Status of CERES Surface-Only Flux Algorithms for Edition 3

David P. Kratz[1], Shashi K. Gupta[2],
Anne C. Wilber[2], and Victor E. Sothcott[2]

[1]NASA Langley Research Center
[2]Science Systems and Applications, Inc.

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Background

- CERES uses several surface-only flux algorithms to compute SW and LW surface fluxes in conjunction with the detailed model used by SARB. These algorithms include:

LPSA/LPLA:
Langley Parameterized SW/LW Algorithm

		Model A	Model B	Model C
SW	Clear	Li et al.	LPSA	--
	All-Sky	--	LPSA	--
LW	Clear	Inamdar and Ramanathan	LPLA	Zhou-Cess
	All-Sky	--	LPLA	Zhou-Cess

References:

SW A: Li et al. (1993): *J. Climate*, **6**, 1764-1772.
SW B: Darnell et al. (1992): *J Geophys. Res.*, **97**, 15741-15760.
Gupta et al. (2001): *NASA/TP-2001-211272*, 31 pp.
LW A: Inamdar and Ramanathan (1997): *Tellus,* **49B**, 216-230.
LW B: Gupta et al. (1992): *J. Appl. Meteor.,* **31**, 1361-1367.
LW C: Zhou et al. (2007): *J. Geophys. Res.*, **112**, D15102.
SOFA: Kratz et al. (2009): JAMC, doi:10.1175/2009JAMC2246.1.

Background (contd.)

- The SOFA SW & LW Models use rapid parameterizations to calculate the transfer of energy from TOA to surface.
- SW Model A and LW Models A & B were incorporated at the start of the CERES project.
- SW Model B was adapted for use in the CERES processing shortly before the launch of TRMM.
- The Edition 2B SW & LW surface flux results have undergone extensive validation (See: Kratz et al. 2009 JAMC2246.1), and provide independent verification of the SARB results.
- LW Model C will be introduced in Edition 3 processing to maintain two independent LW algorithms after the CERES Window Channel is replaced in future versions of the CERES instrument.

Status of SW & LW Models as of November 2009

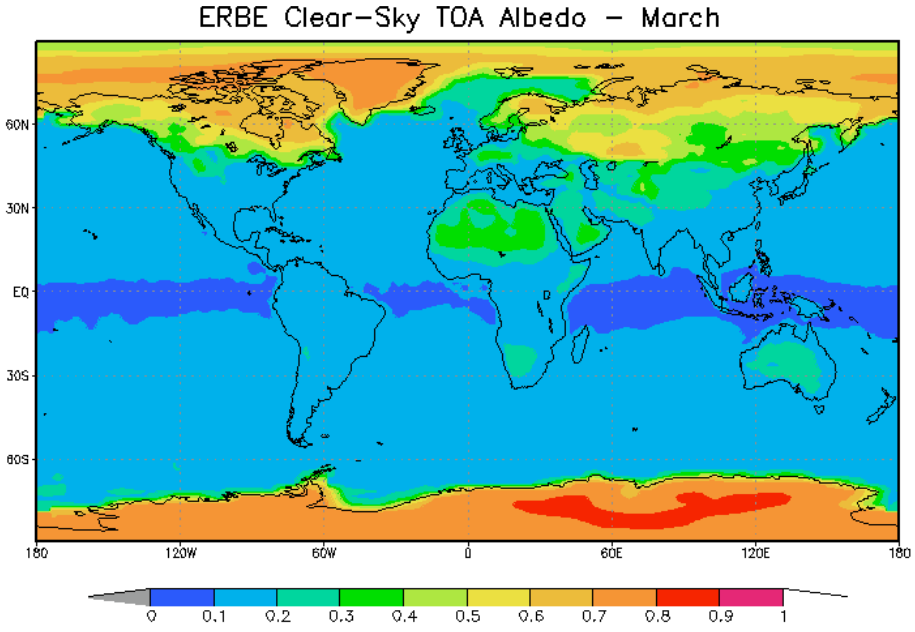
- SW Model A provides satisfactory global flux retrievals, though there remain problems with cloud contamination and significant flux underestimations for cases with low water vapor amounts.
- SW Model B has been improved significantly, though additional improvements are still required in several areas.
- LW Models A provides very good clear-sky results for most validation sites; however, the polar sites yield a modest negative bias due to a known discrepancy at low water vapor amounts.
- LW Models B & C provide very good clear-sky and all-sky results for all of the validation sites that were considered.
- LW Models A, B & C tend to overestimate downward surface fluxes for cases where the surface temperatures significantly exceed the lowest layer air temperature, and underestimate downward surface fluxes for cases where inversions exist.

Planned SW Model B Algorithm Improvements for Edition 3 (Page I)

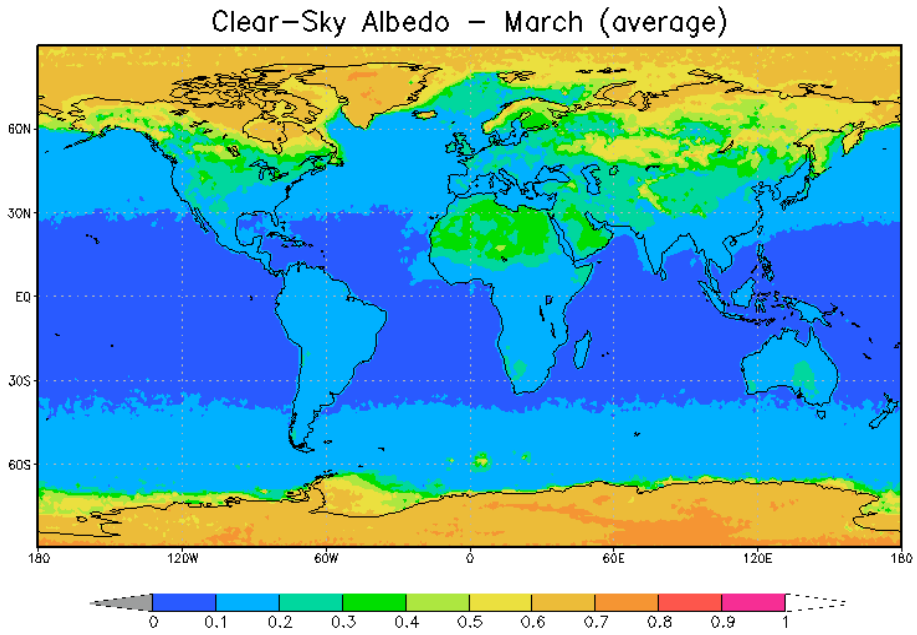
- Correct code limitation that prevents flux calculation for O_3 column abundances exceeding 500 Dobson units.
- Modify formulation to provide a more realistic dependence of instantaneous surface albedo on cosine of the solar zenith angle.
- For Terra processing, replace monthly climatology clear-sky TOA albedos based on 48 months of ERBE data with TOA albedos based on 70 months of Terra data.
- For Aqua processing, upgrade clear-sky TOA albedos by using 70 months of Terra data rather than 46 months of Terra data.

Comparison of Clear-sky TOA Albedo derived from ERBE & Terra Data

Clear-Sky TOA Albedo from 48 Months of ERBE Data



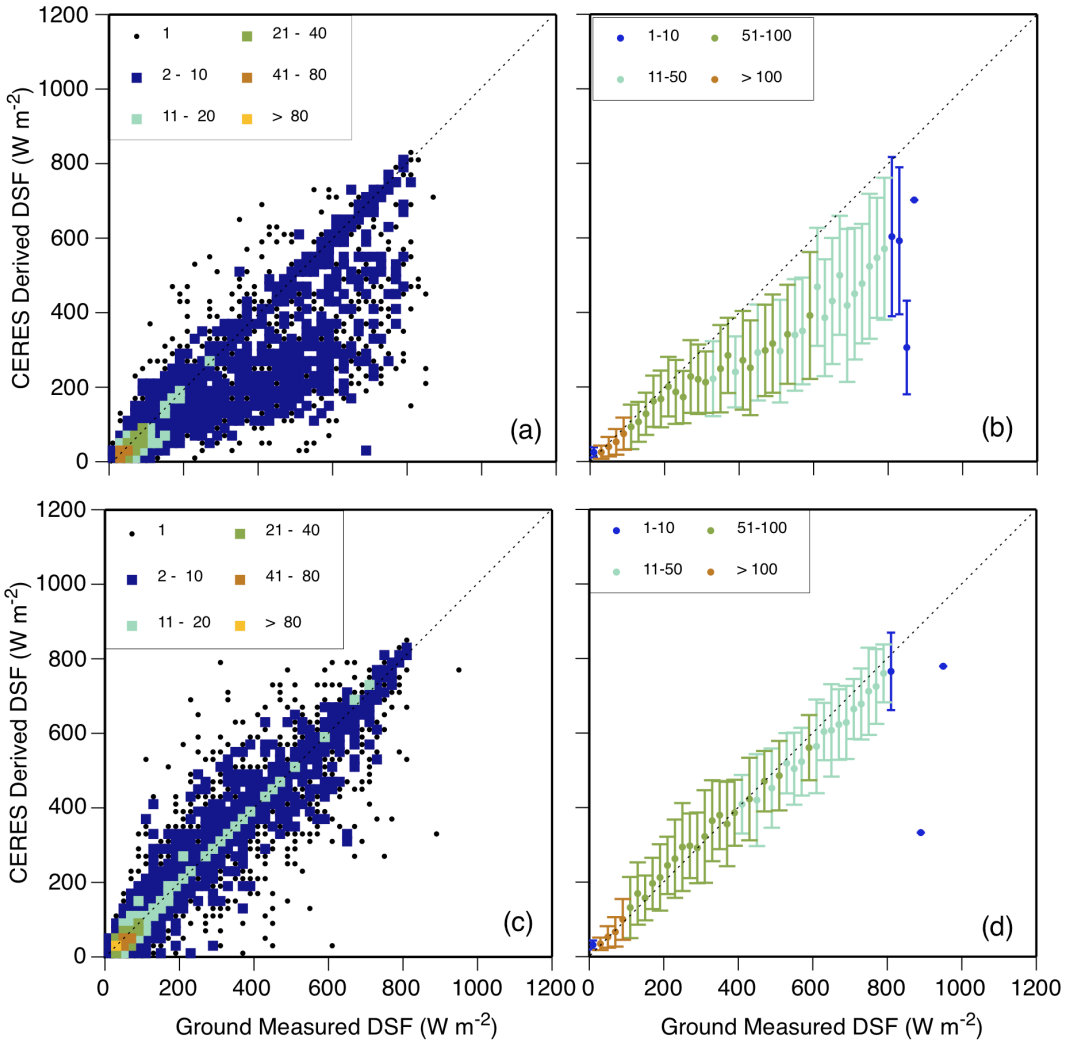
Clear-sky TOA Albedo from 70 Months of Terra Data



Comparison between surface-measured and CERES-derived fluxes

Comparisons of SW Model B under cloudy-sky conditions for the polar sites Georg von Neumayer and Syowa showing the improvement between the Terra results using the ERBE TOA clear-sky albedo (a & b) and the Aqua results using the Terra clear-sky albedo (c & d).

Plots b & d represent bin-averaged equivalence of the scatter plots a & c.

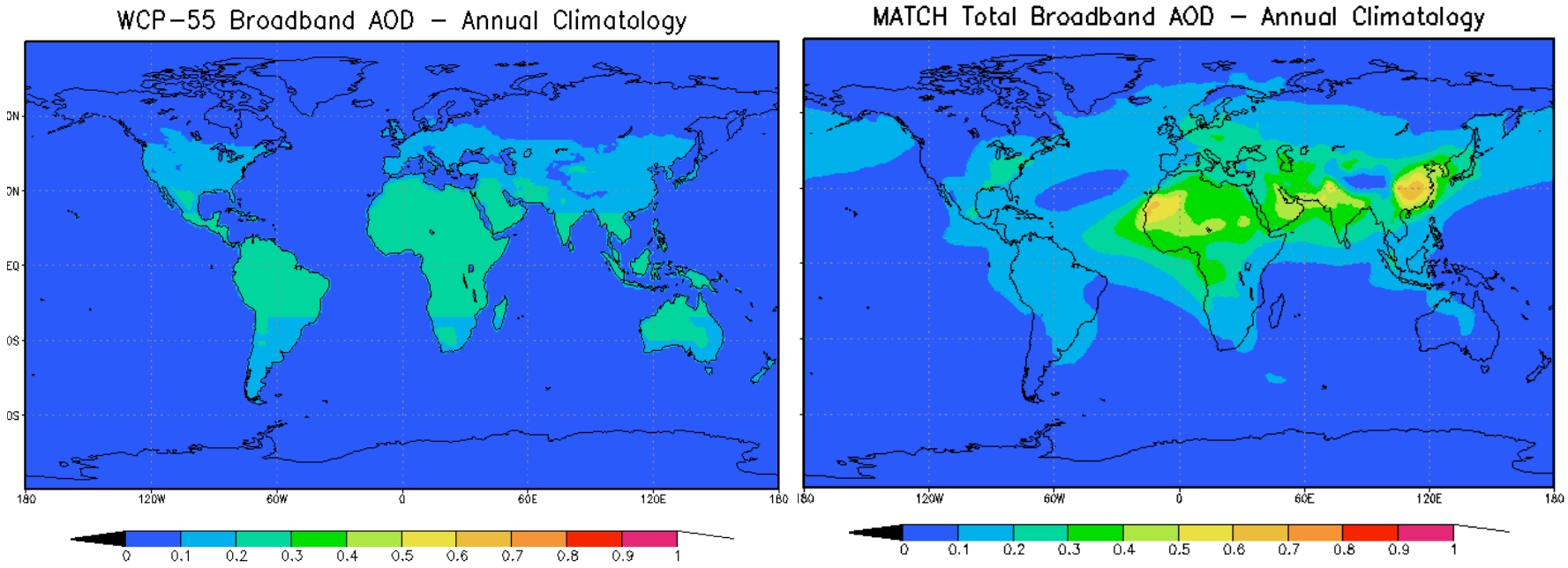


Planned SW Model B Algorithm Improvements for Edition 3 (Page II)

- Revise the Rayleigh scattering formulation in SW Model B
- Replace the WCP-55 aerosol properties in SW Model B with the MATCH aerosol optical depths and the OPAC single scattering albedos and asymmetry parameters.
- If necessary, revise the molecular absorption parameterizations in SW Model B using the latest HITRAN database.
- Examine the relationship between clear and cloudy-sky results.

Comparison of WCP-55 and MATCH Aerosol Optical Depths

The MATCH aerosols provide a more realistic distribution of aerosol optical depths than the WCP-55 aerosols



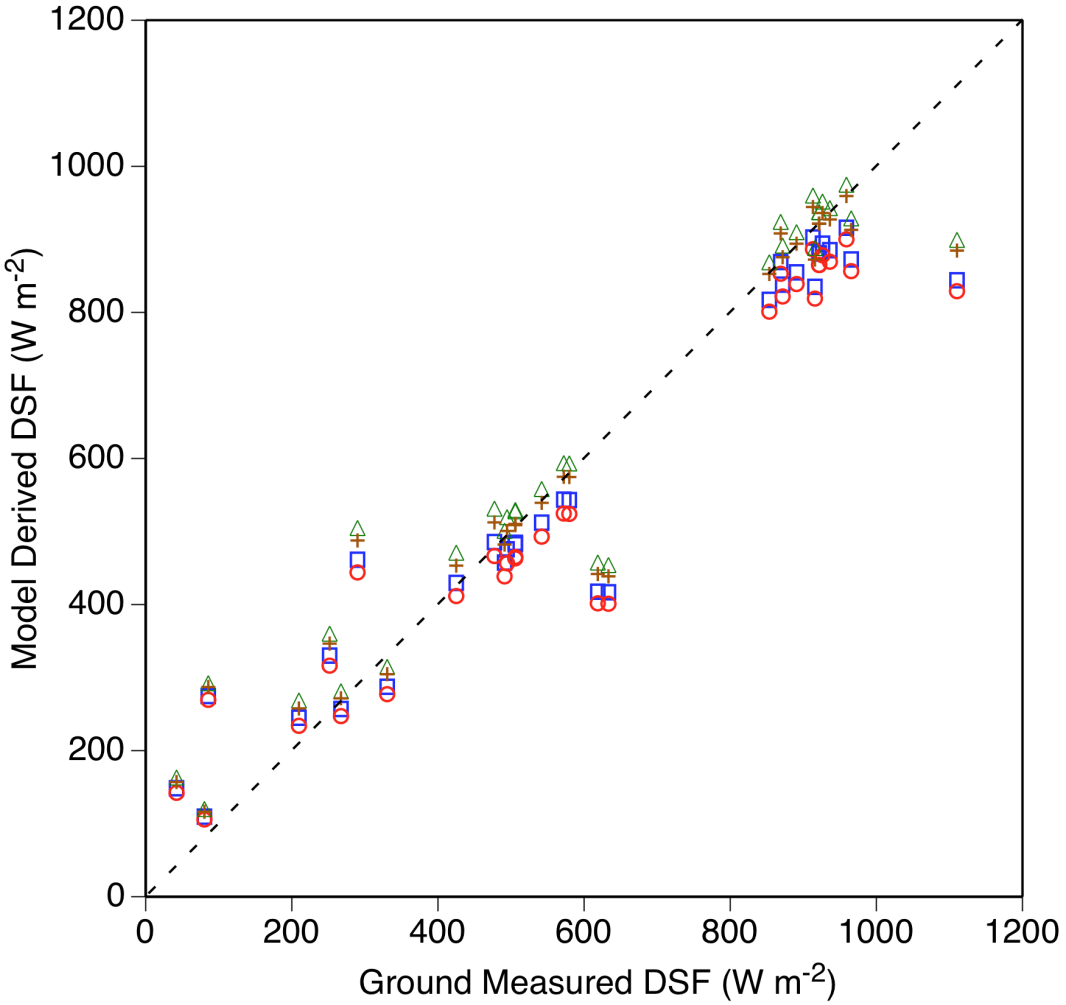
Flux Comparisons for SGP Surface Site

☐ Old Rayleigh, WCP-55 Aerosols

O New Rayleigh, WCP-55 Aerosols

Δ Old Rayleigh, MATCH Aerosols

\+ New Rayleigh, MATCH Aerosols



Planned LW Algorithm Improvements

- LW Model C: Reformulated to handle cases involving cirrus and low water vapor amounts (Edition 3).
- LW Model C: Algorithm modifications completed to incorporate code into CERES processing (Edition 3).
- LW Models A, B & C: Implement near-surface air-temperature constraints to manage cases where the surface temperature either greatly exceeds or falls below (inversion) the overlying air temperatures, (Edition 3).