Visualizing High Performance Computing Data
Earthquake Simulation of Hayward Fault: SW4
(In 3 minutes or less)

Steven Walton
University of Oregon

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What are we modeling?

- Lawrence Livermore (LLNL) and Lawrence Berkeley (LBNL) National Labs are working on earthquake modeling within the Bay area.
- United States Geologic Survey (USGS) predicts a 1 in 3 chance of a rupture with $\geq$ 6.7 magnitude in the next 30 years.
- LLNL and LBNL have created new earthquake modeling sims that are 4-8x more resolved than previous models.
- Scientists typically look at only 2D slices of data

Figure: Hayward Fault Line (source: Berkeley Seismology Lab)

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- Read more at: https://www.llnl.gov/news/hayward-fault-earthquake-simulations-increase-fidelity-ground-motions

Figure: Hayward Fault Line (source: Berkeley Seismology Lab)

In Situ

- So much data is being generated at once that it is impossible to save all of it and do analysis Post Hoc (after the fact)
- We need to analyze data as it is being generated, we call this In Situ.
- Still need to compress data so we can visualize it fast enough.
- We can use Visit or Ascent
- Visit is great for post hoc methods
- Ascent is built for in situ methods and with a small modification of code we can enable in situ techniques.

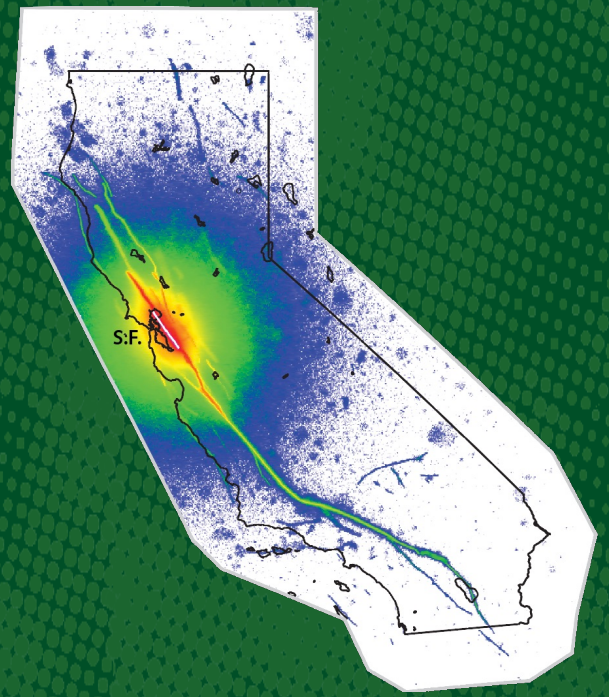


Figure: Aftershocks of M=7.1 Earthquake (source: Temblor)

- Let's open up Visit and plot a single time step

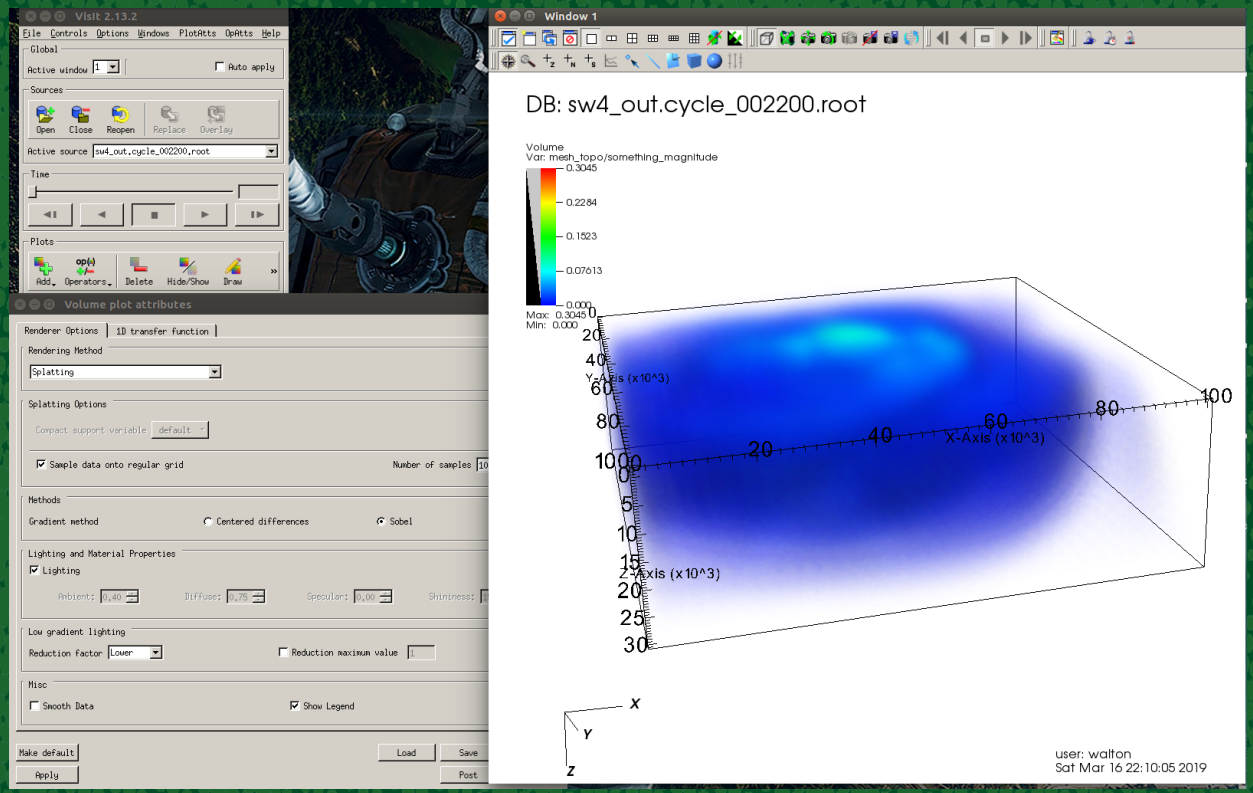
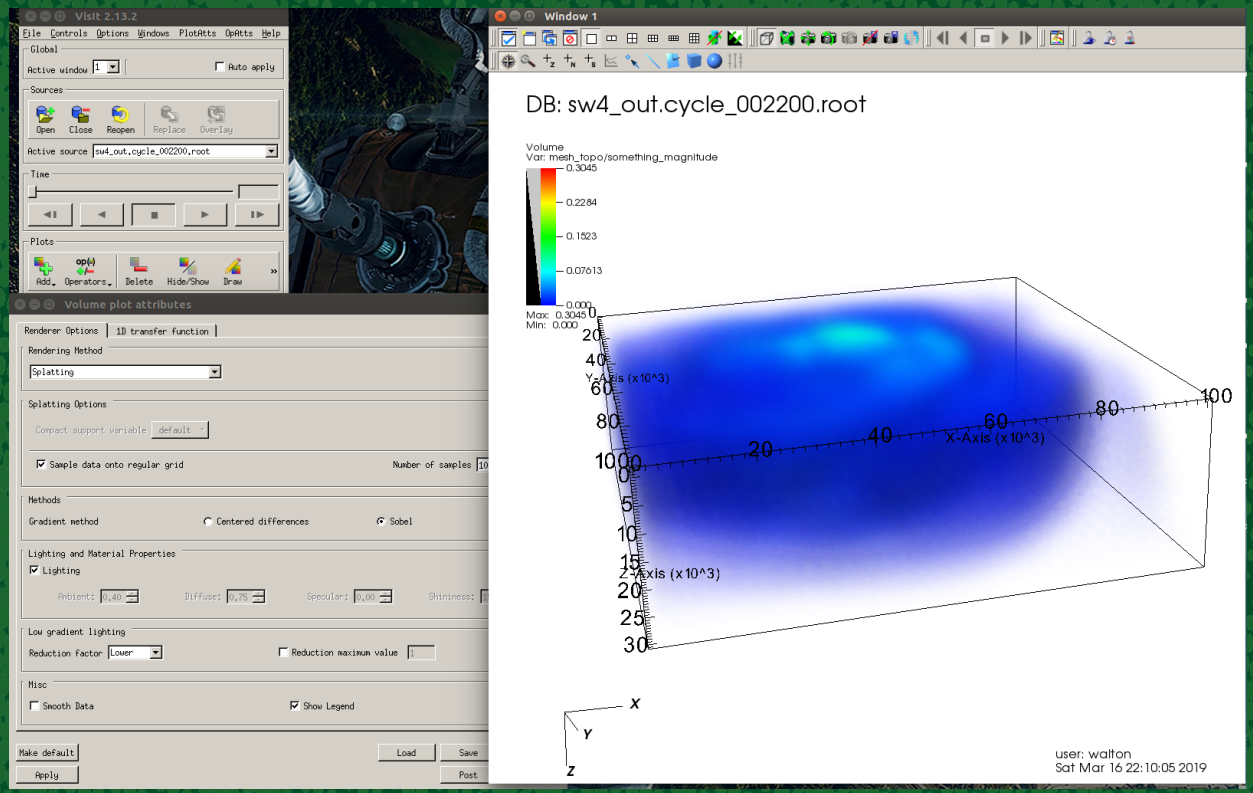


Figure: Visit Setup

- Let's open up Visit and plot a single time step
- Let's try to apply some operators



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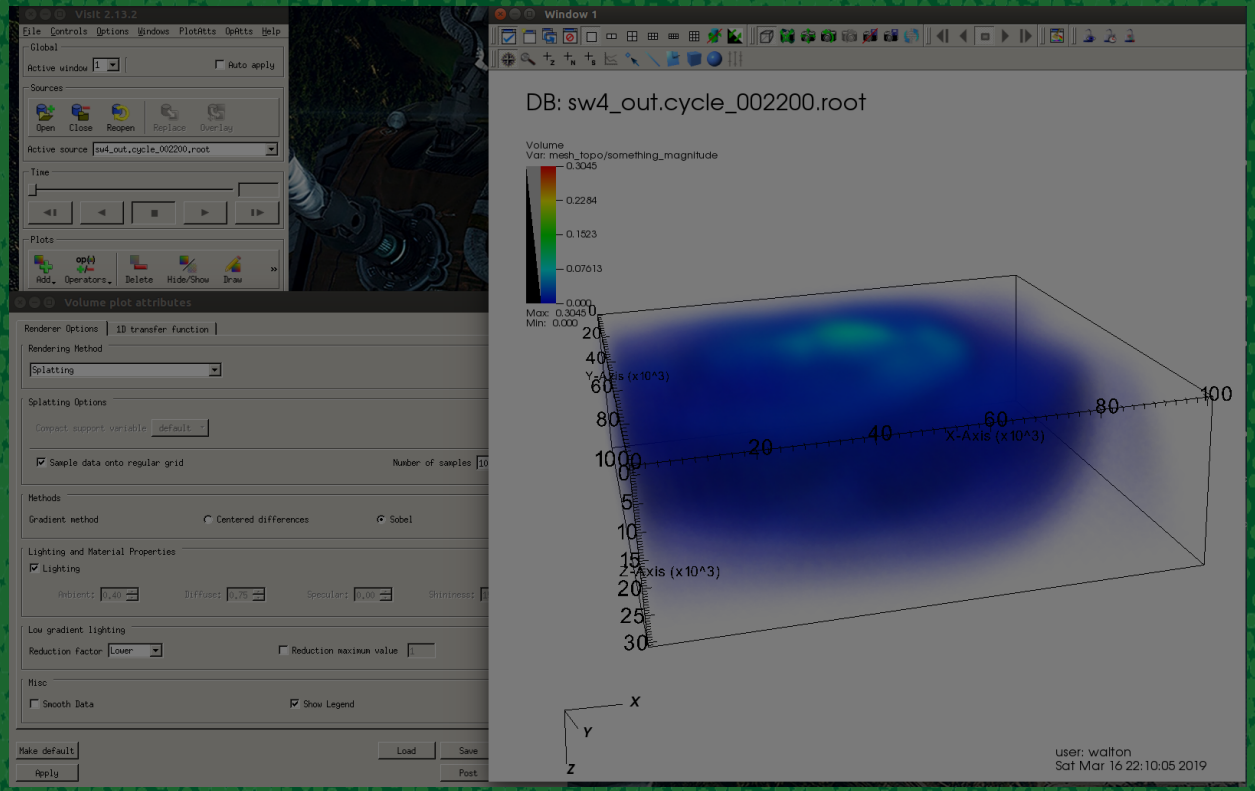


Figure: Visit Setup

- Let's open up Visit and plot a single time step
- Let's try to apply some operators
- ... Memory is full

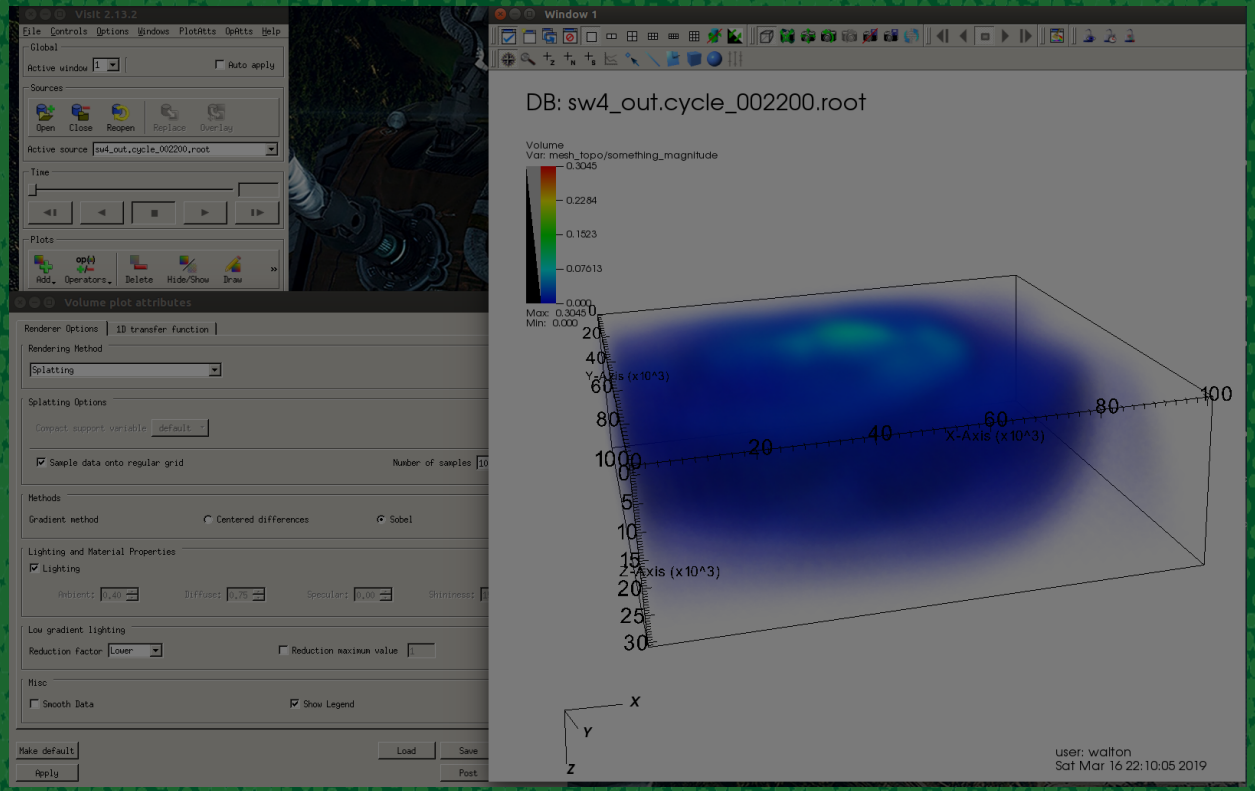
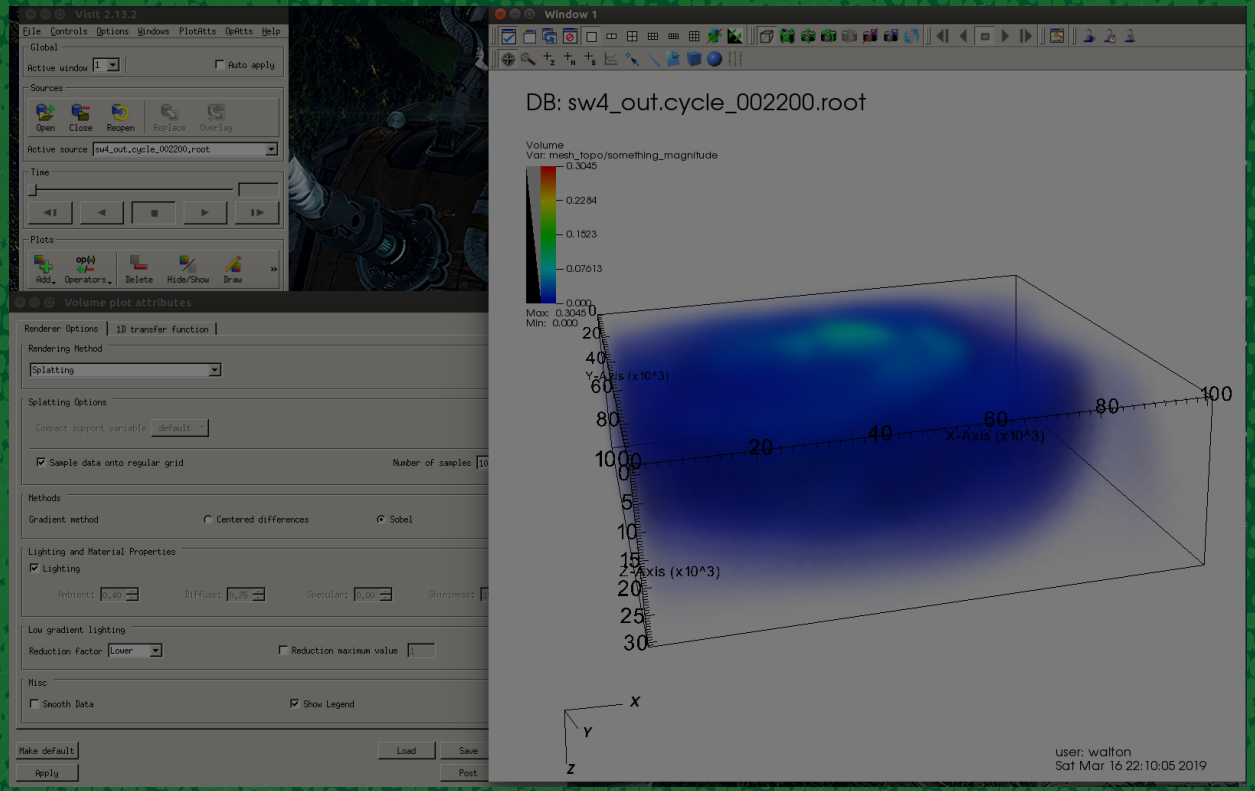


Figure: Visit Setup

- Let's open up Visit and plot a single time step
- Let's try to apply some operators
- ... Memory is full
- ... Computer crashed



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- ... Computer crashed
- ...
- ... Let's go to Alaska

Figure: Visit Setup

So what's it look like?

- Lots of low frequency data underneath the surface
- Lots of high frequency data on the surface
- Can we try to reduce the data size and focus on the important stuff?

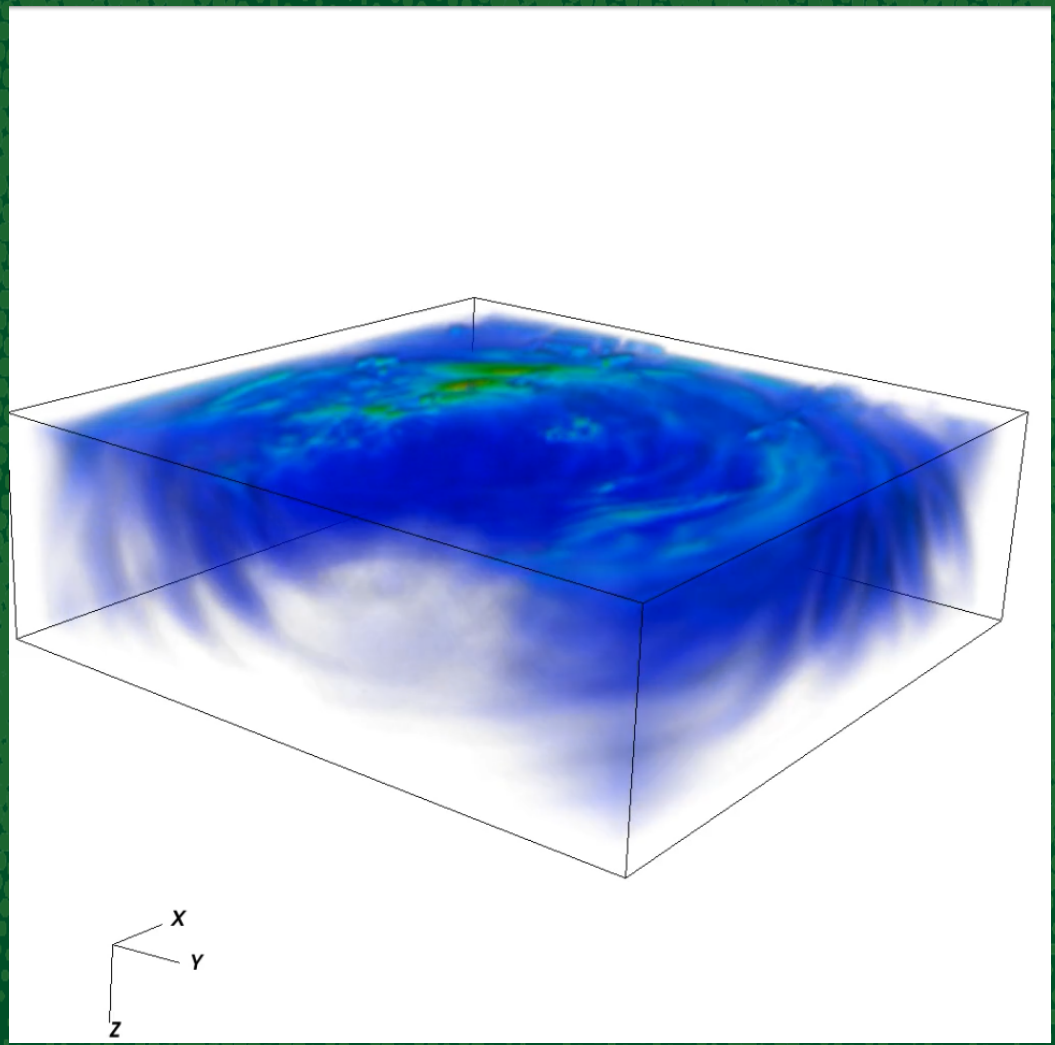

Figure: Raw data plotted

0.01 Threshold

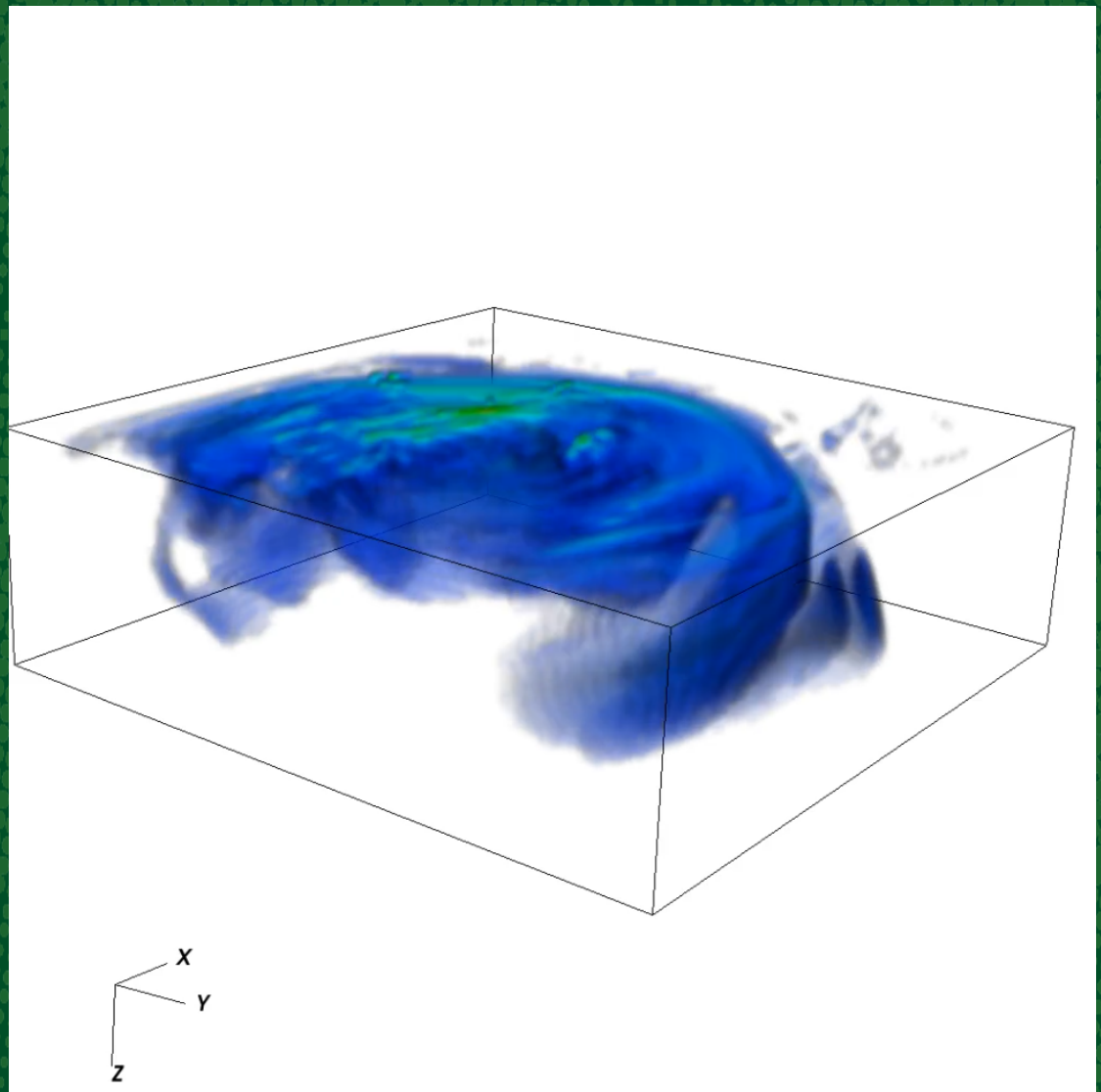

Figure: 0.01 Threshold Applied

0.02 Threshold

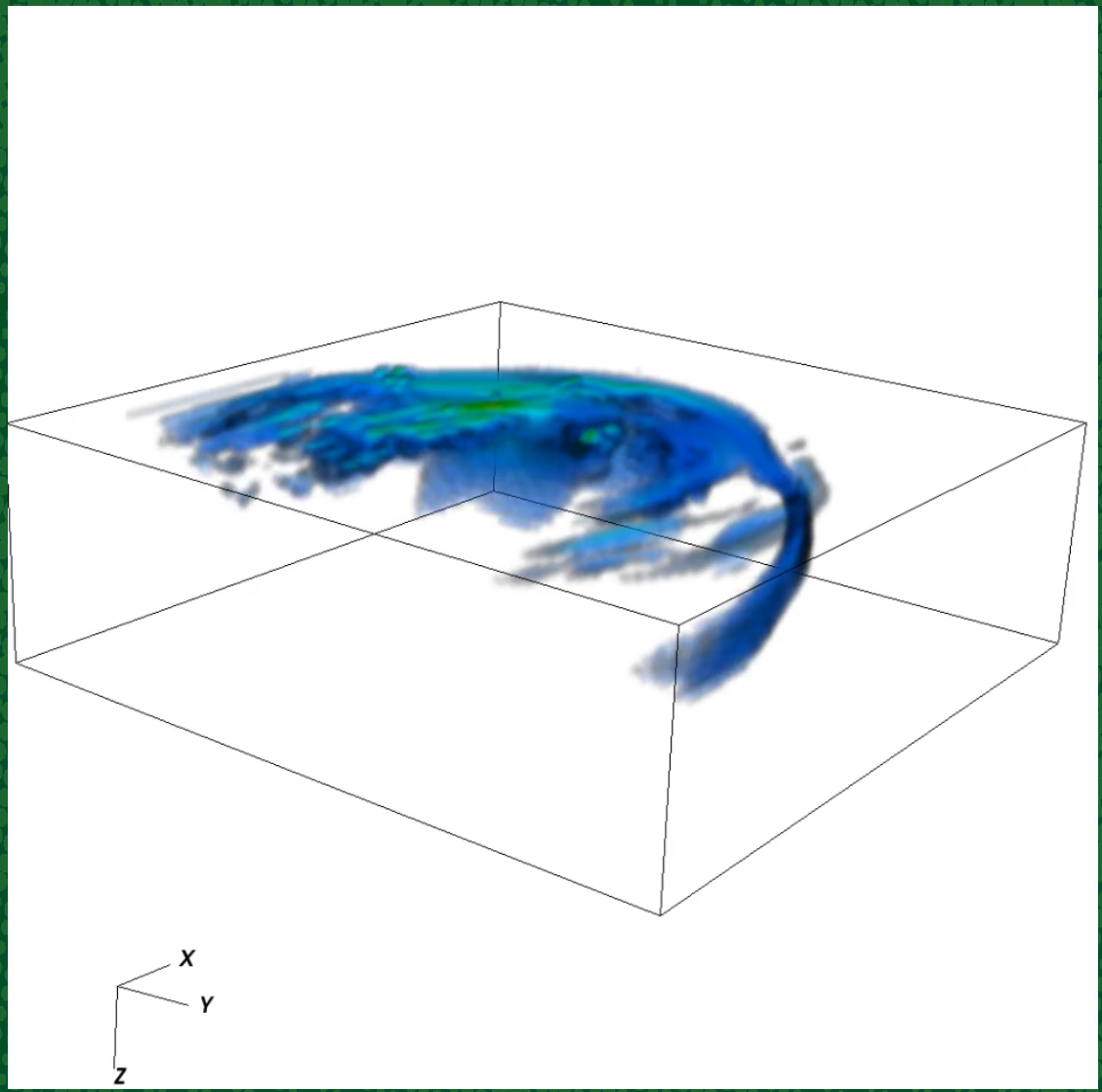

Figure: 0.02 Threshold Applied

What about Ray Tracing the image?

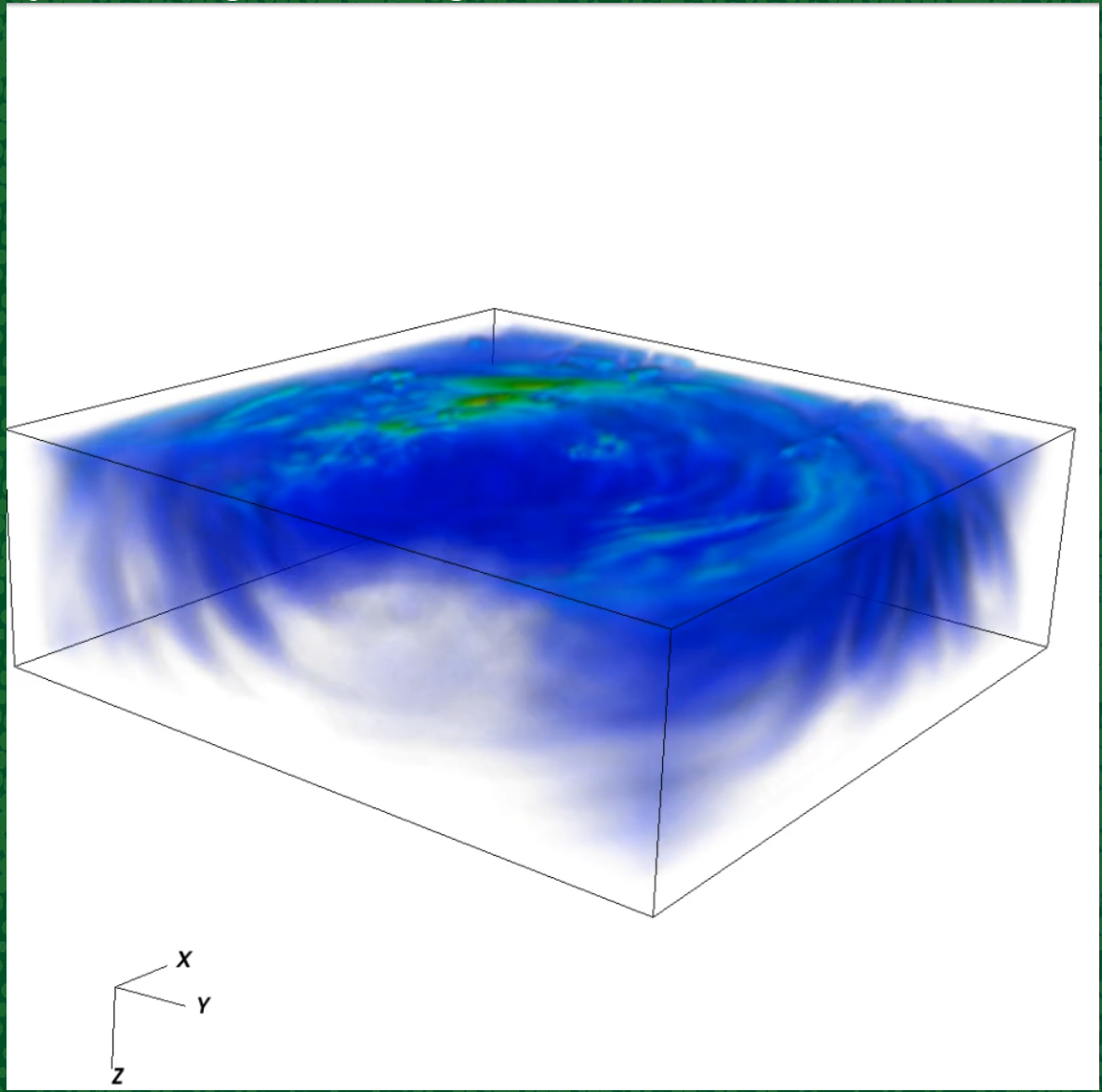

Figure: 0.02 Threshold Ray Tracing

More rays equals more better?

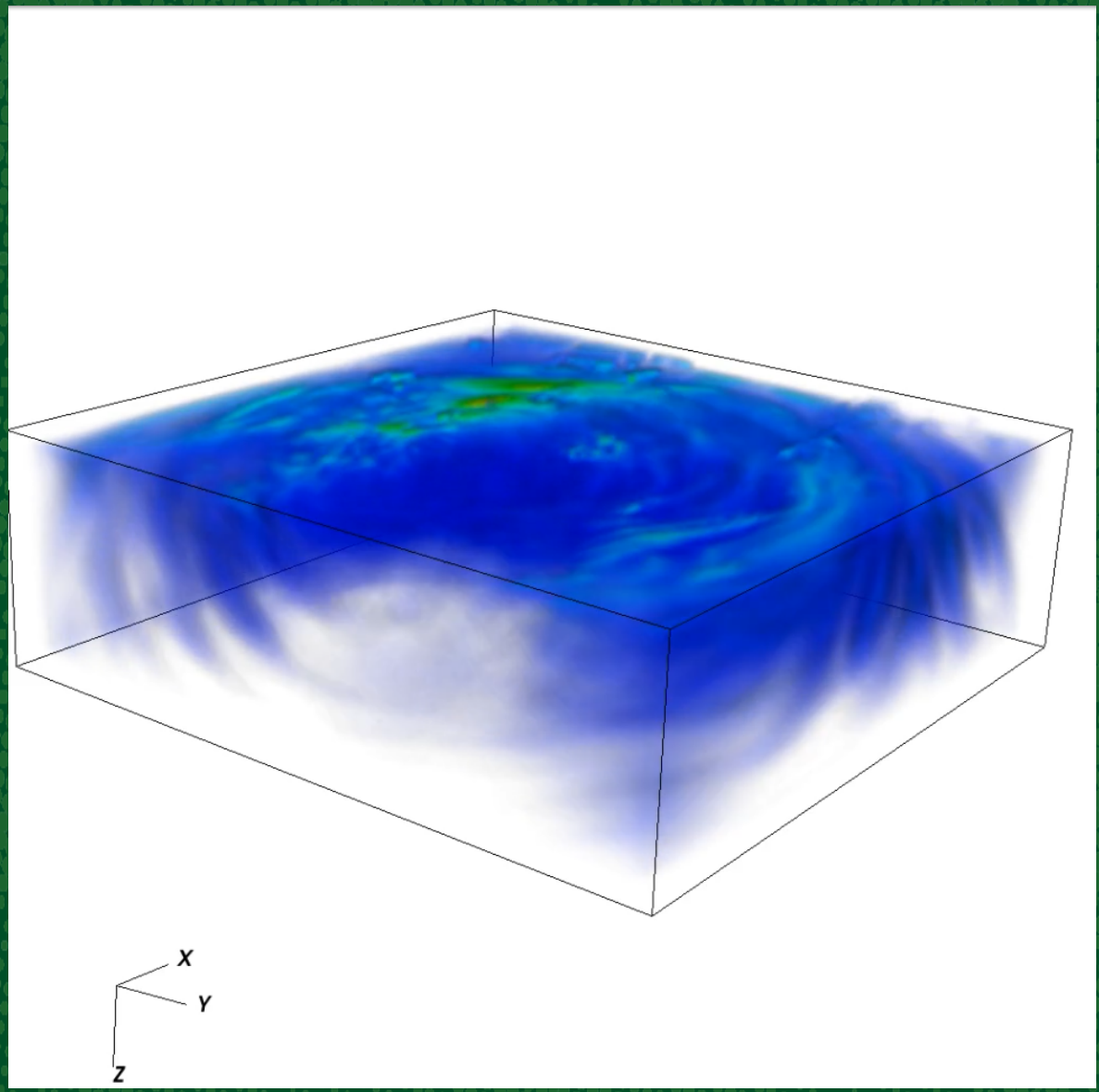

Figure: 0.02 Threshold High Resolution Ray Tracing

Where to next

- We need to get this running in Ascent now.
- Provide an in situ method for performing the same features.
- Requires restructuring the data so that we can use VTK-h filters.
- We need to extend features in both VTK-m and VTK-h.
- Make pretty pictures.
- Deliver product to scientists and make them happy.