

A Day Without Space: *Economic Security Ramifications*



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Outline

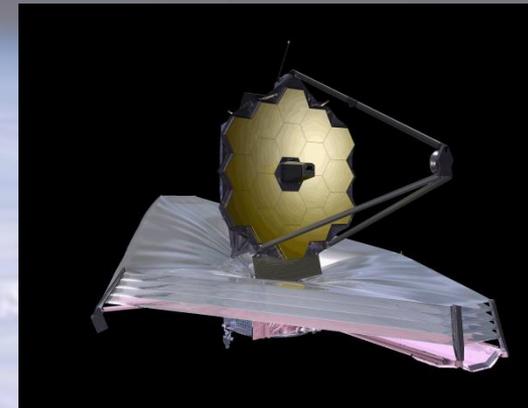
- Introduction
- NASA Technology Transfer
- Local Economic Impacts
- Impact on Launch Industry
- Science Missions Services and Economic Impacts
- Commercial Space Investments
- Space Communication Services
- Aeronautics Economic Benefits
- NASA's Impact on Education
- Summary

Introduction



The NASA Vision

To reach for new heights and reveal the unknown, so that what we do and learn will benefit all humankind.



The NASA Mission

Drive advances in science, technology, and exploration to enhance knowledge, education innovation, economic vitality and stewardship of Earth.



Introduction

- **NASA conducts its missions and activities with the ultimate goal of public benefit.**
 - **NASA provides the knowledge (data, technology infusion) which enable services that greatly benefit our Nation and the world.**
 - **Examples of services include: satellite communications, earth remote sensing, weather monitoring, disaster response, satellite-aided search & rescue and space weather forecast.**
 - **Economic benefit can be measured in a number of different ways:**
 - **NASA's missions contributes significantly to the aerospace industry through contracts and jobs.**
 - **Technology transfer to commercial markets**
 - **Economic impact to local regional areas**
 - **Education programs support students to pursue careers in science & engineering.**



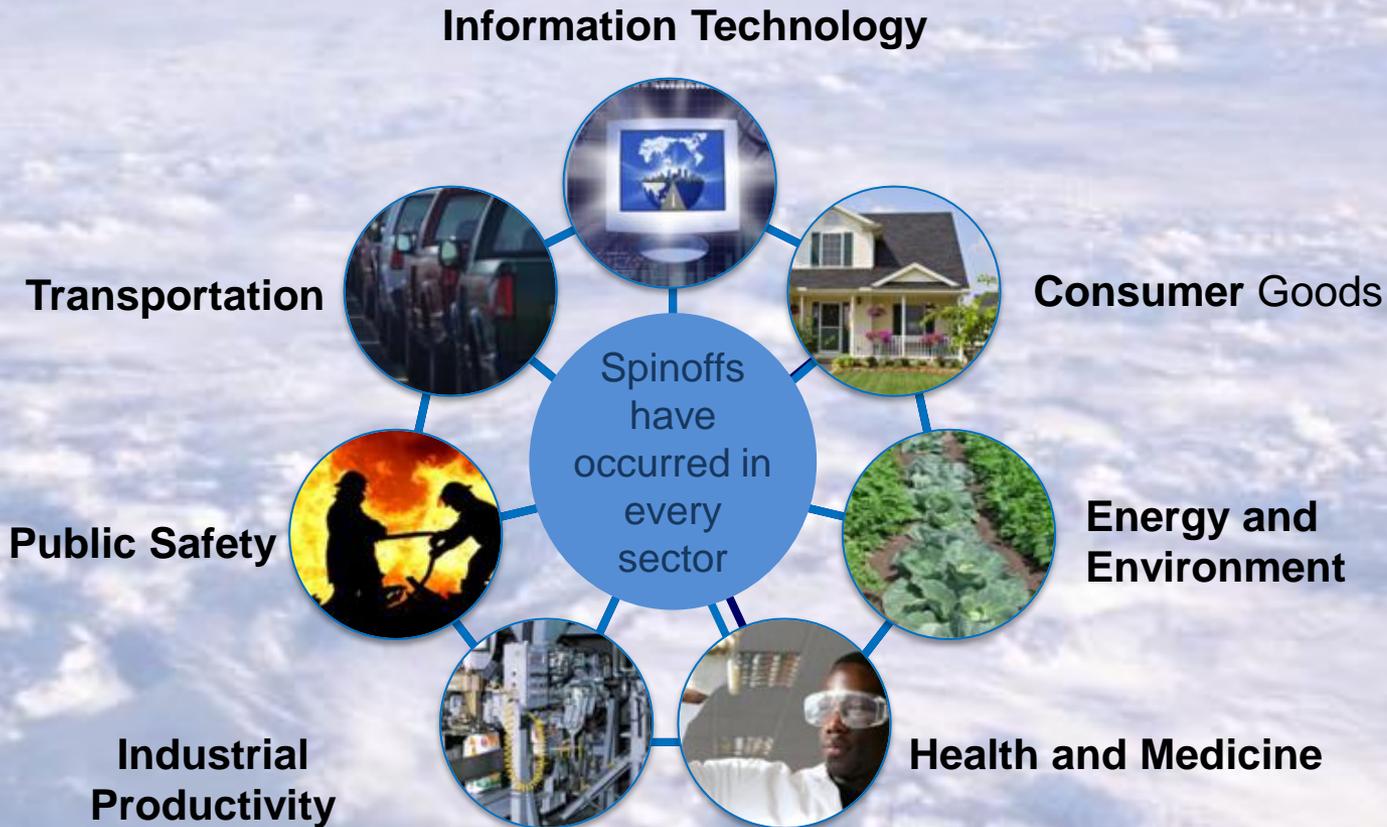
Tracking of Hurricane Karl



Space images of Haiti earthquake

NASA in Your Life

With **over 1,750 recorded NASA spinoffs**, NASA technologies influence our lives in a variety of ways—making us safer, healthier, and more efficient.



NASA Technology: Improving Our Lives

A 2011 survey showed 34% respondents (of the 250 tech transfer successes) over the past five years revealed that commercialized NASA technologies have:

- Created over 8000 jobs
- Generated over \$1B in revenue
- Created more than \$6B in cost avoidance
- Saved more than 250,000 lives
- Significantly improved quality of life for more than 100 million people



Advanced Diagnostic
Ultrasound in Microgravity



Lithium Batteries for Cars



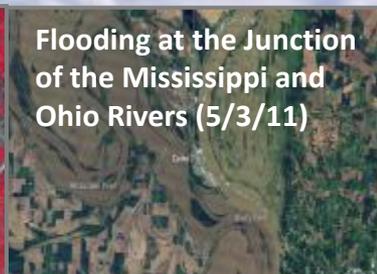
Infrared Thermometers



Clean Energy



Tornado damage
near Birmingham,
Alabama (5/4/11)



Flooding at the Junction
of the Mississippi and
Ohio Rivers (5/3/11)



LED Light Therapy For Pain Management



Groundwater Remediation

Weather Forecasting

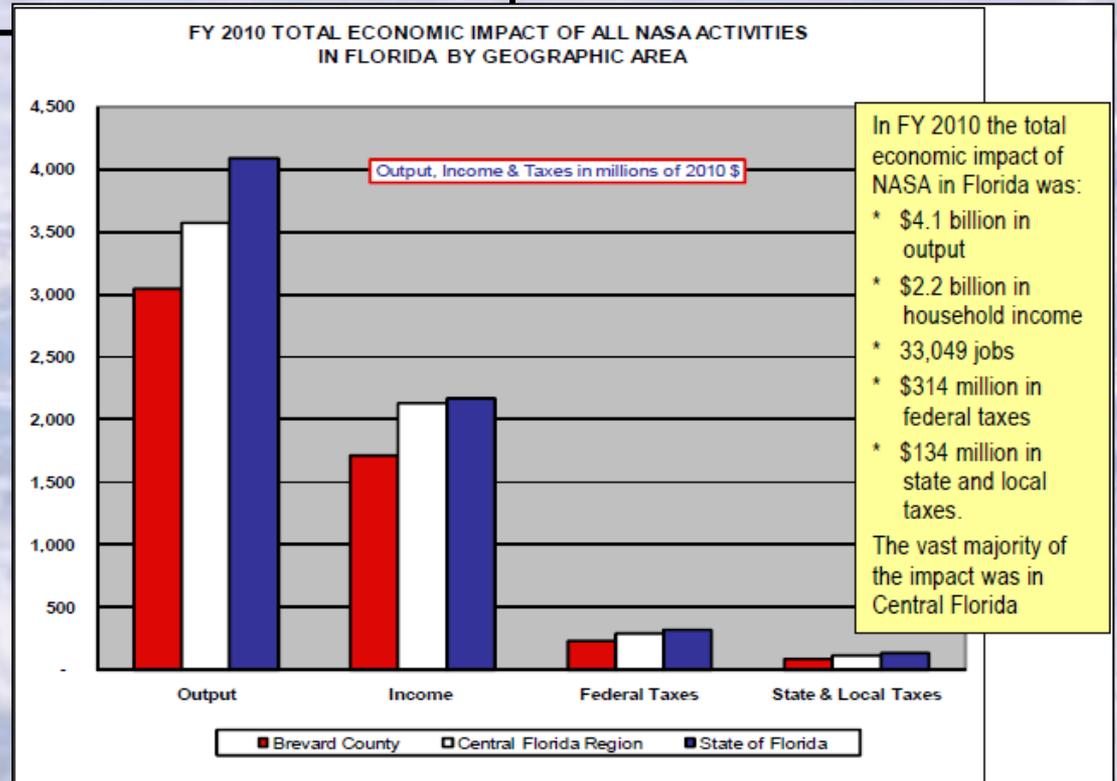
Local Economic Impact

- All NASA funding is “spent on the ground”, fueling the economy with jobs, industry contracts, commodity purchases, partnerships with industry, DoD and academia, local travel and tourism, and growth to household incomes.
- NASA funds 9 NASA Centers and JPL across the country adding to the economy of its local regional areas.
 - Some studies estimate that NASA investment produces x2 impact on local economy.



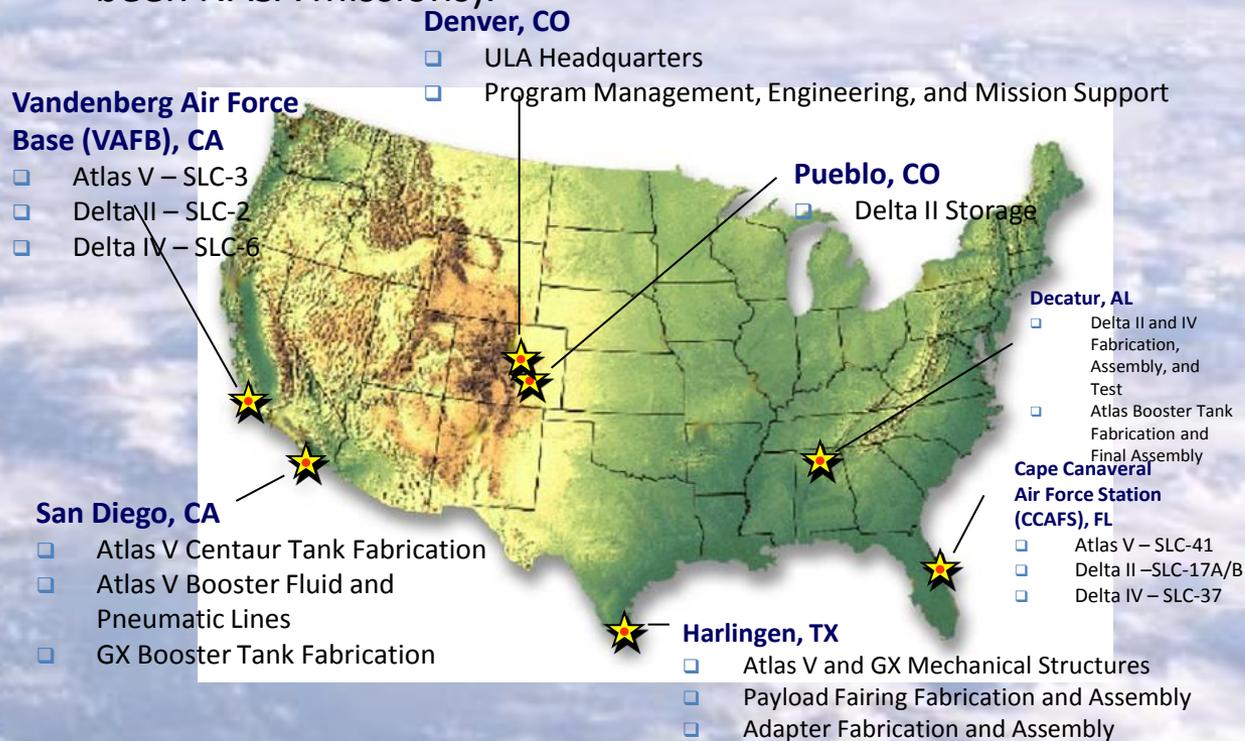
KSC's Economic Impact FY 2010

- \$1.8 billion in FY 2010 was spent in support of space program activities in the State of Florida.
- The total worker population on/near-site KSC in FY 2010 was 13,630. 73% were employed by prime contractors, 17% were KSC/NASA federal civil service workers. Total gross earnings of all space-related workers at KSC were \$1.1 billion.



NASA's impact on US launch industry

- United Launch Alliance is a launch system provider with annual sales of about \$2B employing 3,600 people across the US.
- In 2011, ULA's fleet of Atlas V, Delta II and Delta IV launched 11 missions which accounted for approximately 80% of US launches in 2011.
- NASA missions account for 30% of United Launch Alliance's (ULA) customer base (since 2006, 17 out of 56 missions have been NASA missions).



Most Recent NASA Payload Launches



Atlas V
MSL
11/26/11



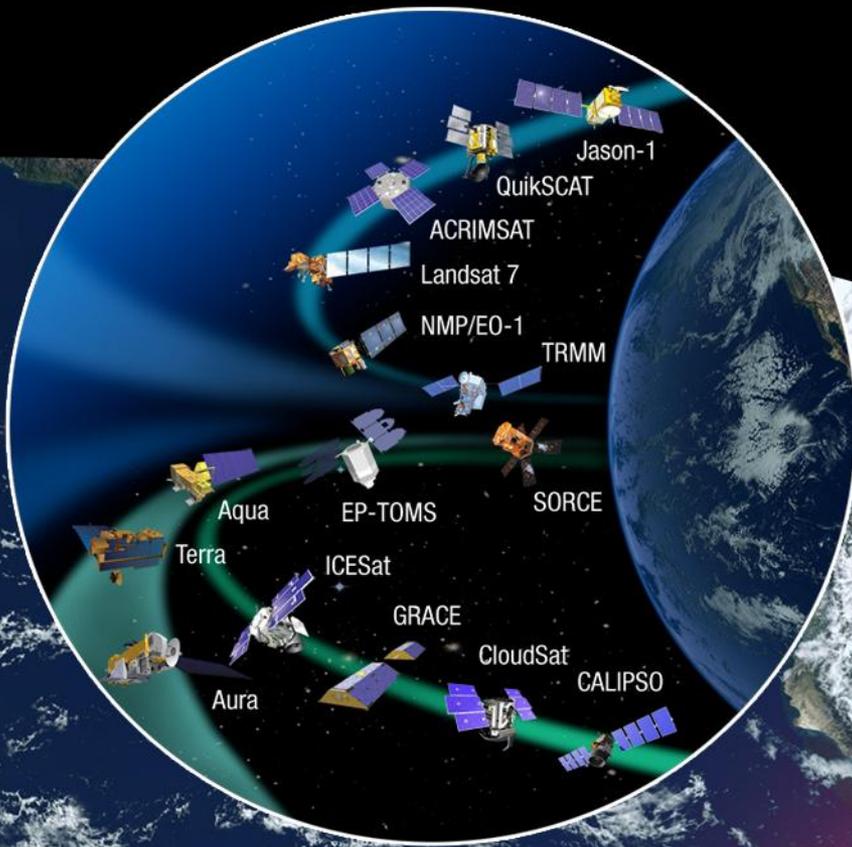
Delta II
NPP
10/28/11



Delta IV
GOES-P
3/4/10

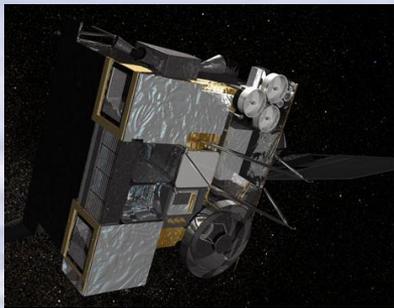
Earth Science

Missions provide services to multiple users and fuel the economy.



Earth Science Mission Data and Services

- NASA's Earth Science division operates multiple Earth Observation satellites and provides data for multiple users and services in the U.S. and abroad:



GOES-P Mission



NOAA-N Mission

- Agriculture: enhance agriculture management and policy making
- Air quality management (partnership with EPA)
- Climate change assessment, planning to respond to climate changes and policy analysis
- Disaster forecast, mitigation and response (extreme weather events, fires, large scale natural and human-induced disasters)
- Remote sensing data is used for ecological forecasting and environmental management of National Parks, endangered species, etc.
- Public health applications of environmental data: emergency preparedness and response, infectious diseases, and environmental health issues
- Water resources management
- Weather monitoring and forecast



NPP Mission



Smoke from Yellowstone Fires

Detecting Oil During the Gulf of Mexico Oil Spill

- An Applied Sciences project that began in 2008 helped jump start efforts to track the location of oil in the Gulf of Mexico
 - The sheer size of the Gulf of Mexico has historically forced federal agencies to rely on chance sightings of oil spills
 - The collaboration of researchers from NRL, NASA Langley Research Center (LaRC), and the National Oceanic and Atmospheric Administration's Center for Satellite Applications and Research (NOAA/STAR) developed innovative techniques for using satellite data to improve and semi-automate detection of oil spills
 - This technology was used to track the spill, provide data for operational decisions and assess the impact on the Gulf habitat



The Applied Sciences Program of SMD supports efforts to discover and demonstrate innovative and practical uses of NASA Earth science and satellite observations. More at <http://appliedsciences.nasa.gov>

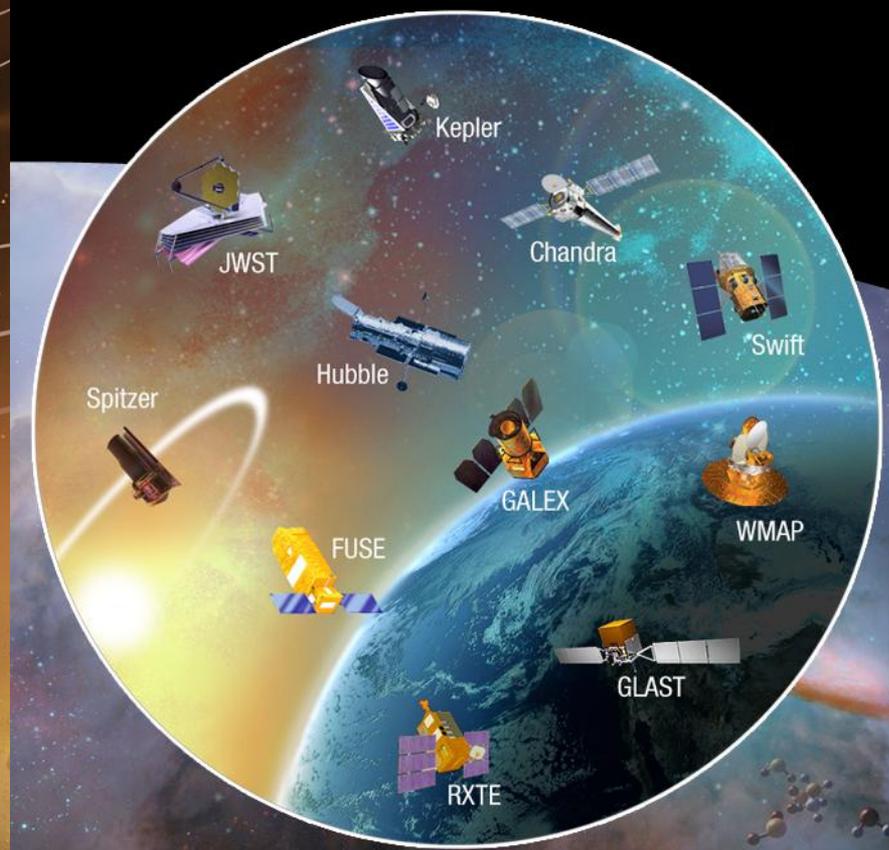
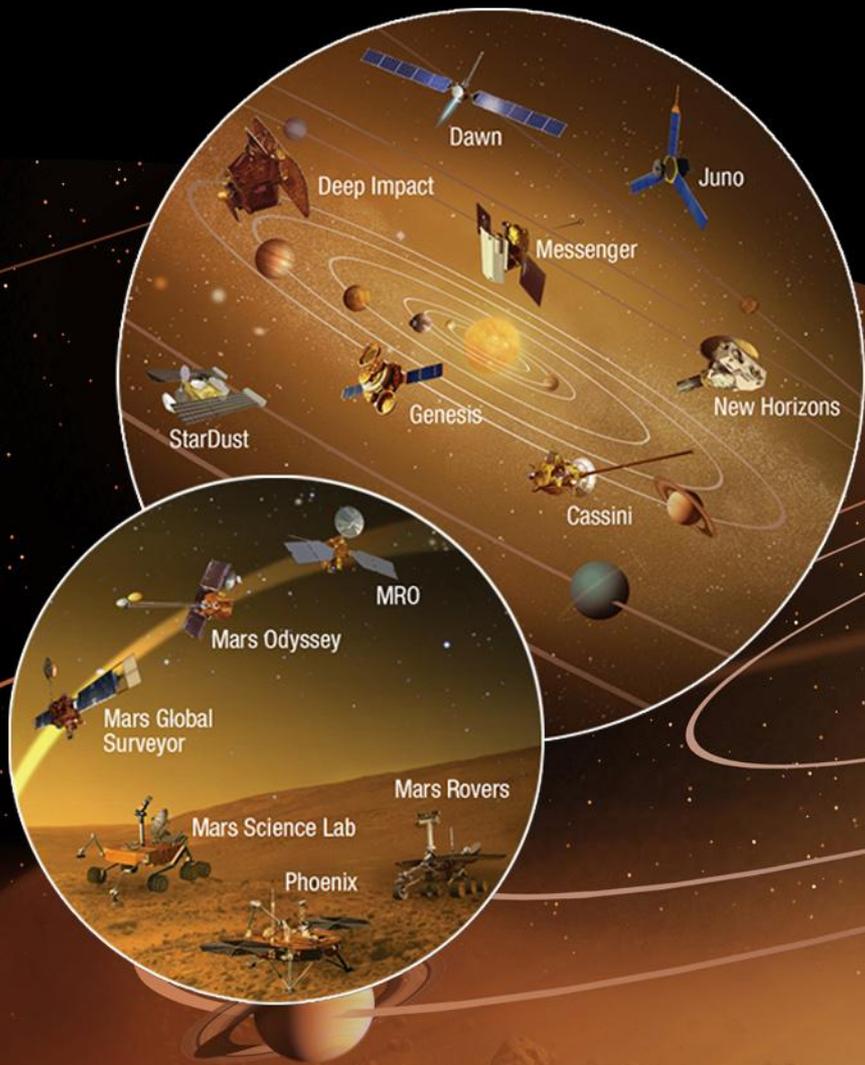
Tracking Volcanic Ash from Iceland

- When ash from a volcano in Iceland closed airports and threatened the safety of international travel, Applied Sciences projects and partnerships provided critical information on the location and trajectory of ash plume
 - NASA's investment in volcanic ash research and its longstanding partnership with NOAA provided the framework for developing customized reports for the Volcanic Ash Advisory Center in London using data from several instruments on NASA and European satellites.
 - This event was the first time NASA directly assisted a non-U.S. Volcanic Ash Advisory Center.
 - Critical information was provided to VAAC during the height of the shutdown of European air traffic.



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Planetary Science & Astrophysics



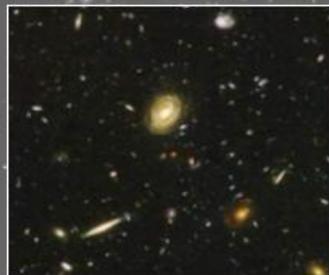
James Webb Space Telescope - Overview



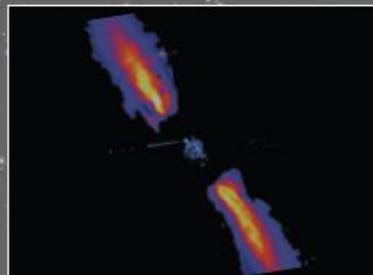
James Webb Space Telescope (JWST) goes beyond Hubble and other space telescopes by seeing things that they cannot see...

- How did the universe make galaxies?
- Are there other planets that can support life?
- How are stars made?

JWST is about beginnings: the beginning of galaxies, the beginning of stars, the beginning of planets and life.



First Light



Planets and the Origins of Life



The Assembly of Galaxies



Birth of Stars and Planets

JWST Fuels the Economy

Total \$M/FY10 FTEs

Utah ~\$65 M/50 FTEs

- ATK Aerospace Company
- Space Dyamics Lab/ Utah St. U
- Hexcel Corporation
- Aerospace Machining

Idaho

- University of Idaho

Ohio ~\$23M

- Brush Wellman
- Keithley
- Lake Shore Cryotronics
- Glenn Research Center

New York ~\$110M/40 FTEs

- Aeroflex
- Cranetech Inc
- Indium Corp of America
- ITT Space Systems, LLC
- JPW Structural Contracting, Inc
- Moog Inc
- Sigmaddyne
- University of Rochester
- ValveTech Inc

New Hampshire

- Optical Solutions Inc
- Timkin Aerospace & Super Precision

Oregon

- Precision Measurements & Instr.

Minnesota

- ION Corp
- Minco Products, Inc.
- Sheidahl CO.

Massachusetts

- Appli-Tec Inc
- Hypertronics Corporation

Nevada

- TRAX International Inc

Alaska

- ASRC

Illinois

- Boeing
- Numerical Precision

Pennsylvania

- Tyco Engineered Systems

Connecticut

- Zygo

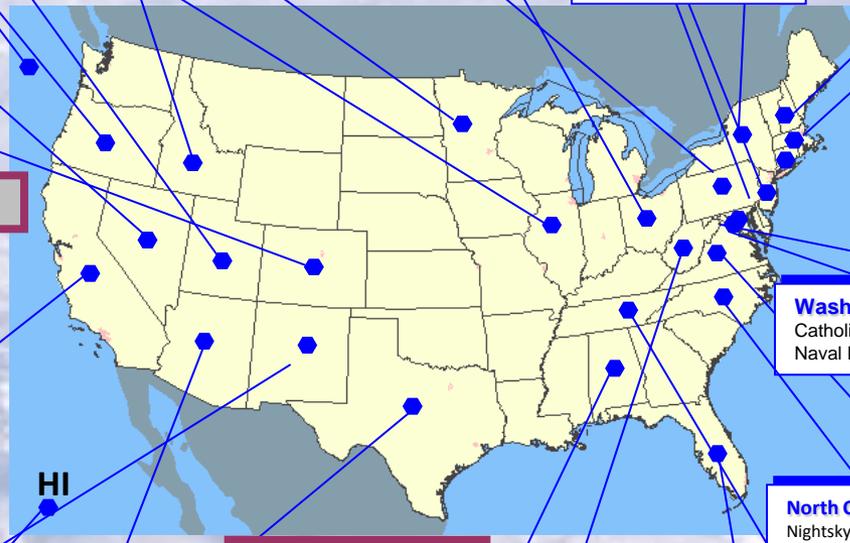
New Jersey ~\$20M

- Newark Electronics
- Quantum Coatings, Inc

Maryland ~\$2,600M/~500 FTEs

Colorado ~\$330 M/80 FTEs

- ABSL Space Products
- Ball Aerospace & Tech Corp
- Blue Line Engineering
- CTD
- Raytheon Company
- SEAKR Engineering, Inc
- Space Science Institute



California \$1,750 M/~400FTEs

- ATK Space Systems Inc
- Composite Optics
- Dow-Key Microwave Corp
- Geologics Corp
- Glenair
- Hewlett Packard
- JDS Uniphase
- JPL
- Lockheed Martin ATC
- NEA electronics
- Magna Tool
- Maxwell Technologies
- Moog
- Newport Corporation
- Northrop Grumman Aerospace Systems
- Parsons Infrastructure & Technology
- Raytheon Vision Systems
- Rockwell Scientific
- Sabritec
- SAIC
- St Systems USA, Inc
- SVG Tinsley Laboratories
- Sunrise Technologies, Inc
- Synopsys, Inc
- Tayco Engineering, Inc
- Tavis Corp
- University of California
- Vacco
- Ames Research Center

Maryland (continued)

- Bechdon Company, Inc.
- Boeing
- Computer Science Corporation
- Conceptual Analytics
- Curtis Management Co.
- Energy Solutions International, LLC
- General Dynamics
- Genesis Engineering Co., LLC
- Global Science & Technology
- Goddard Space Flight Center
- Hammers Company
- Honeywell / HTSI
- Jackson & Tull Chartered Engineers
- Janis Research Company
- Johns Hopkins University
- Litton
- Lockheed Martin
- Lorr Company
- Mega Engineering
- Microtel
- NGST Electronics
- Northrop Grumman
- Nu-Tek
- QSS Group, Inc.
- Raytheon
- RSTX
- Science Application International Corporation
- SGT
- Sigma
- Space Telescope Science Institute
- SRS Technologies
- SSAI
- University of Maryland
- USRA
- Wolcott Park

Washington DC

- Catholic University
- Naval Research Lab

North Carolina

- Nightsky Systems

New Mexico

- Cortez III Service Corp
- DoE

Texas ~\$110M/40 FTEs

- Muniz Engineering
- National Instruments
- Texas A&M University
- Johnson Space Center

West Virginia

- NASA GSFC IV&V

Tennessee

- Jacobs Technology

Arizona ~\$25M/10 FTEs

- Dynaco
- Honeywell International, Inc
- Optical Device Engineering Corp
- University of Arizona
- Arizona State University

Alabama ~\$77M/45 FTEs

- Axsys Technologies
- Marshall Space Flight Center
- SRI
- Mantech - Nexolve

Florida

- Advanced Quick Circuits
- CDA InterCorp
- Geodetic Services

Virginia ~\$40M/15 FTEs

- BAE Systems Information & Electronics Systems Integration
- General Dynamics
- Man Tech
- National Research Initiatives
- Orbital Sciences Corporation

Hawaii

- GL Scientific
- Mauna Kea Engineering
- University of Hawaii

NASA invests in Commercial Space

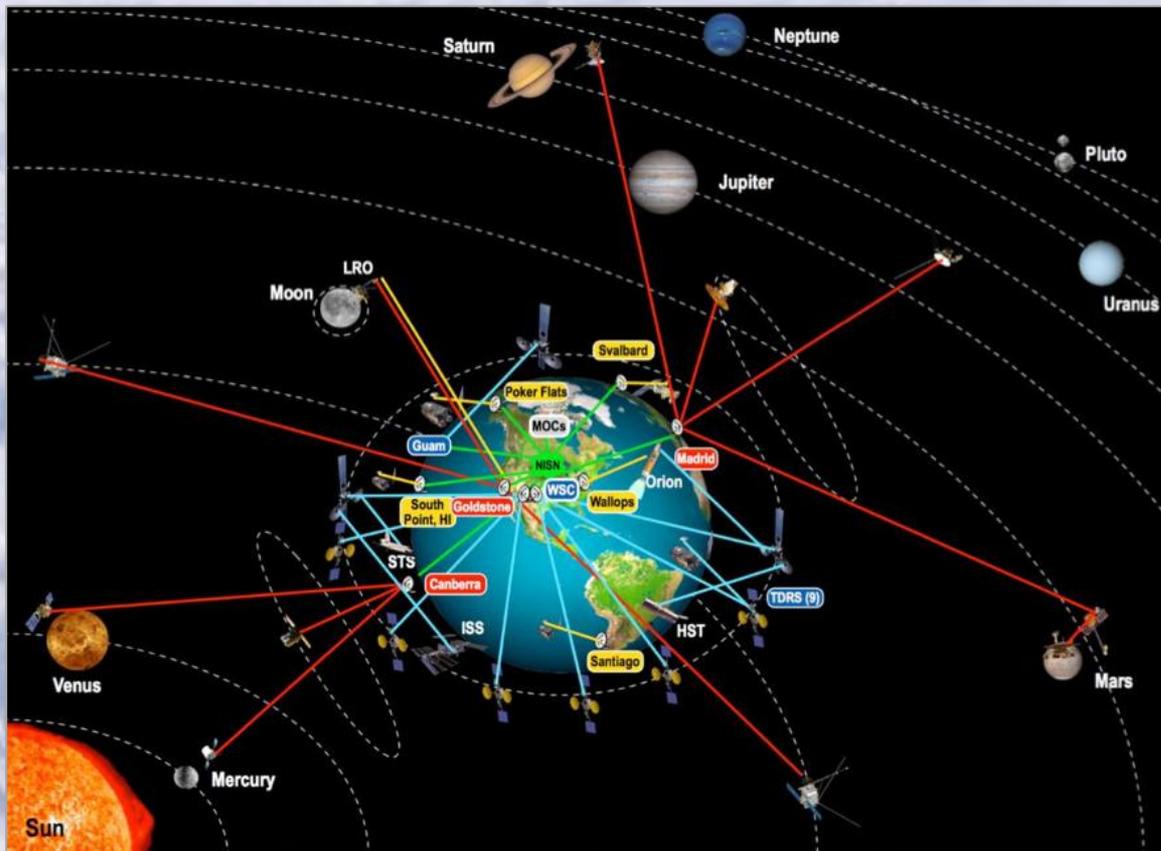
- NASA's COTS and CCDev programs are investing in Commercial Space to develop commercial cargo and crew space systems to service ISS and incentivize other commercial space markets.
 - Analysis by Commercial Space Flight Federation, an industry group, estimates that an average of 11,800 direct jobs would exist each year from FY 2011 to FY 2015 as a result of investment in **commercial crew and cargo services** with the amount of funding in NASA's budget request.
- NASA is also investing in Google X-Prize activities (contracts total \$30M with 6 companies for lunar data) and has established partnerships with General Motors (Robonaut2, ultimately for use by GM in vehicle production), LEGO, Microsoft, Google, Facebook and FourSquare.



Space Communication and Navigation (SCaN)

- The SCaN program is responsible for providing communications services for **all of NASA's missions**
 - SCaN coordinates multiple space communications networks as well as network support functions to **regulate, maintain, and grow** NASA's space communications and navigation capabilities. It includes multiple programs, examples:

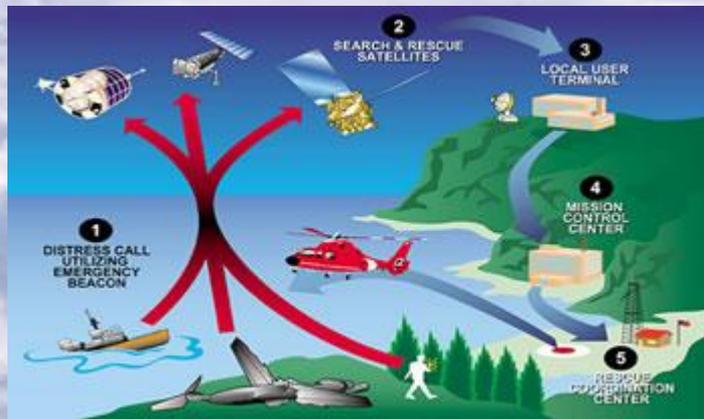
- TDRSS
 - 8 operational satellites that provide in-flight communications with spacecraft operating in low-Earth orbit.
- Satellite-Aided Search and Rescue
- Deep Space Network
 - Key role in the Deep Impact Mission - maintains the link between spacecraft and earth.
- Space Network
 - Provides tracking and data relay for spacecraft, satellites, and expendable launch vehicles (ELV) using space and ground segments.
- Others, including technology development



Search and Rescue (SAR)/Distress Alerting Satellite System (DASS)

- **Satellite-Aided Search and Rescue**

- More than 800,000 emergency beacons in use worldwide by the civil community
 - most mandated by regulatory bodies.
- It is expected to have more than 100,000 emergency beacons in use by U.S. military services.
- Since the first launch in 1982, current system has contributed to saving over **20,000** lives worldwide.
- NASA is responsible for Search and Rescue Research and Development.



Technology for satellite detection and location of aircraft and vessels in distress was developed by NASA in the 1970s. It evolved into an international cooperative effort with spacecraft hardware provided by United States, Canada, France, and Russia - called **Cospas-Sarsat System**.

Cospas-Sarsat System currently has **38 participating countries**, SAR payloads on 11 satellites, a worldwide network of 58 ground terminals, and supports search and rescue agencies worldwide

- GPS-based DASS development is funded by NASA with the goal to make it an operational part of International Cospas-Sarsat, which would significantly enhance its performance

For more information visit https://www.spacecomm.nasa.gov/spacecomm/programs/search_and_rescue.cfm

Tracking and Data Relay Satellite System (TDRSS)

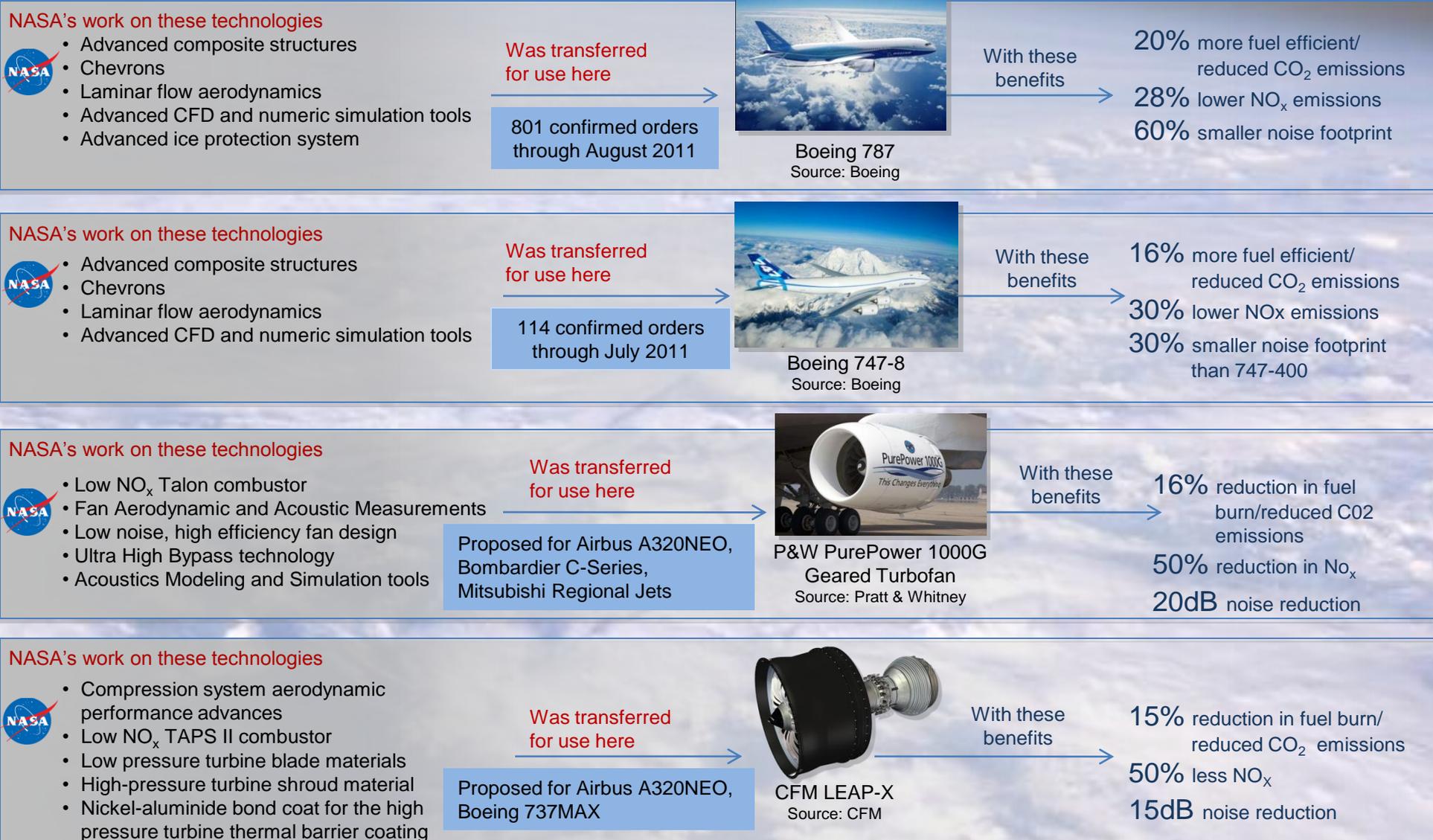
- Cluster of 8 communication satellites used mostly NASA, NOAA and DoD Earth orbiting missions, but also supports ships, airplanes and sites like Antarctic Pole Station as requested
- Commercial launch providers use TDRS services for parts of ascent trajectory (i.e. can't reliably launch commercial satellites w/o TDRS services)
- Provides support to commercial satellite industry on as needed basis, (such as support to specific maneuvers, parts of the trajectory, etc.)
- This space communications system has demonstrated unanticipated versatility:



- The South Pole TDRSS Relay was installed in December 1997
- During a medical emergency at the National Science Foundation's Antarctic Amundsen-Scott South Pole Station in 1999, TDRS-1 provided the high speed internet connectivity that allowed Dr. Jerri Nelson to communicate with doctors in the United States, as she performed a self-biopsy and administered chemotherapy for her breast cancer.
- TDRS-1 provided a similar service three years later, when a remote team of medical personnel assisted in the knee surgery on a meteorologist at the same South Pole station.

For more information visit <https://www.spacecomm.nasa.gov/spacecomm/programs/tdrss/default.cfm>

NASA Aeronautics = Economic Benefits



NASA Technology Onboard Commercial Fixed-Wing Aircraft

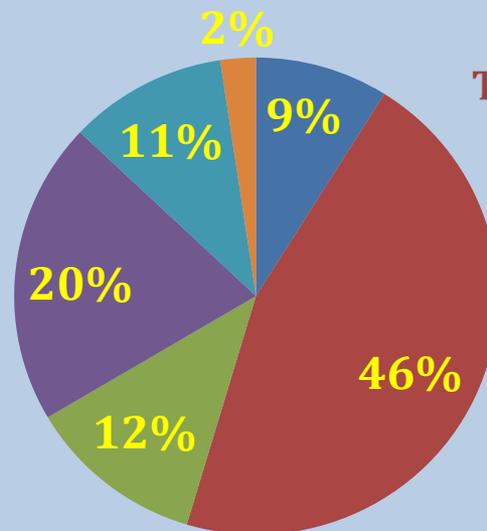


NASA's Impact on Education

- NASA invests in Space Grants to help students achieve Science, Technology, Engineering and Mathematics (STEM) degrees through internships, flight project opportunities and awards.
- From 2006 to 2011, there were 6868 students who received significant Space Grant support and graduated during that timeframe and were tracked after graduating.
- Of the 6868 students, the chart below shows 91% retention in STEM fields by either continuing Advanced degrees or pursuing a STEM career.



“Advancing high quality STEM Education using NASA’s unique Capabilities”



Total number of students = 6,868

- Non STEM
- Advanced STEM Degree
- STEM Academia
- STEM Industry
- Aero Industry
- NASA/JPL

Summary

- **NASA enables a number of services, such as:**
 - Data from earth science satellites, such as, GOES, NPP, NOAA, enable a number of applications, such as, weather monitoring and forecast, agriculture management, climate change assessment, water resources management,
 - NASA Satellites support disaster recovery, such as, Gulf of Mexico oil spill, Volcano eruption in Iceland, and fires over California.
 - TDRSS enables satellite communications
 - Satellite-Aided Search & Rescue
- **NASA impacts the US economy in a variety of ways:**
 - Technology transfer of its research & development to commercial markets
 - NASA funding at 9 NASA Centers and JPL produces x2 economic impact to the local regions.
 - NASA missions account for >30% of US launches making NASA a significant contributor to the US launch industry and its economy.
 - Programs, such as JWST provide vital knowledge about our universe and fuel the economy by awarding numerous new contracts, creating new jobs for advanced, skilled workforce and adding to the local economies of contractors.
 - NASA's Commercial Space programs will have a large economic impact by creating new commercial space markets, such as crew and cargo space transportation services, and Lunar space transportation services which will enable space tourism, space habitats, etc.
 - NASA's Education programs encourage students to pursue STEM degrees continues to have a significant impact on the number of students entering the science and engineering workforce.