National Aeronautics and Space Administration

HIGH-END COMPUTING

at the NASA Advanced Supercomputing (NAS) Division

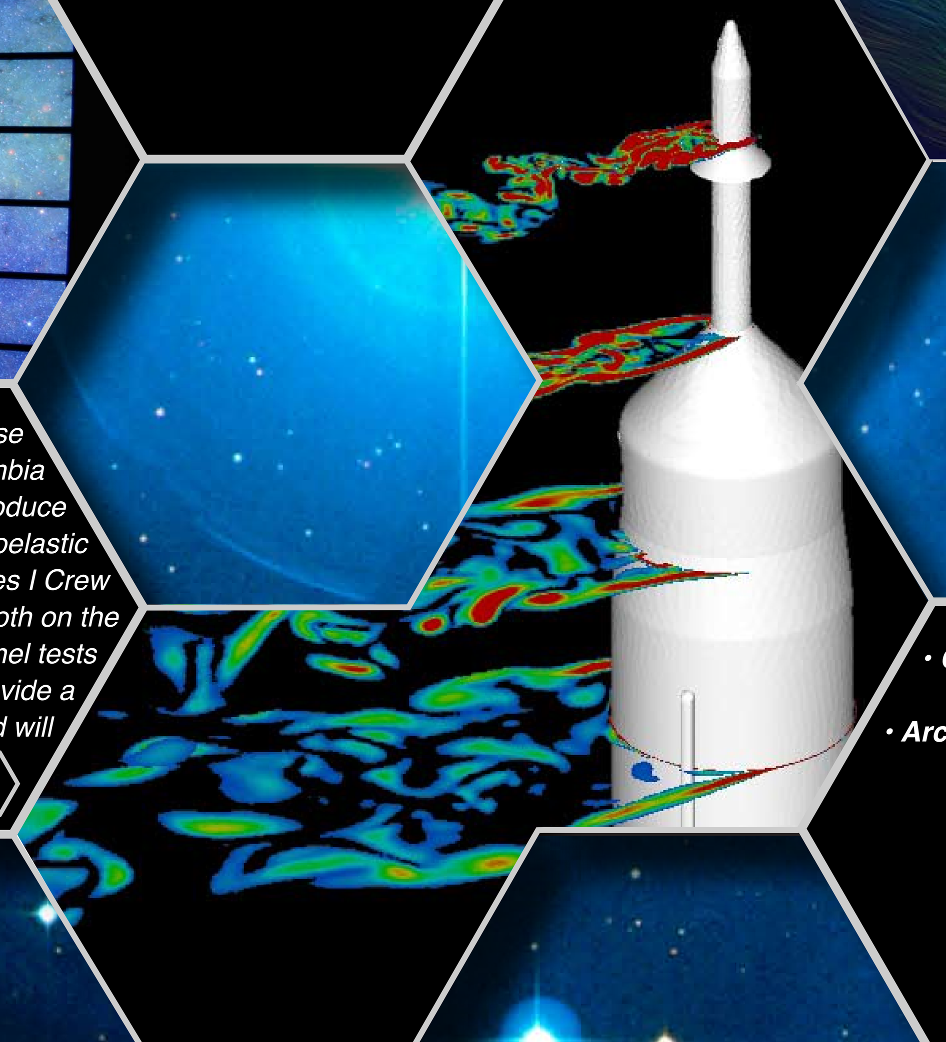
The NAS facility is home to some of the most powerful, and one of the "greenest" supercomputers in the world. With a combined capability of more than 700 teraflops (each teraflop is one trillion floating point operations per second), these supercomputers support fascinating science and engineering research in all NASA mission areas.

INTEGRATED SERVICES

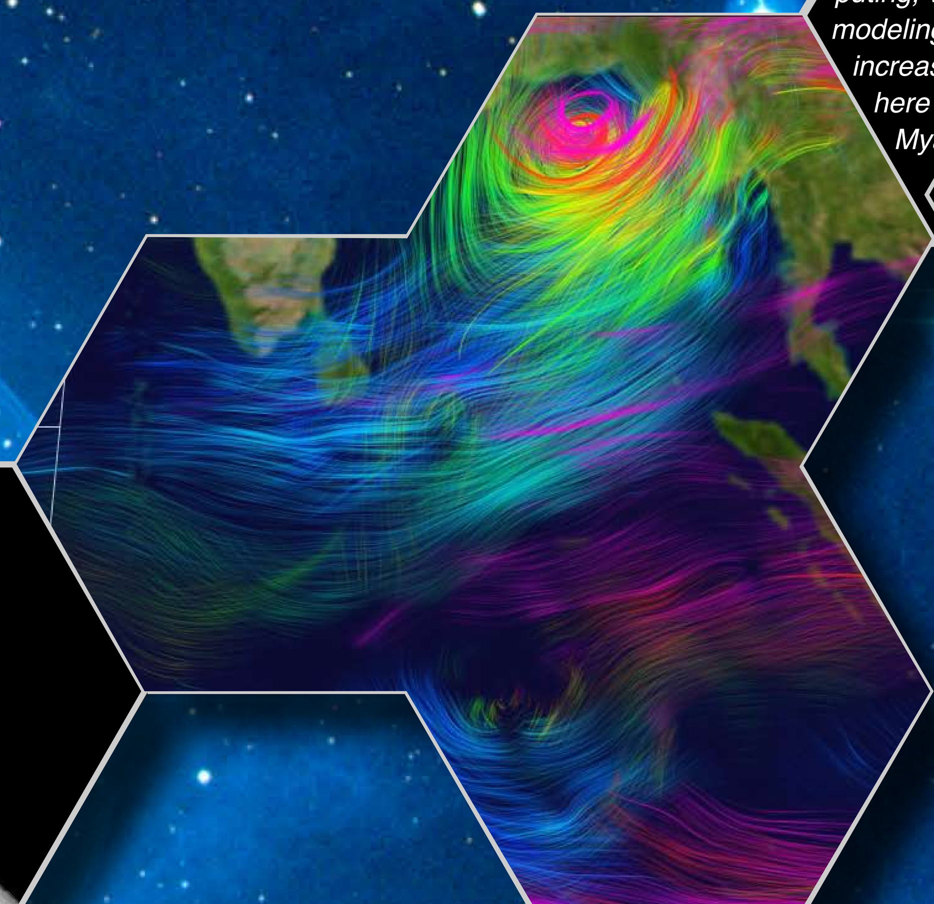
NAS doesn't just provide computing cycles—it is a full-service organization offering NASA resources with support in the areas of high-speed networking, visualization, modeling and simulation, application optimization, data storage management, and 24x7 user support to NASA users and partners.

This full spectrum of services, coupled with world-class computing resources, provides the building blocks needed to enable work such as: design analysis of future spacecraft to take us back to the moon, on to Mars, and beyond; generating the massive amounts of data required to model an entire storm front; calculation of more efficient flight patterns to help unclog our nation's congested airports; and to analyze anomalies during Space Shuttle missions to help ensure a safe return into Earth's atmosphere..

The quarter-billion pixel display of the hyperwall-2 visualization system—equivalent to the graphics capability of nearly 600 Microsoft Xbox game consoles—allows scientists to view and explore data downloaded from satellites and probes for such challenges as explaining how early stars and other structures in the universe formed and evolved. NAS specialists write custom software to help users discover new details within huge datasets, in real time, while being calculated on the supercomputers.



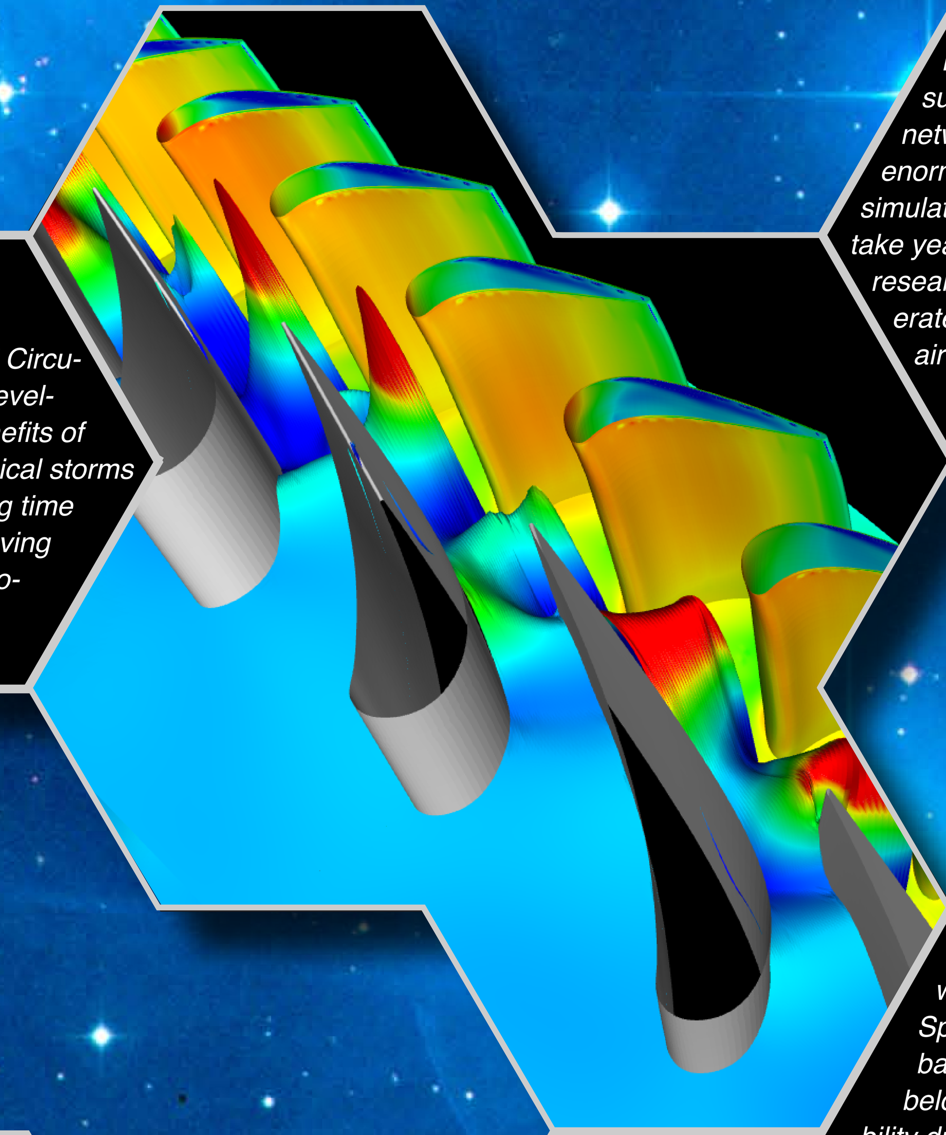
NASA engineers use the 14,336-core Columbia supercomputer to produce computational aeroelastic simulations of the future Ares I Crew Launch Vehicle (CLV), both on the ground and during ascent. Since accurate wind tunnel tests are hard to attain, data calculated on Columbia provide a benchmark for comparison with wind tunnel data, and will result in a better, safer design for the CLV, set to send astronauts to the International Space Station by 2014.



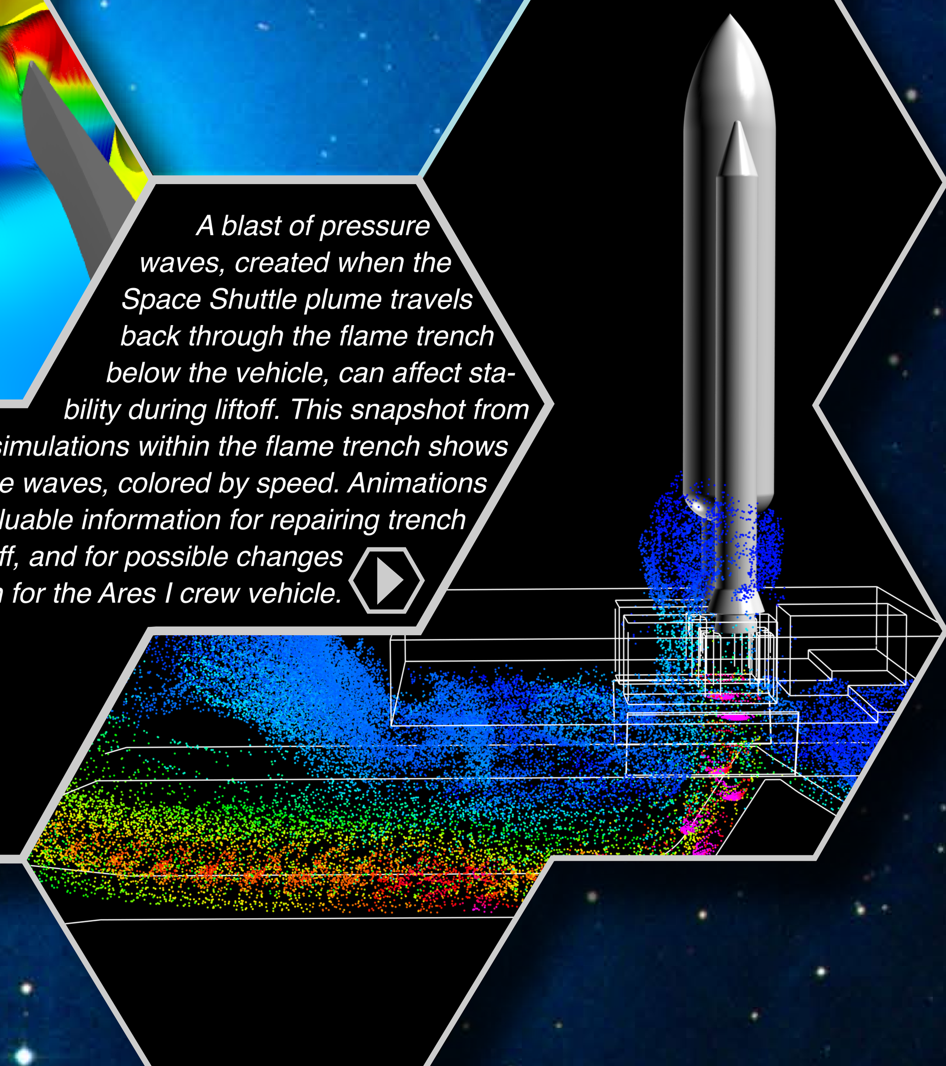
In its quest to improve and push the limits of global weather prediction, NASA is integrating supercomputing, visualization, and multi-scale modeling systems to improve and increase lead-time of predicting tropical storms. Shown here is a 3D simulation of Cyclone Nargis (April 2008, Myanmar) generated using the finite-volume General Circulation Model (fvGCM) coupled with NASA-developed visualization techniques. Potential benefits of increasing lead-time of tropical storms include increasing warning time for local in-habitants, saving lives, and reducing economic damage.

The NAS facility currently houses three supercomputers and a mass storage system:

- ***Pleiades (pictured):*** *51,200-core SGI Altix ICE, 609 Tflop/s peak*
- ***Columbia:*** *14,336-core SGI Altix 3700/4700, 89 Tflop/s peak*
- ***Schirra:*** *640-core IBM POWER5+, 4.8 Tflops/s peak*
- ***Archival storage system:*** *Spectra Logic/SGI, 16-petabyte storage capacity*



NAS engineers support lightening-fast networks to help enable enormous computational simulations that would otherwise take years to complete. Aeronautics researchers are figuring out ways to reduce noise generated by aircraft turbine engines. Calculations of the airflow and pressure inside a turbine help researchers identify and understand the sources of noise deep in the engine core. The image shows a portion of this unsteady pressure field circulating through the turbine blade rows to later emerge as noise from the engine exhaust.



A blast of pressure waves, created when the Space Shuttle plume travels back through the flame trench below the vehicle, can affect stability during liftoff. This snapshot from time-accurate, 3D simulations within the flame trench shows particle traces of the waves, colored by speed. Animations give scientists valuable information for repairing trench damage created on liftoff, and for possible changes to the trench configuration for the Ares I crew vehicle.

NAS is preparing for a 10-petaflops high-end computing environment in 2012—more than 10 times today's capability. Such an increase in computing power, coupled with faster networks and greater storage capacity, will enable near-real-time aerospace design and a deeper understanding of our planet and the universe.

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