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The use of multi-angular polarimetric remote sensing to constrain aerosol absorption and direct radiative forcing

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Over the last two decades, the satellite remote sensing datasets have provided continuous and valuable information to constrain the climate models' simulation of global aerosol extinction (scattering + absorption), i.e. aerosol optical depth (AOD). However, the climate models simulation lacked the observational constraints of such important properties as aerosol absorption, because the commonly used single-viewing photometric satellite sensors have weak or no sensitivity to aerosol absorption. In this study, we demonstrate that remote sensing by satellite multi-angular polarimeters (MAP) provides sufficient constraints on emission of absorbing aerosol species and could be further used to estimate global aerosol absorption and its effect on climate. The resulting estimate of present-day globally-averaged aerosol absorption optical depth (AAOD) is 0.0070, 95% confidence interval [0.0068, 0.0073], at the 550 nm wavelength (mid-visible), and 72.9% of that is caused by anthropogenic emissions. The all sky direct radiative forcing (DRF) due to aerosol is -0.14 W/m^2 [-0.25, +0.0.1] and the primary aerosol absorber black carbon (BC) +0.33 [+0.17, +0.54] W/m^2.

Keywords: aerosol emission, absorption, radiative forcing, PARASOL/GRASP, adjoint GEOS-Chem

References

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