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 #3
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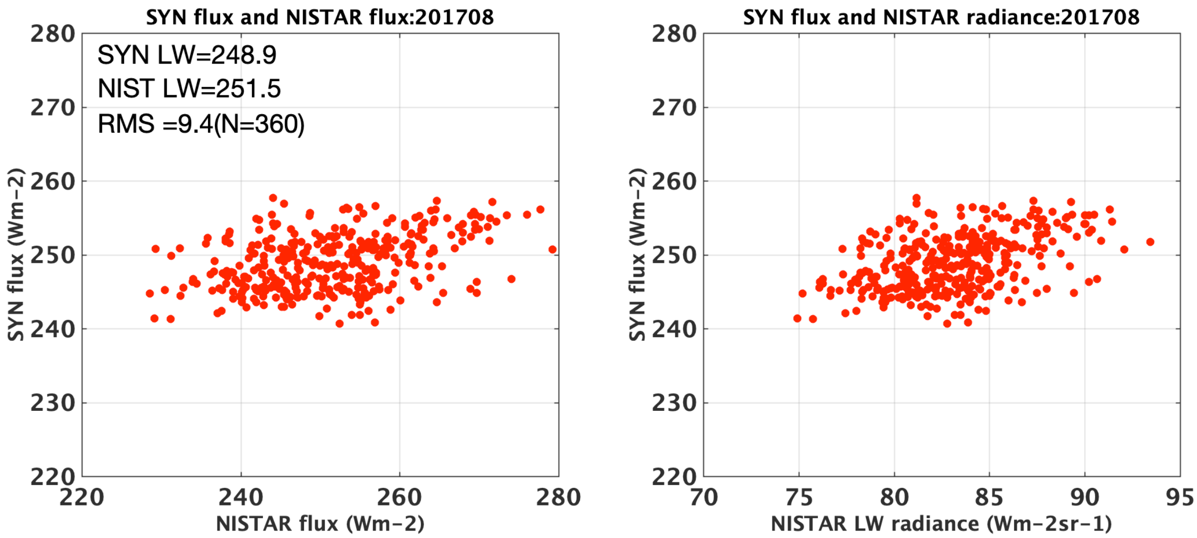
General comments:
This paper presents the scheme and algorithm of deriving TOA SW/LW flux from NISTAR measurements and comparison also made with the corresponding results derived from CERES. I am impressed by the detailed and clear description of the algorithms. The paper is very well written and relevant to the community. I recommend publication after addressing the minor issues listed bellowed. It doesn’t seem that the uncertainties in the algorithms would give a consistent bias seeing in the differences between NISTAR and CERES. Has there been analysis with the NISTAR instrument measurements and calibration? The low correlation between NISTAR LW flux and that of CERES is puzzling. To bypass the potential uncertainties in part of the algorithms, it may be useful to look at the correlation between the NISTAR LW radiances and the CERES flux to see if they are correlated at all.

*The NISTAR instrument team (who produces the L1 data) is responsible for the instrument calibration and the team has presented their calibration at the DSCOVR science team meetings(https://avdc.gsfc.nasa.gov/pub/DSCOVR/Science_Team_Meeting_Sept_2019/L1/NISTAR_Goddard%20Science%20Team%2020190917.pdf). So far their analysis are mainly focused on the SW channel. NISTAR has three broadband electrical substitution radiometers (ESRs). All ESRs have a large background noise as they measure the change in incident optical power. Two steps are utilized to remove the background noise: first using a shutter to modulate the source which removes most of the background noise then using dark space view to remove the residual shutter-modulated background. The shutter modulated background is largest for the total channel and is smaller for the SW channel. As the LW is derived from the difference between total and SW channels, both total channel and SW channel background noises contribute to the LW uncertainty. The NISTAR total channel uncertainty is 1.5% and the SW channel uncertainty is 2.1%. Assuming the SW flux is 210 Wm-2 and the LW flux is 240 Wm-2, thus gives the total flux uncertainty as 450*1.5%=6.8Wm-2, and the SW flux uncertainty as 210*2.1%=4.4Wm-2. The resulted uncertainty in LW flux is 8.1 Wm-2, which can explain most of the LW differences between NISTAR and CERES SYN shown in Table 4. See added description on page 6. The low correlation is also caused by the background noise in both the total and SW channels. Details on NISTAR calibration are added on pages 5 and 6. Below is an example of August 2017, where the correlation between CERES SYN LW and NISTAR LW flux is about 0.38, and the correlation between CERES SYN LW flux and the NISTAR LW radiance is about 0.41. It is obvious that the low correlation is mainly from the instrument calibration.*



Specific comments:
Page 5 and 6: The authors have derived the regression equations for the unfiltered radiances (Eq 3 and 4); what is the reason for using the less accurate ratio method (Eq. 5 and 6)?

The Equations 3 and 4 are the original method we planned to use for the NISTAR unfiltering. But unlike other LEO instruments that have scene-type information and Sun-viewing geometry for each footprint, and the regression can be applied based upon the scene type and Sun-viewing geometry of each footprint. NISTAR views the entire Earth as a single pixel, and the cloud fraction, cloud type, and land/ocean portions differ from time to time. Luckily, the NISTAR SW spectral response function is such that the ratio between filtered and unfiltered radiances exhibit very little sensitivity to the scene types and Sun-viewing geometry. We rewrote the sections on page 7 and 8 to correct this.

Page 14: How are the portion of the Earth not visible to NISTAR decided? Also, similar to NISTAR missing some of the daytime portion of the Earth, it must be seeing part of the night time side of the Earth. Are these taking into account for the longwave calculations?

The mask is calculated based upon the solar zenith angle and the EPIC viewing zenith angle and each EPIC pixel is identified as nighttime hidden to EPIC, or nighttime visible to EPIC, or daytime hidden to EPIC, or daytime visible to EPIC. Both the daytime and nighttime visible to EPIC are considered for the CERES SYN product to compare with the NISTAR LW measurements. Some clarification is added on page 14 and Figure 6b) is modified accordingly.