

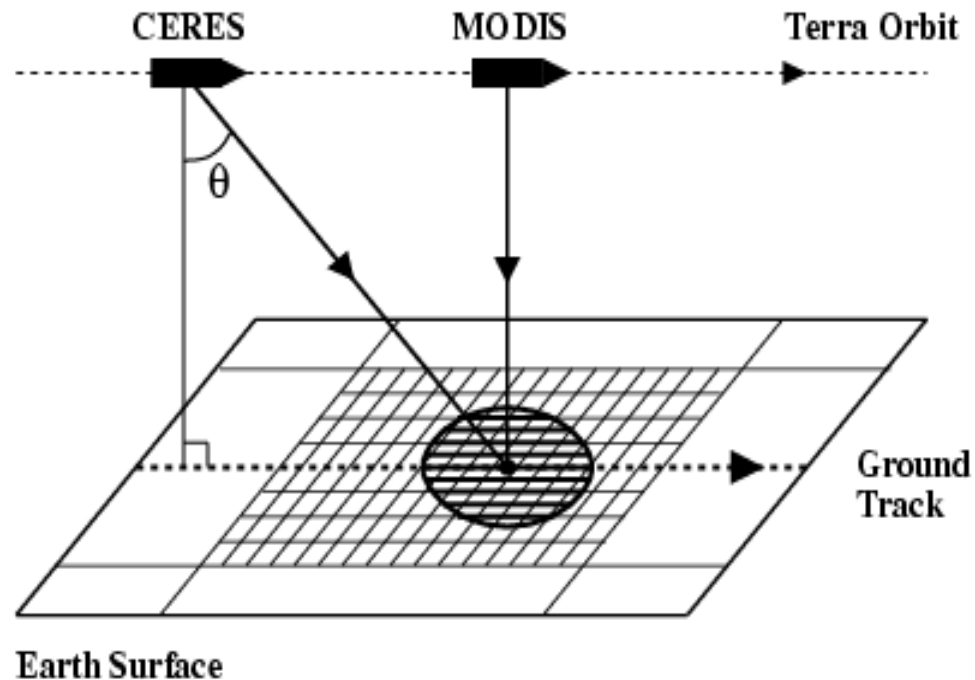
CERES/Terra Instantaneous TOA Flux Consistency

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CERES and MODIS Geometry for Along-Track Data



Analysis Steps

- Making a list of uniform scene regions using 79 days of CERES/Terra along-track data.
- Making narrow-to-broadband fits using corresponding cross-track data (FOVs are matched within 3 minutes).
- Processing along-track data twice:
 1. Converting MODIS narrowband into broadband radiance and into near-nadir flux;
 2. Adding random Gaussian noise to CERES radiance (sigma = narrow-to-broadband STD fit).
- Final error analysis (FOV Level, CERES – MODIS VZA difference: from 50° to 60°).

SSF Cloud Classification

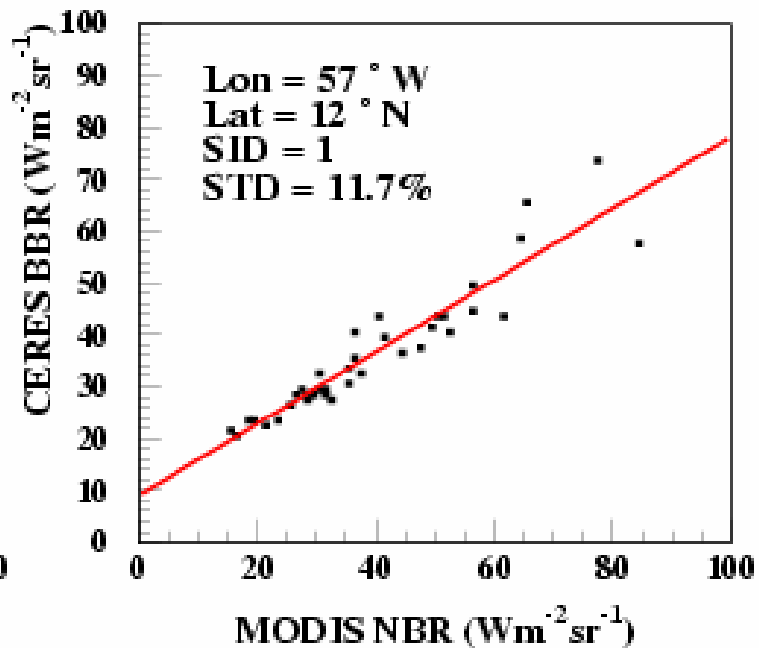
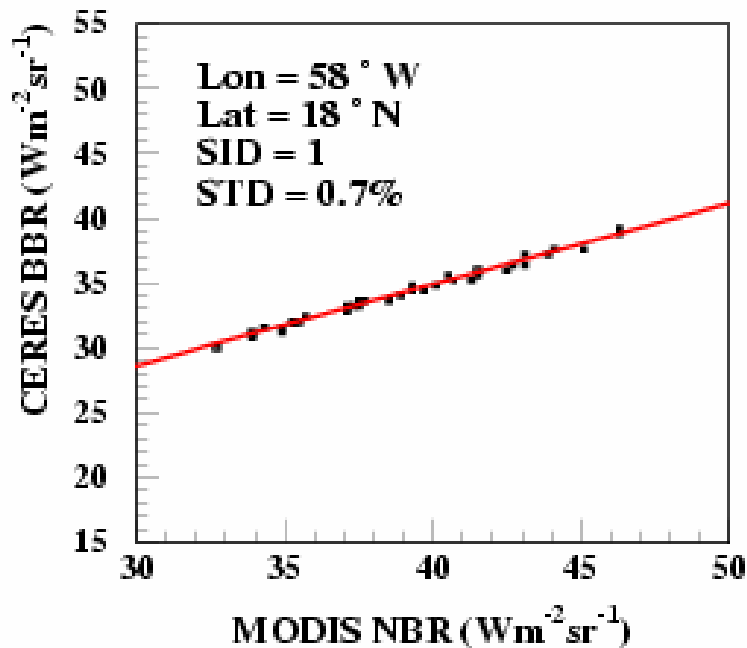
(Each Cloud Layer)

	PCL			MCL			OVC		
High	19	20	21	22	23	24	25	26	27
Mid	10	11	12	13	14	15	16	17	18
Low	1	2	3	4	5	6	7	8	9
	Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

PCL: CF = 0.1 - 40%	High: EP < 440 mb	Thin: $\tau < 3.35$
MCL: CF = 40 - 99%	Mid: EP = 440 - 680 mb	Mod: $\tau = 3.35 - 22.63$
OVC: CF = 99 - 100%	Low: EP > 680 mb	Thick: $t > 22.63$

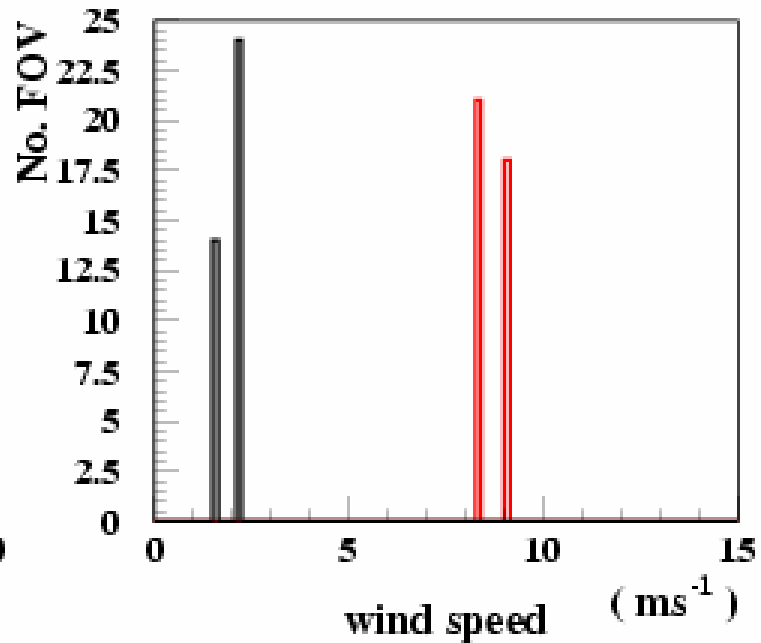
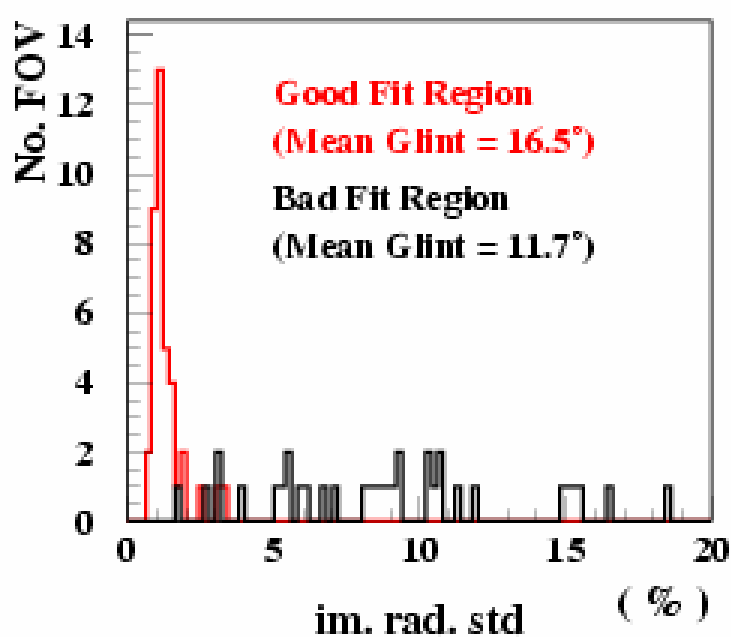
SW Narrow-to-Broadband Fit

Uniform SID = Clear-Sky Ocean

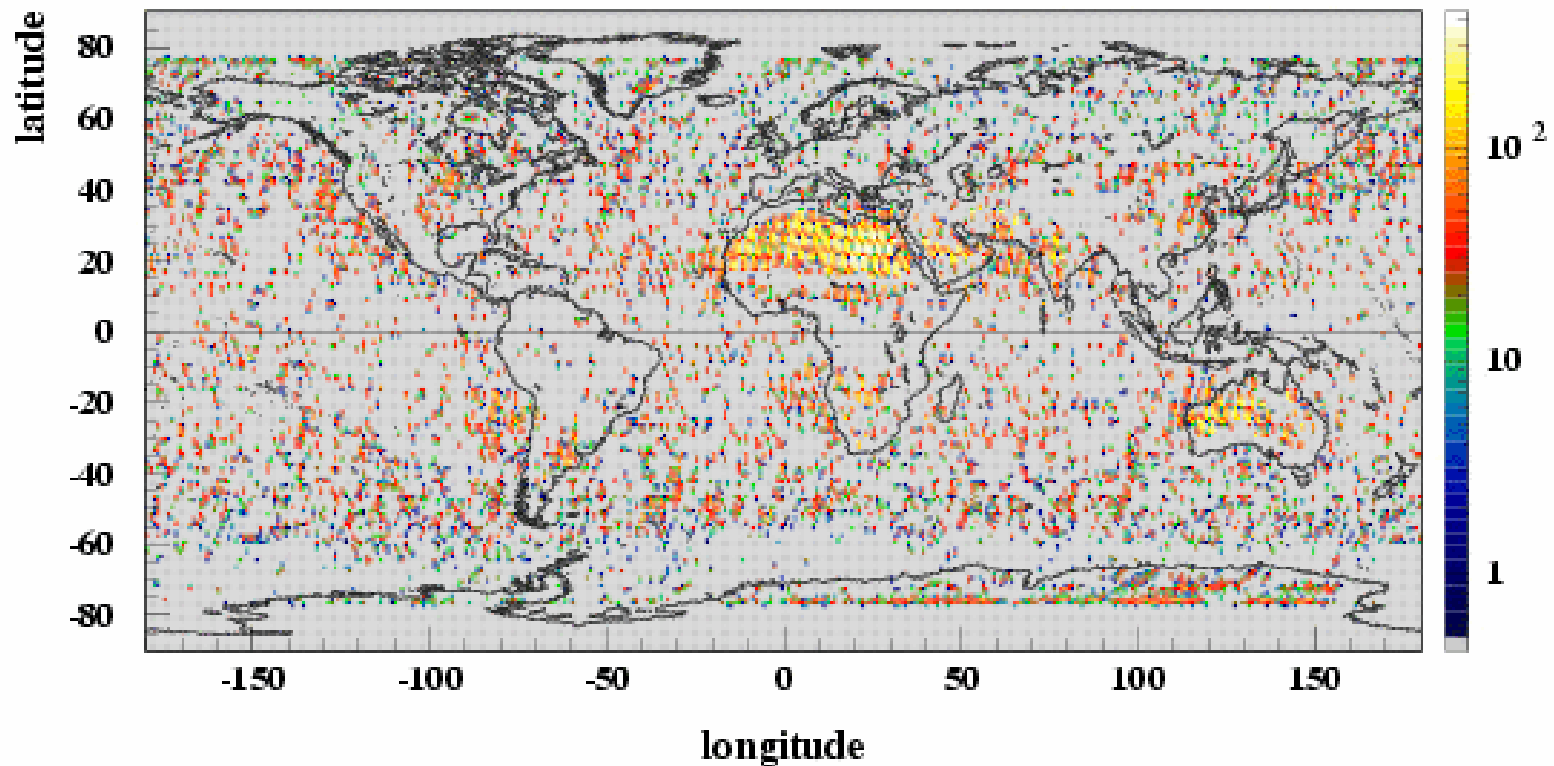


Scene Difference

Clear-Sky Ocean



Along-Track Data Used:
79 Days, No. FOV = 371,872



TOA Flux Errors due ADMs

TOA Flux Consistency = rms $[F(\theta) - F(\theta_0)]$

Two Passes Through Data

1. $\text{rms}_1(\text{tot})^2 = \text{rms}(\text{adm})^2 + \text{rms}(\text{n2b})^2$

2. $\text{rms}_2(\text{tot})^2 = \text{rms}(\text{adm})^2 + 2 \text{rms}(\text{n2b})^2$

Ocean Scene Type SW TOA Flux RMS (%)

All-sky ADM RMS = 5.35% (Tot RMS = 5.75%)

CLR		PCL			MCL			OVC		
12.12	High							10.31	6.38	3.59
	Mid		10.76			10.15			5.61	3.96
	Low	9.53	17.85		7.68	5.68			3.28	3.97
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

No-Glint All-sky ADM RMS = 3.95% (Tot RMS = 4.46%)

CLR		PCL			MCL			OVC		
4.53	High								4.59	2.83
	Mid								4.69	5.17
	Low	5.70	9.27		3.98	5.22			3.13	2.97
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Land & Snow/Sea-Ice SW TOA Flux RMS (%)

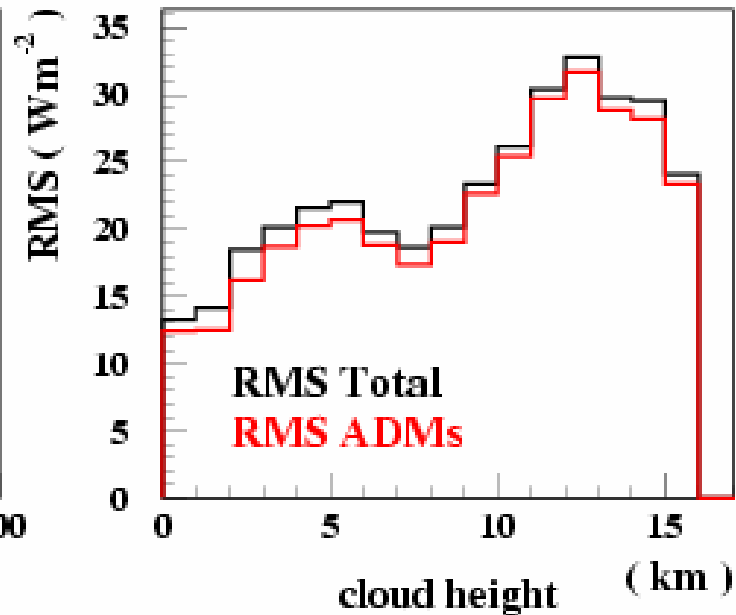
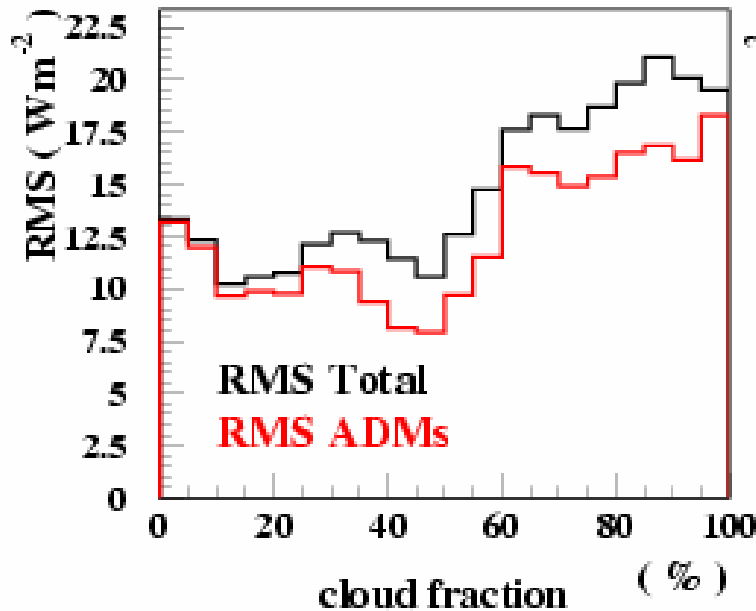
Land: All-sky ADM RMS = 4.16% (Tot RMS = 4.41%)

CLR		PCL			MCL			OVC		
3.65	High							7.70	4.23	
	Mid					6.60			3.35	
	Low	9.78	7.99			5.77		2.92	4.61	
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Snow/Sea-Ice: All-sky ADM RMS = 7.85% (Tot RMS = 7.97%)

CLR		PCL			MCL			OVC		
6.28	High							8.75	9.23	
	Mid	5.77			7.76			7.63	3.59	
	Low	11.74	25.94		9.75	12.49		5.56	5.92	
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

SW TOA Flux Consistency versus Cloud Properties (ocean)



Ocean & Desert LW TOA Flux RMS (%)

Ocean: All-sky ADM RMS = 2.68% (Tot RMS = 2.83%)

CLR		PCL			MCL			OVC		
0.95	High							11.38	8.06	6.75
	Mid					6.58			4.23	4.10
	Low	1.11	1.34		1.47	2.67			2.06	2.26
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Desert: All-sky ADM RMS = 2.00% (Tot RMS = 2.08%)

CLR		PCL			MCL			OVC		
1.96	High									3.34
	Mid									
	Low	3.59				1.79				
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Land & Snow/Sea Ice LW TOA Flux RMS (%)

Land: All-sky ADM RMS = 2.39% (Tot RMS = 2.46%)

CLR		PCL			MCL			OVC		
2.03	High							10.35	7.88	
	Mid					5.29				2.06
	Low	2.20	2.83			2.09			3.72	2.35
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Snow/Sea Ice: All-sky ADM RMS = 2.56% (Tot RMS = 2.64%)

CLR		PCL			MCL			OVC		
2.51	High							5.18	2.82	
	Mid	1.98	4.36		2.30	5.44		3.22	3.99	
	Low	2.42	2.07		2.32	2.79			2.16	2.65
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Summary

- ➡ **Combining CERES along-track and cross-track data, narrow-to-broadband conversion and artificial noise technique we are able to estimate instantaneous TOA flux errors due to ADMs.**
- ➡ **Narrow-to-broadband fit errors contribution is on a level of 0.4-0.5% for all-sky SW and 0.1-0.2% for all-sky LW TOA flux.**