Cloud-Aerosol Transport System (CATS) for ISS
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An Unprecedented Opportunity

• CATS is a lidar remote sensing instrument designed to provide profile measurements of aerosol and clouds.
• CATS is a directed opportunity from the ISS National Laboratory to improve science utilization of the ISS.
• CATS is an attached payload for the JEM-EF – the first such payload developed by NASA.
• CATS is not a “business as usual” project – it is specifically intended to demonstrate a low-cost, streamlined approach to developing ISS payloads, akin to the Shuttle Hitchhiker payloads.
• CATS is one of the first ISS payloads dedicated to Earth Science.

The CATS project has three simultaneous goals:
1. Provide long-term (~4 months to ~3 years) operational science from ISS
   • airborne instrument heritage ensures success
   • provide data continuity beyond CALIPSO
2. Provide tech demo on-orbit
   • high rep-rate laser
   • photon-counting detection
   • UV (355 nm) laser operation in space
3. Provide risk reduction for future Earth Science missions
   • UV (355 nm) laser operation in space
   • HSRL receiver concept

CATS is strongly based on heritage from the ER-2 Cloud Physics Lidar (CPL) and the airborne CATS instruments.

Science Capabilities

The goal of the CATS lidar is to provide near-real-time measurements of clouds and aerosol that can be assimilated into aerosol transport models.

Lidar profiling generates a time-height cross-section of the atmosphere, revealing cloud and aerosol structure. From this data information on layer boundaries, optical depth, extinction, depolarization, and at least a coarse discrimination of aerosol type (e.g., smoke, dust pollution) can be derived.

Lidar measurements that can simultaneously identify aerosols, provide vertical context, and monitor the transport of aerosols will make important contributions to NASA science goals.

Data Products

CATS has multiple operational modes, but primary attributes include:
• A 532 nm HSRL channel to provide aerosol backscatter profile
• Extinction profile
• Optical depth
• 355, 532, and 1064 nm backscatter channels, all with polarization sensing capability
• Corrected backscatter ratio
• Extinction profile (assuming S-ratio)
• Color ratio for aid in aerosol typing
• Depolarization ratio for phase and aerosol typing

Measurement resolution can be traded for measurement accuracy, but the baseline resolution is 30 m vertical by 1/20 second (~350 m horizontal).

Models are used to determine climate forcing and predict future climate change. Observations provide constraints needed to model aerosol properties and behavior. CATS can help improve the vertical distribution of aerosol and aerosol type.

Data Applications

The ISS orbit (51-degree inclination) permits extensive measurements over primary aerosol source and aerosol transport regions. The orbit also allows for study of diurnal effects.

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CATS Payload

The CATS payload is a standard JEM-EF volume (approximately 1.5 m x 1 m x 0.8 m). Payload mass is limited to 500 kg.

Cut-away view showing internal payload components. A 60-cm diameter telescope occupies the main portion of the volume. Two lasers (for redundancy and for tech demo purposes) are mounted on either side of the telescope.

The Payload Interface Unit (PIU) provides the connection to the JEM-EF. Power, data, and coolant fluid pass through the PIU to the payload.