Updated ARM Archive VISST Datasets: GOES-8,-10,-11 SGP Broadband Fluxes Derived using Improved Narrowband-to-Broadband Conversion Fits

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Introduction

- Minnis Group at NASA/Langley provides near-realtime and historical VISST SGP domain datasets to ARM archive
  - Properties derived from geostationery satellites GOES-8,-10,-11
  - SGP Domain 32°-42°N, 91°-105°W
  - VISST technique uses 4 channels to derive various cloud & radiative properties, e.g. Cloud Phase, Optical Depth, BB LW/SW fluxes
  - GOES-EAST and –WEST VISST (currently G12 & G10) available in near-realtime from NASA website http://www-pm.larc.nasa.gov
  - After each month, GOES-WEST pixel-level (4km res) and gridded (0.5^{o} res) netcdf files made available to ARM Archive
  - Historical re-processing of GOES-8 &-10 is ongoing, incorporating VISST algo improvements and NB-BB fit updates
  - Currently, 95 monthly datasets available at ARM archive (or awaiting upload)

Status of VISST Datasets Delivered to ARM Archive

- Update:
  - Near-realtime VISST data available from Sep05- Aug07 (~1 month lag)
  - Previous VISST processing used Jan-Aug 1998 GOES-8-TRMM NB-BB fit
  - NB-BB conversion fits updated for Apr00-Mar03 GOES-8, 2004 GOES-10
  - Historical data re-processing (V3) just completed from May 1998- Mar 2003 (through end of GOES-8 record)
  - Historical data re-processing (V2) of 2004 GOES-10 data completed

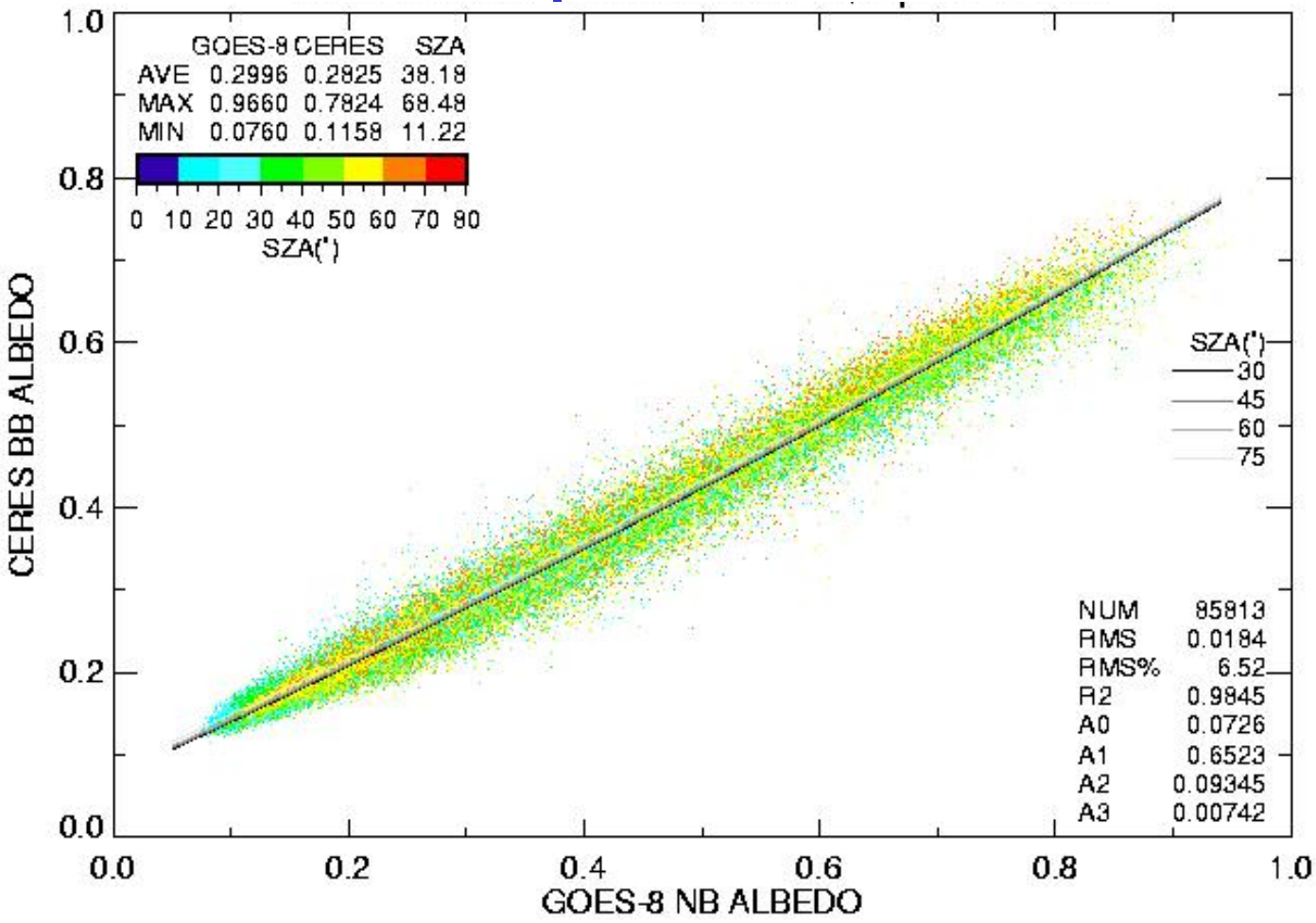
- Currently for SGP: 71 reprocessed historical, 24 near-realtime monthly datasets sent to archive (sidenote, Jan-Feb 2006 archived for TWP)

- Need to know bias and RMS errors of new and old BB fluxes from VISST available from ARM archive

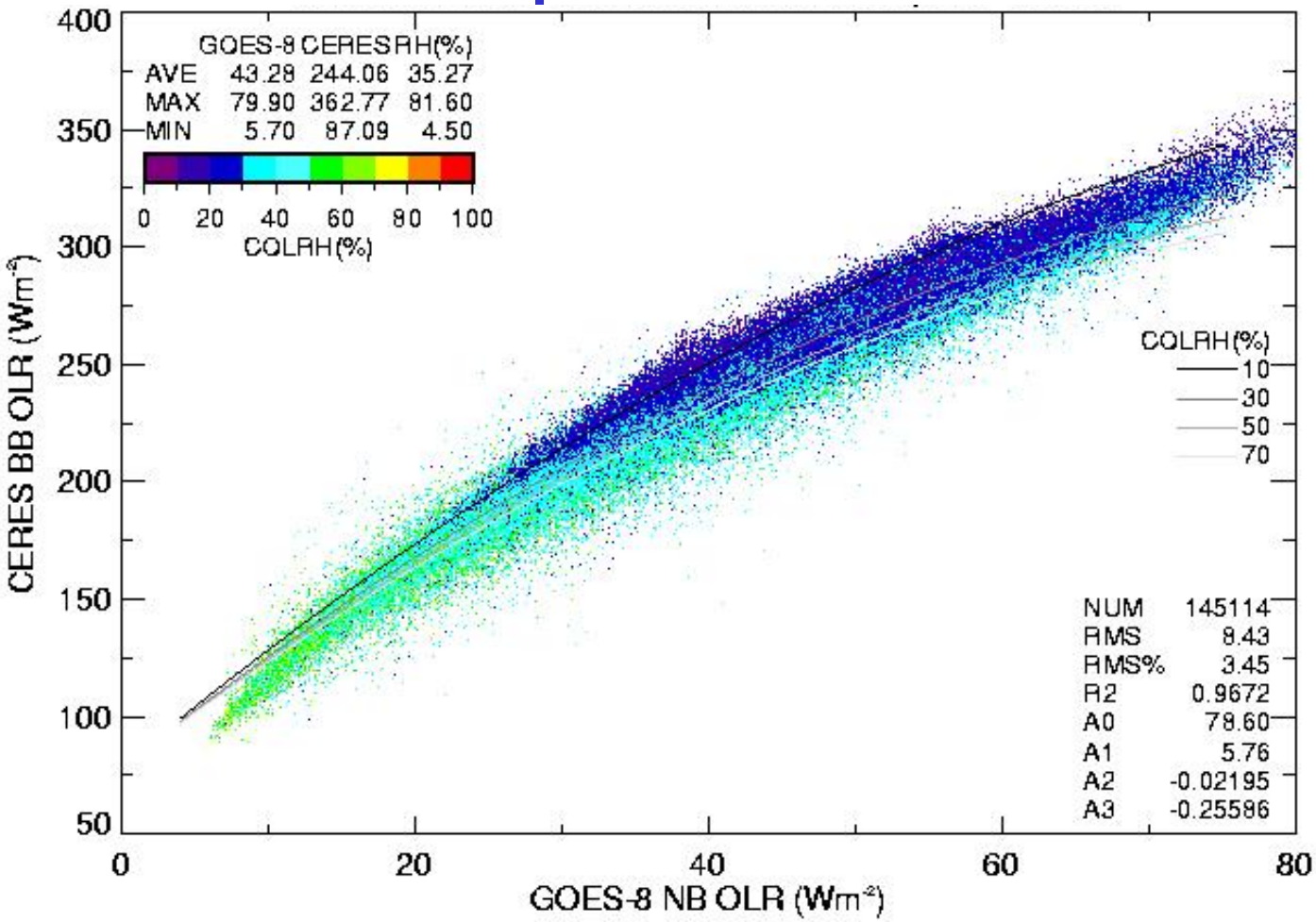
Deriving a Narrowband-to-broadband Conversion Fit

- BB fluxes from Terra Ed2C Revision 1 CERES FM-1 or FM-2 scanner are matched with the GOES NB fluxes
  - CERES 20-km Single Scanner Footprint TOA/Surface Fluxes and Clouds (SSF; Geier et al, 1999)
  - SSF footprint data averaged into 1° grid: Monthly Gridded Surface Fluxes and Clouds (SFC)
  - CERES FM-1 or 2 SFC fluxes (cross-track mode only) matched to 1° GOES NB fluxes within ±15 minutes of overpass time, at CERES VZA < 65°, GOES VZA < 70°
  - Convert NB flux to BB using empirical equations:
    - $SW_{bb} = a_0 + a_1*S_{nb} + a_2*S_{nb}^2 + a_3*\ln(1/csza))$ (1)
      where SW_{bb}= SW BB flux, S_{nb} = SW NB flux, csza=cos(SZA)
    - $OLR_{bb} = A_0 + A_1*L_{nb} + A_2*L_{nb}^2 + A_3*L_{nb}*\ln(colRH)$ (2)
      where OLB_{bb} = LW BB flux, L_{nb}=LW NB flux, and colRH=column-weighted RH
  - Third order correction applied to OLR

GOES-8 Narrowband vs CERES Broadband Albedo: Apr00-Mar03

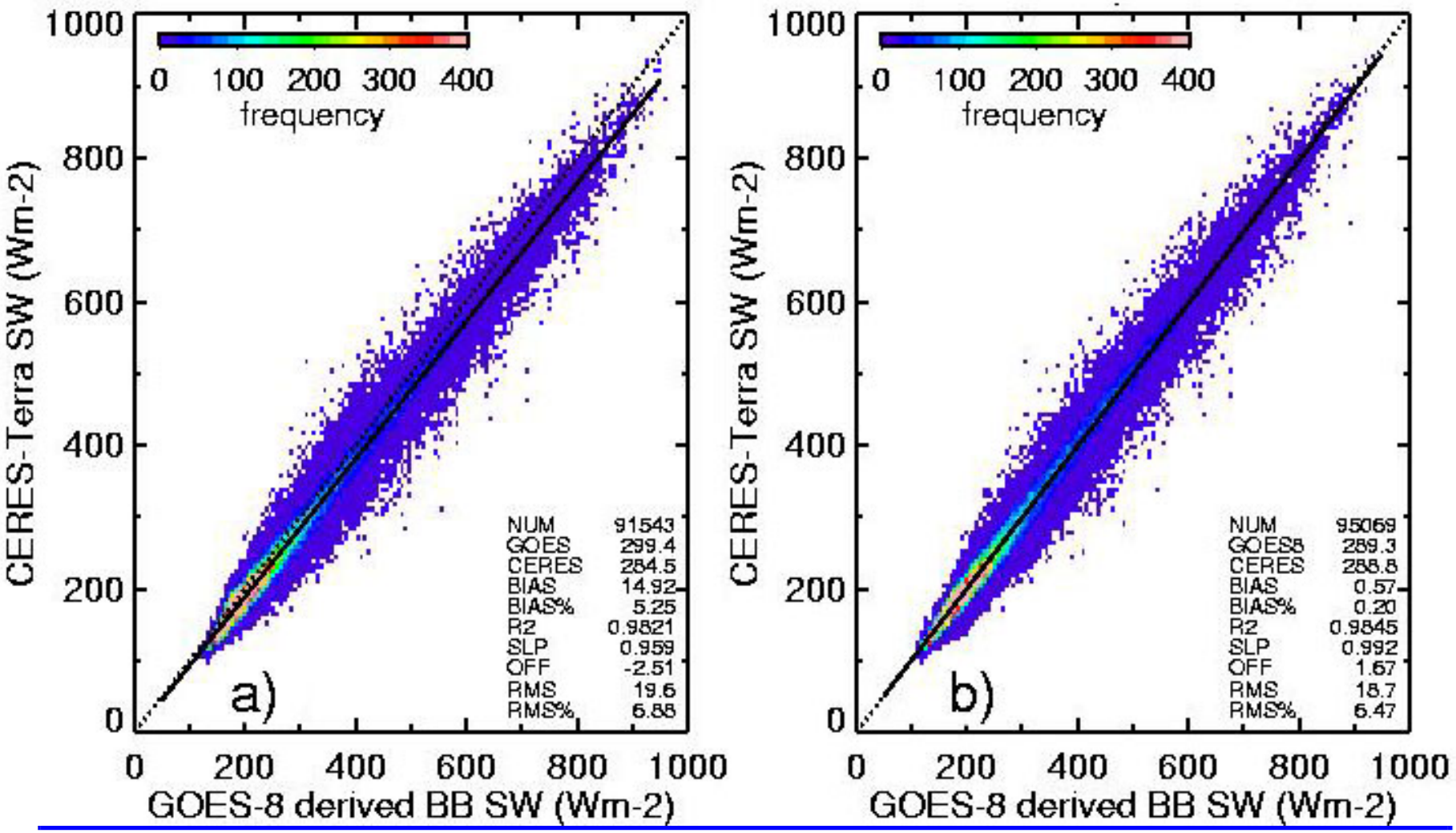


GOES-8 Narrowband vs CERES Broadband LW Flux: Apr00-Mar03



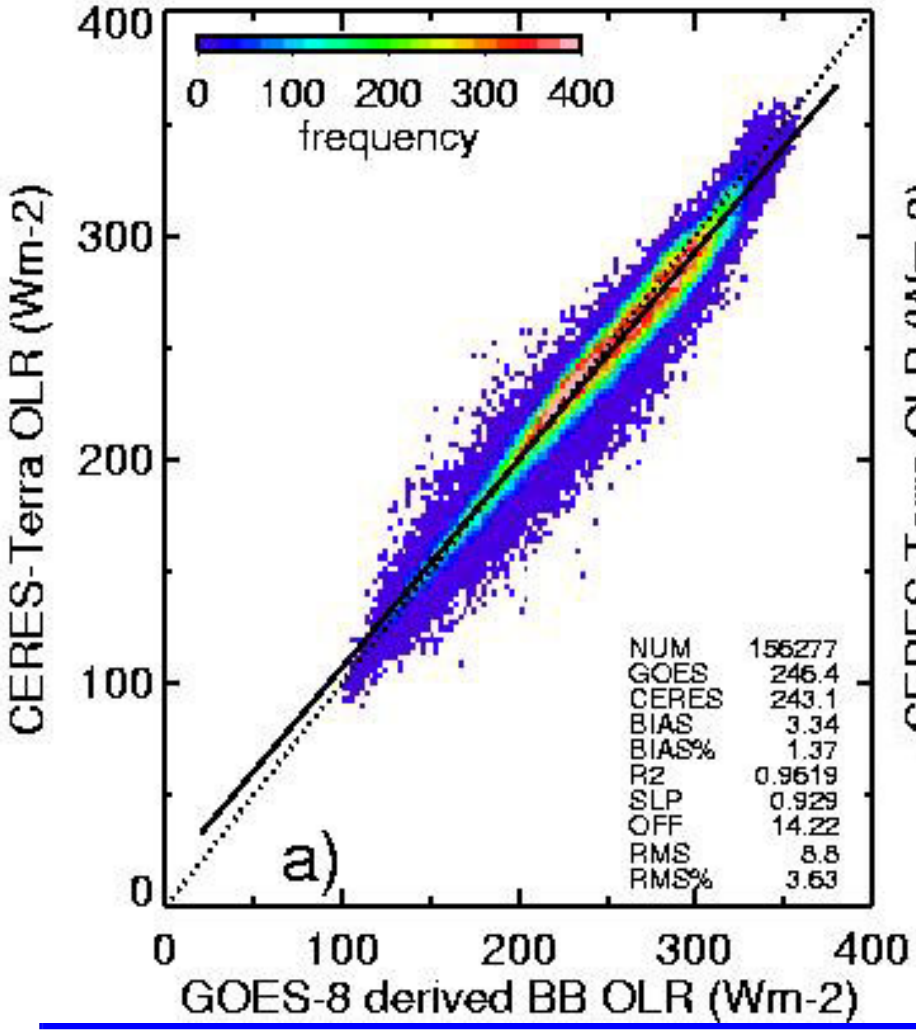
Apr00-Mar03 ARM SGP GOES-8 Derived BBSW Fluxes vs CERES

Previous VISST (1998 NB-BB fit) VISST V3 (Apr00-Mar03 NB-BB fit)

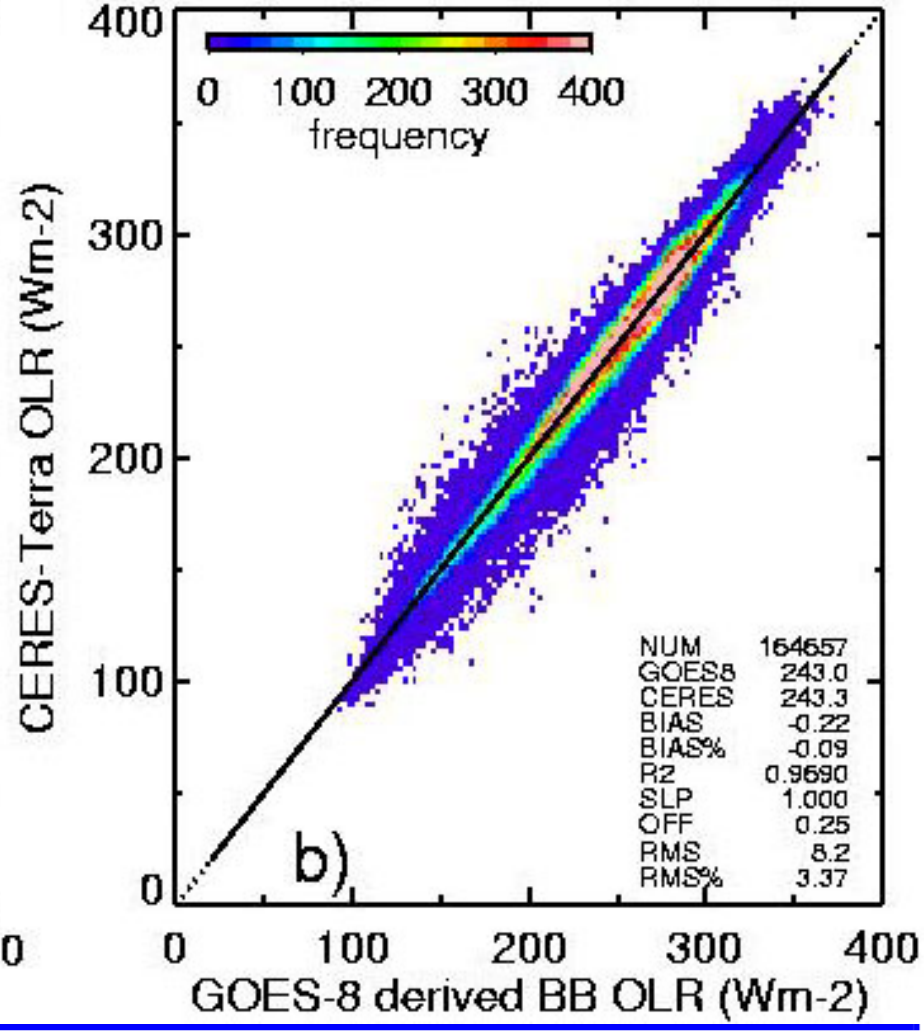


Apr00-Mar03 ARM SGP GOES-8 Derived BBLW Fluxes vs CERES

Previous VISST (1998 NB-BB fit)

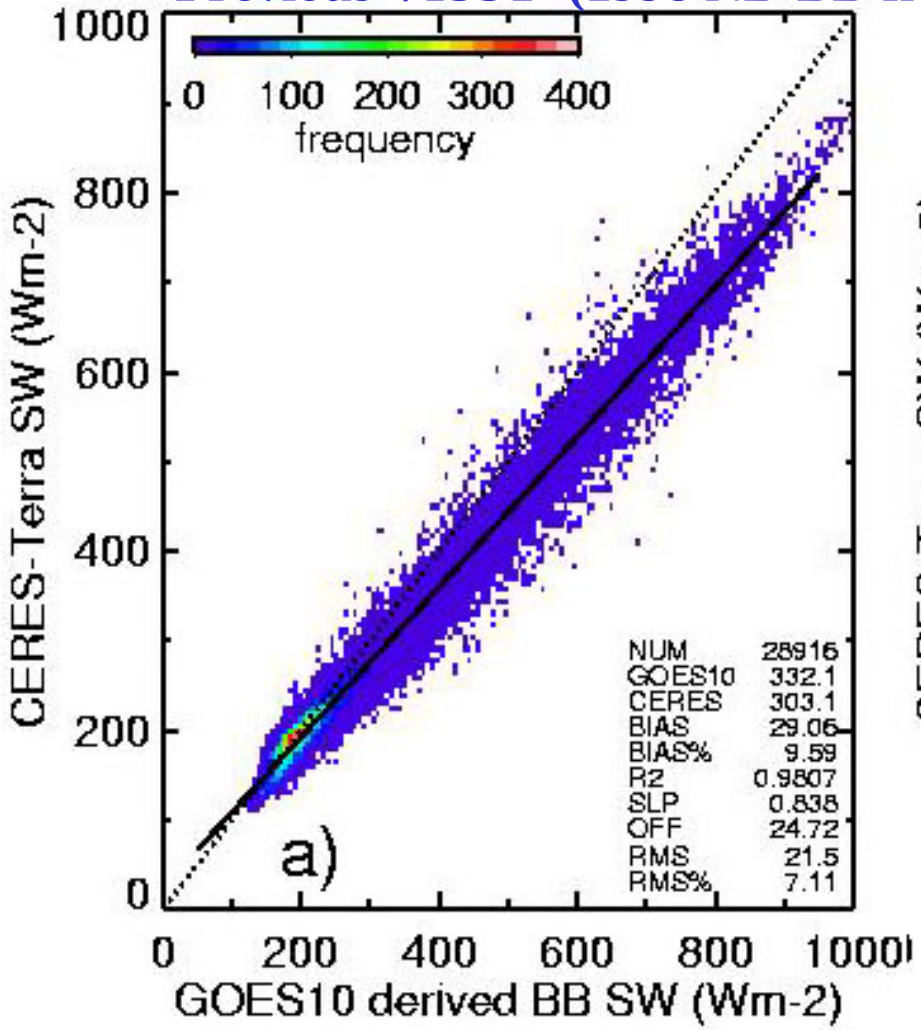


VISST V3 (Apr00-Mar03 NB-BB fit)

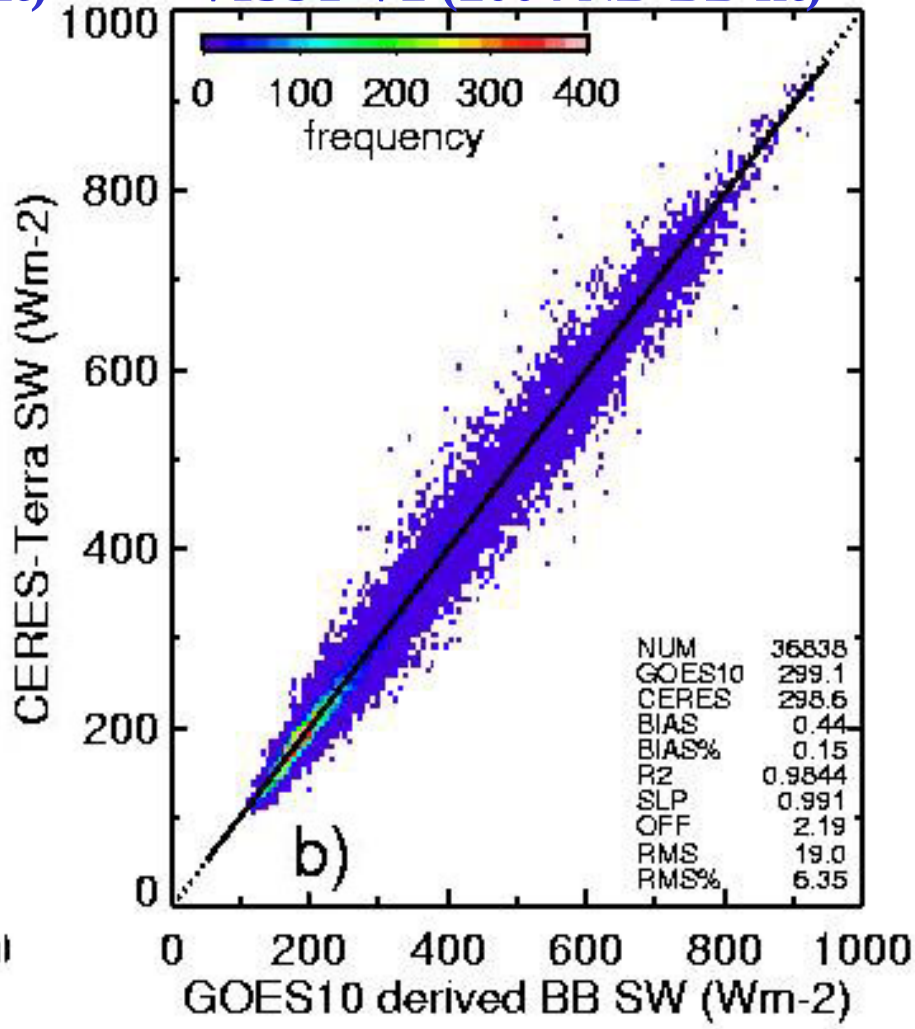


2004 ARM SGP GOES-10 Derived BBSW Fluxes vs CERES

Previous VISST (1998 NB-BB fit)

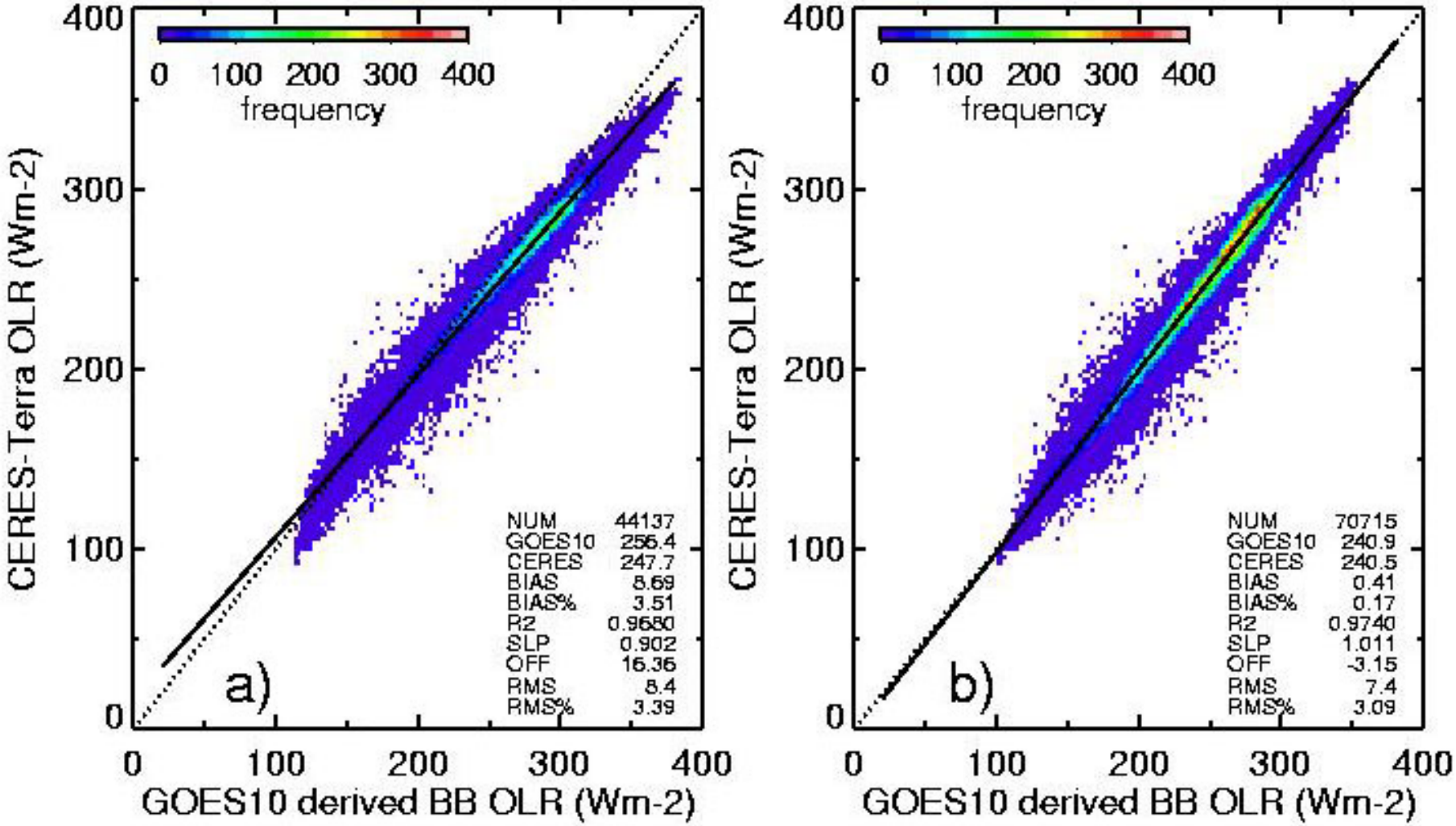


VISST V2 (2004 NB-BB fit)



2004 ARM SGP GOES-10 Derived BBLW Fluxes vs CERES

Previous VISST (1998 NB-BB fit) VISST V2 (2004 NB-BB fit)



Outside Validation

- The Apr00-Mar03 GOES8-Terra and 2004 GOES10-Terra NB-BB fits obviously reduce errors in GOES-derived broadband fluxes within those respective time periods

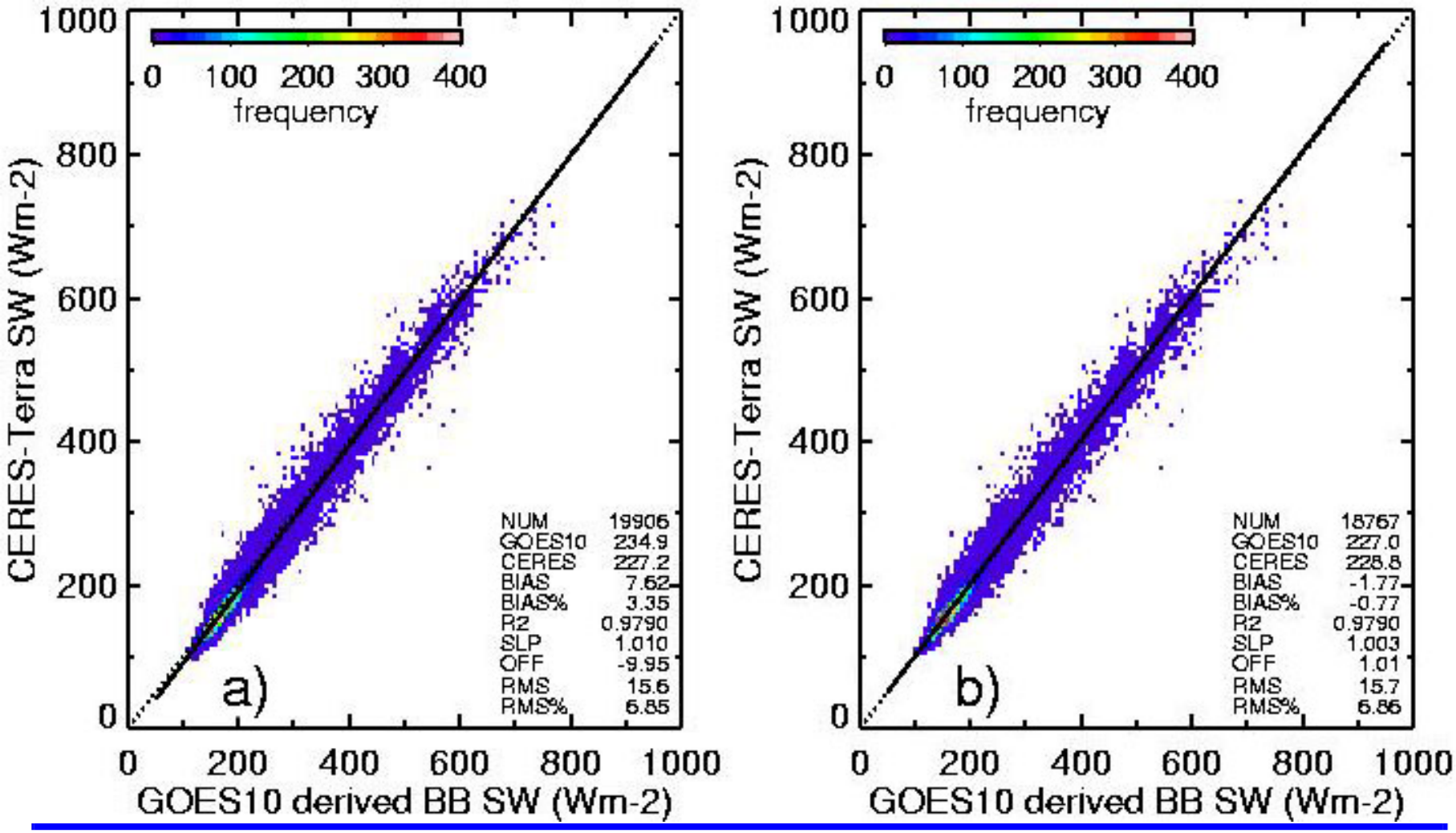
- Until more NB-BB fits for recent data are derived, need to apply 2004 GOES10-Terra fit in near-realtime VISST processing

- Need external validation of fit, to have confidence that it is applicable to times other than the derivation period

- Compare GOES10-derived BB fluxes from Sep05-Feb06 (currently in ARM archive, derived using 1998 GOES8-TRMM fit) with those derived using 2004 GOES10-Terra fit

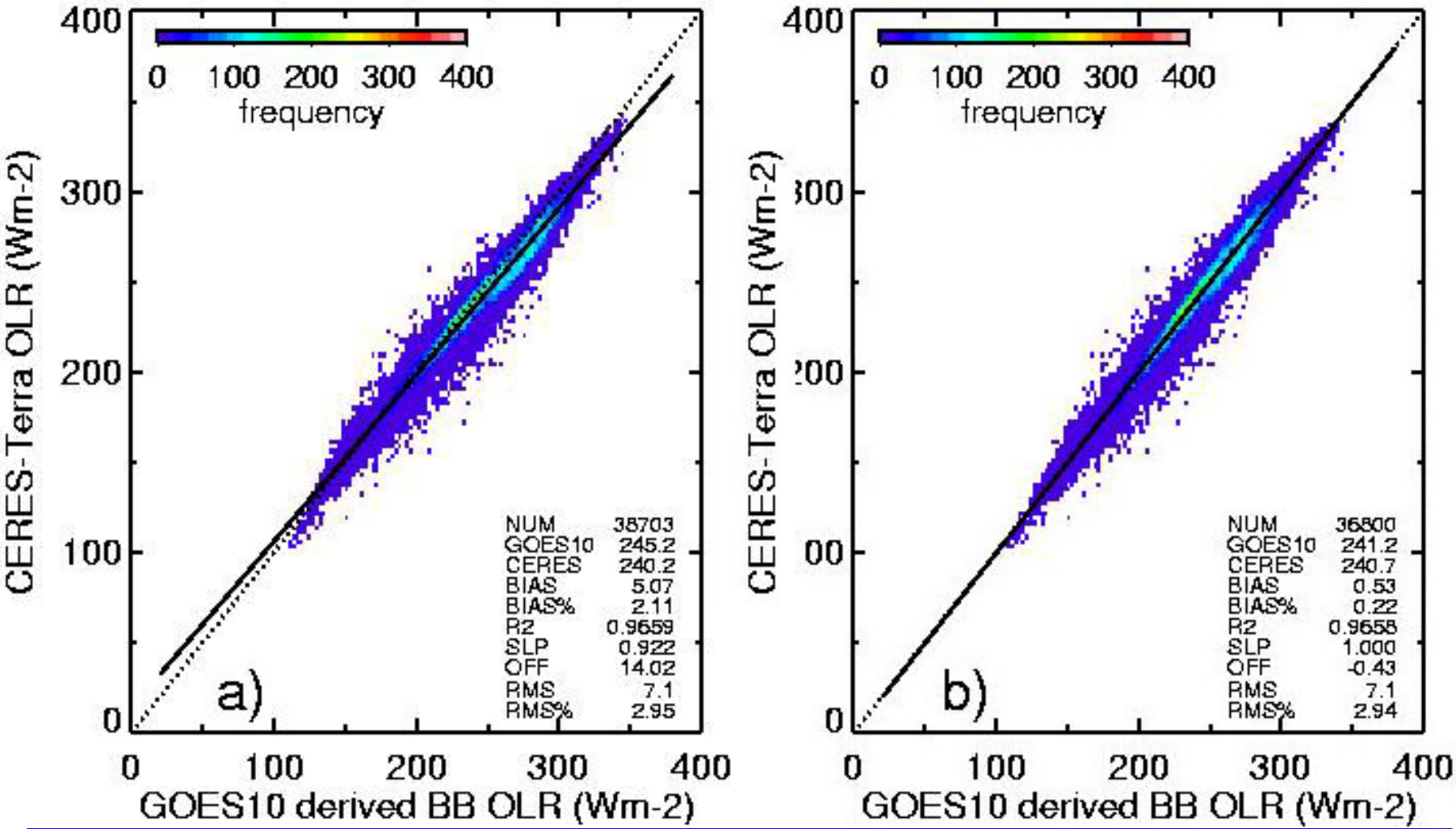
Sep05-Feb06 ARM SGP GOES-10 Derived BBSW Fluxes vs CERES

VISST V2 (1998 NB-BB fit) VISST Val (2004 NB-BB fit)



Sep05-Feb06 ARM SGP GOES-10 Derived BBLW Fluxes vs CERES

VISST V2 (1998 NB-BB fit) VISST Val (2004 NB-BB fit)

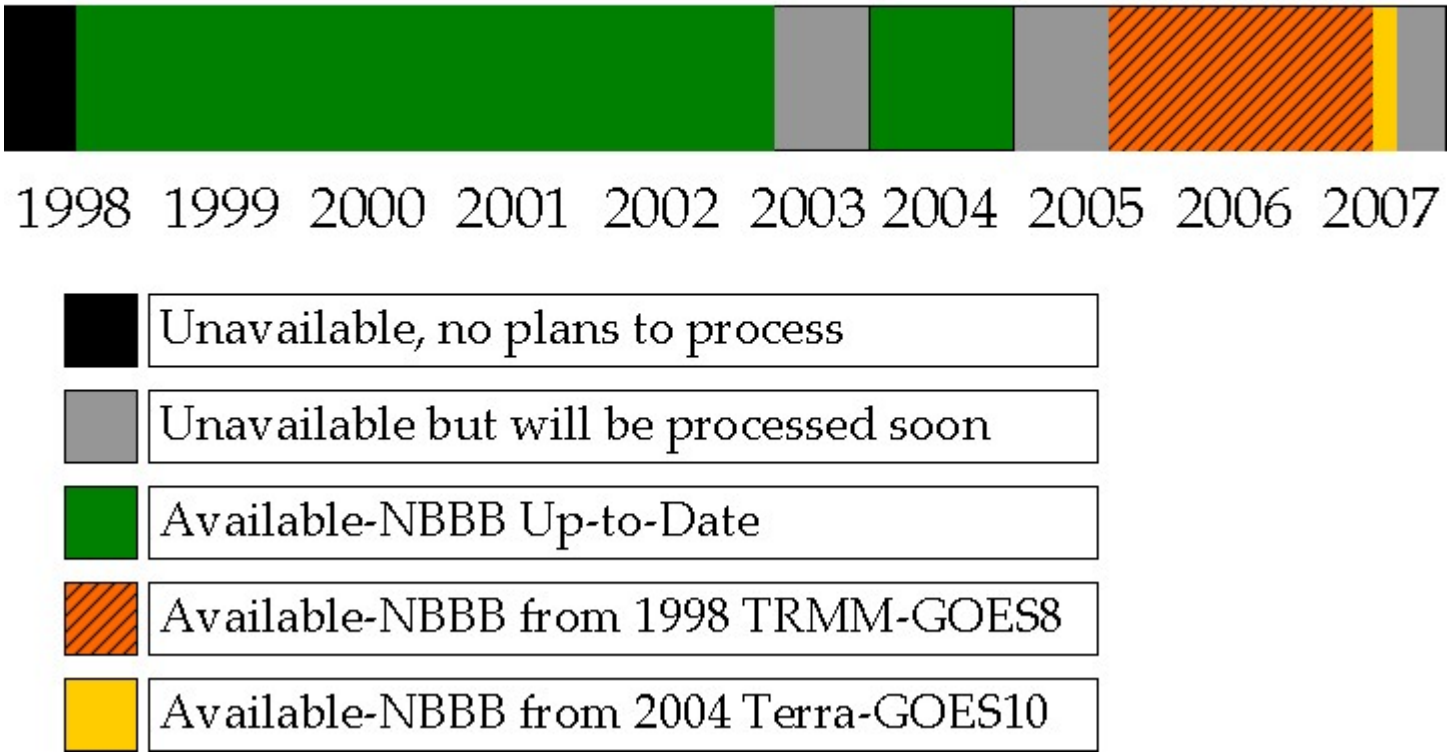


GOES-derived Broadband SW/LW Errors: Old and New

	Dates	Old Bias	Old RMS	New Bias	New RMS
G8 OLR	4/00-3/03	3.3 Wm^{-2}	8.8 Wm^{-2}	-0.2 Wm^{-2}	8.2 Wm^{-2}
G10 OLR	2004	8.7 Wm^{-2}	8.4 Wm^{-2}	0.4 Wm^{-2}	7.4 Wm^{-2}
G10 OLR*	9/05-2/06	5.1 Wm^{-2}	7.1 Wm^{-2}	0.5 Wm^{-2}	7.1 Wm^{-2}
G8 SW	4/00-3/03	14.9 Wm^{-2}	19.6 Wm^{-2}	0.6 Wm^{-2}	18.7 Wm^{-2}
G10 SW	2004	29.1 Wm^{-2}	21.5 Wm^{-2}	0.4 Wm^{-2}	19.0 Wm^{-2}
G10 SW*	9/05-2/06	7.6 Wm^{-2}	15.6 Wm^{-2}	-1.8 Wm^{-2}	15.7 Wm^{-2}

***indicates the "new" values are for the GOES-10-Terra 2004 NB-BB coefficients, as validation.**

ARM Archive SGP GOES-x VISST Dataset Availability



SUMMARY

- New SGP NB-BB fits:
  - GOES-8 April 2000-March 2003
  - GOES-10 Jan-Dec 2004
  - New fits decrease bias and RMS errors in all datasets
  - GOES-10 2004 fit now used in near-realtime VISST
- VISST SGP datasets reprocessed:
  - GOES-8 May98-Dec99 using Jan-Aug1998 TRMM-G8 fit
  - GOES-8 Jan00-Mar03 using Apr00-Mar03 Terra-G8 fit
  - GOES-10 Jan-Dec04 using 2004 Terra-GOES-10 fit
- ARM Archive deliveries:
  - Pixel-level netcdf files (e.g. datastream sgpvisstpx04g08v3minnis)
  - 0.5^{o} gridded netcdf files (e.g. datastream sgpvisstgdg08v3minnis)

Future Work

- Produce new SGP NB-BB fits:
  - GOES-10 April 2003- March 2006
  - GOES-11 July 2006-June 2007 (when CERES SFC available)
- Reprocess SGP:
  - GOES-10 April-December 2003
  - GOES-10 Jan 2005-Jun 2006
  - GOES-11 Jun 2006- present
- Update:
  - Realtime GOES-11 processing currently uses 2004 GOES-10 NB-BB fit (as of June 8, 2007)
  - Will update realtime to use GOES-11 Jul06-Jun07 fit (when available)
- Then NSA, TWP, MASRAD…

http://www-pm.larc.nasa.gov

Other Domains

- SGP Jan-Aug 1998 TRMM-GOES8 fit
  - OLR: 7.2 W/m^2 RMS
  - SW: 0.021 albedo RMS (8.3%)

- MASRAD Ed2C Jun-Aug05 Terra-GOES10 fit
  - OLR: 7.3 W/m^2 RMS
  - SW: 18.4 W/m^2 RMS

- TWPICE Ed2C Nov-Dec05 Terra-MTSAT fit
  - OLR: 9.5 W/m^2 RMS
  - SW 31.4 W/m^2 RMS

VISST Tests

Daytime Tests

Iteratively, Solve for

Optical Depth (Tau), using observed Visible Reflectance

match observed reflectance to parameterized modelled reflectance

Cloud Temperature (Tcld), using 11 um Brightness Temperature (T4)

Effective Radius (Re), using 3.9 um Brightness Temperature (T3)

Test for Phase

Nighttime Tests

Iteratively, Solve for τ Tau, Tcld, Re, by
minimizing differences between Model and Observed BTD3-4,
BTD4-5, as a function of observed (T4)

Reference: Minnis, P.; Kratz, D. P.; Coakley, J. A., Jr.; King, M. D.;Garber, D.; Heck, P.; Mayor, S.; Young, D. F. and Arduini, R.: Cloud Optical Property Retrieval (Subsystem 4.3). "Clouds and the Earth's Radiant Energy System (CERES)Algorithm Theoretical Basis Document, Volume III: Cloud Analyses and Radiance Inversions (Subsystem 4)", NASA RP 1376 Vol. 3,edited by CERES Science Team, December, 1995, pp. 135-176. (Available under Publications, http://www-pm.larc.nasa.gov)