Review #2

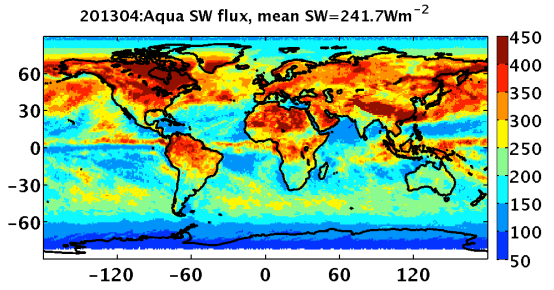
Major comments

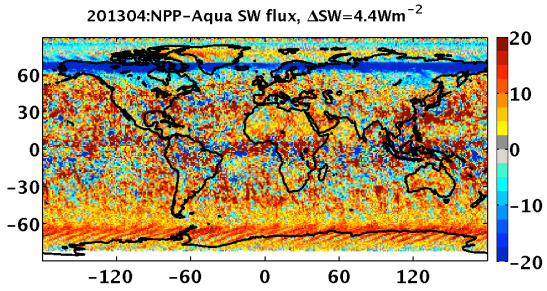
This manuscript attempts to quantify the flux uncertainties in the NPP-CERES fluxes because NPP does not have a rotating CERES instrument to generate NPP specific ADM as the TERRA and AQUA satellites had and has to borrow the ADM generated from AQUA satellite. The study uses AQUA MODIS radiances to create simulated fluxes for both AQUA and NPP footprints - going through the same narrowband to broadband conversion and using the same ADM for radiance to flux conversion to isolate the differences due to footprint size alone. The differences due to both footprint size and cloud properties are examined with VIIRS-adjusted cloud properties and subsequent ADM. This study helps to understand and quantify the uncertainty in the current NPP CERES fluxes due to missing its own ADM. However, the description of the methodology could be much improved by adding proper flow chart and naming convention.
Thank you for your time reviewing this paper. We added a flow diagram (Figure 6) to illustrate the process of convoluting the high-spatial-resolution MODIS pixel-level radiances and cloud/aerosol retrievals with CERES-Aqua and CERES-NPP point spread functions to provide narrowband radiances and cloud/aerosol properties for the respective simulated CERES-Aqua and CERES-NPP footprints, and the simulated CERES-NPP footprints with VIIRS-like cloud properties. These narrowband radiances are then used to derive broadband radiances and they are converted to fluxes using the Aqua ADMs.

The other missing piece of information is how the uncertainties estimated with simulated fluxes starting from MODIS pixel radiances are measured against actual retrieved NPP CERES flux?
As illustrated in Fig. 3 in the revised manuscript, the overpass times for NPP are different from those of Aqua. The broadband radiances generated using narrowband-to-broadband coefficients also differ from the measured broadband radiances. Direct comparison between fluxes in the simulated CERES-NPP footprints and the actual CERES-NPP footprints will mostly show the difference caused by the afore mentioned differences (the simulated CERES-NPP used the Aqua Sun-viewing geometry). The focus of the paper is to assess the effect of footprint size difference and scene identification difference on flux inversion without having to account for the overpass time difference and calibration difference. This is the reason that we designed this study and used narrowband-to-broadband regression to derive the broadband radiances.

Similar comparisons between the matched NPP and AQUA radiances (Figure 1) could be applied to match fluxes. Likewise, gridded monthly flux differences between the operational CERES-AQUA and CERES-NPP retrievals (similar as Figures 3, 5, 6) would provide an all-inclusive uncertainty that the current simulated uncertainty estimates could put into perspective.
We compared the fluxes using matched NPP and Aqua footprints as suggested by the reviewer. Results are provided in Fig. 2 and Table 1, and descriptions are on page 8. However, as mentioned above and demonstrated in Fig. 3, the overpass time differences between the Aqua and NPP orbits dominate the monthly gridded flux differences, as shown below. The left plot

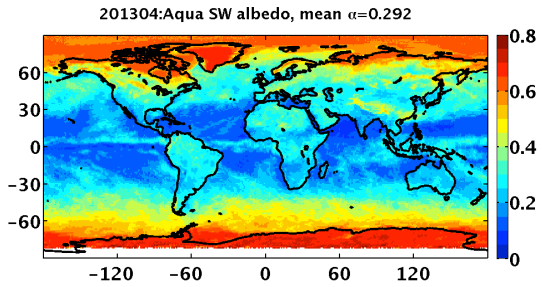
shows that monthly gridded SW flux for Aqua and the right plot shows the SW flux differences between NPP and Aqua. Most of the features in the difference plot resemble those in Fig. 3.

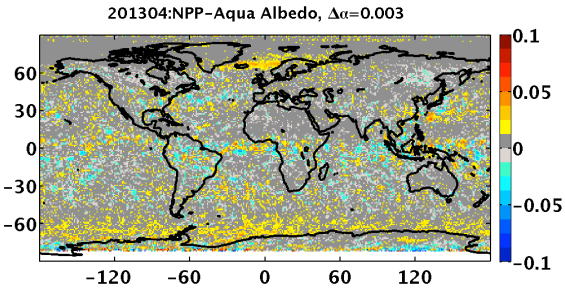




We can compare the albedo between NPP and Aqua to bypass the insolation difference, as shown below (figure on the left is the monthly mean albedo and figure on the right is albedo difference between NPP and Aqua). The global monthly mean albedo from CERES-NPP is about 0.003 (1.02%) greater than the global monthly mean albedo from CERES-Aqua (0.292). We believe these differences stem from the combination of calibration difference, ADM and scene type differences. It is impossible to attribute how much each of them contributed to the albedo difference just by comparing the flux/albedo from Aqua and NPP. This is the reason that we come up with this study to isolate the contribution of ADM and scene type differences to flux difference.

We added the albedo difference plot (Fig. 4) in the revised manuscript and some discussions on page 8.





Detailed comments:

1. The methodology description is very confusing. Please explain clearly how each of the three products are produced, use an acronym for each of them and the intermediate products, i.e.,

SNR- Aqua - simulated narrowband radiance with Aqua footprint size

SBR -Aqua - simulated broadband radiance with Aqua footprint size

SBF-Aqua --- simulated broadband flux with Aqua footprint size

We rewrote the methodology section and defined that $I_a^s(\lambda)$ is the narrowband radiance for the simulated CERES-Aqua footprints, I_a^s is the broadband radiance for the simulated CERES-Aqua footprints, and F_a^s is the broadband flux for the simulated CERES-Aqua footprints. Their counterparts for the simulated CERES-NPP footprints are $I_n^s(\lambda)$, I_n^s, and F_a^s, and they are $I'^s_n(\lambda)$, I'^s_n, *and* F'^s_a for the simulated CERES-NPP footprints with VIIRS-like cloud fraction and

cloud optical depth. The CERES-Aqua measured broadband radiance is I_a^m, *and the CERES-NPP measured radiance is* I_n^m. *The corresponding fluxes are* F_a^m *and* F_n^m.

2. Need a flow chart to illustrate the methodology. Something like:
MODIS-Aqua -> SNN-Aqua -> (narrowband to broadband conversion) SBR-Aqua ->(MODIS ADM) SBF-Aqua
MODIS-Aqua -> SNN-NPP -> SBR-NPP -> (MODIS ADM) SBF-NPP
MODIS-Aqua -> SNN-NPP -> SBR-NPP -> (likeNIiRS ADM) SBF-NPP2
We added a flow diagram (Figure 6) to illustrate the process of convoluting the high-spatial-resolution MODIS pixel-level radiances and cloud/aerosol retrievals with CERES-Aqua and CERSE-NPP point spread functions to provide narrowband radiances and cloud/aerosol properties for the respective simulated CERES-Aqua, and simulated CERES-NPP footprints with MODIS cloud properties and with VIIRS-like cloud properties. These narrowband radiances are then used to derive broadband radiances and they are converted to fluxes using Aqua ADMs.

3. Once product acronym is defined, specify which two products are compared in Figures 3, 5, 6.
Modified the captions using the acronym (now Figures 7, 8, 9).

4. line 71-73 From this sentence, it is inferred that one of the CERES instrument on the TERRA/AQUA satellites used RAP scanning mode to create ADM at the beginning of the mission. How long was the RAP mode in operation? line 82-83 says ADM was created from multi-year CERES measurements from both RAP and crosstrack mode. Does that mean both CERES instruments were used for ADM? Please clarify.
We specified the total lengths of RAP data collect for Terra and Aqua on lines 83-84: "There are about 60 months of RAP data collected on Terra and about 32 months of RAP data collected on Aqua.". We clarified that the "Terra ADMs and Aqua ADMs were developed separately using multi-year CERES Terra and Aqua measurements in RAP mode and in cross-track mode using the scene identification information from MODIS" at lines 98-101.

5. line 119: why do you use different view zenith angle requirement for LW radiance?
We modified the SW radiance matching criterion of viewing zenith angle to be the same as LW radiance (i.e. 2 degrees). We updated the Table 1 and Figure 1 for the SW comparison.

6. Figure 1 and Table 1: could you add plots for total radiance comparison between CERES-NPP and CERES-AQUA? Also, the difference in radiances between CERES-NPP and CERES-NPP could be partly due to different footprint size besides the calibration?
CERES instruments measure radiances in total, SW, and window channels. These measured radiances are filtered radiances, which then are unfiltered by accounting for the spectral response function for each channel. Unfiltered radiances are provided for LW, SW, and window channels, but not for total channel, thus we are unable to compare the total radiances. The reviewer is correct, that footprint size difference also contributes to the radiance difference. However, the effect of footprint size on radiance should be random. The radiance bias is mostly from the calibration difference between CERES-Aqua and CERES-NPP, and the footprint size difference can increase the RMS error. We added this in the revised version.

7. Figure 2 Caption: add "CERES" before footprints
This figure is replaced with Figure 6 in the revised version.

8. line 170-173: The narrow-band to broad-band conversion coefficients are derived from simulated MODIS AQUA radiances and CERES-AQUA broadband radiance. Could these coefficients also be footprint size dependent? The same coefficients are now applied to convert both simulated CERES-AQUA and CERES-NPP footprint.
The narrowband-to-broadband (NB2BB) regression coefficients should not be dependent on the footprint size, but the broadband and narrowband radiances and fluxes could change as the footprint size changes which sometimes results in more/fewer clouds in the footprints.

9. line 177-178: Actually it would be interesting to compare the simulated CERES-AQUA and CERES-NPP fluxes at footprint level even with different footprint size. How would this comparison differ from the comparison between matched CERES-AQUA and CERESNPP observations in Figure 1?
We compared fluxes using matched CERES-Aqua and CERES-NPP footprints in Figure 2 and also included the mean fluxes and root-mean-square errors in Table 1. Some discussions are also added to the paper (page 8). We also compared the fluxes from simulate CERES-Aqua and simulated CERES-NPP at the footprint level using data of April 1, 2013. Flux differences and RMS errors are provided on page 12, which are much smaller than the flux biases and RMS errors listed in Table 1.

10. Figure 4 (cloud property difference between MODIS and VIIRS) and the generation of SBF-NPP2 are better introduced before comparison the three products (Figure 3.5, 6) to ease the logic flow. Also be specific about difference (MODIS- VIIRS) or the other way?
We revised the paper by adding a section dedicated to the comparison between NPP and Aqua (section 2) and the cloud property differences are discussed in this section in the revised manuscript (Figure 5).

11. Paragraph: 238-250 how is uncertainty defined?
We revised this paragraph to be more specific. The uncertainty refers to the differences between simulate CERES-Aqua and CERES-NPP.

12. Could you provide a map of difference in ADM?
As shown in Equation (1), for a given scene type, ADM (R) is defined as a function of solar zenith angle, viewing zenith angle, and relative azimuth angle. Additionally, ADM is also different for different scene types. Averaging anisotropy values into monthly grid box means could be misleading.

13. Finally, please have native English-speaking colleagues check the grammar usage. There are many awkward sentences.
We did a thorough editing of the paper.