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Spatial and Temporal Patterns of Aerosol-Cloud Interactions

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This study determines the spatial and temporal distribution of regions with frequent aerosol-cloud interactions (aci) and identifies their meteorological determinants based on CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) and ECMWF (European Centre for Medium-Range Weather Forecasts) data products.

Atmospheric aerosols influence the microphysical structure of clouds, while both also respond to meteorological conditions. The potential radiative adjustments to changes in a cloud system associated with aerosol-cloud interactions are grouped and termed as effective radiative forcing due to aerosol-cloud interactions (ERFaci). It is difficult to distinguish, to what extent radiative forcing and precipitation patterns of clouds are a result of cloud feedbacks to aerosols or the existing meteorological conditions. A complete understanding of aerosol-cloud-meteorology interactions is crucial as the uncertainty range of ERFaci in climate change modeling could be significantly reduced.

In the present study it is suggested that presence of hydrated aerosols is an implication for aci. Knowledge of their vertical and horizontal distribution and frequency over the globe would be important for understanding ERFaci. To identify regions with aerosol-cloud transitions the CAD score (cloud-aerosol discrimination) of the CALIOP (Cloud-Aerosol LIdar with Orthogonal Polarization) instrument on the CALIPSO satellite is used. It separates aerosols and clouds according to the probability distribution functions of 5 parameters (attenuated backscatter, total color ratio, volume depolarization ratio, altitude and latitude) and assigns the likelihood of cloud or aerosol presence. This parameter is used to calculate relative frequencies of aci on a global scale from 2006 to 2013.