Introducing the Argonne Leadership Computing Facility Analysis Environment

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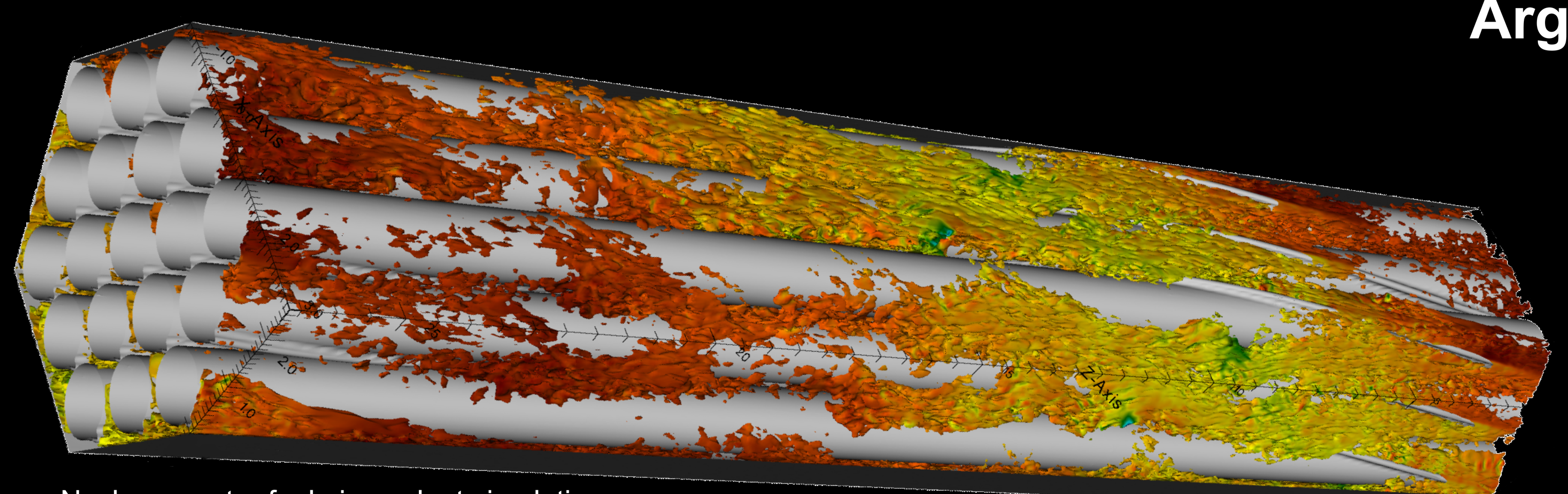
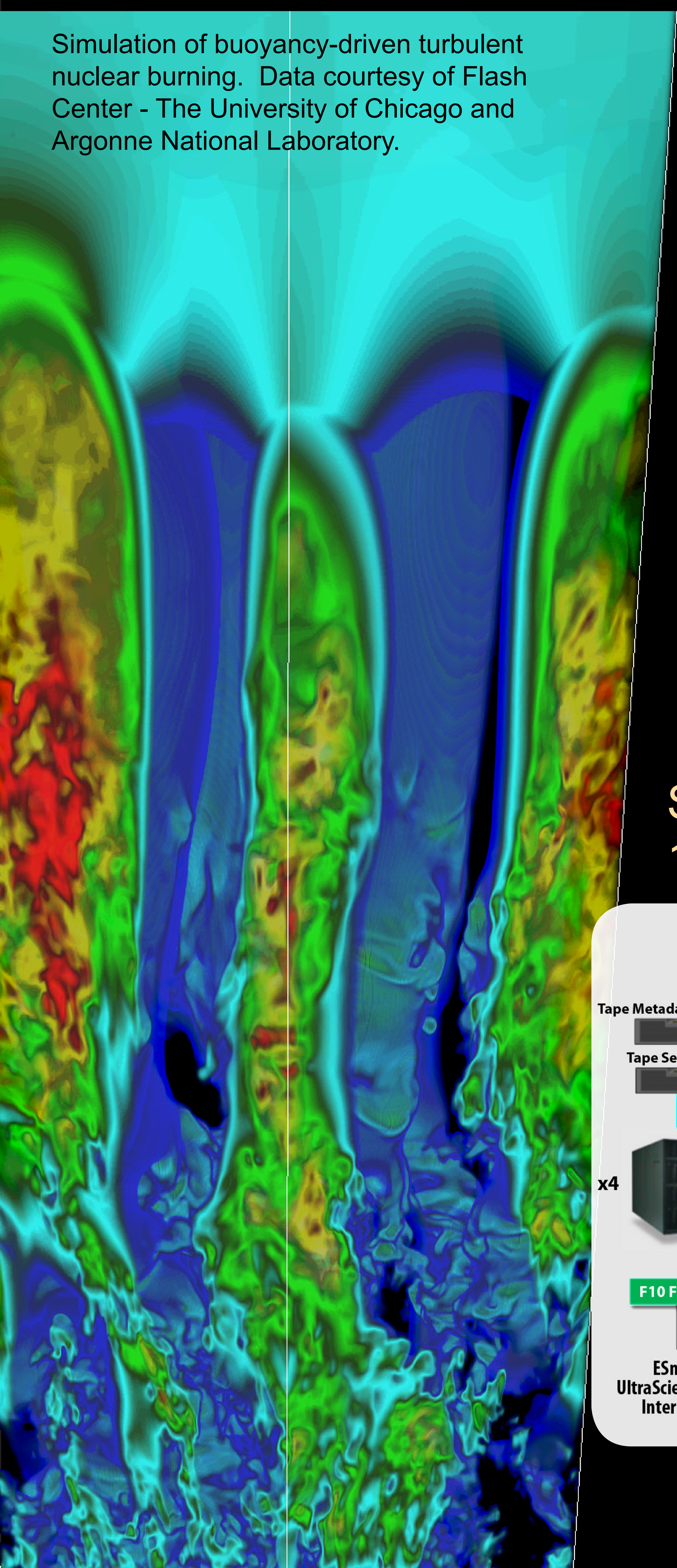


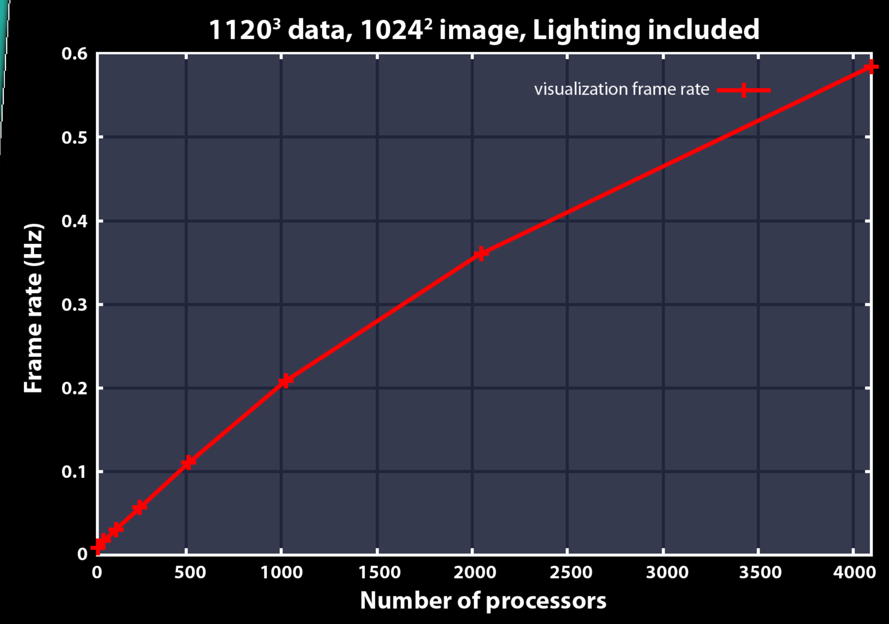
Nuclear reactor fuel pin coolant simulation.
Image courtesy of Andrew Siegel, Argonne National Laboratory

The increasing scale of computational power required by modern simulations requires new approaches to visualization and analysis systems. Scaling a traditional visualization-analysis cluster to the petascale would result in untenable size, power, and cooling requirements. The Argonne Leadership Computing Facility (ALCF) is therefore integrating the analysis and visualization directly into the Blue Gene/P (BG/P) resource itself. This approach will let us exploit the large memory footprint of BG/P and will result in a system capable of both computing and analyzing petascale data efficiently.

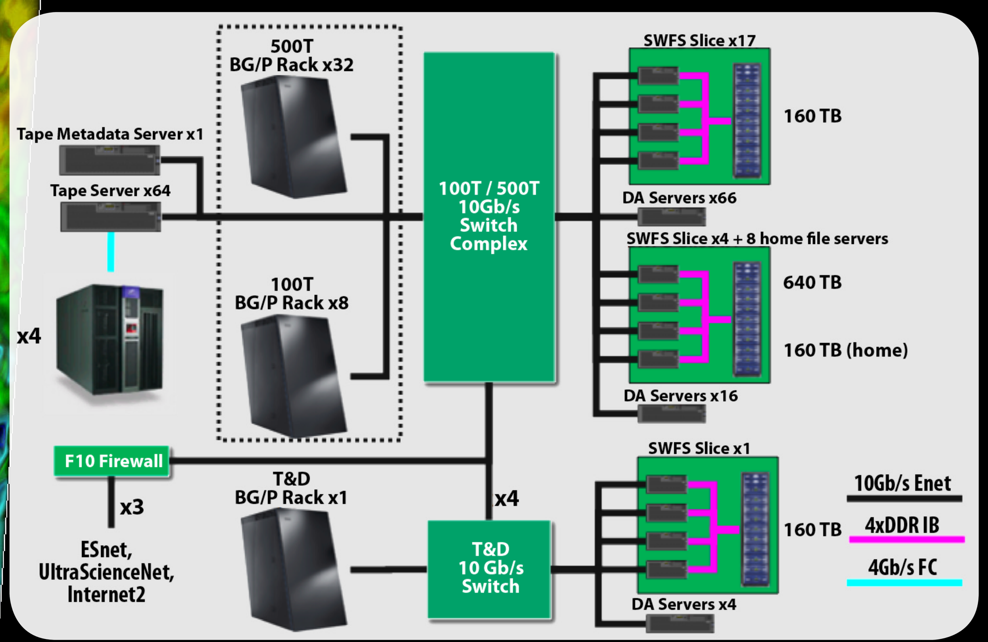


Simulation of buoyancy-driven turbulent nuclear burning. Data courtesy of Flash Center - The University of Chicago and Argonne National Laboratory.

Strong scalability of visualization directly on ALCF's BG/P

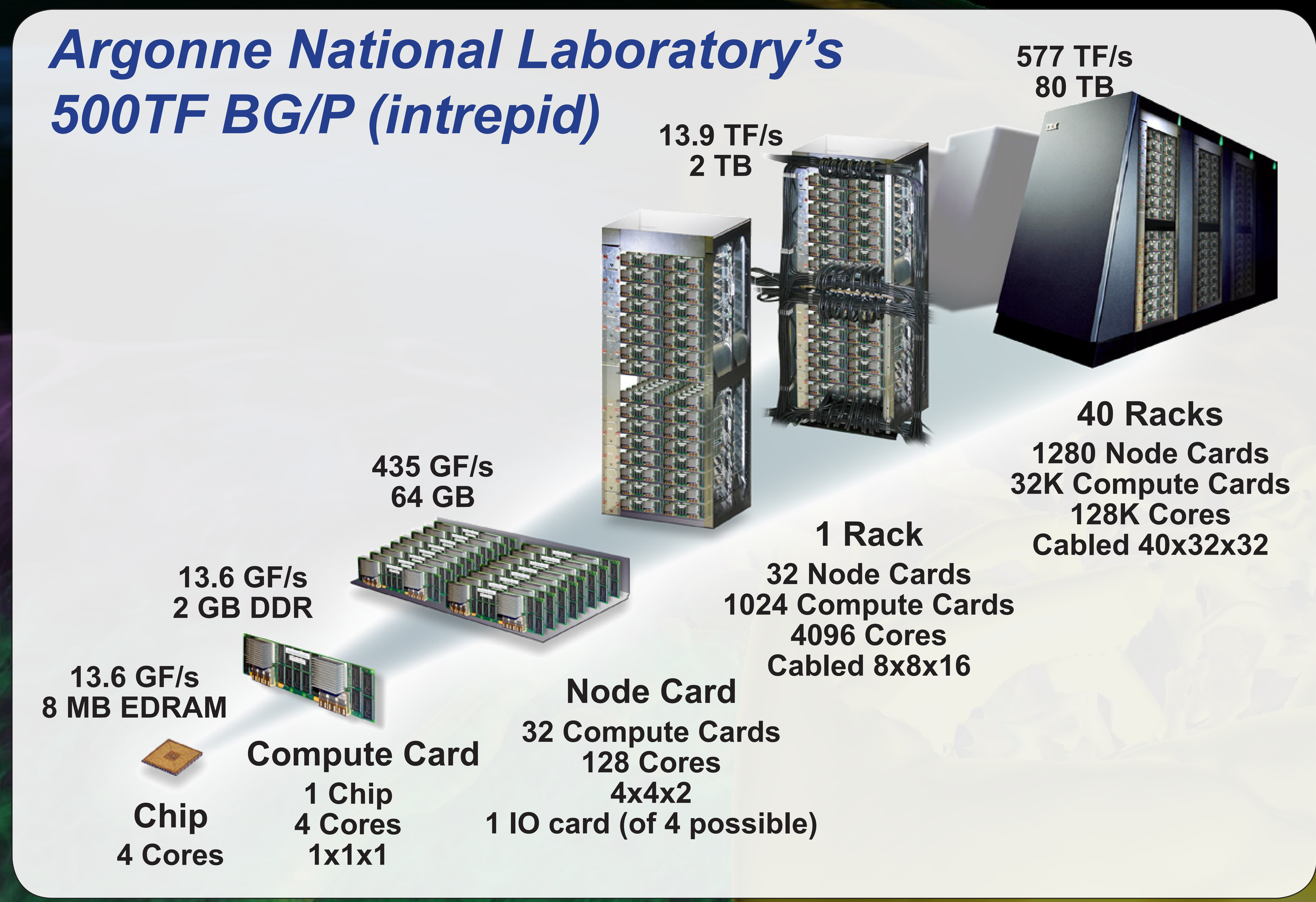


System diagram of ALCF's T&D, 100T, and 500T BG/Ps

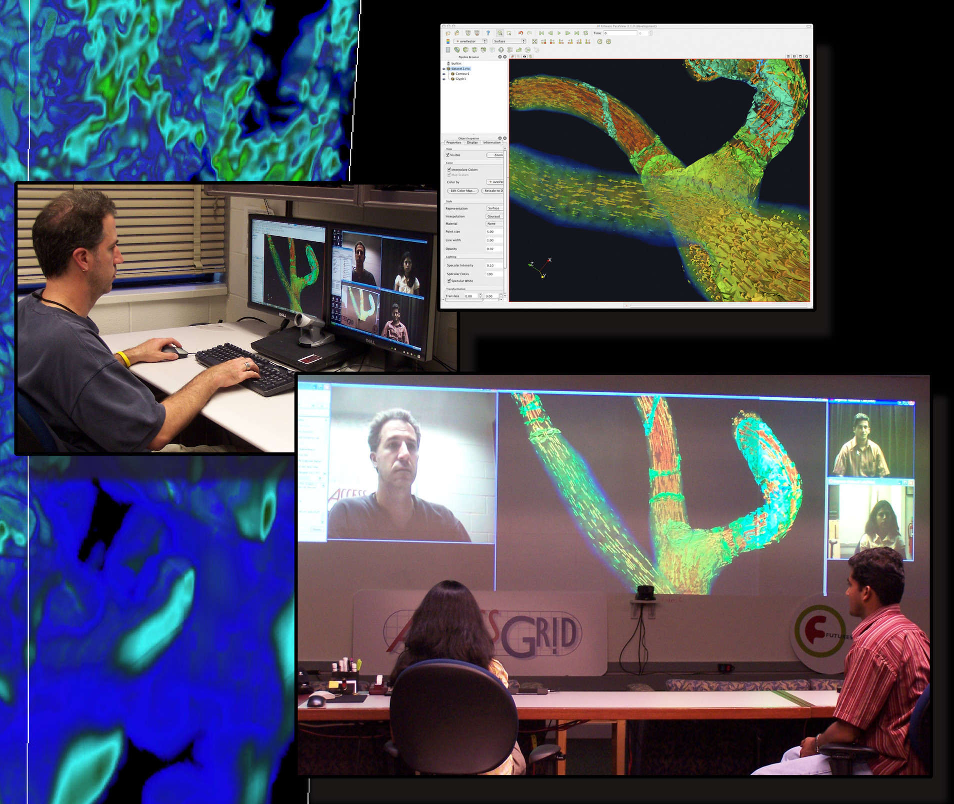


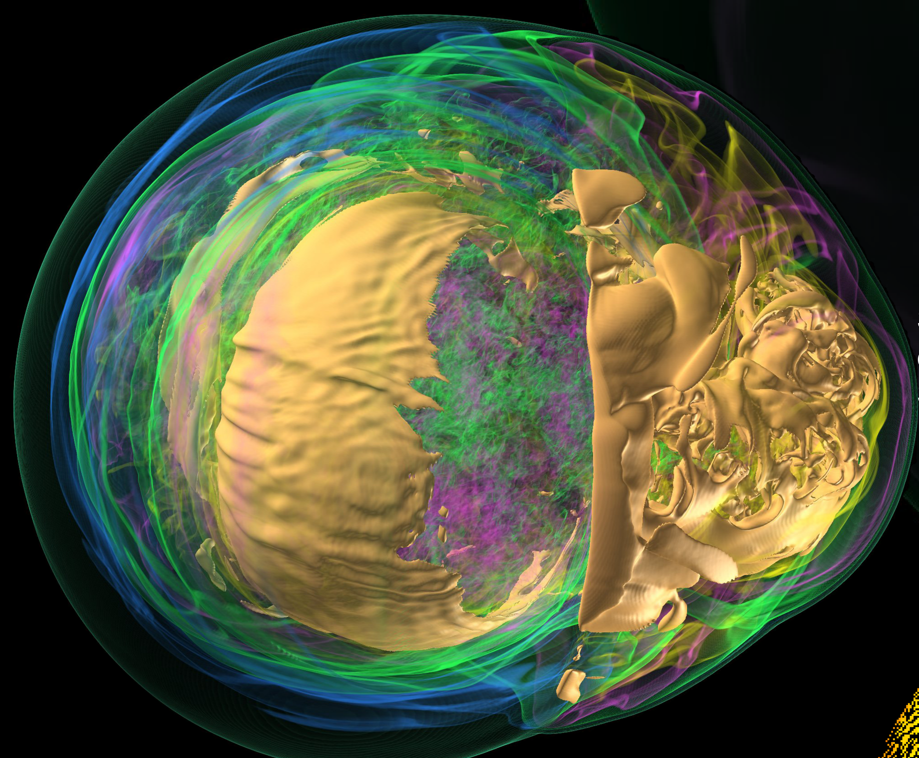
Real-time generation of time-varying data coupled with photo-realistic rendering provide insight into supernova core collapse. Such visualizations can be scaled to tens of thousands and ultimately hundreds of thousands of cores on BG/P. To date, we have successfully rendered data consisting of more than 10 billion data elements per time-step with over 8 thousand cores. By studying the visualization problem from both an algorithmic as well as a systemic perspective, bottlenecks are identified and addressed as we progress toward unprecedented scales.

ALCF's Intrepid will be capable of over 500 TeraFlops

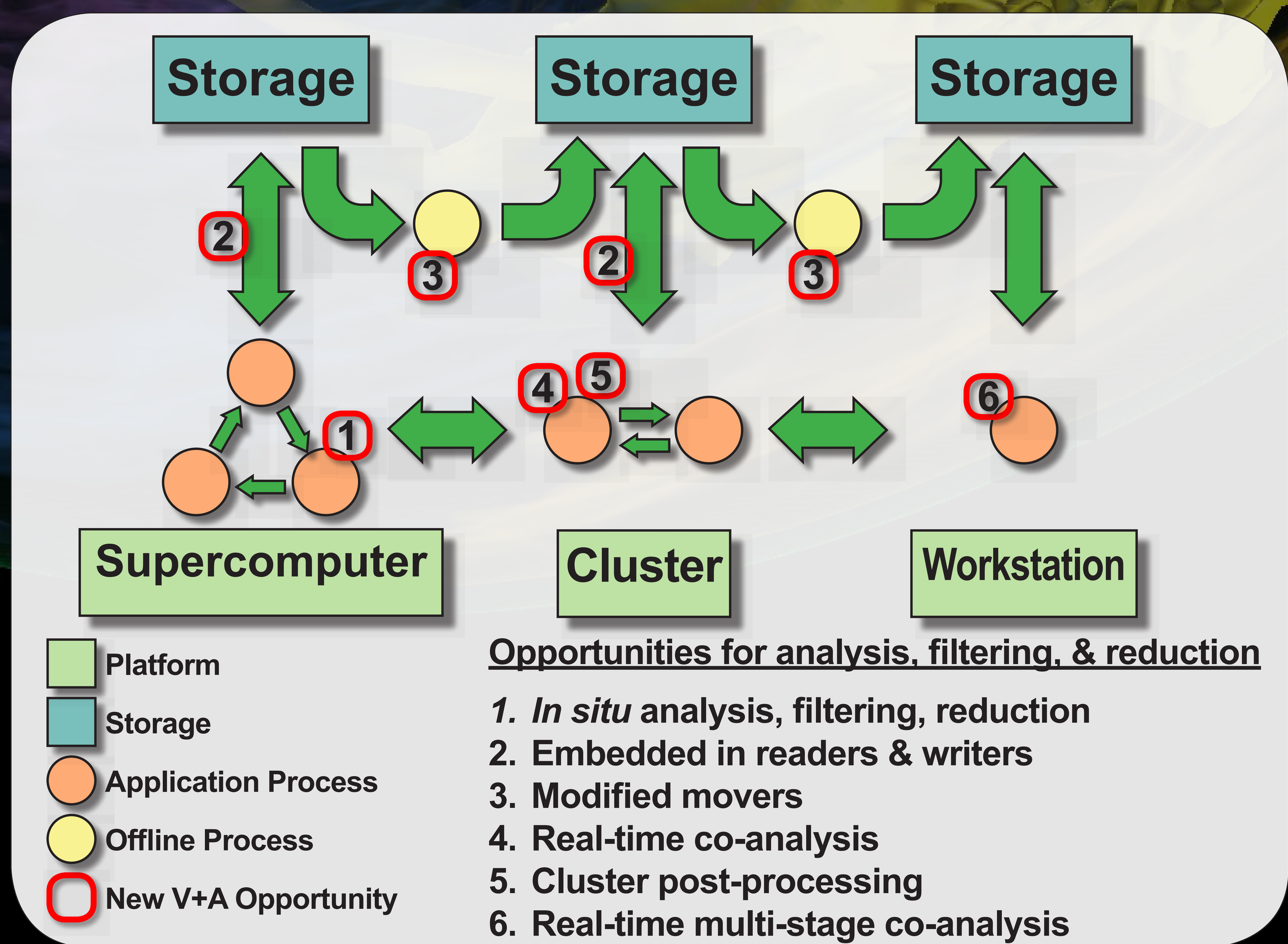


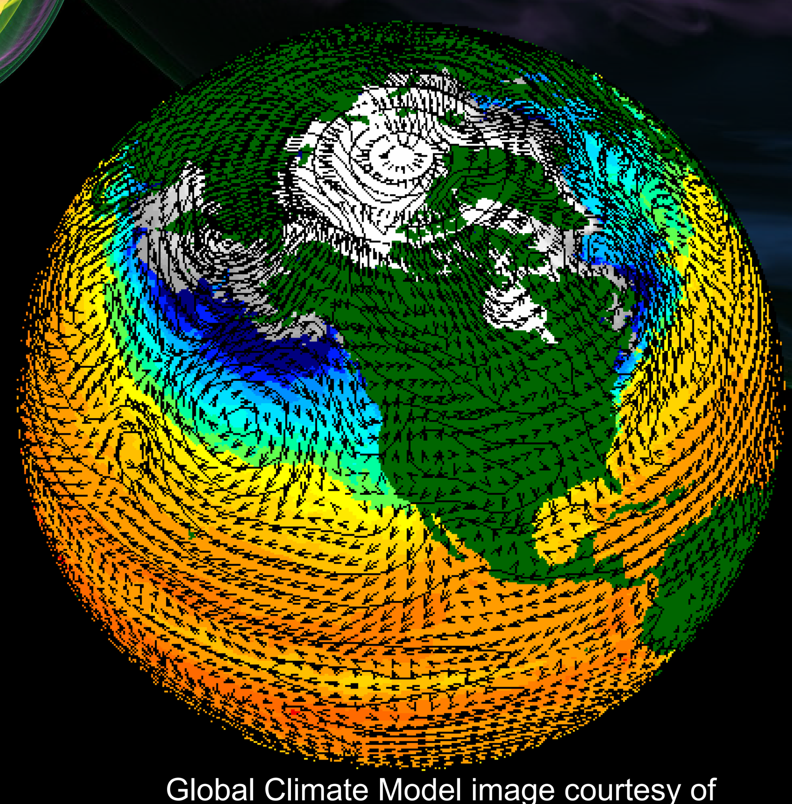
Allocating a percentage of Blue Gene/P for analysis will allow extraction of information and yield a balance between the computation and filtering operations. A traditional Linux cluster will also be available. Conservative early estimates indicate that this will include a minimum of: 2 TB of RAM, 512 cores, ~64 10 gigaBit connections to the ALCF storage system, and 128 of the latest graphics cards. This system will provide a traditional footprint for users to get up and running quickly.





Simulation data of early stages of supernova core collapse courtesy of John Blondin of North Carolina State University and Anthony Mezzacappa of Oak Ridge National Laboratory.





Global Climate Model image courtesy of Robert Jacob, Argonne National Laboratory

- Automating the analysis process to manage data products growing in complexity and size.
- Modeling data analysis to better utilize resources
- Combining analysis in situ with simulation
- Applications: VisIt, ParaView, VTK, VMD, and Argonne's vl3. Select custom solutions will be developed as needed.