NASA & Ames Research Center

Introduction

Presented by:
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NASA Ames Research Center
Your Planet is Changing

- Measuring Water Use
- GPM (2014)
- OCO-2 (2014)
- Suomi NPP (2011)
- SMAP (2015)
- DSCOVR (NOAA) 2015
- Jason-3 (2017)
- Landsat 8 (USGS) 2013
- OSTM/Jason-2 2008
- CALIPSO 2006
- CloudSat (2006)
- Aura
- Understanding Global Warming
- Simulating Worldwide Weather (GEOS-5)
- Air Pollution Reduction
- Jason-3 sees Ongoing El Niño
- Measuring Ice Thickness
- Terra 1999
- Landsat 7 (USGS) 1999
Off the Earth, for the Earth

- Atlas V (Boeing)
- Antares (Orbital)
- Falcon 9 (SpaceX)
- Dragon Cargo (SpaceX)
- Cygnus (Orbital)
- Crew Dragon (SpaceX)
- CST-100 STARLINER (Boeing)

Logos of NASA, CSA/ASC, JAXA, and Esa.
Technology Drives Exploration

Space Travel

Living in Space

Manufacturing, Materials, 3-D Printing

Science Instruments

High-Tech Computing

Robotics
NASA Aeronautics

NASA Aeronautics Vision for Aviation in the 21st Century

- Safe, Efficient Growth in Global Operations
- Innovation in Commercial Supersonic Aircraft
- Ultra-Efficient Commercial Vehicles
- Transition to Alternative Propulsion and Energy
- Real-Time System-Wide Safety Assurance
- Assured Autonomy for Aviation Transformation
Ames is One of the Early NACA Laboratories

Joseph S. Ames

NACA
Langley
Ames
Lewis
Dryden
NASA

1915 1939 1940 1946 1958
- Occupants:
  - ~1130 civil servants; ~2,100 contractors; 1,650 tenants
  - 855 summer students in 2016
- FY2016 Budget: ~$915M (including reimbursable/EUL)
- ~1,900 acres (400 acres security perimeter); 5M building ft²
- Airfield: ~9,000 and 8,000 ft runways
Major Research Facilities

- Wind Tunnels
- ARC Jet Complex
- Range Complex
- Simulators
- Advanced Supercomputing
Core Competencies at Ames Today

- Air Traffic Management
- Entry Systems
- Advanced Computing & IT Systems
- Intelligent/Adaptive Systems
- Cost-Effective Space Missions
- Aerosciences
- Astrobiology and Life Science
- Space and Earth Sciences
Air Traffic Management

Air Traffic Demonstration – ATD-2

UAS Traffic Management
Entry Systems

MSL Thermal Protection System

PICA

MEDLI

ADEPT

Interaction Heating Facility (IHF)
Advanced IT and Computing Systems

Supercomputing Systems

Big Data Analytics

Large Scale Visualization

Enterprise Managed Cloud Computing

Quantum Computing

Disruptive Technologies
Intelligent Adaptive Systems

Mission Support Tools, Decision Support Tools

Self-Driving Car

Autonomous Navigation

UAS Autonomy

Free Flyers

Autonomous Hazard Characterization
Intelligent Adaptive Systems

Synchronized Position Hold, Engage Reorient, Experimental Satellites

Activity Mission Planning For Mars
Activity Mission Planning For Crew On ISS
Activity Mission Planning For Human Robotic Teams / Future

Astronauts Self-scheduling And Planning

PayLoad & Drill Subsystem

Distributed Ops Testing

Partnering Lander Concept

Planetary Lake Lander
Adaptive science for dynamic phenomena in deep-space missions. Field testing in Chile.

Self Driving Car
Adapt space robotics technology to “fleet management” use.

Astrobee Free-Flyer
Autonomous nav, docking and recharge, and mobile sensor IVA work on the ISS
Cost-Effective Space Missions @ Ames

- Biosentinel
- LCROSS (2009)
- LADEE (2013)
- TechEdSat-4
- TechEdSat-5
- PhoneSat (2013), EDSN (2013)
Aerosciences
Astrobiology & Life Sciences

- Sub-surface planetary exploration
- Biosignatures
- Radiation science
- Synthetic biology
- Environmental life support
- Gravitational Biology
- Life detection
- Origins of life
- Missions
- Microfluidic Sensors
- WetLab-2
- Seedling Growth
- Rodent Research
Space & Earth Sciences

Research Areas
- Extrasolar Planets
- Infrared Astrophysics
- Planetary Sciences
- Extreme Environments Field Research

Technology/Instruments
- Exoplanet Imaging Technologies
- Near-Mid Infrared Imagers & Spectrometers
- UV/Visible Spectrometers

Missions
- Operations: Kepler/K2, SOFIA, IRIS
- Development: TESS, Resource Prospector
- Completed: LADEE, LCROSS, Lunar Prospector

Centers of Excellence & Virtual Institutes
- Mars Climate Modeling Center
- Ames Astrochemistry Laboratory
- NASA Astrobiology Institute
- NASA Solar System Exploration Virtual Institute

Research Areas
- Atmospheric Sciences
- Biospheric Sciences
- Carbon Cycle & Ecosystem Modeling
- Applied Sciences

Technology/Instruments
- Airborne Remote Sensing & In Situ Instruments
- Small Unmanned Aerial Vehicles (UAVs)
- Wildfire Monitoring from UAVs

Centers of Excellence
- NASA Earth Exchange (NEX)
- Earth Science Projects Office (ESPO)
- Airborne Sensor Facility (ASF)
- Small Unmanned Aerial Vehicles (UAVs)

Recent Airborne Science Campaigns
- ATom (2015-2020): Atmospheric tomography
- ATTREX (2010-2015): Tropical tropopause
- HS3 (2010-2015): Hurricanes & severe storms
- IceBridge (2009-2017): Polar icecaps
Partnerships at Ames

Commercial

Virtual Institutes

NASA Research Park

Inter-Agency

International

Bay View

Eastside/Airfield

NASA Ames Campus

Shenandoah Historic District

NRP South Campus

Academia
Come Join the Ames Family

Upcoming openings:
- Computer Scientists
- Engineers: Aerospace, Software, Electrical, Materials, Systems
- Physical Scientists: Astrobiology, Biosciences, Space, and Earth Sciences
- Business Operations (HR, Public Affairs, Procurement, IT)

Pathways and Education Programs: Internships, Fellowships, Intern Employment and Recent Graduate Program
- Engineering
- Physical Scientist
- Human Resources
- Finance
- Business Administration

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Questions?
Aviation is vital to our nation's economy

- $82.5 billion positive trade balance
- $1.6 trillion total U.S. economic activity
- 10.6 million direct/indirect jobs
- $771 billion spent by air travelers in U.S. economy
- 18.1 million tons of freight transported by U.S. airlines

(Sources for statistics listed at https://www.nasa.gov/aero/infographics.html)
Mission Directorates

Aeronautics

Space Technology

Science

Human Exploration and Operations
NASA has made decades of contributions to aviation

NASA-developed technology is on board every U.S. commercial aircraft and control tower.

- GLASS COCKPIT
- DIGITAL FLY-BY-WIRE
- TURBO AE
- AIR TRAFFIC MANAGEMENT
  - Center TRACON Automation System (CTAS) – 1990s
  - Traffic Management Advisor (TMA) – 1990s
  - Surface Management System (SMS) – 2000s
  - Future Air Traffic Management Concepts Evaluation Tool (FACET) – 2000s
- AREA RULE
- LIGHTNING PROTECTION STANDARDS
- COMPOSITE STRUCTURES
- SUPERCRITICAL AIRFOIL
- JET ENGINE COMBUSTORS
- ENGINE NOZZLE CHEVRONS
- ENGINE NOZZLE CHEVRONS
- WINGLETS
- ICING DETECTION
- WIND TUNNELS
- RUNWAY GROOVES
- AIRBORNE WIND SHEAR DETECTION
- COMPUTATIONAL FLUID DYNAMICS (CFD)
- NASA STRUCTURAL ANALYSIS (NASTRAN)
- AIR TRAFFIC MANAGEMENT
- SURFACE MANAGEMENT SYSTEM (SMS)
- AREAS RULE
- JET ENGINE COMBUSTORS
- ENGINE NOZZLE CHEVRONS
- ENGINE NOZZLE CHEVRONS
- WINGLETS
- ICING DETECTION
- WIND TUNNELS
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Less Noise: Chevron Nozzles

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Global Growth in Aviation
Opportunities and Challenges

2017
4 BILLION PASSENGER TRIPS

2036
7.8 BILLION PASSENGER TRIPS

41,030 New Aircraft Deliveries
$6.1 Trillion Market Value

Asia-Pacific Market is Nearly 40% of New Aircraft Deliveries

78% of New Aircraft Deliveries are Single Aisle Class (including Regional Jets)
NASA Aeronautics Strategies for Research

We are meeting global aviation challenges by using six research thrust areas to organize our research.

- **Safe, Efficient Growth in Global Operations**
  • Achieve safe, scalable, routine, high-tempo airspace access for all users

- **Innovation in Commercial Supersonic Aircraft**
  • Achieve practical, affordable commercial supersonic air transport

- **Ultra-Efficient Subsonic Transports**
  • Realize revolutionary improvements in economics and environmental performance for subsonic transports with opportunities to transition to alternative propulsion and energy

- **Safe, Quiet and Affordable Vertical Lift Air Vehicles**
  • Realize extensive use of vertical lift vehicles for transportation and services including new missions and markets

- **In-Time System-Wide Safety Assurance**
  • Predict, detect and mitigate emerging safety risks throughout aviation systems and operations

- **Assured Autonomy for Aviation Transformation**
  • Safely implement autonomy in aviation applications
Where does NASA aeronautics research happen?

Aeronautics research takes place at four of NASA’s centers.

Major Areas of Inter-Center Collaboration

- **Langley/Glenn**: Propulsion-Airframe Integration
- **Ames/Langley**: Flight Deck & Ground Based Automation Integration; Flight Mechanics; Aerodynamics
- **Armstrong/Other Research Centers**: Flight Experiment Integration

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Energy usage reduced by more than 60%

Harmful emissions reduced by more than 90%

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OF DISPARATE TECHNOLOGIES
URBAN AIR MOBILITY
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