

National Aeronautics and Space Administration

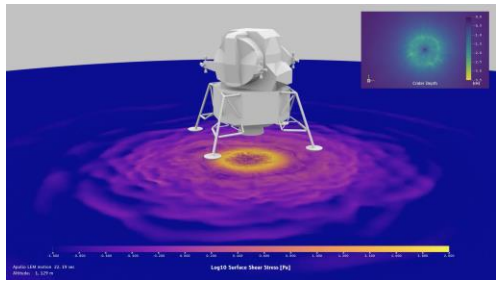
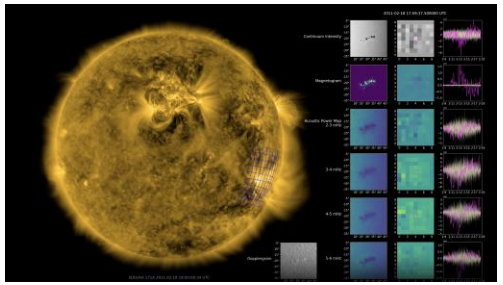
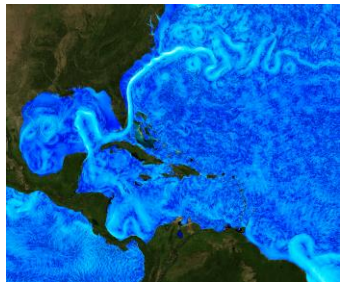
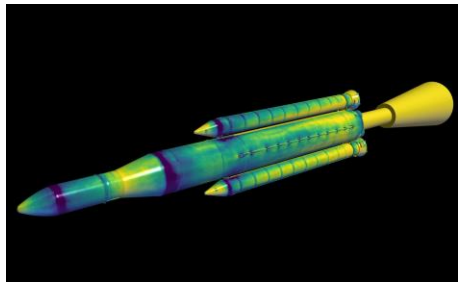
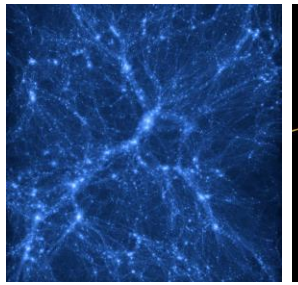
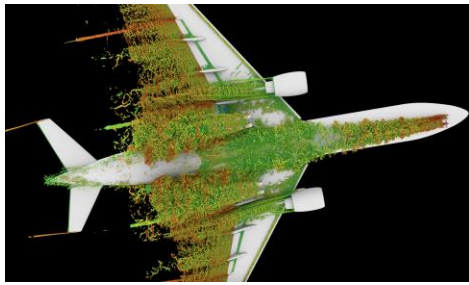
# Visualization & Data Analysis at the NAS

Nina McCurdy

NASA Advanced Supercomputing Division

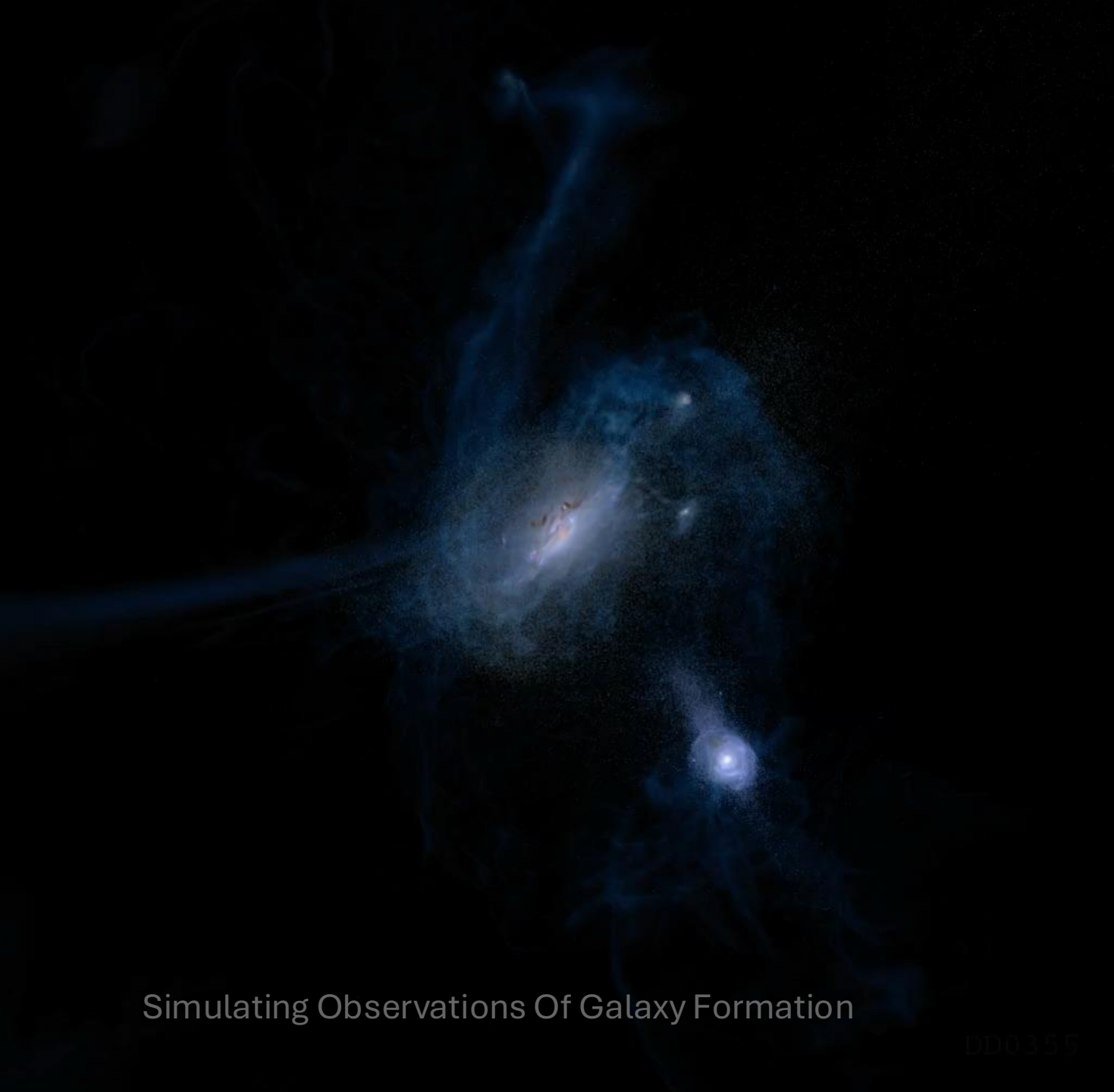
Ames Research Center

April 29, 2025

# Scientific Visualization and Data Analysis Services

- Collaborate closely with customers to develop custom scientific visualization and data analysis products:
  - Handle all modern computational grid systems and point data.
  - Specialize in handling large, complex, non-standard datasets.
  - Provide support extending beyond existing capabilities.
- Provide more in-depth/long-term support
  - Concurrent Visualization
    - Instrument code for direct access to data without disk I/O.
    - Create high-cadence visualizations (e.g., every timestep) with little or no overhead.
  - Scalable I/O
    - Implement parallel I/O strategies for large-scale codes.
  - Big Data Management and Workflows
    - Exploit software and hardware features for large data handling.
    - Develop file, filesystem, and archive strategies for scalable performance.
  - Custom Interactive Data Exploration Environments on the hyperwall




Simulating Observations Of Galaxy Formation

*Chris Henze/NASA Ames*

# Optimized pipelines

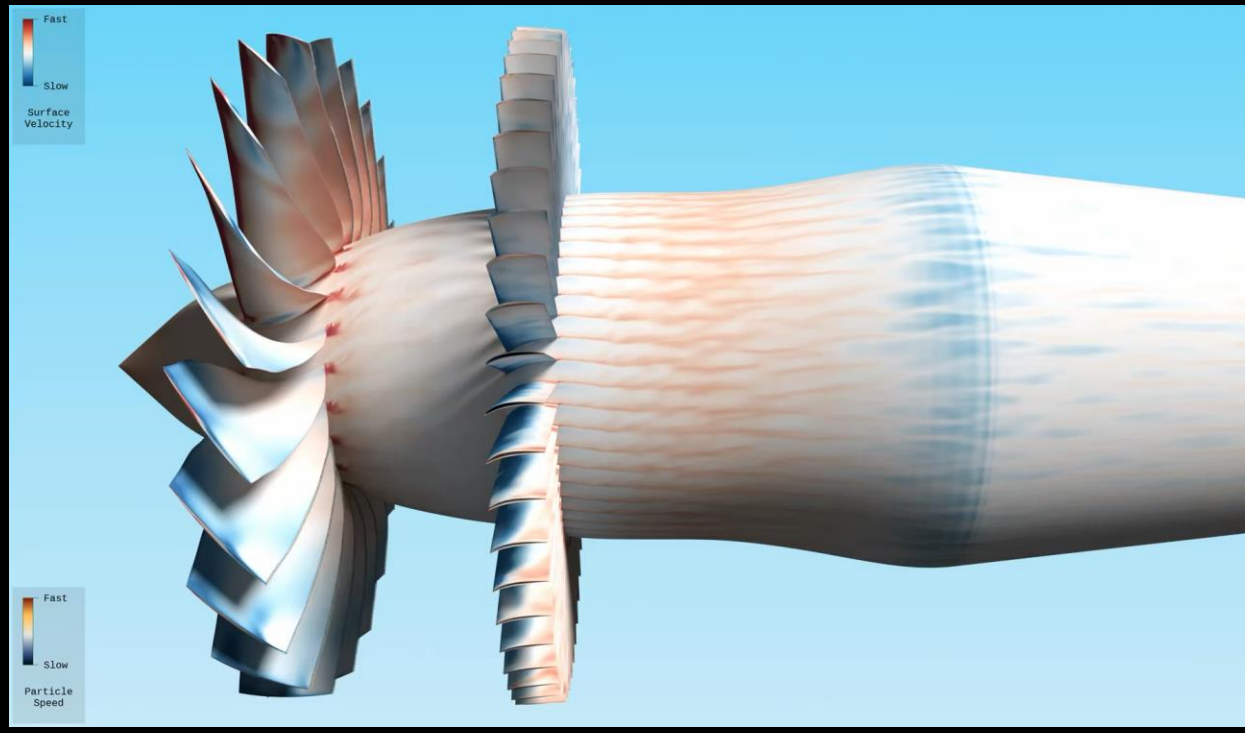
- Collaboration with STSci and Johns Hopkins University.
- Simulating the evolution of Milky Way-sized galaxies over the course of 13.7 billion years.
- Streamlined analysis pipeline resulting in a 500x speedup.
- Produced in-house HPC radiative transfer code, yielding additional speedup
  60+hrs/frame => 5 seconds/frame.

# Distributed Particle Advection

- Supports static and time-varying datasets on curvilinear and unstructured meshes.
- Sustained rates of over ten million particles/sec with over one billion particles in flight.

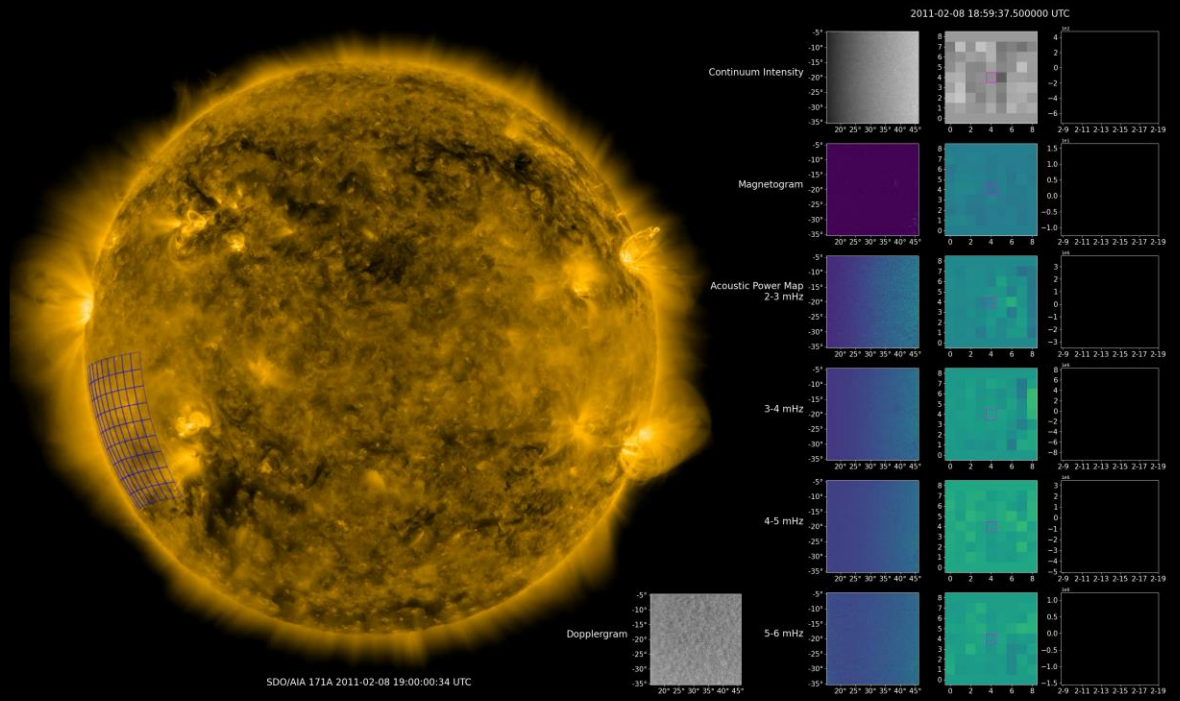


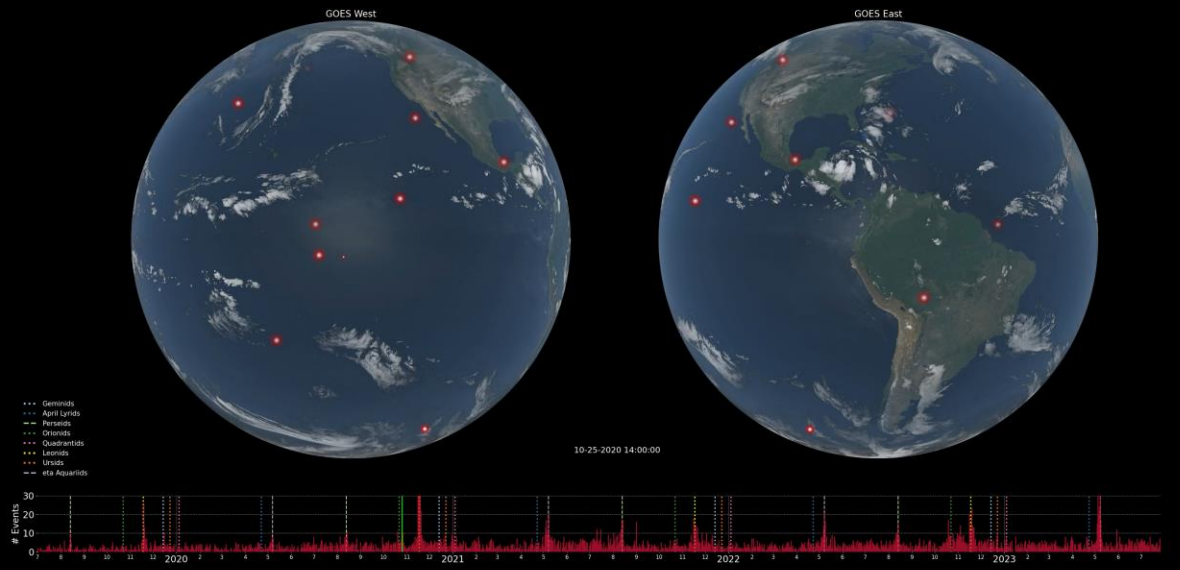
Iced wing CFD Simulations for Aerodynamic Performance Predictions



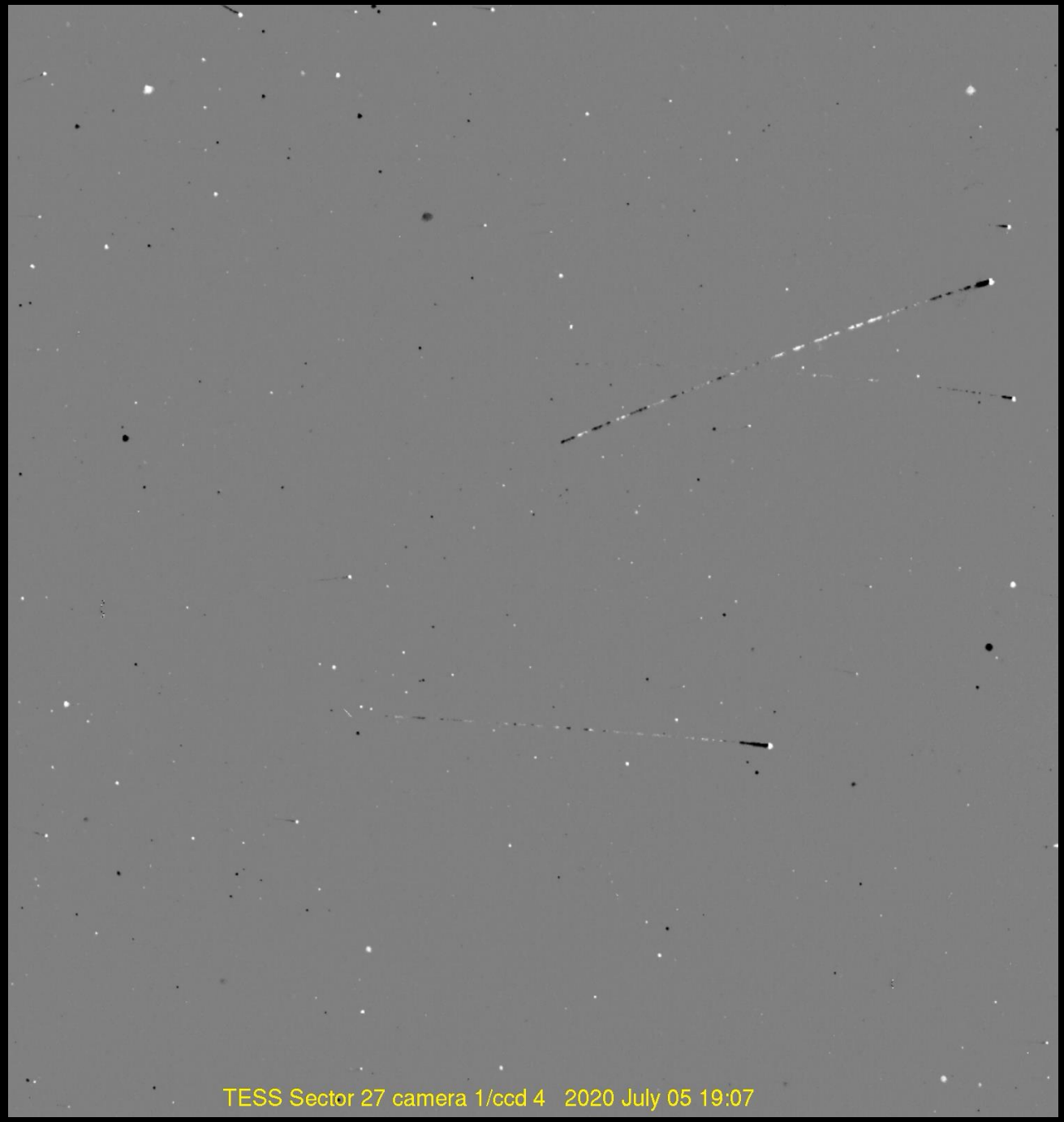

Modeling Aerodynamic and Acoustic Fields Around Turbofan Engines

*Timothy Sandstrom/NASA Ames*




Nina McCurdy/NASA Ames



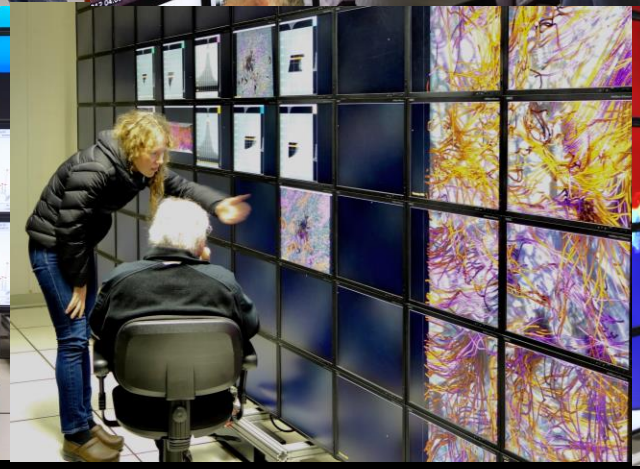
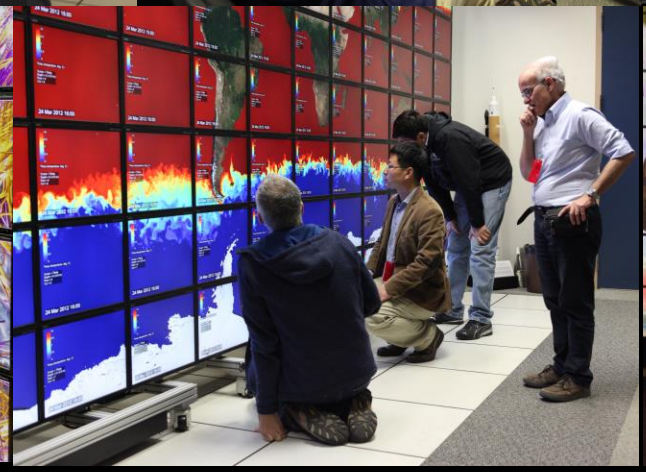
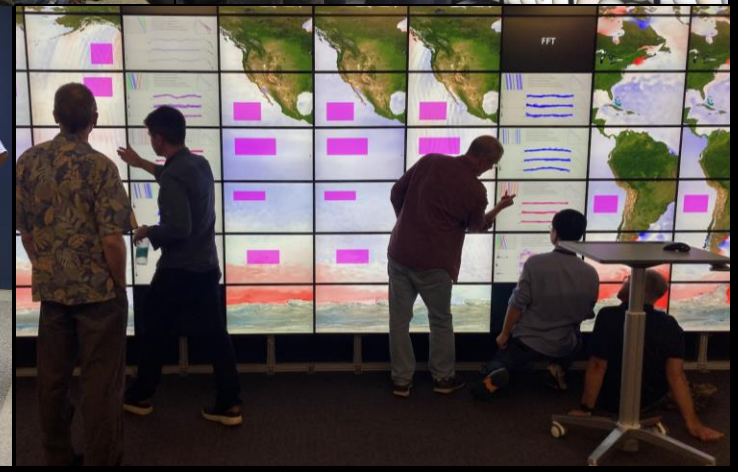

Chris Henze/NASA Ames

# Supporting Science & Engineering with the NAS hyperwall

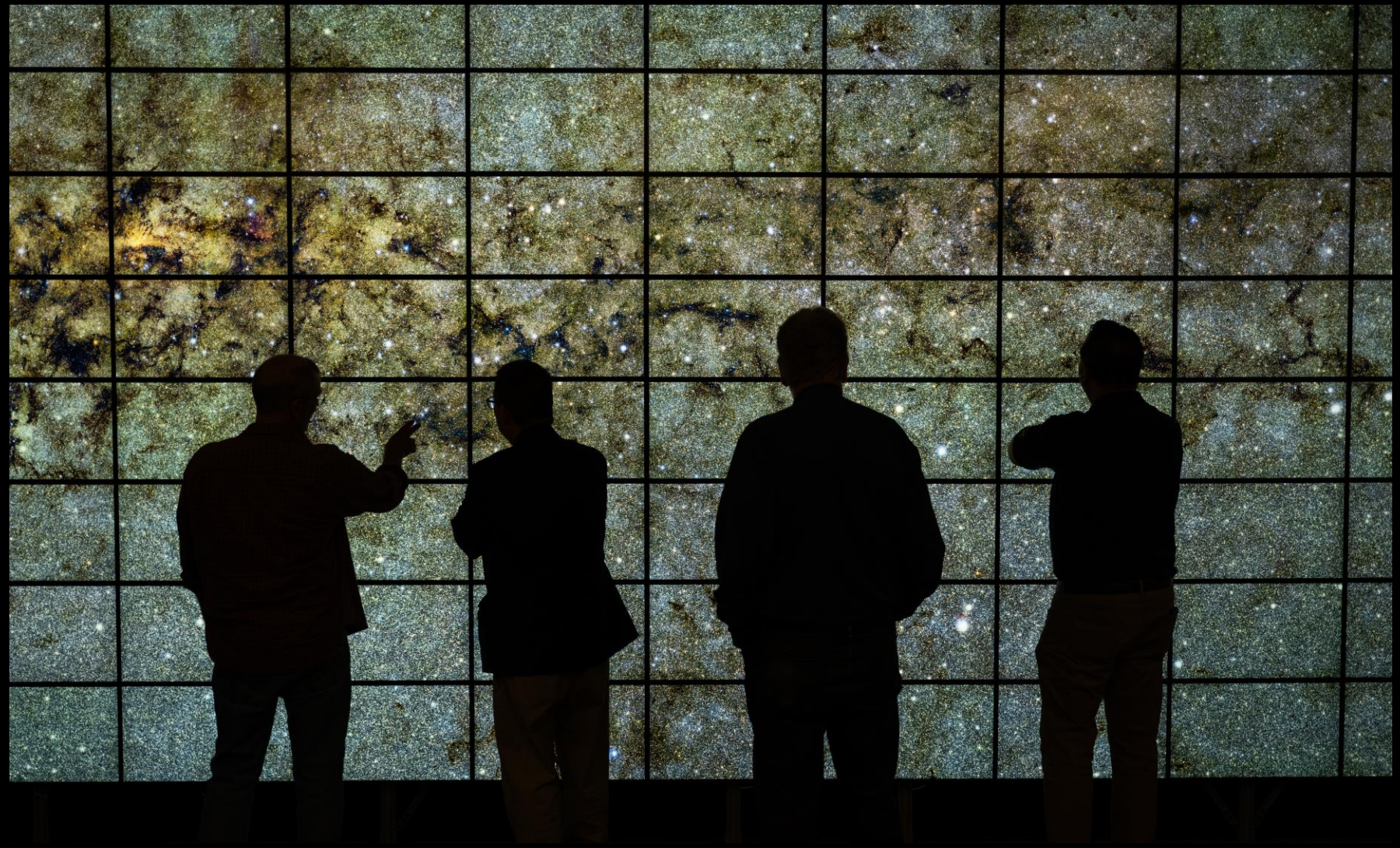






# Supporting Science & Engineering with the NAS hyperwall



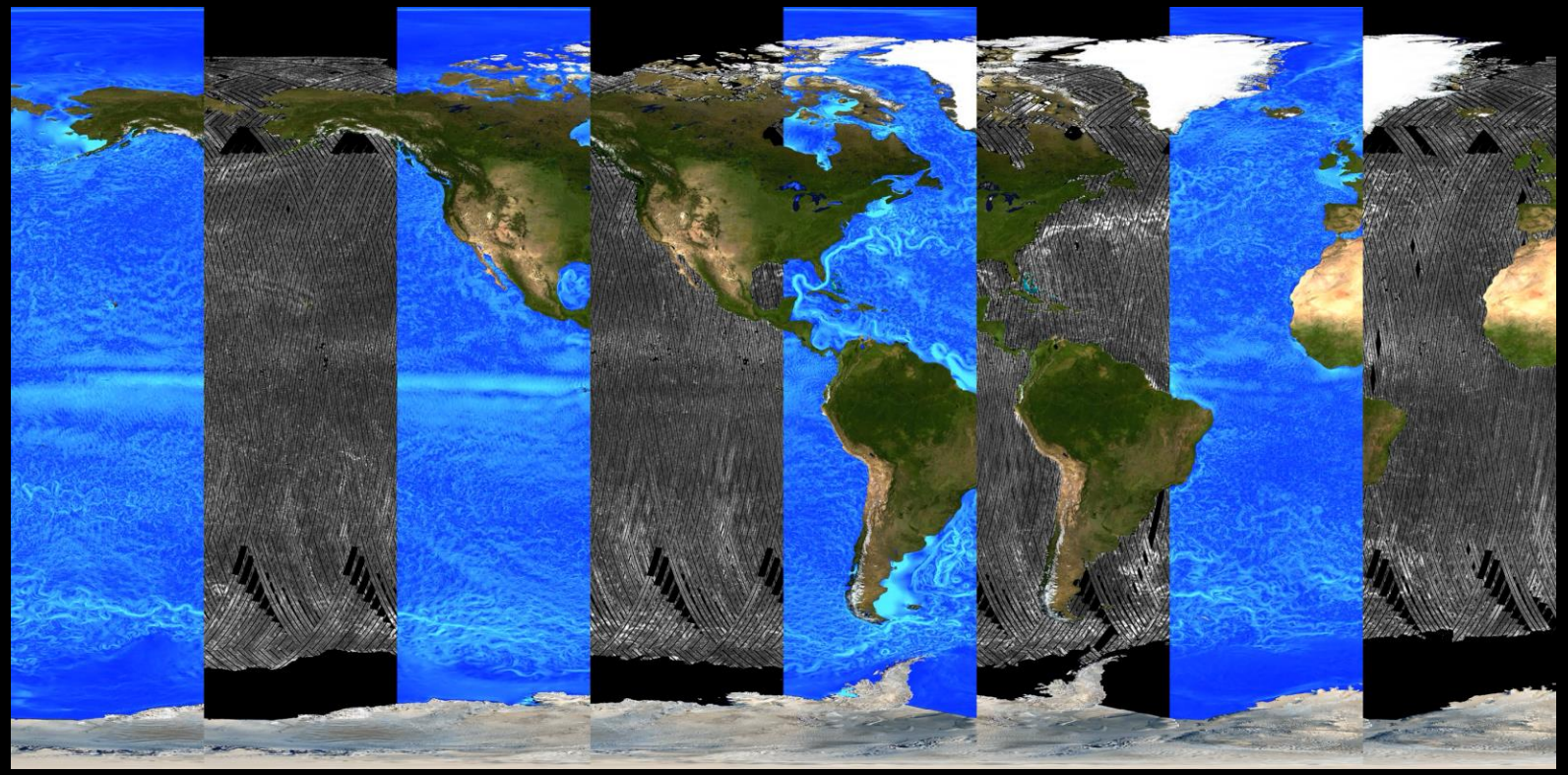
- 128 CPU nodes, each with 2 24-core Intel Xeon Platinum 8268 processors.
- Total cores: 6,144 processor cores.
- 128 NVIDIA Quatro RTX 6000 GPUs.
- 1.8 PB BeeGFS filesystem built on the hyperwall SSDs.
- Interconnects: woven into the NAS infrastructure via InfiniBand.

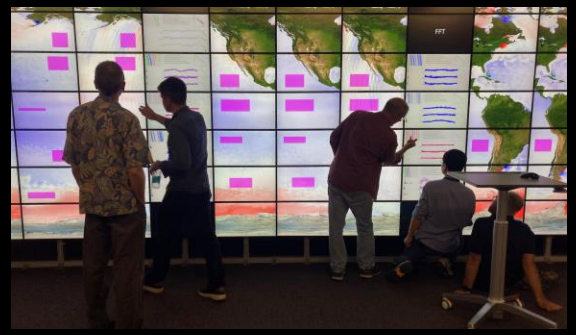
8 x 16  27” 4K monitors
≈ 17K x 61K pixels
≈ 1 billion pixels!!

# Supporting Science & Engineering with the NAS hyperwall

## Enabling Comparative Analysis of Model vs. Observational Datasets.

- Ongoing collaboration with key SWOT (Surface Water and Ocean Topography Mission) and ECCO (Estimating Climate and Circulation of the Ocean) scientists to develop hyperwall utilities that support rapid analysis and comparative analysis of SWOT+ECCO data.
- Enabling scientists to interactively complete research tasks that would otherwise take months, and allowing them to pursue new lines of scientific inquiry.



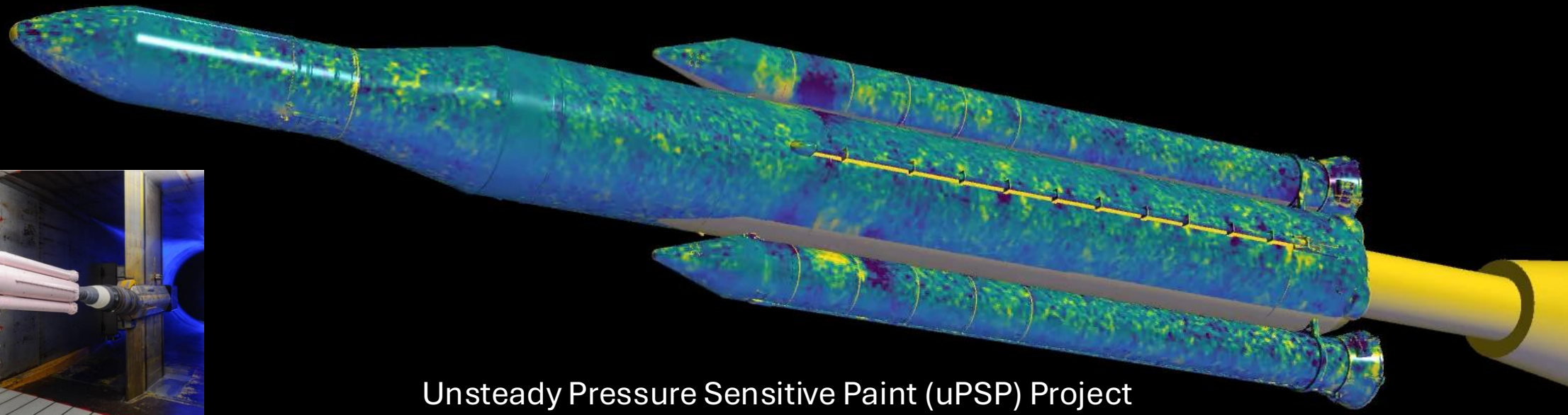


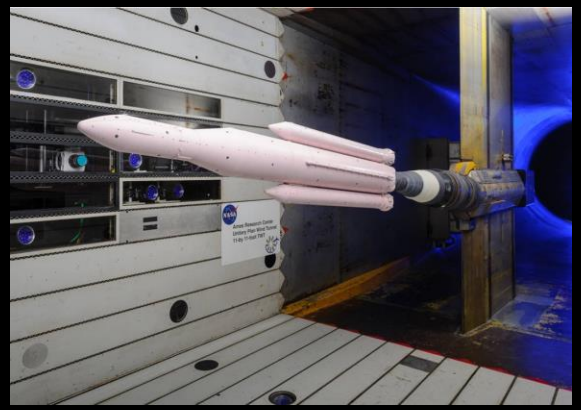




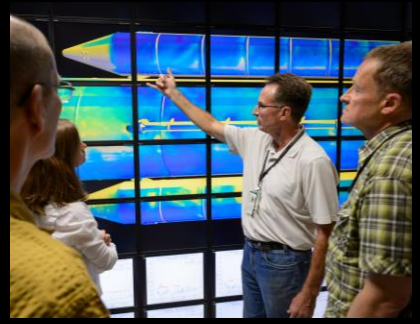
# Supporting Science & Engineering with the NAS hyperwall

## Enabling Near-Realtime Analysis of Wind Tunnel Test Data with Red Rover.





*Credits: NASA Ames / Dominic Hart*





Unsteady Pressure Sensitive Paint (uPSP) Project

### 2019

- Live uPSP data sent from SLS transonic buffet test in Unitary Plan Wind Tunnel (UPWT) to HECC resources for near-realtime processing and display.
- Reduced processing time from 1 day per test point to 1 minute.

### 2025

- Second uPSP SLS UPWT test in April
- UPWT + NAS collaboration to develop custom, comprehensive, hyperwall analysis utilities.
- Currently being employed to explore, analyze, and interrogate the latest datasets.

# Supporting Science & Engineering with the NAS hyperwall

## Extending our support to other experimental ARC Facilities

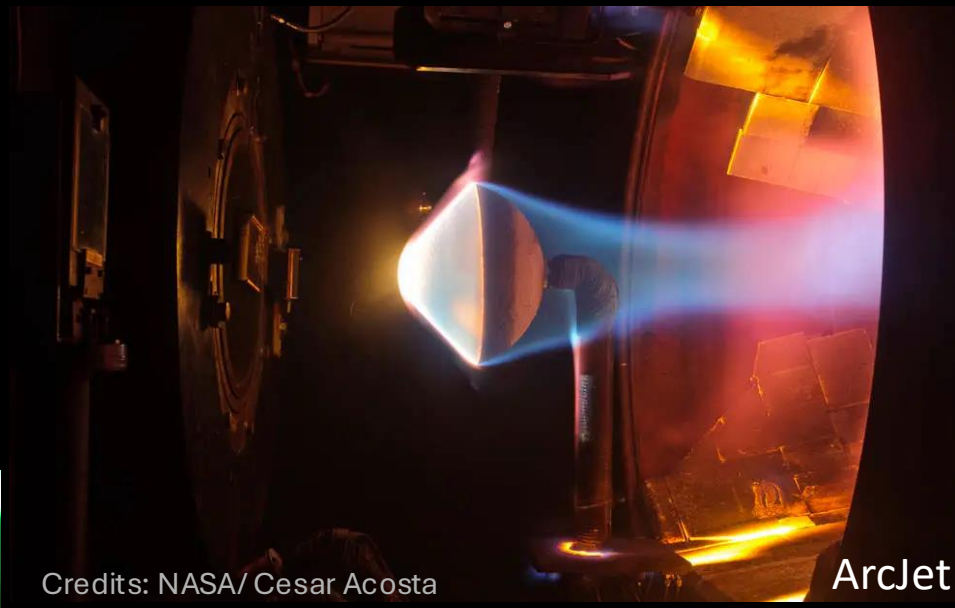
- National Full-Scale Aerodynamics Complex (NFAC).
- NASA Ames Fluid Mechanics Laboratory (FML).
- NASA Ames Coronagraph Experiment Laboratory (ACE).
- NASA ArcJet-Complex.



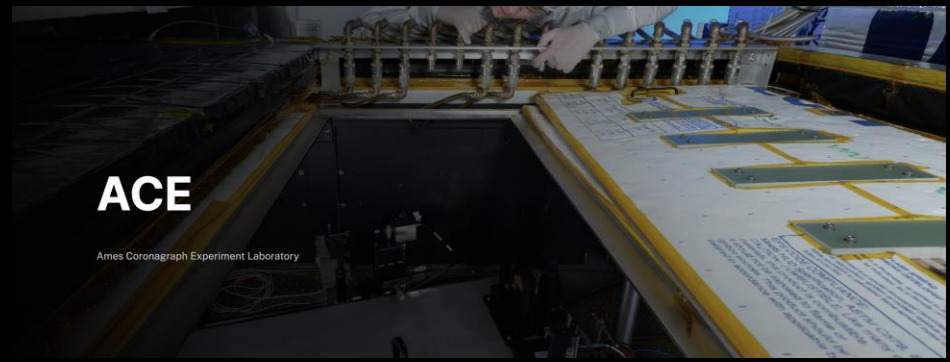

Credits: NASA/Dominic Hart




Credits: NASA/ Eric James




Credits: NASA/ Cesar Acosta



# Thank you! Questions?

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