“The Effect of ENSO-types and SAM phases on Southern Hemisphere Blockings”

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INTERDISCIPLINARY CLIMATE INVESTIGATION CENTER
Definition:

In a more complex review, an atmospheric blocking event are seen as **quasi-stationary planet waves of large amplitude** (Karoly 1983; Lindzen 1986) and as members of a set of process that correspond with a mid-term between what is known as **low-frequency variability** (teleconnection patterns) and high-frequency mechanism that modulate the eddy disturbances (Cyclogenesis) (Frederiksen, 1982).
Why Study Atmospheric Blockings?

• because, they ...

• are an important class of the **sectoral weather regime** of highly nonlinear nature;

• are associated with the variability of day-to-day and responsible for the persistence weather conditions and **climate extremes** (e.g. Concentration of air pollutants, dry and wave’s heat);

• mostly ... has great potential for **socio-economic impacts**.
ENSO-types and SAM phases

• **Types?** ENSO “Canonical” or “Modoki”

• It’s widely recognized that the Southern annular mode (SAM) and the El Niño-Southern Oscillation (ENSO) are both the *most important patterns of large scale climate variability* for the extratropics and tropics, respectively (e.g. Rasmusson and Carpenter, 1982; Gong and Wang, 1999; Thompson and Wallace, 2000).
Data and Methodologies

• Based on the 32-years (1979-2010) from NCEP Climate Forecast System Reanalysis (CFSR) 6-hourly Products [Saha et al. 2010].

• Indices:
  1. 500 hPa Geopotential data (0.5×0.5° spatial resolution), to define the blocking index;
  2. 700 hPa Geopotential data (2.5×2.5° spatial resolution) to define the daily Southern Annular Mode Index;
  3. Temperature at 2 meters ((0.5×0.5° spatial resolution) to define the Monthly ENSO index;
Blocking Index, Spatial structure

• The Basis of Instantaneous detections:
  • 1D and 2D versions;
  • At each time interval, the geopotential height gradient is computed simultaneously 7.5º westward e eastward (2.5º steps).
  • The procedure ensure that each blocked gridpoint represent a period in time of a “large-scale blocking pattern” (~1100 km over midlatitudes).
• Minimum lifetime of 3 days.

First detection is the λ center of the detection.

The mean of detections is the λ center of the event.

15 degrees of longitude

25 degrees of longitude
First maximum in annual frequency. [Tibaldi et al. 1994]

Second maximum in annual frequency. [Sinclair 1996; Marques and Rao, 1998]
• During Summer, the LSBE are confined in West Pacific at low-latitudes. [Berrisford et al., 2006; Oliveira et al., 2014]

• In fall, the LSBE are poleward displaced when compared with previous season.

• The winter period is a “snapshot” of the weather.
The first mode is **ENSO- Canonical**, explains about of 35%.

The second mode is **ENSO- Modoki**, which explains 12%.

Table 3.

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<th>Z700 Anomalies</th>
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<td>$\lambda \pm \delta \lambda$</td>
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<td>1</td>
<td>153.53 ± 107.44</td>
<td>1209.84 ± 76.67</td>
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<tr>
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The first mode for anomalies field from 20ºS to 90ºS is SAM phenomena, that explains 10.36% of the total variance.

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Negative SAM phase

Positive SAM phase
ENSO-Warm Canonical

Legenda
- Positive
- Negative

Winter

Low-freq. Upper Zonal Wind

ENSO-Warm Can/Neg SAM  ENSO-Warm Can/Pos SAM

Summer

Fall

(c) $\alpha=0.33;0.15$

(d) $\alpha=0.27;0.26$

Spring

Winter
ENSO-Warm Modoki
(Ashok et al., 2007)

The zonal winds structure during Modoki-type of ENSO are weaker than those observed during Canonical-type, probably associated with the differences in energy wave propagation from troposphere to the stratosphere [Xie et al., 2012]
Conclusions

✓ The 32-yr of the variability of the LSBF and LSBE and their relationships with the combined phases of the two-types (Canonical and Modoki) of ENSO and the Southern Annular Mode was briefly presented.

✓ During the Canonical-type of ENSO-Warm combined with the negative SAM phase, the preferred location of the LSBE is over the East Pacific, whereas during Modoki-type of ENSO-Warm the LSBE occur preferentially in a region shifted westward from those in Canonical-type in a clear association with the heat sources in tropics.

✓ Thus, this preferred region during modoki winter, statistically represent a new preferred region for blocking events.

✓ Nevertheless, in both, Canonical or Modoki-types of ENSO-Warm combined with positive SAM phase, the LSBE always occur over the Southeast of New Zealand.

✓ In addition, similar LSBE preferred locations occurs during the two-types of ENSO-Cold when combined with SAM phase, although in a much lower-frequency.
Referências:


Fim

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