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Title:	Applications of In Situ Visualization for Ocean, Cosmology, and Plasma
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ABSTRACT

This is a five minute or less talk for the Office of Science SDAV All Hands Meeting on 2/20/2013. It describes our work with three domains of science: ocean modeling (POP), cosmology(HACC), and plasma(VPIC). In particular it presents work that was directly related to in situ analysis and our future work with these models under SDAV.

SDAV
Scalable Data Management, Analysis, and Visualization

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APPLICATIONS OF *IN SITU* VISUALIZATION FOR OCEAN, COSMOLOGY, AND PLASMA

John Patchett (LANL)

SDAV All-Hands Meeting
February 20-22, 2013

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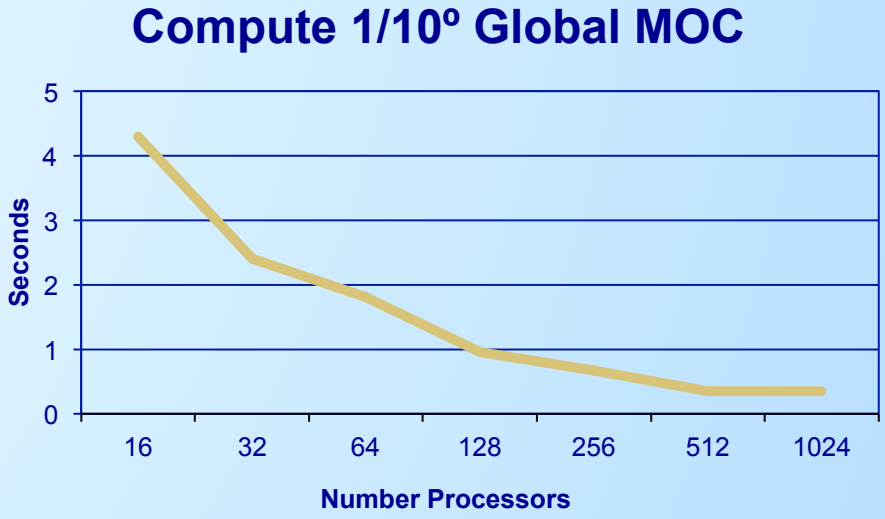
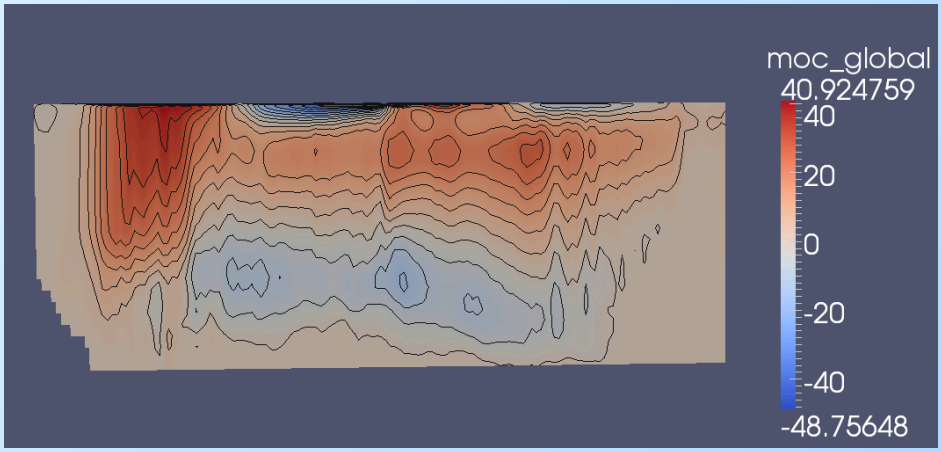
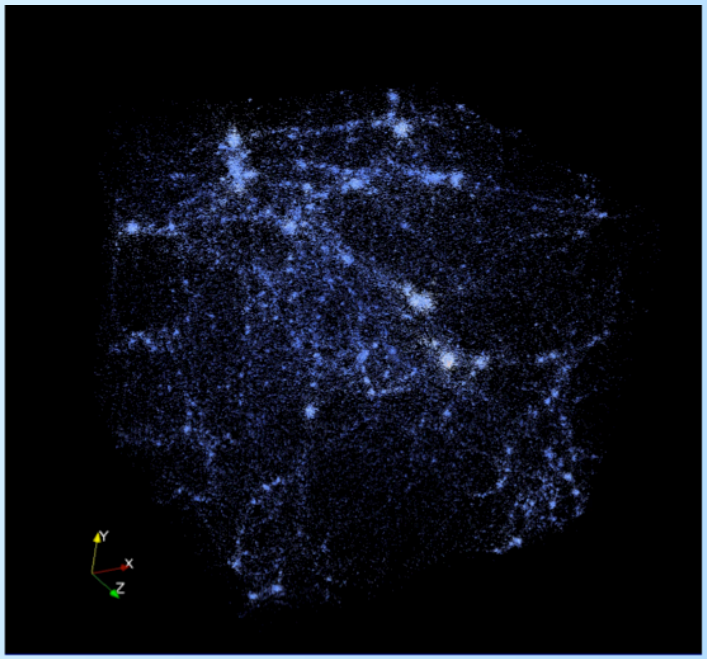
In Situ for Ocean

- Parallel Ocean Program (POP)
- Meridional Overturning Circulation (MOC)
  - -text book diagnostic not scaled for high resolution
  - -used to understand ocean circulation
- Designed and implemented a parallel MOC
- ParaView-Catalyst
  - -Collaboration with Kitware
  - -In memory POP adaptor
  - -MOC to be converted into a ParaView filter





In Situ for Cosmology



Hardware/Hybrid Accelerated Cosmology Code (HACC)
- -Cosmological Simulation runs big

Halos
- -Areas of higher density
- -Important cosmological features
- -Original slab based method of halo finding not scaling

Parallel Halo Finding solution
- -friends of friends algorithm with range finding data structures
- -Started as post processing then went native in situ

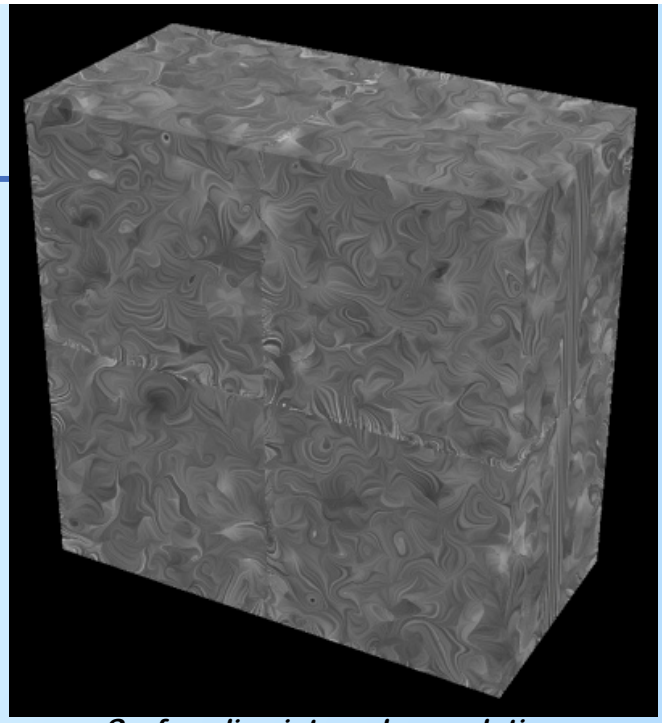
Improved memory usage for Halo Finding
- -15-32 bit values/particle reduced to 6-32 bit values/particle

"The Outer Rim" simulation
- Full Restarts: 100TB/time step
- Particles Only: 40TB/time step
- Halo Catalogs: < 10TB total
- Store initial conditions + halo features, re-compute if necessary

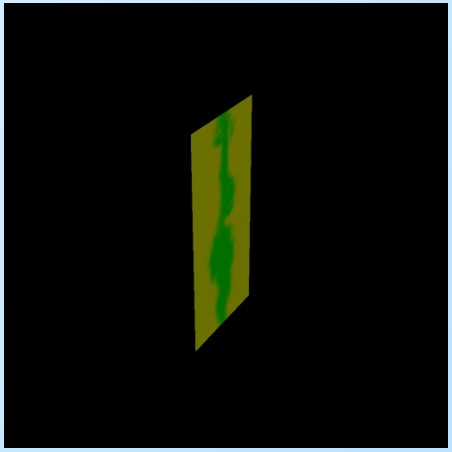
Example 2012: 15-20 hours on 65k cores – no restarts written – Halo Catalogs less taxing on I/O

In Situ for Plasma

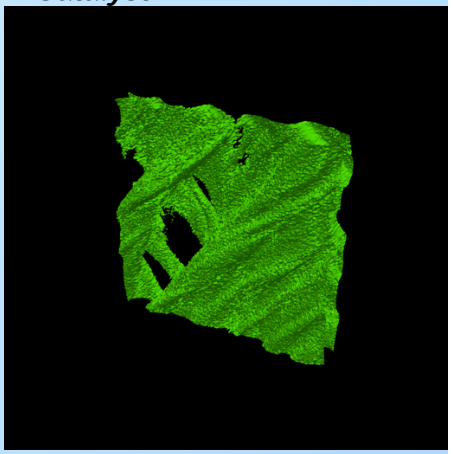
- VPIC (Vector Particle in Cell)
- Extremely large output files
  - -Large in quantity and count
  - -Difficult for end user to do basic visualization
- Designed and Developed parallel VPIC reader for post processing
  - -enabled motivated user to work on different supercomputers using visualization to investigate simulation outputs between runs
- Actively developing in situ capability
  - Hard Coded Operators:
  - Surface Line Integral
  - Convolution,
  - slice, contour
- In Situ + PISTON
  - Contour Operator



Surface line integral convolution generated in VPIC using ParaView-Catalyst



2D slices produced in-situ with VPIC



Contours made using PISTON in-situ

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Conclusion

- We continue to work with Ocean, Cosmology, and Plasma scientists producing solutions to their large scale problems
- We find apps that run big with an associated analysis task that isn't running big
- We develop and implement parallel algorithms as solutions
- We typically provide a number of interfaces to the solutions
- We enable simulations to run bigger and do more complex analysis

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