CliPAS *Climate Prediction and its Application to Society*

Development of Boreal Summer Monsoon Intraseasonal Oscillation (MISO) Diagnostics

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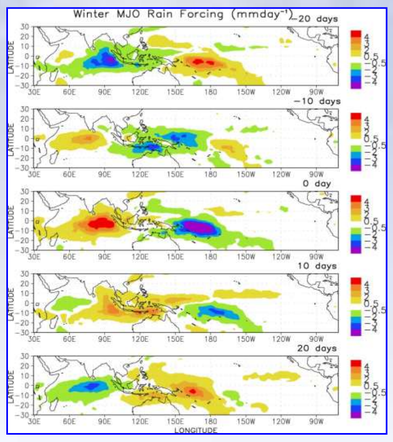
1. Introduction

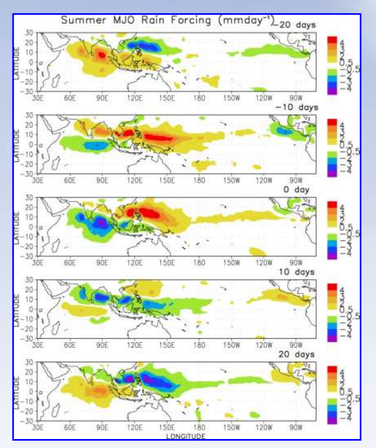
As a measure of the strength of the MJO, Wheeler and Hendon (2004) Realtime Multivariate MJO (**RMM**) index used the first two leading multi-variate EOF modes of the equatorial mean (between 15S and 15N) OLR, and zonal winds at 850 and 200 hPa. This index captures equatorial eastward propagating mode, the MJO, very well and has been applied all year around to depict MJO activity.

It has been well recognized that the tropical intraseasonal variations exhibits prominent seasonal variation [Madden 1986, Wang and Rui 1990] During boreal summer, the variability centers of OLR are shifted from equatorial zone during boreal winter to off-equatorial monsoon troughs and the propagation patterns changed dramatically. It is hence not clear whether RMM index remains a best measure of the boreal summer monsoon intraseasonal oscillation (**MISO**).

MJO in N.H. Winter



MJO in N.H. Summer



From MJO working group website

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

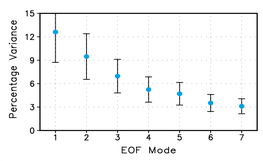
2. The New MISO Index

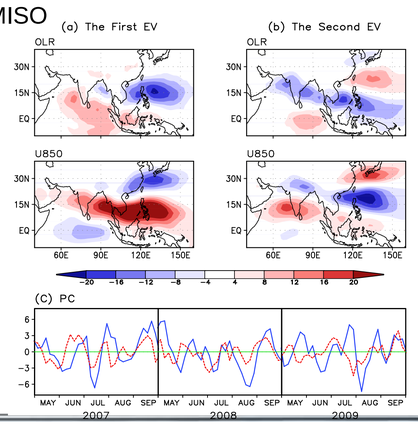
Criterion for Determining the MISO Index

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

The New MISO Index:
Multivariate EOF Modes of 5-day mean OLR and U850 over Asian monsoon (ASM) domain (10ºS-40ºN, 40º-160ºE)

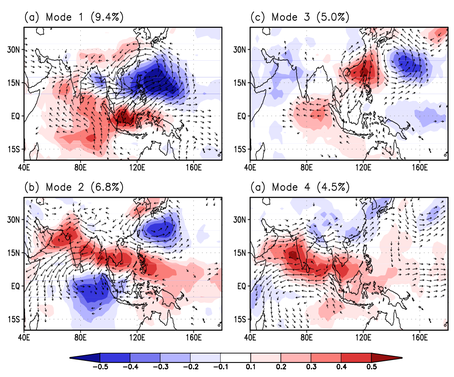
Eigen value for each mode with uncertainty



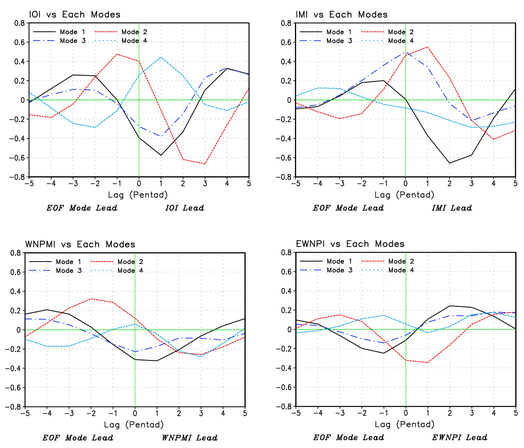


Correlation Coefficients against Each Mode

Shading: OLR, Vector: 850-hPa Wind



Lead-lag Correlation between Regional MISO indices and ASM EOF modes



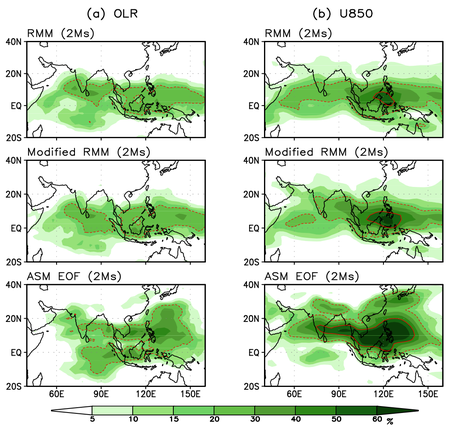
Regional Monsoon ISO Indices

- 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)

3. Issues on Determining the New Index

Q1: IS RMM index enough for representing MISO?

Fractional Variance Explained by Each Index



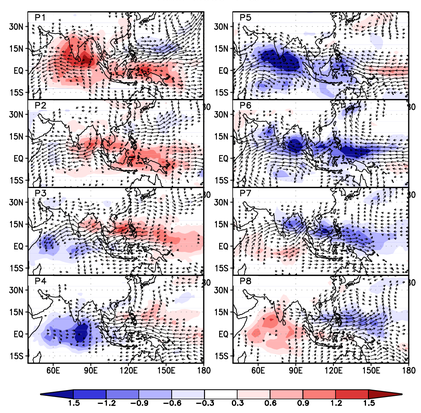
RMM with 2 EOF modes: It explains more than 20% of total variance of 5-day mean OLR and U850 in warm season between Equator and 15ºN.

Modified RMM with 2 EOF modes: It better explain variability over the NH subtropics then RMM but its explanation still confines between Eq and 17ºN.

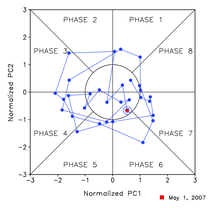
ASM EOF with **2 modes:** Its fractional variance is much larger than that of RMM index particularly over subtropical Asian monsoon domain.

Life Cycle Composite of the 1st and 2nd RMM Modes

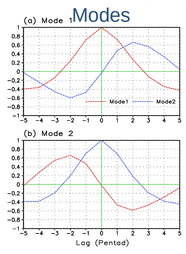
Normalized Composite Anomaly for Strong Events



Phase Diagram of PC1 and PC2

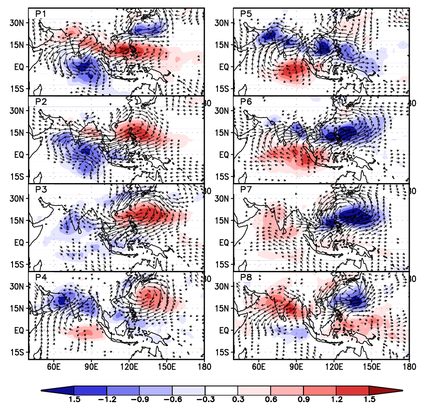


Correlation between Modes

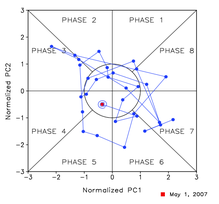


Life Cycle Composite of the 1st and 2nd ASM EOF Modes

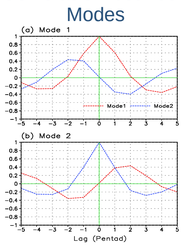
Normalized Composite Anomaly for Strong Events



Phase Diagram of PC1 and PC2

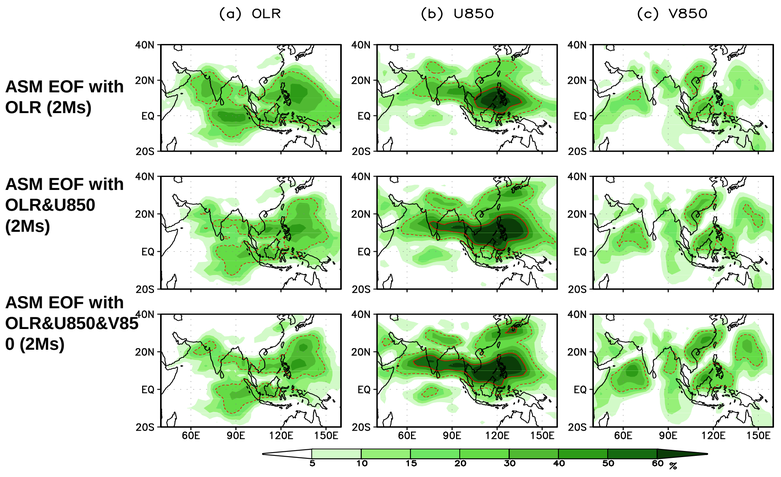


Correlation between Modes



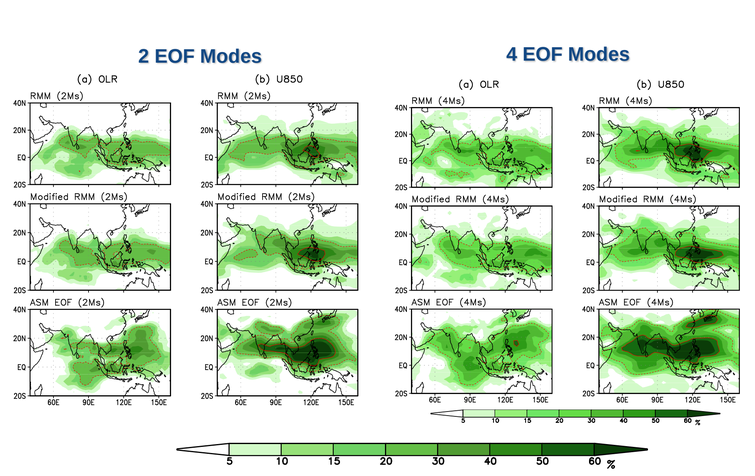
Q2: How many variables are necessary for MISO?

Fractional Variance

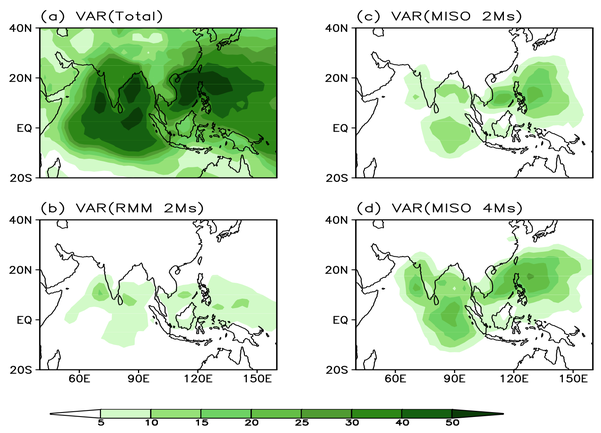


Q3: How many modes are necessary for MISO?

Fractional Variance

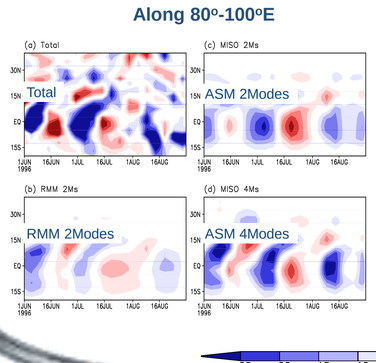


Variance of Pentad OLR Anomaly from total field and reconstructed field from RMM and MISO index

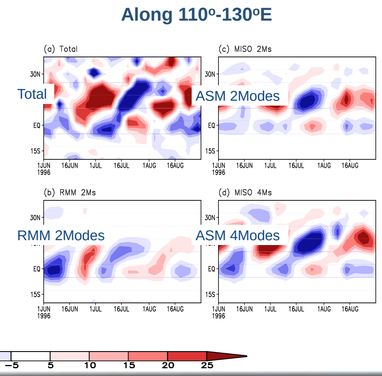


Northward Propagation of Pentad OLR Anomaly

Along 80º-100ºE

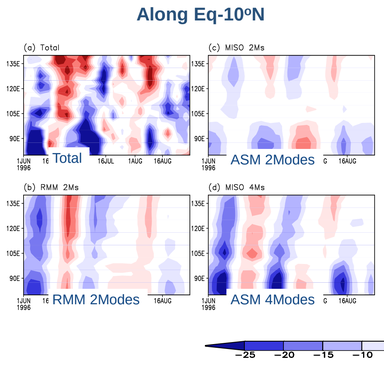


Along 110º-130ºE

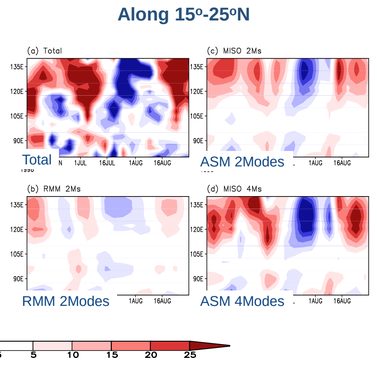


Eastward Propagation of Pentad OLR Anomaly

Along Eq-10ºN



Along 15º-25ºN



Summary

- We suggest a new MISO index which is defined by the first four multivariate EOF PCs of pentad OLR and U850 anomaly over the ASM region (10ºS-40ºN, 40º-160ºE).
- The RMM index captures the OLR variability primarily in the equatorial region whereas the new MISO index captures large portion of the variability in the off-equatorial region, yielding more realistic variance pattern.
- The new MISO index describes ISO variability center better, captures more fractional variance and captures northward as well as eastward propagating pattern better in the ASM domain then the RMM index.

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