# Recent Improvements to CALIOP Level 3 Aerosol Profile Product for Global 3-D Aerosol Extinction Characterization

**Overview of the Level 3 Aerosol Profile Product**

<table>
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<tbody>
<tr>
<td>Version 1 Beta:</td>
<td>December 2011</td>
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**Aerosol extinction profiles & aerosol optical depth**
- Monthly-averaged
- Near-global coverage (82°S to 82°N) below 12 km
- Derived from CALIPSO level 2 aerosol extinction

**Sky Conditions**
- All Sky
- Cloud Free
- Cloudy-Sky, Transparent
- Cloudy-Sky, Opaque

**Overview of Sky Conditions**
- All profiles averaged, regardless of cloud cover.
- Provides view of entire column.
- Only profiles with transparent clouds averaged.
- Inaccessible to passive observations or cause biases in passive retrievals.

“Sky condition” defines cloud cover in aerosol extinction profiles that are averaged together. Above, aerosol extinction profiles in white are excluded for the given sky condition.

**New Sky Conditions**

- **All-Sky**
- **Cloud-Free**
- **Cloudy, Transparent**
- **Cloudy, Opaque**

**Negative Signal Anomaly Mitigation**

Occasional anomalously negative backscatter on surface can cause very negative or low-biased extinction in lowest range bin.

**Ver. 3 Mitigation Strategy:** Ignore Level 2 extinction within 60 meters of surface prior to generating Level 3 average.

**Changes in Extinction and AOD Relative to Version 1**

- All-species extinction profile changes are confined to lowest 2-3 km. Largest difference in 1-2 bins near surface.
- Updated averaging strategy recommended by Amiridis et al. 2013 greatly reduces high bias in V1 dust extinction profiles.

<table>
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<tr>
<th>Global Aerosol Extinction 2008-08, Night</th>
<th>Global Dust Extinction 2008-08, Night</th>
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<tr>
<td>All aerosol species</td>
<td>Dust</td>
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**Motivation for Improvements**

In the Version 1 Beta release of the Level 3 Aerosol Product:
- Sky conditions are confusing and misrepresentative
- Due to Level 3 averaging, Column AOD Mean is biased low
- Dust-only averages are biased high (Amiridis et al., 2013)

Artifacts exist in extinction profiles near surface

The Version 3 release improves these aspects of the product.

**Level 3 Extinction over Pacific Ocean**

**Corrected Column AOD Computation**

Two methods to compute monthly-mean column AOD from level 2 aerosol extinction profiles:

**Method 1:** Average column AODs

**Method 2:** Integrate averaged extinction

**Improved Single Aerosol Species Averages**

- Extinction and AOD reported separately:
  - All aerosol species
  - Polluted dust
  - Dust
  - Smoke

**Data Availability**

- Level 3, Version 3 now available for the entire CALIOP mission (Jun 2006 to current month-1)
- Data and documentation: https://eosweb.larc.nasa.gov
- Winker et al., 2013 ACP

**References:**

Ma et al., 2013, “Comparison of AOD between CALIPSO and MODIS: significant differences over major dust and biomass burning regions”, Atmos. Meas. Tech., 6, 2391-2401


Winker et al., 2013, “The global 3-D distribution of tropospheric aerosols as characterized by CALIOP”, Atmos. Chem. Phys., 13, 3345-3361