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1. Background

Two Types of El Nino

Different type  Different impact

(Wang et al. 2018)
1. Background

What is the Double peaked El Nino?

- Two separate, concurrently growing, centers of warming are identified.
- Have been evidenced in CGCMs
- Without precedent in observations

( Graham et al. 2017 )
2. Topic of research

BUT!!

Double Peaked El Nino events exist in real world.

What Mechanism?
3. Data

All data are monthly (1980 - 2019/2)

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<tr>
<th>ERSST</th>
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<th>SST</th>
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<tbody>
<tr>
<td>GODAS</td>
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<td>Currents (u,v,w)</td>
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<td>Wind stress</td>
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<td>Potential Temperature</td>
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<td>CMAP</td>
<td>________________</td>
<td>Precipitation</td>
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How to define the Double peaked El Nino?

2S~2N, 160 ~ 270 (interval 30)

> 1 STD: detect El Nino

Find Peak

If the double peaks exist in NDJ
4. Results

Distribution of El Nino peaks

(a) All peak (1980-2018)

(b) NDJ peak

- **Double Peaked El Nino (3)**
  - 02/03, 06/07, 18/19

- **Cold Tongue El Nino (3)**
  - 82/83, 97/98, 15/16

- **Warm Pool El Nino (6)**
  - 86/87, 87/88, 91/92, 94/95, 04/05, 09/10
4. Results

Evolution of SSTA

(a) Cold Tongue

(b) Warm Pool

(c) Double peak

Late development
4. Results

Mature phase of each El Nino case

WP & DP
PRCP, zonal wind stress

Similar pattern
4. Results

Advection terms of each peak

(a) Central peak (5S-5N & 185-215E & AUG-NOV)

(b) Eastern peak (5S-5N & 240-270E & AUG-NOV)

Central peak
Zonal advection Feedback

Eastern peak
Thermocline feedback
4. Results – Central peak

**180E**

- Negative wspd anomaly
  - Less evaporation cooling
  - Contribute to developing warm center

**135W**

- Positive wspd anomaly
  - More evaporation cooling
  - Cutoff the peaks

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**Developing phase of Wind Speed anomaly**

(a) Wind speed (5S-5N & AUG-NOV) vs Warm Pool

- 135E 180 135W 90W

(b) Wind speed (5S-5N & AUG-NOV) vs Double Peak

- 135E 180 135W 90W

 longitude

longitude
4. Results – Eastern peak

Developing phase

- Strong ITCZ prcp
- Strong Westerly in the central pacific
- High sea level in the eastern pacific
- Strong thermocline feedback term
4. Results – Eastern peak

Area average of boxes & Dynamic sea level height

Simplified Sverdrup balance at equator

\[ g \int_0^x \frac{\partial h}{\partial x} \, dx = \frac{1}{\rho H} \int_0^x \tau_x \, dx \]

\[ h(x) = h(0) + \frac{1}{\rho g H} \int_0^x \tau_x \, dx \]
4. Results – Role of ITCZ precipitation

Reg. & Partal Reg. w.r.t. the ITCZ Precipitation

LBM Experiments
5. Summary

< Double Peaked El Nino >