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Assessing the spatial distribution of aerosols over clouds using a combination of MODIS and CALIPSO data

Jan Cermak (1) and Theodore L. Anderson (2)

(1) Laboratory for Climatology and Remote Sensing (LCRS), Philipps-Universitaet Marburg, Germany, (2) Department of Atmospheric Sciences, University of Washington, Seattle/WA, USA

Improved understanding of the human role in climate change requires better knowledge of the global radiative forcing by aerosols. While the horizontal distribution of aerosol layers has been addressed by satellite missions in the past, the assessment of multi-layer situations with aerosols above clouds has been largely neglected. Thus current knowledge of aerosol/cloud distribution and corresponding climatic forcing is incomplete in this respect.

In this paper we make use of the A-Train constellation of passive and active sensors to detect aerosol layers above clouds. The CALIOP lidar on CALIPSO allows for the direct assessment of vertical layering in the atmosphere; distinct cloud and aerosol layers can be identified. Collocated spectral data recorded by MODIS on AQUA is used to map the spatial extent of the features identified in the CALIOP data. The time difference of a mere 30 seconds between both satellite measurements allows for this quasi-simultaneous assessment.

The development of a scene-specific transfer function is then attempted to reproduce aerosol optical depth retrieved from CALIOP data in MODIS data for aerosol-above-cloud situations. Quantifying the the amount of aerosol above cloud will provide an important observational constraint on global estimates of its radiative impact. Additional data are also needed - in particular, cloud top albedo and aerosol single-scattering albedo. Possible approaches to obtaining this information will also be discussed.