Radiative Forcing by Sea Salt Aerosols: Modulation by Sea Surface Winds

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We have analyzed the wind dependence of sea-salt aerosol direct radiative forcing in both, visible (0.2-4 μm) as well as in infrared (8-14 μm) over a region of longitudinal belt of 10 degree (60-70º E) and latitudinal span of (40ºS- 20ºN). Study region was divided into 6 sub-regions of 10º x 10º box. Study of direct radiation forcing due to sea-salt aerosols and its wind dependence over large temporal and spatial span, is sparse. By utilizing MODIS derived daily aerosol optical depth (AOD) (at 550 nm) and NCEP daily wind data we developed relationships between aerosol optical depth (AOD) and wind speed for all the six regions. These equations show the exponential increase in AOD as function of wind speed similar to the earlier studies. Here we assume that there is no increase in other aerosol species other than sea-salt with wind speed as we have eliminated the continental influence (using back-trajectories). We then eliminated the contribution of background aerosol concentrations to AOD to obtain sea-salt aerosol optical depth. An exponential decrease was observed in background aerosol optical depth with latitude as we move towards south while there was no clear latitudinal dependence for wind index. To derive optical properties related to sea-salt we used empirical cum model approach. By varying the relative abundance of sea-salt components, we reproduced the observation values in model calculations. Outcome from these model calculations was used as input to radiative transfer model (SBDART, Santa Barbara DISORT Atmospheric Radiative Transfer Model) to calculate direct radiative forcing at top of the atmosphere (TOA), surface and atmospheric forcing. At high wind speeds (>10 m/s) contribution of sea-salt in composite aerosol AOD at 0.55 μm is observed to be greater than 70%. Shortwave forcing due to sea-salt aerosols at ocean surface was observed as high as ~40 W/m2 and corresponding value in long wave is about 3 W/m2.