A Novel Index (NGAI) for Aerosol Categorization and AOD Fraction Determination with Satellite Retrievals

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Abstract

Based on the discrepancy in spectral gradient of optical depth, the Normalized Gradient Aerosol Index (NGAI) is proposed for aerosol categorization in this study. The well agreement (93% overall accuracy) with the ground-based measurements from AERONET (Aerosol Robotic Network) indicates the great performance of NGAI derived from MODIS (Moderate Resolution Imaging Spectroradiometer) aerosol optical depth (AOD) products in discriminating the category between mineral dust (DS), biomass burning (BB) and anthropogenic pollutant (AP) aerosols, in particular the discrimination between BB and AP. And the more importantly, the AOD fractions of dominated aerosols can be reasonably acquired based on the NGAI value exhibited from mixed aerosols. With the auxiliary data products of CALIPSO (Cloud-Aerosol Lidar with Orthogonal Polarization) in extinction profile and aerosol subtype, the most unique reference of AOD fraction has been produced for validating the counterparts derived from NGAI. The correlations of AOD fraction between NGAI and CALIPSO approach 0.65, 0.68 and 0.80 for DS, BB and AP aerosols, respectively. The further application of NGAI points out the significance of AOD fraction to efficiently capture the aerosol direct effect on radiative forcing (RF) in regional scale, especially when mixed type of aerosols are present. The results of all validations and applications suggest that the proposed NGAI can be an efficient index in performing aerosol category with fractional AOD of mixed aerosols in terms of satellite remote sensing and ground measurement. Moreover, the advantages of NGAI can be extended to address the constraint of missing single scattering albedo (SSA) in regional or global scale as a new data product related to aerosol property.

Key word: NGAI; Satellite remote sensing; AOD; SSA; Aerosol type; AERONET; MODIS; CALIPSO; AOD fraction; Aerosol radiative forcing