Decadal Variations of Tropical Cyclone Intensity over the western North Pacific

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Outline

I. Motivation

II. Data and Methodology

III. Numerical Simulation

IV. Contributions of factors

V. An possible mechanism

VI. Summary
I. Motivation

- Decadal variations in TC activity

1. TC frequency --- 20-year period (central/eastern Pacific SST)
   (Yumoto and Matsuura 2001; Matsuura et al. 2003; Yumoto et al. 2003)

2. TC track
   - Ho et al. (2004) ---- interdecadal variability
   - Liu and Chan (2008) ---- decadal variability
   - Wu and Wang (2008) ---- significant westward shift over the past four decades

3. TC intensity
   - Chan (2008) --- Cat45 TC frequency --- 16-32-year period
Uncertainty in TC intensity records

1. Cat45 TCs frequency over the WNP increase since the 1970s
   (Webster et al. 2005; Elsner et al. 2008)

2. The upward trend ----- a part of interdecadal variations
   (Chan 2006)

3. The upward trend only detected in JTWC, not in RSMC and STI
   (Wu et al. 2006; Yu et al. 2007; Song et al. 2010; Ren et al. 2011; Wu and Zhao 2012)

Does it really exist?

or

is it just a result of uncertainty in TC records?
Objectives

1) To verify the TC intensity variations in the WNP basin on the interdecadal and decadal time scales over the period 1948-2010

2) To examine the possible mechanisms associated with these variations
Recently, Wu and Zhao (2012; *J.Climate*)

1. Assessing historical TC intensity datasets with a TC intensity model—-*Coupled Hurricane Intensity Prediction System*(CHIPS) (Emanuel 2006; Emanuel et al. 2008)

2. Reproducing the evolution of the basin-wide TC intensity in the JTWC best track dataset over the period of 1975-2007

3. Cat45 TC number is a most sensitive and reliable index----in response to changes in the vertical wind shear and SST.
II. Data and Methodology

- TC data from JTWC
- Extended reconstructed SST (Version 3) from NOAA
- Monthly wind field from NCEP/NCAR reanalysis
- Coupled Hurricane Intensity Prediction System CHIPS

(Emanuel 2006; Emanuel et al. 2008)
### III. Numerical Simulation

<table>
<thead>
<tr>
<th>Experiments</th>
<th>Simulation Description</th>
</tr>
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<tbody>
<tr>
<td><strong>CTRL</strong></td>
<td>Both of SST and vertical wind shear are observed from 1948 to 2010.</td>
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</table>
III. Numerical Simulation

Red-CTRL
Green-observation
Black-adjustment----(Emanuel(2005))
Spectral analysis
<table>
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<tr>
<th>Periods</th>
<th>Mean time for a TC to achieve Cat45</th>
<th>Total lifetime Cat45</th>
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<tbody>
<tr>
<td>1948-1964</td>
<td>2.61 days</td>
<td>6.68 days</td>
</tr>
<tr>
<td>1965-1972</td>
<td>3.13 days</td>
<td>8.25 days</td>
</tr>
<tr>
<td>1973-2010</td>
<td>3.30 days</td>
<td>8.84 days</td>
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</table>

**Intensity evolution**

![Graph showing intensity evolution over time](#)
### IV. Contributions of SST, Shear and TC tracks

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<td>SST is observed in 1965, but vertical wind shear changes with the observation from 1965 to 2010.</td>
</tr>
<tr>
<td><strong>V65</strong></td>
<td>Shear is observed in 1965, but SST changes with the observation from 1965 to 2010.</td>
</tr>
<tr>
<td><strong>VT65</strong></td>
<td>Both of SST and vertical wind shear are set to be those observed in 1965.</td>
</tr>
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IV. Contributions of SST, Shear and TC tracks

CTRL (black)
VT65 (blue)
V65(green)
T65(red)
V. A possible mechanism-Observational analysis

![Graph showing Cat 45 TC frequency with positive and negative phases]

Positive phase: $R(b,c)=0.83$

Dashed line-Observation
Solid line-CTRL

Positive phase – Negative phase

![Map showing TC tracks and TC Formation]
V. A possible mechanism-Observational analysis

850hPa

Positive phase – Negative phase
Shading: SST

Correlation between Cat45 TC frequency and global SST
VI. Summary

Decadal Variations of central/eastern Pacific SST

Decadal Variations of the intensity and locations of monsoon

TC formation locations and Subsequent TC tracks

Cat45 TC frequency
Thanks for your attention!