Author response to reviews of "Analysis of simultaneous aerosol and ocean glint retrieval using multi-angle observations" by Kirk Knobelspiesse et al.

Feb 8, 2020

We would like to express our gratitude to the reviewers for their thorough and positive assessment. Below are our individual responses to each reviewer, reviewer's text in italics.

We would also like to note that we have added supplementary material at data.nasa.gov at the following location:
https://data.nasa.gov/Earth-Science/MISR_MODIS_AtmCorrection/sg4r-ftwb
This contains figures similar to 3, 4, 5 and 7, but for each of the 7,000+ simulations at various geometries and parameter states. We have added a note regarding this in the 'code and data availability section.

Anonymous Referee #1

This study presents a theoretical information content analysis to evaluate the capability of multi-angular MISR 865nm measurements to simultaneously determine aerosol and ocean surface sun glint variables, including AOD, fine-mode fraction, relative humidity, and surface wind speed. Such analysis was accomplished by a radiative transfer simulation of seven sets of MISR observation geometries and the Bayesian-based information content (and error) analysis. Authors also performed several comparative information analysis to evaluate the sensitivity of retrieval errors to solar & view geometries, plane-parallel atmosphere assumption in radiative transfer, and wind direction.

This is an important study, as indicated by the authors, which is to lay the groundwork for the design of an algorithm for a simultaneous retrieval of aerosol and ocean surface properties from MISR. The paper is well written and well organized. I have the following comments that author may consider:

Thank you

1. It seems to me that correlation between errors of individual observations and correllation between the prior error of each state elements are not considered in the Bayesian information analysis. However, these error covariances may exist between MISR's multi-angular observations, as well as between some retrieved variables (such as AOD and fine-mode fraction, AOD and RH). It is thus necessary to explicitly declare the assumption of error correlation in this work and discuss its potential impacts to the results.

This is true, although we expect the impact to be minimal for MISR. To further clarify, we added the following statement to the end of section 2.4:

Finally, we should note that a disadvantage of our implementation of GENRA is that it does not account for uncertainty correlation in the data. However, we expect MISR observations for each camera to be largely uncorrelated (Kahn et al. (2005b)). The resulting posterior PDF expresses covariance between parameters, but cannot account for model uncertainties that are correlated in parameter space.

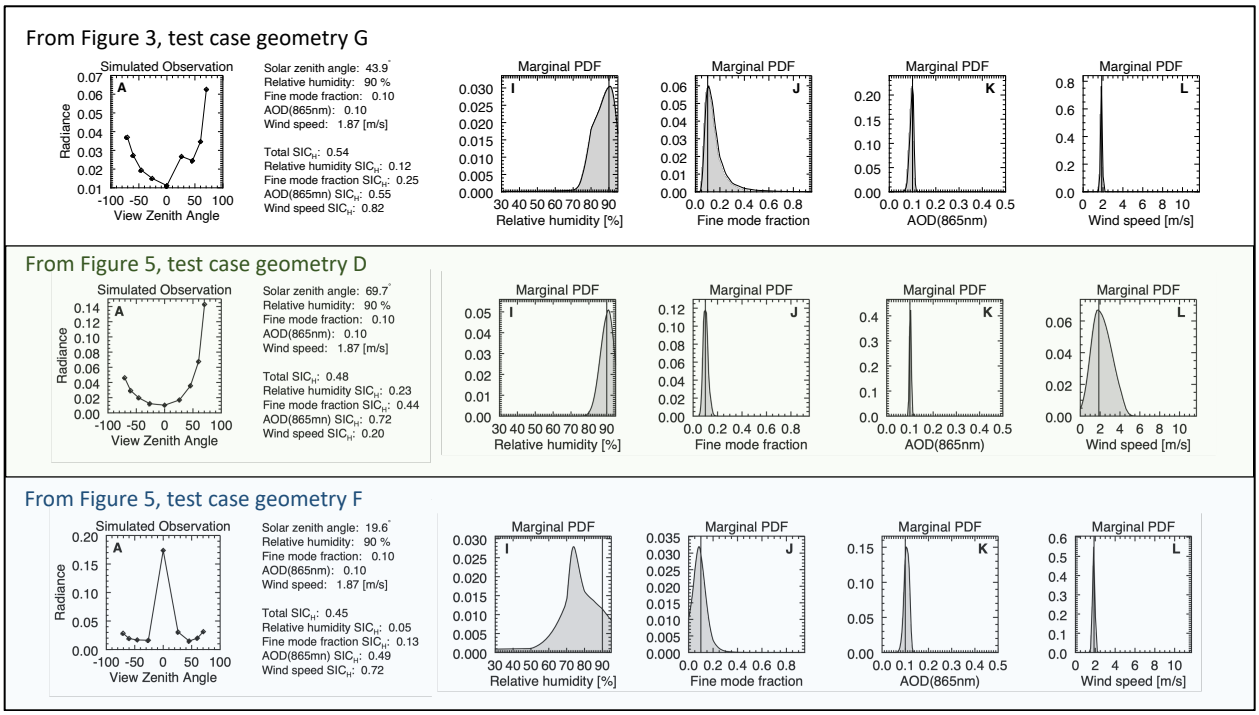
2. I agree with the reviewer #1 that more analysis should be performed to extend the currently selected geometrical conditions. It will be of interest to see the results for MISR observations in solar principal plane and perpendicular plane (which are currently missing in the selected geometries, as in Figure 1).

Please refer to the comments above regarding this topic. We would like to reiterate that MISR does not observe in the solar principal plane, and observes in the perpendicular plane at low solar zenith angles (roughly 20 degrees), where the relative azimuth angle is relatively unimportant. Case F is about 20 degrees from the perpendicular plane.

For an illustration of all MISR observed geometries in an orbit, please see Figure 2, panel (b) of Knobelspiesse and Nag, 2018 (https://doi.org/10.5194/amt-11-3935-2018). Analogous to Figure 1 in this paper, we can see that observation geometries close to the solar principal plane only occur at extremely high solar zenith angles (corresponding to high latitudes), while the perpendicular plane is observed at low zenith angles (about 20 degrees, corresponding to low latitudes).

3. In the section of results, readers need to compare posterior PDFs for different conditions but tend to get lost to flip back-and-forth between Figures 3 to 7. I would recommend to rearrange the panels in Figure 3-7 by combining same panels for different conditions. Doing so will help the comparative interpretation.

We agree that visualization of high dimensional spaces is difficult, and we much balance utility and brevity. To that end, we don't want to repeat figures reconstructed in multiple formats in the same manuscript. However, we have taken the marginal PDF's from the three comparable cases (same parameter state, different geometry) and rearranged them in a figure here. Since this reviewer response is also available to all readers, we hope this is an adequate solution.



4. The symbol "r" is used to represent both relative humidity and particle radius. Authors may want to use different symbols for them to avoid confusion.

Good point. We updated particle radius in equation 1 to use ‘R’ rather than r.