

Laser Remote Sensing from ISS: CATS Cloud and Aerosol Level 2 Data Products (Heritage Edition)

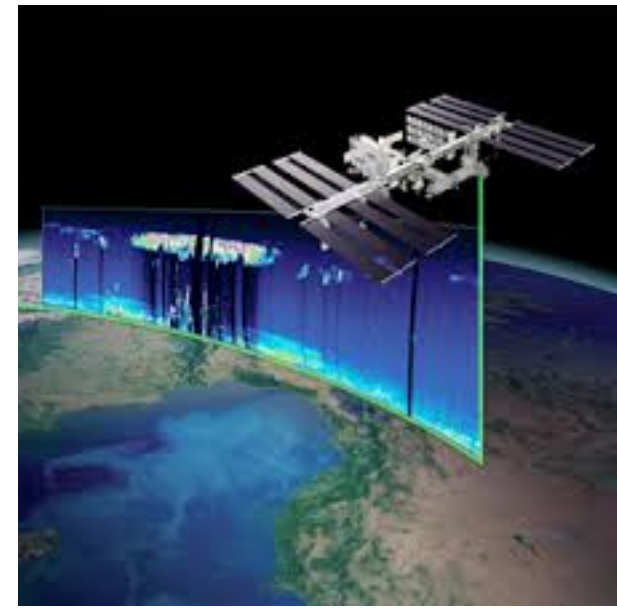
Sharon Rodier⁽¹⁾, Mark Vaughan⁽³⁾, Steve Palm⁽²⁾, Mike Jensen⁽¹⁾, John Yorks⁽²⁾, Matt McGill⁽⁴⁾, Chip Trepte⁽³⁾, Tim Murray⁽¹⁾, Kam-Pui Lee⁽¹⁾

⁽¹⁾ Science Systems and Applications Inc., Langley Research Center, Hampton VA, USA

⁽²⁾ Science Systems and Applications Inc., Goddard Space Flight Center, Greenbelt, MD USA

⁽³⁾ NASA, Langley Research Center, Hampton VA, USA

⁽⁴⁾ NASA, Goddard Space Flight Center, Greenbelt, MD USA



Introduction:

The Cloud-Aerosol Transport System (CATS) instrument was developed at NASA's Goddard Space Flight Center (GSFC) and deployed to the International Space Station (ISS) on 10 January 2015. CATS is mounted on the Japanese Experiment Module's Exposed Facility (JEM_EF) and will provide near-continuous, altitude-resolved measurements of clouds and aerosols in the Earth's atmosphere. The CATS ISS orbit path provides a unique opportunity to capture the full diurnal cycle of cloud and aerosol development and transport, allowing for studies that are not possible with the lidar aboard the CALIPSO platform, which flies in the sun-synchronous A-Train orbit.

One of the primary science objectives of CATS is to continue the CALIPSO aerosol and cloud profile data record to provide continuity of lidar climate observations during the transition from CALIPSO to EarthCARE. To accomplish this, the CATS project at NASA's Goddard Space Flight Center (GSFC) and the CALIPSO project at NASA's Langley Research Center (LaRC) are closely collaborating to develop and deliver a full suite of CALIPSO-like level 2 data products that will be produced using the newly acquired CATS level 1B data whenever CATS is operating in science modes 1. The CALIPSO mission is now well into its ninth year of on-orbit operations, and has developed a robust set of mature and well-validated science algorithms to retrieve the spatial and optical properties of clouds and aerosols from multi-wavelength lidar backscatter signals. By leveraging both new and existing NASA technical resources, this joint effort by the CATS and CALIPSO teams will deliver validated lidar data sets to the user community at the earliest possible opportunity. The science community will have access to two sets of CATS Level 2 data products. The "Operational" data products will be produced by the GSFC CATS team utilizing the new instrument capabilities (e.g., multiple FOVs and 1064 nm depolarization), while the "Heritage" data products created using the existing CALIPSO algorithms and the CATS 532 nm channels and the total 1064 nm channel

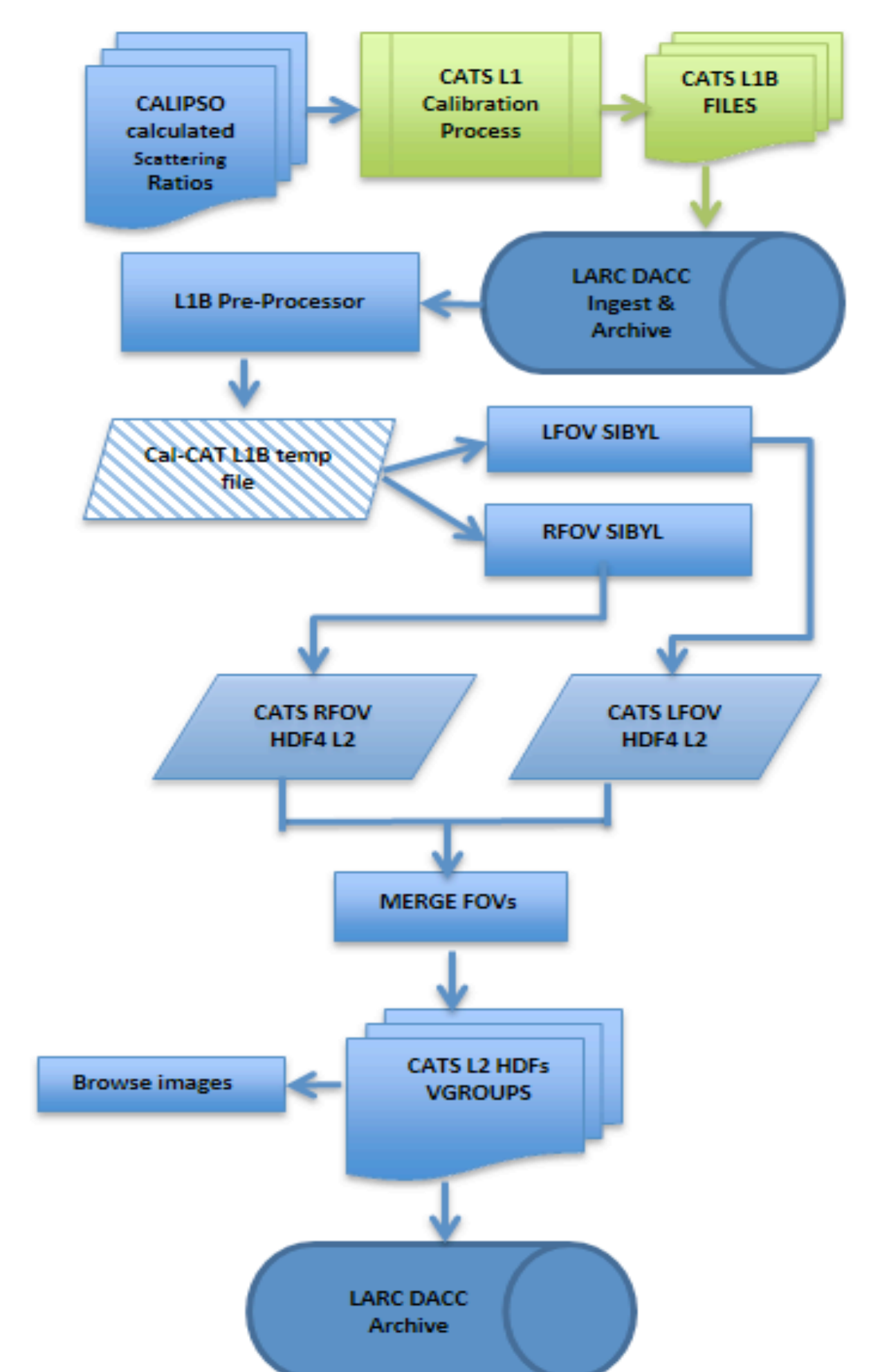
Below is the development of the CATS "Heritage" level 2 software and data along with some initial results with operational data.

METHODOLOGY:

Producing high quality CALIPSO-like Level 2 products requires addressing differences between the instrument sampling rates, vertical resolution, and signal-to-noise (SNR) characteristics. To ingest the CATS data, the 532 nm and 1064 nm attenuated backscatter channels must be converted from single shot profiles sampled at ~350 m horizontally with a uniform 60 m vertical resolution spanning a total of 30 km (28 km to -2 km), to the CALIPSO 5 km downlinked major frame structure that consists of 15 profiles sampled at ~330 m horizontally that span 42 km (40 km to -2 km) vertically and are averaged onboard both vertically and horizontally to different spatial resolutions that vary with range from the lidar. Additional required parameters such as molecular and ozone number density are also calculated and ancillary instrument parameters are extracted to create required CALIPSO parameters such as QC Flags, noise scale factors, and RMS background measurements. A set of four software modules (called Product Generation Executables or PGEs) were constructed to accomplish these tasks:

- 1) Ingest/Archive: receives CATS data files from GSFC and archives them for ordering by the public via the LaRC Atmospheric Sciences Data Center.
- 2) L1B Pre-Processor: converts CATS L1B into CALIPSO-like L1B by applying CALIPSO's onboard averaging scheme to the CATS data.
- 3) L2 FOV Merge: while each CATS FOV is processed separately by the Heritage software, the results from both FOVs are reported in single L2H data files. This is consistent with the CATS L1B files, which also report all FOVs in a single file for each day and night orbit segment.
- 4) CATS Lidar Browse Image creation: generates images of the CATS L1B and L2H data products for display on the CATS web pages.

Due to SNR differences between the two instruments, turning of the detection levels threshold will be required to accurately perform feature classification of the clouds and aerosols in each scene. Preliminary results from the first CATS downlinks show that the CATS SNR is higher than the CALIPSO SNR at night, especially at 1064 nm. With respect to the Level 2 Heritage products, these differences are expected to have minimal impact on the quality of the layer detection and optical properties results reported in the L2H products, largely due to the extensive spatial averaging done by the CALIPSO retrieval algorithms.



The Heritage processing flow for Science Mode 1. From ingest to pre-processing, execution of the L2 algorithms, to post-processing and finally archival of the CALIPSO-like data sets

CATS and CALIPSO Coincident Measurements

