

## ***Interactive comment on “Determining the Daytime Earth Radiative Flux from National Institute of Standards and Technology Advanced Radiometer (NISTAR) Measurements” by Wenying Su et al.***

### **Anonymous Referee #1**

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11. In ERB calibration your definition of filtered radiance as IRRADIANCE/SOLIDANGLE is only true if the instrument has a completely flat spectral response, which from fig 2 is certainly not the case for NISTAR SW & NIR channels.

113-132. This is based on CERES unfiltering of Loeb et al 2001 I assume (where they are also labelled Eqns 3 & 4 at <https://journals.ametsoc.org/doi/pdf/10.1175/1520-0450%282001%29040%3C0822%3ADOURFT%3E2.0.CO%3B2> ). Is it completely identical to CERES using the same decades old CERES radiative transfer database? This might be important to briefly mention as it could help eliminate mere inversion biases when you compare to CERES later in the paper.

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142. This is confusing, although I accept it probably amounts to same thing, are look up tables of a & b values (Eqns 3 & 4) or a table of kappa ratios actually used? Only if both techniques are used separately should there be 4 rather than just 2 eqns?

143. How are spectrally dependent changes to the transmission of the quartz filter due to outgassing contamination measured after launch and throughout the mission?

144. What about quartz filter leakage? Are you using the NIR channel for that somehow (similar to Loeb et al 2001 above)?

146. Are you sure no unfiltering of the total channel is required, if so how? Was its spectral response measured to be certain? How are you certain no changes to the effective gains of the cavity channels due to electronics radiation exposure are occurring? I'm assuming you do not have onboard blackbodies?

147. How are the SW and Total channels balanced in the solar region as in Kratz et al 2002? (<https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2001JD001170>)

261. what is a shutter cycle? Why is a boxcar filter used in the demodulation algorithm? Are details of these processes important?

264. Recommended based on what, the URL does not work?

266. Why 4 hour "running means" and how is this different from a 4-hour wide boxcar filter from the terminology you used earlier? Does this mean a 4-hour running mean is taken of the boxcar filtered then 2-hour averaged data? Why are the 4 hour means suggested by the NISTAR instrument team?

286. These GERB comparisons need a reference.

311. Why does the onboard data processing cause this?

315. How are the offsets countered, space looks?

332. With as few as 10 EPIC results per day are these always equally spaced in time?

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If not, could this not lead to biases?

338. So it seems the LW difference is greatest in Northern Hemisphere Winter, when more ocean is observed? This may be a calibration artifact or error in knowledge of the NISTAR SW channel for the UV region. As per the point above for line 147, how are you balancing SW and Total channels to assure accurate LW in daylight?

352. "A comprehensive spectral database has been developed", so is it different from that used by CERES?

355. So is a constant of 0.8690 used for all NISTAR unfiltering? Unfiltering of LEO scenes varies greatly by several percent especially for ocean scenes etc. So, it seems a value of 0.3% difference for primarily land vs Pacific Ocean scenes would vary more (and maybe adds to your seasonal cycle). What results lead to the 0.3% conclusion and did you try a scene by scene unfiltering?

370. Is this the PSF of the EPIC telescope separate from its array of detectors? How was it measured?

388. Again, this could be due to a constant unfiltering factor?

392. Loeb et al 2018 only quotes the 1% accuracy figure as do you, please provide a peer reviewed SI traceable reference.

396. Please give a peer reviewed reference for the 2.1% NISTAR SW accuracy figure.

404. With so many error sources not well known it is wrong to simply add them all in quadrature, which assumes they are all random and independent. A more sophisticated error analysis is needed.

407. The  $1.8\text{Wm}^{-2}$  accuracy for CERES LW applies for nighttime LW only. During the day which is always the case for NISTAR it is less accurate. This is because it requires the earlier discussed balancing of the SW and Total channel which if done wrong can result in measuring the Earth warmer at night than during the day for example (see

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Fig11b, Page 14 at <https://journals.ametsoc.org/doi/pdf/10.1175/2010JTECHA1521.1> ). Hence for NISTAR which only views day LW, this is an important consideration.

415. Guesstimate? This is most unsatisfactory for any science paper, let alone one on climate measurements. Please do better.

423. Again, adding in quadrature for so many uncertain, often modelling terms is not acceptable. For example, consider how the error in knowledge of SW vs Total solar response could be systematic because of an error in the ground lab, it will partly cancel in the Total – SW subtraction.

428. This is true, in addition to the above-mentioned systematic nature of SW and Total errors not considered in your quadrature additions. A more sophisticated analysis is needed.

Overall this paper has merit but needs work to fill in the blanks on some of the processes/references used. The large differences of NISTAR from CERES appears strange and would seem at first look to be largely from algorithm errors. I feel this could be acceptable being a new measurement, but needs to be stated more clearly in the paper as such. The use of constant SW unfiltering also raises concern and leads to the possibility it is a cause of the larger than expected seasonal cycles, but more investigation is needed. Also some insight in the introduction into the purpose of NISTAR would be good, such as giving illustration if and how it complements the climate observing system discussed by Weilicki et al 2013 (<https://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-12-00149.1> ).

In summary, this paper could become suitable for publication, given more work, research and additions that address the points above. It should then be re-considered under peer review.

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