

CERES Angular Distribution Model Analyses

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OUTLINE

- i) CERES SSF Edition3: ADM-related Issues
- ii) TOA Flux Sensitivity to Cloud Algorithm Changes
- iii) Clear Ocean ADMs and MATCH Aerosols
- iv) MISR vs CERES TOA Albedo Comparison

CERES ADMs

Satellite	Data Used	Reference	Data Products
TRMM	SSF Ed1 (01/98-08/98; 03/00)	Loeb et al. 2003 (JAM)	SSF Ed2B
Terra	SSF Ed1A (03/00 – 02/02)	Loeb et al. 2004 (JAOTECH)	SSF Ed2B
Aqua	SSF Ed1B (08/02 – 06/04)	Same as Terra	SSF Ed2A

Terra Edition3 TOA Flux/ADMs

Use the same ADMs as in Edition2B with the following modifications:

- Aqua sea-ice SW ADMs for Terra.
- Terra permanent snow nighttime LW ADMs for Aqua Ed3.
- 5 years of CERES Terra to produce new fresh and permanent snow SW ADMs.

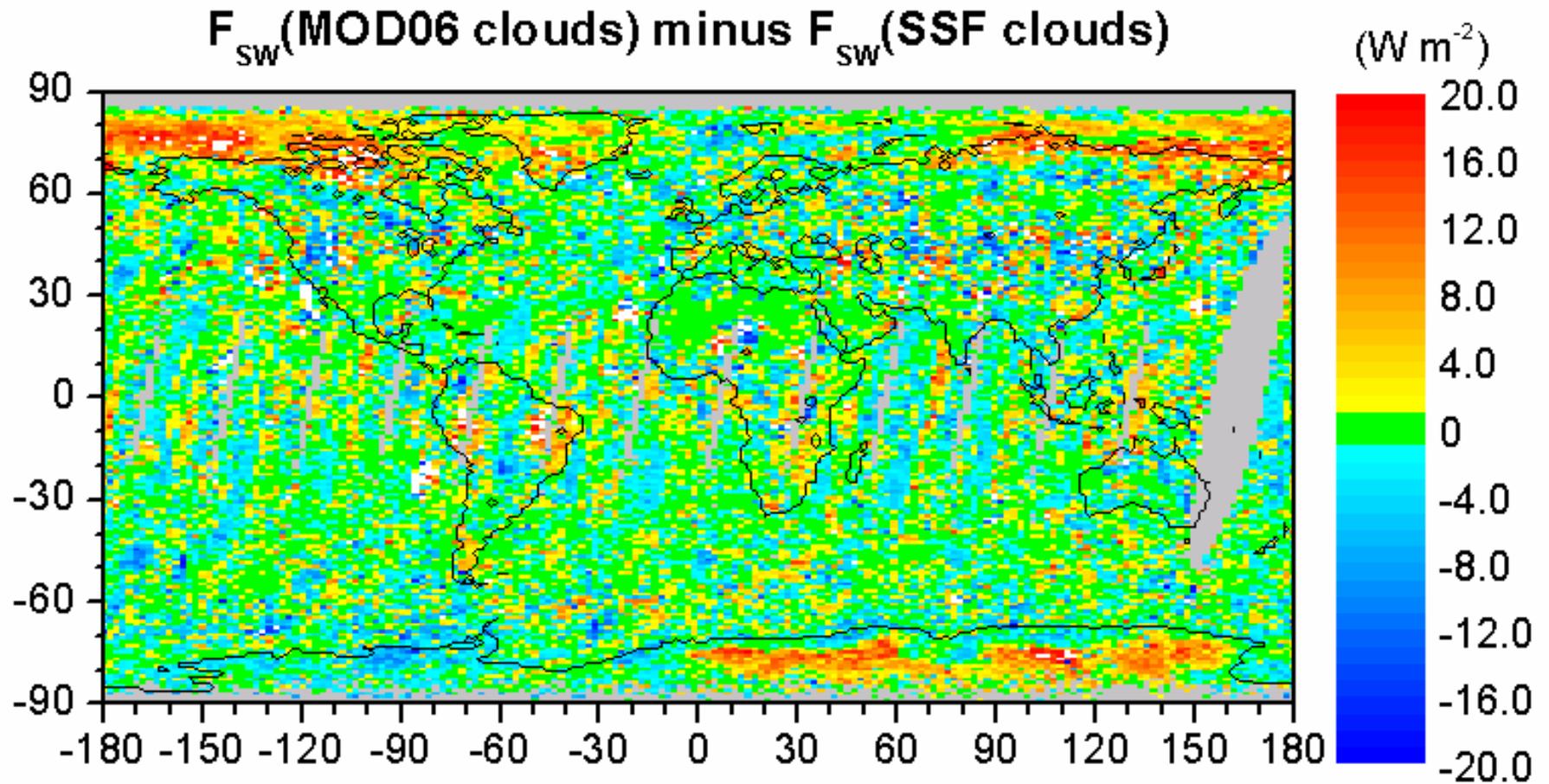
Will CERES ADMs need to be redeveloped given Edition3 cloud algorithm changes?

- Depends on how significant the changes are:
 - We found significant TOA flux sensitivity to cloud algorithm changes over polar regions between Terra Ed2 and Aqua Ed1 cloud algorithms.
- Long term question: Should we produce one set of Terra+Aqua ADMs?

TOA Flux Sensitivity to Cloud Algorithm Changes

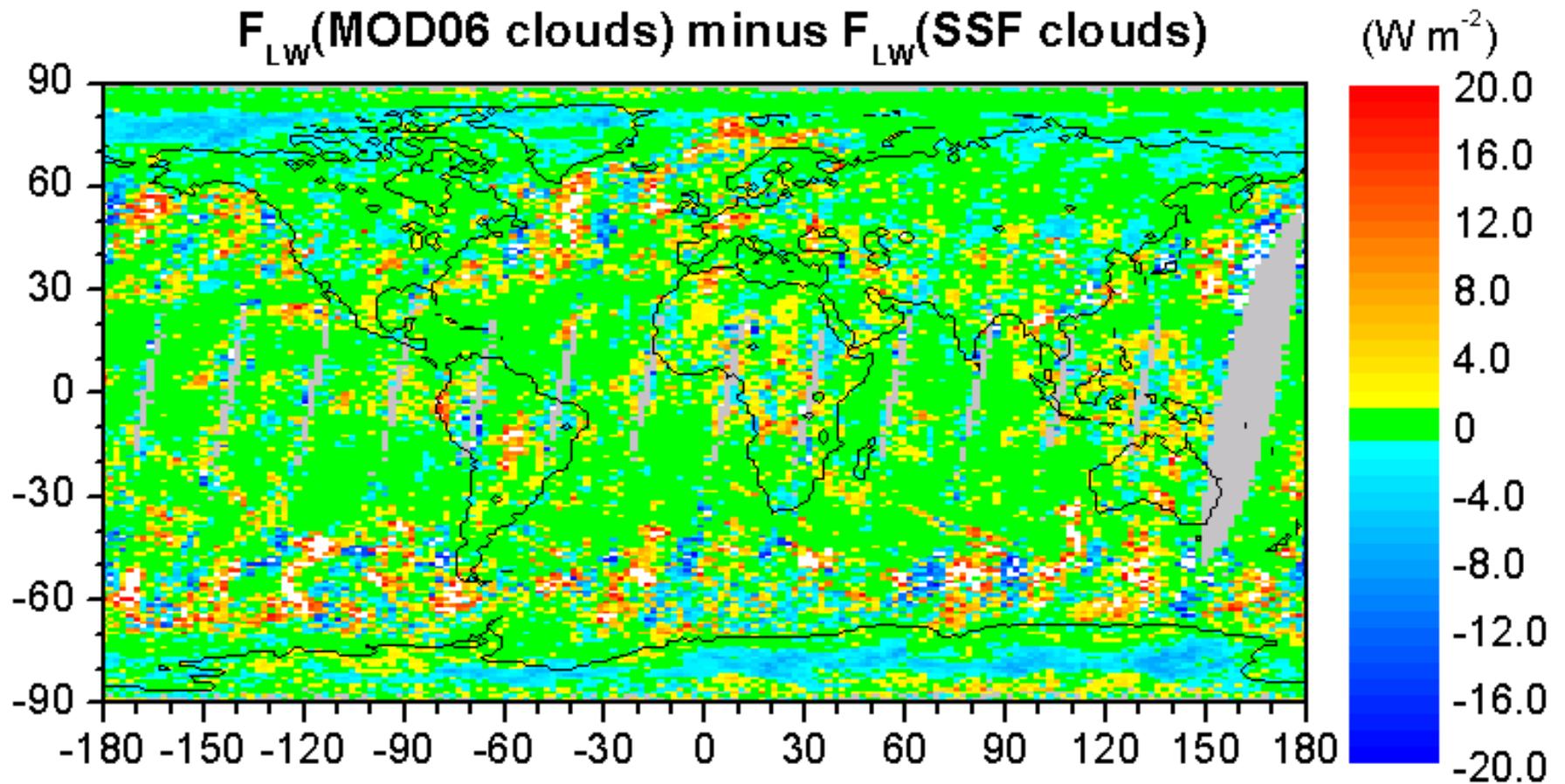
- Produce 1 day of a modified CERES Terra SSF using MOD06 clouds instead of SSF clouds
- Compare TOA flux with MOD06 clouds vs SSF clouds
- Consider only CERES footprints with valid MOD06 and SSF cloud properties and fluxes
- Day used: March 15, 2001

SW TOA Flux Difference

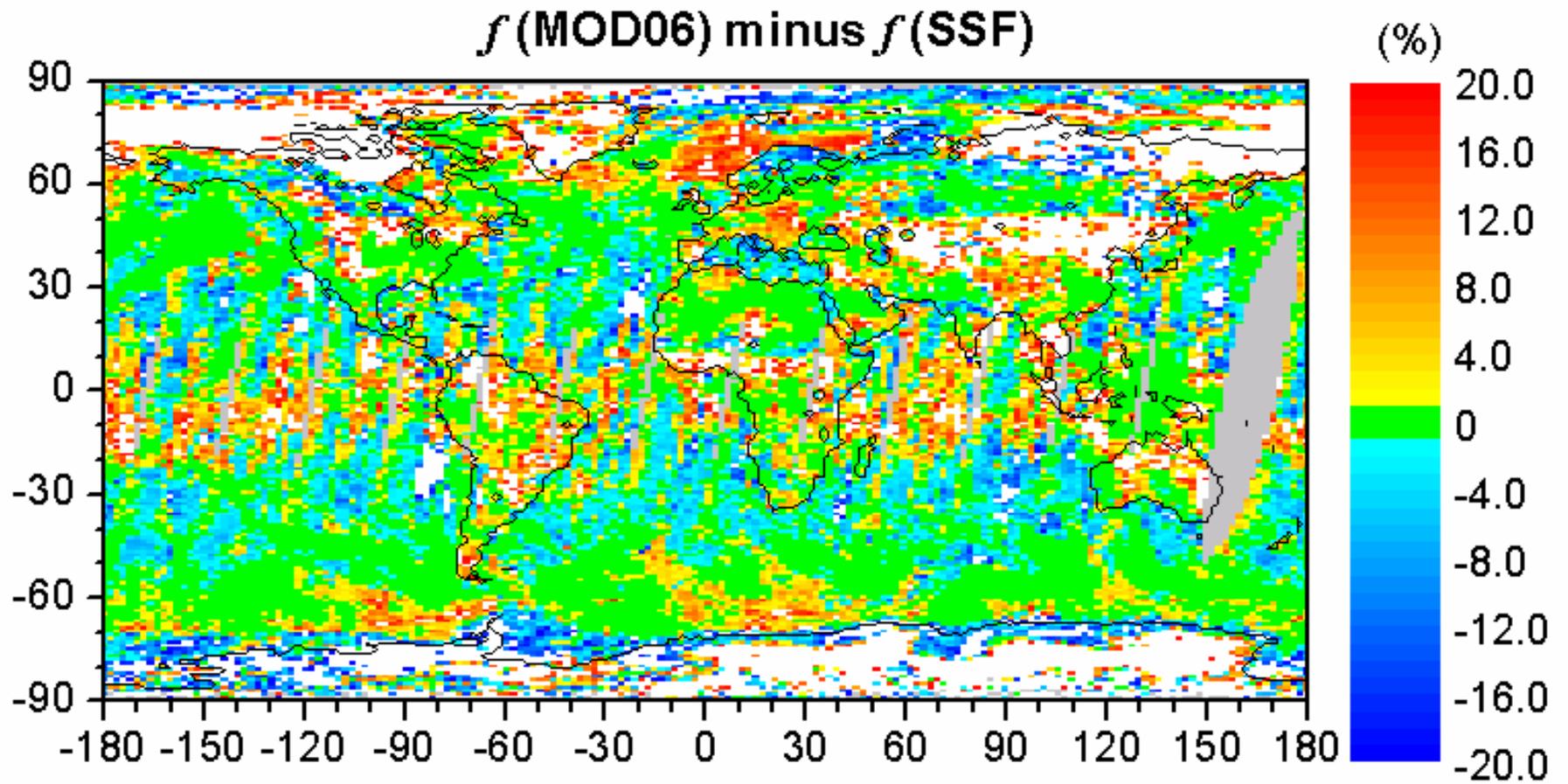


Note: Instantaneous TOA Flux Averages in $1^{\circ} \times 1^{\circ}$ regions.

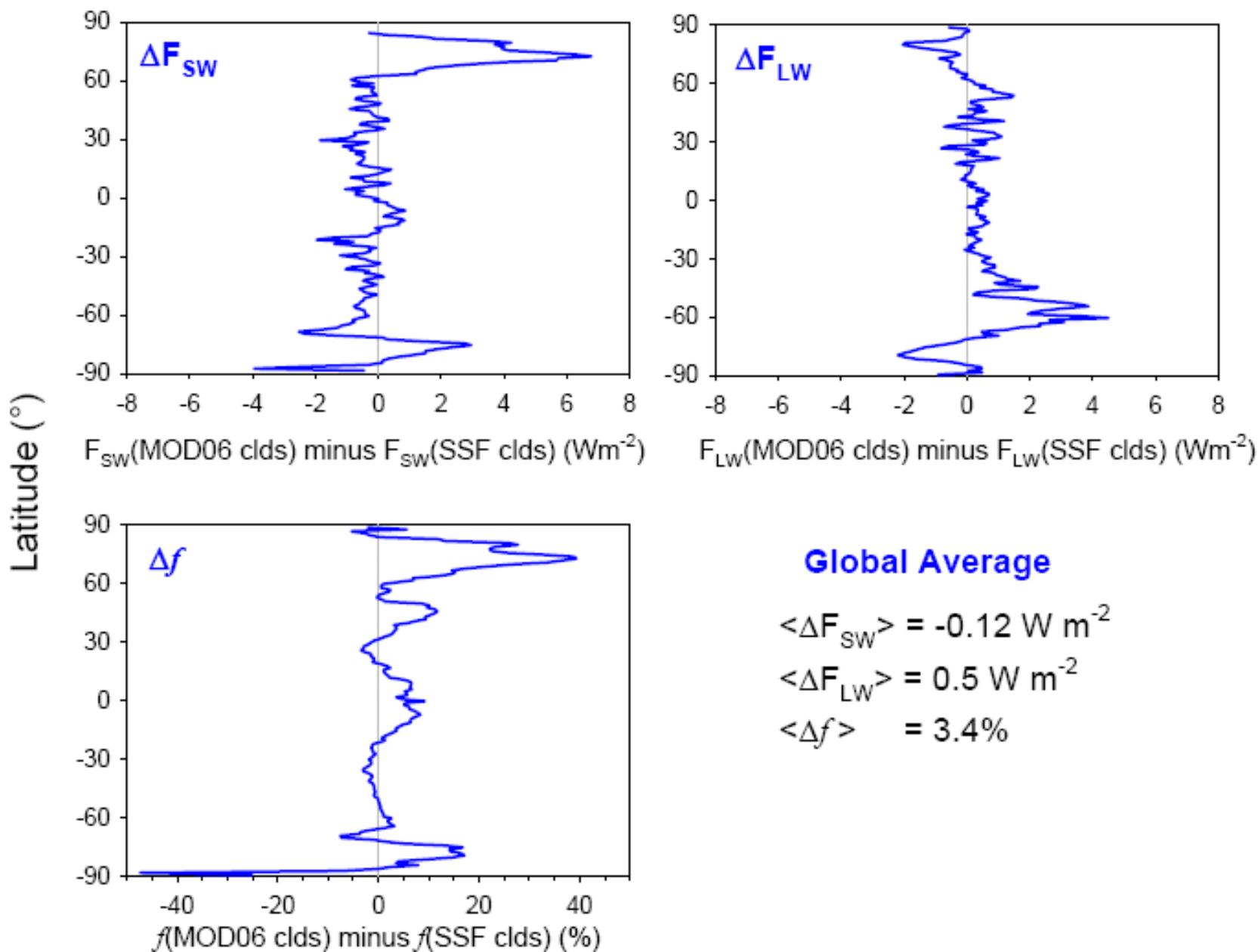
LW TOA Flux Difference



Cloud Fraction Difference

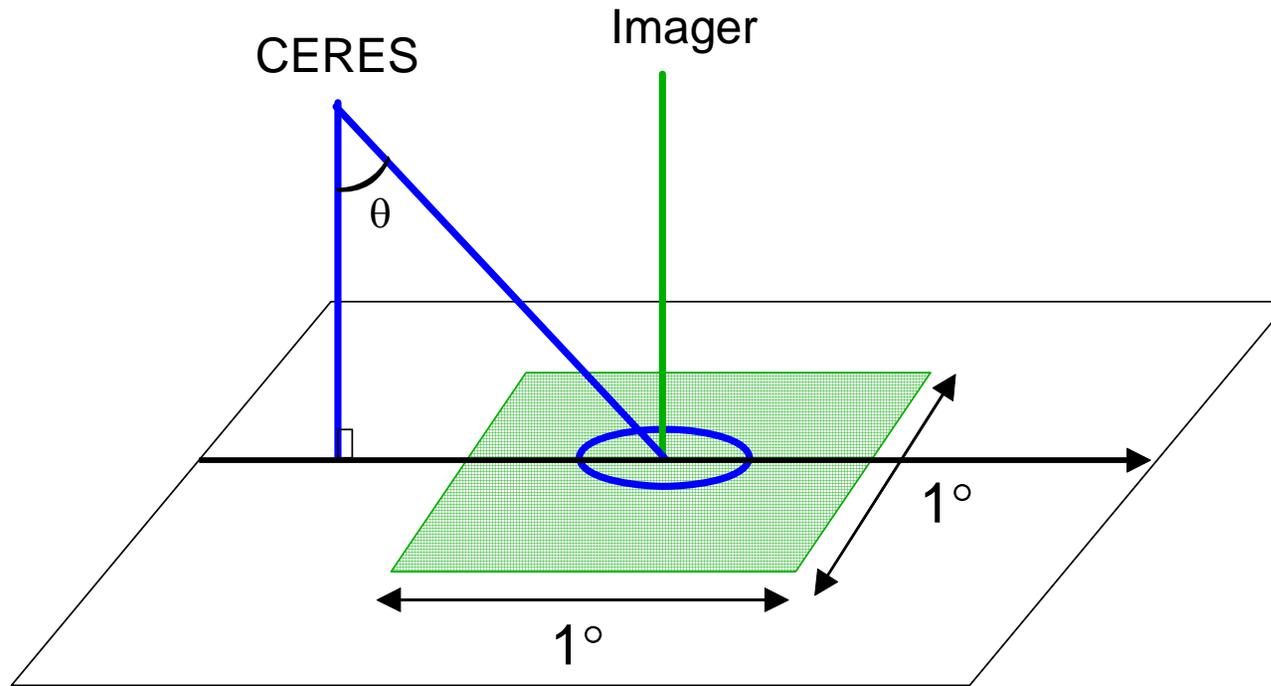


Zonal Average Differences



Clear Ocean Instantaneous TOA Flux Uncertainty

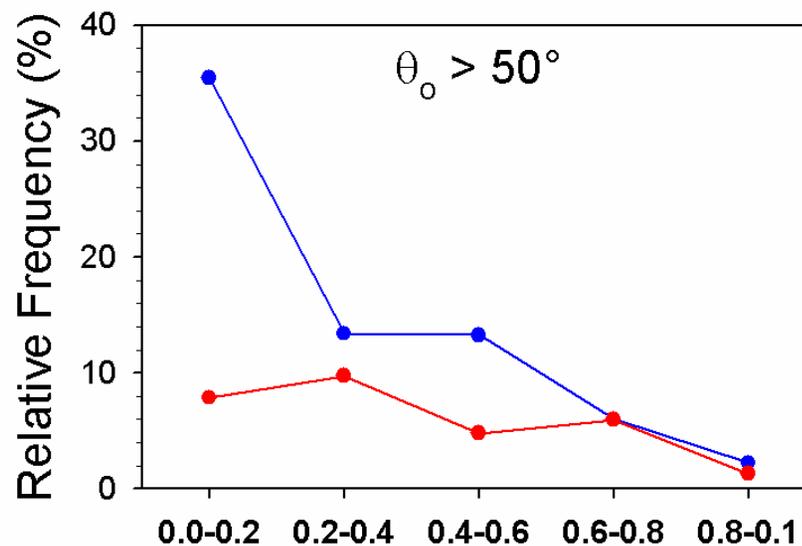
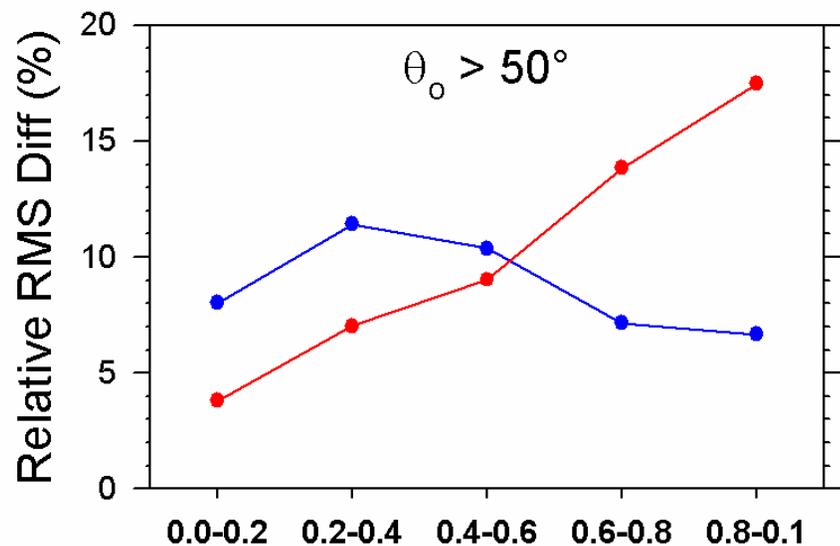
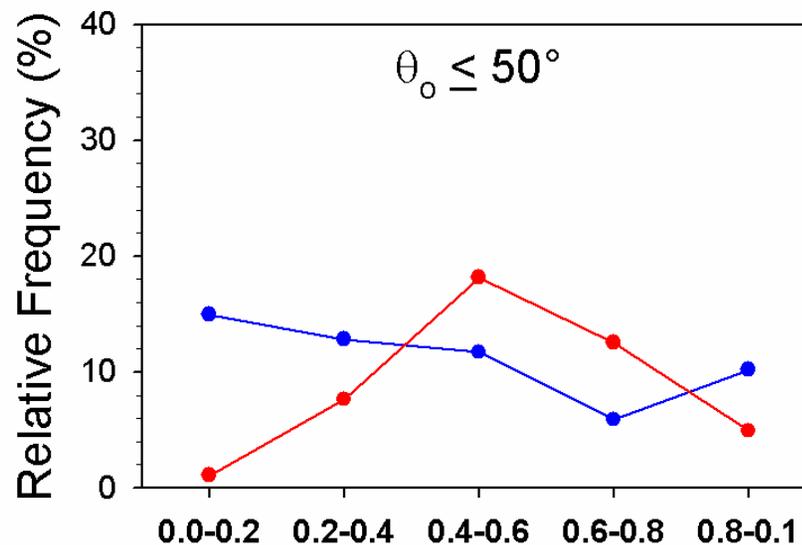
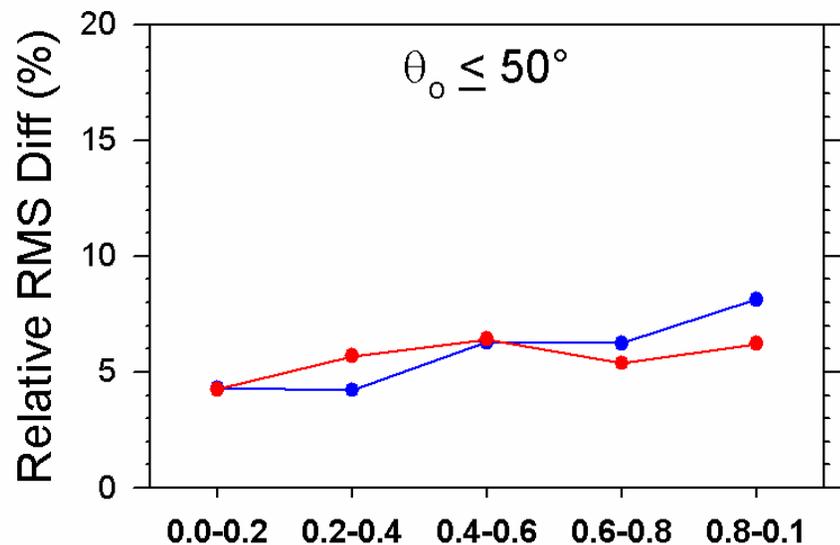
Instantaneous TOA Flux Consistency Tests



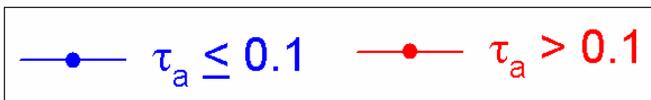
- Convert imager nadir visible radiance to broadband flux
- Compare off-nadir CERES flux with nadir flux inferred from imager visible radiance.

$$\text{Consistency} = [F(\theta=50^\circ-60^\circ) - F(\text{Nadir})] / F(\text{Nadir}) \times 100\%$$

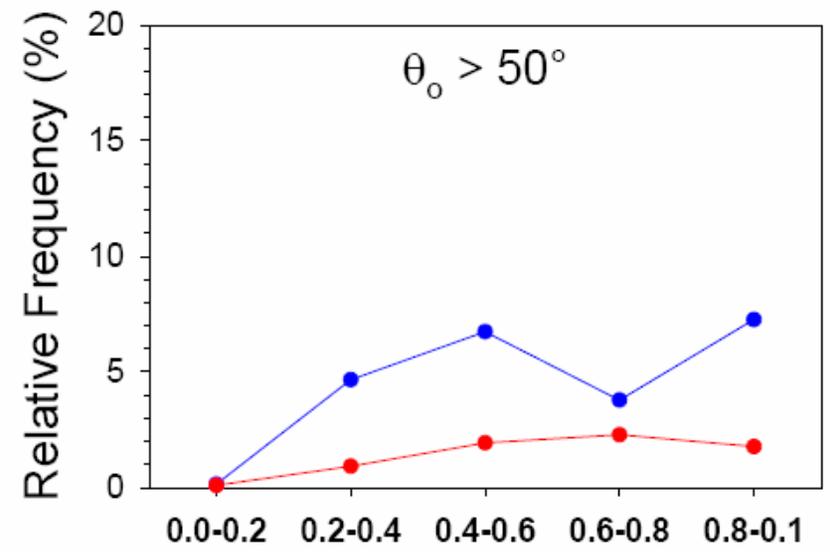
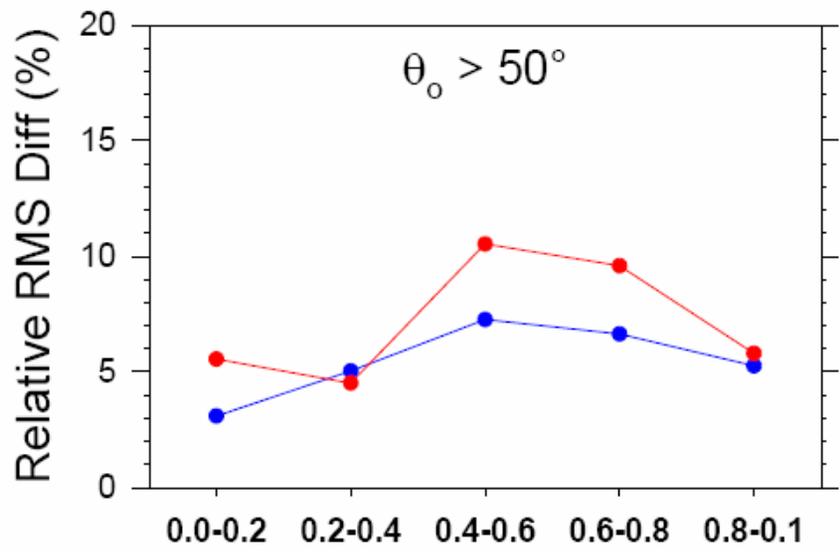
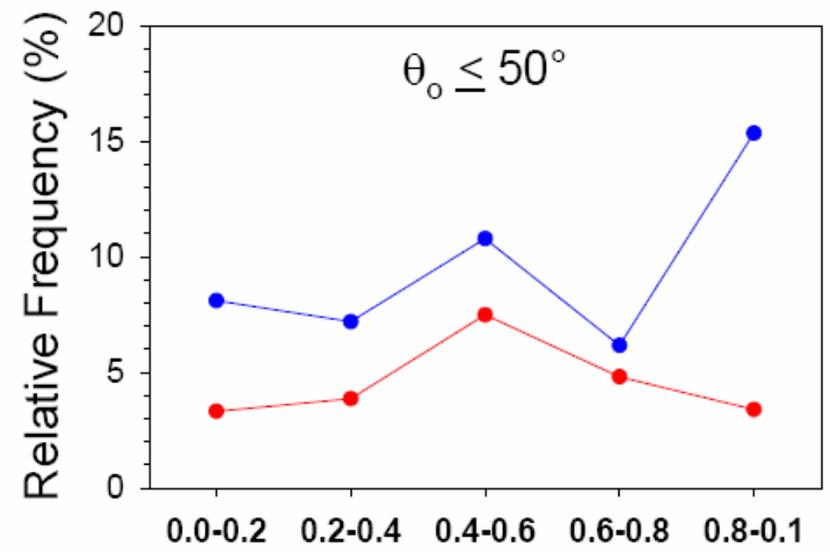
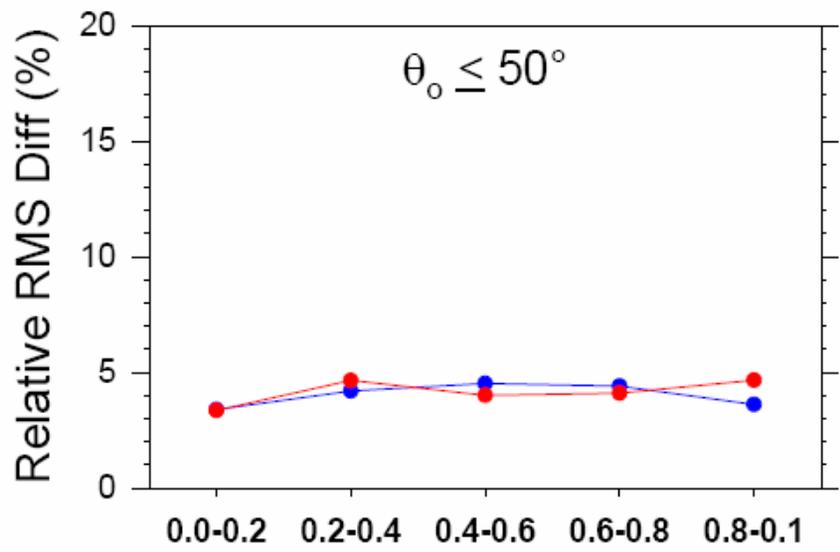
Clear Ocean SW TOA Flux Consistency vs Aerosol Fine Mode Fraction



0.55 μm Aerosol Fine Mode Fraction

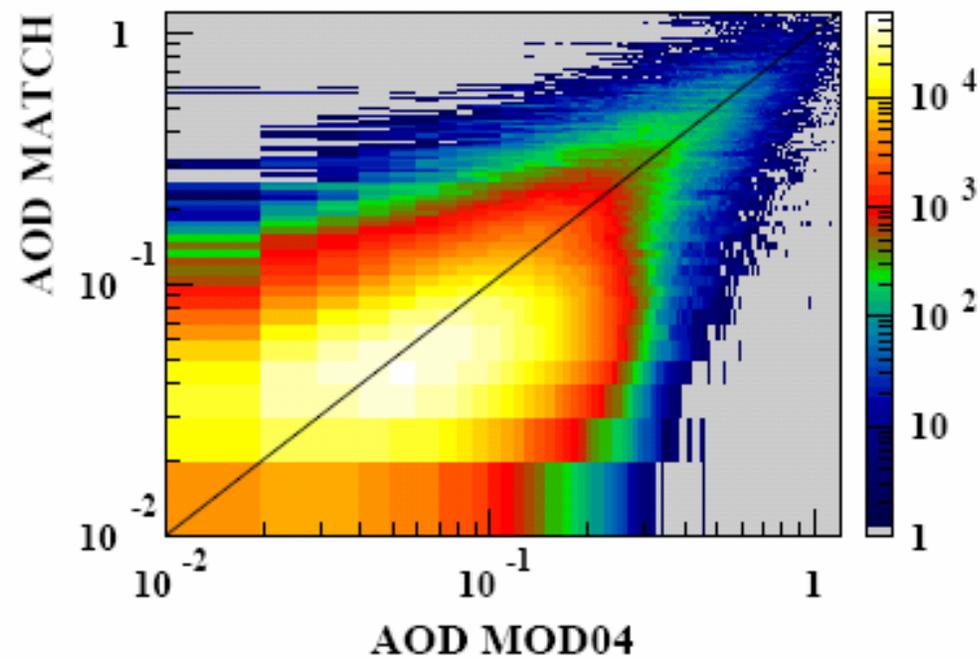
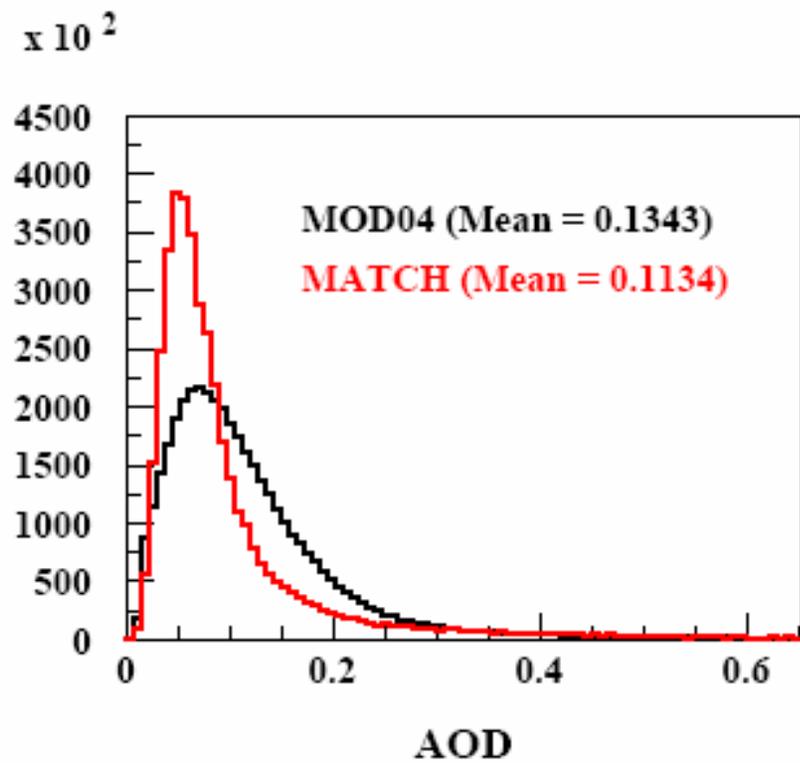


Clear Ocean SW TOA Flux Consistency vs Aer. FMF - CERES-MODIS-MISR



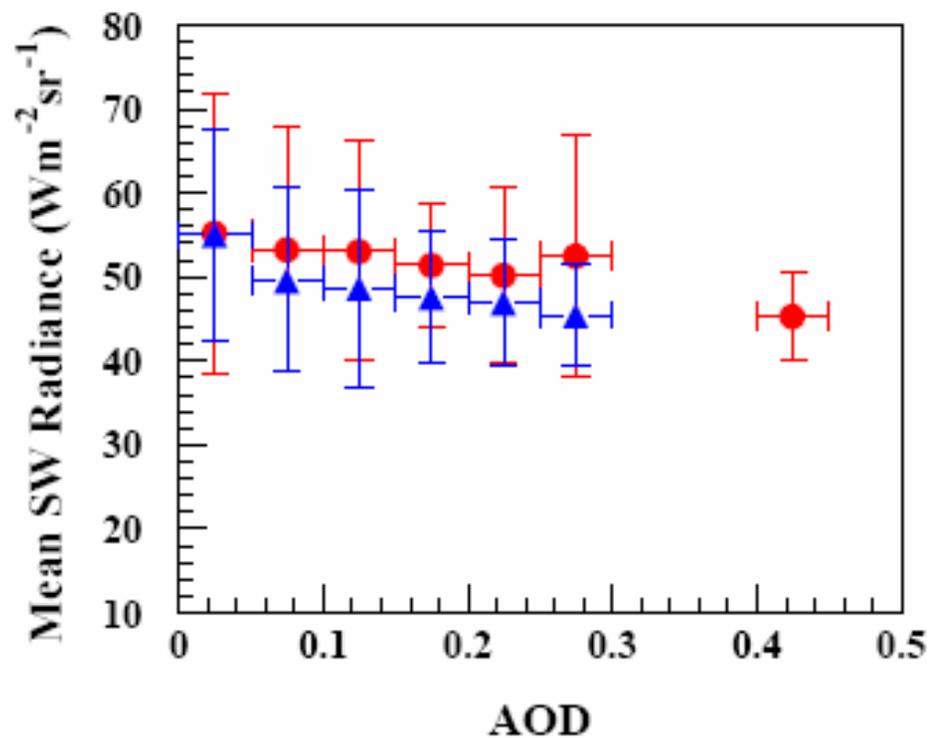
0.55 μm Aerosol Fine Mode Fraction



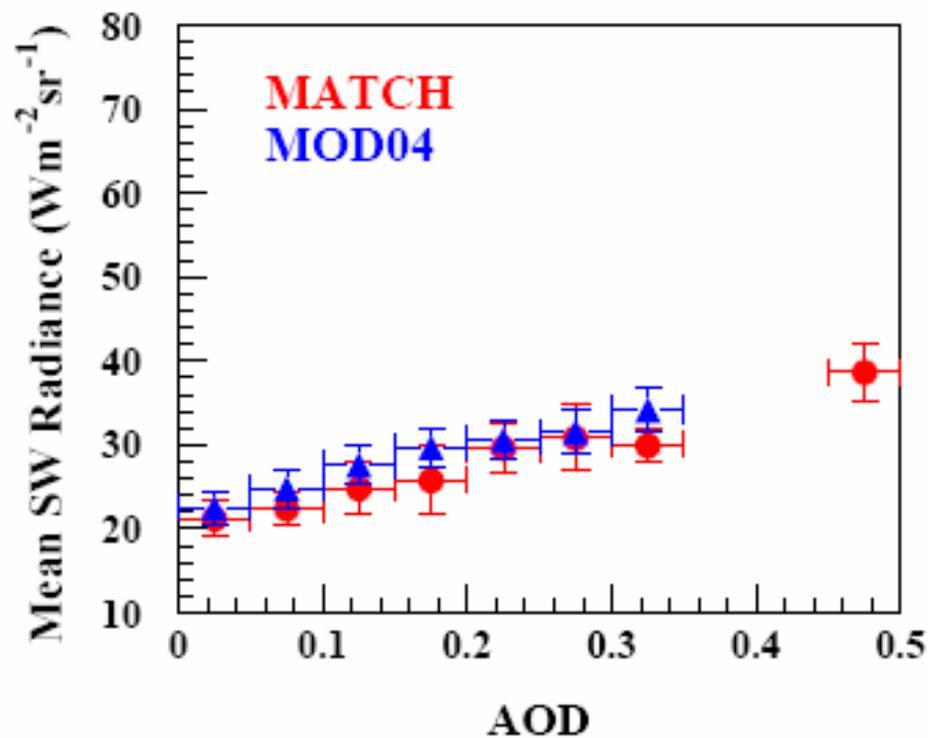


Clear Ocean CERES SW Radiance vs Aerosol Optical Depth

$\theta_o=30^\circ-40^\circ, \theta=30^\circ-40^\circ; \phi=0^\circ-10^\circ$



$\theta_o=30^\circ-40^\circ, \theta=50^\circ-60^\circ; \phi=80^\circ-90^\circ$



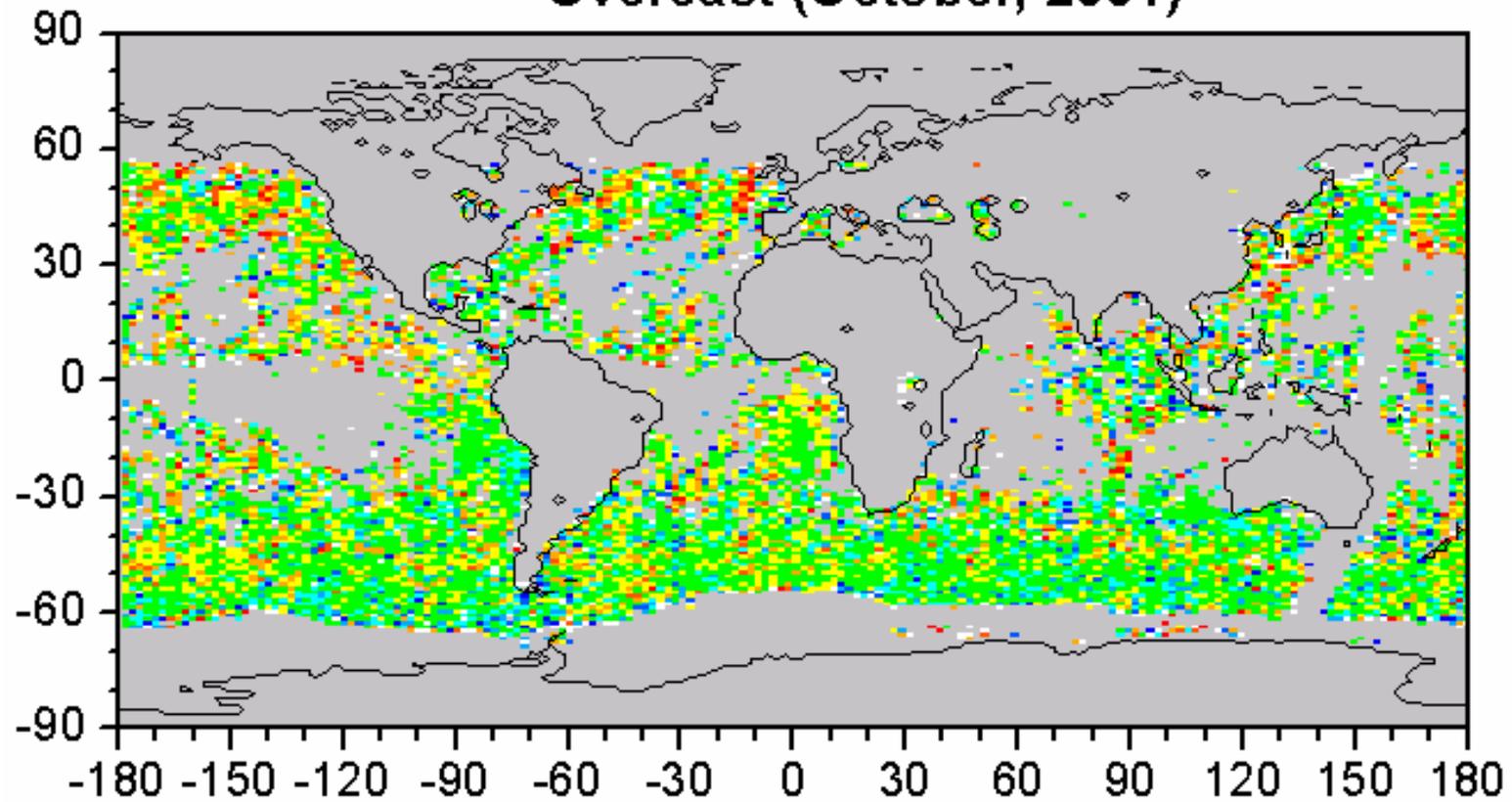
TOA Albedo Comparison between CERES & MISR

Narrow-to-Broadband MISR TOA Albedo

- Use 25 days of merged CERES-MISR-MODIS data (SSF) for CERES alongtrack days (1 year).
- Derive narrow-to-broadband regressions between MISR and CERES radiances for each MISR angle by scene type (e.g., MODIS cloud fraction, cloud-top pressure, precipitable water).
- Use radiance narrow-to-broadband regressions to derive albedo narrow-to-broadband regressions.
- Convert Level-2 MISR TOA albedos to broadband.
- Compare gridded “broadband” MISR albedos with CERES crosstrack albedos within MISR swath ($\theta < \sim 30^\circ$).

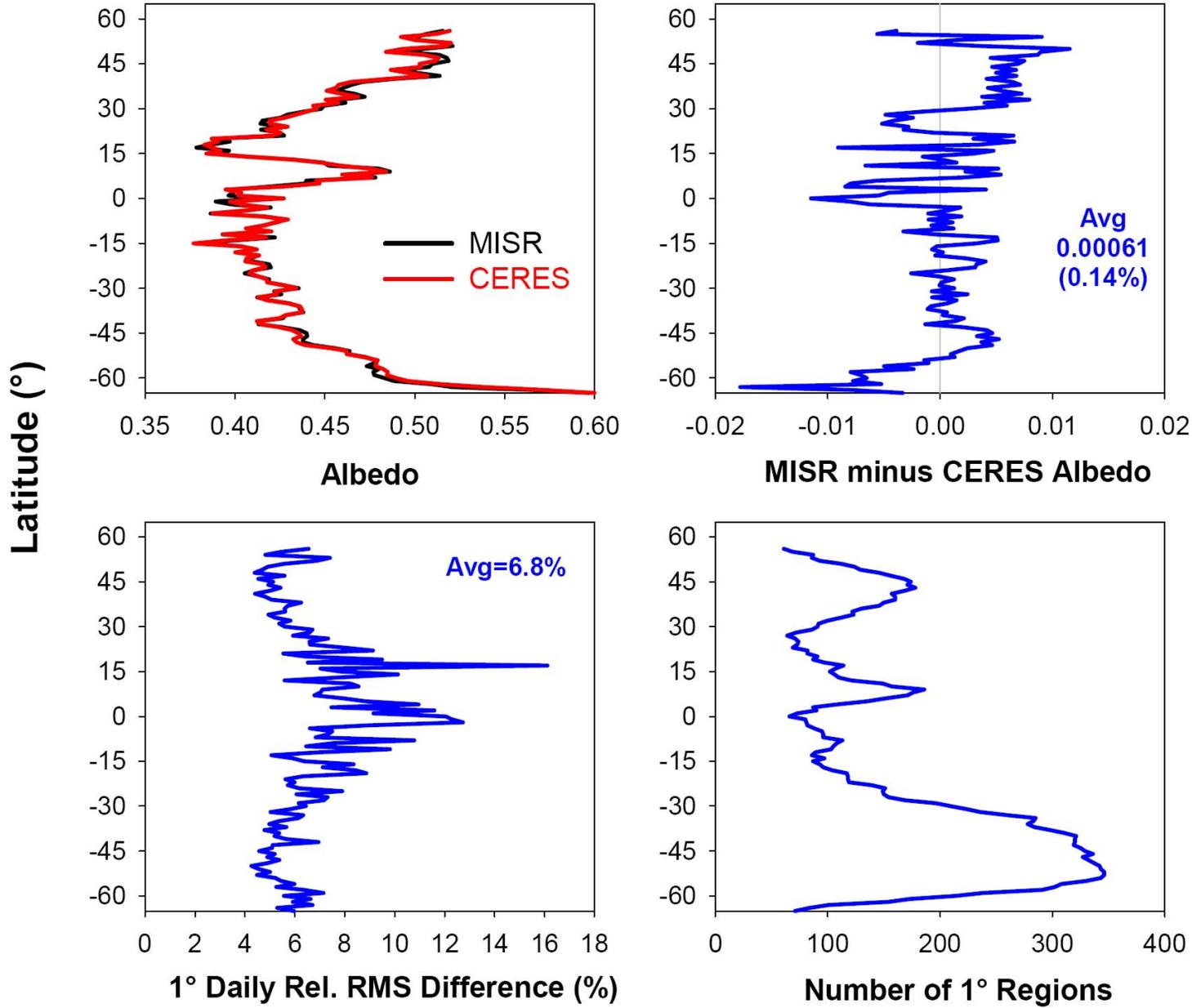
(See Wenbo Sun ADM WG presentation for more details)

**Albedo (MISR) minus Albedo (CERES)
Overcast (October, 2001)**



$\Delta\alpha$

MISR-CERES TOA Albedo Comparison (Overcast Ocean; October 2001)



Summary

- CERES SSF Edition3: ADM-related Issues
 - => Will use Ed2 ADMs for Edition3.
 - => Need to assess how this impacts TOA flux accuracy.
- TOA Flux Sensitivity to Cloud Algorithm Changes (MOD06 vs SSF):
 - => Greatest sensitivity in polar regions (up to 7 Wm^{-2} SW; 4 Wm^{-2} LW).
 - => Global average difference $< 0.2 \text{ Wm}^{-2}$ SW; 0.5 Wm^{-2} LW.
- Clear Ocean Instantaneous TOA Flux Uncertainty:
 - => Exploring use of MATCH AOD and aerosol type for clear ocean ADMs.
 - => Need to revisit clear ocean TOA flux consistency vs fine-mode fraction results with more data.
- MISR-CERES TOA albedo comparison for overcast conditions:
 - => 60°S - 60°N Albedo relative difference $< 0.15\%$.
 - => 1° daily relative RMS difference = 6.8% .
 - => No apparent systematic regional or latitudinal biases.
 - => Next: clear, broken, all-sky.