



The assessment of global climatology of AOD and AAOD with integrated aerosol-climate model results, satellite retrievals, and ground-base measurements

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The total solar extinction of atmospheric aerosols (measured by aerosol optical depth, or AOD) and its absorbing fraction (absorbing aerosol optical depth, or AAOD) are critical parameters in studying aerosol-climate interaction. However, because of the heterogeneity of aerosol source emissions and the complexities of aerosols transformation and deposition processes, the assessment of global distribution of AOD and AAOD is still a challenging task. Even though remarkable progresses in aerosol modeling and measurement experiments have been made in recent years, there is still a significant discrepancy between the modeled and observed results. The goal of this study is to assess global AOD and AAOD distribution using our recently developed aerosol-climate model and the accumulated remote sensing data as well as surface measurements, and then to minimize the model-observation discrepancy by optimizing the anthropogenic emissions of primary carbonaceous aerosols used in the model.

The AOD and AAOD of anthropogenic aerosols are derived based on a 3D interactive aerosol-climate model [Kim et al., 2008] developed based on NCAR CAM3. The model calculated aerosol microphysical, chemical, and radiative properties of three primary aerosols such as BC, OC, and sulfates as well as their mixtures using a two-moment scheme. The aerosol transformation under atmospheric conditions is also fully considered. The AOD and AAOD of mineral aerosols (dust aerosols) are derived based on the model climatology from the Model of Atmospheric Transport and Chemistry (MATCH) driven by the NCEP/NCAR reanalysis data [Mahowald et al., 1997; Kistler et al., 2001]. We apply in the model two emission sets for primary carbonaceous aerosols based on fossil fuel emissions derived from respectively MIT EPPA model and Bond et al. [2004]. Together with GEIA biomass burning, using these two emissions we have produced two sets of anthropogenic aerosol climatology corresponding to the high (MIT EPPA) and low (Bond) carbonaceous emissions, respectively. We then apply an inverse modeling skill to optimize our anthropogenic emissions of primary carbonaceous aerosols by minimizing modeled AOD and AAOD discrepancies from measurements from 74 selected stations of AERONET as well as MODIS AOD and OMI AAOD. The aerosol climatology derived using the observational constrains will be used in aerosol-climate interaction studies.