

Metrics for Boreal Summer and Asian Monsoon In traseasonal Oscillation (MISO)

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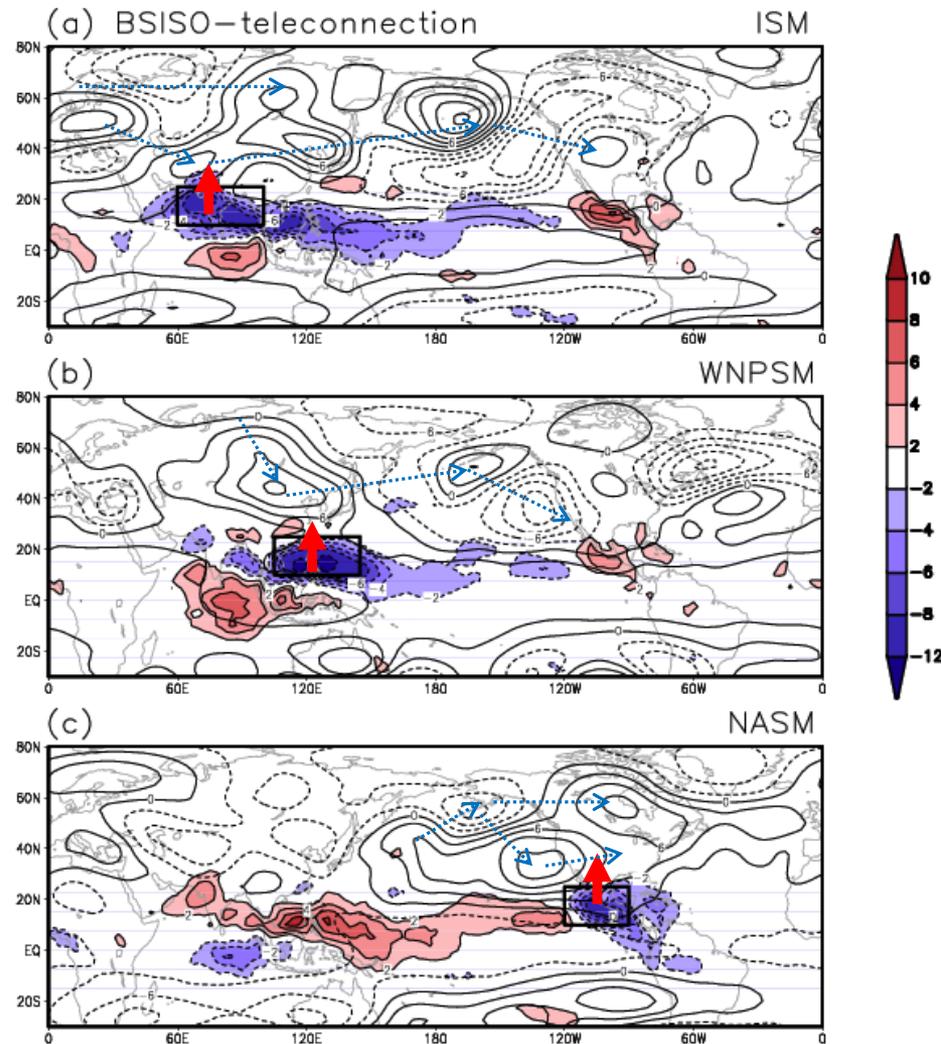
Boreal Summer Monsoon ISO Teleconnection

Boreal Summer Teleconnection

- ✓ **Silk road pattern** (Enomoto et al. 2003)
- ✓ **Western North Pacific-North America pattern** (Wang et al. 2001)
- ✓ **Tokyo-Chicago express** (Lau et al. 2004)
- ✓ **Circum global teleconnection (CGT)** (Ding and Wang 2005)

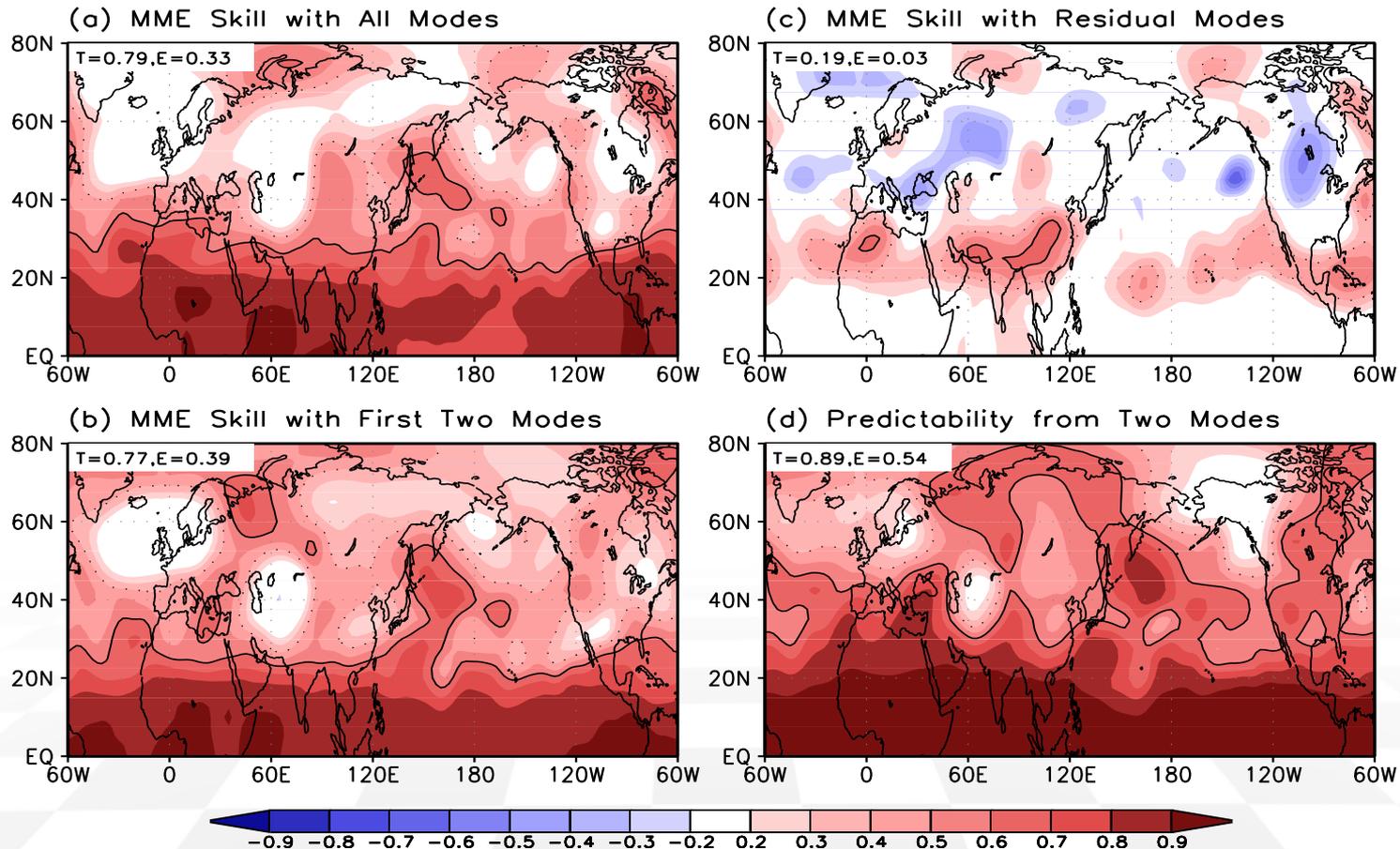
Regressed GPH200 (Contour) and OLR (shading) according to ISM, WNPSM, and NASM index

Blue and red arrows indicate the propagation of the wave activity flux.



Predictability Source of Boreal Summer Extratropical Atmospheric Variability

JJA 200-hPa Geopotential Height

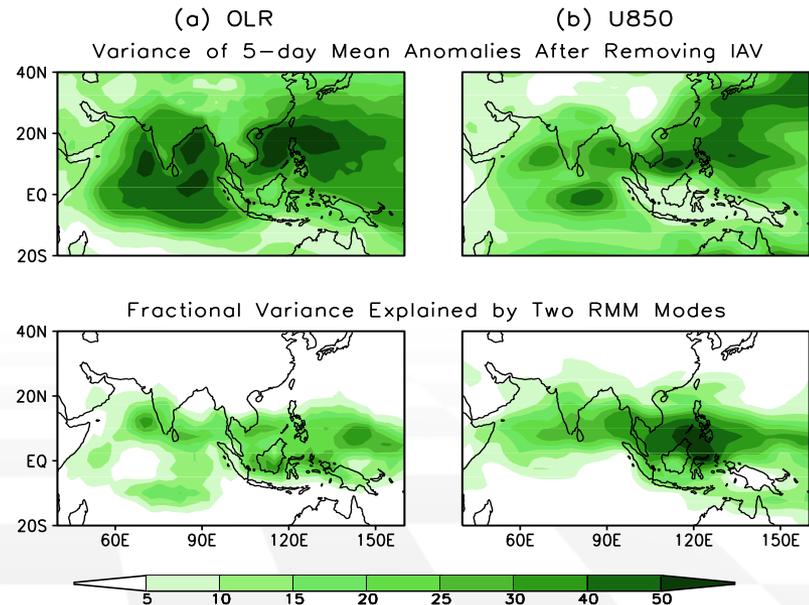
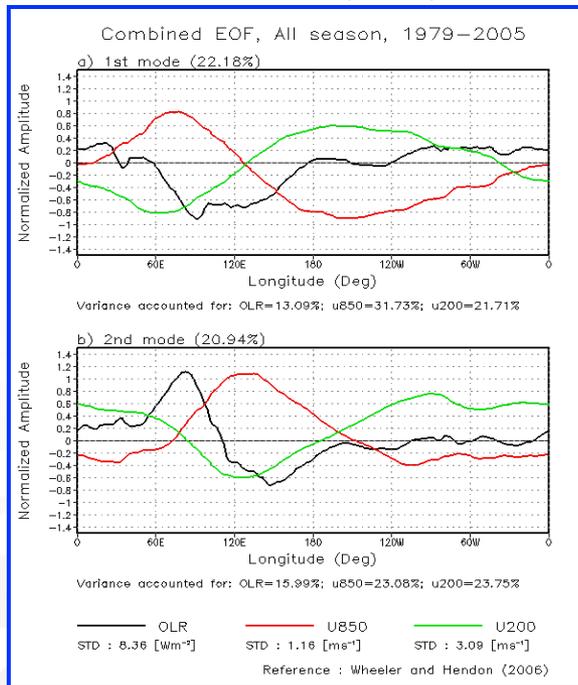


Motivation:

Limitation of the RMM index for representing BS MISO

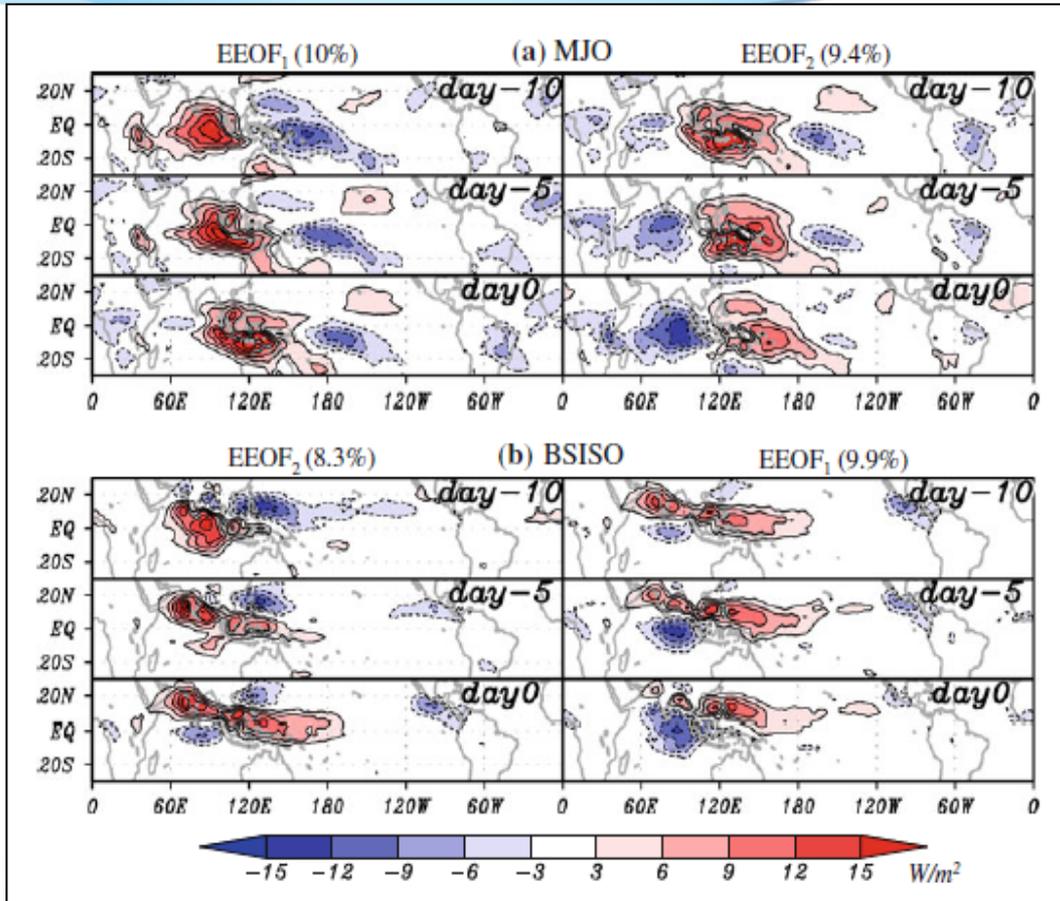
As a measure of the strength of the MJO, **Wheeler and Hendon (2004) Realtime Multivariate MJO (RMM) index** used the **first two leading multivariate EOF modes of the equatorial mean (between 15S and 15N) OLR, and zonal winds at 850 and 200 hPa**. This index captures equatorial eastward propagating mode, the MJO, very well and has been applied all year around to depict MJO activity. However, **it is not clear whether RMM remains a best measure of the boreal summer monsoon intraseasonal oscillation (MISO)** that is **one of the most prominent short-term climate variability in the global climate system and more complex in nature than the MJO**

Wheeler and Hendon (2004)



RMM index has limitation to explain ISO variability over off-equatorial monsoon domain in boreal summer.

Bimodal Representation of the Tropical ISO

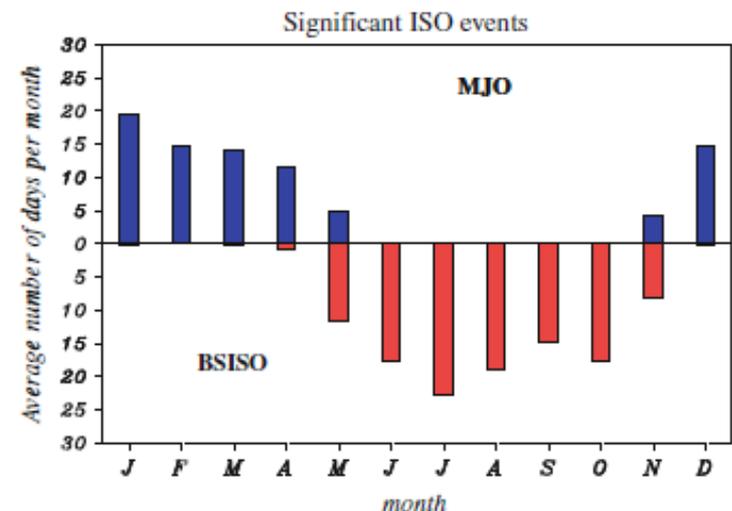


Rainfall anomalies propagate in a eastward fashion and mainly affect the Tropical eastern hemisphere

Rainfall anomalies propagate in a northeast fashion and mainly affect the Tropical eastern hemisphere

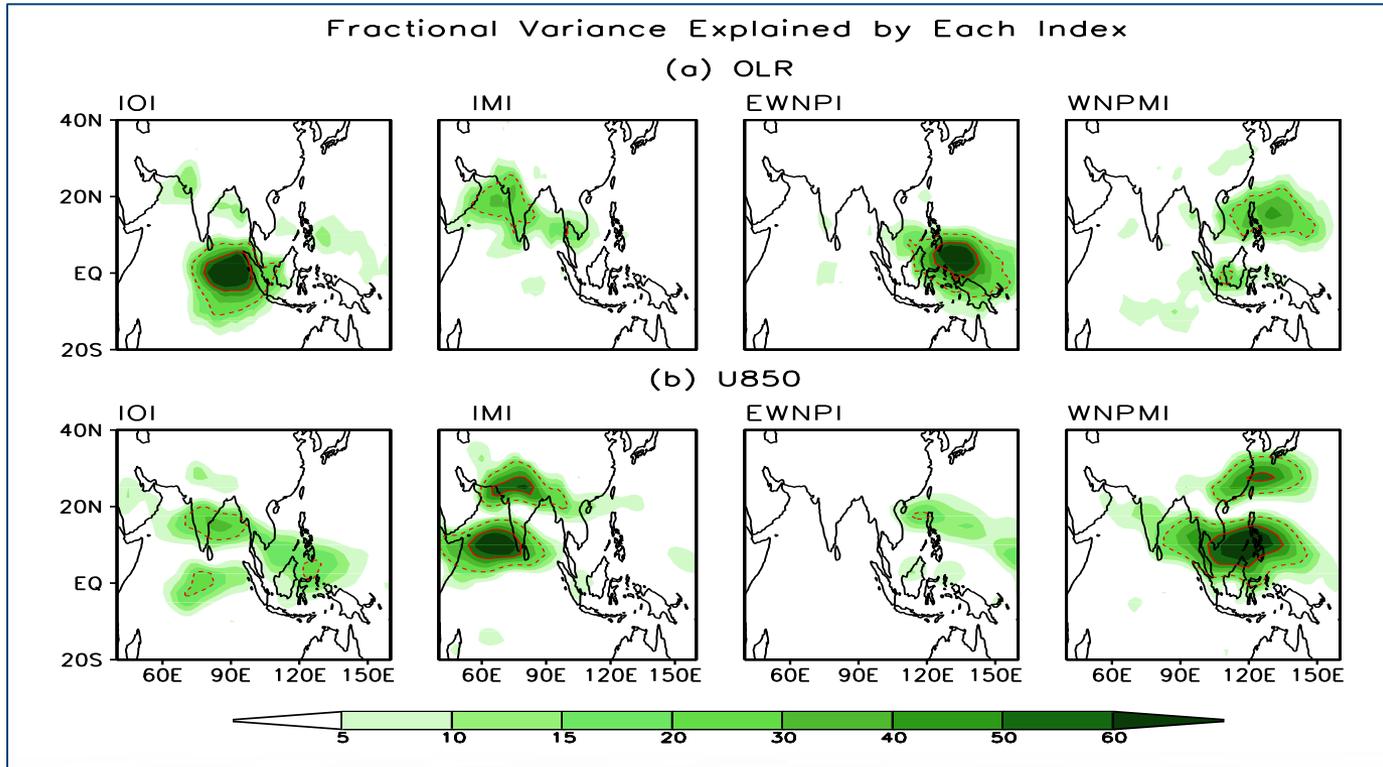
Spatial-temporal pattern of OLR anomaly associated with the intraseasonal oscillation during (a) boreal winter (DJF, referred to as MJO mode) and (b) boreal summer (JJA, referred to as BSISO mode) by means of the extended EOF (EEOF) analysis.

Kikuchi et al. (2011, Clim Dyn)



Motivation:

Limitation of the regional indices for representing BS MISO



Regional Monsoon ISO Indices

- IOI (Indian Ocean Index): OLR(80-100E, 5S-5N)
- IMI (Indian Monsoon Index, Wang et al. 2001): U850 (40-80E, 5-15N) - U850 (60-90E, 20-30N)
- EWNPI (Equatorial WNP Index): OLR(125-140E, Eq-7.5N)
- WNPMI (Western North Pacific Monsoon Index, Wang and Fan 1999): U850 (90-130E, 5-15N) - U850 (110-140E, 22.5-32.5N)

Can one design a better index to describe boreal summer MISO?

Process to define the MISO index

Data Process

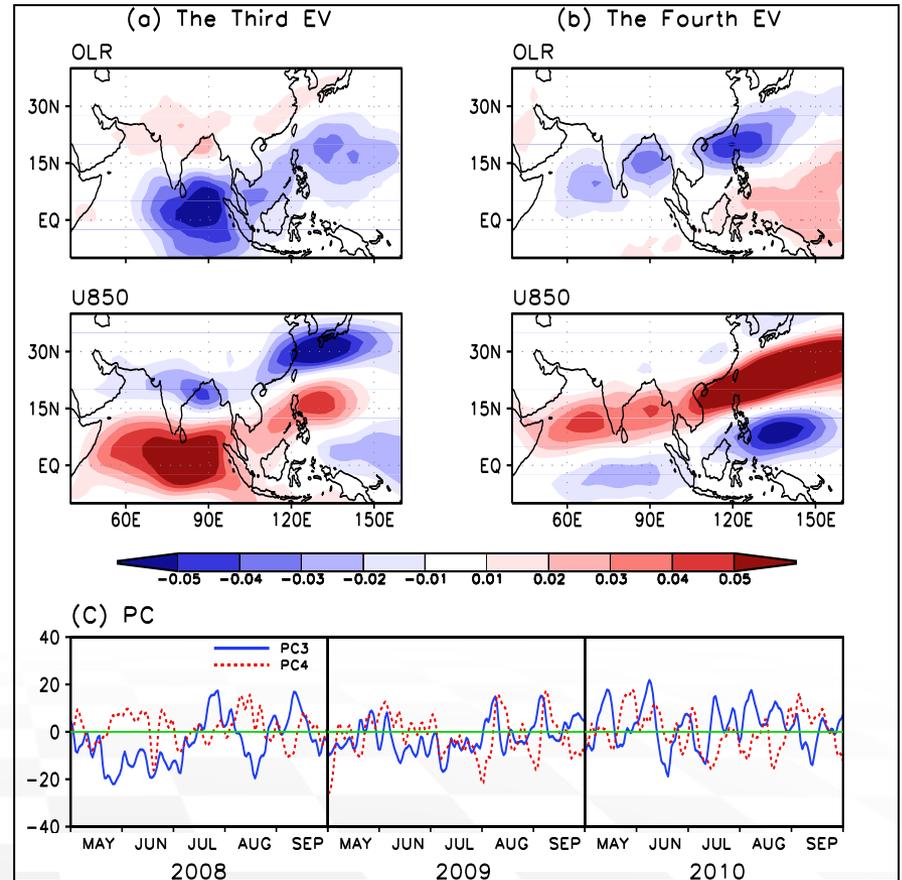
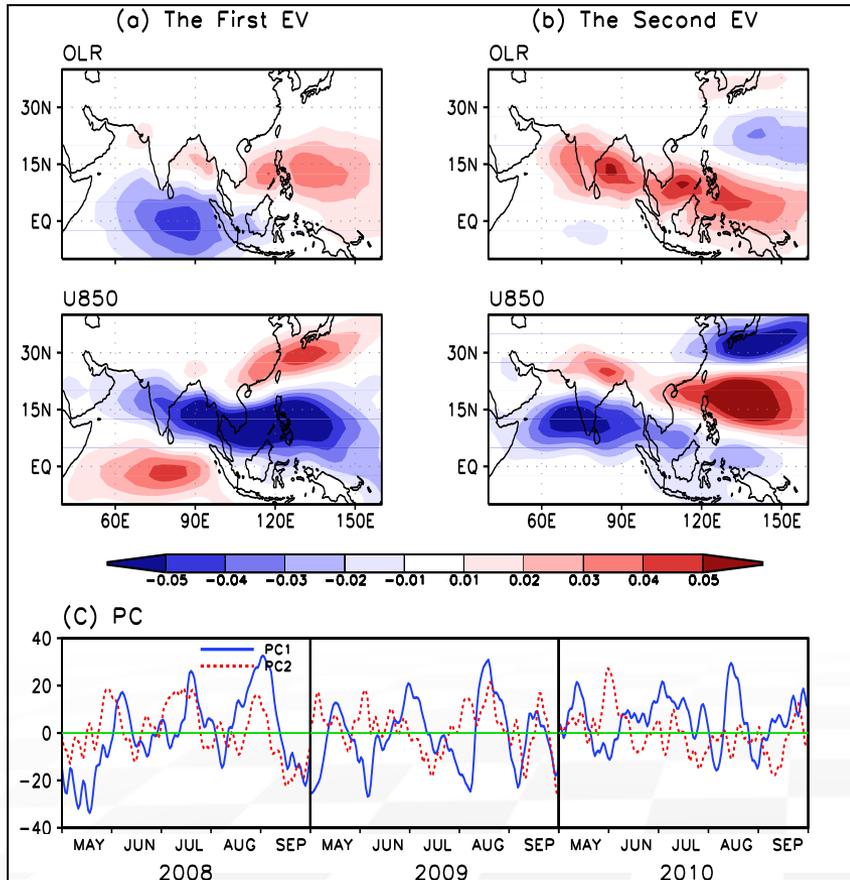
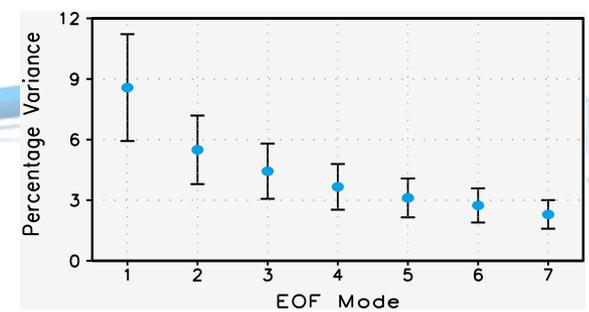
- **Variables** : daily OLR and U850
- **Data Period**: MJJAS 1981-2010
- Removal of the first 3 harmonics in climatological annual cycle
- Removal of the effect of ENSO signal through subtracting last 120 day mean
- Normalization of each of two fields by area averaged temporal standard deviation (The ASM standard deviation is 27.58 W m^{-2} for OLR and 3.62 m s^{-1} for U850)
- **MISO index**: The first four leading multivariate EOF modes of daily OLR and U850 over the ASM region (10°S - 40°N , 40° - 150°E)

✓ Filtering is not applied to define MISO index for monitor and forecast purpose

Criterion for Determining the MISO Index

1. Fractional variance explained by the reconstructed field from the MISO index
2. Ability to capture the northward propagating MISO

MV EOF Modes for BS MISO



Major Northward Propagating MISO mode

Grand Onset mode (LinHo and Wang 2002)

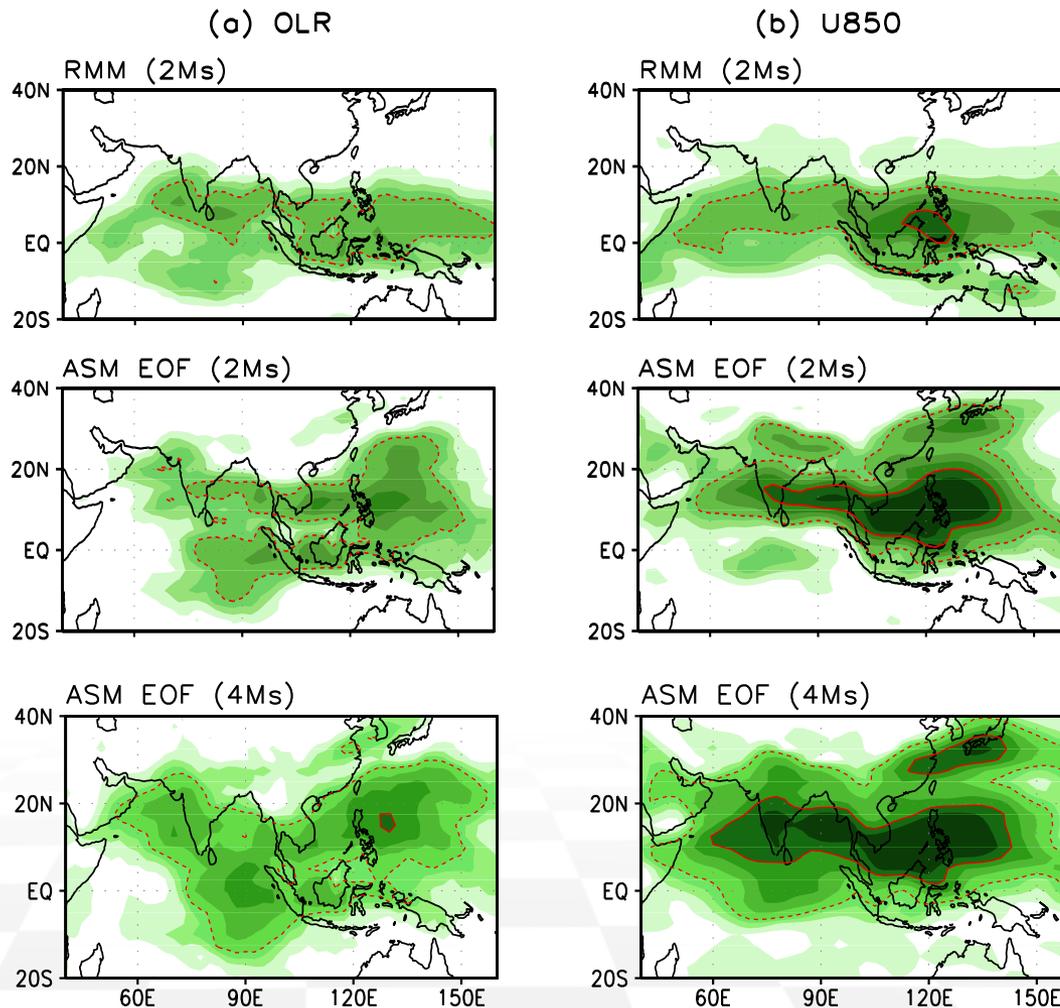
Fractional Variance

: Comparison between RMM and MISO

**RMM Index
(2 Modes)**

**MISO Index
(2 Modes)**

**MISO Index
(4 Modes)**

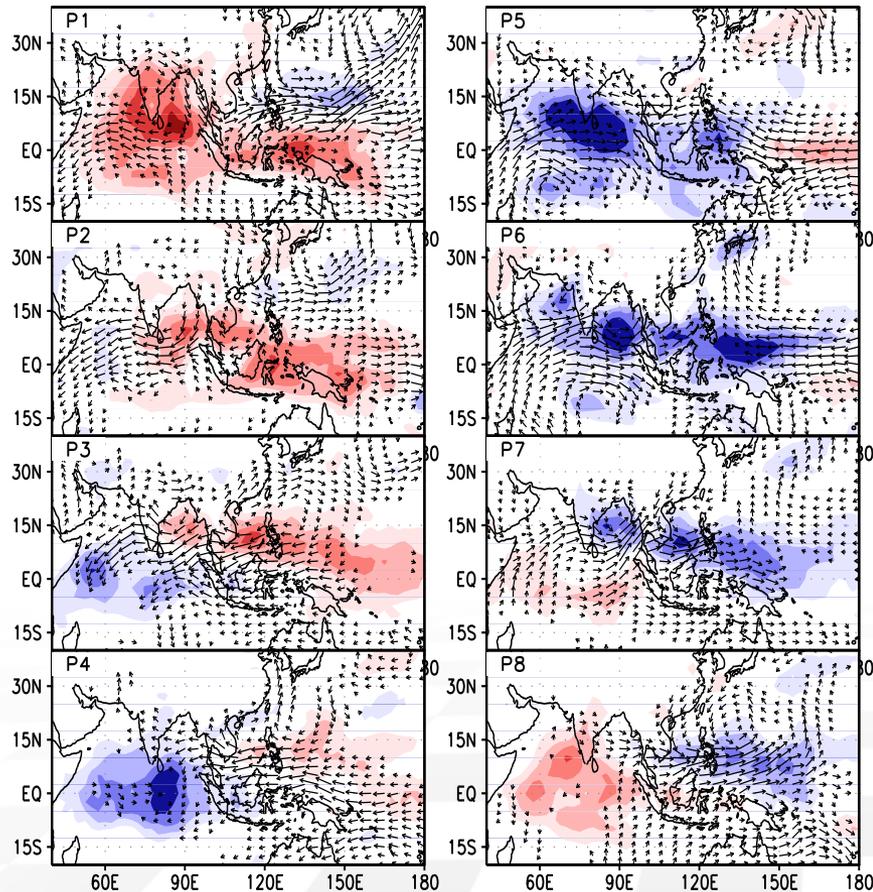


Life Cycle Composite

: Comparison between RMM and MISO

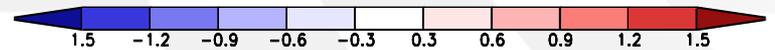
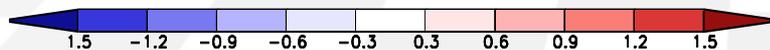
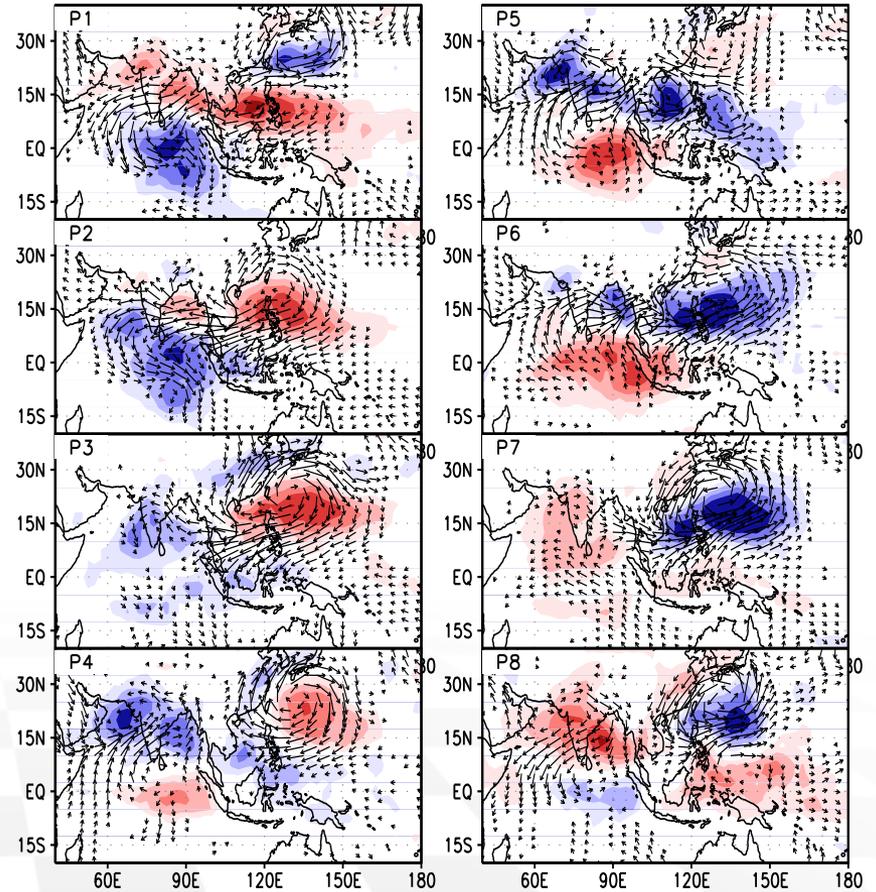
RMM Index

RMM Mode 1 & 2

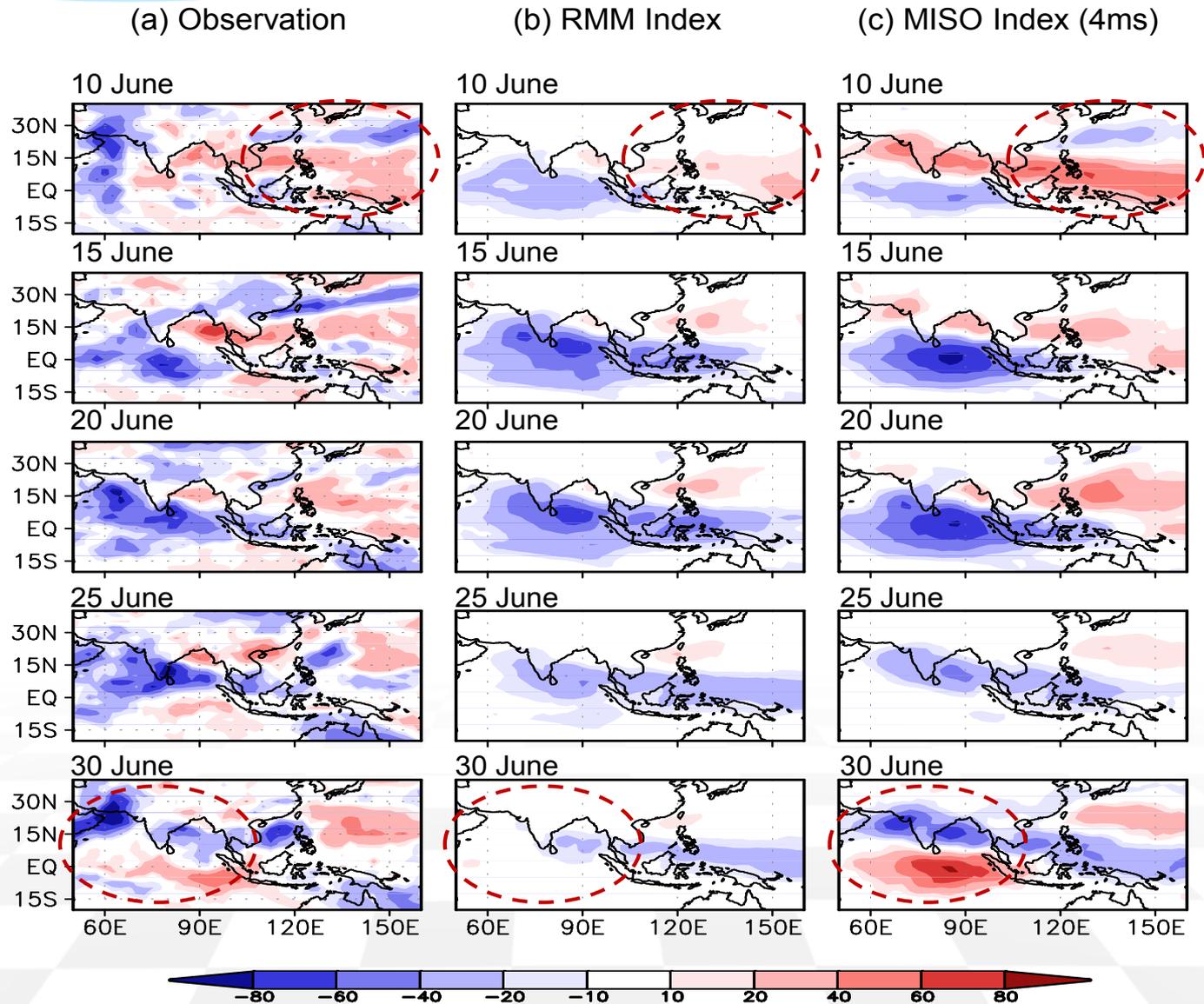


MISO Index

ASM EOF Mode 1 & 2

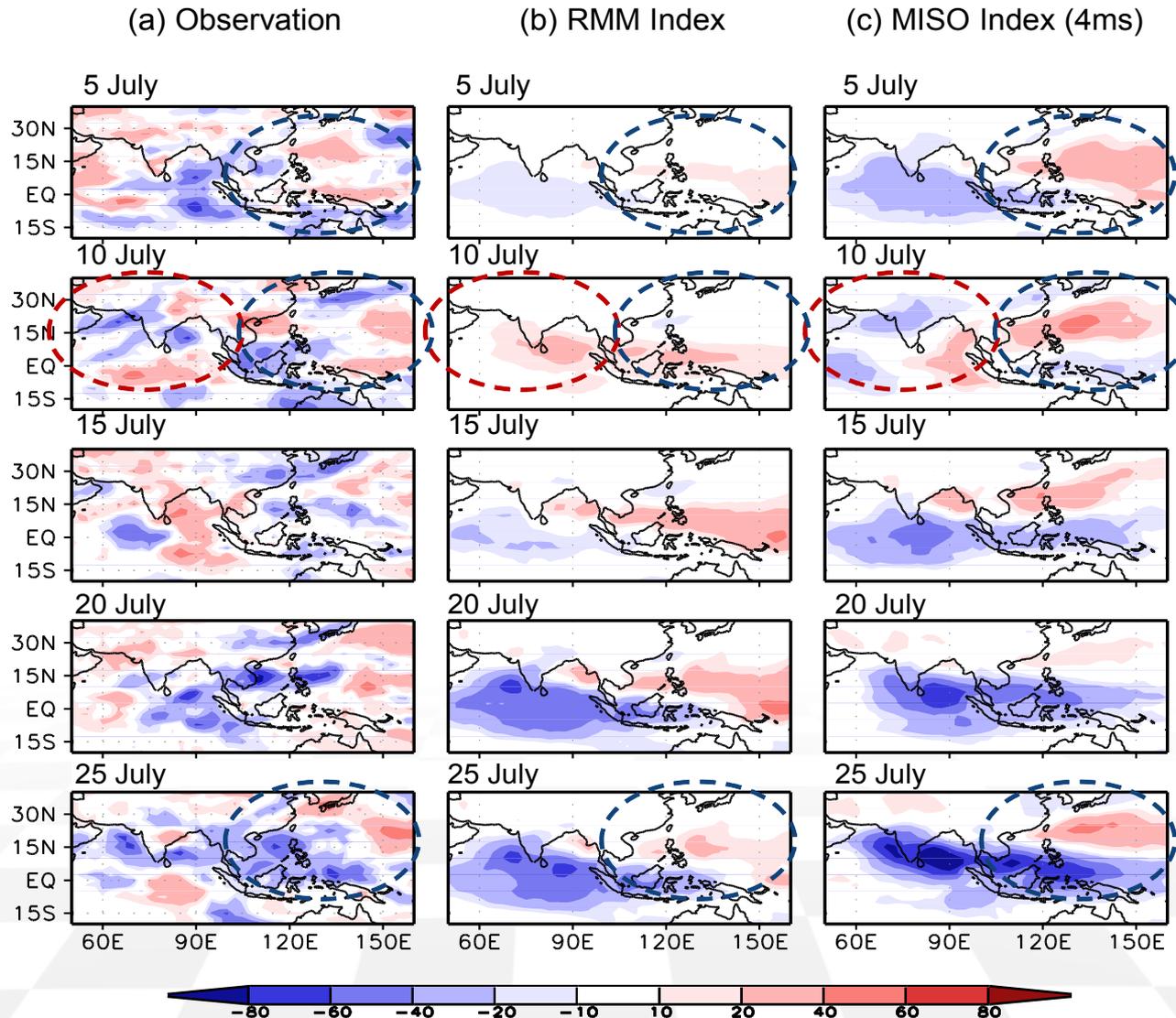


Reconstructed Pentad OLR Anomaly in 2007 : Comparison between RMM and MISO



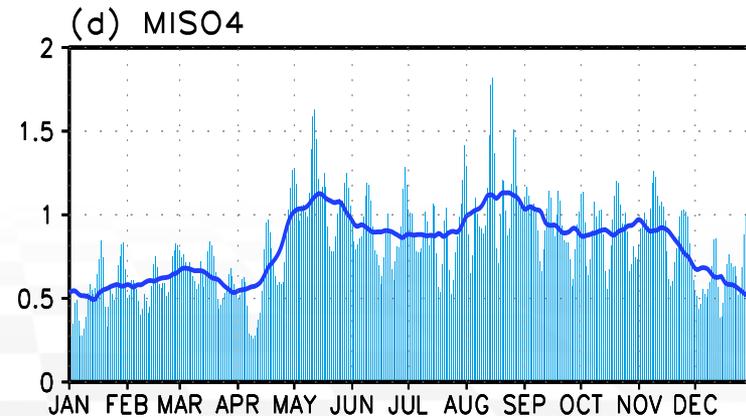
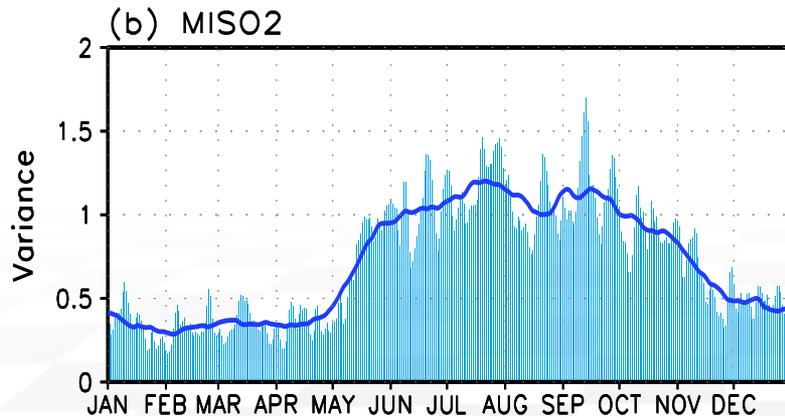
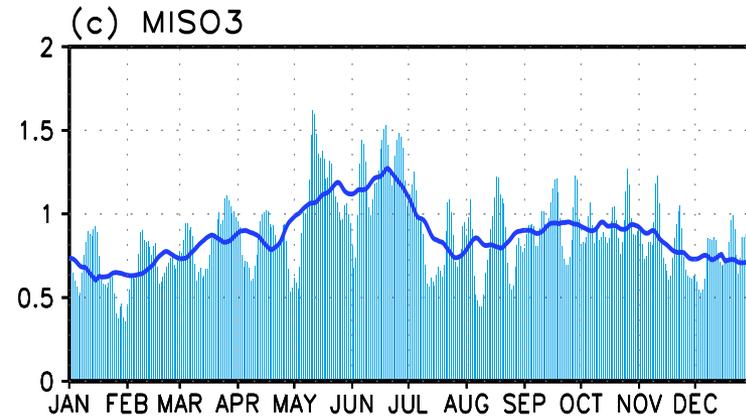
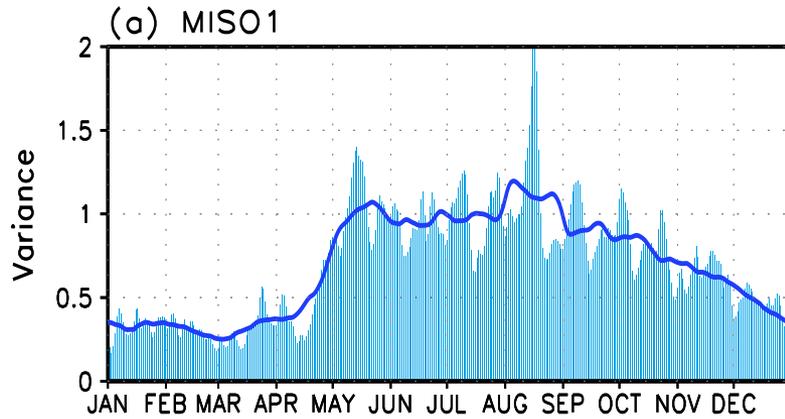
Reconstructed Pentad OLR Anomaly in 2010

: Comparison between RMM and MISO

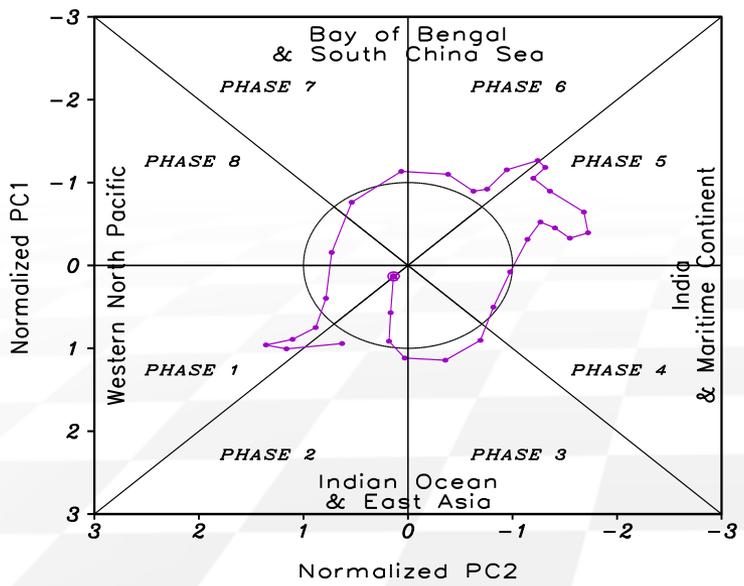
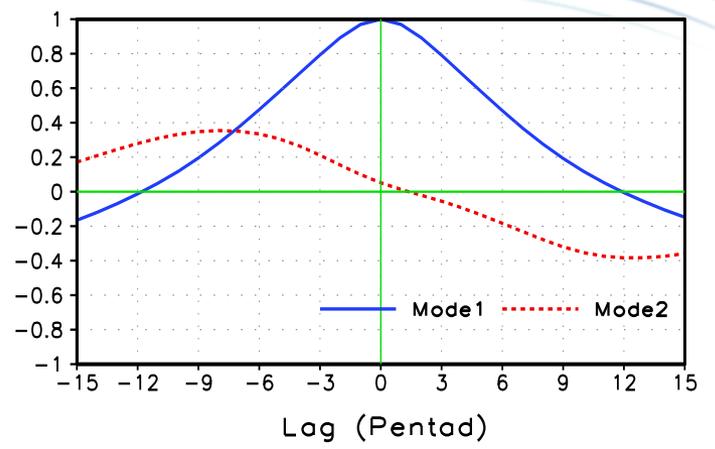
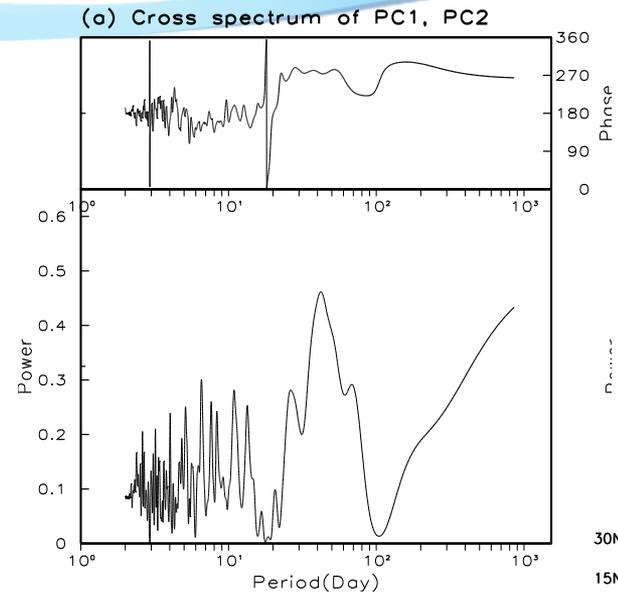
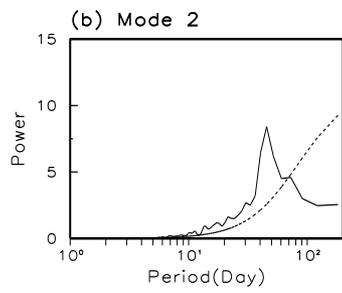
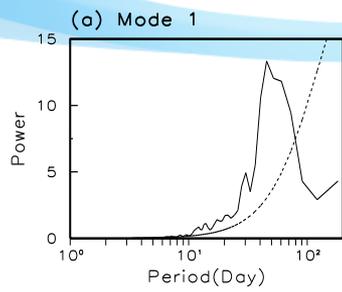


Characteristics of the MISO Index

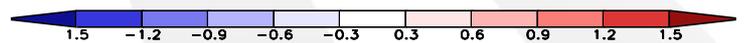
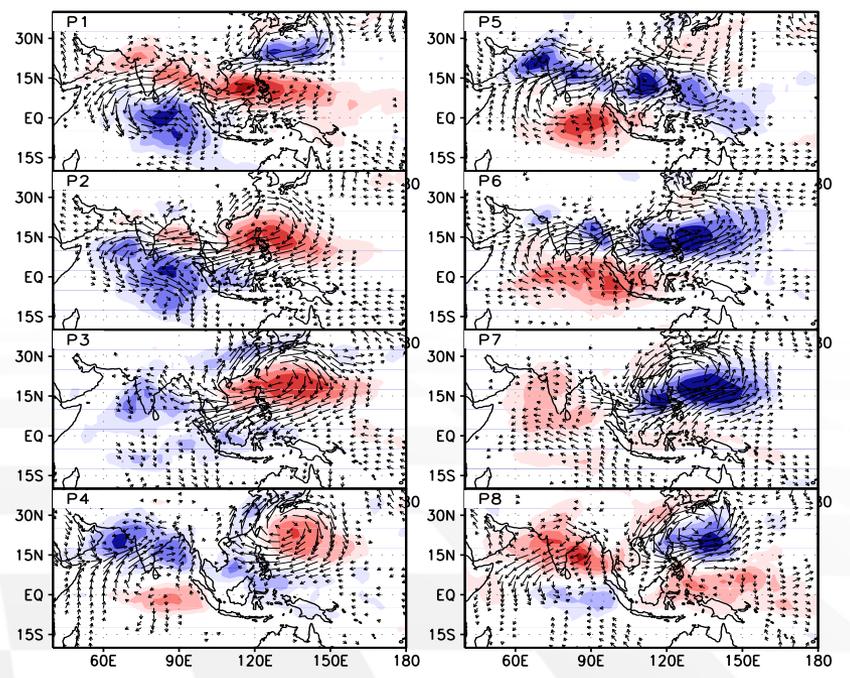
Seasonal Cycle of Variance of MISO Index (1981–2010)



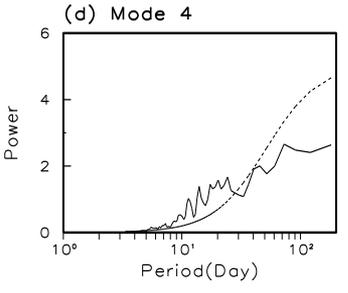
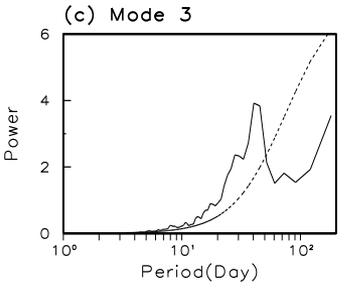
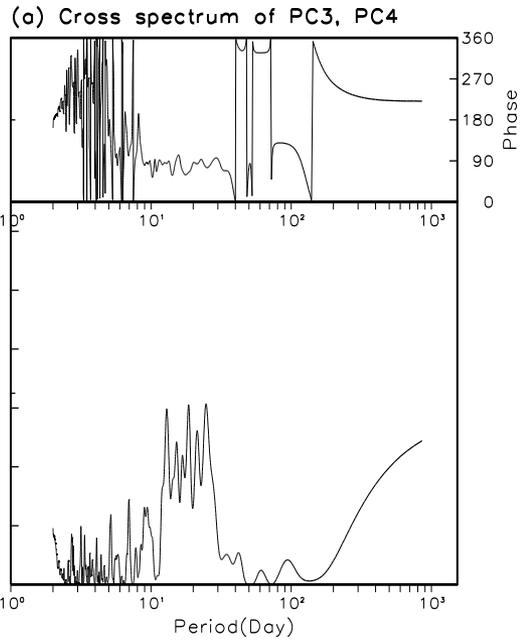
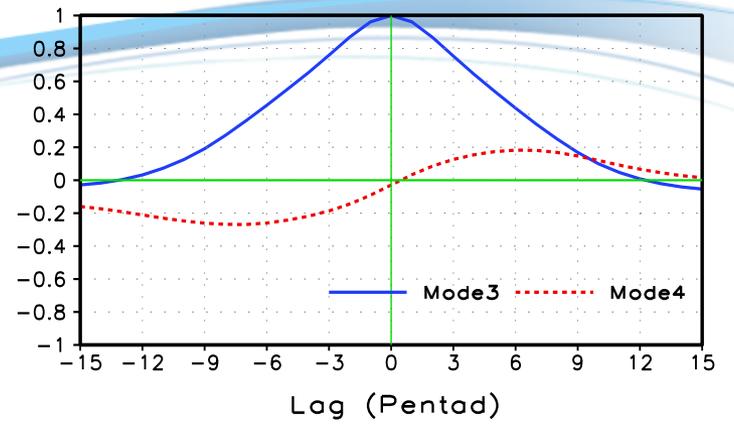
MISO EOF 1 & 2



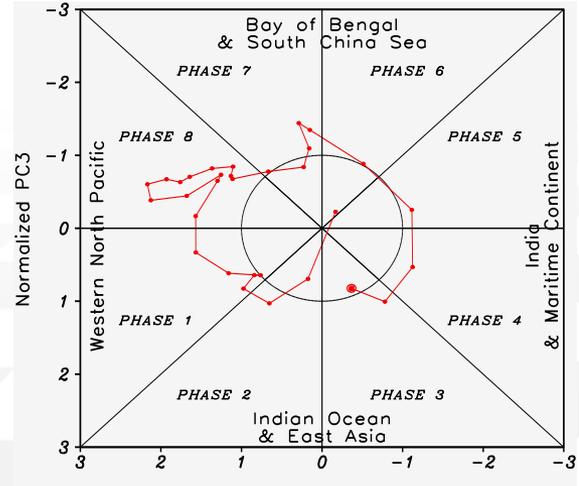
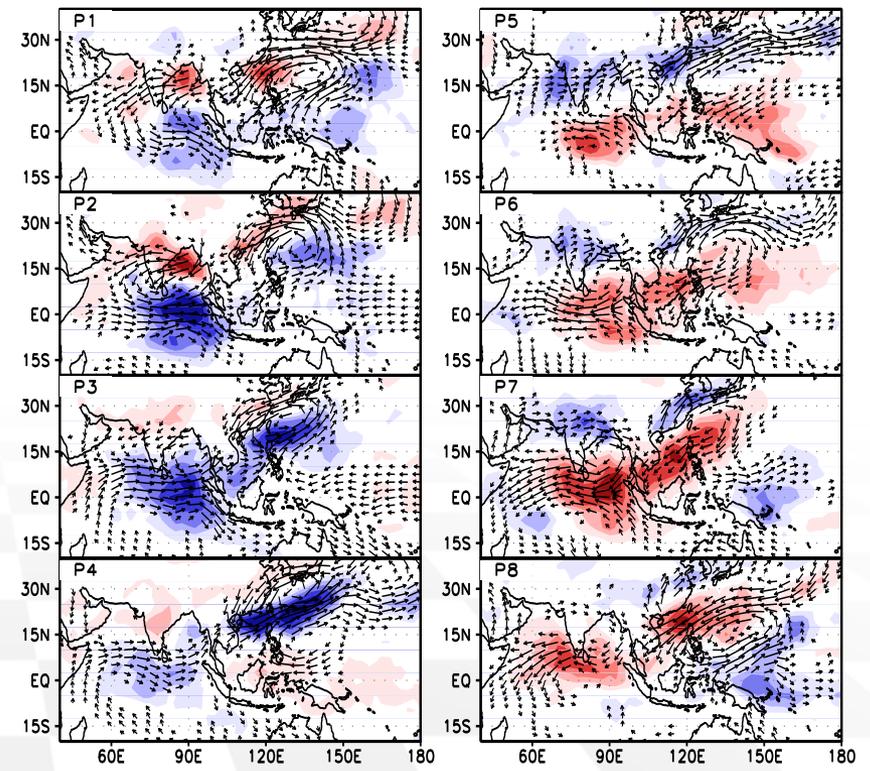
ASM EOF Mode 1 & 2



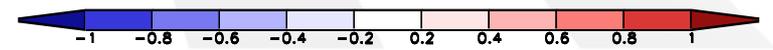
MISO EOF 3 & 4



ASM EOF Mode 3 & 4

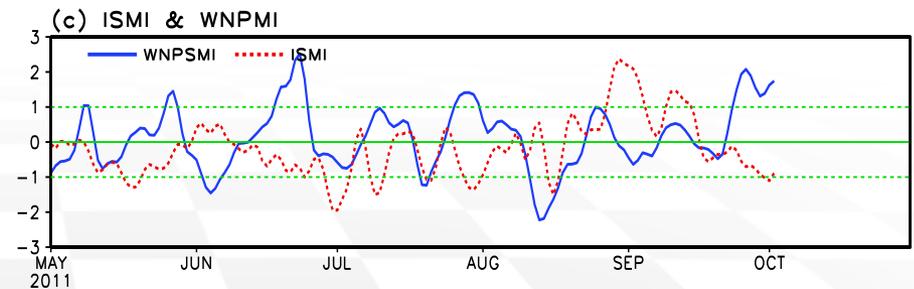
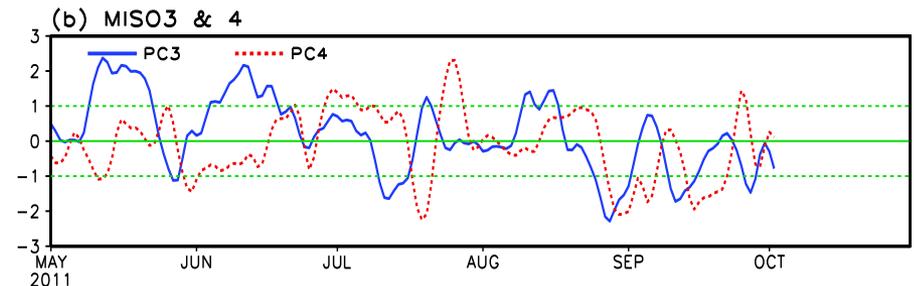
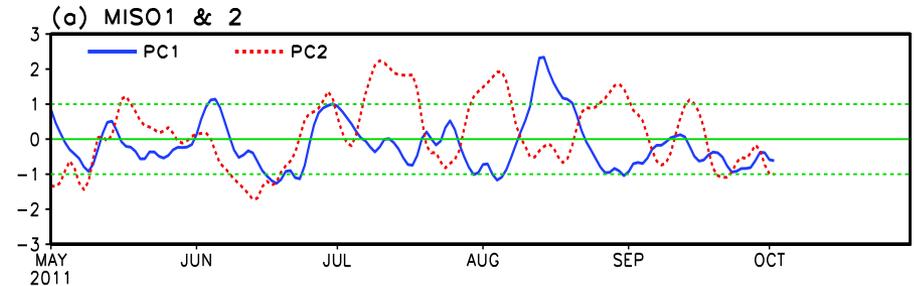
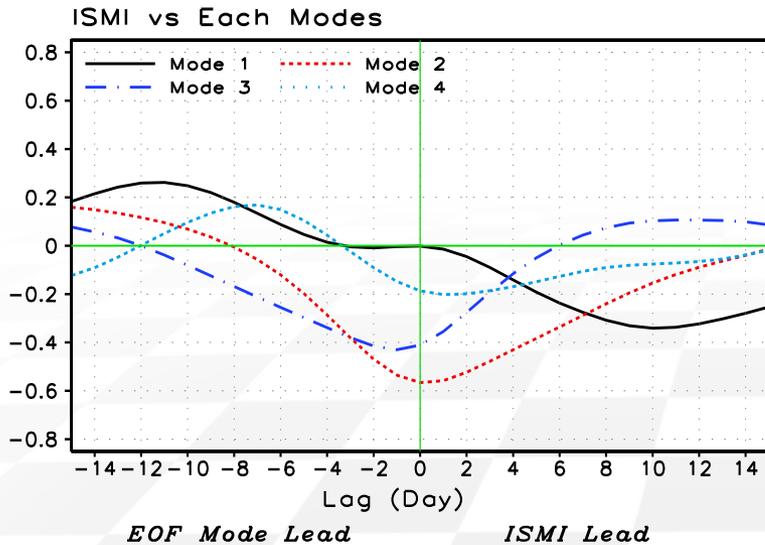
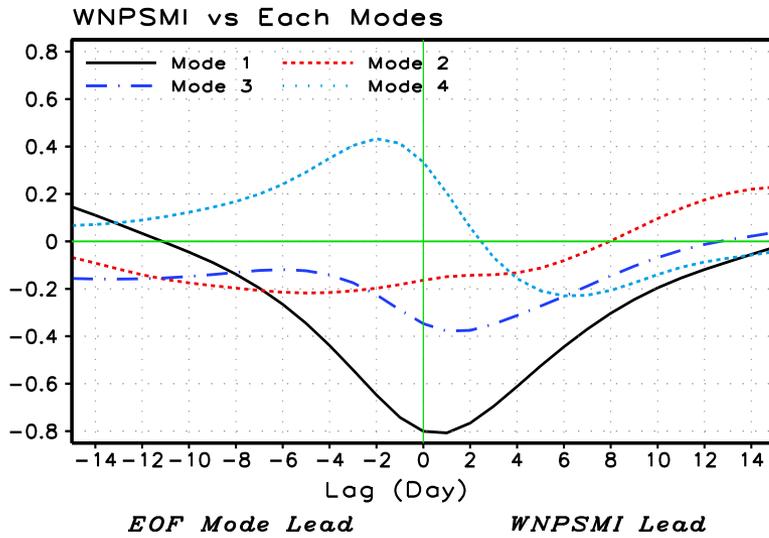


⊙ May 25, 2011 (Starting Date)



Relationship with Regional Monsoon Index

S



Development of MISO Monitoring Website

<http://iprc.soest.hawaii.edu/users/jylee/miso/miso.htm>

The screenshot shows a Windows Internet Explorer browser window displaying the MISO Monitoring website. The browser's address bar shows the URL <http://iprc.soest.hawaii.edu/users/jylee/miso/miso.htm>. The website's header features the title "Boreal Summer Monsoon Intraseasonal Oscillation" and the acronym "MISO" in a stylized font, accompanied by a globe icon. A navigation menu on the left includes links for Home, Introduction, Definition of MISO Index, Real-time Monitoring, and Data and Program. The main content area contains a welcome message and a "MISO Monitoring" phase diagram. The diagram is a scatter plot with axes labeled "Normalized PC1" and "Normalized PC2", both ranging from -3 to 3. It is divided into eight phases: PHASE 1 (Western North Pacific), PHASE 2 (Indian Ocean & East Asia), PHASE 3 (Indian Ocean & East Asia), PHASE 4 (Indio. & Maritime Continent), PHASE 5 (Indio. & Maritime Continent), PHASE 6 (Bengal & South China Sea), PHASE 7 (Bay of Bengal & South China Sea), and PHASE 8 (Western North Pacific). A legend at the bottom of the diagram indicates starting dates: Aug 16 (grey), Sep 5 (purple), Sep 12 (orange), Sep 19 (blue), and Sep 26 (red). To the right of the diagram, text explains that phase diagrams are for the recent 40 days and that the distance from the center indicates the strength of the MISO signal. The browser's status bar at the bottom shows "Internet | Protected Mode: On" and a zoom level of 75%.

MJO Monitoring (Source: NCEP CPC) - Windows Internet Explorer

<http://iprc.soest.hawaii.edu/users/jylee/miso/miso.htm>

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MJO Monitoring (Source: NCEP CPC)

Boreal Summer Monsoon Intraseasonal Oscillation

MISO



[Home](#)

[Introduction](#)

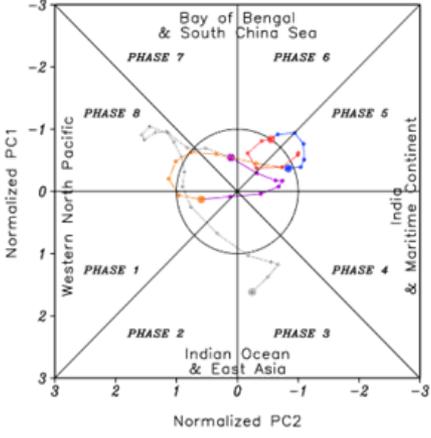
[Definition of MISO Index](#)

[Real-time Monitoring](#)

[Data and Program](#)

Welcome to the monitoring page on Boreal summer monsoon intraseasonal oscillation (MISO)! This website provides the latest information on ISO over the Asian monsoon region using MISO index. This webpage is updating at 04:00 UTC on every Wednesday.

MISO Monitoring



Phase diagrams for the recent 40 days. Click 'definition of MISO index' for detail description.

The farther away from the center of the circle the stronger the MISO signal.

MJO Monitoring (Source: NCEP CPC)

Internet | Protected Mode: On

75%

Summary

We suggest a **new MISO index that is defined by the first four multivariate EOF modes of daily OLR and U850 anomaly** over the ASM region (10°S - 40°N , 40° - 160°E).

The RMM index captures the OLR variability primarily in the equatorial region whereas **the MISO index captures large portion of the variability in the off-equatorial region**, yielding more realistic variance pattern.

The MISO index describes better ISO variability center and represents better northward as well as eastward propagating pattern in the ASM domain than the RMM index

The northward-propagating MISO component can be monitored using the phase diagram between the first and second PC similar as the eastward-propagating MJO. Taking into account distinct regional characteristics of MISO with smaller horizontal scale than MJO, the reconstructed field from the first four modes may provide more useful information.



Thank You!



Boreal Summer Monsoon Intraseasonal Oscillation

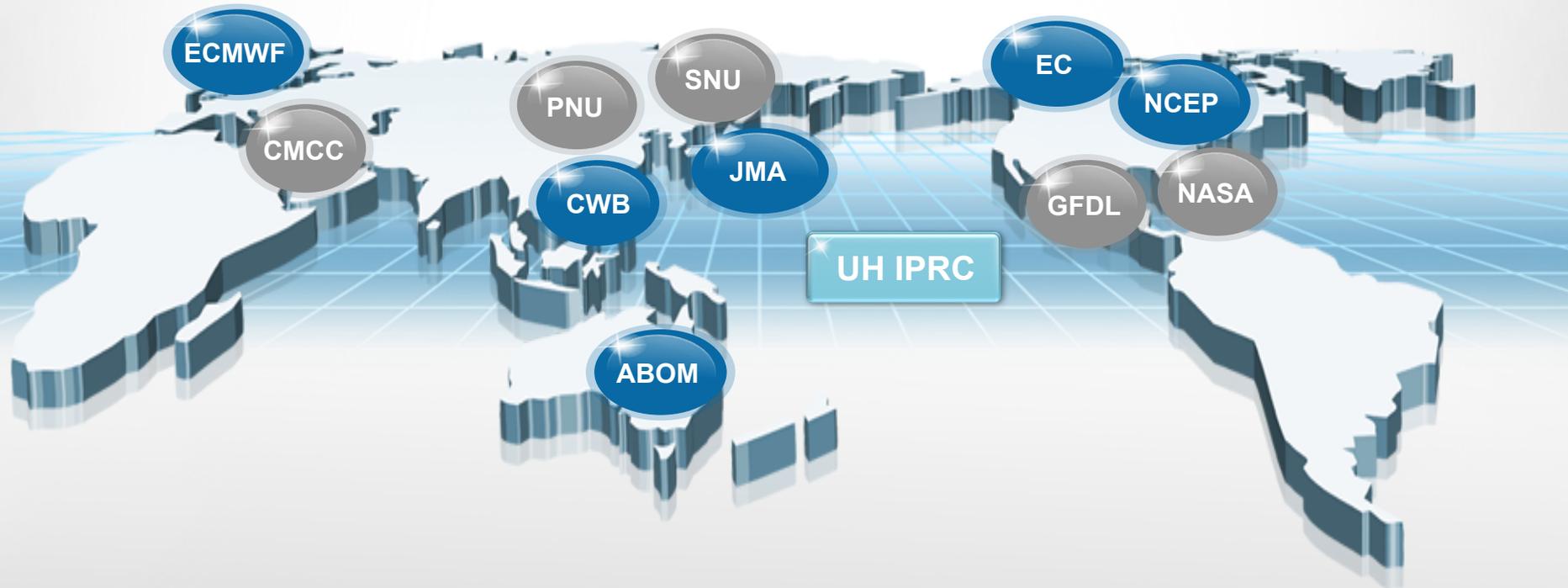
MISO



CLIVAR/ISVHE

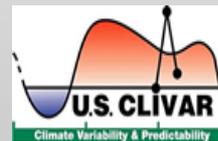
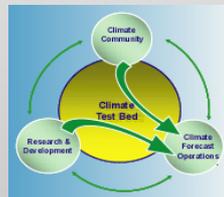
Intraseasonal Variability Hindcast Experiment

The **ISVHE** is a coordinated multi-institutional ISV hindcast experiment supported by **APCC, NOAA CTB, CLIVA R/AAMP & MJO WG, NOAA CTB, and AMY.**

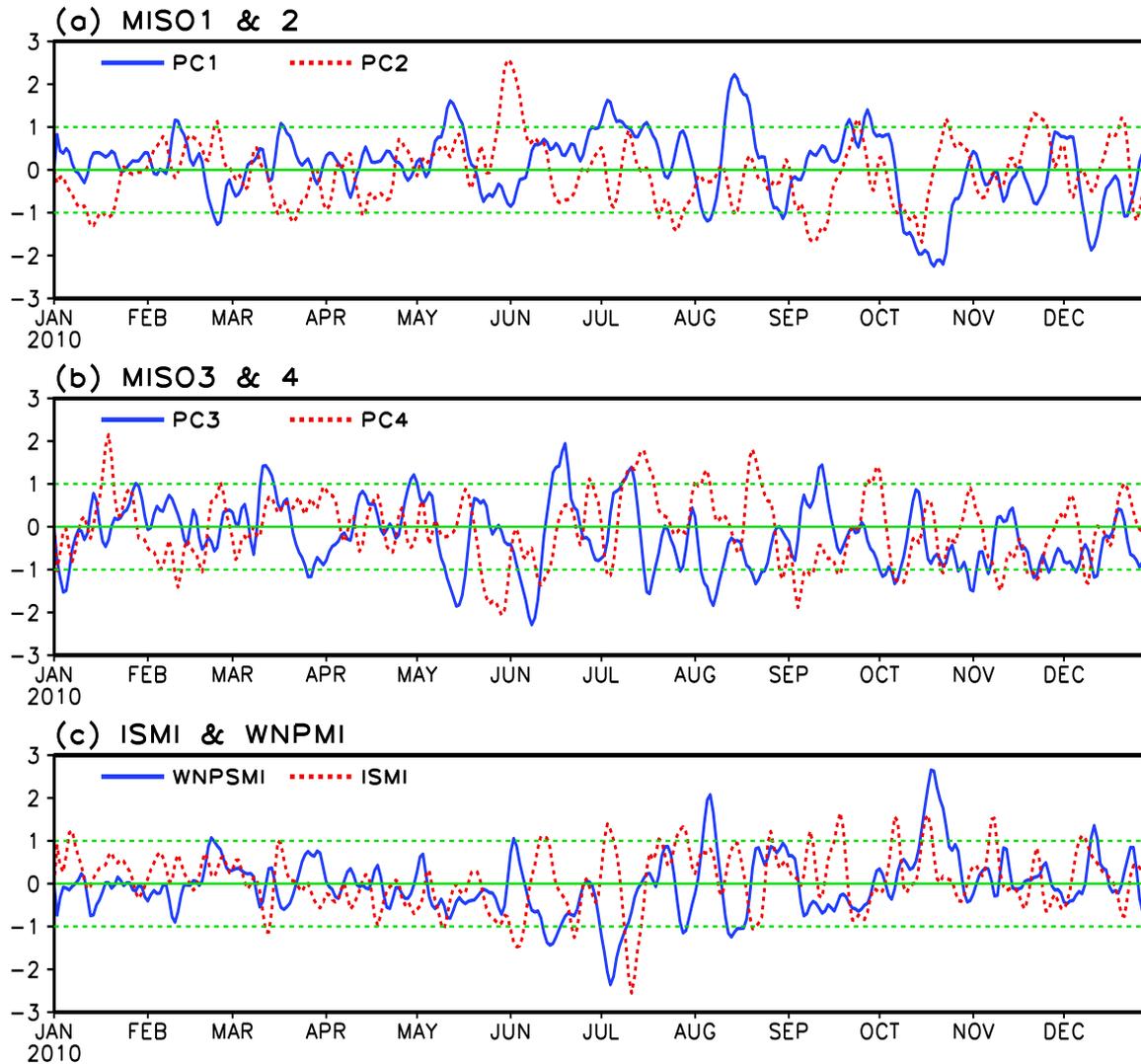


<http://iprc.soest.hawaii.edu/users/jylee/clipas.htm>

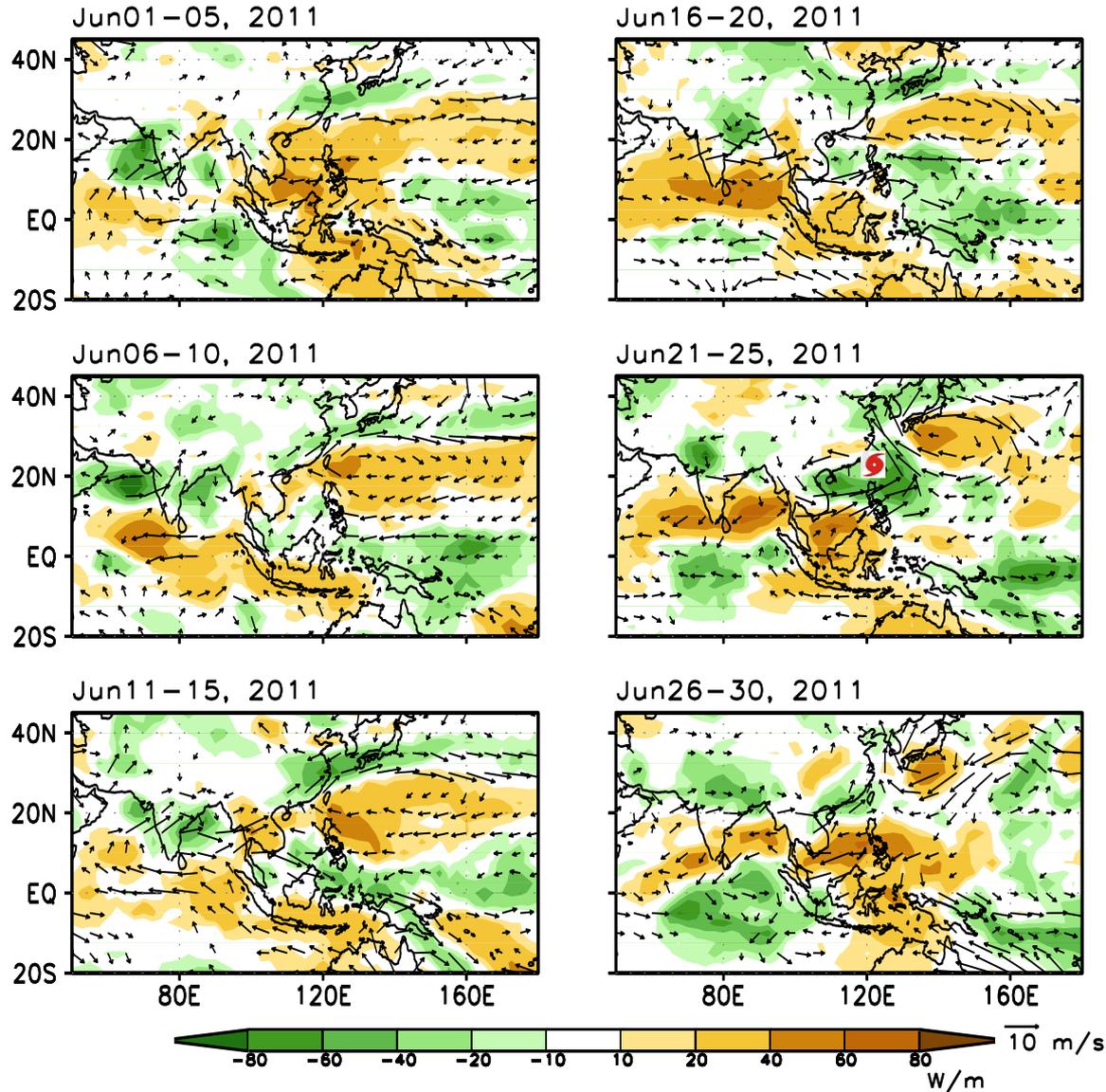
Supporters



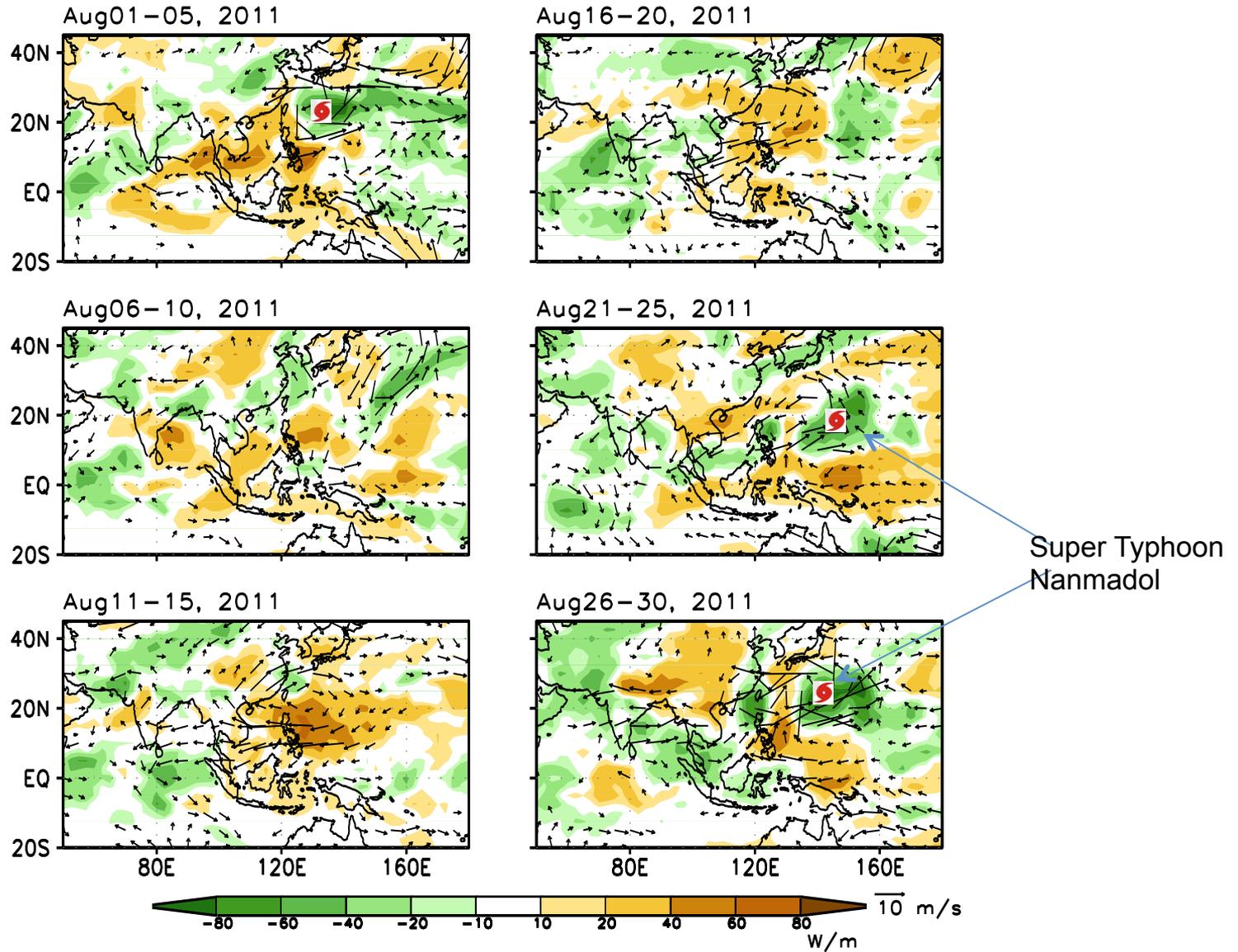
Normalized Monsoon Indices/ 2010



OLR and 850-hPa Wind Anomaly / June 2011



OLR and 850-hPa Wind Anomaly / Aug 2011

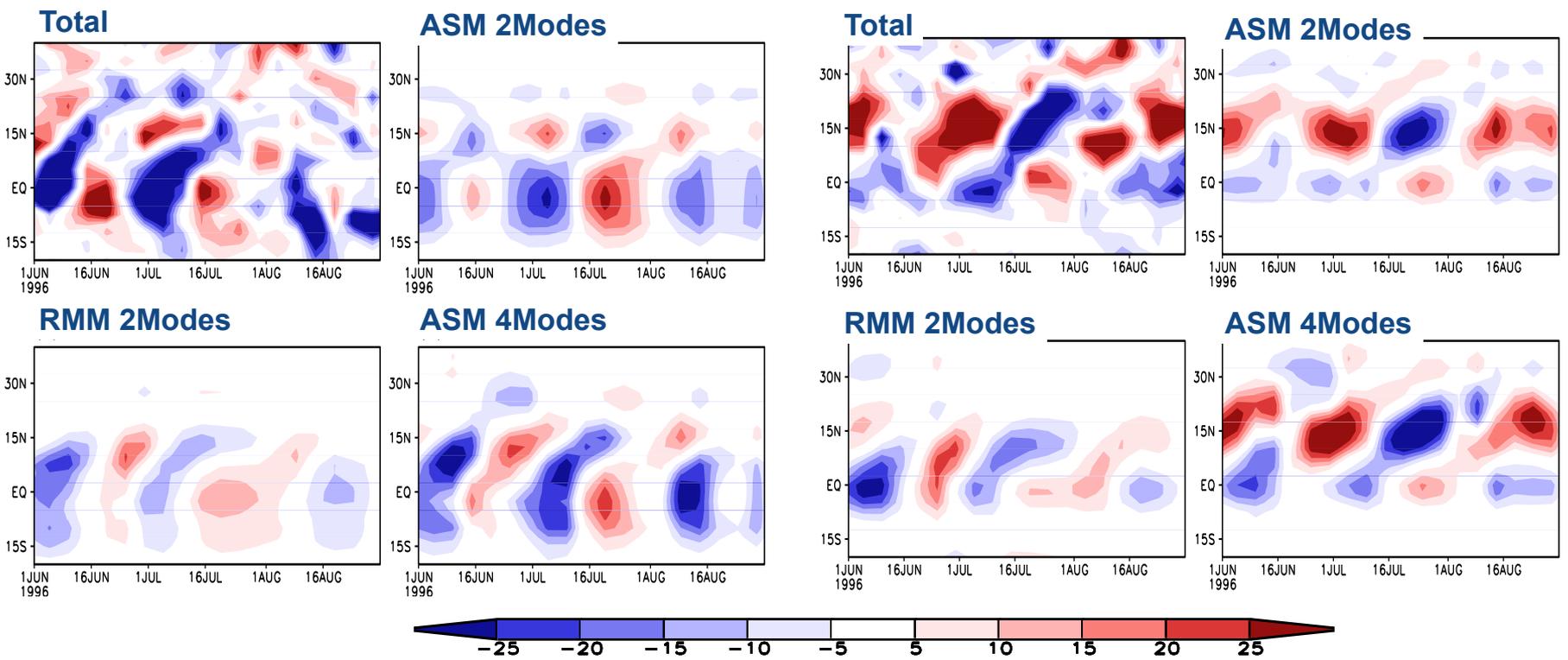




Northward Propagation of Pentad OLR Anomaly

Along 80°-100°E

Along 110°-130°E



ASM EOF 4 modes better capture northward propagation of pentad OLR anomaly.