Comparison of CERES-MODIS cloud properties (Terra and Aqua) with ARM NSA retrievals

Baike Xi

University of North Dakota

Shaoyue Qiu and Xiquan Dong, UND

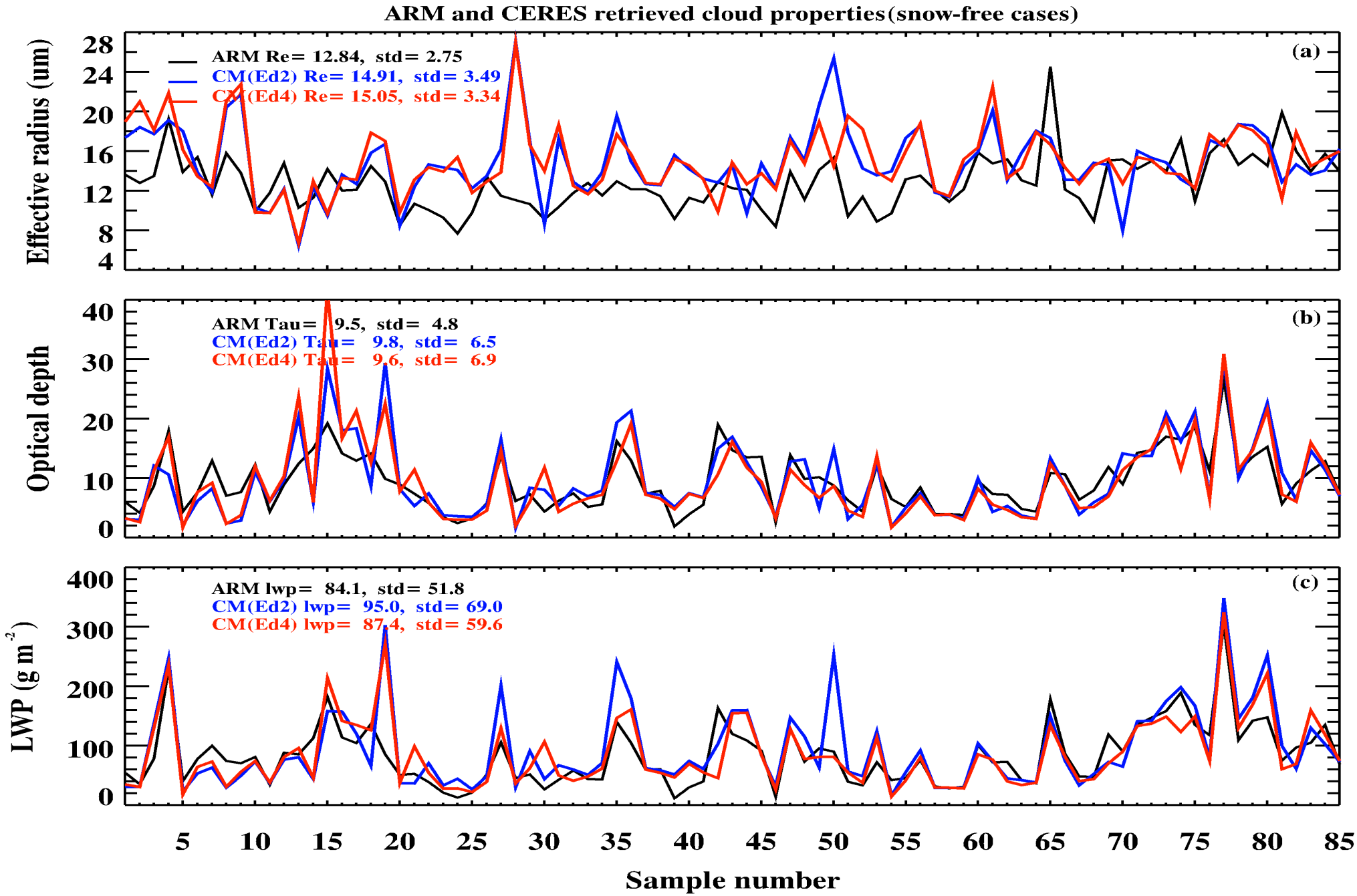
Pat Minnis and Sunny Sun-Mack, NASA LaRC

Snow-free cases

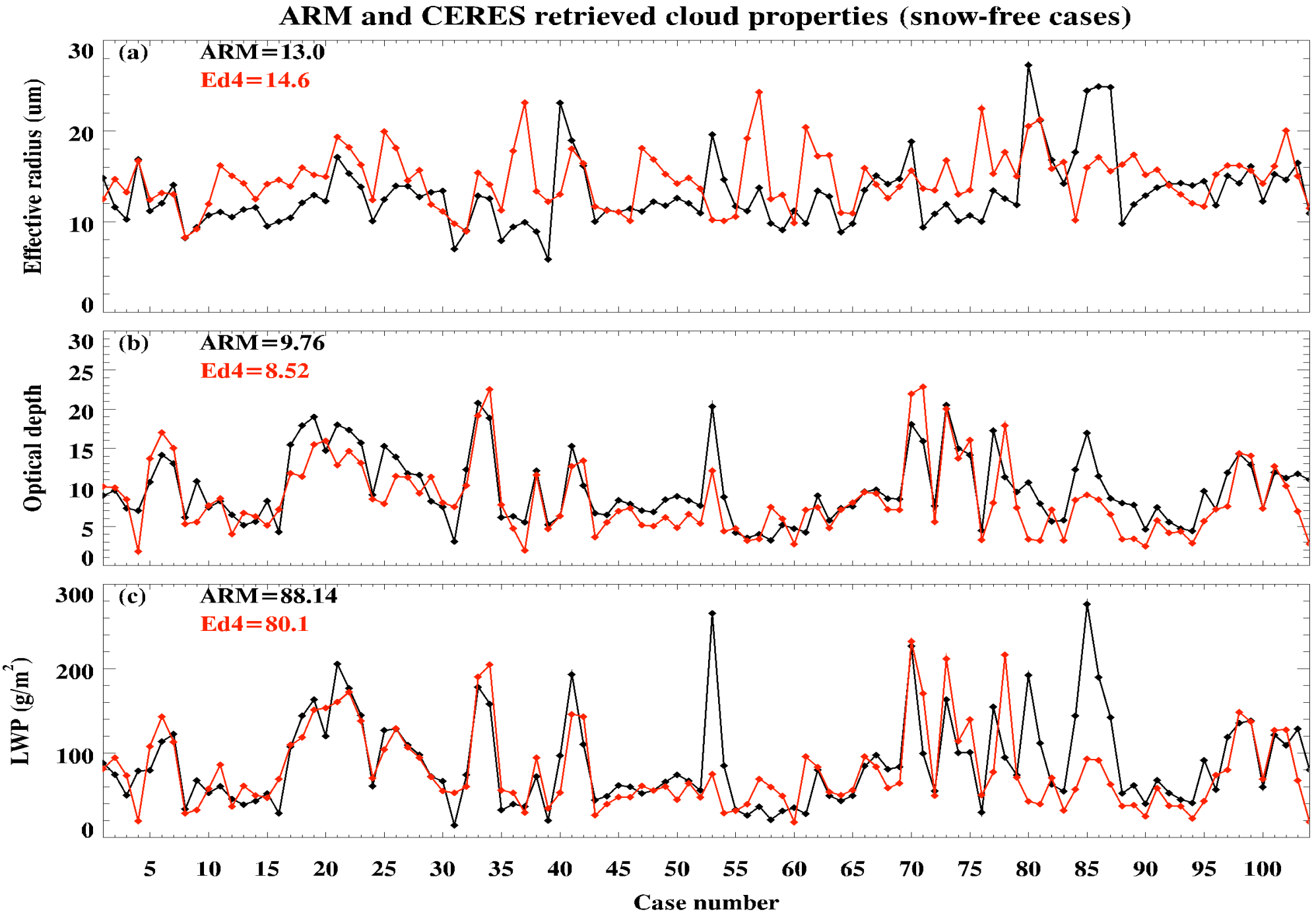
85 TERRA CASES

104 AQUA CASES

TERRA cloud properties (85 cases)

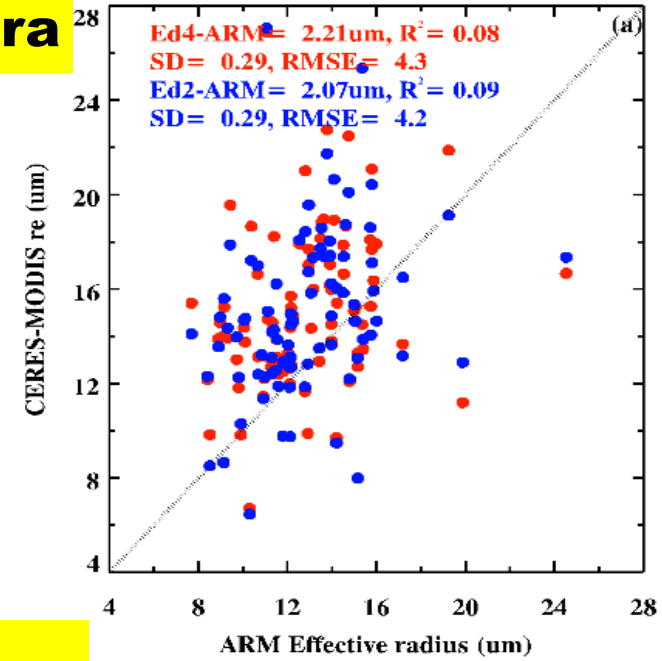


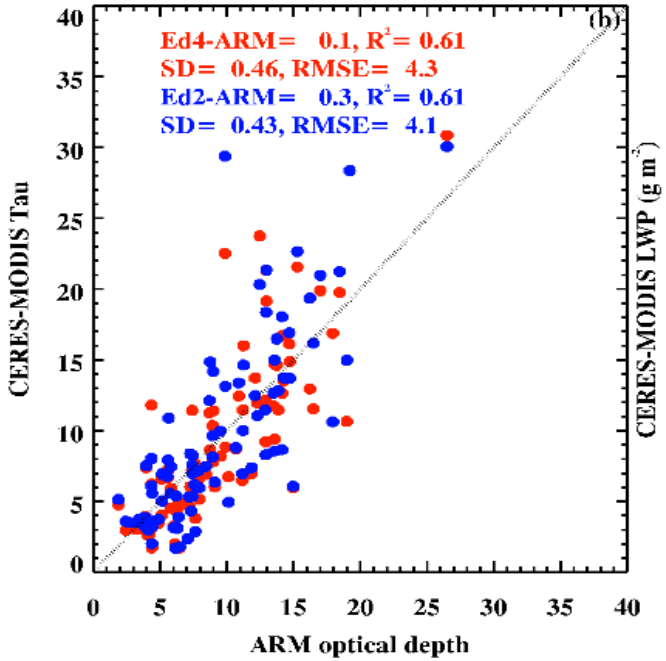
AQUA cloud properties (104 cases)

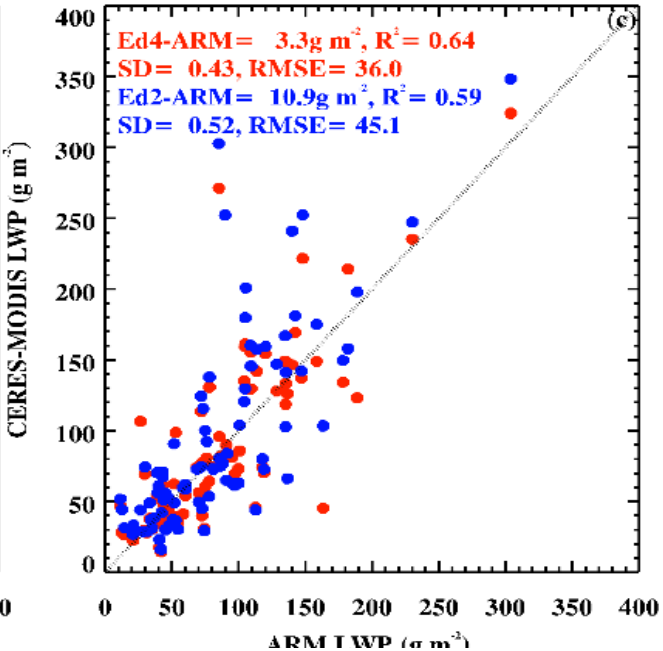


Terra and Aqua Cloud Properties against ARM retrievals

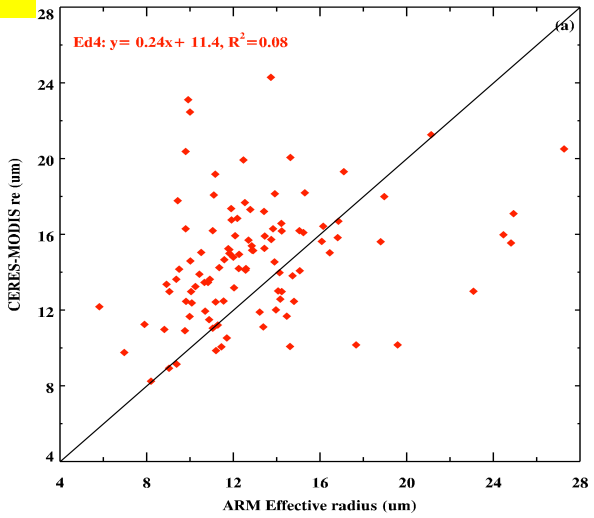
Terra

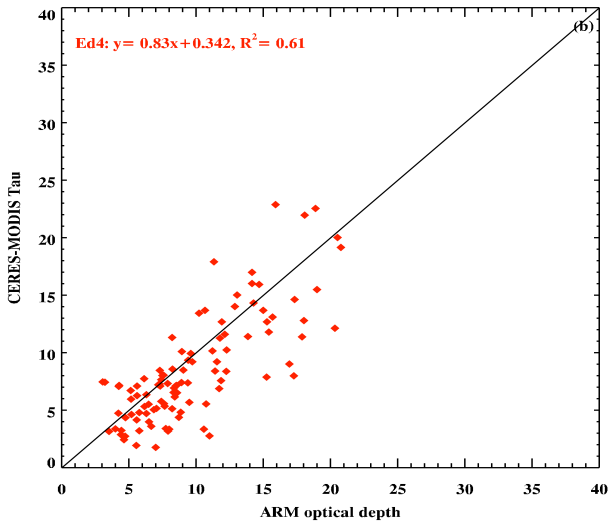


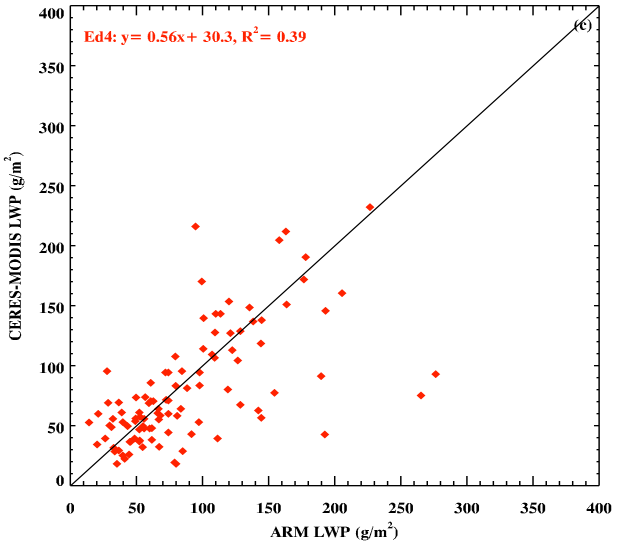




Aqua

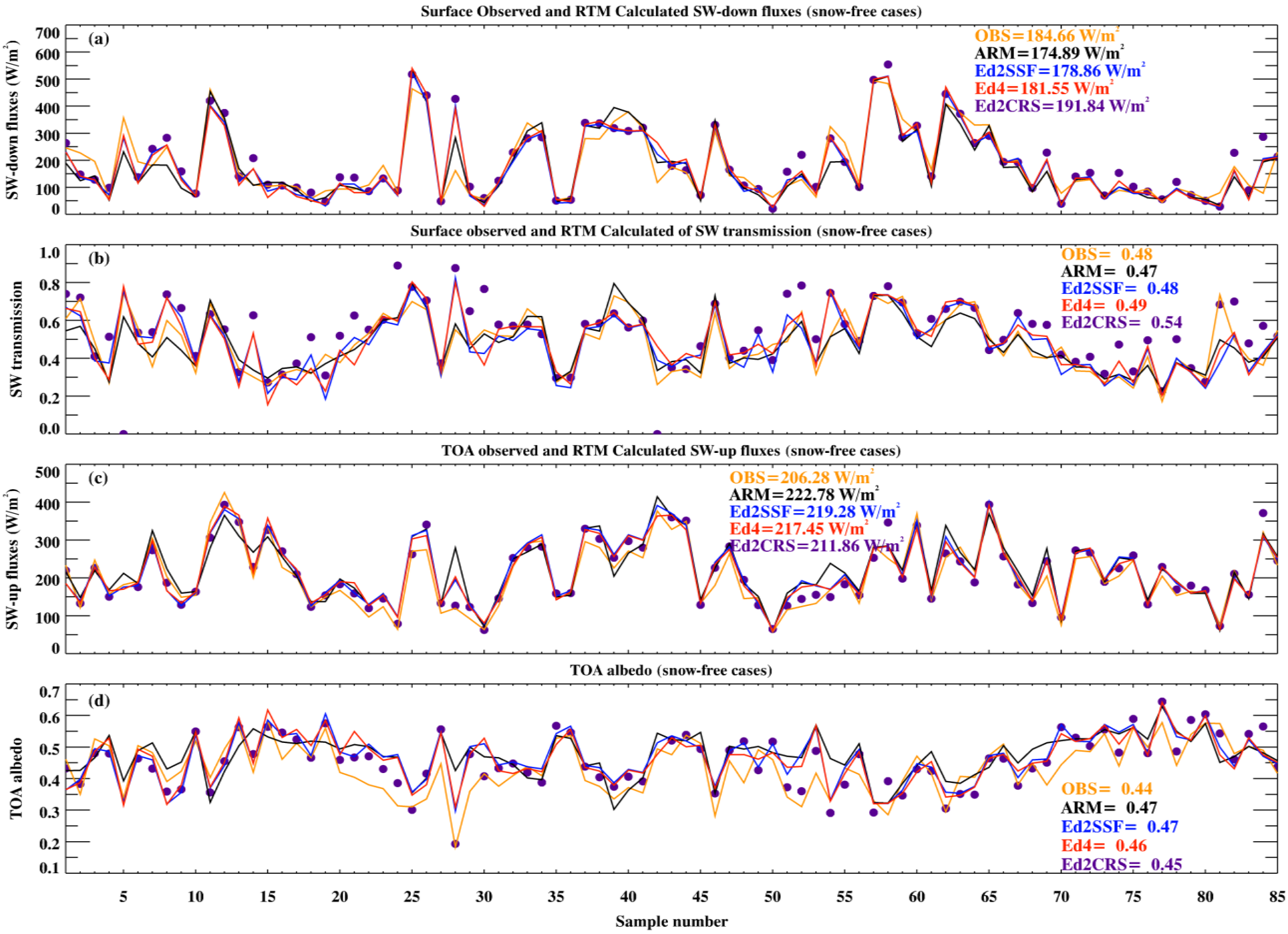




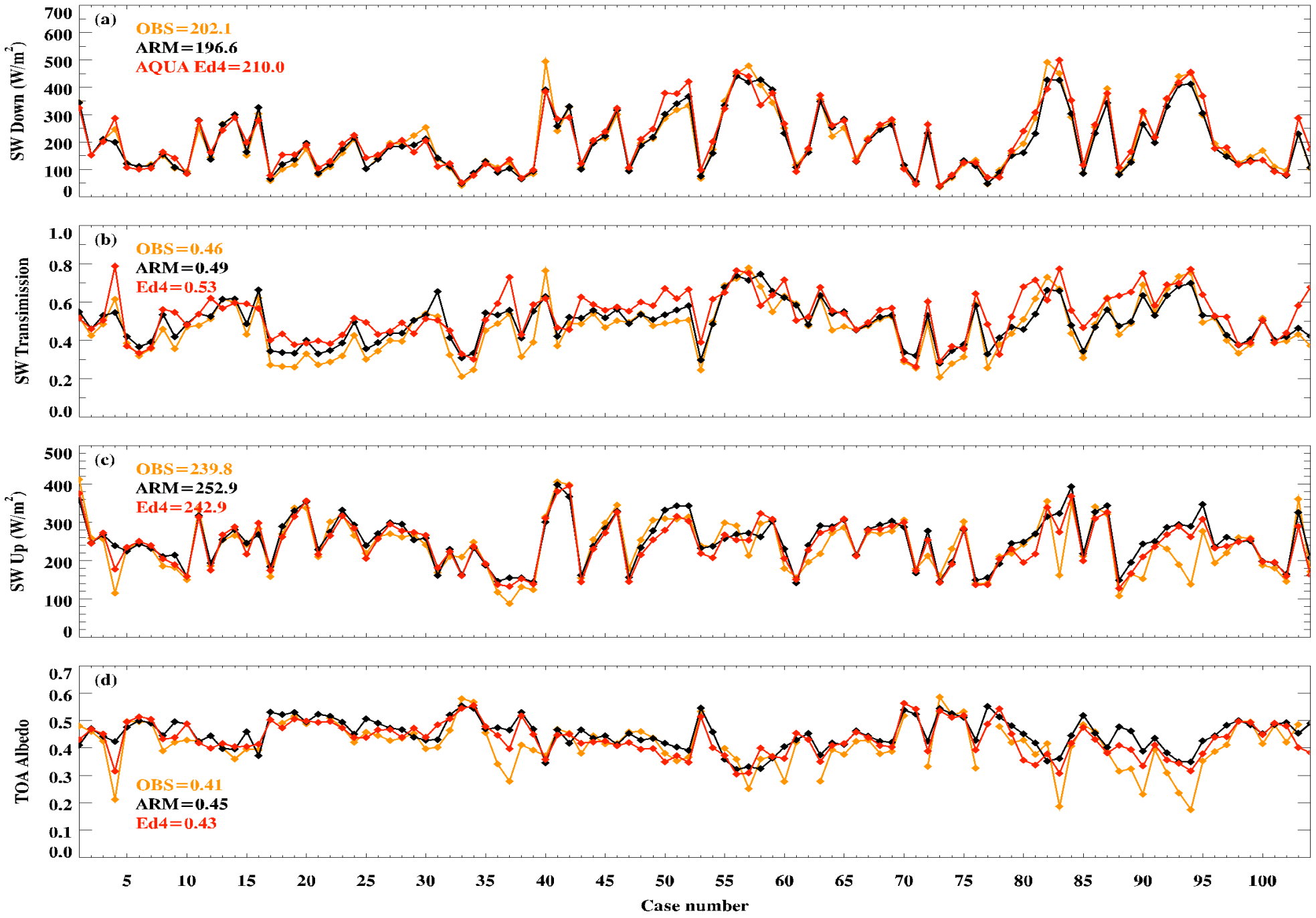


1) **Terra: ARM re=12.8 vs. Ed4=15.1 um, ARM tau=9.5 vs. 9.6, ARM LWP=84.1 vs. 87.4 gm^{-2}**
2) **Aqua: ARM re=13.0 vs. Ed4=14.6 um, ARM tau=9.8 vs. 8.5, ARM LWP=88.1 vs. 80.1 gm^{-2}**

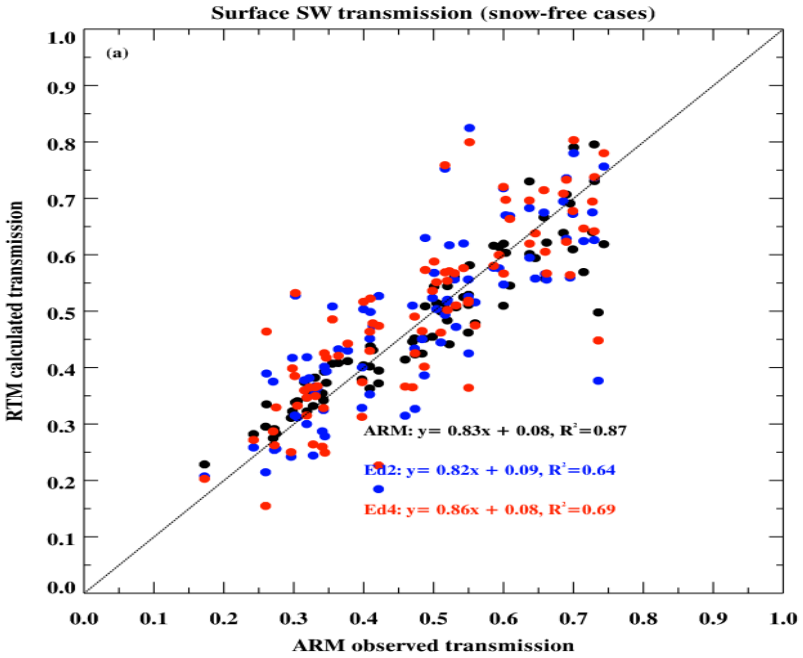
TERRA surface transmission and TOA albedo

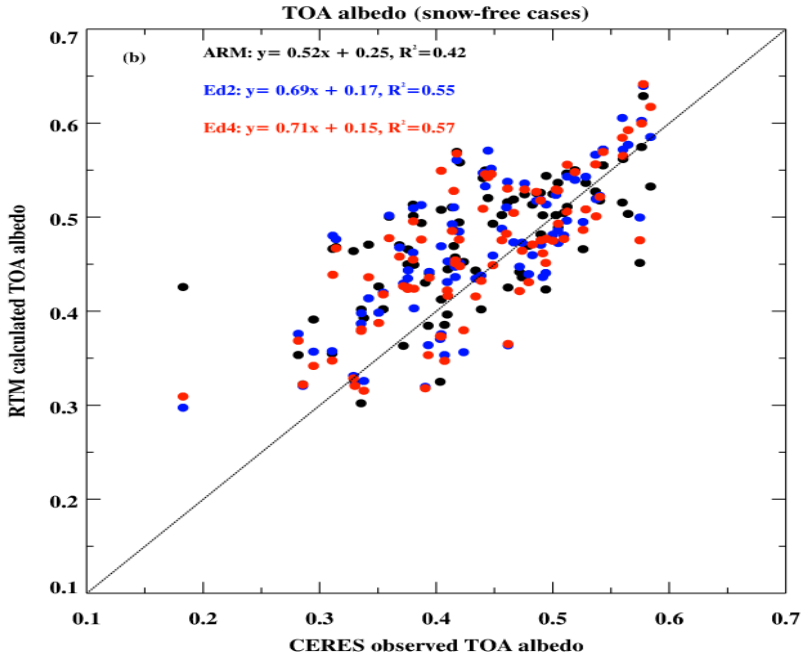


AQUA surface transmission and TOA albedo

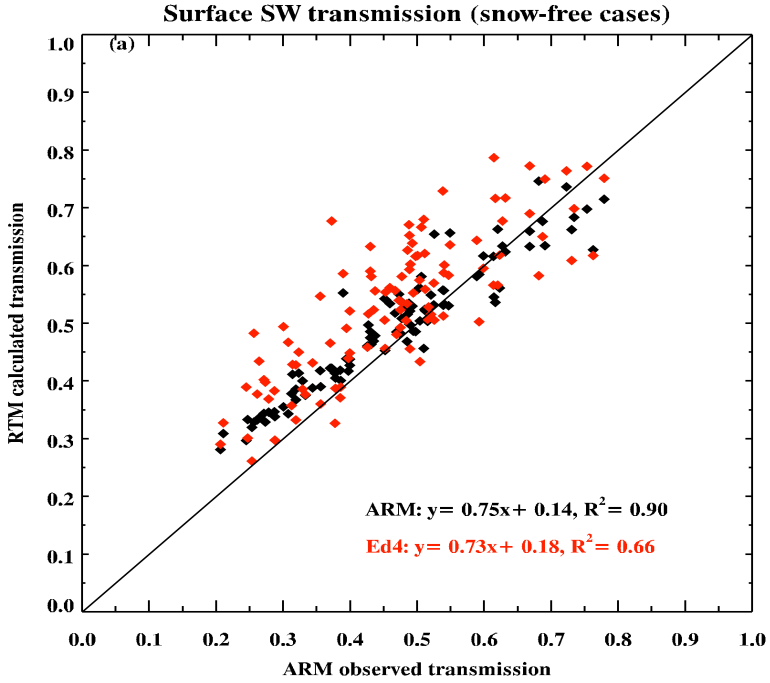


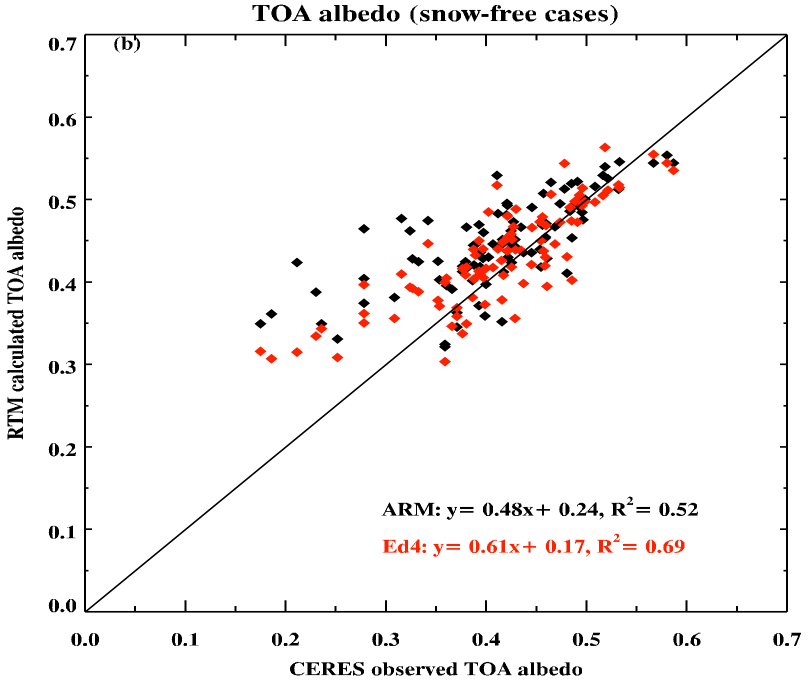
TERRA


Surface SW transmission (snow-free cases)
(a)
ARM: y= 0.83x + 0.08, R²=0.87
Ed2: y= 0.82x + 0.09, R²=0.64
Ed4: y= 0.86x + 0.08, R²=0.69
RTM calculated transmission
ARM observed transmission


TOA albedo (snow-free cases)
(b)
ARM: y= 0.52x + 0.25, R²=0.42
Ed2: y= 0.69x + 0.17, R²=0.55
Ed4: y= 0.71x + 0.15, R²=0.57
RTM calculated TOA albedo
CERES observed TOA albedo

AQUA


Surface SW transmission (snow-free cases)
(a)
ARM: y= 0.75x+ 0.14, R²= 0.90
Ed4: y= 0.73x+ 0.18, R²= 0.66
RTM calculated transmission
ARM observed transmission


TOA albedo (snow-free cases)
(b)
ARM: y= 0.48x+ 0.24, R²= 0.52
Ed4: y= 0.61x+ 0.17, R²= 0.69
RTM calculated TOA albedo
CERES observed TOA albedo

Summary

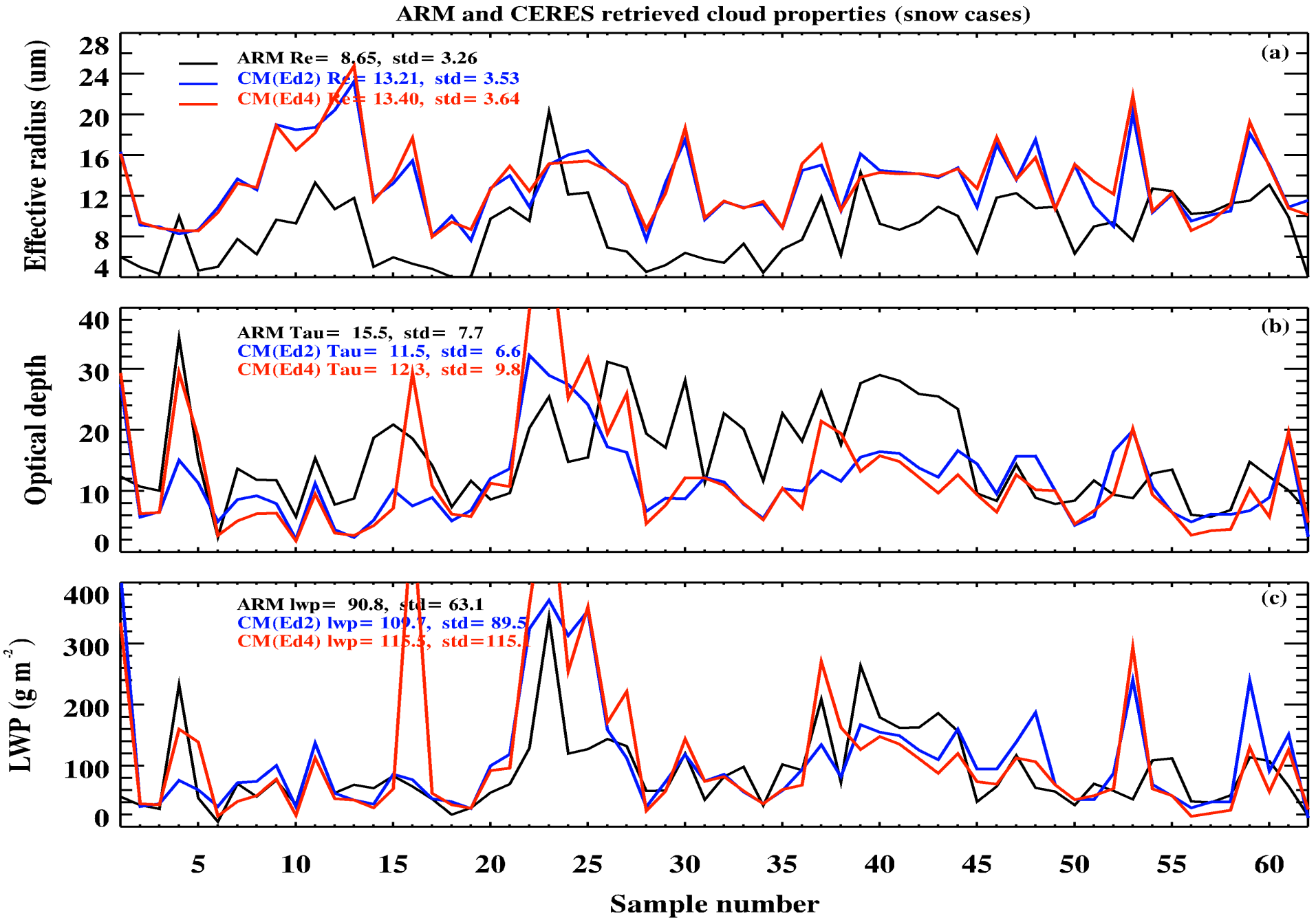
		Re	Tau	LWP	SFC SW↓cloud	T_{trans}	TOA SW↑	R_{TOA}
TERRA	OBS				184.7	0.48	206.3	0.44
	ARM	12.8	9.5	84.1	170.5	0.47	215.9	0.46
	ED2	14.9	9.8	95.0	174.3	0.49	212.5	0.45
	ED4	15.1	9.6	87.4	176.9	0.49	210.8	0.45
AQUA	OBS				202.1	0.46	239.8	0.41
	ARM	13.0	9.8	88.1	196.6	0.49	252.9	0.45
	ED4	14.6	8.5	80.1	210.0	0.53	242.9	0.43

Snow cases

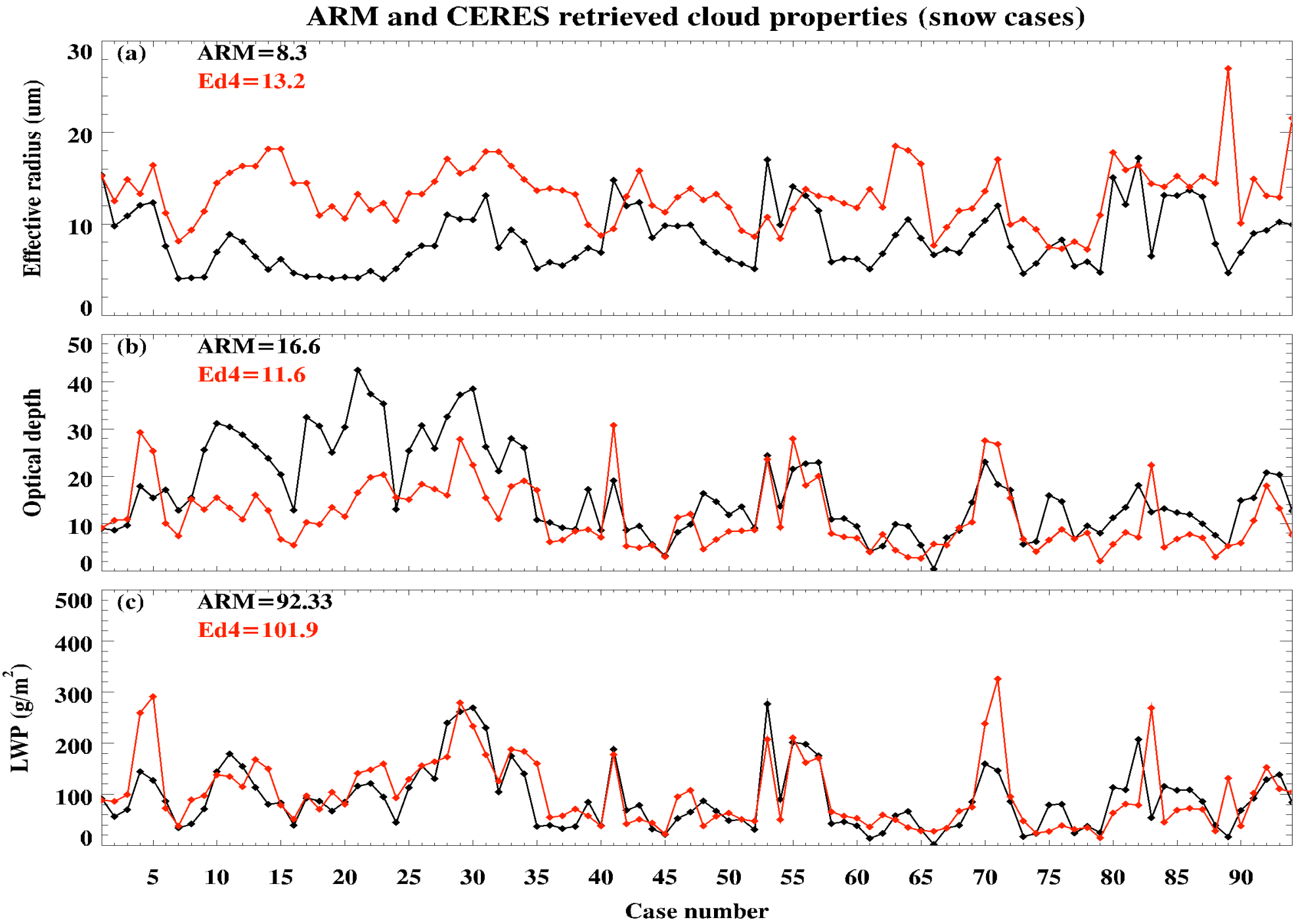
62 TERRA CASES

94 AQUA CASES

TERRA cloud properties (62 cases)

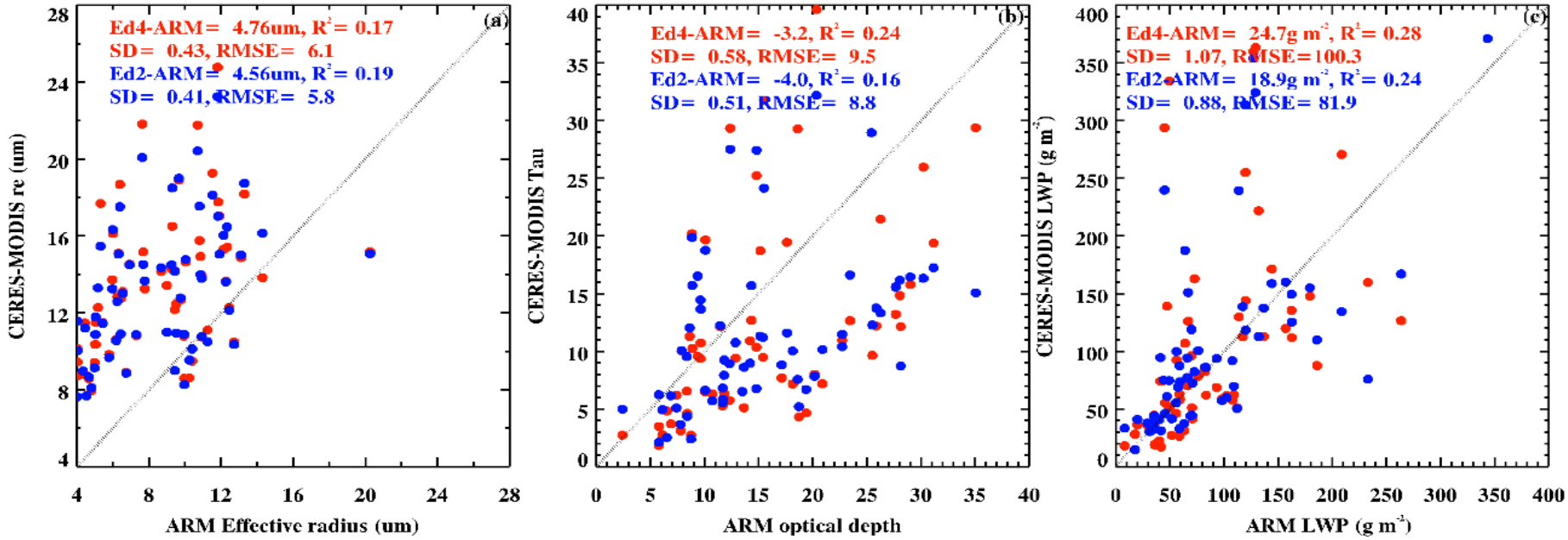


AQUA cloud properties (94 cases)

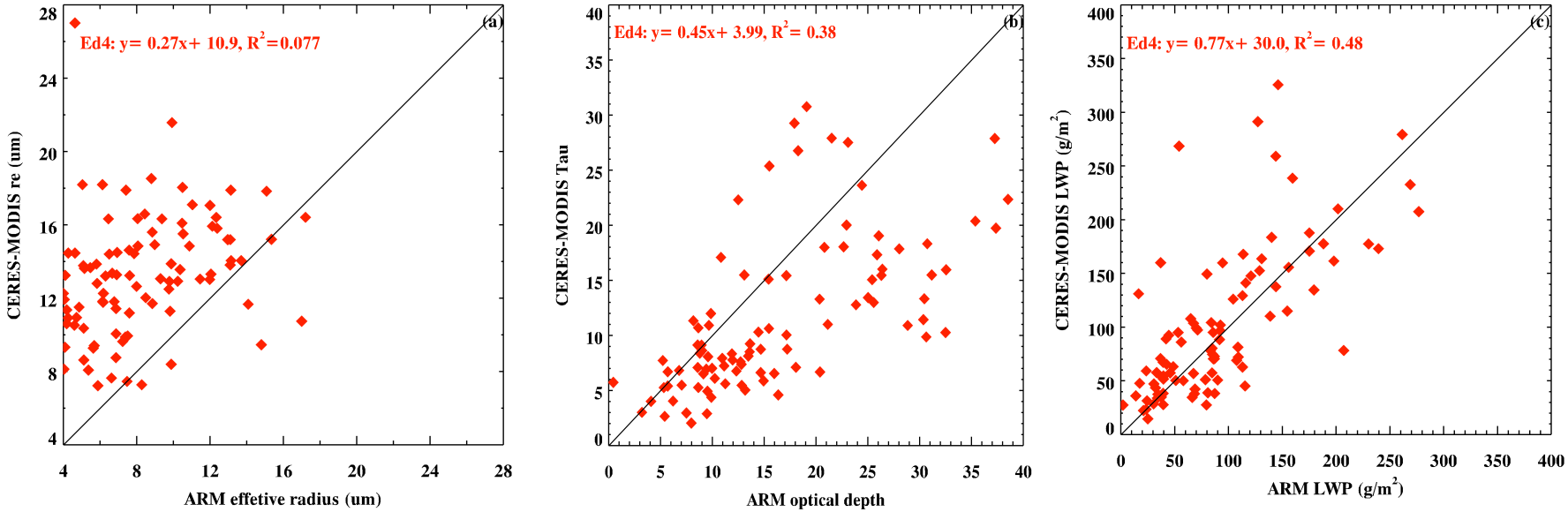


Terra and Aqua Cloud Properties against ARM retrievals

TERRA

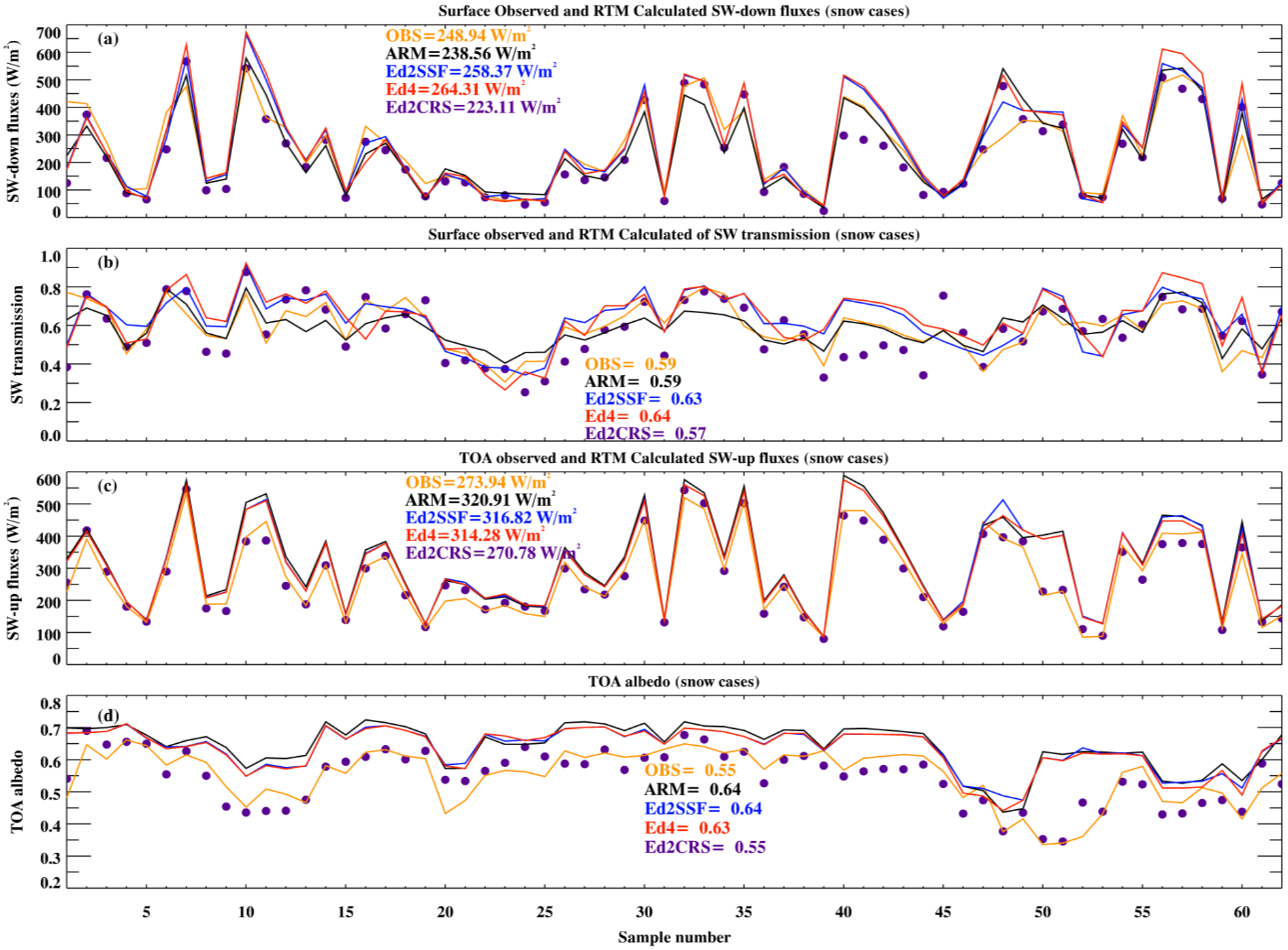


AQUA

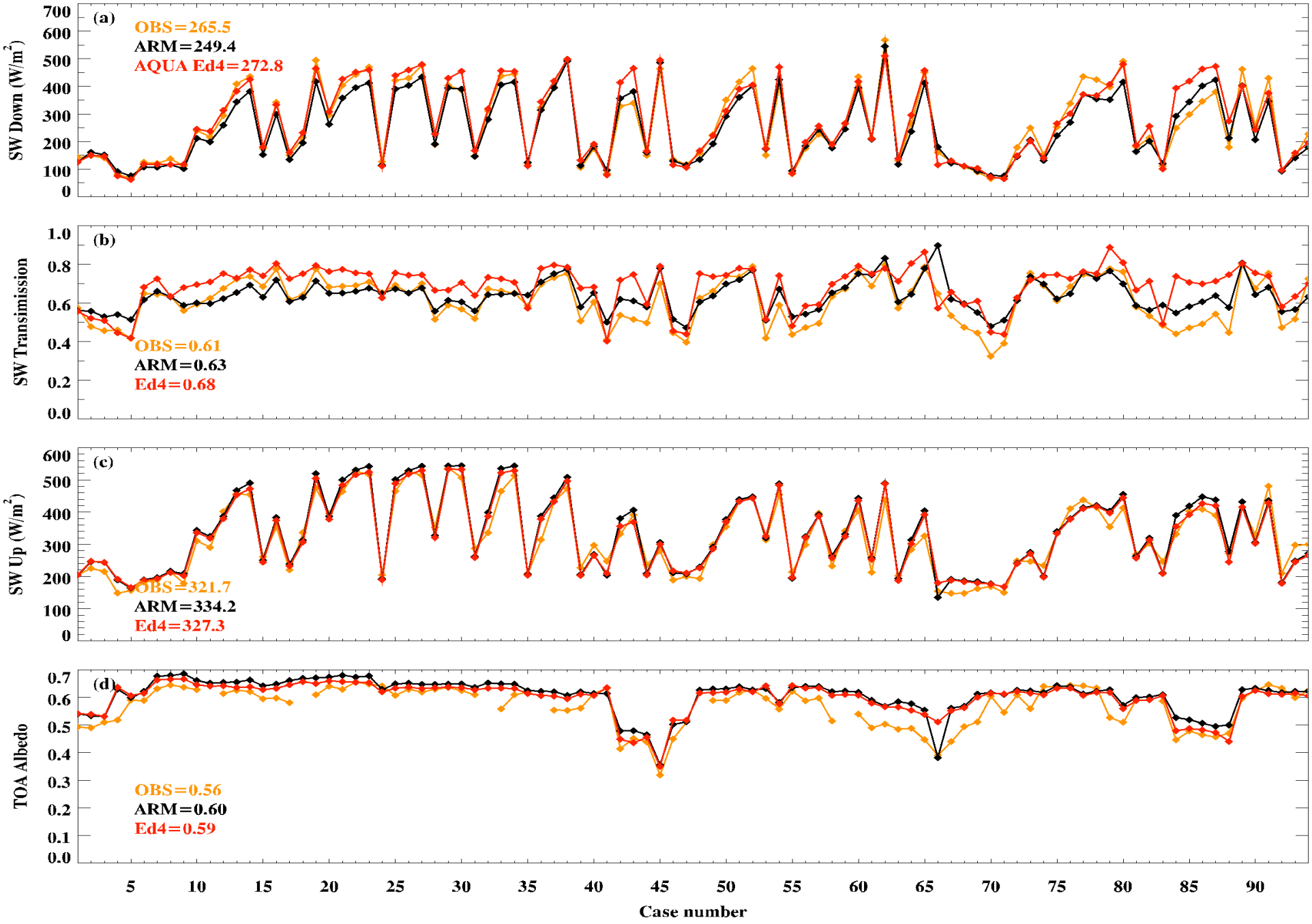


1) **Terra: ARM re=8.7 vs. Ed4=13.4 um, ARM tau=15.5 vs. 12.3, ARM LWP=90.8 vs. 115.5 gm^{-2}**
2) **Aqua: ARM re=8.3 vs. Ed4=13.2 um, ARM tau=16.6 vs. 11.6, ARM LWP=92.3 vs. 101.9 gm^{-2}**

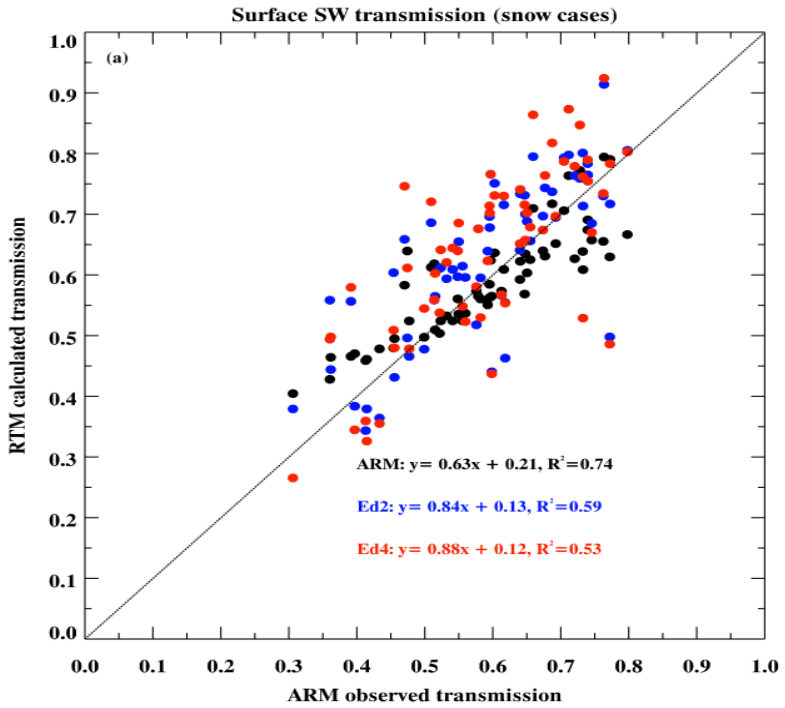
TERRA surface transmission and TOA albedo

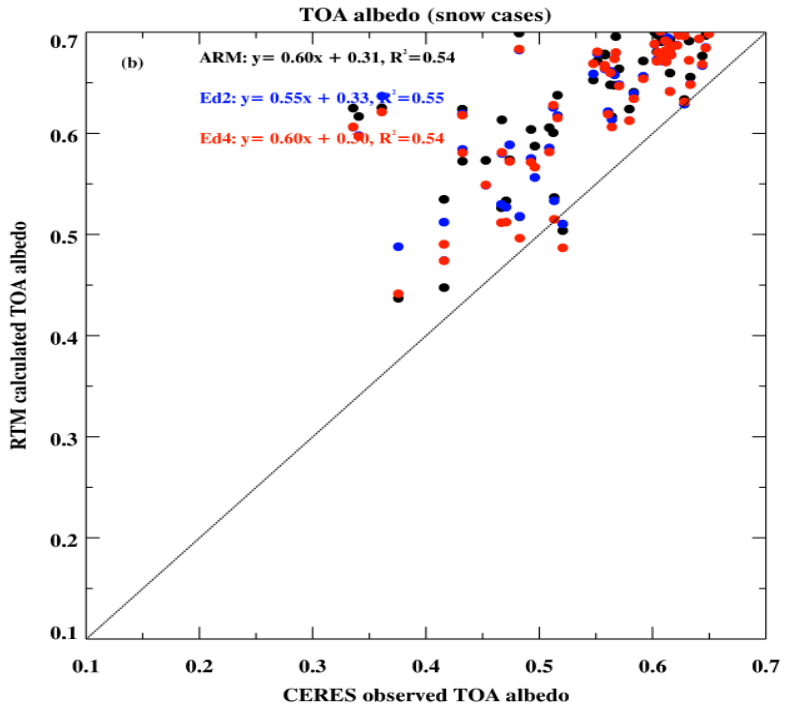


AQUA surface transmission and TOA albedo

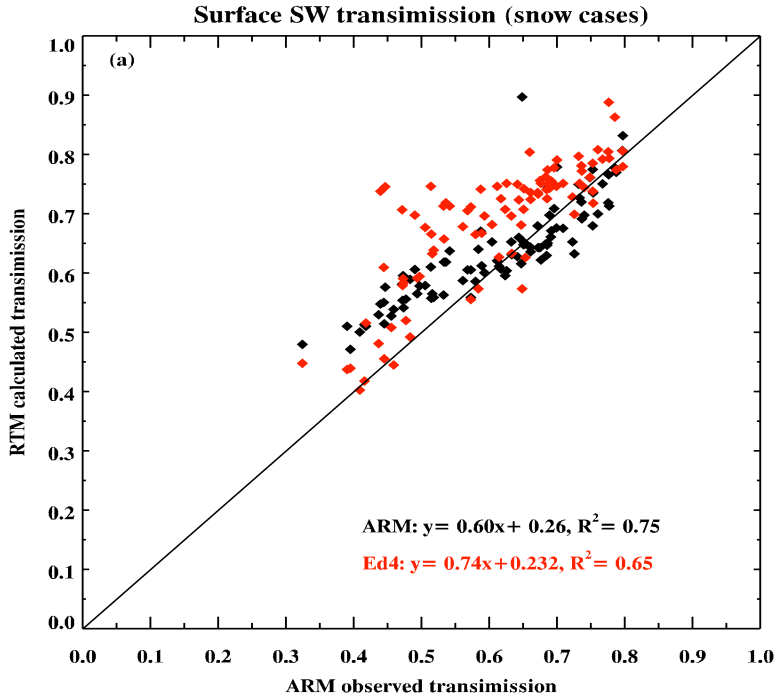


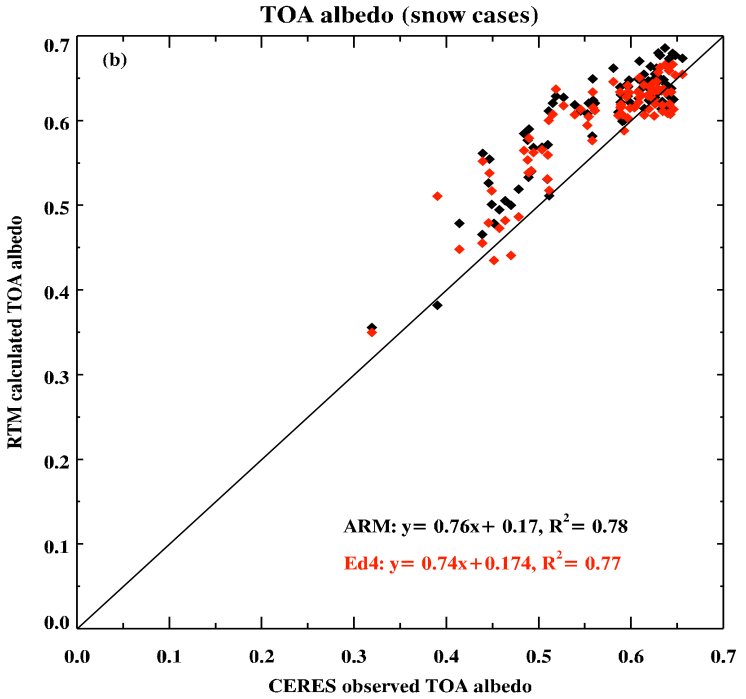
TERRA


Surface SW transmission (snow cases)
(a)
RTM calculated transmission
ARM observed transmission
ARM: y= 0.63x + 0.21, R²=0.74
Ed2: y= 0.84x + 0.13, R²=0.59
Ed4: y= 0.88x + 0.12, R²=0.53


TOA albedo (snow cases)
(b)
ARM: y= 0.60x + 0.31, R²=0.54
Ed2: y= 0.55x + 0.33, R²=0.55
Ed4: y= 0.60x + 0.30, R²=0.54
RTM calculated TOA albedo
CERES observed TOA albedo

AQUA


Surface SW transimission (snow cases)
(a)
RTM calculated transimission
ARM observed transimission
ARM: y= 0.60x+ 0.26, R²= 0.75
Ed4: y= 0.74x+0.232, R²= 0.65


TOA albedo (snow cases)
(b)
RTM calculated TOA albedo
CERES observed TOA albedo
ARM: y= 0.76x+ 0.17, R²= 0.78
Ed4: y= 0.74x+0.174, R²= 0.77

Summary for snow cases

		Re	Tau	LWP	SFC SW↓cloud	T_{trans}	TOA SW↑	R_{TOA}
TERRA	OBS				248.9	0.59	273.9	0.55
	ARM	8.7	15.5	90.8	228.2	0.60	306.3	0.61
	ED2	13.2	11.5	109.7	247.2	0.64	302.5	0.61
	ED4	13.4	12.3	115.5	252.9	0.64	300.1	0.60
AQUA	OBS				265.5	0.61	321.7	0.56
	ARM	8.3	16.6	92.3	249.4	0.63	334.2	0.60
	ED4	13.2	11.6	101.9	272.8	0.68	327.3	0.59