In the CALIOP retrieval algorithm, detection of a layer from the backscatter measurements is followed by its classification as a "cloud" or "aerosol", currently using 5-dimensional Probability Density Functions (PDFs) which are derived using a training set (Liu et al., 2009). The five dimensions are the mean attenuated backscatter at 532 nm, the layer integrated total attenuated color ratio, the mid layer altitude, integrated volume depolarization ratio and latitude. With the release of the new version 4 level 1 data, it became necessary to optimize the CAD algorithm for the version 4 level 2 data. Accordingly, a new set of CAD PDFs was generated and has subsequently been used in test versions of new level 2 data. A new element in version 4 is to extend the algorithm to stratospheric altitudes, where volcanic layers as well as occasional cloud and smoke layers are observed. Yet another important application of the new CAD algorithm relates to the layers detected at the single shot (333 m) resolution, even though these layers were not used in the training sets for building the PDFs. These are dense layers often seen embedded within large scale dust, smoke and marine layers and are detected using the 1064 nm backscatter measurements. In the past, these layers were classified as clouds by default and removed before averaging over the weaker signals (Vaughan et al., 2009). We present characterization and performance of the new CAD algorithm for all of these components, i.e., in the troposphere, stratosphere as well as for the single shot layers. Only nighttime data are used for the analyses presented here.

**OVERALL CHANGES FROM VERSION 3 TO VERSION 4**

Most samples in V4 classified with high confidence (CAD>70), but the fraction with low/medium scores (<40>CAD<40) has also increased.

Layers which have changed types (aerosol to clouds and vice versa) generally have low CAD score (expected).

A significant fraction of V3 aerosols gets reclassified as V4 clouds in mid to high southern latitudes in June 2008 – consistent with general lack of aerosol sources in these regions.

Some clouds in V3 become aerosols in V4 in the northern tropics. A smaller fraction of clouds becomes aerosols at high southern latitudes often having high depolarization and are likely misclassified clouds, as in so suggested by a larger number of cirrus fringes in V4.

**INTRODUCTION**

**CAD PERFORMANCE IN THE TROPOSPHERE**

**CAD PERFORMANCE IN THE STRATOSPHERE**

Aerosol V3 vs V4 Cloud Change, June 2008, Night

Clouds V3 vs V4 Change, June 2008, Night

**CAD FOR SINGLE SHOT LAYERS (333M)**

**CONCLUSIONS**:

- V4 CAD has made significant improvements in the troposphere, including classification of thick layers over Taklamakan desert and transport of layers from Asia to springing Arctic.
- In the stratosphere, volcanic layers and STS layers in the PSC regime are being correctly classified.
- V4 CAD has been successful in classifying the thick single shot (333m) aerosol layers embedded within extended dust plumes.

**REFERENCES**

- Chen, B. et al., Detection of dust aerosol by combining CALIPSO active lidar and passive IR measurements, Atmos. Chem. Phys., 10, 4241-4251, 2010