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Interactive comment on "Estimating downwelling solar irradiance at the surface of the tropical Atlantic Ocean: A comparison of PIRATA measurements against several re-analyses and satellite-derived data sets" *by* Mélodie Trolliet et al.

Anonymous Referee #1

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Review of "Estimating downwelling solar irradiance at the surface of the tropical Atlantic Ocean: A comparison of PIRATA measurements against several re-analyses and satellite-derived data sets" by Trolliet et al.

This manuscript compares hourly estimates of downwelling solar irradiance at the surface (DSIS) from two atmospheric reanalyses and three satellite-based products to measurements from PIRATA moorings at five locations in the tropical Atlantic. The re-

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sults show that the satellite-based estimates generally perform much better than the reanalyses in terms of total DSIS and cloud forcing. These results will be useful for the research community and should be published. However, some revisions are necessary to improve the clarity and organization of the presentation. The manuscript is also presently a somewhat repetitive description of the statistics for each data set without much comparison between them or discussion of the reasons for the different or similar results for different data sets. Below are more detailed comments and suggestions for improvement.

Main comments:

The discussions of the results for the satellite-based data sets are very similar, and the performances relative to PIRATA are also similar. I suggest putting the satellite-based data set results in one section and discussing them together in order to avoid repetition. The MERRA and ERA results could also be put into the same section and discussed together for the same reason. Making these changes would improve the readability of the manuscript.

The layout of the figures can be improved. Currently they are structured so that a certain parameter is shown for all data sets in a given figure. However, in the text the results are discussed separately for each data set. It makes more sense to put all HelioClim plots (i.e. Fig. 2a,b, Fig. 3a,b, etc.) in the same figure, and the same for SARAH, CAMS, and the reanalyses.

As stated in the manuscript, potential biases in the PIRATA time series are an issue and complicate validation of the satellite-based data sets. These biases are discussed in section 1.1, but there's no summary or estimate of the overall uncertainty in the PIRATA hourly data. Can you provide an estimate? I would expect the buoy measurements may be biased low regardless of any aerosol buildup, based on the persistent low biases shown in Fig. 7 of Foltz et al. (2013), possibly due to fading of the radiometers' coatings with time. It might be helpful to plot the DSIS bias as a function of DSIS to help figure

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out if biases of buoy DSIS may be partially to blame. I would expect the bias may be larger for larger DSIS if the buoy data have biases, essentially due to a bias in the buoy radiometers' gain coefficients. I don't see any evidence of this dependence in your figures, but it's difficult to tell for sure.

Other comments:

It's unclear how repetitive buoy tilting/rocking from waves would introduce a mean bias for a daily average (p. 3, lines 21-24). A brief explanation here would help. For a systematic tilt (e.g. on the equator due to strong zonal currents) it's easier to imagine.

p. 4, line 19: I would expect equatorial moorings to be influenced the most by tilt due to currents. North of about 8N currents should be much weaker in the mean.

Foltz et al. (2013) found a significant low bias from the mooring at 19S,34W despite no apparent dust buildup. It's not clear why, but it could explain your large discrepancies at that location.

p. 5, lines 21-22: Why not use the same EO as is used for PIRATA? That would ensure that differences in DSIS are the only thing contributing to differences in KT. Or if the EO values from different data sets are basically the same, that should be stated.

p. 6, lines 4-5: It's not clear how 30-min values were converted to hourly. Do you add anomalies from the TOA irradiance to 1-min TAO irradiance, then average this to an hourly average?

The portion of section 2 on p. 7-8 describes methodology more than results, so could be moved to section 1.

Why do you show only the 6S, 10W location in the figures? Please explain. In Fig. 2 the font within the figure (Mean, bias, st-dev, corr_coeff) is too small to read.

p. 10, lines 15-20: Are you saying here that HelioClim does not have enough cloud radiative forcing? It seems like it, but not sure.

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p. 10, line 23: Are the results for 0n0e and 0n10w shown in a figure or table?

p. 10, lines 25-26: Why the underestimation and overestimation? Low cloudiness?

p. 11, line 1: Are you referring to the bias for KT=0.7?

p. 11, line 13: Please explain why it is important that spatial gradients are reproduced.

p. 11, line 19: I don't see this underestimation ion Fig. 2c.

p. 12, line 27: What is special about KT=0.6-0.7 that results in large biases in the satellite analyses? Because it appears so consistently, it would be worthwhile to know.

p. 13, line 5: "do not correlate" might be too strong of a statement, since some correlations are 0.82-0.91.

p. 13, line 9: What is the difference between true solar time and mean solar time?

p. 13, line 17: MERRA results are in Fig. 5c,d according to figure caption, not Fig. 5a.

p. 14, line 20: This statement is very confusing.

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