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<i>Title:</i>	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



U.S. DEPARTMENT OF
ENERGY

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Science

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)

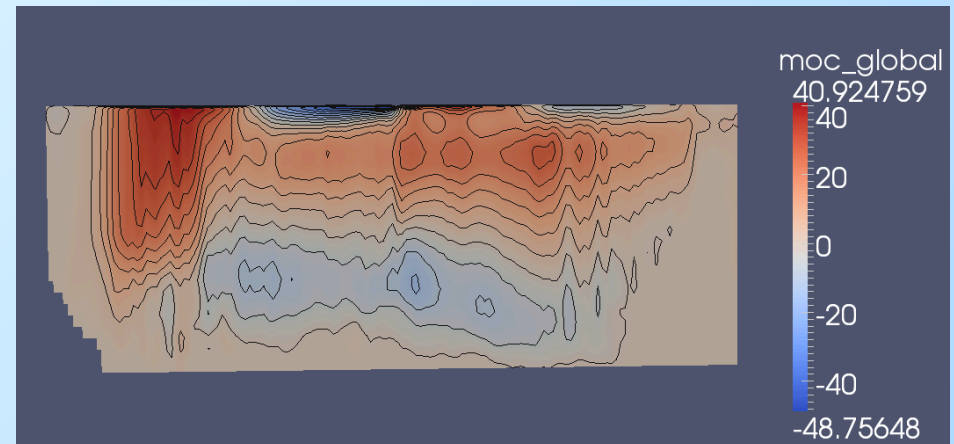
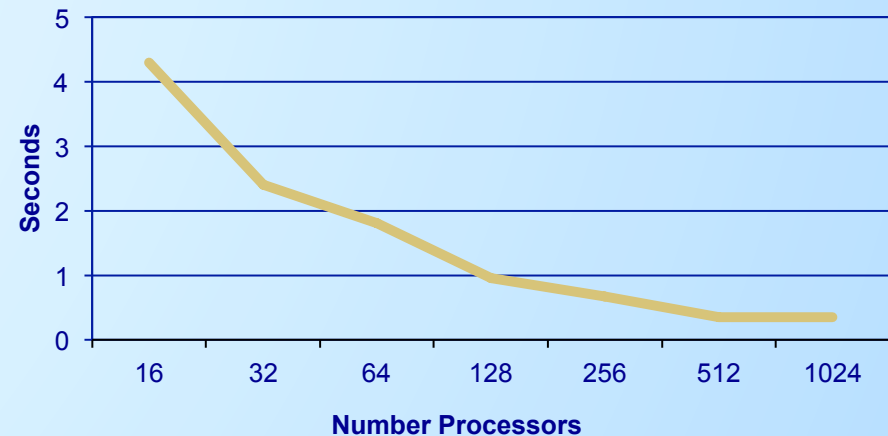
- text book diagnostic not scaled for high resolution
- used to understand ocean circulation

Designed and implemented a parallel MOC

ParaView-Catalyst

- Collaboration with Kitware
- In memory POP adaptor
- MOC to be converted into a ParaView filter

Compute 1/10° Global MOC



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

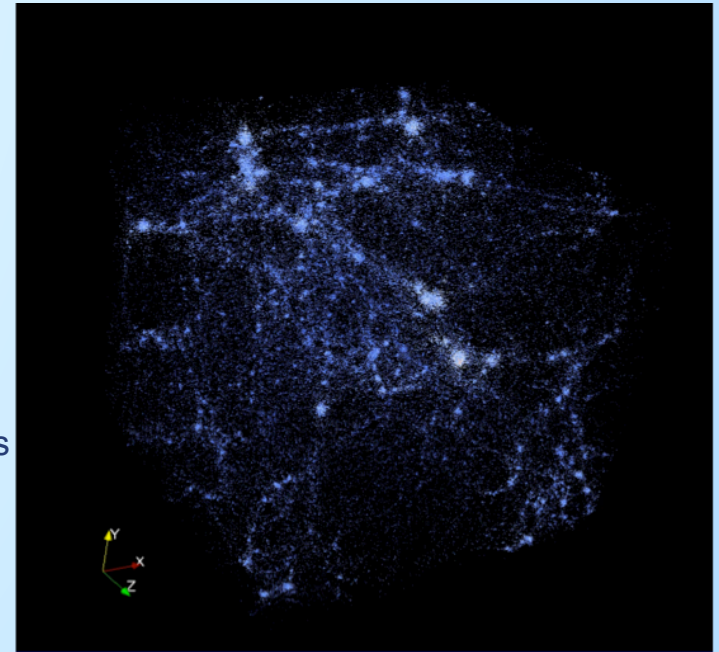
Full Restarts: 100TB/time step

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:

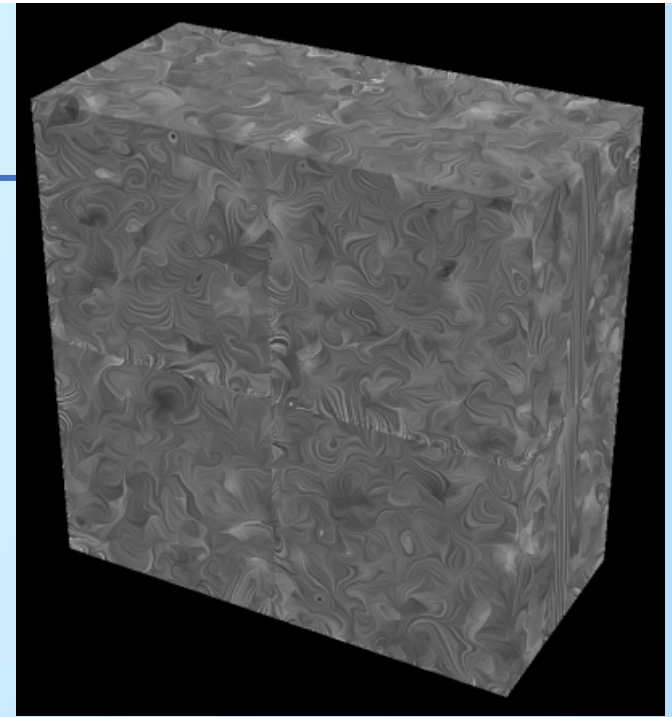
Surface Line Integral

Convolution,

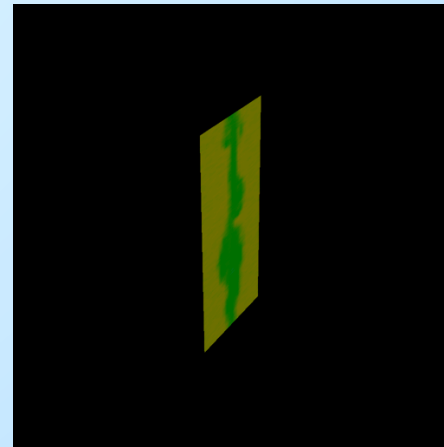
slice, contour

In Situ + PISTON

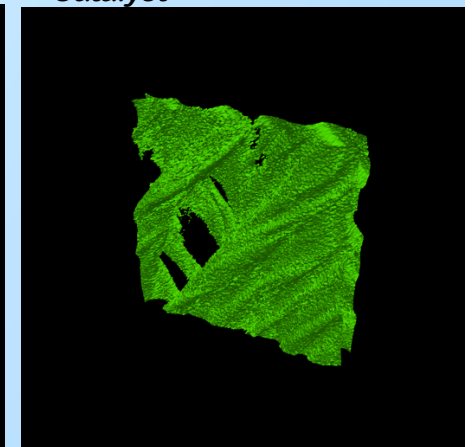
Contour Operator



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