2012 AGU Fall meeting

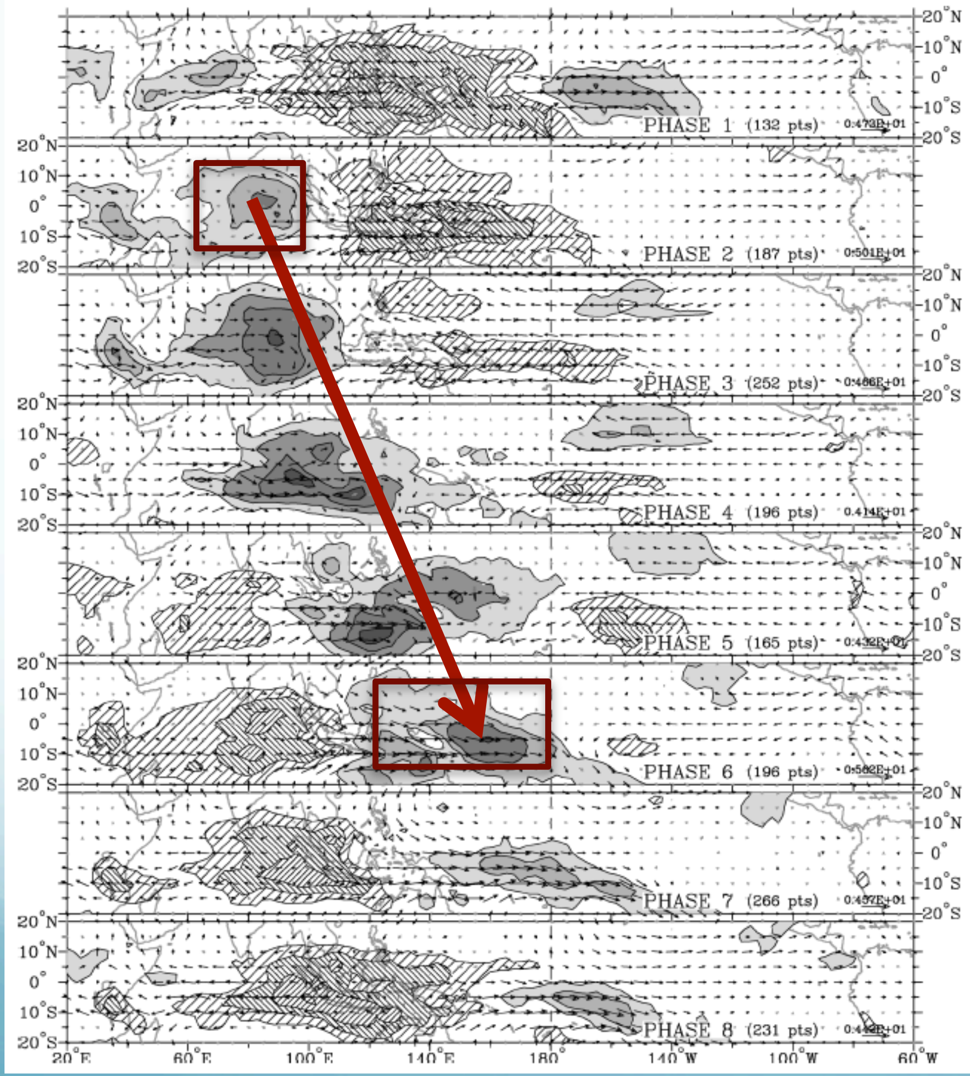
Propagating vs. Non-propagating MJO

Daehyun Kim[1], Jong-Seong Kug[2], and Adam H. Sobel[1,3,4]

[1]Lamont-Doherty Earth Observatory, Columbia University, New York
[2]Korea Institute of Ocean Science & Technology, Ansan, Korea
[3]Department of Applied Physics and Applied Mathematics, Columbia University, New York
[4]Department of Earth and Environmental Sciences, Columbia University, New York

December 3, San Francisco, CA

"Life-cycle" of the MJO

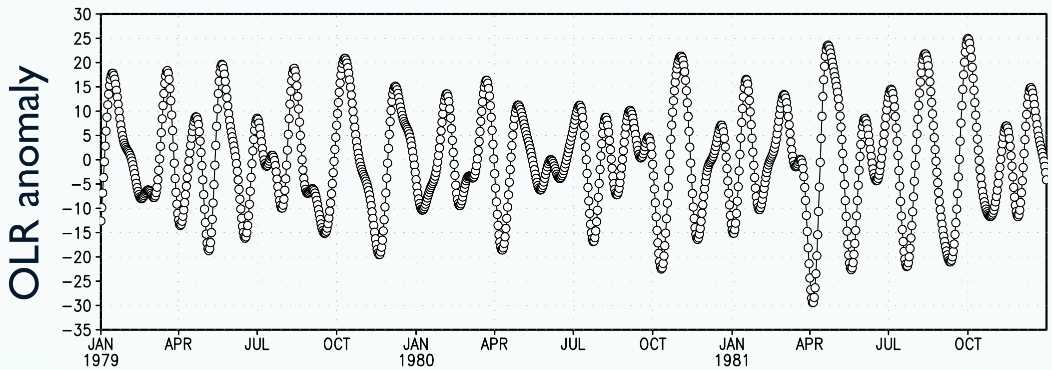


- We focus on the propagation from the IO to the WP.
- Is every IO convection making propagation to the WP? If not, what makes the difference?
- Seek IO convection onset days, examine propagation characteristics of each event.

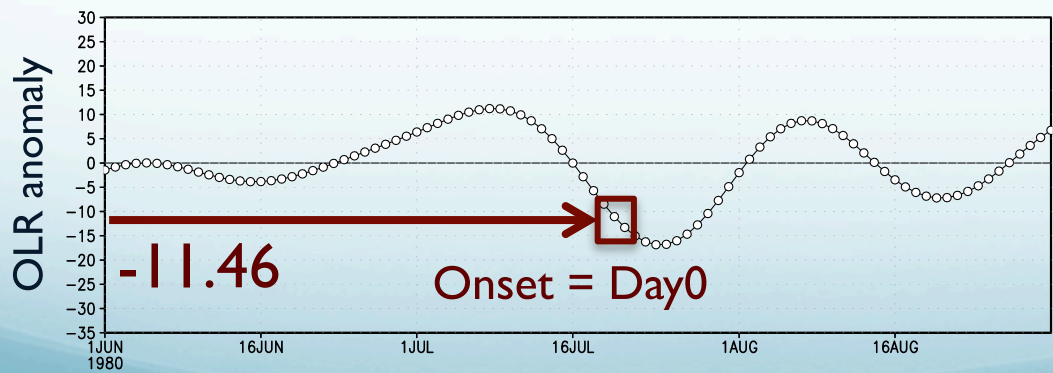
OLR (shaded)
850hPa wind (arrow)
Wheeler and Hendon (2004)

Detecting Onset of IO Convection

20-100 day filtered OLR anomaly
averaged over the IO (70-100E, 15S-15N)

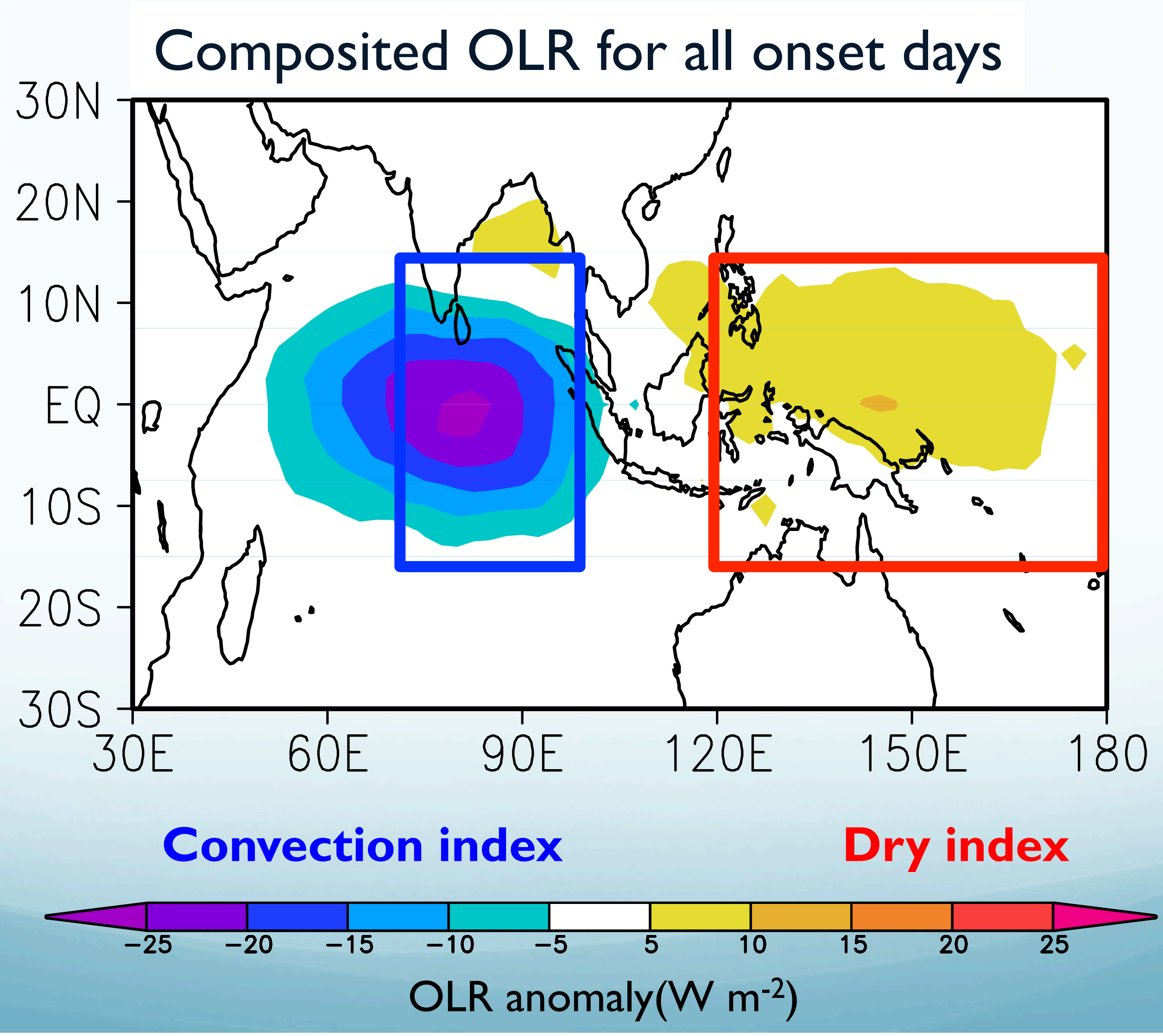


std = 11.46 W m^{-2}

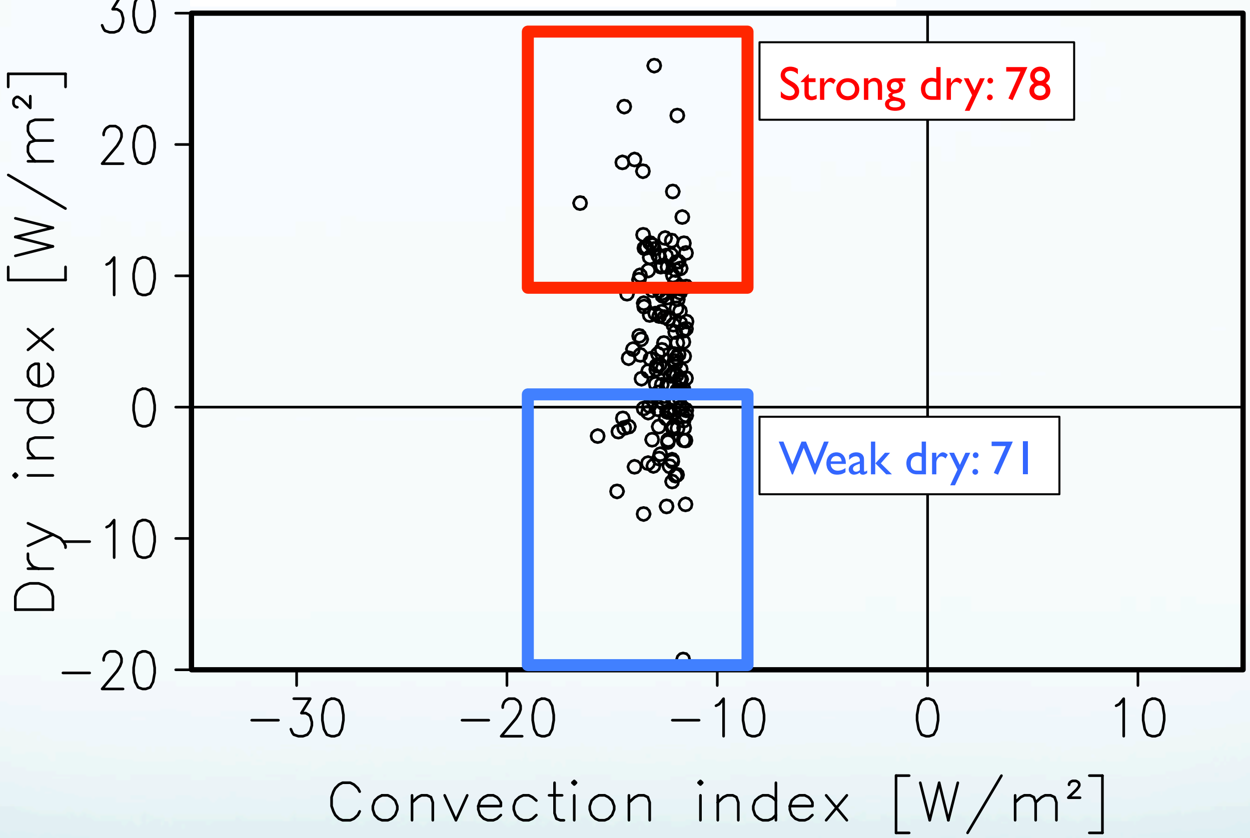


Data Source: NOAA AVHRR

IO Convection Onset



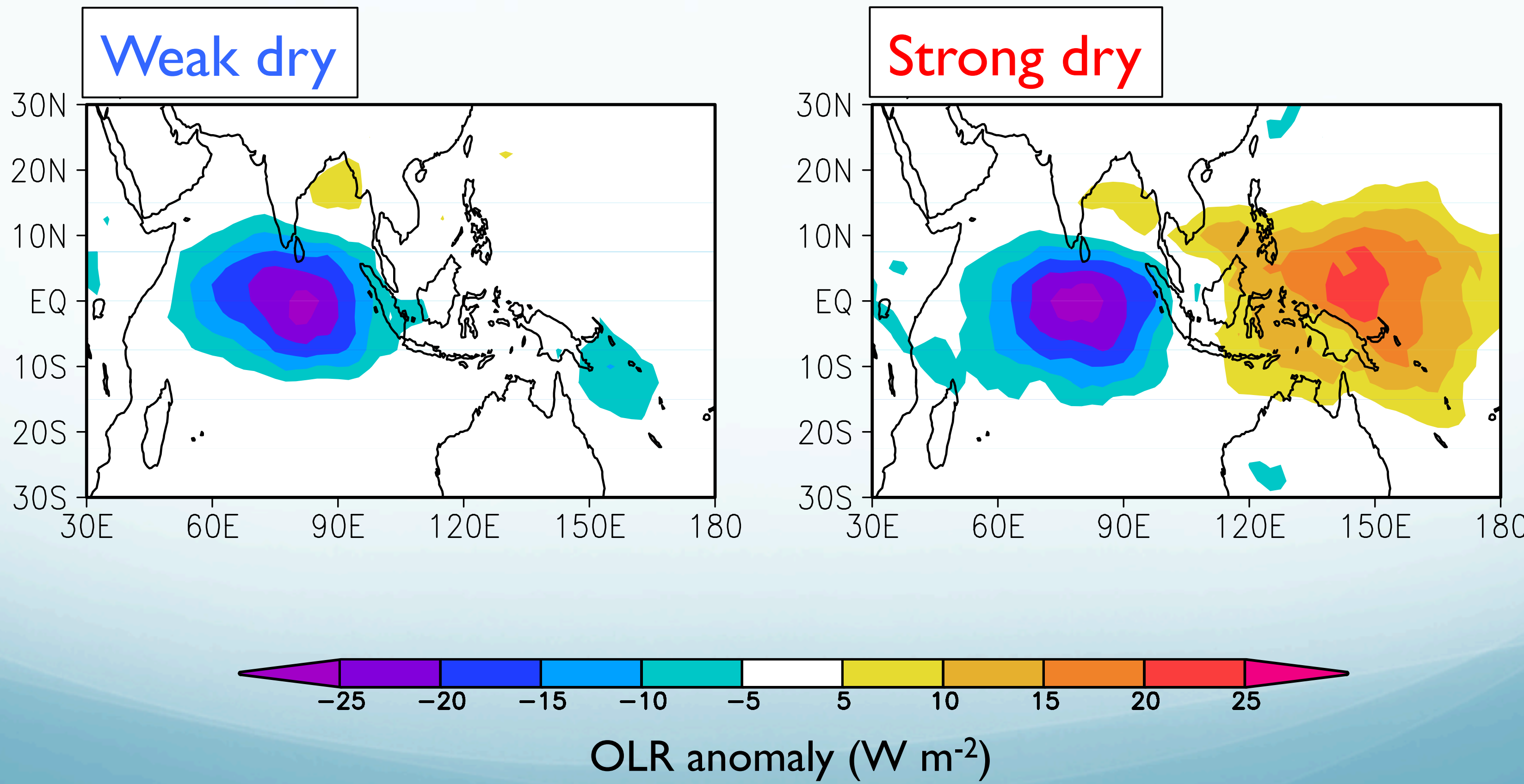
Convection vs. Dry index



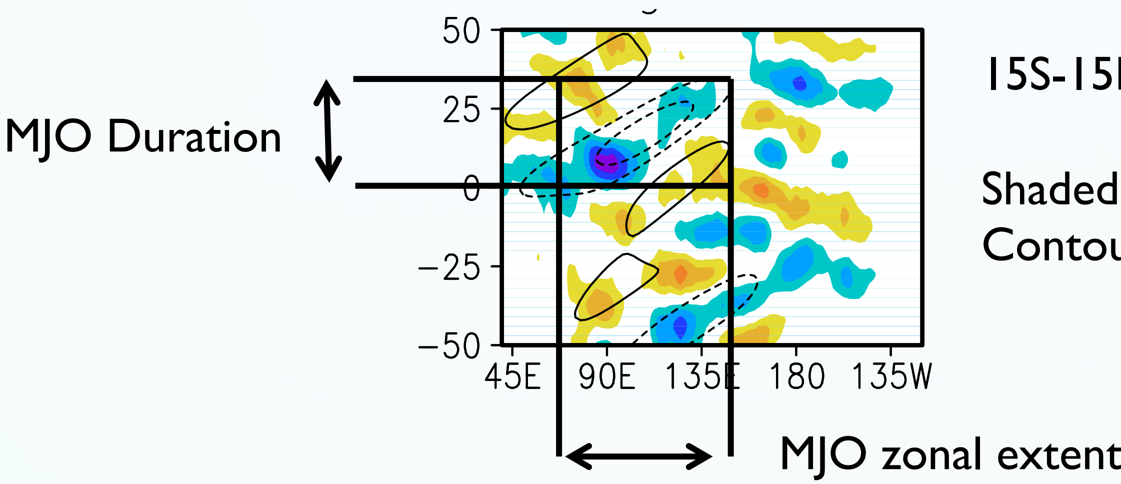
The dry anomaly over the WP doesn't strongly tied to the convection anomaly over the IO

Weak Dry vs. Strong Dry

Composited OLR for each group



MJO Propagation Properties



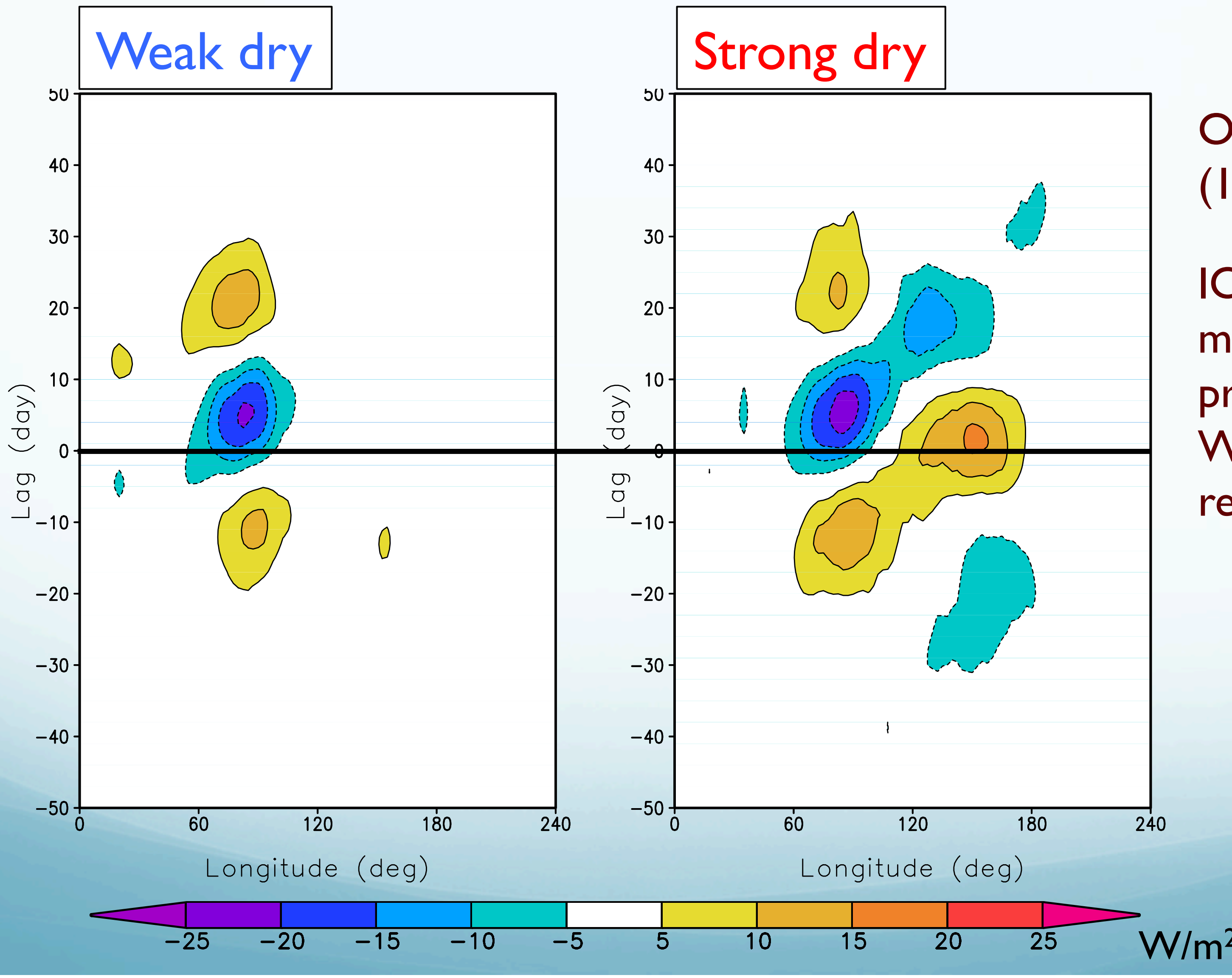
15S-15N averaged anomaly

Shaded: 20-100 day filtered
Contour: MJO filtered

Category	Weak Dry	Strong Dry
Number of MJO events	41 (71)	44 (78)
MJO zonal extent [deg]	33.2	60.2
MJO Duration [day]	18.77	26.34

MJO convection lives longer and propagates further to the east when there is a relatively stronger dry anomaly over the WP

Propagation Characteristics



OLR anomaly (10S-10N avg.)

IO convection makes eastward propagation when WP dryness is relatively stronger

Column Integrated Moist Static Energy Budget

Moist static energy: m = CpT + gz + Lq

1 2 3 4 5

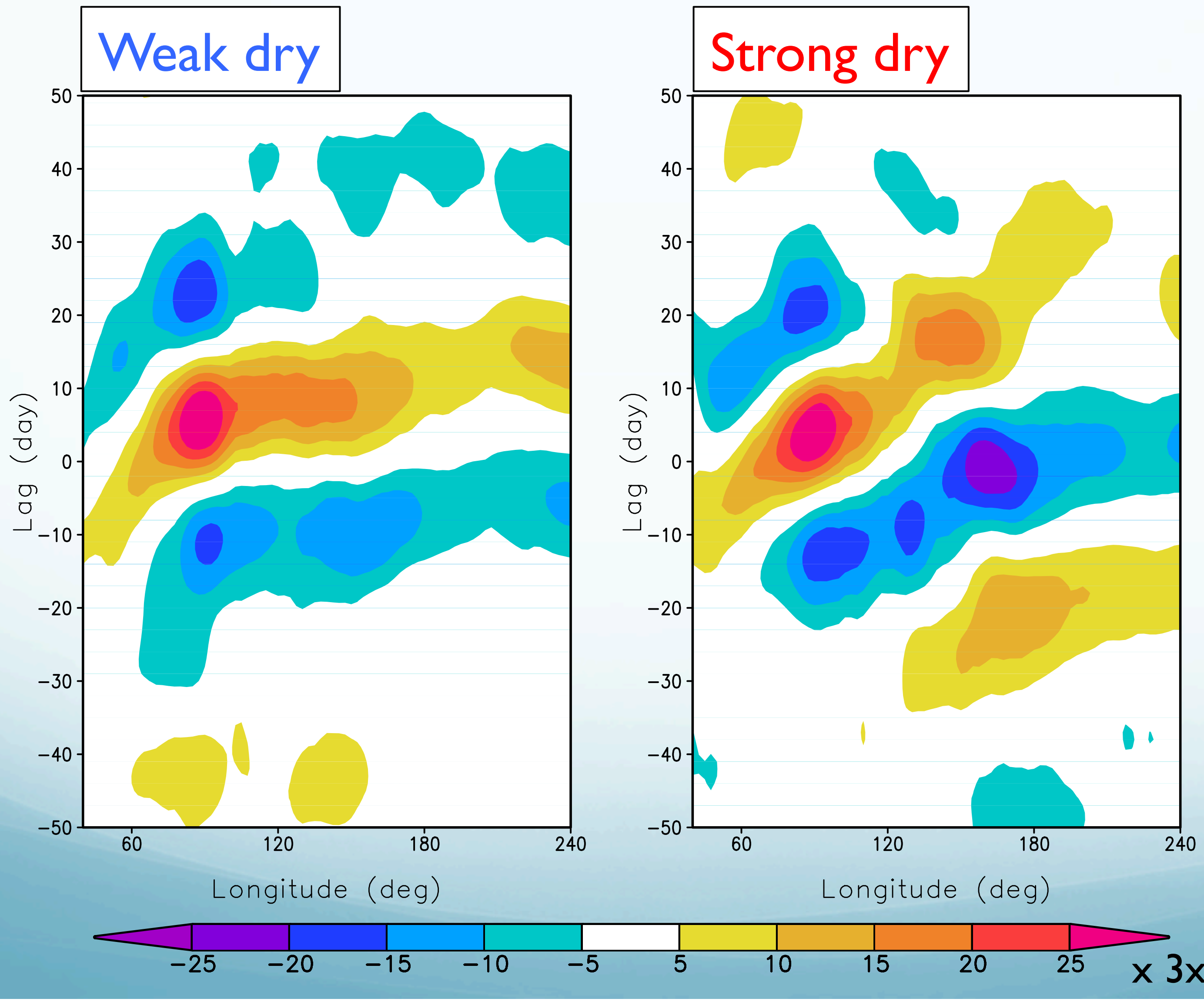
$$\left\langle \frac{\partial m}{\partial t} \right\rangle = -\left\langle \vec{V} \cdot \nabla m \right\rangle - \left\langle \omega \frac{\partial m}{\partial p} \right\rangle + LH + SH + \langle LW \rangle + \langle SW \rangle$$

<> : Column integration

1. Storage
2. Horizontal advection
3. Vertical advection
4. Surface turbulent fluxes
5. Radiative fluxes

Data Source: ERAinterim, OAflux

Propagation of <MSE>

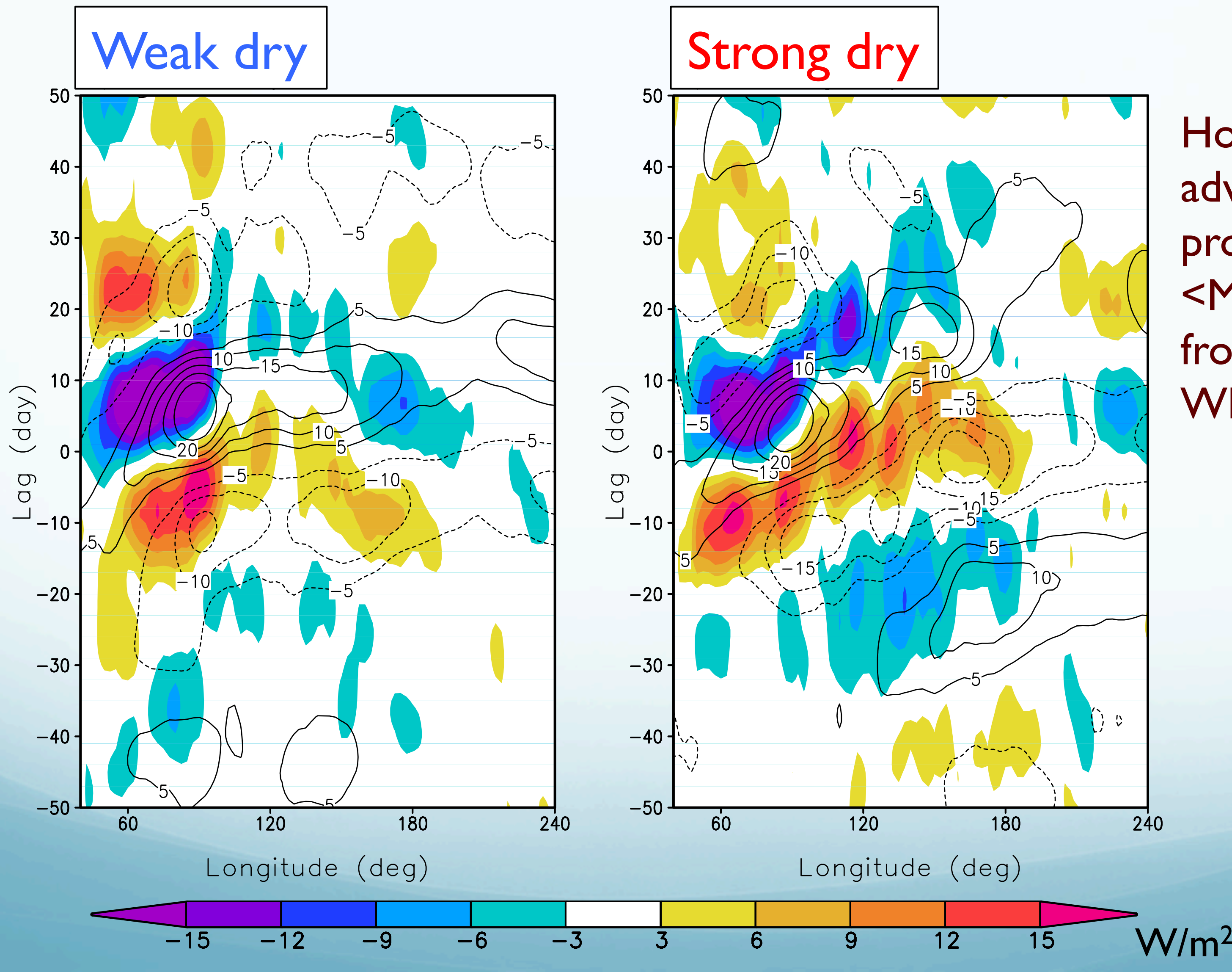


x 3×10^5 J/m^2

<m> anomaly (10S-10N avg.)

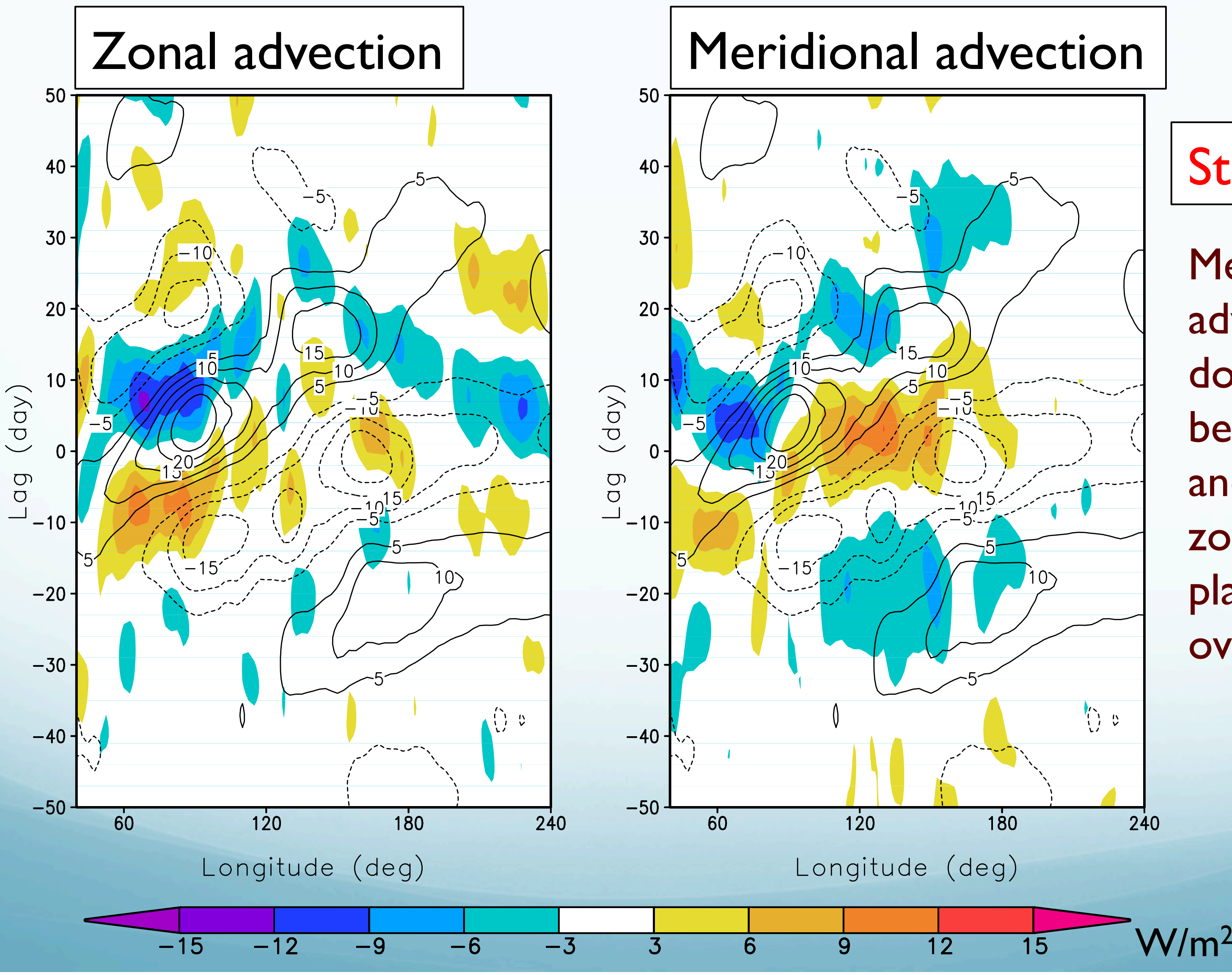
Consistent with that of OLR anomaly

<Horizontal advection of MSE>



Horizontal advection leads propagation of <MSE>, especially from the IO to the WP

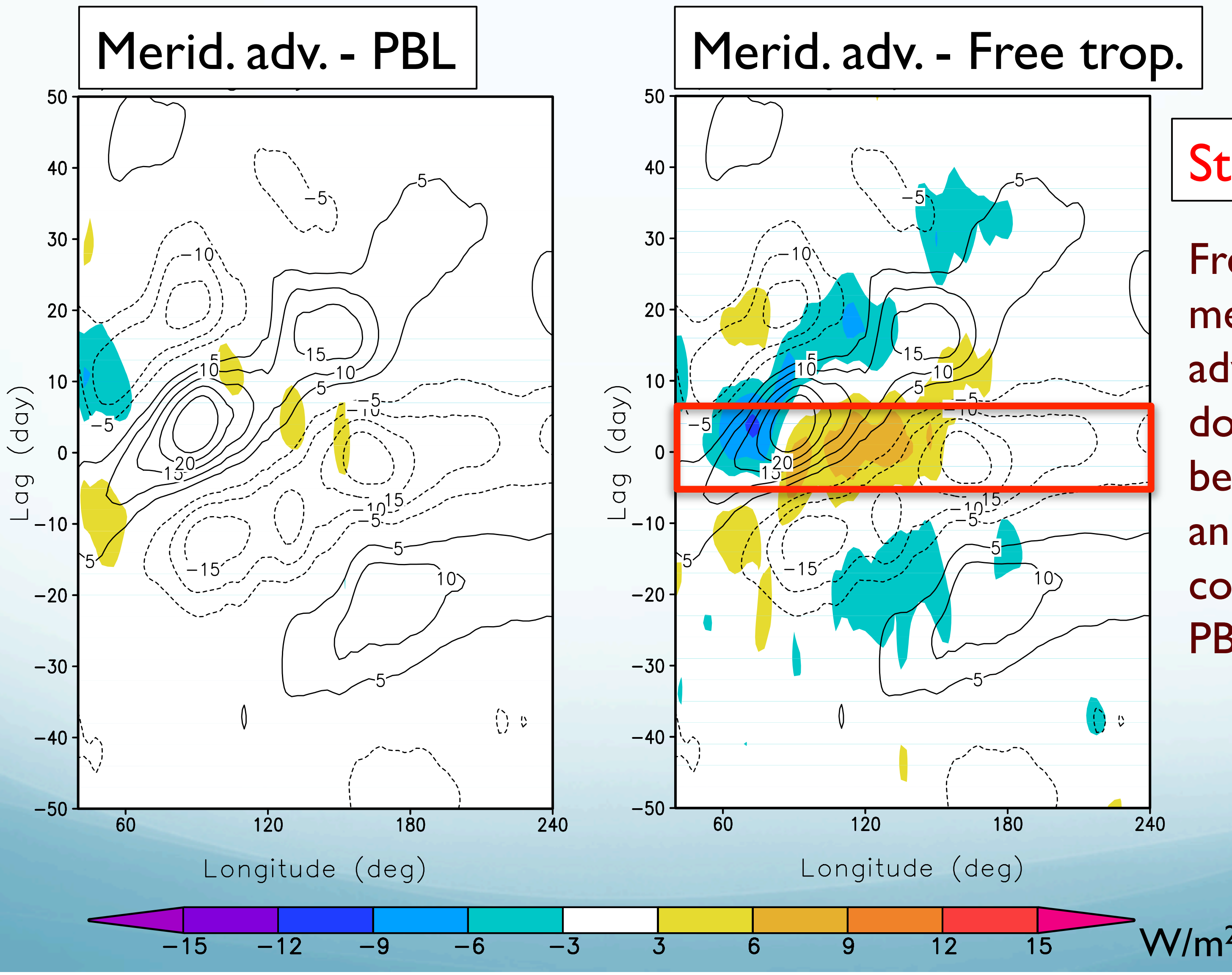
Zonal vs. Meridional Advection



Strong dry

Meridional advection dominates in between the IO and the WP, while zonal advection plays a bigger role over the IO

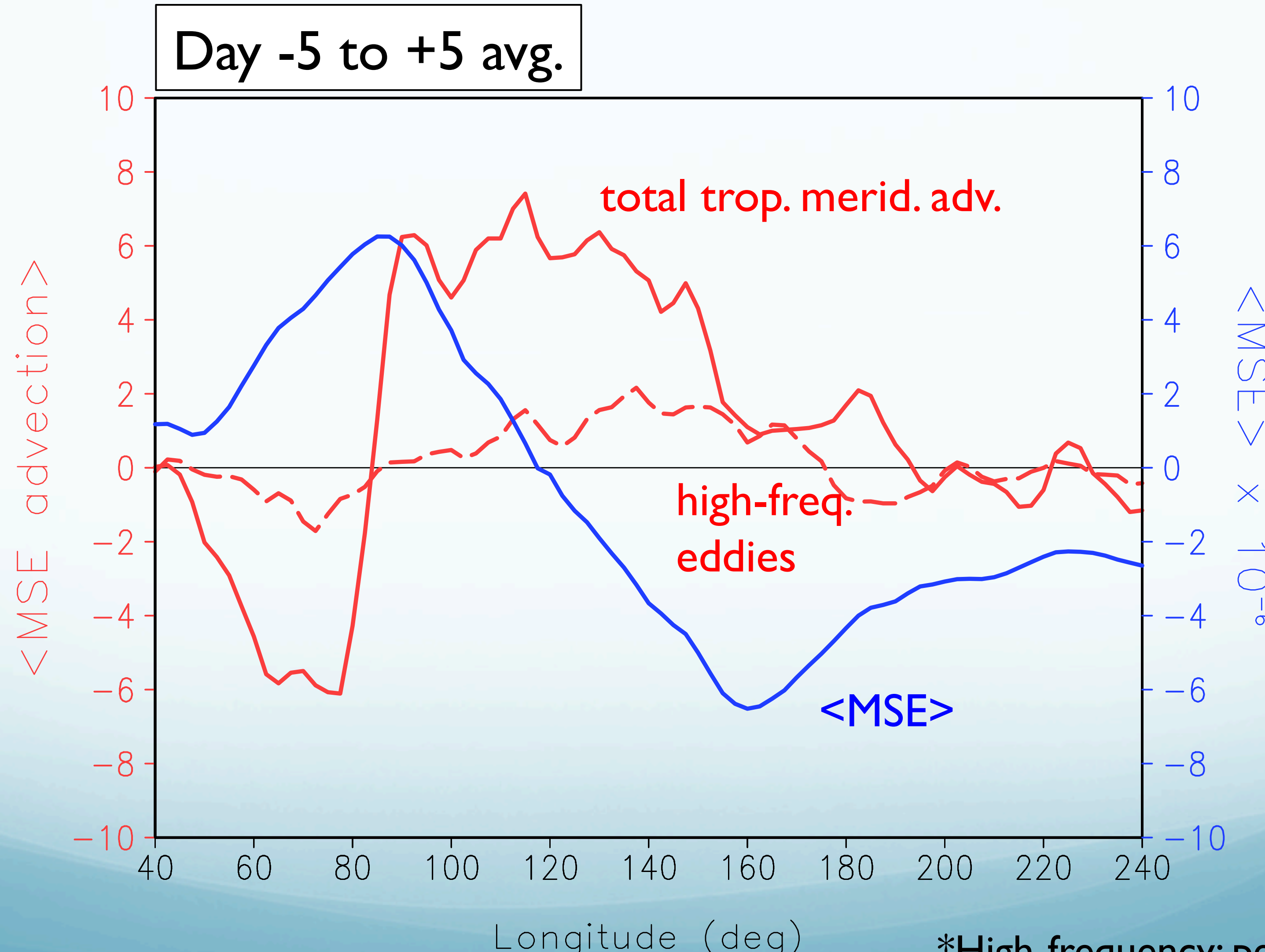
PBL vs. Free Troposphere



Strong dry

Free tropospheric meridional advection dominates in between the IO and the WP, while contribution from PBL is minor

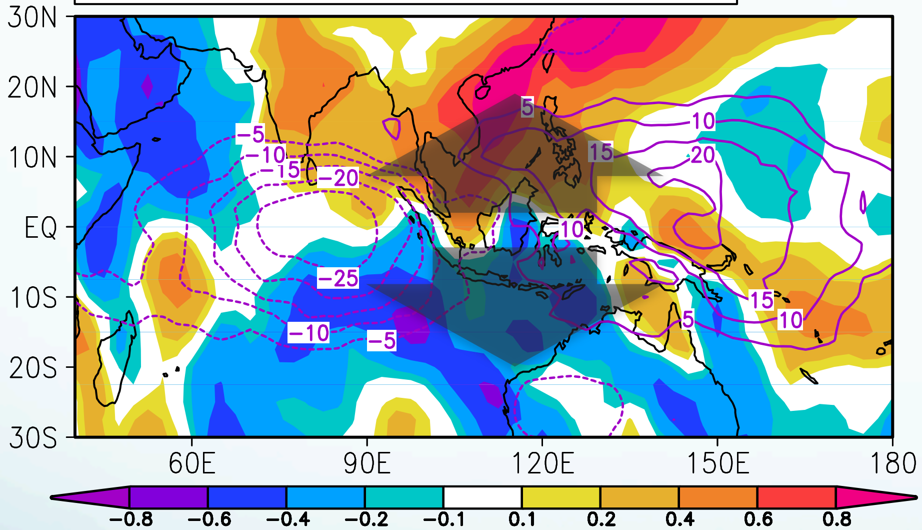
Role of high-frequency eddies



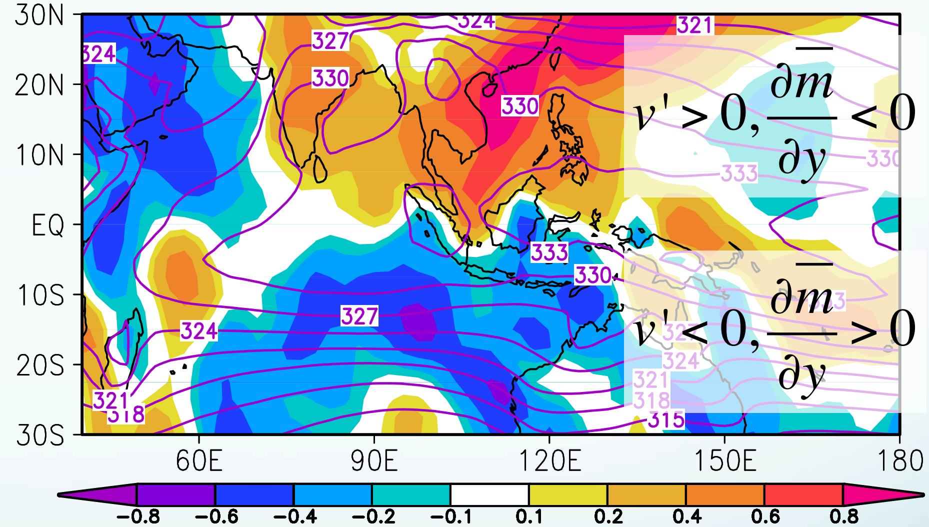
*High-frequency: period<20days

Role of Poleward Flow in Front of Convection

Strong dry (Day0-4 avg)



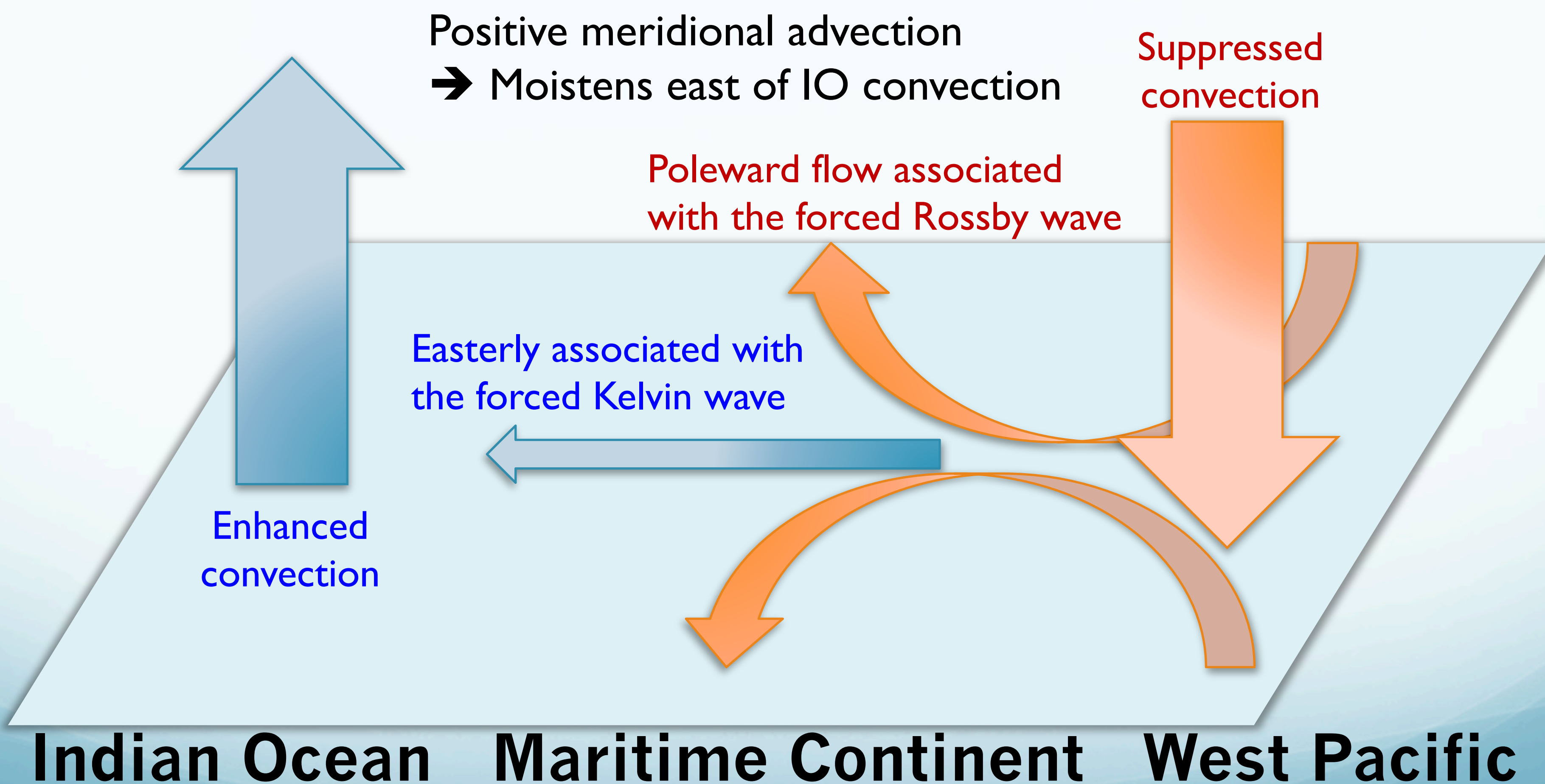
Merid. Adv.: $-v'\frac{\partial \overline{m}}{\partial y}$



Shaded: 750hPa v anomaly ($m\ s^{-1}$)
Contour: OLR anomaly ($W\ m^{-2}$)

Shaded: 750hPa v anomaly ($m\ s^{-1}$)
Contour: mean MSE ($kJ\ m^{-2}$)

Schematic view



Summary

- Associated with the MJO, the planetary-scale convective anomaly over the Indian Ocean (IO) often propagates eastward and reach the west Pacific (WP), but not always.
- All 189 IO convection onset events are classified into three categories based on the strength of the dry anomaly over the WP.
- The IO convection anomaly lives longer, and makes a further propagation to the east when the dry anomaly is relatively stronger. When the dry anomaly is relatively weaker, the convection anomaly ceases before reach the WP in most cases.
- Meridional advection of <m> in the free troposphere plays an important role on the propagation of IO convection. Contributions from PBL are minor.
- The dry anomaly plays a dynamically active role on the propagation of the IO convection through the Rossby wave response to it, which enhances meridional advection of <m> in front of the convection anomaly by inducing poleward flow.