CERES NOAA-20 Edition1B SSF

CERES shortwave (SW), longwave (LW), and longwave-channel (LW-channel) channel radiative fluxes are derived from empirical Angular Distribution Models (ADMs) that convert a measured radiance in a given Sun-Earth-satellite viewing configuration to a top-of-atmosphere (TOA) radiative flux. As there is no rotating azimuth scan mode for the flight model (FM6) on NOAA-20, the ADMs developed for Aqua are used to convert the measured radiances to fluxes on NOAA-20. Further details about the Aqua ADMs can be found in Su et al. (2015) and the table below provide additional details on Aqua ADM scene classification.

CERES Terra/Aqua Shortwave Channel ADMs for Different Scene Types

Scene Type	Description
Clear Ocean	Function of wind speed, aerosol optical depth, and aerosol type;
Cloud Ocean	Function of cloud phase; Continuous 5-parameter sigmoid function of cloud fraction and cloud optical depth.
Land & Desert Clear	1°- regional monthly ADMs using modified Ross-Li 3-parameter fit for difference NDVI, $\cos\theta_0$ and surface roughness (θ_0 is solar zenith angle);
Land & Desert Cloud	Function of cloud phase; continuous 5-parameter sigmoid function of cloud cover and cloud optical depth; used 1°-regional clear-sky BRDFs to account for background albedo.
Permanent Snow	Clear Antarctica: use MISR data to develop ADMs that account for the effect of sastrugi Clear Greenland: one ADM
	Partly cloudy: cloud fraction (4)
	Overcast: cloud phase (2), and log optical depth bin (4)
Fresh Snow	1°- regional monthly ADMs using modified Ross-Li 3-parameter fit for difference NDVI, $\cos\theta_0$ and surface roughness (θ_0 is solar zenith angle);
	Cloudy: function of cloud fraction and snow fraction; for overcast consider surface brightness and cloud optical depth
Sea-Ice	Clear: sea ice fraction (6), for 100% sea ice coverage use sea ice brightness index (3) to classify surface brightness
	Partly cloudy: cloud fraction (4), for 100% sea ice coverage use sea ice brightness index (3) to classify surface brightness
	Overcast: sea ice brightness index (5), phase (2), linear function of ln(cloud optical depth)

CERES Terra/Aqua Longwave and Window Channel ADMs for Different Scene Types

Scene Type	Description
Clear Ocean, Land, Desert	Function of Ocean, Forest, Cropland/Grass, Savanna, Bright Desert, Dark Desert, precipitable water, lapse rate, skin temperature.
Clouds Over Ocean, Land Desert	Function of precipitable water, skin temp, surface-cloud temp. diff; continuous function of parameterization involving cloud fraction, cloud and surface emissivity, surface and cloud temp.
Clear Permanent Snow, Fresh Snow, Sea-Ice	Discrete intervals of surface skin temperature.
Cloudy Permanent Snow, Fresh Snow, Sea-Ice	Function skin temp, surface-cloud temperature difference; continuous function of parameterization involving cloud fraction, cloud and surface emissivity, surface and cloud temp.

TOA Flux differences between NOAA-20 and Aqua

The slight difference between Aqua and NOAA-20 orbits leads to overpass time difference, thus the solar zenith angle distributions between them are different. The NOAA-20 orbit is 45 minutes behind Suomi NPP. The data shown below is consistent for NOAA-20. Figure 1 shows the solar zenith angle as a function of latitude sampled by Aqua (left) and S-NPP (right) for April 2013. For a given latitude, S-NPP covers a wider range of solar zenith angle than Aqua. For April 2013, the solar zenith angles at the S-NPP overpass times are also smaller than the solar zenith angles at the Aqua overpass times, except over the north pole.

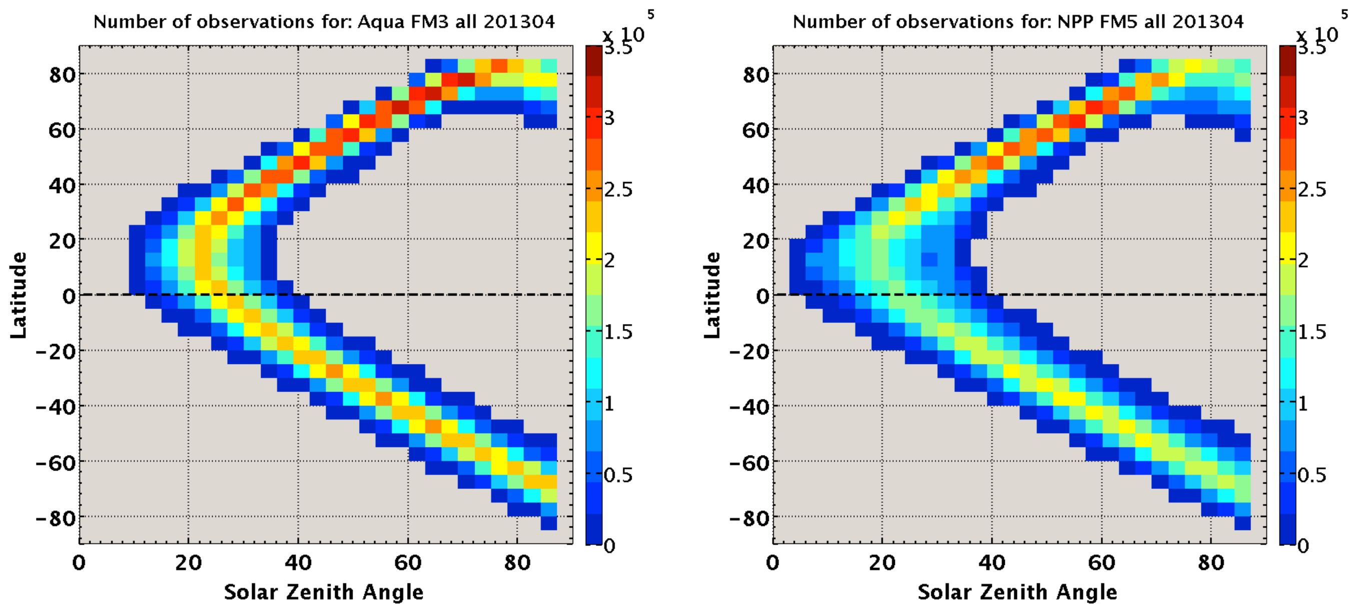

Figure 1. Solar zenith angle as a function of latitude sampled by Aqua (left) and S-NPP (right) for April 2013.

The solar zenith angle difference between S-NPP and Aqua results in that the monthly mean solar insolation from S-NPP is larger than that from Aqua by 13.4 Wm^{-2} (1.4%) for April 2013. Figure 2 shows the monthly mean TOA upwelling SW flux from S-NPP and the SW flux difference between S-NPP and Aqua for April

2013. The monthly mean TOA upwelling SW flux from S-NPP is about 1.8% higher than that from Aqua, and some distinct features were observed (such as the large negative difference north of 60°N and the slant paths south of 60°S). These features are caused by the differences in solar insolation and disappeared in the albedo difference (Figure 3). The remaining difference between S-NPP and Aqua after accounting for the difference in solar insolation is about 0.7 Wm^{-2} (0.003*242).

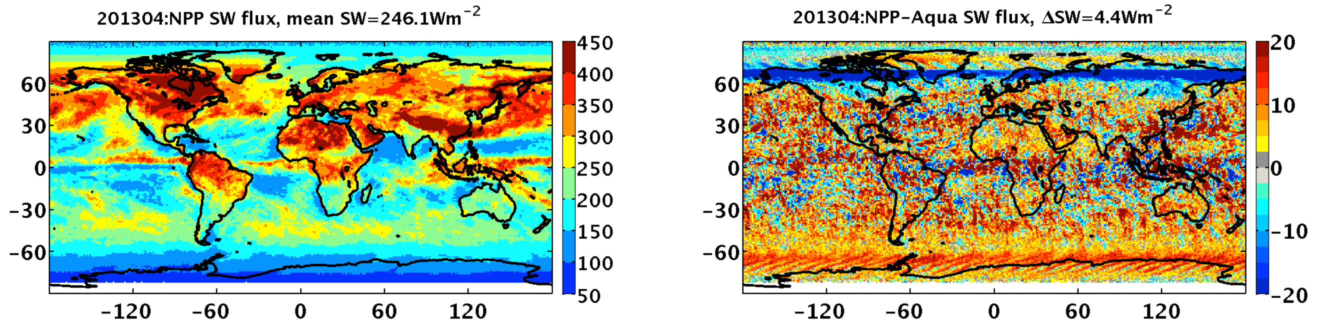

Figure 2. Monthly mean TOA upwelling SW flux from S-NPP (left) and the flux difference between S-NPP and Aqua (right) for April 2013.

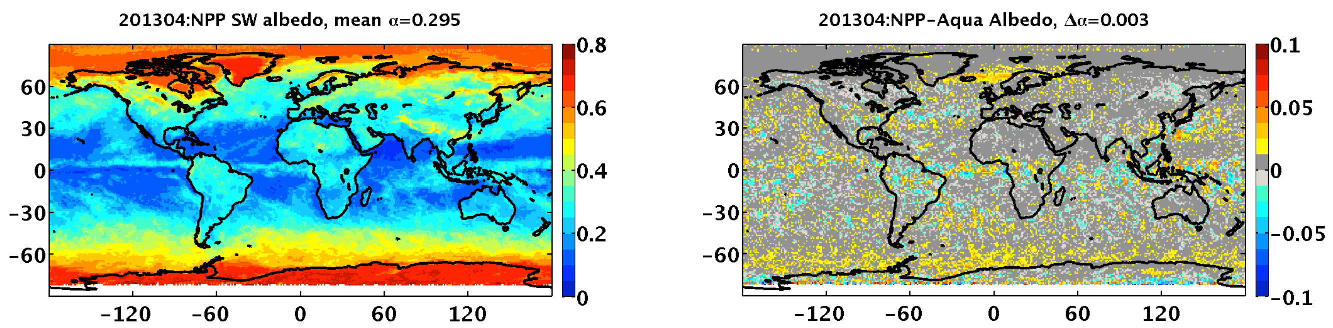

Figure 3. Monthly mean albedo from S-NPP (left) and the albedo difference between S-NPP and Aqua (right) for April 2013.

Figure 4 and Figure 5 show the monthly mean daytime and nighttime TOA outgoing LW flux from S-NPP and the difference between S-NPP and Aqua for April 2013. For both daytime and nighttime, the TOA outgoing LW flux from S-NPP is smaller than that from Aqua by 1-2 Wm^{-2}.

The causes for the flux differences shown here are not clear at the writing of this document. Possible causes include but not limited to 1) instrument calibration; 2) scene identification, as some MODIS channels used for cloud retrievals are not available on VIIRS; 3) use of the ADMs developed with Aqua measurements for S-NPP. These issues are currently being investigated by the CERES science team members.

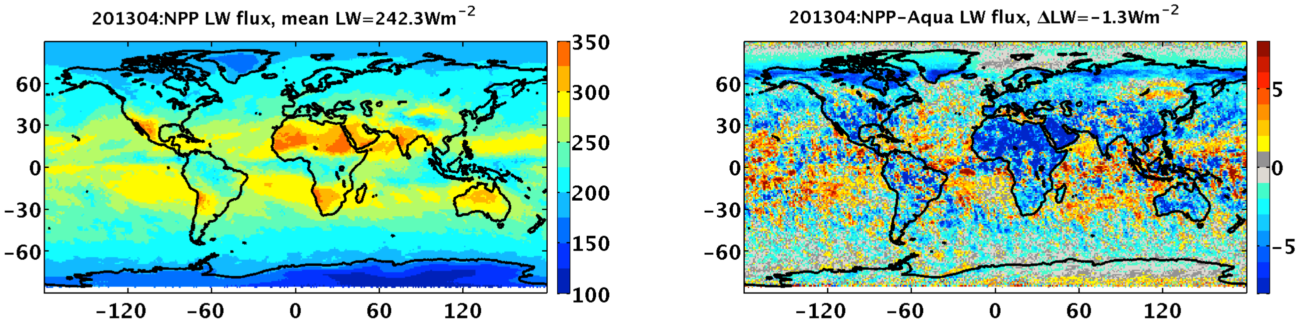

Figure 4. Monthly mean daytime TOA outgoing LW flux from S-NPP (left) and the difference between S-NPP and Aqua (right) for April 2013.

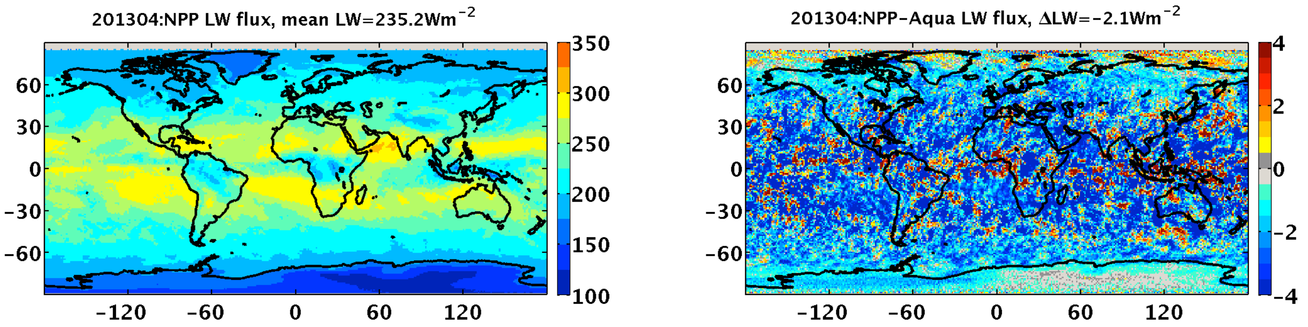

Figure 5. Monthly mean nighttime TOA outgoing LW flux from S-NPP (left) and the difference between S-NPP and Aqua (right) for April 2013.

Wenying Su, Joseph Corbett, Zachary Eitzen, Lusheng Liang, Next-Generation Angular Distribution Models for Top-of-Atmosphere Radiative Flux Calculation from the CERES Instruments: Methodology, Atmos. Meas. Tech. Disscuss., 8:611-632, doi:10.5194/amtd-8-611-2015, 2015.

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