Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-260-AC2, 2019

Atmospheric Measurement Techniques Discussions
Open Access

Interactive comment on "A geometry-dependent surface Lambertian-equivalent reflectivity product for UV/Vis retrievals: Part II. Evaluation over open ocean" *by* Zachary Fasnacht et al.

Zachary Fasnacht et al.

zachary.fasnacht@ssaihq.com

Received and published: 14 October 2019

We greatly appreciate and thank the reviewers for their efforts related to this manuscript. They have provided important comments which have lead to several improvements in the paper. All comments from reviewers have been addressed below. *Reviewers' comments/questions below are denoted with italics*, responses are in plain text, **and additions to the manuscript are in bold**.

Responses to Reviewer 2:

Page 7, line 34-35 reads "We select sun glint scenes when the difference between the measured LER at 354 nm and 388 nm is less than -0.05." How is the threshold value chosen? Is there any reference or evidences indicating this number represents a good threshold? And why not define sun glint based on the sun-glint angle (or sun-glint angle)?

We changed the terminology of co-scattering angle to sun-glint angle because ultimately that is all that we meant by the co-scattering angle. Since sun-glint angle is more well known, we have taken the reviewers advice in making the change.

The reviewer raises some good questions about the methodology for choosing sun glint scenes. There appears to be some confusion with the text in the explanation of the sun glint scenes. We first focus on scenes where the sun-glint angle is less than 20 degrees and then additionally apply the LER difference screen. The reason for the LER difference screen is that clouds in the sun glint region are difficult to detect and therefore remove. Cloud fractions are typically biased high for sun glint regions making separation between clouds and sun glint challenging. By using the LER difference screen, we are able to more easily distinguish between clouds and sun glint.

Pg 7 Line 30-Pg 8 Line 4 was updated to address this concern:

"We compare cases with and without sun glint separately because the reflection of light in each case is quite different. For comparisons excluding sun glint scenes, we screen out data with a sun-glint angle of less than 20^{o} in which sun glint can occur. For the comparisons with sun glint, **while the sun-glint angle of 20^{o} is again used to choose the sun glint region, additional screening based on the spectral dependence of the measured LER is performed to remove clouds within the sun glint region. The reason for this is that cloud fraction retrievals are affected by sun glint. The** difference in LER occurs because of a spectrally dependent error in the underestimation of the Rayleigh scattering of diffuse light when one assumes a Lambertian ocean surface, when the reflectance is in fact specular. We select sun glint scenes when the difference between the measured LER at 354 nm and 388 nm is less than -0.05. **We note that some weaker sun glint has an LER difference that is not below this threshold, but here we focus on stronger glint that has no cloud contamination.**"

We do note that due to a clerical error, a few values in Table 2 were incorrect, but this has since been corrected. The change is minor and does not have any impact on the final conclusions of the paper.

We did put some more thought to the threshold that was used for the LER difference in response to the reviewer's questions about it. We have done this by comparing the LER difference (354nm-388nm) from the OMI measurements with the absolute LER at 466nm from OMI. This analysis shown in Fig. 1 of the response shows two different distributions of data for cloud and sun glint. The data affected by clouds have a slope of nearly 0, whereas the sun glint data show a strong negative slope since the error in LER for sun glint is spectrally dependent. Using this shows that a threshold of -0.05 distinguishes sun glint from clouds. Below is the figure showing this comparison for January 2006 for data with a sun-glint angle less than 20o. The cutoff of -0.05 is shown in the solid black line with everything below it being included in the sun glint analysis.

Similarly in Fig 2. of the response, we plotted the LER difference as a function of crosstrack position for January 2006 for sun-glint angles less than 20^o. For OMI, sun glint typically occurs in rows 10-30. Here it also appears clear that a cutoff of -0.05 is effective to define the strong sun glint region.

Finally, Fig. 3 of the response compares MODIS visible satellite imagery with OMI LER at 466nm and the LER difference from OMI to show that a threshold of -0.05 does a good job defining the stronger glint region.

We note that this threshold is arbitrary in how it is chosen, but we feel that this provides the best evaluation of the sun glint data in avoiding contamination from clouds. We have refrained from including these figures in the paper at this time since the focus of this paper is not on the evaluation of our sun glint model.

Page 17, line 3-5: "There is also a seasonal variation in GLER due to the changing viewing geometry of satellite measurements as the SZA changes through the year." Can the authors add more evidence to prove this statement? It seems to the sun glint may play an import role in the seasonal variation. I also curious if the seasonal variation is also related to any seasonal changes in wind speed or chlorophyl concentration. So it would be helpful if the time series for, sun glint angle, wind speed, and chlorophyll concentration are also provided (at least examined by the authors). Ok. Continuing my last comment, the sensitivity analysis in section 3.5 indeed confirms that changes in chlorophyll concentration will not be able to cause the GLER seasonal variation.

Per the reviewers' request, we have added these additional data to Fig 9 and show that the seasonality is mainly due to the sun-glint angle seasonality. This request is very beneficial as it also addresses a question by reviewer 1 asking whether the chlorophyll or wind speed measurements could cause the drift in the GLER – OMI-derived LER difference. This figure shows that there is not a similar drift in either of the measurements meaning that the drift in the differences is likely at least partly instrumental.

Page 22, line 18: "lambda" is . –> "lambda" is the wavelength.

We have made the change noted by the reviewer.

Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2019-260/amt-2019-260-AC2-supplement.pdf

---

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-260, 2019.

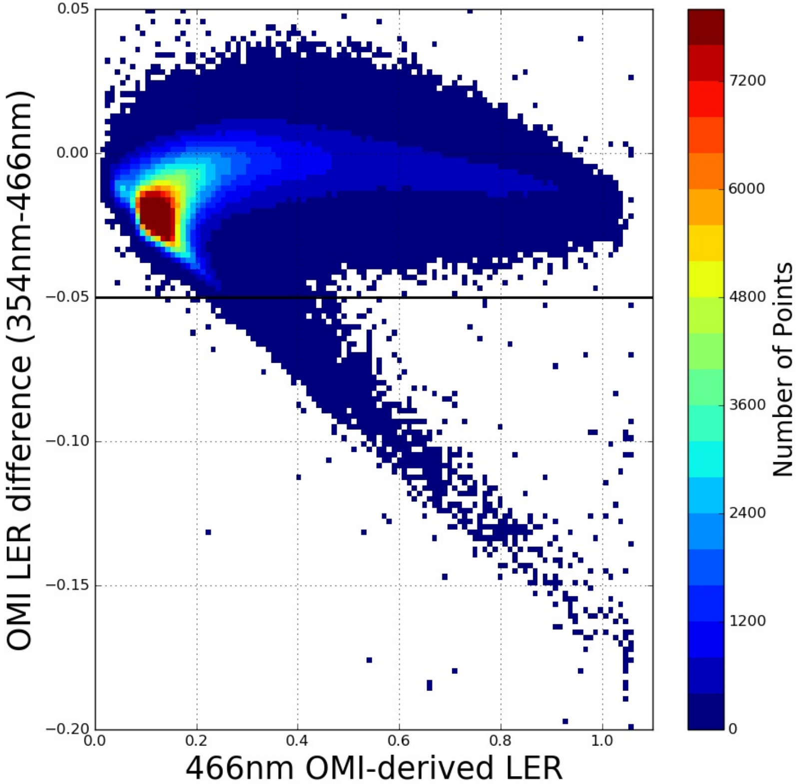

Fig. 1. Comparison of 466nm OMI-derived LER and the difference between 354nm and 466nm OMI-derived LER for January 2006.

Printer-friendly version

Discussion paper

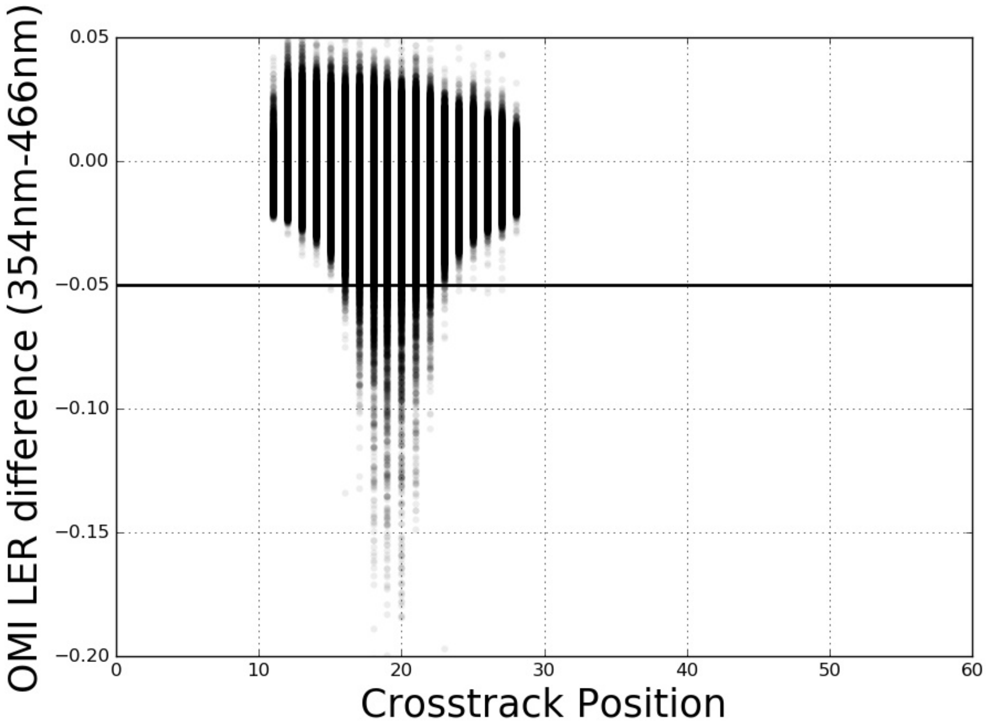

Fig. 2. LER difference plotted as a function of crosstrack for sun glint possible pixels defined as sun-glint angle less than 20 degrees

Printer-friendly version

Discussion paper

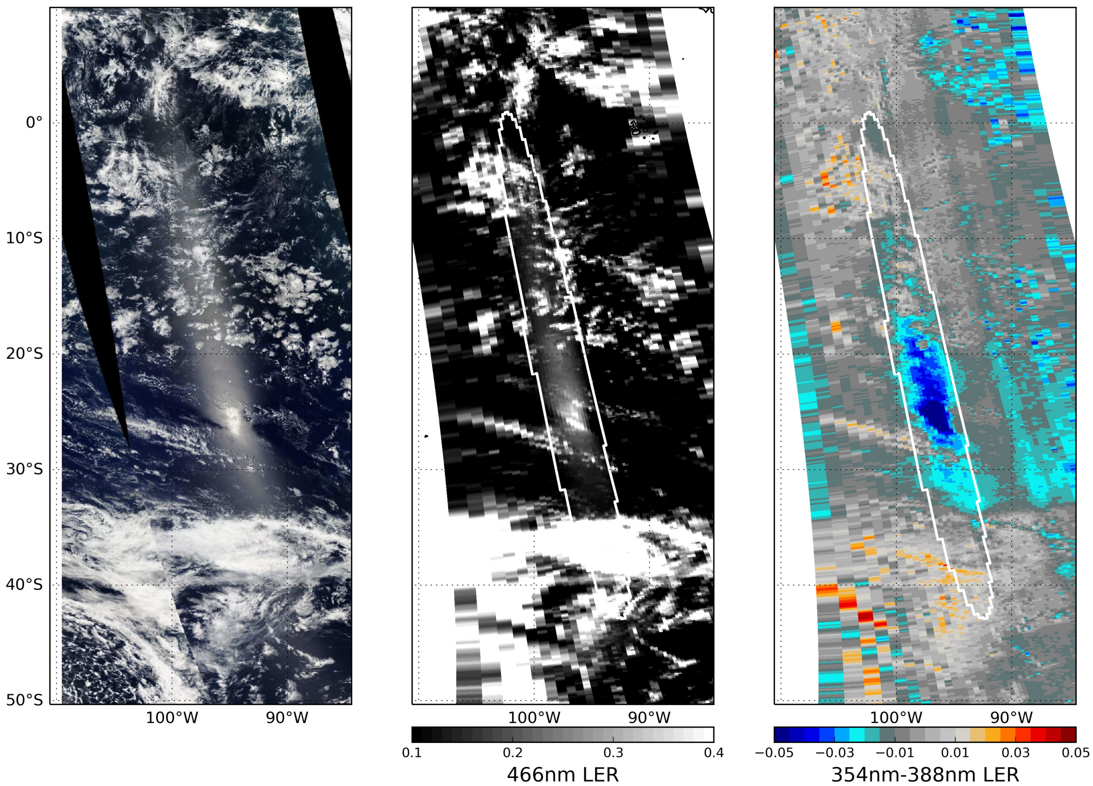

Fig. 3. OMI Delta R for an orbit on Jan 3, 2006 compared with the 466nm OMI-derived LER in middle and MODIS visible satellite imagery on left

Printer-friendly version

Discussion paper