# Analysis of the origins of east Pacific easterly waves

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## OBJECTIVE

- To investigate the tracks and origin of easterly waves (EWs) in the east Pacific.

## MOTIVATION

The east Pacific Ocean is the second most active hurricane basin in the world. Previous work suggests that the majority of tropical cyclogenesis events in the east Pacific are seeded by easterly waves originating from Africa (e.g. Avila et al. 1991). It is hypothesized in this study that most of the EWs in the east Pacific are not linked to EWs originating in Africa but are initiated in-situ. Previous studies have provided evidence of different mechanisms that can generate EWs locally. For example, Zehnder et al. 1991 suggest that flow crossing over the topography in Central America may give rise to lee cyclogenesis events and the development of EWs. This study will focus on the origins and tracks of easterly waves in the east Pacific. Particular focus is placed on the Bight of Panama where Serra et al. 2010 showed an easterly wave genesis maximum. This study focuses on the months of June-November when EWs are most active.

## DATA

- TRMM precipitation dataset (0.5 degree) from 1999-2009
- WRF August 2005 Simulation (54 km grid spacing)
- NCEP/NCAR zonal and meridional wind (2.5 degree) from 1998-2012

## METHODS

**Composites and Lag Correlation**

- U wind 2-10 day band pass filter
- V wind 2-10 day band pass filter
- Precipitation 2-10 day band pass filter

**Events**

- An easterly wave was defined as a disturbance that crosses over a 5x5 degree averaging box and had anomaly amplitude 1.5 standard deviation from zero.
- 86 events in the east Pacific (5-10N, 85-90W)
- 96 events in the Caribbean (5-10N,70-75W)
- 89 events in the Atlantic(5-10N,45-50W)

## RESULTS

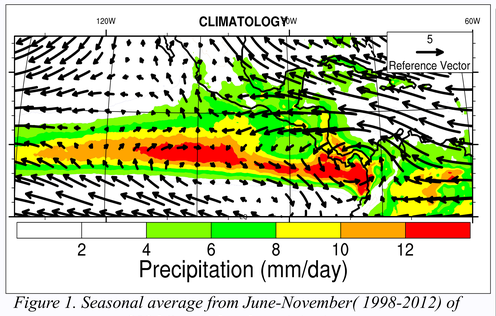


*Figure 1. Seasonal average from June-November( 1998-2012) of 850 hPa wind and precipitation.*

- Cyclonic low-level flow to the west of the Bight of Panama provides favorable background vorticity.
- A precipitation maximum just to the west of the Panama Bight shows strong background precipitation favorable for easterly wave growth.

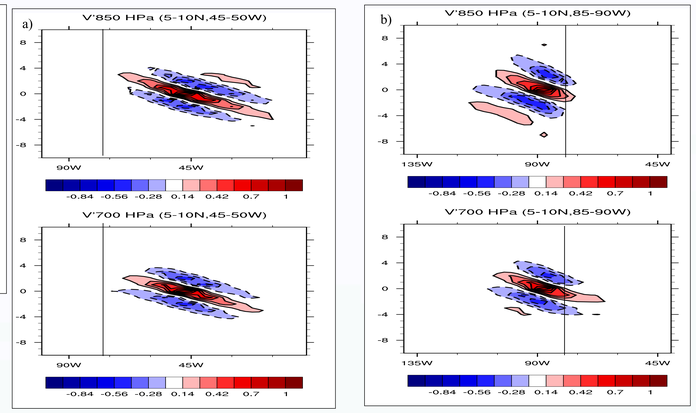


*Figure 2. a) 10 day lag correlation of 2-10 day band pass filtered V wind anomaly in the Atlantic correlated with those in the 3-13N tropical belt. Shaded values are statistically significant at the 95% confidence level, values above 0.14 are shaded. b)Same as (a), but in the east Pacific.*

- In Figure 2a waves in the Atlantic are not significantly correlated to those in the east Pacific. Furthermore, in Figure 2b waves originate near the Bight of Panama.

### Composites

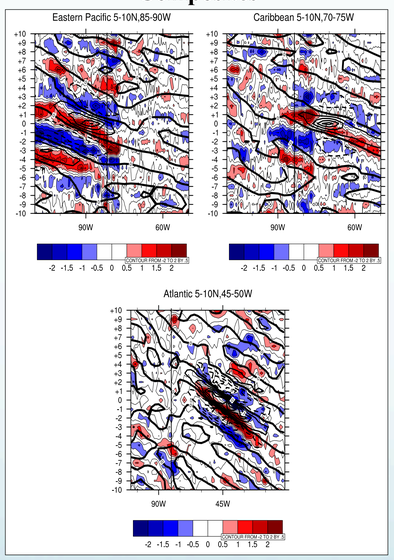


*Figure 3. Composite Hovmoller of 2-10 day band pass filtered V wind and 2-10 day band pass filtered precipitation averaged from 3-13N. Precipitation anomalies are shaded. V wind anomalies are contoured, with dashed negative values. The solid black line shows the longitude of the Bight of Panama.*

- Composite show that easterly waves that originate in Africa do not cross over to the east Pacific.

### Model vs Reality

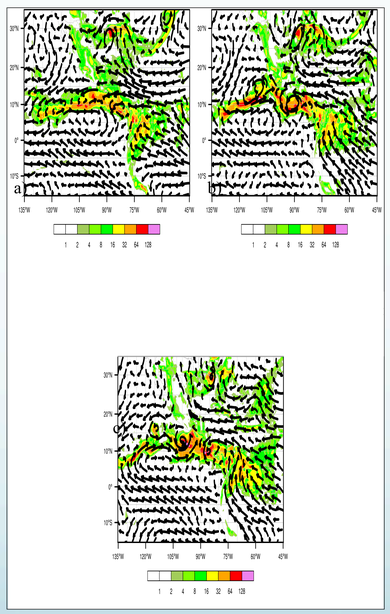


*Figure 4. a) WRF model daily total precipitation and mean 850 hPa wind from August 6th 2005, b) August 8th 2005, c) and August 10th 2005.*

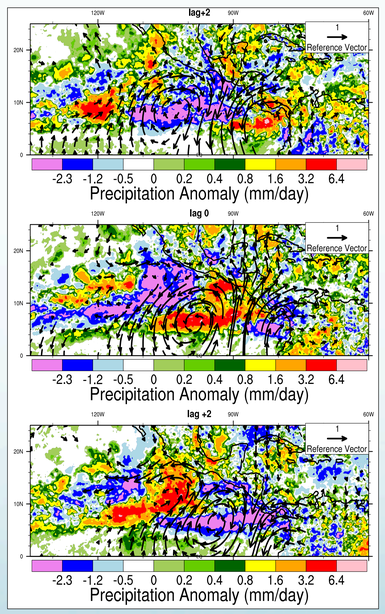


*Figure 5. Lagged composite of precipitation anomalies and 850 hPa wind anomalies averaged over 5-10N,85-90W. Only wind anomalies greater than 0.15 are plotted.*

- Observed easterly wave features in Figure 5 support the progression, origin, trajectory and intensity of the wave modeled using WRF shown in Figure 4.

## CONCLUSIONS

- The Bight of Panama is a climatologically favorable environment for the development of easterly waves due to the low-level cyclonic flow and precipitation maximum.
- Composites of easterly waves support the idea that most easterly waves are generated in east Pacific rather than initiating in Africa.
- Composites and lag correlation plots support the idea that convective and dynamical signatures of waves do not appear to cross over from the Atlantic to the Pacific.
- The WRF model simulates the location, track, and intensity of easterly waves when compared to observations in a limited case study.

## FUTURE WORK

- Use the WRF model to remove the influence of African easterly waves on the east Pacific to determine whether easterly waves can be locally generated .
- Investigate the specific role of Bight of Panama to easterly wave generation in WRF.
- Correlate east pacific developing waves to tropical cyclone frequency.
- Opportunity to evaluate model ability to track easterly waves.

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