

**Analysis of the MJO-wind speed  
relationship in the Indian Ocean  
using RAMA observations**

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17<sup>th</sup> CMMAP Meeting

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# Outline

- **Recent MJO theory**
- **Methods and Data**
- **Results**
  - **LHFLX vs. precip. for filtered time series**
  - **LHFLX vs. precip for global MJO indices**

# Recent MJO Theory

- **Moisture mode** – instability whose growth & propagation depend on feedbacks which alter tropospheric moisture (e.g. Raymond & Fuchs 2007, 2009; Sobel & Maloney 2012)
- Destabilized by surface fluxes and cloud radiative feedbacks (i.e. *processes that control column MSE*; Sobel et al. 2009 Raymond et al. 2009).

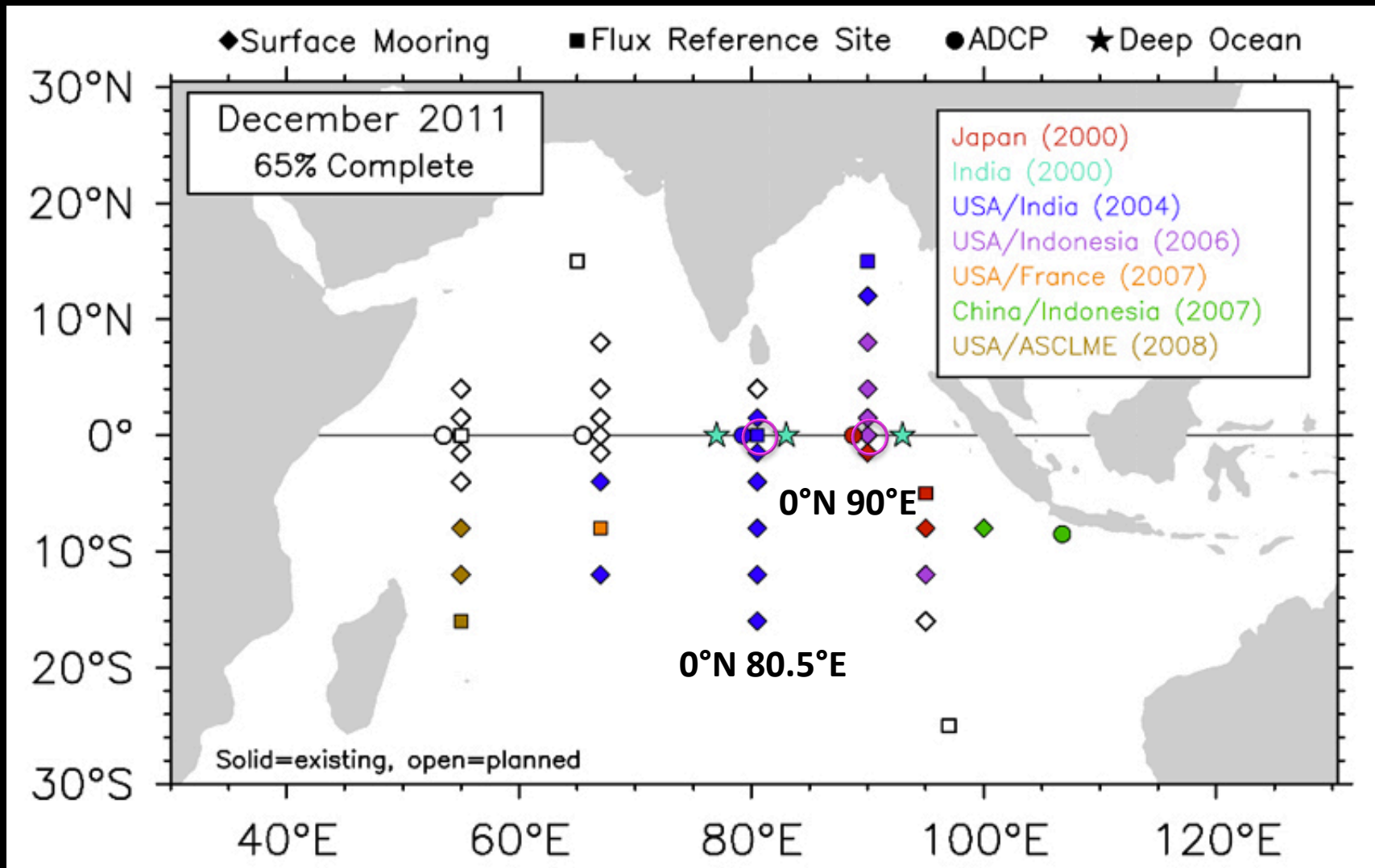
$$\left\langle \frac{\partial m}{\partial t} \right\rangle = -\left\langle \vec{V} \cdot \nabla m \right\rangle - \left\langle \omega \frac{\partial m}{\partial p} \right\rangle + LH + SH + \langle LW \rangle + \langle SW \rangle$$

**Relative importance of each term to precip**

# Approach

- Use observations to assess intraseasonal surface flux-precipitation relationship in the Indian Ocean
- Surface fluxes computed using COARE flux bulk algorithm (Fairall et al. 2003)
- Builds off Araligidad & Maloney (2008), Maloney et al. (2007), and Maloney & Esbensen (2007)

# Data

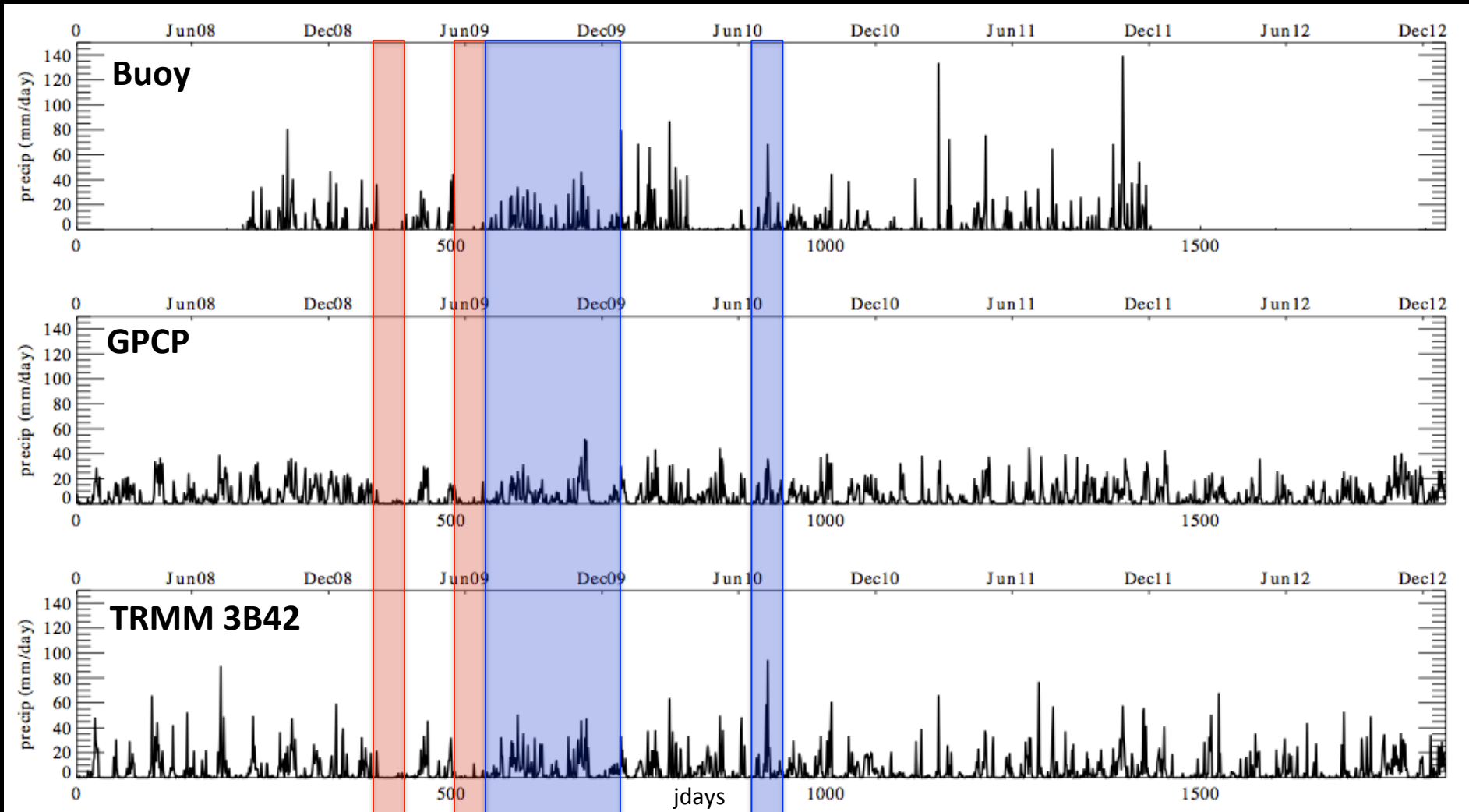


# Daily Avg. Precipitation Time Series

June 2008

0°N 80.5°E

Dec 2012



- TRMM & GPCP interpolated to Buoy point

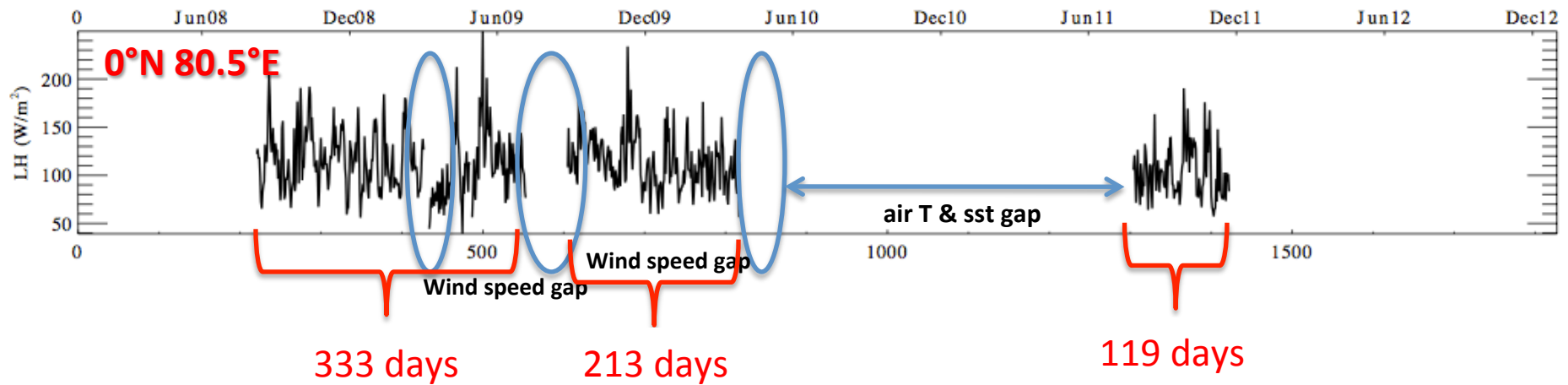
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# Flux Time Series

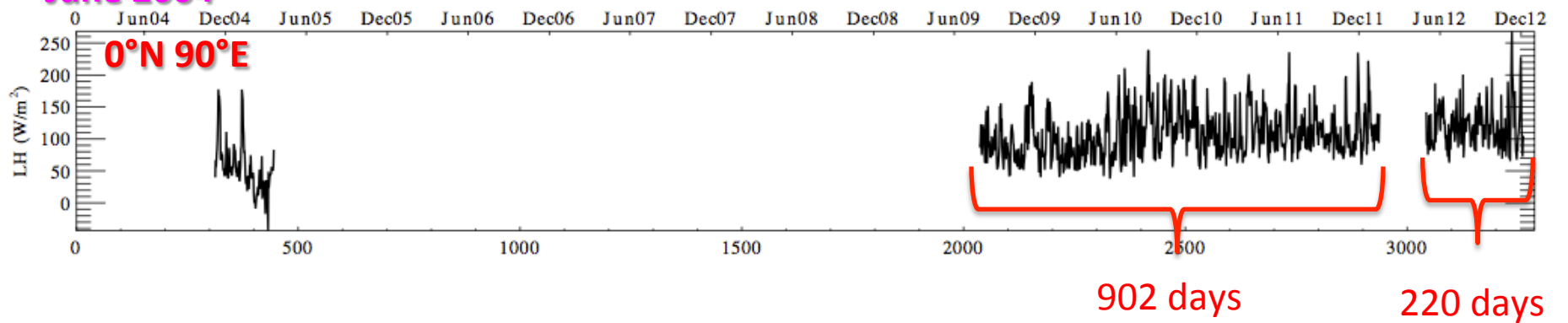
June 2008

Dec 2012



June 2004

Dec 2012



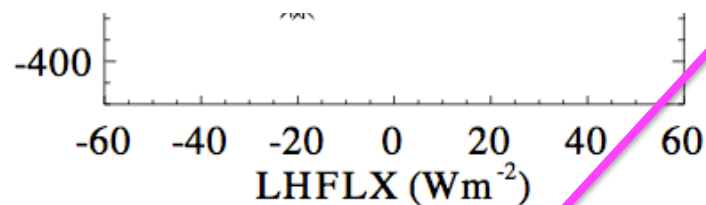
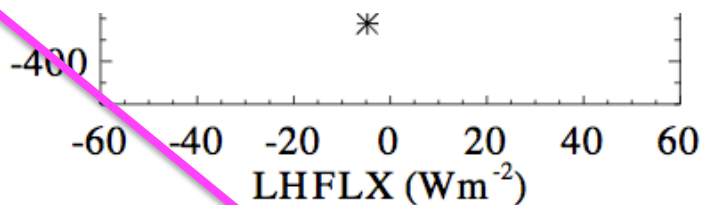
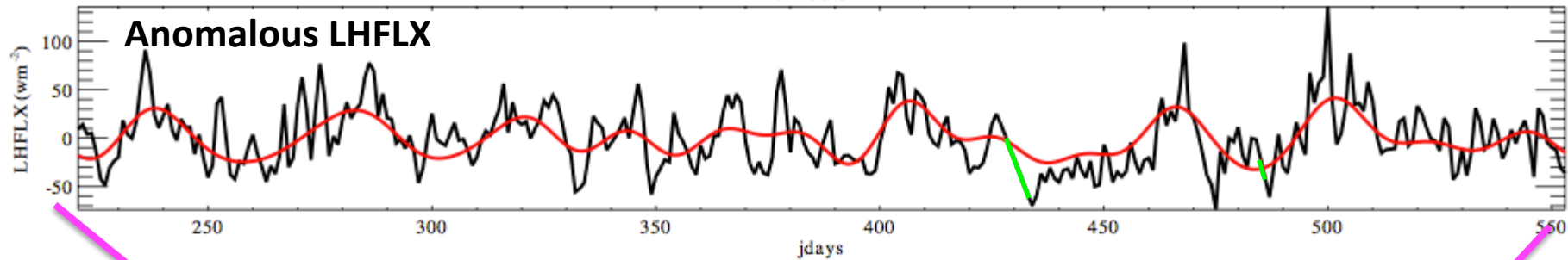


# LHFLX vs. Precip : 0°N 80.5°E

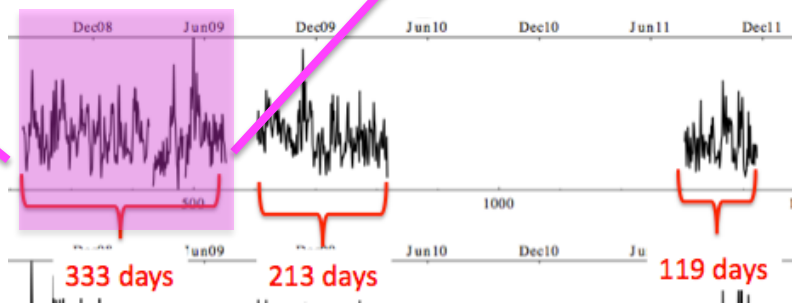
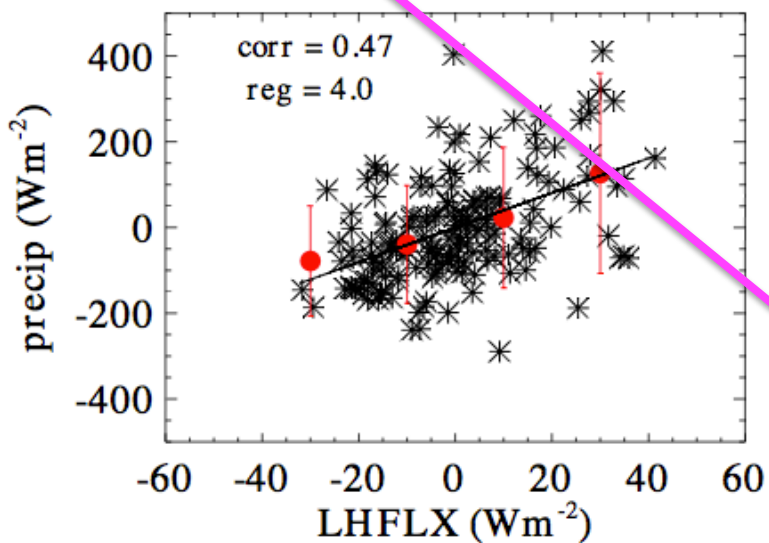
Buoy

TRMM

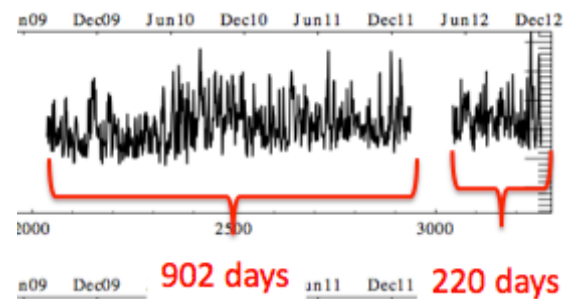
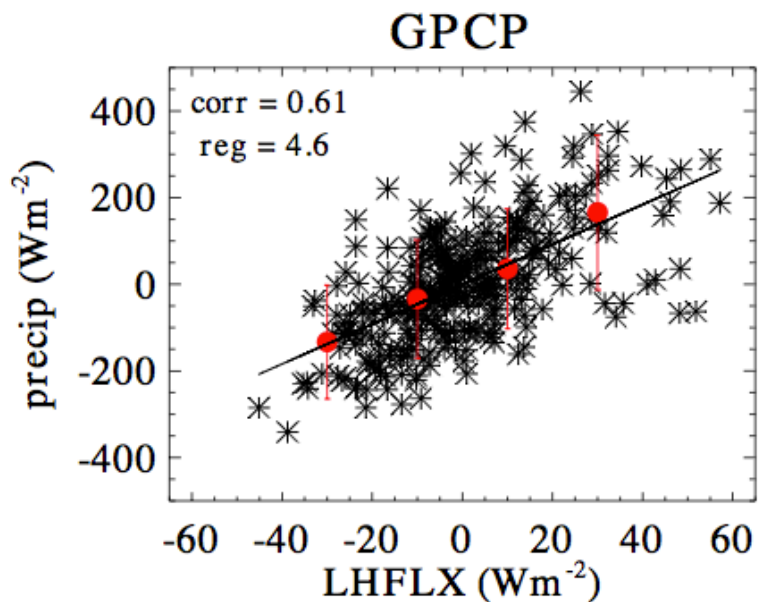
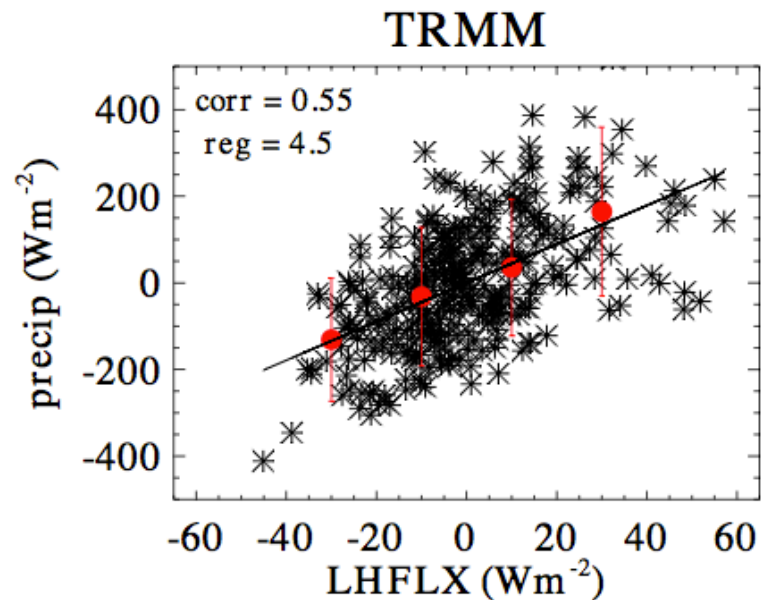
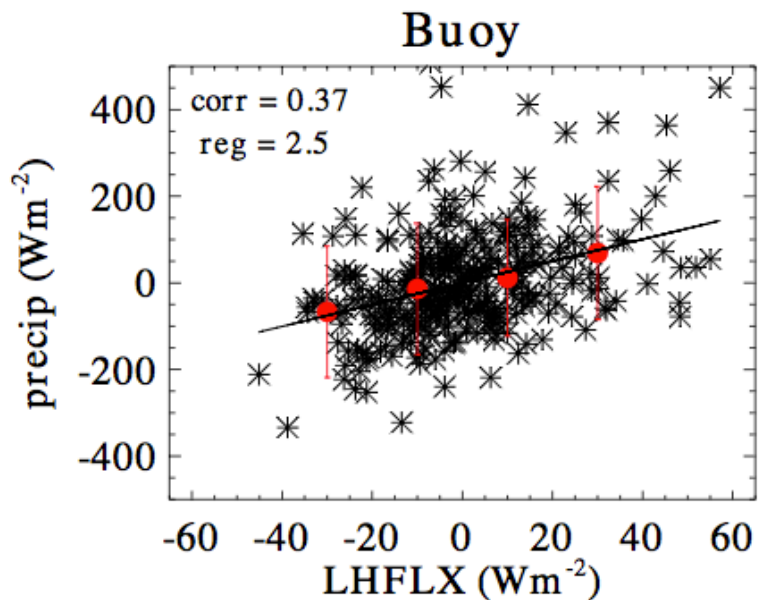
0N80.5E



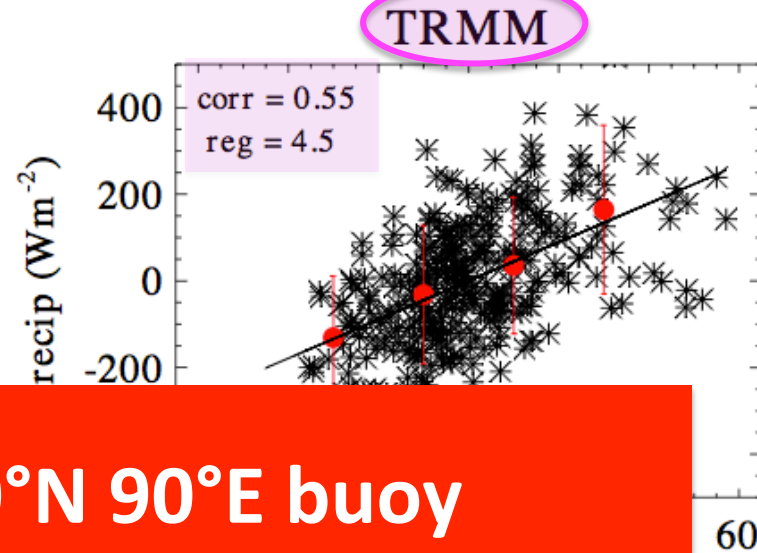
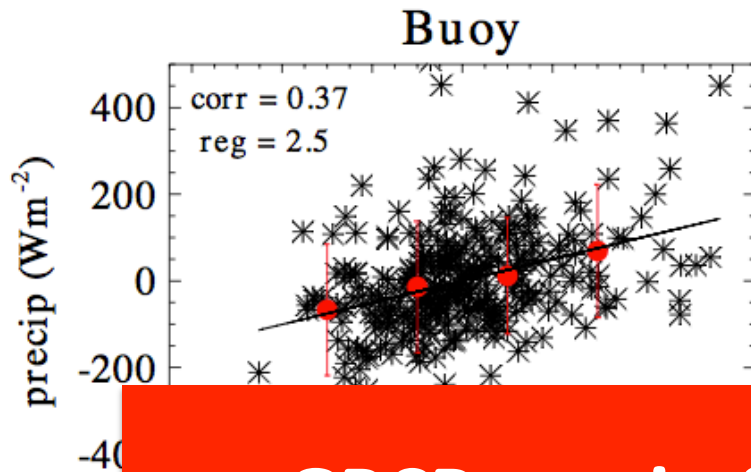
GPCP



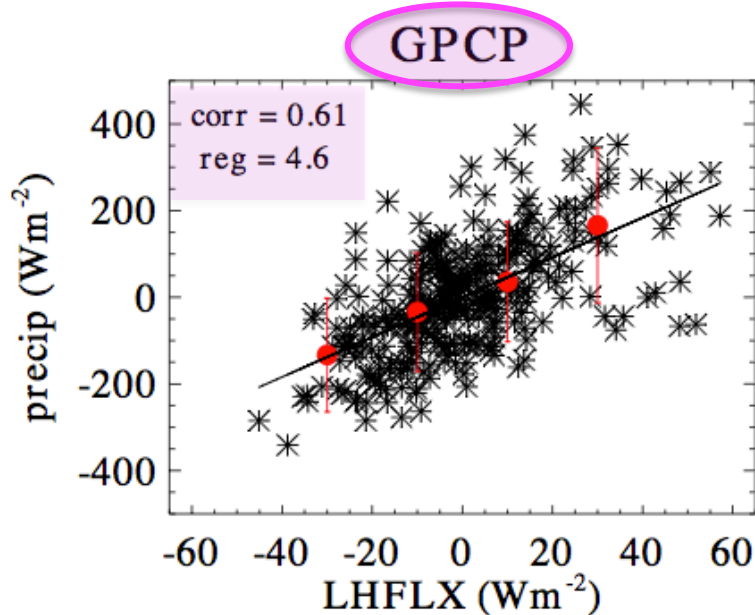
# LHFLX vs. Precip : 0°N 90°E



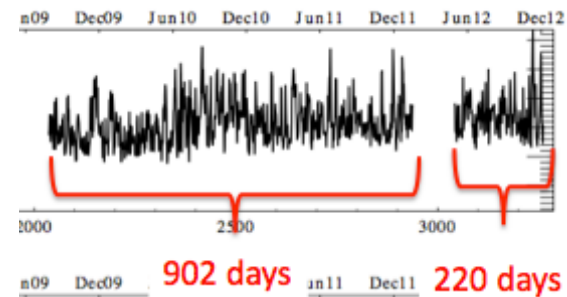
# LHFLX vs. Precip : 0°N 90°E



**GPCP precip & 0°N 90°E buoy**



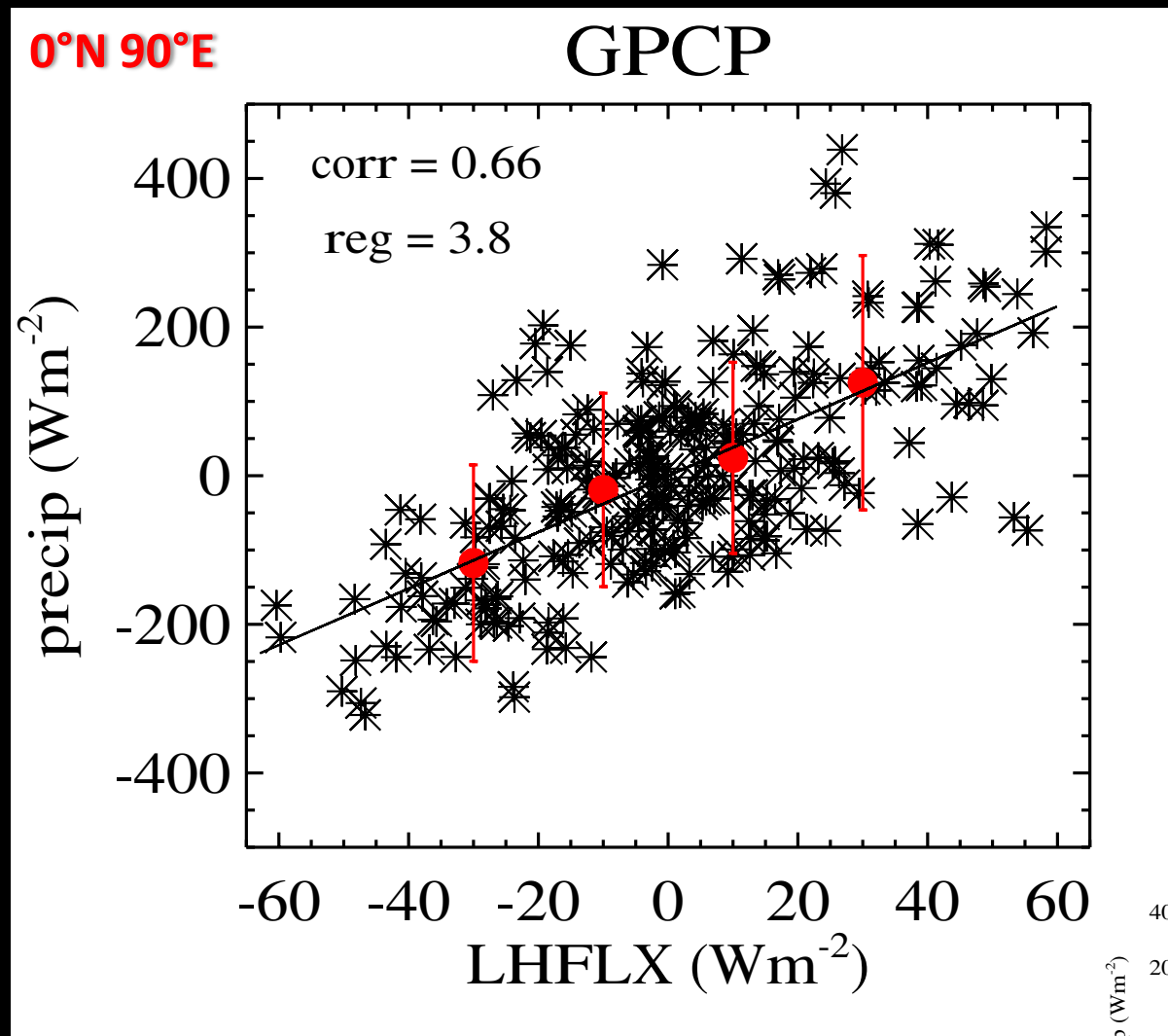
- 20 – 100 day Lanczos bandpass filter on anomalies
- Every 4<sup>th</sup> day plotted
- TRMM, GPCP LHFLX anom ~20% precip anom



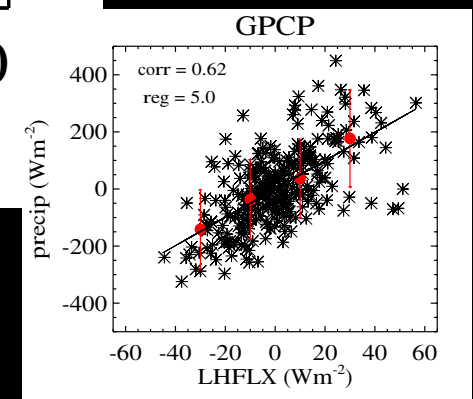
# **Isolate effect of wind induced flux variability**

- **Feed COARE flux algorithm 50-day running mean of SST, RH, and air T**
- **Feed COARE flux algorithm 50-day running mean wind speed**

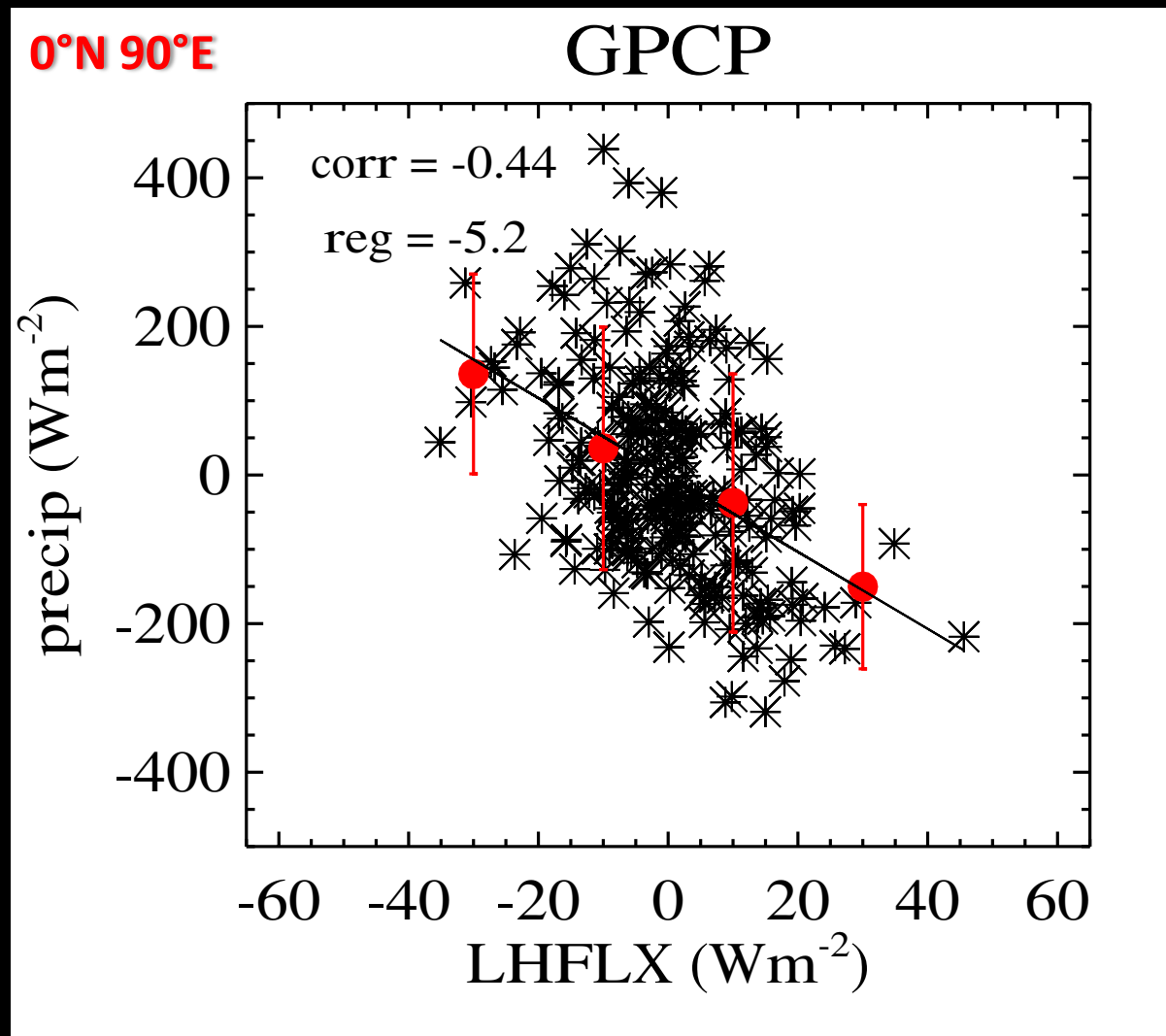
# 50-day running mean thermo. to compute LHFLX



- Regression coefficients decrease
- TRMM, GPCP LHFLX anom  $\sim 26\%$  precip anomalies



# 50-day running mean wind speed to compute LHFLX

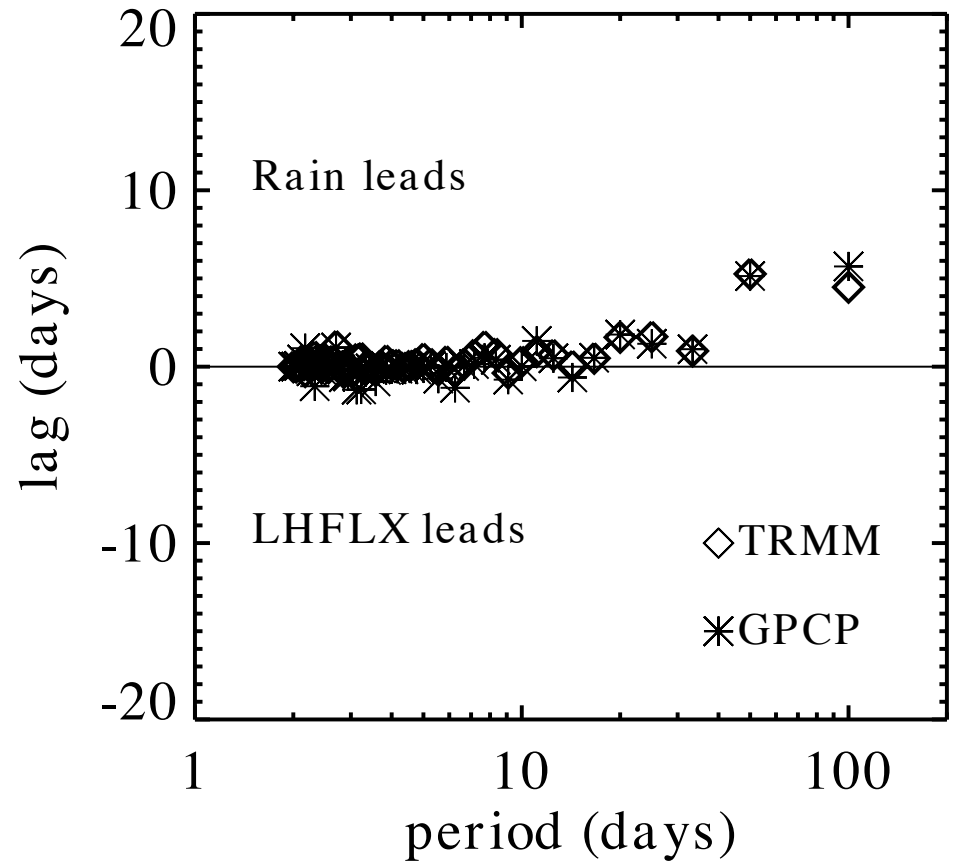
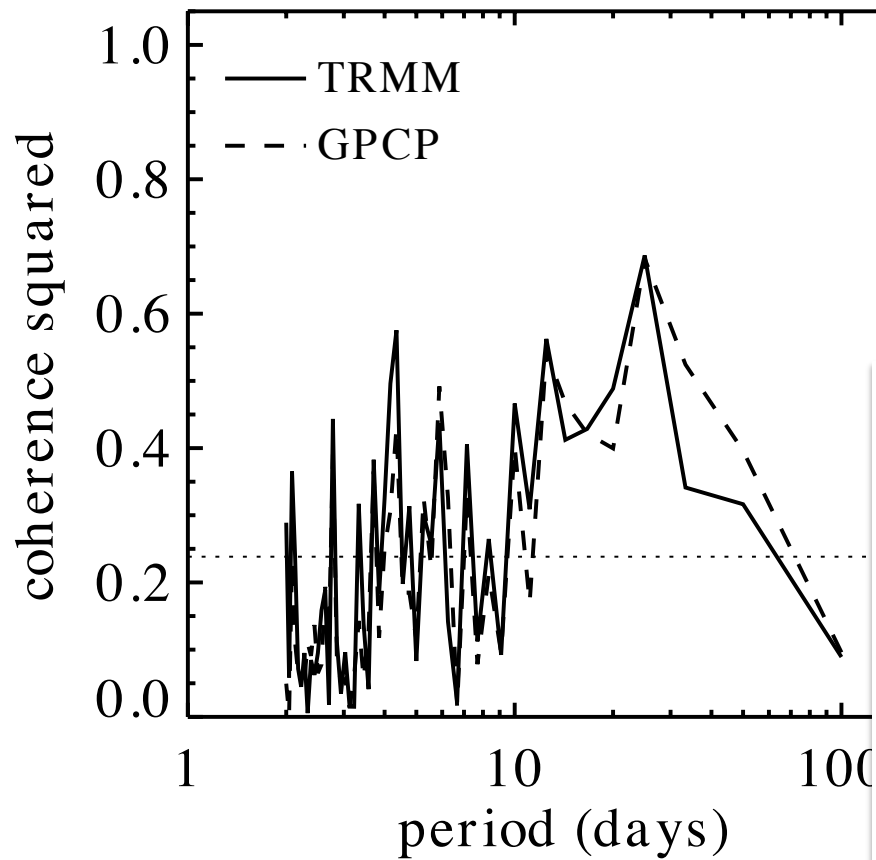


- Relationship switches
- Intraseasonal LHFLX anomalies more wind driven vs. thermodynamic driven

# **Can we understand why correlation between precip and LHFLX switches?**

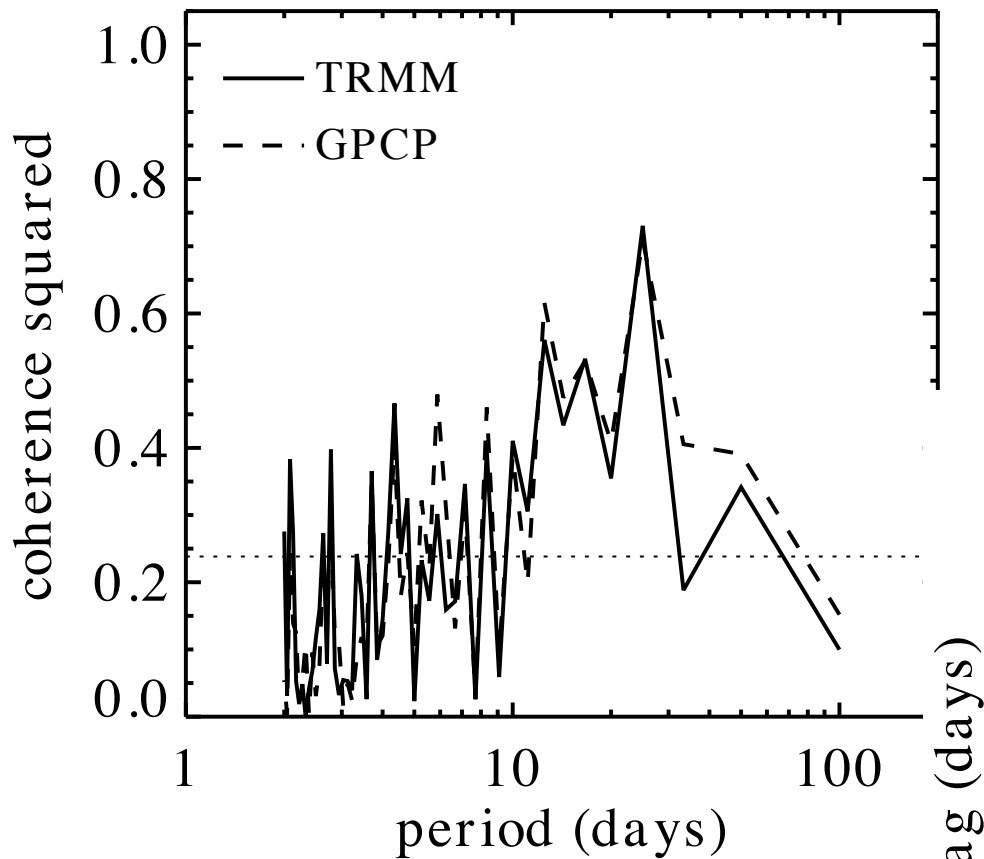
- **Examine coherence and phase relationship between LHFLX and GPCP rain**

# Coh<sup>2</sup> LHFLX & Precip at 0°N 90°E

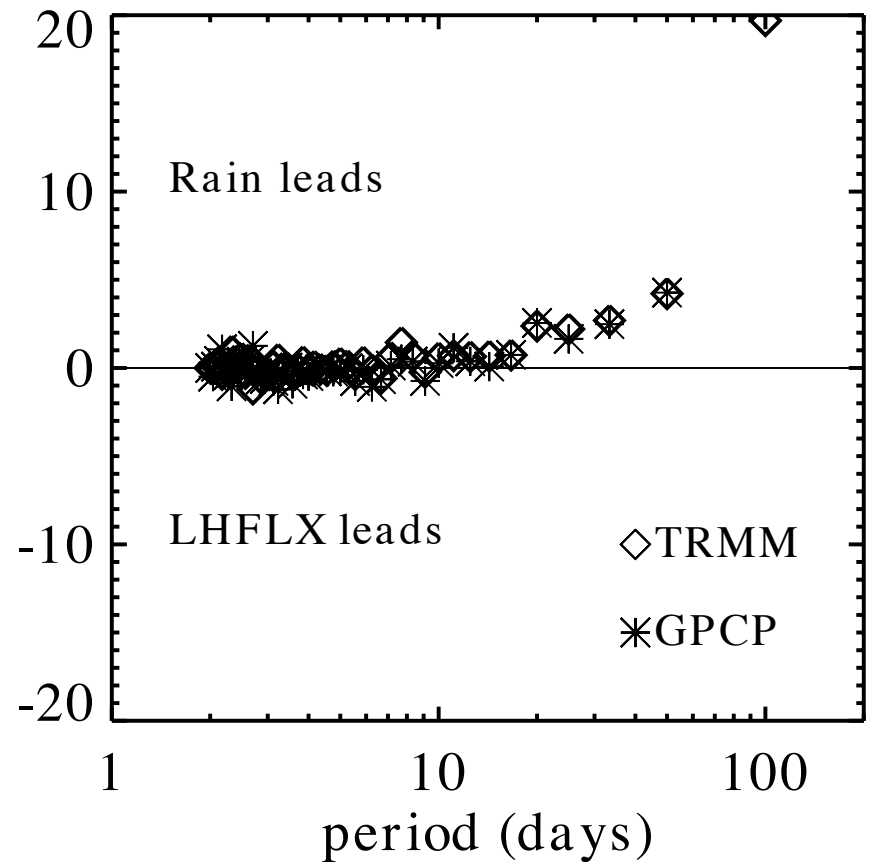




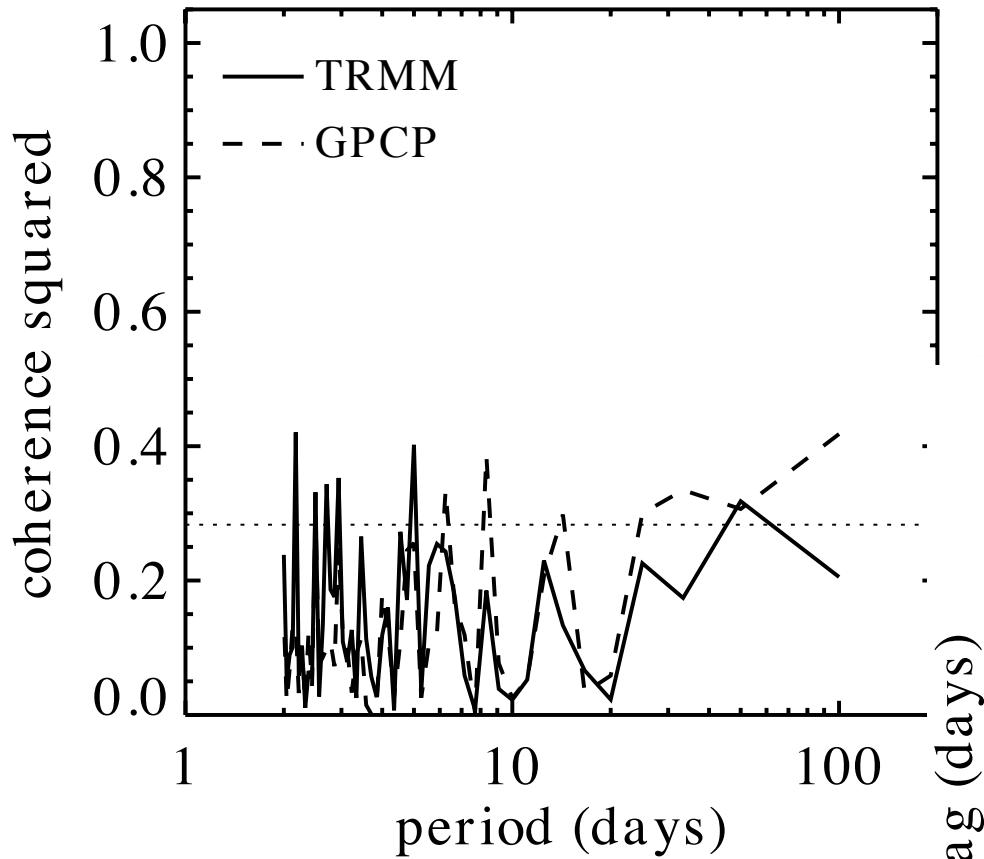
# Coh<sup>2</sup> LHFLX & Precip at 0°N 90°E



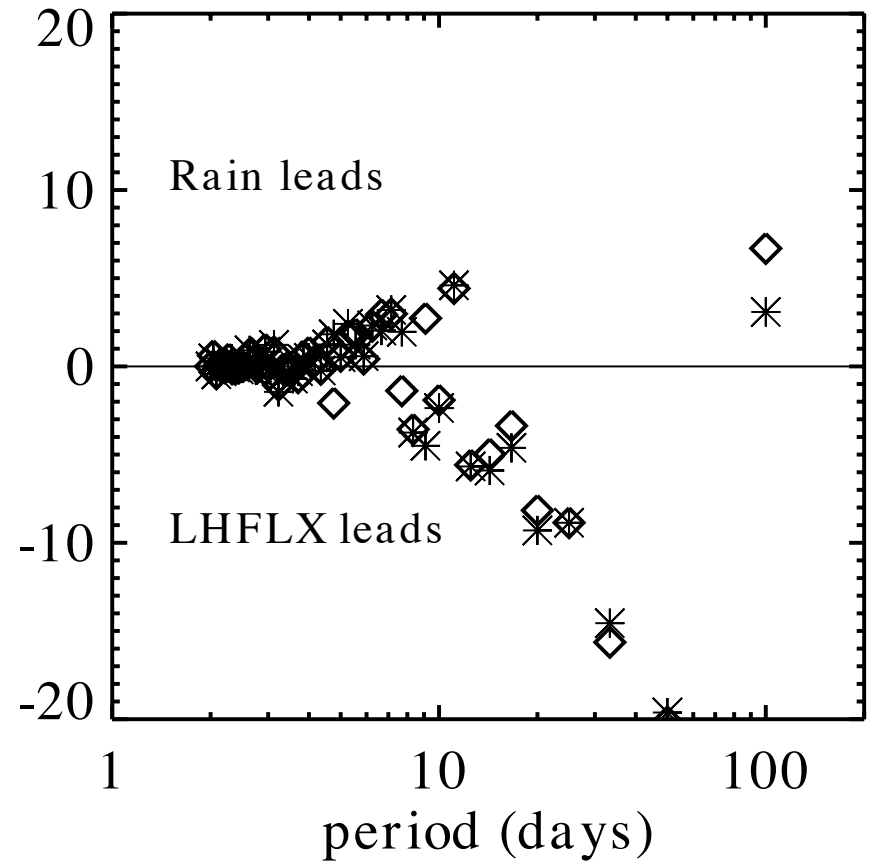
**LHFLX with  
smoothed  
thermodynamics**



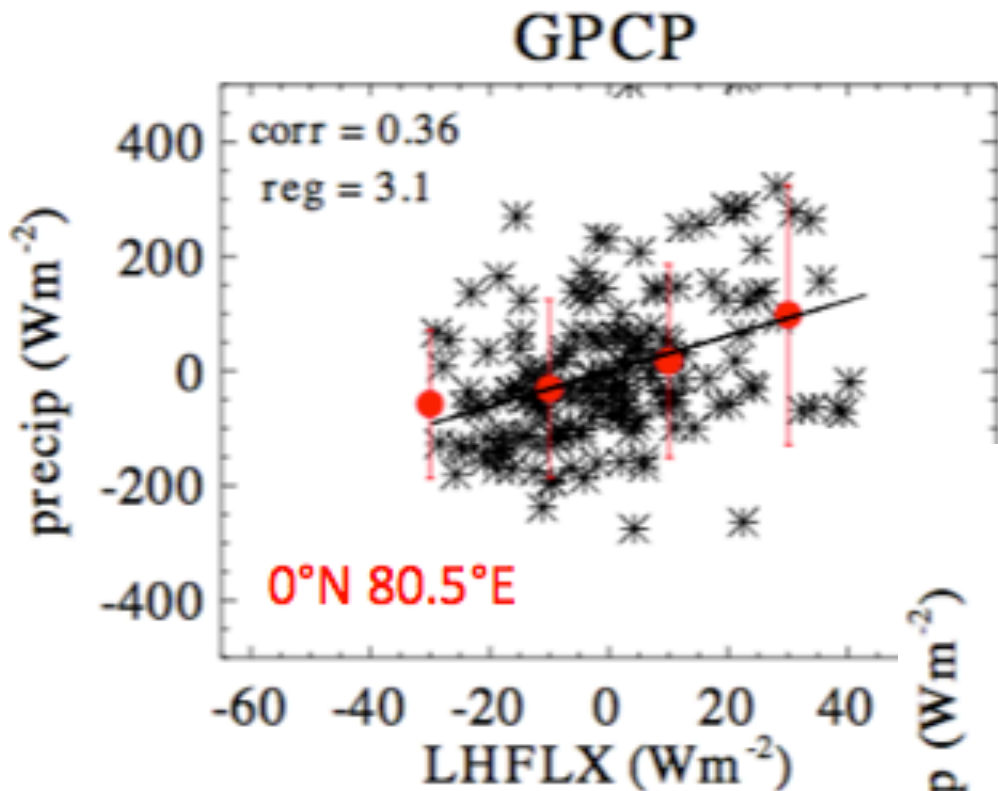
# Coh<sup>2</sup> LHFLX & Precip at 0°N 90°E



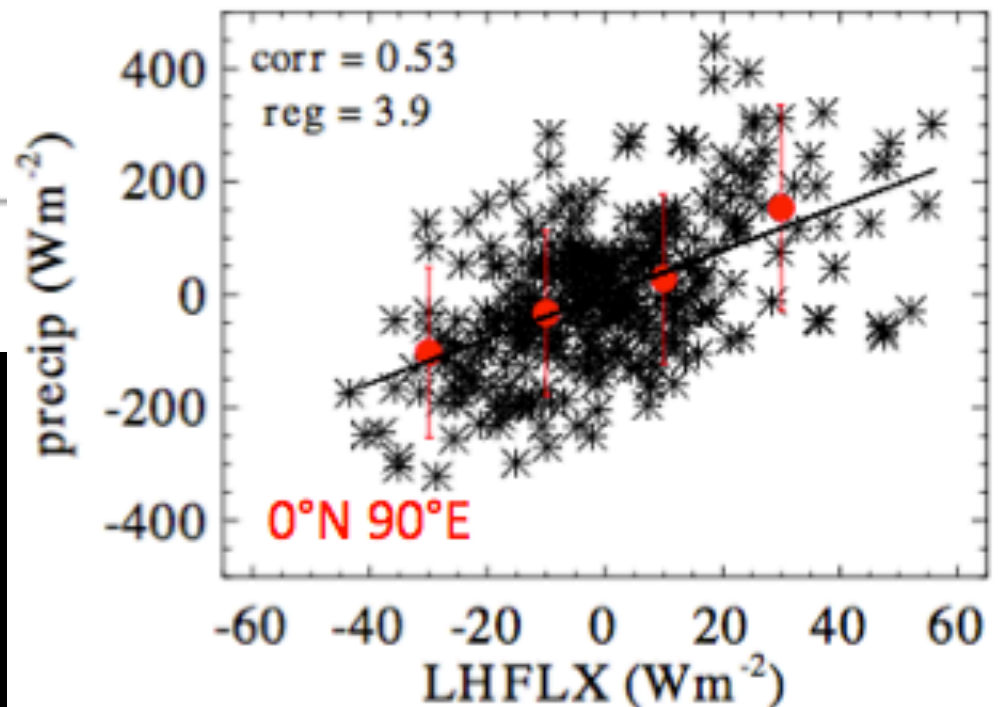
**LHFLX with  
smoothed wind  
speed**



# Is mesoscale gustiness important to intraseasonal LHFLX variability?

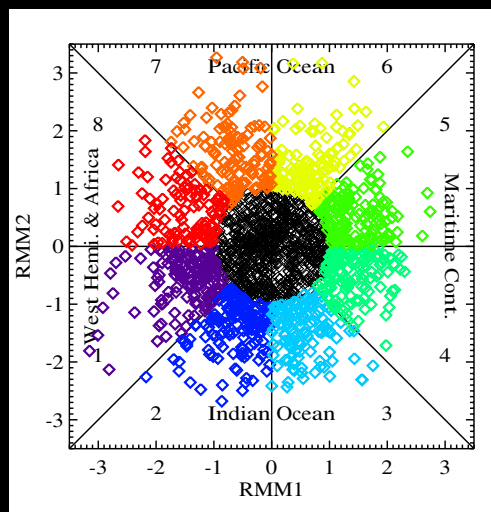


LHFLX with daily averaged wind vectors to minimize meso effects

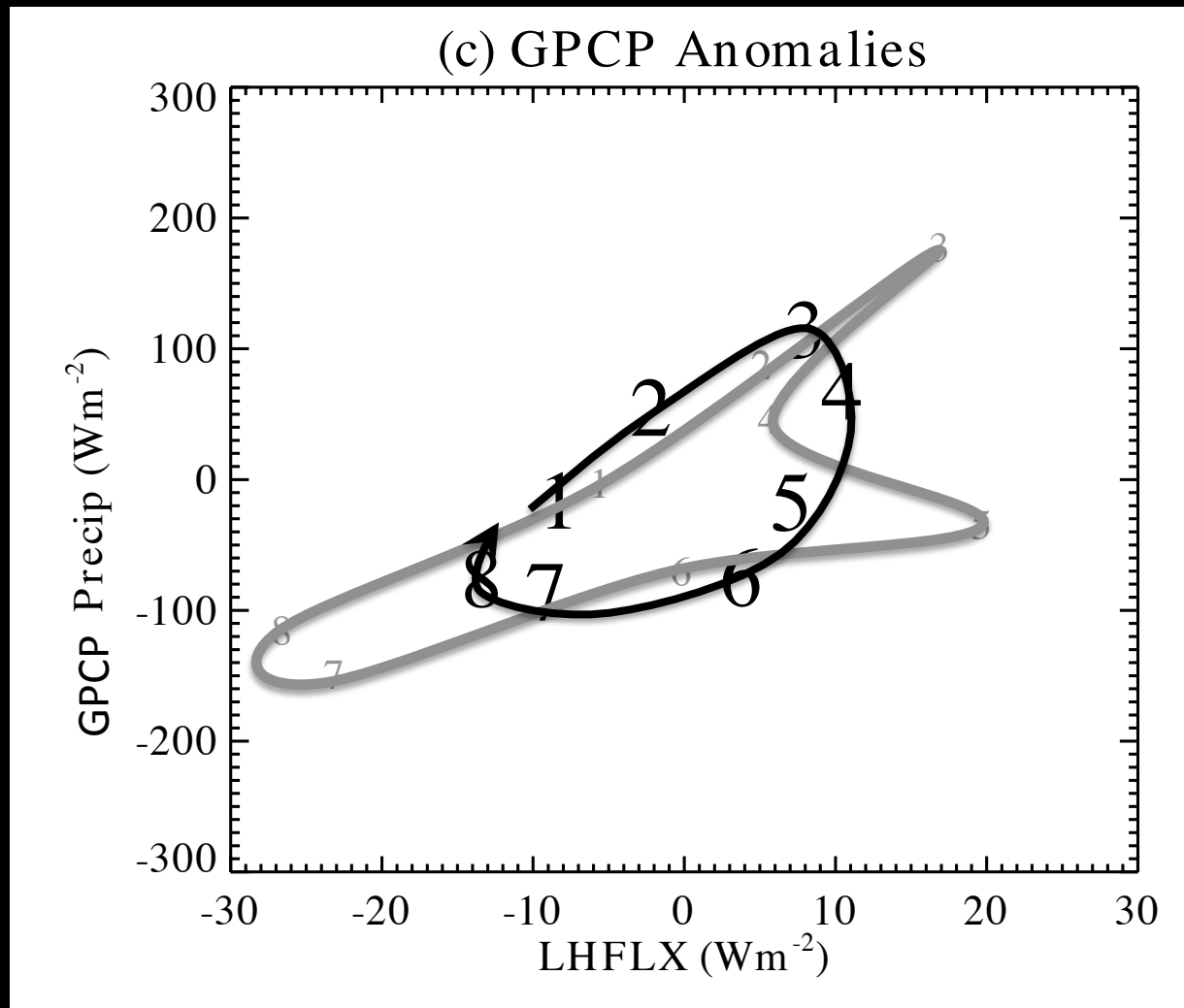


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# RMM phase anomalies at 90°E buoy

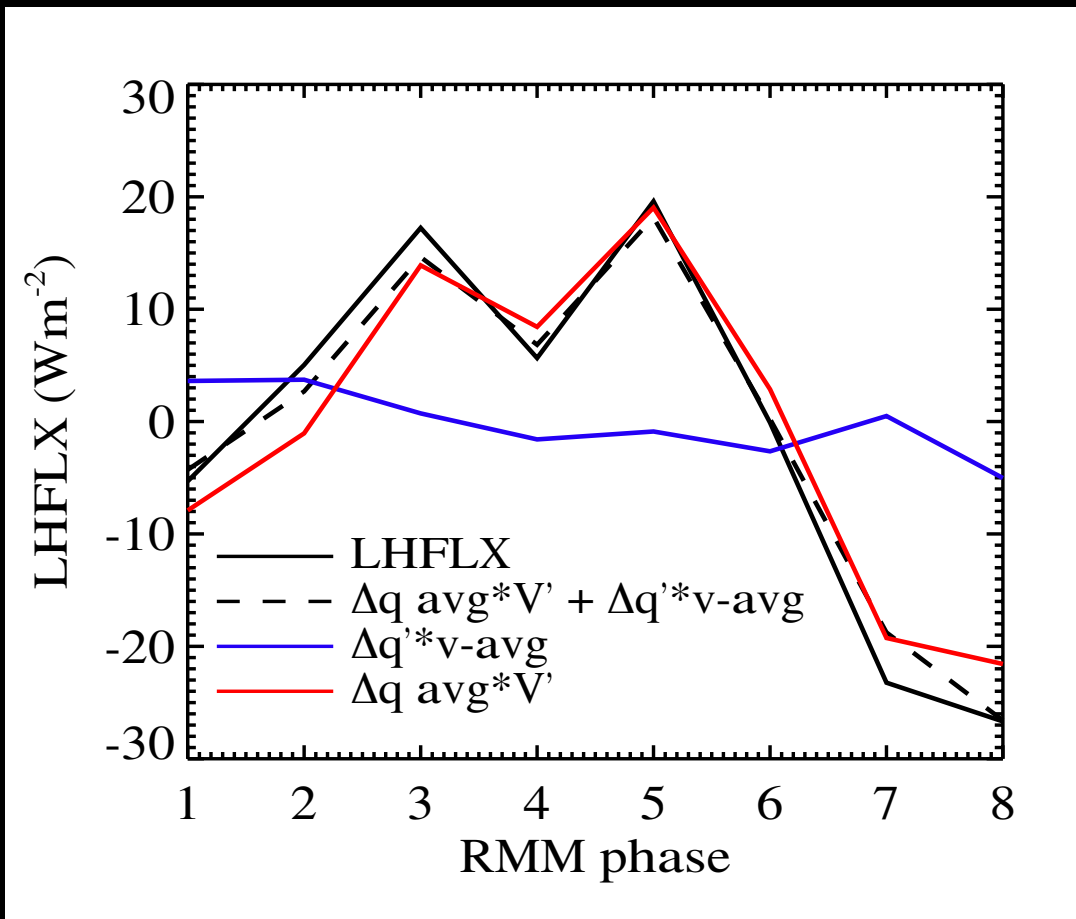


- Black – 20-100 day bandpass filtered

# Linearization of LHFLX

$$LH' = \rho L C_H \left( \overline{v' \Delta q} + \bar{v} \Delta q' + (v' q')' \right)$$

- Bar – MJO cycle mean
- Prime – deviation
- LHFLX variability more wind driven vs. thermo driven



## Summary

- LHFLX anom. about 20% - 25% of precip anom.
- Intraseasonal LHFLX anomalies more wind driven vs. thermodynamic driven
- Global index composites show lead-lag relationship between LHFLX and precipitation

## Future Work

- CRM runs of DYNAMO events
  - Tweak wind and/or mesoscale organization to isolate LHFLX feedback effects

Extra slides



MSE budget terms at 155°E

