Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**

CCMC User Experience:
Analysis Tool Refinement using Enlil Case Studies

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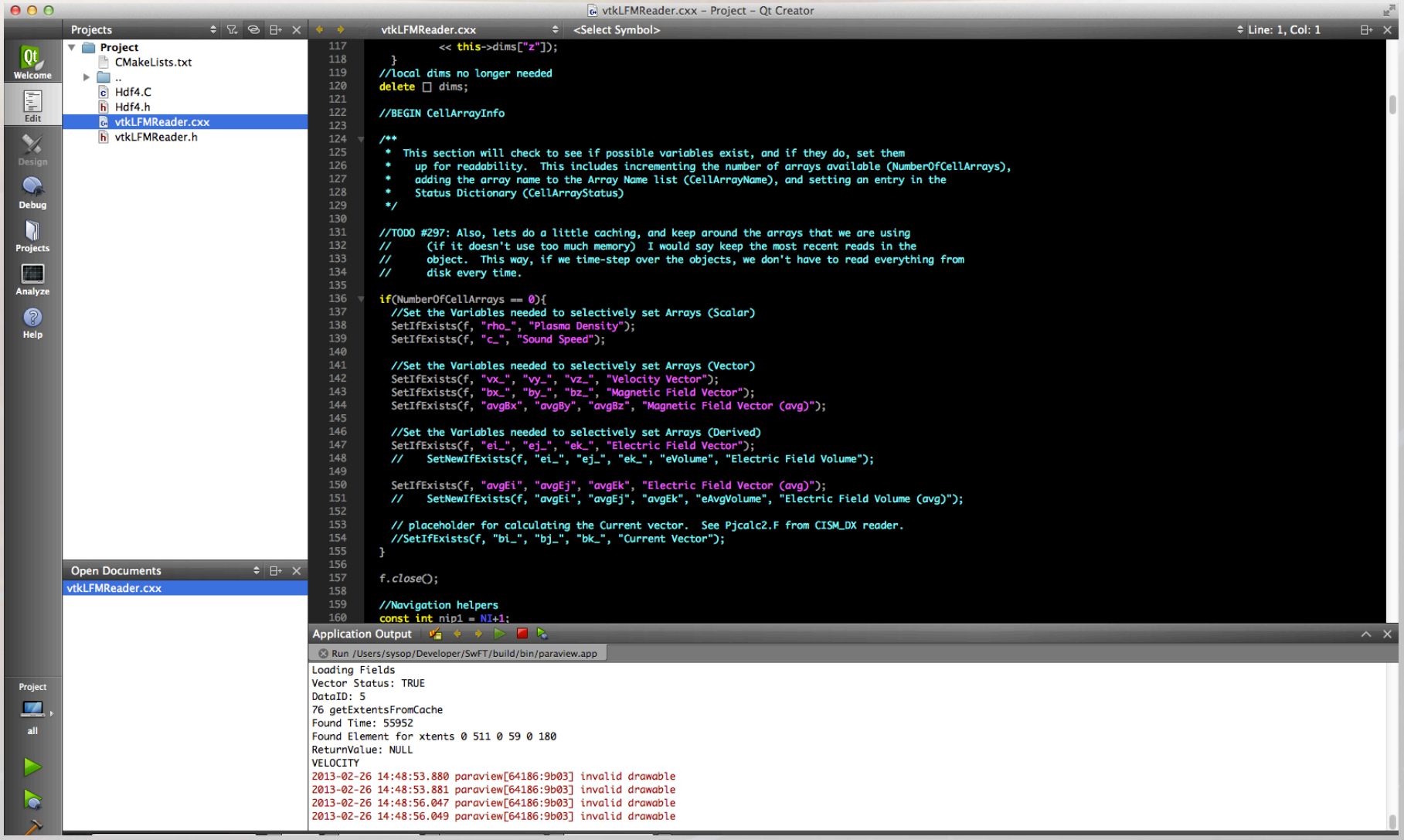
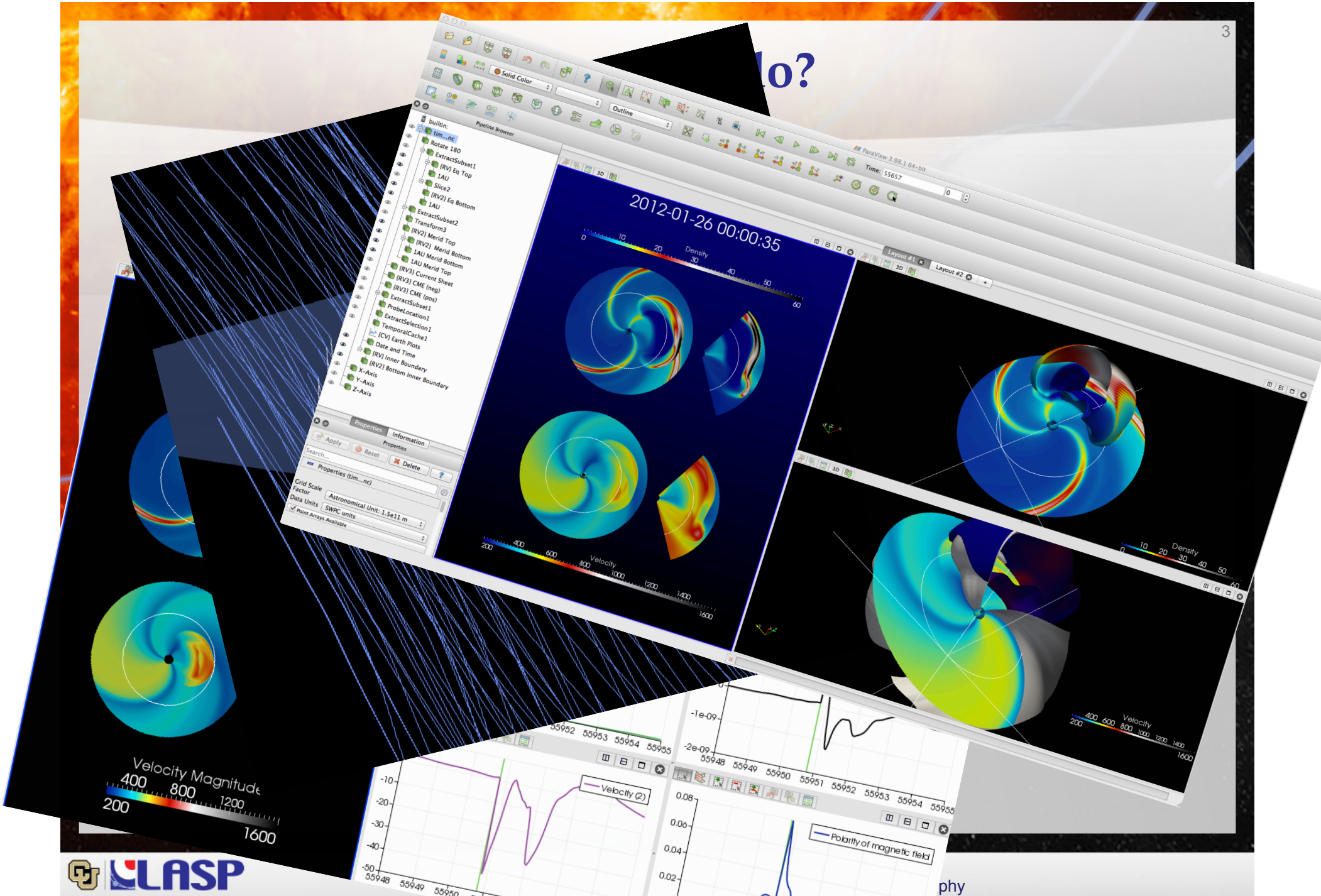
What do I do?


vtkLFMReader.cxx – Project – Qt Creator
Projects
Project
CMakeLists.txt
..
Hdf4.C
Hdf4.h
vtkLFMReader.cxx
vtkLFMReader.h
Open Documents
vtkLFMReader.cxx
Welcome
Edit
Design
Debug
Projects
Analyze
Help
Project
all
vtkLFMReader.cxx
<Select Symbol>
Line: 1, Col: 1
<< this->dims["z"]);
}
//local dims no longer needed
delete [] dims;
//BEGIN CellArrayInfo
/**
* This section will check to see if possible variables exist, and if they do, set them
* up for readability. This includes incrementing the number of arrays available (NumberOfCellArrays),
* adding the array name to the Array Name list (CellArrayName), and setting an entry in the
* Status Dictionary (CellArrayStatus)
*/
//TODO #297: Also, lets do a little caching, and keep around the arrays that we are using
// (if it doesn't use too much memory) I would say keep the most recent reads in the
// object. This way, if we time-step over the objects, we don't have to read everything from
// disk every time.
if(NumberOfCellArrays == 0){
//Set the Variables needed to selectively set Arrays (Scalar)
SetIfExists(f, "rho_", "Plasma Density");
SetIfExists(f, "c_", "Sound Speed");
//Set the Variables needed to selectively set Arrays (Vector)
SetIfExists(f, "vx_", "vy_", "vz_", "Velocity Vector");
SetIfExists(f, "bx_", "by_", "bz_", "Magnetic Field Vector");
SetIfExists(f, "avgBx", "avgBy", "avgBz", "Magnetic Field Vector (avg)");
//Set the Variables needed to selectively set Arrays (Derived)
SetIfExists(f, "ei_", "ej_", "ek_", "Electric Field Vector");
// SetNewIfExists(f, "ei_", "ej_", "ek_", "eVolume", "Electric Field Volume");
SetIfExists(f, "avgEi", "avgEj", "avgEk", "Electric Field Vector (avg)");
// SetNewIfExists(f, "avgEi", "avgEj", "avgEk", "eAvgVolume", "Electric Field Volume (avg)");
// placeholder for calculating the Current vector. See Pjcalc2.F from CISM_DX reader.
//SetIfExists(f, "bi_", "bj_", "bk_", "Current Vector");
}
f.close();
//Navigation helpers
const int nip1 = NI+1;
Application Output
Run /Users/sysop/Developer/SwFT/build/bin/paraview.app
Loading Fields
Vector Status: TRUE
DataID: 5
76 getExtentsFromCache
Found Time: 55952
Found Element for xtents 0 511 0 59 0 180
ReturnValue: NULL
VELOCITY
2013-02-26 14:48:53.880 paraview[64186:9b03] invalid drawable
2013-02-26 14:48:53.881 paraview[64186:9b03] invalid drawable
2013-02-26 14:48:56.047 paraview[64186:9b03] invalid drawable
2013-02-26 14:48:56.049 paraview[64186:9b03] invalid drawable

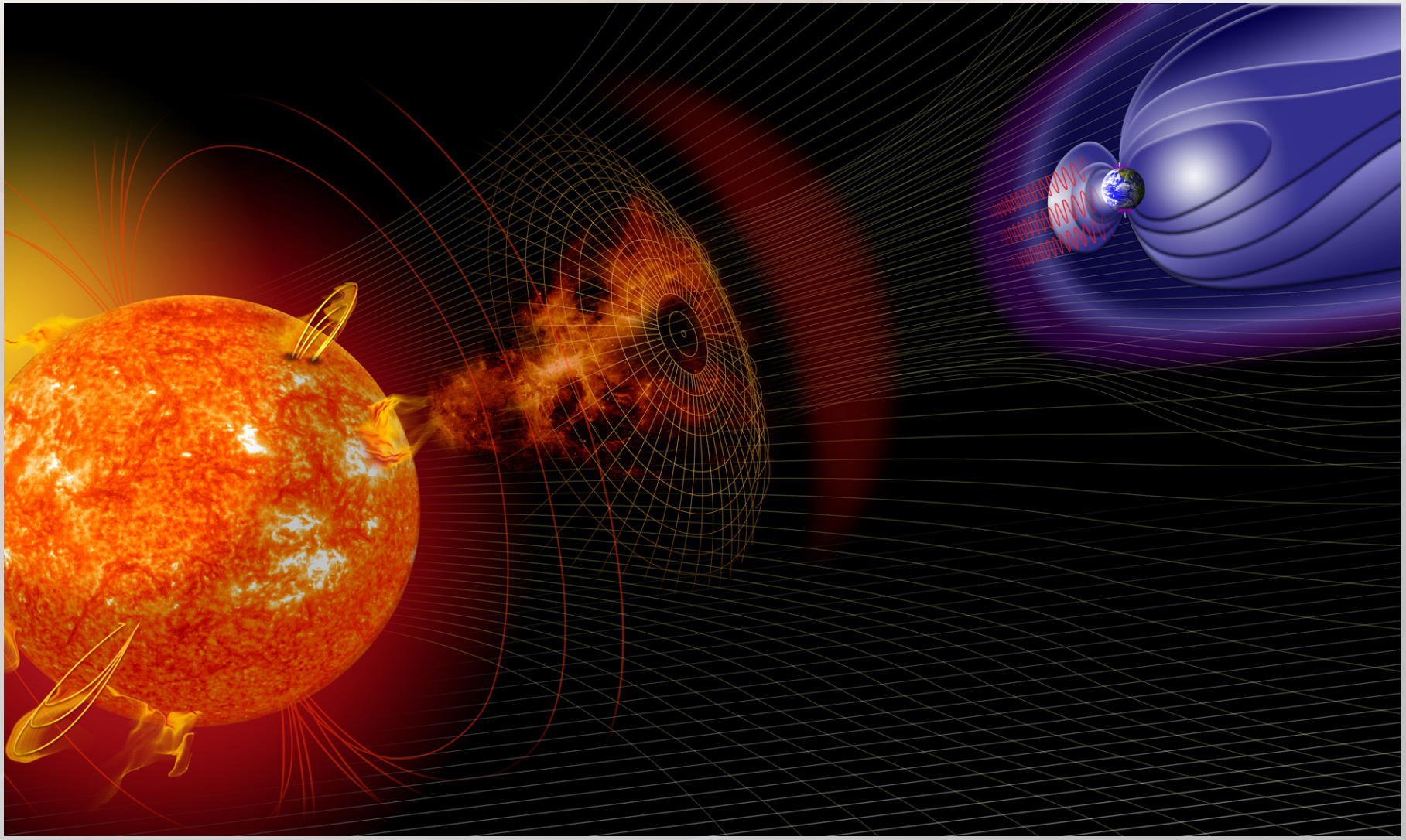
lo?


Velocity Magnitude
400
800
1200
200
1600
2012-01-26 00:00:35
Density
Velocity
Velocity (2)
Polarity of magnetic field

Why?

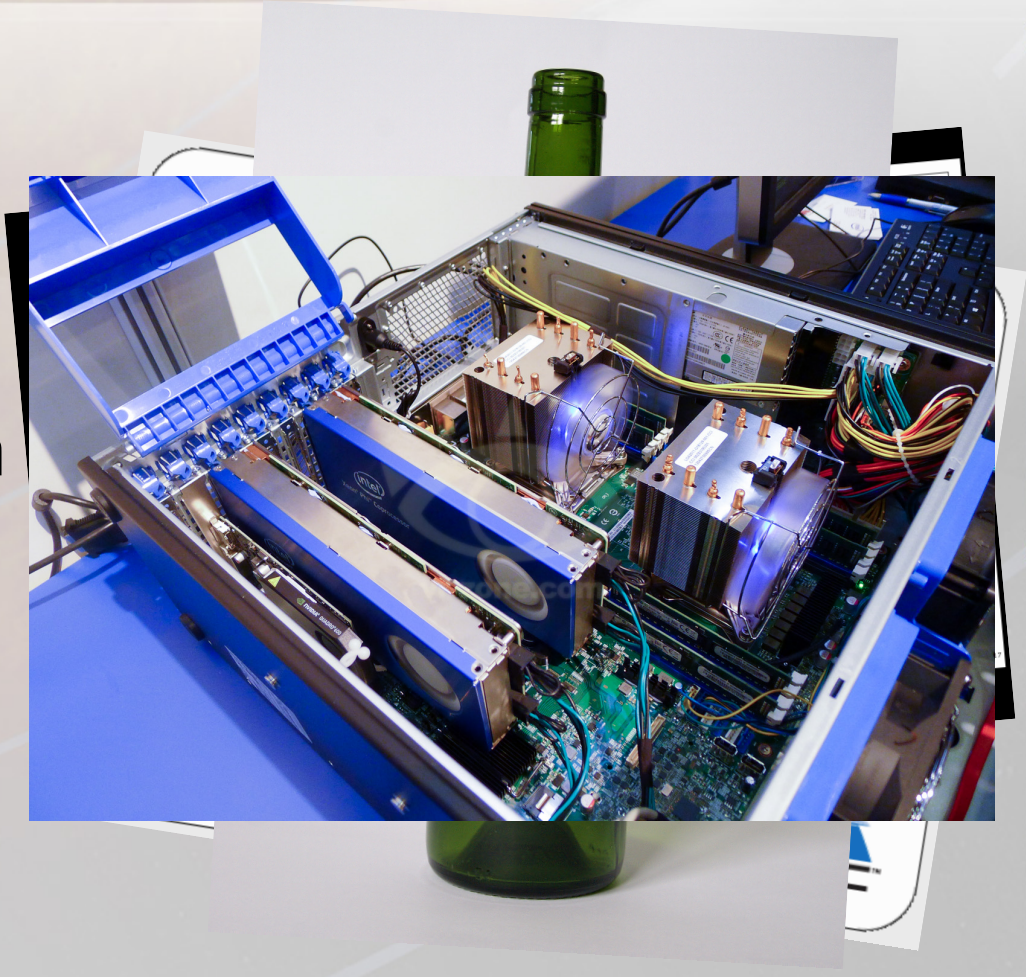
- Because Space Weather is IMPORTANT!
- Because current analysis tools are hard to use, and are MANUAL!
- To improve Space Weather Situational Awareness:
  - Know what is going on
  - Know what might happen
  - Make a plan to mitigate problems!
- To find the analysis bottlenecks!
- To use modern scientific computing hardware to solve these bottlenecks!

The big puzzle…



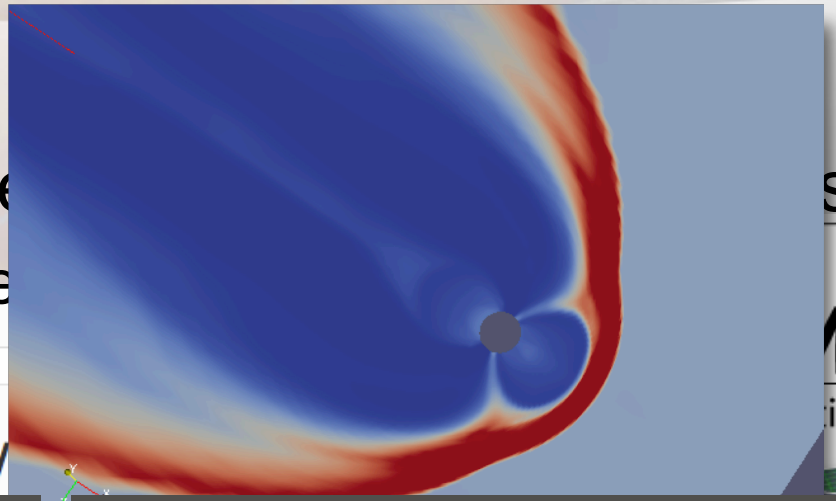
How?

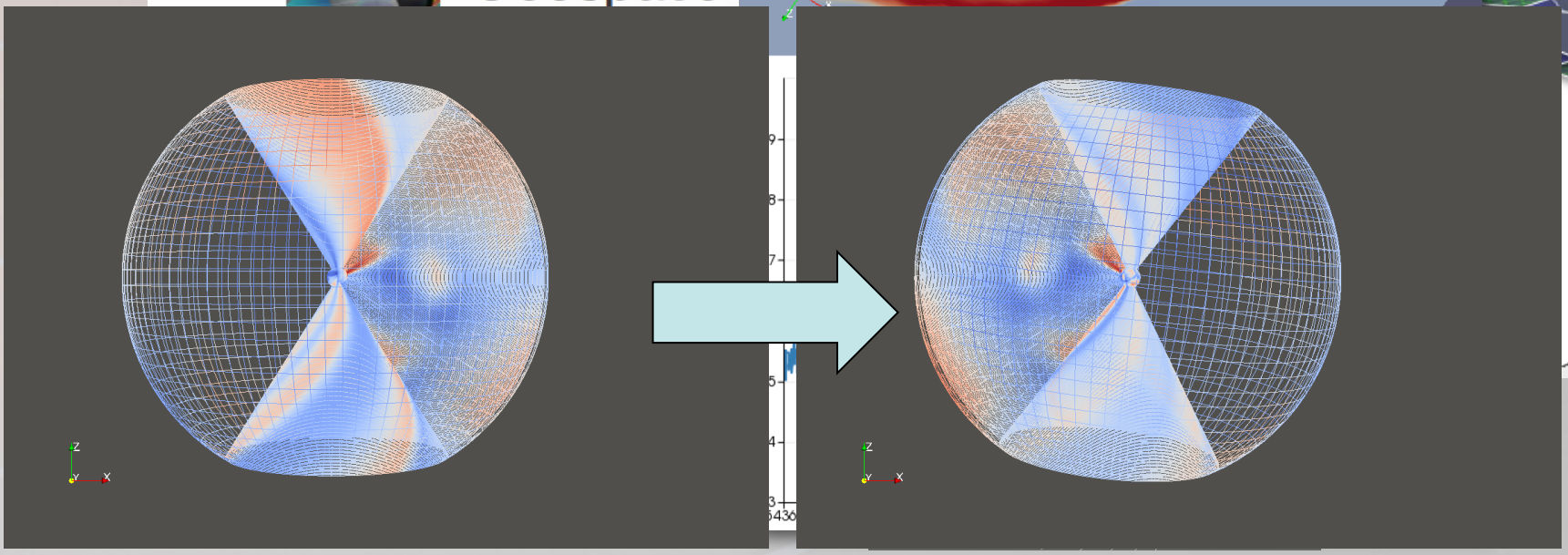
- Need a platform on which to work!
- Gain understanding through case studies!
- Identify bottlenecks in the studies!
- Find creative ways to solve the problems!



Building a platform

- Use ParaView as base
- Create toolkit to facilitate
  - LFM and Enlil data reade
  - CDAweb Toolkit
  - Transformation Tools



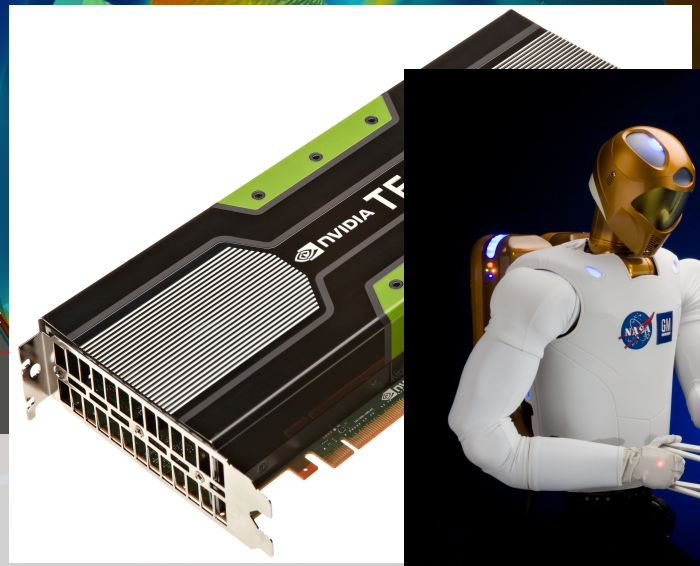


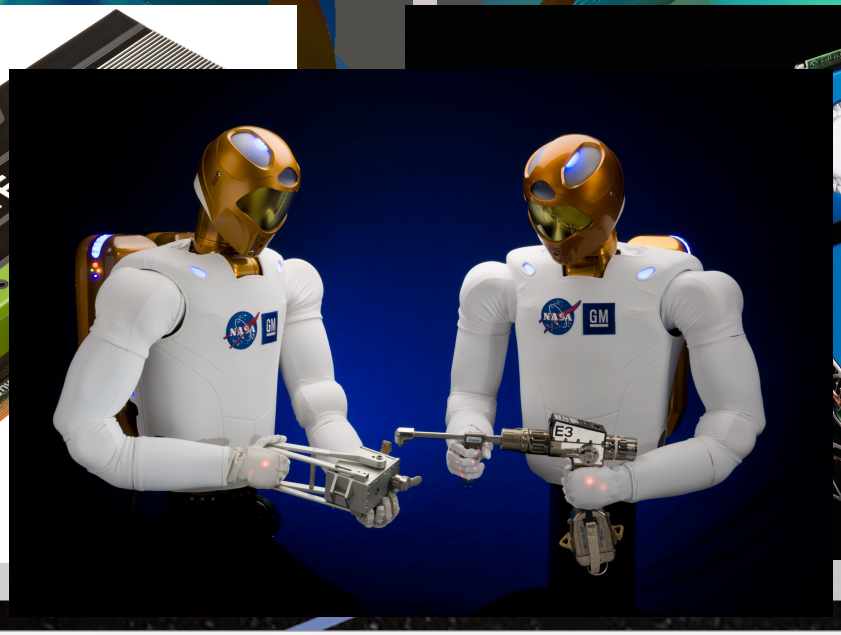
Gaining Understanding

- I'm a computer scientist, so…
- Case Studies!
- To unders[illegible] going on, must work t[illegible] analys[illegible] roblems.
- The m[illegible] problems wo[illegible]ked, the better the too[illegible] can be refined
- Bottlen[illegible]ks become o[illegible]ous!

Finding solutions

- Modern model analysis will require modern computational ability!
- Need to harness the power of new and emerging technology
- Tasks that can be automated should be automated





How CCMC helps

- This research would not be possible without CCMC!
- All study cases are run at CCMC
- To date, over 300 runs have been completed in support of this research

Runs on Request: Heliosphere Simulations Results

Total Number of Runs in the Database: 4195
Total Number of Search Results in this Database: 302

Event Date	Run Number	Key Words	Model Type
Run	Joshua_Murphy_120713_SH_14	10Jan2013-14	Heliosphere	ENLIL	2.7	2132	2132	--	--
Modeled Run	Joshua_Murphy_120713_SH_1	fast track run	Heliosphere	ENLIL	2.7	2132	2132	--	--

Refining Tools – First Case Study

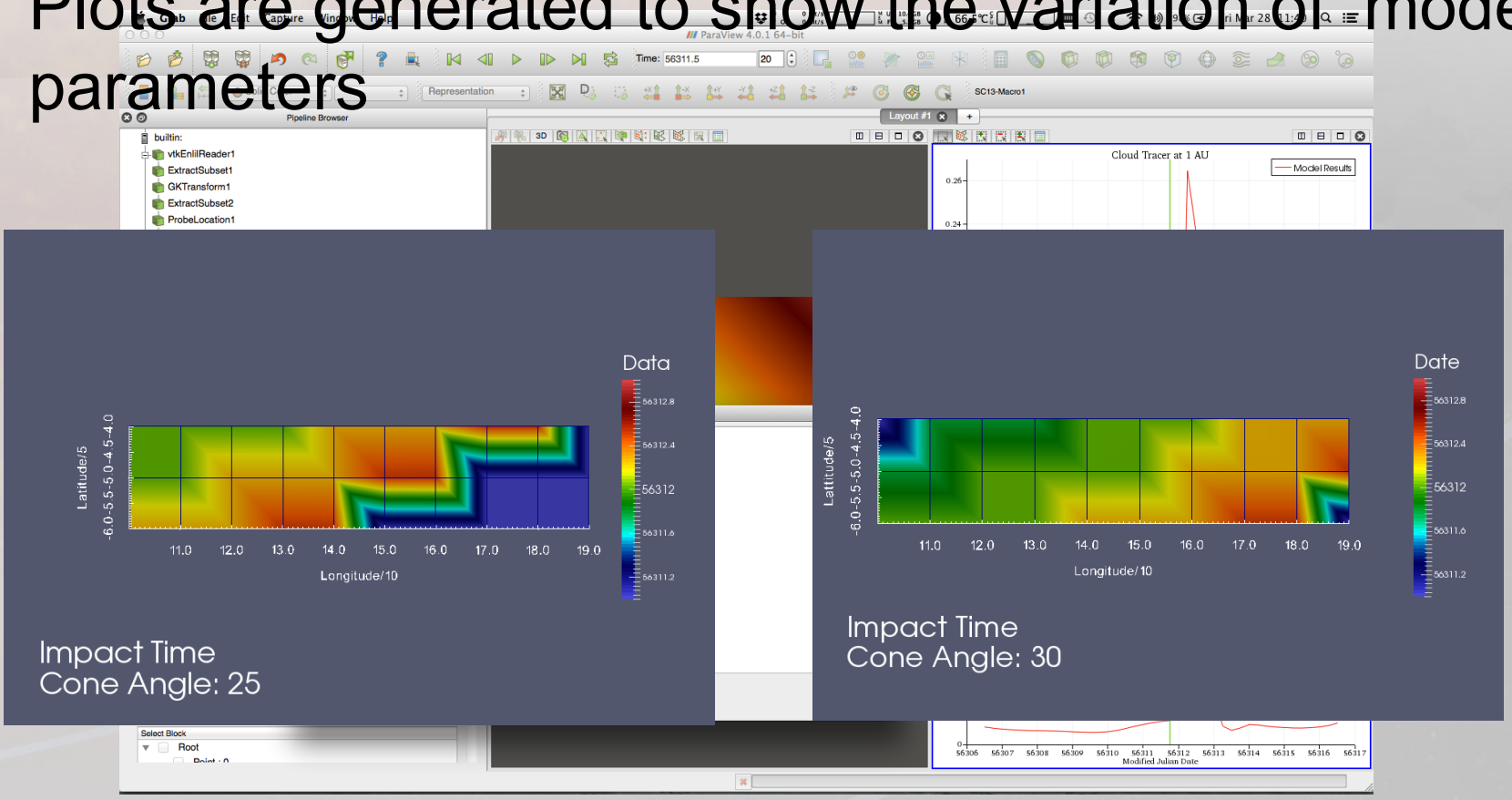
- Parametric Enlil Study to find impact-time variations based on differing CME parameters
- Attempt to determine the impact of errors in cone model parameters on space weather forecasts
- Will eventually cover a large parameter space

Completed Runs

- Enlil runs submitted to CCMC with:
  - Latitude of the CME varying at 5 degree intervals
    - Currently -20 degrees to -35 degrees
  - Longitude of the CME varying at 2 degree intervals
    - Currently 20 degrees to 38 degrees
  - Cone Angle intervals of 5 degrees
    - Currently 25 degrees to 50 degrees
- Based on actual events!

Analysis of a CME

- CME impact time is calculated for each model run
- Plots are generated to show the variation of model parameters



CCMC Impressions

- Provides invaluable resource
- User interface is lacking some needed features
  - Some things (such as Carrington rotation selection) can and should be automated
  - Need better status information related to pending jobs
  - Need a way of removing runs that are not needed
- Could use better/easier online visualization tools
  - ParaView Web might be a good fit (using GHOSTkit of course)

Research Directions

- Future Work will include
  - Automated feature extraction
  - Unified model environment
  - ‘One click’ satellite comparisons
  - Additional model support
  - Magnetosphere tools
  - Radiation Belt tools

Questions?

Contact LASP

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