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Analysis of cloud properties over the VOCALS region from in situ and satellite data and comparison to CAM3.1

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UA-VOCALS

The VAMOS Ocean Cloud Atmosphere Land Study at The University of Arizona

VAMOS Ocean Cloud Atmosphere Land Study

VOCALS

DATA

Experiment or satellite platform	Platform type	Year	Location	Instrumentation for the acquisition of			
				LWP	Cloud fraction	Cloud base	Cloud top
VOCALS	ship	2008	SE Pacific	MW radiometer	ceilometer	ceilometer	MMCR
Stratus cruises	ship	2001, 2003-2007	SE Pacific	MW radiometer	ceilometer	ceilometer	MMCR
ASTEX	surface	1992	N Atlantic	MW radiometer	ceilometer	ceilometer	915-MHz radar
TIWE	surface	1991	Eq. Central Pacific	ceilometer, radar	ceilometer	ceilometer	915-MHz radar
RACE	aircraft	1995	Canada	FSSP			
ASTEX	aircraft	1992	N Atlantic	Hot wire probe			
FIRE	aircraft	1987	NE Pacific	FSSP, 260X			
CloudSat	satellite	2006-2008	SE Pacific	CPR			
Aqua	satellite	2006-2008	SE Pacific	AMSR-E	MODIS		
CALIPSO	satellite	2006-2008	SE Pacific			CALIOP	CALIOP
DMSP	satellite	2006-2008	SE Pacific	SSM/I			

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The VAMOS Oc
at The Univers

The importance of the ma
atmosphere-ocean couple
However, the simulation
Coupled Forecast Syster
VOCALS Modeling Plan
VOCALS and previous fi
these issues through two

- to integrate in-situ
  boundary layer (M
- to evaluate and im

To this end, we have per

- A satellite intercor
- A multi-platform c
- A budget analysis

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Satellite Intercomparison | Multi-Platform Comparison

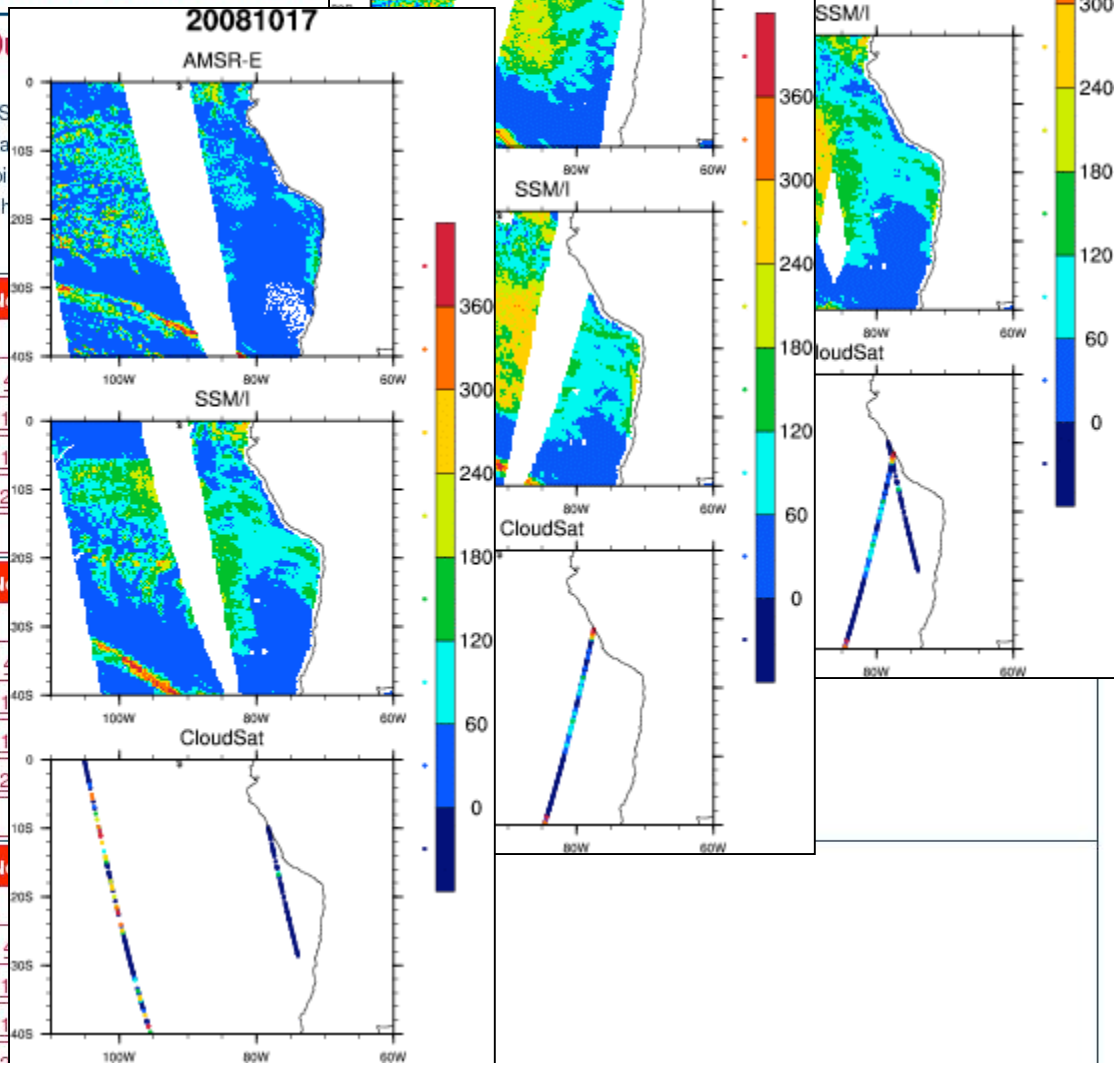
Satellite Intercomparison of LWP D

Presented here are plots of mean daily LWP (g/m^2) from AMS
(F13 and F15). AMSR-E and SSM/I are compared to CloudSa
separately are averaged together and shown at the middle poi
the total number of profiles in OND 2008. Generally, LWP is h
AMSR-E and SSM/I.

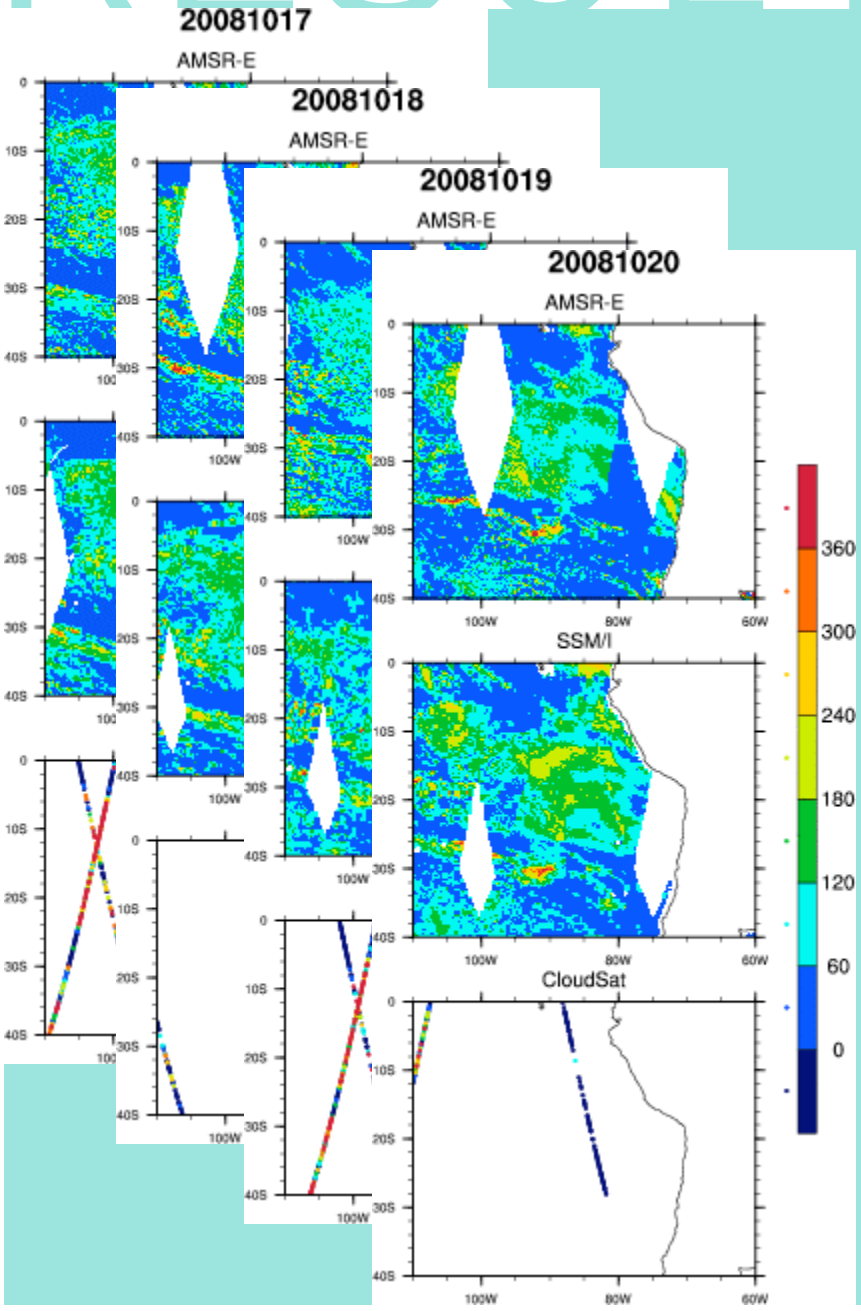
	October							N		
Morning				1	2	3	4			
	5	6	7	8	9	10	11	2	3	4
	12	13	14	15	16	17	18	9	10	1
	19	20	21	22	23	24	25	16	17	1
	26	27	28	29	30	31		23	24	2
								30		

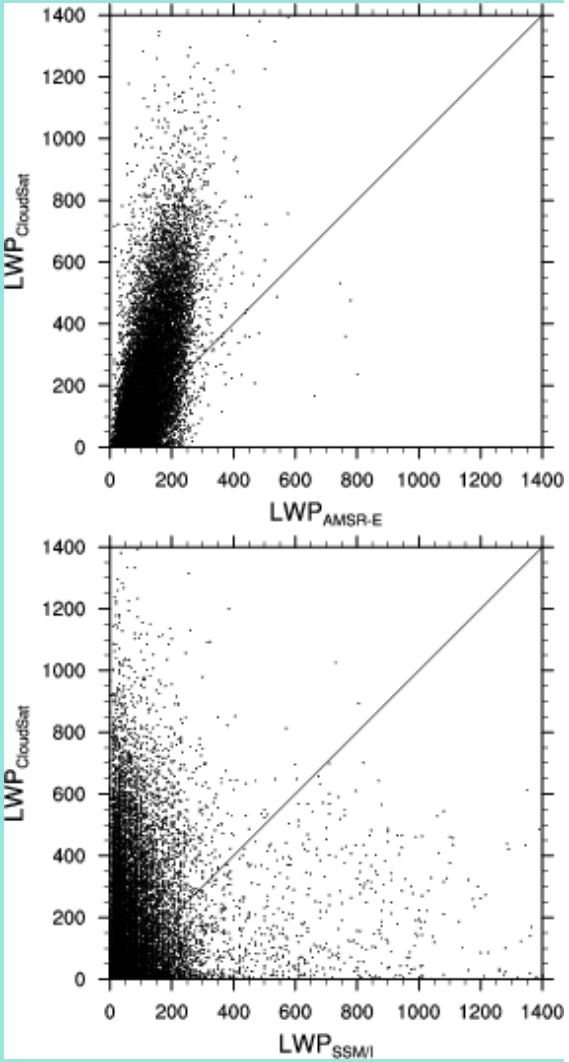
	October							N		
Afternoon				1	2	3	4			
	5	6	7	8	9	10	11	2	3	4
	12	13	14	15	16	17	18	9	10	1
	19	20	21	22	23	24	25	16	17	1
	26	27	28	29	30	31		23	24	2
								30		

	October							N		
Composites				1	2	3	4			
	5	6	7	8	9	10	11	2	3	4
	12	13	14	15	16	17	18	9	10	1
	19	20	21	22	23	24	25	16	17	1



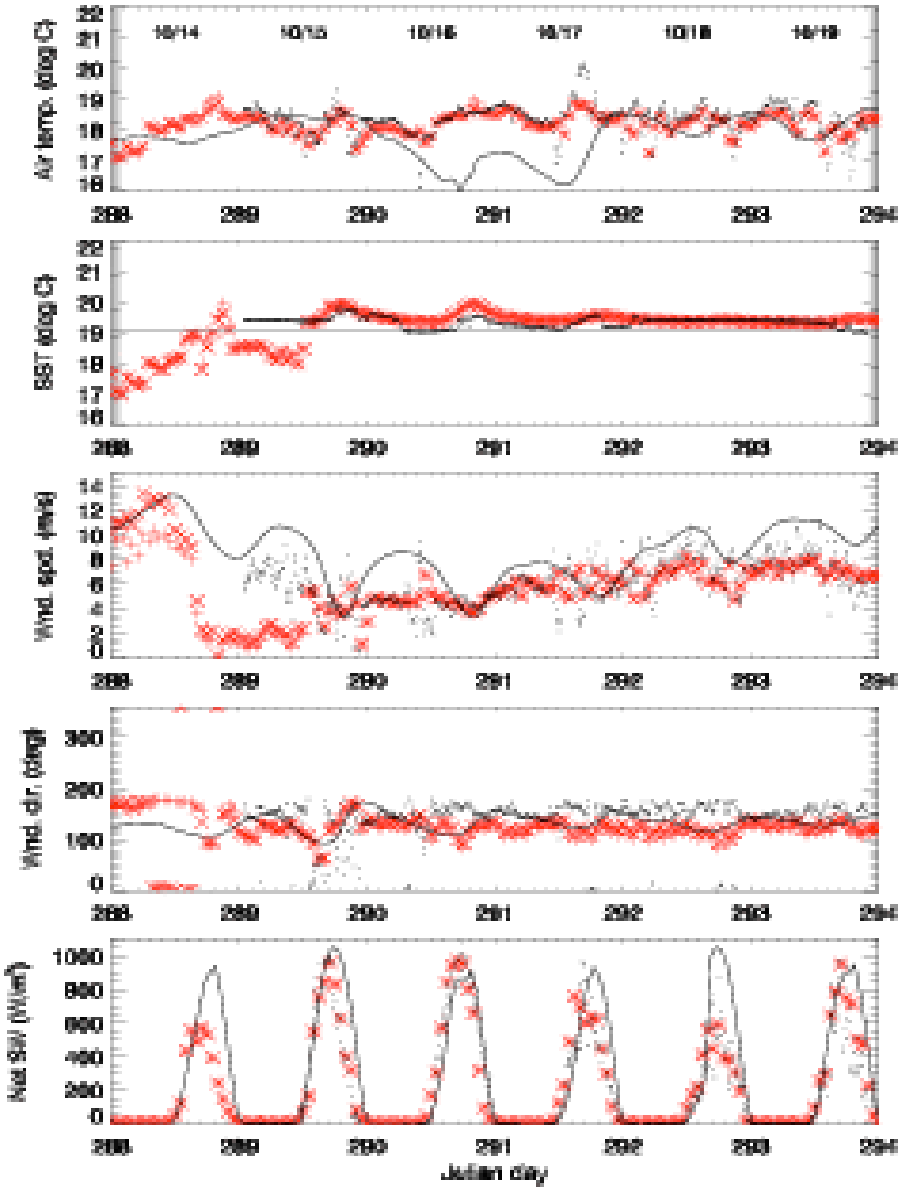
RESULTS

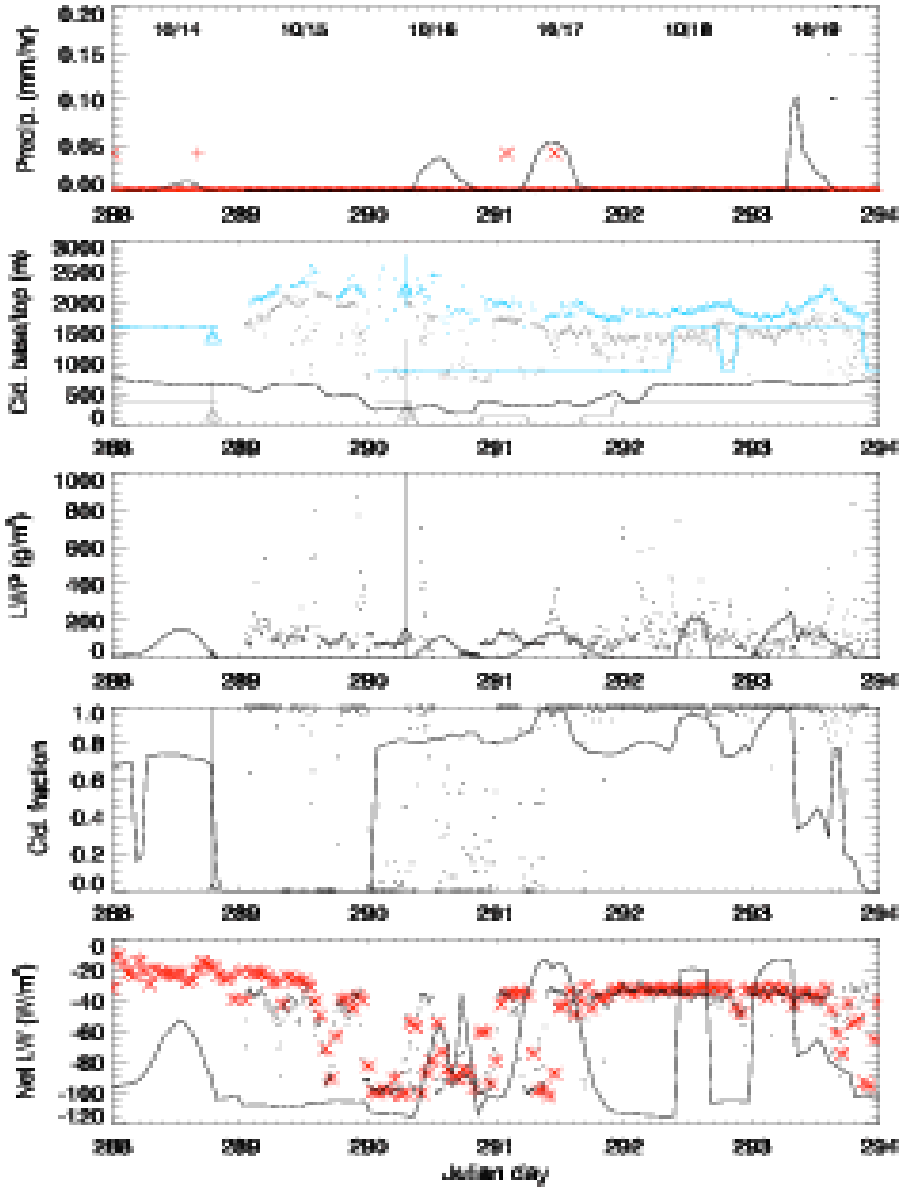




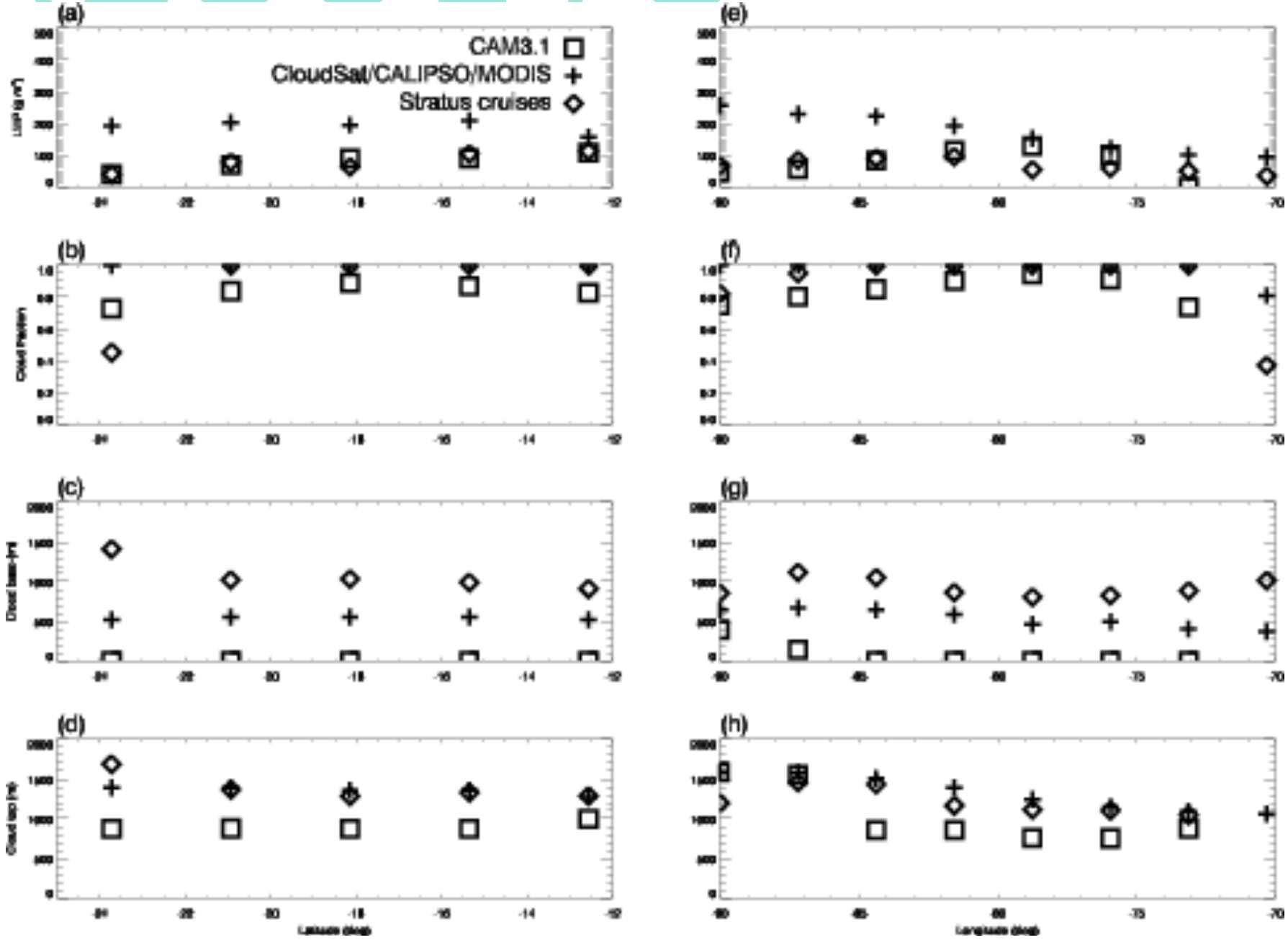
- CloudSat LWP > AMSR-E LWP > SSM/I LWP (even when precip. removed)

RESULTS


10/14
10/15
10/16
10/17
10/18
10/19
Air temp. (deg C)
SST (deg C)
Wind. spd. (m/s)
Wind. dir. (deg)
Net SW (W/m²)
Julian day


10/14
10/15
10/16
10/17
10/18
10/19
Precip. (mm/hr)
Cld. base/top (m)
LWP (g/m²)
Cld. fraction
Net LW (W/m²)
Julian day

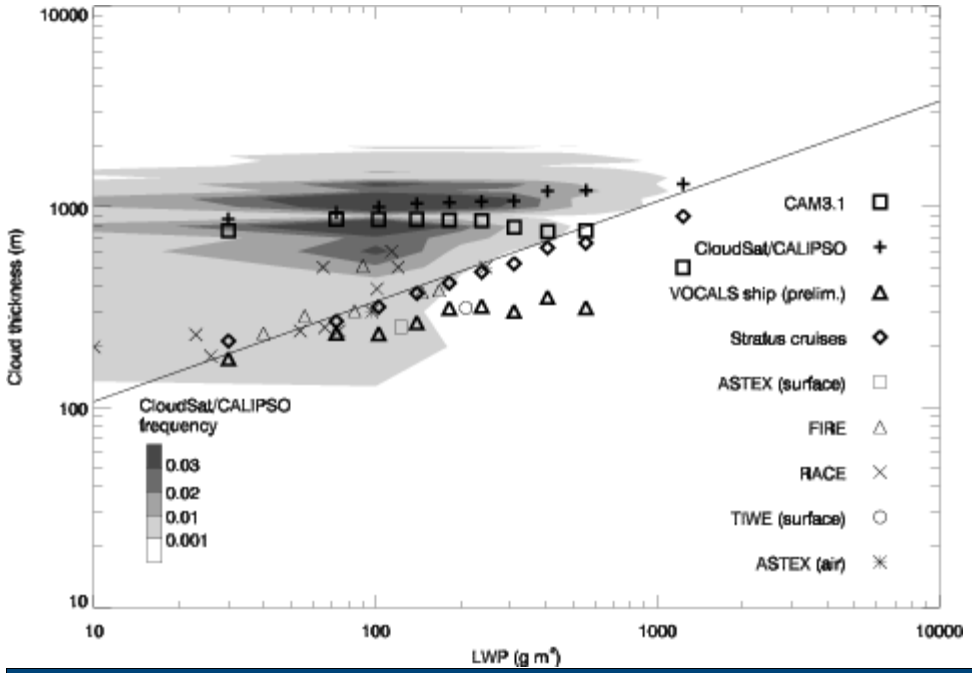
RESULTS

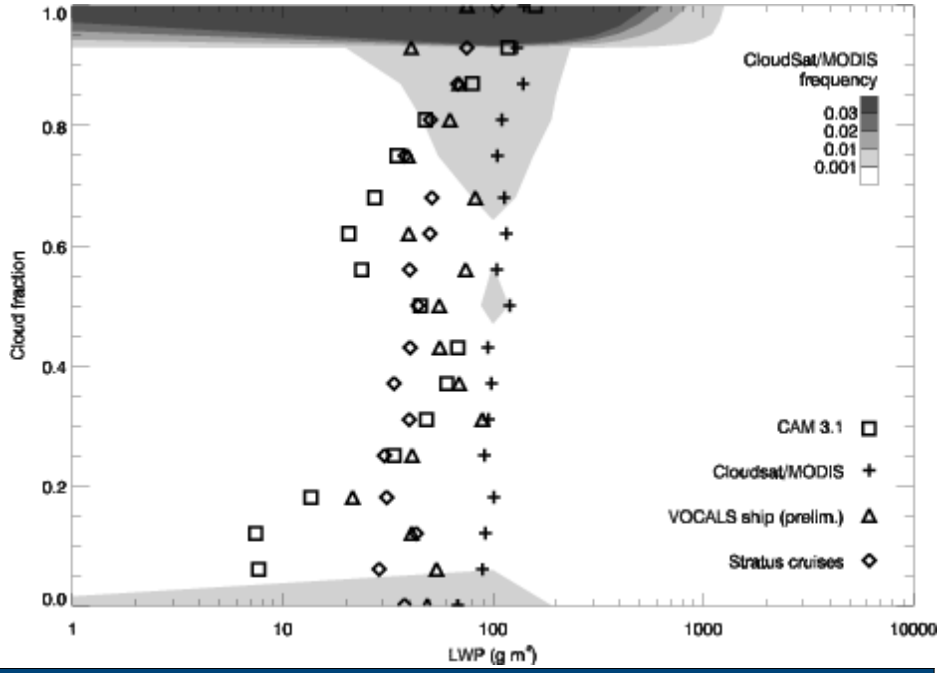


RESULTS

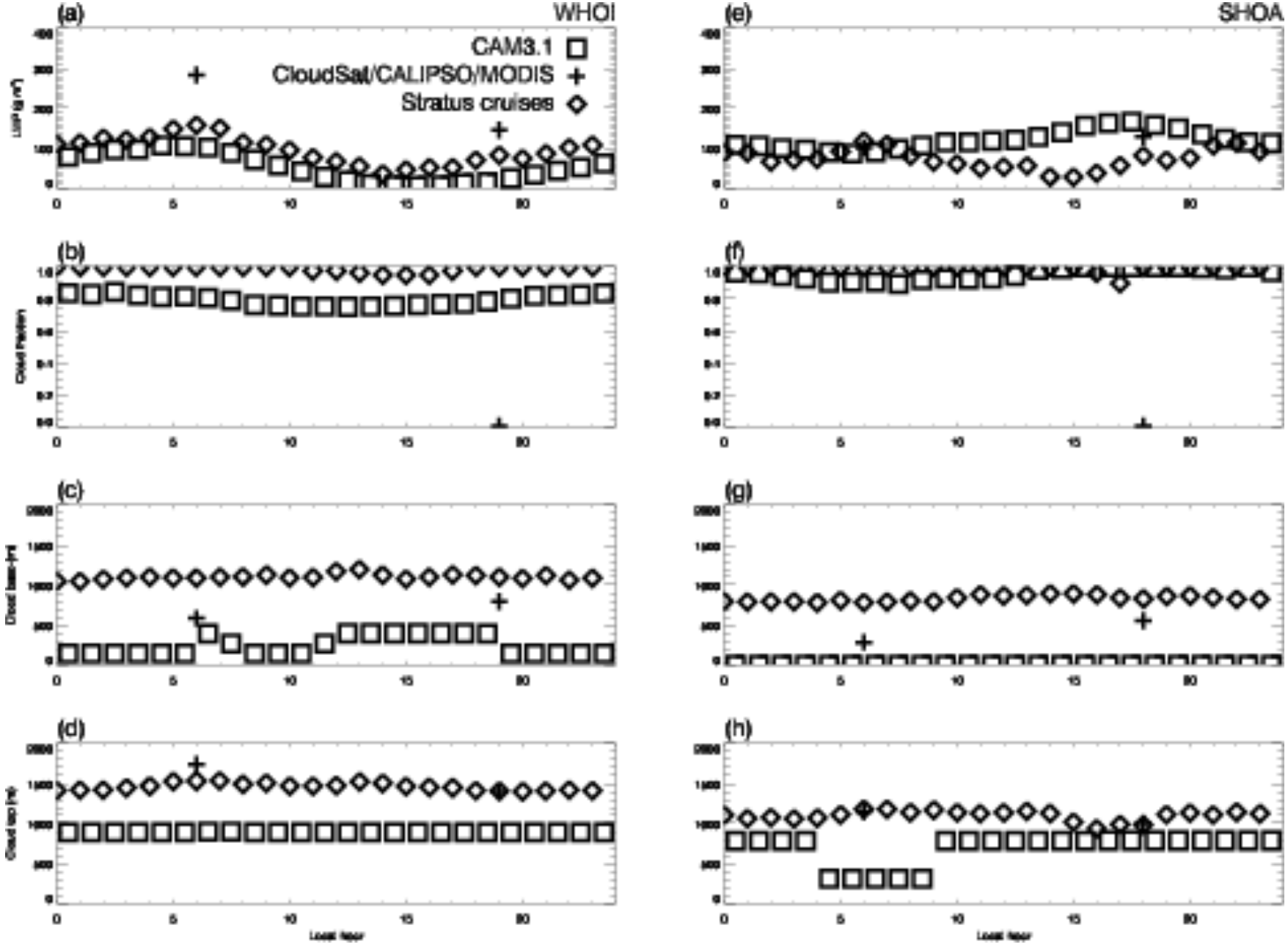
Comparison of LWP relationships

- CloudSat/CALIPSO/MODIS have different relationships than in situ obs.
- CAM3.1 thickness lowest at very high LWP.





RESULTS


(a)
WHOI
CAM3.1
CloudSat/CALIPSO/MODIS
Stratus cruises
(e)
SHOA
(b)
(f)
(c)
(g)
(d)
(h)

CONCLUSIONS

- CloudSat LWP higher than that of older satellite sensors and in situ obs.
- CALIPSO cloud too thick due to lower cloud bases.
- CloudSat/CALIPSO LWP-thickness relationship much different than adiabatic.

- CAM3.1 LWP consistent with in situ obs.
- CAM3.1 clouds too thick and too low.
- CAM3.1's LWP-thickness relationship differs from adiabatic: thickness lowest at very high LWP.
- CAM3.1 CF lower than observed.

- Ship and satellite measurements have diurnal cycle similar to previous studies.
- CAM3.1 captures the diurnal cycle well at WHOI buoy but has an opposite diurnal cycle at the SHOA buoy **(Coupled Ocean-Atmosphere-Land Hypothesis 3)**.

- Paper *only* about the pre-VOCALS ship data in preparation.

FUTURE WORK

- FRACADJ puts f_{Sc} in the highest layer below the inversion *that contains cloud water.* If there is no cloud water below the inversion, f_{Sc} = 0.

- This simple but physically consistent change has a substantial impact on the model.