
17. Building VisIt on a Windows computer
18. Installing VisIt on a MacOS X computer
19. Hanging at 12% on Windows computers
20. Getting the Plugin Developer's Guide
21. Writing a plugin for VisIt
22. When new versions of VisIt are released
23. What is new in the latest version of VisIt
24. Compilers that can be used to build VisIt
25. VisIt's licensing agreement
26. Slow performance with ATI cards on Linux
27. Custom plugins with a downloaded VisIt binary
28. Getting HDF5 data into VisIt
29. Getting NETCDF data into VisIt
30. When I run VisIt on my Linux machine, I get a black screen
31. I get the message 'Publisher cannot be verified' when installing VisIt on Windows
32. Which libraries should I enable in `build_visit`?

VisIt-users Mailing List

- You may only post to mailing list if you are also a subscriber.
- Approximately 400 recipients, approx. 300 posts per month.
- Developers monitor mailing list, strive for 100% response rate.
- Response time is typically excellent (O(1 hour)).
  - International community participates … not unusual for a question from Australia to be answered by a European, while all US developers are asleep.
- List Address: visit-users@ornl.gov
- More information: https://email.ornl.gov/mailman/listinfo/visit-users
- Archive: https://email.ornl.gov/pipermail/visit-users/

VisItusers.org

- Great source for VisIt tips and recipes.
- Users section has lots of practical advice:
  - "I solved this problem using this technique"
  - "Here's my script to do this analysis"

Misc [edit]

- Using VisIt in an mxterm
- Using derived data functions (DDFs)
- Using the command line interface
- How volume rendering works in VisIt
- Using cross-mesh field evaluations ... how to do differences, access other time slices, etc
- Keyframing example
- Exporting databases
- Directions for specific machines
- Using the VisIt Python API with a standard Python interpreter
- Pages that contain instructions specific to certain user groups and needs
- Issues related to running VisIt on Windows under cygwin
- VisIt's Camera model
- Using VisIt's mpeg2encode
- Molecular data features
- Extracting alpha
- (Very) High resolution rendering
- Elevating shapefiles
- Raytracing your visualizations with POV-Ray and a tutorial POV-Ray exporting example

VisItusers.org is the VisIt project's staging area for usage recipes and future formal documentation.

VisIt Users Forum

- http://www.visitusers.org/forum
- Increasingly popular option; you can post without receiving 300 emails a month
  - But it is viewed by less people and less well supported.
- Google indexes these pages.

Manuals & Other Documentation

- Getting Started Manual
- Users Manual
- Python Interface
- Getting Data Into VisIt
- VisIt Class Slides
- VisIt Class Exercises
- {Tutorials}

Resources

- **Presenters:**
  - Eric Brugger brugger1@llnl.gov
  - Cyrus Harrison cyrush@llnl.gov

- **User resources:**
  - Main website: http://www.llnl.gov/visit
  - Wiki: http://www.visitusers.org
  - Email: visitusers@ornl.gov

- **Development resources:**
  - Email: visit-developers@ornl.gov
  - SVN: http://portal.nersc.gov/svn/visit