The South Pacific Meridional Mode: A Mechanism for ENSO-like Variability

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Motivation

- North Pacific Meridional Mode (NPMM) (Chiang and Vimont, 2004)
  - Subtropical trade wind variability caused by NPO;
  - Wind-Evaporation-SST (WES) feedback extending the variability into deep tropics
- NPMM can trigger ENSO events (Chang et al. 2007)

Is there a similar Meridional Mode in the South Pacific?
If so, can it trigger ENSO events?
Data

- **AGCM-slab models**
  - CMIP3
  - ENSO excluded
- **Fully coupled models**
  - Preindustrial scenario
- **Reanalysis products**

- Remove seasonal cycle and apply 1.5yr low pass filter

<table>
<thead>
<tr>
<th>Models</th>
<th>Slab/Picntrl (yr)</th>
<th>Reanalysis</th>
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</thead>
<tbody>
<tr>
<td>CCCma</td>
<td>30 / 1001</td>
<td>surface winds (NCEP), precipitation</td>
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<td>(GPCP v2.2), SLP (Hadley center), SST</td>
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<td></td>
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<td>(HadISST and ERSST v3); 1979 to date</td>
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<tr>
<td>CCCma T63</td>
<td>30 / 350</td>
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<tr>
<td>GFDL CM2.0</td>
<td>50 / 500</td>
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<tr>
<td>GFDL CM2.1</td>
<td>100 / 500</td>
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<tr>
<td>INM-CM3</td>
<td>60 / 330</td>
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<tr>
<td>MIROC(hires)</td>
<td>20 / 100</td>
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<tr>
<td>MIROC(medres)</td>
<td>60 / 500</td>
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<td>MPI ECHAM5</td>
<td>100 / 506</td>
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<tr>
<td>MRI</td>
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<tr>
<td>NCAR CCSM4</td>
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<tr>
<td>HadGEM1</td>
<td>70 / 172</td>
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AGCM-Slab Meridional Modes

- **North Pacific Meridional Mode (NPMM)**
  - Confined to northern hemisphere

- **South Pacific Meridional Mode (SPMM)**
  - Extends onto the equator and perturbs the zonal equatorial gradient in SST/SLP
Mechanisms of the SPMM are also responsible for the ENSO-like variability in the absence of dynamical coupling.
Positive cloud feedback

The stronger the cloud feedback is, the larger the ENSO-like variability will likely be.
Hypothesis: due to the distribution of mean surface winds determining the spatial extent of the WES feedback
SPMM in climate models and observations

- Similar characteristics of the SPMM in fully coupled models and observations.

- Differences:
  - Enhanced equatorial signal, resembling ENSO
  - Equatorial warming lags behind the SEP warming
NPMM-SPMM difference
---in fully coupled models and observations

1. Different equatorial impacts; 2. different ENSO flavors
NPMM-SPMM difference

--- in fully coupled models and observations

Fully coupled

NCEP

Central Pacific El Nino

Canonical El Nino
Summary

• SPMM identified in AGCM-slab models: Physically symmetric to NPMM
  – SPMM acts as a stronger connection between tropics and extra-tropics
  – leads to ENSO-like variability in the absence of ocean dynamics

• Positive cloud feedback largely accounts for the inter-model difference of the magnitude of ENSO-like variability

• SPMM seems to be active in both fully coupled climate models and observations
  – acts as a potential trigger of ENSO

• SPMM and NPMM may be related with different flavors of ENSO
Thanks