CERES Terra Edition2B SSF TOA Fluxes - Accuracy and Validation

CERES shortwave (SW), longwave (LW), and window (WN) 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. The first set of CERES ADMs were developed from 9 months of CERES TRMM SSF measurements over the Tropics (Loeb et al., 2003a,b). These ADMs were used to generate TOA fluxes on the CERES TRMM Edition2B SSF product. The TRMM ADMs were also used to produce TOA fluxes for the CERES Terra Edition1A SSF product while a new set of global ADMs based on CERES Terra data were being developed.

The new global CERES Terra ADMs are now complete and are being used to generate TOA fluxes on the CERES Terra Edition2B SSF product (Loeb et al., 2004). The new ADMs are based on 24 months (Mar 2000 - Feb 2002) of CERES Terra Edition2A SSF data. The main features of the new Terra ADMs are given below. For a more detailed description of the CERES Terra ADMs see Loeb et al. (2004).

- Empirical ADMs over snow and sea-ice.
- Increased angular resolution in nonpolar regions (2 degrees).
- Use of "continuous" SW and LW ADM scene types over ocean, land, and desert.
- Monthly 1 degree regional clear land+desert ADMs.

- Neural network scheme to improve TOA flux estimates for footprints with excessive "no retrievals". No retrievals can occur when imager data is missing or when the cloud algorithm cannot provide a physical retrieval. If the scene characteristics over 35% or more of a CERES FOV are unknown, TOA fluxes are estimated using a neural network scheme. Approximately 3% of the CERES data fall in this category.

The tables below provide additional details on Terra ADM scene classification and validation results. Further details can be found in the following CERES Science Team Meeting presentations:

- Development of New CERES/Terra Angular Distribution Models - Fall 2002 (PDF)
- TOA Radiative Flux Estimation From CERES Angular Distribution Models - Spring 2003 (PDF)
- TOA Radiative Flux Estimation From CERES/Terra Angular Distribution Models - Fall 2003 (PDF)

CERES Terra Shortwave Channel ADMs for Different Scene Types

Scene Type	Description
Clear Ocean	Function of wind speed; Correction for aerosol optical depth included.
Cloud Ocean	Function of cloud phase; Continuous function of cloud fraction and cloud optical depth (5-parameter sigmoid).
Land & Desert Clear	1°- regional monthly ADMs using Analytical Function of TOA BRDF (Ahmad and Deering, 1992).
Land & Desert Cloud	Function of cloud phase; continuous function of cloud cover and cloud optical depth; used 1°-regional clear-sky BRDFs to account for background albedo.
Permanent Snow	Function of Cloud Fraction, Surface Brightness, cloud optical depth
Fresh Snow	Function of Cloud Fraction, Surface Brightness, Snow Fraction, cloud optical depth
Sea-Ice	Function of Cloud Fraction, Surface Brightness, Ice Fraction, cloud optical depth

CERES Terra 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, precip. water, lapse rate, skin temperature.
Clouds Over Ocean, Land Desert	Function of precip. water, skin temp, sfc-cloud temp. diff; continuous function of parameterization involving cloud fraction, cloud and sfc emissivity, sfc and cloud temp.
Permanent Snow, Fresh Snow, Sea-Ice	Each a function of cloud fraction, sfc temp, sfc-cld temp diff

CERES Instantaneous SW TOA flux uncertainties for Terra and TRMM ADMs

Region	S_o W m^{-2}	Terra ADMs W m^{-2} (%)	TRMM ADMs W m^{-2} (%)

		Clear-Sky	All-Sky	Clear-Sky	All-Sky
Tropics	1150	5.2 (2.2)	14.3 (5.1)	7.7 (3.5)	14.3 (5.8)
Midlat	870	4.2 (3.0)	13.5 (3.9)	7.3 (5.6)	13.7 (4.1)
Polar	540	12.8 (4.3)	17.3 (5.9)	37.0 (11.7)	29.2 (9.8)

CERES Instantaneous LW TOA flux uncertainties for Terra ADMs

Region	Terra ADMs W m^{-2} (%)		TRMM ADMs W m^{-2} (%)	
	Clear-Sky	All-Sky	Clear-Sky	All-Sky
Tropics	3.3 (1.1)	5.1 (1.8)	3.4 (1.1)	5.3 (1.9)
Midlat	2.9 (1.0)	5.4 (2.3)	2.7 (1.0)	5.6 (2.2)
Polar	3.4 (1.6)	4.0 (2.0)	3.3 (1.4)	5.0 (2.3)

Uncertainties in Regional Mean SW TOA fluxes (24-hour averages)

	December 2001		June 2002	
	Mean Bias	Regional RMS	Mean Bias	Regional RMS
TRMM ADMs	0.21	1.77	-0.85	1.89
Terra ADMs	-0.42	0.89	-.056	0.96

Uncertainties in Regional Mean Daytime LW TOA fluxes

	December 2001		June 2002	
	Mean Bias	Regional RMS	Mean Bias	Regional RMS
TRMM ADMs	-0.13	1.45	0.35	1.32
Terra ADMs	-0.04	0.93	0.26	0.82

Uncertainties in Regional Mean Nighttime LW TOA fluxes

	December 2001		June 2002	
	Mean Bias	Regional RMS	Mean Bias	Regional RMS
TRMM ADMs	0.28	1.63	0.69	1.37
Terra ADMs	-0.1	1.34	0.24	1.02

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