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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relationship between wind speed and aerosol optical depth over remote ocean" *by* H. Huang et al.

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My main concern regarding this paper is the lack of in depth discussion of the AOD data set used from AATSR. Two references are mentioned in section 2 (Data), but one is a PhD thesis and the other is a conference proceedings, thus not accessible to the reviewer. Given this, the authors should include more information in their description of the dataset. What are the uncertainties on the retrieved AOD? Has the product been validated against AERONET observations, especially in marine regions? How does it compare to other satellite AOD products like MODIS or MISR?

Reply: *We have thoroughly revised data section of the manuscript, added a more detailed description of the dataset and retrieval algorithm , as well as some more ac-*

cessible references(Thomas et al., 2008, 2009a,b,c; Sayer et al., 2010). Globaerosol AATSR has been validated against AERONET stations, the correlation between the two datasets is about 0.9 with a RMS 0.05(Portela et al., 2009), the result shows the AATSR AOD product has a systematic positive bias of 0.056 *(Portela et al., 2009). More validation details can be found at http://www.globaerosol.info/. One of the possible explanations is the validation is made for land based and coastal AERONET stations, and thus may not be directly applicable to the remote ocean. However, since the bias appears to be relatively independent of AOD (Portela et al., 2009), it should have a limited impact on the observed AOD vs windspeed relationship. An other possible reason for the possible bias in the AATSR AOD is contamination by residual cloud. Although the AATSR cloud mask is considered quite stringent, it is possible that thin cirrus, which is now believed to be very common (Baran, 2009) , might not be removed. This could cause a small, consistent offset in the observed AOD.*

2.Also, the authors mention the issue of whitecaps in influencing surface reflectance and retrieval of AOD by SeaWiFS in their introduction. This is an important issue, yet it is only mentioned in passing in section 2. Could the author be more specific in their discussion of the AATSR retrieval? As the surface reflectance is retrieved independently of the AOD, could they show how surface reflectance varies with wind speed thus constraining the whitecap effect

Reply: *We added a detail description of the algorithm used in the data part. A short description of the ORAC algorithm is given here: the ORAC dose not try to separate the contributions of surface and atmosphere to the TOA radiance. Instead, it is an optimal estimation (OE) scheme, the basic principal is to make use of Levenberg-Marquart iteration to find the best fit of modelled radiance based on the state of atmosphere and surface to the first four of AATSR's channels in both views. The algorithm uses a forward model, which is composed of sub-models of aerosol, gases and surface reflectance,*

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to simulate the radiance at the top of atmosphere. ORAC retrieves AOD at0.55μm, aerosol effective radius and surface reflectance for each of the retrieval channels (under the constraint that the ratio of the surface reflectance in the forward and nadir views is fixed). The retrieval of effective radius is achieved by varying the mixing ratios of the different size modes (eg. Fine, accumulation and coarse) in externally mixed aerosol classes of fixed composition. In the surface reflectance model,the Bidirectional Reflectance Distribution Function (BRDF) is used to describe the angular variation of the surface reflectance and the effects and variations of white caps, under light and sun glint are considered(Sayer et al., 2010). More detail descriptions of the algorithm and forward model are given by Thomas et al. (2009a,b,c).

3.Finally, the southern ocean is a very cloudy region and cloud contamination has hampered the retrieval of AOD from other satellites like MODIS. How are clouds dealt with in the AATSR retrieval? Do the authors impose a cloud cover threshold in the data that they use?

Reply: *As the aerosol retrieval is only possible in clear sky conditions, it is vital that pixels containing cloud are not included in the retrieval. The GlobAEROSOL AATSR product makes use of ESA's operational sea surface temperature cloud flag(Zavody et al., 2000). This uses a combination of thresholds on the thermal infrared channels, spatial coherence and ratios between different channels, and is believed to be quite reliable over the ocean. In the paper, we did not use cloud cover threshold. We have added a short description ofcloud flag in the date section in the final revised manuscript.*

Minor comments:

1.Figure 3. Please clarify in the figure caption that the horiztonal and vertical lines represent the chosen threshold.

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Reply: *We have made modification to the caption of the figure.*

2.Figure 4 seems to indicate that 20-40% of the Southern Ocean cannot be considered remote ocean, as theta>0.035. It is unclear in the text whether the author eliminate those points in their analysis of the southern ocean or whether these are included in Figs 6-8. The text on page 24517, line 3 based on this analysis, we have chosen remote ocean points over three regions shown as black frames in Fig. 4â€İ is somewhat ambiguous and seems to indicate that all points in the boxes have been chosen. Please clarify.

2. Reply: *For the southern regions, there are some 'colourful' regions, but we do not eliminate those values because the color of these regions indicate the wind directions are from 70-140 degree, i.e. westerlies. Strong westerly winds are almost ubiquitous in the southern oceans, and it is this which causes this dependence of AOD on wind speed, rather than a particular source of transported aerosol. Indeed, as there are no large continents in this region,it can be thought of as a remote ocean region, with little influence from continents.*

We have made it clearly in the revised paper.

3.Correlation coefficient in Figures 6-9. I assume that the R2 shown is for the AOD binned by wind speed. To get a sense of the actual scatter in the data, it would be useful to also indicate the correlation coefficient for the ensemble of the daily data without any averaging.

Reply: *The R^2 is the correlation coefficient for the AOD binned by wind speed, we have clarified it in the revised paper.*

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