Simulations of the Indo-Pacific Warm Pool by IPCC Models

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1. Motivation

How well the warm pool is simulated by our state-of-the-art climate models in ensemble runs?

What are the causes of these biases? Whether the biases in the simulation of the warm pool can be linked to the biases in the ENSO asymmetry in the manner suggested by theory?
2. Models and Data

◆ Models
SST: 19 no flux adjustment IPCC AR4 models in the 20th century simulation
Time: Jan. 1900 to Dec. 1999, monthly
Data Website: ftp-esg.ucllnl.org

◆ Observations
SST: HadISST1 (Rayner et al. 2003)
Time: Jan. 1871 to present, monthly
3. Results  Warm Pool Size

Model biases:

1. Smaller warm pool
2. Smaller positive trend in the warm pool size
Warm Pool Size

Model biases:

1. Excessive westward extension of the cold-tongue
2. Excessive eastward extension of the warm pool over off equatorial region
3. Meridionally confined to equator (pacific) and southward shift (Indo ocean)
Maximum SST

Model biases:

1. Higher maximum SST
2. Larger positive trend in the maximum SST
ENSO Statistics

Model biases:

1. Weak ENSO asymmetry
2. The lack of the elevation of ENSO activity in the later part of the 20th century
The time-mean effect of ENSO

Sun and Zhang (2006), Sun et al. (2010), Hua et al. (2010)

**Lower max. SST, Larger warm pool**

Lack of asymmetry of ENSO indicates a weak or nonexistent time-mean effect of ENSO in models. That result in a smaller warm pool and a higher maximum SST in climatology. Since the ENSO was stronger in the later part of the 20\textsuperscript{th} century in observation, the lack of warm phase effect in ENSO simulations and the lack of elevations of ENSO activity in the models cause to the weaker trend in warm pool size and stronger trend in the maximum SST.
4. Summary and Discussion

- Simulations of the Indo-Pacific warm pool by IPCC models have common biases:
  1. Smaller and warmer warm pool; higher maximum SST
  2. Weaker positive trend in the warm pool size; stronger positive trend in the tropical maximum SST

- ENSO statistic biases:
  1. Lack of ENSO asymmetry in the models
  2. Lack of the elevation of ENSO activity in the models in the later part of the 20th century

- The lack of ENSO asymmetry is a root cause of the warm pool simulation biases.
Thanks!