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Discussions

Interactive comment on "A study of polarimetric noise induced by satellite motion: Application to the 3MI and similar sensors" *by* Souichiro Hioki et al.

Souichiro Hioki et al.

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Thank you very much for sparing your time to go through our manuscript. It is our pleasure to have you as a reviewer and we greatly appreciate your consistent attitude toward the constructive revision. All your inputs regarding the presentation issues are taken into account in the revised manuscript to the best of our understanding. But, if there is any remaining issue, we are happy to address them in the following review process. More detailed answers to the comments and questions are as follows:

1. I'd like to see a clearer description in the abstract and introduction that the co-registration and interpolation issue in 3MI (and POLDER) is due to the non-

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simultaneous observation.

We appreciate that the reviewer pointed out the basic principle of the source of the error. The type of error that we are addressing in this paper is important for any polarimetric instrument that does not use the beam-splitter, as the error comes from the inevitable synthesis of temporally or spatially inhomogeneous data. The question is how to quantify them and how to mitigate them. The SGLI itself suffers from some interpolation errors, but way less than that of the 3MI and POLDER. In the revised manuscript, we bring this point at the very beginning of the abstract. We also insert a paragraph in an appropriate part of the introduction.

2. To be consistent with Povey and Grainger paper, you should use the term 'error'.

We agree with the reviewer that the term 'noise' is not precise. We replace the term 'noise' with 'error' in the revised manuscript.

3. Is there a reference for the meaning of the file format names that aren't spelled out?

Yes, we reference the SGLI Data Users Handbook in the revised manuscript. We also add a brief description.

4. I would think "classification" of data, not "stratification", is a more appropriate.

Thank you for the comment. We correct the terminology according to the comment in the revised manuscript.

5. The coastlines appears to be significantly biased but not clouds, particularly over land. Color scale issue?

Figure 1 is the same figure with a modified color scale. The error over the land cloud is not still evident, and our understanding is that the land at 0.869 μm over this region is bright enough that the reflectivity contrast to the cloud is not as significant as that over the ocean. In the revised manuscript, we include the figure with the new color scale.

6. How would cloud motion during the filter wheel acquisition period affect the results?

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It is an interesting point to be considered for the co-registration of multiple views of the same cloud. Indeed, the Multi-angle Imaging Spectroradiometer (MISR) team considers the cloud motion during the co-registration. However, it is unlikely that it affects the polarimetric accuracy of the 3MI as the acquisition time interval is 0.25 seconds. If a cloud element travels for, say 1% of a 3MI pixel (0.04 km = 40 m), the wind speed must be 160 m/s, which is unrealistic except for very extreme locations.

7. The word "stratified" is used, but I think you mean "correlation".

The expressions are corrected in the revised manuscript as the reviewer encourages.

8. I missed the explanation of why you are dividing the Laplacian by L.

This is because we found from the preliminary study that the relation between L_p error and the along-track Laplacian (L_{AT}) does not strongly depend on the value of L. As the DOLP is defined as the L_p/L, we expect that dividing the L_{AT} by L would be helpful to sort out the DOLP error. This description is added at the end of Section 2.2.2.

9. I'm not sure the Discussion section is really any different than a part of the results.

In the revised manuscript, we move the Monte Carlo model results into the discussion so that it serves as the discussion on the understanding of the noise structure, rather as the primary results of the study. This responds to the Dr. Otto Hasekamp's comment, as well.

10. What would be nice thing to include in a discussion section is some thoughts about how these results can be used.

Thank you very much for the suggestion. We add a subsection that summarizes our thoughts about the possible application of the current results.

11. Are the shifting weights described in Table 1 and 2 the same for all view angles?

Yes, it is the same for all view angles.

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12. It would be nice to see more discussion of how large these errors are compared to the overall 3MI uncertainty. Are they the main source of uncertainty? What is the significance of these uncertainties for the ability to retrieval geophysical parameters?

The 3MI's target error in the polarimetry is defined on clear-sky homogeneous scene over dark surface (Fougnie et al. 2018 JQSRT), and the value is 5×10^{-4} in terms of polarized reflectance. The radiometric noise is anticipated to be less than this, and as Fig. 2 shows, the motion-induced error can contribute significantly to the total error budget. At this point, we cannot say for sure that it will be the dominant error source, but at least we could mention that the magnitude of estimated error is larger than the mission specification except for homogeneous scenes. In the revised manuscript, we add a dedicated paragraph to place the results into the context of the mission requirements. The retrieval accuracy depends highly on the specific details of the retrieval techniques, but we point to the Dr. Otto Hasekamp's study in the introduction. We are not aware of relevant study regarding the error in cloud retrievals.

We greatly appreciate your constructive comments that let us make the manuscript more accessible for readers. Once again, thank you very much for your substantial encouragements.
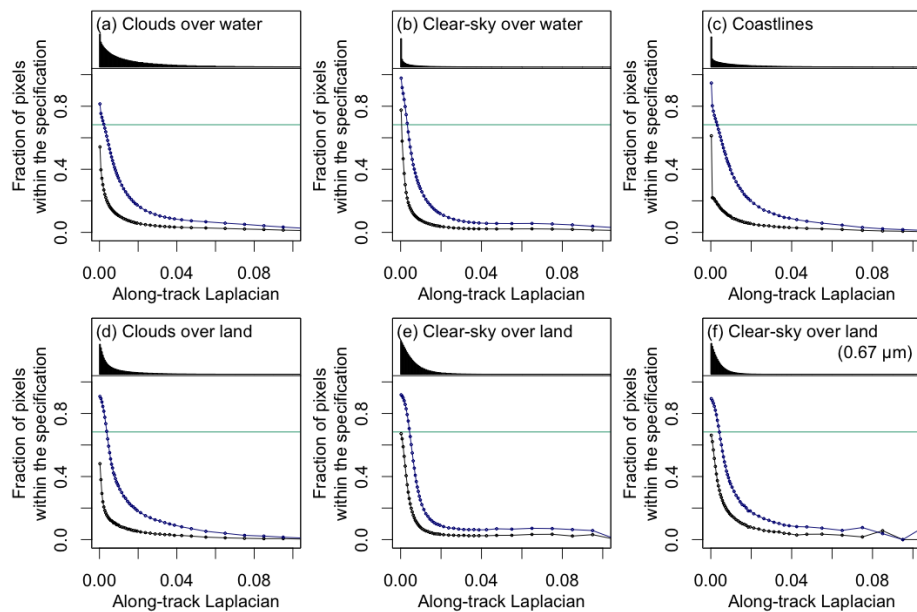
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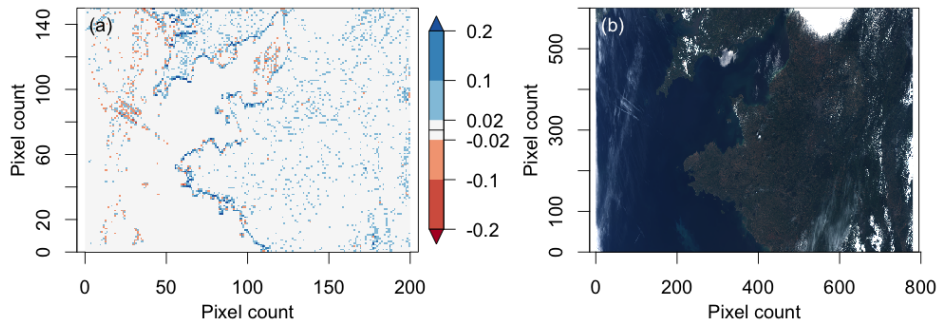
Fig. 1. (a) The DOLP difference between proxy and reference data. (b) The visible composite of the SGLI Level 1B data the same zone (visualized by authors, original data by JAXA).

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Fig. 2. The fraction of pixels within the POLDER specification (dark blue) and the 3MI specification (black) in each bin of along-track Laplacian. The density histograms of the along-track Laplacian is on top