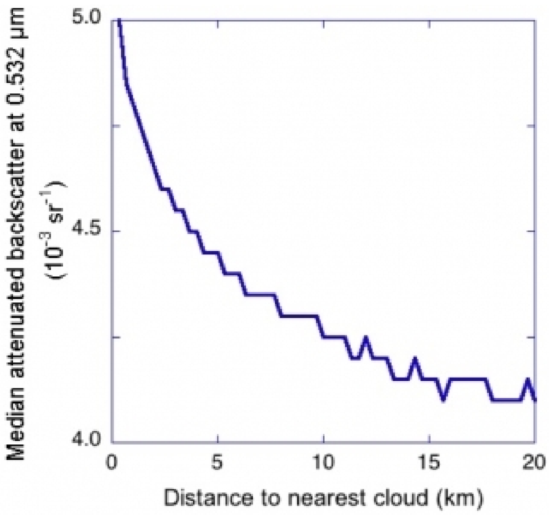
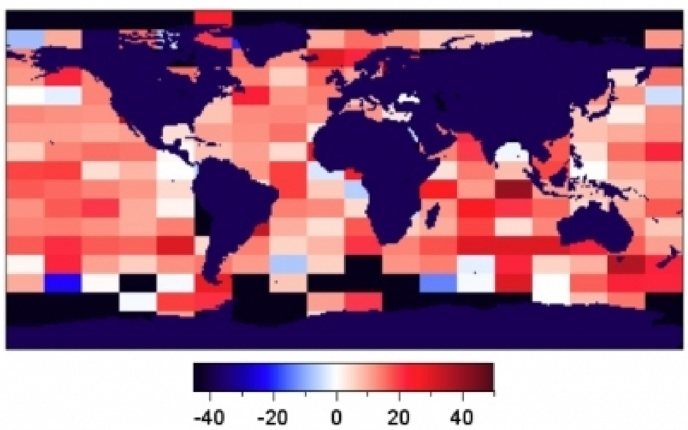
CALIPSO Observations of Aerosol Changes Near Clouds





Relative difference of median 532 nm attenuated backscatter values at 0-5 km and 15-20 km distance from clouds (%)

The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) satellite provides measurements of the vertical structure and properties of thin clouds and aerosols over the globe. This image is based on a month long dataset of global lidar observations by CALIPSO. It illustrates that clouds are surrounded by a transition zone of systematically changing aerosol properties. The figure confirms earlier studies (e.g., Koren et al. (2007), which detected transition zones in the immediate vicinity of clouds (extending up to 3-4 km) in several geographical regions. However, the top panel of this image also reveals that the transition zone is much wider than previously thought, and over oceans it typically extends to about 15 km away from clouds. This confirms that the enhanced clear sky brightness in the vicinity of clouds observed by MODIS is due not only to three-dimensional radiative interactions between cloudy and clear areas (e.g., Image of the Week from March 2008) but also to optically thicker aerosol near clouds. The bottom panel shows that the transition zone is a global phenomenon that appears in most oceanic regions. Detailed analysis of the CALIPSO dataset also reveals that the transition zone is confined to altitudes below the top of nearby clouds, and that aerosol particle size is increased near clouds. These trends agree with earlier studies (e.g., Tackett and Di Girolamo 2009) that found the transition zone to arise from two processes: aerosol swelling in the humid air near clouds, and the collision and subsequent evaporation of cloud droplets, which merges many small aerosol particles into fewer bigger ones. Characterizing the transition zone is important for better understanding two critical yet poorly understood aspects of anthropogenic climate change—aerosol-cloud interactions and aerosol radiative effects—and for devising effective sampling strategies for measuring aerosol properties from space.

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