

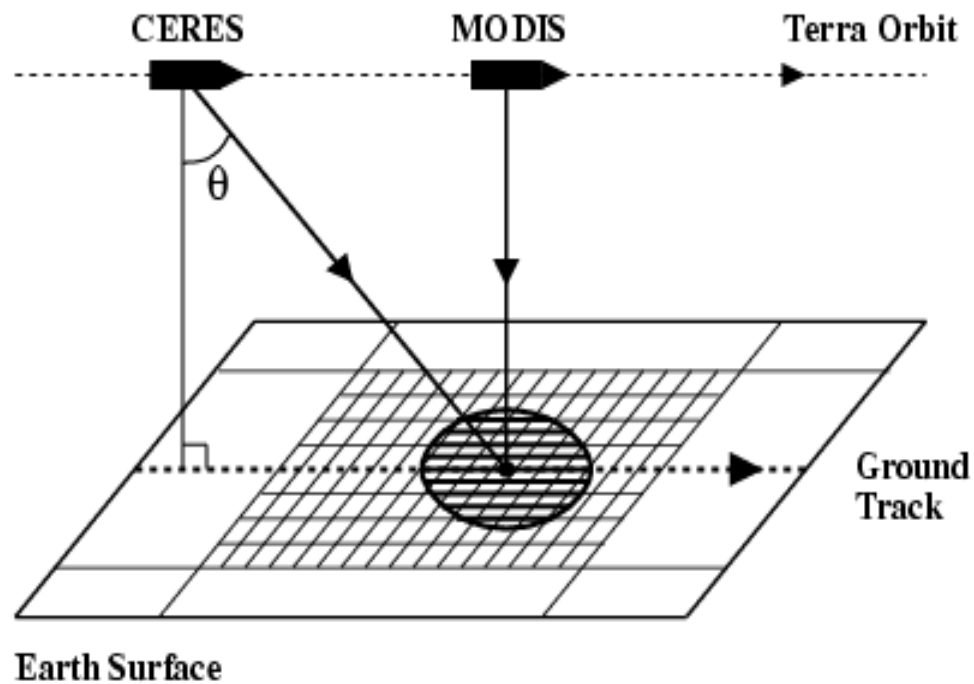
CERES/Aqua Instantaneous TOA Flux Consistency

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CERES Inversion Group Meeting, November 2005

CERES and MODIS Geometry for Along-Track Data



Analysis Steps:

- **Making a list of more than 90% uniform regions using 47 days of CERES/Aqua (2002-2004) and 48 days of CERES/Terra along-track data (2000-2002).**
- **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 (3 min. match) 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°), single cloud layer only.**

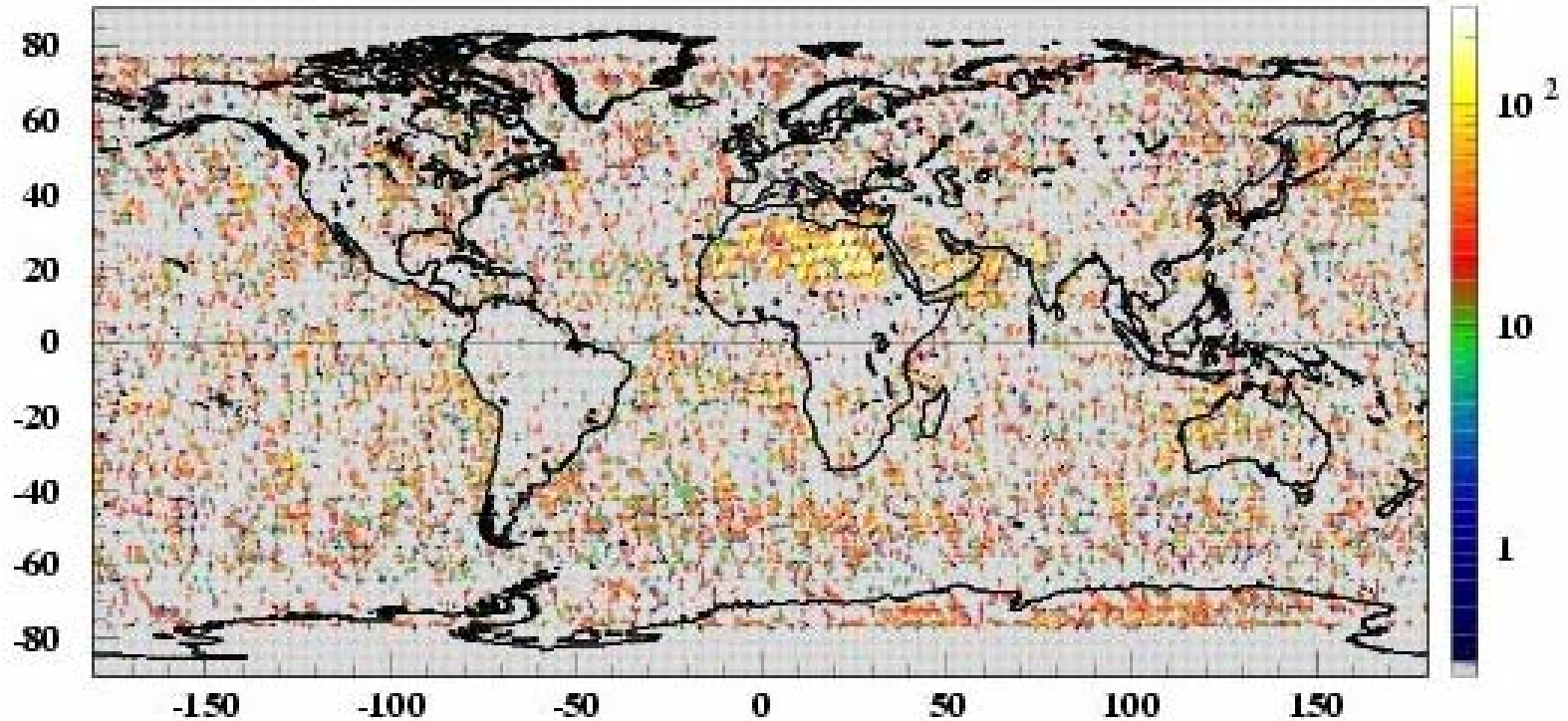
SSF Cloud Classification

(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: $t > 22.63$

Aqua: 47 Days, N FOV = 401,239
Terra: 48 days, N FOV = 545,018



TOA Flux Errors due ADMs

TOA Flux Consistency = rms [F(θ) - F(θ_o)]

Two Passes Through Data

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

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

No-Glint Ocean Scene Type SW TOA Flux RMS (%)

Aqua Ocean: All-sky RMS = 4.23% (6.04%)

CLR		PCL			MCL			OVC		
5.28	High							10.21	6.70	3.99
	Mid	16.01							5.62	4.20
	Low	8.33	10.06		10.63	6.13		25.50	3.78	3.61
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Ocean: All-sky RMS = 4.07% (5.21%)

CLR		PCL			MCL			OVC		
6.27	High							11.64	6.84	3.72
	Mid					10.73			5.65	4.15
	Low	7.77	9.68		7.31	5.28		28.51	3.06	3.56
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Land SW TOA Flux RMS (%)

Aqua Land: All-sky RMS = 6.58% (5.03%)

CLR		PCL			MCL			OVC		
3.05	High	3.01						9.79	8.11	4.65
	Mid	4.63				7.85			4.77	3.06
	Low	10.59	7.65			10.81			4.83	4.43
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Land: All-sky RMS = 5.77% (4.90%)

CLR		PCL			MCL			OVC		
4.12	High	4.09						23.27	6.01	3.92
	Mid	5.30	16.38			7.36			5.04	4.11
	Low	8.65	8.10		16.53	5.97			6.43	4.36
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Snow/Ice SW TOA Flux RMS (%)

Aqua Snow/Ice: All-sky RMS = 8.23% (7.40%)

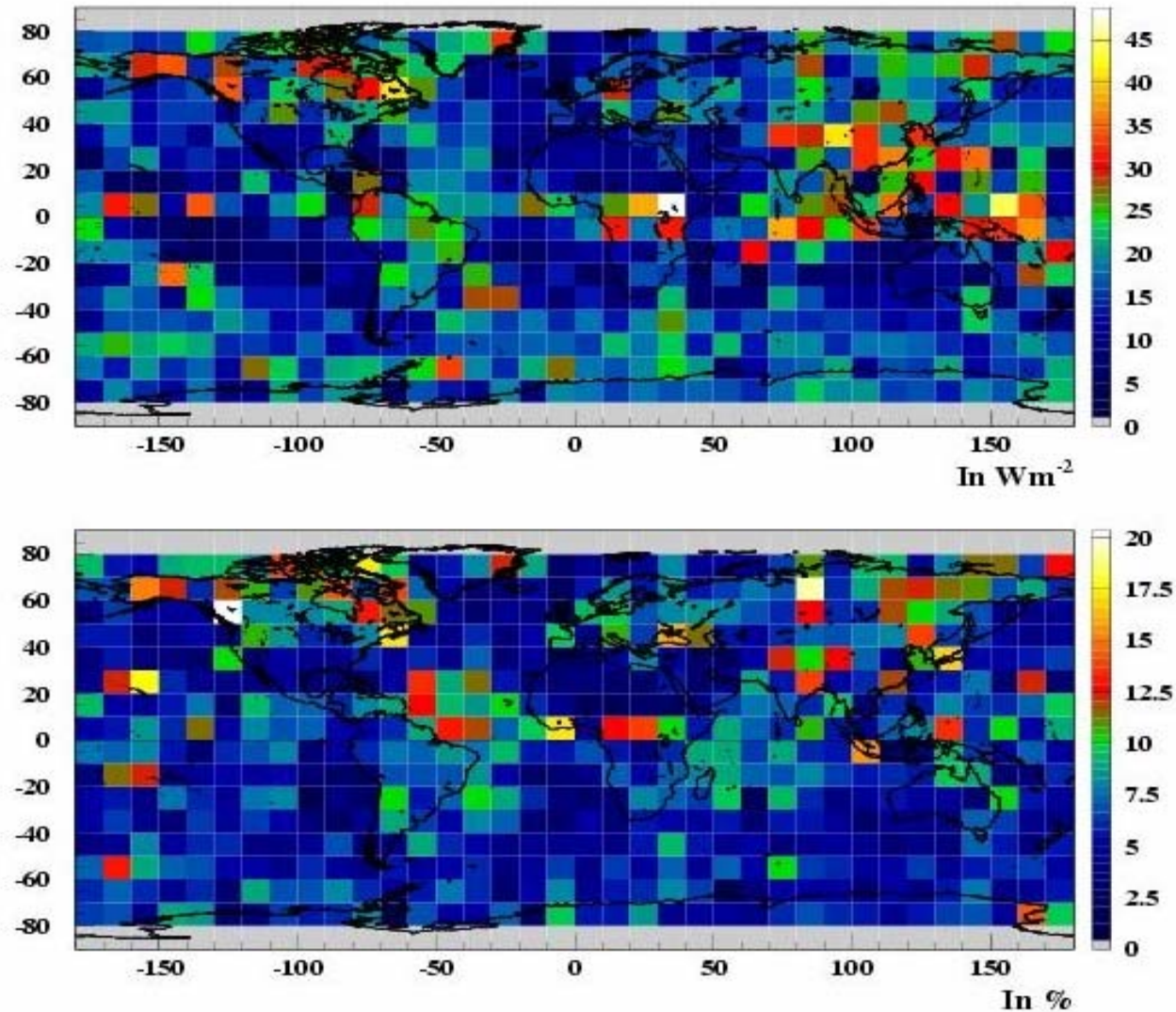
CLR		PCL			MCL			OVC		
5.02	High	6.04						8.65	8.79	
	Mid	5.37	10.12		6.19	10.16		7.35	6.97	
	Low	9.79	17.50		11.54	14.18		8.85	5.17	
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Snow/Ice: All-sky RMS = 8.50% (8.17%)

CLR		PCL			MCL			OVC		
7.22	High				11.26			9.97	6.19	9.40
	Mid	6.21	12.42		7.08	9.54		10.28	4.87	15.27
	Low	10.05	17.01		9.04	10.77		8.50	5.98	6.47
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

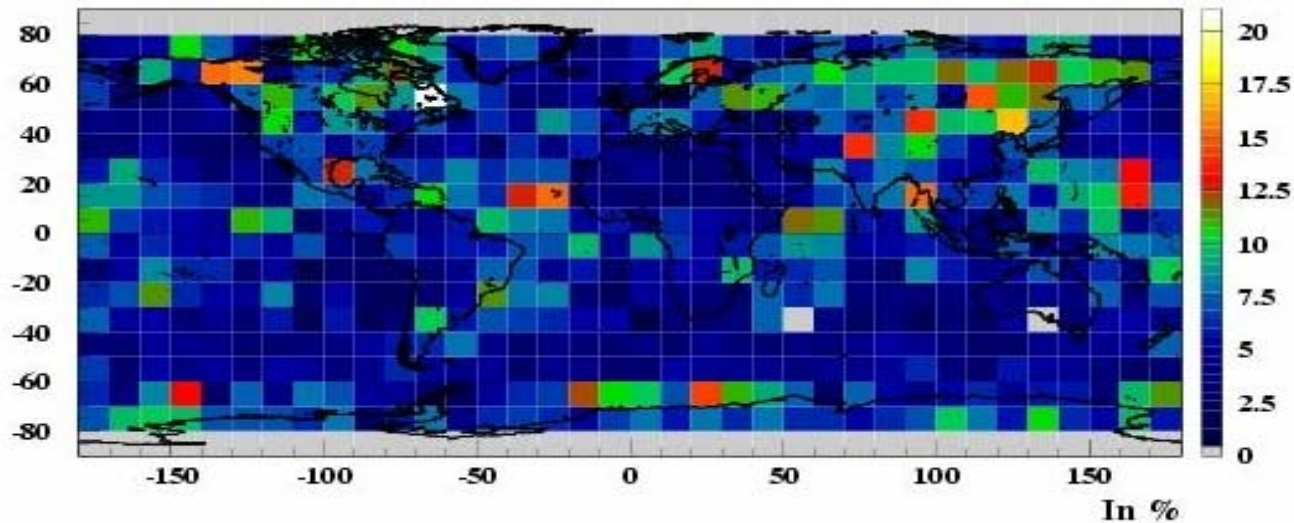
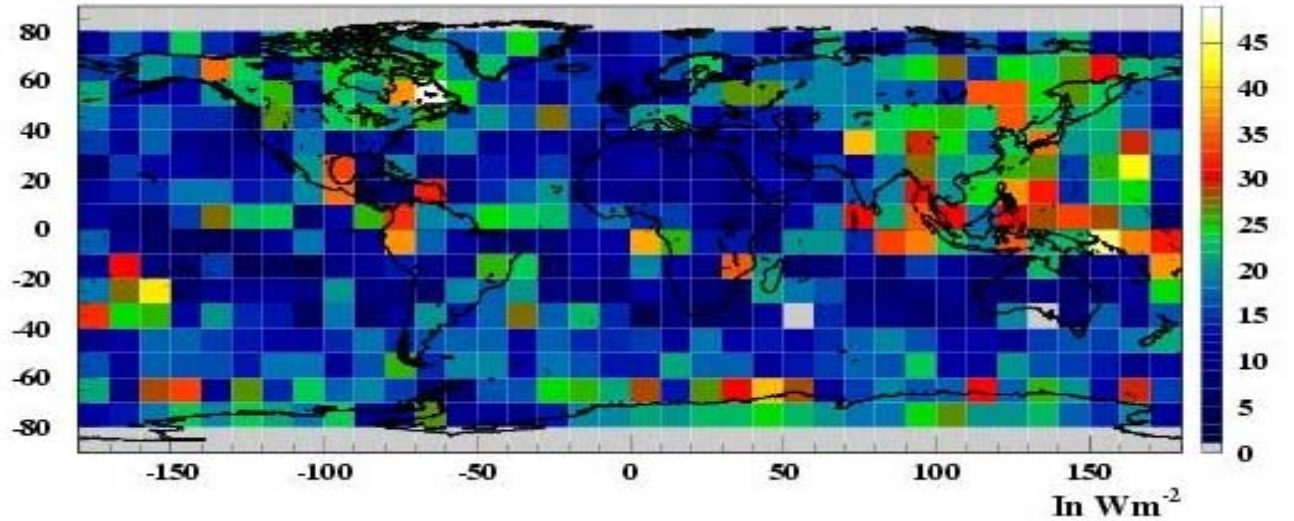
Aqua: All-Sky Regional SW RMS

Global RMS = 18.38 Wm⁻² (7.01%)

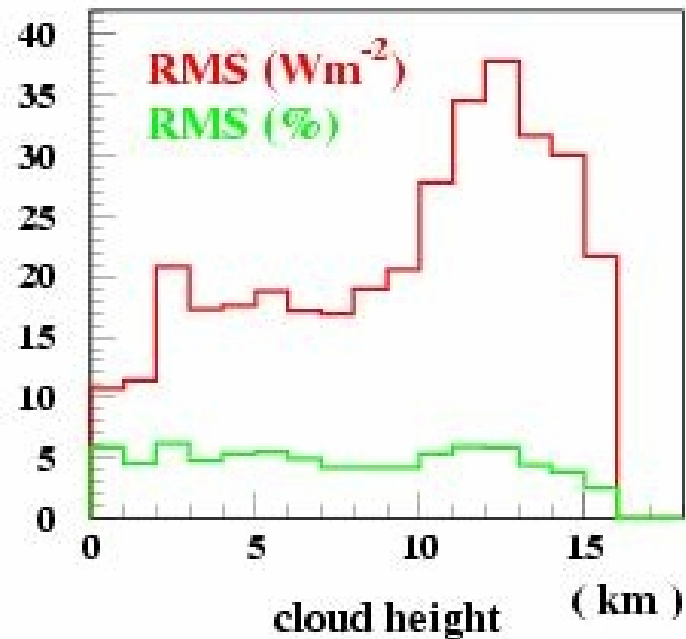
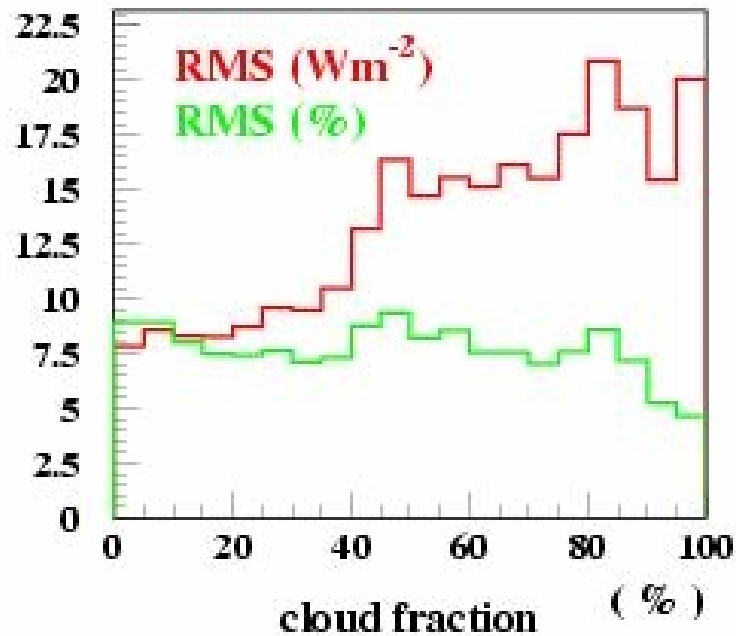


Terra: All-Sky Regional SW RMS

Global RMS = 18.55 Wm^{-2} (6.67%)



SW TOA Flux Consistency versus Cloud Properties (Ocean)



Ocean LW TOA Flux RMS (%)

Aqua Ocean: All-sky RMS = 2.39% (2.30%)

CLR		PCL			MCL			OVC		
1.06	High	1.05						6.04	7.69	5.97
	Mid	1.02							4.72	2.28
	Low	0.73	0.71		1.05	0.99			1.52	1.96
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Ocean: All-sky RMS = 2.66% (2.63%)

CLR		PCL			MCL			OVC		
0.97	High	1.95						6.35	7.79	7.31
	Mid					5.13			4.47	4.84
	Low	0.96	1.08		1.06	2.42		2.51	2.24	2.42
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Land LW TOA Flux RMS (%)

Aqua Land: All-sky RMS = 2.94% (1.97%)

CLR		PCL			MCL			OVC		
1.60	High	2.42						2.41	6.75	5.90
	Mid	2.15				3.42			3.77	3.35
	Low	1.57	1.53			1.18			1.35	1.64
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Land: All-sky RMS = 3.41% (2.09%)

CLR		PCL			MCL			OVC		
1.85	High	2.65						5.62	8.51	7.58
	Mid	2.00	1.88			3.69			3.94	2.07
	Low	2.00	1.96		3.26	1.43			1.27	2.25
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Snow/Ice LW TOA Flux RMS (%)

Aqua Snow/Ice: All-sky RMS = 2.13% (2.26%)

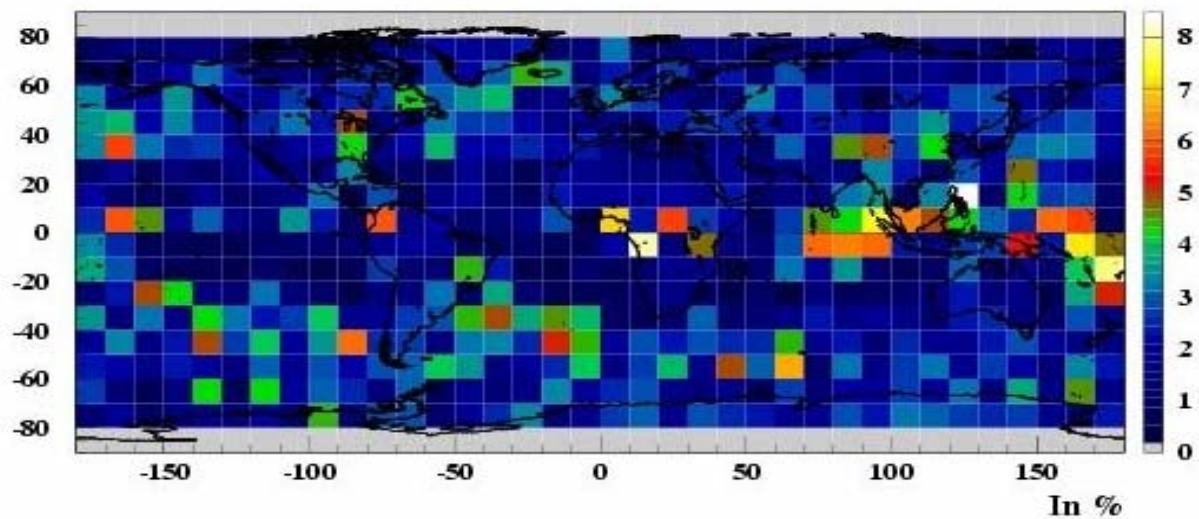
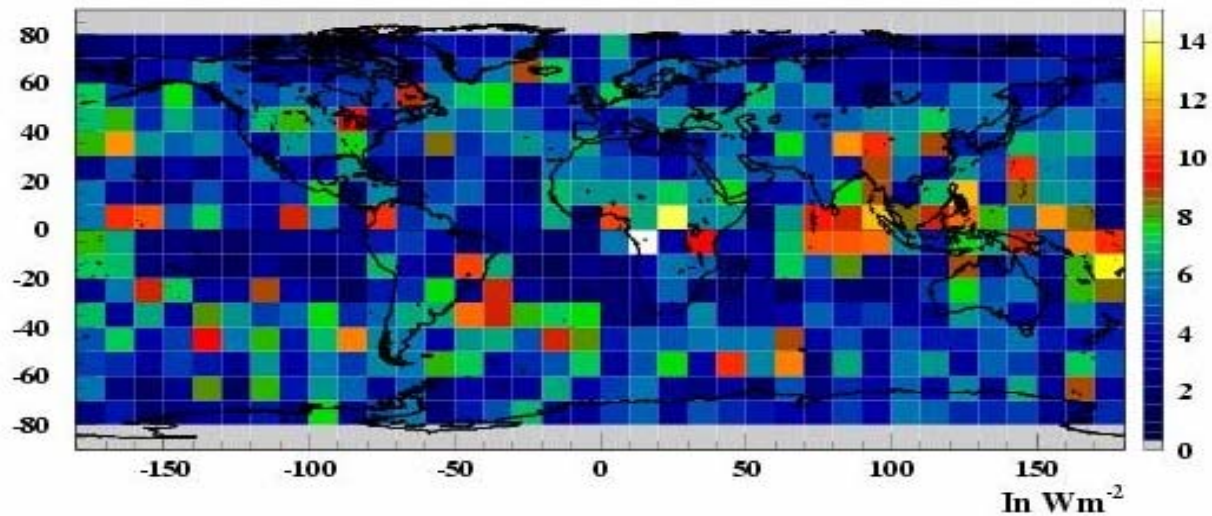
CLR		PCL			MCL			OVC		
2.27	High	2.20						5.01	7.46	
	Mid	2.96	1.52		2.05	2.50		1.84	3.40	
	Low	2.19	1.37		1.96	1.61		2.43	1.61	
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

Terra Snow/Ice: All-sky RMS = 2.78% (2.87%)

CLR		PCL			MCL			OVC		
2.85	High	2.58			2.39			5.15	5.16	4.10
	Mid	2.35	5.59		2.36	2.23		4.00	4.85	3.84
	Low	2.12	2.34		2.45	2.22		5.48	2.19	5.54
		Thin	Mod	Thick	Thin	Mod	Thick	Thin	Mod	Thick

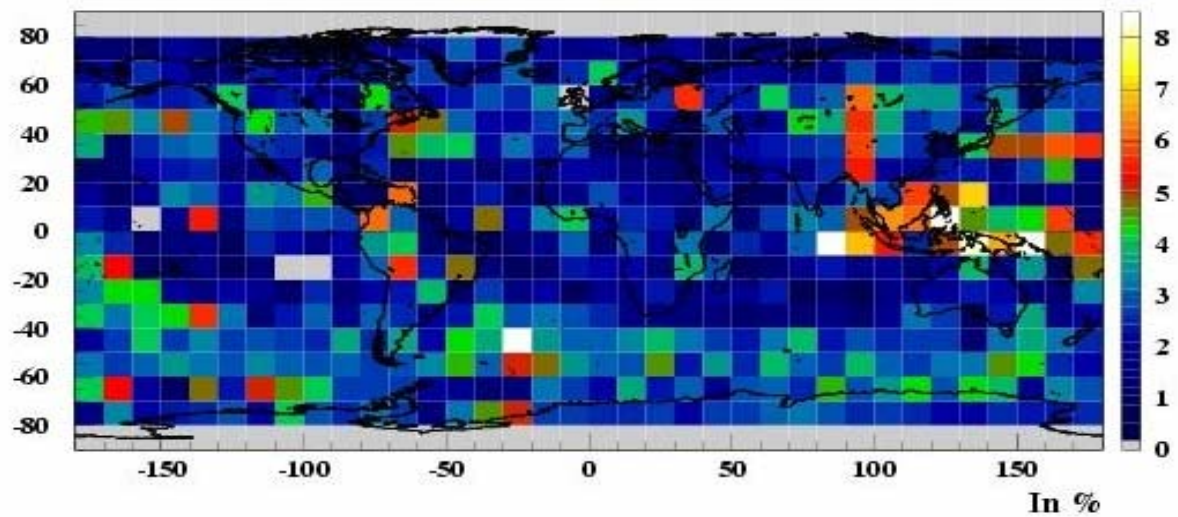
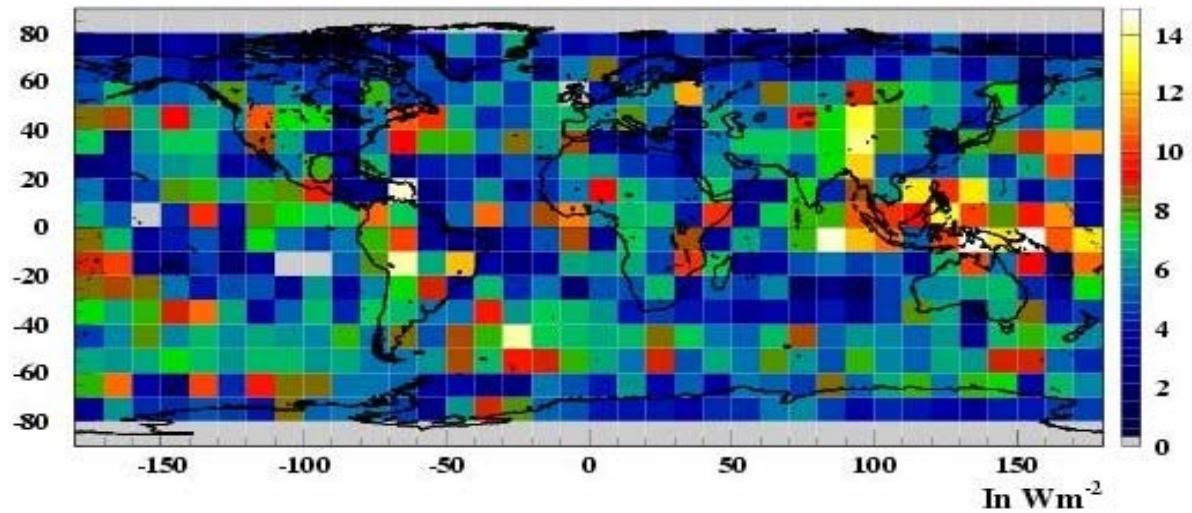
Aqua: All-Sky Regional LW RMS

Global RMS = 5.67 Wm^{-2} (2.79%)



Terra: All-Sky Regional LW RMS

Global RMS = 6.79 Wm⁻² (3.30%)



Summary

- ➡ **Instantaneous CERES/Aqua and CERES/Terra ADM consistency generally agree within 1%.**
- ➡ **CERES/Aqua ADMs over Snow/Ice surface are improved due to more consistent cloud retrievals in polar regions.**
- ➡ **Future test: Analysis with *conventional* cuts.**