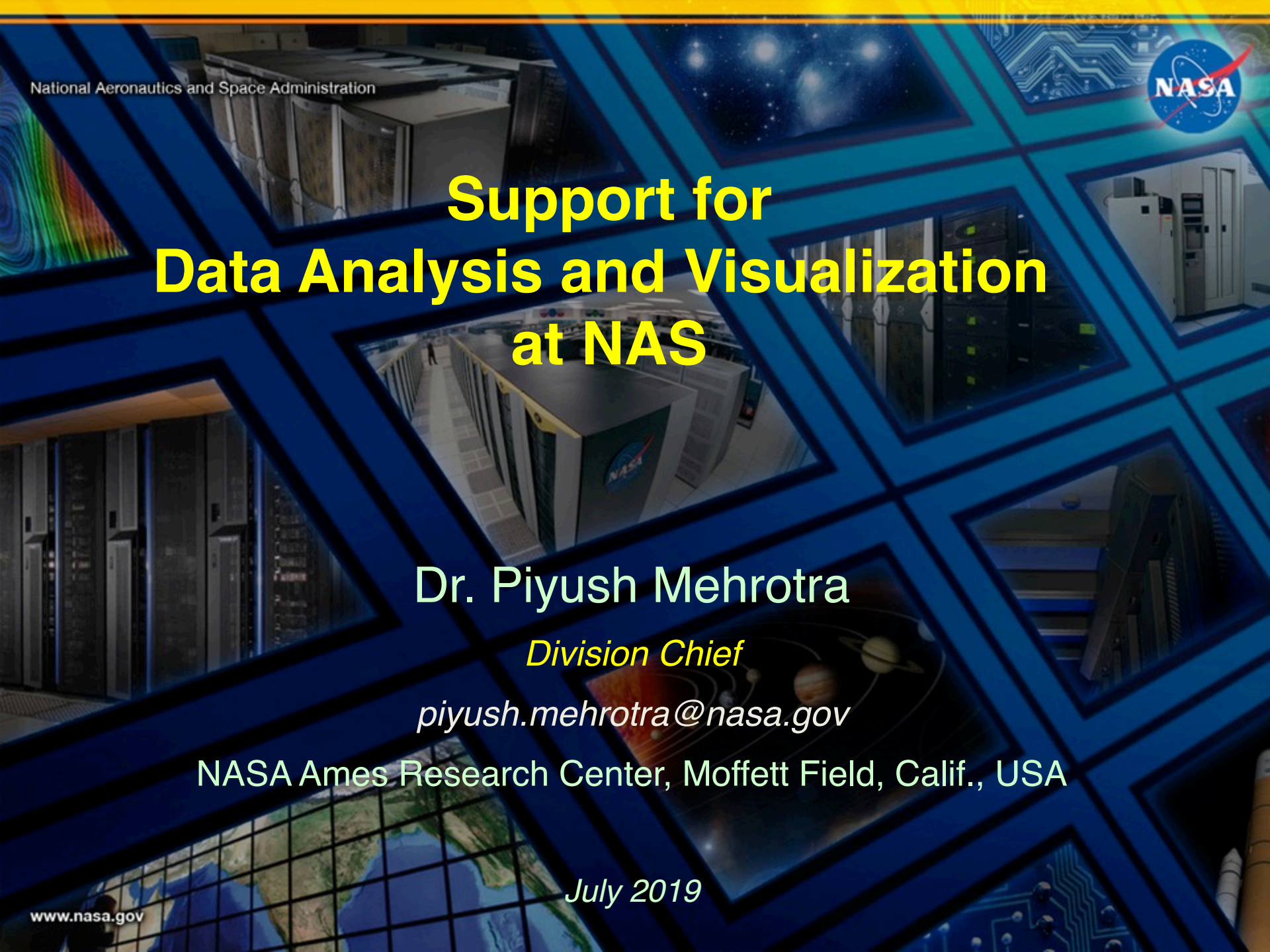

Support for Data Analysis and Visualization at NAS

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Division Chief

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NASA Ames Research Center, Moffett Field, Calif., USA

July 2019

Advanced Computing @ NAS

Cloud Computing

Accelerator Technologies

Collaborative Environments

Data Analytics, Visualization & Machine Learning

Disruptive Technologies (Quantum, ...)

Supercomputing @ NAS

NASA's Premier Supercomputer Center

Charter: to support supercomputing requirements of all NASA Mission Directorates

Over 500 science & engineering projects with more than 1,550 users

Storage:

- Global storage (Lustre based): ~40 PB
- Archival storage capacity: 1 EB

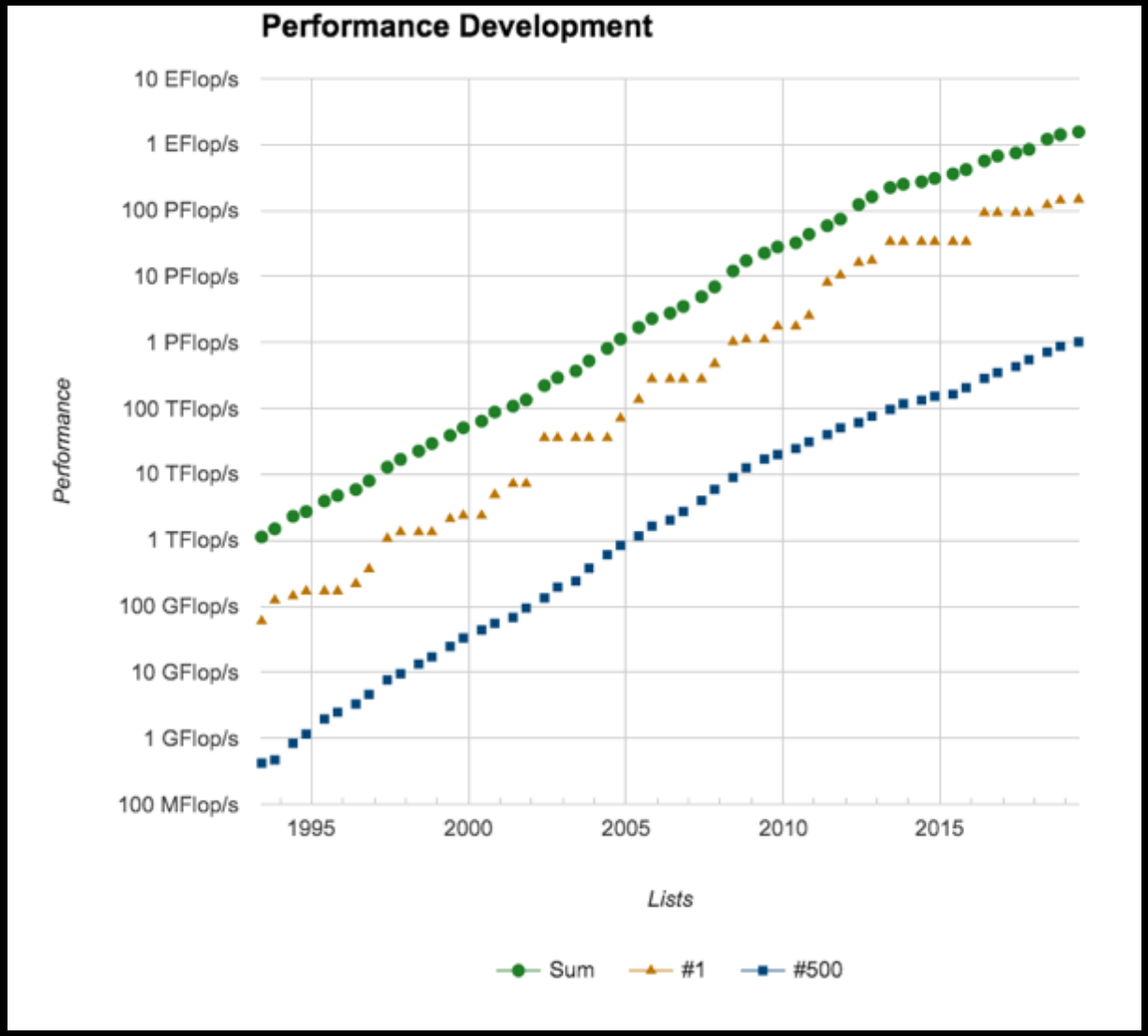
Network connectivity: 10GB/s

Pleiades: *7.25*
multi-generati
#33 on TOP500

Electra: *8.32 PF peak*
2880 nodes; container-bas
#37 on TOP500 (#15 in US

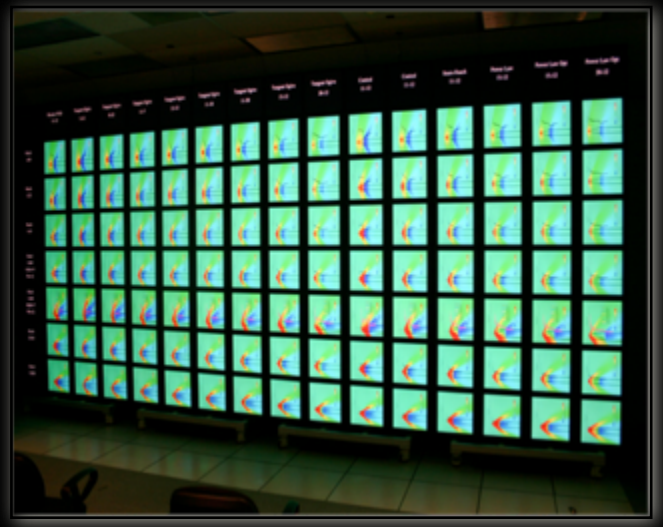
Modular Supercomputing Facility:
Artist's rendering of future facility

TOP500 List of Supercomputers

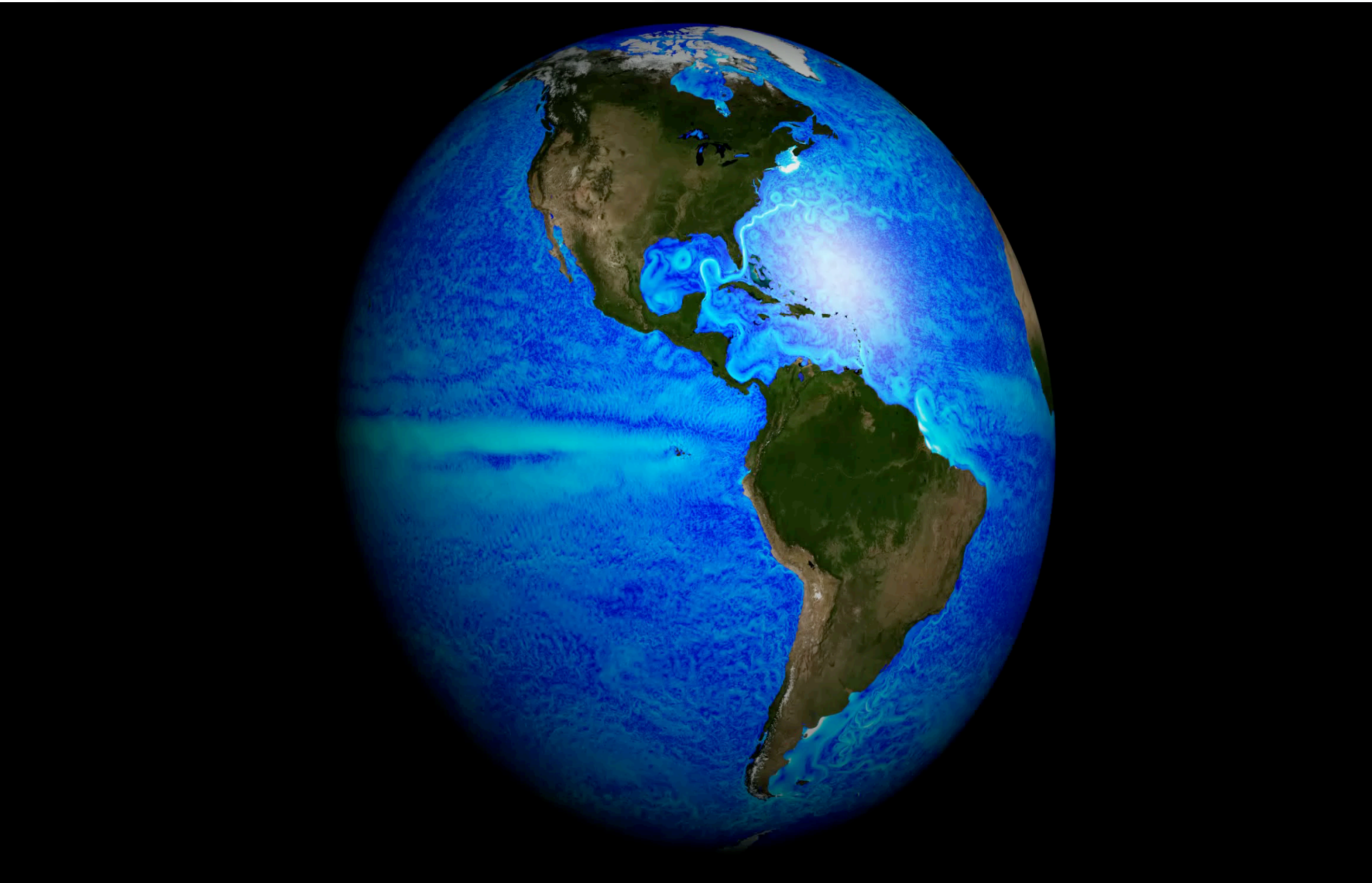


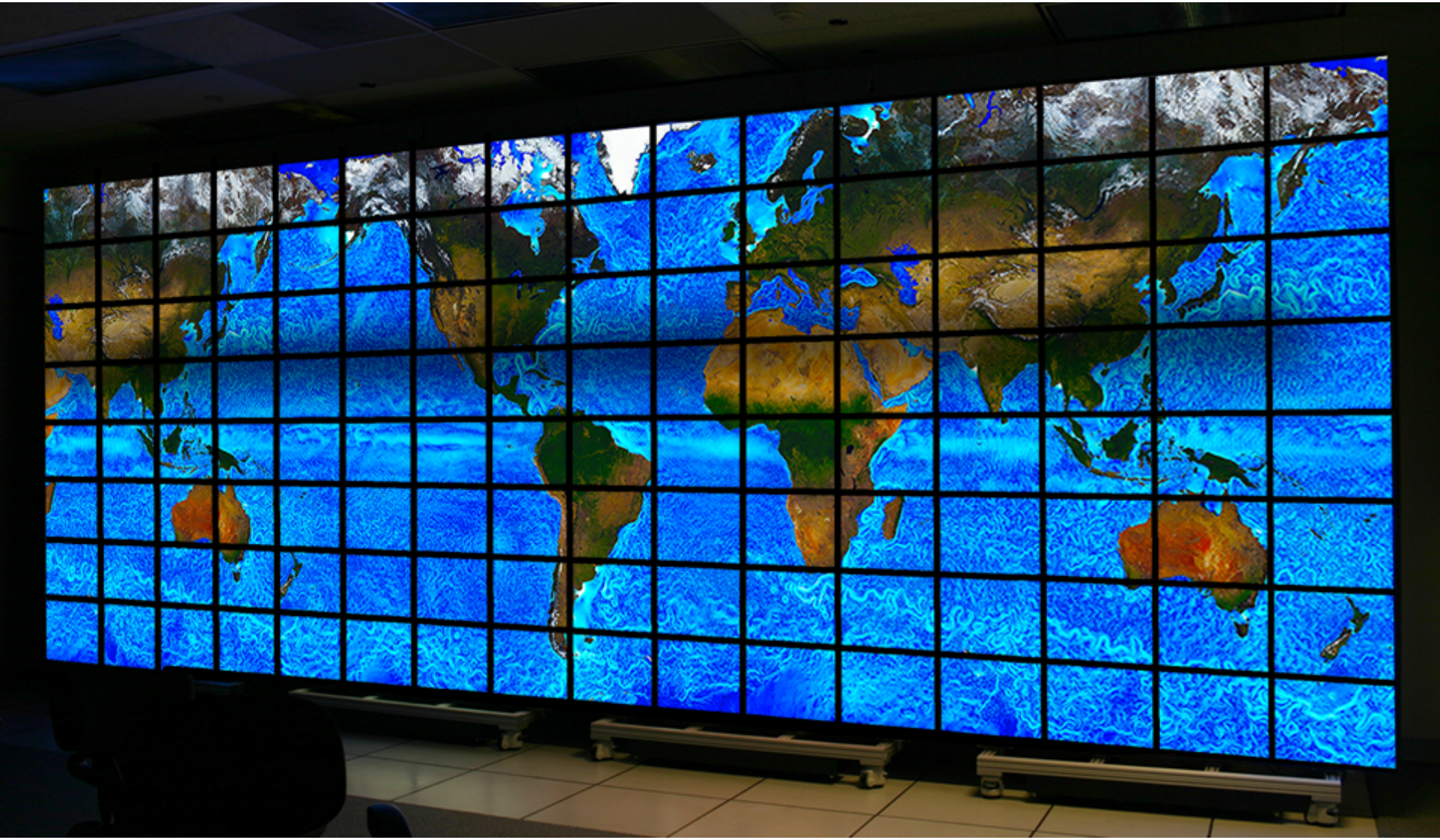
Advanced Visualization

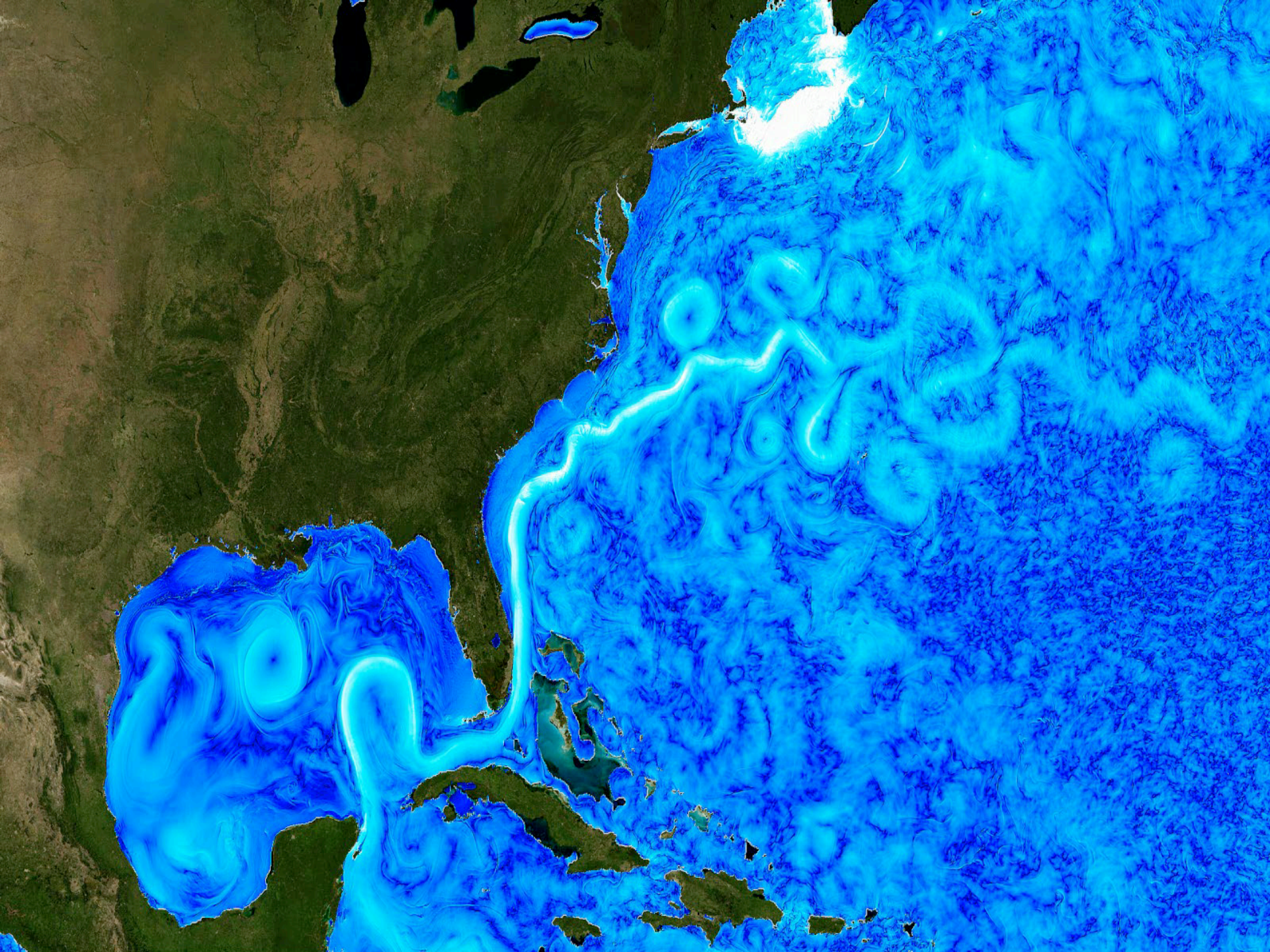
- ***Supercomputing-scale visualization system*** to handle massive size of simulation results and increasing complexity of data analysis
  - 8x16 LCD display (23 feet x 10 feet)
  - 245 million pixels
- ***Two primary modes***
  - Single large high definition image
  - Sets of related images (e.g. parameter study)
- ***High-bandwidth to HEC resources***
  - *Traditional Post-Processing*: Direct read/write access to Pleiades file systems eliminates need for copying large datasets
  - *Concurrent Visualization*: Runtime data streaming allows visualization of every simulation time step - ultimate insight into simulation code without increase in traditional disk I/O

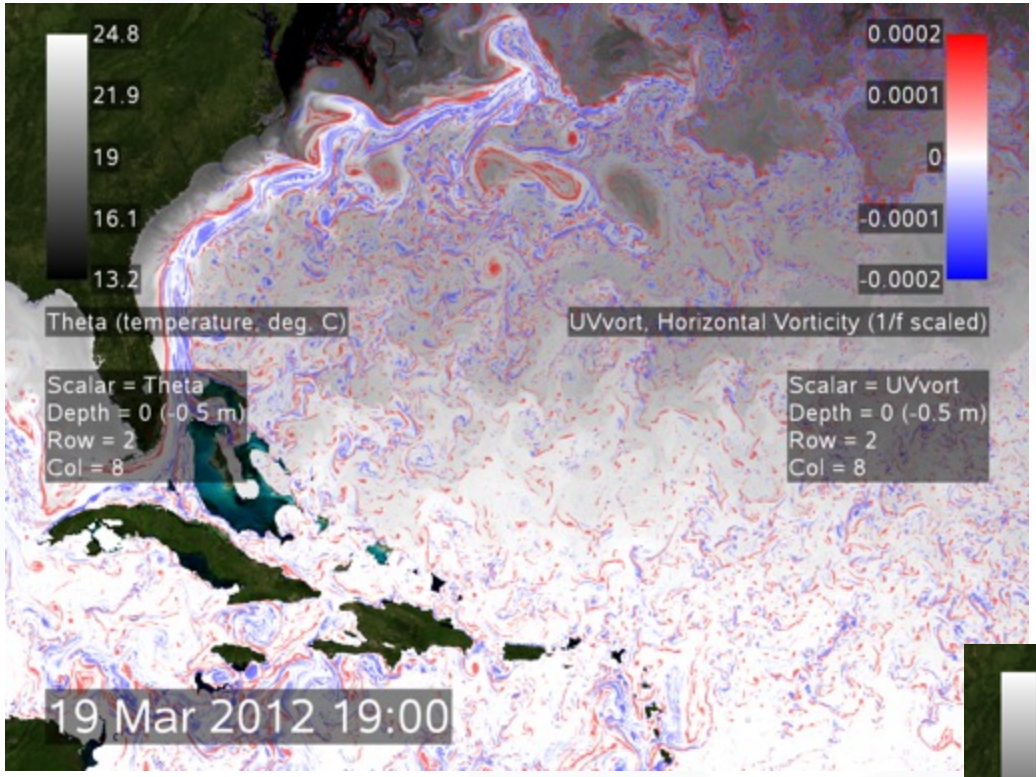


Global Ocean Current Modeling



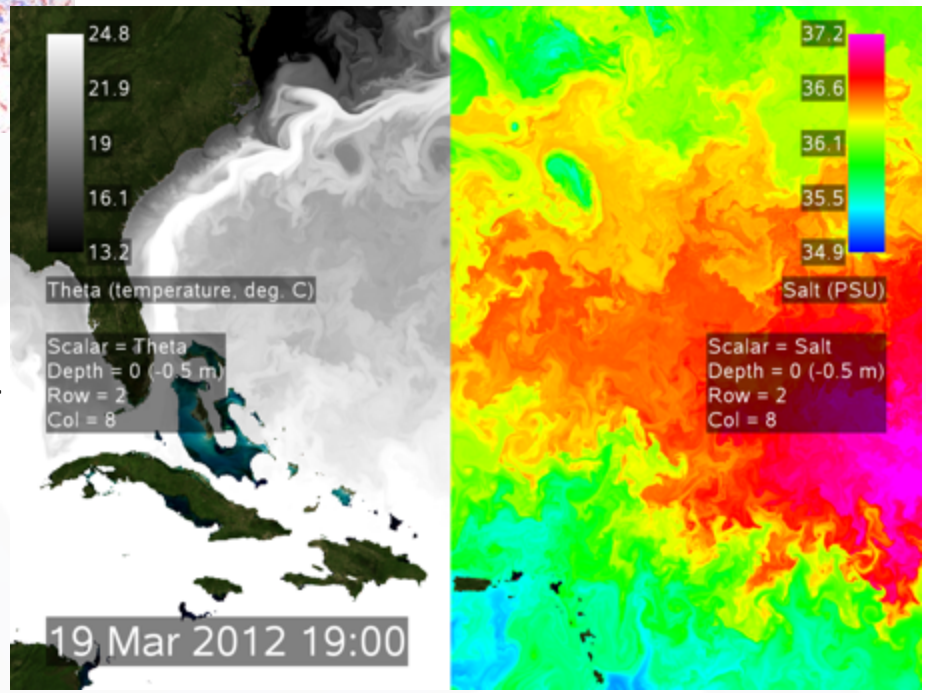


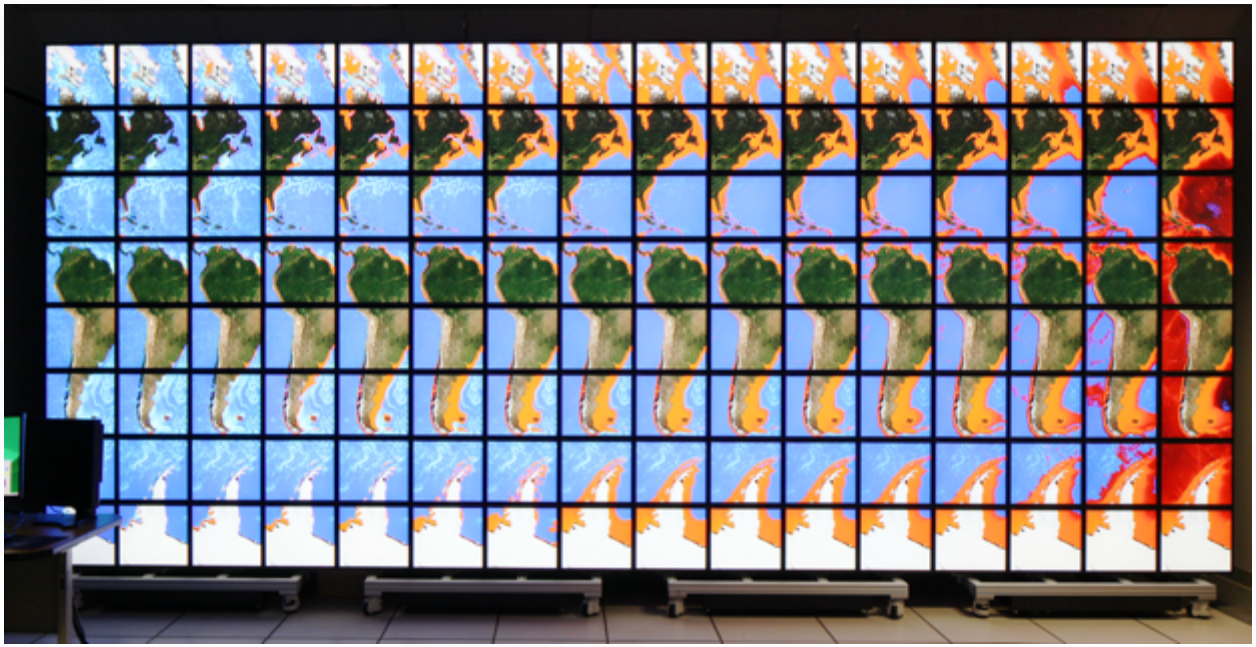




Overlay comparison of two different scalar variables - horizontal vorticity (curl of the horizontal velocity) and temperature.

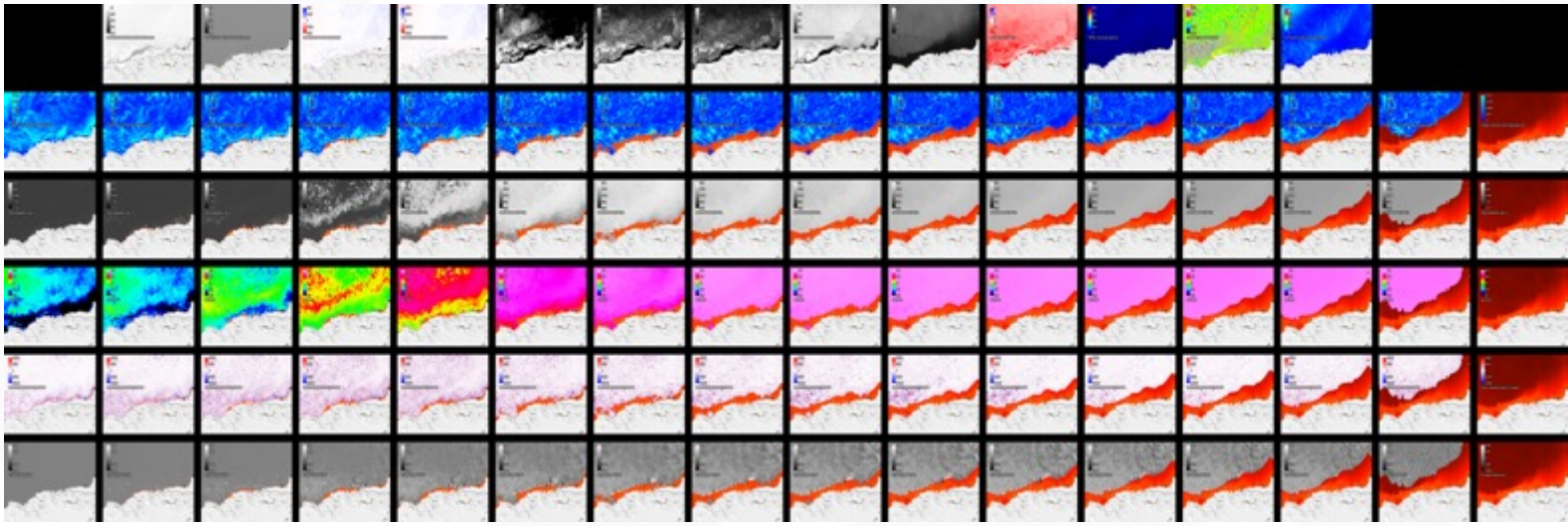
Side-by-side comparison of two different scalar variables (left - temperature, right - salt concentration) on a single screen; the cut can be moved interactively



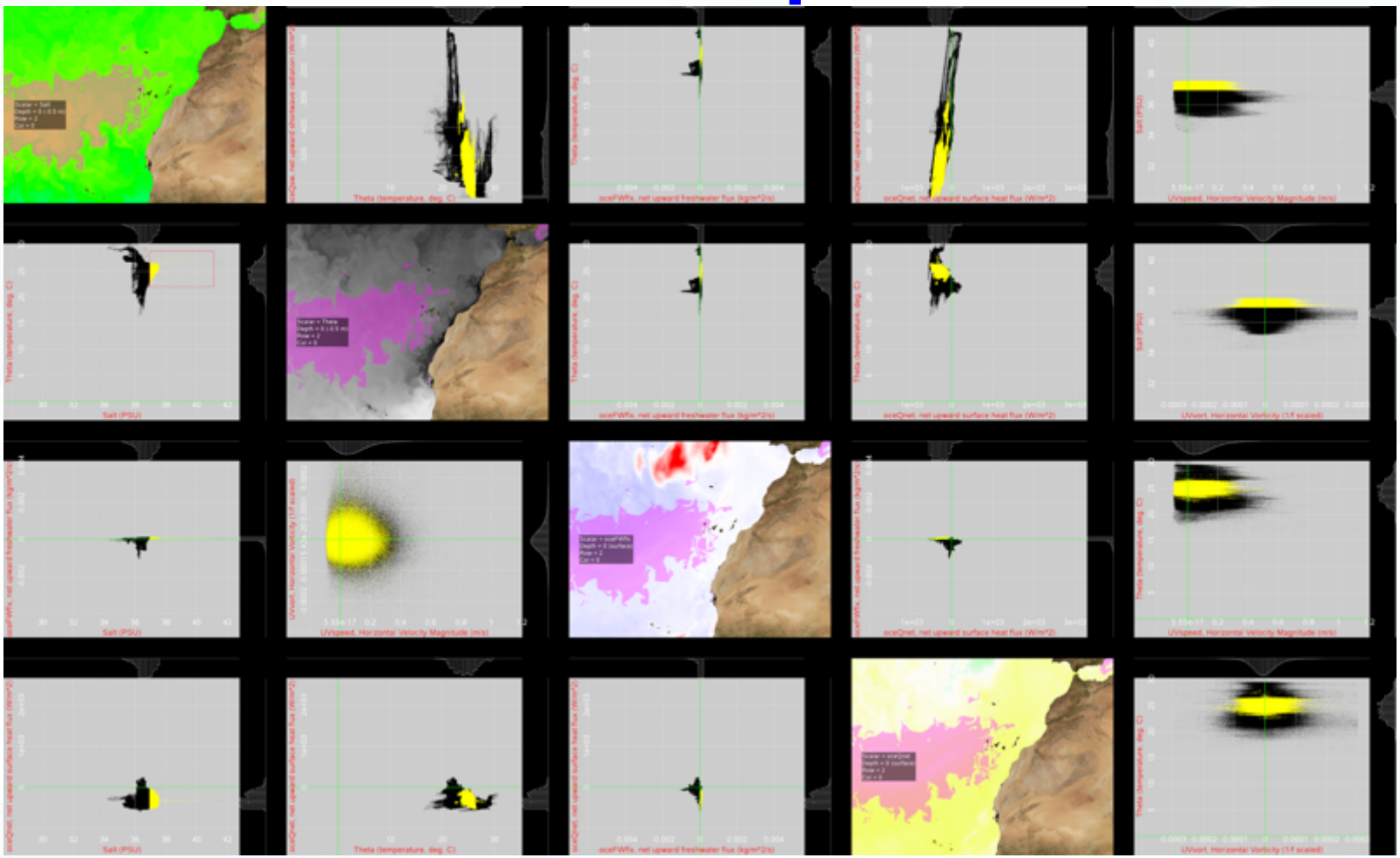


Depth analysis using a view showing multiple depths of a single north-south section of the globe - horizontal velocity magnitude around the Americas, with depth increasing to the right. The orange is the ocean floor

Finding correlations made easy by showing all data for a given region; depth increases left to right for the 3D fields

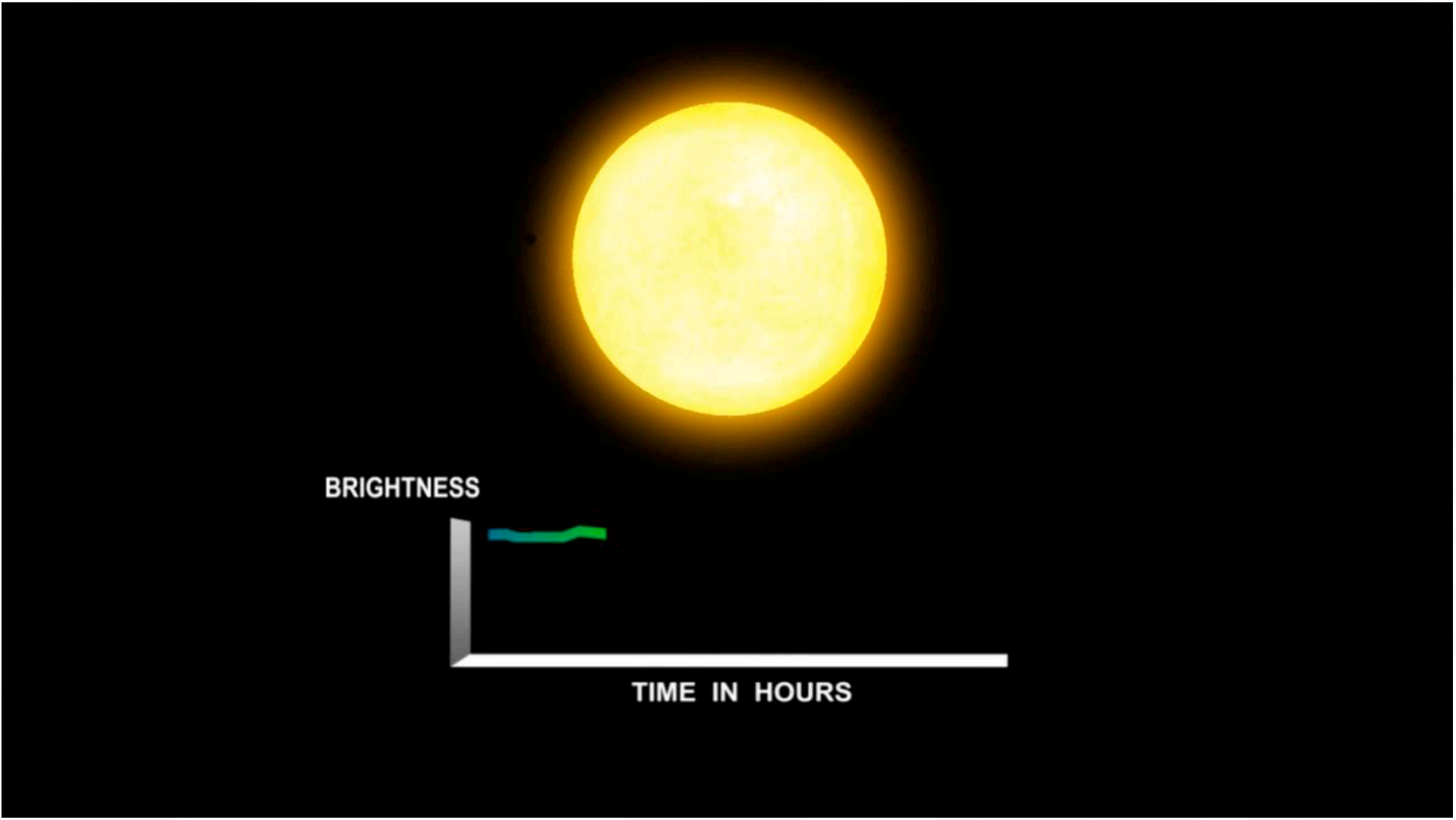


Scatter plot

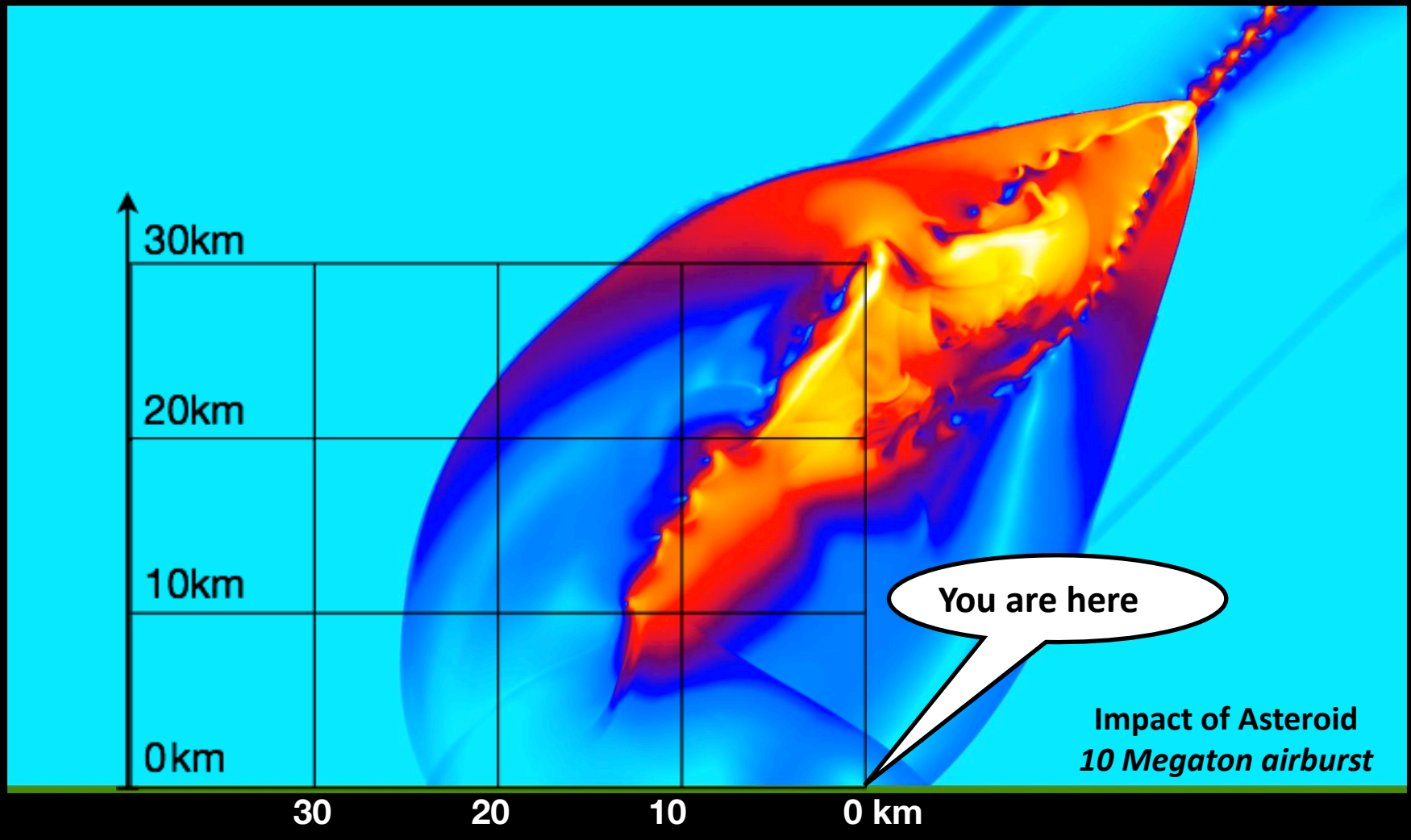


Quantitiative analysis using linked scatterplots where selections made in one show up in the others - data from the eastern Atlantic off the coast of North Africa; yellow indicates selected points

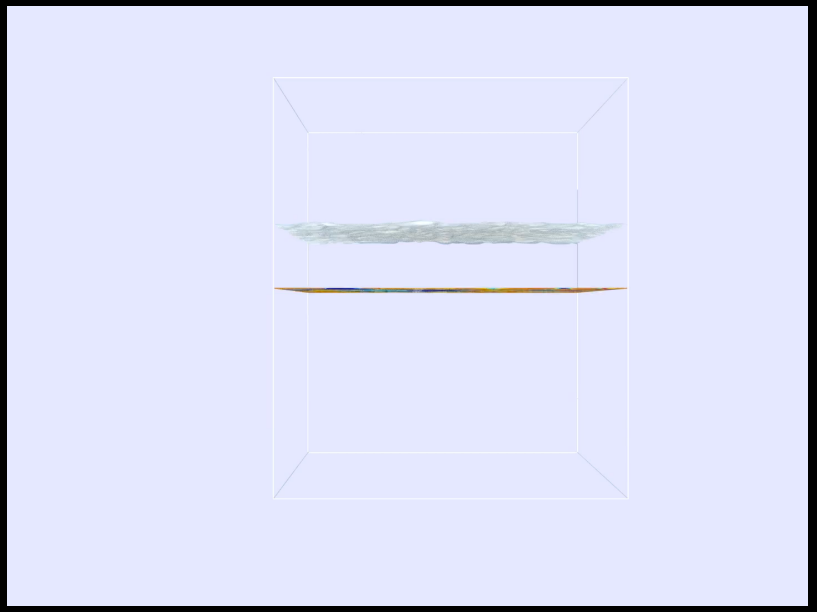
Search for Exoplanets: Kepler



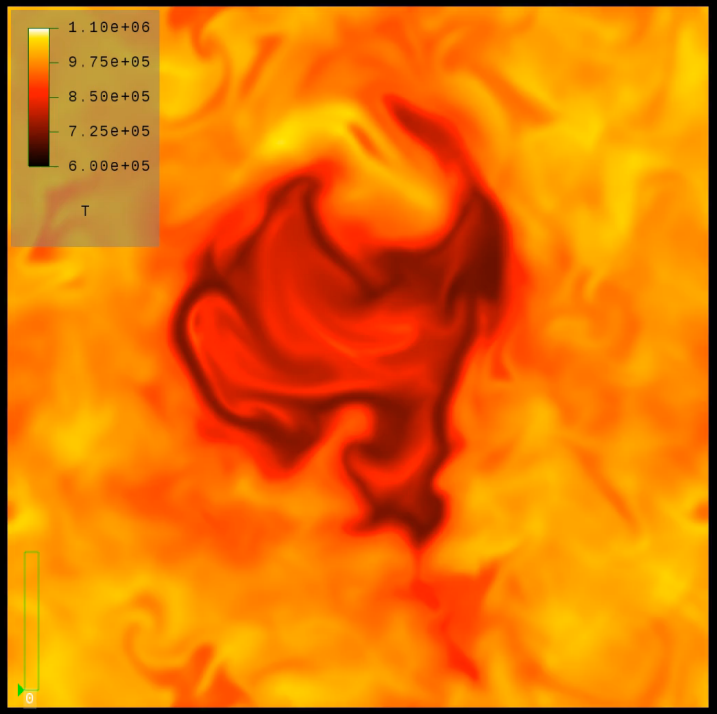
Kepler data


30km
20km
10km
0km
30
20
10
0 km
You are here
Impact of Asteroid
10 Megaton airburst

Space Weather Forecast

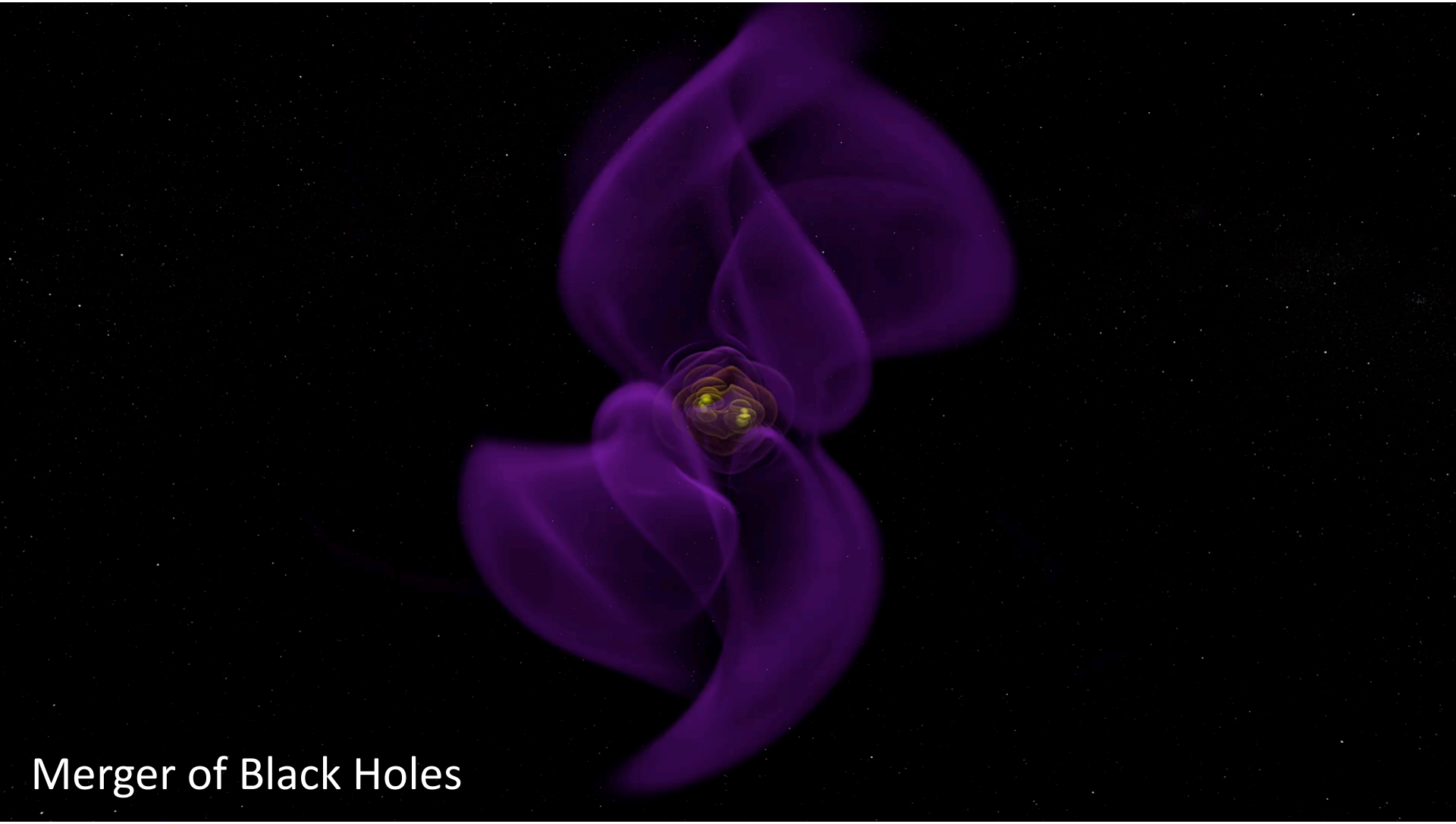


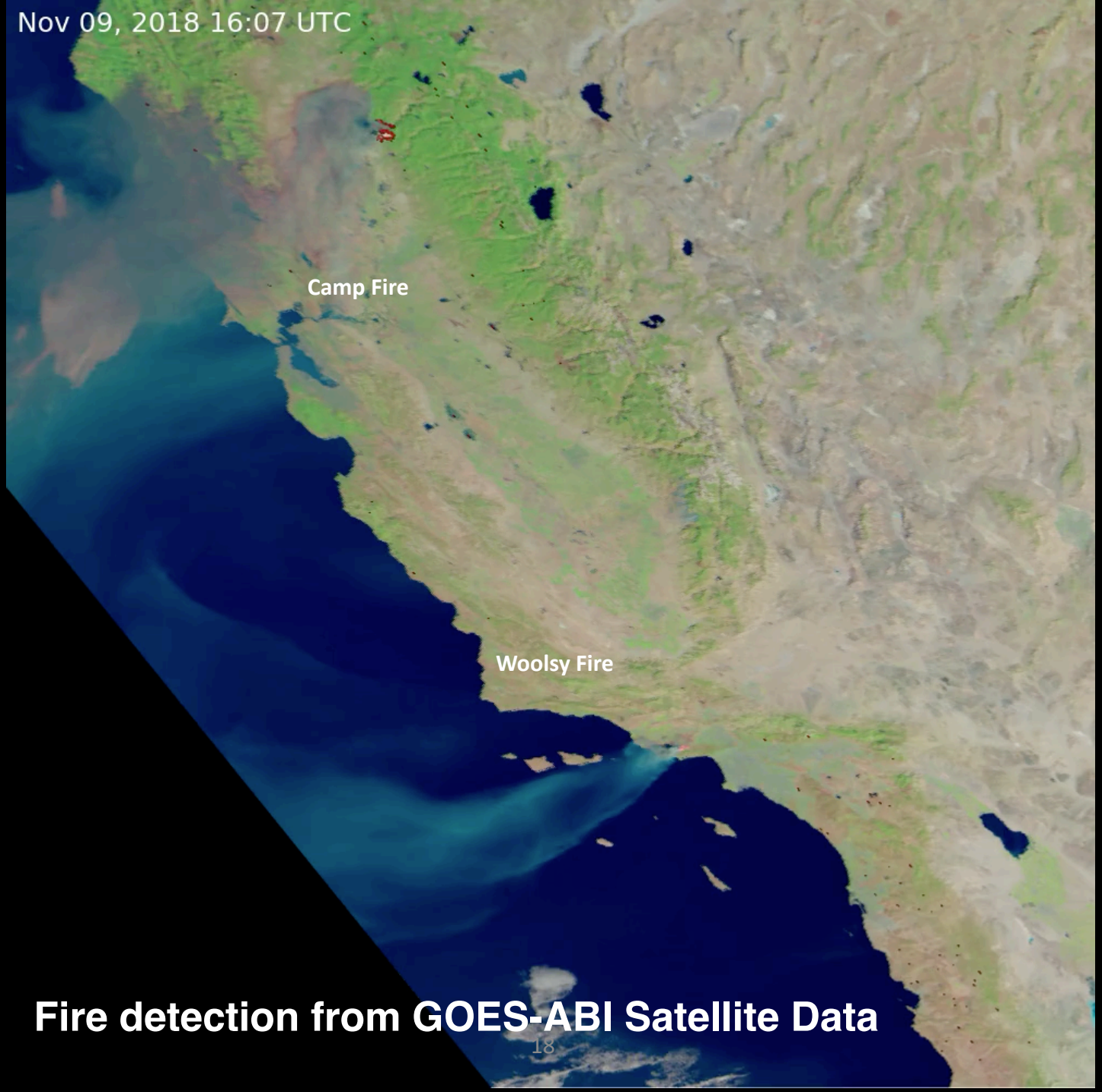
Three-dimensional MHD simulation results reveal spontaneous formation of funnel-like magnetized structures in the corona.



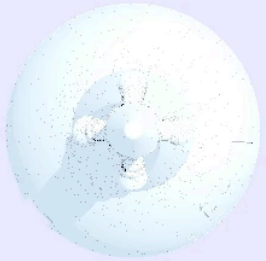
Temperature distribution 10,000 km above the solar surface

Artist's rendition of a solar flare


Merger of Black Holes



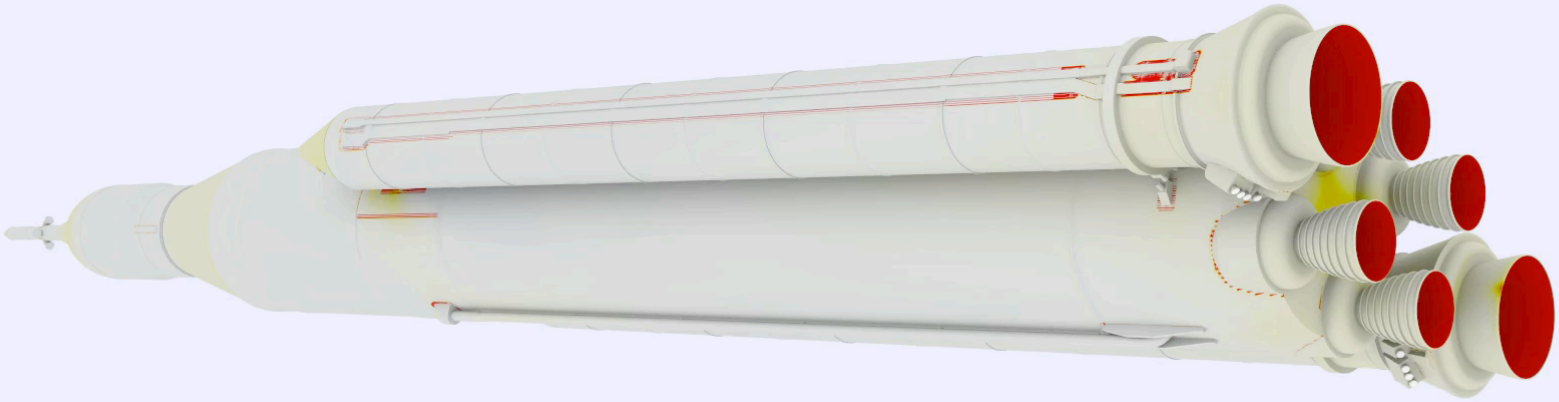
Fire detection from GOES-ABI Satellite Data



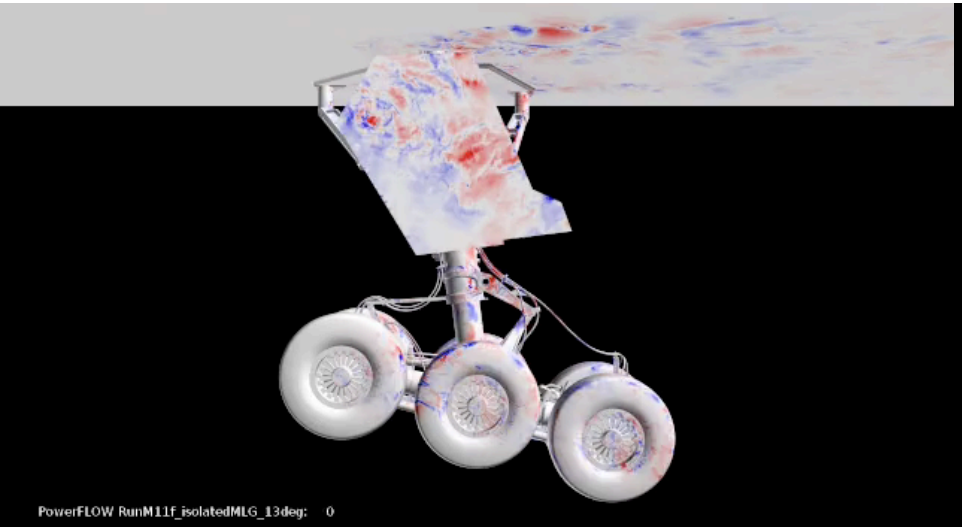
Launch Abort Vehicle Simulation

Modeling the Launch Environment

Space Launch System – Stage Separation



0 ' 0 "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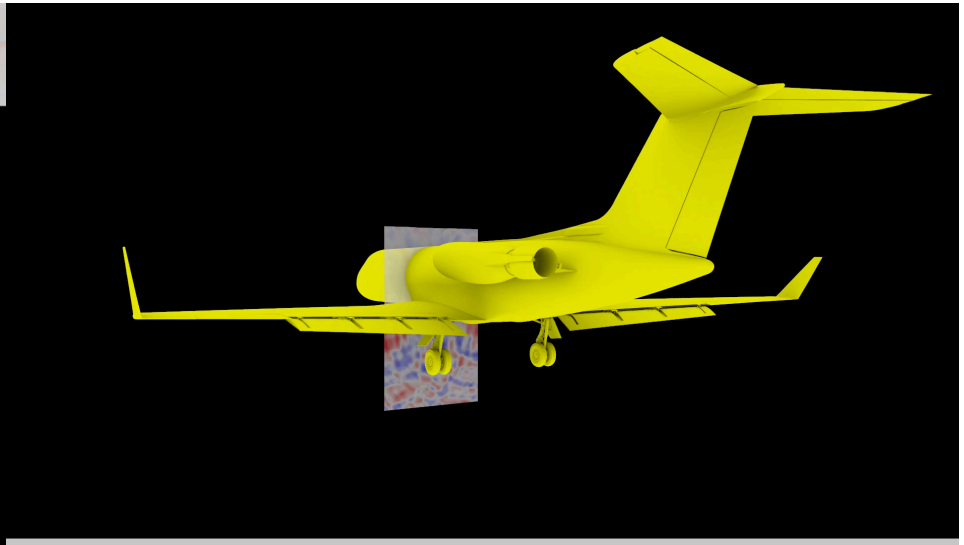

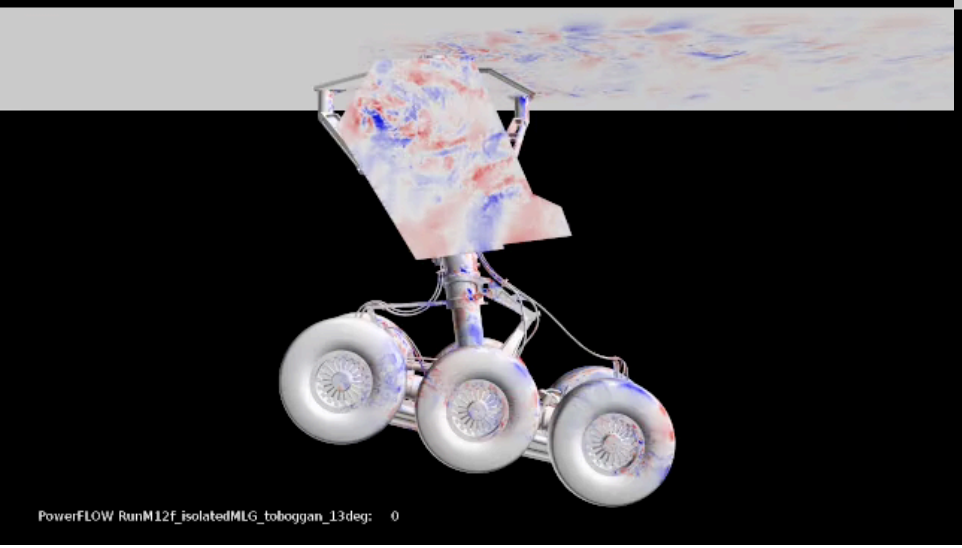
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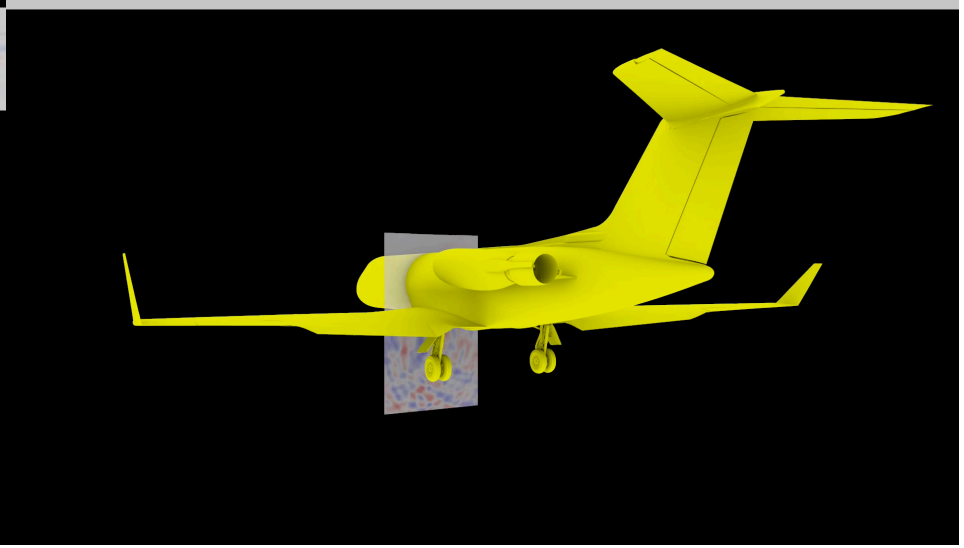
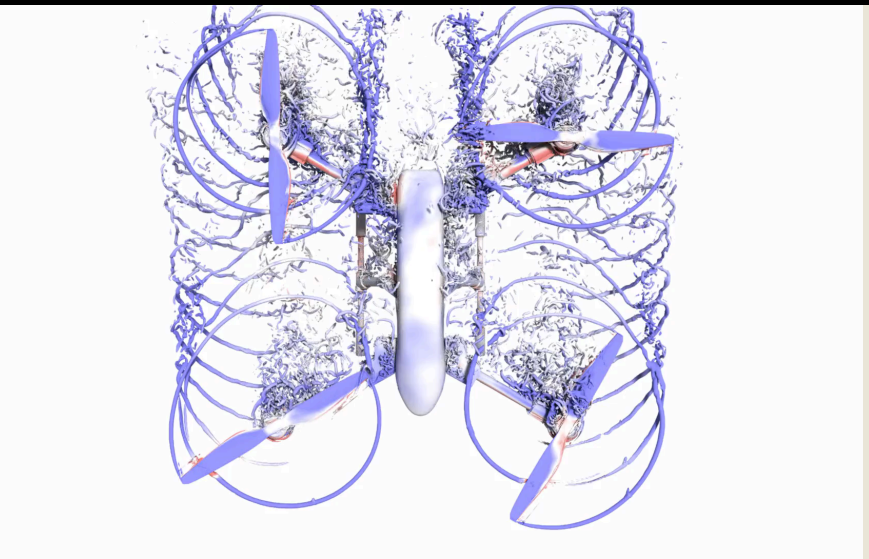
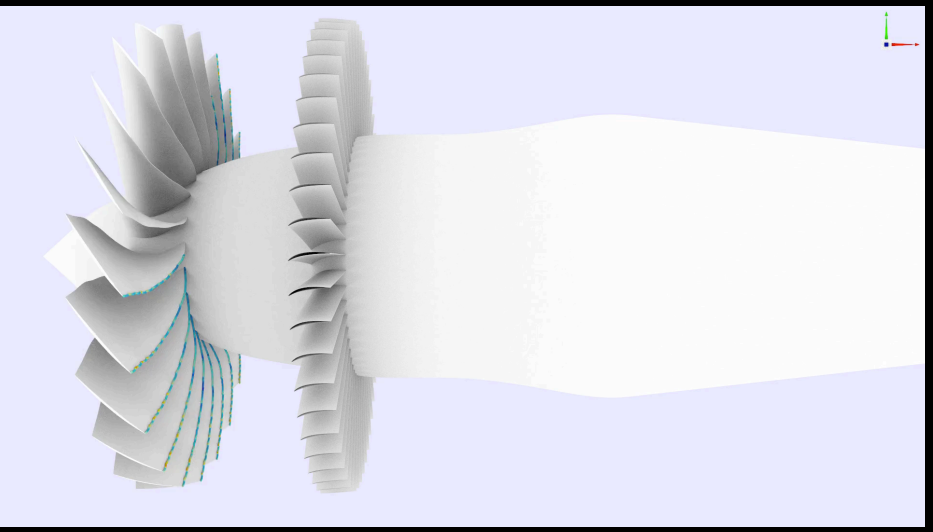
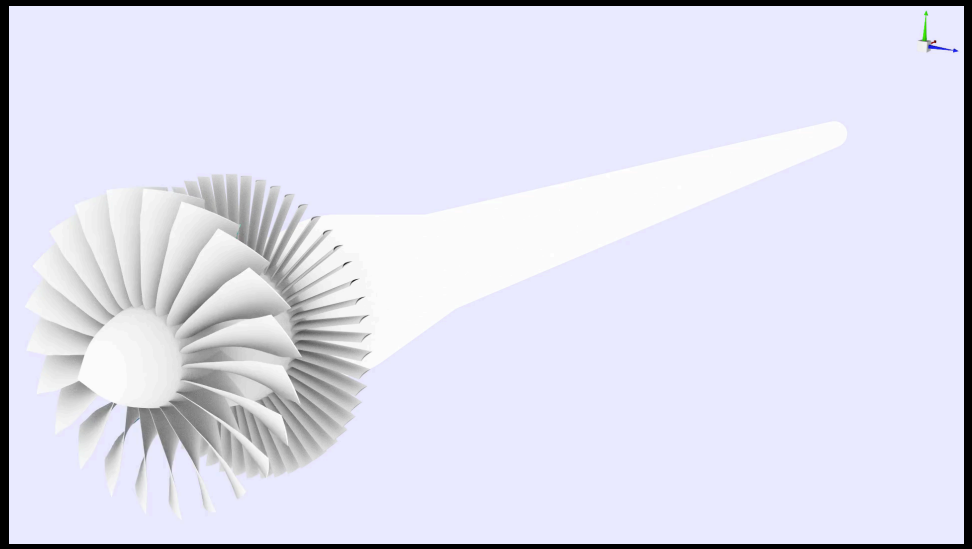




Drone Analysis – Original & Improved Configurations

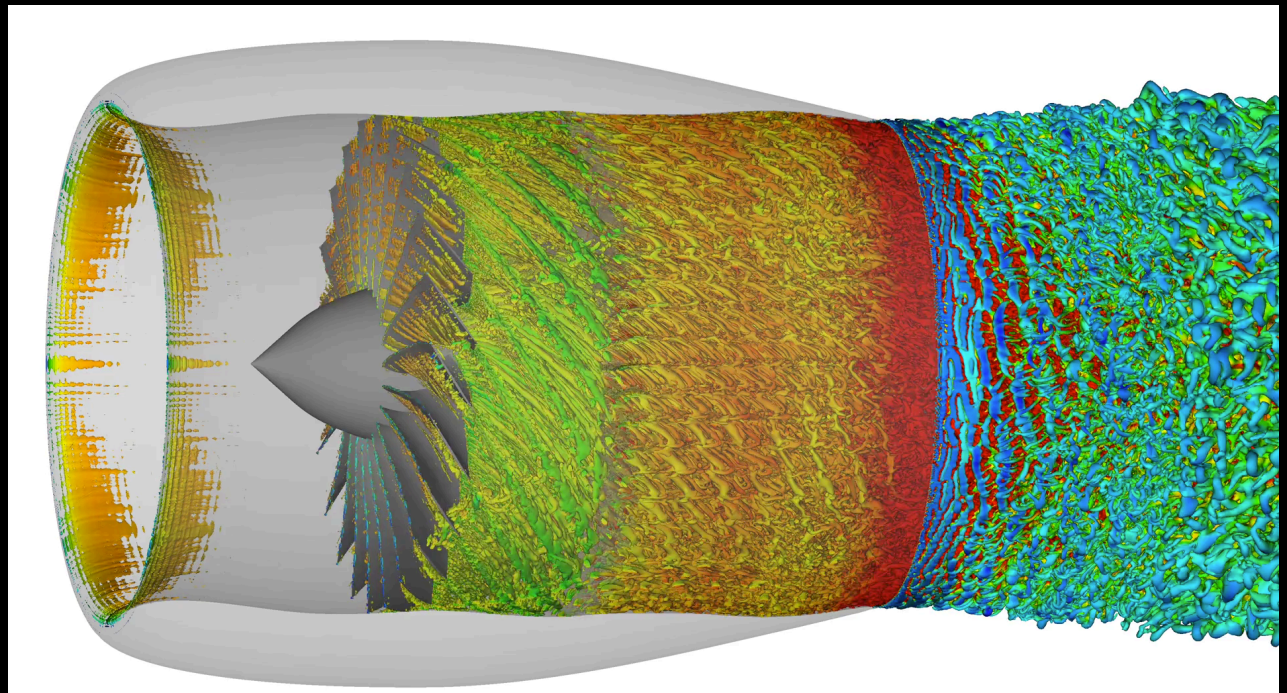
Fan Broadband Noise Prediction





Particle traces colored by U velocity magnitude

Cartesian Navier-Stokes Simulation of Fan Noise: iso-surfaces of q-criterion colored by Mach number



Acknowledgements

- NAS Division, ARC
  - HECC Project
    - Visualization Team
    - Pubs Media Group
  - ATAP Team
  - CART3D Team
  - Computational Physics Branch
  - LAVA Team

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- Goddard Numerical Relativity Group, GSFC
- ECCO Consortium, JPL/MIT

Questions?

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http://www.nas.nasa.gov/hecc