CALIPSO Observations of the Vertical Distribution and Transport of Dust over the Arabian Sea during the Asian Summer Monsoon Season

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Multiyear space-borne observations have revealed the persistent occurrence of an intense aerosol plume that engulfs the north Arabian Sea every year during the Asian summer monsoon season (June-September). Sea salt aerosols produced insitu by the high speed ocean surface winds and the long-range transport of mineral dust from the Arabian Desert contribute significantly to the generation of this plume in which the aerosol optical depth (AOD at 550 nm) often exceed 0.7. While spatial distribution of this plume is reasonably well understood, the information on the aerosol types and their altitude variations are mostly lacking. In the present study, the altitude profiles of aerosol backscatter coefficient (β_a) and volume depolarization ratio (δ) obtained from the CALIPSO observations along the sub-satellite tracks are used to discriminate the highly non-spherical aerosols (mainly mineral dust) from the largely spherical aerosols during the Asian summer monsoon period of 2006-2008. These, together with the air back-trajectory analysis and the AOD retrieved from MODIS data are used to obtain the 3-dimensional distribution of aerosols and investigate the pathways of atmospheric transport of different aerosol types over the Arabian Sea and the Indian Ocean regions [40-75ºE; 20ºS-30ºN]. Intensity of the aerosol plume maximizes during the June-August period, when the altitude profiles of β_a over the Arabian Sea at north of 10°N show a well-mixed aerosol layer below 1 km and an aerosol layer between 1 to 5 km with a rather moderate decrease in β_a. In this region, the mineral dust is prominently observed throughout the altitude band between the surface and 5 km with δ in the range of 0.1-0.3. Between 10ºN and 5ºS, the dust layer is present only above 1 km with δ in the range of 0.1-0.2, the upper boundary of which monotonically decreases from ~5 km at 10ºN to ~2 km at 5ºS. In contrast, the aerosols present below ~1 km in this region are highly spherical with δ<0.04. This appears like a front with pristine oceanic airmass containing mostly spherical aerosols penetrating from south Indian Ocean to the north Arabian Sea and the dust-laden airmass from Arabia riding over this airmass towards the south Arabian Sea.

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