1. Introduction

The Cloud–Aerosol Transport System (CATS) lidar has been operating onboard the International Space Station (ISS) since February 2015 and provides vertical observations of clouds and aerosols using total attenuated backscatter and depolarization measurements. From February – March 2015, CATS operated in Mode 1, providing backscatter and depolarization measurements at 353 and 1064 nm. CATS began operation in Mode 2 in March 2015, providing backscatter and depolarization measurements at 1064 nm and has continued to operate in the present mode. CATS level 2 products are derived from these measurements, including feature detection, cloud – aerosol discrimination, cloud and aerosol typing, and optical properties of cloud and aerosol layers. Here, we present changes to our level 2 algorithms, which were aimed at reducing several biases in our version 1 level 2 data products. These changes will be incorporated into our upcoming version 2 level 2 data release in summer 2017.

Additionally, owing to the near – real time (NRT) data downlinking capabilities of the ISS, CATS provides expedited NRT data products within 6 hours of observation time. This capability provides a unique opportunity for supporting field campaigns and for developing data assimilation techniques to improve simulated cloud and aerosol vertical distributions in models. We additionally present preliminary work toward assimilating CATS observations into the NASA Goddard Earth Observing System version 5 (GEOS-5) global atmospheric model and data assimilation system.

2. Modifications to Cloud – Aerosol Discrimination

Experiments conducted in marine boundary layers proved challenging for the CATS version 1 cloud – aerosol discrimination algorithm. Owing to their high backscatter, this misclassification had significant implications for the aerosol optical thickness (AOT), as the lidar ratio for used aerosol layers if often greater than the lidar ratio used for water clouds. In the CATS version 2 cloud – aerosol discrimination algorithm, a horizontal persistence test has been implemented and modifications to algorithm thresholds have been made to reduce the misclassification of water clouds as aerosol.

3. Updated Aerosol Typing Algorithm and Lidar Ratios

The CATS mode 2 version 1 aerosol typing algorithm was designed similarly to the CALIPSO aerosol typing algorithm. Notable differences include CATS aerosol typing was performed at 1064 nm vs. 353 nm for CALIPSO and a refined elevated aerosol definition for improved smoke identification over marine layers based on Nowottnick et al. [2015]. The CATS mode 2 version 2 aerosol typing algorithm has several modifications to the version 1 algorithm, including:

- Reduction in dust & dust mixture depolarization ratio thresholds based on aerosol type comparisons with CALIPSO over south Asia
- Incorporation of a horizontal persistence test to reduce type “striping” in aerosol layers
- Utilization of GEOS-5 simulated aerosols to help discriminate polluted continental vs. smoke aerosol layers to permit polluted continental classification over water

4. CATS NRT Data Applications

CATS NRT data products are available within 6 hours of data acquisition and include observed L1B data (total attenuated backscatter & depolarization ratio) and L2 vertical feature mask products. As a result, CATS NRT data has been used in the flight planning of several field campaigns.

We also are developing a 1-D ensemble data assimilation technique for assimilating cloud-cleared CATS observations into GEOS-5 to correct simulated vertical distributions of aerosols.

5. Summary

CATS continues to operate on the ISS providing high quality observations of clouds and aerosols. Our updated version 2 level 2 products will be released during summer 2017 and include:

- Improved cloud – aerosol discrimination
- An updated aerosol typing algorithm that utilizes GEOS-5 aerosols for classifying smoke and polluted continental aerosols

CATS NRT products are available for field campaign support and are being utilized to develop a 1-D ensemble assimilation technique in GEOS-5.