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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct and semi-direct radiative forcing of smoke aerosols over clouds" *by* E. M. Wilcox

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General Comment

The author discusses a novel approach to produce estimates of both the direct and semi-direct radiative forcing of carbonaceous aerosols above clouds using satellite observations by the AMSR-E, OMI, and CERES sensors in the A-train constellation. While the overall approach is generally robust and well thought out, the method relies in the interpretation of the OMI aerosol Index (AI) as a direct semi-quantitative measure of the aerosol optical depth. This assumption is not justified as discussed below.

Specific comments

Although, as stated by the author, variations in aerosol altitude over a bright surface do

not have a significant impact on ultraviolet radiance, the aerosol height above the cloud does have an important effect on the near-UV spectral dependence. As documented in the literature, the AI is the result of changes in the spectral dependence in the UV, not just the radiance change at a single wavelength. In addition to the dependence of the AI signal on the aerosol layer optical depth and the height above the cloud, the AI also depends on the optical depth of the cloud itself, and on the aerosols absorption angstrom exponent (AAE). The sensitivities of the AI to these parameters have been documented in a soon to be published peer-reviewed manuscript which is available to the author upon request. For the above stated reasons, the observed AI of aerosols above the cloud cannot be simply interpreted as a proxy of the aerosol optical depth without accounting for the uncertainty associated with the mentioned dependencies.

Other comments

In addition to CALIPSO observations, a direct measure of the aerosol optical depth above the cloud can be obtained from polarization measurements by the POLDER sensor on the PARASOL satellite [Waquet et al., JAS, 2008]. The POLDER capability should be discussed in the literature review of this manuscript. It is also suggested that the use of the POLDER aerosol optical depth to characterize the above-cloud aerosol load be considered.

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