Coupled Interactions of the Monsoons

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Mantra: Coupled ocean-land-atmosphere interactions are inherent in Global monsoons and US hydroclimate.

Two illustrations of how air-sea coupling can change land-atmosphere interactions.
Model Experiments

Results from last 50 years of a multi-Century coupled model integration is used

Results from last 50 years (1951-2000) of the SAME AGCM as used in the coupled model but forced with observed (Reynolds v1.1) SST is also used
# Model Description

## COLA AGCM V3.2

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 PBL</td>
<td>NON-LOCAL</td>
</tr>
<tr>
<td>2 SHORTWAVE</td>
<td>CAM3.0</td>
</tr>
<tr>
<td>3 LONGWAVE</td>
<td>CAM3.0</td>
</tr>
<tr>
<td>4 CONVECTION</td>
<td>RAS</td>
</tr>
<tr>
<td>6 VERTICAL RESOLUTION</td>
<td>28 SIGMA LEVELS (IDENTICAL TO NCEP REANALYSIS)</td>
</tr>
<tr>
<td>7 HORIZONTAL RESOLUTION</td>
<td>T62 (~200 KM)</td>
</tr>
<tr>
<td>8 LAND SURFACE</td>
<td>SSIB WITH 6 SOIL LAYERS</td>
</tr>
<tr>
<td>9 DYNAMICAL CORE</td>
<td>CAM3.0 (EULERIAN)</td>
</tr>
</tbody>
</table>

## MOM3 OGCM

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 VERTICAL MIXING</td>
<td>KPP</td>
</tr>
<tr>
<td>2 MOMENTUM MIXING</td>
<td>SMAGORINSKY (1963)</td>
</tr>
<tr>
<td>3 TRACER MIXING</td>
<td>REDI (1982)</td>
</tr>
<tr>
<td>4 QUASI ADIABATIC STIRRING</td>
<td>GENT AND McWILLIAMS (1990)</td>
</tr>
<tr>
<td>6 VERTICAL RESOLUTION</td>
<td>25 Z LEVELS (17 IN THE UPPER 450 M)</td>
</tr>
<tr>
<td>7 HORIZONTAL RESOLUTION</td>
<td>1.5 (ZONAL), 0.5 FROM 10S-10N AND 1.5 IN THE EXTRA-TROPICS</td>
</tr>
<tr>
<td>8 DYNAMICAL CORE</td>
<td>FINITE DIFFERENCE</td>
</tr>
<tr>
<td>9 NO SEAICE</td>
<td>SEAICE FRACTION PRESCRIBED</td>
</tr>
</tbody>
</table>
Decorrelation time (in days) of the daily precipitation
From daily rain gauge observations
The correlation of twice removed triad precipitation

GOLD, DJF

GOLD, JJA

COUPLED, DJF

COUPLED, JJA

UNCOPLED, DJF

UNCOPLED, JJA

0.073 0.1 0.2 0.3 0.4 0.5
The lag (in days) by which evaporations leads precipitation
Zonal wavenumber frequency spectrum of OLR for JJAS
Precipitation Differences

GOLD, Winter

GOLD, Summer

GOLD-COUPLED, Winter

GOLD-COUPLED, Summer

GOLD-UNCOUPL ED, Winter

GOLD-UNCOUPL ED, Summer

COUPLED-UNCOUPLIED, Winter

COUPLED-UNCOUPLIED, Summer

Legend:

-1.5  -1  -0.5  -0.25  0.25  0.5  1  1.5
Correlation of P and Ts

**GOLD, Winter**

**GOLD, Summer**

**COUPLED, Winter**

**COUPLED, Summer**

**UNCOPLED, Winter**

**UNCOPLED, Summer**

-0.5  -0.3  -0.2  -0.1  0.1  0.2  0.3  0.5
The correlation of twice removed triad precipitation
The lag (in days) by which evaporations leads precipitation
Conclusions

- Continental Monsoons without exception exhibit O-L-A interactions
- Differences in impact of air-sea coupling on winter climate vs summer climate of US also highlight O-L-A interactions
- Air-sea coupling enhances sub-seasonal activity that ultimately promotes more robust land-atmosphere interactions