Validation of CALIPSO Lidar Observations Using Data From the NASA Langley Airborne High Spectral Resolution Lidar

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Overview
This poster focuses on preliminary comparisons of data from the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) instrument on the Cloud-Aerosol Lidar and Infrared PathfinderSatellite Observations (CALIPSO) spacecraft with data acquired by the NASA Langley Airborne High Spectral Resolution Lidar (HSRL). A series of 20 aircraft validation flights was conducted from 14 June through 27 September 2006, under both day and night lighting conditions and a variety of aerosol and cloud conditions. This poster presents comparisons of CALIOP measurements of attenuated backscatter at 532 and 1064 nm and depolarization at 532 nm with near coincident measurements from the airborne HSRL as a preliminary assessment of CALIOP calibration accuracy.

Note that the CALIOP data presented here are the pre-release version. These data have known artifacts in calibration which have been corrected in the December 8 CALIPSO data release which was not available at the time the comparisons were conducted for this poster. The HSRL data are also preliminary. No artifacts are known to exist; however, refinements in calibration and algorithms are likely to be implemented before validation comparisons are made final.

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Validation Methodology

- 20 CALIOP validation flights conducted between June 14 – Sept 27, 2006
- 4 night lights
- 12 – day lights
- 6 flights coordinated with other platforms on TexAQS/GoMACCS
- Validation Instrument: Airborne High Spectral Resolution Lidar (HSRL)
- Aircraft Platform: NASA Langley King Air B-200

Quantitative CALIOP-HSRL Comparisons

Quantitative HSRL-CALIOP data comparisons are possible only for portions of flight tracks that are cloud free above the aircraft platform. As shown below, the King Air nominally flies at approximately 9 km. Attenuation of the CALIOP lidar signal from cloud free above the aircraft makes quantitative comparison difficult.

The arrows on the image plot indicate regions over which the CALIOP and HSRL data were horizontally averaged to improve the temporal coincidence between the satellite and airborne data. The arrows on the line plots indicate the altitude regions over which the profile data were averaged for the computation of the relative differences indicated on the plots.

Segments of the 8 August HSRL data in near coincidence with CALIPSO show excellent agreement at both the 532 and 1064 nm wavelengths. In the top line plot figure, the quantitative comparisons were limited to regions above boundary layer clouds. Because of the rapidly varying nature of boundary layer clouds and the unavoidable temporal mismatch between the satellite and aircraft based measurements, boundary layer clouds provide a poor target for calibration assessment.

Airborne High Spectral Resolution Lidar

- Independently measures aerosol/cloud extinction and backscatter at 532 and 1064 nm
- Includes:
  - Backscatter channels at 1064 nm
  - Polarization sensitivity at 532 and 1064 nm
- Measurement capabilities:
  - Extensive measurements
  - Backscatter at 532 and 1064 nm
  - Extensive measurements
  - Scattering at 532 nm
  - Intensive measurements
  - Coherence (or Angstrom exponents) for backscatter (\(C_{\Delta\lambda}/q\))
  - Coherence to backscatter ratio at 1064 nm
- Depolarization at 532 and 1064 nm

Future Plans

- Quantitative comparisons for all validation flights
  - Incorporate cloud clearing into both CALIOP and HSRL data set for more accurate calibration comparisons
  - CALIOP Calibration assessment
  - 532 and 1064 nm total backscatter
  - Depolarization ratio
  - Assessment of CALIOP Level 2 products
  - Cloud-aerosol discrimination
  - \(q\) selection
  - Aerosol backscatter
  - Aerosol extinction
  - Aerosol depolarization
  - Layer base/top altitudes
  - Calibration below layers
  - Assessment of new algorithms using HSRL data for test cases