

# Technology Investments For Suborbital Science

Emerging Suborbital Vehicle Workshop

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# Earth Science Division Overview

- Overarching goal: to advance Earth System science, including climate studies, through spaceborne data acquisition, research and analysis, and predictive modeling
- Six major activities:
  - Building and operating Earth observing satellite missions, many with international and interagency partners
  - Making high-quality data products available to the broad science community
  - Conducting and sponsoring cutting-edge research
    - Field campaigns to complement satellite measurements
    - Analyses of non-NASA mission data
    - Modeling
  - Applied Science
  - **Developing technologies to improve Earth observation capabilities**
  - Education and Public Outreach



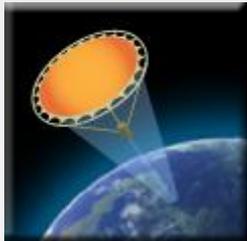
# Earth Science Technology: Program Elements

The Earth Science Technology Office (ESTO) is a **targeted, science-driven, competed, actively managed, and dynamically communicated technology program** and serves as a model for technology development.

Competitive, peer-reviewed proposals enable selection of best-of-class technology investments that **retire risk** before major dollars are invested: a cost-effective approach to technology development and validation.

ESTO investment elements include:

## Observation Technologies:



### **Instrument Incubator Program (IIP)**

provides robust new instruments and measurement techniques

### **Advanced Component Technologies (ACT)**

provides development of critical component and subsystem technologies for instruments and platforms

## Information Technologies:



### **Advanced Information Systems Technology (AIST)**

provides innovative on-orbit and ground capabilities for communication, processing, and management of remotely sensed data and the efficient generation of data products and knowledge

# Key Technology Challenges

**Active Remote Sensing Technologies** to enable atmospheric, cryospheric and earth surface measurements

**Large Deployables** to enable future weather, climate and natural hazards measurements

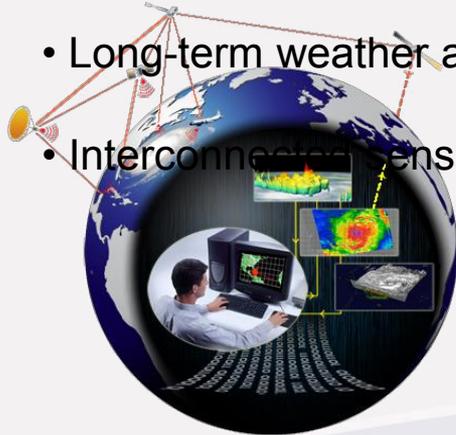
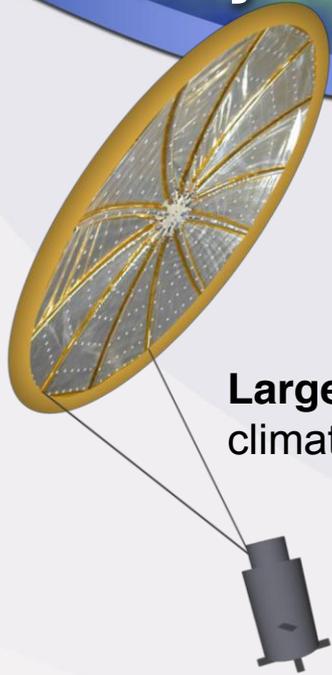
- Atmospheric chemistry using lidar vertical profiles
- Temperature, water vapor, and precipitation from geostationary orbit
- Ice cap, glacier, sea ice, and snow characterization using radar and lidar
- Soil moisture and sea surface salinity using L-band
- Tropospheric vector winds using lidar

**Intelligent Distributed Systems** using advanced communication, on-board processors, autonomous network control, visualization, holographic memory, and seamlessly linked models.

- Long-term weather and climate prediction linking observations to models
- Intelligent data fusion to merge multi-mission data

**Information Knowledge Capture** through 3-D visualization, holographic memory, and seamlessly linked models.

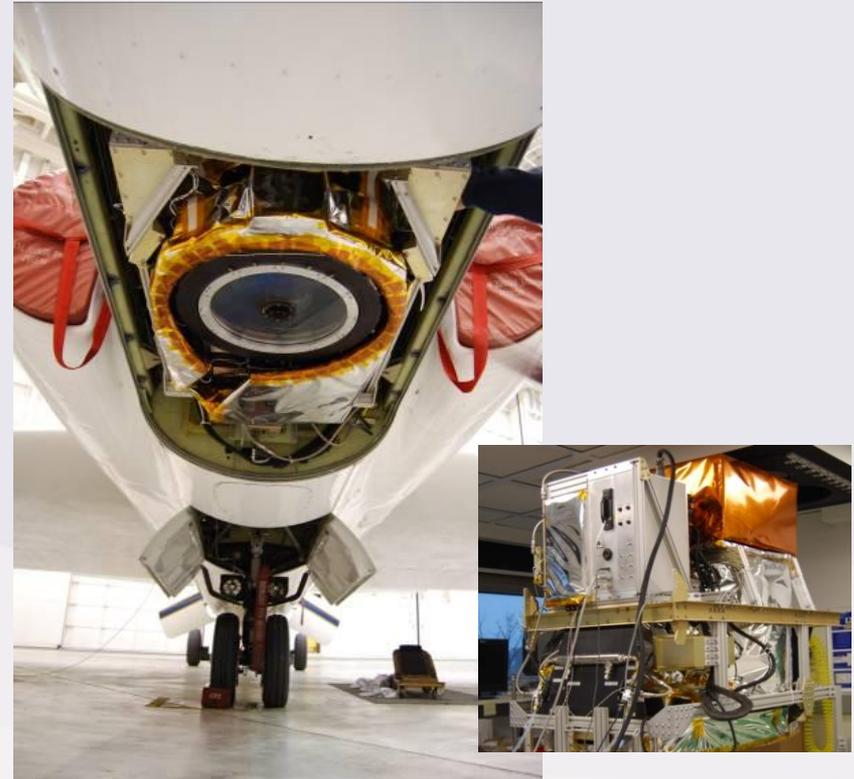
- Real time science processing, archiving, and distribution of user products



# Key Technology Challenges: Active Remote Sensing Technologies



The Doppler Aerosol Wind Lidar (DAWN) is an airborne coherent-detection, wind-profiling Doppler lidar system using state of the art 2-micron pulsed laser technology. DAWN was deployed on NASA's DC-8 aircraft in support of the NASA Genesis and Rapid Intensification Processes (GRIP) flight campaign. (*Kavaya, NASA LaRC*)



The Tropospheric Wind Lidar Technology Experiment (TWiLiTE) project developed an airborne direct-detection Doppler lidar wind instrument that was integrated into the NASA ER2 aircraft in 2009. (*Gentry, NASA GSFC*)



# Highlights: UAVSAR

## Heritage



**AIRSAR**

## Status



**UAVSAR**

## Future



**UAVSAR Global Hawk  
(in development)**

## UAVSAR Capabilities:

- 2X better resolution than AIRSAR
- Agile waveform
- Multimode operation
- Over 1.2 million km<sup>2</sup> of L-Band Radar imagery
- Supporting DESDynI, SMAP and IPY
- Global Hawk UAV will carry two pods to enable increased range and Single Pass Interferometry

	<b>First Flight</b>	<b>Mass</b>	<b>Power</b>	<b>Volume</b>
<b>AirSAR</b>	1988	3840 lbs	> 10 KW	> 1500 cu ft
<b>UAVSAR</b>	2008	~1000 lbs	2.1 KW	81 cu ft

*Today, UAVSAR is a fully capable airborne instrument for measurements of surface features – from glacier movement and seismic activity to vegetation change to land subsidence and groundwater use.*

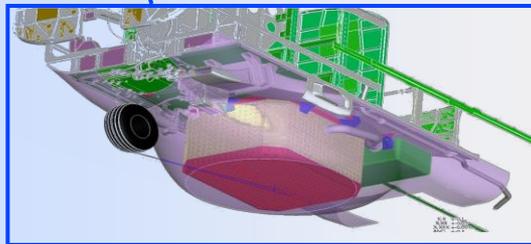


# Technology Developments on UAVs



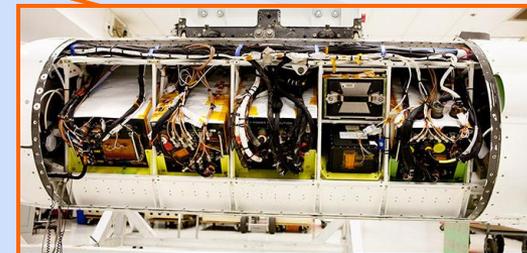
## Land, Vegetation, & Ice Sensor (LVIS)

This task will integrate the LVIS capability onto the Global Hawk and provide an automated, reliable package for high altitude measurements.



## Global Ozone Lidar Demonstrator (GOLD)

GOLD will enable, for the first time, Ozone LIDAR measurements from a high-altitude aircraft that support global atmospheric composition and climate change investigations.



## UAVSAR

The Uninhabited Aerial Vehicle – Synthetic Aperture Radar (UAVSAR) project will install two existing UAVSAR pods on a UAV for the first time. On Global Hawk, UAVSAR will generate precise topographic maps and single-pass polarimetric interferograms of ice and vegetation.



# Stimulus-Funded Development: Facility Class Instruments

## Enhanced MODIS Airborne Simulator (eMAS)

This task will replace major subsystems on the MAS to extend its service life, increase reliability and improve data. The task will also increase spectral coverage, resolution, and calibration accuracy. The upgraded MAS will fly on the NASA ER-2.

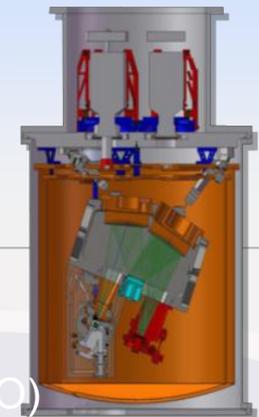


## Portable Remote Imaging Spectrometer (PRISM)

PRISM will be a UV-NIR (350 to 1050 nm) spectrometer capable of airborne measurements from a variety of platforms. PRISM will be particularly optimized for coastal ocean measurements, with unprecedented sensitivity across the large range of coastal reflectance. PRISM will be test flown on the DHC-6 Twin Otter.

## Next Generation Airborne Visible InfraRed Imaging Spectrometer (AVIRISng)

This next generation AVIRIS-class imaging spectrometer will help continue measurements of upwelling spectral radiance and support the HypSIRI Decadal Survey mission. Several new subsystems will help AVIRISng to achieve a factor of two improvement in SNR and spectral resolution relative to AVIRIS, as well as significant reductions in mass and volume for future flights on the DHC-6 Twin Otter.



# Airborne Science Program

## Observing Platforms for Earth System Science Investigations



WB-57



Global Hawk



ER-2



G III



Learjet



DC-8



Ikhana



P-3



S-3B



B-200



Twin Otter



SIERRA



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