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Interactive comment on "Aerosol effect on the distribution of solar radiation over the clear-sky global oceans derived from four years of MODIS retrievals" *by* L. A. Remer and Y. J. Kaufman

Anonymous Referee #2

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Main comments:

The paper describes the long-term aerosol optical thickness and radiative forcing over global ocean by the MODIS measurement. There is a lot of effort to calculate the global aerosol radiative forcing. But the calculation using satellite measurement data is of high importance and interest for diverse studies of global and regional climate change. I think that the subject of this paper is original, important for aerosol and climate community, and the paper is well written. Nevertheless, several important clarifications could significantly improve the paper.

The advantage using satellite retrieved aerosol optical thickness in calculation of aerosol radiative forcing is global coverage in spite of their uncertainty range. At the same time, the main weakness using those data is the lack of information of single scattering albedo (SSA), since it can change the sign of radiative forcing from negative to positive at the TOA over bright surface. SSA shows quite different value according to aerosol type and mixing status, especially in outflow region over South and East Asia. Thus, please have a table to list all uncertainties from the error analysis according to each component of aerosol optical properties.

5014, line4-5: The aerosol radiative forcing at TOA is much affected by single scattering albedo (SSA) especially over the bight surface like desert region or cloud. Even though this study confines the region in ocean surface, the uncertainty of SSA is important for the reflected fluxes at TOA. Thus, the provision of uncertainty of SSA retrieved from MODIS algorithm is very helpful to understand that of radiative forcing at TOA (MODIS SSAs are not publicly used in present).

5017, section 4.2: 1) Even though the model results are not sensitive to the shape of atmospheric profile, the column amount of water vapor (the amount is variable according to latitude) and ozone will be affected to flux calculation. Thus, the errors of their assumption should be provided.

2) The TOA radiative forcing is very sensitive to surface albedo. And it highly depends on solar zenith angle, and changeable from ocean to ocean, and coast region. Thus it needs to explain the reason the author used sea surface albedo by 0.07.

3) The aerosol vertical profile is also important factor to calculate TOA fluxes (negligible at the surface). There are large amount of aerosols outflow from northern Africa (desert dust), South Africa (biomass burning), South and East Asia (polluted aerosol and dust in spring time), and the maximum aerosol concentration will be located 1-2 km high above sea surface. The sensitivity test will be helpful to understand their effect to TOA forcing.

5017, section 4.3: In spite of the importance of SSA in calculation of ARF at TOA, there is no information about SSA such as monthly mean values and seasonal variation. In addition to Fig. 2 for aerosol optical thickness, the presentation of SSA (plot or table) will be very helpful to understand the magnitude of ARF because SSAs are used in this study.

5023, section 5: The author explains the radiative forcing differences with seasonal and latitudinal variations besides aerosol optical thickness. It is quite reasonable since the aerosol radiative forcing is different in different latitude and season even though their aerosol optical properties are exactly same. But, different aerosol type also gives different aerosol optical characteristics. It will be also helpful to discuss using aerosol type, which can give the general information about solar radiation absorption by aerosol.

Minor comments

5017, line16, Fig 1: There is no explanation about aerosol optical properties (aerosol type) for 9 models like single scattering albedo, and asymmetry factor. It needs to understand forcing difference between different aerosol models.

5021, Fig. 5: There is no legend (or color bar)

5021, line 12 and 21: Figure 5 and Figure 7 can be changed to Fig. 5 and Fig. 7 since the others are used by “Fig.” not “Figure”

5020, line 13: Except the errors of ratio F_calc(24)/F_calc(I) due to aerosol type and varying optical properties, what is the error of ratio itself by simple conversion instantaneous into diurnal mean value? The ratio should be smaller than 1.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 5007, 2005.

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Interactive Comment