Predictability of Eastern Pacific Intraseasonal Variability

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and participating modeling groups

Based on
The eastern Pacific warm pool represents a region of strong ISV during boreal summer.

The dominant mode of EPAC ISV is of 30–50 day periodicity characterized by both eastward as well as northward propagation (e.g., Jiang and Waliser, 2008, Jiang and Waliser (2009), Maloney et al, 2008).
A see-saw pattern of convective activity exists between the west and east Pacific (Maloney and Esbensen 2007; Maloney et al. 2008).

In addition to the 30-50 day mode a quasi biweekly mode of ISV was discovered over the warm pool.

Is the EPAC ISV a local expression of the MJO? (Maloney and Hartmann, 2000; Maloney et al. 2007).

Eastward propagating convective signals from West to east Pacific.

Or a mode driven by local convection circulation feedbacks (Jiang et al. 2012; Jiang et al. 2013; Rydbeck et al (2013)).

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Regional Impacts of ISV over the Eastern Pacific

- **Caribbean Precipitation**
  - Martin et al. 2010

- **Central America Mid-Summer Drought**
  - Magana et al. 1999; Small et al. 2007

- **North American Monsoon**
  - Lorenz and Hartmann 2006

- **El Nino Development**
  - Vintzileos et al. 2005

- **Caribbean Sea LLJ**
  - Serra et al. 2010

- **Gap Winds**
  - Maloney & Esbensen 2003

- **Tropical Cyclone**
  - Maloney and Hartmann (2000a,b)
  - Higgins and Shi (2001); Jiang et al. (2012)

*Figure courtesy, X. Jiang (UCLA/JPL)*
Most GCMs underestimate the intraseasonal variance over the eastern Pacific (Lin et al, 2008).

Only models with higher horizontal resolution and model physics could capture the EPAC ISV modes reasonably. Especially the QBM (Jiang et al 2010)

Only seven out of the 16 CMIP5 GCMs captured the spatial pattern of the leading ENP ISV mode (Jiang et al, 2012, 2013). The biases are still quite high.

Model fidelity in representing EPAC ISV is closely associated with the ability to simulate a realistic summer mean low-level circulation.

But we are yet to understand the fidelity of the models in the prediction mode. Few, if any multi-model studies have explored the predictability and prediction skill of EPAC ISV
The ISVHE is the FIRST/BEST coordinated multi-institutional ISV hindcast experiment supported by APCC, NOAA CTB, CLIVAR/AAMP & MJO WG/TF, and AMY.
The EPAC ISV mode is isolated using combined EOF analysis of 20-100 day filtered TRMM precipitation and U850 anomalies.

PC1 prediction skill ~7-15 days

PC2 skill < 7 days in all models except ECMWF
Higher prediction skill (3-5 days) is associated with hindcasts initiated from the EPAC ISV convective phase as compared to those in the subsidence phase.
EPAC ISV and the MJO

Probability distribution of EPAC ISV amplitude associated with active MJO conditions (in blue) and quiescent MJO conditions (in red);

Eastward propagation of precipitation and wind anomalies in the EPAC ISV phase composites for a) active MJO conditions and b) quiescent MJO conditions.

probability distribution of EPAC ISV amplitude associated with active MJO conditions (in blue) and quiescent MJO conditions (in red);

Eastward propagation of precipitation and wind anomalies in the EPAC ISV phase composites for a) active MJO conditions and b) quiescent MJO conditions.

EPAC ISV is convective phase is phase locked with subsidence phase of MJO convective activity over the western Pacific warm pool.

Probability of occurrence of MJO (shown as percentage) in the eight RMM phases for a) subsidence b) convective phase of EPAC ISV.

EPAC ISV associated with strong MJO conditions have a stronger amplitude than that associated with quiescent MJO conditions.
Hindcasts divided between Active MJO (>= 1.2) and Quiescent MJO (< 0.8)

Four models exhibit distinctly higher prediction skill for EPAC ISV under active MJO conditions

Neena et al, 2014
Two estimates of EPAC ISV predictability from model hindcasts

**Single Member Approach**

Error -- Difference between hindcast PC values for two ensemble members.

**Ensemble Mean Approach**

Error -- Difference between hindcast PC values for an individual ensemble member and the ensemble mean of all other members.

As in
Waliser et al. (2003, 2004); Liess et al. (2005); Fu et al. (2007)
Neena et al 2014
EPAC ISV Mode 1 Predictability & Prediction Skill

a) PC1

PC1 predictability ~15-23 days

b) PC2

PC2 predictability ~9-17 days

Neena et al, 2014
Typical single member prediction skill for E.Pac ISV is 7-12 days. Ensemble prediction only slightly improves the skill. Predictability estimates for E.Pac ISV is about 20-30 days.

* Predictability estimates are shown as +/- 3 day range

Neena et al, 2014
The predictability & prediction skill of boreal summer EPAC ISV is investigated in the ISVHE hindcasts of eight coupled models.

EPAC ISV predictability based on individual ensemble members is about 15-20 days while for ensemble means it is about 20-30 days.

EPAC ISV prediction skill slightly better in some most/some models when initial state has convection vs subsidence in EPAC and for active vs quiescent MJO conditions.

Ensemble average EPAC ISV forecasts does not show much improvement over single member in the EPAC for the model/forecast systems analyzed.

The EPAC ISV amplitude is weaker during quiescent MJO conditions. Four models EPAC ISV prediction skill showed a strong dependence on the MJO amplitude at hindcast initiation.

The relative roles of MJO forcing, other remote forcings from W.Pacific and local feedbacks in initiating and sustaining the EPAC ISV is still not clear. Exploring such mechanisms would be quite relevant for EPAC ISV simulation and prediction.
Thank You