Using Aura MLS to Study Intraseaonal Variations (Madden-Julian Oscillation, MJO) of H_2O and CO in Tropical Tropopause Layer (TTL)

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Aura Meeting, Boulder, September 2006

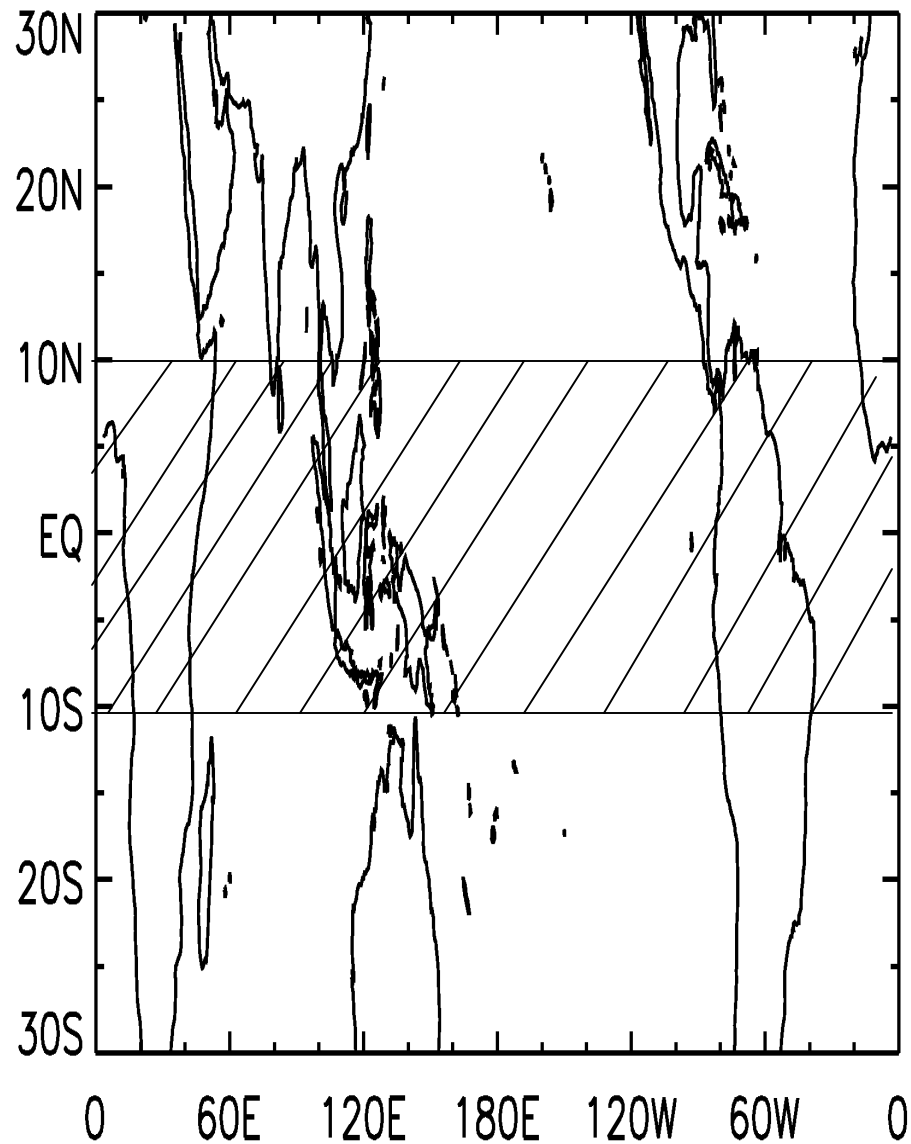
Introduction

- Study of H_2O in the TTL: A greenhouse gas, sources of active chemical radicals (HO_x), dynamics of stratosphere-troposphere exchange

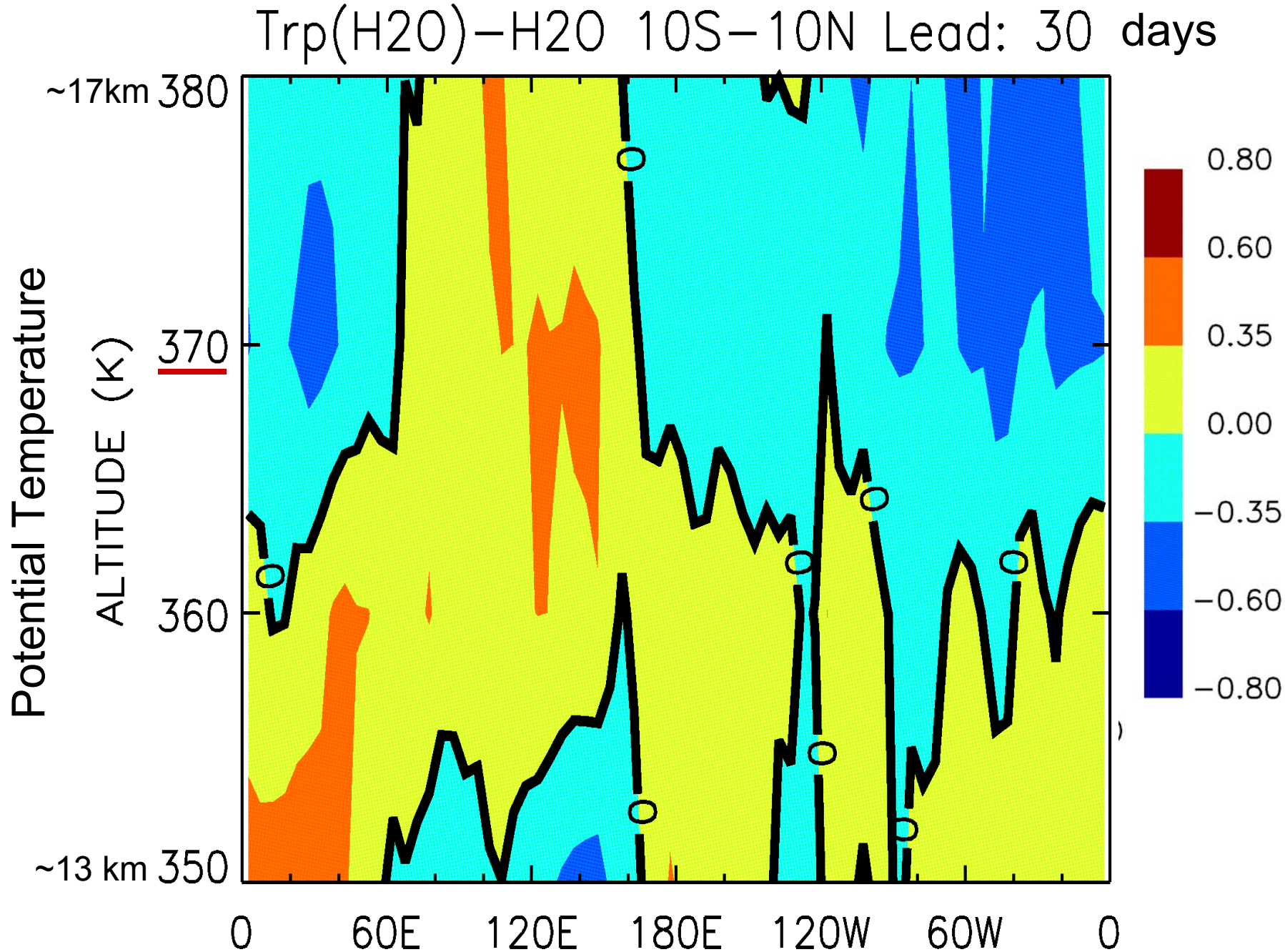
- Study of CO in the TTL: Unlike H_2O, it's not influenced by temperature

- Intraseasonal scale variations: Convection and chemical species are related: The effects of MJO

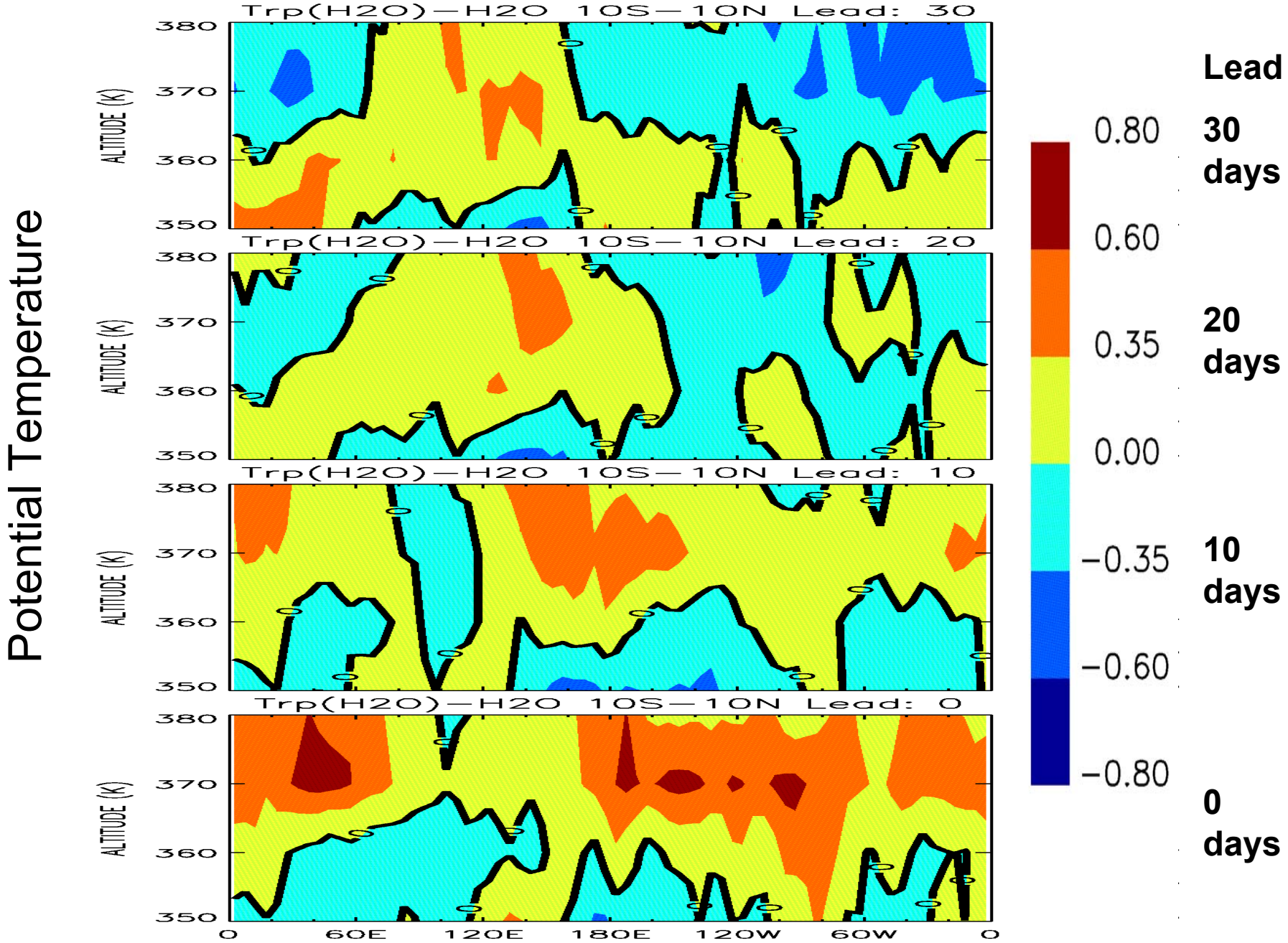
Tropical Mean H_2O: Zonally averaged between 10°S-10°N at 370 K



Aura MLS Nov 2004 – May 2005, v1.51



Correlation of Trp(H_2O) and H_2O, 10°S-10°N



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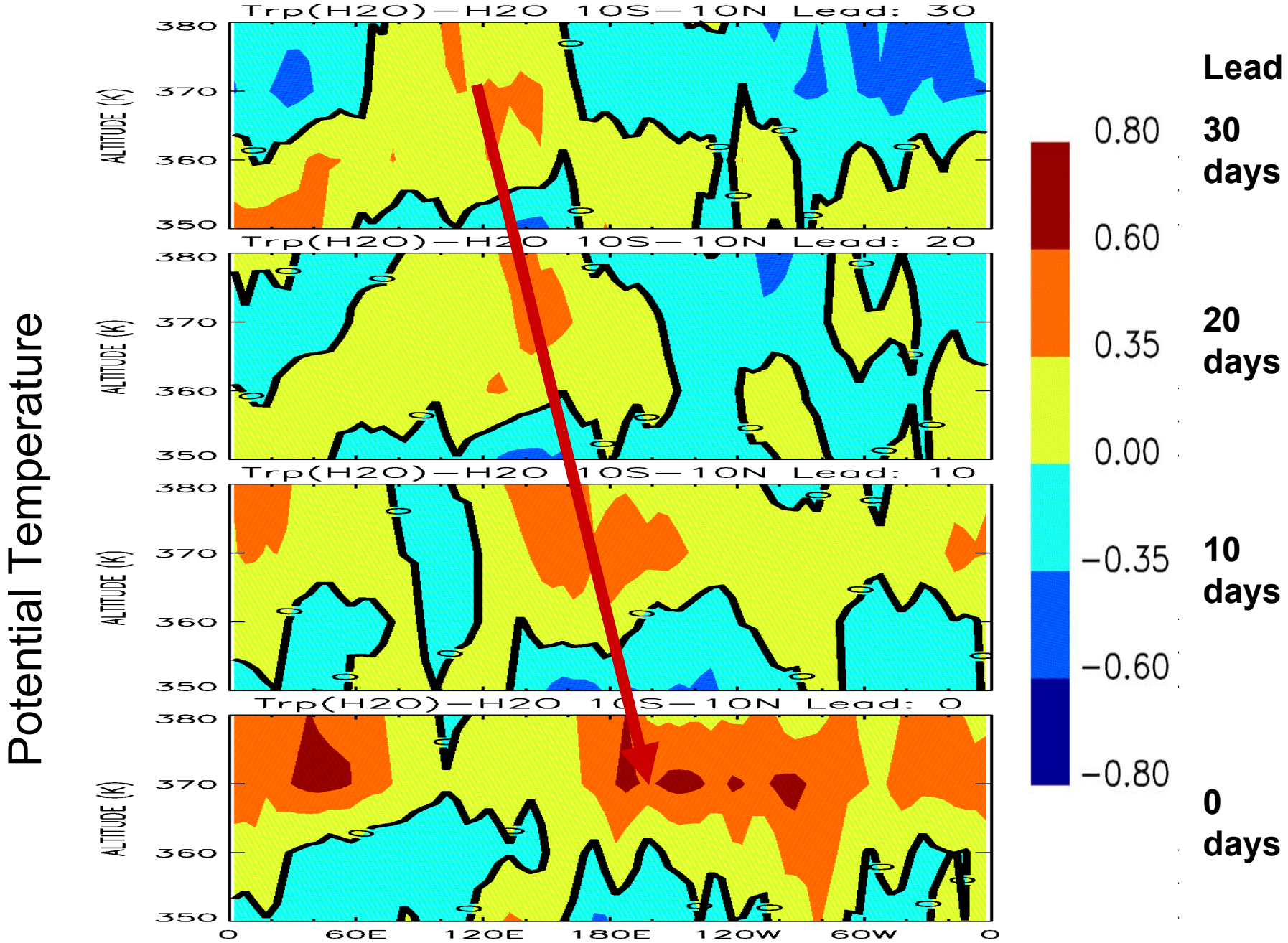

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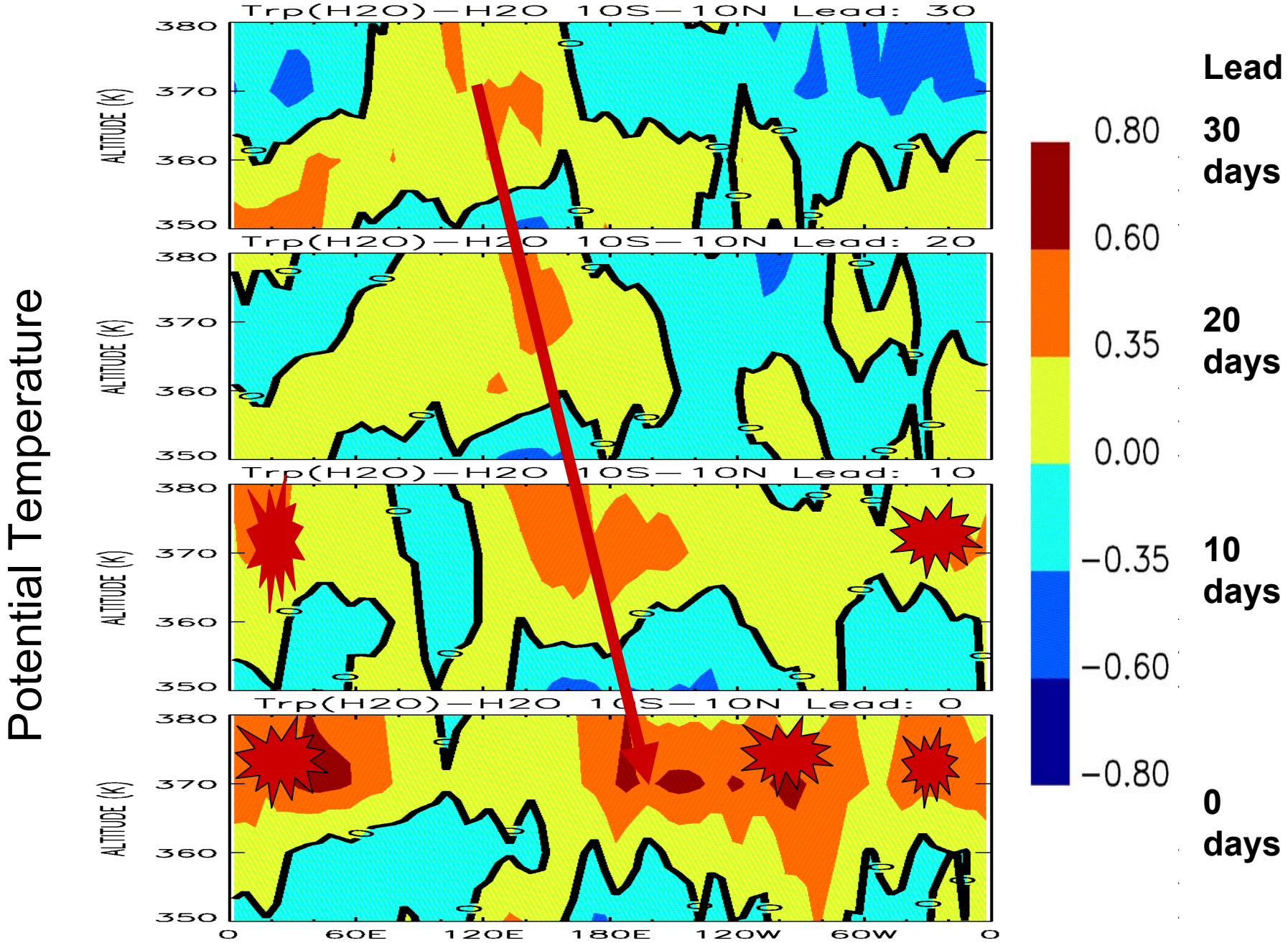
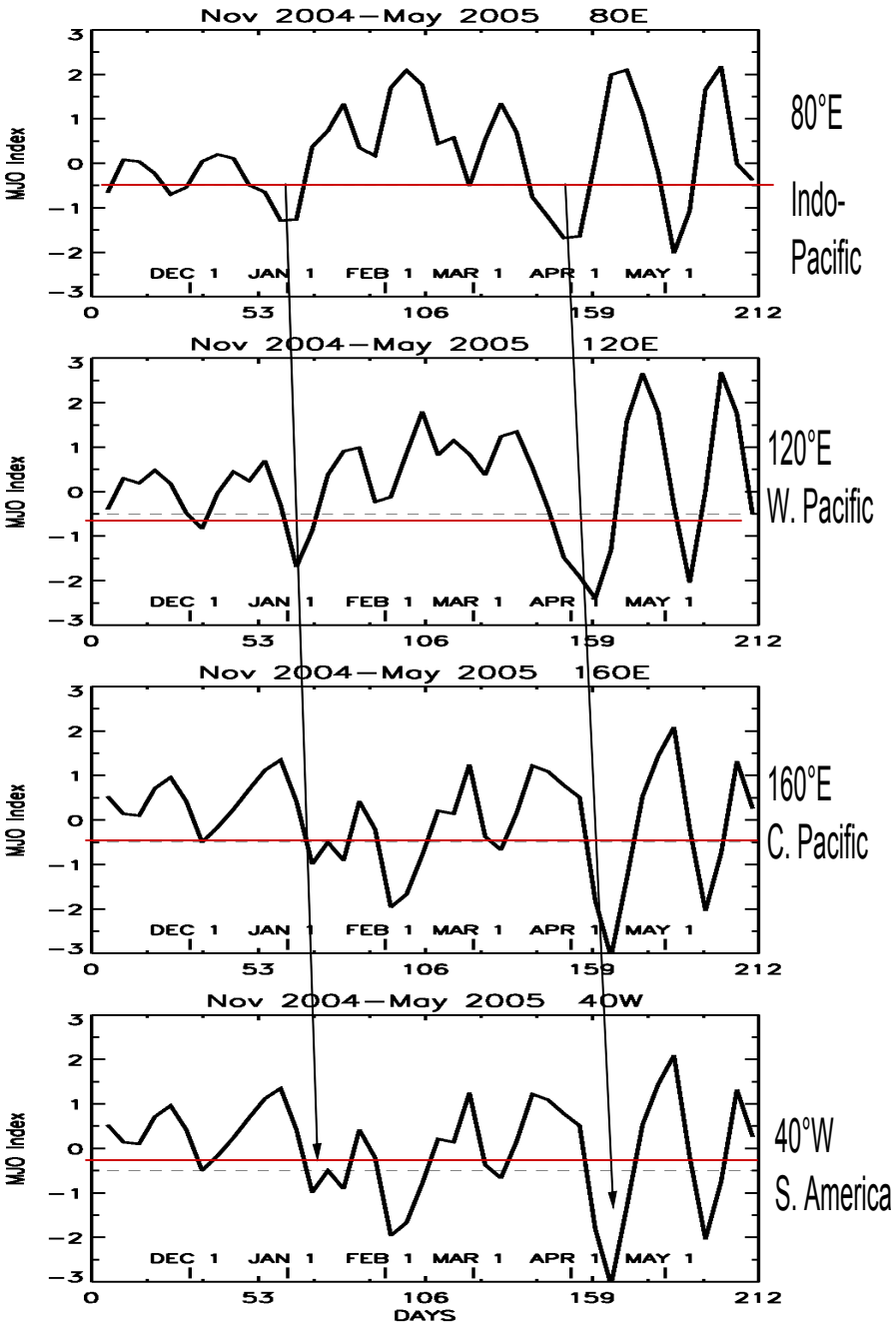
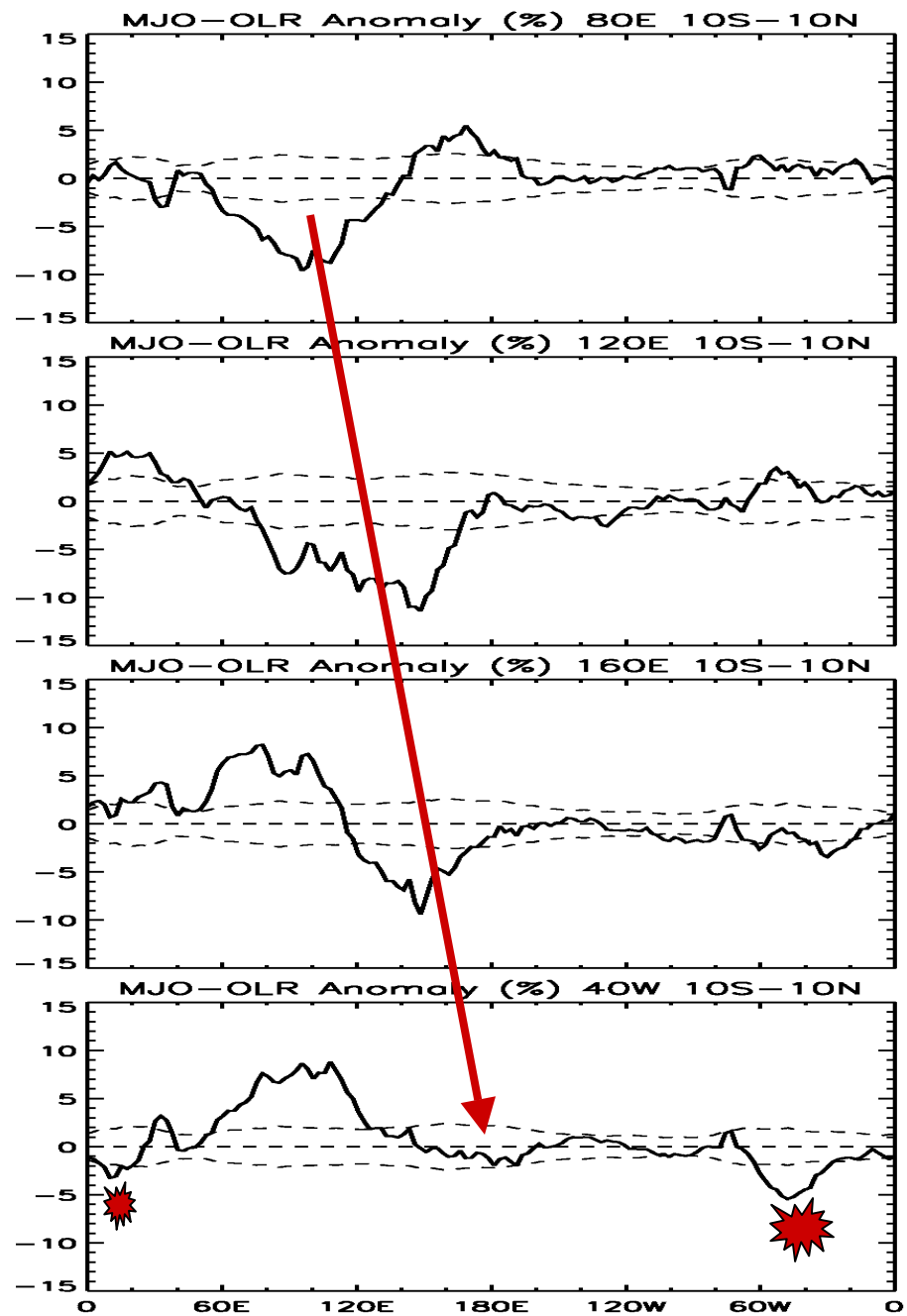


CPC MJO Indices, Nov 2004-May 2005

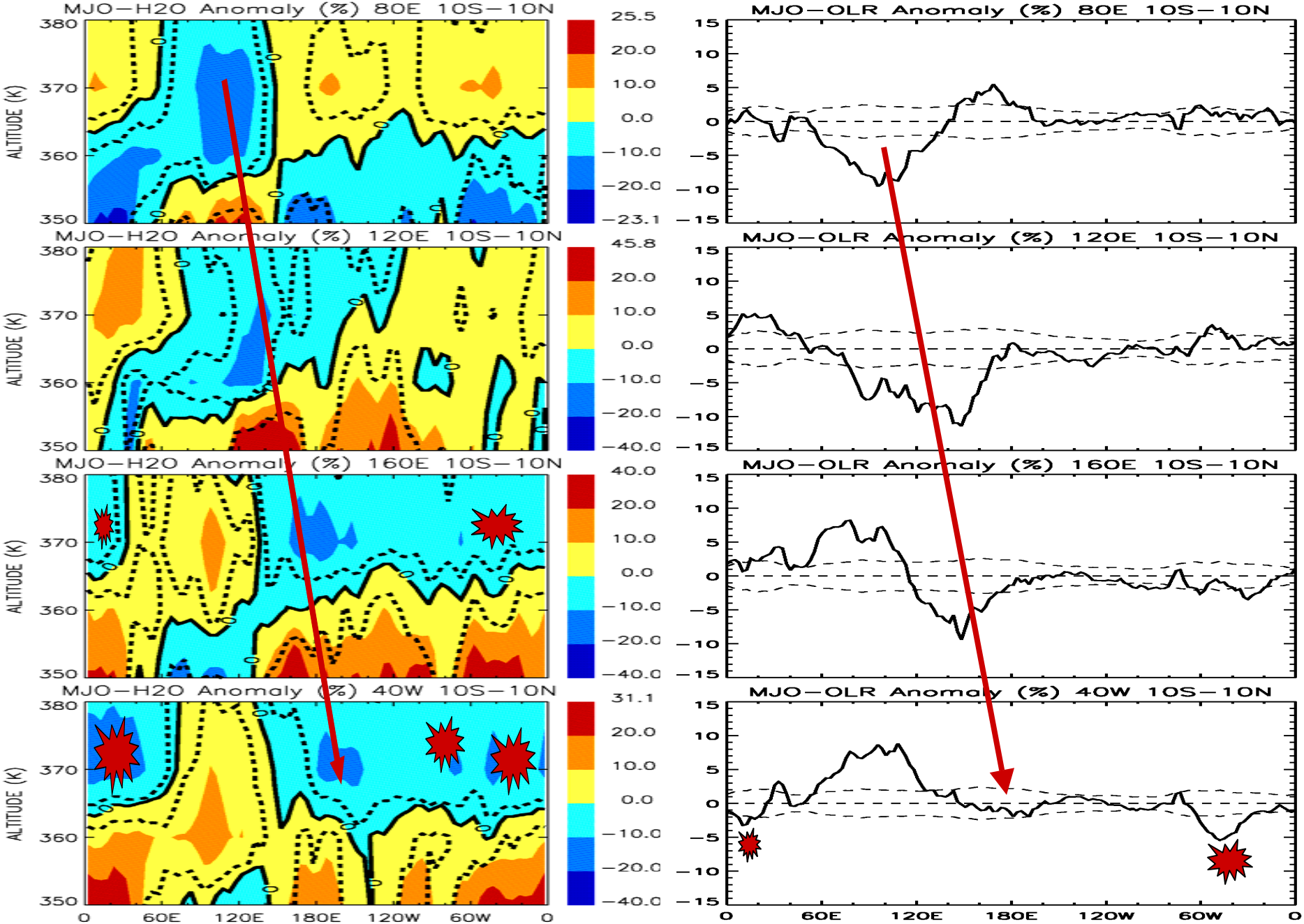


MJO-OLR Anomaly (%) 10°S-10°N

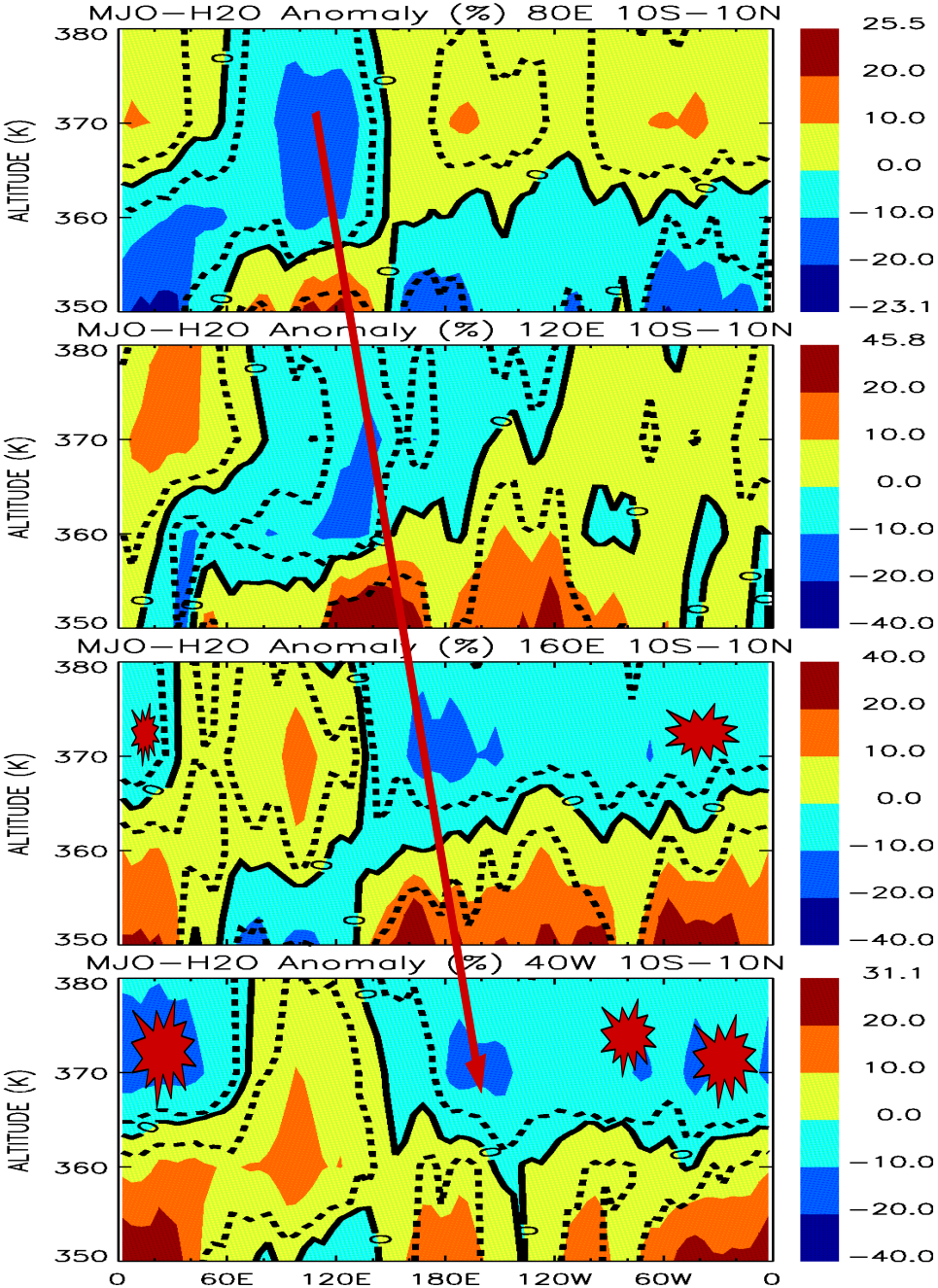


MJO-H_2O Anomaly (%) 10°S-10°N

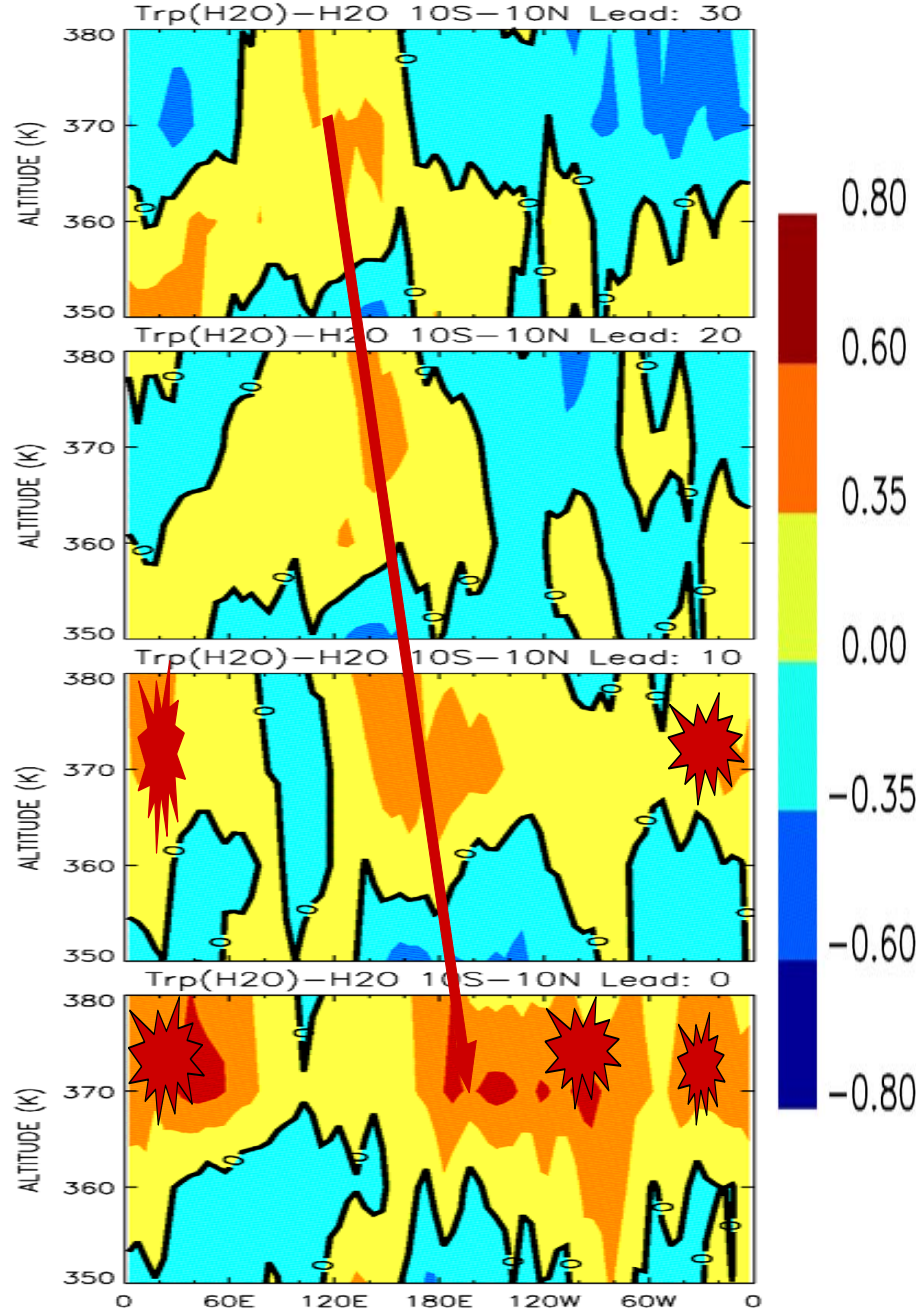
MJO-OLR Anomaly (%) 10°S-10°N



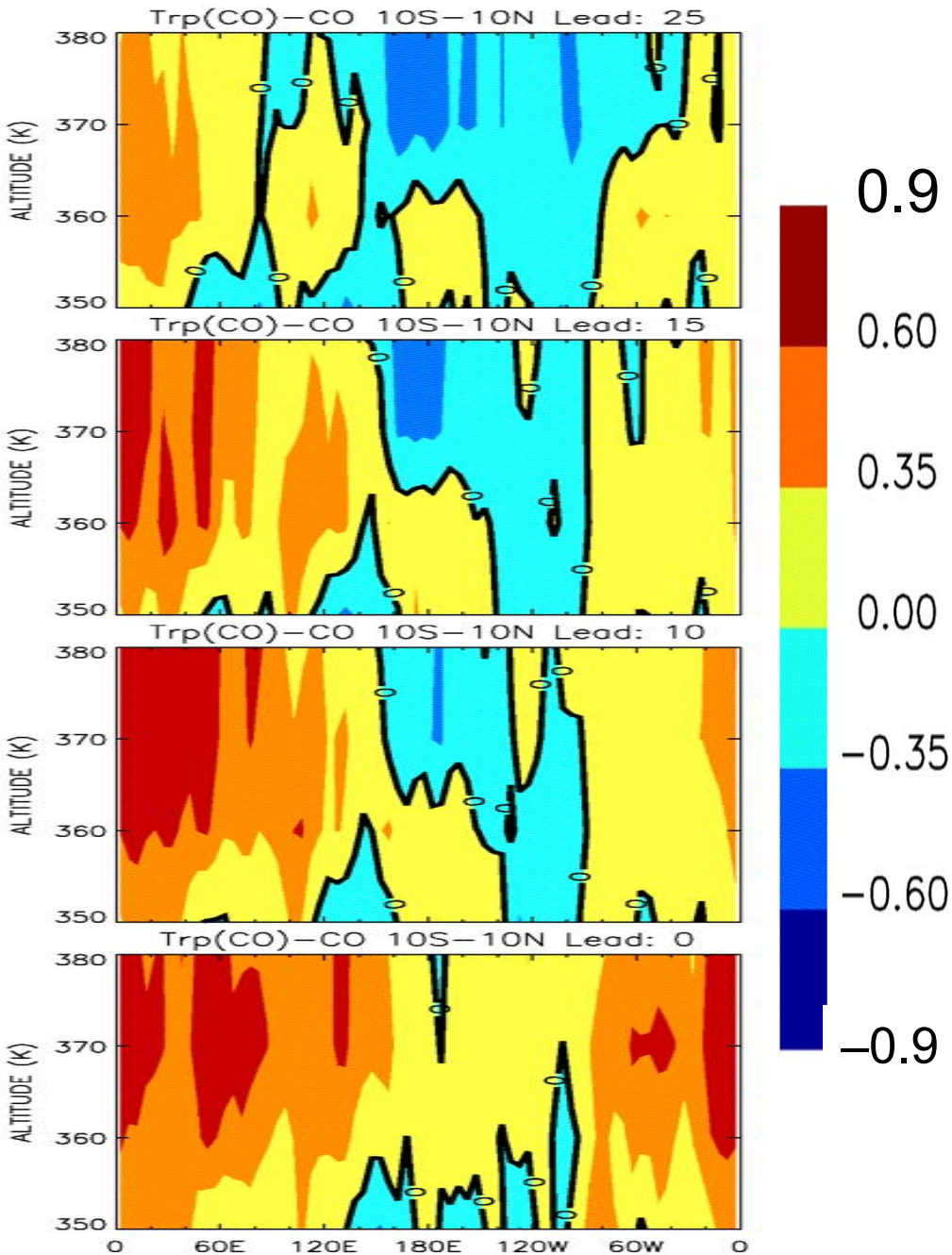
MJO-H_2O Anomaly (%) 10°S-10°N



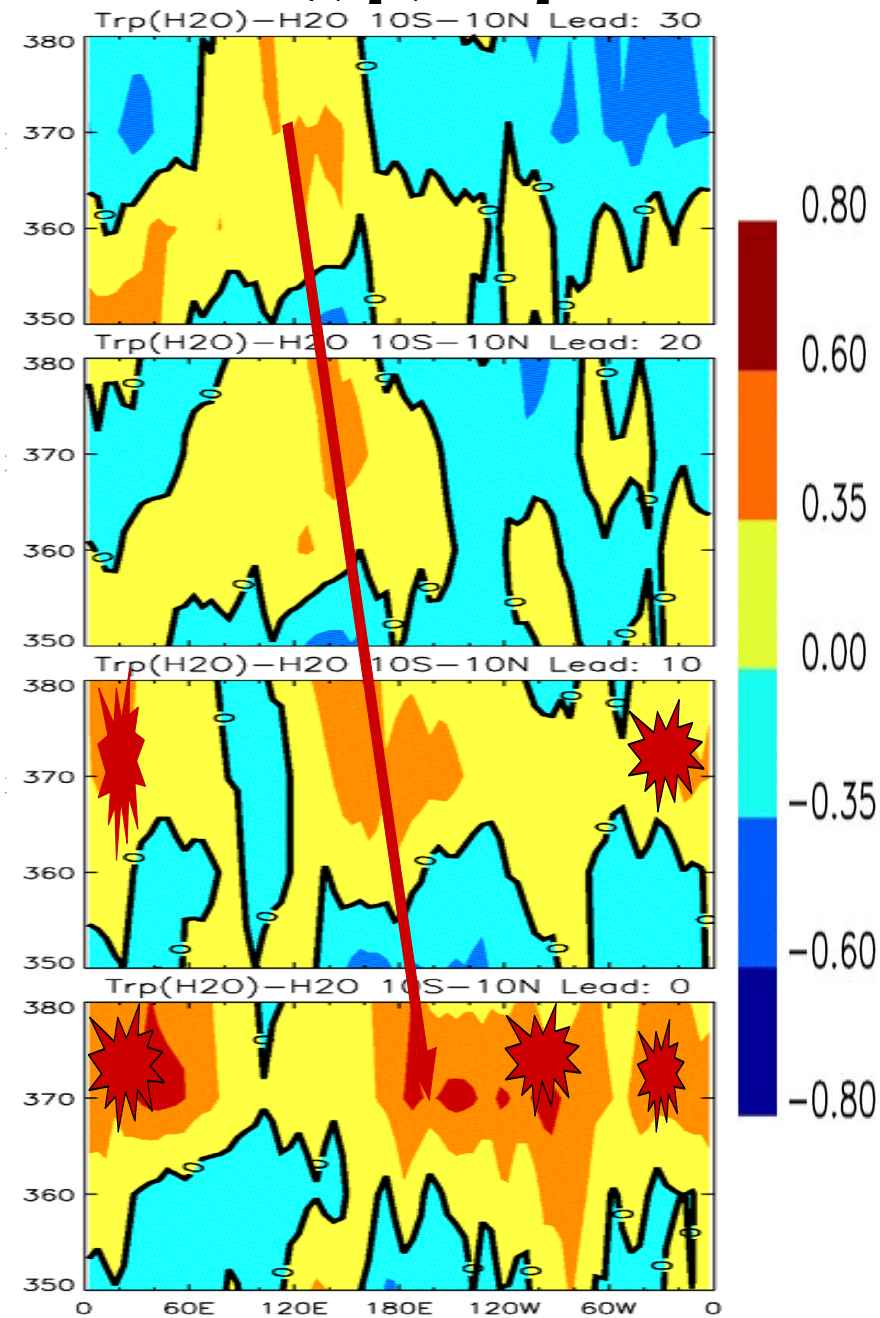
Correlation of Trp(H_2O) and H_2O, 10°S-10°N



Correlation of Trp(CO) and CO, 10°S-10°N



Correlation of Trp(H_2O) and H_2O, 10°S-10°N



Conclusions:

- Tropical mean H_2O at the altitude of 370 K is regulated by the MJO and its associated convective system

- There is an isentrope on which variations of H_2O and temperature are highly correlated (NCEP+Aura MLS: ~370K. Implications of higher vertical resolution in v2.1 ???)

- Tropical mean CO at the altitude of 370 K is dominated by large surface emission of CO, and the MJO helps inject CO into the TTL from the lower troposphere

(Paper submitted to JGR).

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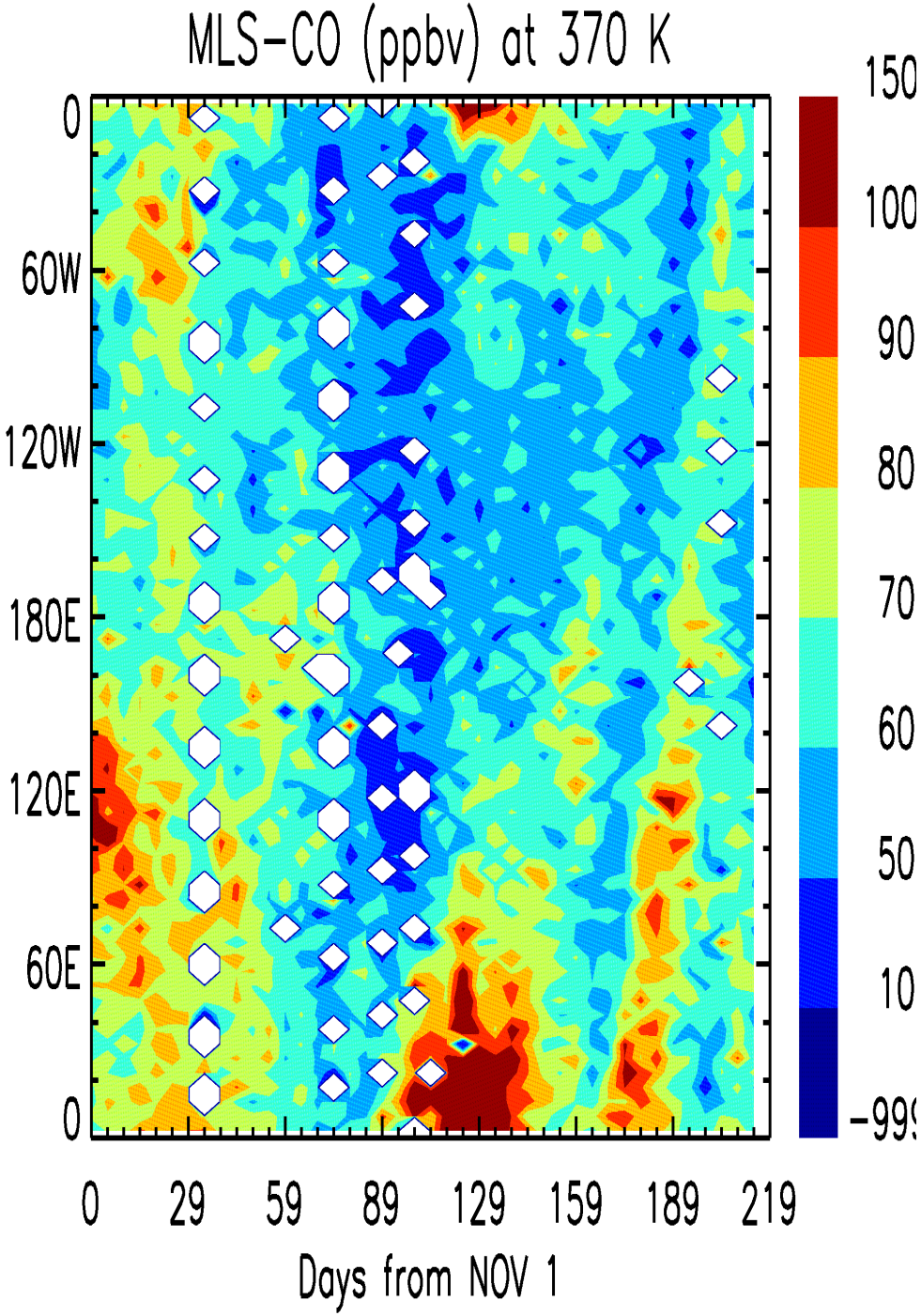
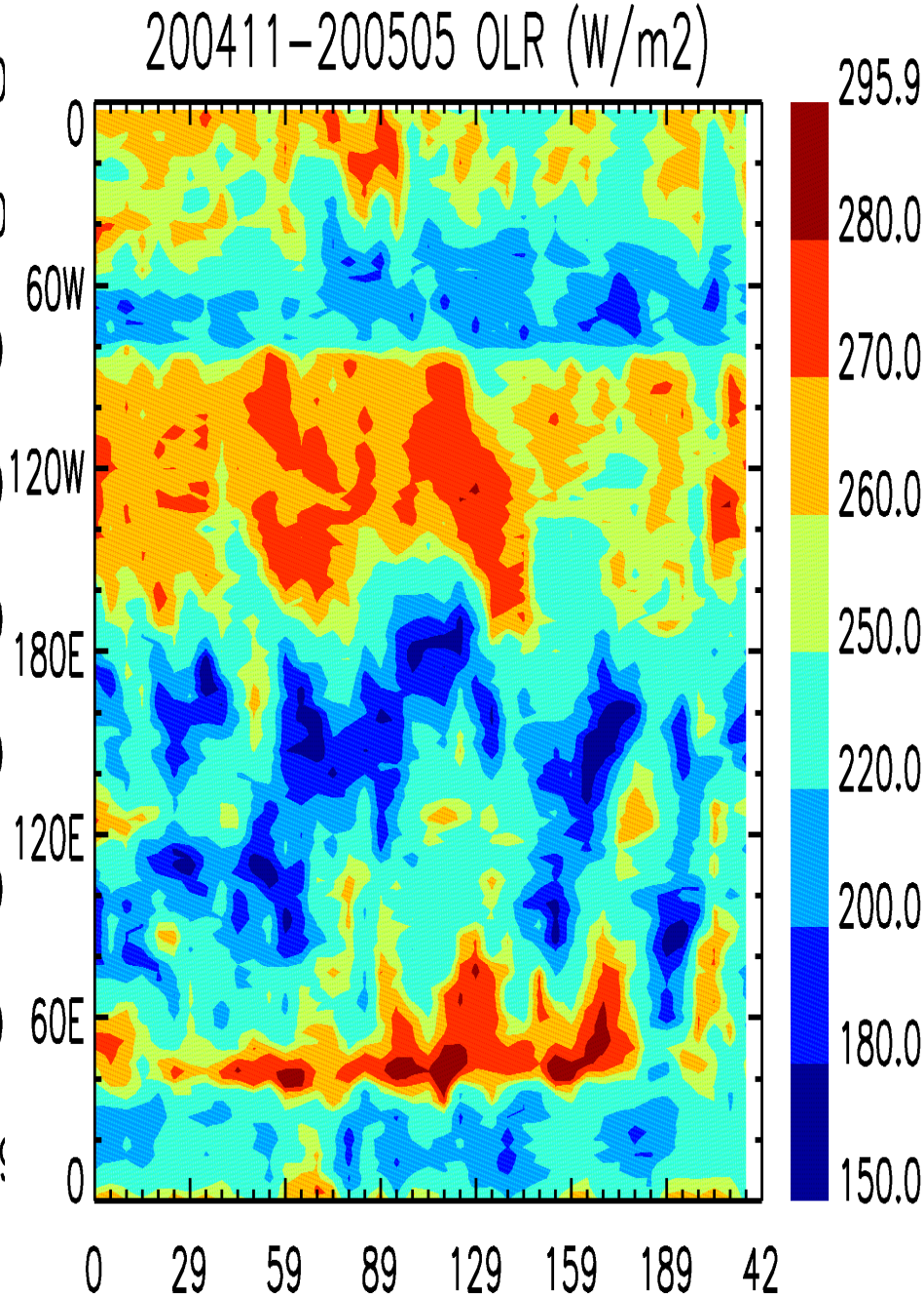
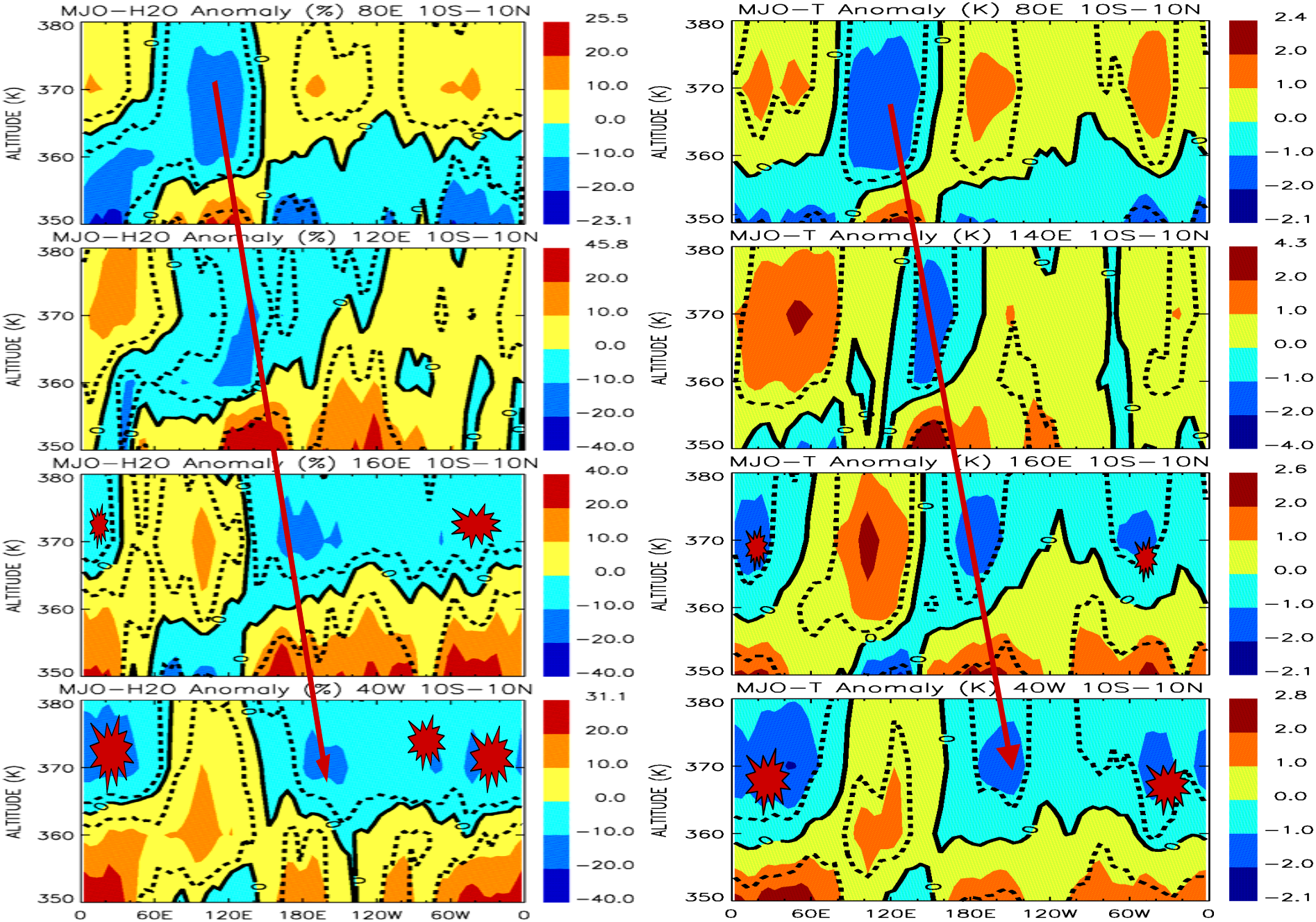
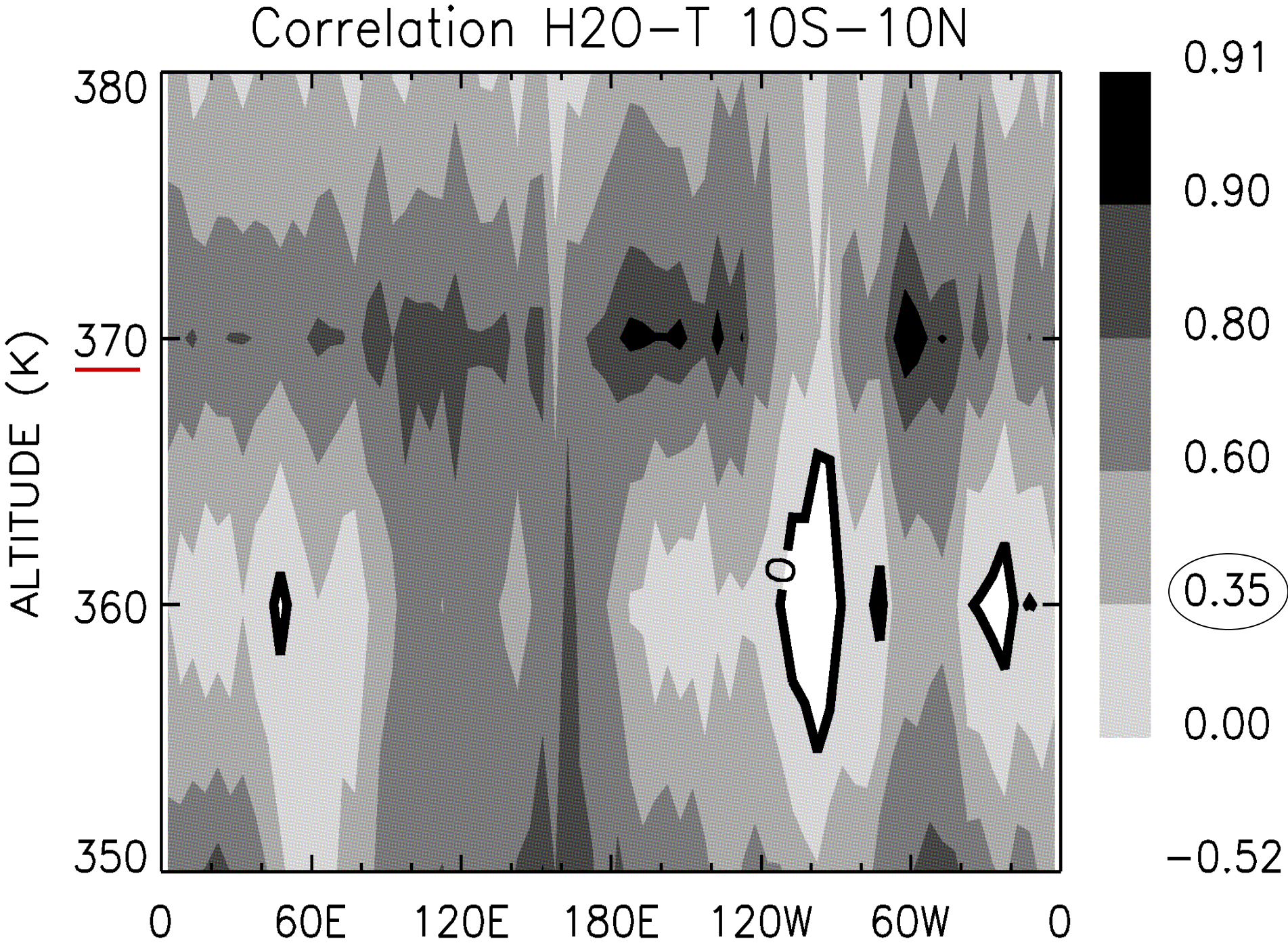

MLS-CO (ppbv) at 370 K
0
60W
120W
180E
120E
60E
0
0
29
59
89
129
159
189
219
Days from NOV 1
150
100
90
80
70
60
50
10
-99


200411-200505 OLR (W/m2)
0
60W
120W
180E
120E
60E
0
0
29
59
89
129
159
189
42
295.9
280.0
270.0
260.0
250.0
220.0
200.0
180.0
150.0

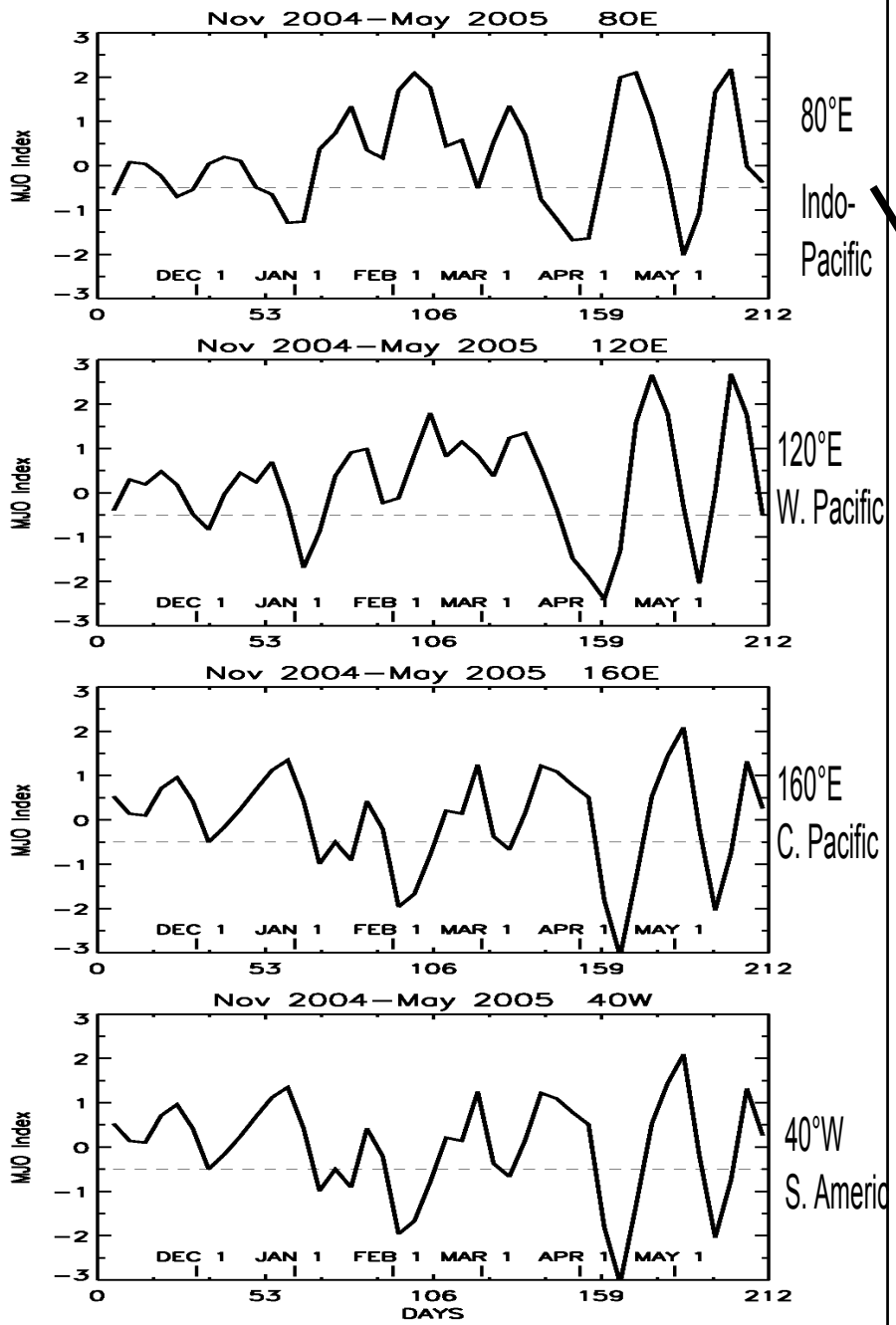
MJO-H_2O Anomaly (%) 10°S-10°N

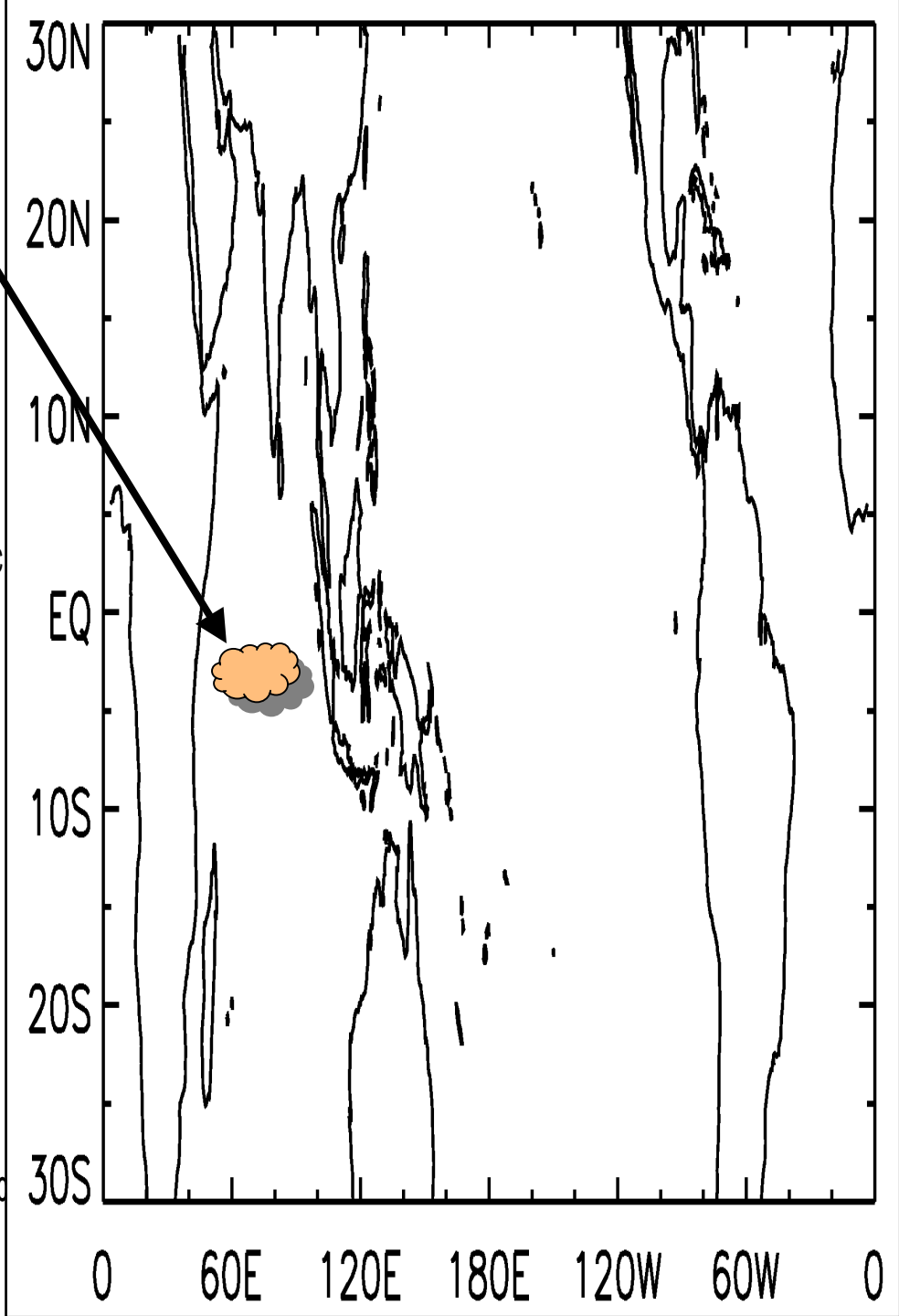
MJO-T Anomaly (K) 10°S-10°N



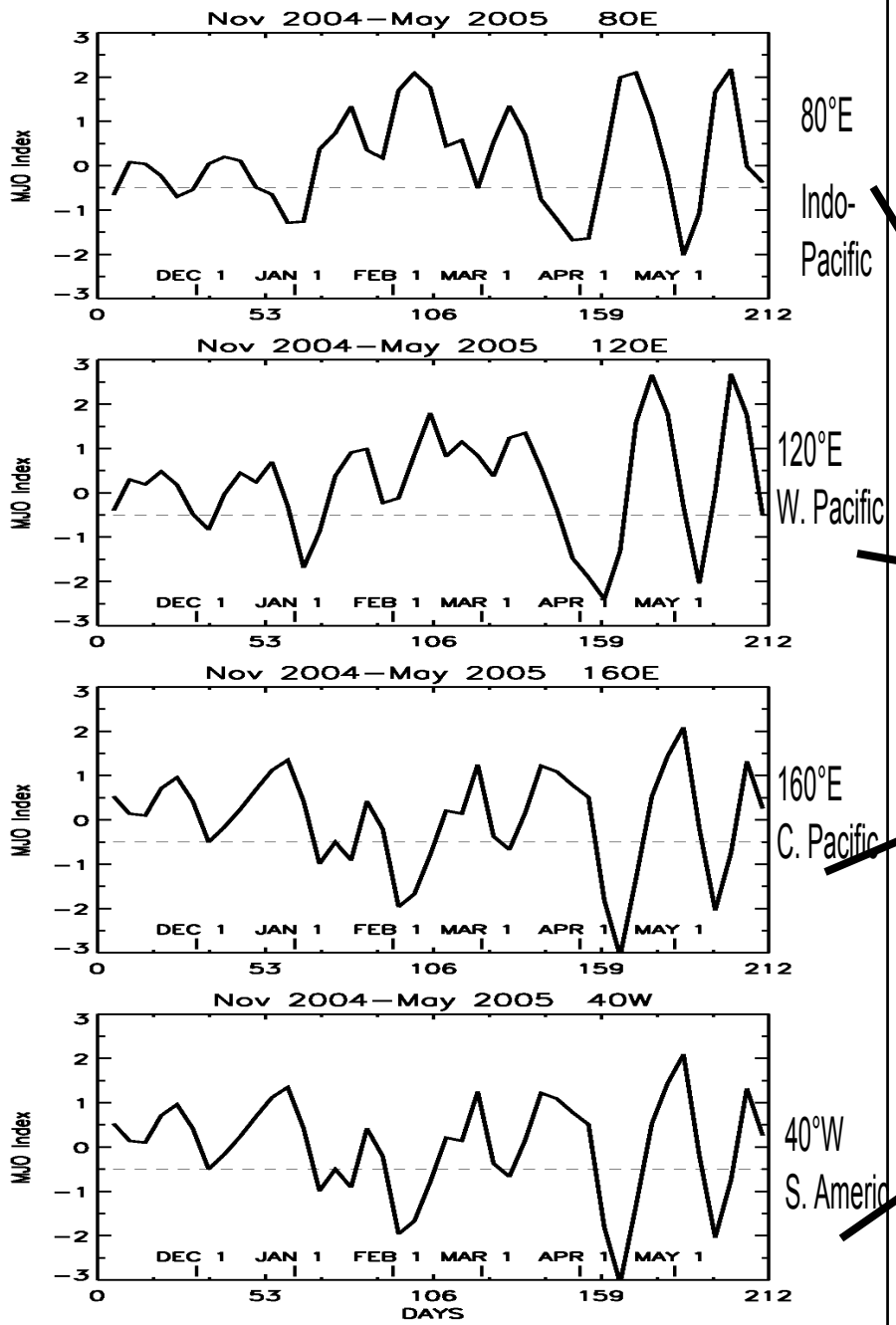

Correlation H2O−T 10S−10N
ALTITUDE (K)
380
370
360
350
0
60E
120E
180E
120W
60W
0
0.91
0.90
0.80
0.60
0.35
0.00
−0.52

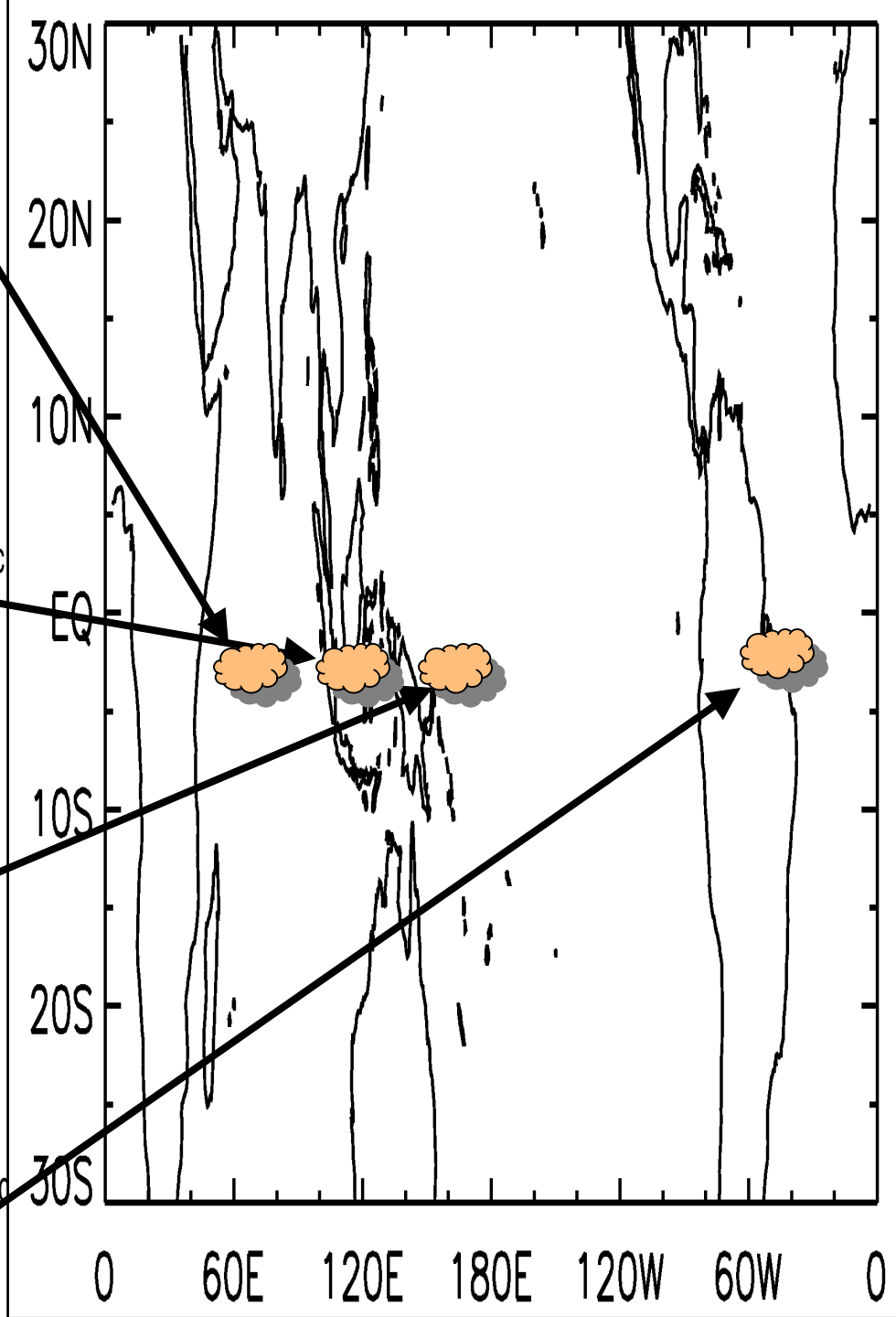
CPC MJO Indices, Nov 2004-May 2005



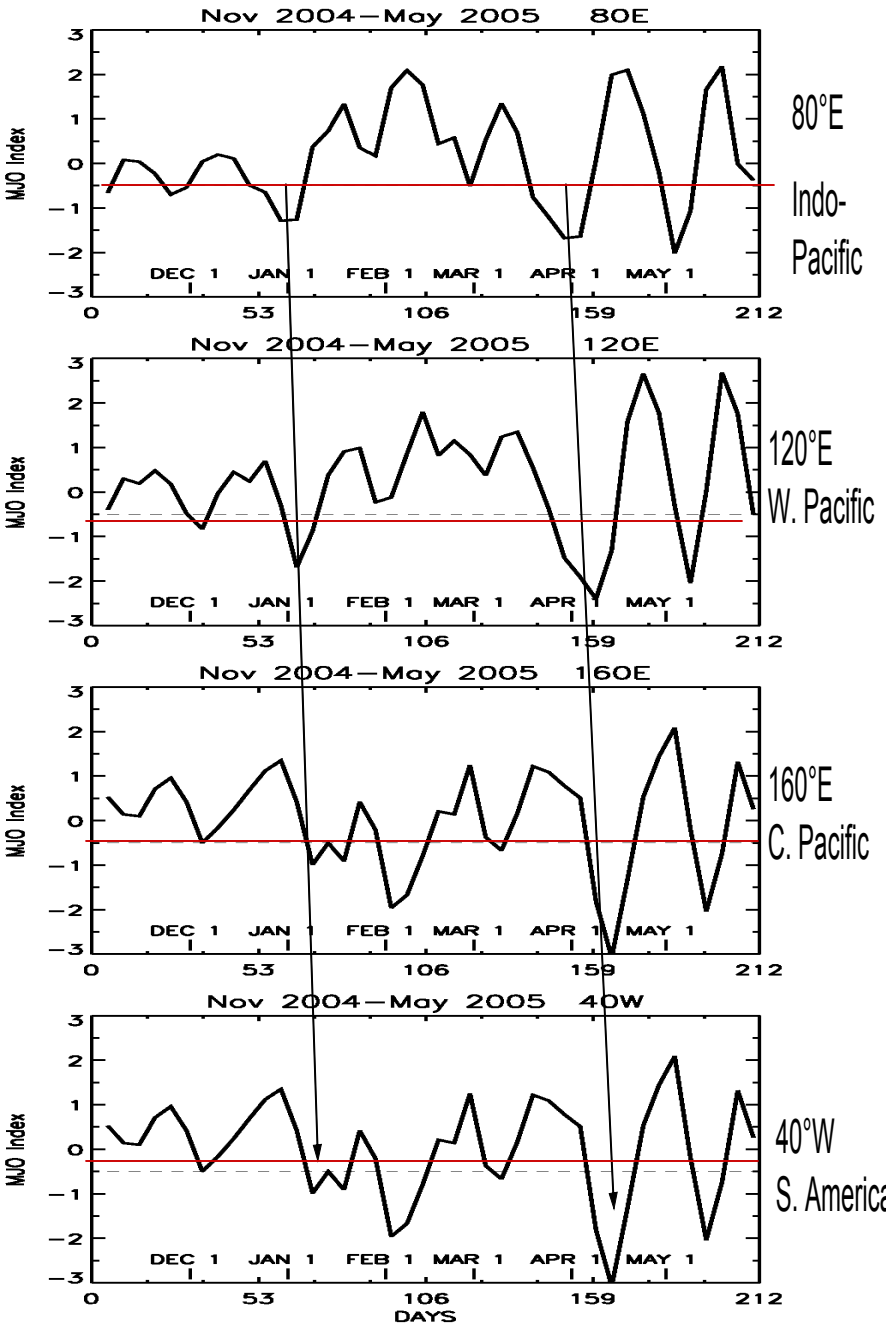


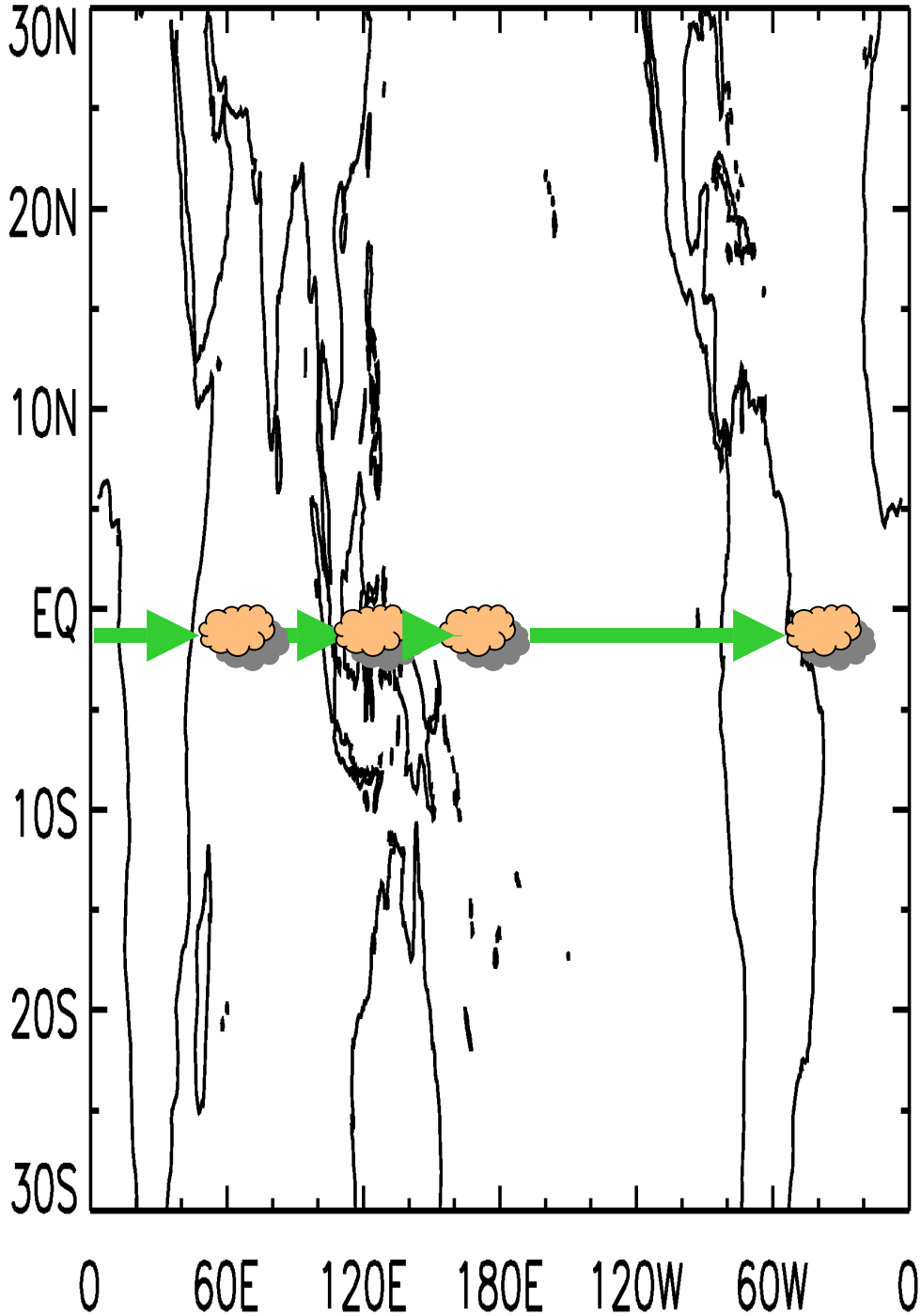
CPC MJO Indices, Nov 2004-May 2005

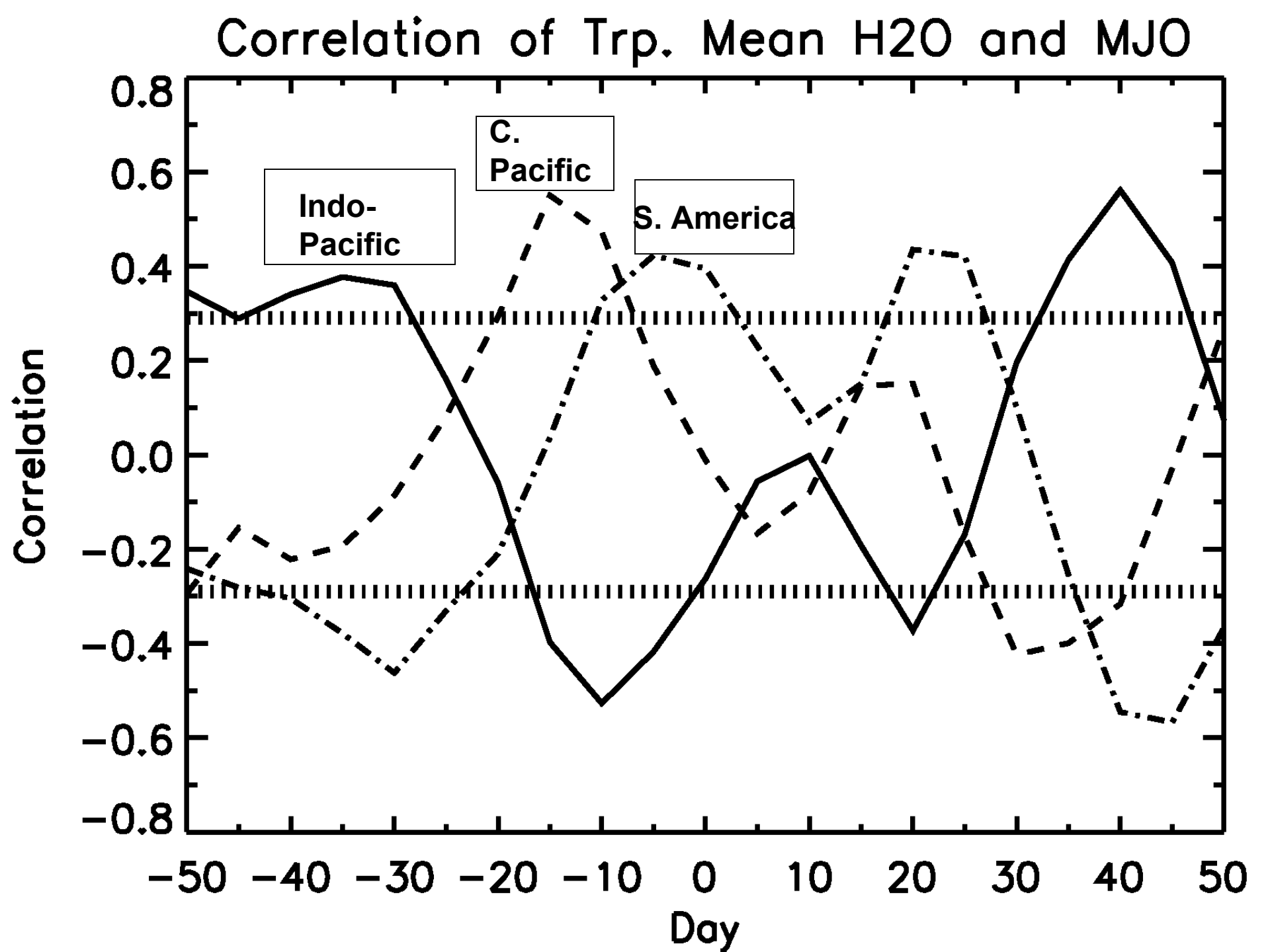


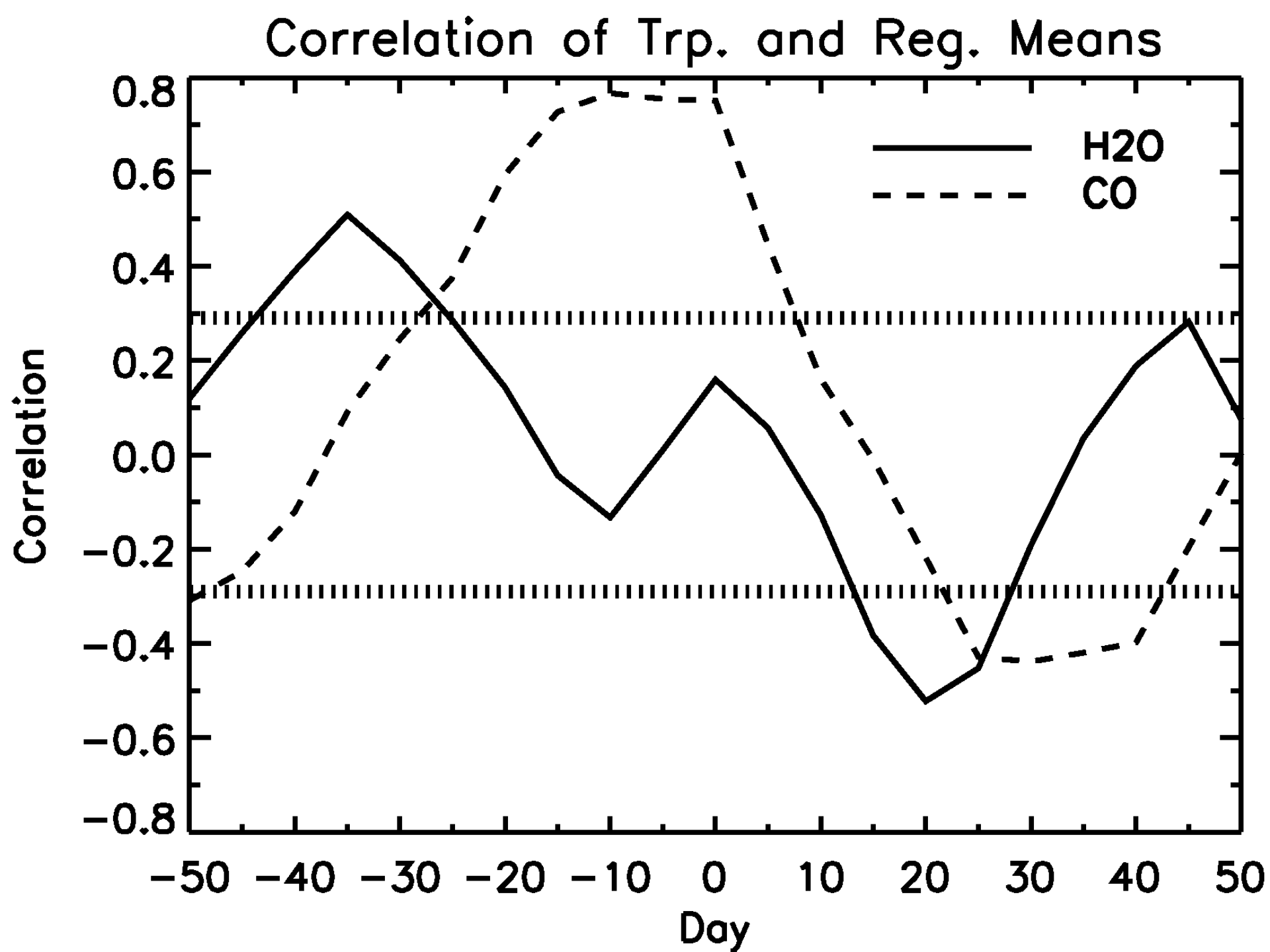


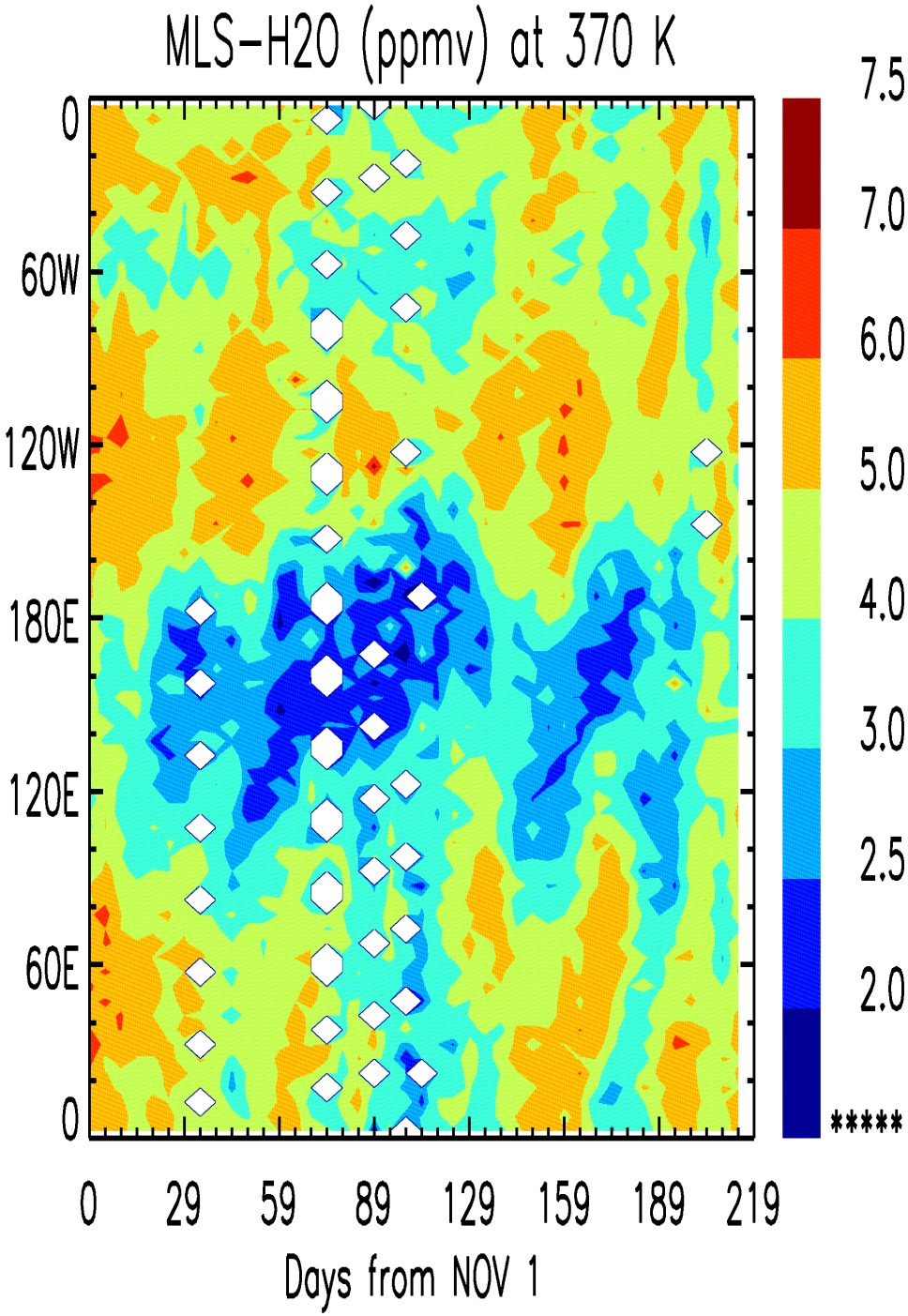
CPC MJO Indices, Nov 2004-May 2005

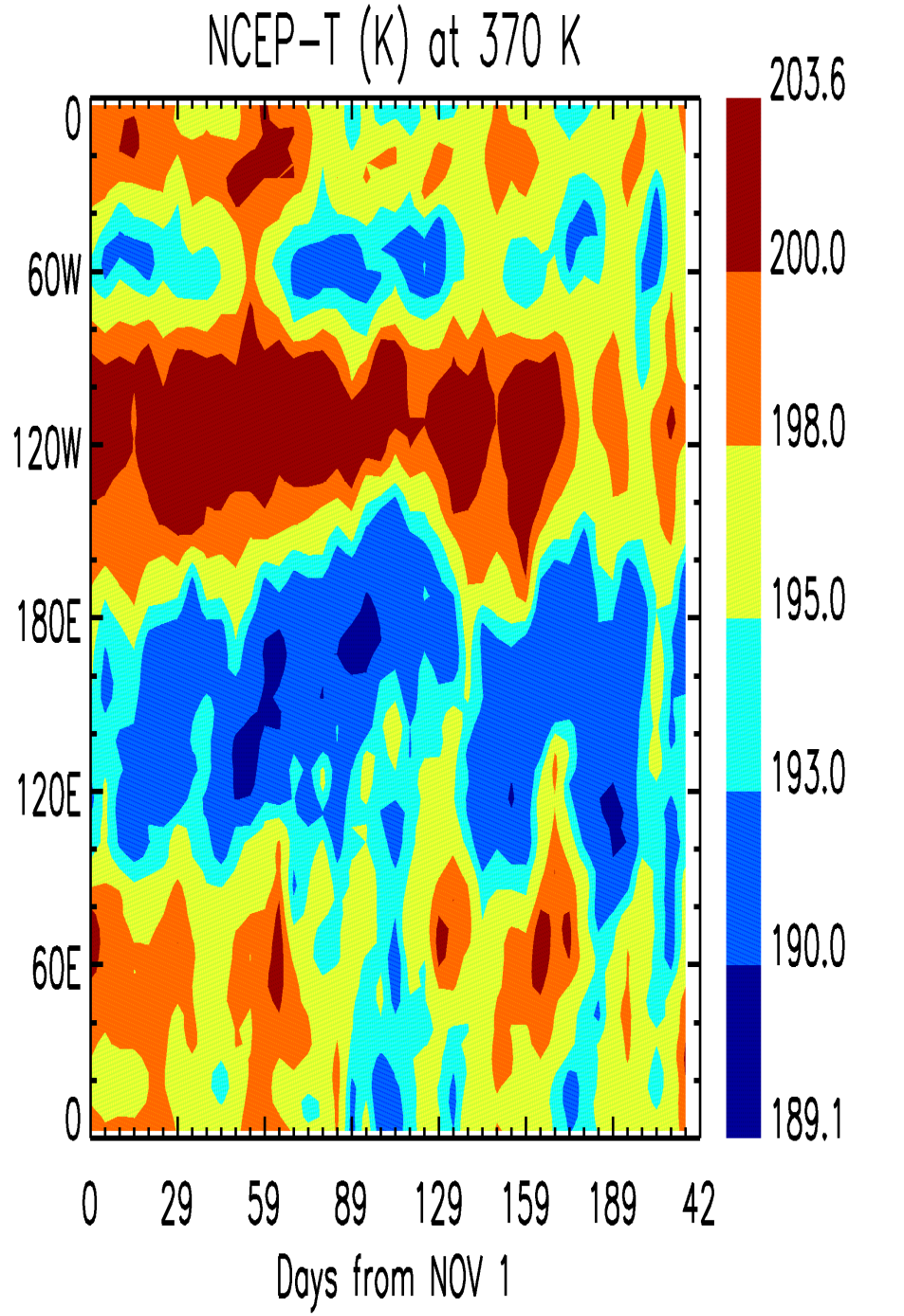





Correlation of Trp. Mean H2O and MJO
Indo-Pacific
C. Pacific
S. America
Correlation
Day
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−50
−40
−30
−20
−10
0
10
20
30
40
50


Correlation of Trp. and Reg. Means
H2O
CO
Correlation
Day
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4
−0.6
−0.8
−50
−40
−30
−20
−10
0
10
20
30
40
50


MLS-H2O (ppmv) at 370 K
0
60W
120W
180E
120E
60E
0
0
29
59
89
129
159
189
219
Days from NOV 1
7.5
7.0
6.0
5.0
4.0
3.0
2.5
2.0
*****


NCEP-T (K) at 370 K
0
60W
120W
180E
120E
60E
0
0
29
59
89
129
159
189
42
Days from NOV 1
203.6
200.0
198.0
195.0
193.0
190.0
189.1