
Visualization & Data Analysis
in support of
NASA's Mission
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NASA 2018 Strategic Plan Overview

NASA's 64-page Strategic Plan is organized around 4 themes and their related Strategic Goals.

Vision

To discover and expand knowledge for the benefit of humanity.

Mission

Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the Solar System and bring new knowledge and opportunities back to Earth. Support growth of the Nation's economy in space and aeronautics, increase understanding of the Universe and our place in it, work with industry to improve America's aerospace technologies, and advance American leadership.

Strategic Goals

- **DISCOVER** — EXPAND HUMAN KNOWLEDGE THROUGH NEW SCIENTIFIC DISCOVERIES.
- **EXPLORE** — EXTEND HUMAN PRESENCE DEEPER INTO SPACE AND TO THE MOON FOR SUSTAINABLE LONG-TERM EXPLORATION AND UTILIZATION.
- **DEVELOP** — ADDRESS NATIONAL CHALLENGES AND CATALYZE ECONOMIC GROWTH.
- **ENABLE** — OPTIMIZE CAPABILITIES AND OPERATIONS.

NASA Centers

NASA Ames Research Center

Armstrong Flight Research Center

Jet Propulsion Laboratory

Glenn Research Center

Goddard Space Flight Center

HQ

Langley Research Center

Marshall Space Flight Center

Johnson Space Center

Stennis Space Center

Kennedy Space Center

Ames Research Center in Silicon Valley

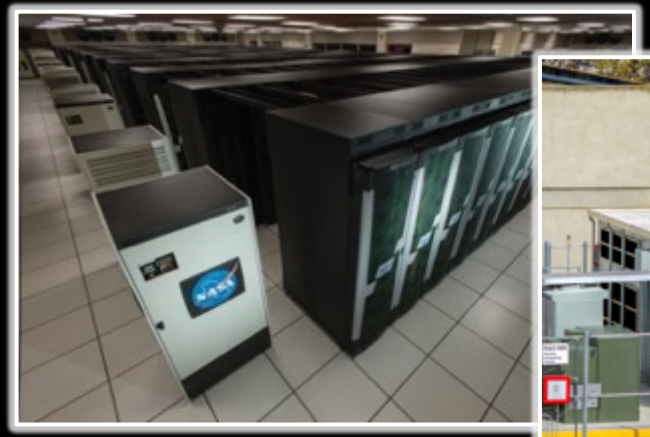
- Occupants:
  - ~1200 civil servants; ~1,900 on-site contractors; ~2,500 NRP workforce
  - ~700 summer students in 2018
- FY19 Budget (est.): ~$910M (including reimbursable/EUL)
- ~1,900 acres (400 acres security perimeter); 5M building ft^2
- Airfield: ~9,000 and 8,000 ft. runways

NASA Advanced Supercomputing (NAS) Division

NASA's Premier Supercomputer Center

Charter: to meet the supercomputing needs of all NASA's Mission Directorates

Over 600 science & engineering NASA related projects with more than 1,600 users across the nation & the world



Pleiades: 7.25 PFs;
245,000+ cores

Electra: 8.32 PFs;
124,416 cores

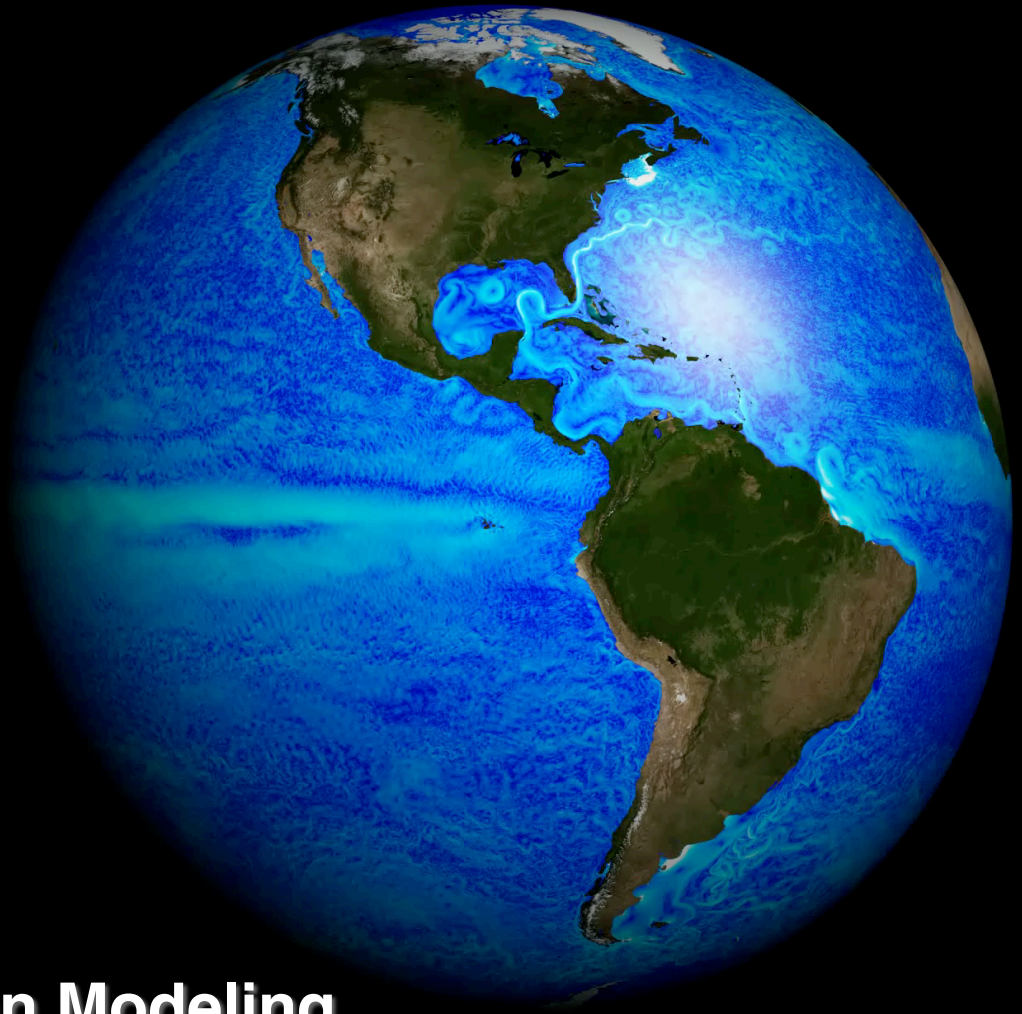
Advanced Visualization

- ***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)

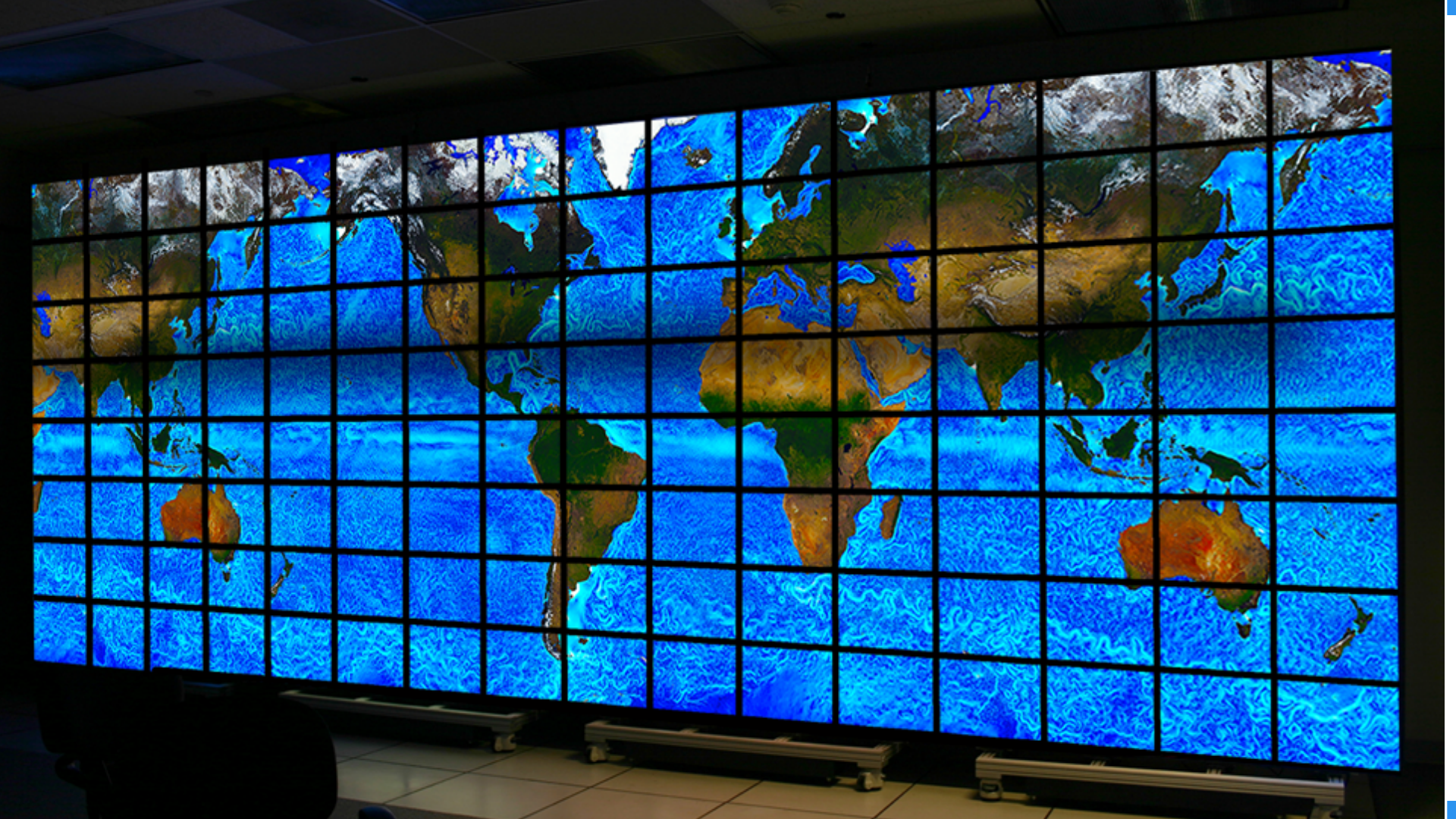
- ***High-bandwidth to HPC resources***
  - *Traditional Post-Processing*: Direct read/write access to Pleiades file systems eliminates need for copying large datasets
  - *Concurrent Visualization*: Runtime data streaming allows visualization of every simulation time step - ultimate insight into simulation code without increase in traditional disk I/O

VISUALIZATION
&
DATA ANALYSIS



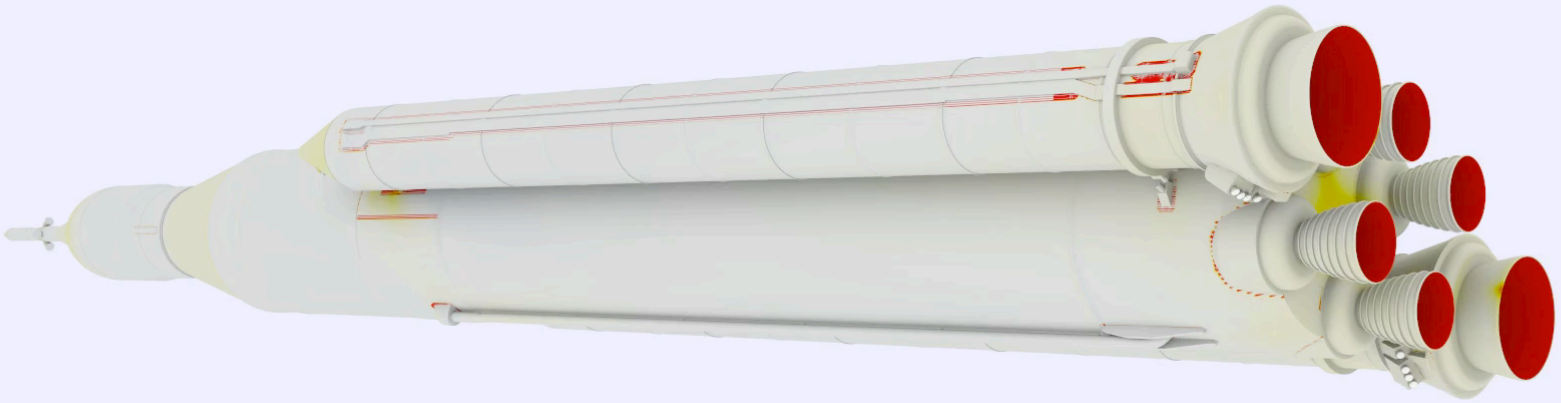
Global Ocean Modeling

ECCO Consortium: MIT & JPL



Modeling the Launch Environment

Space Launch System – Stage Separation



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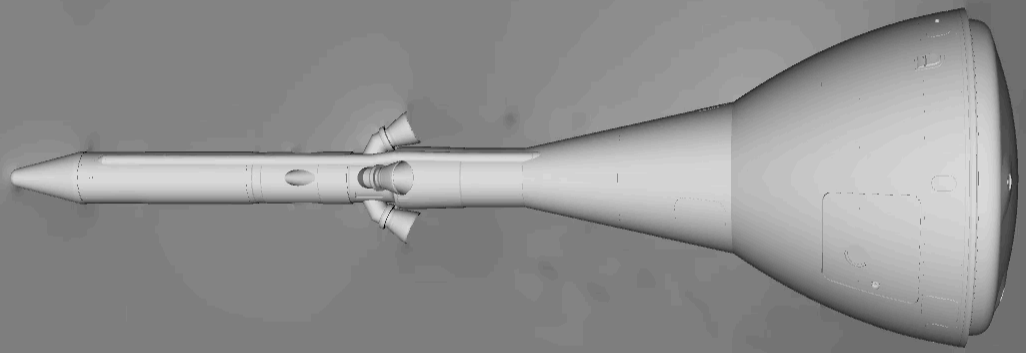
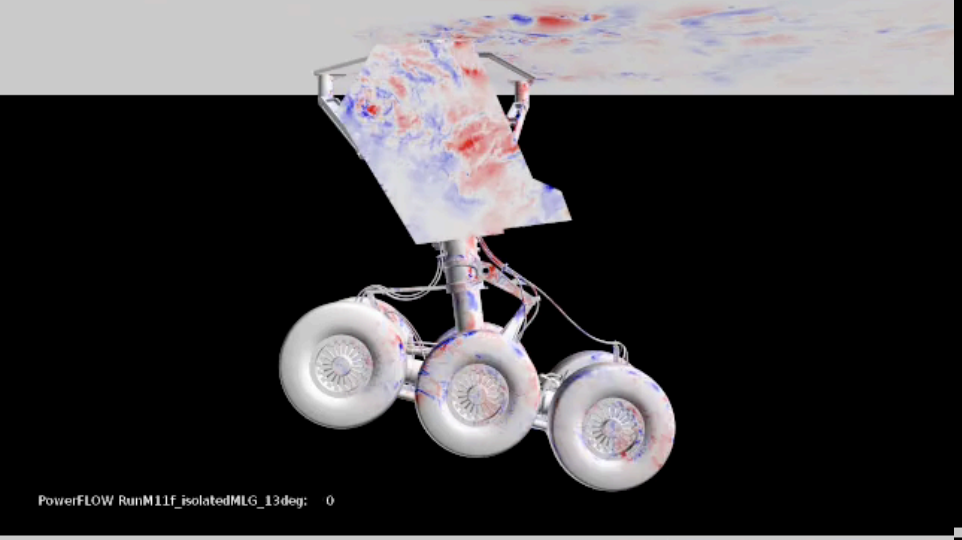


Launch Abort Vehicle Simulation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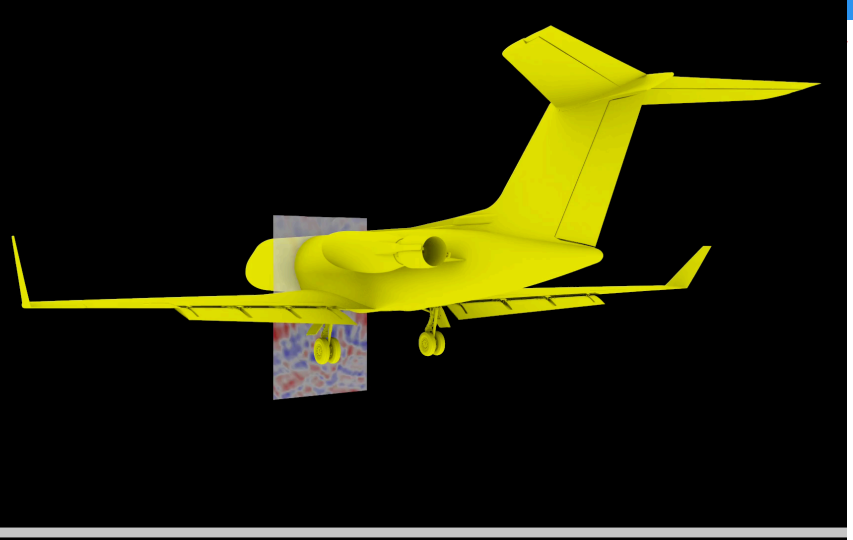

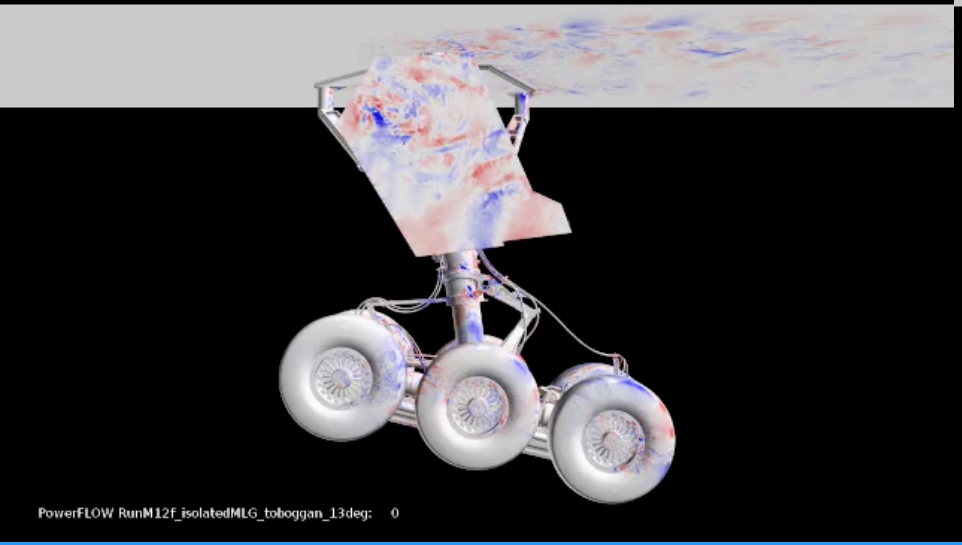
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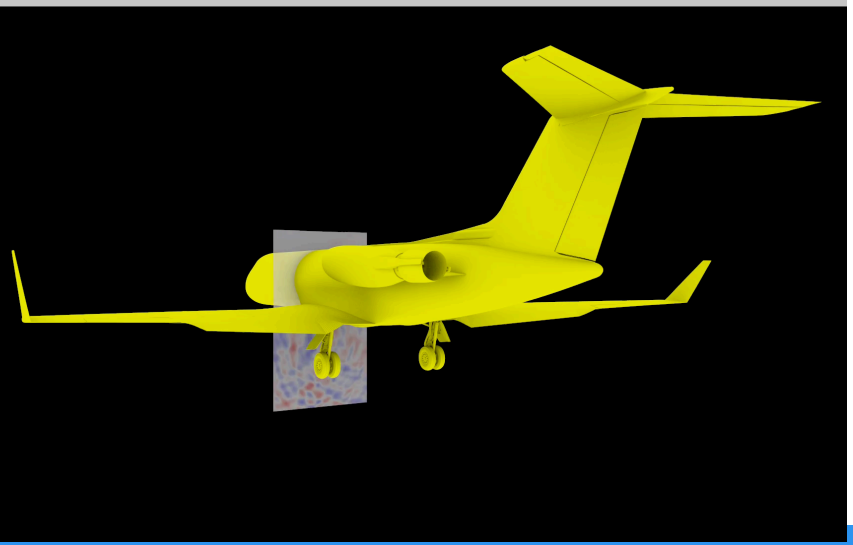
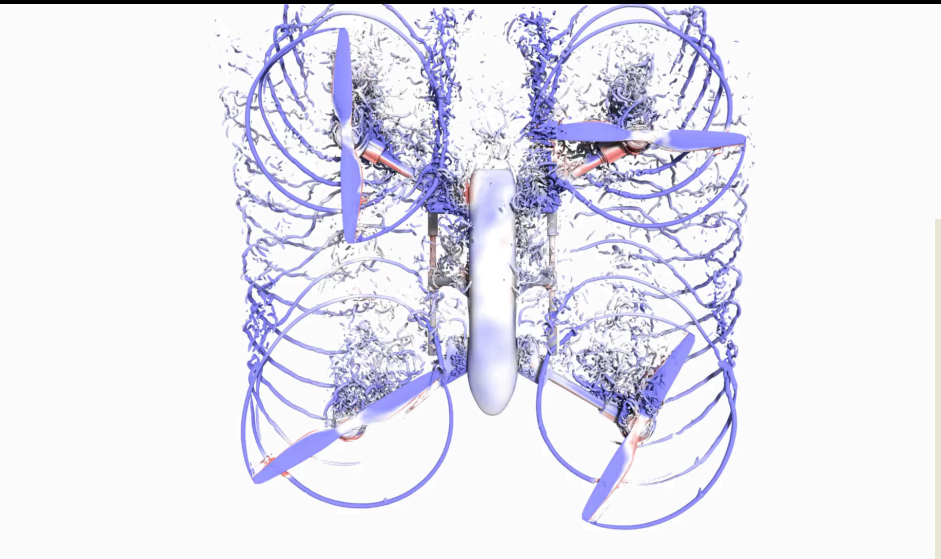
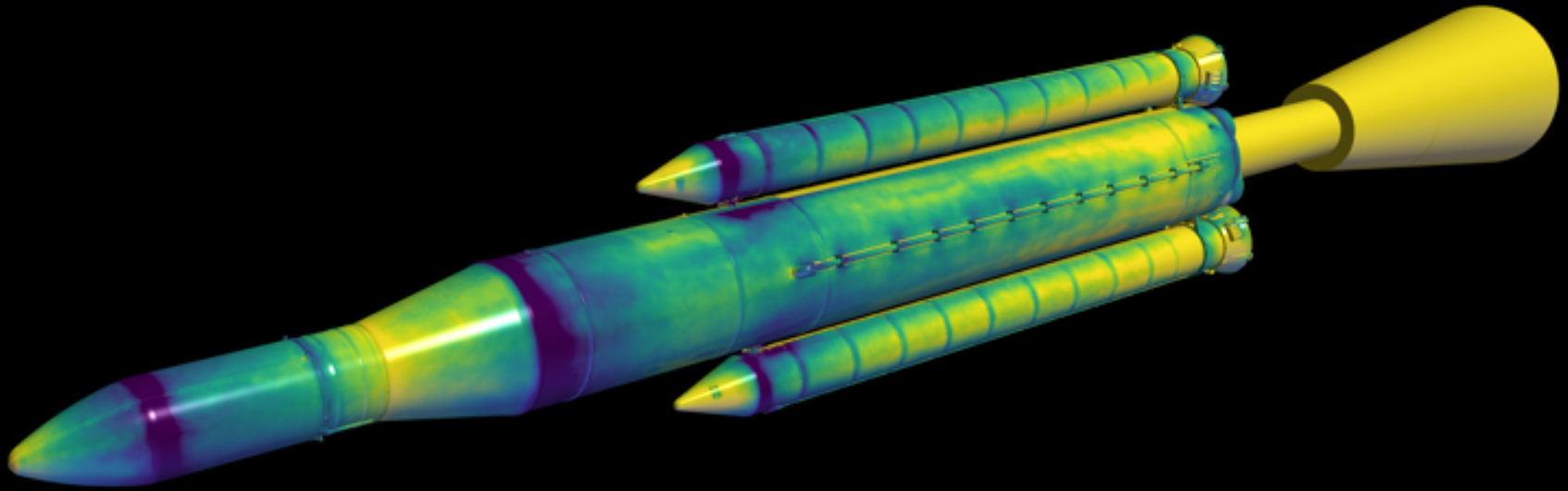


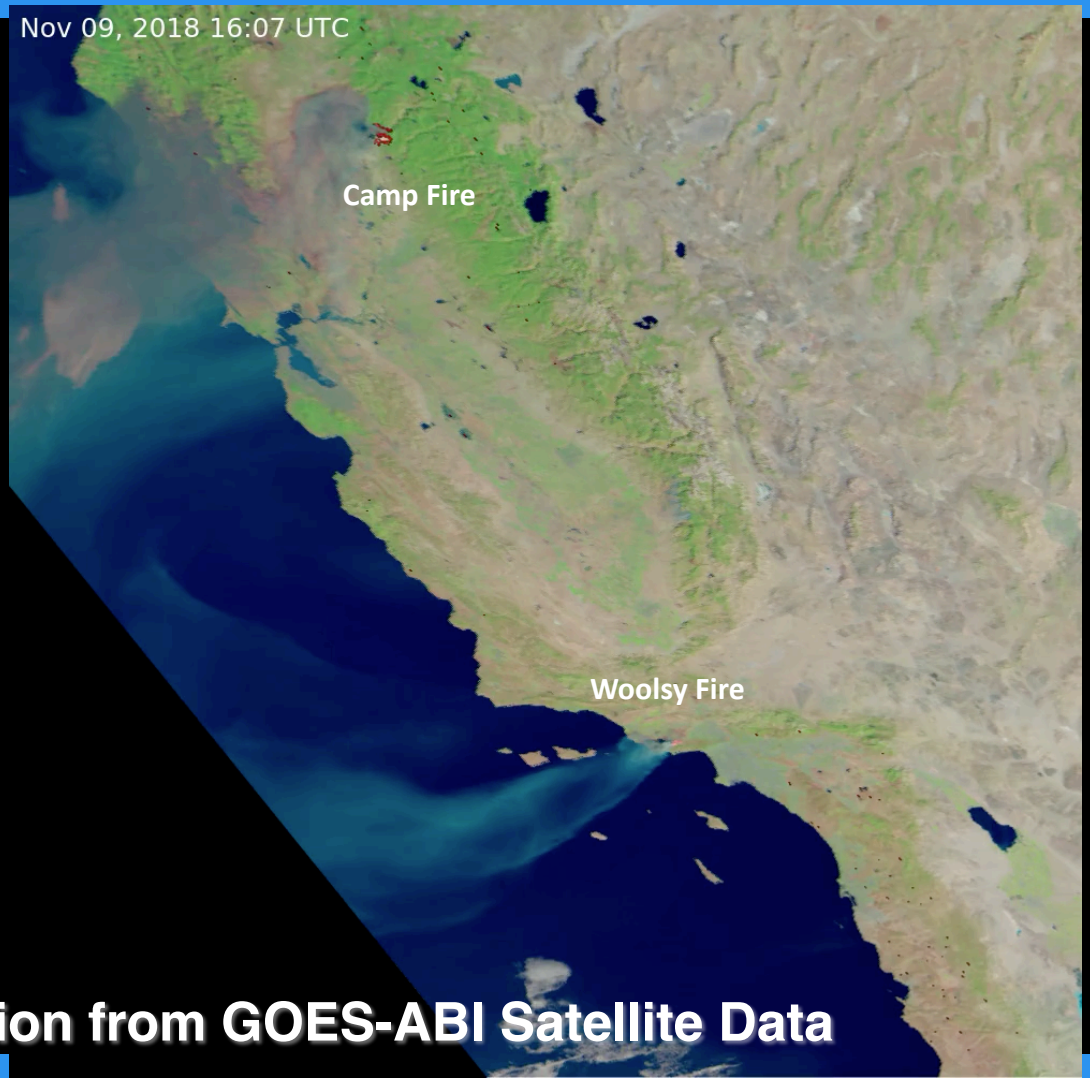


Drone Analysis – Original & Improved Configurations

Wind tunnel runs of SLS model using pressure sensitive paint to estimate pressure/loads



Near real-time analysis of test data using Supercomputer resources
with potential for computer-guided data acquisition



Fire detection from GOES-ABI Satellite Data

GEONEX, NASA Ames

Sample NASA AI/ML Projects

- **Feature detection**
  - Shock waves & vortices from flow data
  - Exoplanet identification from Kepler data
  - Artifact identification, e.g., trees, from satellite data
- **Prediction**
  - Solar flares/space weather from solar surface magnet fields data
  - Asteroid properties from light curves
  - Solar cells current-voltage properties from IV curves
- **Anomaly detection**
  - Aviation safety issues from flight data
  - Systems behavior, e.g., ISS control operations
  - Ammonia and CO2 concentration using carbon nanotube sensors on the ISS
- **Interactive assistants/robots that can learn f ISS crew**
- **Autonomous rovers**

- **Mission Support**
  - Email Classification/Records Management
  - Scientific Document Tagging
  - Network Traffic Anomaly Detection
  - Service Desk Ticket Analysis & Trending
  - Detect CUI* content in documents

NASA's Data Analysis Challenges

NASA data is increasing in volume and complexity
from multiple sources: observational, simulation and experimental

- **Discovery**
  - Multi-petabytes of data with little metadata
- **Data Access & Management**
  - Siloed data with non-intuitive access interfaces/APIs
  - Distributed storage not co-located with computational resources
- **Tool/Algorithm development at scale**
  - One-off algorithms/tools/workflows with little support for sharing
- **Analysis infrastructure**
  - Heterogeneous hardware requirements
- **Workforce & Culture issues**

Agency-wide committees:
- Data Stratgey
- Digital Transformation

Questions?

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