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Does "Critical Cloud Fraction" depend on Single Scattering Albedo?

Kruthika Eswaran (1), Satheesh SK (1,2), Jayaraman Srinivasan (1,2)

(1) Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bangalore, India (kruthika.eswaran89@gmail.com), (2) Divecha Centre for Climate Change, Indian Institute of Science, Bangalore, India

Recent studies on above-cloud aerosol direct radiative forcing have argued that it is possible to define a ‘critical cloud fraction (CCF)’ at which the radiative forcing switch from a cooling to a warming effect. Here, we show that this is not true over regions influenced by different types of aerosol sources. Bay of Bengal plays an important role on the onset of Indian monsoon. This small oceanic region, surrounded by landmass with distinct anthropogenic activities, is influenced by a variety of aerosol sources and air mass types. Using four years of multi-satellite data analysis, we demonstrate that CCF varies with aerosol composition and changed from 0.28 to 0.13 from post monsoon to winter as a result of shift from less absorbing to moderately absorbing aerosol. Our results, in conjunction with radiative transfer simulations, indicate that we can estimate aerosol absorption from space using independently measured top of the atmosphere (TOA) fluxes (CALIPSO-MODIS-CERES combined algorithms for example). Using aerosol forcing at top of the atmosphere derived using CERES data and aerosol optical depth (AOD) from MODIS, the "optically-equivalent" aerosol type over a particular region could be inferred as more absorptive or more scattering based on the slope of the forcing versus AOD plots, which substantially varies as a function of single scattering albedo (SSA). This is carried out over a pristine oceanic region where it is expected that SSA and AOD have a dominant effect on the aerosol forcing compared to aerosol size.