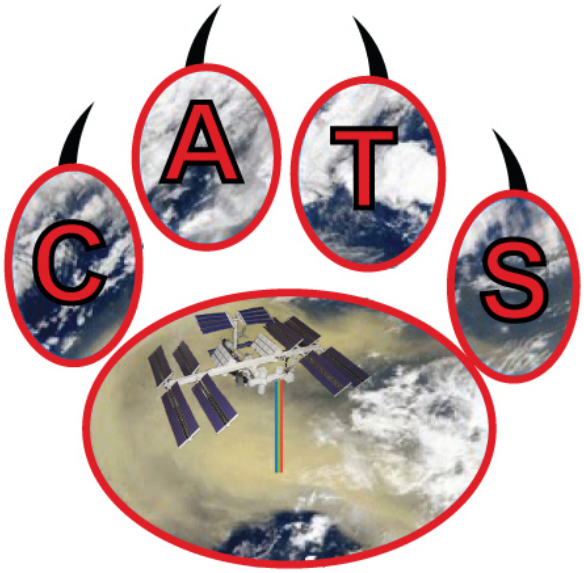


# CATS Data Release Notes
# L2O Version Releases: 1.05

02 September 2016

The Cloud-Aerosol Transport System (CATS), launched on 10 January 2015, is a lidar remote sensing instrument that provides vertical profiles of atmospheric aerosols and clouds. The vertical profile information obtained by CATS, particularly at multiple wavelengths and with depolarization information, provides height location of cloud and aerosol layers, as well as information on particle size and shape. The CATS instrument provides measurements of cloud and aerosol profiles similar to CALIPSO, filling in the gap in diurnal coverage of CALIPSO, so this information can continually be used to improve climate models and our understanding of the Earth system and climate feedback processes. Changes in algorithms for our fifth release corresponding to our Version 1.05 Level 2 data products are described here.

## 1.0 Algorithm Changes

The following list of algorithm changes were made in L2O Version 1.05:

- The CATS Version 2-07 L1B data improved the accuracy of the backscatter calibration, in turn decreasing the magnitude of the attenuated total backscatter values at 532 and 1064 nm. Since the CATS layer detection algorithm relies on threshold values of 1064 nm attenuated total backscatter, these thresholds were updated in L2O Version 1.05 to improve sensitivity to layer detection of optically thin cloud and aerosol features.
- The cloud phase score was updated to represent less confidence in layers with mid-layer temperatures between 0 and -20 C.

- After a more thorough comparison of CATS and CPL lidar ratios and extinction coefficients within ice clouds, the CATS layer effective multiple scattering factors were updated in V1-05 products to:
    - *Ice Clouds*: Values of 0.673 (Mode 7.2) and 0.423 (Mode 7.1) at 1064 nm and 0.545 (Mode 7.1) at 532 nm (Note: these values are still being tested and may be updated in future data product versions). Previous versions used 0.77 at all wavelengths and modes, derived from scaling the CALIPSO layer effective multiple scattering factor of 0.60 using instrument measurement geometries. In theory, the multiple scattering factor should be the same for both modes. These current multiple scattering factors, especially in Mode 7.1, likely include instrument biases in addition to multiple scattering effects.
    - *Water Clouds*: Values of 0.55 (Mode 7.2, 1064 nm), 0.50 (Mode 7.1, 532 nm), and 0.40 (Mode 7.1, 1064 nm) are used for water cloud effective multiple scattering factors at both wavelengths based on scaling the CALIPSO values. More work will be conducted to update this value for future versions.
    - *Aerosols*: A value of 1.00 is used for both wavelengths, as was the case in previous versions. CALIPSO also uses a value of 1.0.

## 2.0 Parameter Specific Comments

**Mode 7.2 532 nm Integrated Attenuated Backscatter**
Unlike the Mode 7.1 data, where the 532 and 1064 nm signals are comparable, the Mode 7.2 532 and 1064 nm signals are very different. Mode 7.2 data at 532 nm is noisy due to issues with stabilizing the seeded laser (laser 2). Since the frequency stability is poor on laser 2, it is not aligned properly with the CATS etalon causing very weak signal transmission. Unfortunately we do not have the necessary controls to fix the problem. **We do not recommend using the 532 nm integrated attenuated backscatter in Mode 7.2 for any application.** In fact, very few parameters are reported at 532 nm in CATS L2O products due to the increased noise.

Due to the signal transmission issues at 532 nm, laser 2 was thermally tuned to increase the laser energy at 1064 nm to 2 mJ per pulse. Thus the 1064 nm signal in mode 7.2 is very robust, with higher signal-to-noise ratio and lower minimum detectable backscatter than the Mode 7.1 data. **We highly recommend using the 1064 nm data for any analysis that is wavelength-independent (i.e. layer detection, relative backscatter/extinction intensity).**

**Layer Top/Base Altitude**
Strongly scattering layers are more accurately detected than weakly scattering layers, especially during daytime. Because signal-to-noise ratios (SNR) are higher during nighttime compared to daytime, nighttime detection of features is easier than daytime. This is typical for all lidar systems. When analyzing cloud or aerosol boundary heights at various times of day, using a minimum threshold for AOD (i.e. layers with AOD > 0.50)

or integrated attenuated backscatter (layers with IAB > 0.02) that is typically detected during both night and day conditions is recommended.

Please note that when using a small amount of data (several granules), layer detection may favor some bins over others due to interpolation from the raw 78 m vertical bins to the 60 m vertical bins reported in the data products. This affect is very minimal when using large amounts of data (>200 granules). Also, the base bin/altitude reported may not be the true base. For highly scattering features, the layer base may appear lower than it really is due to multiple scattering effects and opaque layers that completely attenuate the backscatter signal will cause the reported base to be higher than reality.

For L2O V1-05, the layer base bin is decreased by one bin (increase in height) when the base bin is directly above the surface detection. This was done to avoid contamination of the layer-integrated properties of aerosol layers near the surface from the surface return signal.