

# Bimodal Variability in Tropical Diabatic Heating: Results from MISMO and Other Tropical Sounding Sites

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# Current View of Dominant Profiles of Tropical Diabatic Heating – Idealized Latent Heating Profiles based on Radar Observations

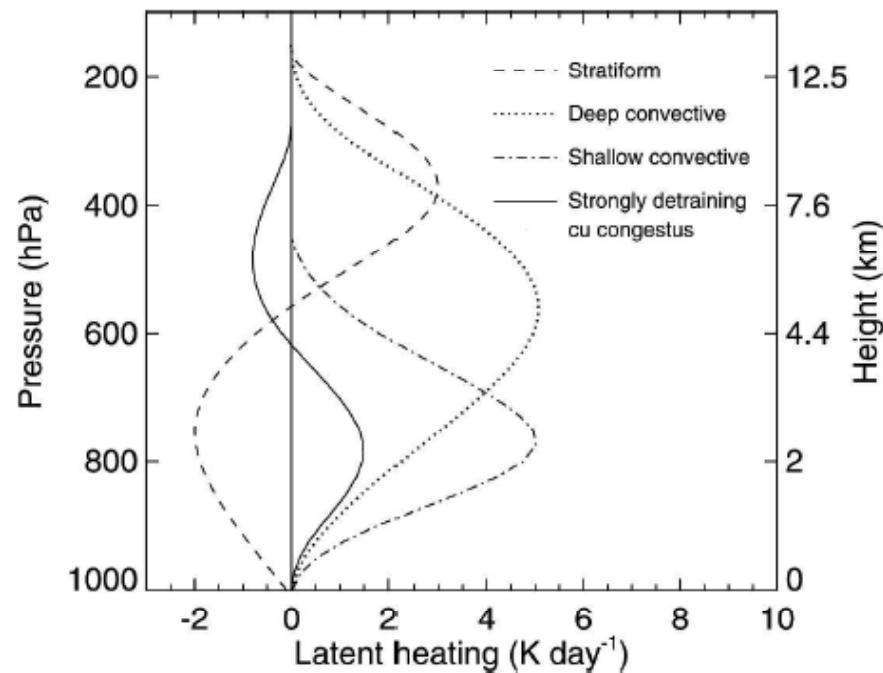
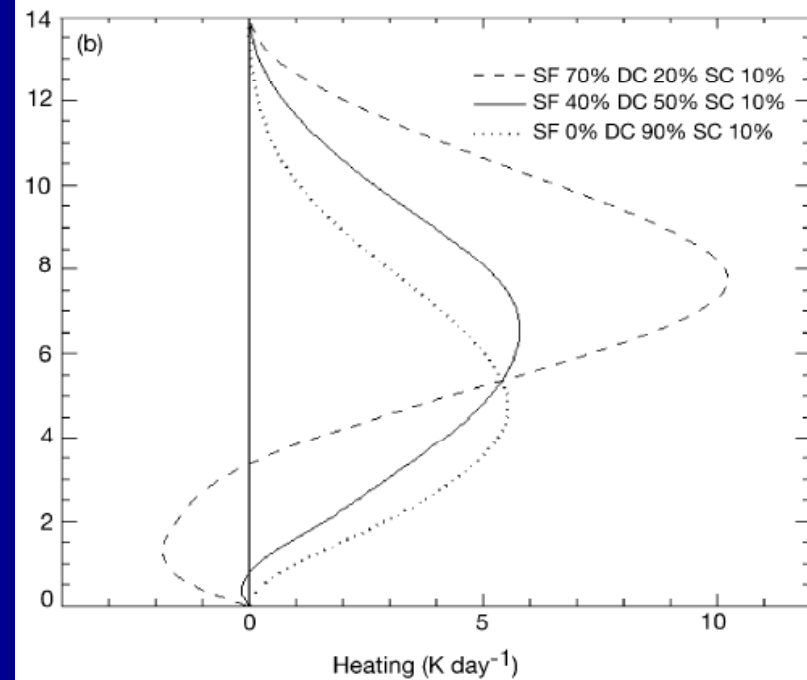


FIG. 1. Idealized latent heating profiles for different precipitating cloud types.

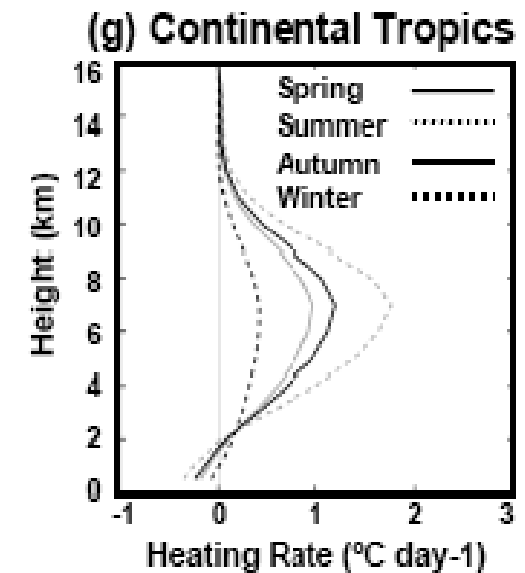
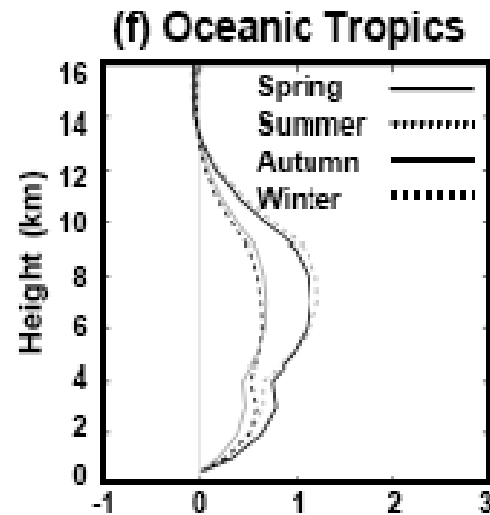
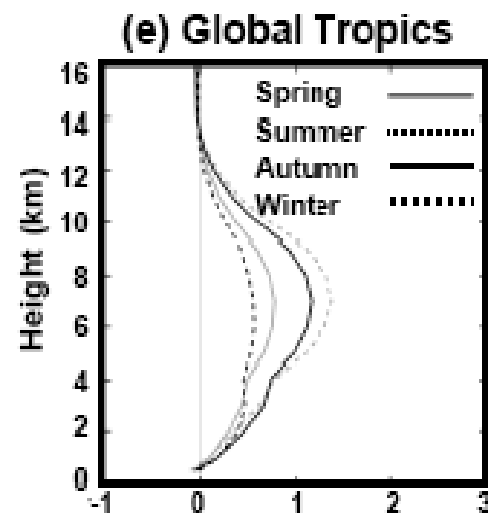
Schumacker et al. (2008)



Schumacker et al. (2004)

# TRMM CSH Latent Heating Profiles

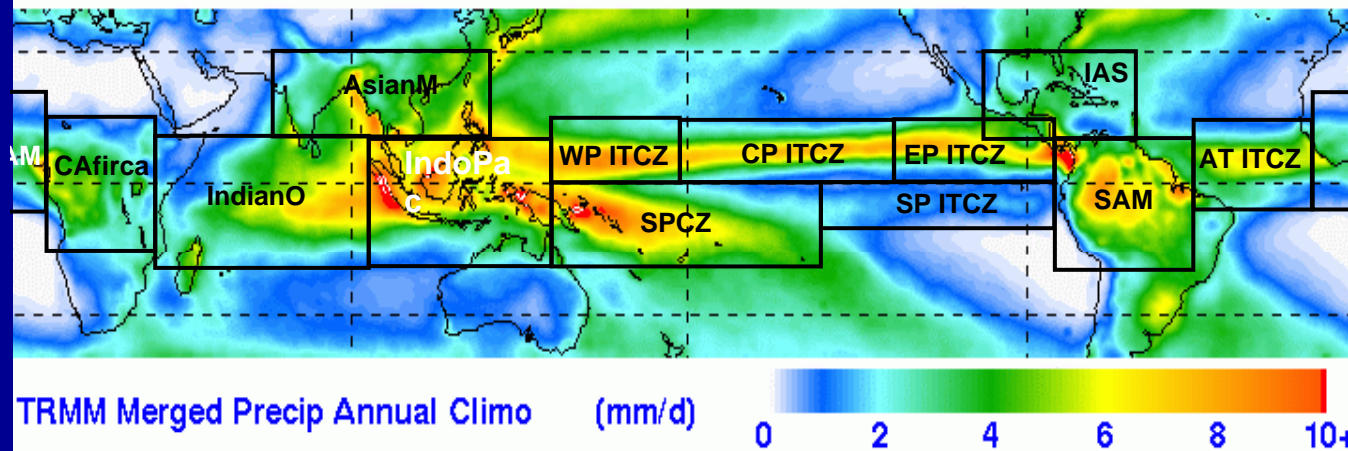
## – Double Peaks over the Ocean?



Tao et al. (2006)

# Tropical Rainfall Measuring Mission (TRMM)

## Six - Year TRMM Climatology



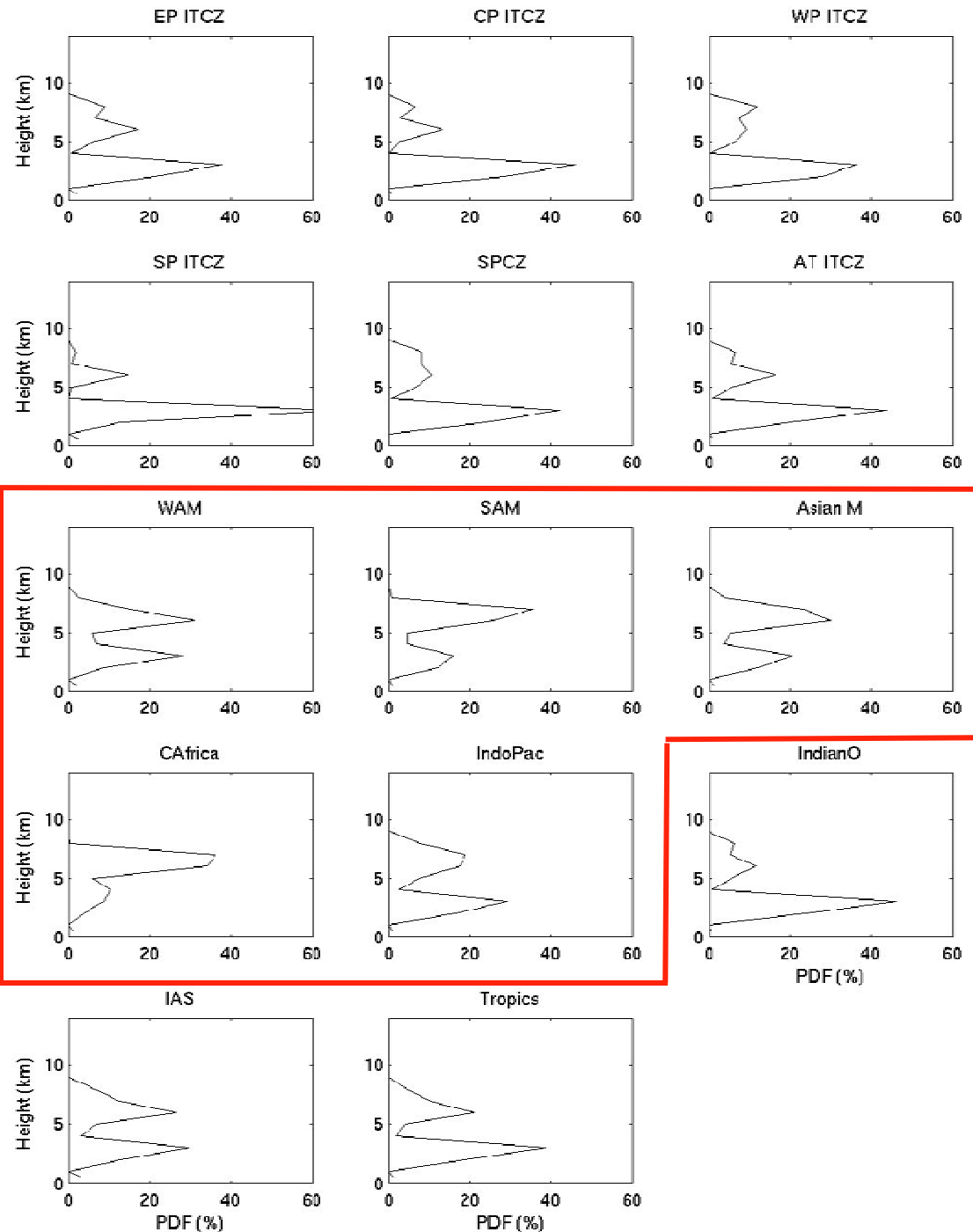
January 1998 – December 2003

[http://trmm.gsfc.nasa.gov/images/6-year\\_TRMM\\_climo.gif](http://trmm.gsfc.nasa.gov/images/6-year_TRMM_climo.gif)

Indeed:

(1) PDF of TRMM CSH peaks

– Bimodal over most tropical regions, even over land (red box)

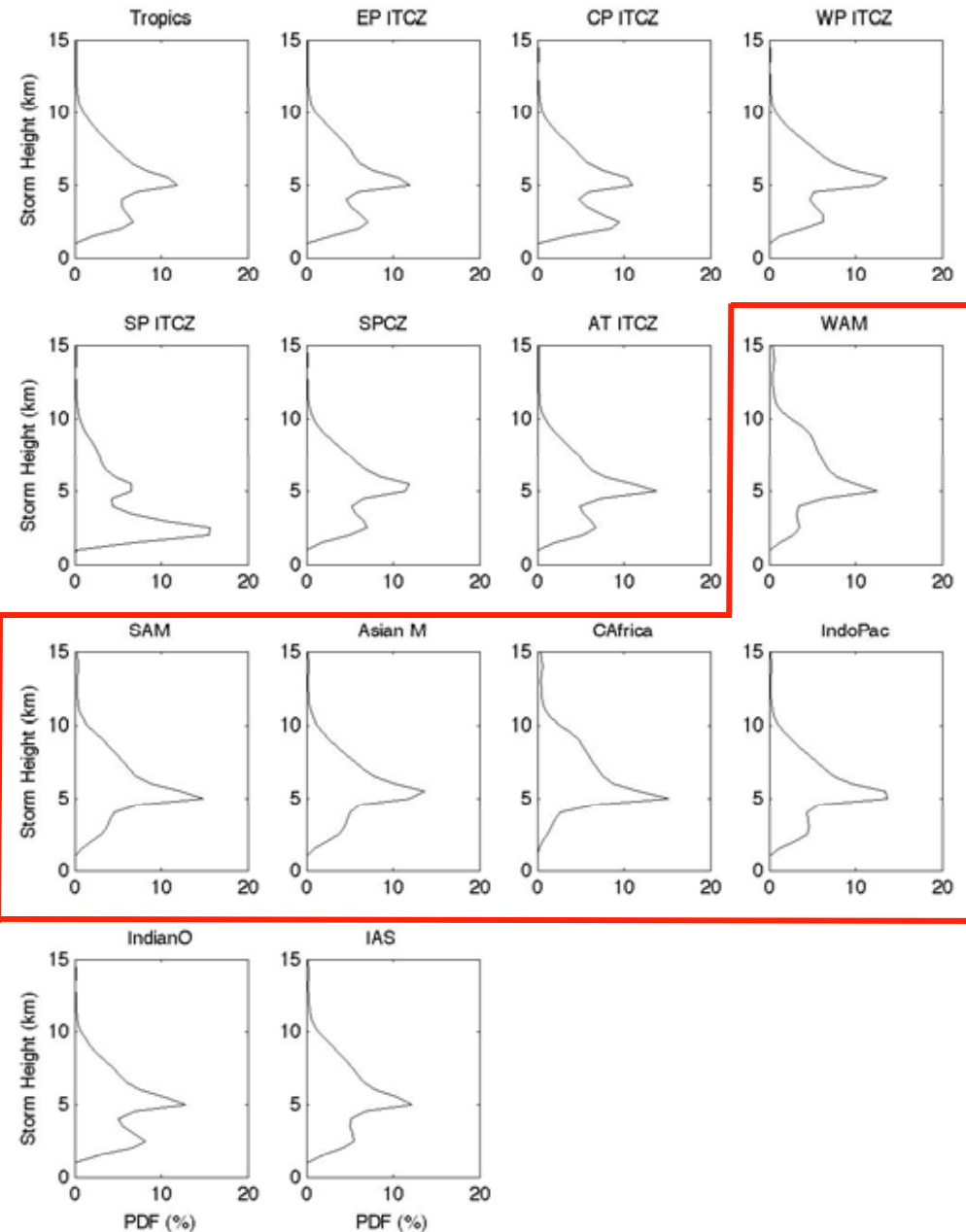


Indeed:

(2) PDF of TRMM PR  
echo top height (3A25)

– Bimodal only over the  
oceans

(also see Short and Naramura  
2000)



## Issues to be addressed:

- Is the low-level heating peak (bottom-heavy heating profile) real?
- If it is, how can bottom-heavy heating profiles be objectively and systematically identified?
- How do diabatic heating profiles derived from MISMO compare to those from other tropical regions?

# Sounding Data Sources



Not included:

Marshall Islands (Yanai et al 1973)

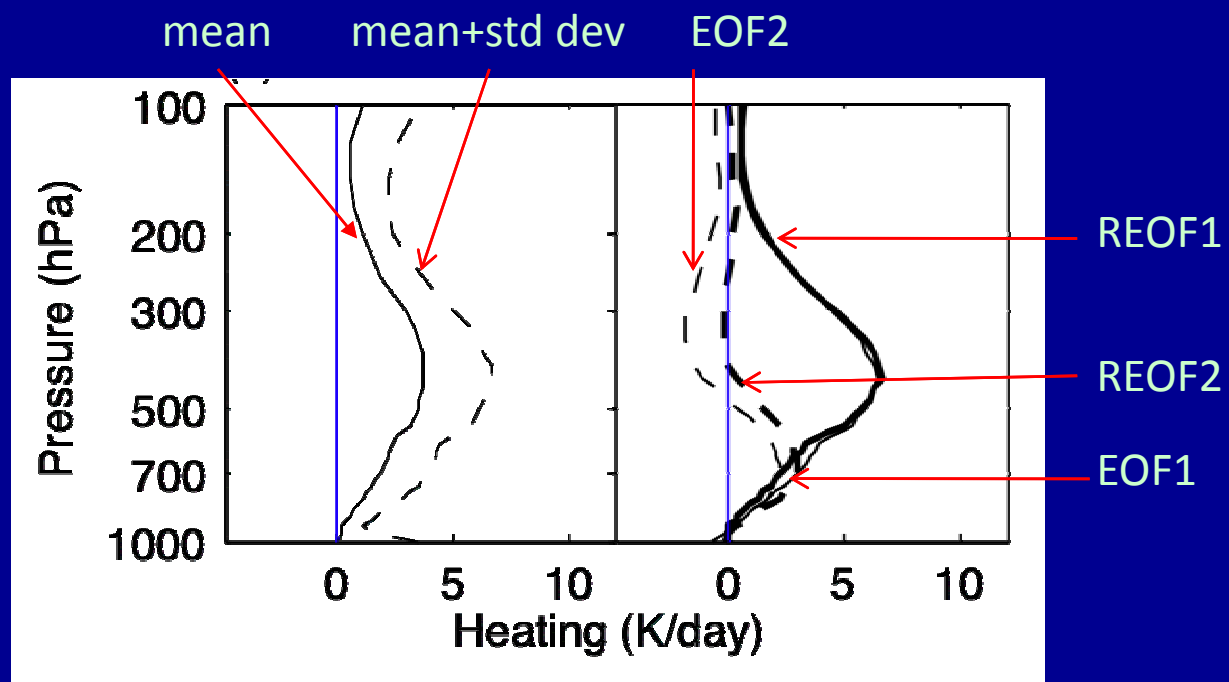
Winter MONEX (Johnson and Young 1983)

AMEX (Frank and McBride 1989)

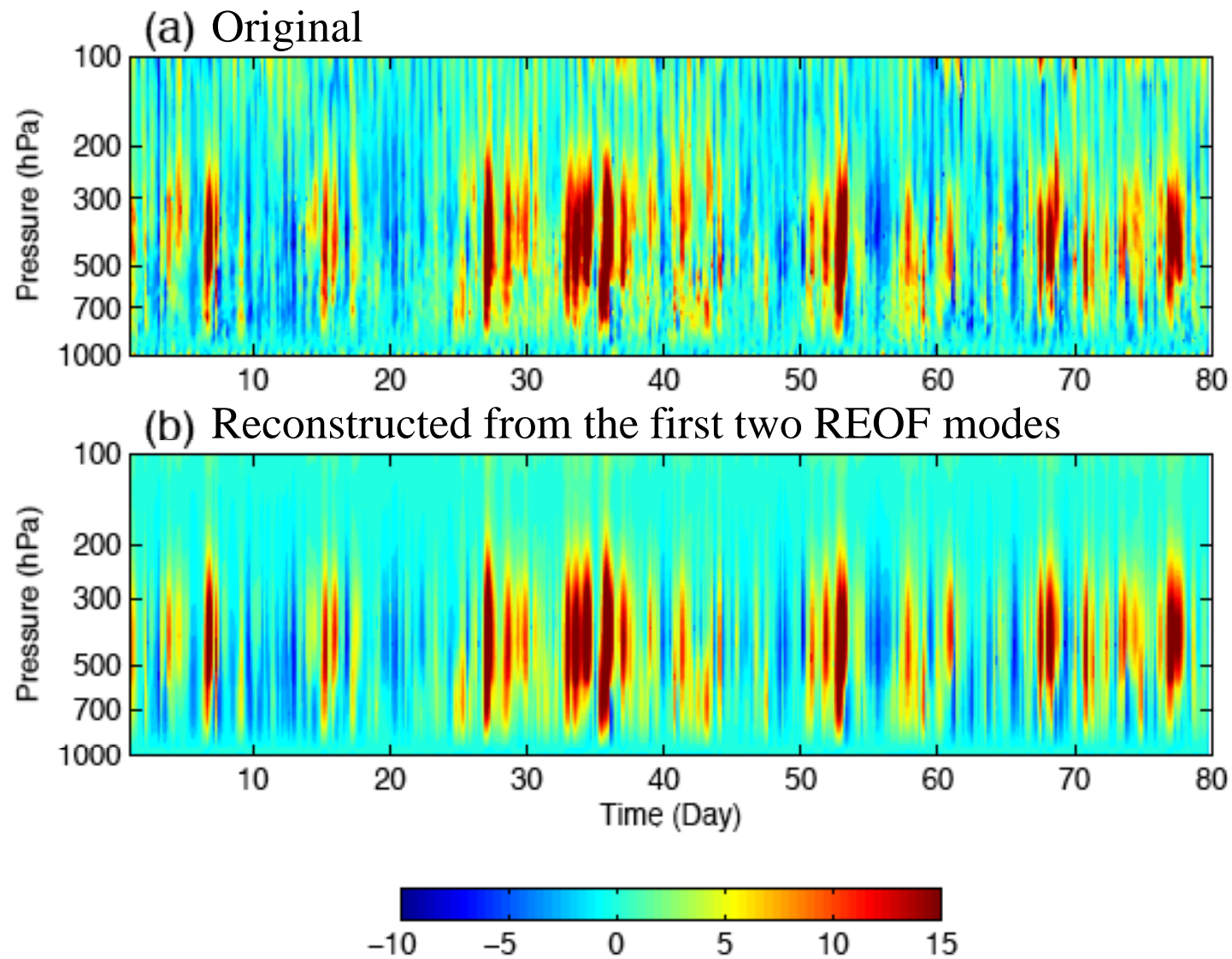
BOMEX (Nitta and Esbensen 1974)

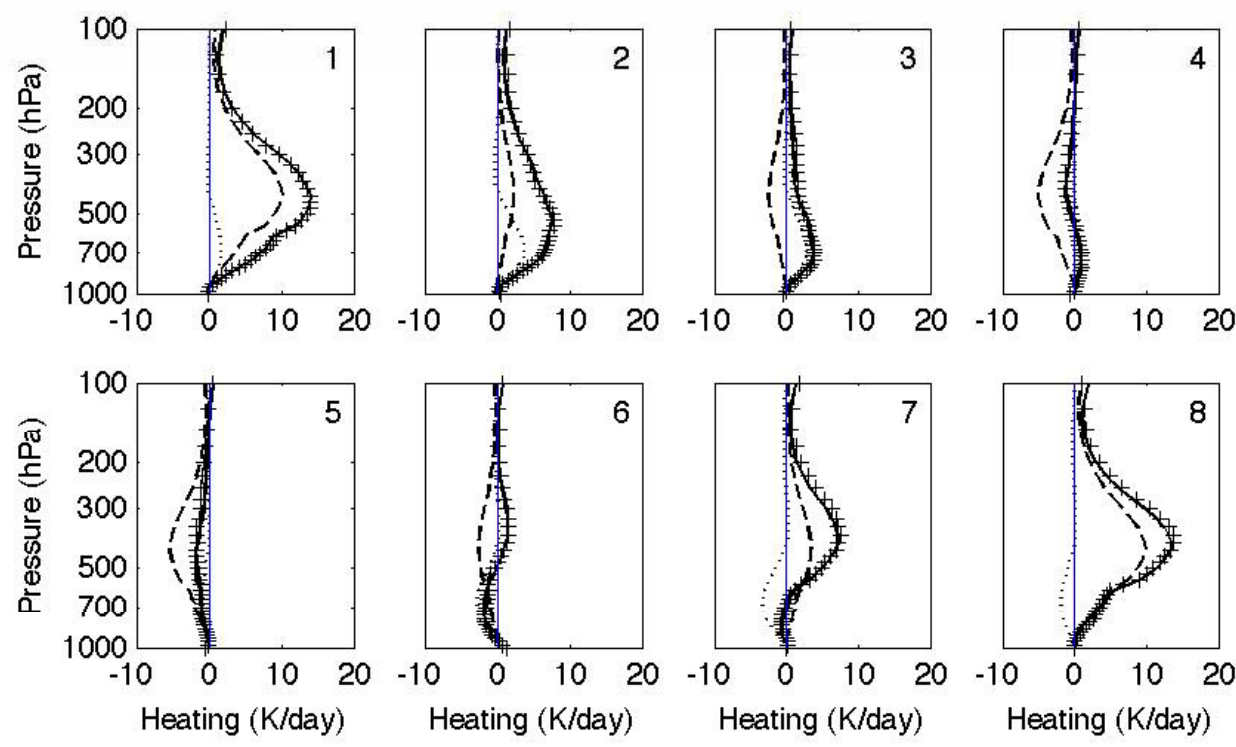
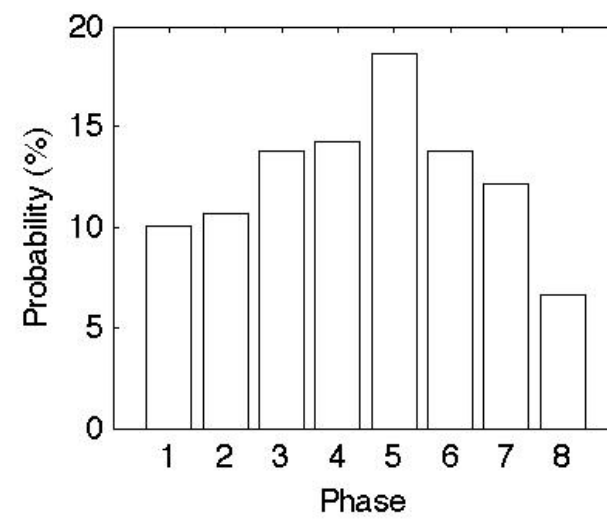
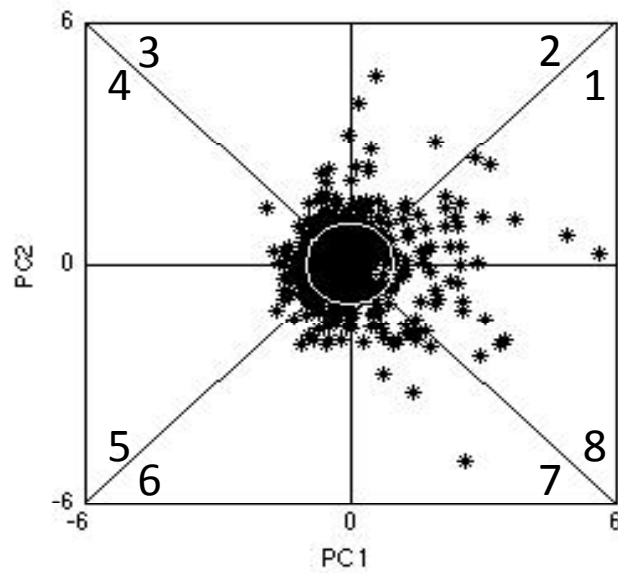
TAMEX (Johnson and Bresch 1991)

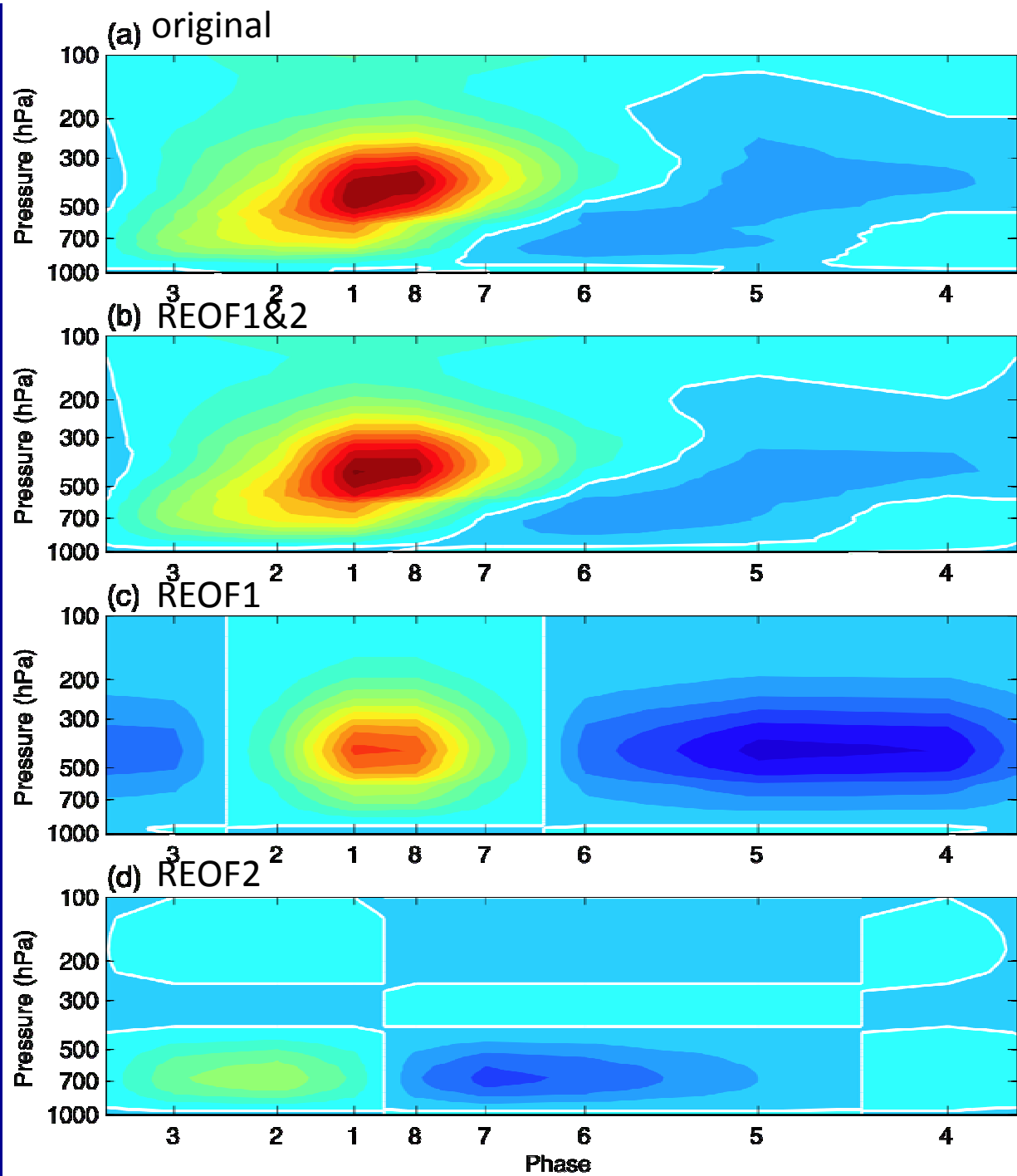
## TOGA COARE Q1



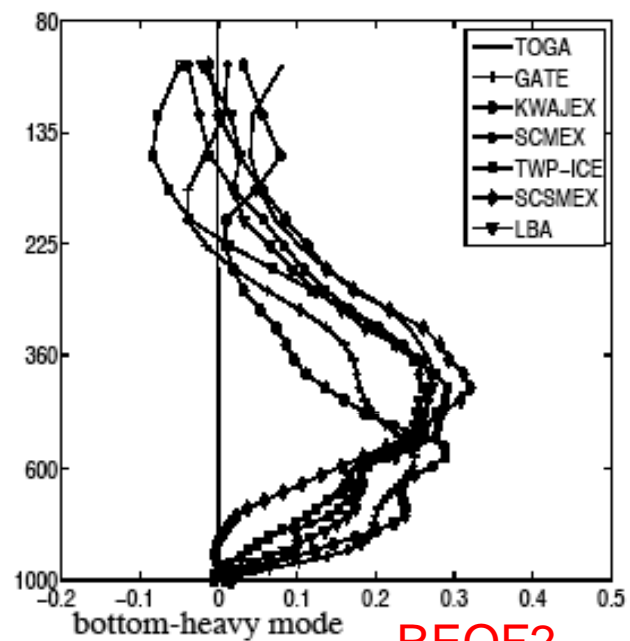
## TOGA COARE Q1 Time Series



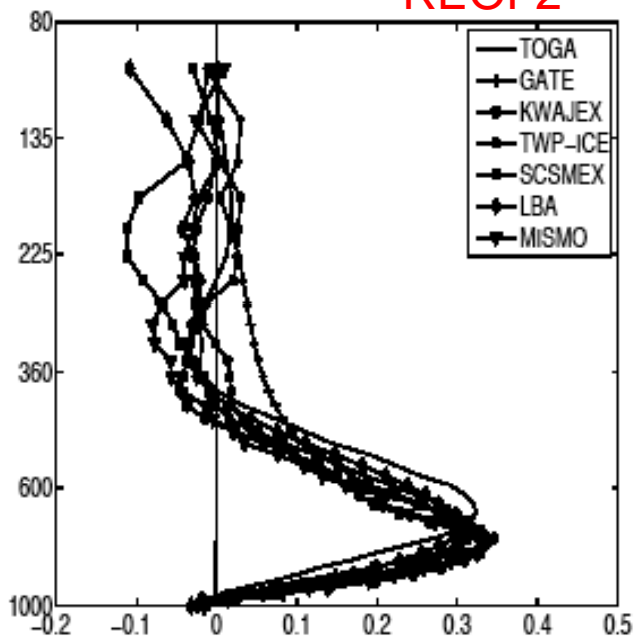




Mean profiles

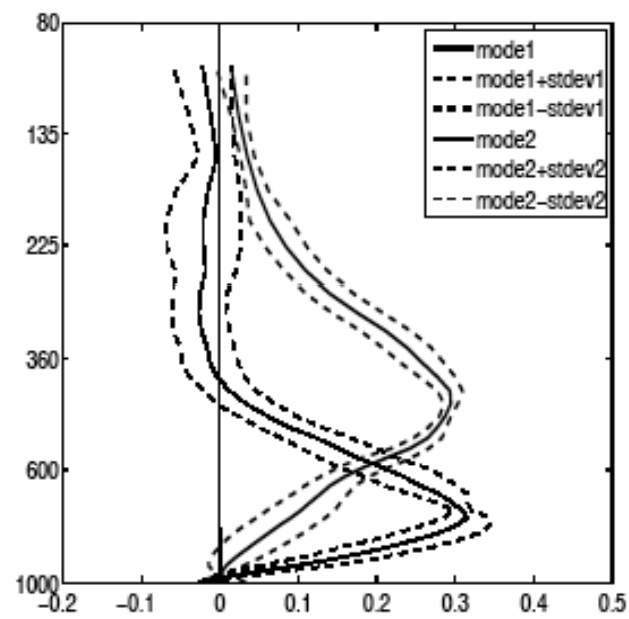
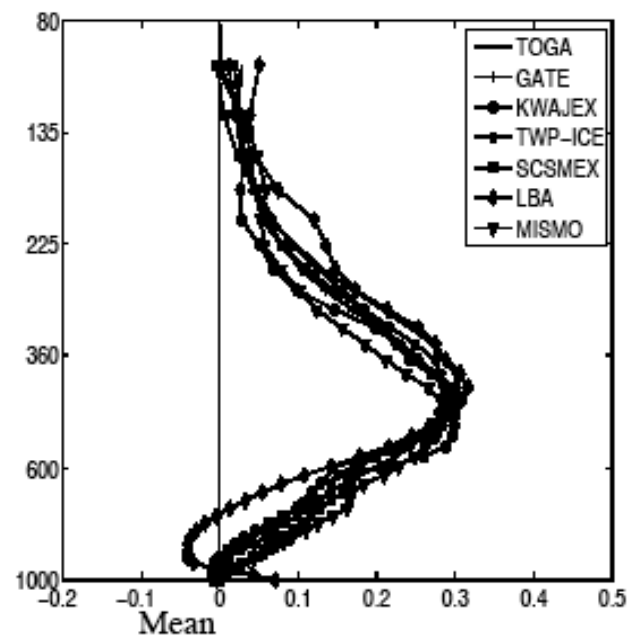


REOF2



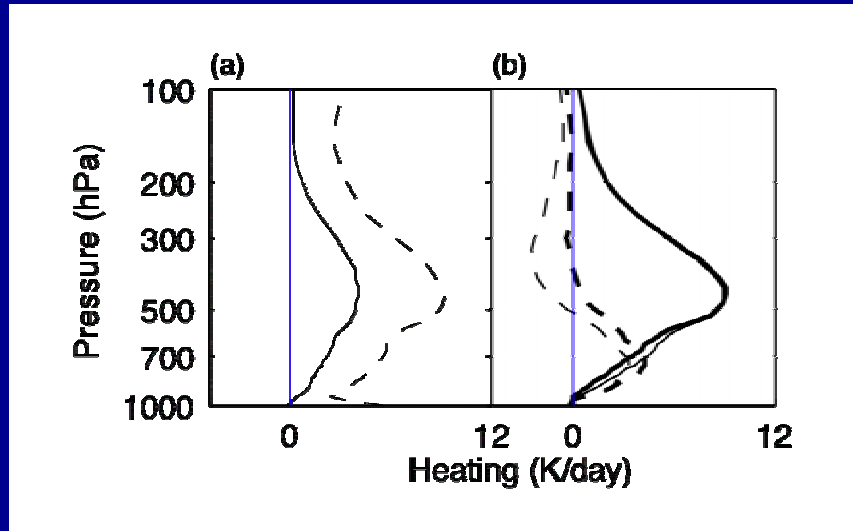
top-heavy mode

REOF1

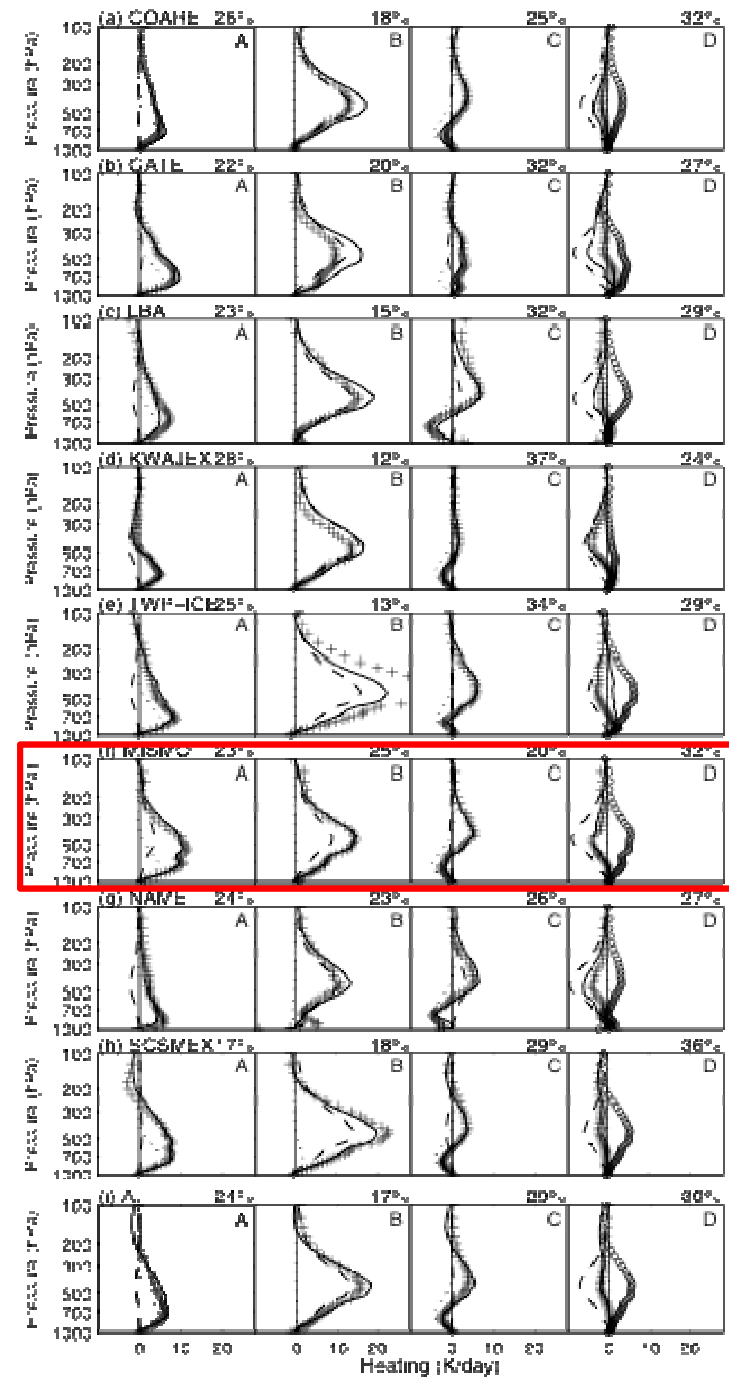
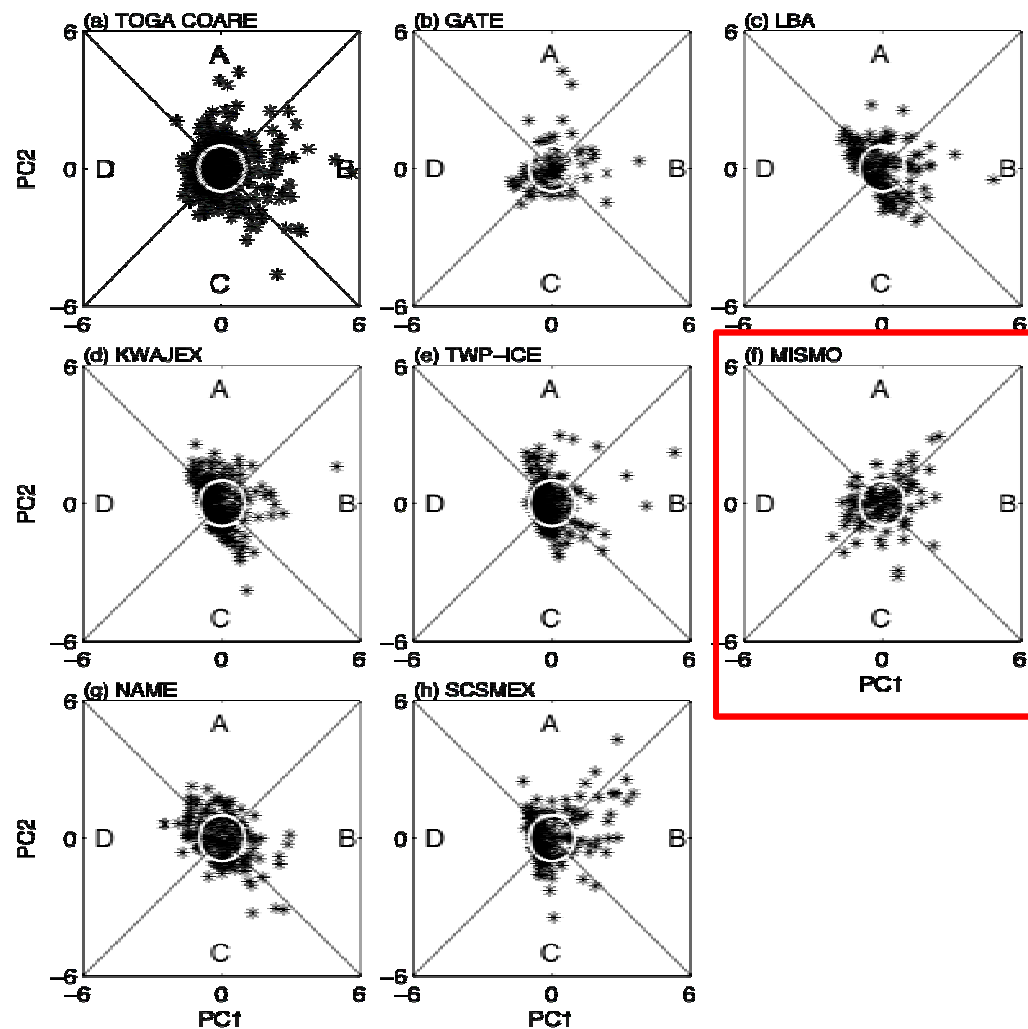


Field Experiment \ EOF Mode	EOF			REOF		
	1	2	3	1	2	3
TOGA COARE	<b>79.4</b>	<u>11.2</u>	5.1	<b>76.7</b>	<u>10.1</u>	1.5
GATE	<b>74.8</b>	10.5	<u>8.0</u>	<b>71.4</b>	8.3	<u>6.4</u>
LBA	<b>48.9</b>	<u>34.4</u>	12.1	<b>42.7</b>	<u>30.5</u>	10.8
KWAJEX	<b>79.2</b>	<u>14.8</u>	3.2	<b>77.9</b>	<u>14.2</u>	2.4
TWP-ICE	<b>89.3</b>	<u>5.9</u>	2.6	<b>88.1</b>	<u>5.5</u>	2.2
<i>MISMO</i>	<i><b>83.0</b></i>	<i><u>11.0</u></i>	<i>3.0</i>	<i><b>81.0</b></i>	<i><u>6.0</u></i>	<i>1.5</i>
SCSMEX	<b>89.3</b>	<u>7.7</u>	1.5	<b>88.3</b>	<u>6.5</u>	1.1
NAME	<b>51.0</b>	<u>24.7</u>	16.9	<b>40.3</b>	<u>21.7</u>	14.0

# Combined REOF Analysis



Field Experiment \ REOF Mode	Fractional Variance	
	1	2
TOGA COARE	70.7	12.4
GATE	52.7	25.7
LBA	46.7	33.9
KWAJEX	80.8	17.0
TWP-ICE	83.1	8.7
<i>MISMO</i>	<i>62.7</i>	<i>15.6</i>
SCSMEX	76.4	8.2
NAME	45.2	19.8
Total	74.2	10.6



# Summary

MISMO Q1 data share many similarities with Q1 data from other tropical field experiments:

(a) Two REOF leading modes, one shallow and bottom heavy, one deep and middle heavy, can be used to reconstruct the main structure and variability;

(b) Bottom-heavy heating profiles are as frequent and strong as top-heavy ones.

**Conclusion:** More research attention should be paid to the role of bottom-heavy heating profiles in tropical large-scale dynamics.

