The lidar sub-surface perpendicular polarization returns: Creating a value-added CALIPSO ocean profile product

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With the launch of the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite, the remote sensing community will benefit from the unprecedented range-resolved lidar measurements acquired by a space-based instrument. While the primary objective of this satellite will be to measure the vertical distributions of clouds and aerosols, CALIPSO will simultaneously acquire vertical profile measurements of the Earth's oceans (down to 2.0 km below the sea level). As a "concept-proof" study for future space-based lidar measurements of the ocean, this proposal explores the potential of using the CALIPSO ocean measurements as a value-added global survey of underwater scattering bodies.

Measuring subsurface scatterers from space-based lidar has never been proven before. Although our theoretical analysis and previous LITE studies indicate that CALIOP may provide the first space-based subsurface lidar signals from its 532nm perpendicular polarization channel, the first step toward producing this CALIPSO ocean product is to verify that CALIOP subsurface particle backscattering lidar signal does exist and has acceptable quality. This study performs careful examination of CALIPSO sub-surface data to answering questions such as, 1. How often are the sub-surface parallel polarization signals saturated because of strong surface reflectance? 2. Are the sub-surface perpendicular polarization signals immune from the surface reflectance? 3. What are the signal-to-noise ratios of 532nm perpendicular polarization channel for the first several vertical subsurface bins? 4. How do we quantify the parallel/perpendicular cross-talk errors in the sub-surface 532nm perpendicular polarization channel measurements? 5. Is the 532nm perpendicular polarization signal correlated to the backscatter information derived from MODIS water-leaving radiances? 6. How to resolve the vertical delaying related to impulse (transient) responses?

We study the CALIOP subsurface signals to answer these questions. The CALIPSO sub-surface data products will be produced and the data will be available to the public. The ultimate goal is to provide the spatial and temporal distributions of undersea total backscatter derived from CALIOP 532-nm dual-polarization returns. Combined with collocated ocean color measurements, the global data product generated from the CALIOP measurements at 532-nm channel may provide unique and valuable inputs to serve a broad ocean science user community.