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FACT SHEET

The Cloud-Aerosol Transport System (CATS): A New Earth Science Capability for ISS

PI: Matthew McGill | Science Lead: John Yorks

Why is CATS Important?

- *Current uncertainties in cloud and aerosol properties limit our ability to accurately model Earth's climate system and predict climate change*
- *CATS provides vertical profiles of cloud and aerosol properties on a global scale to address these uncertainties*
  - *Improve aerosol and air quality model forecasts*
  - *Provide data for studies of climate issues such as cloud-aerosol interaction*
- *CATS will fill the looming data gap in global lidar measurements after CALIPSO*

Japanese Experiment Module-Exposed Facility (JEM-EF) on the International Space Station (ISS)

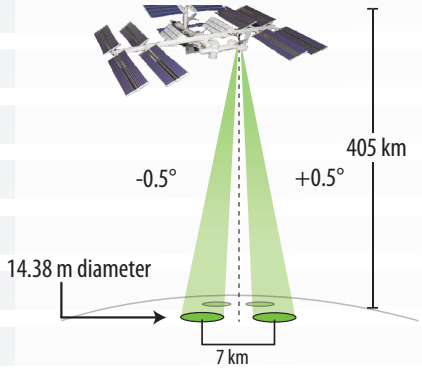
CATS Overview

- *CATS is a lidar remote sensing instrument for use on the International Space Station (ISS)*
  - *Installed on the Japanese Experiment Module – Exposed Facility (JEM-EF)*
  - *Intended to operate on-orbit for at least 6 months, and up to 3 years*
  - *Launch in late 2014*
- *CATS provides vertical profiles of cloud and aerosol properties at 3 wavelengths (355, 532, 1064 nm)*
- *CATS payload is based on existing instrumentation built and operated on high-altitude NASA ER-2 aircraft*
  - *Cloud Physics Lidar (CPL)*
  - *Airborne Cloud-Aerosol Transport System (ACATS)*
- *Operates in 1 of 3 main science modes to meet mission goals*
  - ***CALIPSO-like multi-beam mode (532 and 1064 nm)***
  - ***High Spectral Resolution Lidar (HSRL) technology demonstration mode (532 nm)***
  - ***UV (355 nm) technology demonstration mode (with 532/1064 nm)***

Operating Modes

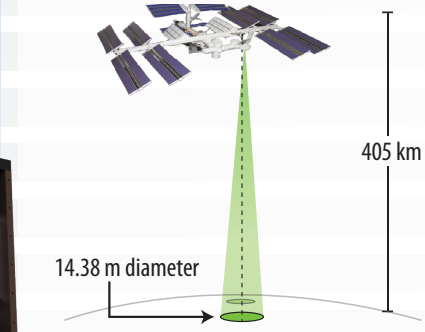
MULTI-BEAM MODE

CALIPSO-like: 532/1064 nm



TECH DEMO MODES

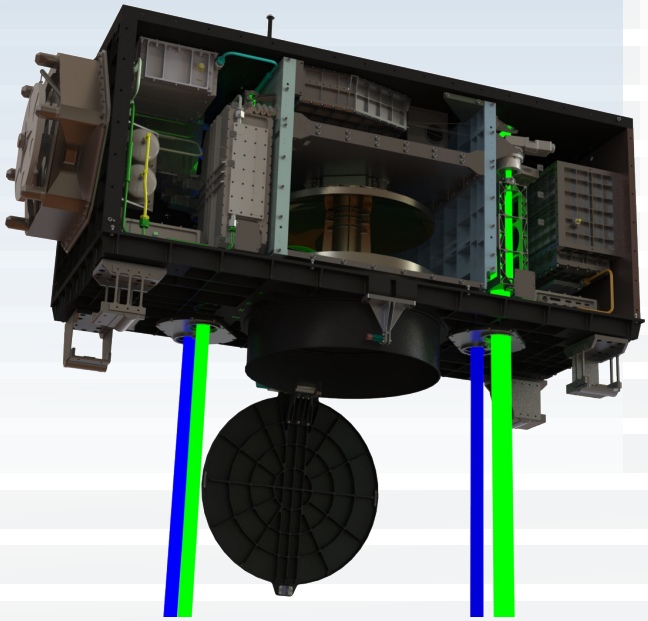
CALIPSO-like: 532/1064 nm
HSRL: 532 nm
UV: 355 nm



Instrument

- *CATS employs 2 high repetition rate lasers*
  - *One operates at 2 wavelengths (532, 1064 nm)*
  - *Second is seeded to provide narrow linewidth for HSRL measurements and frequency-tripled for use at 355 nm*
- *CATS has a 60 cm beryllium telescope with narrow field-of-view (FOV)*
  - *4 instantaneous fields of view (IFOV)*

Laser 1 Type	Nd: YVO_4
Laser 1 Wavelengths	532,1064 nm
Laser 1 Rep. Rate	5000 Hz
Laser 1 Output Energy	~1 mJ/pulse
Laser 2 Type	Nd: YVO_4, seeded
Laser 2 Wavelengths	355, 532,1064 nm
Laser 2 Rep. Rate	4000 Hz
Laser 2 Output Energy	~2 mJ/pulse
Telescope Diameter	60 cm
View Angle	0.5 degrees
Telescope FOV	110 microradians



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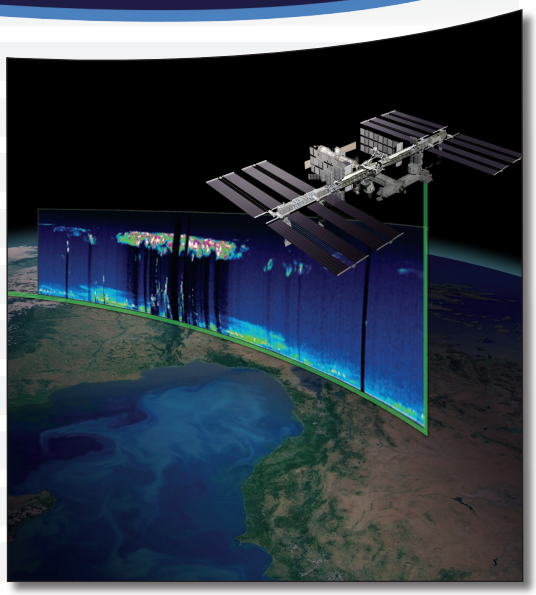
Science Goals

- *Extend global lidar data record for continuity of climate observations*
  - *Continue record of vertical profiles of cloud/aerosol properties*
  - *Improve our understanding of aerosol and cloud properties and interactions*
  - *Improve model based estimates of climate forcing and predictions of future climate change*
- *Improve operational aerosol forecasting programs*
  - *Improve model performance through assimilation of near-real-time cloud/aerosol data*
  - *Enhance air quality monitoring and prediction capabilities by providing vertical profiles of pollutants*
  - *Improve strategic and hazard warning capabilities of events in near-real-time (dust storms, volcanic eruptions)*
- *Technology demonstration for future space-based lidar missions*
  - *Demonstrate HSRL aerosol retrievals and 355 nm data for future mission development*
  - *Laser Technology Demo/Risk Reduction: high repetition rate, injection seeding (HSRL), and wavelength tripling (355 nm)*

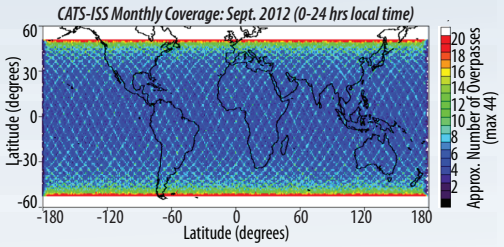


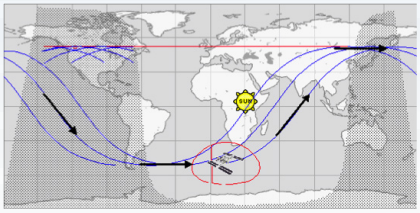
Nature of CATS Development

- *CATS is not a "business as usual" project for NASA science*
  - *Not a flight mission – it is an attached payload launched as cargo*
  - *Intended as a pathfinder for quick turn-around, low-cost Class D payloads*
  - *Being used as a pathfinder for NASA-developed attached science payloads for ISS*
  - *ISS defined the success criteria – not driven by science measurements/products (build-to-cost/ build-to-schedule, **not** build-to-requirements)*
  - *Heavily streamlined, efficient management and reporting processes*
- *CATS leverages numerous NASA investments to enable cost effective science:*
  - *Heritage from multiple aircraft instrument developments*
  - *Multiple SBIR/STTR-derived technologies*
  - *ESTO and technology investments*

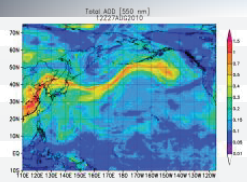
ISS Utilization

- *ISS provides a low-cost platform for earth science capabilities*
- *ISS orbit is a 51° inclination orbit at an altitude of about 405 km*
  - *Provides more comprehensive coverage of tropics and mid-latitudes than sun-synchronous orbiting sensors*
    - *Primary aerosol transport paths*
  - *Nearly a 3 day repeat cycle (1° × 1° grid box)*
  - *Permits study of diurnal (day to night) changes in aerosol/cloud effects*
    - *Cannot be achieved with other Earth Science satellite orbits*





Science Overview



Research

Forecasting