

CERES and Model Comparisons Over Ocean and Snow

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3rd CERES-II Meeting
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Compare TOA Shortwave radiance and flux between CERES and model over the **brightest** (snow) and **darkest** (ocean) surfaces for clear and overcast conditions respectively. (extreme albedo but uniform).

CERES data used : CRS Edition 2B

Model used: COART (Coupled Ocean-Atmosphere Radiative Transfer)



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Date for CERES data (3 days in three years):

May 1-3, 2000-2002.

$30 < \text{Latitude} < 70$ (north and south) for ocean surface.

$\text{Latitude} > 75^\circ$ (Arctic) for snow surface.

Based on climatology, Arctic snow in early May is thickest but un-melted yet.



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CERES data selection criteria for clear sky:

- 1). *Clear fraction = 100%*
- 2). *Relative STD of imager radiance < 4%*

CERES data selection criteria for cloudy sky:

- 1). *Clear fraction = 0%*
- 2). *Relative STD of imager radiance < 6%*
- 3). *Cloud type: water*
- 4). *Cloud Tau > 8.*
- 5). *10 μm < RE < 14 μm*



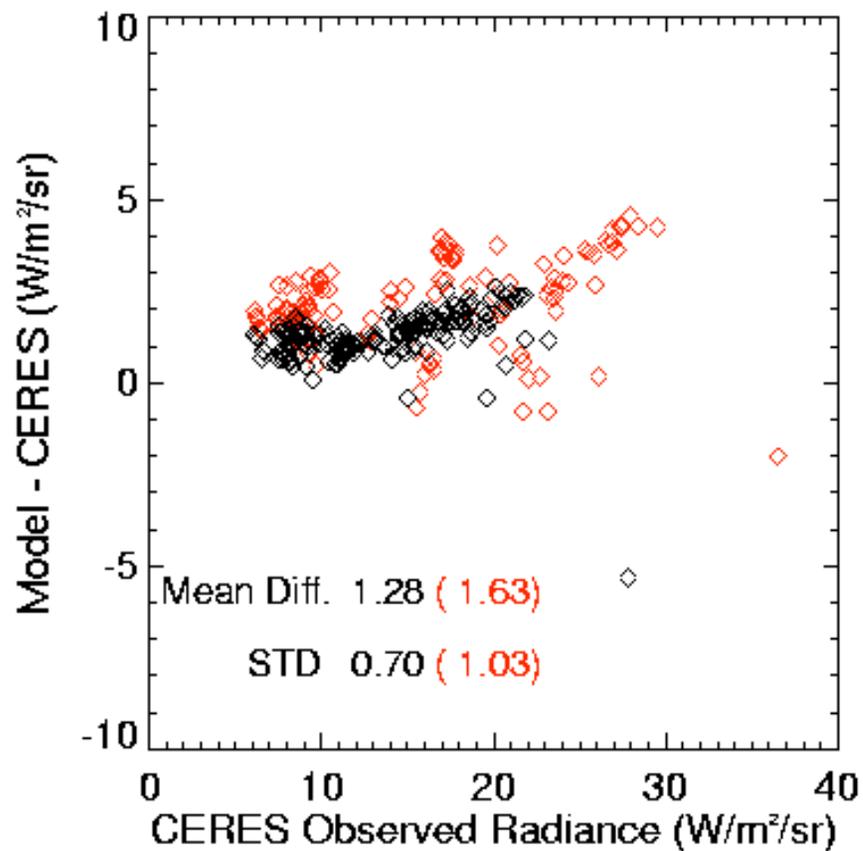
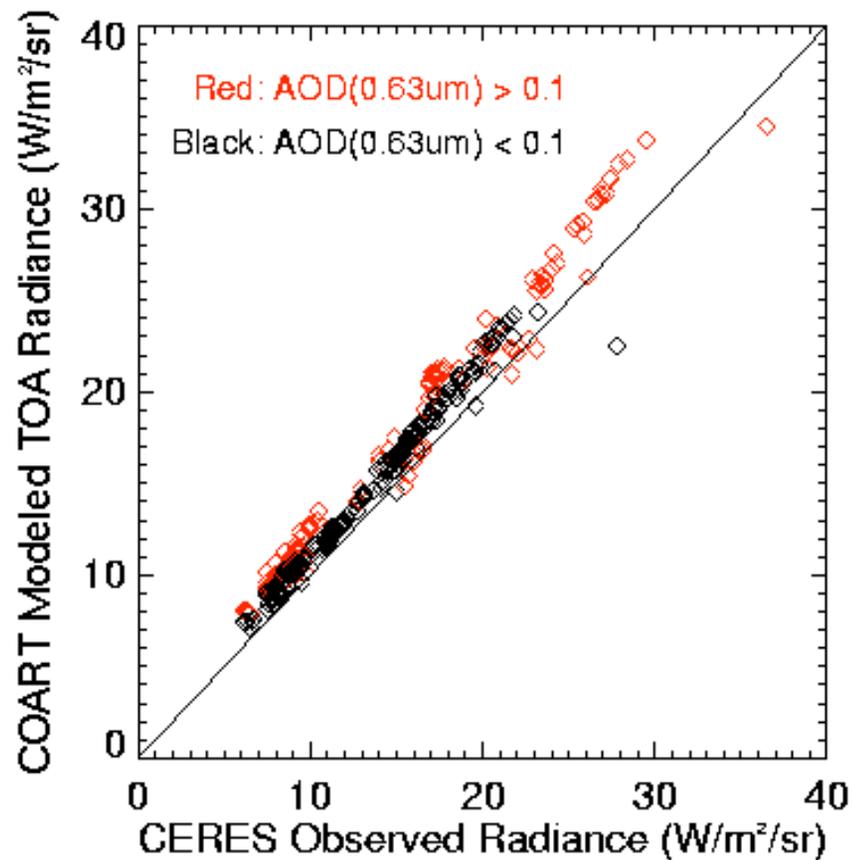
Other criteria:

- 1). *Wind speed < 15 m/s for clear ocean*
- 2). *T_surface < 270°K for snow surface*
- 3). *Surface type must be 100% water or snow*

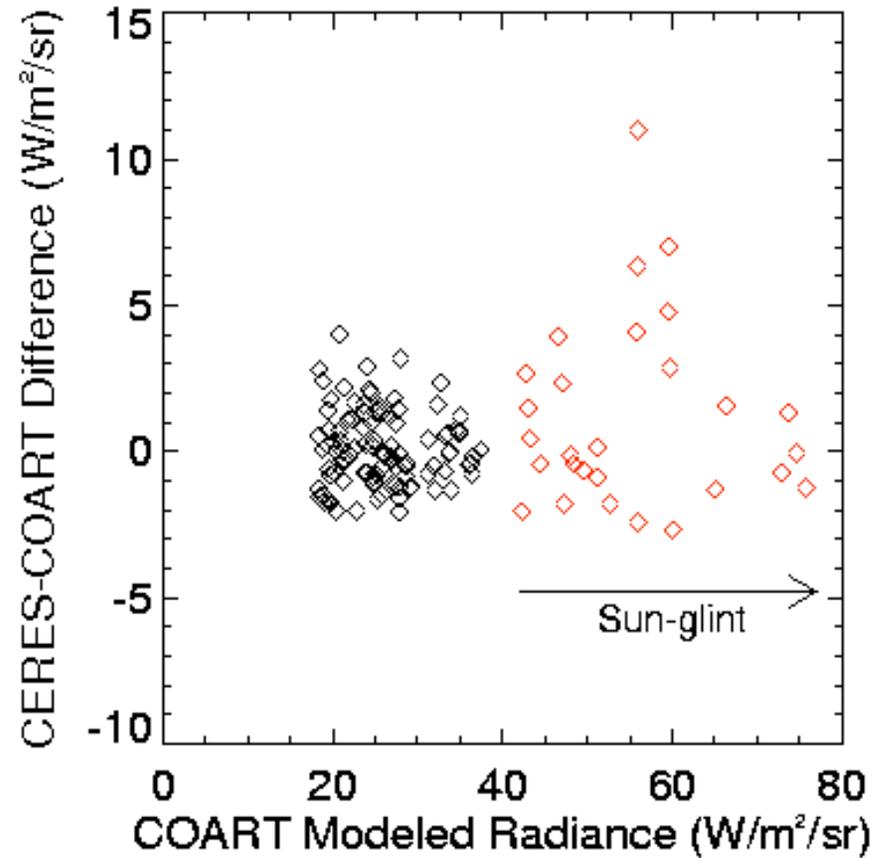
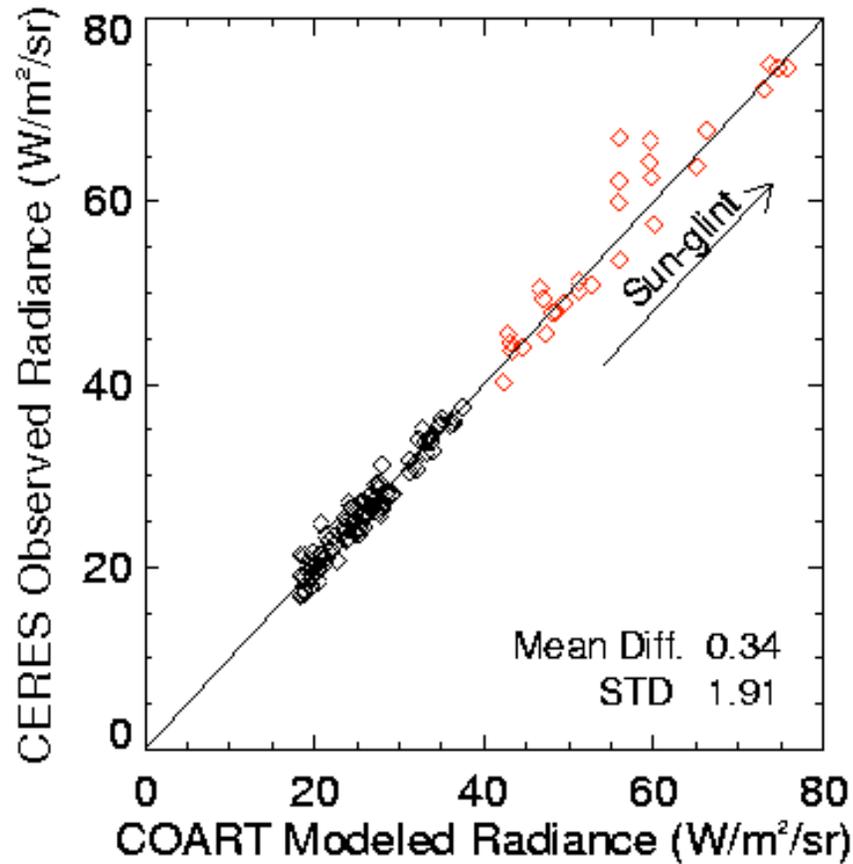
Total PW, cloud properties (Tau, Re, height), AOD (0.63um) and wind speed for model input are from CERES data; others are based on standard atmospheric models.



CERES-Model TOA SW Radiance Comparison Over Ocean (Clear Sky)



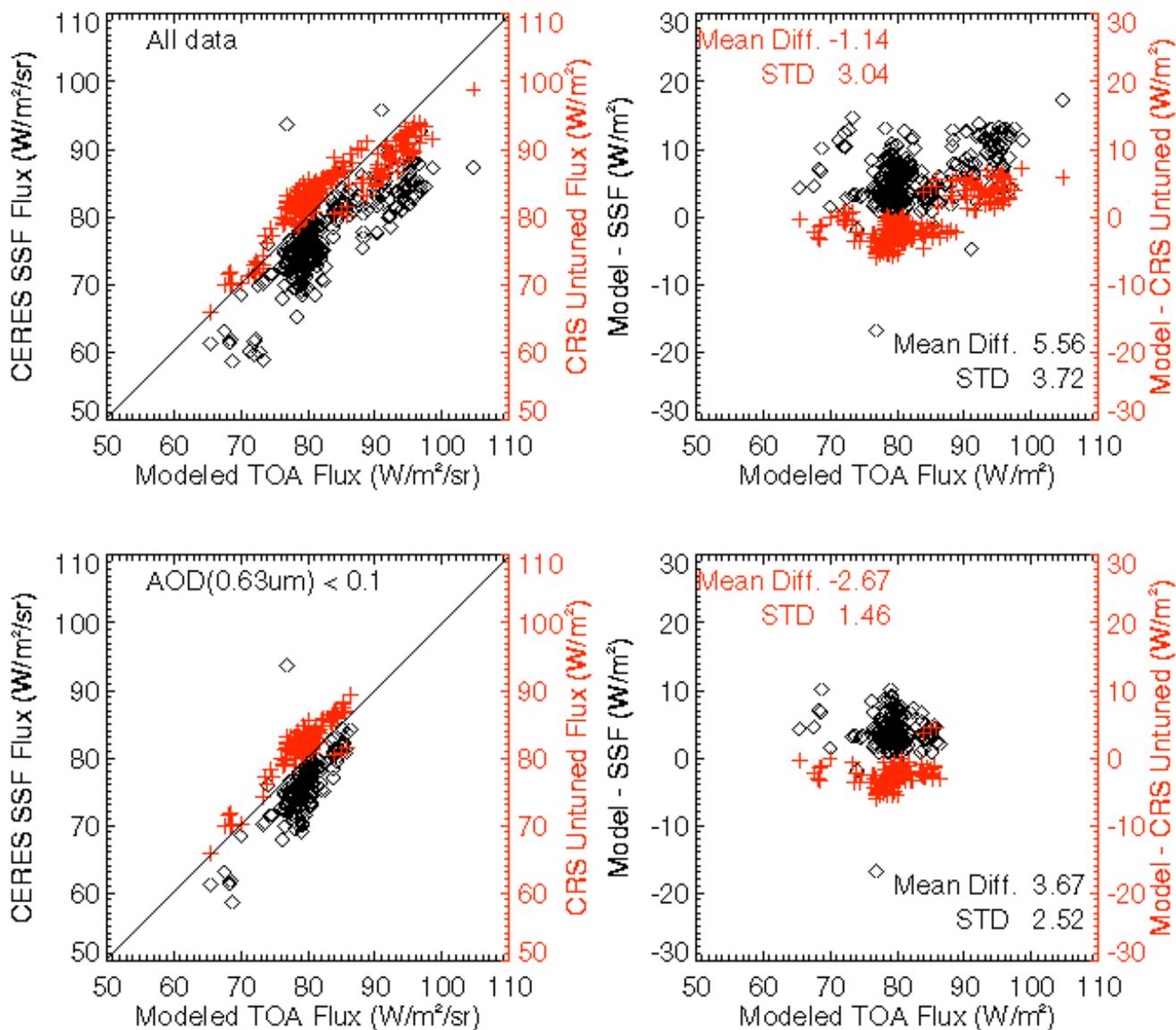
CERES-Model SW Radiance Comparison for CLAMS (July, 2001)



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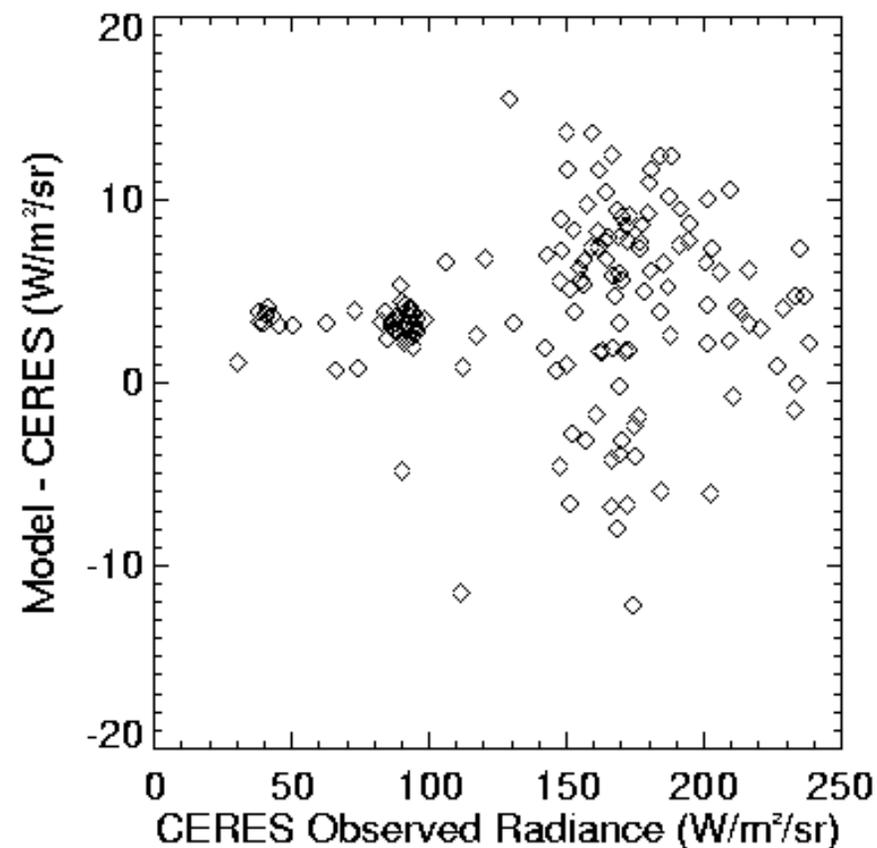
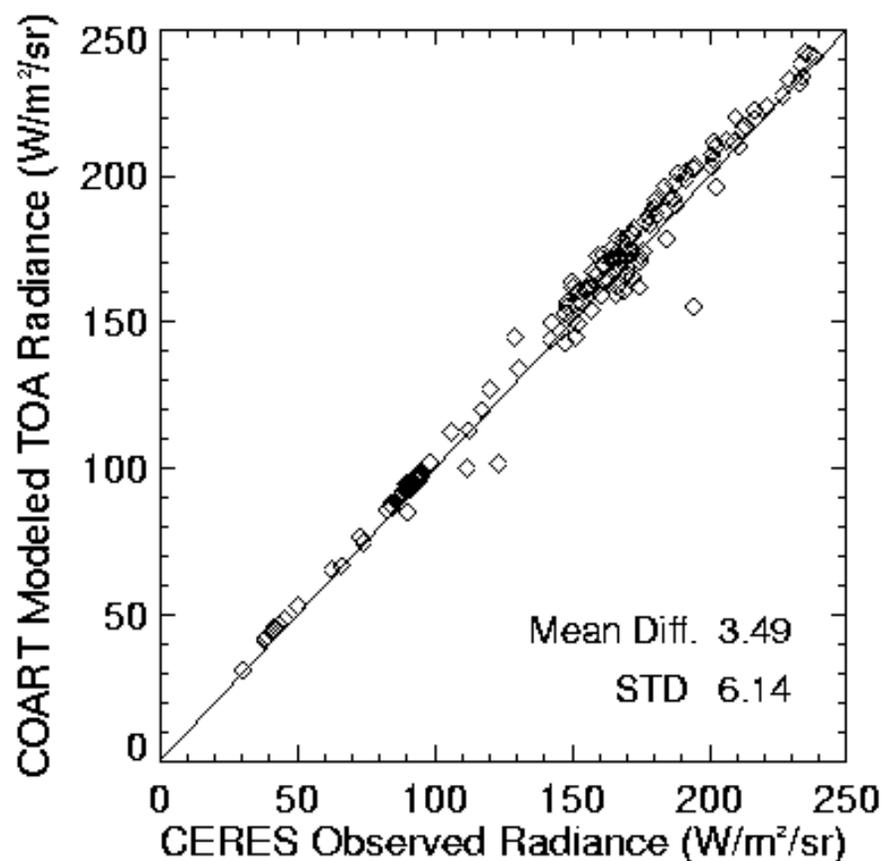
CERES-Model TOA SW Flux Comparison Over Ocean (Clear Sky)



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CERES-Model SW Radiance Comparison Over Ocean (Cloudy Sky)



Water cloud; Cloud Tau, height, Re , and phase are from SSF data.

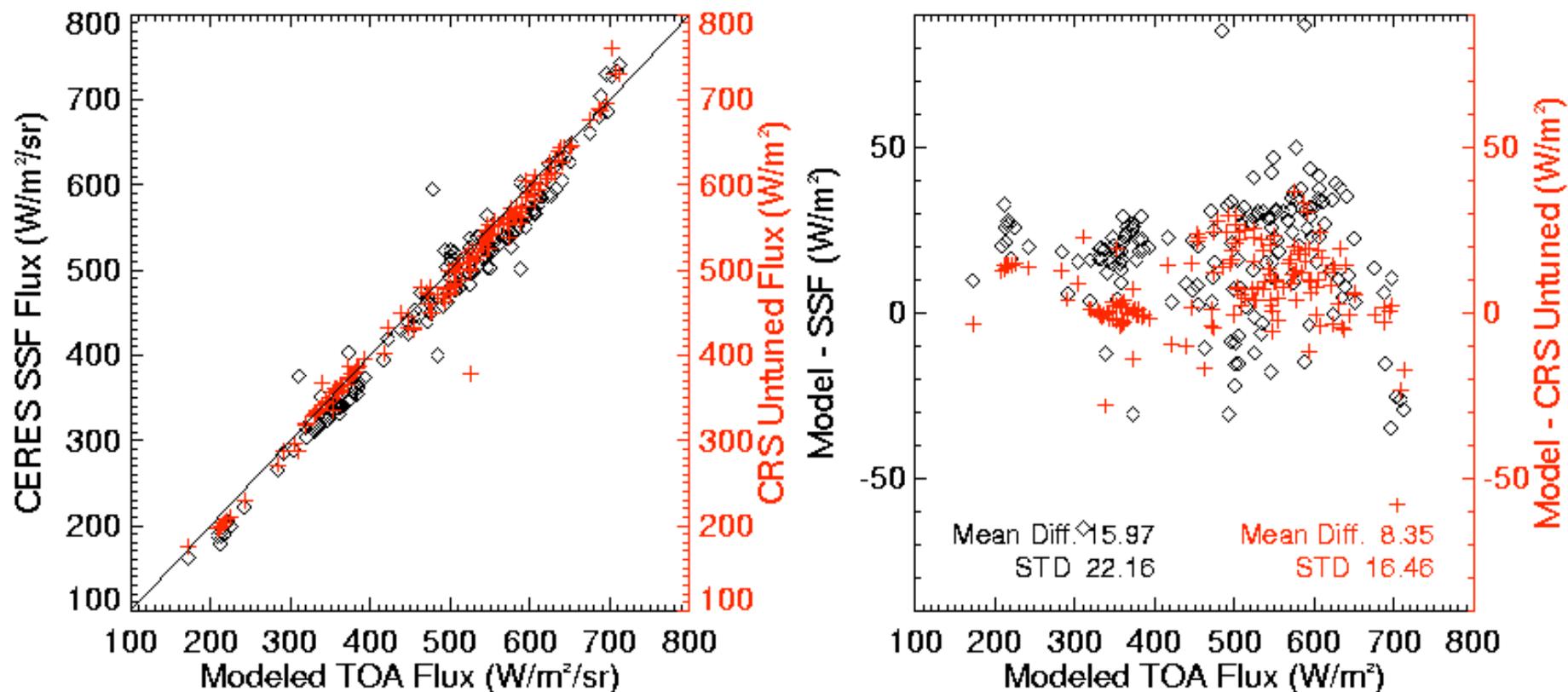
Tau > 10, $10\mu m < Re < 14\mu m$, Cloud fraction = 100.



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CERES-Model Toa SW Flux Comparison Over Ocean (Cloudy Sky)



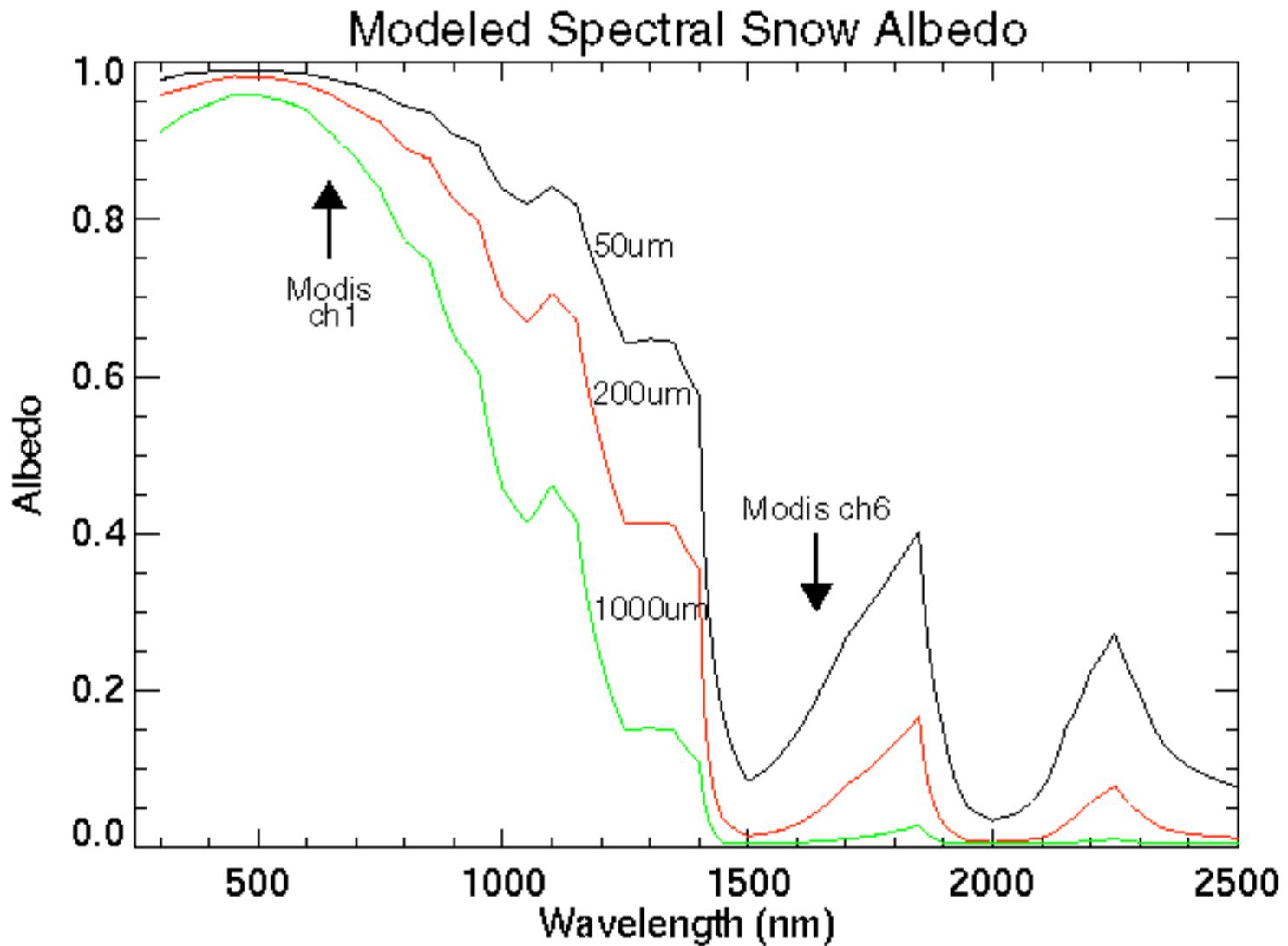
Water cloud; Cloud Tau, height, Re, and phase are from SSSF data.

Tau > 10, 10 μ m < Re < 14 μ m, Cloud fraction = 100.



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Snow surface albedo is determined mainly by these snow properties:

⌘ *Grain size*

⌘ *Soot contamination*

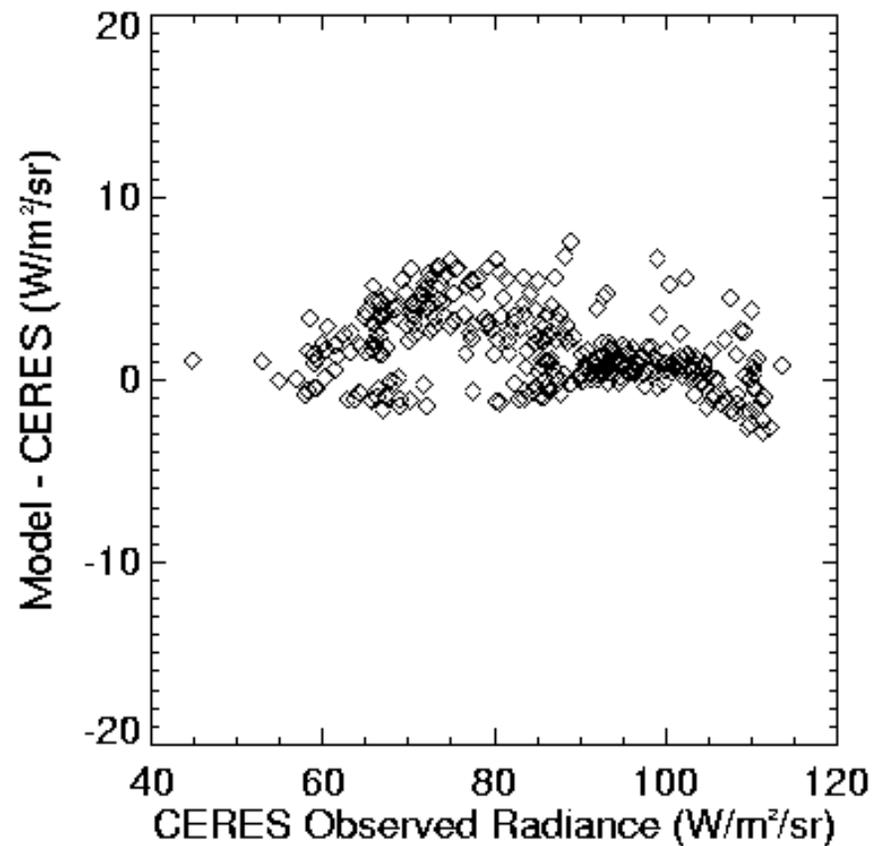
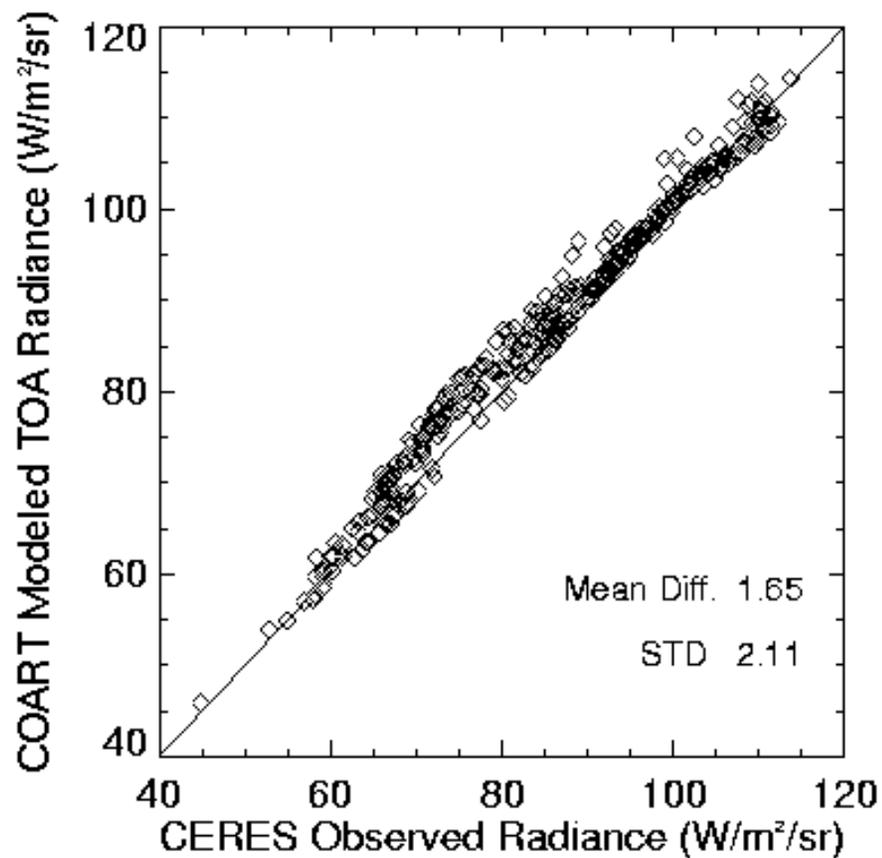
⌘ *Thickness*

Due to high extinction, only few centimeters of snow could be considered as optically semi-infinite.

Aerosol, cloud, and solar zenith angle also affect snow surface albedo.



CERES-Model SW Radiance Comparison Over Snow (Clear Sky)



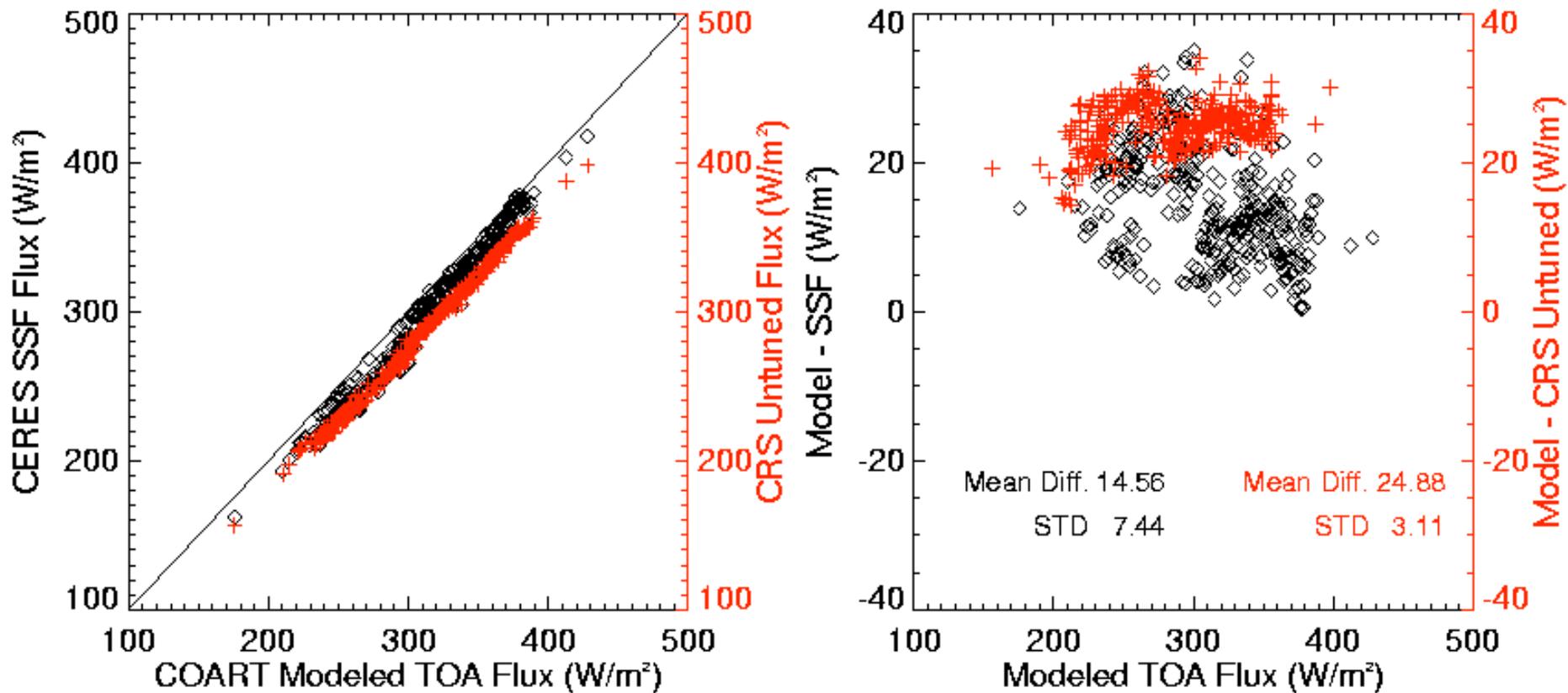
Latitude $> 75^\circ$; May 1-3



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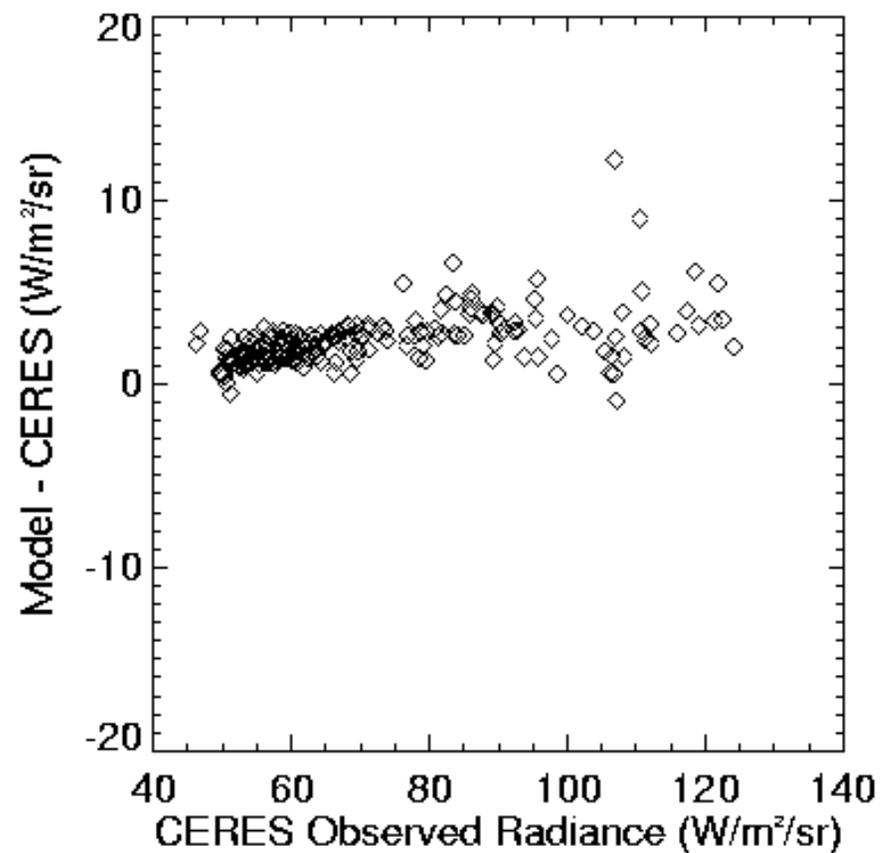
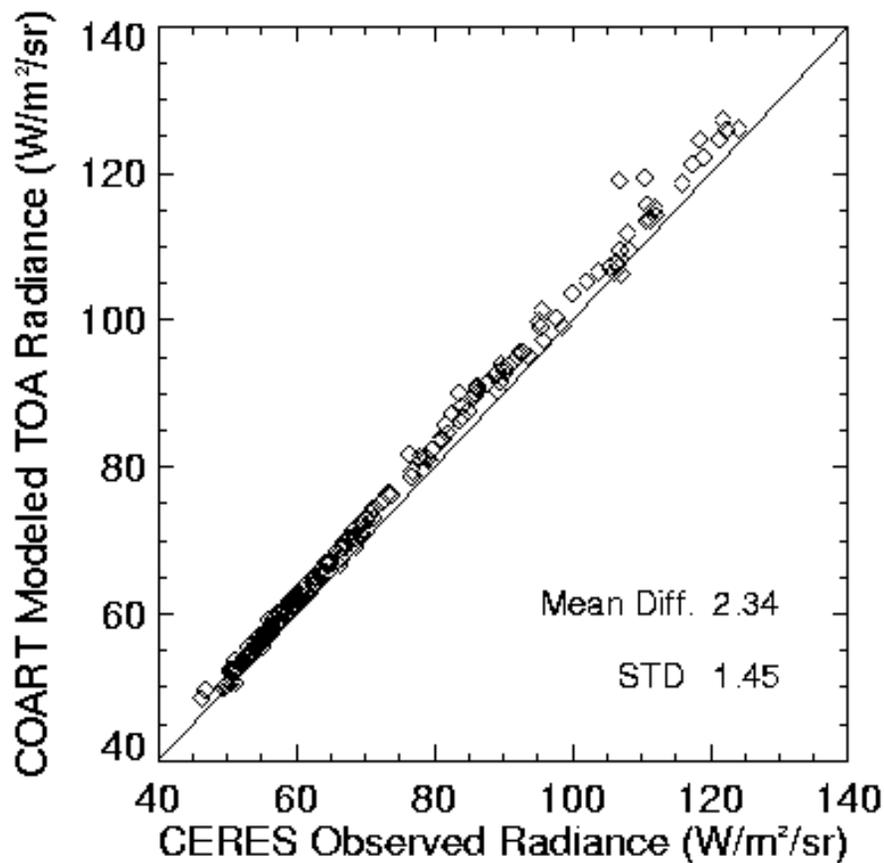
TOA SW Flux Comparison Over Snow (Clear Sky)



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CERES-Model SW Radiance Comparison Over Snow (Cloudy Sky)



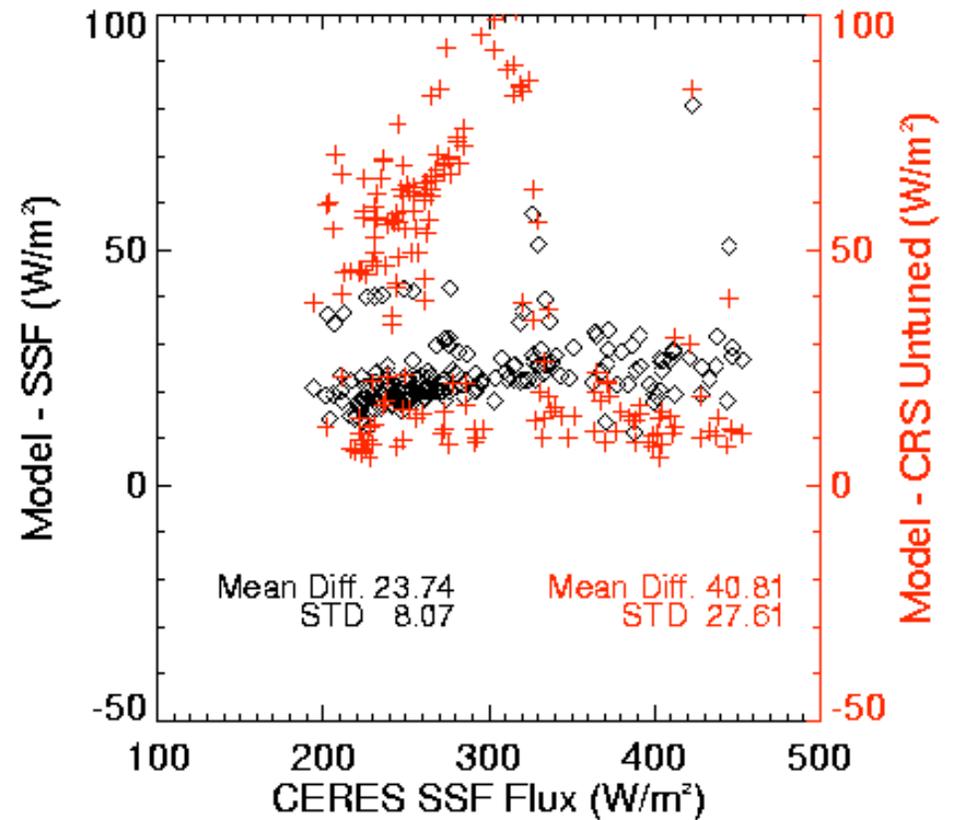
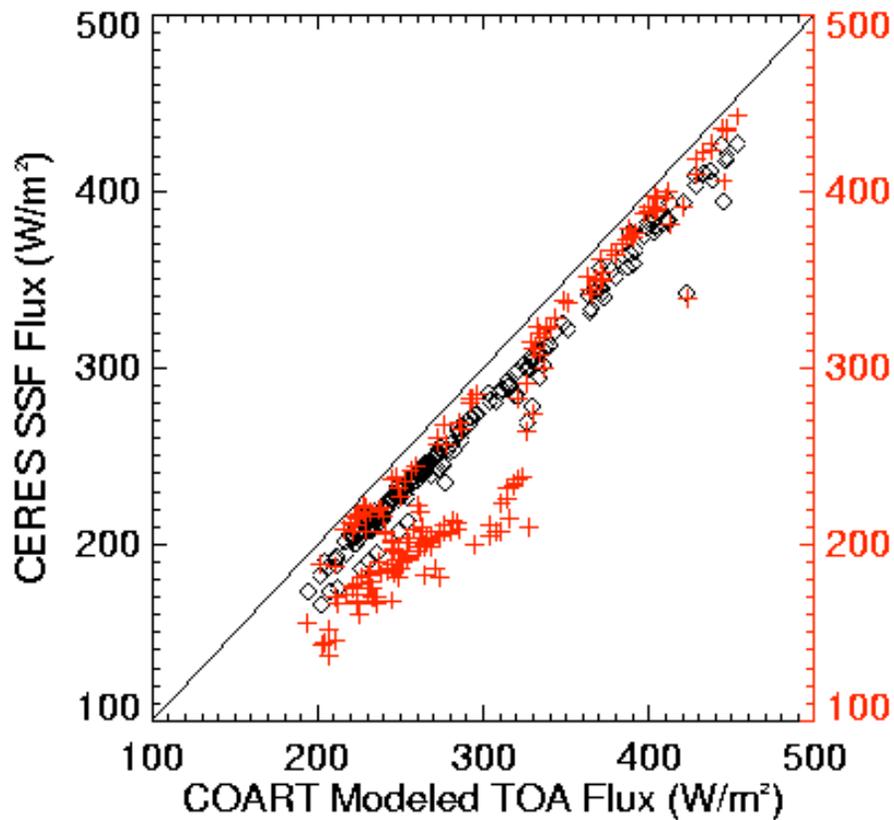
Latitude > 75°; May 1-3



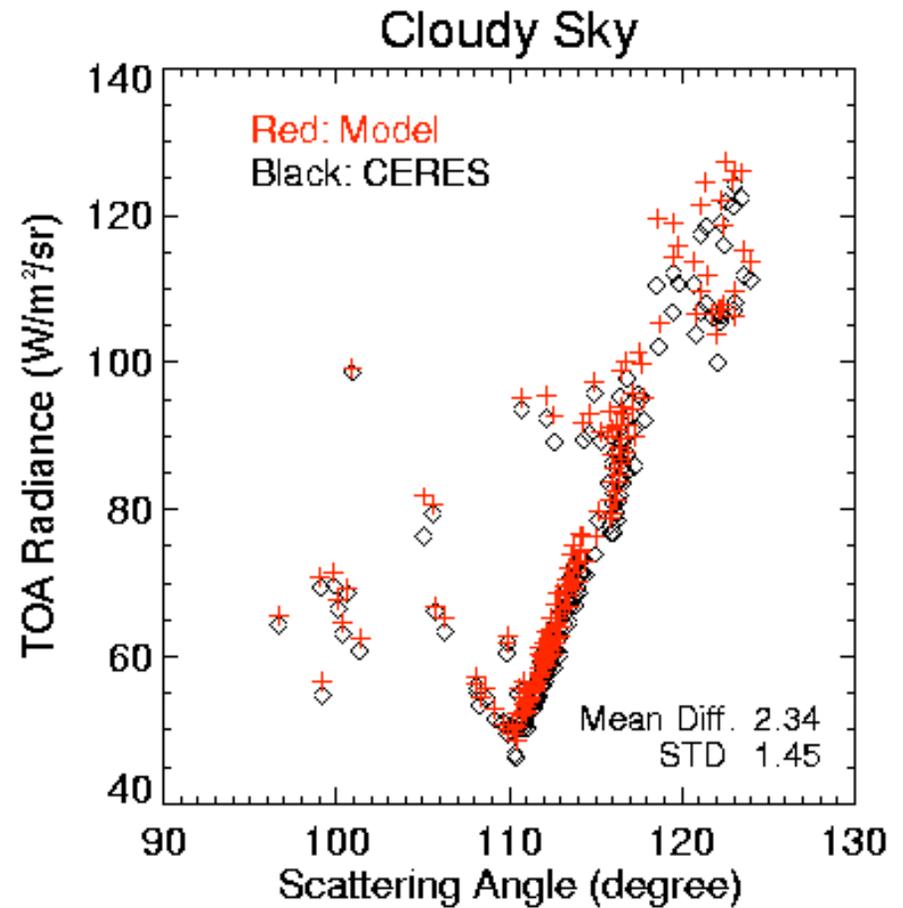
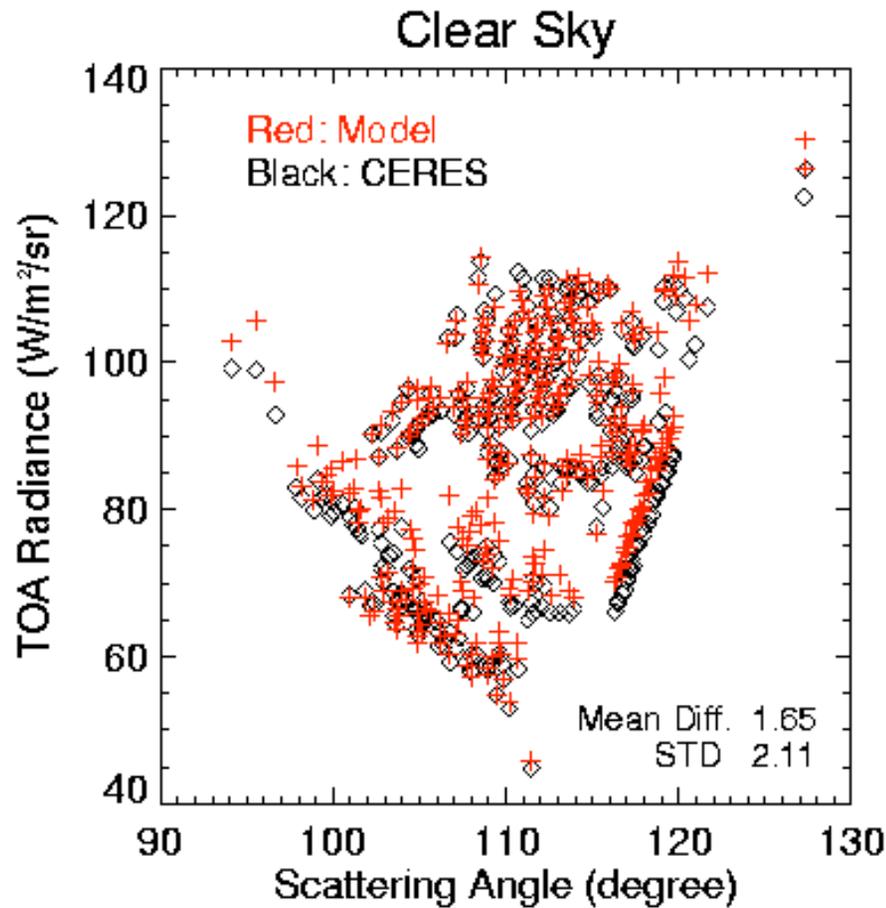
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TOA SW Flux Comparison Over Snow (Cloudy Sky)



TOA SW Radiances Over Snow Versus Scattering Angle



Differences of CERES and Model for TOA Radiances and Fluxes

			Clear sky			Cloudy sky		
			Mean	Std	RMS (#%)	Mean	Std	RMS (#%)
Ocean	Rad.	Model-CERES	1.28	0.70	1.46 (9.9%)	3.49	6.14	7.04 (4.7%)
	Toa Flux	Model - SSF	3.67	2.52	4.44 (5.6%)	15.97	22.16	27.26 (5.6%)
		Model - CRS	-2.67	1.46	3.04 (3.8%)	8.35	16.46	18.41(3.8%)
Snow	Rad.	Model-CERES	1.65	2.11	2.68 (3.1%)	2.34	1.45	2.75 (3.7%)
	Toa Flux	Model - SSF	14.56	7.44	16.34 (5.3%)	23.74	8.07	25.07 (8.6%)
		Model - CRS	24.88	3.11	25.08 (8.1%)	40.81	27.61	49.2 (16.9%)



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Summary

- CERES SW radiances and fluxes over ocean and snow are compared with model for selected clear and cloudy conditions.
- The relative RMS differences between CERES SW radiance and model are less than 5%, except for the clear ocean case (9.9%). The differences between CRS SW flux and model are less than 4% over ocean, but they are larger over snow.
- The difference is likely due to the aerosol absorption over ocean and due to both the aerosol and surface albedo over snow.
- More constraints for model input are required for more accurate calculations, most importantly, the aerosol absorption and surface albedo.

