Greetings from Bob Cess

……

Bob Wins Best in Show !

Congratulations to Bob Cess for his Best in Show win at the 25th Annual Vanderbilt Invitational Concours. The event took place Sunday, August 21st, 2005. Bob won Best in Show for his beautifully restored 1962 Giulietta Spider.

2D cloud structure change and radiative effects over the tropical region during 1998 El Nino

Moguo Sun and Robert Cess
Institute for Terrestrial and Planetary Atmospheres
Stony Brook University

CERES II, 4th STM, Hampton, VA
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Outline

- Motivation
- Data and Method
- 2D Cloud Structure change over both western and eastern equatorial Pacific regions during 1998 El Nino
- CRF Cancellation over tropical western Pacific region
- Summary

Motivation

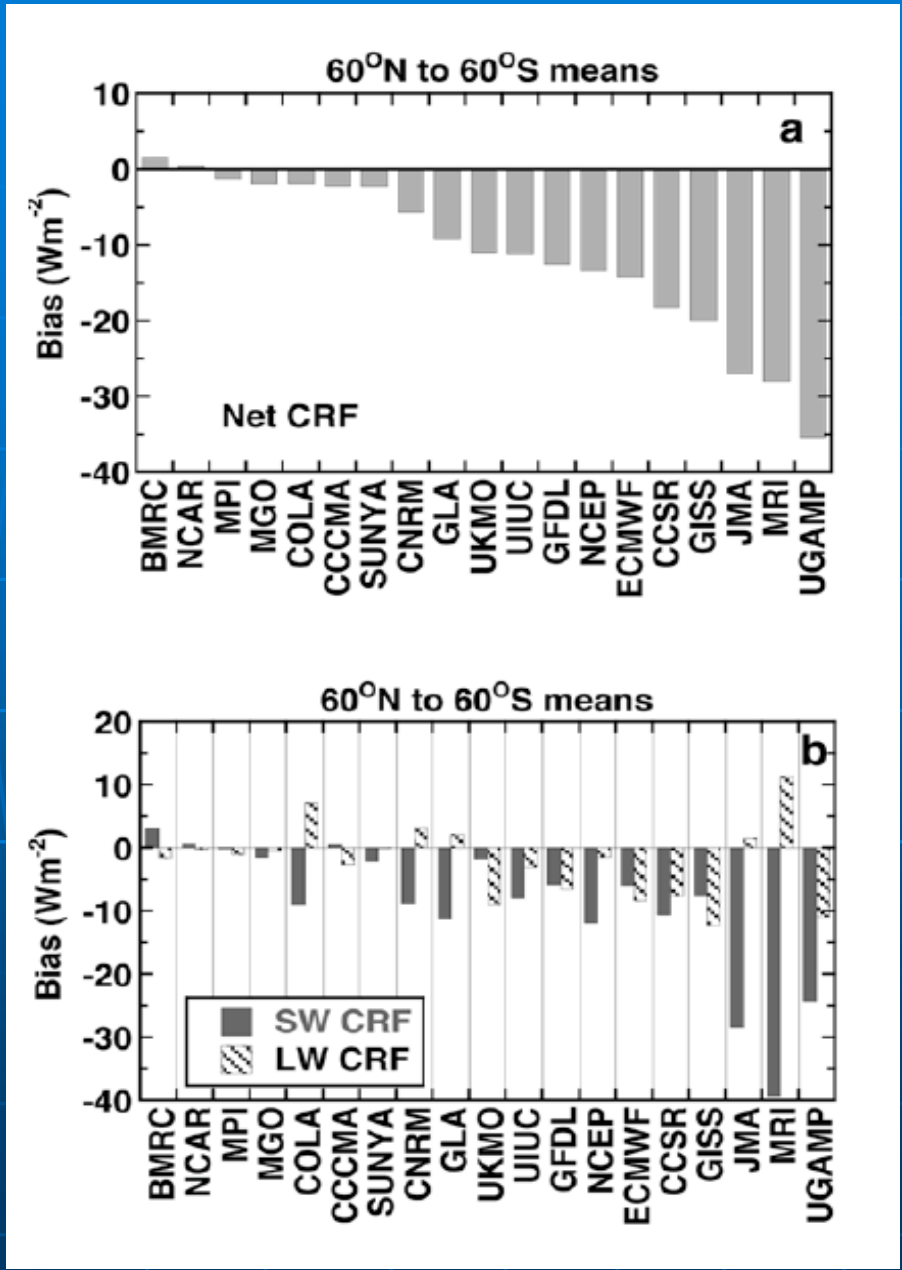


Figure 4. (a) The Net CRF biases, relative to ERBE and averaged from 60°S to 60°N, for each of the 19 GCMs. (b) The same as (a) but for SW and LW CRF biases. (c) The net

Potter, G.L. and R.D. Cess, 2004, JGR

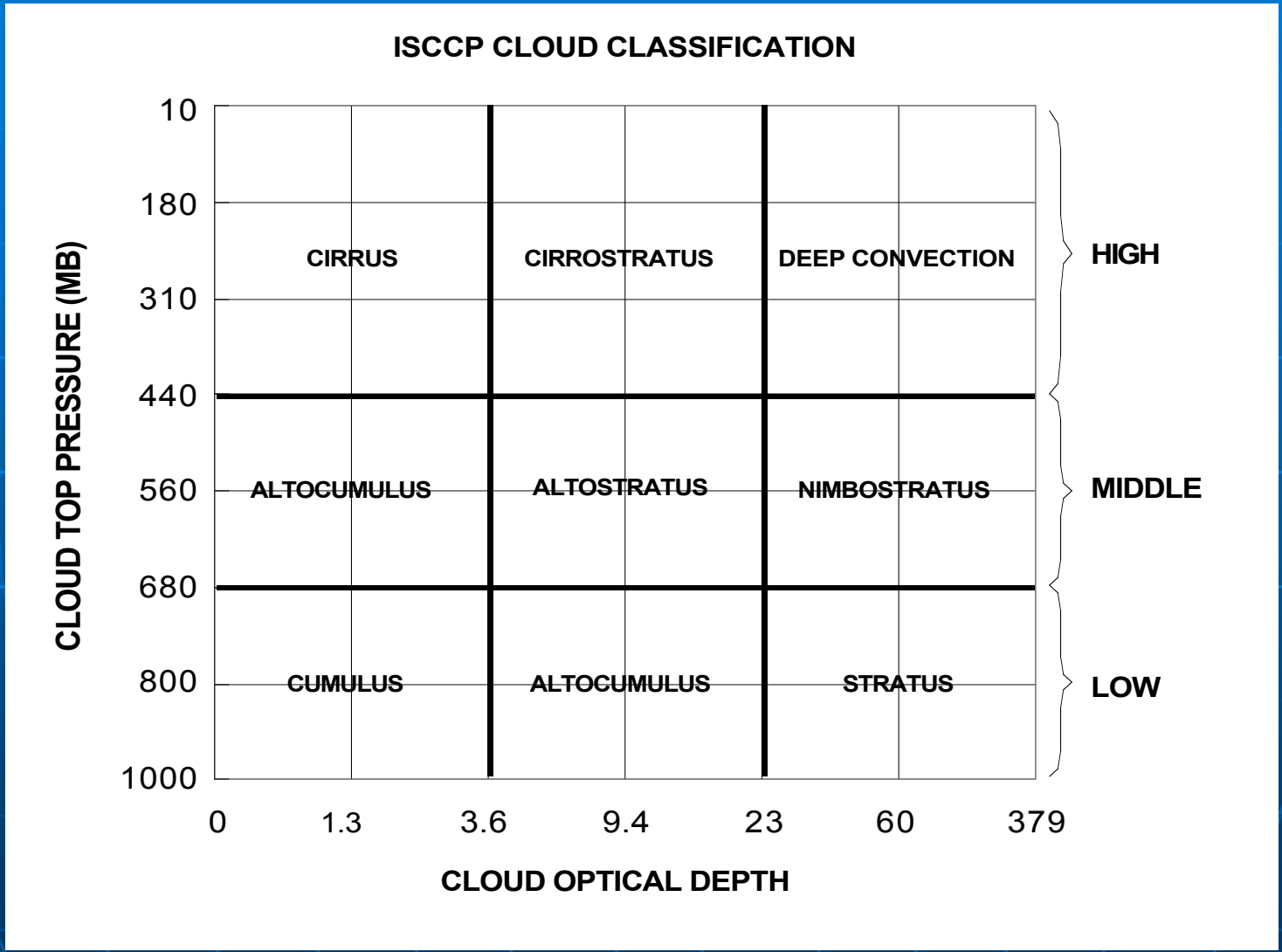
Motivation

"The effort to more quantitatively characterize cloud errors in models has been hampered by the considerable amount of uncertainties of available cloud data. …… cloud radiative forcing (CRF) is a more objective measure. However, CRF only measures the accumulative effects of clouds and therefore it does not necessarily provide the physical insight on particular model biases."

Zhang, M.H. et al., 2005, JGR

To calculate cloud amount of different types and their associated CRFs.

ISCCP Cloud Classification



Data and Method

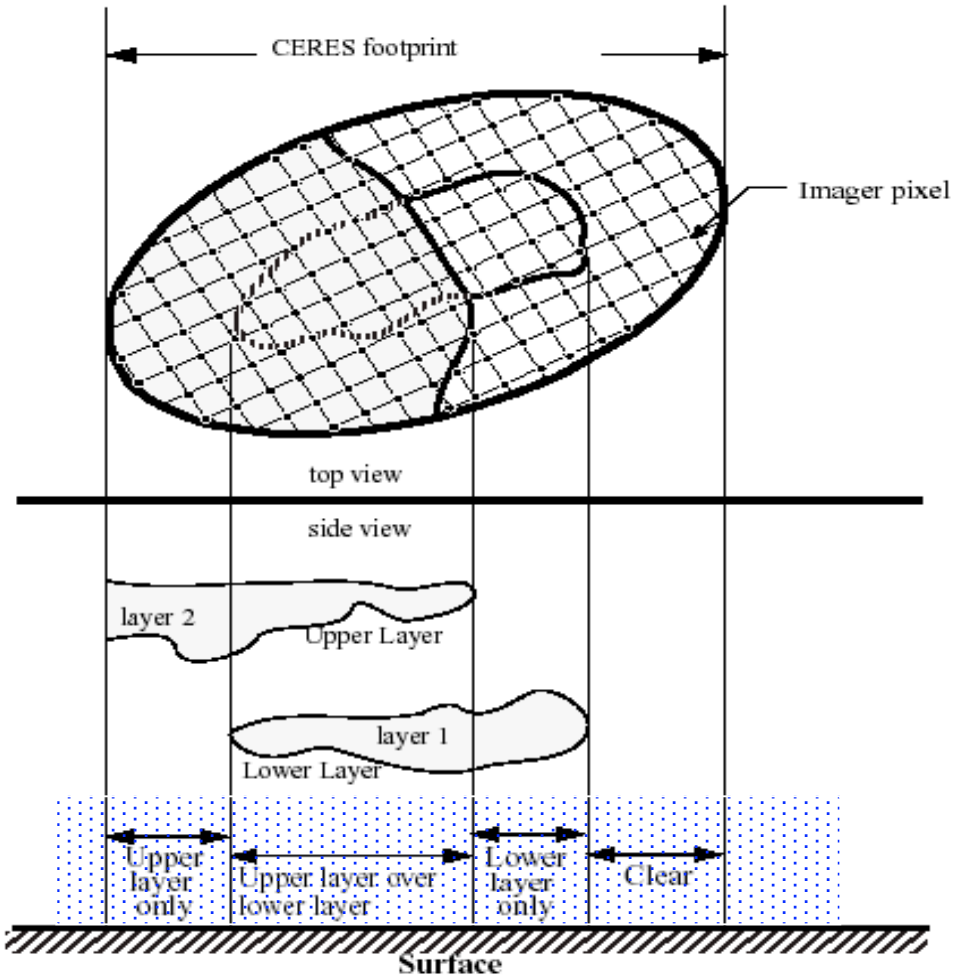


Figure 4-10. CERES Clear/layer/overlap illustration

Data: CERES SSF
SSF_TRMM_Edition2B

4 types of footprints:

- Upper layer cloud only
- Upper layer and lower layer
- Lower layer cloud only
- clear

Cloud fraction

$$f_{kl} = \frac{n_{kl}}{N + N_c}$$

$$= \frac{\sum_{h=1}^{nh} m_{klh}}{\sum_{k,l} n_{kl} + \sum_{h=1}^{nh} n_{ch}}$$

Total pixels for cloud type {k,l} in a 1x1 grid for a month

Total pixels within 1 x 1 grid for a month

f_{kl}: cloud fraction for cloud type {k,l}

$k=1,\ldots,6$

$l=1,\ldots,7$

SWCRF

$$SWCRF_{kl} = S_c - S_{tkl} = f'_{kl}(S_c - S_{kl})$$

$$S_{kl} = \frac{1}{n_{kl}} \sum_{h=1}^{m_{klh}} S_{klh}$$

$$S_c = \frac{1}{n_c} \sum_{h=1}^{m_{ch}} S_{ch}$$

S_{kl} denotes the TOA all-sky reflected SW and S_c that for clear skies

LWCRF

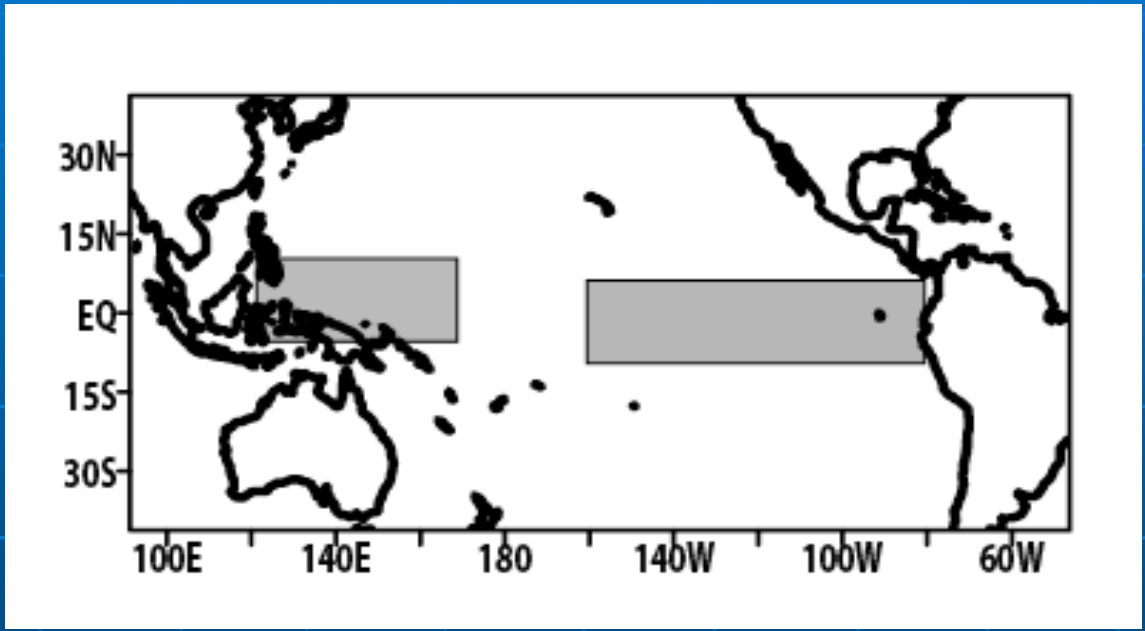
$$LWCRF_{kl} = F_c - F_{tkl} = f'_{kl}(F_c - F_{kl})$$

$$F_{kl} = \frac{1}{n_{kl}} \sum_{h=1}^{m_{klh}} F_{klh}$$

$$F_c = \frac{1}{n_c} \sum_{h=1}^{m_{ch}} F_{ch}$$

F_{kl} and F_c, respectively, denoting the all-sky and clear-sky TOA emitted LW

TWP and EST



TWP: 120E-170E, 5S–10N

EST: 160W-80W, 7.5S-7.5N

Period: 01/98-08/98

97/98 El Nino

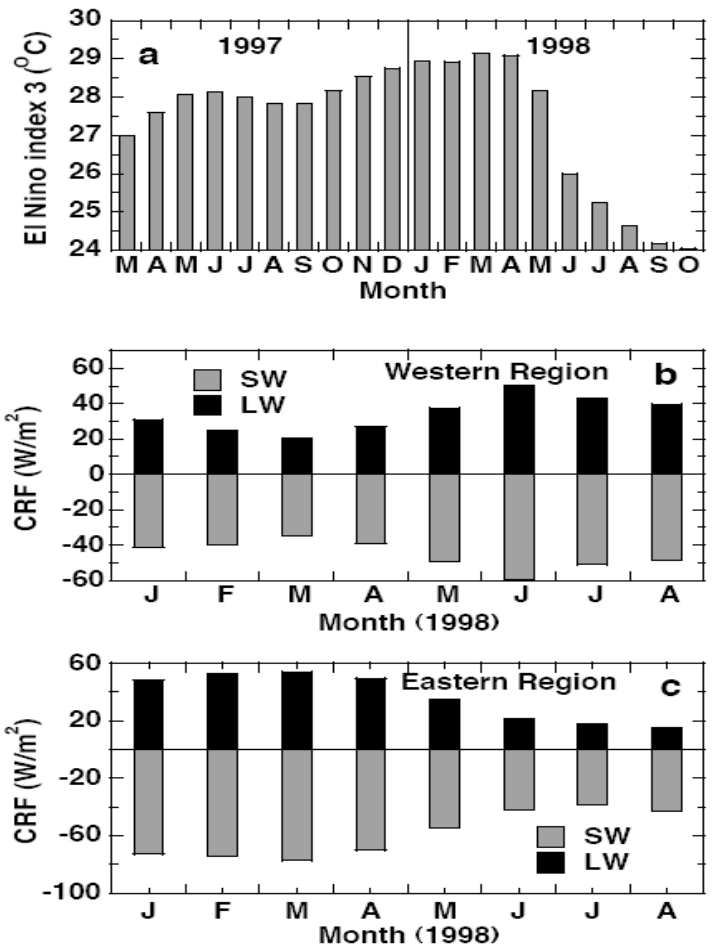
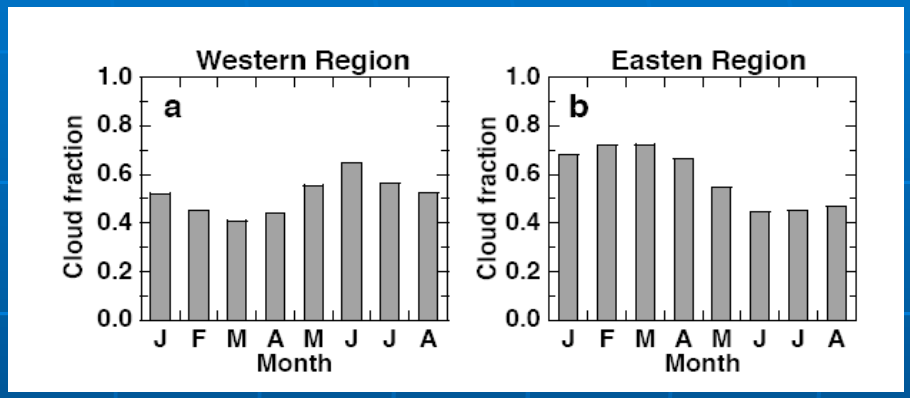
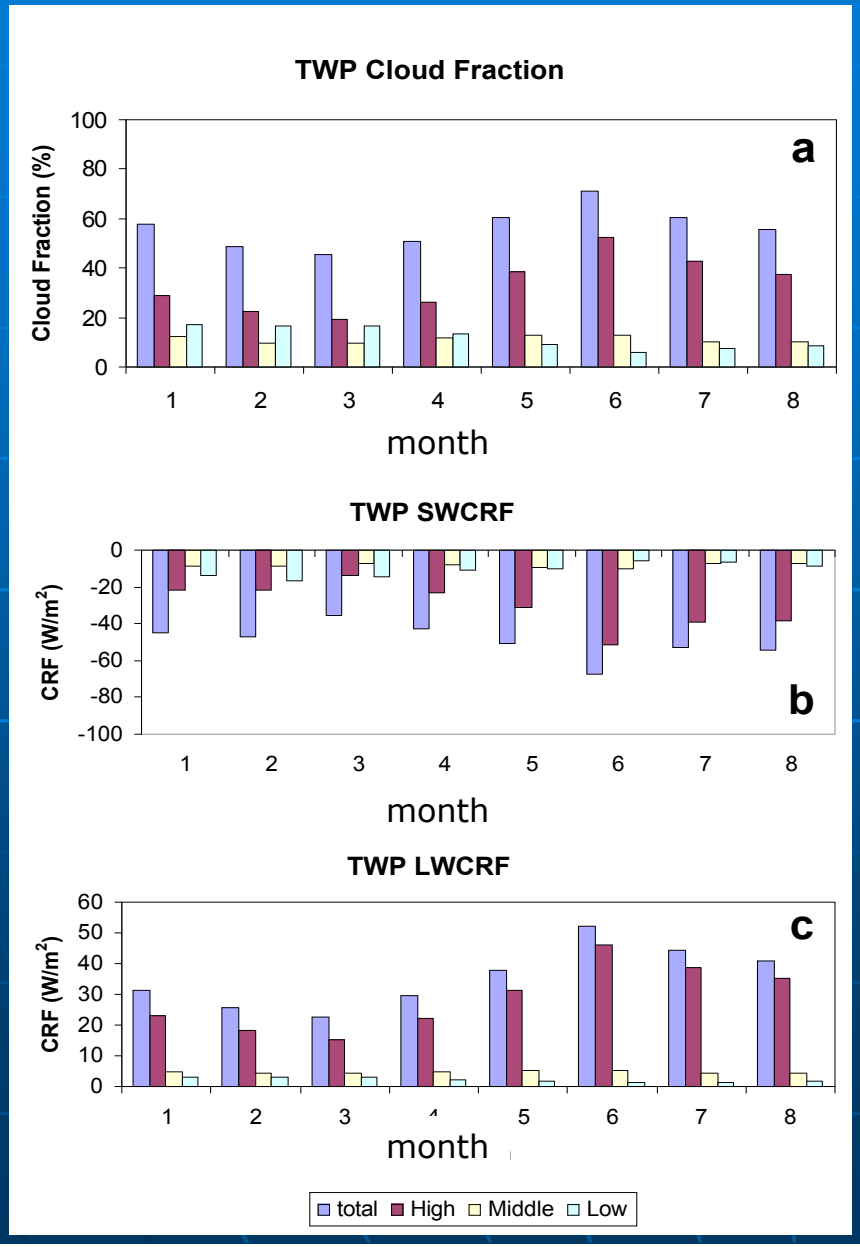


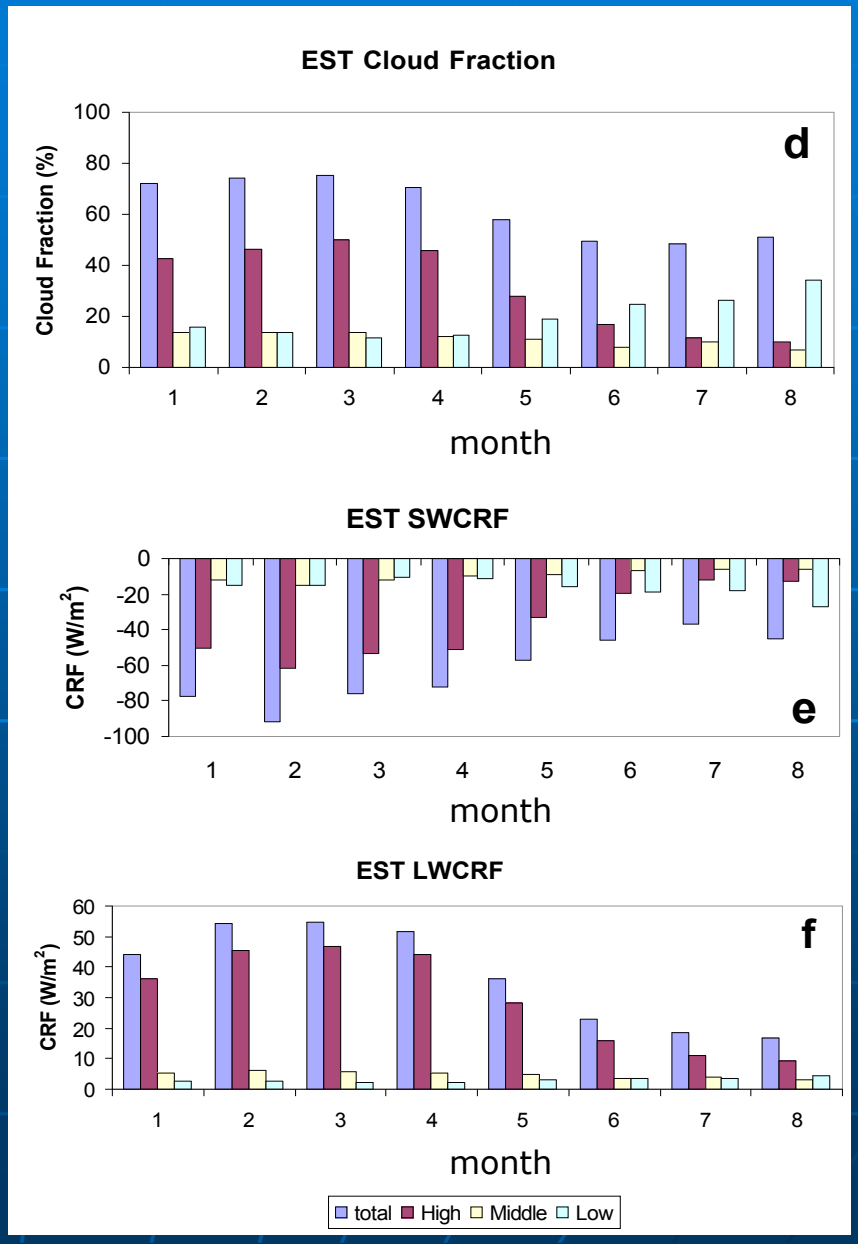
Figure 2



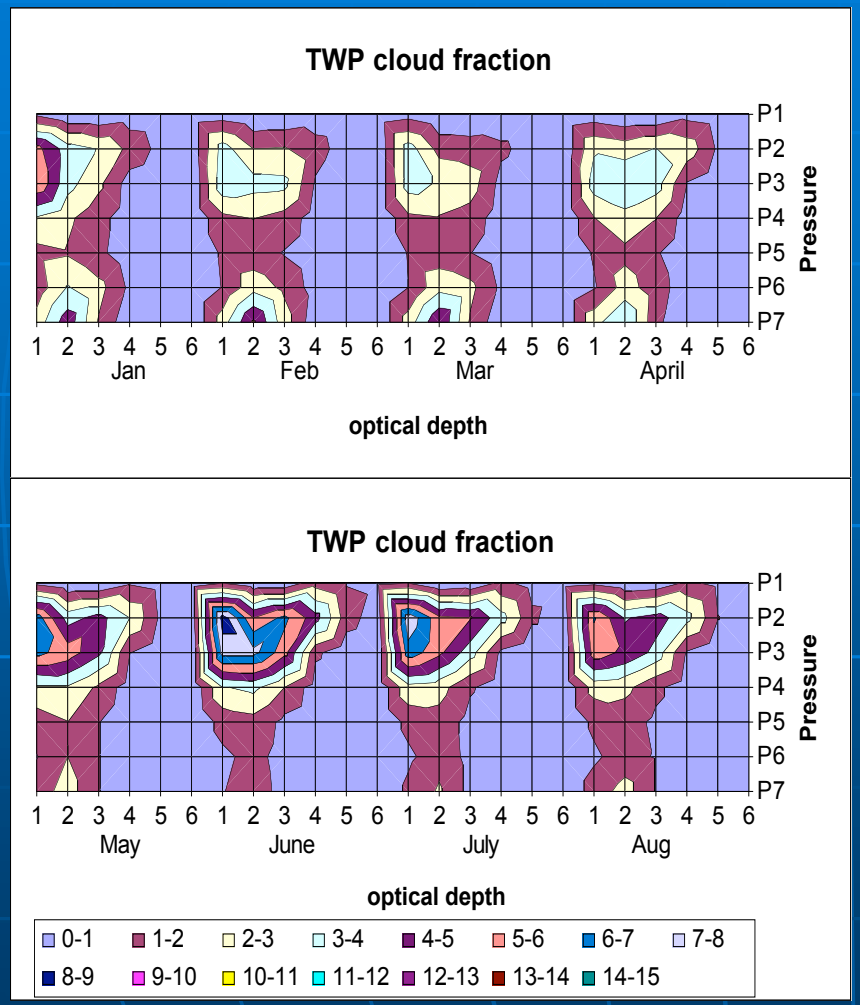
Cess and Sun, JGR, submitted

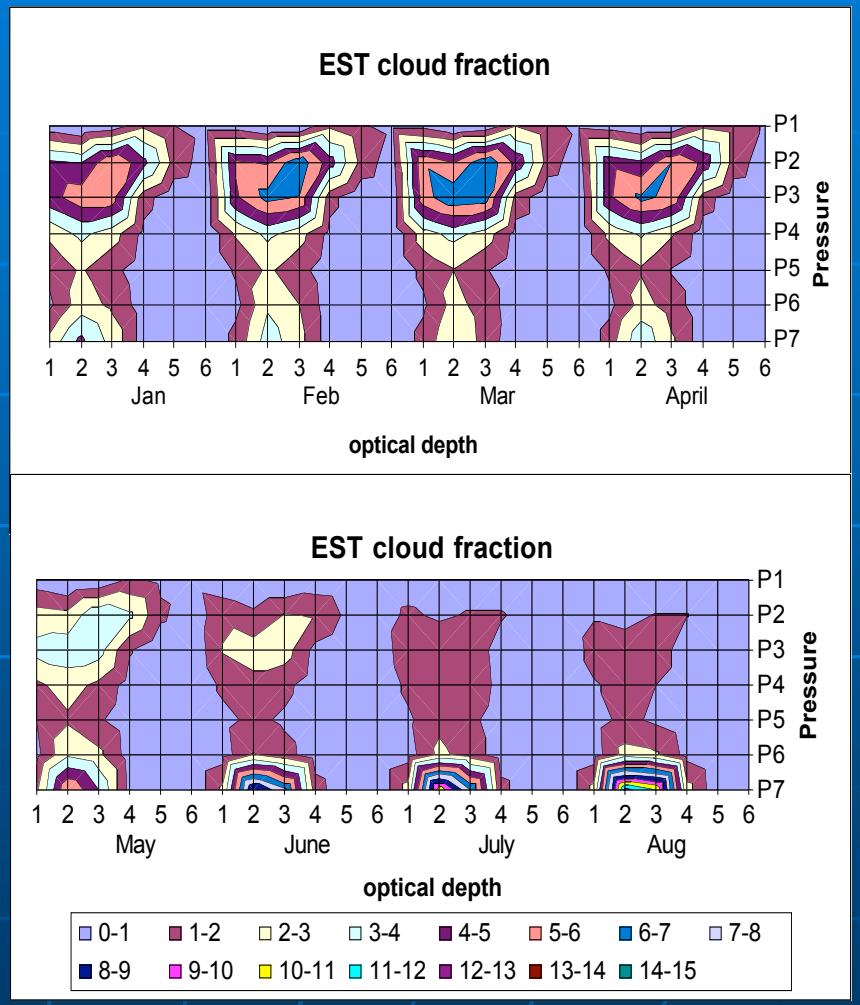
Cloud fraction and CRF





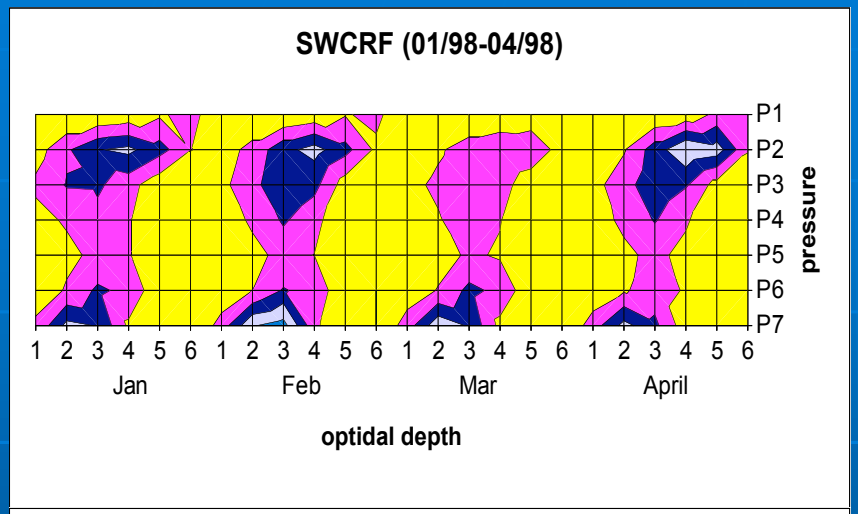
2D ISCCP-like Cloud Structure

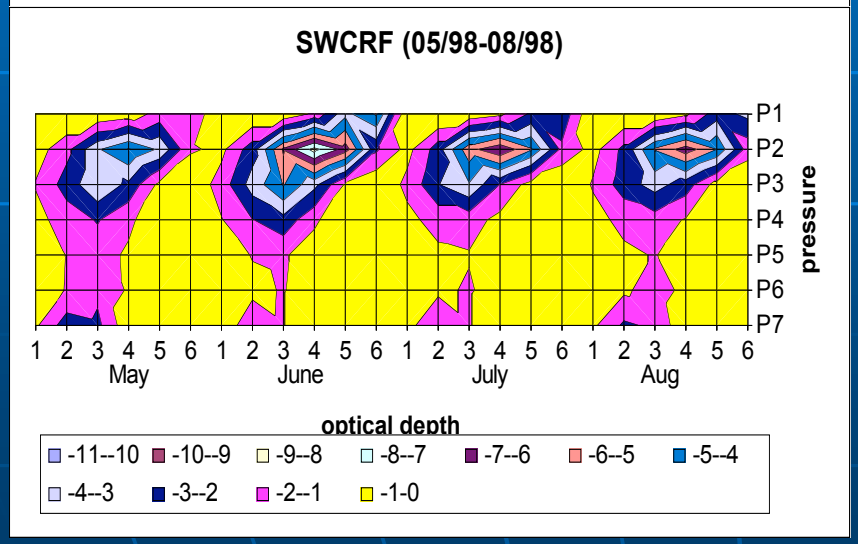


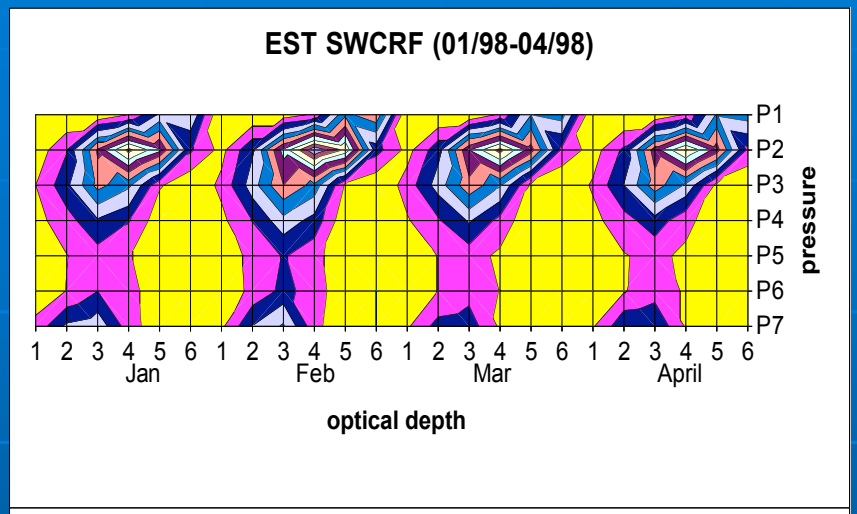


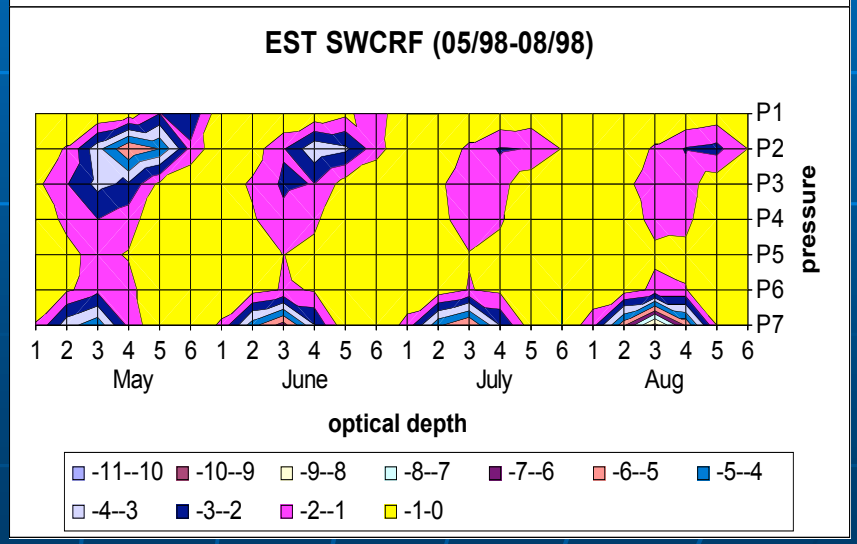
TWP SWCRF

EST SWCRF



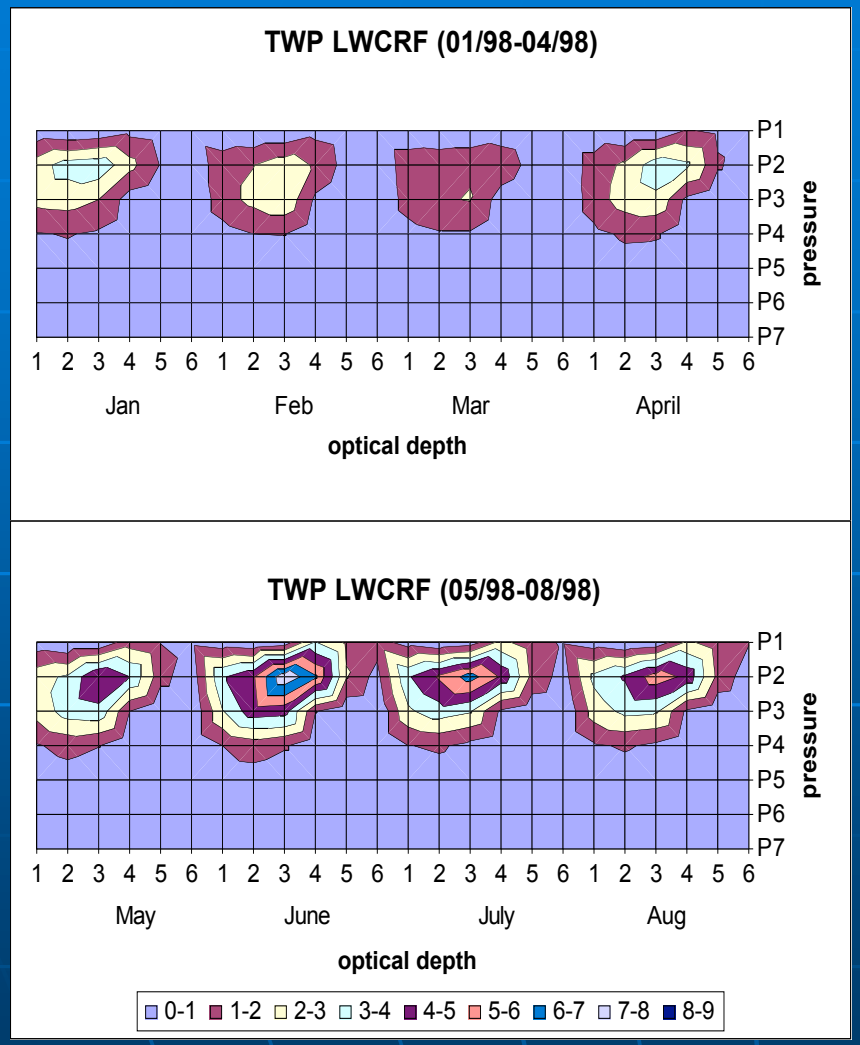


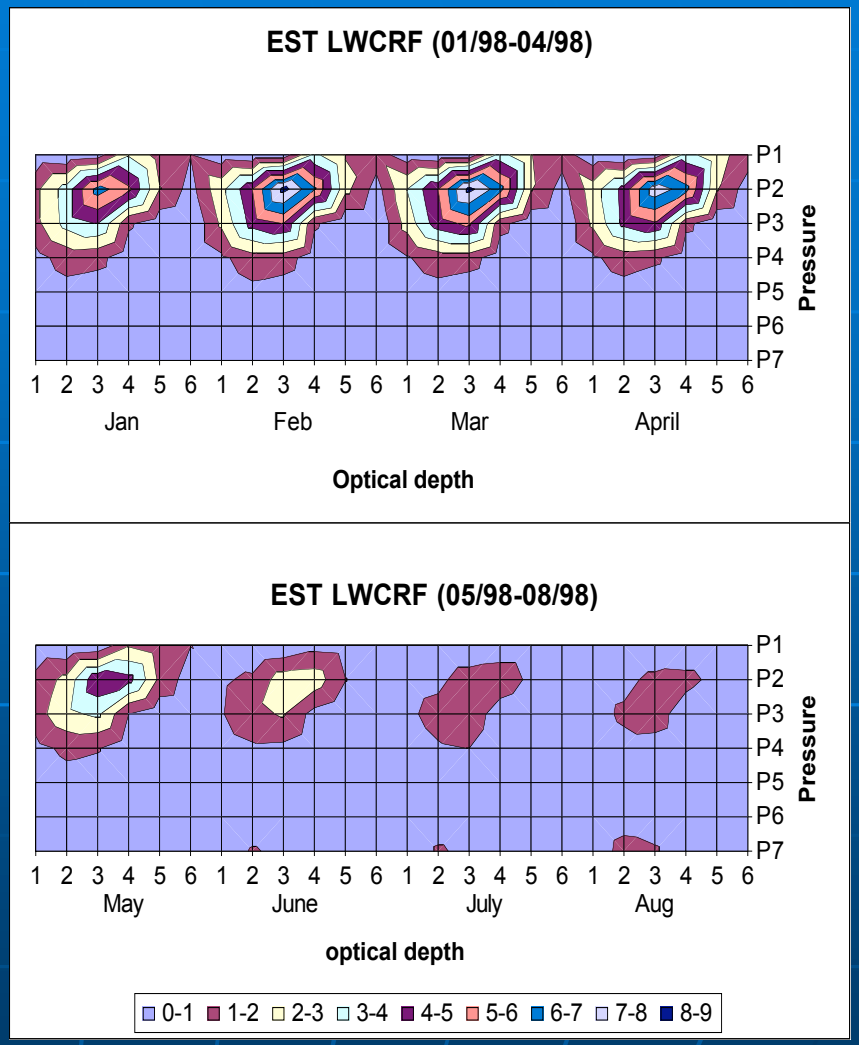




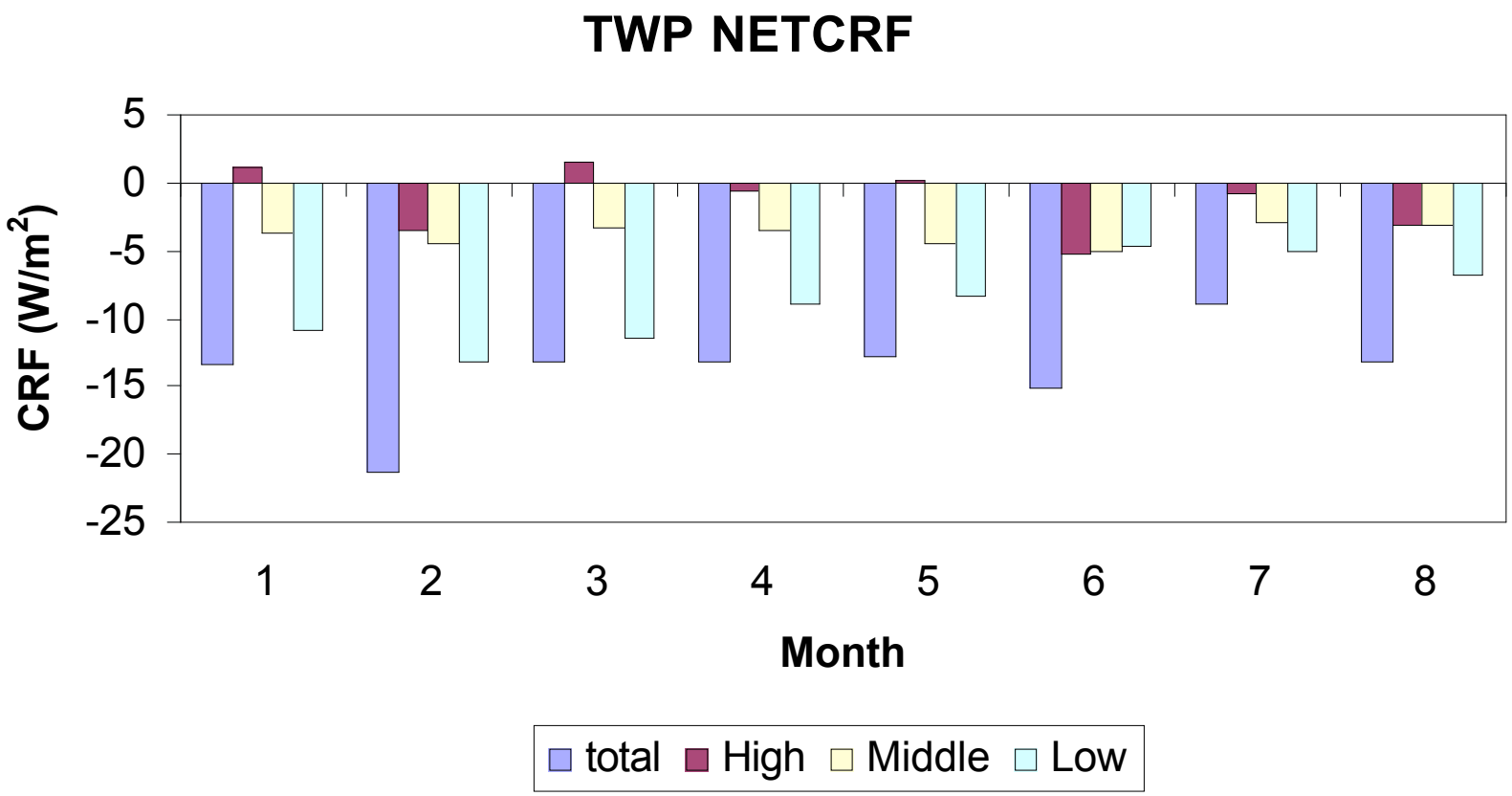
TWP LWCRF

EST LWCRF

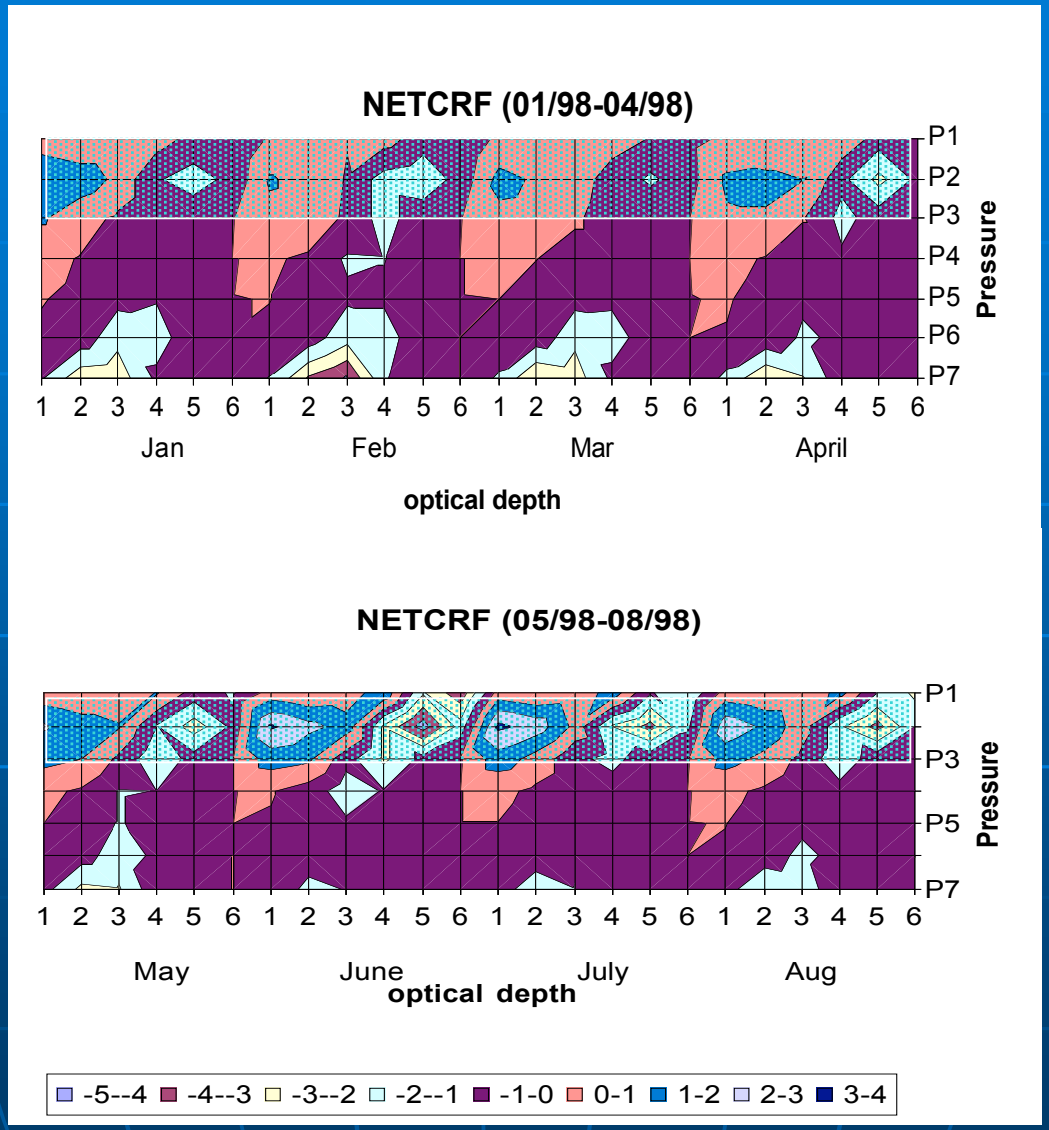




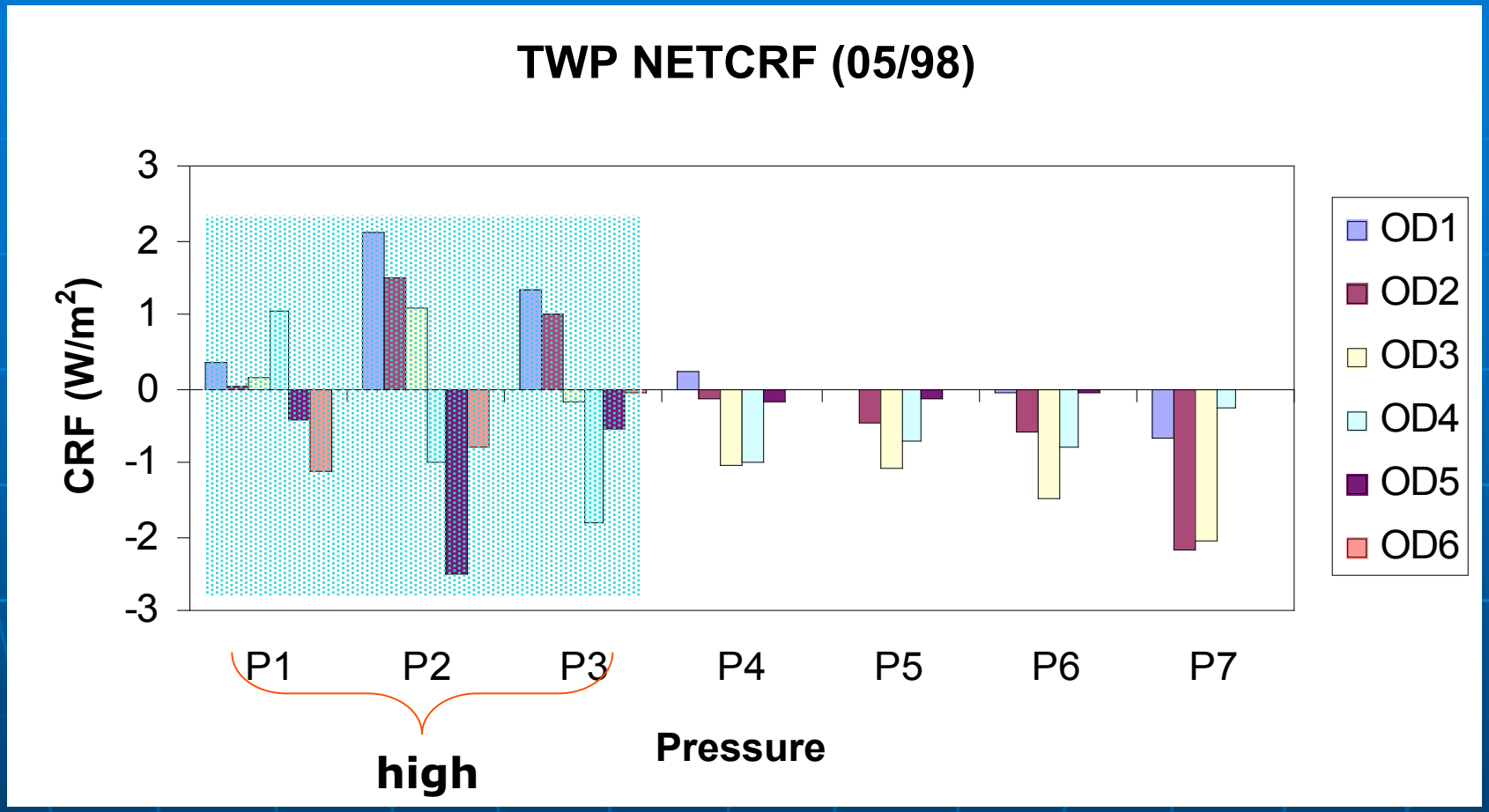
TWP NETCRF


TWP NETCRF
5
0
-5
-10
-15
-20
-25
CRF (W/m2)
1
2
3
4
5
6
7
8
Month
total
High
Middle
Low

TWP NETCRF


NETCRF (01/98-04/98)
P1
P2
P3
P4
P5
P6
P7
Pressure
1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6
Jan
Feb
Mar
April
optical depth
NETCRF (05/98-08/98)
P1
P3
P5
P7
Pressure
1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6 1 2 3 4 5 6
May
June
July
Aug
optical depth
-5--4
-4--3
-3--2
-2--1
-1-0
0-1
1-2
2-3
3-4

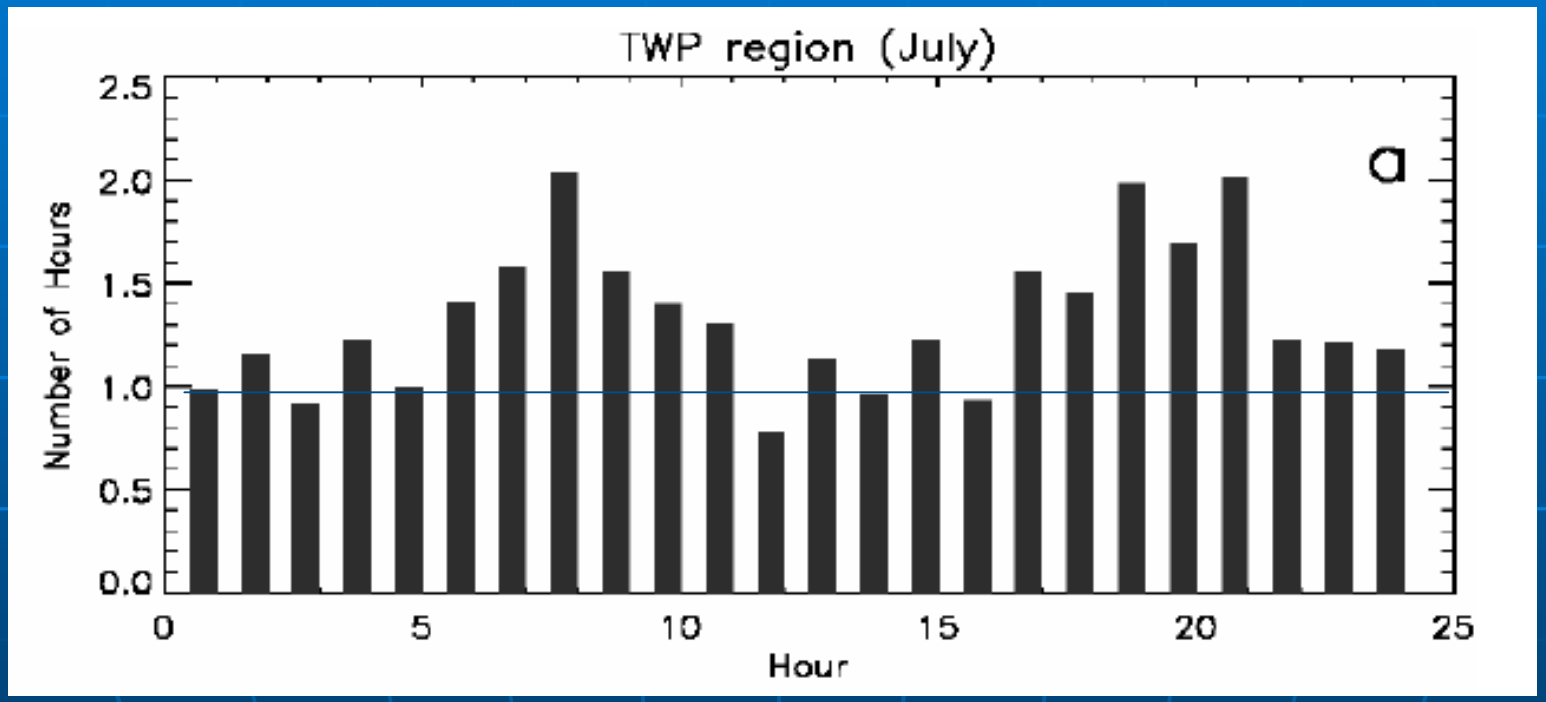
CRF cancellation for high clouds



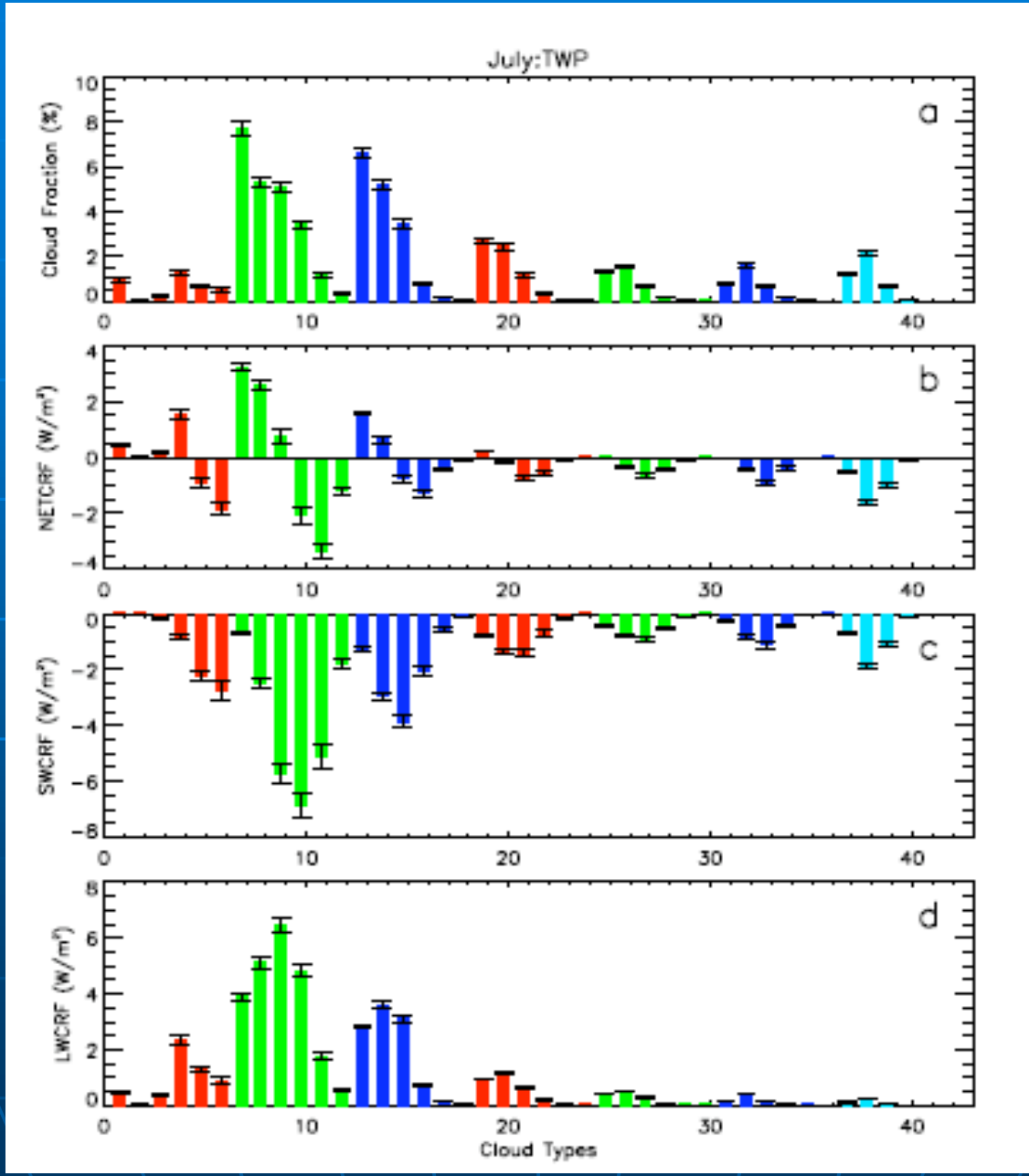
Summary

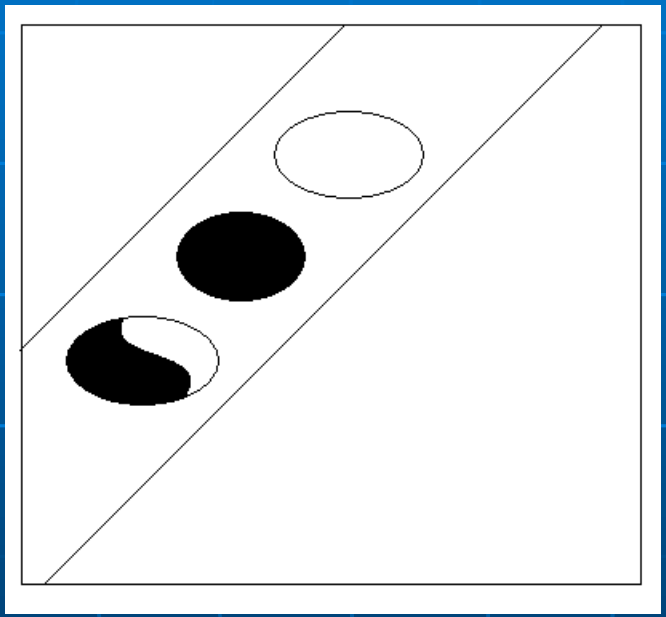
- 2D cloud structure change and their radiative effects over tropical equtorial region during 1998 El Nino are revealed by quantification of ISCCP like sub-cloud type amount and their associated CRFs.
- The quantification helps to better understand radiative effects of different cloud types and CRF cancellations among themselves.

Thank you!



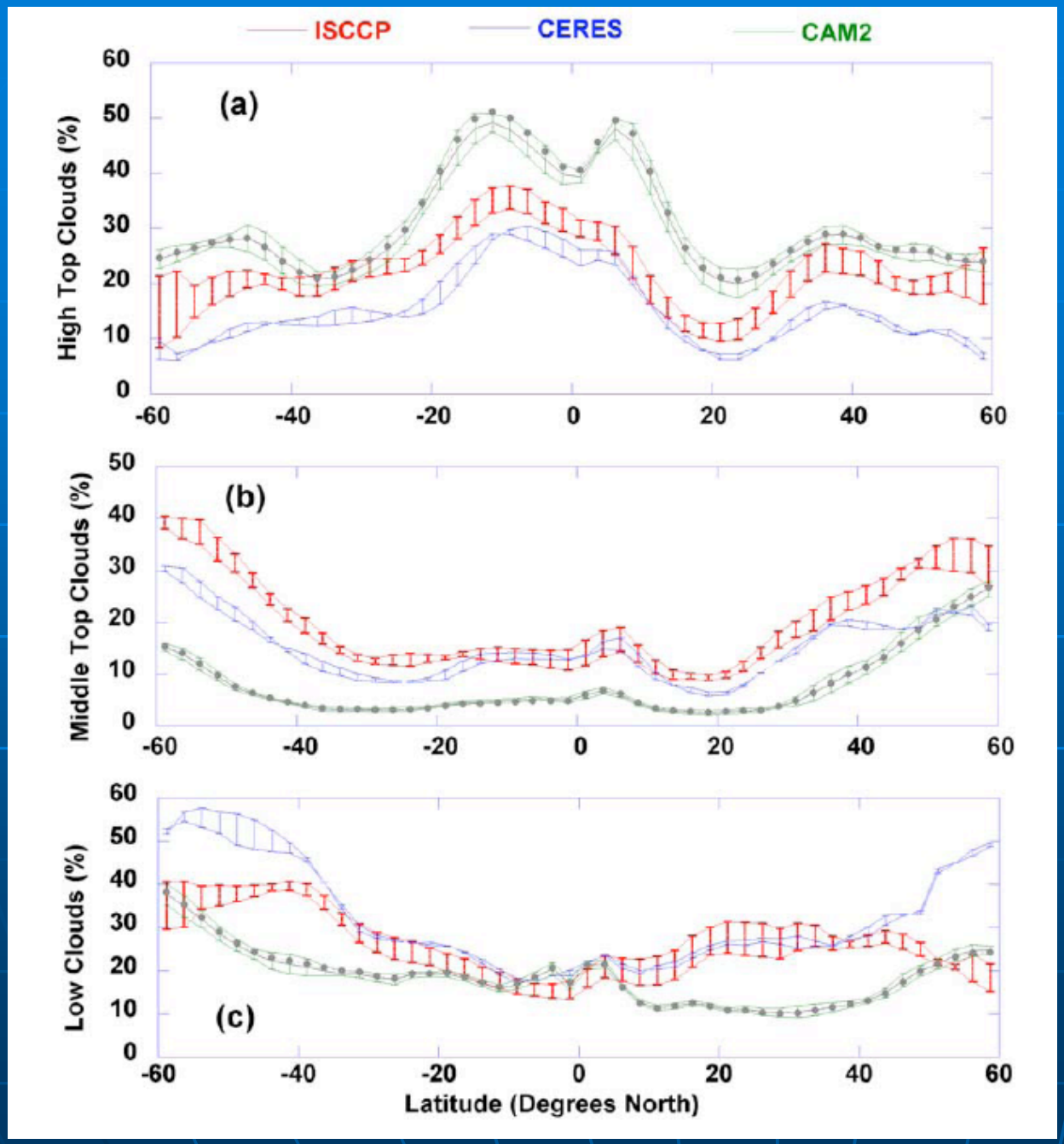
Diurnal Sampling for a 1x1 grid


July:TWP
a
b
c
d
Cloud Fraction (%)
NETCRF (W/m²)
SWCRF (W/m²)
LWCRF (W/m²)
Cloud Types



CERES

CLOUDS AND THE EARTH'S RADIANT ENERGY SYSTEM



Zhang, M.H. et al., 2005, JGR

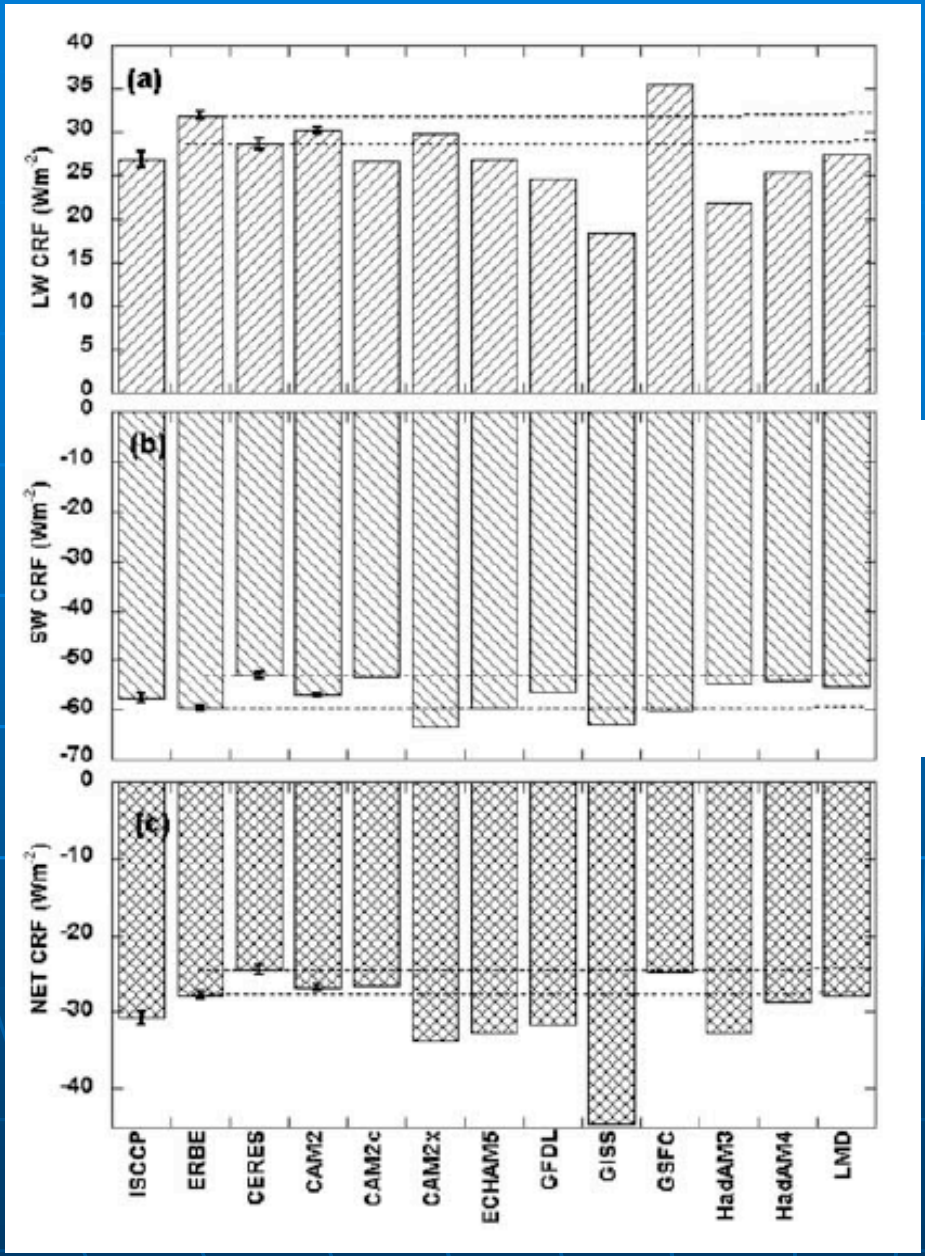
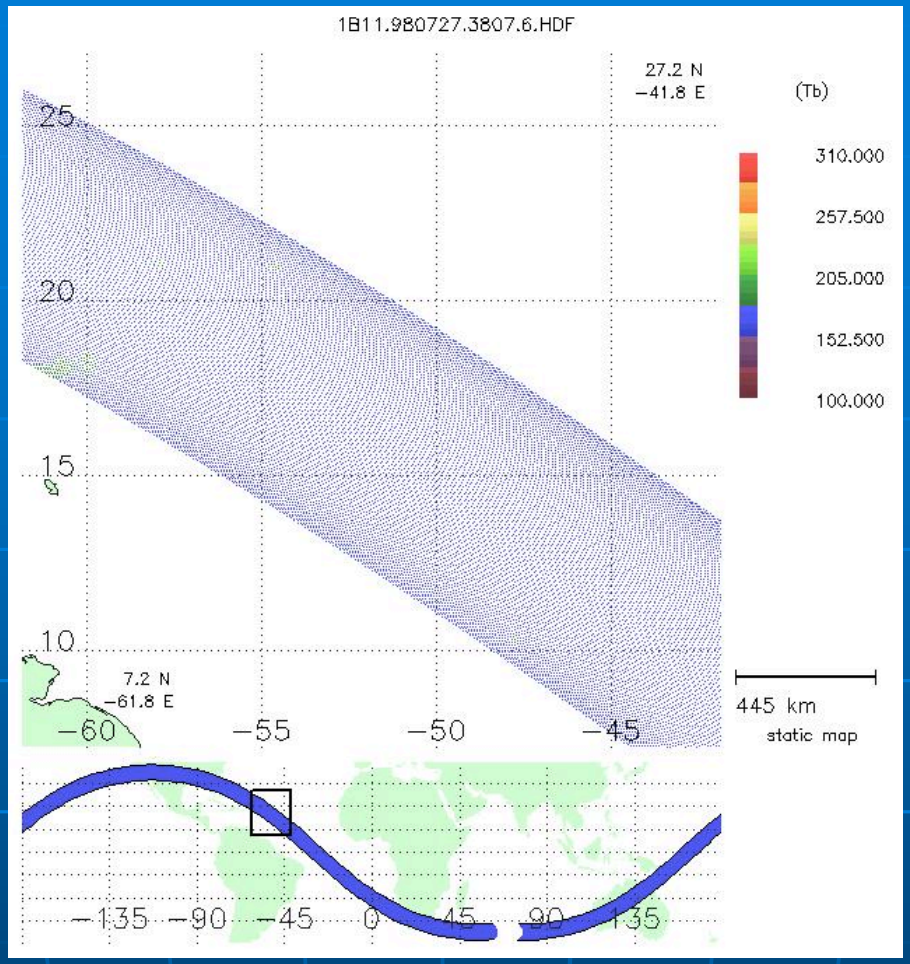
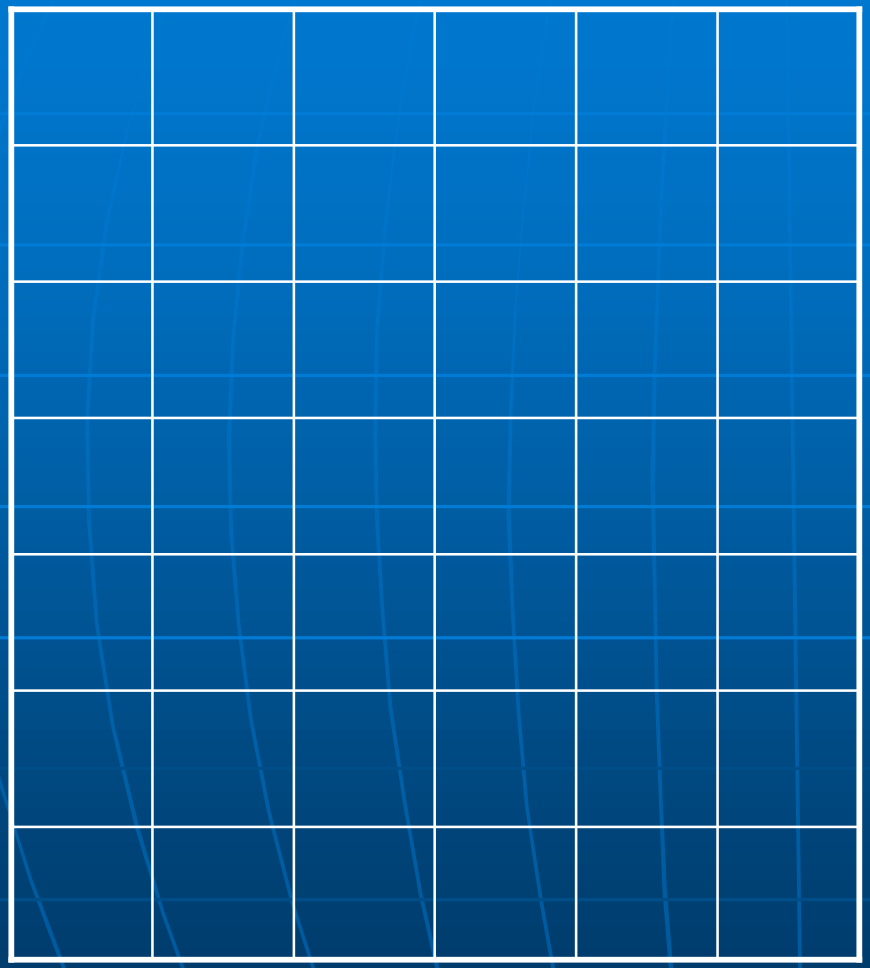


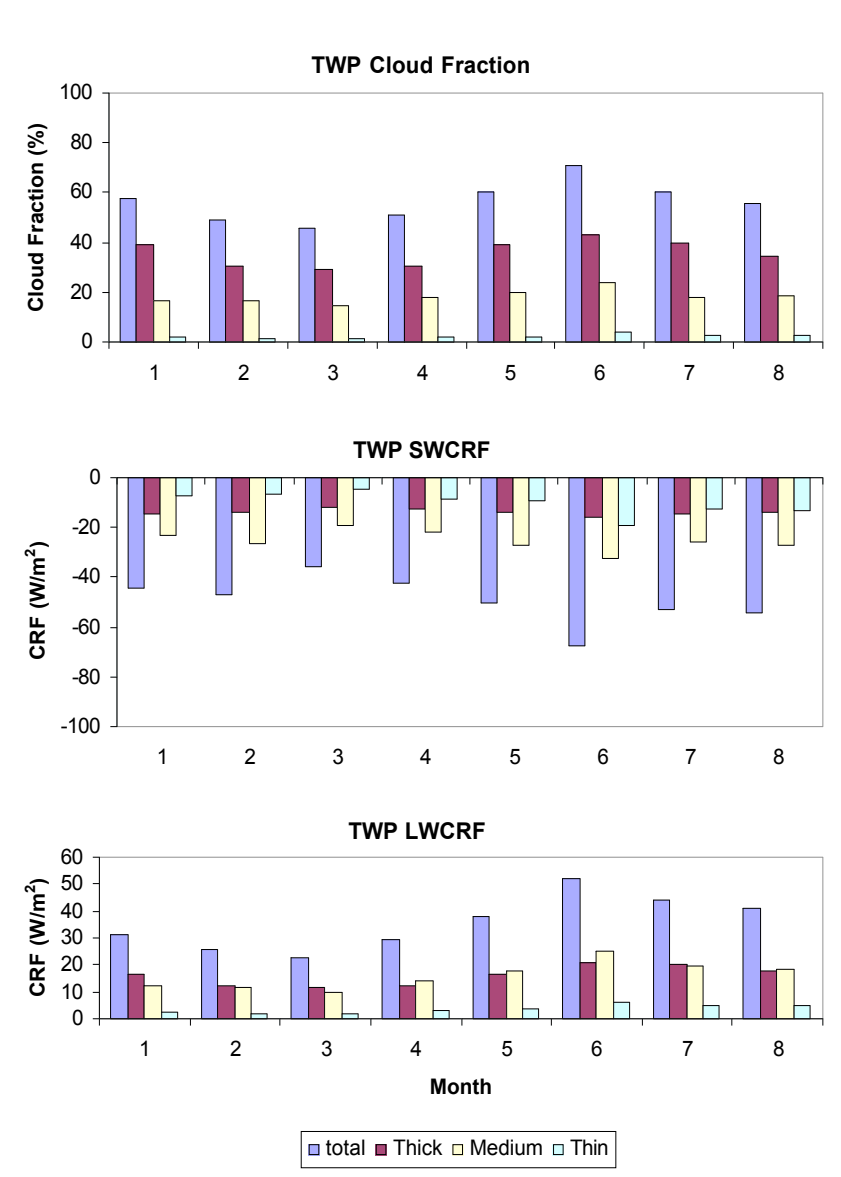
Figure 6. DJF cloud radiative forcing at the TOA averaged from 60°N to 60°S from measurements and from the models: (a) longwave CRF, (b) shortwave CRF, and (c) net CRF. The error bars for ISCCP FD, ERBE, CAM2 are their interannual standard deviations excluding the El Nino years. The error bar for CERES is from the two DJF seasons of 2001 and 2002. The ERBE and CERES values are also drawn as horizontal lines.

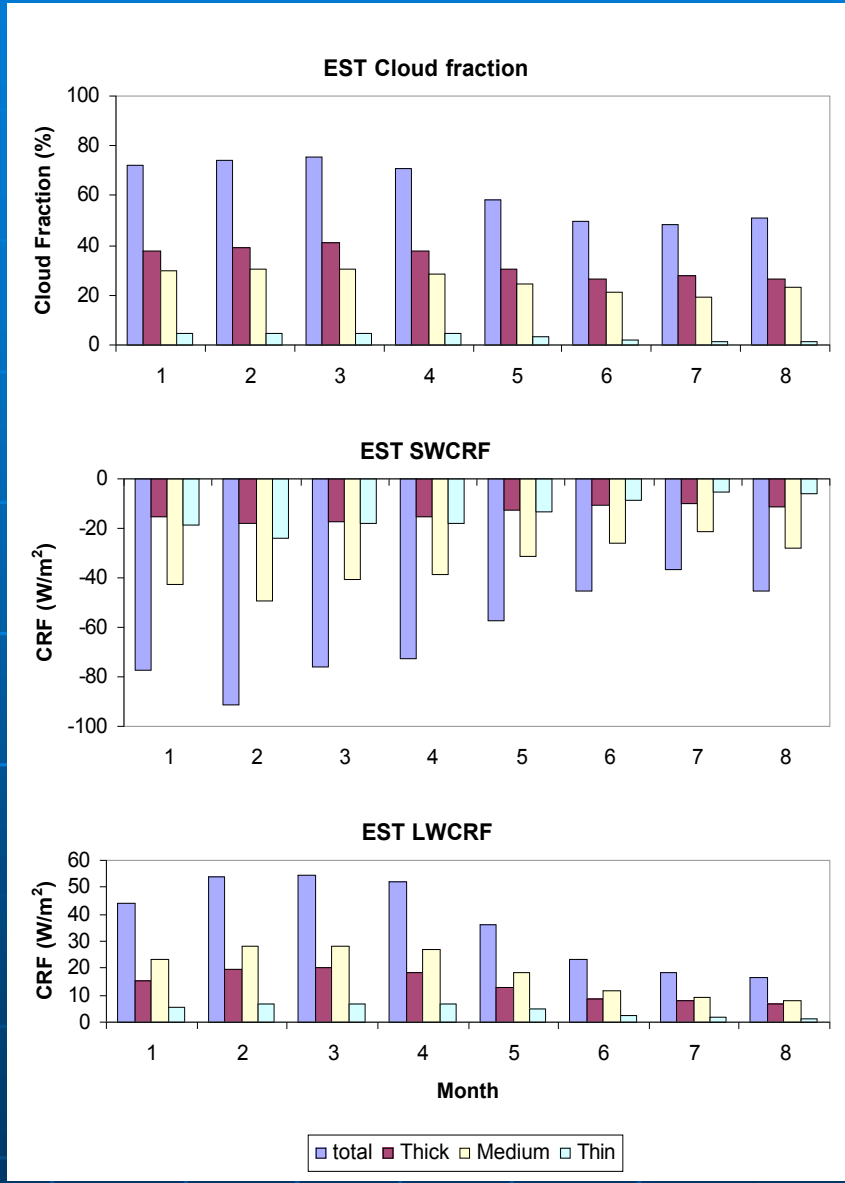
Zhang, M.H. et al., 2005, JGR


1B11.980727.3807.6.HDF
27.2 N
−41.8 E
(Tb)
310.000
257.500
205.000
152.500
100.000
25
20
15
10
7.2 N
−61.8 E
−60
−55
−50
−45
445 km
static map
−135
−90
−45
0
45
90
135

42 drawers




TWP Cloud Fraction
Cloud Fraction (%)
100
80
60
40
20
0
1 2 3 4 5 6 7 8
TWP SWCRF
CRF (W/m2)
0
-20
-40
-60
-80
-100
1 2 3 4 5 6 7 8
TWP LWCRF
CRF (W/m2)
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8
Month
total Thick Medium Thin


EST Cloud fraction
Cloud Fraction (%)
100
80
60
40
20
0
1 2 3 4 5 6 7 8
EST SWCRF
CRF (W/m2)
0
-20
-40
-60
-80
-100
1 2 3 4 5 6 7 8
EST LWCRF
CRF (W/m2)
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8
Month
total Thick Medium Thin

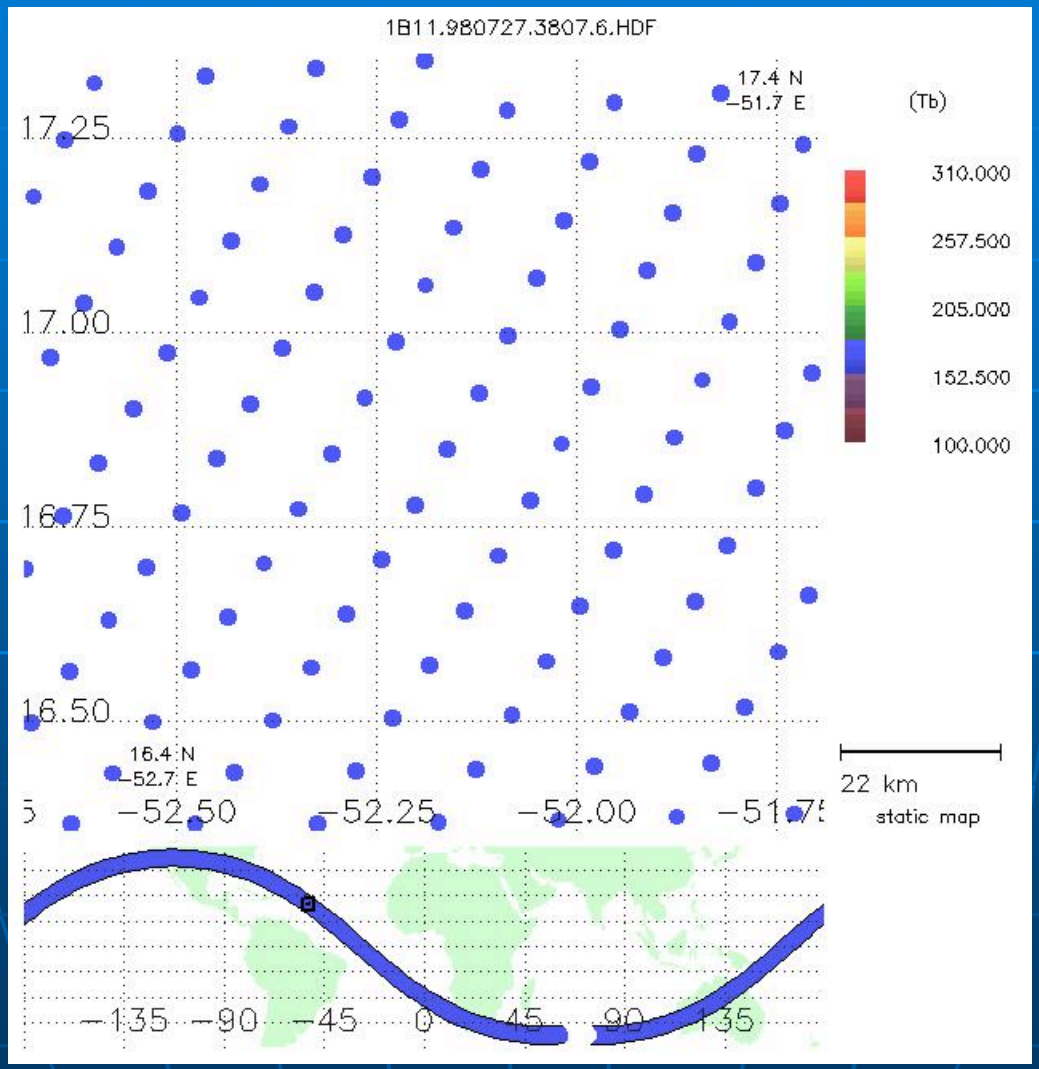
	TCLD	*TSWCRF*	*TLWCRF*
CLD	**0.952561**	-0.92988	0.99377
SWCRF	-0.88918	**0.968464**	-0.98597
LWCRF	0.914157	-0.93093	**0.998551**
CLD	**0.699036**	-0.42649	0.450614
SWCRF	-0.57605	**0.53231**	-0.3478
LWCRF	0.650862	-0.4408	**0.402218**
CLD	**-0.7817**	0.832768	-0.93222
SWCRF	0.794302	**-0.78058**	0.931475
LWCRF	-0.76468	0.806961	**-0.91417**

25th ANNUAL
VANDERBILT INVITATIONAL CONCOURS
2005

1ST IN CLASS

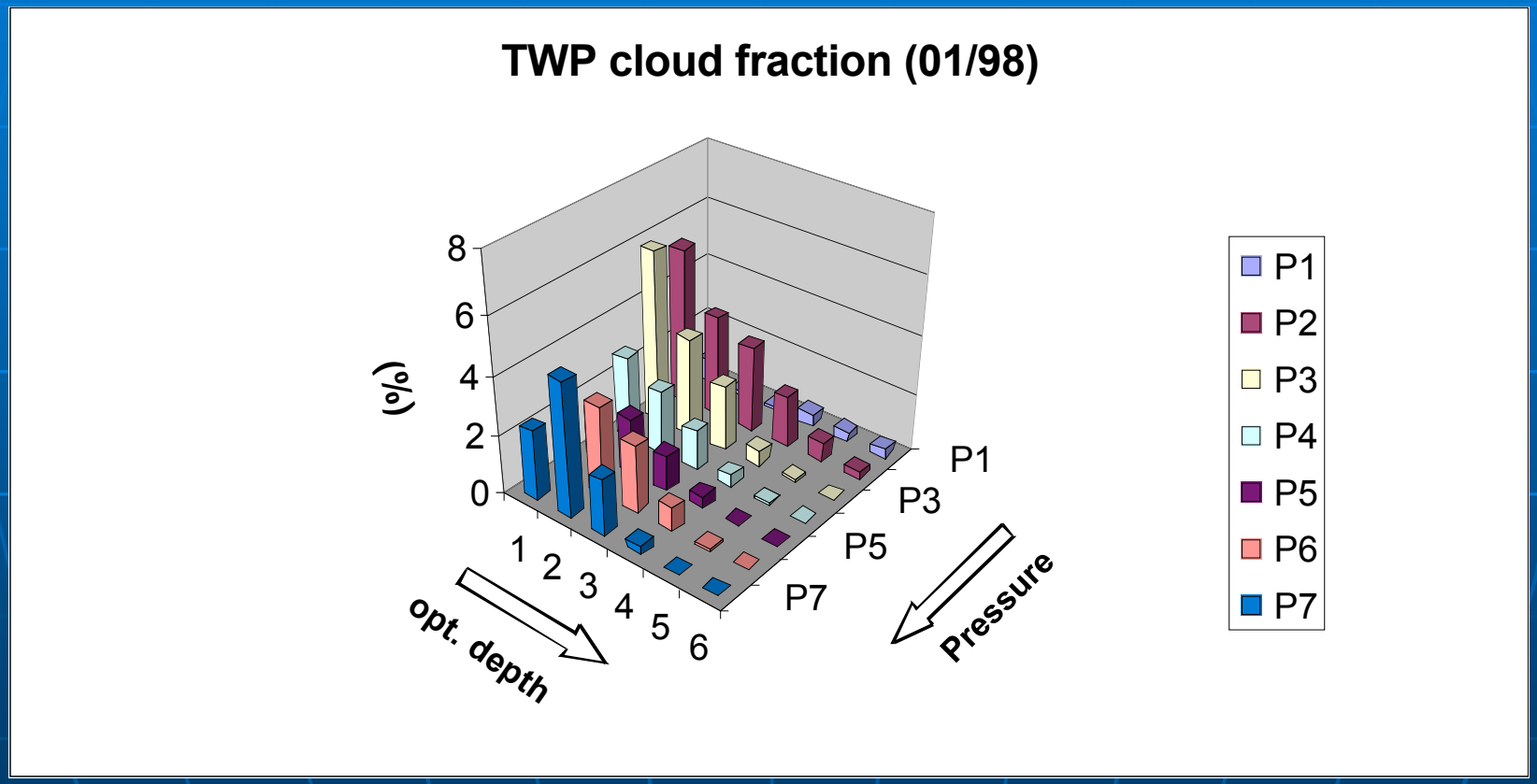
BEST OF SHOW

Method



1 x 1 grid

ISCCP like cloud fraction



TWP correlation coefficients

		TCLD	TSWCRF	TLWCRF
Total				
High	CLD	0.952561		
	SWCRF		0.968464	
	LWCRF			0.998551
Middle	CLD	0.699036		
	SWCRF		0.53231	
	LWCRF			0.402218
Low	CLD	- 0.7817		
	SWCRF		-0.78058	
	LWCRF			- 0.91417