

CERES Terra/Aqua Edition4A SYN1deg

Observed TOA Fluxes – Accuracy and Validation

Accuracy and Validation

This section is devoted to the SYN1deg Ed4A observed TOA flux validation. The GEO accuracy and validation can be obtained in the CldTypHist Ed4A DQS. The SYN1deg Ed4A combines the CERES observed and GEO hourly derived fluxes. For accuracy and validation of the CERES-only TOA fluxes can be found in the SSF1deg Ed4A DQS. The solar incoming radiation data and associated uncertainty can be found in the EBAF Ed4.0 DQS. The incoming solar radiation is the same for the SSF1deg Ed4A and SYN1deg Ed4A products.

SYN1deg Ed4A TOA Observed Flux Uncertainties

The monthly $1^{\circ} \times 1^{\circ}$ regional all-sky SW flux uncertainty is due to: 1) CERES instrument calibration uncertainty of 1 W m^{-2} (1σ), 2) the radiance-to-flux conversion error of 1 W m^{-2} (1σ) (Su et al. 2015b), and 3) the diurnal correction (based on constant meteorology) uncertainty of 3.5 W m^{-2} (Doelling et al. 2013). The diurnal correction uncertainty value is based on comparisons with Geostationary Earth Radiation Budget (GERB) observed broadband SW fluxes. The diurnal correction may be overestimated, since the GERB geostationary domain has a disproportionate number of strong diurnal cycle regions as compared with the globe. The combined monthly regional all-sky SW flux uncertainty is 3.8 W m^{-2} . The daily regional all-sky SW diurnal uncertainty is 8 W m^{-2} (Doelling et al. 2013).

The monthly $1^{\circ} \times 1^{\circ}$ regional all-sky LW flux uncertainty is due to: 1) CERES instrument calibration of 1.8 W m^{-2} (1σ), 2) the radiance to flux conversion 0.75 W m^{-2} (1σ) (Su et al. 2015b), and 3) the diurnal correction of 0.6 W m^{-2} (Doelling et al. 2016). The diurnal correction uncertainty value is based on comparisons with GERB observed broadband LW fluxes. Again, the diurnal model uncertainty may be overestimated. The combined monthly regional all-sky LW flux uncertainty is 2.0 W m^{-2} . The daily and hourly regional all-sky LW diurnal uncertainties are 1.5 and 2.81 W m^{-2} , respectively (Doelling et al. 2016).

The MODIS cloud property uncertainties may be obtained from the SSF Ed4A Data Quality Summary: https://asdc.larc.nasa.gov/documents/ceres/quality_summaries/CER_SSF_Terra-Aqua_Edition4A.pdf

SYN1deg Ed4A and Ed3A Jan 2014 TOA Observed Flux Comparisons

The SYN1deg Ed4A data product is an improvement over Ed3A as outlined in section 3. The GEO-derived TOA fluxes are used to resolve the regional diurnal flux in between the CERES flux measurements. By subtracting the SYN1deg (with diurnal flux component) from the SSF1deg (no diurnal component) the resulting regional flux map should highlight those regions with strong diurnal cycles. Most of the regional diurnal cycle is observed if both the Terra and Aqua measurements are combined. The combined Terra and Aqua SSF1deg Ed4A product is not available to the public. Early morning and late afternoon SW flux variations and early evening land convection are not captured by Terra and Aqua measurements. Figure 1 displays the SYN1deg Ed3A or Ed4A minus SSF1deg Ed4A SW flux. The SYN1deg Ed4A (top left panel) shows a



positive SW flux over maritime stratus regions where the early morning bright stratus clouds were not captured by the Terra or Aqua measurements. Over land, the negative SW flux is due to the early morning clear skies over very convective regions such as the Amazon not capture by the Terra or Aqua measurements. The SYN1deg Ed3A (top left panel) displays many GEO artifacts. For example, the triangular shaped positive biases across the southern ocean, where the regions have very large view zenith angles, and a positive bias longitude wave pattern that is explained by the 3-hourly sampling, and at 105°W where the bias changes sign and is explained by a GEO satellite boundary between the GOES-East and GOES-West satellites. Since these biases cannot be explained by diurnal processes, they are GEO artifacts. The Ed4A has removed many of these artifacts that exist in Ed3A and should be an improvement over Ed3A.

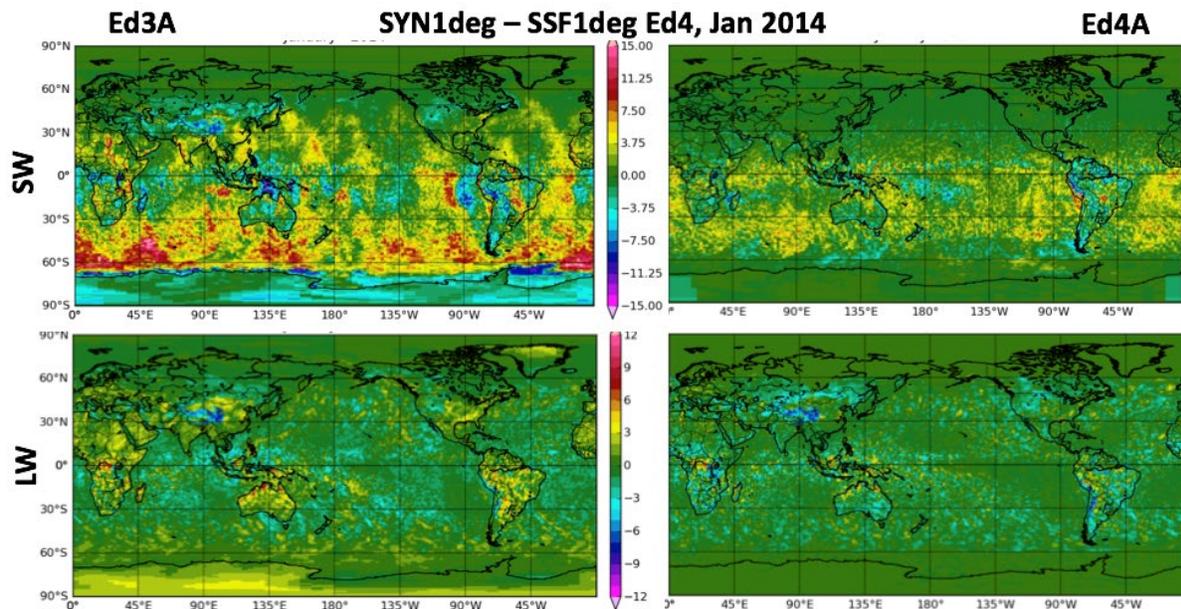


Figure 1. (upper left panel) SYN1deg Ed3A minus SSF1deg Ed4A SW flux ($W m^{-2}$) difference. (upper right panel) same as upper left except for SYN1deg Ed4A. (lower left panel) same as top left panel, except for LW flux. (lower right panel) same as top right panel except for LW flux.

For LW, the SYN1deg Ed3A minus SSF1deg Ed4A flux is difference is slightly larger than the SYN1deg Ed4A. Over deserts, the SYN1deg Ed4A captures the desert LW flux diurnal cycle more accurately than Ed3A, mainly because the hourly fluxes resolve the peak of the diurnal cycle than 3-hourly fluxes. The CERES-Aqua (1:30 PM LECT) LW flux also observes the peak of the LW cycle. There for the SYN1deg and SSF1deg LW flux difference over deserts should be near zero as shown in Ed4A. Typically land afternoon convection peaks at 6PM local time. Neither Terra nor Aqua observes at 6PM, and one would expect that the SYN1deg minus SSF1deg should be LW flux difference should be negative. Most land afternoon convective land regions have a negative LW flux difference in Ed4A, which is not the case with Ed3A. Also, a longitude LW flux discontinuity is observed at 105°W located between the equator and 30°S, which is at the GOES-East and West satellite boundary that is not seen in the Ed4A dataset. These facts suggest that SYN1deg Ed4A is an improvement over Ed3A

No GEO data is used poleward of 60°. The SYN1deg and SSF1deg products are consistent over the poles for the same Edition. There for the polar SW and LW flux differences are due to the CERES SSF Ed4A and SSF Ed3A flux differences.

SYN1deg Ed4A and Ed3A 140° East GEO Domain Time Series Comparison

The CERES product has incorporated 16 GEOs over its 17-year record. It is important that the GEO SW and LW derived broadband fluxes do not show any discontinuities across any GEO boundary, whether spatially or temporally. The CldTypHist E4A DQS (section 4.2 and Fig. 2-1) has plotted the monthly cloud properties by the 5 contiguous GEO domains in order to monitor for any cloud property trends within a GEO satellite record and also to document any cloud property discontinuities between GEO satellites within a GEO domains. The greatest cloud property differences were a result of the number of GEO channels used in the cloud retrievals, especially between the 2-channel and the multi-channel retrievals. While the cloud properties may be a function of GEO imager and are used to identify scene type for the ADMs and narrowband to broadband models, the GEO-derived SW and LW fluxes must be free of any GEO artifacts. This is accomplished by normalizing the GEO-derived fluxes with CERES during the CERES Terra and Aqua overpass times. [Figure 2](#) shows the SYN1deg Ed3A and Ed4A observed TOA SW flux anomaly for the 140° E GEO domain. The Ed3A and Ed4A observed SW flux anomalies are remarkably similar, verifying that the CERES GEO normalization algorithm is removing any GEO satellite dependency and anchoring the GEO fluxes and maintaining the CERES instrument flux calibration. Also, no sharp flux discontinuities are evident along the GEO satellite temporal boundary lines.



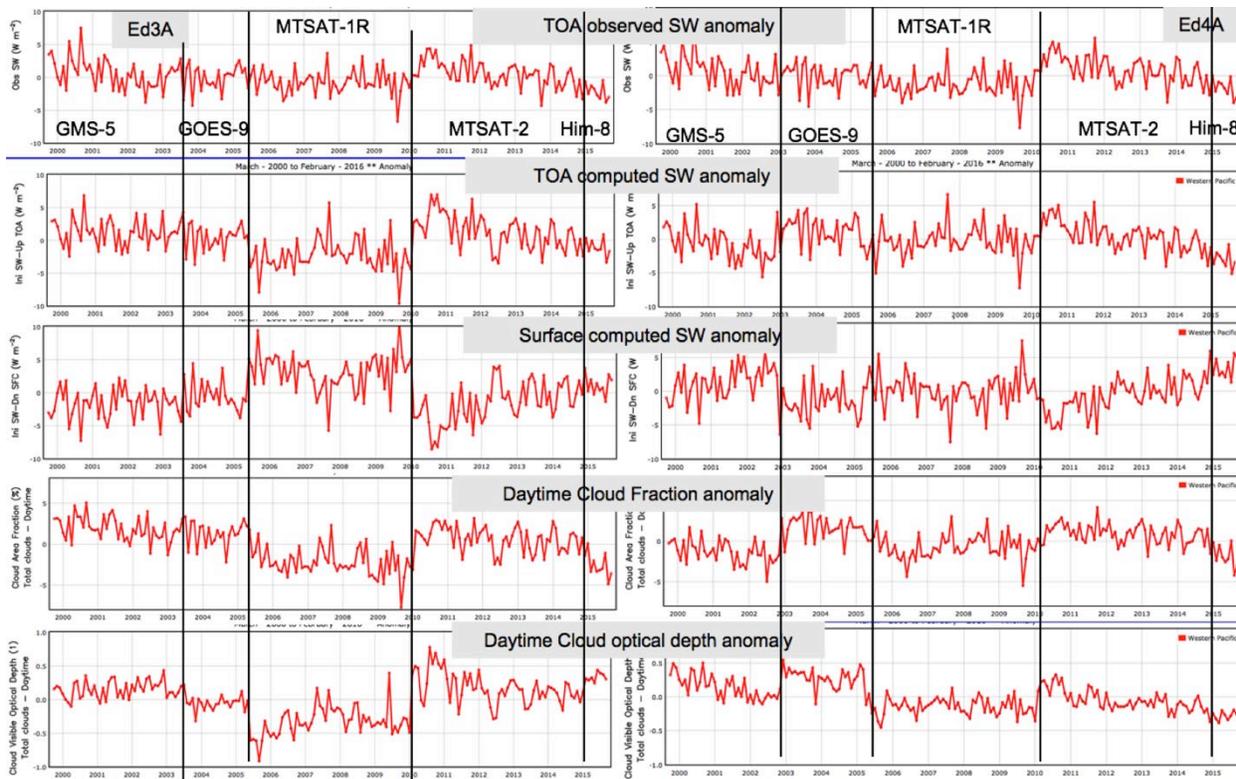


Figure 2. (top left panel) SYN1deg Ed3A TOA observed SW flux anomaly (range $\pm 10 \text{ W m}^{-2}$) for the 140° East GEO domain GEO satellite records designated by the black vertical lines. The GEO satellite names are labeled within the black vertical lines. (top right panel) same as top left panel except for SYN1deg Ed4A. (from top to bottom panels) The TOA computed SW flux anomaly (range $\pm 10 \text{ W m}^{-2}$), the surface computed SW down flux anomaly (range $\pm 10 \text{ W m}^{-2}$), the cloud fraction anomaly (range $\pm 10\%$), and the daytime cloud optical depth (range ± 1).

Figure 2 also illustrates the computed TOA and surface SW flux anomaly, which are computed with hourly GEO and MODIS clouds and GMAO atmospheric profiles. However, since most observed hours are based on GEO clouds, they will be impacted by the GEO cloud retrieval quality. Unfortunately, the tuning, by adjusting clouds and profile parameters, of the computed fluxes with observed fluxes was unsuccessful for GEO clouds. The GEO retrieval uncertainties were too large to confidently adjust the individual cloud properties and atmospheric profiles. The SYN1deg computed “untuned” Ed3A and Ed4A are compared in Figure 2. For Ed3A there are sharp discontinuities in the SW flux anomaly surrounding MTSAT-1R. After applying the MTSAT-1R PSF, there is less of a discontinuity in Ed4A. Ed4A seems to have more consistent computed SW flux and cloud properties across the 5 GEO satellite series. For Ed4A GOES-9 (2003-2005) seems to be the GEO satellite that is the most out of family. The GOES-9 satellite is located over 160° E and there for would have larger view angles over most of the west tropical domain, than the other GEOs, which are located near 140° . It was found that the large view angle GEO multi-channel cloud retrievals have greater cloud fractions and optical depths than for retrieval for nadir conditions. The increase in Ed4A GOES-9 domain cloud fractions and optical depths seem to have increased the computed TOA SW flux and reduced the surface SW flux, when compared with GEOs centered over their GEO domain.

SYN1deg Ed4A and Ed3A Regional Flux Mean and Trend Flux Comparisons

In this section, the Ed4A minus Ed3A regional 2003-2105 (13-year) mean and trend flux differences are quantified. The SYN1deg 13-year Ed4A minus Ed3A observed TOA all-sky SW regional flux difference is shown in [Figure 3](#) top row. There are large negative SW biases over the southern oceans and over some regions in the northern mid-latitudes, which may be indicative of large view angle biases. Also, there are negative and positive patterns across the equatorial tropics, approximately every 45° in longitude, which points to 3-hourly sampling biases. In order to determine, whether Ed4A is an improvement over Ed3A, both Ed3A and Ed4A SW regional fluxes are subtracted from the combined Terra and Aqua SSF1deg Ed4A fluxes in [Figure 4](#). The Terra and Aqua SSF1deg fluxes are considered mostly diurnally complete and when differenced would reveal any GEO artifacts. It is apparent that most of the Ed4A minus Ed3A observed TOA SW regional flux difference are due to SYN1deg Ed3A GEO artifacts. There is much less difference between SYN1deg Ed4A and SSF1deg Ed4A SW regional fluxes. Most of the positive differences occur over maritime stratus regions off the coast of Peru, California, Namibia, and Saharan Africa and most of the negative differences occur over land afternoon convective land. This suggests that the SYN1deg fluxes are accounting for diurnal fluxes not observed during Terra and Aqua overpass times, thus validating that the SYN1deg Ed4A fluxes are adding diurnal value over the SSF1deg observed SW regional fluxes. This improvement is mainly attributed to incorporating hourly GEO imagery in Ed4A, since the GEO SW narrowband to broadband algorithm did not change between the two editions.

Next the Ed3A and Ed4A observed all-sky SW regional 13-year trend anomalies are compared. The SYN1deg Ed4A SW regional trend shows a positive anomaly over equatorial and is attributed to the 2015 El Nino event. Similar to the Ed4A minus Ed3A SW regional flux difference the regional trend differences show GEO artifacts. When comparing the SYN1deg with SSF1deg regional trends, the greater SYN1deg minus SSF1deg trend differences occur for Ed3A and are much reduced for Ed4A. This would indicate that SYN1deg Ed4A SW regional trends are an improvement over Ed3A. It is highly unlikely that SW regional trends would be hidden during local times not observed by either Terra or Aqua overpass times (Taylor and Loeb 2015). If the SYN1deg Ed4A SW fluxes did not contain any GEO artifacts, the SYN1deg minus SSF1deg trend difference should be near zero.

Most of the observed all-sky TOA LW SYN1deg Ed4A minus Ed3A flux is found over land. Similarly, most of the corresponding regional trend difference is mostly over land. However, none of the differences suggest no GEO based artifacts. The SYN1deg minus SSF1deg differences reveal that the more extreme differences occur in the Ed3A dataset. The SYN1deg Ed4A minus Ed3A flux difference can be attributed to the Aqua SSF1deg Ed4A minus Ed3A difference (see Fig. 5-4 in the SSF1deg Ed4A DQS). However, the magnitude of the observed TOA LW flux mean and trend differences are much smaller than the SW differences. The GEO LW derived fluxes are not based on any GEO cloud properties and for Ed4A are constructed from well calibrated IR and WV channel radiances, whereas for Ed3A from well calibrated IR data and GEOS column weighted relative humidity estimates. One would not expect either edition to bring about GEO artifacts.



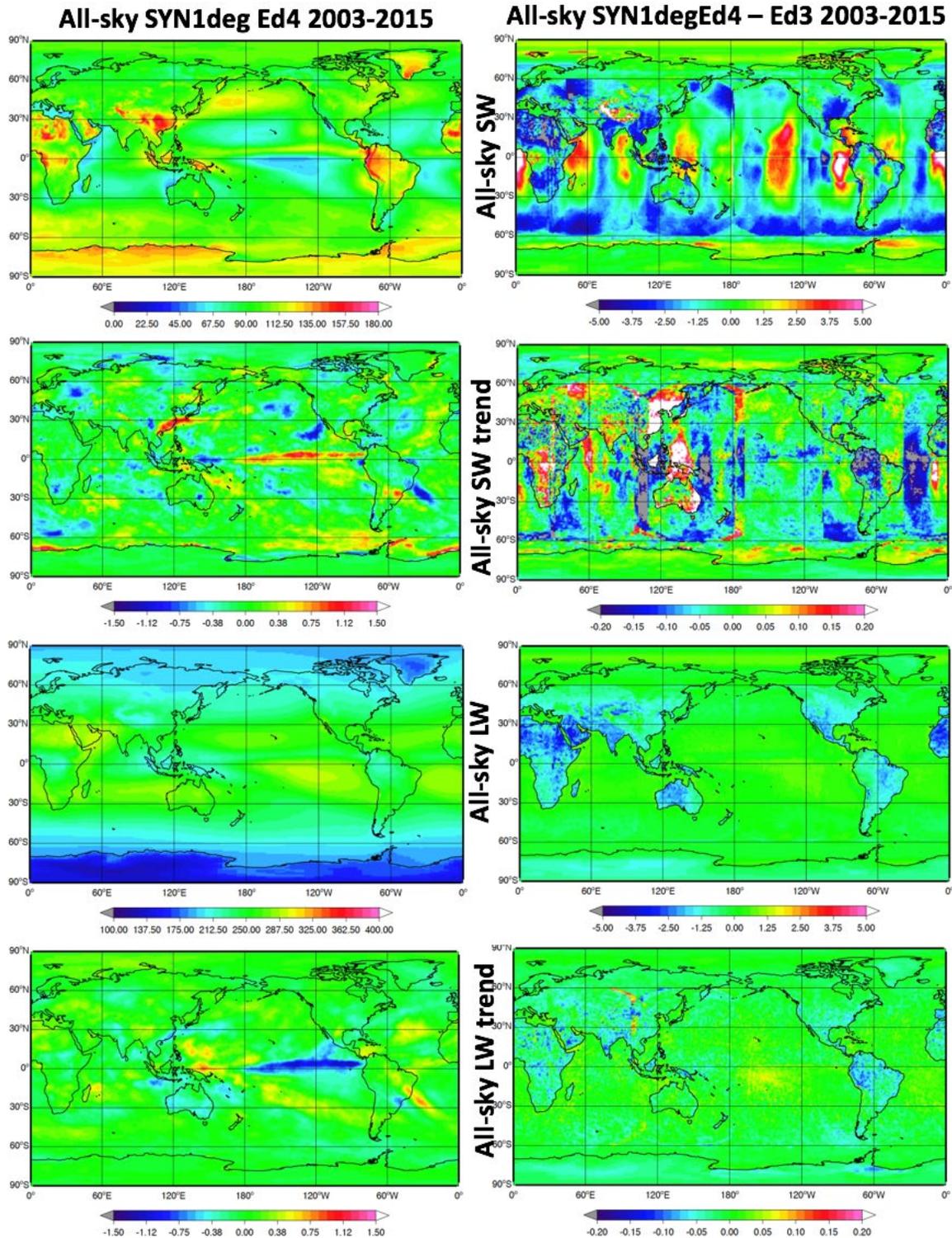


Figure 3. (top to bottom left panels) The SYN1deg Ed4A 2003 to 2015 regional all-sky TOA SW flux means (range 0 to 180 $W m^{-2}$), the all-sky SW trends (range $\pm 1.5 W m^{-2} yr^{-1}$), the all-sky TOA LW flux means (range 100 to 400 $W m^{-2}$), the all-sky LW flux trends (range $\pm 1.5 W m^{-2} yr^{-1}$), (right panels) same as left panels except for SYN1deg Ed4A minus SYN1deg Ed3A.



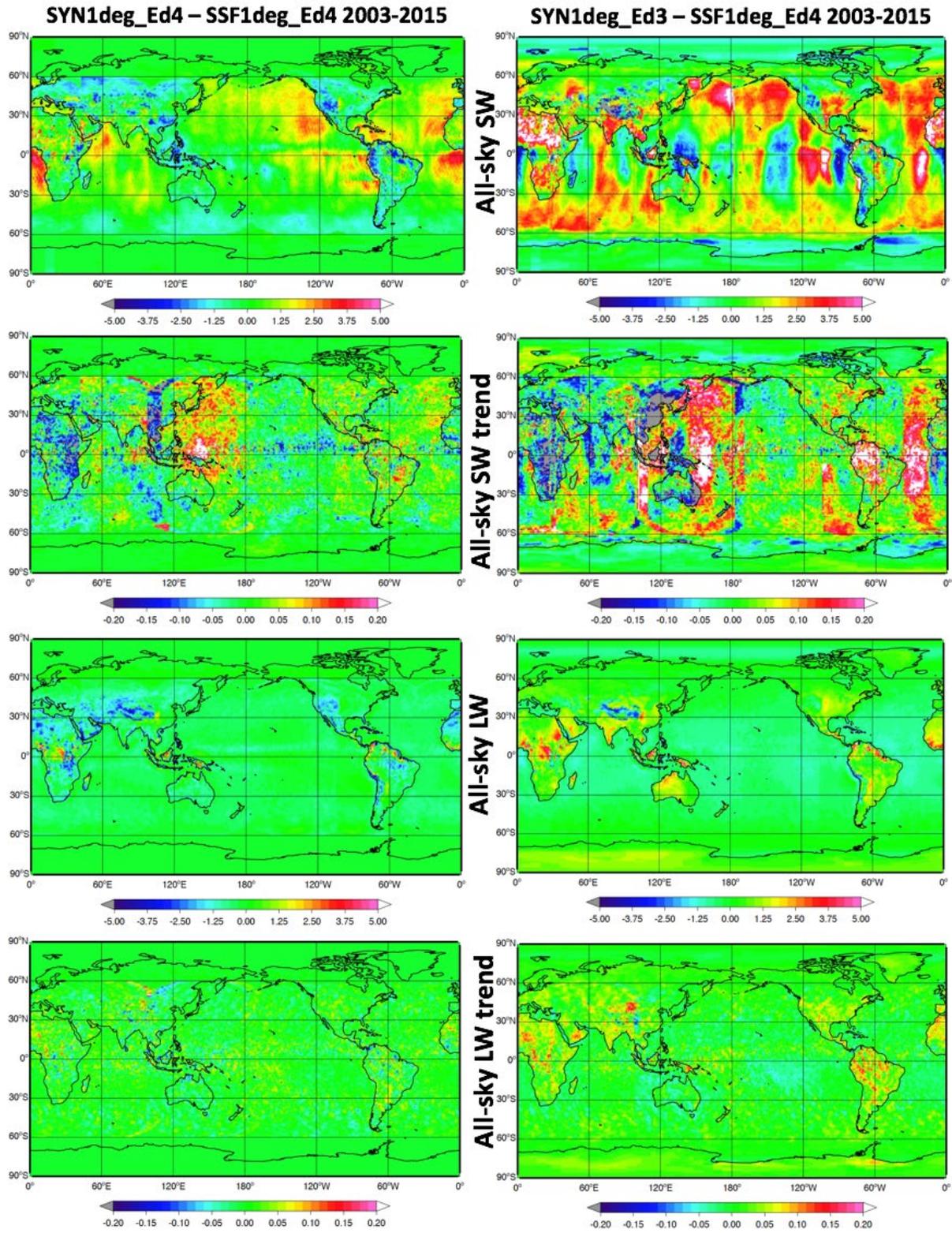


Figure 4. (left panels) same as Figure 3 right panels, except for SYN1deg Ed4A minus SSF1deg Ed4A. (right panels) same as left panels, except for SYN1deg Ed3A minus SYN1deg Ed4A.



The observed TOA clear-sky SW and LW SYN1deg Ed4A and Ed3A are not obtained using GEO fluxes and rely only on CERES measurements. The SYN1deg Ed3A and Ed4A flux differences are discussed in Fig. 5-6 in the SSF1deg DQS and are shown in Figure 5 and Figure 6. The cloud mask is more conservative in Ed4A and greatly improved over polar conditions by successfully detecting clear-sky over sea ice conditions. For the clear-sky LW, more tropical thin cirrus conditions have been flagged as cloudy for Ed4A, thereby increasing the clear-sky LW flux near the tropical convective zones. For the clear-sky SW, most of differences occur over polar regions, where the cloud mask has been improved for Ed4A. Figure 6 show no observed TOA clear-sky SW or LW flux difference between SYN1deg Ed4A and SSF1deg Ed4A, which is anticipated, since no clear-sky GEO fluxes are incorporated in the SYN1deg product.

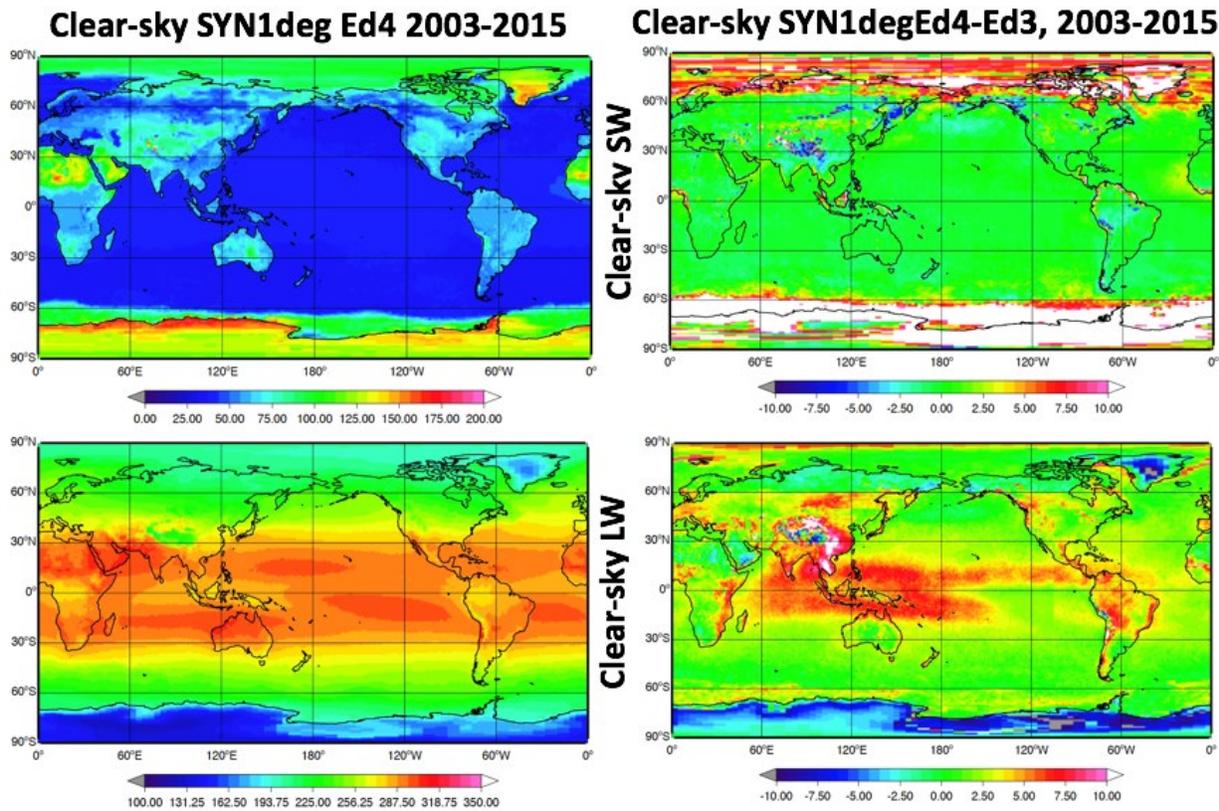


Figure 5. (top left panel) The SYN1deg Ed4A 2003 to 2015 regional clear-sky TOA SW flux means (range 0 to 180 $W m^{-2}$), (bottom left panel) the clear-sky LW flux (range 100 to 350 $W m^{-2}$). (right panels) The SYN1deg Ed4 minus SYN1deg Ed3A 2003 to 2015 regional clear-sky TOA SW (top) and LW (bottom) flux difference. Units $W m^{-2}$.



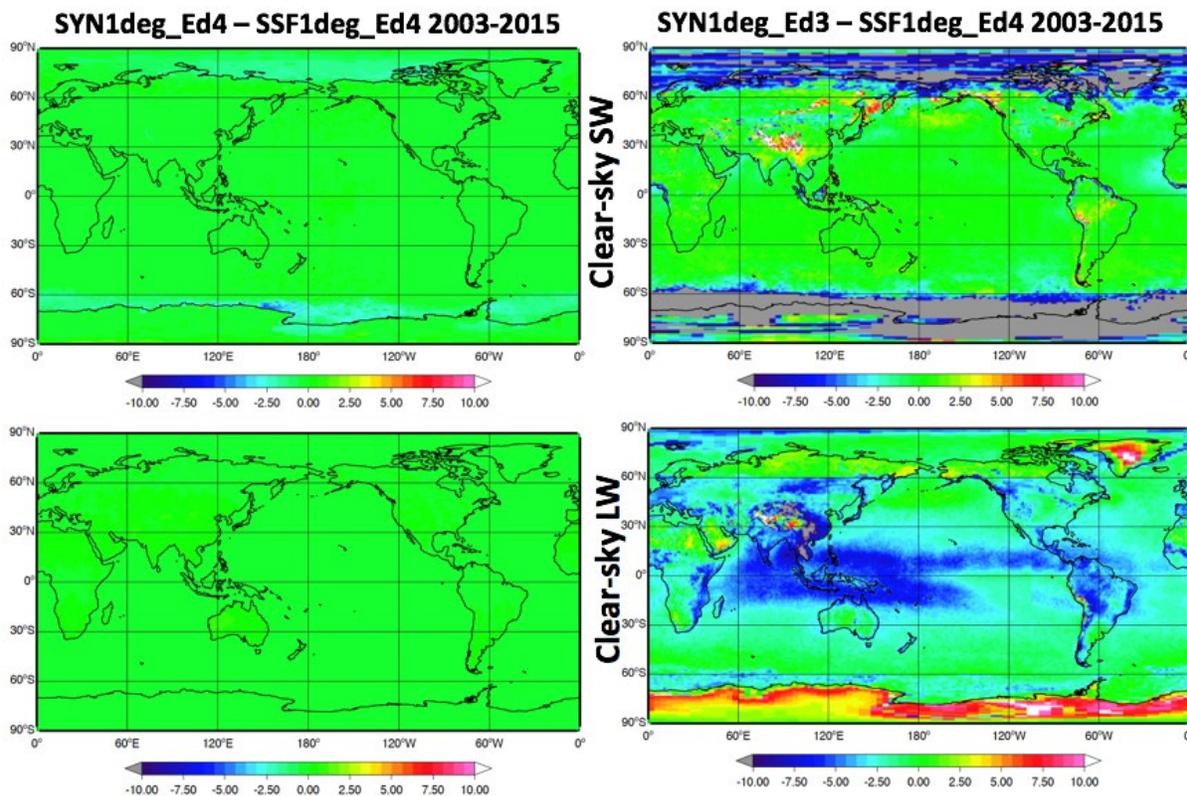


Figure 6. (left panels) Same as Figure 5 right panels, except for SYN1deg Ed4A minus SSF1deg Ed4A. (right panels) Same as left panels, except for SYN1deg Ed3A minus SSF1deg Ed4A. Units $W m^{-2}$.

SYN1deg Ed4A Global Flux Mean and Trend Anomaly Comparisons

The all-sky TOA SW global mean flux anomaly is plotted in Figure 7. During the 2003 to 2015 record the all-sky SW global flux anomaly is within $+1 W m^{-2}$. The SYN1deg Ed4A minus Ed3A SW flux difference variation shows a slight downward trend beginning after 2010. This mainly attributed to the Terra-CERES SSF1deg Ed4A minus Ed3A all-sky TOA SW flux difference, which is explained in the EBAF Ed4A DQS in section 6.3. The underlying cause was the Terra-MODIS band 1 collection 5 calibration had an anomaly in 2003 and in 2009, where the visible radiance degraded by $\sim 1\%$ and 1.5% , respectively. This caused the SSF1deg Ed3A Terra optical depth to show a significant degradation (SSF1deg Ed4A DQS Fig. 4-5). Since the CERES SW ADMs were constructed using the first 5-years of the Terra record, the resulting TERRA TOA SW fluxes show a degradation after 2010 of $0.5 W m^{-2}$ (SSF1deg Ed4A DQS Fig. 5-5). The same SYN1deg Ed4A minus Ed3A TOA SW degradation is also seen in Figure 7 after 2010, although, the magnitude is slightly reduced, since both Terra and Aqua CERES SW observations are used in the SYN1deg Ed4A product. There also seems to be a slight inflection of less than $0.25 W m^{-2}$ in the SYN1deg Ed4A minus SSF1deg Ed4A or EBAF-TOA Ed4.0 TOA SW flux difference trend. The cause of the slight inflection is not known, but could related to the GEO-derived SW fluxes near the terminator not observed by Terra or Aqua may have changed diurnally, due to diurnal cloud property difference across the 16 GEO satellites.

The all-sky SW flux difference between Ed4A and Ed3A suggests that the Ed4A has less of a diurnal component not seen by either Terra or Aqua observations than Ed3A by 0.5 W m^{-2} . Section 4.4 indicated that the Ed4A and Ed3A SW flux difference is mainly due to Ed3A GEO artifacts. The all-sky SW flux SYN1deg Ed4A minus SSF1deg Ed4A difference is 0.5 W m^{-2} , which is the diurnal component not capture by Terra and Aqua observations. The difference in the magnitude of the SSF1deg Ed4A or EBAF-TOA Ed4.0 is due to the EBAF net balance procedure designed to remove the CERES instrument calibration bias.

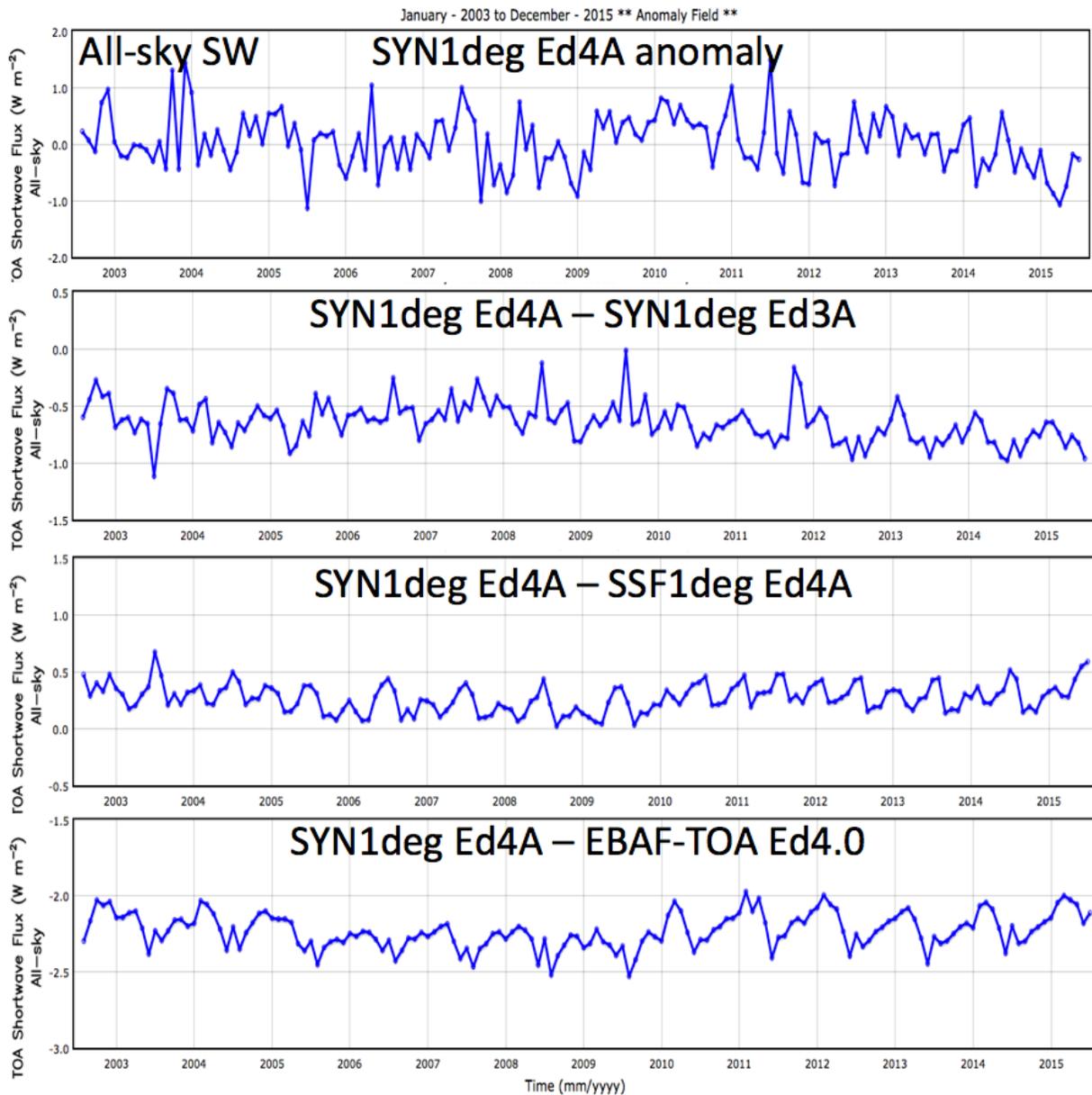


Figure 7. (top to bottom) The SYN1deg Ed4A all-sky SW global flux anomaly, the SYN1deg Ed4A minus SYN1deg Ed4A all-sky SW global flux difference, the SYN1deg Ed4A minus SSF1deg Ed4A all-sky SW global flux difference, the SYN1deg Ed4A minus EBAF-TOA Ed4.0 all-sky SW global flux difference. Units W m^{-2} .

The all-sky TOA LW global mean flux anomaly is plotted in Figure 8. The LW global flux anomaly between 2003 and 2015 was within $\pm 1.5 \text{ W m}^{-2}$. The SYN1deg Ed4A minus Ed3A LW global mean flux difference does not show any trends and the variability is within $\pm 0.2 \text{ W m}^{-2}$ much smaller than the overall natural variability of $\pm 1.5 \text{ W m}^{-2}$. The SYN1deg Ed4A minus SSF1deg Ed4A SW flux difference variability is much smaller than the SYN1deg Ed4A minus Ed3A flux, suggesting that the GEO narrowband to broadband LW flux algorithm was improved by replacing the GEOS column weighted humidity term with the GEO water vapor radiance and the incorporating hourly measurements. The SYN1deg Ed4A minus Ed3A LW flux difference is $\sim -0.2 \text{ W m}^{-2}$ has reduced the LW flux diurnal component not seen by Terra or Aqua observations. However, the SYN1deg Ed4A minus SSF1deg Ed4A LW flux difference or diurnal component of $\sim -0.4 \text{ W m}^{-2}$, which is mostly due to the peak of the land convective, is centered at 18 local time, which is not observed by either Terra or Aqua observations.

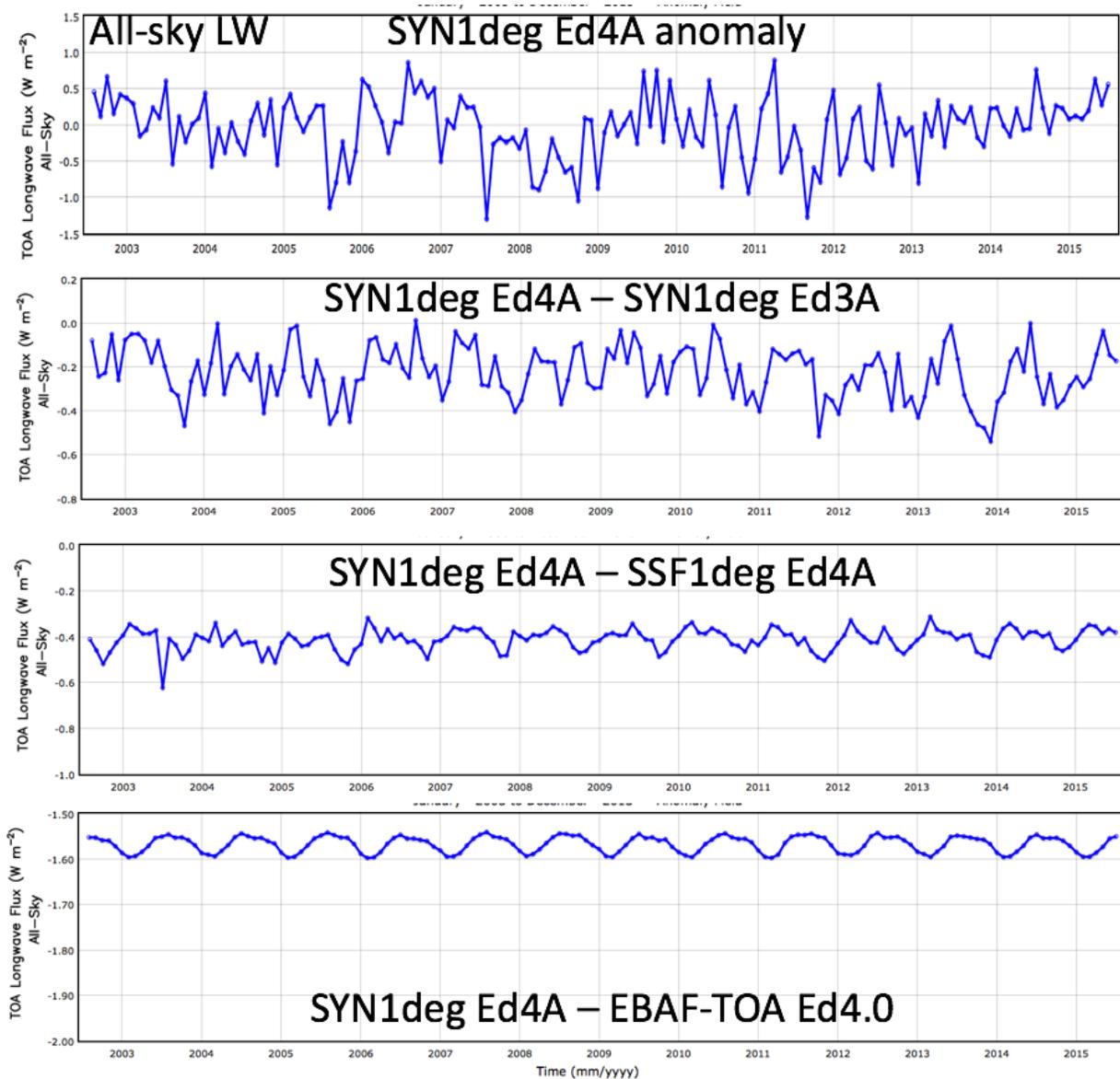


Figure 8. Same as Figure 7 except for all-sky LW.

The clear-sky TOA SW global mean flux anomaly is plotted in [Figure 9](#). During the 2003 to 2015 record the clear-sky SW global flux anomaly is within $+1 \text{ W m}^{-2}$. The SYN1deg Ed4A minus Ed3A clear-sky SW flux variability is the same order of magnitude as the natural variability. The more conservative Ed4A cloud mask and improved sea ice polar cloud mask caused the clear-sky SW fluxes to differ from Ed4A and Ed3A. The SYN1deg Ed4A minus SSF1deg Ed3A clear-sky SW flux difference is within 0.25 W m^{-2} . This was expected, since the SYN1deg Ed4A and SSF1deg Ed4A both incorporate CERES-only clear-sky observations. The Ed4A should have less cloud contamination and there for smaller clear-sky SW fluxes, which is the case for Ed4A. The SYN1deg Ed4A and EBAF-TOA Ed4.0 clear-sky global mean difference of 3.25 W m^{-2} is due to the addition of sub-footprint clear-sky SW fluxes, making the EBAF-TOA product spatially complete and the spatial location of the regions with no CERES clear-sky footprints.

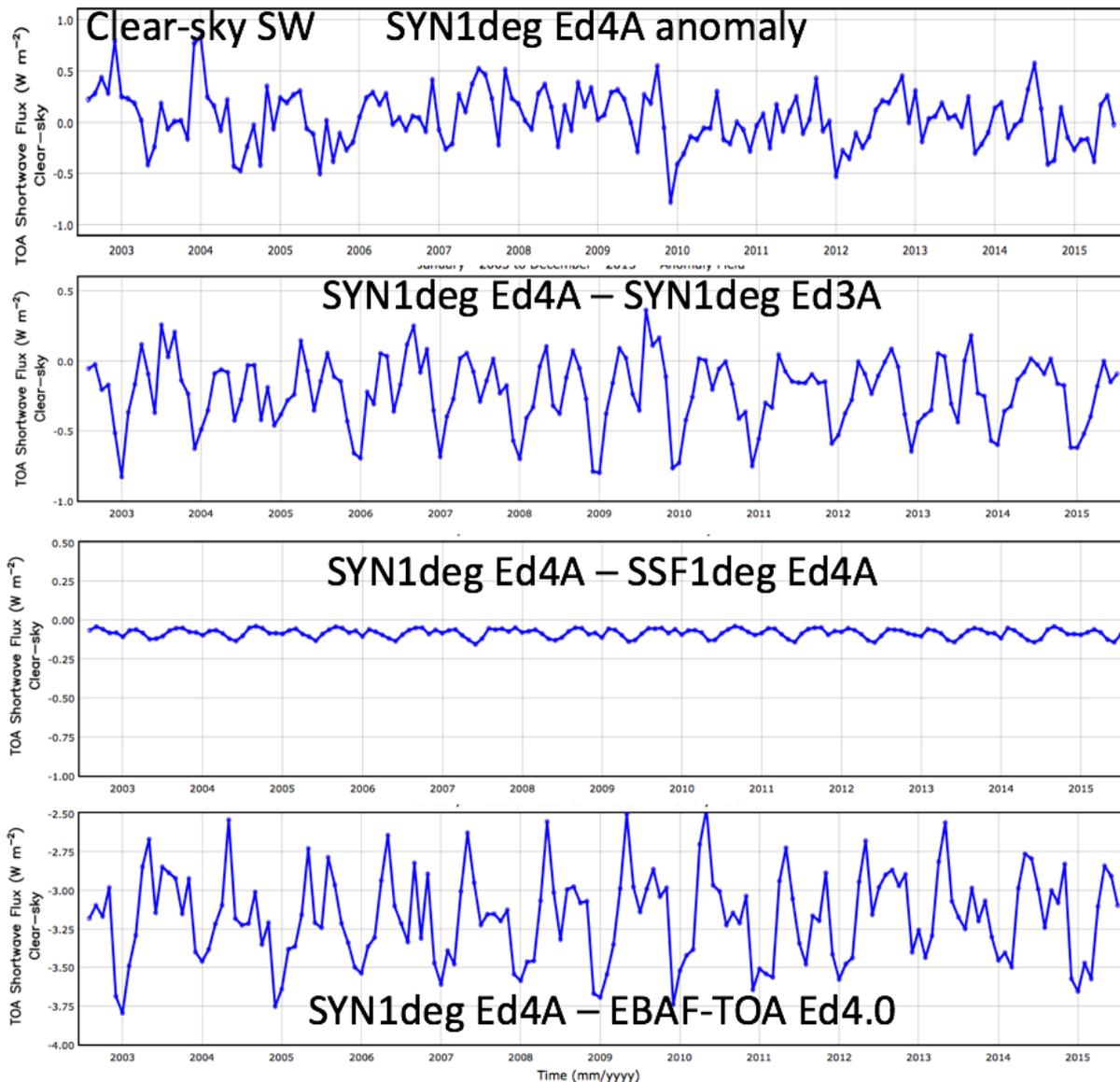


Figure 9. Same as [Figure 7](#) except for clear-sky SW.



The clear-sky TOA LW global mean flux anomaly is plotted in Figure 10. The clear-sky LW global flux anomaly between 2003 and 2015 was within $\pm 1.0 \text{ W m}^{-2}$. The SYN1deg Ed4A minus Ed3A clear-sky LW flux variation was within 1.0 W m^{-2} . However, the LW flux magnitude was 2.5 W m^{-2} indicating that Ed4A had less cloud contamination than Ed3A. The SYN1deg Ed4A minus SSF1deg E3A clear-sky LW flux difference was near zero as expected. The SYN1deg Ed4A minus EBAF-TOA Ed4.0 seems to have a slight negative downward trend. It is unclear what is causing this.

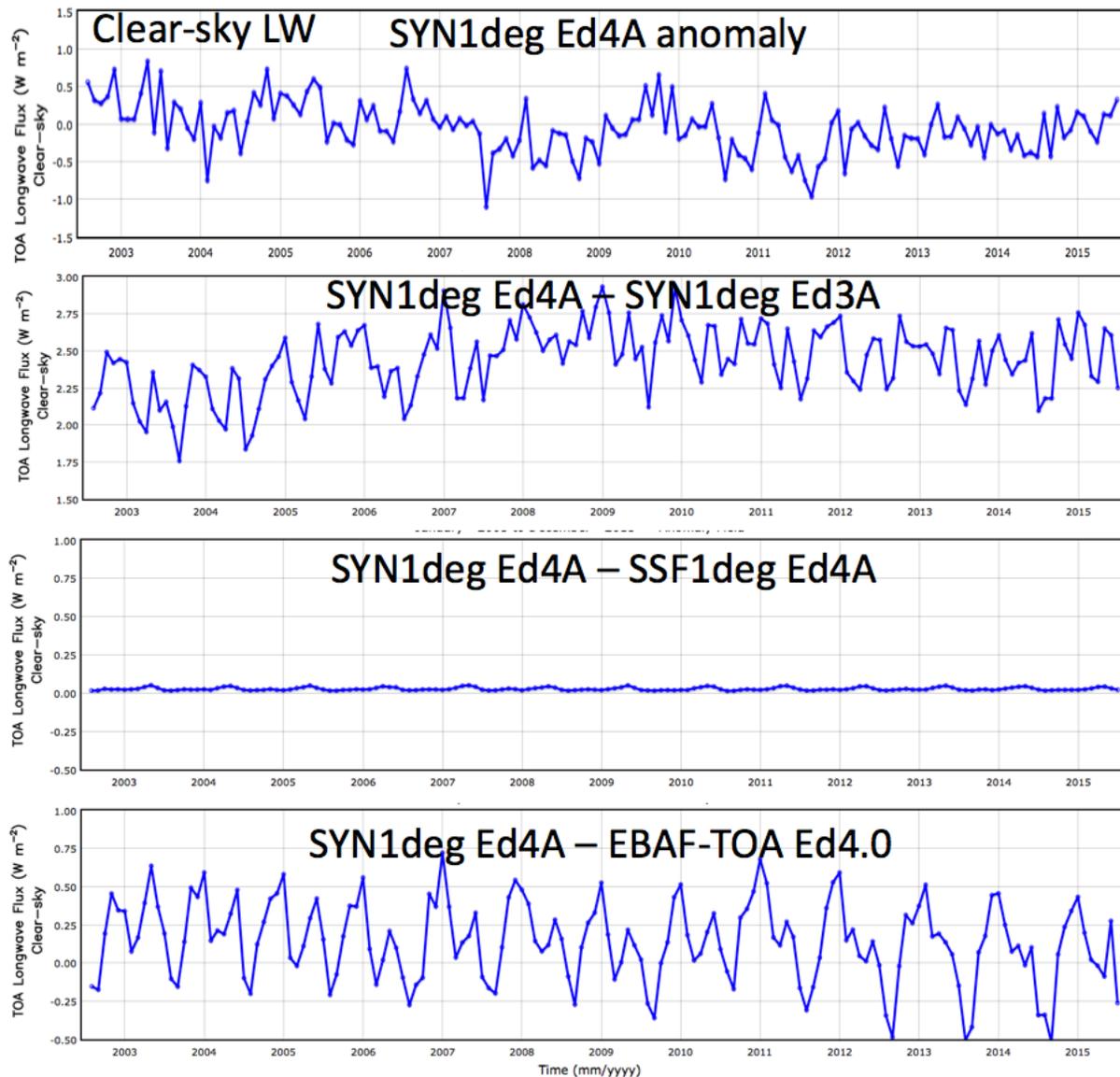


Figure 10. Same as Figure 7 except for clear-sky LW.

SYN1deg Ed4A Global Flux Mean Comparisons

The Jan. 2003 to Dec. 2015 13-year global flux means are shown in [Table 1](#) for the CERES SYN1deg Ed4A, SYN1deg Ed3A, and SSF1deg Ed4A, and EBAF-TOA Ed4.0 flux products. All of the CERES Ed4A products have consistent solar incoming fluxes. The SYN1deg Ed4A minus SSF1deg Ed4A all-sky flux difference, which reflects the diurnal flux component not seen by Terra or Aqua observations, is $+0.4 \text{ W m}^{-2}$ and -0.4 W m^{-2} for all-sky SW and LW, respectively. The SW and LW SYN1deg diurnal flux contribution nearly cancel out in the net flux. The SW SYN1deg flux contribution is positive because both the maritime sunrise and land afternoon sunset SW flux is greater than that using constant meteorology of the SSF1deg Ed4A product. Because SYN1deg Ed4A only used GEO-derived fluxes for solar zenith angles (SZA) less than 60° and relied on SW diurnal models for the remaining SZA, the SYN1deg diurnal component is smaller than the SYN1deg Ed3A, which did not have a SZA threshold. However, the greater SYN1deg Ed3A SW flux is mostly due to Ed3A GEO artifacts, especially for large view angles. The SYN1deg Ed4A LW diurnal component is due to the peak of the land afternoon convection occurring at 18 local time. There was little global mean LW flux difference between Ed4A and Ed3A. The all-sky flux difference between SYN1deg Ed4A and EBAF-TOA Ed4.0 is mainly due to the net balancing of the CERES fluxes with respect to the ocean heat storage term and the uncertainties of the CERES instrument calibration (see EBAF Ed4.0 DQS).

The SYN1deg Ed4A minus SSF1deg Ed4A clear-sky flux differences are very similar for both SW and LW. This is expected, since the SYN1deg Ed4A product only uses CERES clear-sky fluxes. The SYN1deg Ed4A minus Ed3A clear-sky differences are similar in the SW but differ by 2.5 W m^{-2} in the LW. For clear-sky SW it seems that the improved cloud mask over polar regions and reduced cloud contamination over the tropics cancelled out, however, for LW the removing the cloud contamination increased the clear-sky LW flux considerable. The EBAF-TOA clear-sky SW flux differs greatly from the other CERES products, because a EBAF-TOA coding error was found in the clear-sky SW algorithm, the introduction of additional MODIS spectral channels to compute CERES sub-footprint clear-sky fluxes, clear-sky spatial distribution, and the net balancing factor (see EBAF-TOA DQS section 2.4). For EBAF-TOA the clear-sky LW flux is similar to the other CERES products, where the net-balancing, spatial distribution, additional MODIS channels to compute the sub-footprint clear-sky are more compensating than for the SW clear-sky.

Table 1. The 2003 to 2015 13-year global mean TOA solar incoming (S_0), SW, LW, and net fluxes (W m^{-2}) for all-sky and clear-sky conditions as a function of dataset.

Dataset (Wm^{-2})	All-sky				Clear-sky		
	S_0	SW	LW	Net	SW	LW	Net
2003-2015							
SYN1deg Ed4A	340.0	96.9	238.6	4.5	50.2	268.2	21.6
SYN1deg Ed3A	339.8	97.5	238.8	3.5	50.4	265.8	23.5
SSF1deg Ed4A	340.0	96.6	239.0	4.4	50.3	268.2	21.5
EBAF-TOA Ed4.0	340.0	99.1	240.2	0.7	53.4	268.1	18.5



References

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- Doelling, D. R., M. Sun, L. T. Nguyen, M. L. Nordeen, C. O. Haney, D. F. Keyes, and P. E. Mlynchak, 2016: Advances in geostationary-derived longwave fluxes for the CERES Synoptic (SYN1deg) product, *J. Atmos. Oceanic Technol.* 33, 503-521, doi: 10.1175/JTECH-D-15-0147.1.

