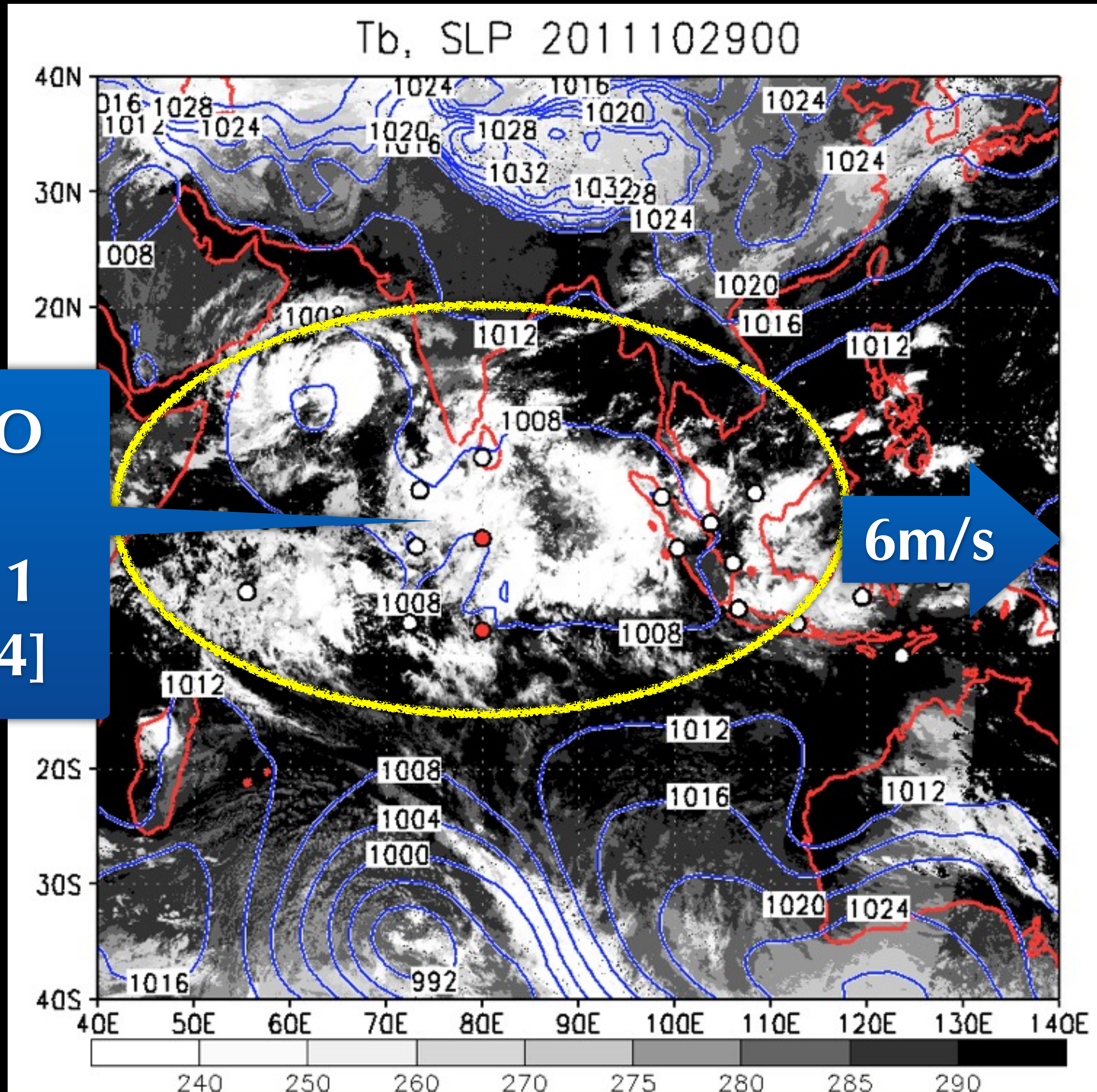
A triggering factor of the eastward propagation of MJO observed in late October during CINDY2011

JAMSTEC/DCOP

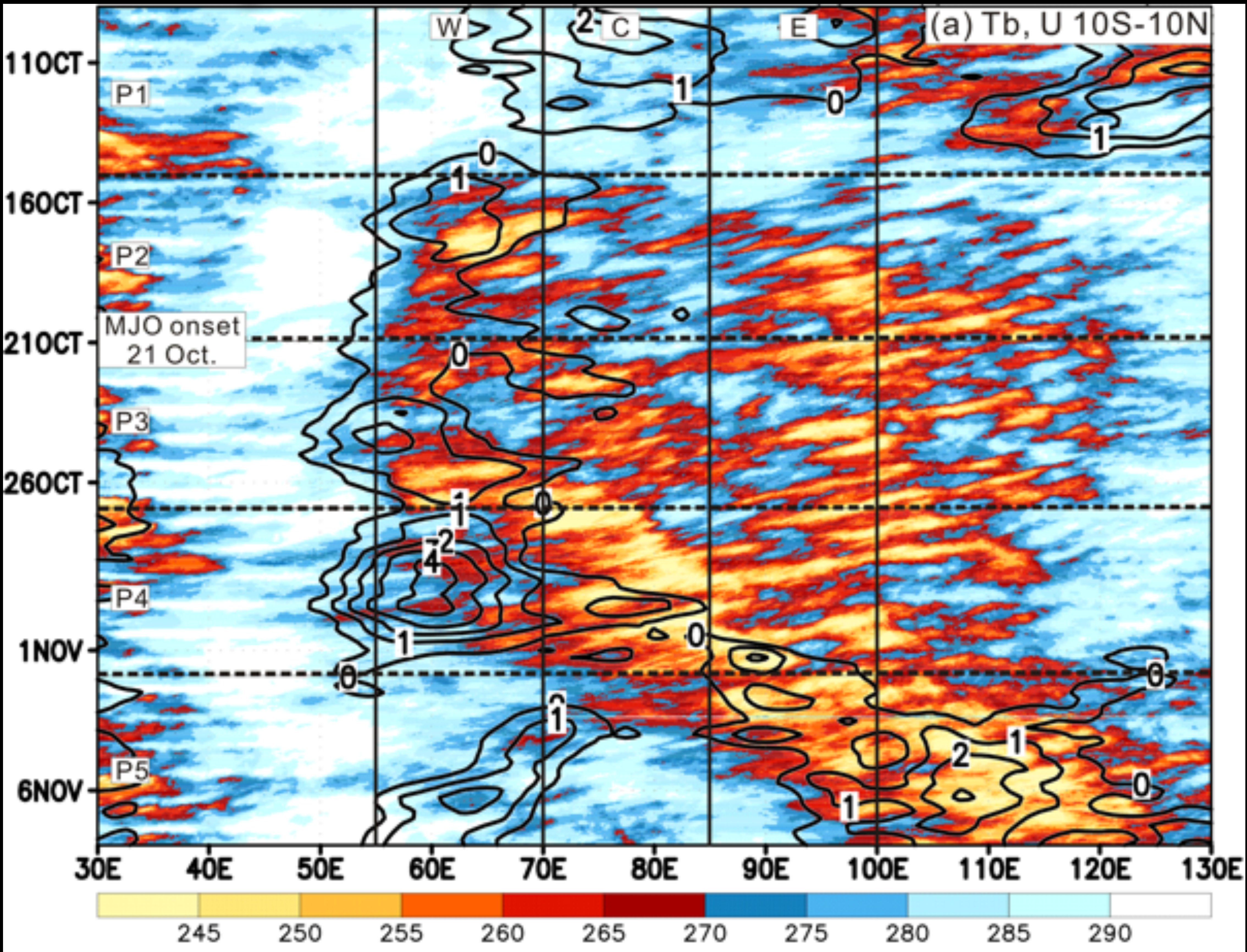
MOTEKI Qoosaku

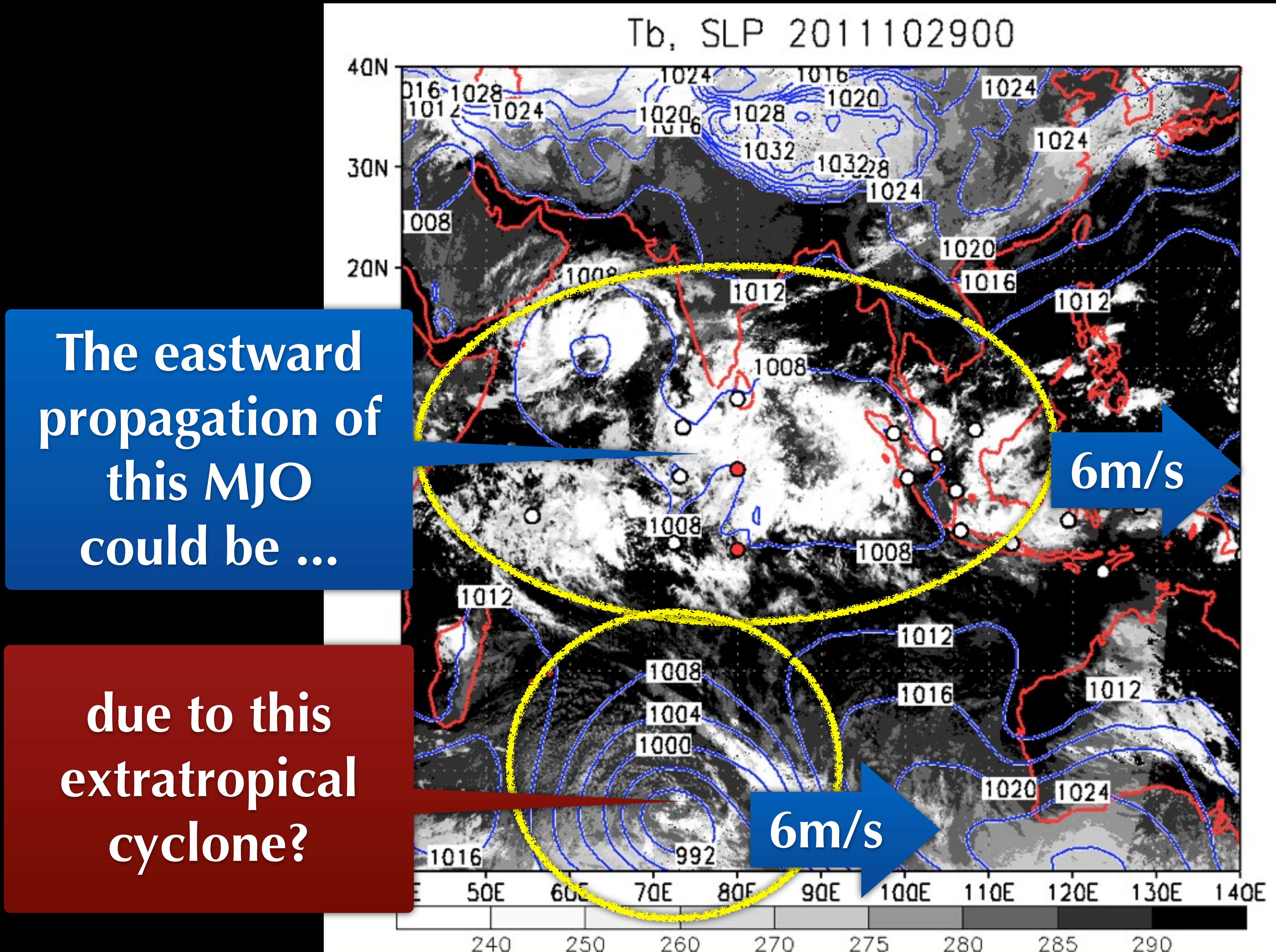
The 1st MJO during CINDY2011 [10/29-11/4]

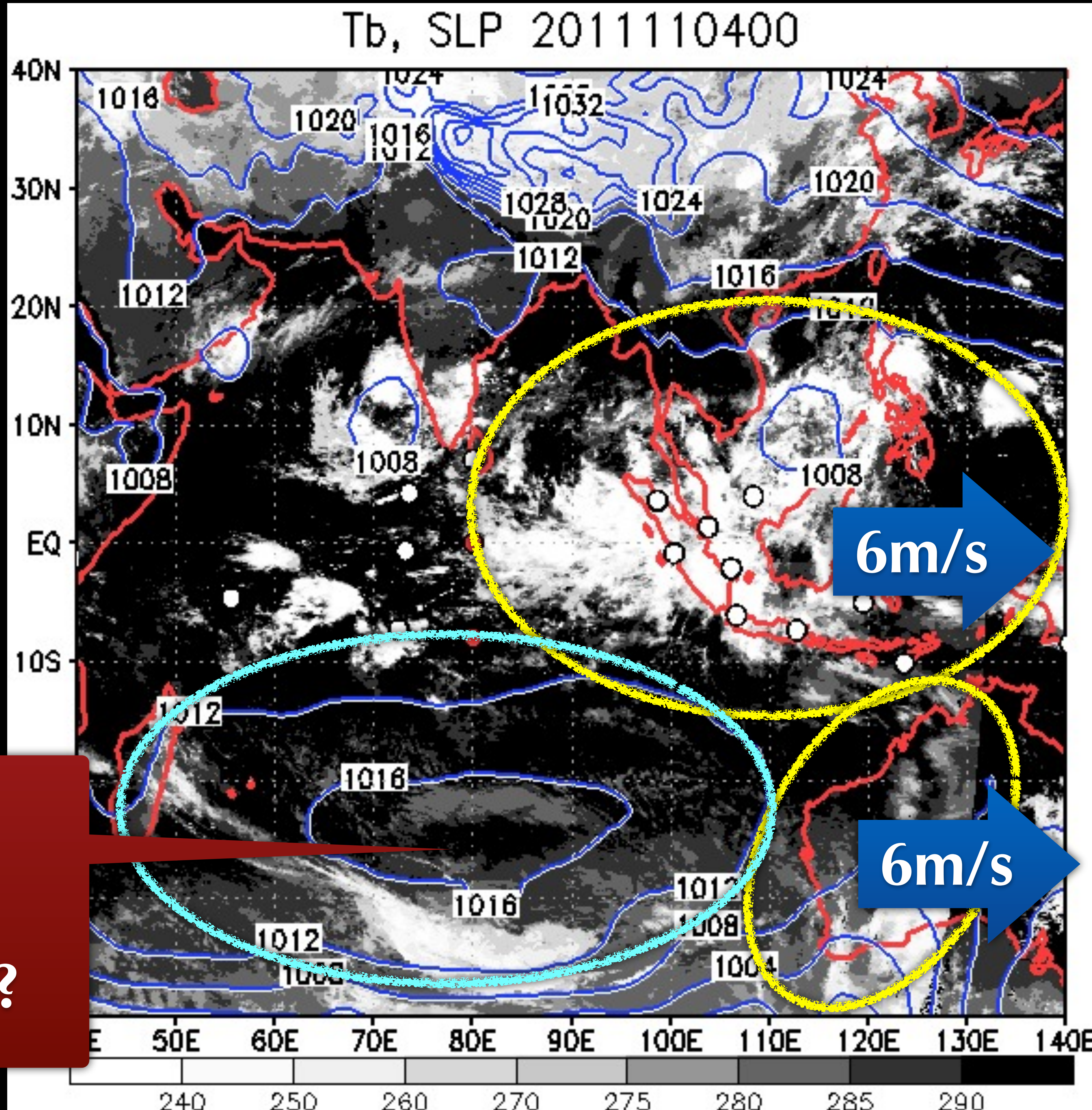


6m/s

1st MJO during CINDY2011/DYNAMO

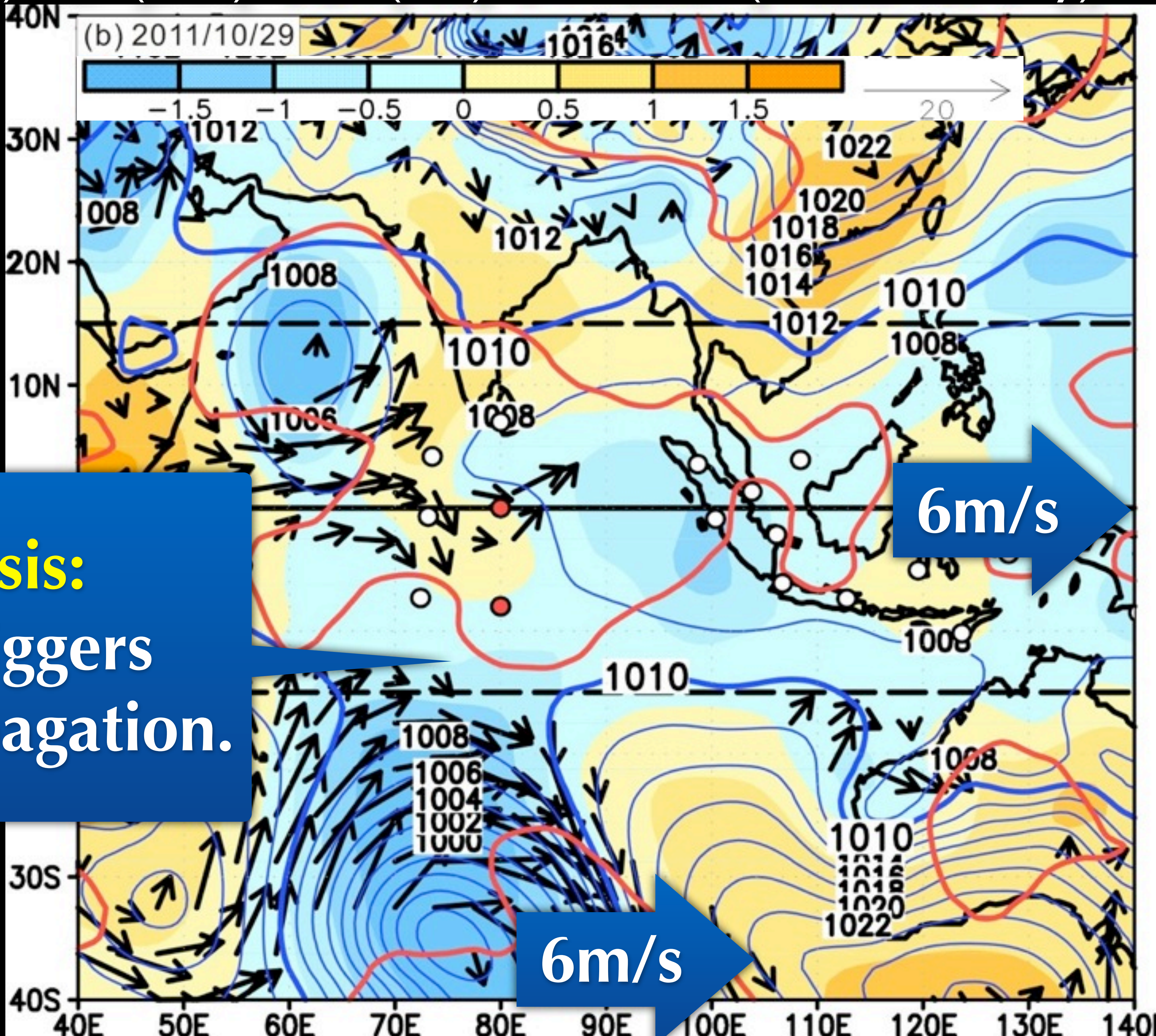



Tb, SLP 2011102900
The eastward propagation of this MJO could be ...
due to this extratropical cyclone?
6m/s
6m/s
40N
30N
20N
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E
240
250
260
270
275
280
285
290



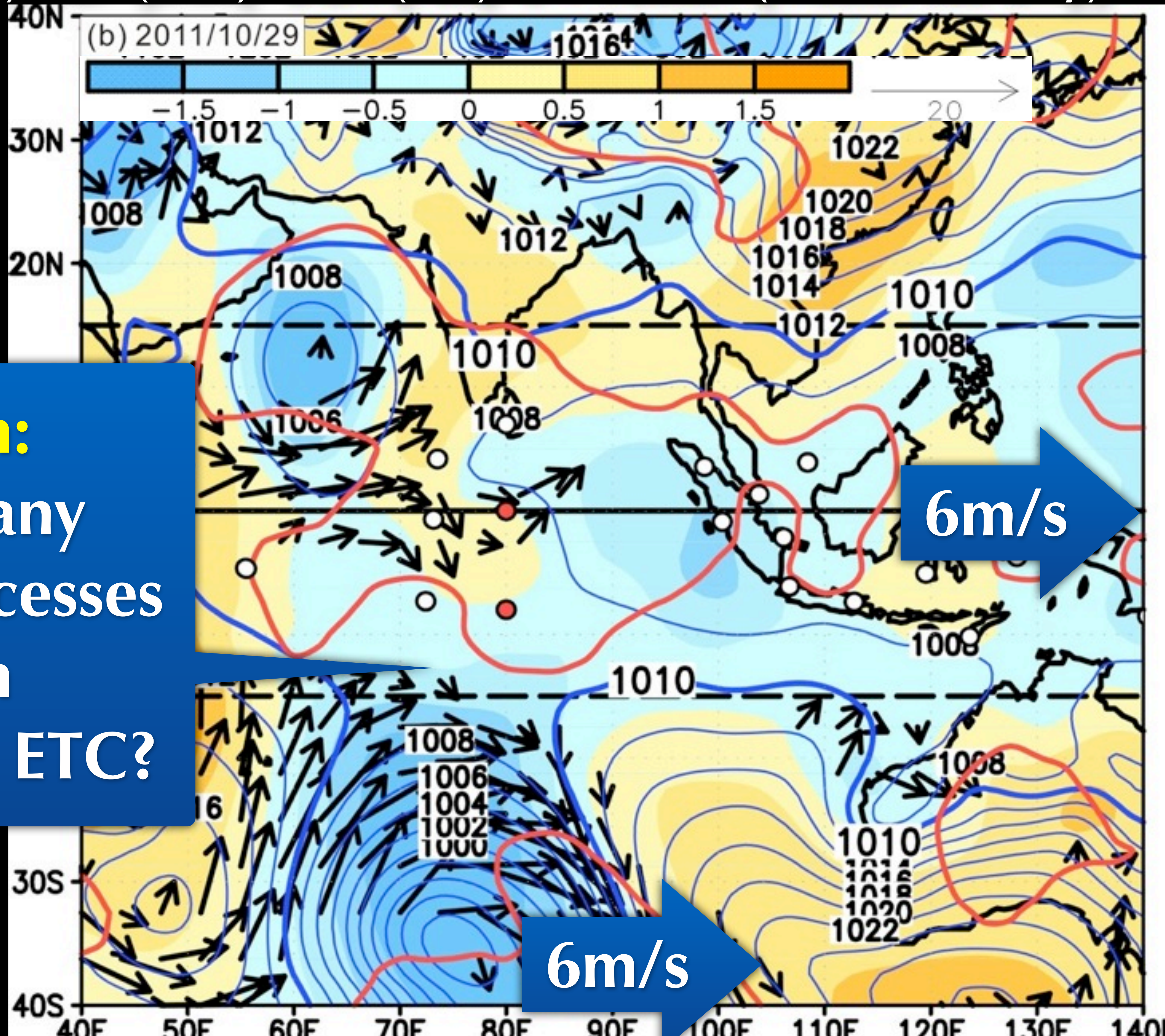
due to the traveling anticyclone?

NZA850 (color) SLP (blue) OLR (red) UV vector (westerlies only)



Hypothesis:
The ETC triggers the MJO propagation.

NZA850 (color) SLP (blue) OLR (red) UV vector (westerlies only)

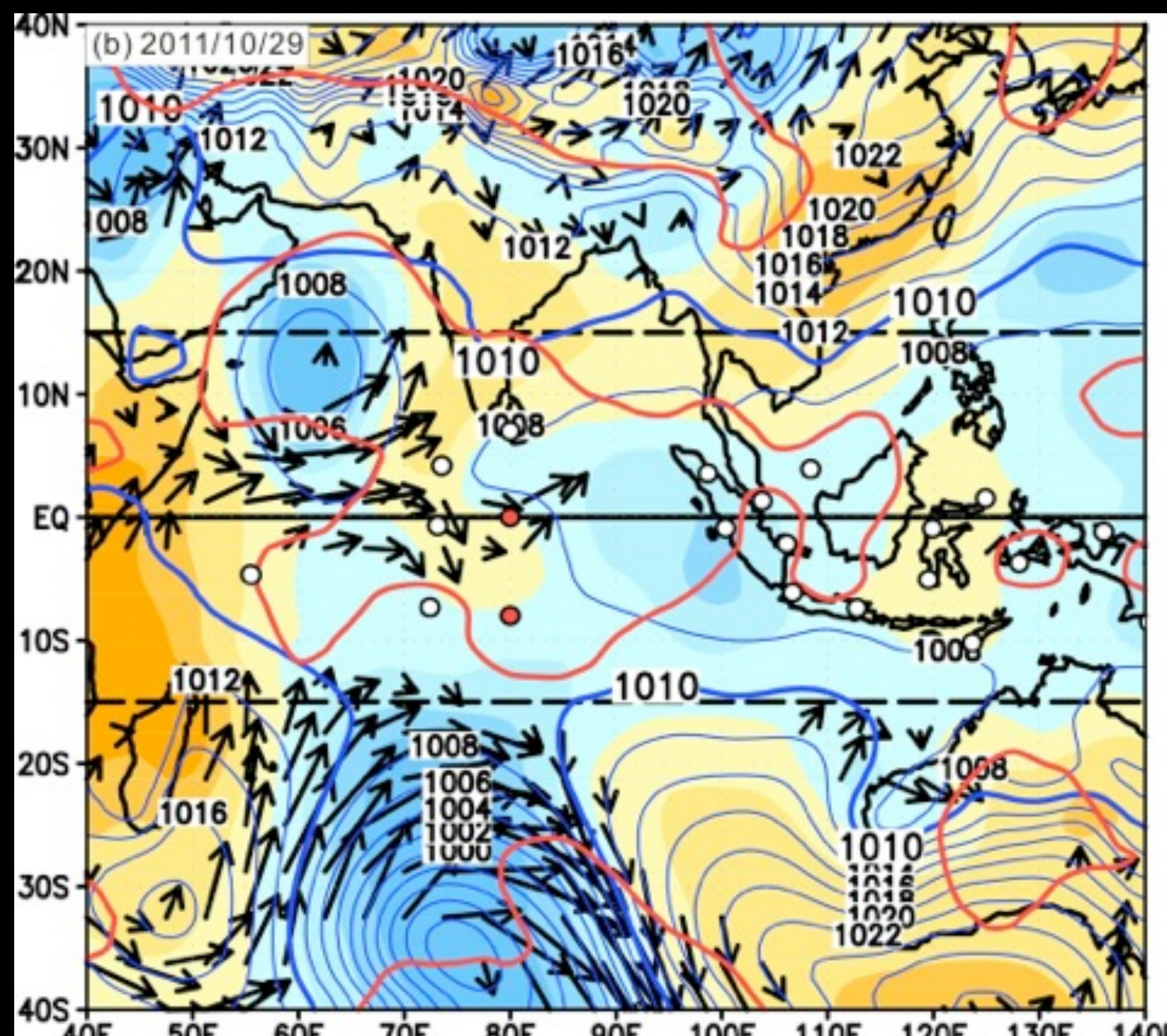


Question:
Are there any coupling processes between the MJO and ETC?

normalized Z anomaly

for the meridional amplitude difference

$$\text{Z anomaly} = \frac{\text{Z} \; - \; \text{Z averaged between 40-140E}}{\textbf{Z variance between 40-140E}}$$



The Japanese 55-year reanalysis for 1958–2012

JRA55

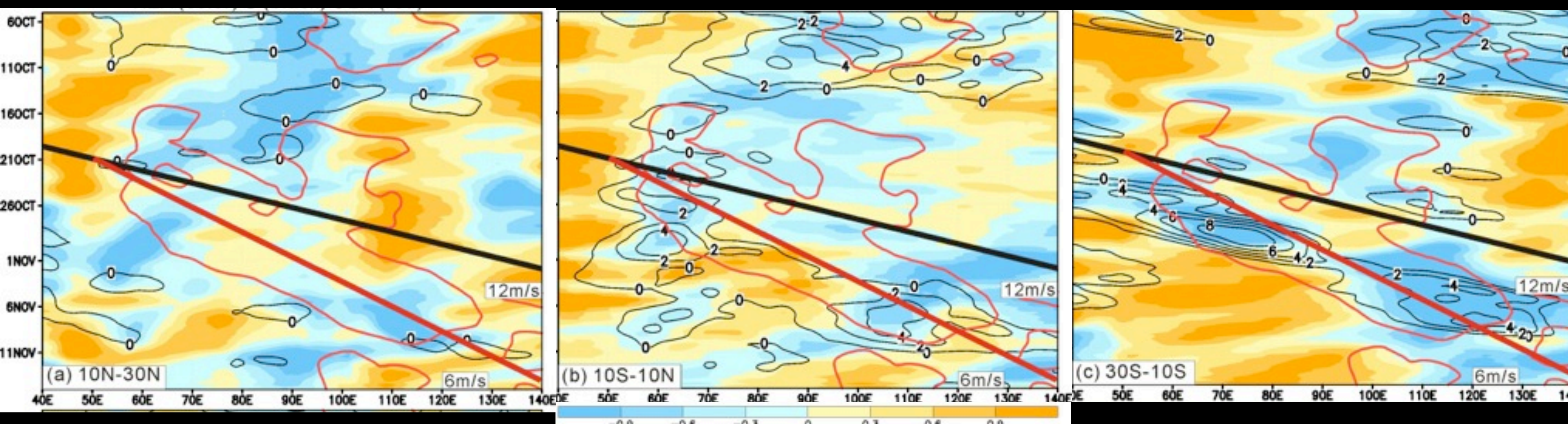
dx, dy: 1.25°

dt: 6h

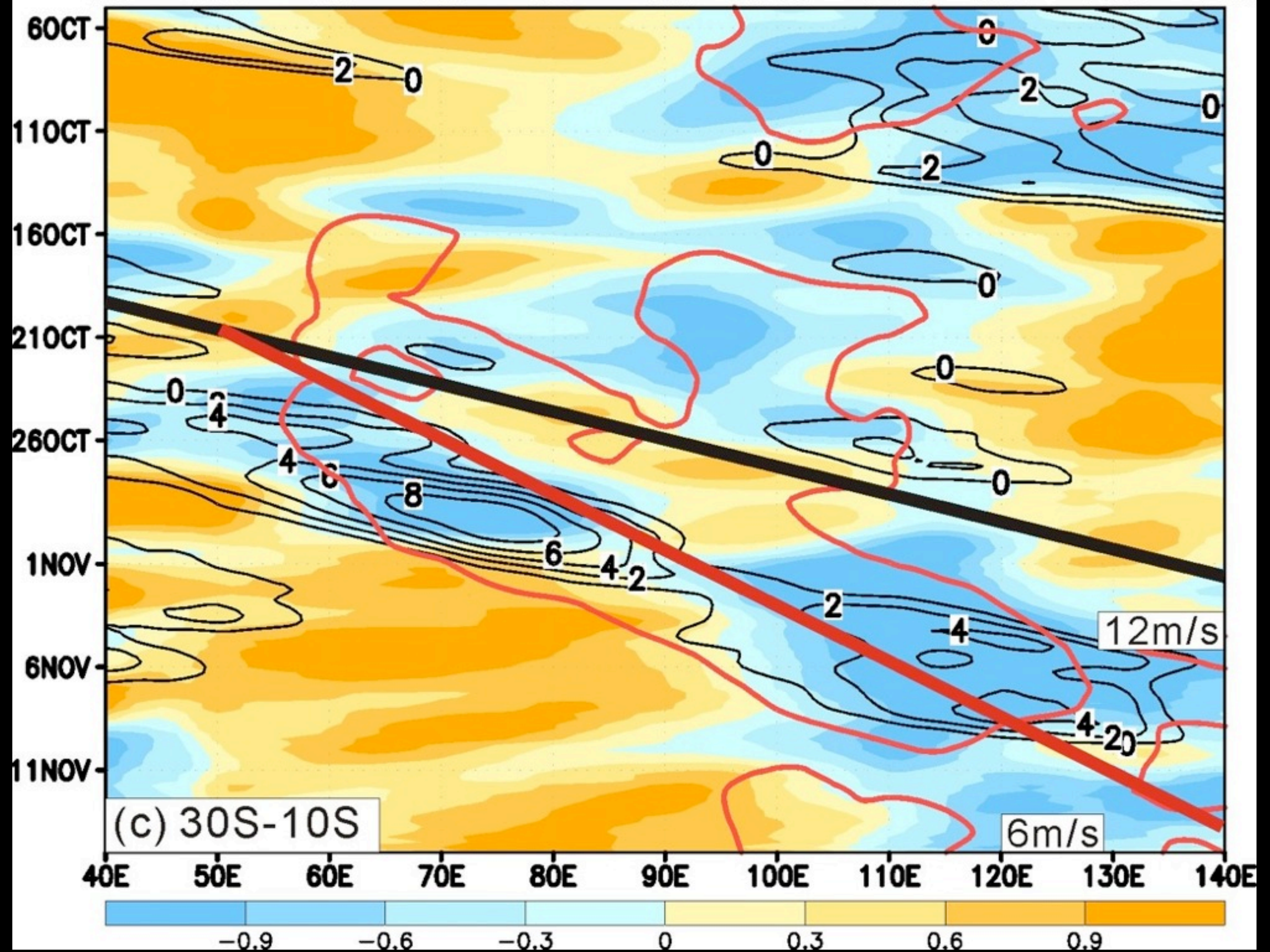
38 levels (1-1000hPa)

NZA (color) positive U (black)

10N-30N 10S-10N 30S-10S

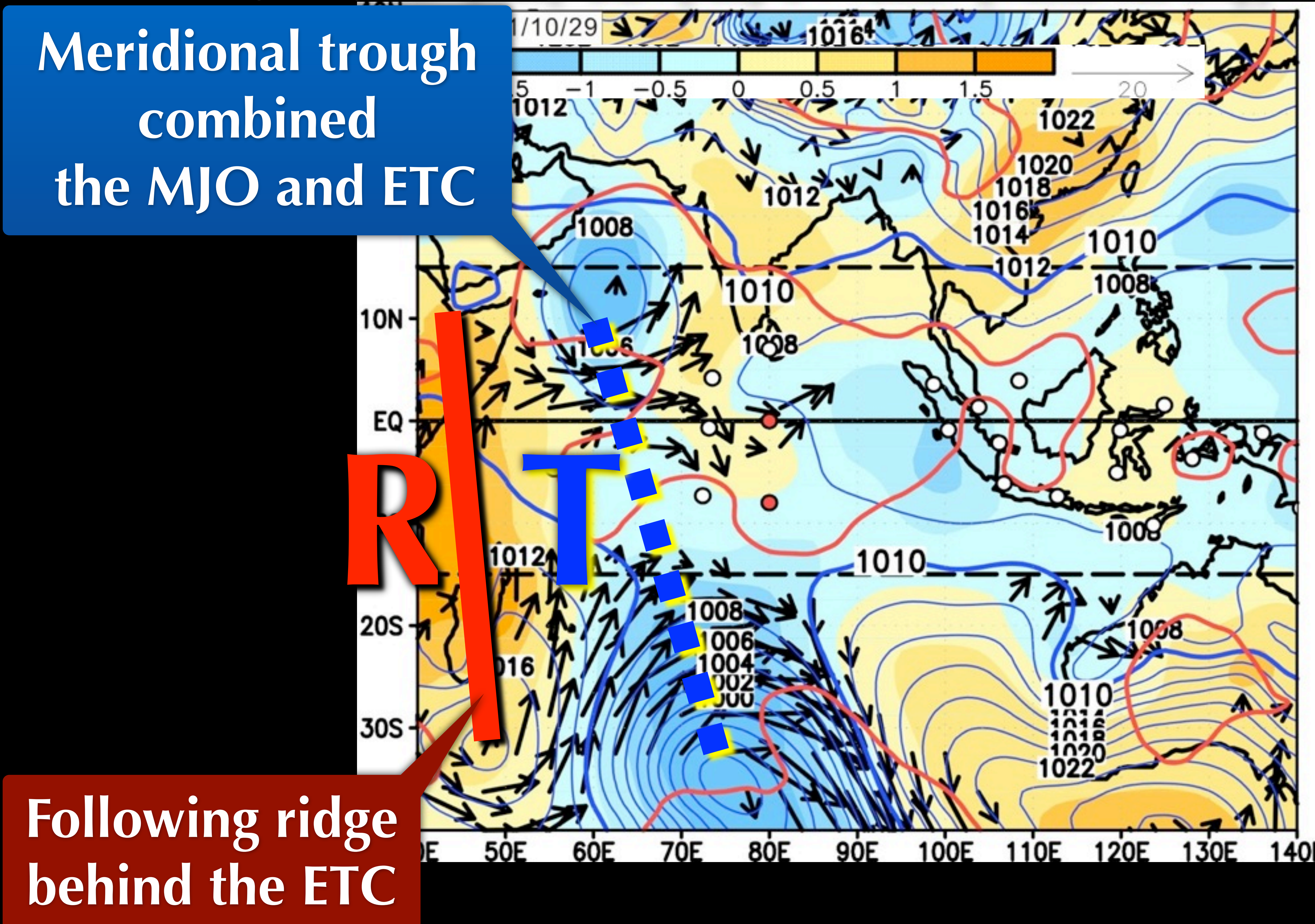


OLR-240W/m^2 (red) for 10S-10N

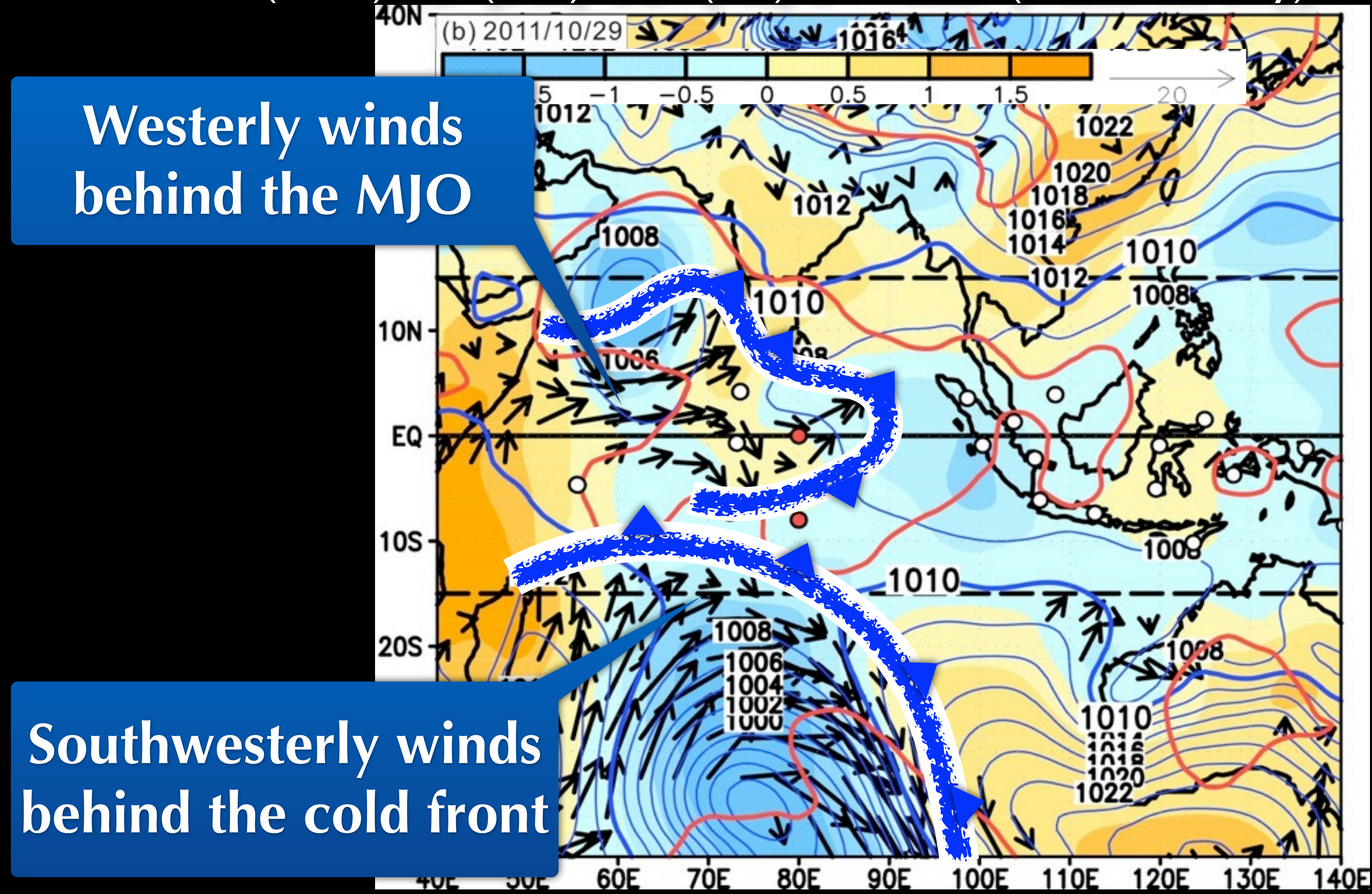


6OCT
11OCT
16OCT
21OCT
26OCT
1NOV
6NOV
11NOV
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E
(c) 30S-10S
12m/s
6m/s
−0.9
−0.6
−0.3
0
0.3
0.6
0.9

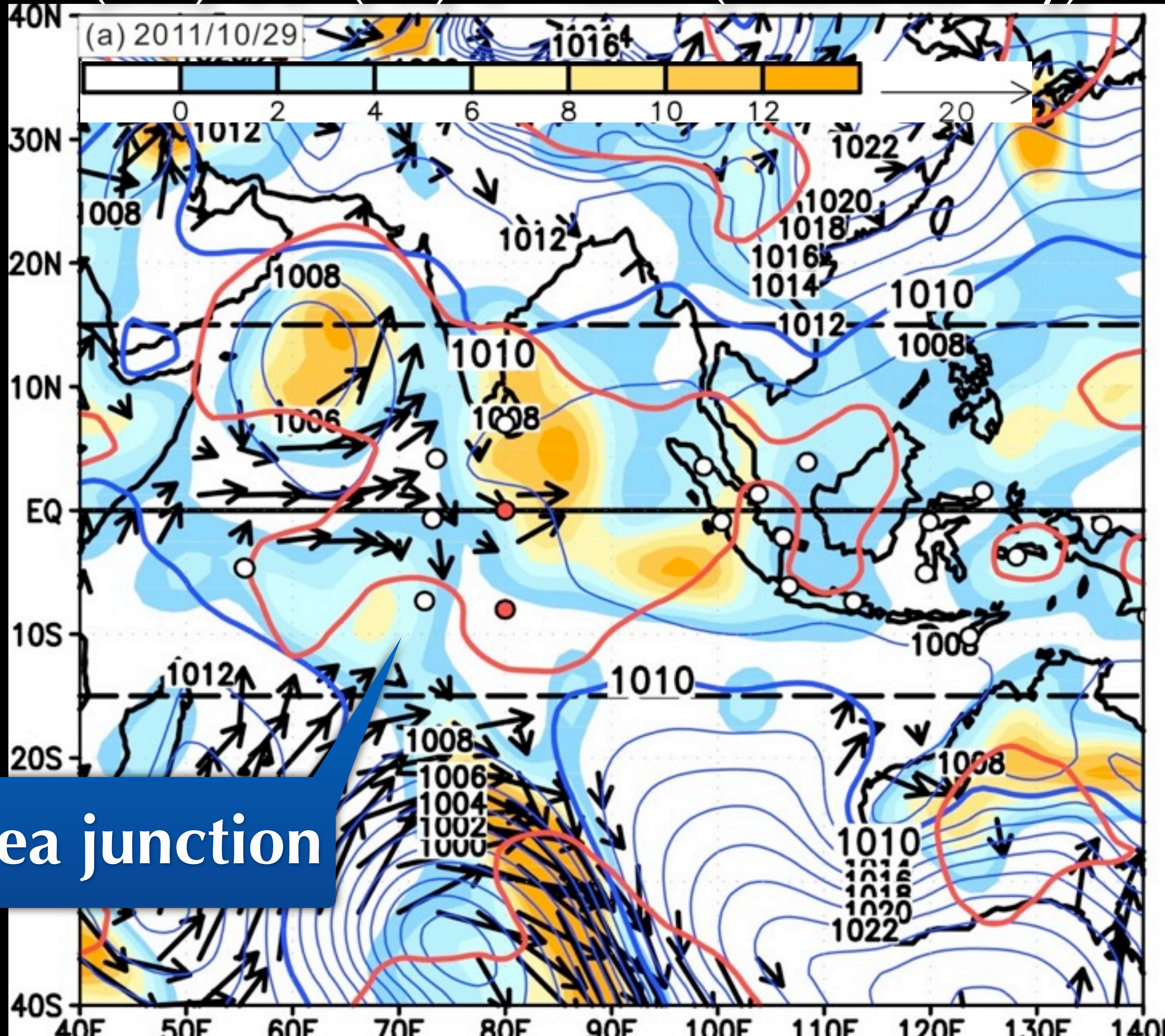
NZA850 (color) SLP (blue) OLR (red) UV vector (westerlies only)



NZA850 (color) SLP (blue) OLR (red) UV vector (westerlies only)

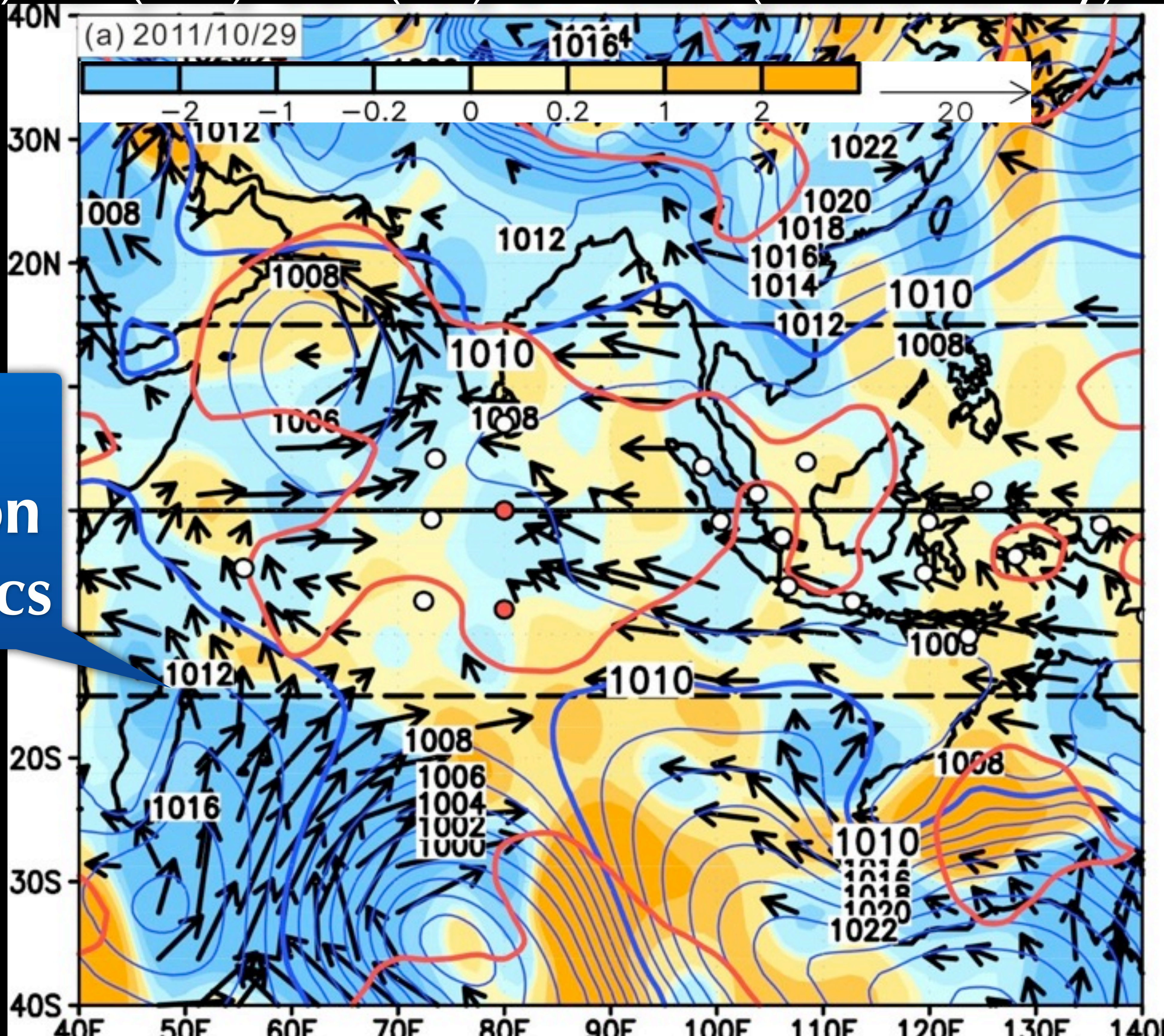


ω850 (color) SLP (blue) OLR (red) UV vector (southerlies only)



Ascending area junction

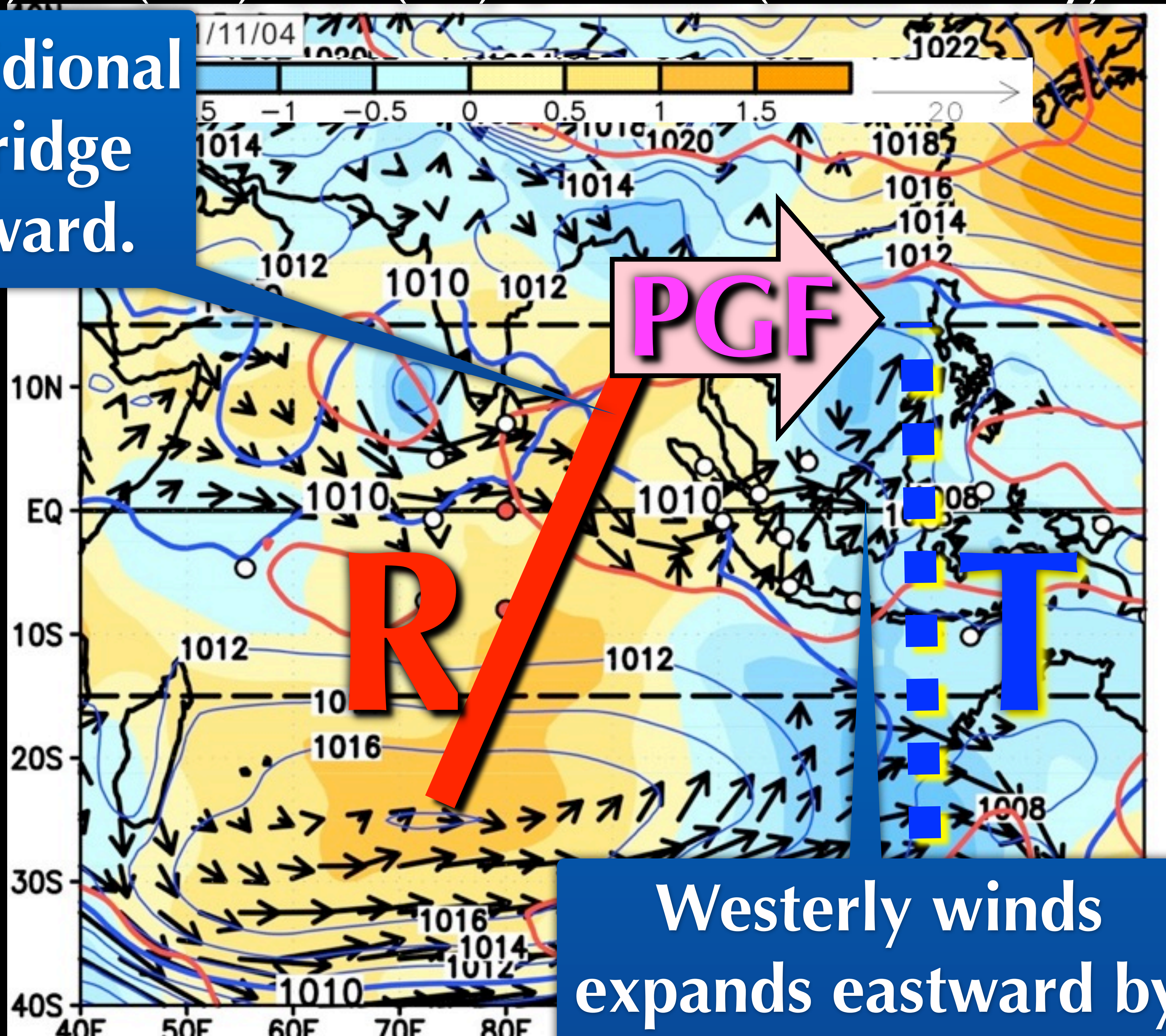
u∇PT850 (color) SLP (blue) OLR (red) UV vector (southerlies only)



Southerly cold advection into the Tropics

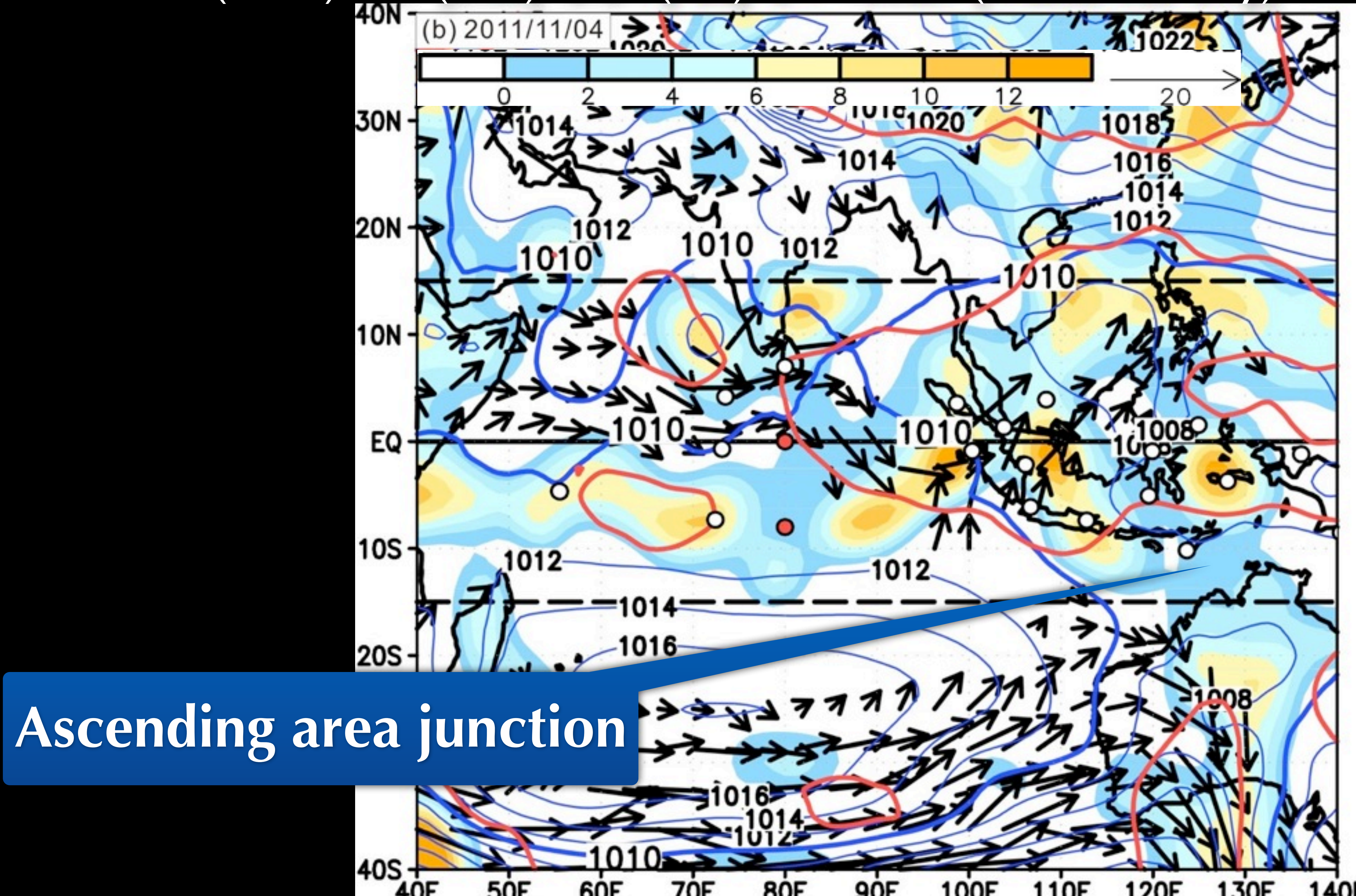
NZA850 (color) SLP (blue) OLR (red) UV vector (westerlies only)

A pair of meridional trough and ridge shifted eastward.

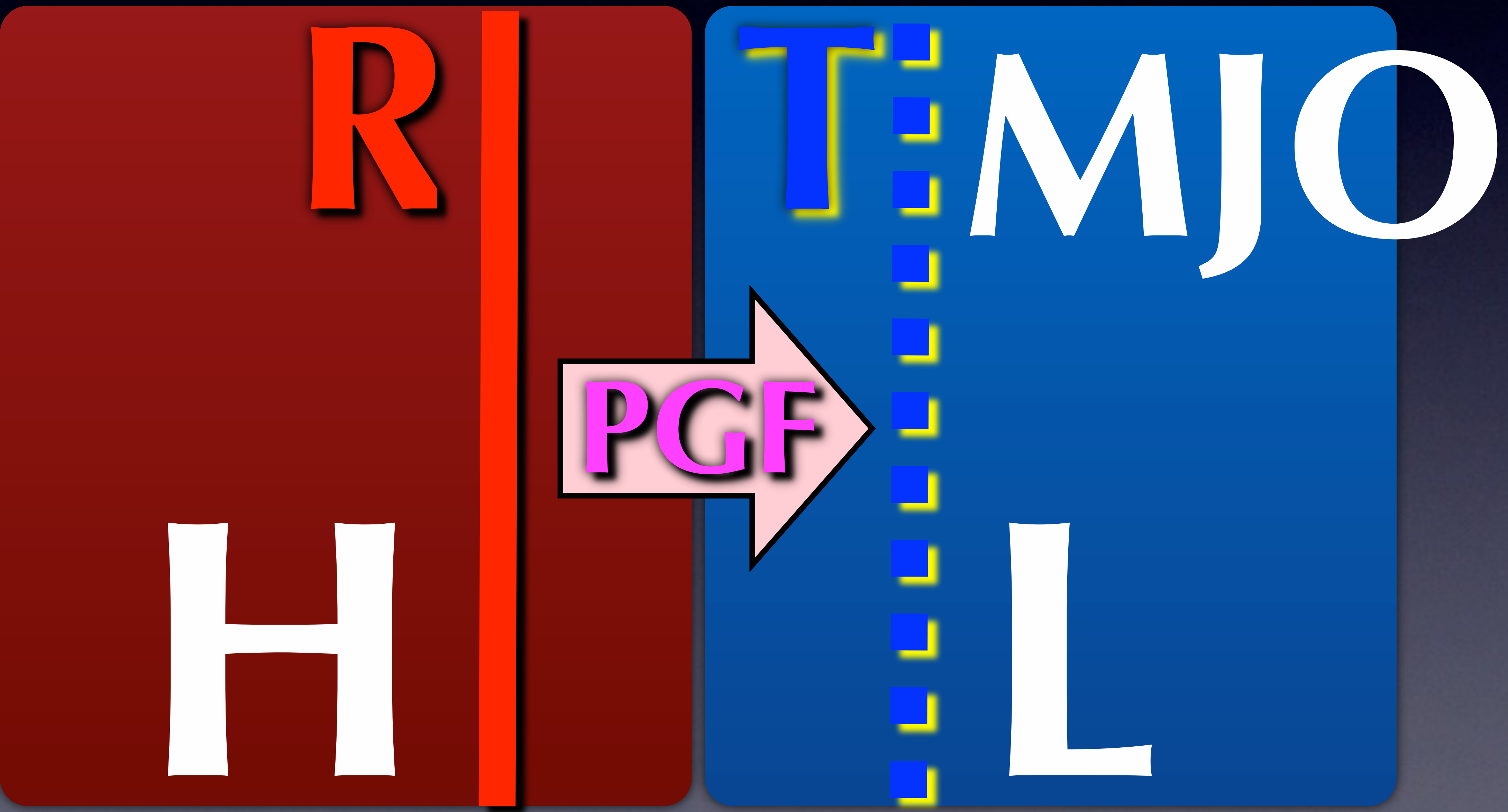


Westerly winds expands eastward by PGF between R/T

ω850 (color) SLP (blue) OLR (red) UV vector (westerlies only)



If coupling occurs, eastward propagation is natural.



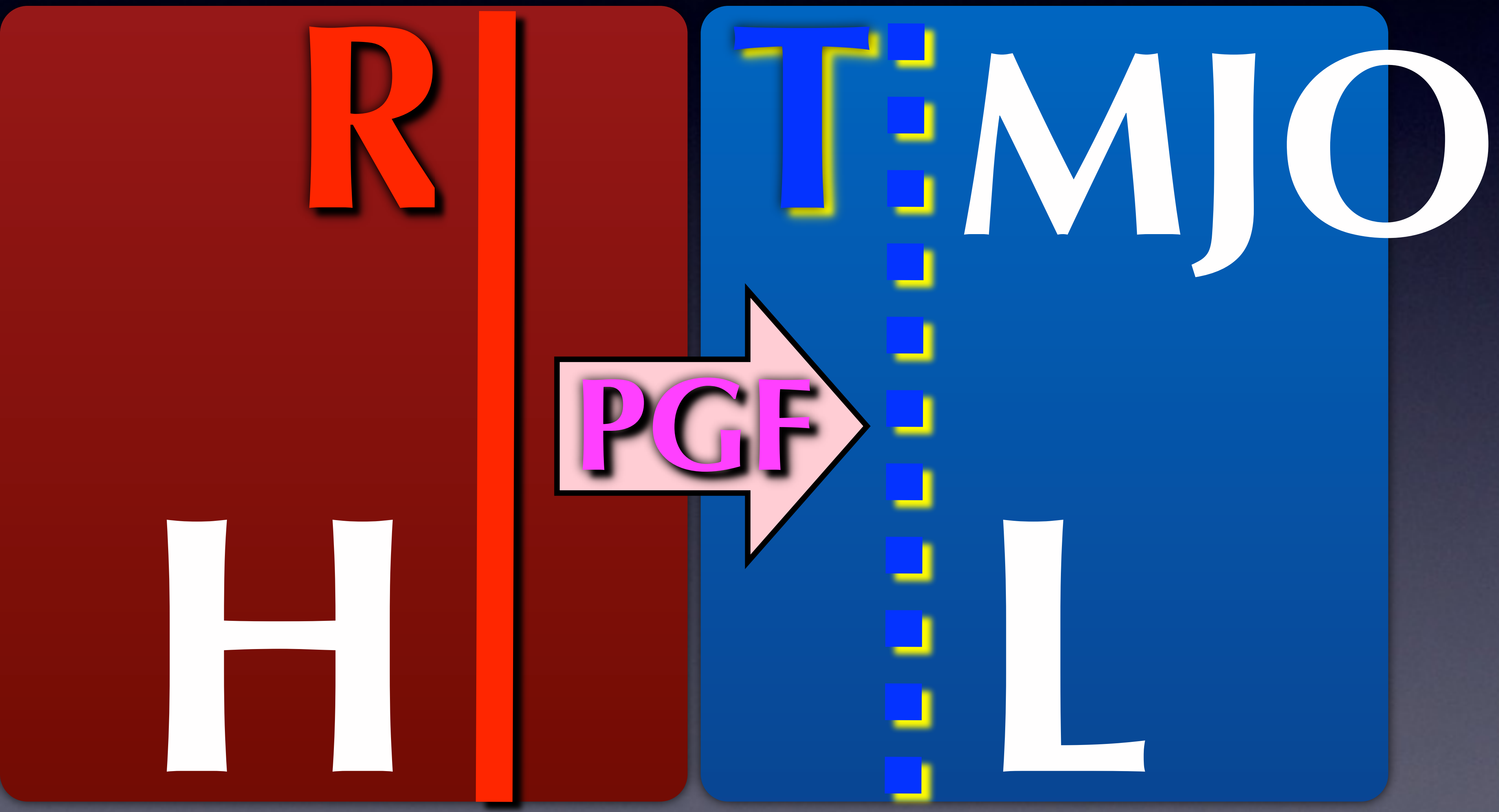
Eurasia High

MJO

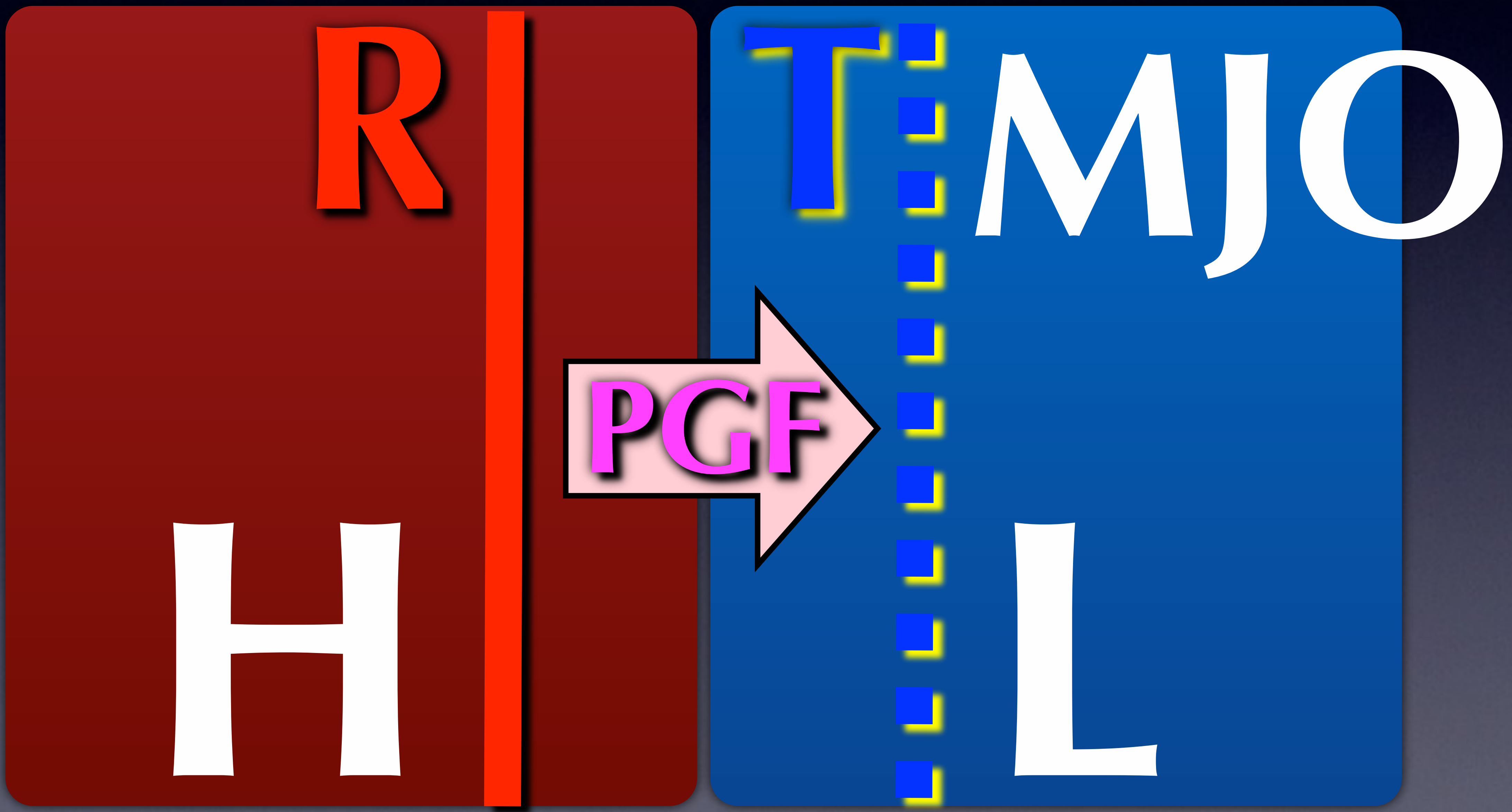
Mascarene High

usually denies the coupling with the ETC.

After Mascarene High decays, ETC can travel into subtropics.



After cold advection intrudes into the Tropics, the MJO is pushed by PGF between R/T.



Hypothesis on the MJO propagation

The ETC is a triggering factor.

60 SOLA, 2016, Vol. 12, 60−64, doi:10.2151/sola.2016-013

Propagation Processes of the Madden–Julian Oscillation Synchronized with an Extratropical Cyclone Observed in Late October during CINDY2011

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Abstract

The eastward propagation processes of the Madden–Julian oscillation (MJO) was examined from a case study of the first MJO generated in late October during CINDY2011. The eastward propagation of the MJO was found to be synchronized with an extratropical cyclone in the Southern Hemisphere. The synchronized propagation of the MJO and the extratrpical cyclone was associated with the ridge and trough pair meridionally extending between 30°S~15°N. The convection center of the MJO shifted eastward as a result of the westerly winds in the tropics, expanding eastward by the zonal pressure gradient force between the ridge and trough.

(**Citation**: Moteki, Q., 2016: Propagation processes of the Madden–Julian oscillation synchronized with an extratropical cyclone observed in late October during CINDY2011. *SOLA*, **12**, 60−64, doi:10.2151/sola.2016-013.)

during the cooperative Indian Ocean experiment on intraseasonal variability in the year 2011 (CINDY2011, Yoneyama et al. 2013; Zhang 2013) were synchronized with strong extratropical cyclones traveling over the Indian Ocean in the Southern Hemisphere. In particular, the mature phase of the primary MJO observed in late October 2011 was completely synchronized with the passage of a very strong extratropical cyclone over the Indian Ocean. The purpose of this study is to investigate the extratropical cyclone in the Southern Hemisphere synchronized with the MJO.

2. Data

The Japanese 55-year reanalysis from 1958−2012 (JRA-55, Ebita et al. 2011; Kobayashi et al. 2015) was used to investigate the large-scale environment. The dataset has a 1.25° horizontal resolution, 38 levels (the surface and 1−1000 hPa), and 6-h inter-

The MJO onset after decay of Mascarene High

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Graphical Abstract

Moteki, Q., 2015: Equatorially anti-symmetric features in the initiation processes of the Madden-Julian Oscillation observed in the late October during CINDY2011. *J. Meteor. Soc. Japan*, http://dx.doi.org/10.2151/jmsj.2015-040.
Early Online Release

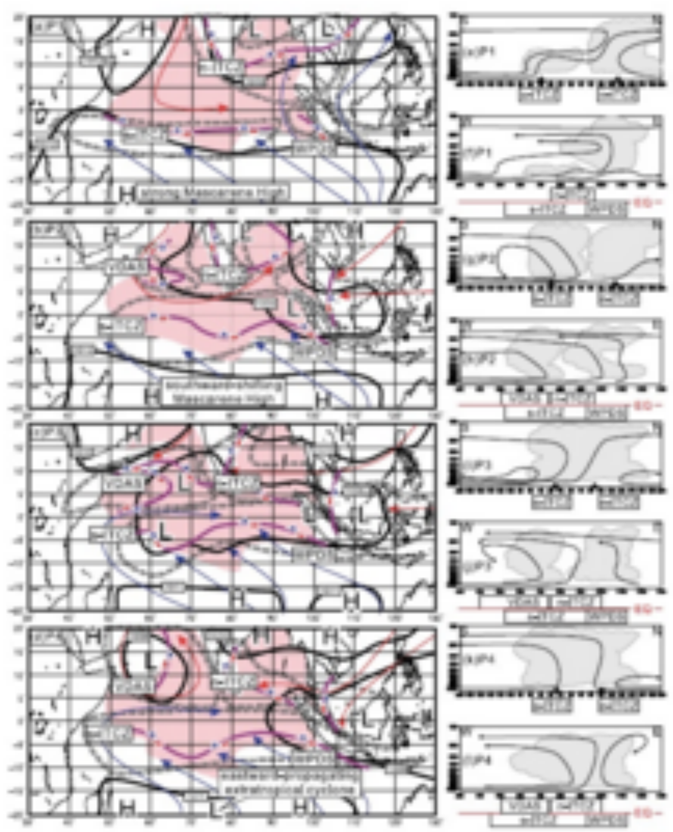
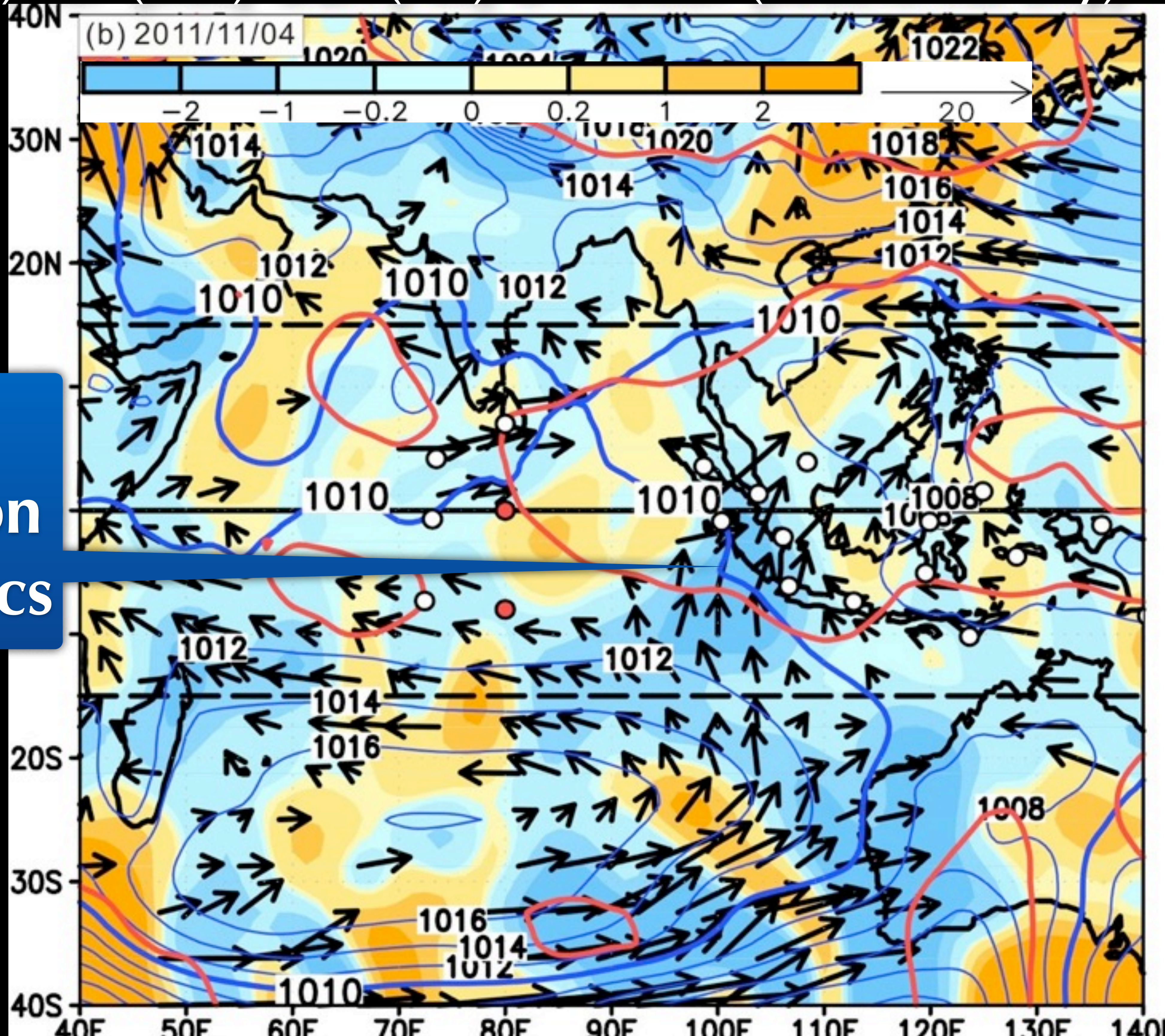
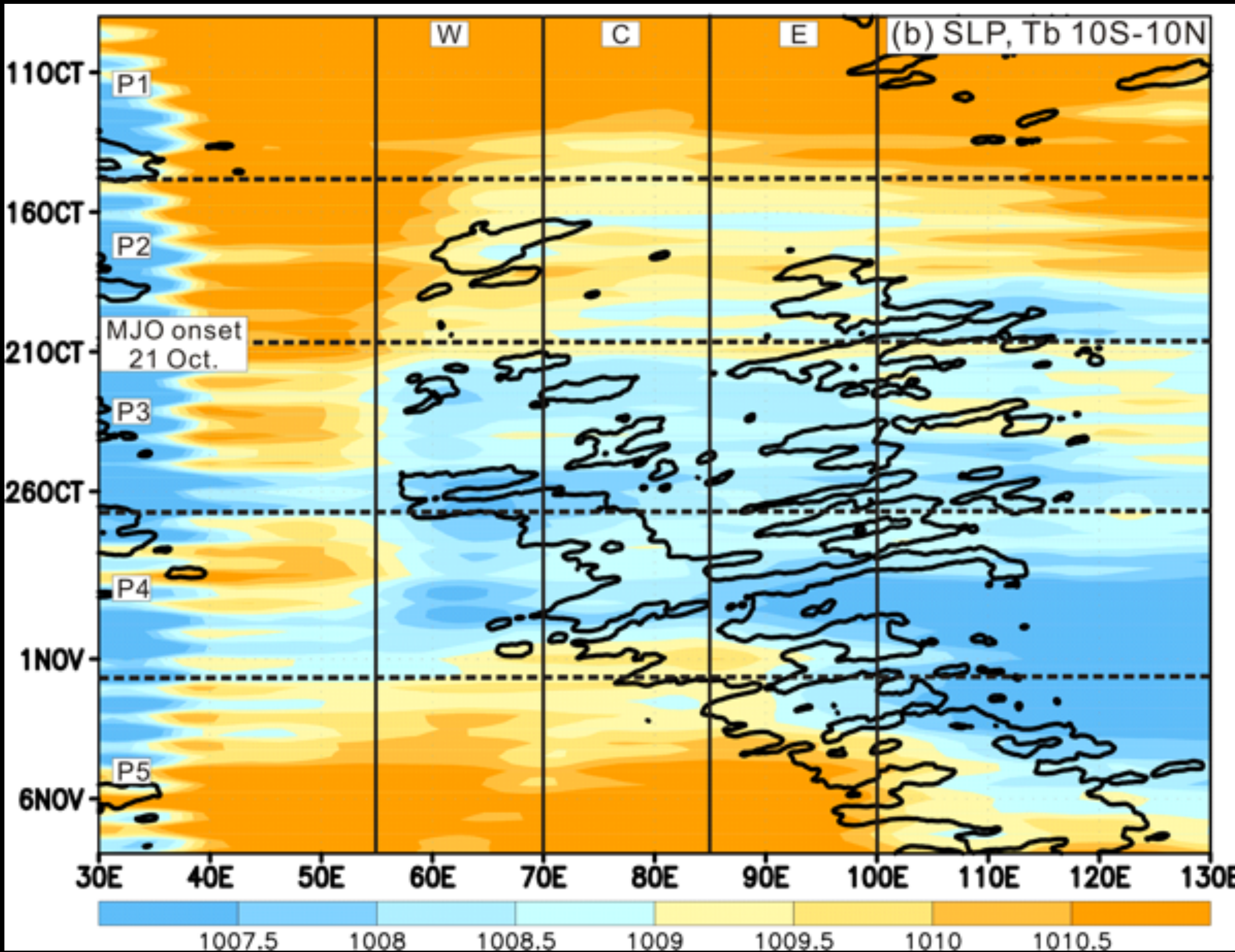


Figure 11. Schematic illustrations of the initiation processes of the MJO event in late October in 2011 for the stages of P1 (convectively suppressed), P2 (developing convection just before MJO onset), P3 (developing convection just after MJO onset), and P4 (mature MJO convection).

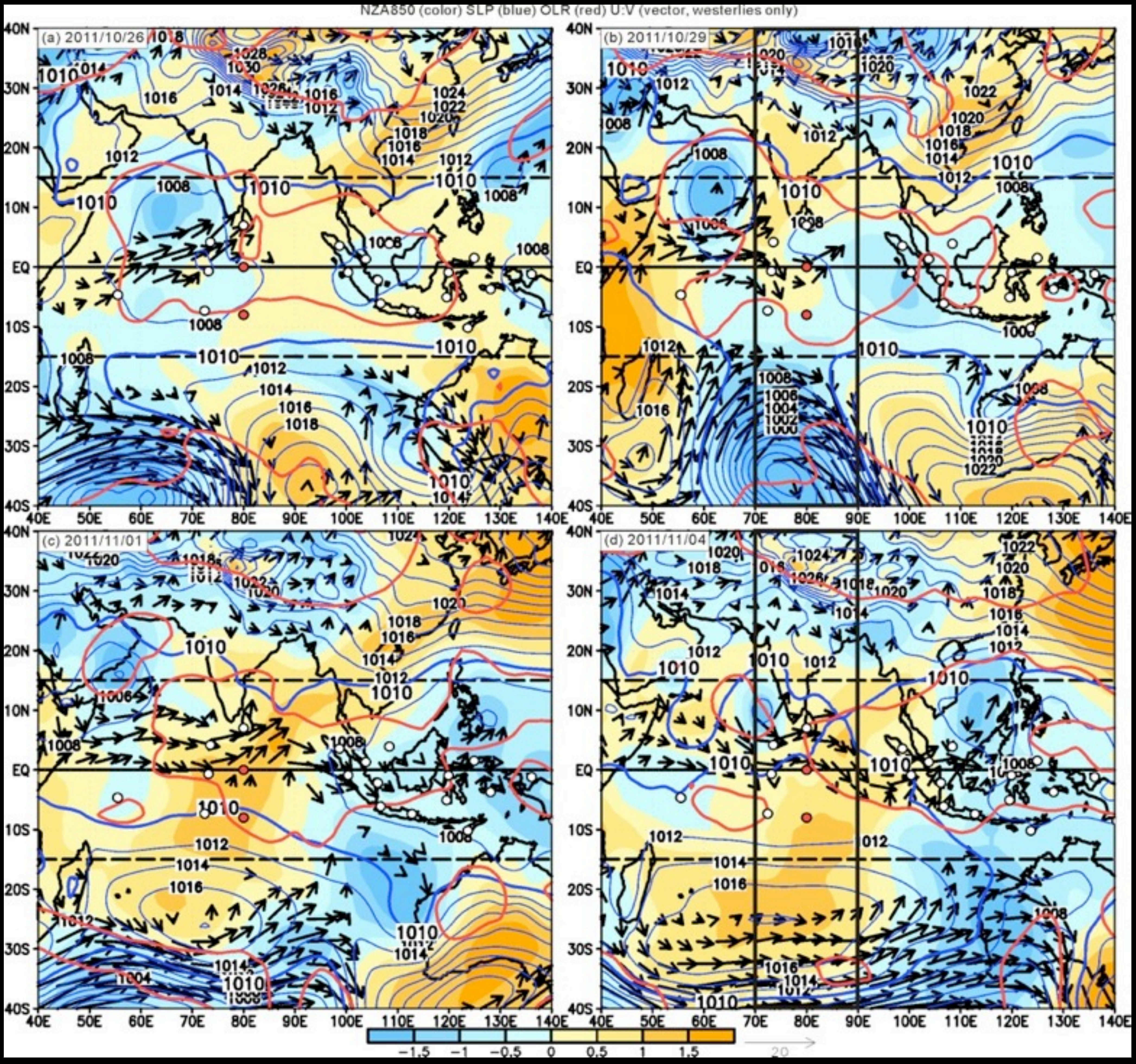
u∇PT850 (color) SLP (blue) OLR (red) UV vector (southerlies only)

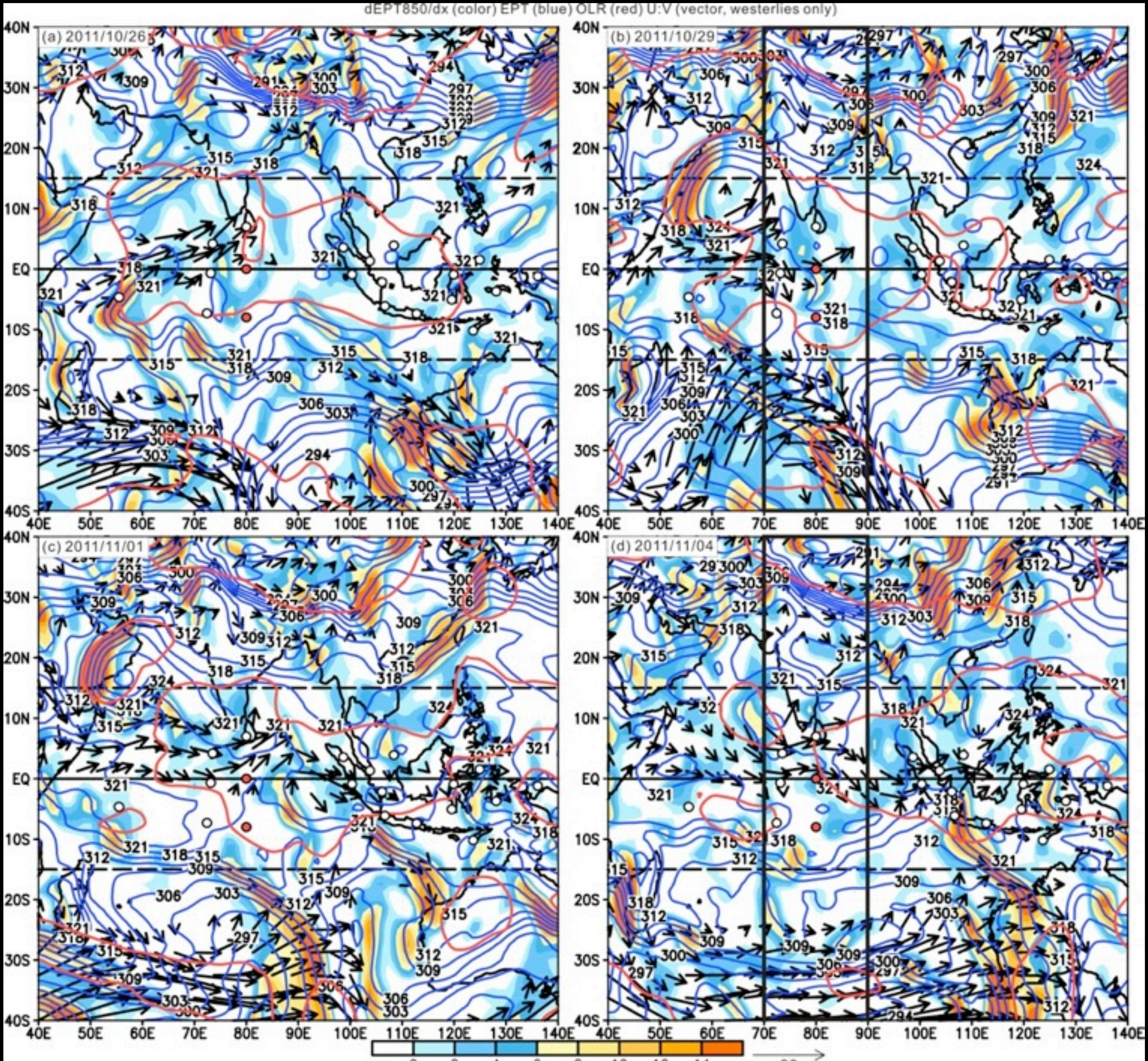


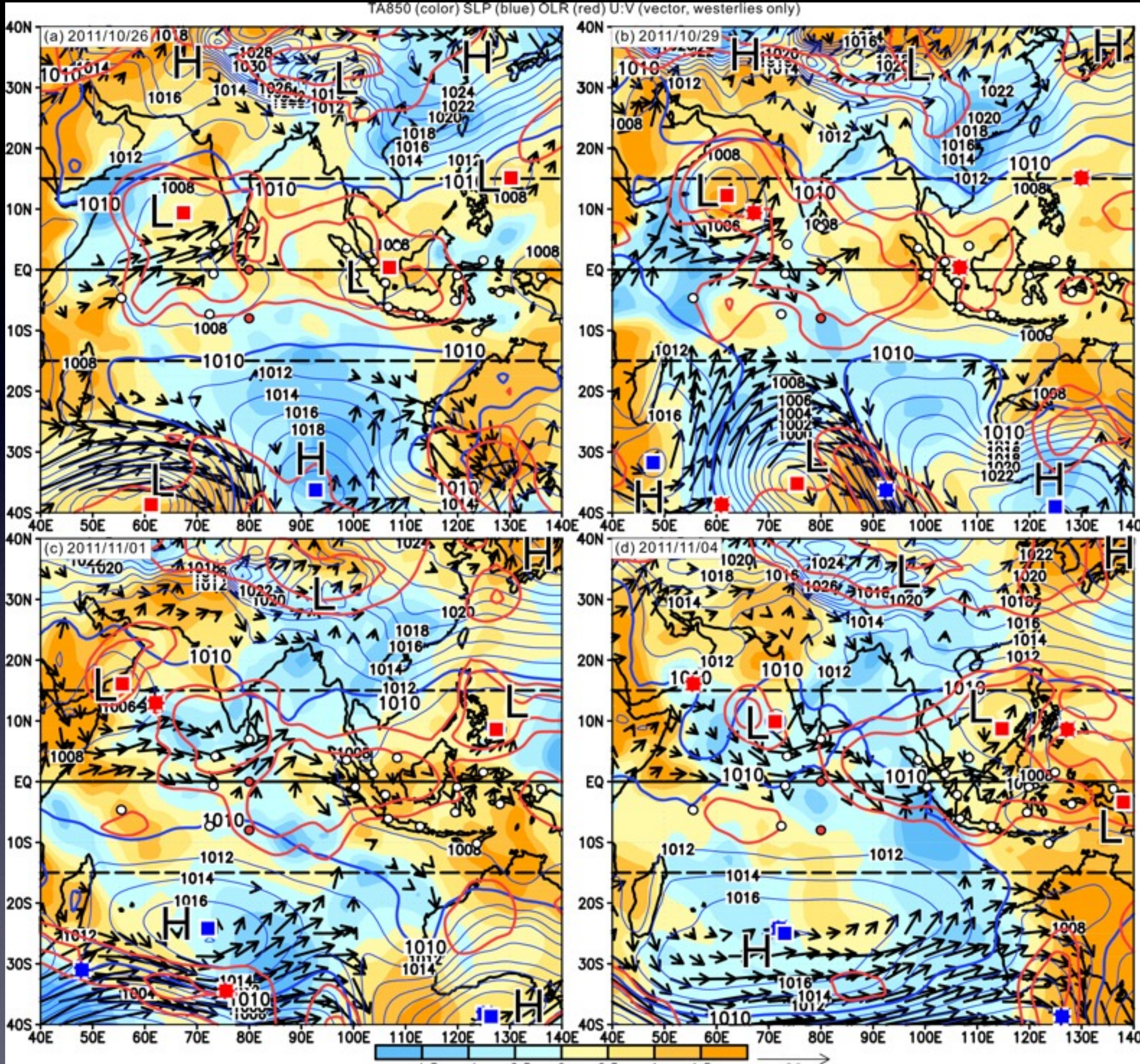
Southerly cold advection into the Tropics

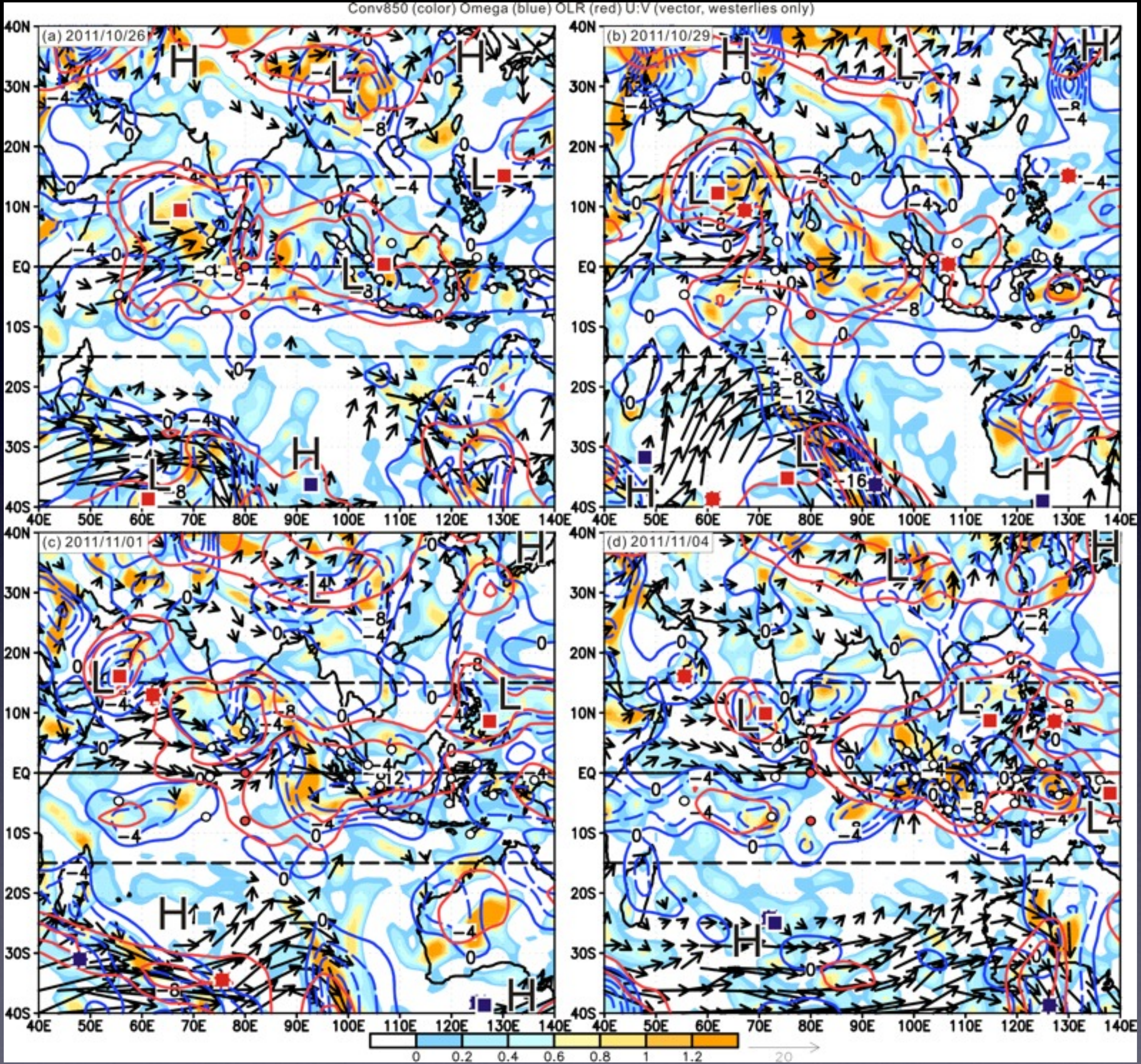


(b) SLP, Tb 10S-10N
W
C
E
P1
P2
P3
P4
P5
MJO onset
21 Oct.
11OCT
16OCT
21OCT
26OCT
1NOV
6NOV
30E
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
1007.5
1008
1008.5
1009
1009.5
1010
1010.5

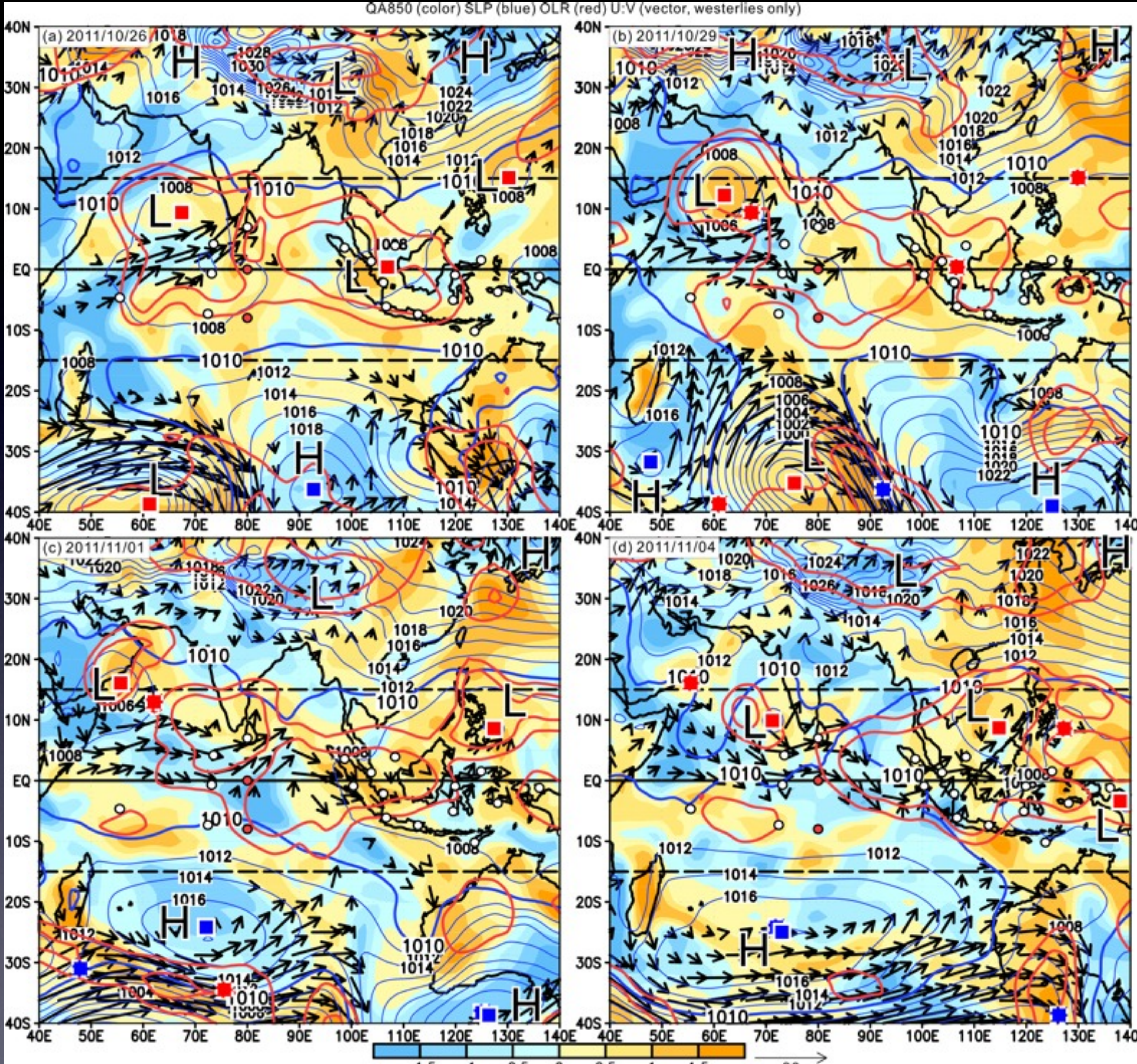

NZA850 (color) SLP (blue) OLR (red) U:V (vector, westerlies only)
(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E 50E 60E 70E 80E 90E 100E 110E 120E 130E 140E
−1.5 −1 −0.5 0 0.5 1 1.5
20

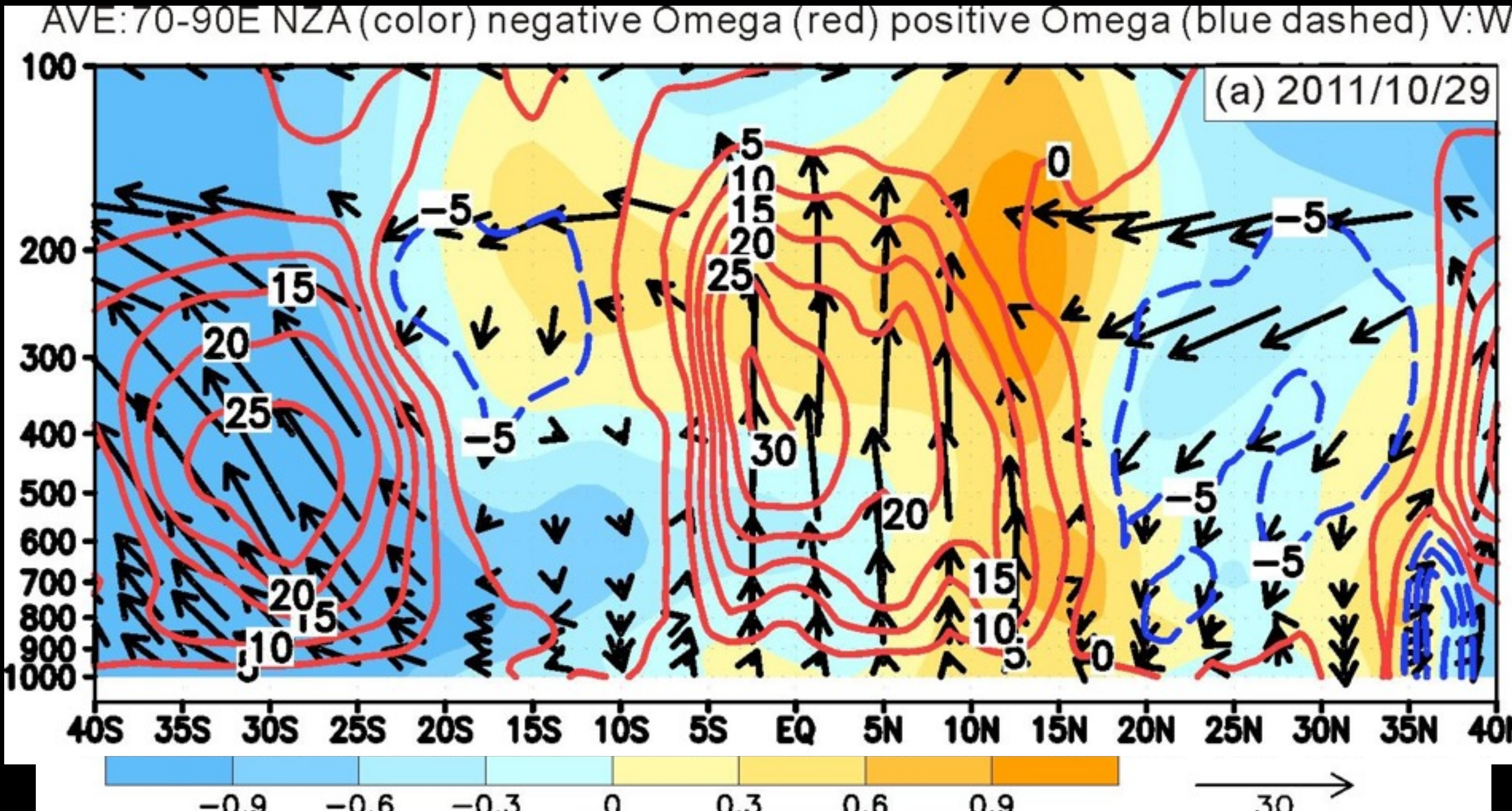

dEPT850/dx (color) EPT (blue) OLR (red) U:V (vector, westerlies only)
(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04
0 2 4 6 8 10 12 14
20

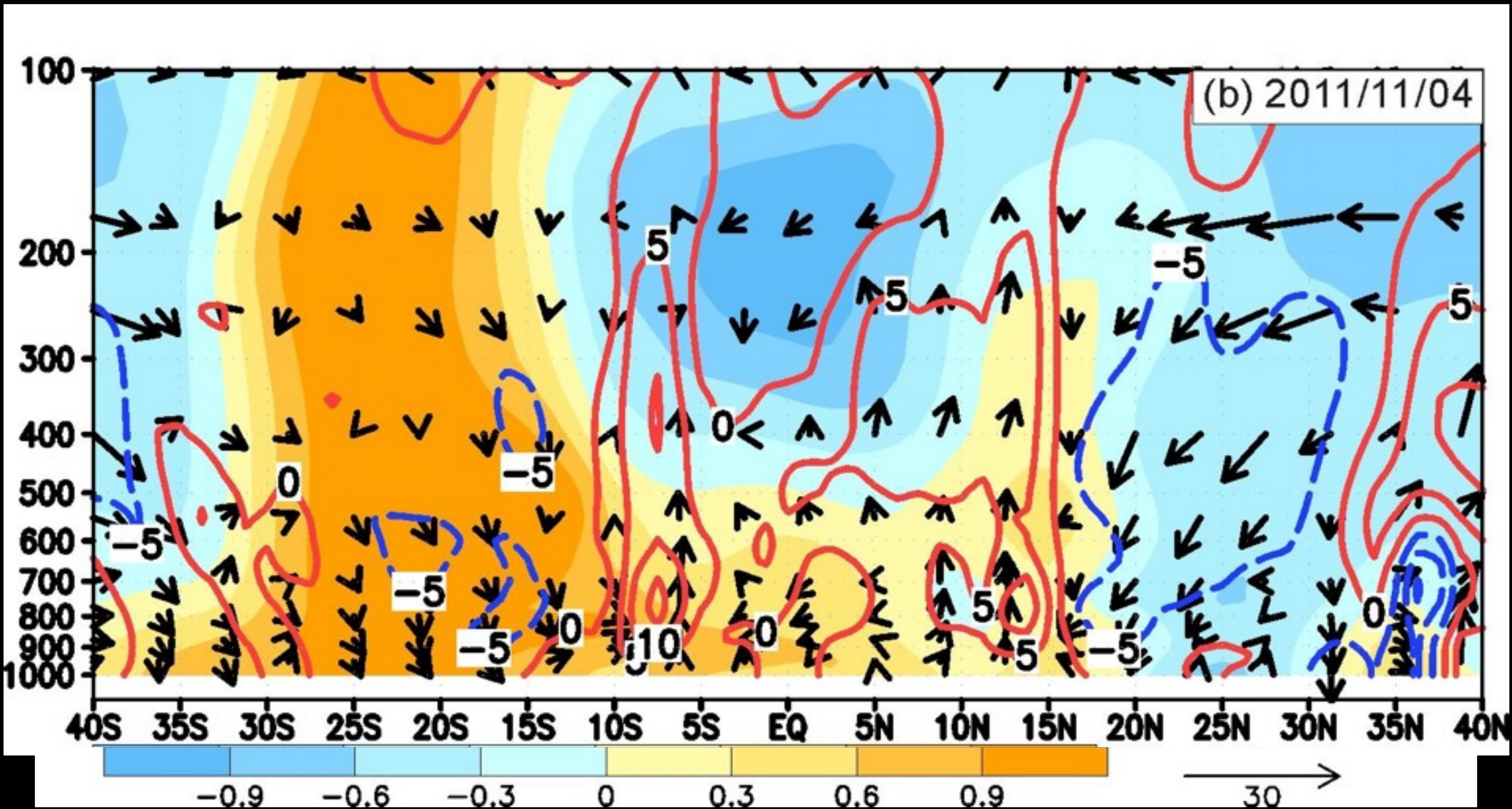

TA850 (color) SLP (blue) OLR (red) U:V (vector, westerlies only)
(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E
−1.5
−1
−0.5
0
0.5
1
1.5
20



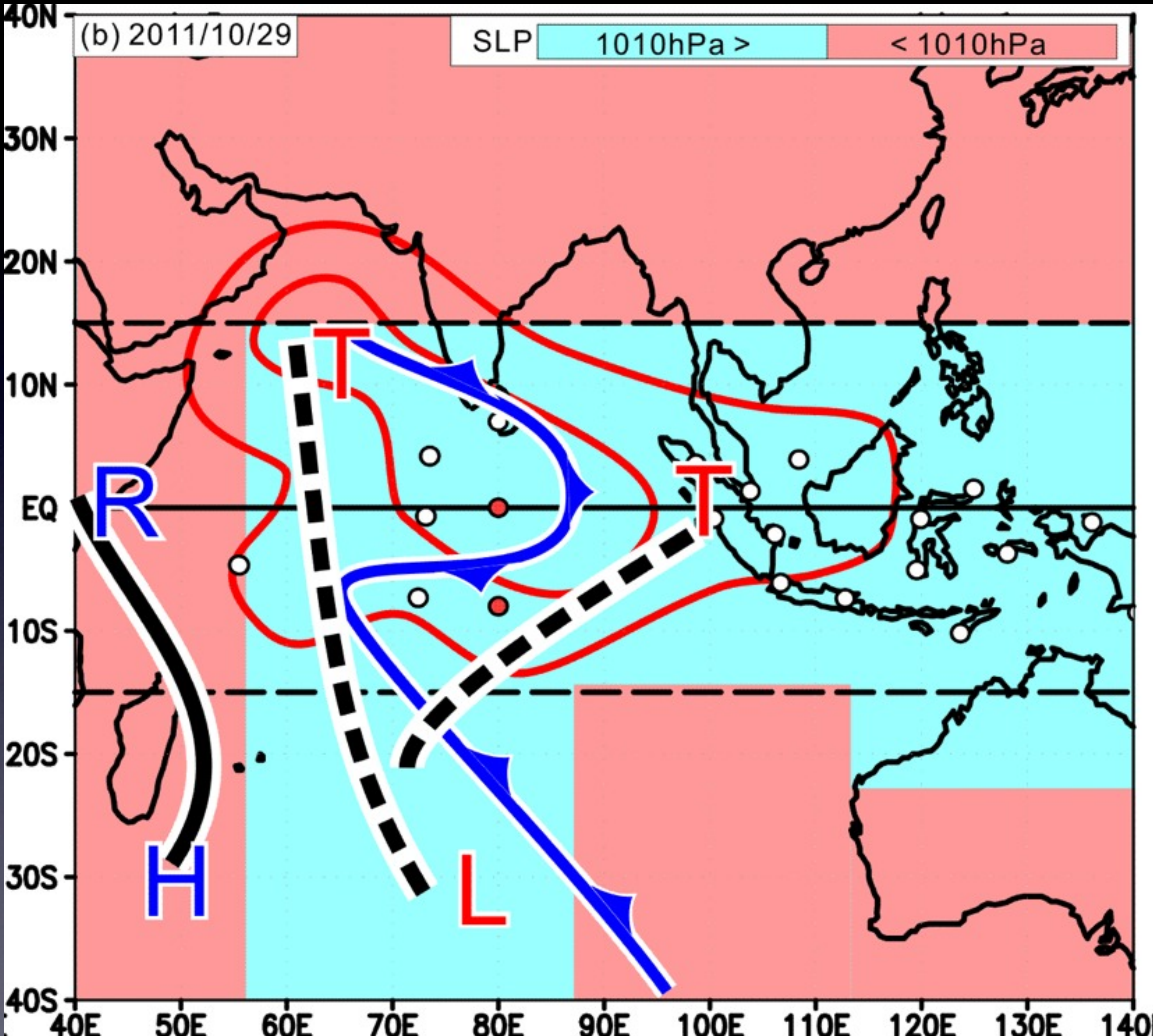
Conv850 (color) Omega (blue) OLR (red) U:V (vector, westerlies only)
(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04


QA850 (color) SLP (blue) OLR (red) U:V (vector, westerlies only)
(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04
−1.5 −1 −0.5 0 0.5 1 1.5
20

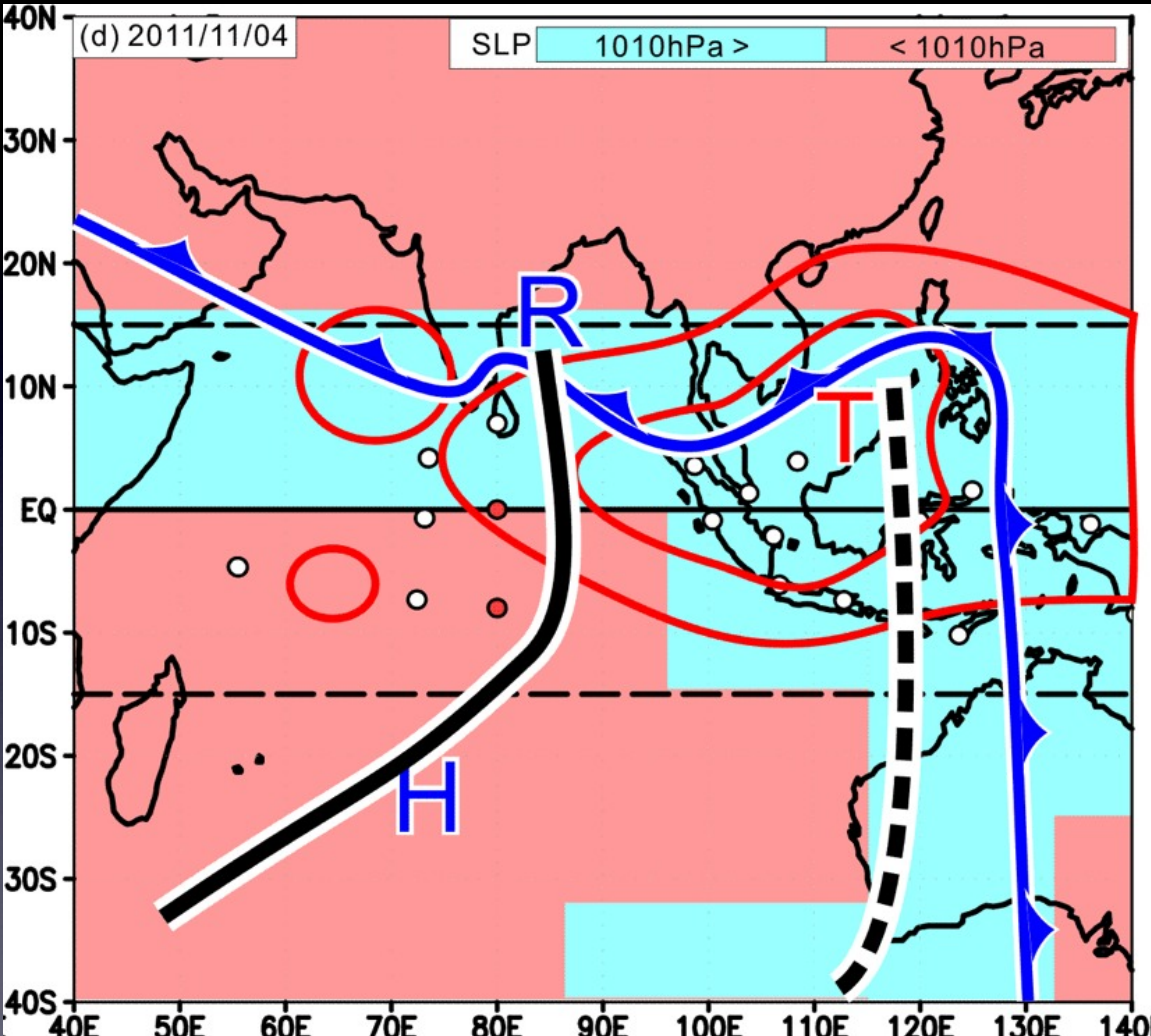

AVE:70-90E NZA (color) negative Omega (red) positive Omega (blue dashed) V:W
(a) 2011/10/29
100
200
300
400
500
600
700
800
900
1000
40S 35S 30S 25S 20S 15S 10S 5S EQ 5N 10N 15N 20N 25N 30N 35N 40N
−0.9 −0.6 −0.3 0 0.3 0.6 0.9
30



(b) 2011/11/04
100
200
300
400
500
600
700
800
900
1000
40S
35S
30S
25S
20S
15S
10S
5S
EQ
5N
10N
15N
20N
25N
30N
35N
40N
−0.9
−0.6
−0.3
0
0.3
0.6
0.9
30



(b) 2011/10/29
SLP
1010hPa >
< 1010hPa
T
T
R
H
L
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E


(d) 2011/11/04
SLP
1010hPa >
< 1010hPa
R
T
H
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
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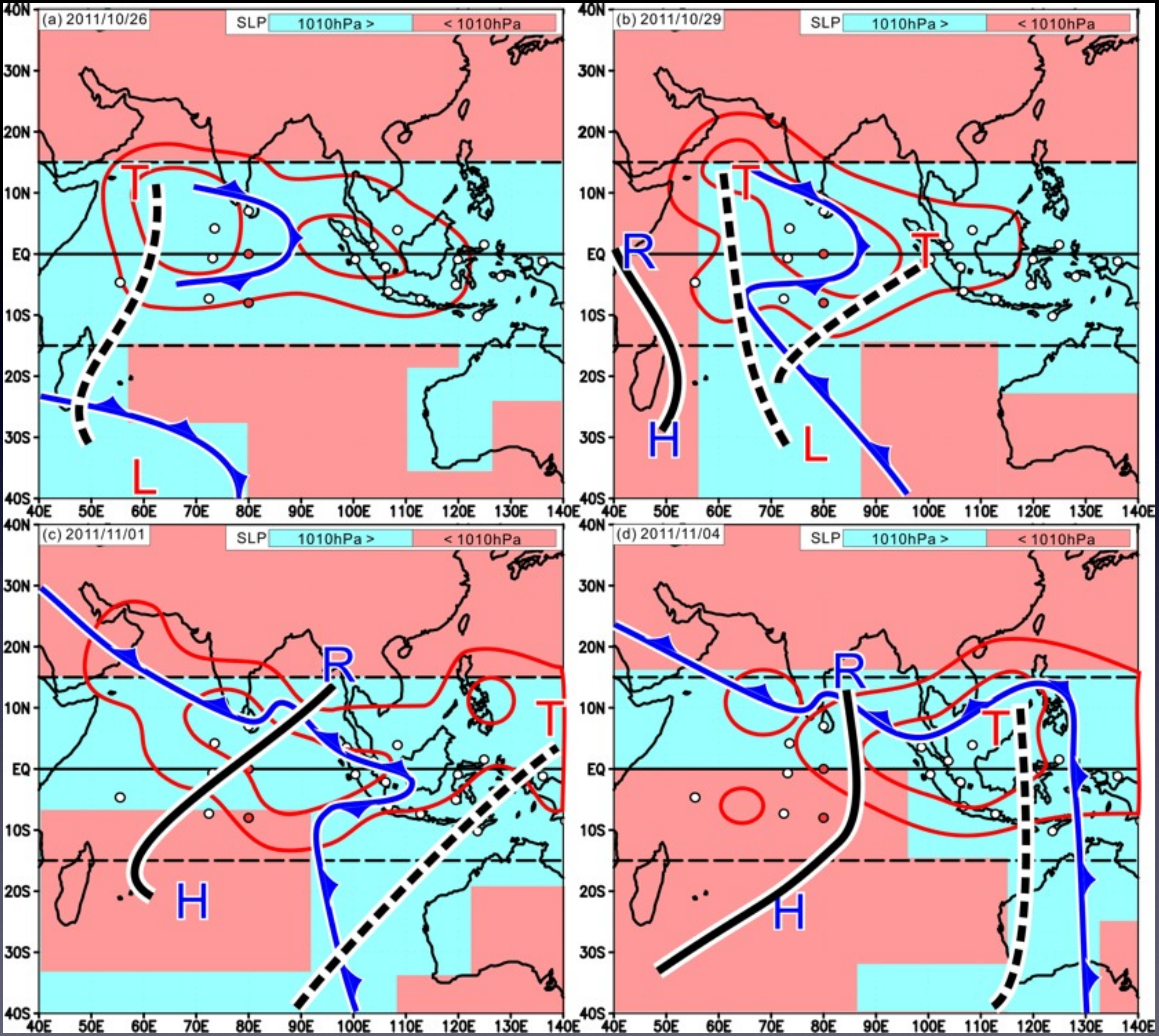
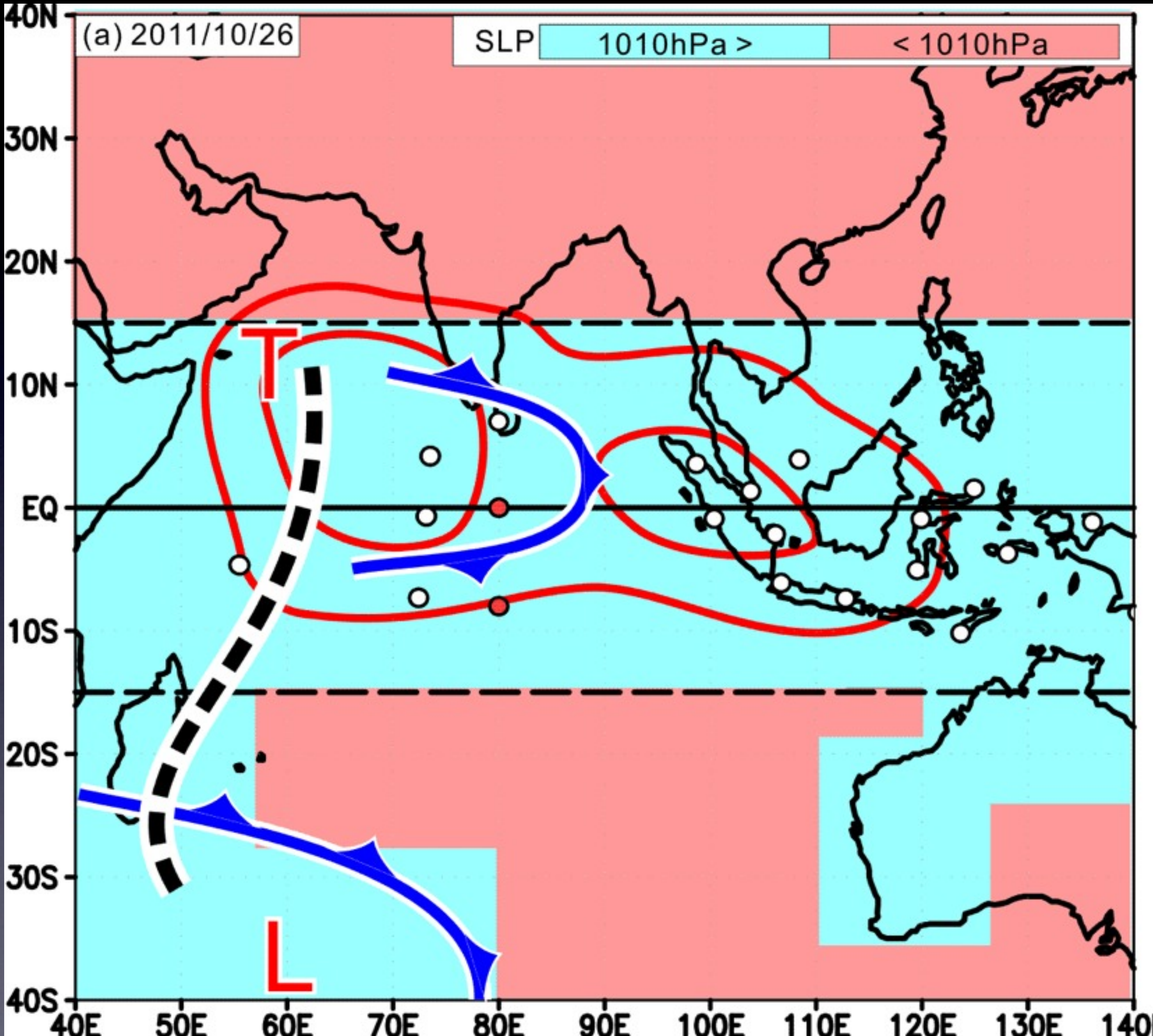
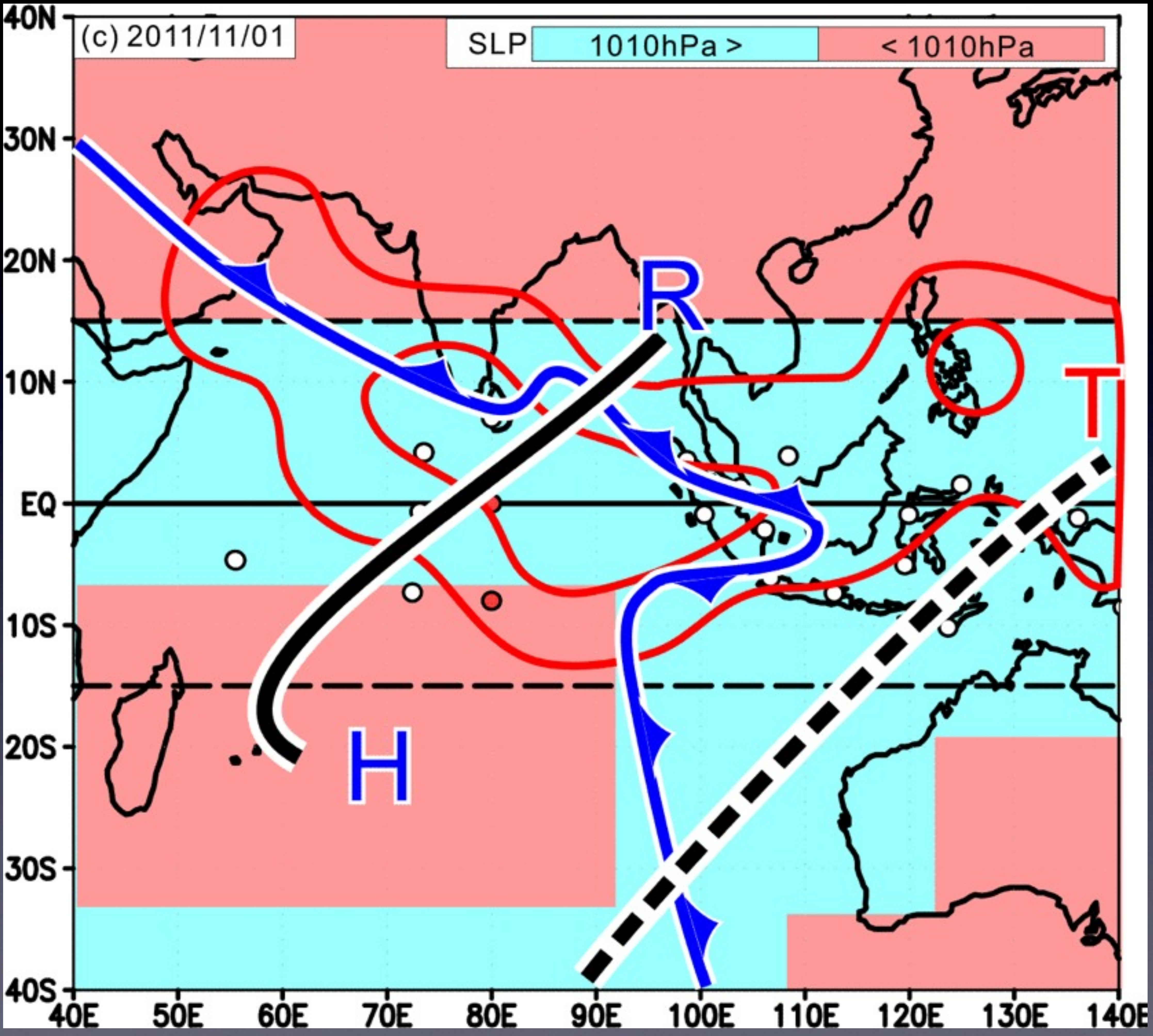
100E
110E
120E
130E
140E



(a) 2011/10/26
(b) 2011/10/29
(c) 2011/11/01
(d) 2011/11/04
SLP
1010hPa >
< 1010hPa
T
L
R
H
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E



(a) 2011/10/26
SLP
1010hPa >
< 1010hPa
T
L
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E



(c) 2011/11/01
SLP
1010hPa >
< 1010hPa
R
T
H
40N
30N
20N
10N
EQ
10S
20S
30S
40S
40E
50E
60E
70E
80E
90E
100E
110E
120E
130E
140E