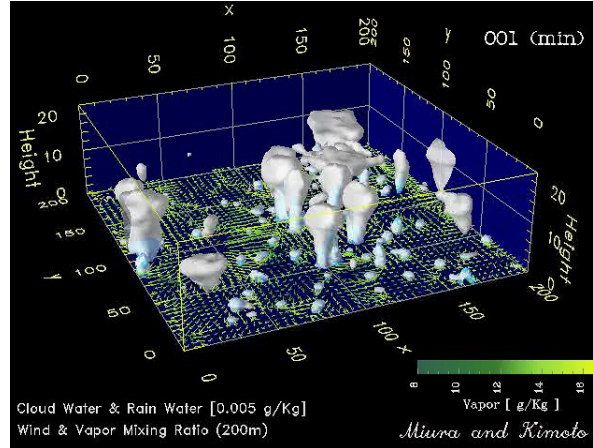


Equatorial asymmetry of a CINDY/DYNAMO MJO event and influence of the seasonal change

Hiroaki Miura
(University of Tokyo)

2003.05

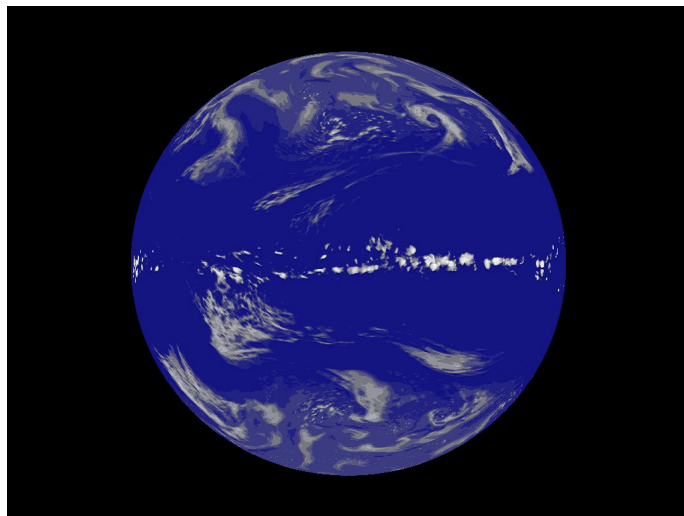
A. Sumi, M. Kimoto, K. Saito, M. Satoh, T. Nasuno



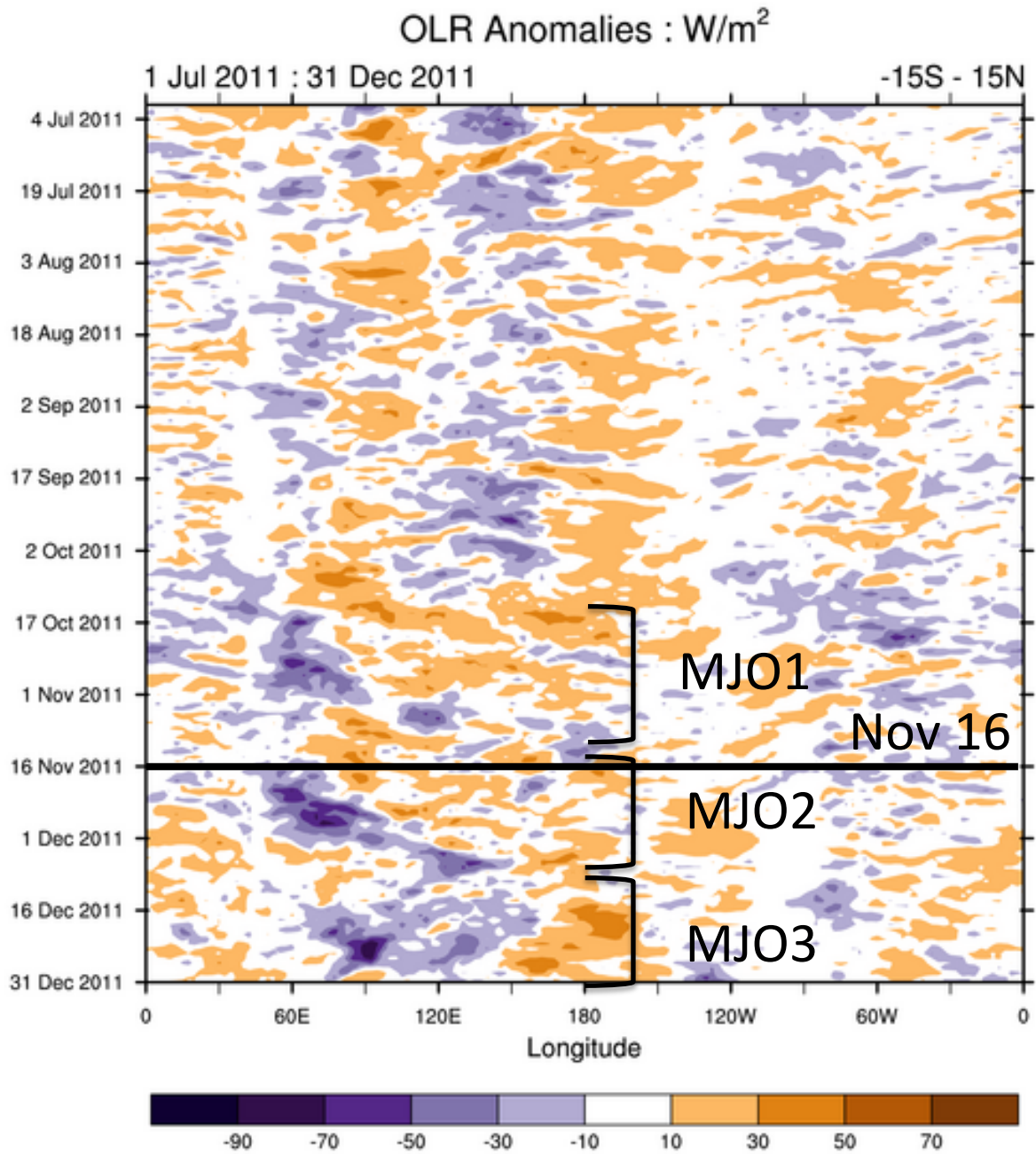
<http://www.thelistlove.com/10-super-superman-facts/#>

CMMAP Web page

2004.10 NSF STC Site Visit



Tomita et al. (2005)
NICAM, 3.5 km, Aquaplanet

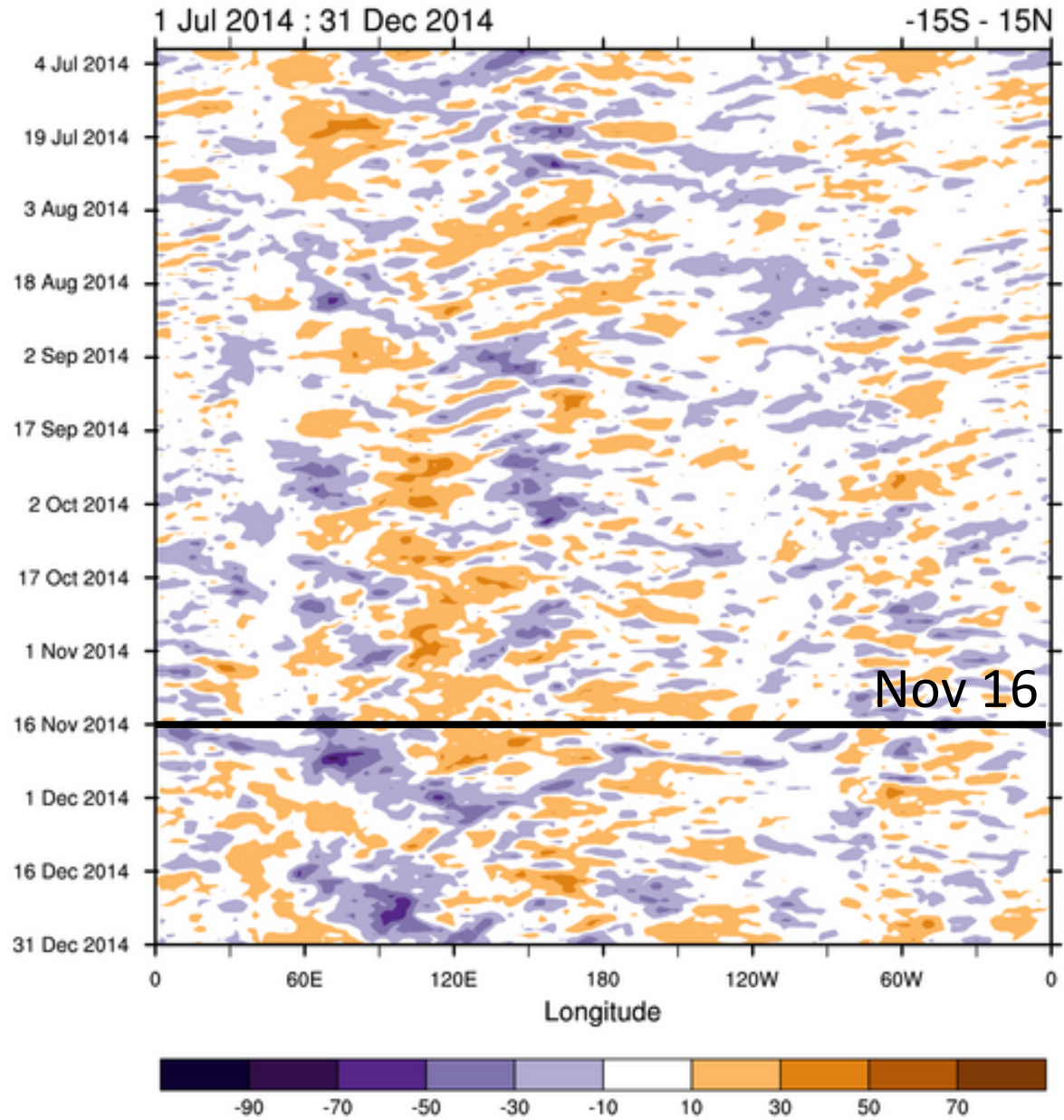


Year 2011

Yoneyama et al. (2013)
CINDY2011/DYNAMO
 observation campaign

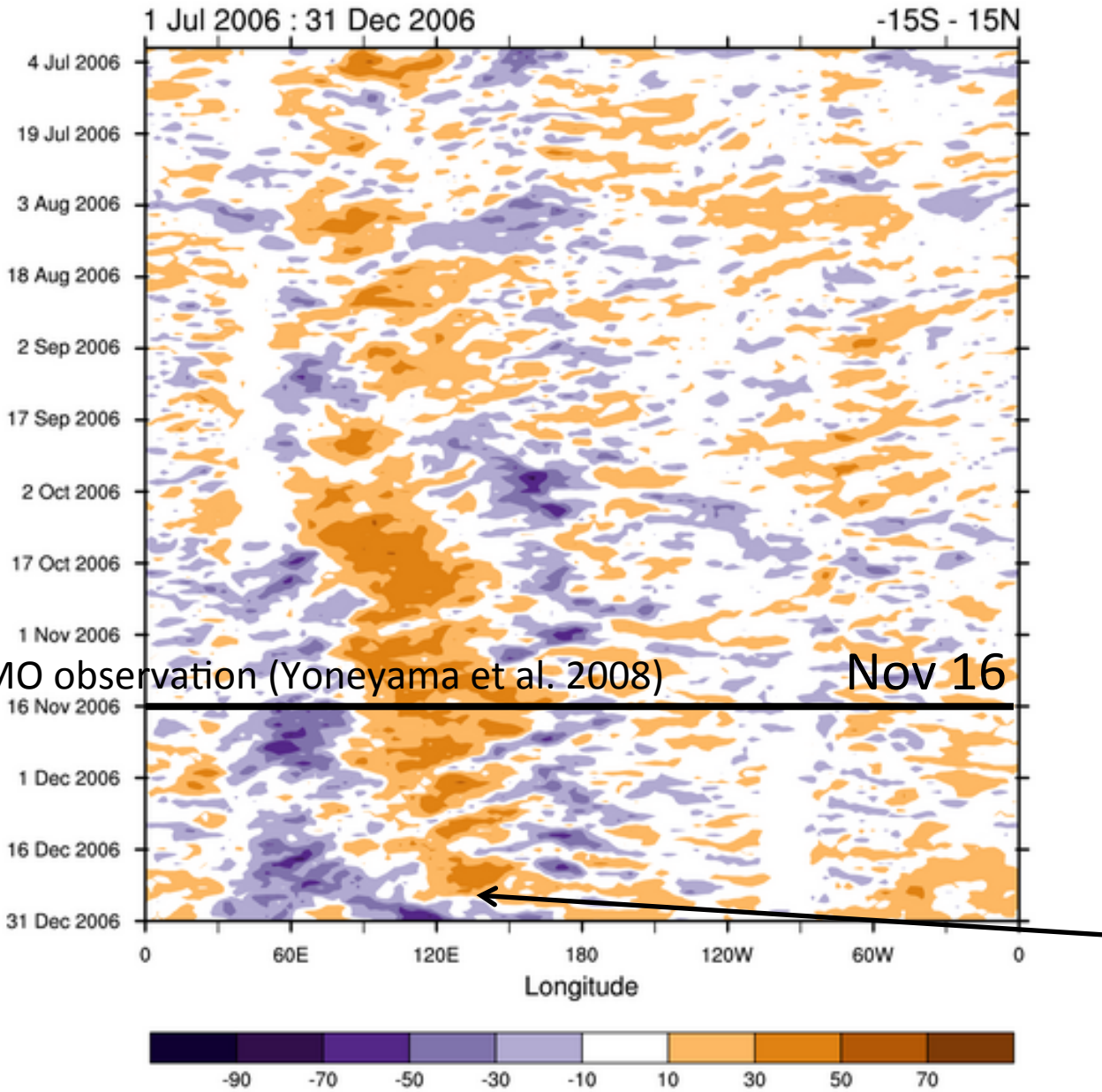
<http://www.bom.gov.au/climate/mjo/#tabs=Time-longitude>

OLR Anomalies : W/m²



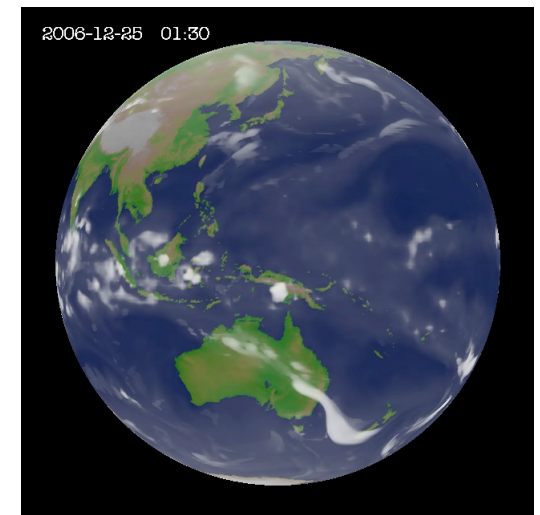
Year 2014

OLR Anomalies : W/m²



Year 2006

Miura et al. (2007)



2012

2013

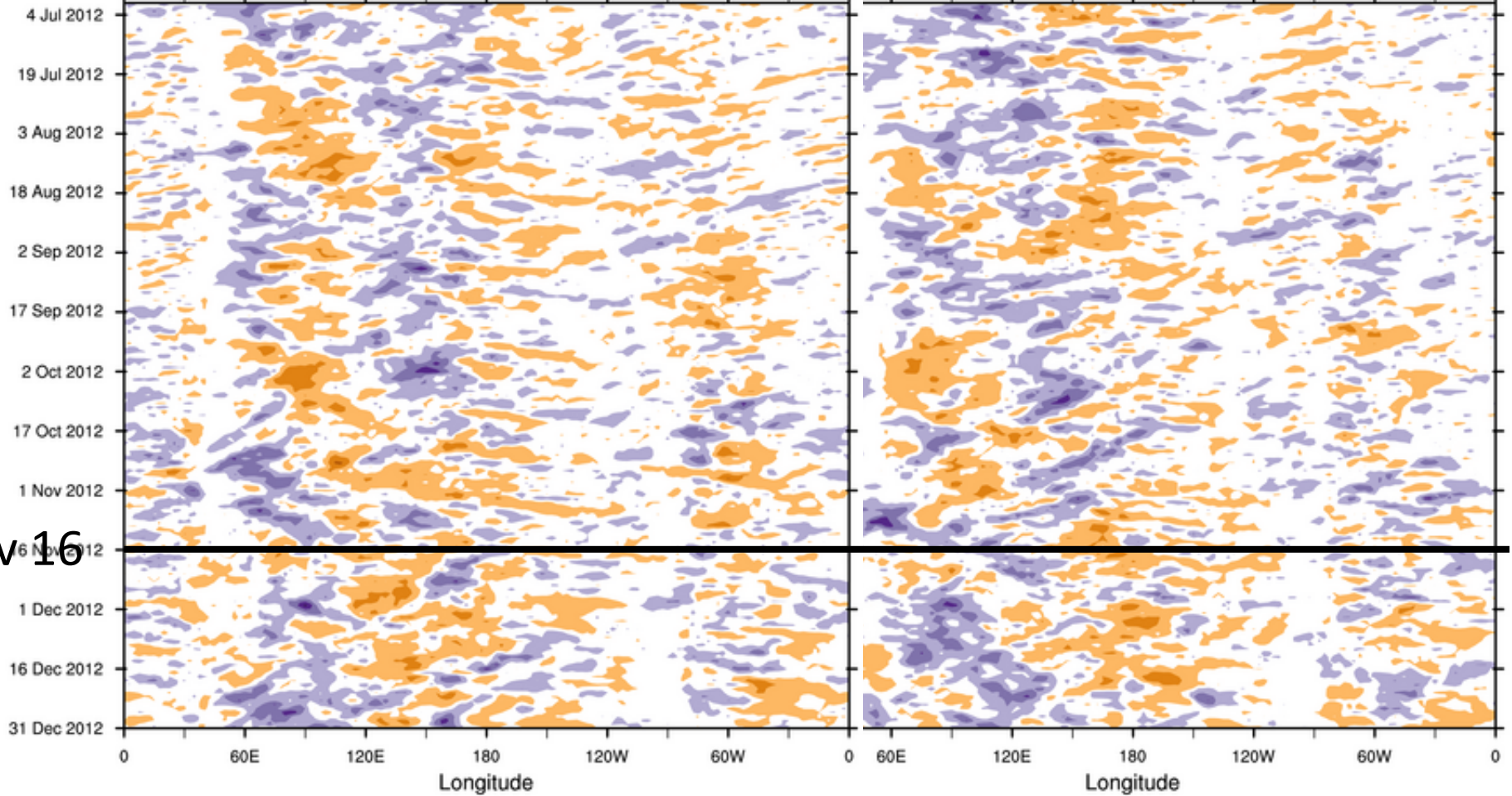
OLR Anomalies : W/m^2

OLR Anomalies : W/m^2

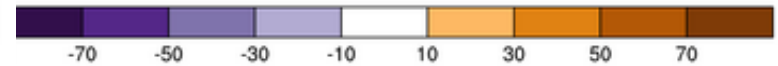
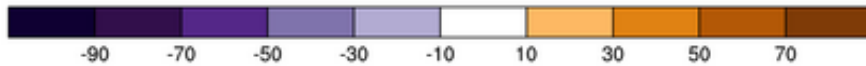
1 Jul 2012 : 31 Dec 2012

1 Jul 2013 : 31 Dec 2013

1 Jul 2013 : 31 Dec 2013



Nov 16



2001

2002

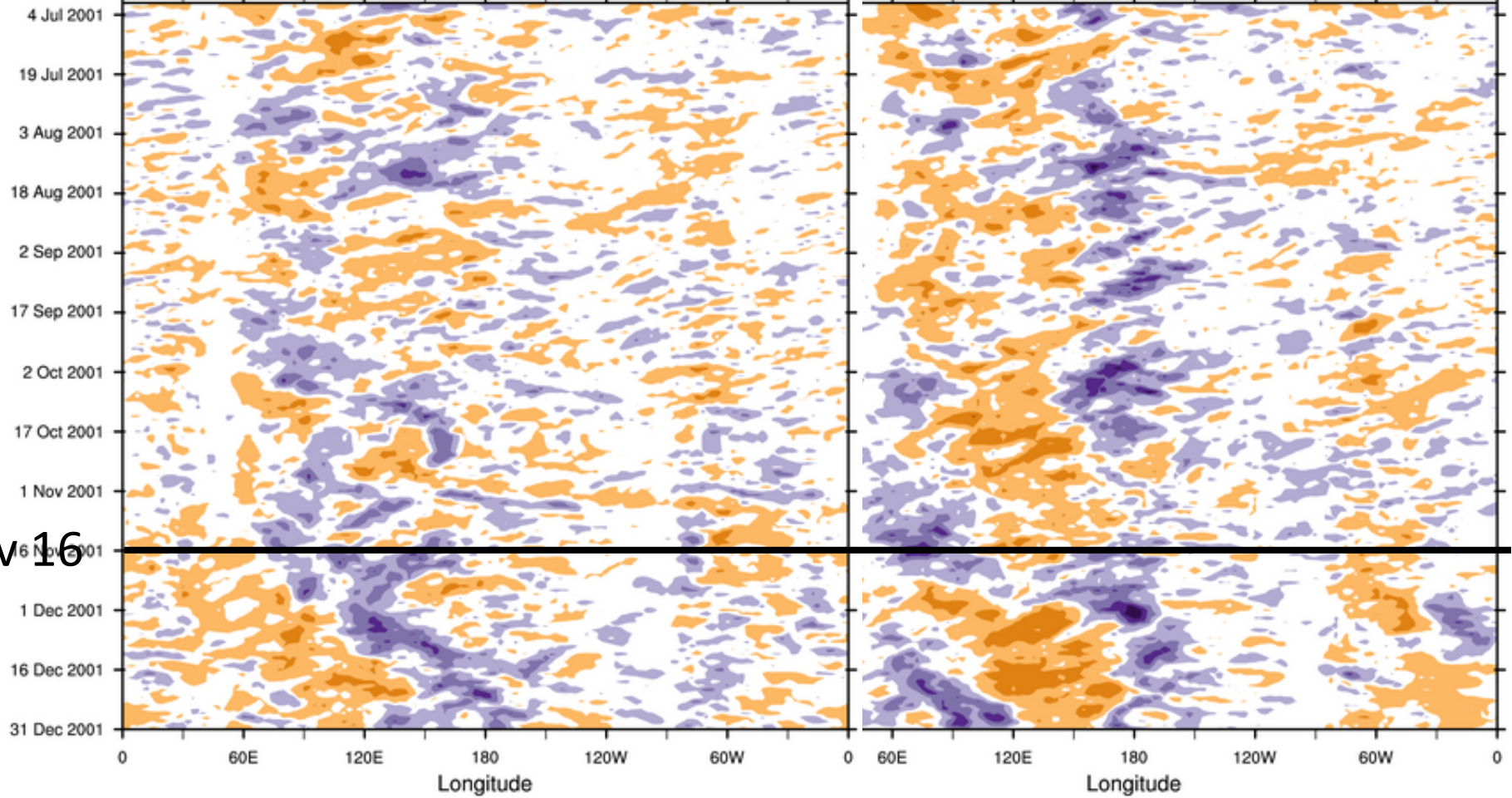
OLR Anomalies : W/m^2

OLR Anomalies : W/m^2

1 Jul 2001 : 31 Dec 2001

1 Jul 2002 : 31 Dec 2002

1 Jul 2002 : 31 Dec 2002



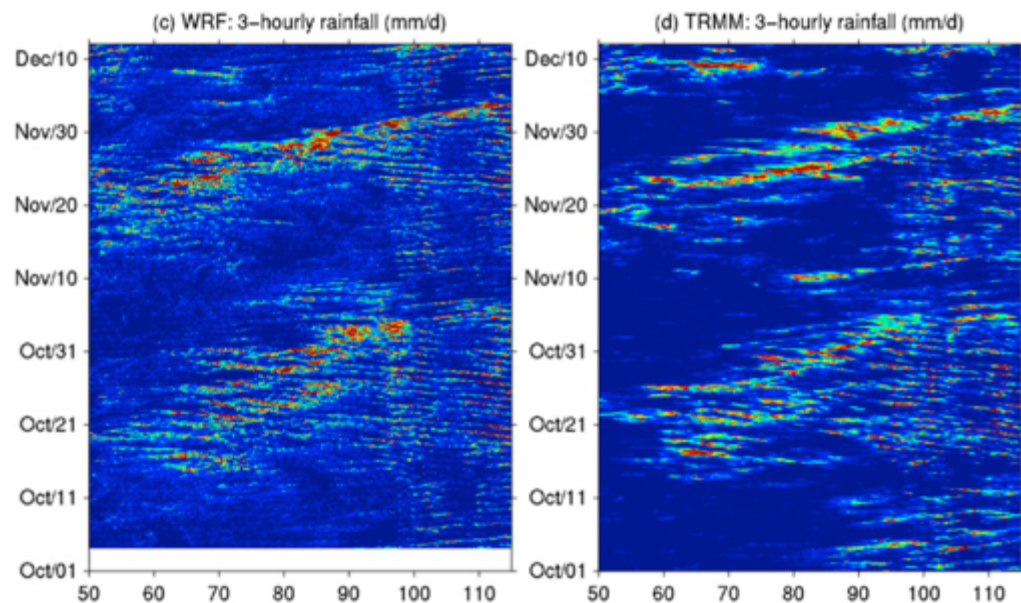
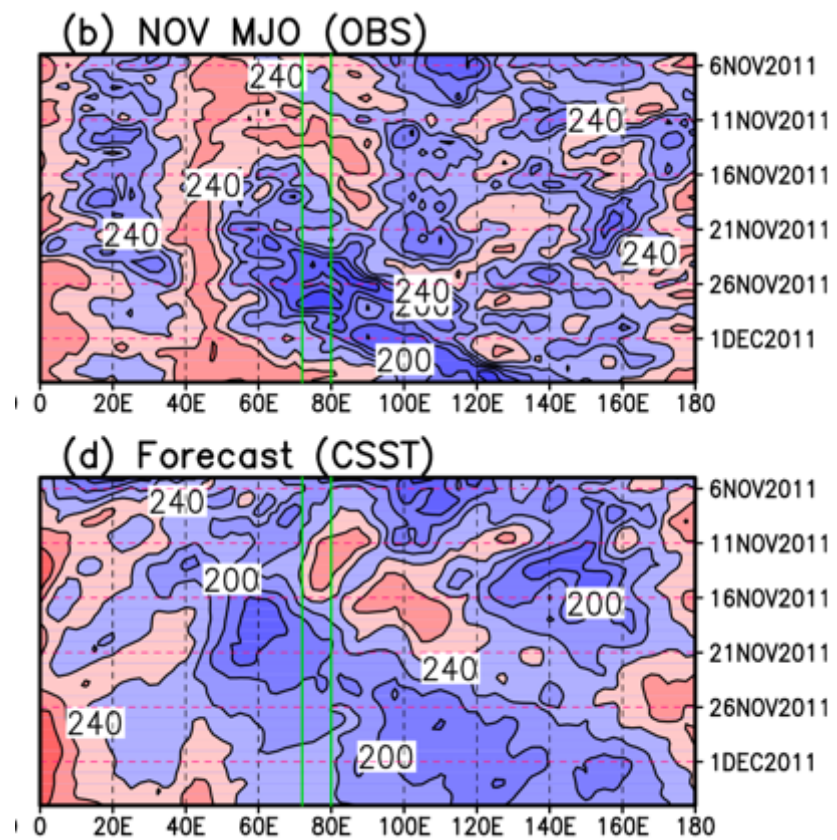
Nov 16

Two simulations by NICAM

- Ensemble runs using a **14-km** mesh
 - Initial dates: 00 UTC on 12-16 October 2011
 - Duration: 60 days (no nudging)
 - SST: prescribed by NOAA OI SST (weekly)
- Single run using a **7-km** mesh
 - Initial date: 00 UTC on 16 October 2011
 - Duration, SST: the same as the 14-km run

Questions:

- Can **MJO2** be simulated realistically by NICAM?
- If it can or can not, why and how?



OLR

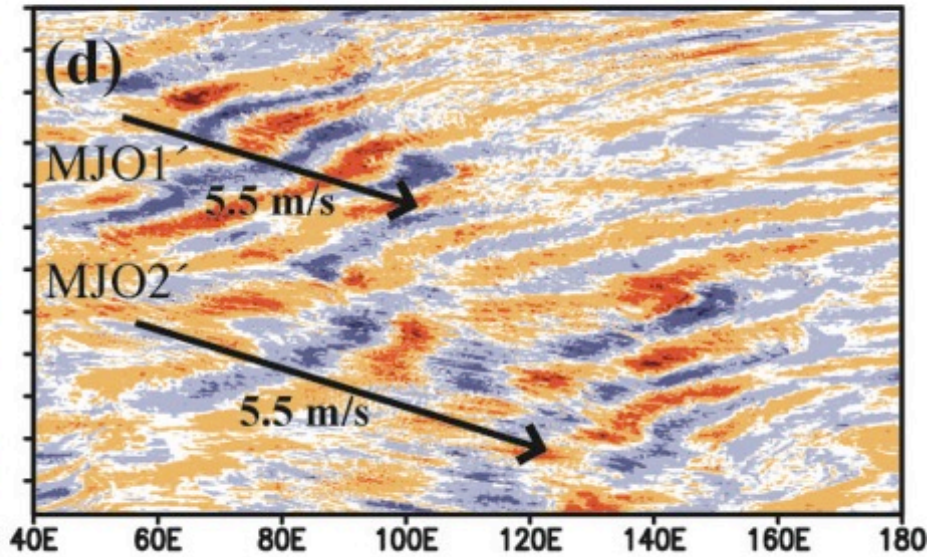
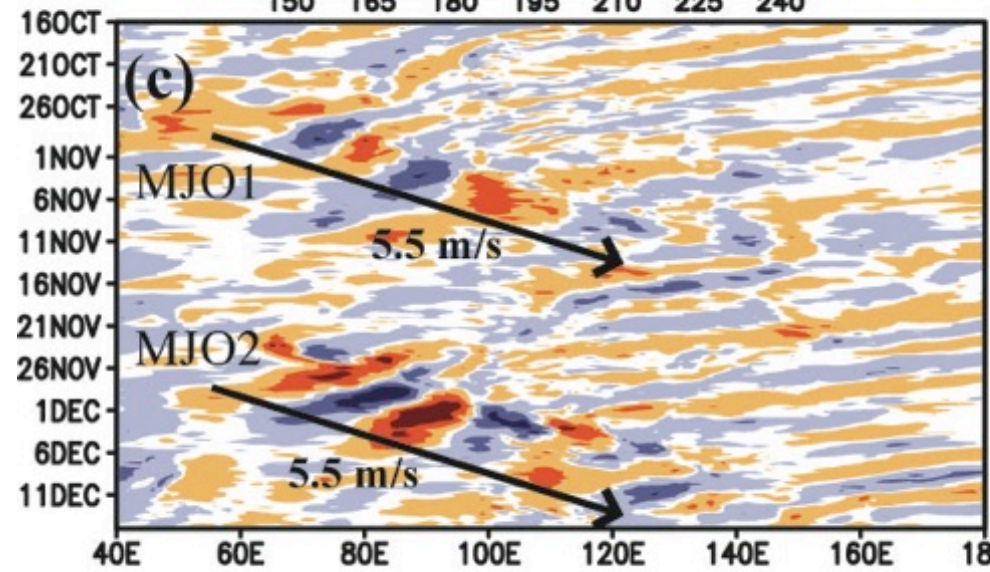
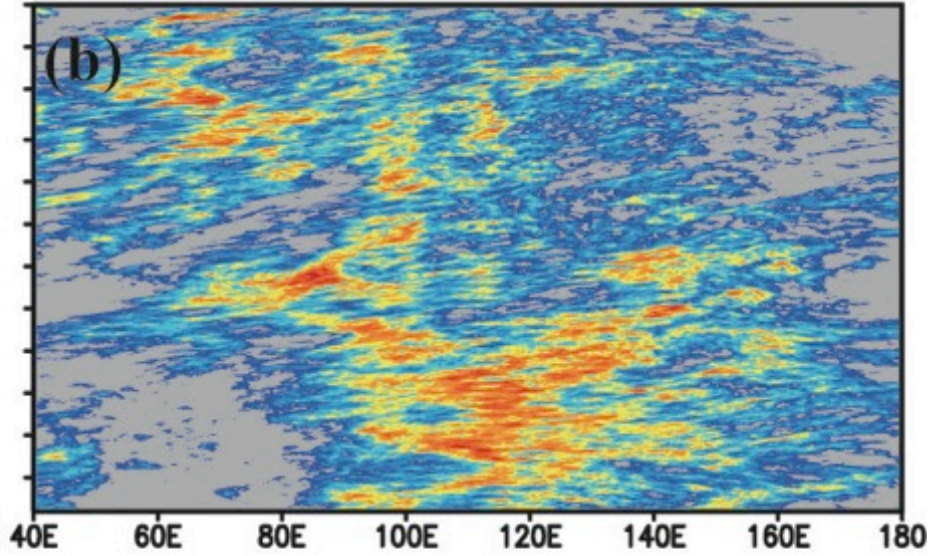
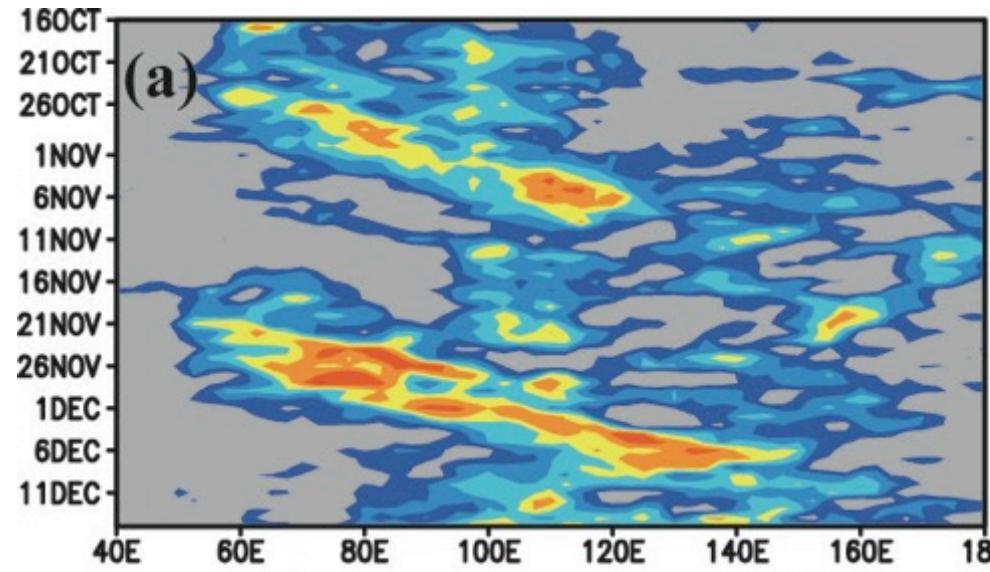
Fu et al. (2015): CGCM

Precipitation

Wang et al. (2015): WRF (regional)

NOAA OLR
NCEP Final v700

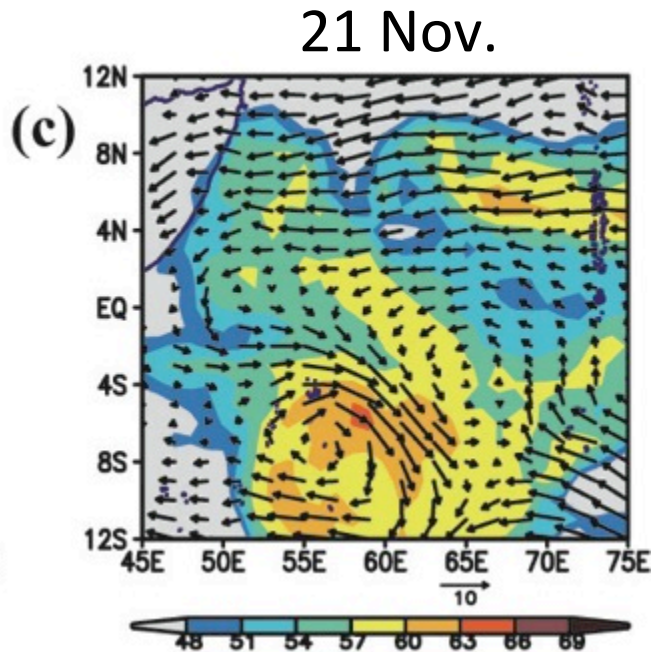
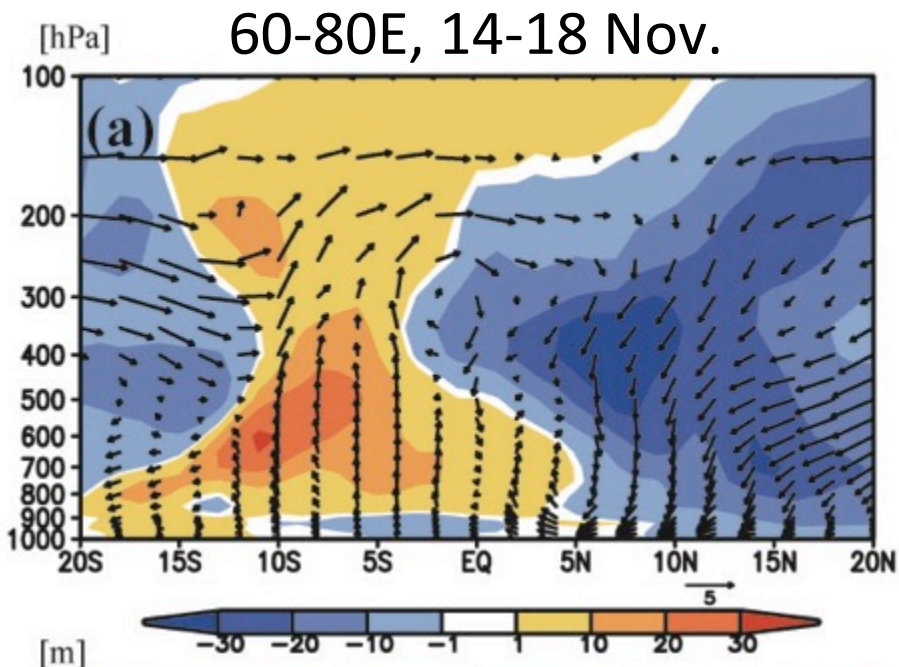
7-km 60-day simulation
(OLR and v700)



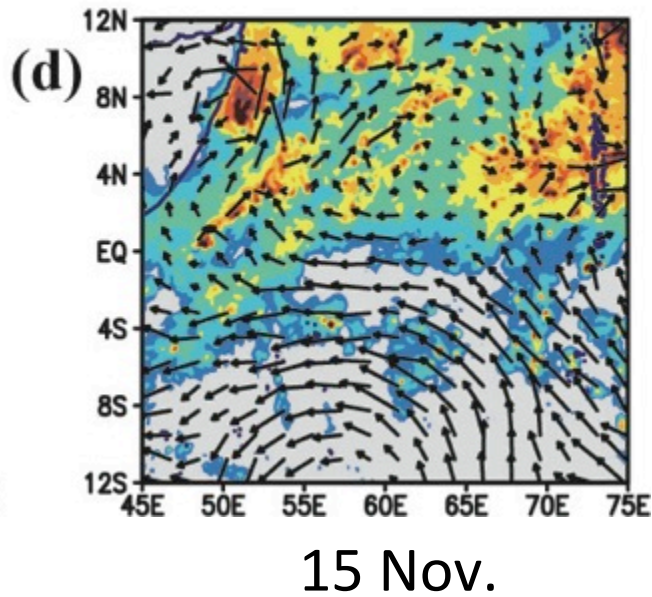
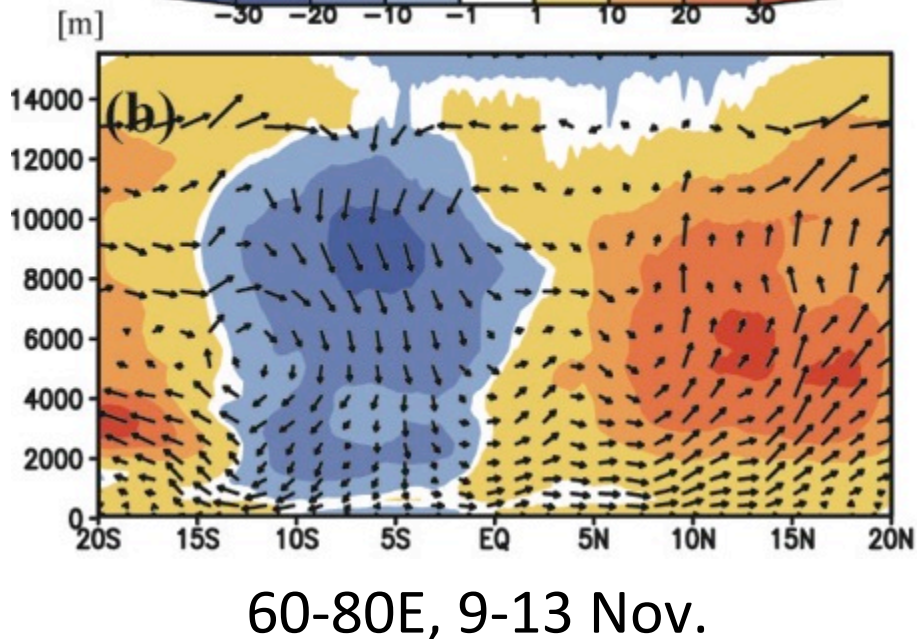
RH and wind anomalies

PW and uv850

NCEP Final



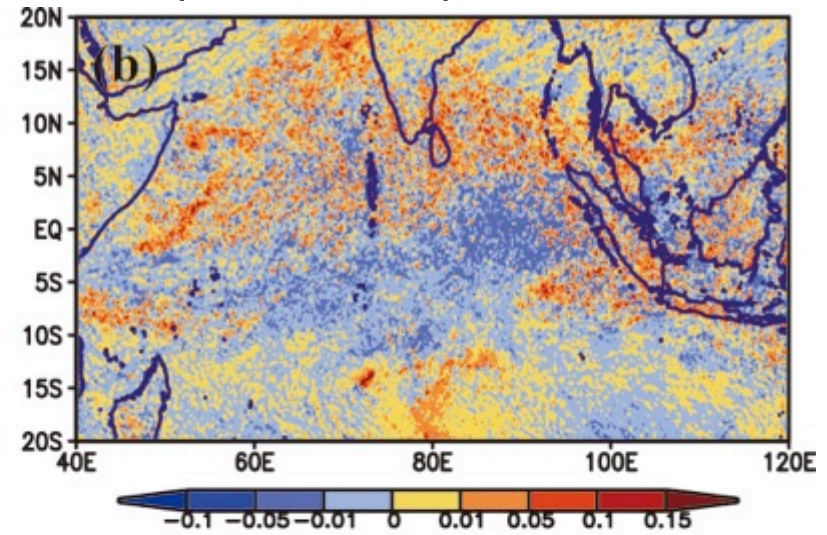
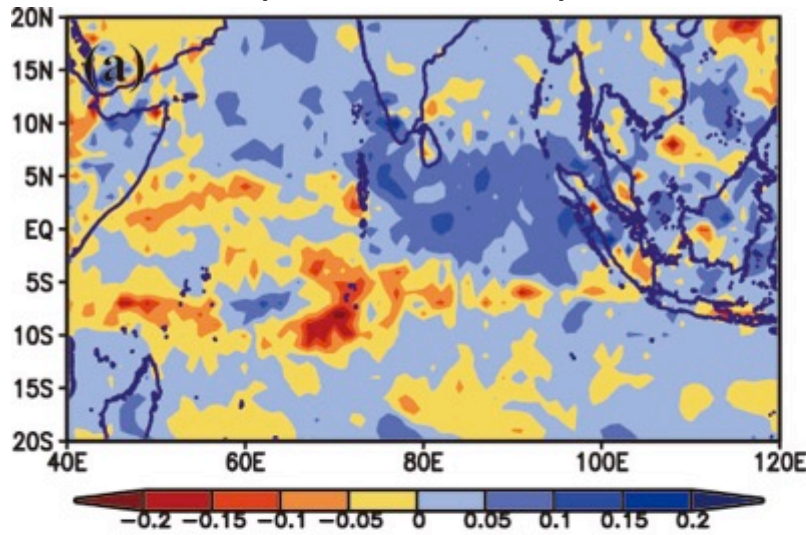
7-km simulation



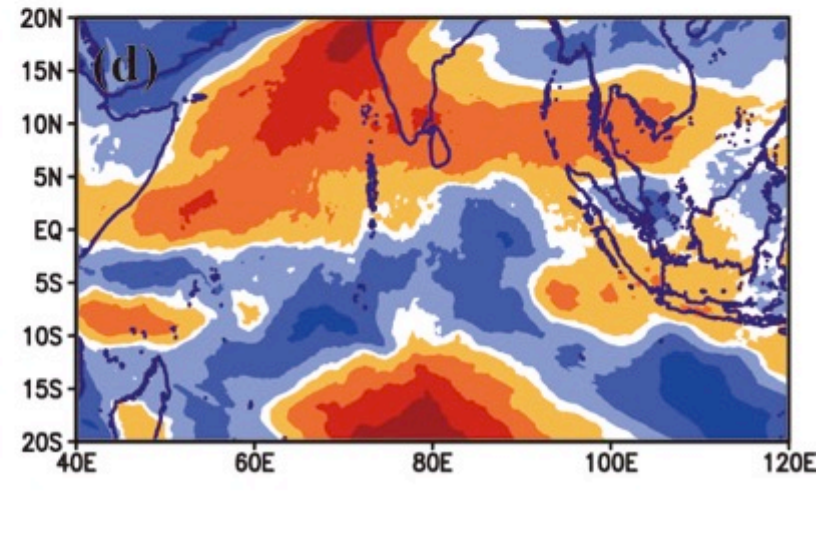
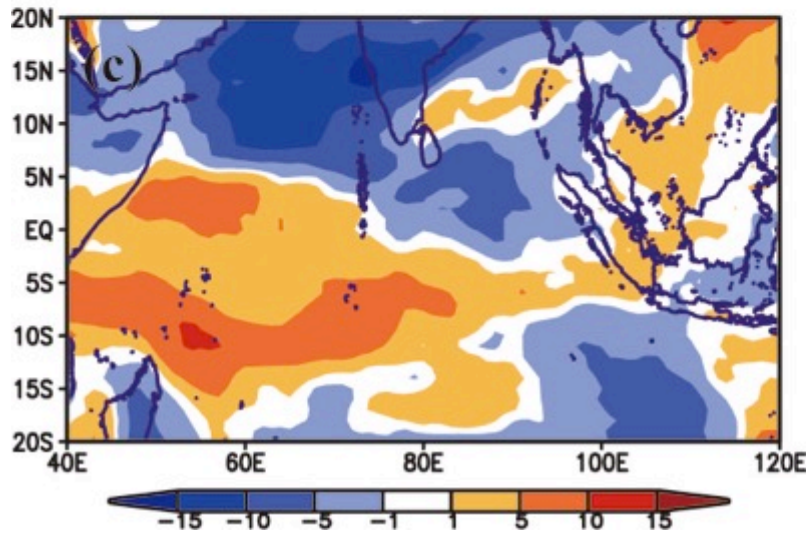
NCEP Final
(14-18 Nov.)

7-km simulation
(9-13 Nov.)

$-\omega'_{500}$
 w'_{500}



PW'

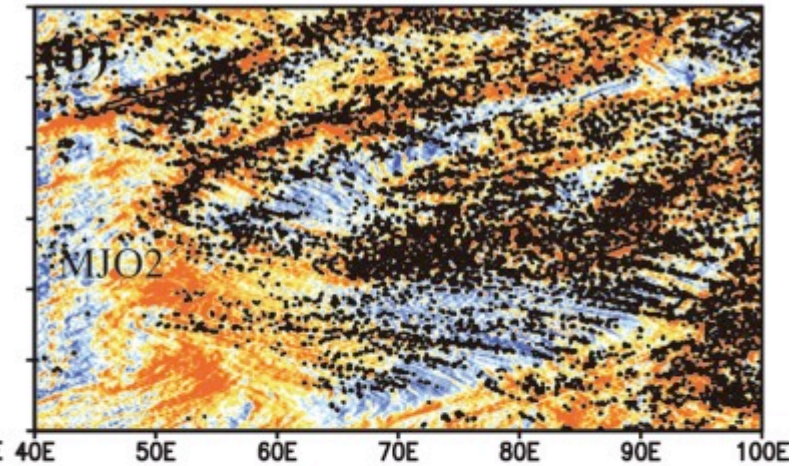
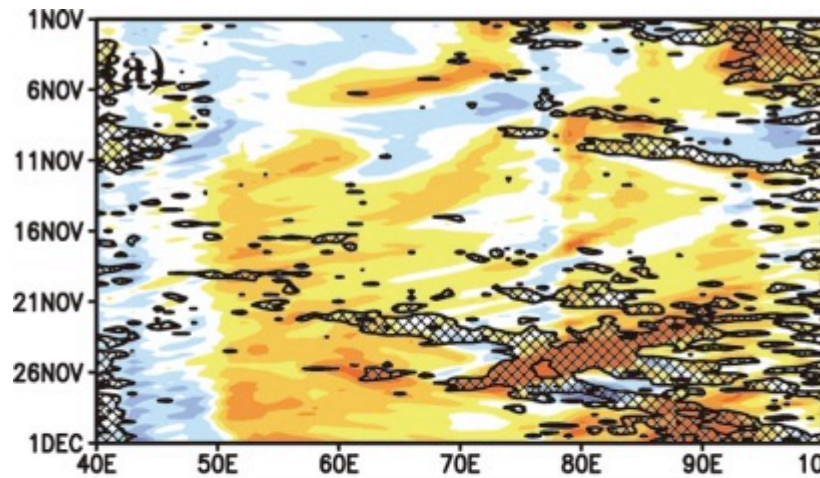


$$\zeta_{850}, -\omega_{700} (w_{700})$$

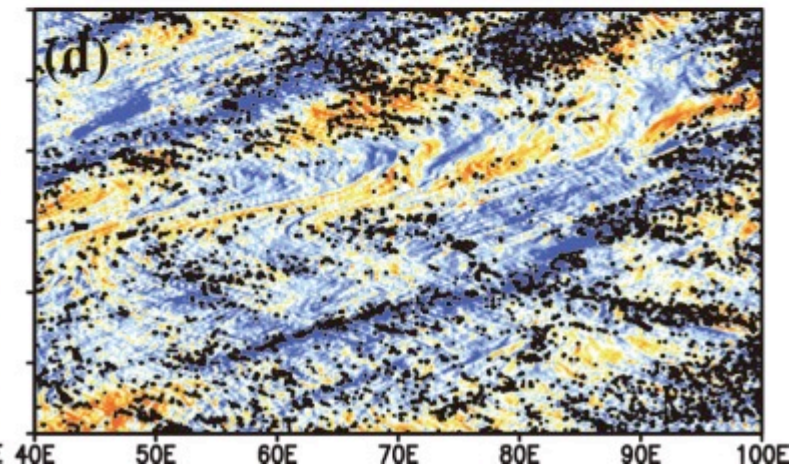
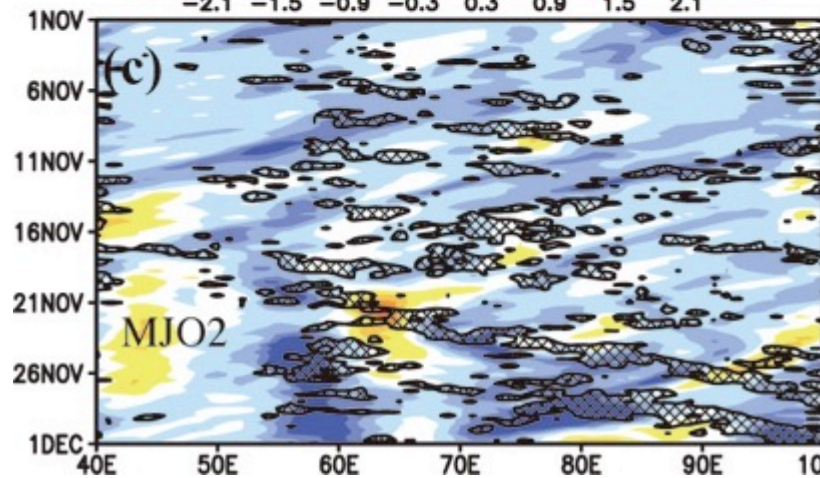
NCEP Final

7-km simulation

0-10N



10S-0

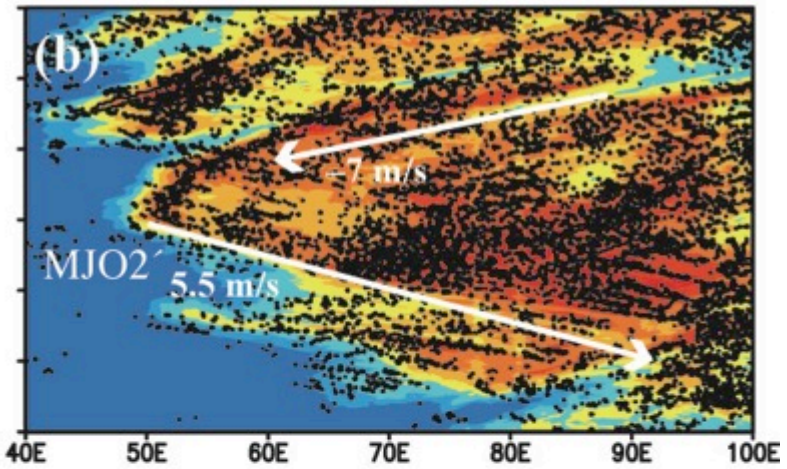
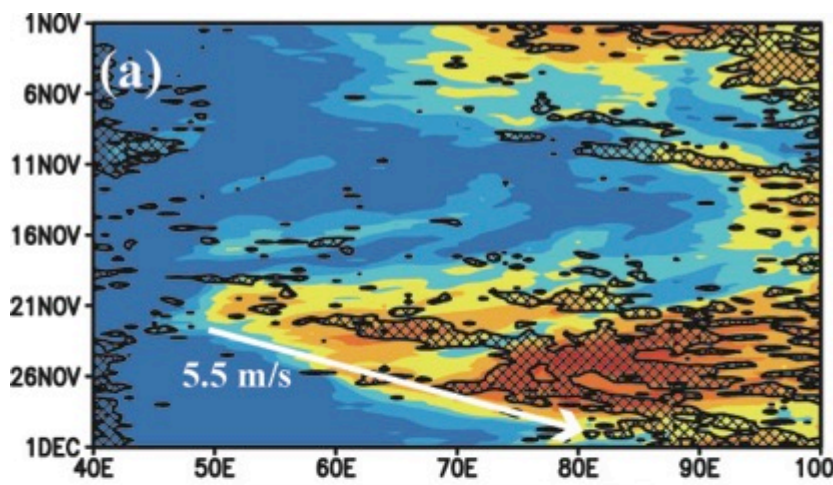


$$PW, -\omega_{700}(w_{700})$$

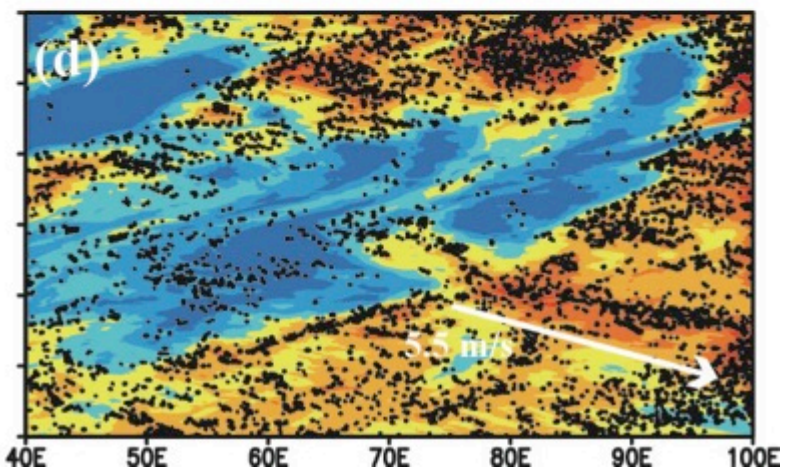
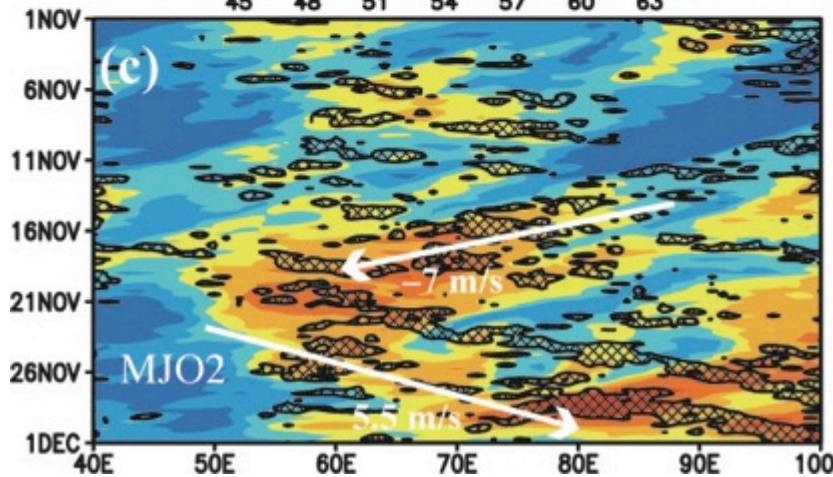
NCEP Final

7-km simulation

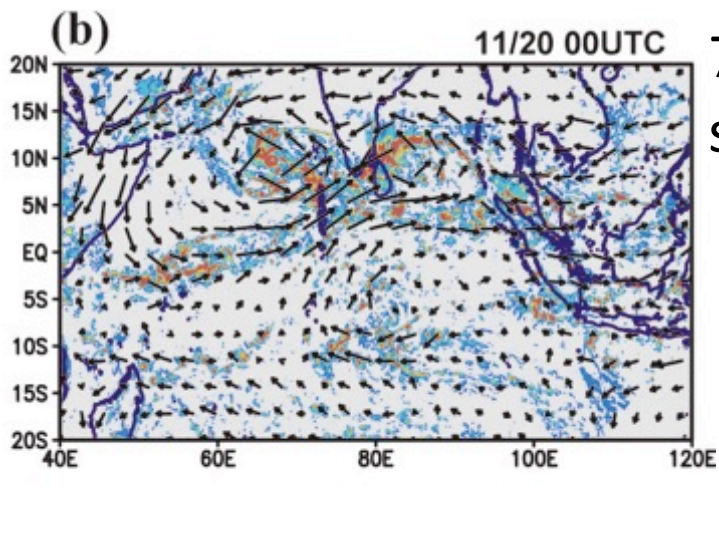
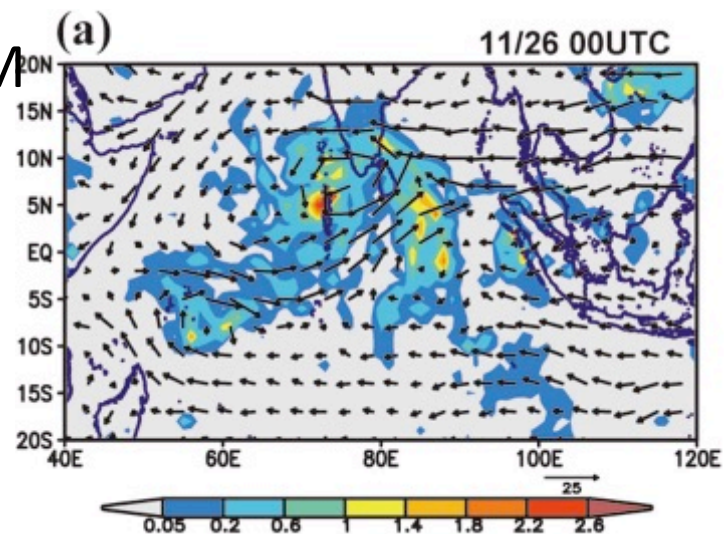
0-10N



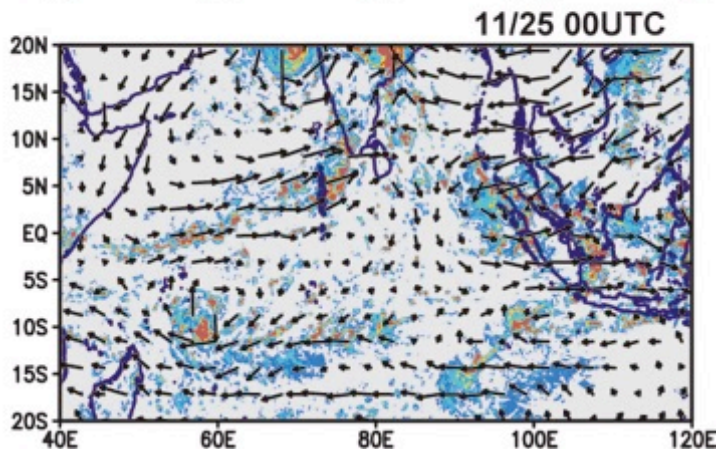
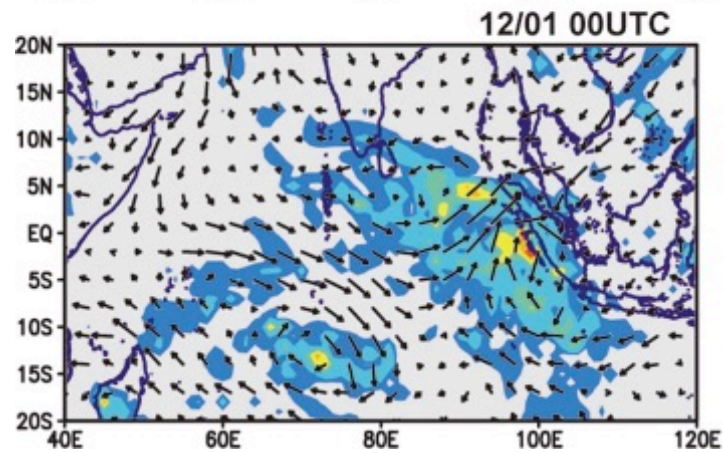
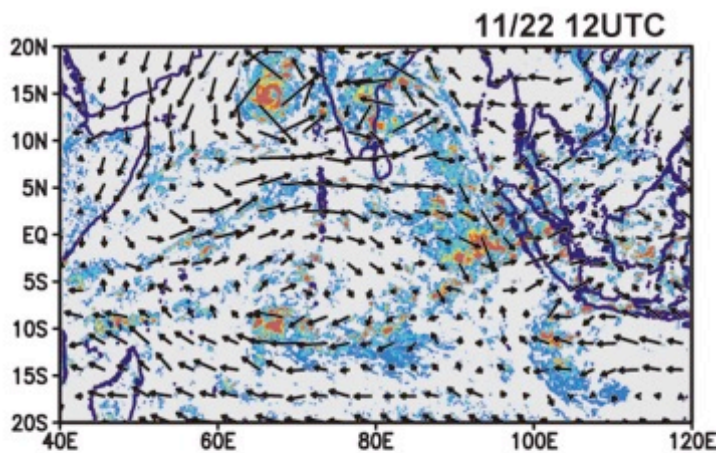
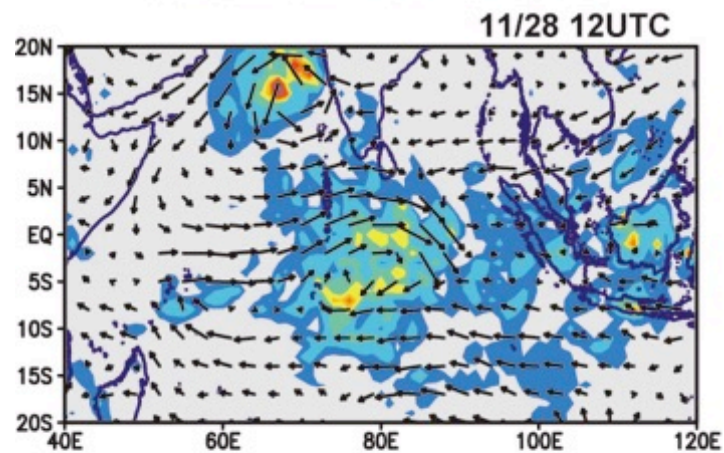
10S-0



TRMM
NCEP



7-km
simulation

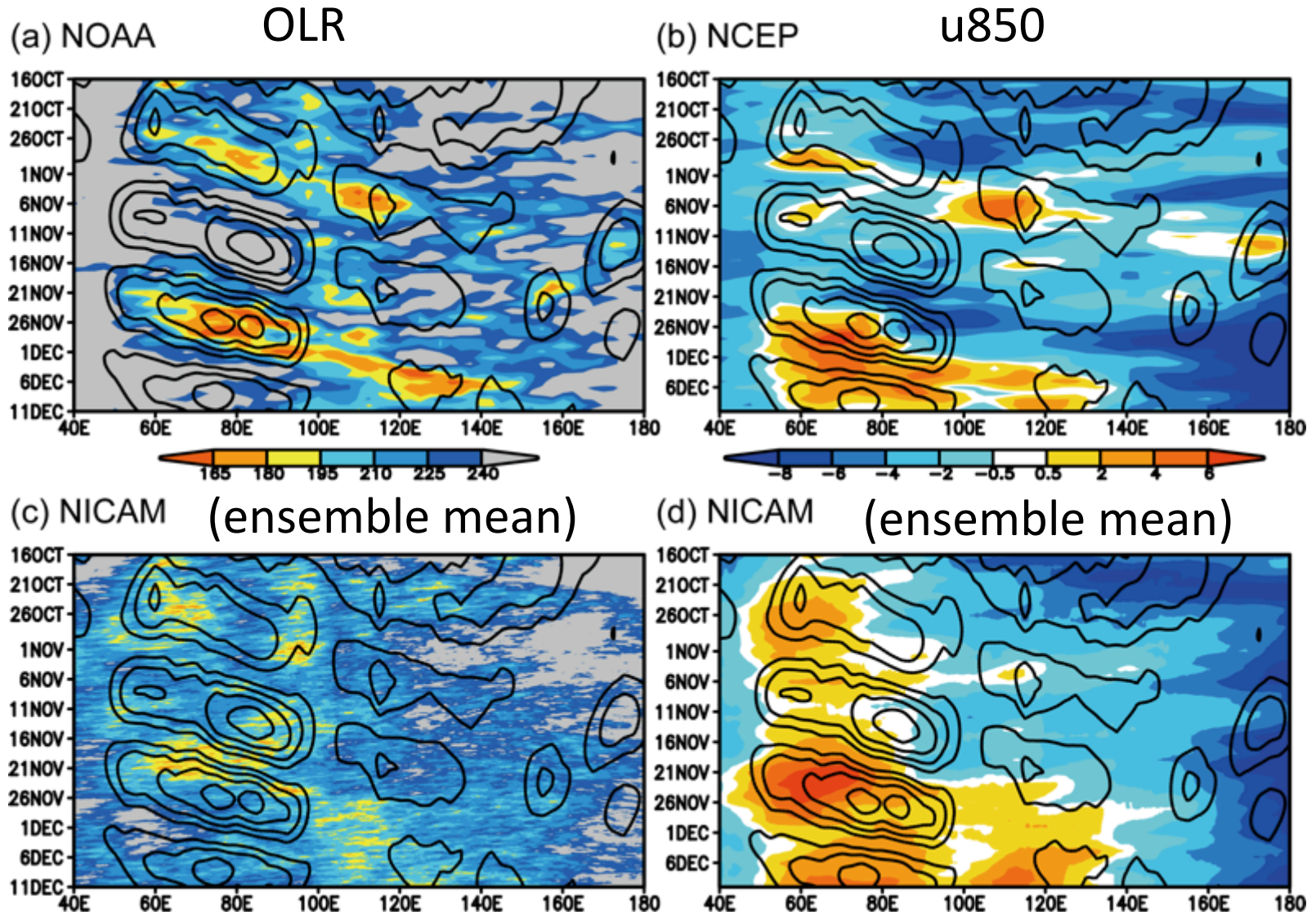


7-km simulation

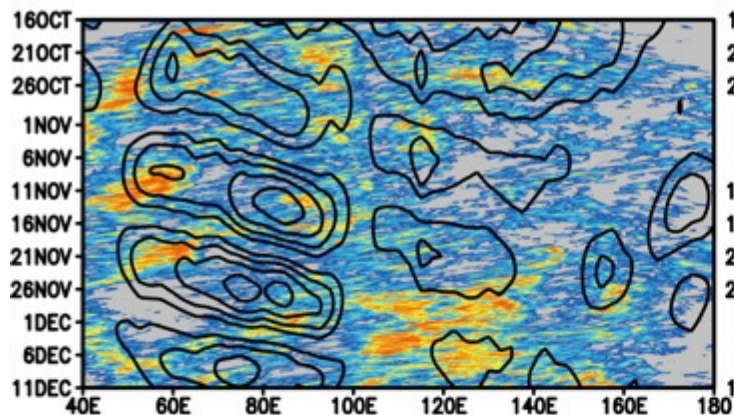
- MJO2 was initiated.
 - Opposite meridional circulation
(onset in the northern hemisphere)
 - Incorrect timing (6 days earlier)
 - Note: SST is constrained by observational data.
- MJO2 moved eastward.
 - Phenomena similar to those observed
 - Cyclonic system like TC05A
 - Northward-southward migration of precipitation
 - Not like Kelvin waves, but more like MRG
(Nakazawa 1986, Yang and Ingersol 2011)

14-km simulation:

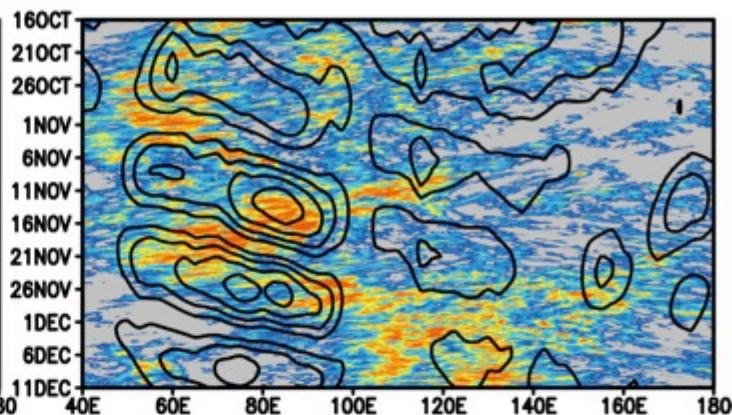
Does MJO2 develop spontaneously in NICAM?



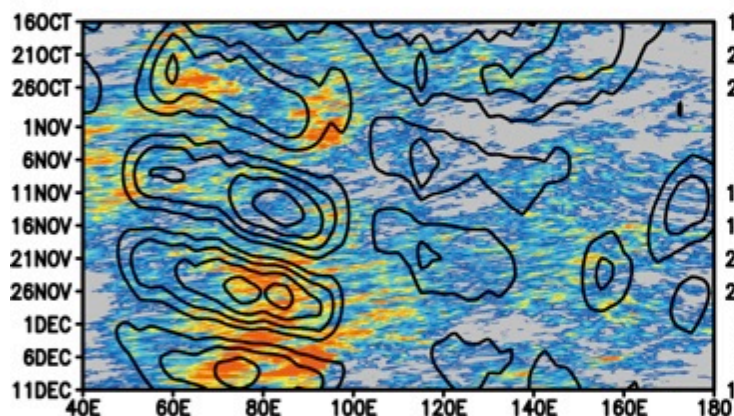
(a) 16 Oct



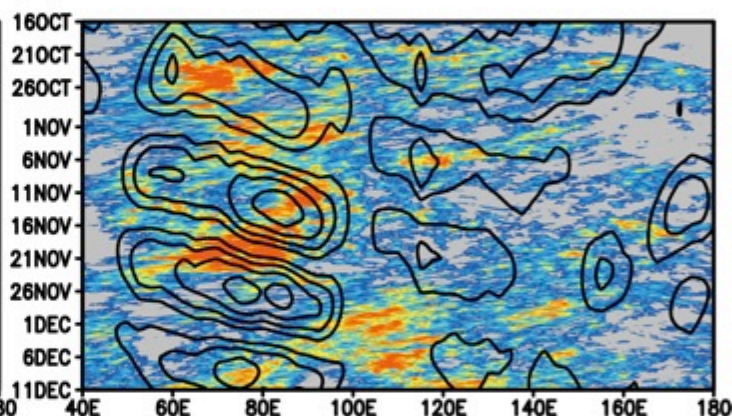
(b) 15 Oct



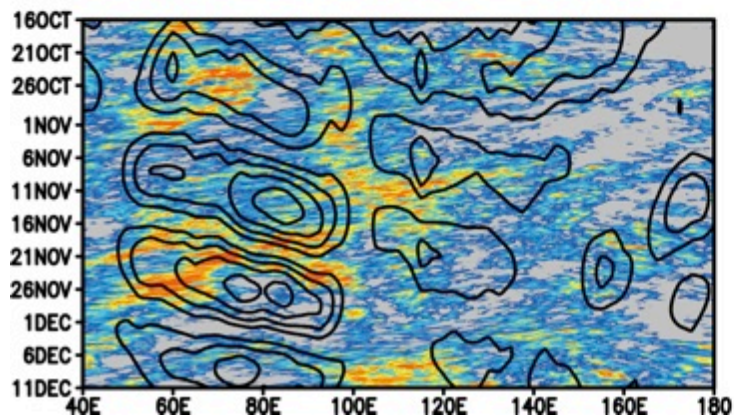
(c) 14 Oct



(d) 13 Oct

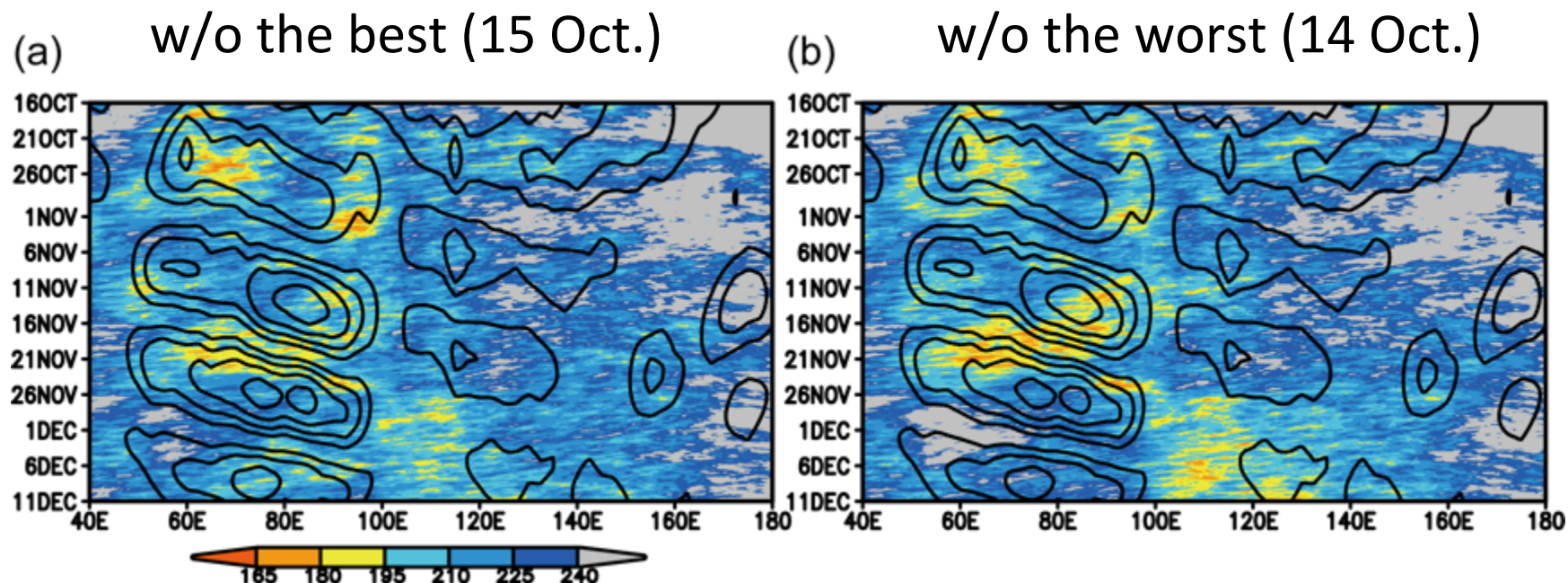


(e) 12 Oct



Insufficient MJO1 and MJO2 in each member.

But, MJO2 emerges in ensemble means.

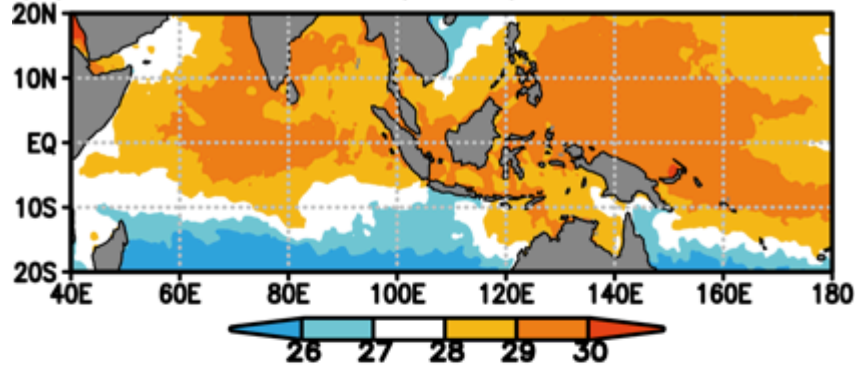


The atmospheric slow (intraseasonal) variability is constrained by external forcings?

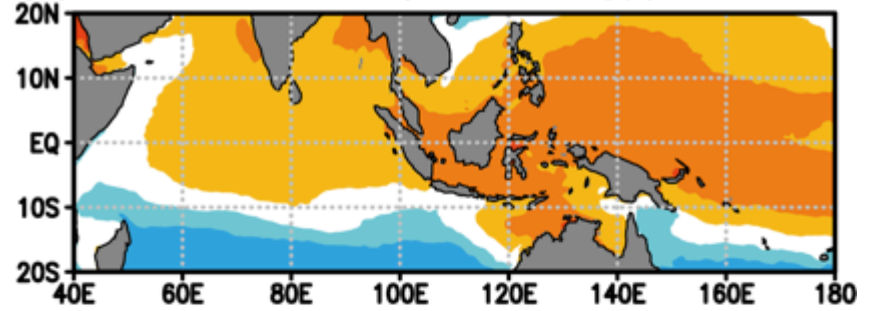
(SST may be the most plausible candidate in this case.)

NOAA OI SST

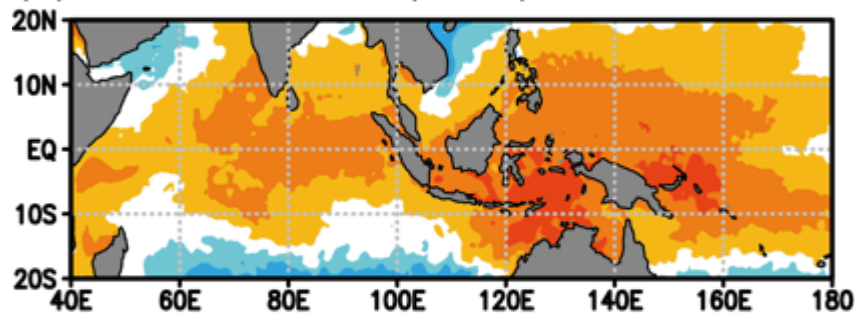
(a) Oct 16–Nov 14 (2011)



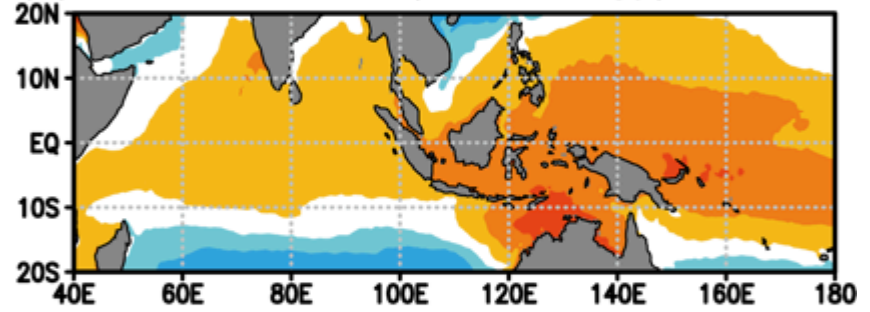
(d) Oct 16–Nov 14 (Climatology)



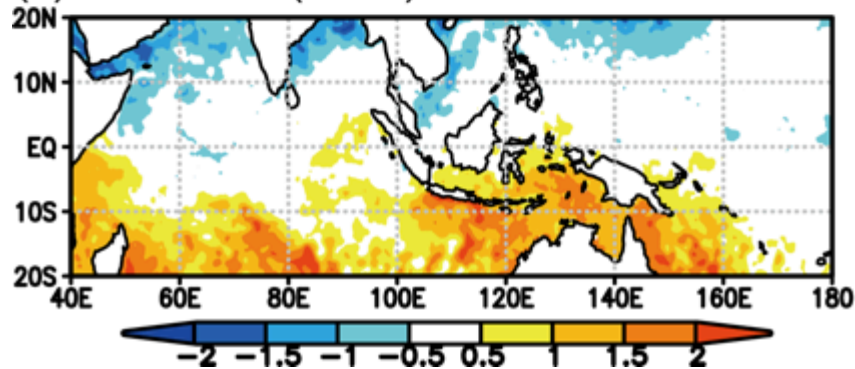
(b) Nov 15–Dec 10 (2011)



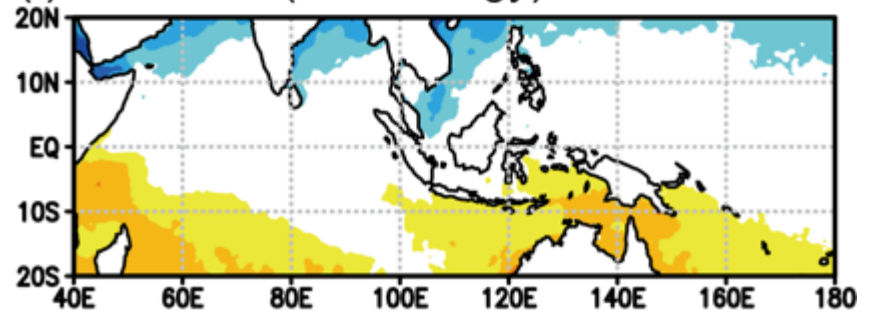
(e) Nov 15–Dec 10 (Climatology)

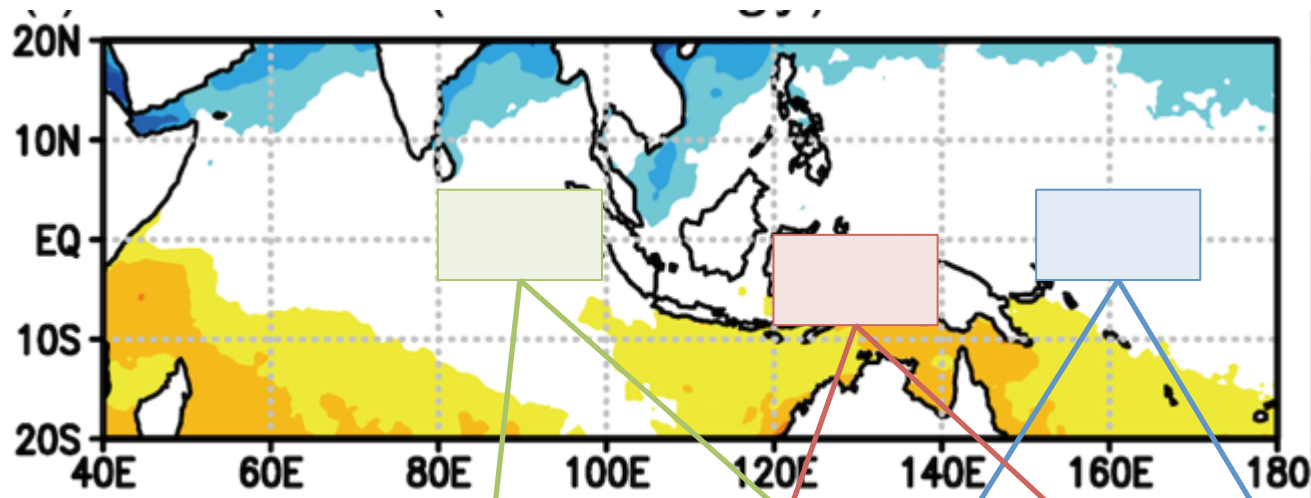


(c) difference (2011)



(f) difference (Climatology)

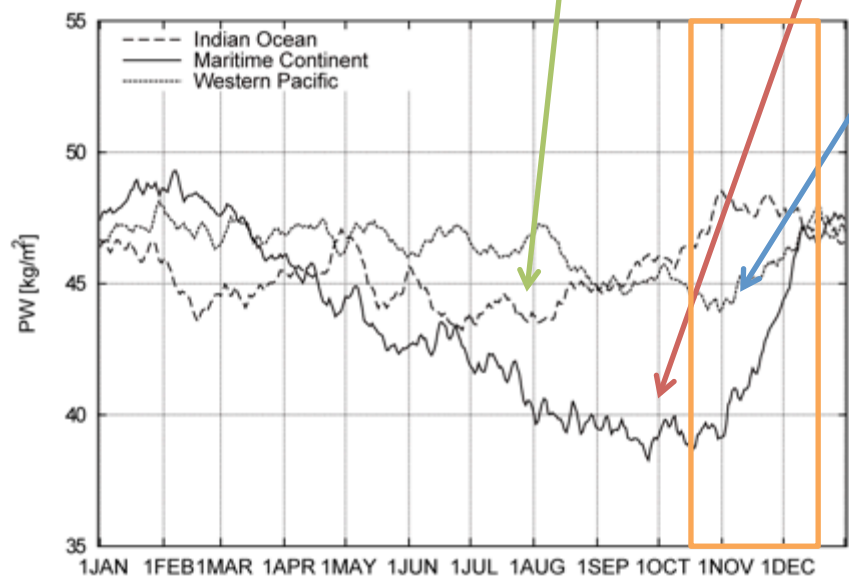




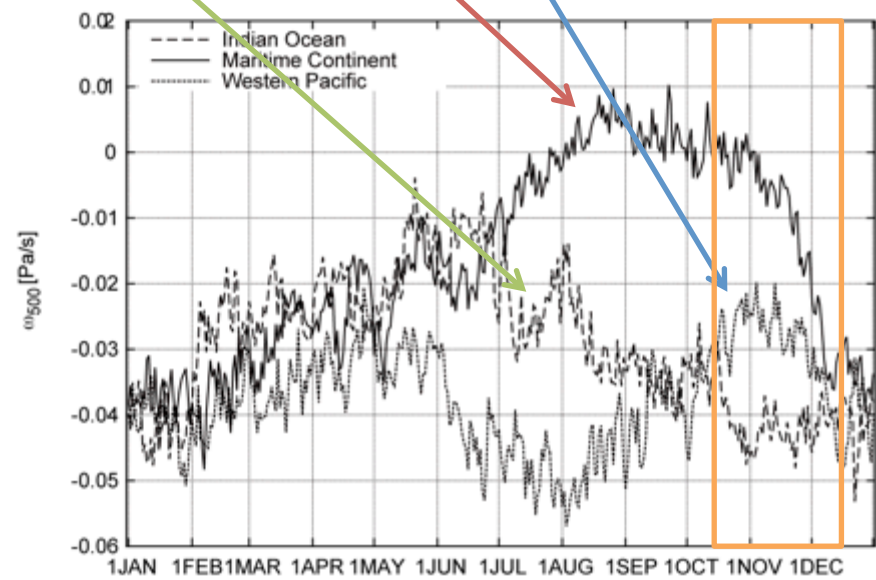
PW (climatology)

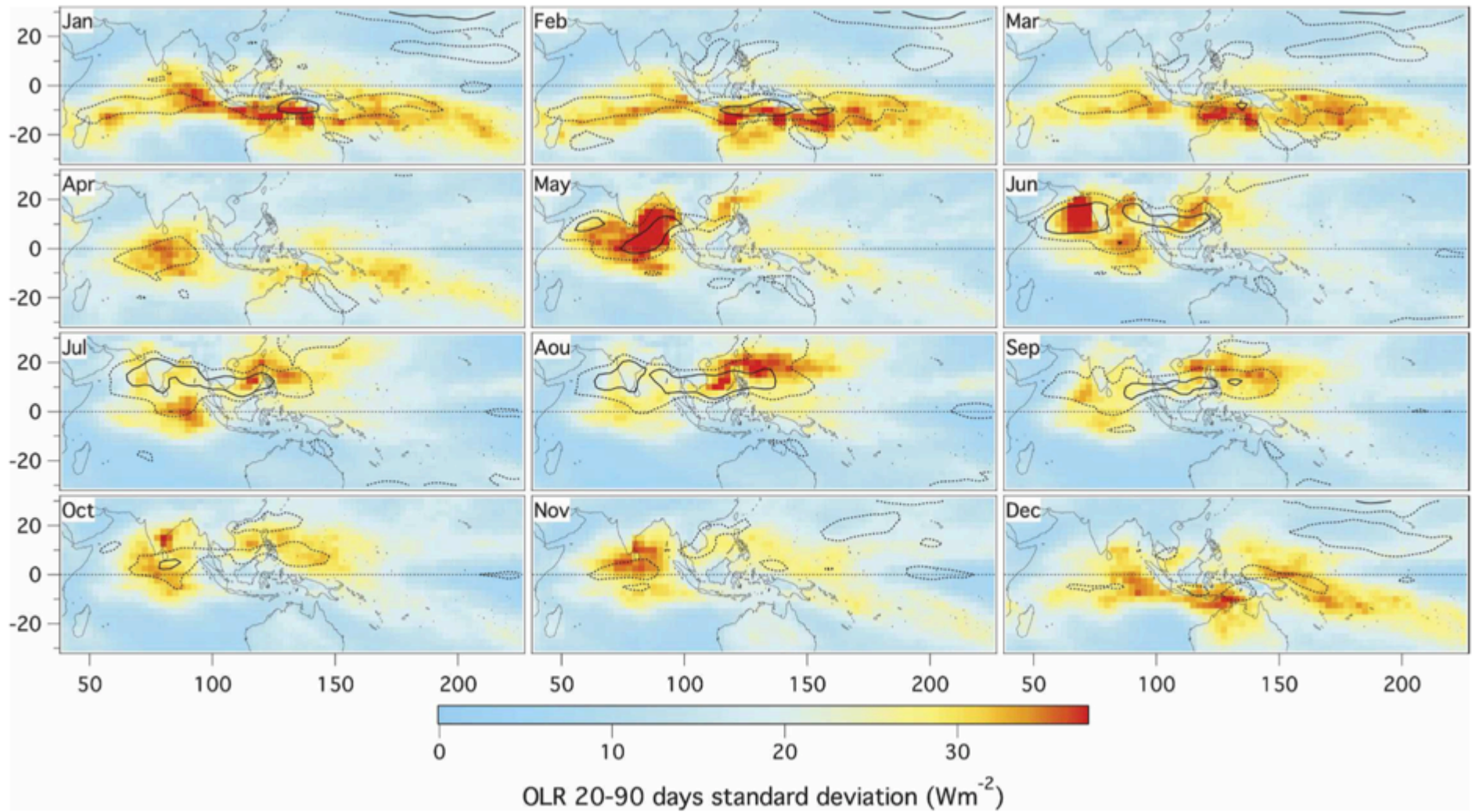
omega500 (climatology)

(a)

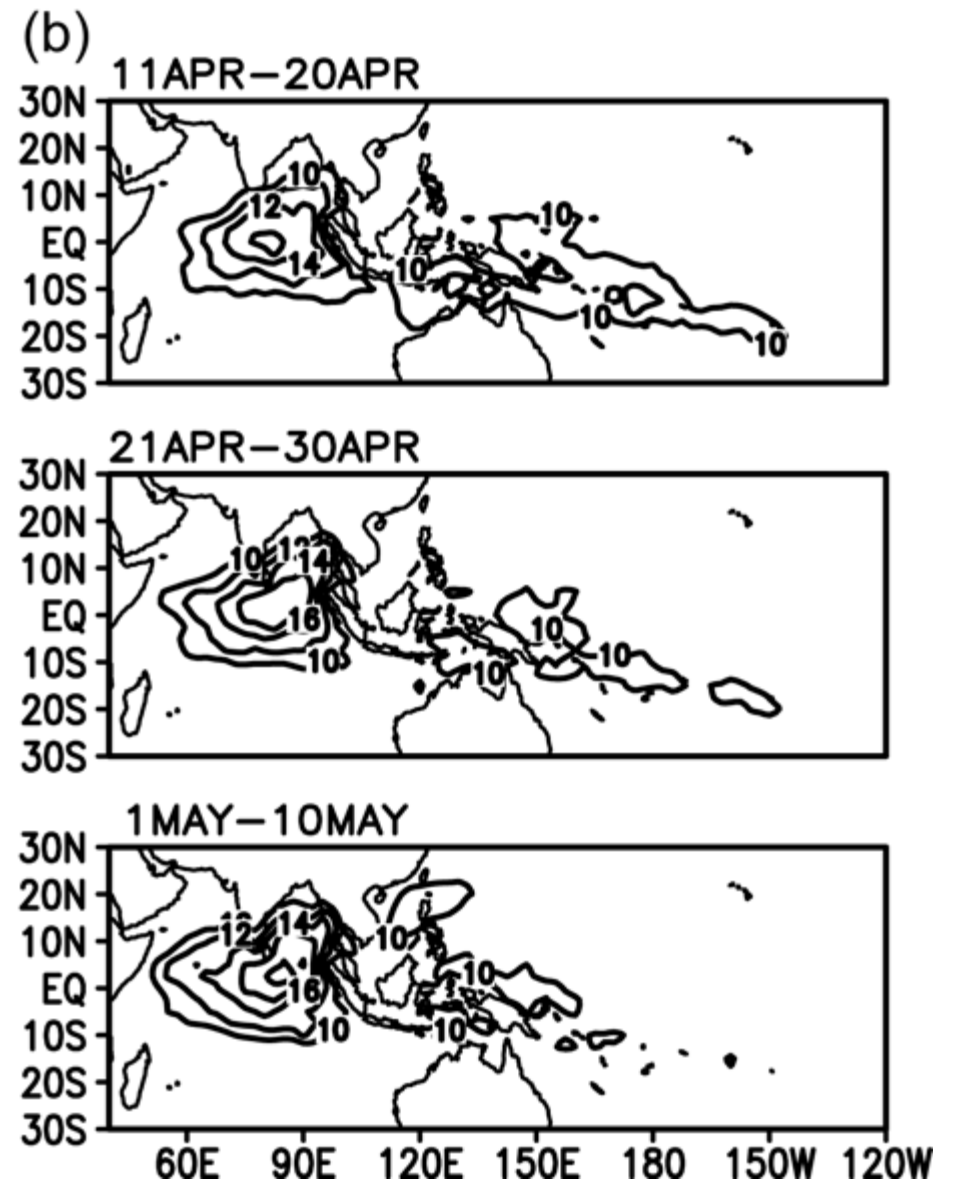
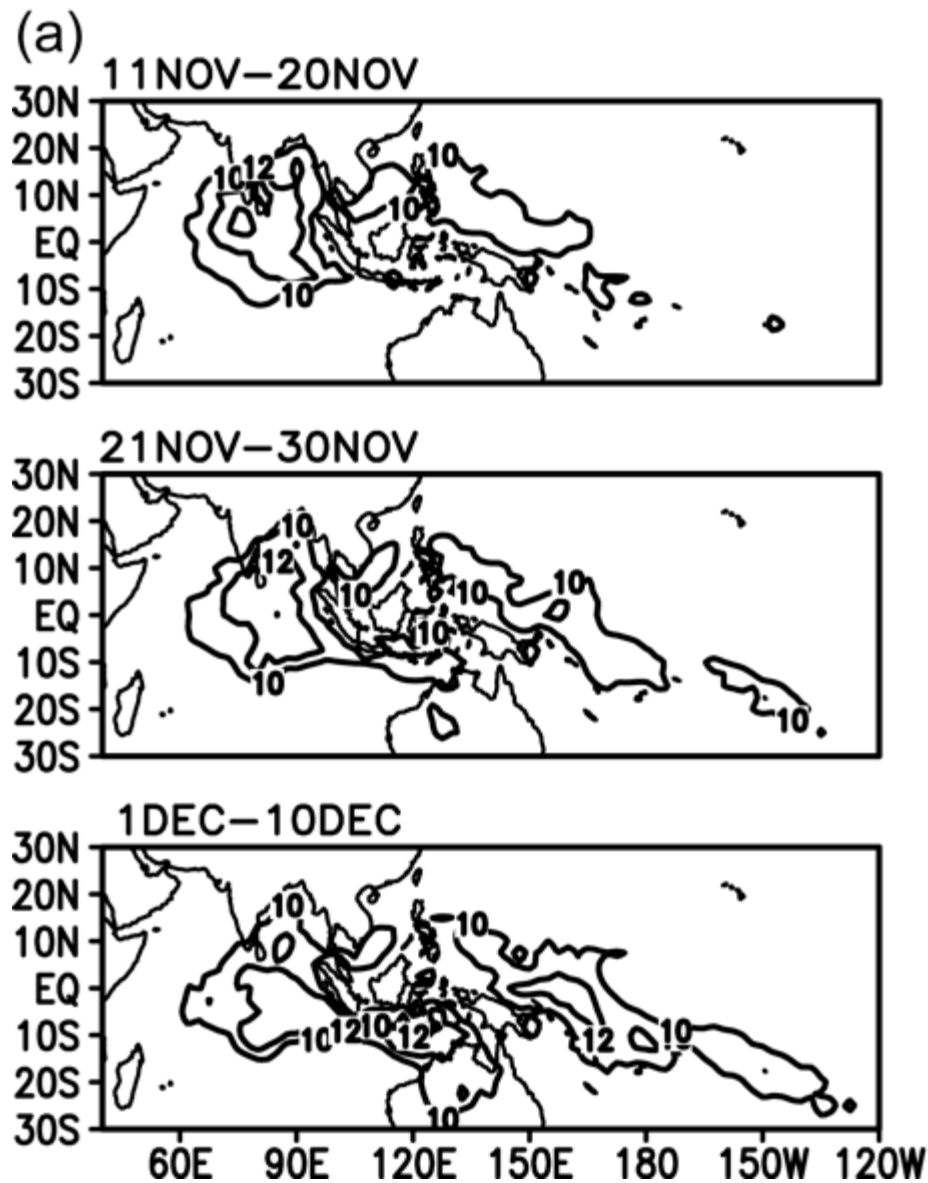


(b)





Bellenger and Duvel (2007)

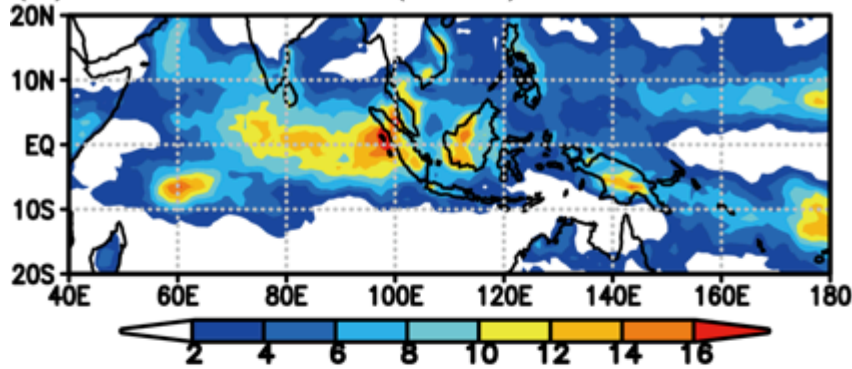


Quick transition within one month.

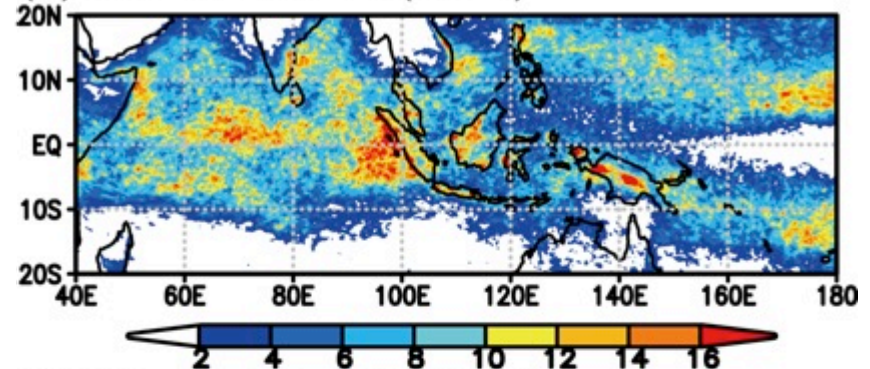
Precipitation (GPCP)

14-km mean

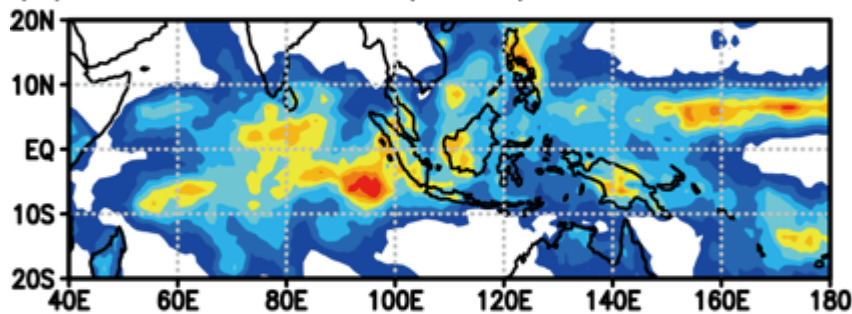
(a) Oct 16–Nov 14 (2011)



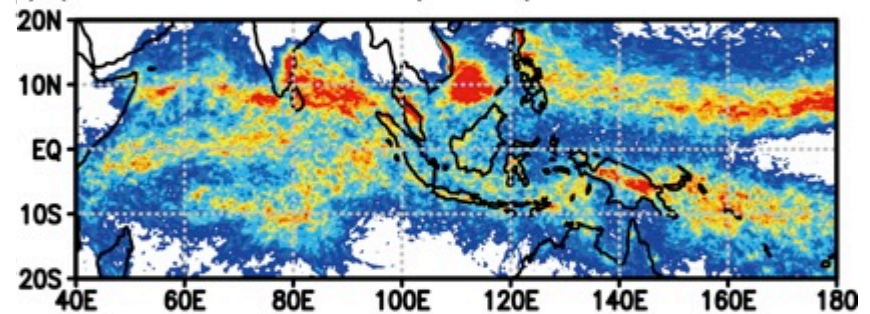
(a) Oct 16–Nov 14 (2011)



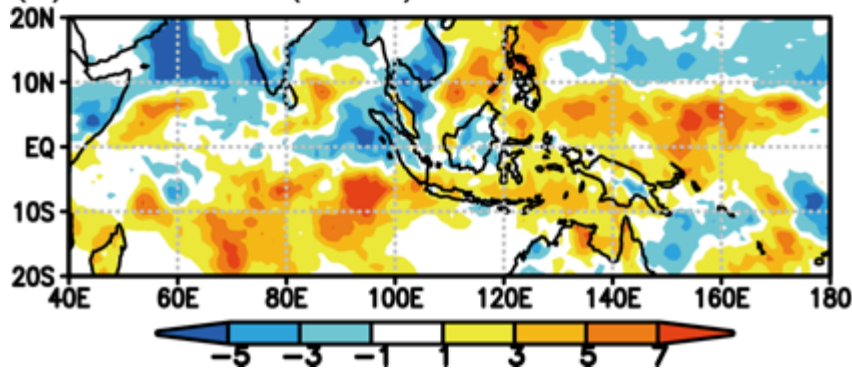
(b) Nov 15–Dec 10 (2011)



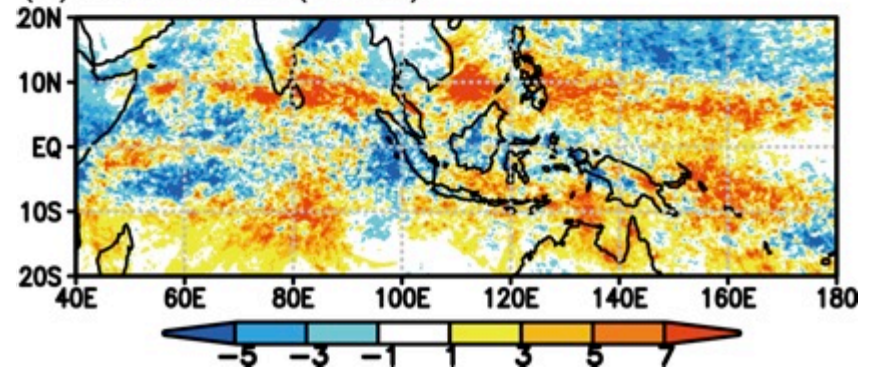
(b) Nov 15–Dec 10 (2011)



(c) difference (2011)



(c) difference (2011)



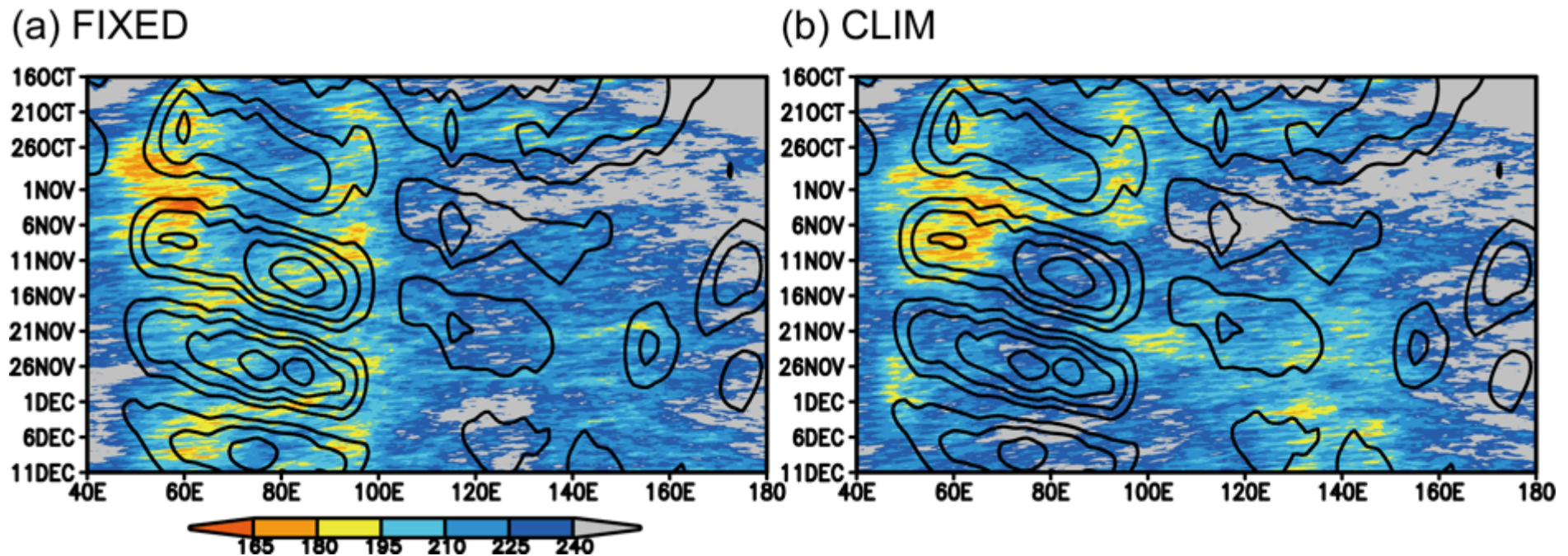
Ensemble mean captures the eastward shift of the precipitation region.

Sensitivity runs

FIXED: SST is fixed at 12 October 2011.

CLIM: Climatological change of SST is given

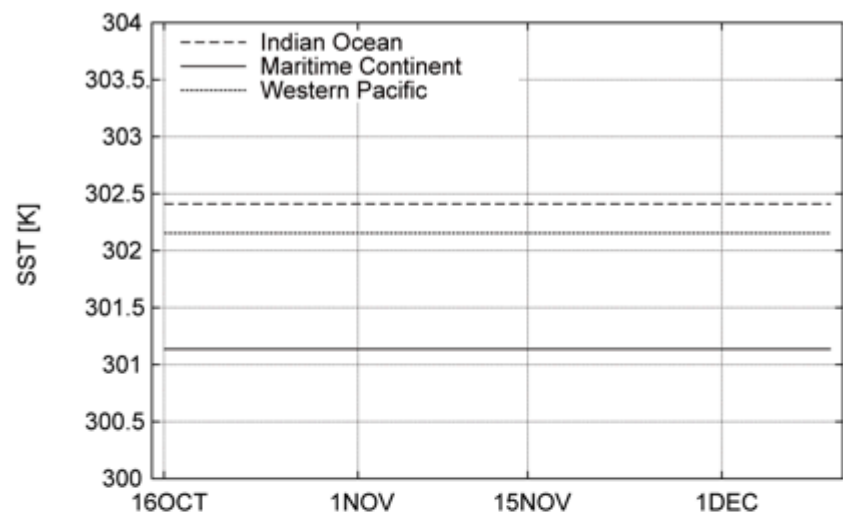
with the anomalies of 12 October 2011.



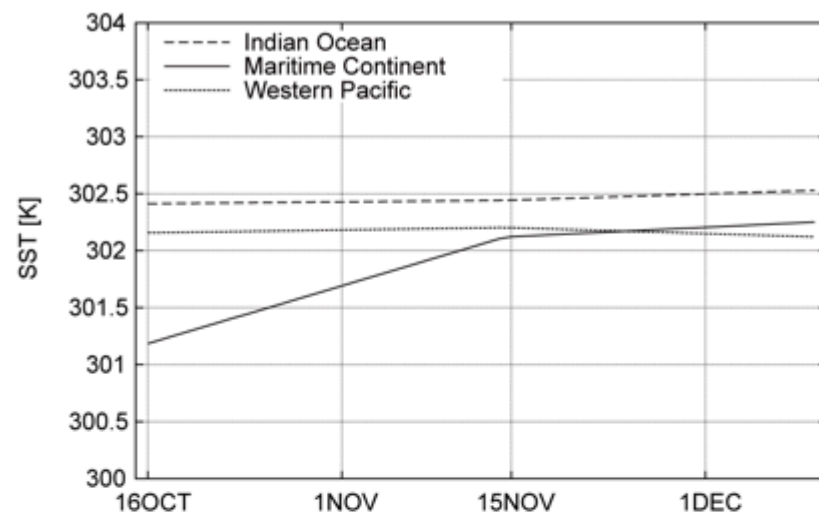
Climatological seasonal change can force the eastward shift of low OLR region in mid to late November.

But, no MJO2 in the central Indian Ocean in CLIM.

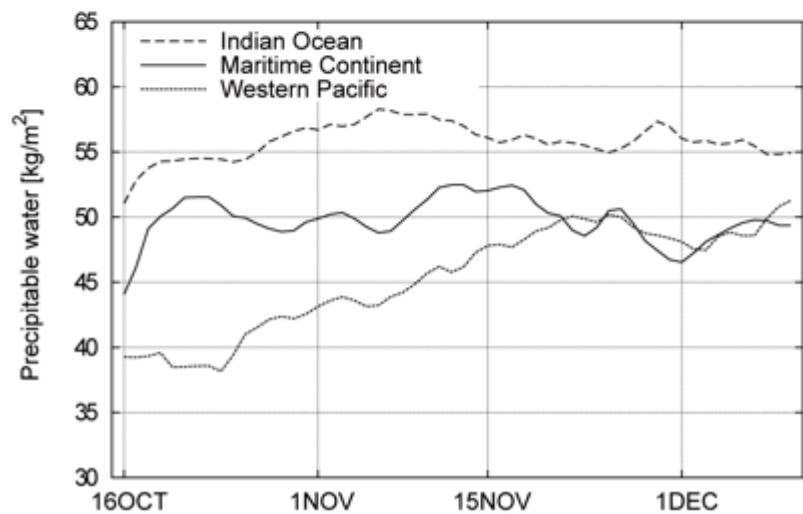
(a) FIXED



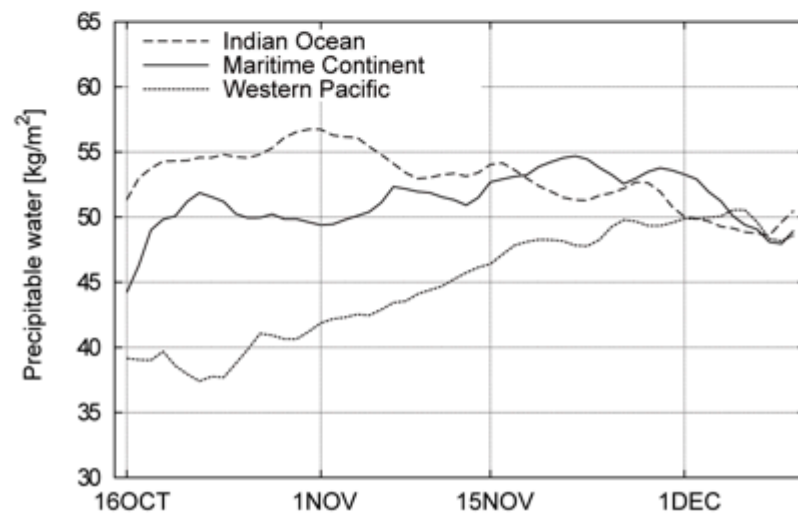
(b) CLIM



(c)



(d)



Summary

- 7-km simulation
 - Some deficiencies
 - Earlier initiation
 - Opposite meridional circulation
 - Realistic northward-southward migration
- 14-km simulation (Miura, Suematsu, and Nasuno, 2015 JMSJ)
 - Earlier initiation as same as 7-km simulation
 - MJO2 appears to be partly forced by the SST seasonal change.
(NICAM was helped by the given SST change.)
 - The seasonal change is fast enough to be comparable with the intraseasonal variability in late November.
 - Is MJO2 a forced response to the seasonal change?
(Not a pure internal mode of the coupled AO system?)