

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

Kirk Knobelspiesse (Referee)

kirk.d.knobelspiesse@nasa.gov

Received and published: 5 November 2020

Review of “A study of polarimetric noise induced by satellite motion: Application to the 3MI and similar sensors” by Hioki et al., amt-2020-407

This manuscript characterizes the error of observations by rotating element polarimetric sensors such as 3MI and POLDER. While this has long been known as a potential issue with this type of instrument, this manuscript provides a reliable quantification of these errors, and a description of potential systematic biases as well.

In terms of scientific significance and quality, this manuscript is excellent. There are

C1

a few (minor) issues regarding presentation quality and terminology that are easily addressed.

More detailed comments and questions.

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-simultaneous observation of polarization filtered intensity measurements (X_{m60} , X_0 , X_{p60}) inherent to rotating filter wheel style instruments. This is important because some other polarimeters have made the (sometimes expensive) choice to use division of aperture or focal plane or other techniques to avoid this issue, and as such have lower expected uncertainties (which generally have less systematic bias too). It is an important point to make for readers who may not be as immersed in the polarization community as ourselves. It would also help explain why SGLI is the reference without interpolation issues. I realize you allude to this issue in several parts of the paper, but I'd like to see a clearer indication in the abstract and start of the introduction.
2. I'm not sure “noise” is the right term to use throughout your paper, since it often involves a bias, so it isn't ‘random’. You cite the Povey and Grainger paper, and to be consistent with that you should use the term ‘error’.
3. Section 2.2.2: is there a reference for the meaning of the file format names that aren't spelled out (POLDK, VRNDK, VNRDL, IRSKD, etc.)
4. Section 2.2.2 – I would think ‘classification’ of the data, not stratification, is a more appropriate term. Later on you use the term stratification in a different way too, and I don't think it is correct either (more on that in a bit).
5. Section 3.1, Fig 3a I'm not sure I follow why the coastlines have what appears to be a significantly biased error (blue in Fig 3a) but the clouds do not. I'm also confused why we don't see these errors for clouds over land in the figure. Perhaps that is a function of the color scaling, which needs to be tightened significantly to make the errors more

C2

obvious. This figure is very hard to see.

6. As an aside, how would cloud motion during the filter wheel acquisition period, affect the results? I realize that is not incorporated into this study, but the techniques of this study could be used to address that issue too, perhaps.

7. Results and Figure 6-10. Here the word stratified is used as well, when I think you really mean correlation, as in, the error is correlated with the Laplacian

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

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

10. What would be a nice thing to include in a discussion is some thoughts about how these results can be used. Are you suggesting it might make sense to assess the observations of the VII sensor to correct the 3MI data for expected systematic bias? Or would it make more sense simply to use this uncertainty estimate to help weight the observations in a retrieval algorithm?

11. Are the shifting weights described in Table 1 and 2 the same for all view angles? I think the answer is yes, but if not there would be implications on differential weighting of one view angle versus another.

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 retrieve geophysical parameters (you could point to information content studies here).

Overall though, great paper. Thank you

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-407, 2020.