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On the correlation between aerosol optical depth and cloud fraction and the covariance with meteorology

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Aerosols act as cloud condensation nuclei, and can thereby impact on the microphysical properties of clouds. In a number of studies, the atmospheric aerosol optical depth, which can be considered representative of the number concentration of aerosols, has been found to correlate with the observed cloud fraction. These studies thus suggest that variations in cloud cover can to some extent be attributed to variations in the aerosol optical depth.

However, aerosols and clouds cannot be assumed to vary independently of meteorological parameters. The present study therefore examines the covariation between aerosol optical depth, cloud fraction and meteorology globally for all ocean regions between 45S and 45N. The purpose is to constrain the part of the correlation between aerosol and cloud fraction that cannot be attributed to controlling meteorological factors. The direct correlation between aerosol optical depth and cloud fraction is revisited and examined for a two-year period between 2007 and 2008. We use aerosol optical depth and cloud fraction observations from the MODerate resolution Imaging Spectroradiometer (MODIS) onboard the Aqua satellite. Atmospheric analysis data from the ECMWF have been used to constrain the covariation between meteorological parameters, aerosol optical depth and cloud fraction.

Constraining the role of meteorology is the key to quantifying aerosol-induced changes to clouds. We conclude, using this two-year data set, which meteorological parameters must be considered, when evaluating the microphysical feedback of aerosols on cloud formation, using remote sensing data.