

General Comment

The authors have carried out a computationally detailed analysis of the sensitivity of space borne limb radiance measurements at ultraviolet, visible, and near IR wavelengths. The authors use the OSIRIS sensor as reference for spectral coverage and viewing geometry characteristics. The methodological approach is sound. The paper is very well written, and the results discussed in detail. The main deficiency of the paper, however, is the inaccurate model representation of several aerosol types in the analysis.

Aerosol Model Assumptions

Desert dust aerosols are known to be non-spherical particles. Although the scattering phase function of non-spherical particles resembles that of spherical particles over a narrow range of scattering angles, ($\sim 150^\circ$), there are significant differences at the range of scattering angles (60° - 120°) of the OSIRIS observations. The authors' treatment of desert dust particles as spherical elements is not justified given the range of scattering angles considered in the analysis. The same criticism applies to the modelling of ice particles which are most certainly not spherical.

The assumed values of single scattering albedo are extremely low. A single scattering albedo value of 0.78 at 452 nm is significantly lower than any measurement at an equivalent wavelength reported by AERONET at any of the sites over arid and semi-arid regions. The Muller et al values of imaginary refractive index, on which the authors have based their SSA calculations, may not be representative of the actual column atmosphere which is what is actually needed in the interpretation and analysis of satellite observations. The authors may refer to the Muller et al (JGR, 2012) paper that shows large discrepancies in single aerosol absorption parameters derived by different techniques.

The dust particle mode radius assumed in this analysis is much larger than AERONET's reported values. The Wiacek et al (2010) reference in support of the assumed particle size distribution parameter does not provide any information on the subject. I suspect that the extremely low SSA values assumed in this analysis are a consequence of the large values of imaginary refractive index and mode radii used in the analysis.

Carbonaceous aerosols contain both black carbon (BC) and organic carbon (OC). As shown by observations based on filter collected samples during SAFARA 2000 [Kirchstetter et al, 2004 JGR], and by OMI satellite observations [Jethva and Torres, 2011], OC in carbonaceous aerosols is responsible for the spectral dependence of aerosol absorption observed at wavelengths shorter than about 420 nm. The smoke aerosol model assumed in this paper assumes BC as the only absorbing component and, therefore, ignores OC absorption effects in the UV. AERONET retrieved absorption parameters are largely insensitive to OC because their inversion algorithm does not use radiance measurements at wavelengths shorter than 440 nm.

Regarding the optical properties of sulfate aerosols, the authors rely on the measurement of Palmer and Williams [1975] that are more relevant to stratospheric sulfate aerosol production at low temperatures in the aftermath of volcanic eruptions. Although I do not expect major differences, the

authors are advised to consult the more recent work of Beyer et al [JGR, 1996] that performed measurements at different temperature conditions.

Recommendation

Because of the large uncertainty in the validity of the desert dust aerosol model, ice particles, and smoke model, any conclusion on the significance of the results of the modeled radiative transfer interaction is equally uncertain. The authors are encouraged to revisit the aerosol models and submit a revised version of their analysis.

Other comments

Pg 1903

Line 12. Is SASKTRAN a vector code?

Line 24. Scattering and surface reflection are two entirely different processes.

Pg 1909

Line 10 This result is not surprising as it is well known that the sensitivity to refractive index is significantly lower at side-scattering angles than at nadir viewing configurations. That is the reason satellite-based aerosol optical depth retrievals are more accurate at off-nadir viewing condition than a near-nadir [Chylek et al., 2003 GRL].

Pg 1915

Line 4 Angular dependent scattering is fundamentally a single scattering property