Geophysical Research Abstracts
Vol. 20, EGU2018-8208, 2018
EGU General Assembly 2018

Importance of accounting for details in aerosol and underlying surface characteristics in calculations of shortwave aerosol radiative effect

Yevgeny Derimian (1), Oleg Dubovik (1), Xin Huang (2), Tatyana Lapyonok (1), Pavel Litvinov (2), Alex B. Kostinski (3), Philippe Dubuisson (1), and Fabrice Ducos (1)

(1) Laboratoire d'Optique Atmosphérique, UMR8518 CNRS, Université Lille, Villeneuve d'Ascq, France, (2) GRASP-SAS, Generelized Retrieval of Atmosphere and Surface Properties, Villeneuve d'Ascq, France , (3) Department of Physics, Michigan Technological University, Houghton, USA

The evaluation of aerosol radiative effect on broadband hemispherical solar flux is often performed using simplified spectral and directional scattering characteristics of atmospheric aerosol and underlying surface reflectance. In this study we present a rigorous yet fast computational tool that accurately accounts for detailed variability of both spectral and angular scattering properties of aerosol and surface reflectance in calculation of direct aerosol radiative effect. The tool is developed as part of the GRASP (Generalized Retrieval of Aerosol and Surface Properties) project. We use the tool to evaluate instantaneous and daily average radiative efficiencies (radiative effect per unit aerosol optical thickness) of several key atmospheric aerosol models over different surface types. We then examine the differences due to neglect of surface reflectance angular anisotropy, non-sphericity of aerosol particle shape and accounting only for aerosol angular scattering asymmetry instead of using full phase function. For example, it is shown that neglecting aerosol particle nonsphericity causes mainly overestimation of the aerosol cooling effect. The magnitude of this overestimation changes significantly as a function of solar zenith angle (SZA) when the asymmetry parameter is used instead of detailed phase function. It was also found that the differences in the calculated aerosol radiative effect for the nonspherical and spherical aerosol models are negligible if detailed BRDF (Bidirectional Reflectance Distribution Function) is used instead of Lambertian approximation of surface reflectance. Additionally, calculations show that usage of only angular scattering asymmetry, even for case of spherical aerosols, modifies dependence of instantaneous aerosol radiative effect on SZA. This effect can be canceled for daily average values, but only if sun reaches the zenith, otherwise a systematic bias remains. Since the daily average radiative effect is obtained by integration over a range of SZAs, the errors vary with latitude and season. In summary, the present analysis showed that use of simplified assumptions causes systematic biases, rather than random uncertainties, in calculation of both instantaneous and daily average aerosol radiative effect. Finally, we illustrate application of the rigorous aerosol radiative effect calculations performed as part of GRASP aerosol retrieval from real POLDER/PARASOL satellite observations.