Review on "*Determining the Daytime Earth Radiative Flux from National Institute of Standards and Technology Advanced Radiometer (NISTAR) Measurements*" by Su et al.

This paper documents the methodology to derive the broadband radiative flux from the measurements of the NISTAR instrument onboard of the DSCOVR mission. Some preliminary results based on this method are compared with the well-developed CERES data. The SW fluxes derived from the NISTAR compares reasonably well with CERES, but the LW fluxes from NISTAR have a systematic bias and low correlation coefficient when benchmarked with CERES.

The topic of this paper is important and suitable for AMT. The paper is well organized. However, the paper lacks some important technical details about the instrument and the methodology, as well as the author's opinion about the usefulness of the NISTAR product. In my view, some significant revisions are needed before the paper can be accepted for publication. Below is a list of questions and concerns I have.

1) The parameterization scheme described in Section 2 to obtain unfiltered radiance from observed filtered radiance is confusing. Up to line 132, the method seems to be based on the polynomial parameterization scheme in Eqs (3) and (4). But then it suddenly changed to the simply ratio-based parameterization in Eqs. (5) and (6). Why are there two types of parameterization? Which one is used?

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.

2) What is the FOV size of the NISTAR instrument? Does it observe the earth pixel by pixel (similar to EPIC) or as a whole? Does its FOV include some cosmic background and, if so, how is that treated?

NISTAR observes the entire sunlit side of the Earth as one pixel. We specifically mentioned this on lines 53-54.

3) Within its FOV, does the NISTAR instrument response to the radiance from different locations and angles equally? In other words, do the radiances from the edge of the earth disc have the same weighting as those from the center of the disc?

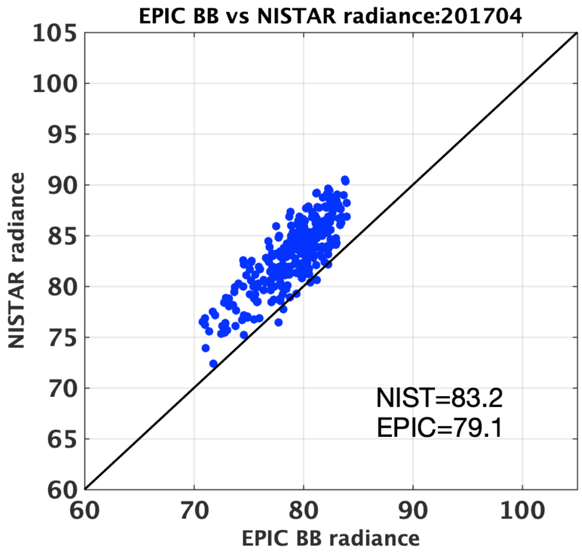
Yes, NISTAR response to the radiance from different locations and angles equally. Optically the instrument is very simple—there aren't any lenses or mirrors, just filters, and a pair of apertures, and incident light is nearly perpendicular to the filters and apertures. The Earth subtends an angle of less than 1 degree from DSCOVR.

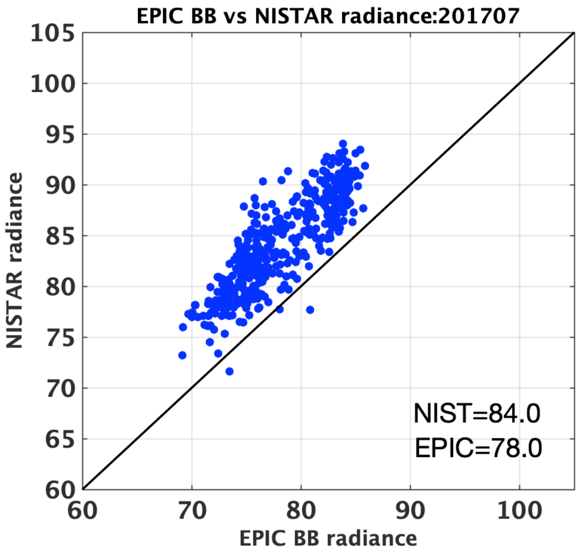
4) It is stated that "*The biases in the anisotropy correction for the DSCOVR scattering angle are mitigated and potentially minimized by the wide range of different scene 71 types viewed in a given NISTAR measurement.*" Some references are needed to support it.

We referenced the Su et al. (2018) paper here. As this is a very new way to measure the Earth radiative flux, no other references are available.

5) In Su et al. (2018), a similar method is used to derive the fluxes from EPIC measurements. One of the byproduct from this EPIC-based method is the "global day-time mean SW radiance" $Ib\bar{\bar{\bar{b}}}$. Is it something directly comparable to the observation of NISTAR instrument? If so, some comparisons should be made because both EPIC and NISTAR have the similar sun-satellite geometry.

Indeed, we have derived the "global daytime mean SW radiances from EPIC". They are consistently lower than the radiances from NISTAR. Below are the comparison between NISTAR and EPIC radiances for April and July 2017. The mean differences are between 4 to 6 Wm-2sr-1. We chose not to include these results in this paper to avoid any confusions and the EPIC and CERES comparisons were provided in Su et al. (2018).





6) I have several questions about the method described in Section 3c. First of all, what is the theoretical based for Eqs 9~ 11? If my understanding is correct, the global mean SW flux is

$$F = \iint_{sunlit} \frac{I[\theta_0(r), \theta^e(r), \emptyset^e(r), \chi(r)]}{R(\theta_0, \theta^e, \emptyset^e, \chi)d^2r} d^2r$$

Where r denotes a point on earth. But this is not equal to

$$\frac{\iint_{sunlit} I[\theta_0(r),\theta^e(r),\emptyset^e(r),\chi(r)]\,d^2r}{\iint_{sunlit} R(\theta_0,\theta^e,\emptyset^e,\chi)\,d^2r}.$$

More detailed mathematically derivations are needed here. Secondly, one might ask if a global mean anisotropic factor is even physically meaningful? The average is over a large range of viewing angles and scene types. Does the result have any physical meaning? Moreover, are the angular and spectral averaging independent and can be treated independently? The derivations in Section 3c seem to suggest they are independent, but this is not obvious to me. Some clarification is needed.

We agree with the reviewer that the above two equations are not the same. The first equation is how we calculate global mean flux from low-Earth orbit satellites (i.e. CERES) using the footprint level data (resolution on the order of 20 km) by first grid the data then area weight to calculate the global mean. We did not use the second equation in our study to derive the fluxes from NISTAR radiance measurements.

To derive the global mean flux from NISTAR measurements, a corresponding anisotropic factor to characterize the sunlit portion of the Earth as a whole is needed, and this is the definition of the global mean anisotropic factor we used in the paper. The global mean anisotropic factor is derived by using the radiances and fluxes defined in the CERES angular distribution models (ADMs). The global mean radiance and flux from CERES ADMs were calculated independently (see Equations 8 and 9 in the revised version). They are used to derive the global anisotropic factor (Equation 10) and subsequently to convert the NISTAR radiance to flux (Equation 11). The deviation of the NISTAR flux used here is not the same as illustrated by the second equation above. This method has been tested for both the NISTAR and EPIC measurements.

7) This paper only shows “how to do it” but does not explain “why to do it” other than it can be done. I understand that this paper is to document the method used to derive the flux from the radiance observations of NISTAR. But I think in addition to the technical details the reader would apricate some insights and opinions from the authors about the usefulness of the product. We already have the state-of-the-art CERES flux product and in Su et al. (2018) flux product has also been developed. What is new/novel/important about the NISTAR flux product other than the fact it can be done? What kind of applications can this product be used for? Some discussions about these important questions should be added to the abstract and conclusion parts.

We added some information on NISTAR measurement and its utility in the introduction (lines 59-68). We also added some perspective on the utility of NISTAR SW fluxes in the conclusion section (lines 486-492).