CLIVAR / ISVHE

Intraseasonal Variability Hindcast Experiment

Design and Preliminary results

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

ISVHE was initiated by an ad hoc group:

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Research Coordinator: **June-Yi Lee**

Preliminary results were prepared by **June-Yi Lee and Bin Wang**

Supporters

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ISVHE

ISVHE MODELS

Intraseasonal Variability Hindcast Experiment

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

Supporters

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ISVHE Participants

Institution	Participants
ABOM, Australia	Harry Hendon, Oscar Alves
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CWB, Taiwan	Mong-Ming Lu
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GFDL, USA	Bill Stern
JMA, Japan	Kiyotoshi Takahashi
MRD/EC, Canada	Gilbert Brunet, Hai Lin
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ISVHE

ISVHE Objectives

- ***Understand physical basis of ISO prediction.***
- ***Estimate potential and practical predictability of ISO in a multi-model frame work.***
- ***Developing optimal strategies for MME ISO prediction.***
- ***Identify model deficiencies and suggest ways to improve models' convective and other physical parameterizations.***
- ***Revealing new physical mechanisms associated with ISV*** that cannot be obtained from analyses of a single model.
- ***Study ISO's modulation of extreme hydrological events*** and ***its contribution to seasonal and interannual climate variation.***

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Experimental Designs

ISVHE

Control Run

Free coupled runs with AOGCMs or **AGCM simulation** for at least 20 years

Daily or 6-hourly output

ISV Hindcast EXP

ISV hindcast initiated **every 10 d** for at least **45 d** with more than **6 ensemble members from 1989 to 2008**

Daily or 6-hourly output

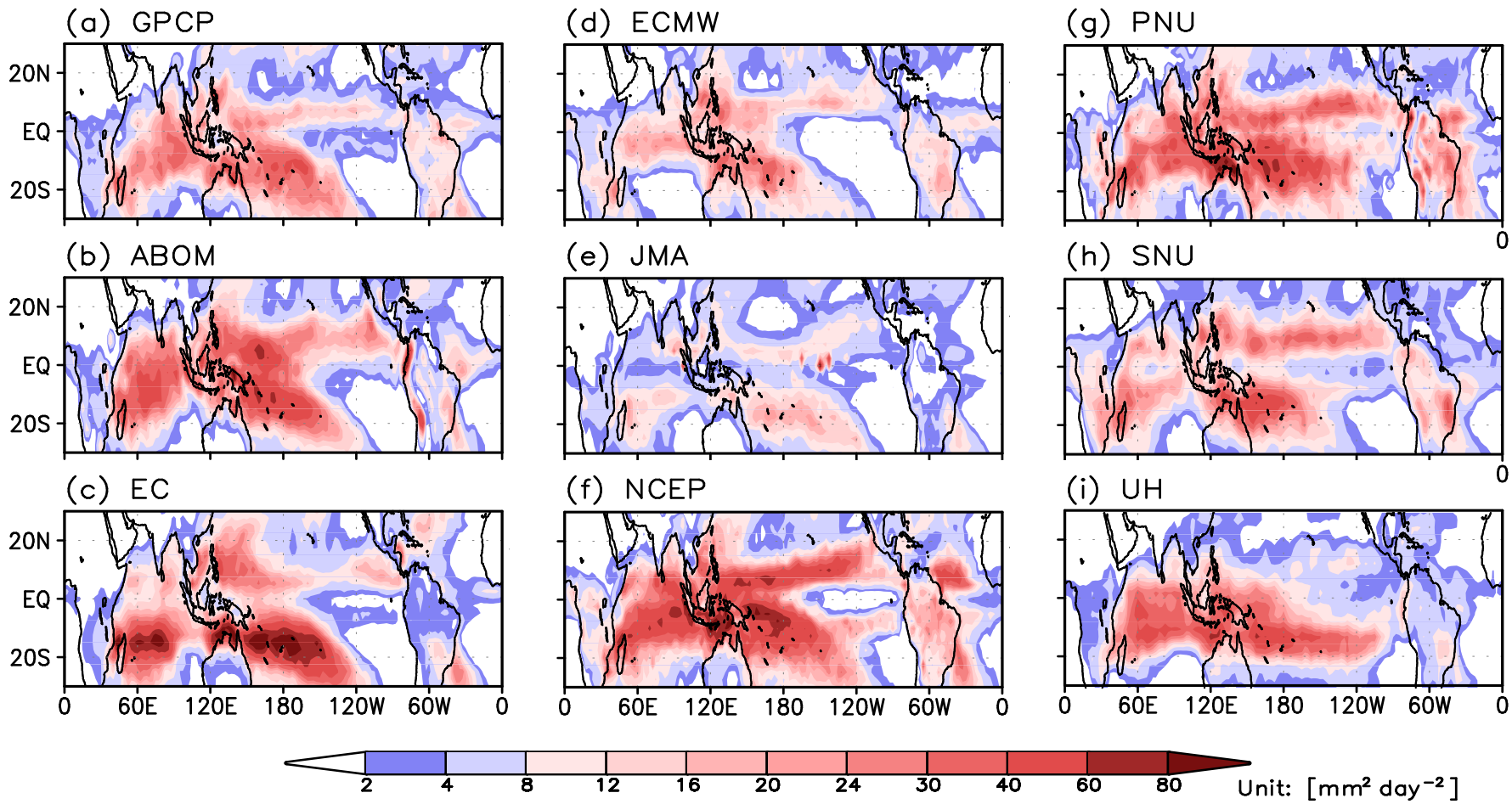
YOTC EXP

Additional EXP for YoTC period **from May 2008 to Sep 2009**

6-hourly output

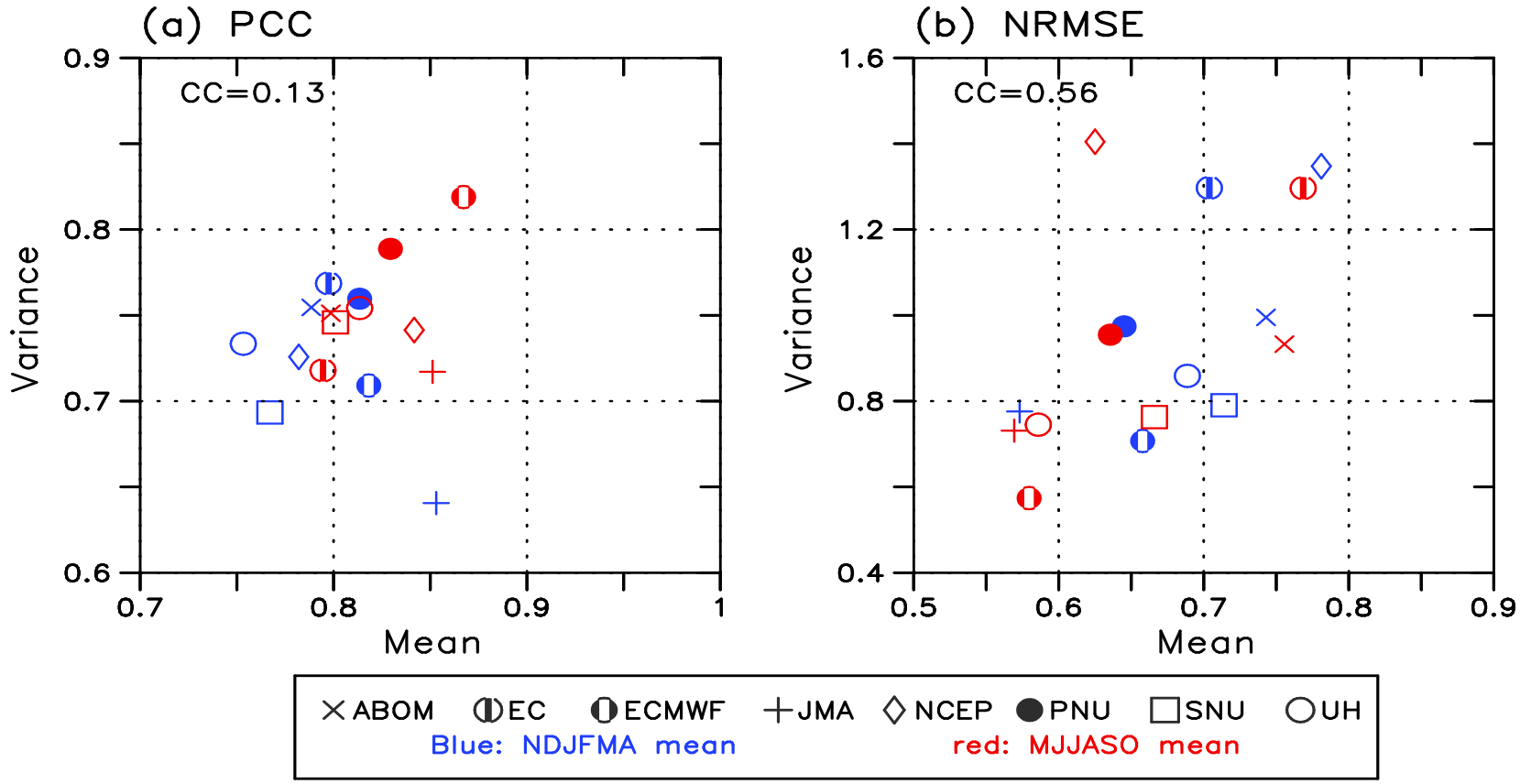
Evaluation on Control Runs

Variance of 20-100-day Bandpass Filtered Precipitation
in Observation and Control Simulations (NDJFMA)



Evaluation on Control Runs

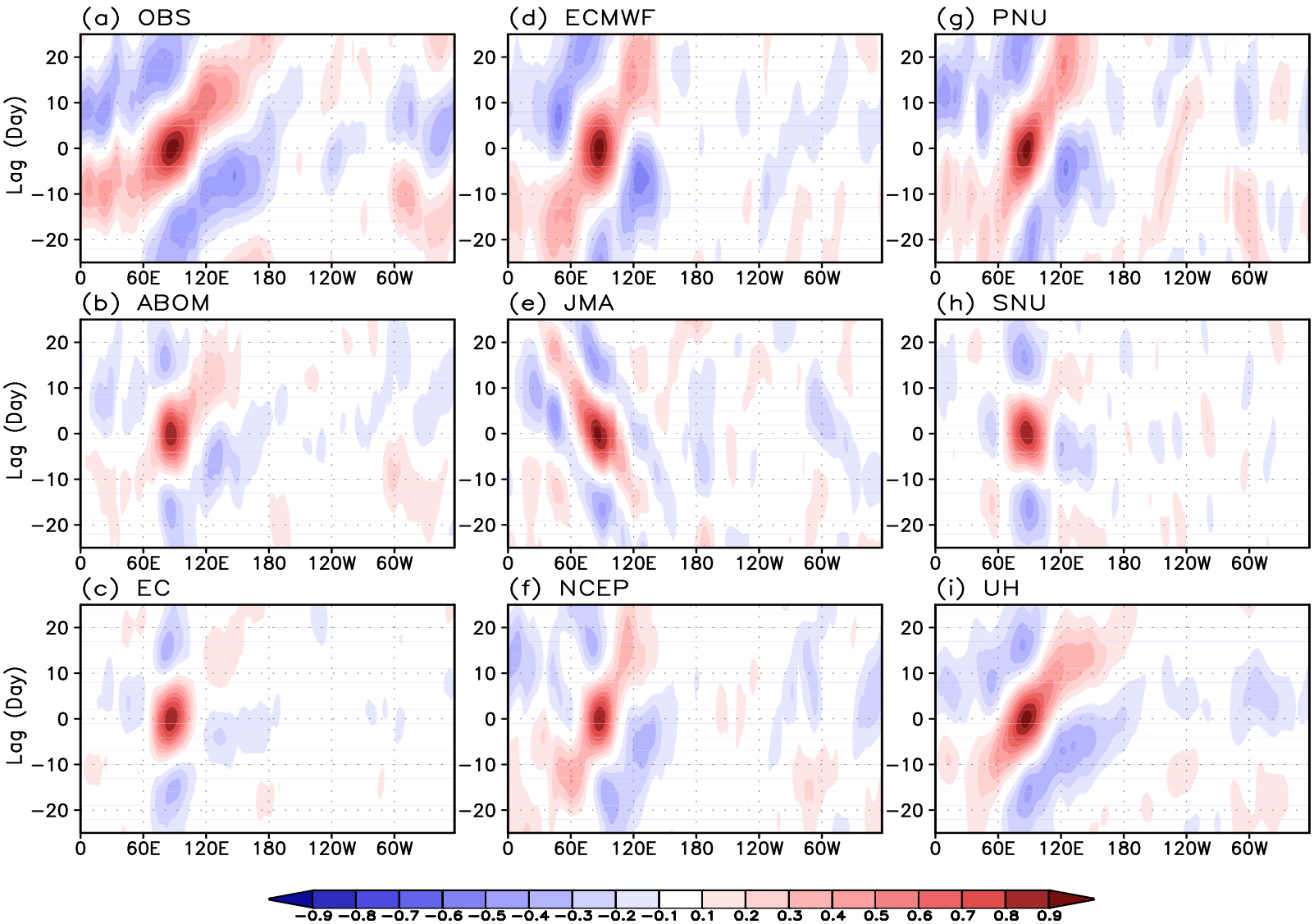
Pattern Correlation Coefficient (PCC) and Normalized Root Mean Square Error (RMSE)
for Mean Precipitation and 20-100-day Variance



➢ The realistic simulation of seasonal mean climatology is related to the realistic simulation of climatological ISO activity

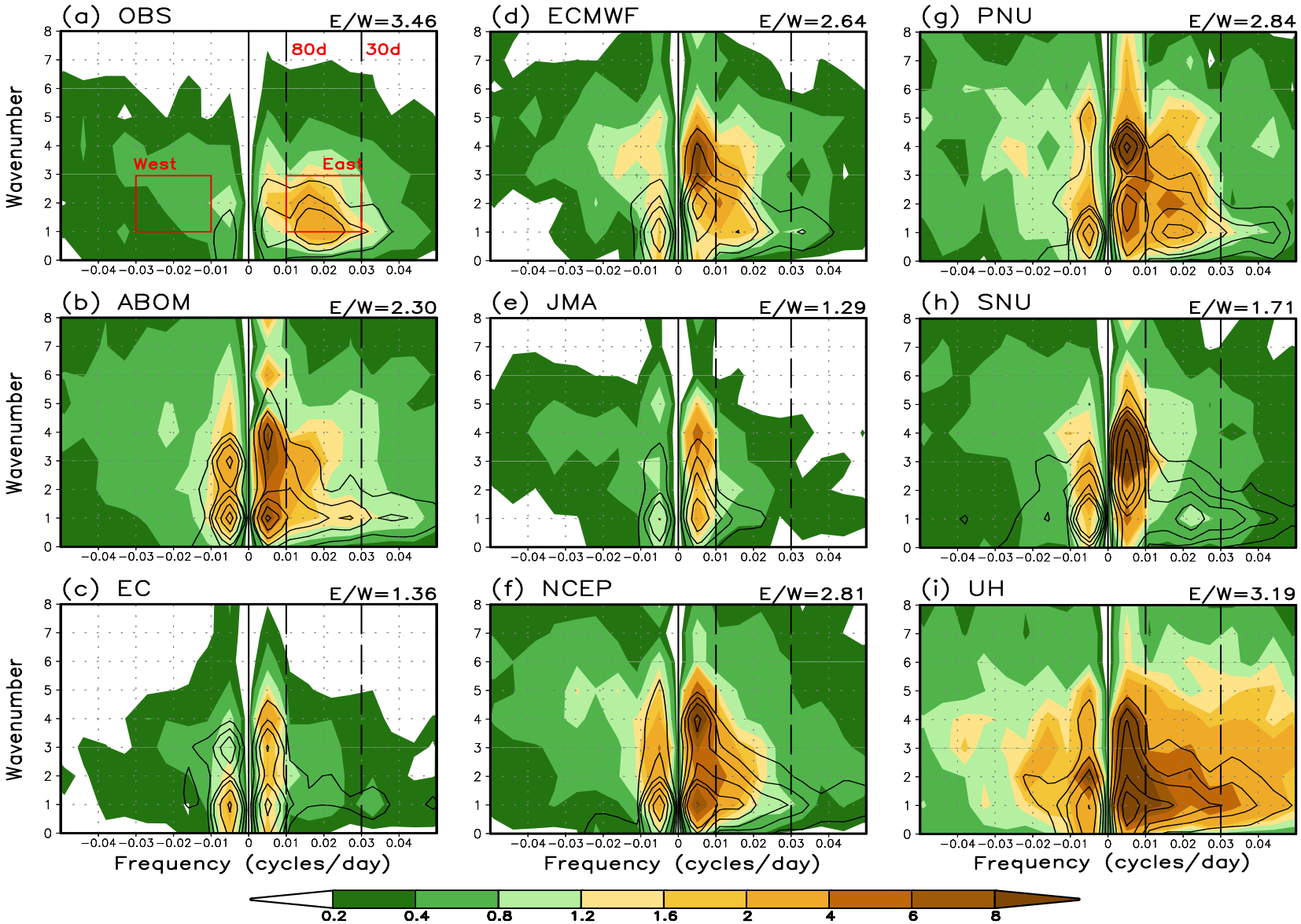
Evaluation on Control Runs

Correlation between IO OLR (75-100E, 10S-5N) & 10S-10N OLR



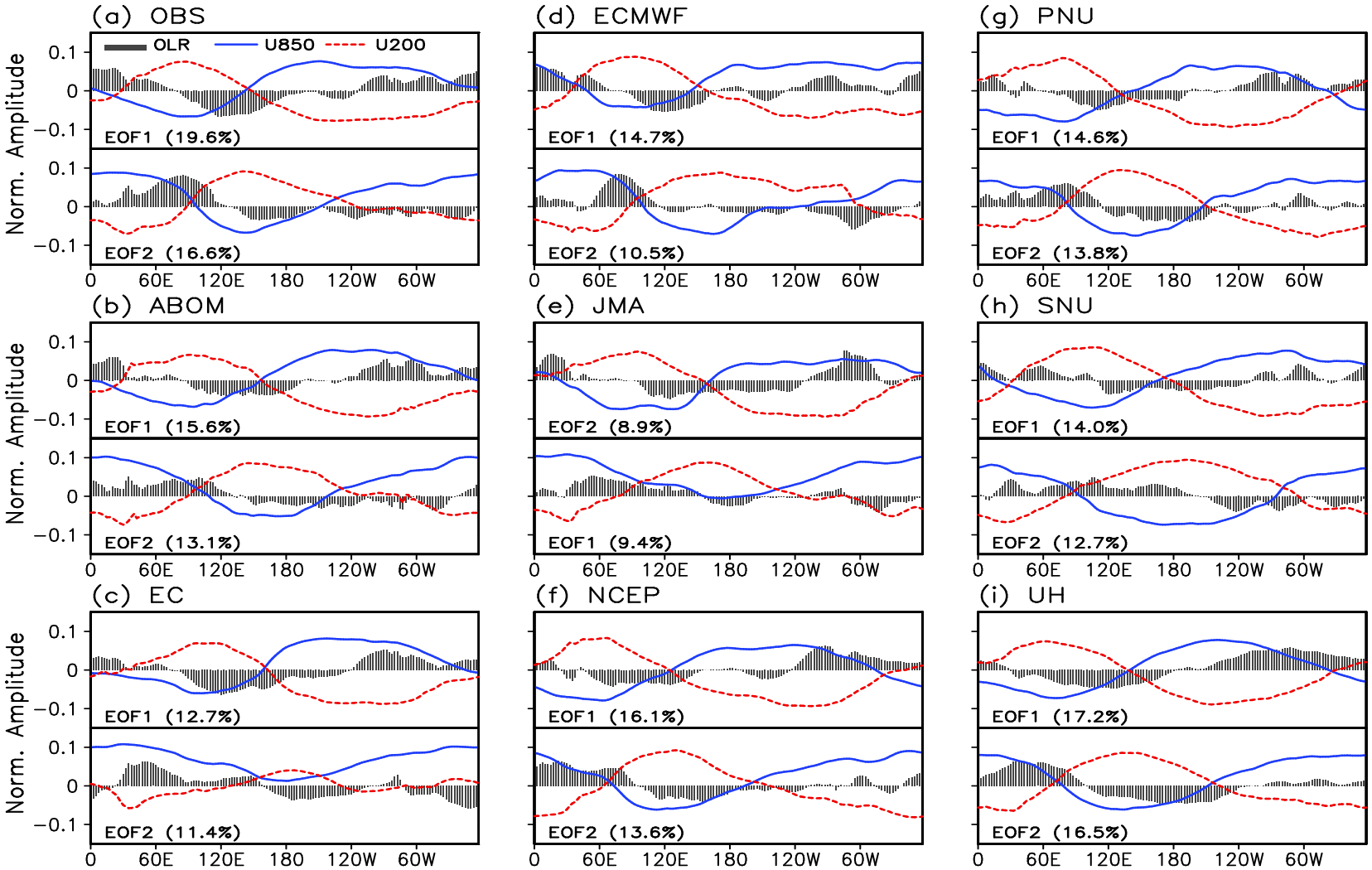
Evaluation on Control Runs

Frequency-wave Power Spectrum of OLR Anomaly for November-April



Evaluation on Control Runs

20-100-Day U850, U200 and OLR
along the equator (15ºS-15ºN)

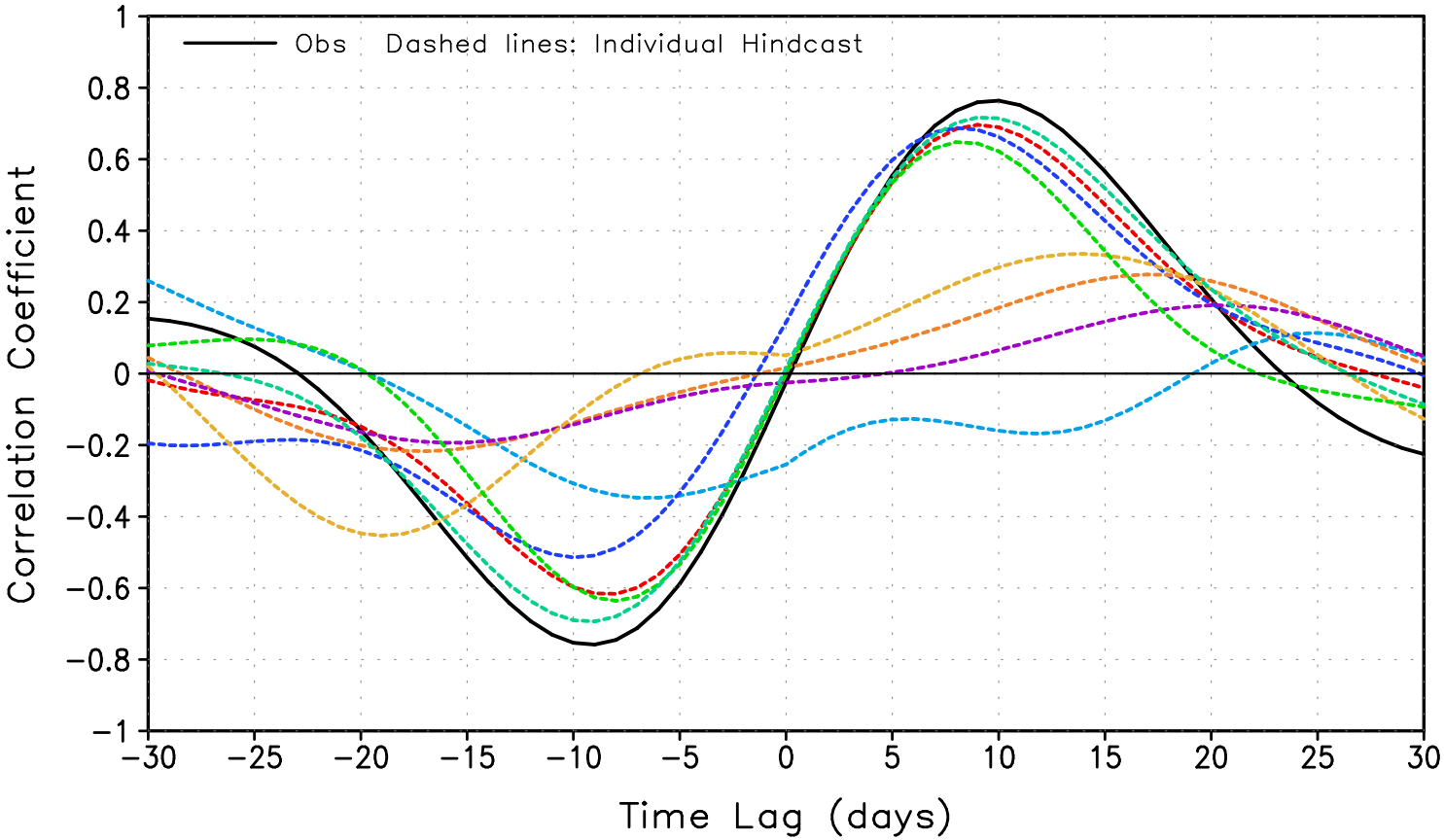


Evaluation on Control Runs

Lead-lag Correlation of RMM1 vs RMM2 for October-March

With Positive time lags corresponding to RMM2 leading RMM1

(Indian Ocean convection leading Maritime Continent convection)

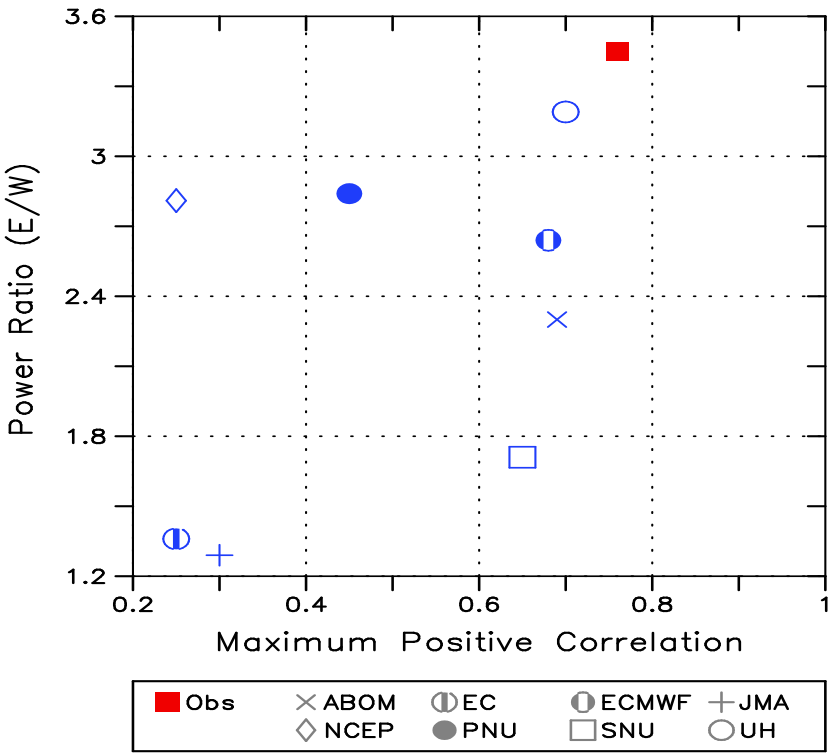


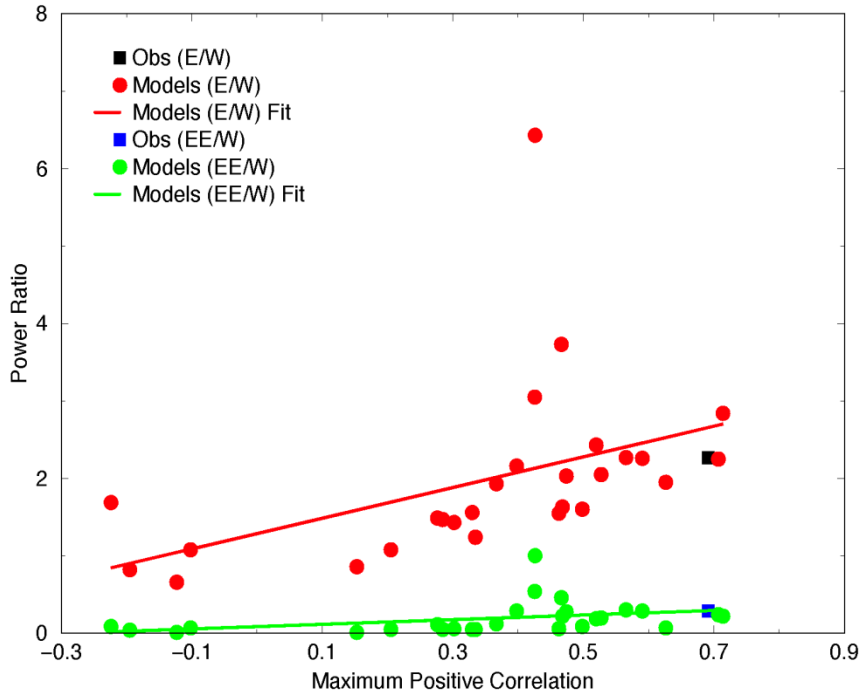
Evaluation on Control Runs

Process-oriented Metrics

for the Identification of the MJO in Models

Scatter plots of the maximum positive correlation between RMM1 and RMM2 vs. the East/West power ratio

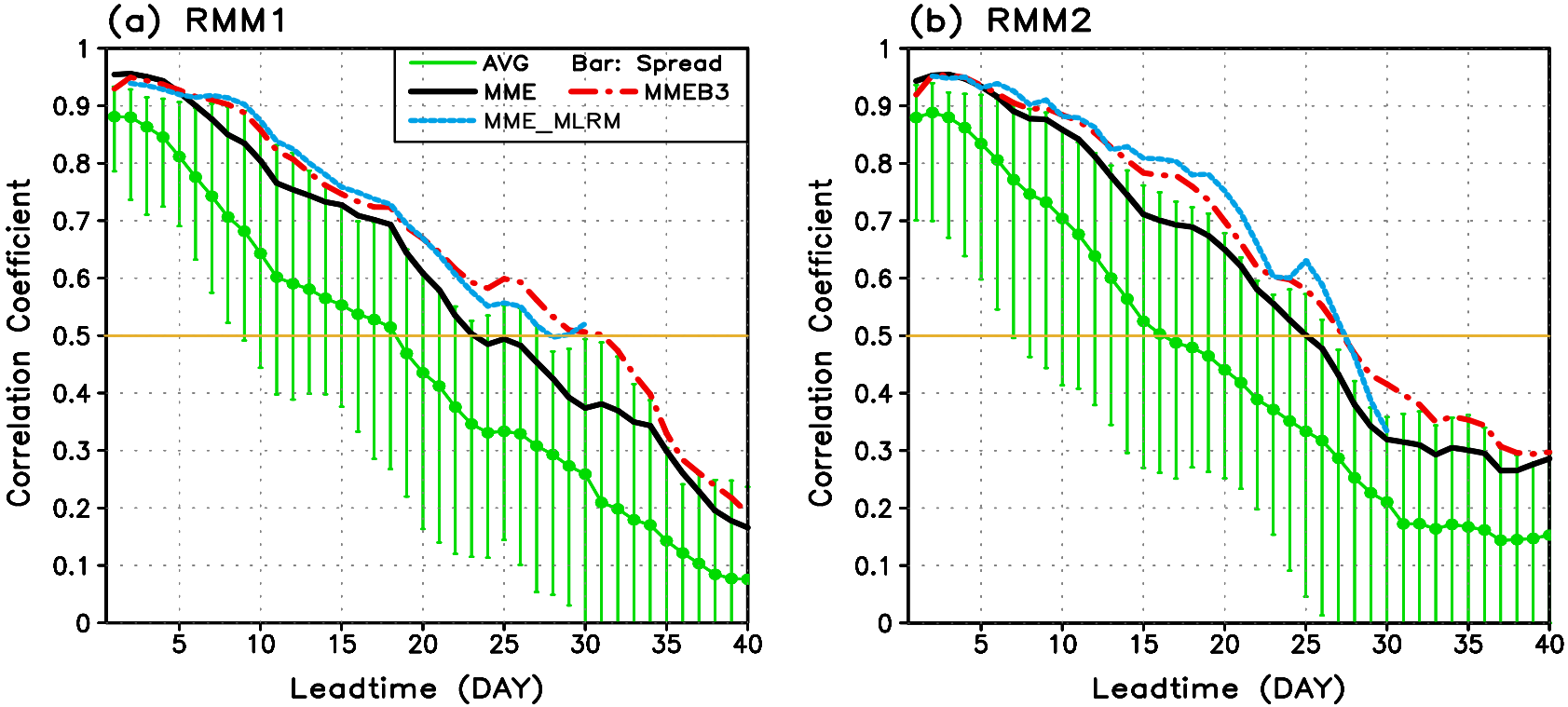




Result from Sperber and Kim (2011, submitted) using CMIP3 models

The MME and Individual Model Skills for MJO

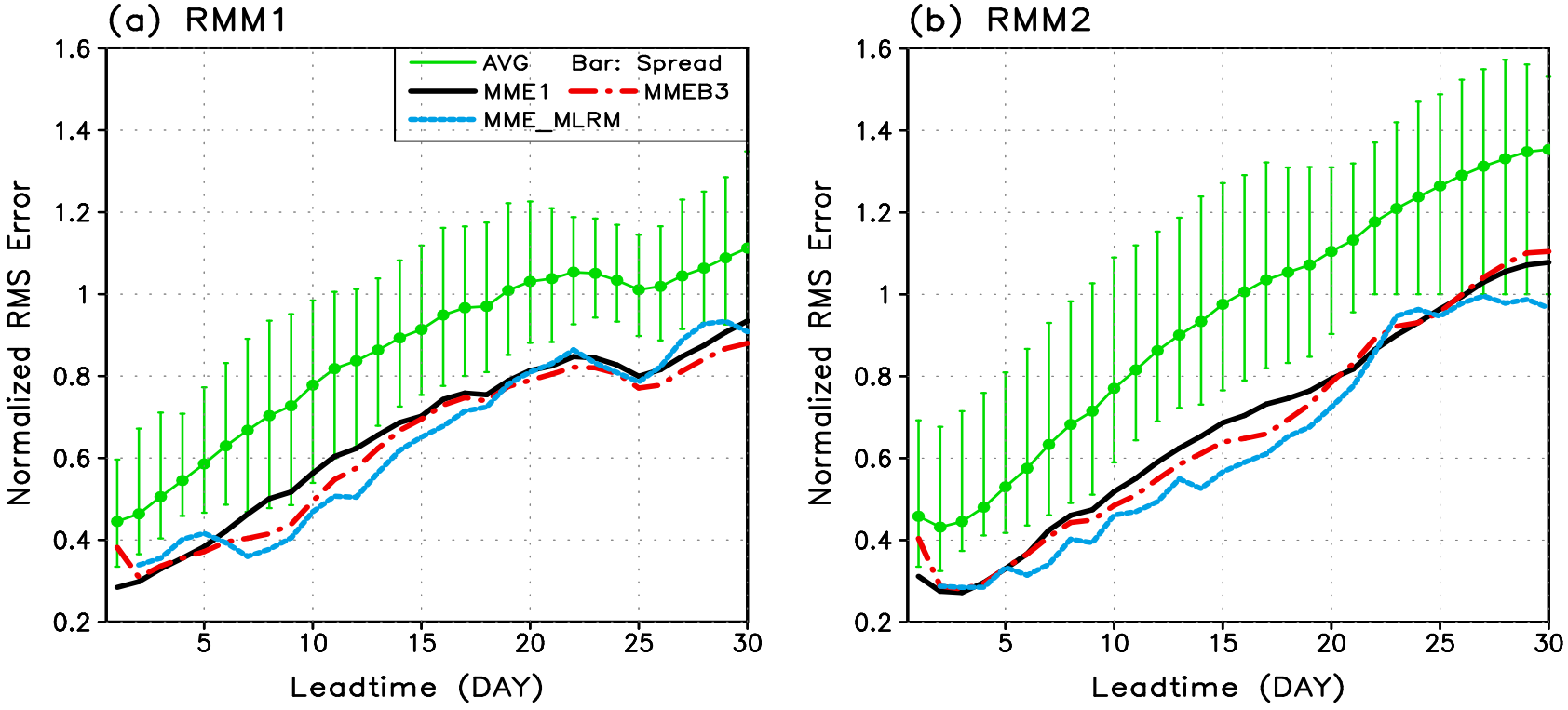
Anomaly Correlation Coefficient



Common Period: 1989-2008
Initial Condition: 1st day of each month from Oct to March
MME: Simple composite with all models
MMEB3: Simple composite using the best three models in a cross-validated way
MME_MLRM: Weighted MME with multi-linear regression method in a cross-validated way

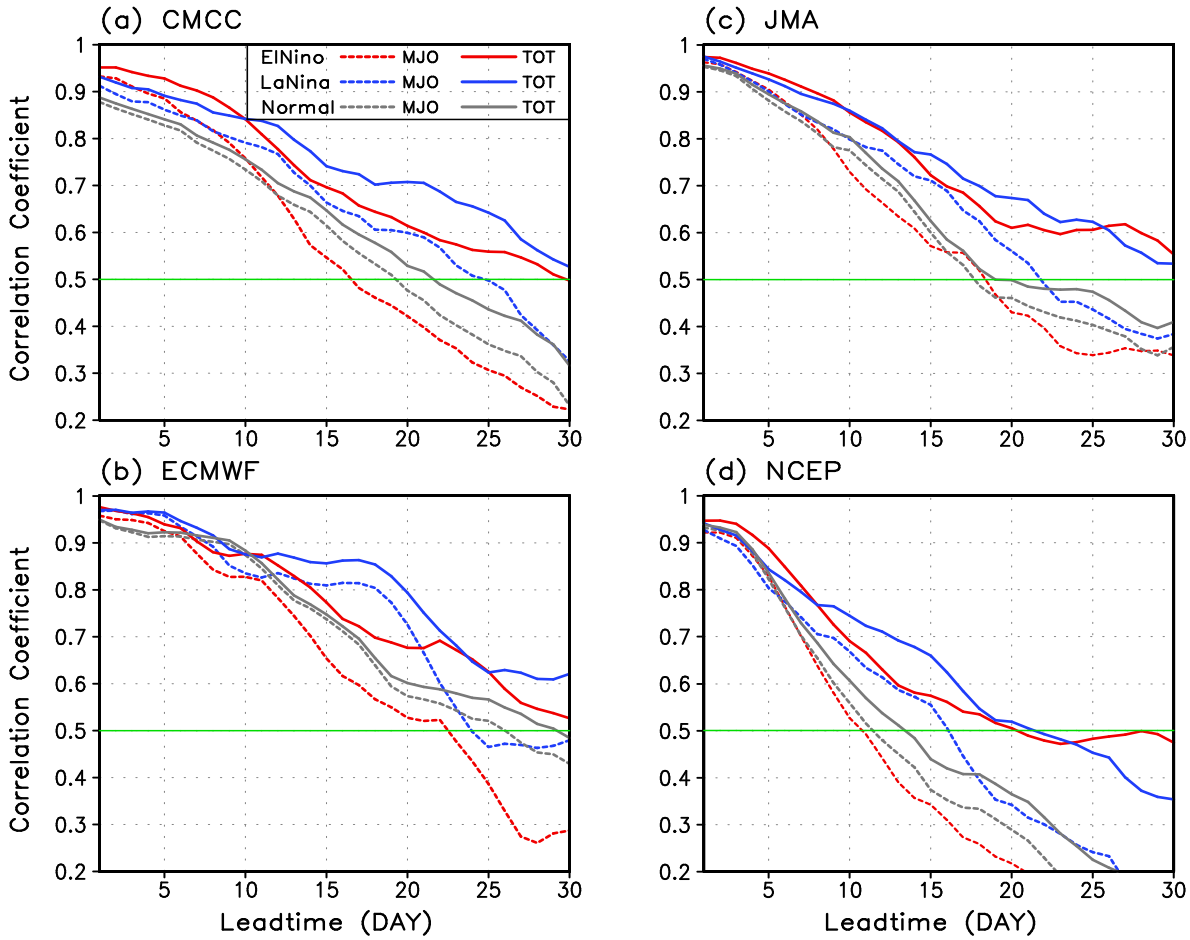
The MME and Individual Model Skills for MJO

Normalized RMSE



ENSO Dependency

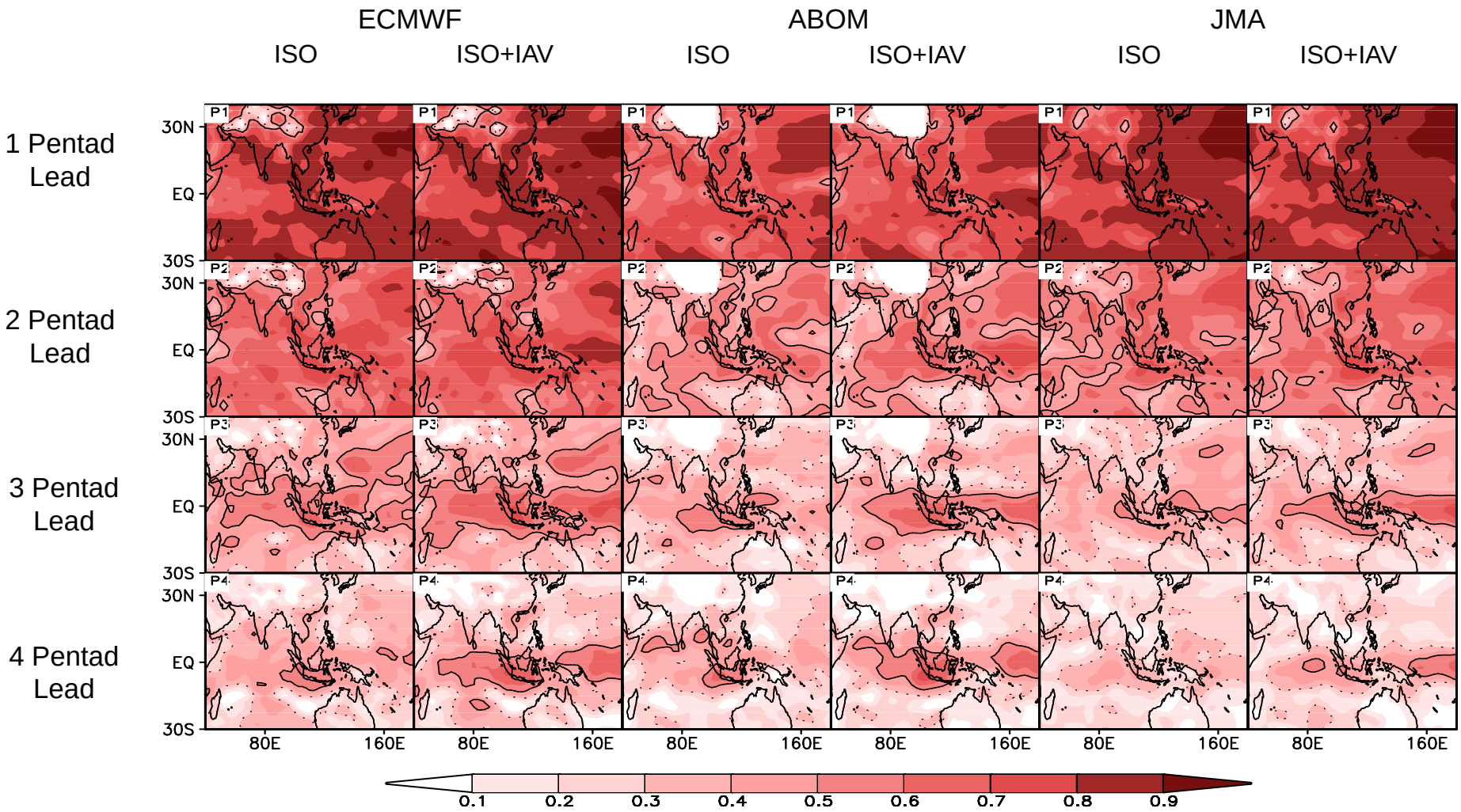
Total anomaly vs ISO component & ENSO Dependency



- ✓ Taking into account IAV anomaly, the practical TCC skill for the RMM1 and 2 extends about 5 to 10 days depends on model. In particular, the skill improvement is remarkable for the RMM1 verifying the interference of the ENSO phase onto the MJO phase.
- ✓ It is noted that the skill in the La Nina years is better than El Nino years in most models.

ISV Forecast Skills / ONDJFM

Temporal Correlation Coefficient Skill for U850



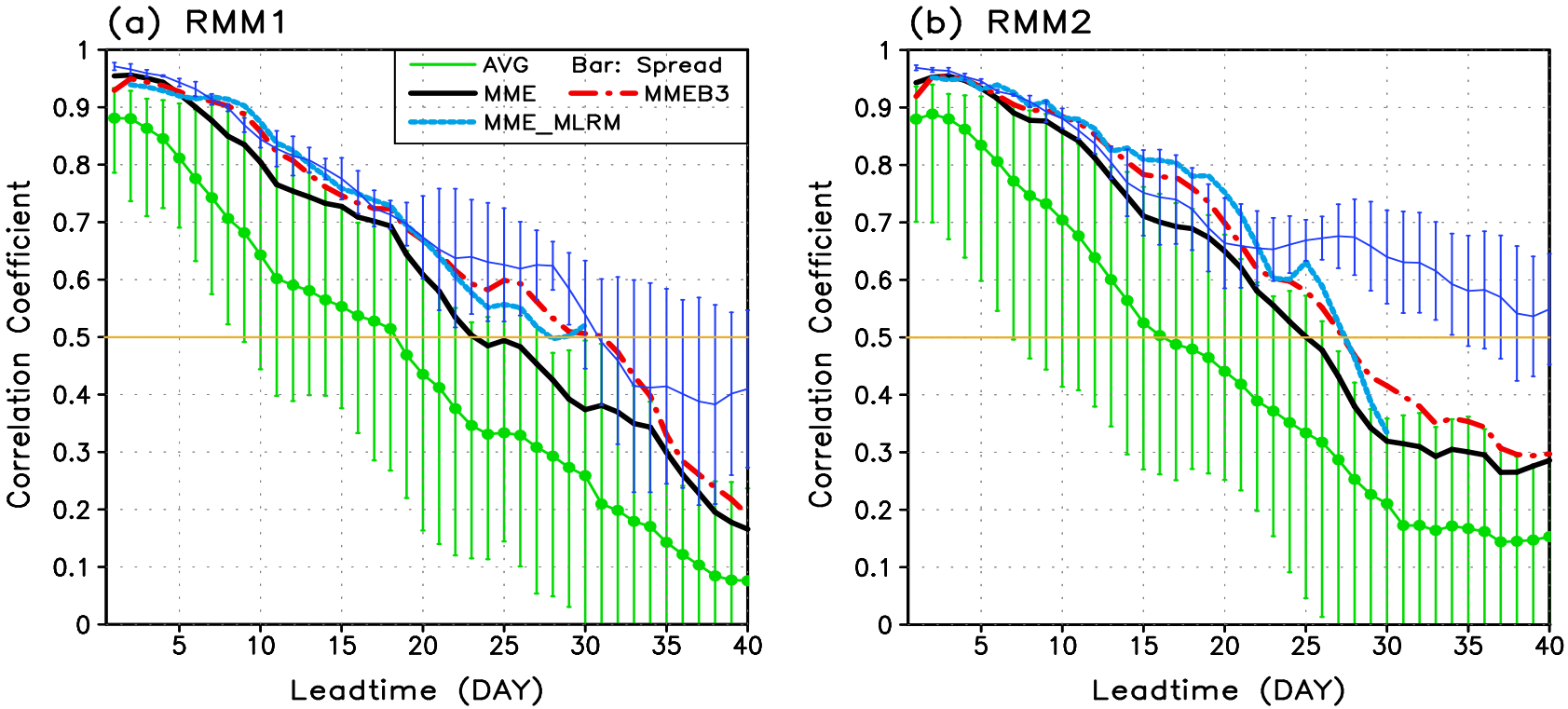
Model's Intrinsic Mode vs Practical Skill

- The best two models have better intrinsic mode of MJO than other models indicating that **correction of the inherent bias in the mean state and intrinsic MJO mode is critical for improving the MJO prediction**.

- Besides model physics, atmospheric initialization may be important. Although JMA coupled model has poor representation of MJO mode, it has useful skill for RMM1 and RMM2 up to 20 to 25 days. It is also shown that an enhanced nudging of divergence field is shown to significantly improve the initial conditions, resulting in an extension of the skillful rainfall prediction by 2-4 days and U850 prediction by 5-10 days (Fu et al. 2011). This suggests that **improvement of initial conditions are a very important aspect of the ISO prediction** (Fu et al. 2011).

Potential Predictability

Anomaly Correlation Coefficient



- Perfect model correlation was used to estimate potential predictability of MJO in coupled models. The blue bar indicates spread of estimation on the predictability using ECMWF and ABOM coupled models.

Summary/Discussion

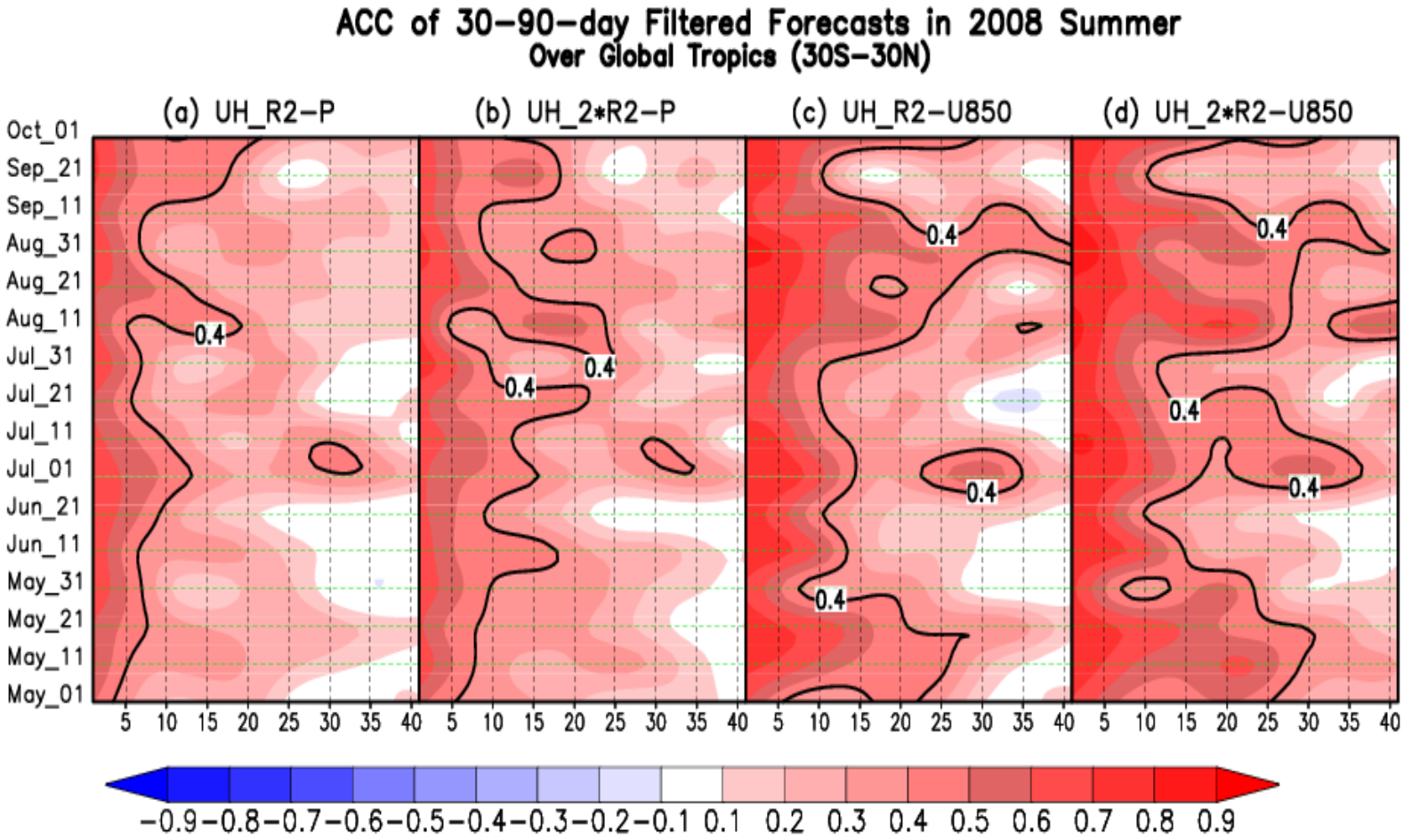
- The ISVHE has been accomplished. Hindcast results collected.
- Simulated ISV variance seems positive related to mean state simulation.
- Best 3 models MME is better than all-model MME. Using the best-3 models' MME, ACC skill for RMM1 & RMM2 reaches 0.5 at 27-day lead.
- Taking into account IAV anomaly, the practical TCC skill for the RMM1 and 2 extends about 5 to 10 days depends on models. The improvement is remarkable for the RMM1.
- The skill in La Nina years is better than El Nino years in most models.
- Perfect model correlation analysis using ECMWF and ABOM coupled models indicates that the RMM1 and RMM2 are potentially predictable up to 40 days.
- An improved initial conditions extends skillful rainfall prediction by 2-4 days and U850 prediction by 5-10 days.

Issues for further analysis

- How to objectively measure the model's performance on simulation of the principal modes?
- In general, what metrics should be used to evaluate the spatiotemporal behavior of the full ISV variability?
- How and why does the performance in simulation of intrinsic modes of ISV relate to the MJO forecast skill?
- Why the best 3 models MME is better than all-model MME? How to establish an optimum MME for deterministic and probabilistic forecast of MJO by using all ensemble members of each model?
- Seasonal stratification is important. Does evaluation of BSISO need different metrics?
- How to downscale the skilful large scale prediction of MJO or MISO to enhance regional prediction of ISV?

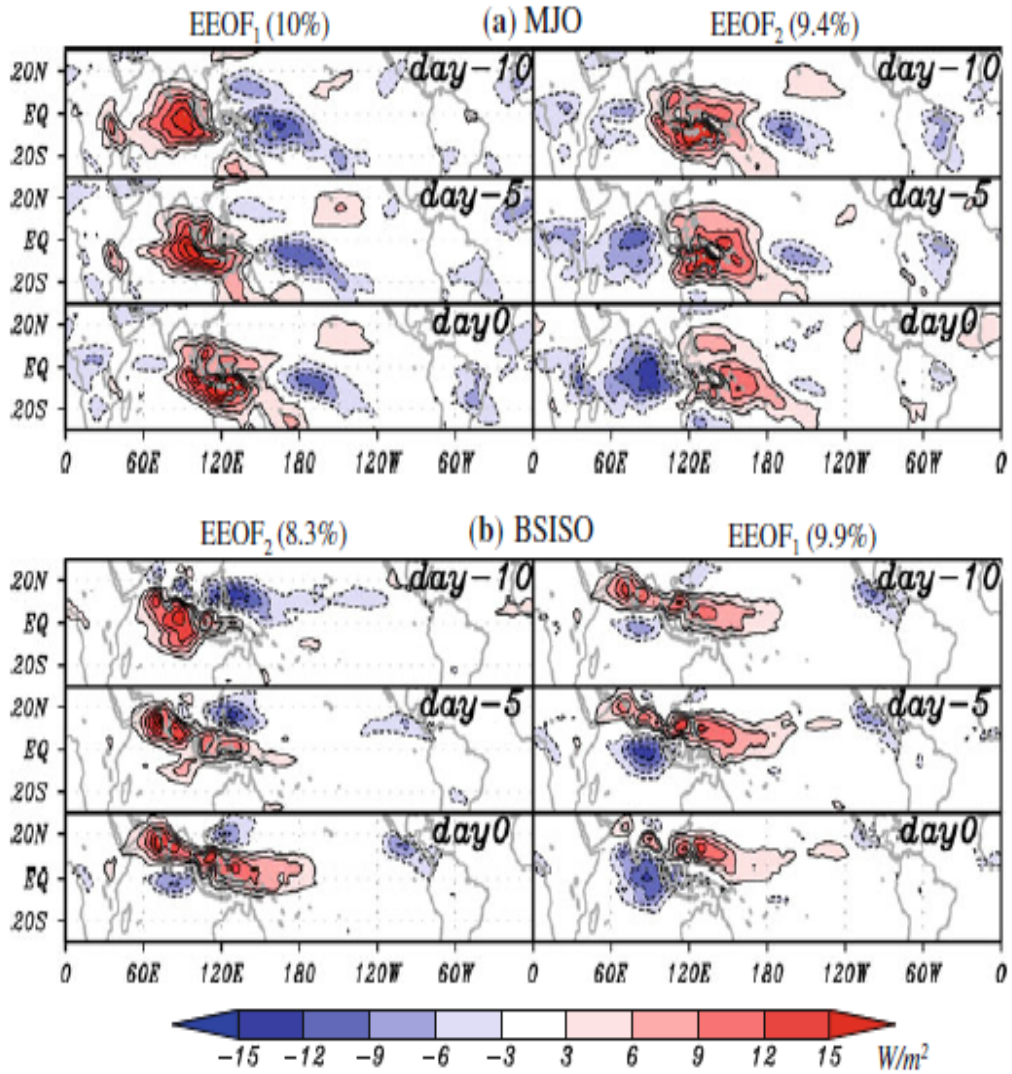
Thank you for questions and comments

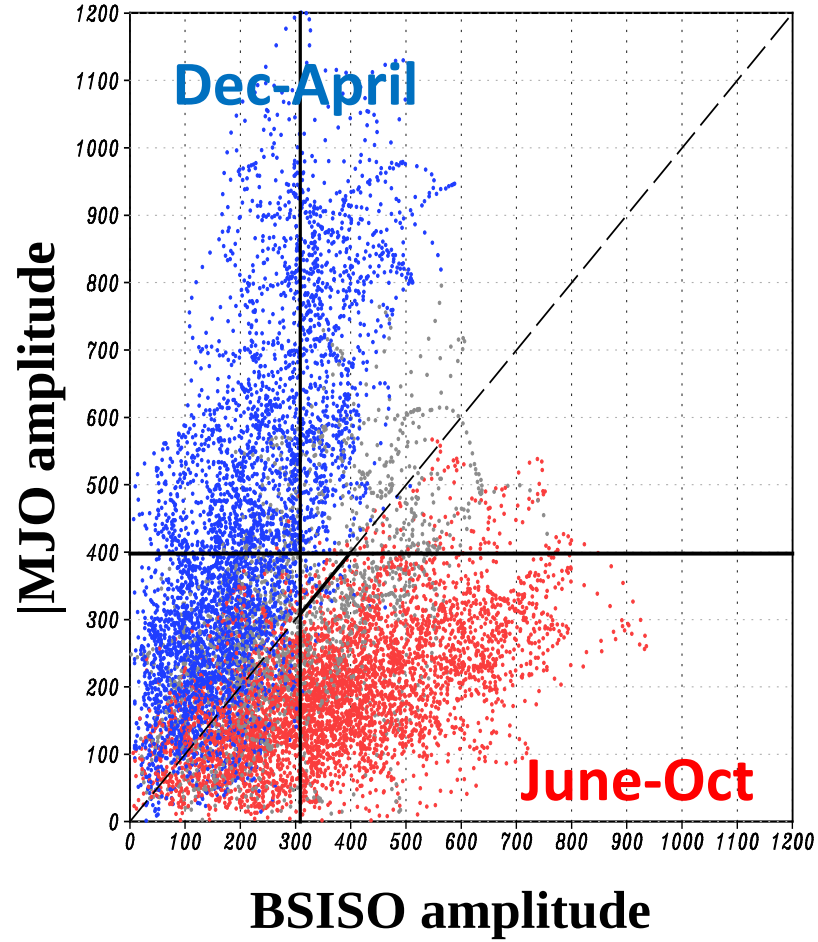
2 Impact of Initial Condition on ISO Prediction

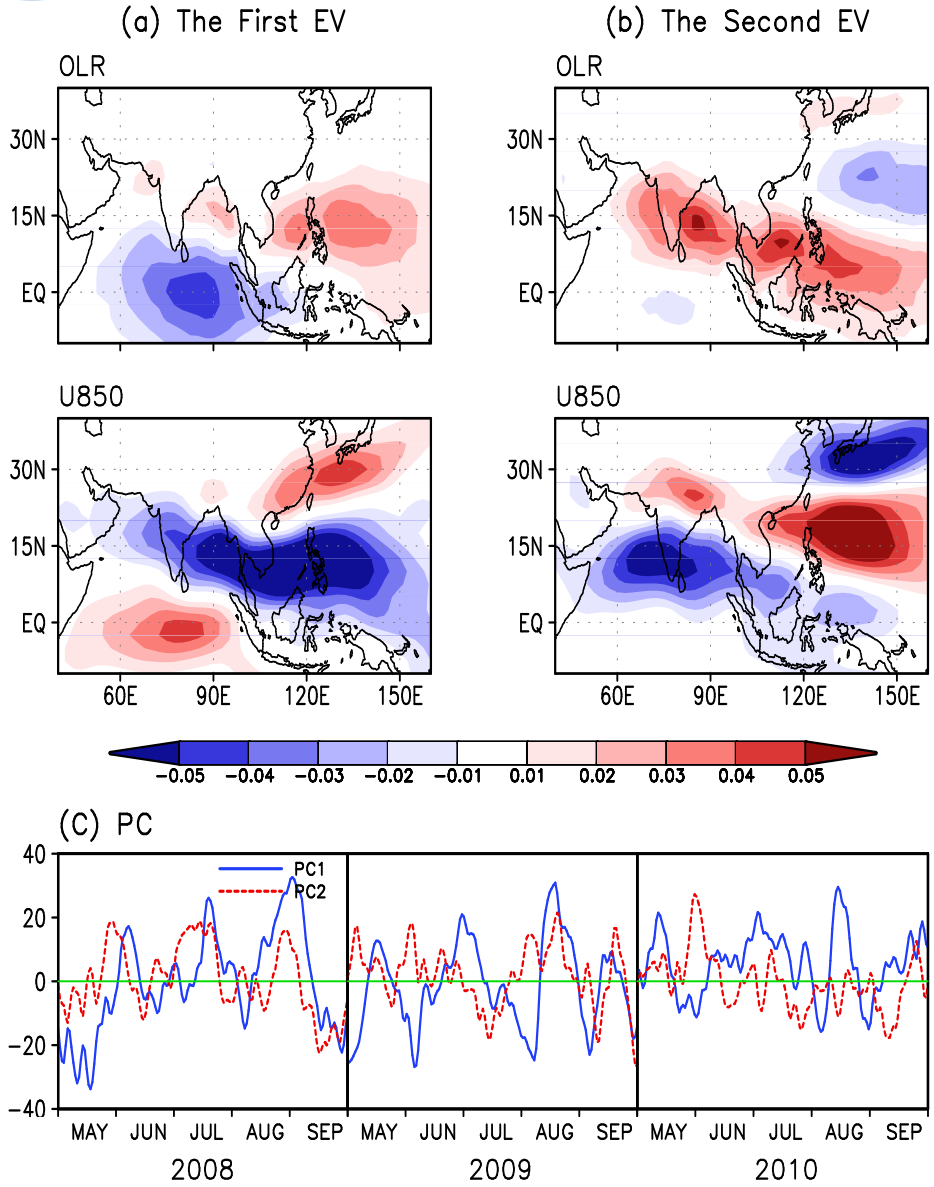
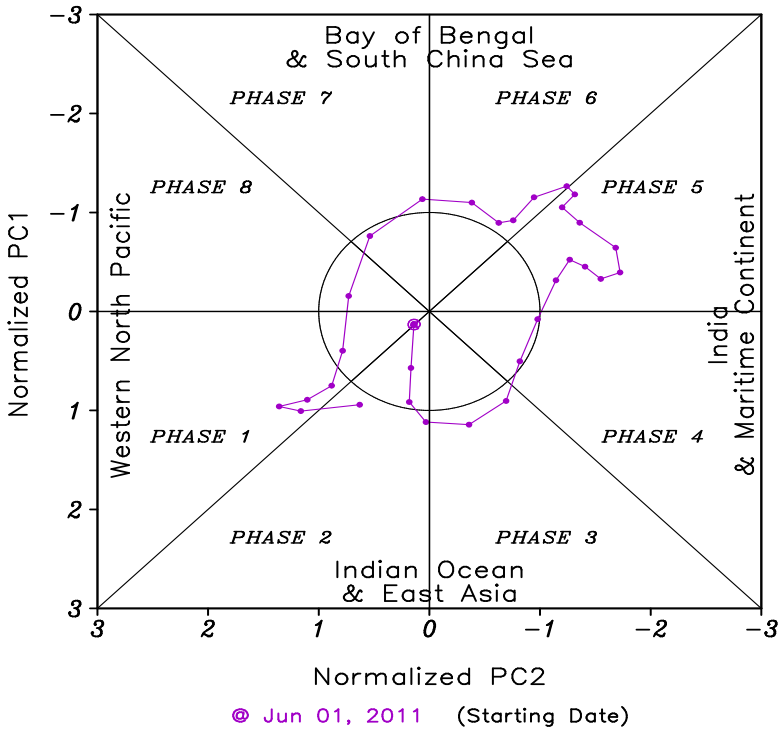


(a) skills of filtered rainfall initialized with the original NCEP_R2; (b) with doubled ISO signals in the NCEP_R2; (c) skills of filtered U850 initialized with the original NCEP_R2; (d) with doubled ISO signals in the NCEP_R2.

3 Bimodal Representation of the Tropical ISO





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

5 A Metrics for Boreal summer monsoon ISO