



# Simulations of the Indo-Pacific Warm Pool by IPCC Models

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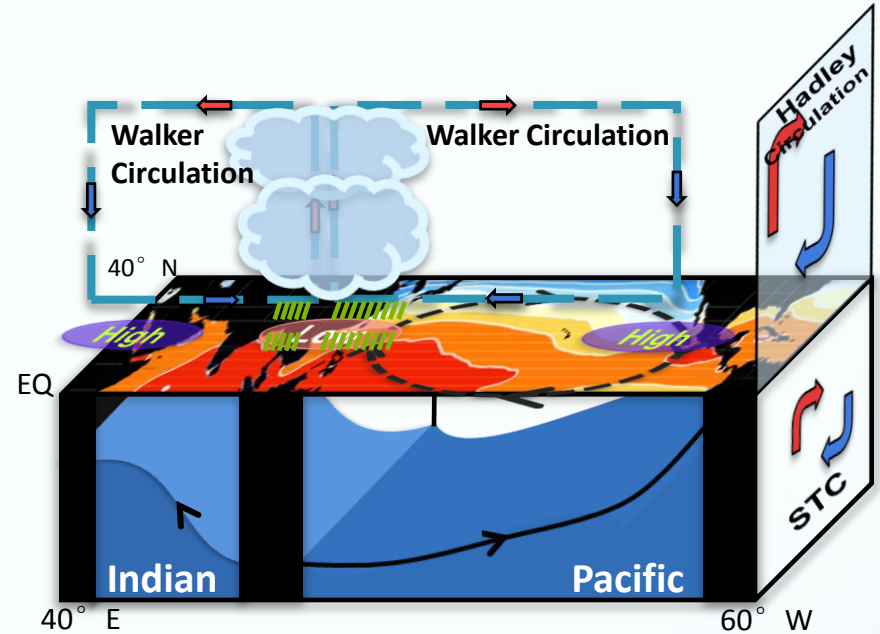
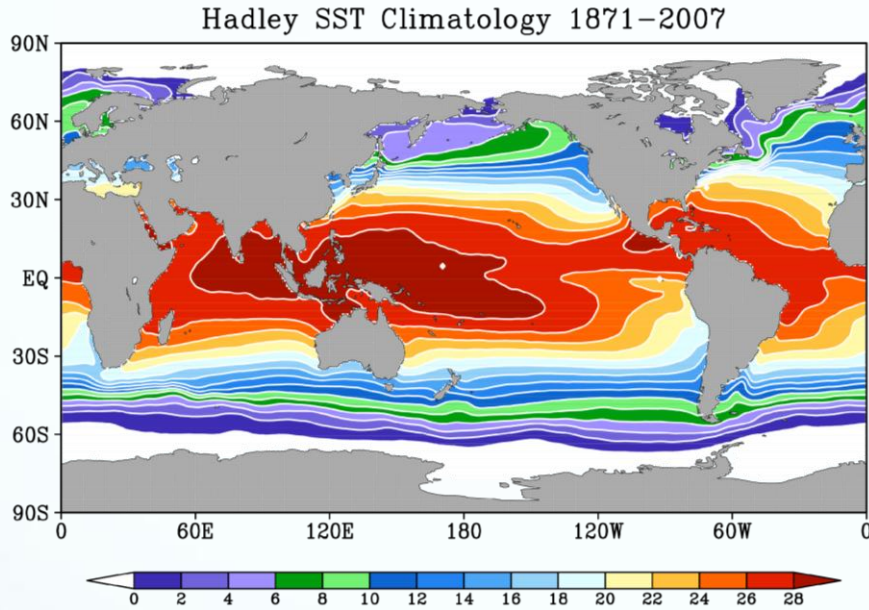
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# Outline

1. Motivation
2. Models and Data
3. Results
  - 3.1 The climatology and trends of warm pool
  - 3.2 ENSO Statistics
4. Summary and Discussion

# 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  
20<sup>th</sup> century simulation

Time: Jan. 1900 to Dec. 1999, monthly

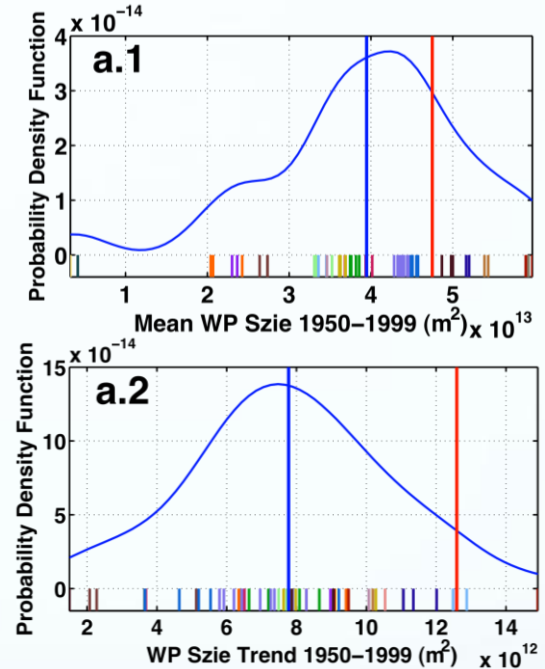
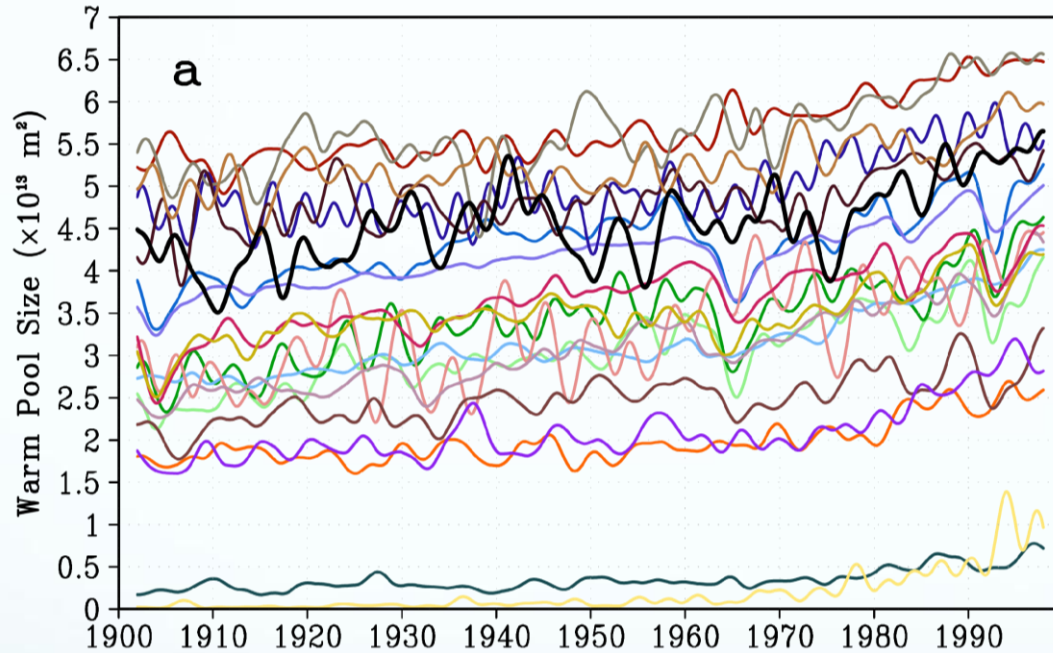
Data Website: <ftp-esg.ucllnl.org>

## ◆ Observations

SST: HadISST1 (Rayner et al. 2003)

Time: Jan. 1871 to present, monthly

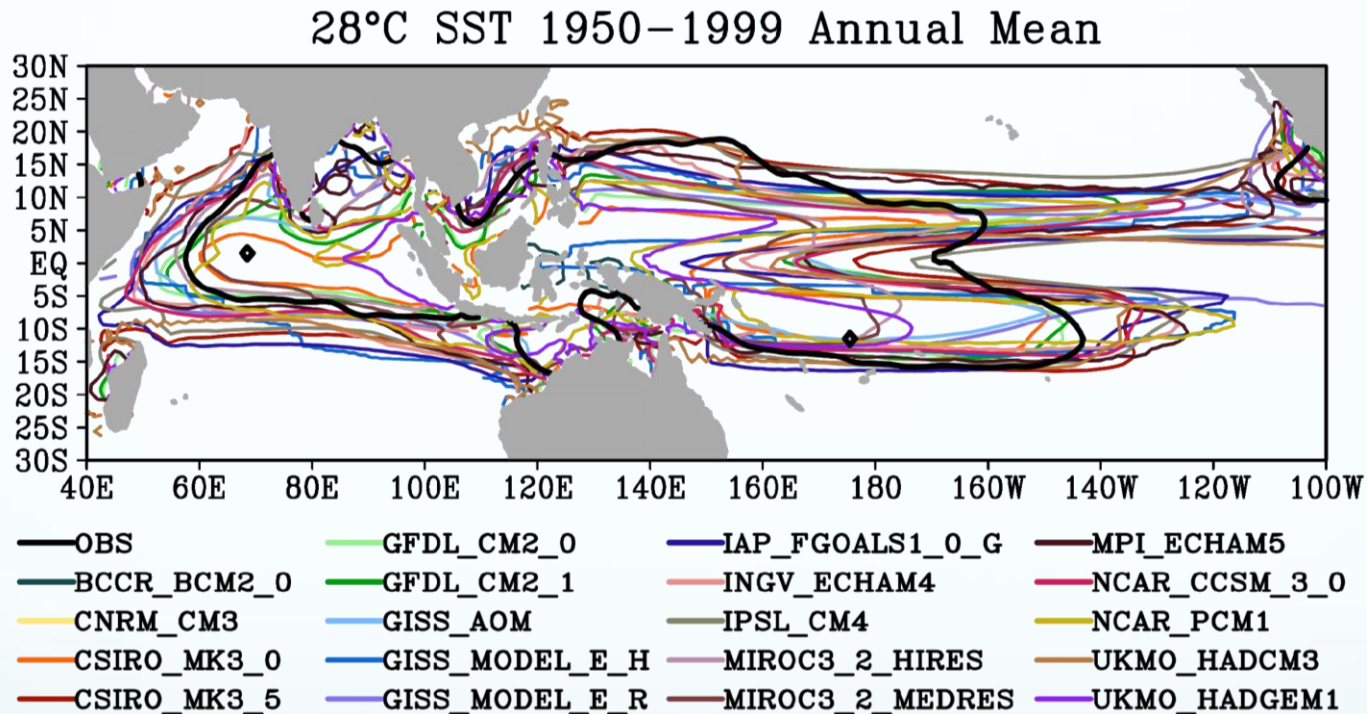
# 3. Results Warm Pool Size



## Model biases:

1. Smaller warm pool
2. Smaller positive trend in the warm pool size

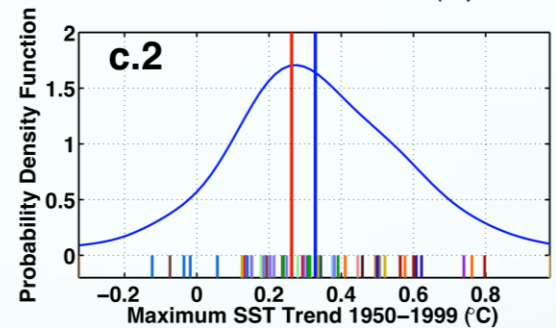
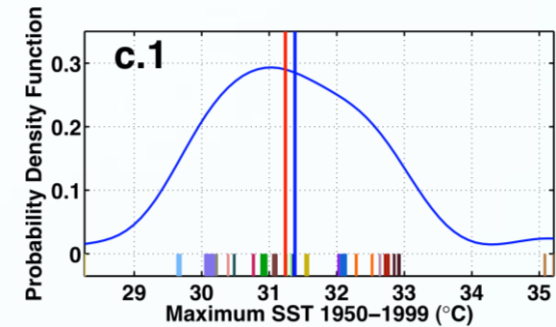
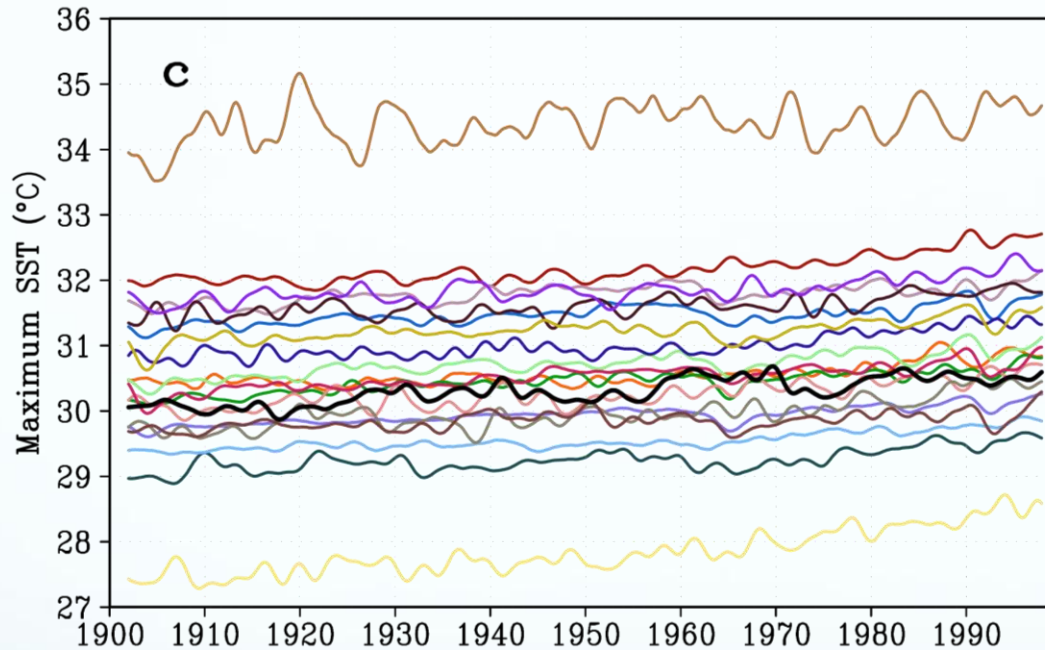
# Warm Pool Size



## 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

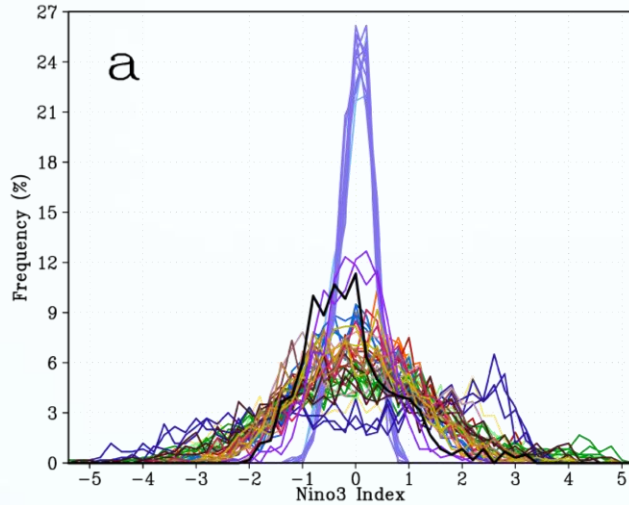


## Model biases:

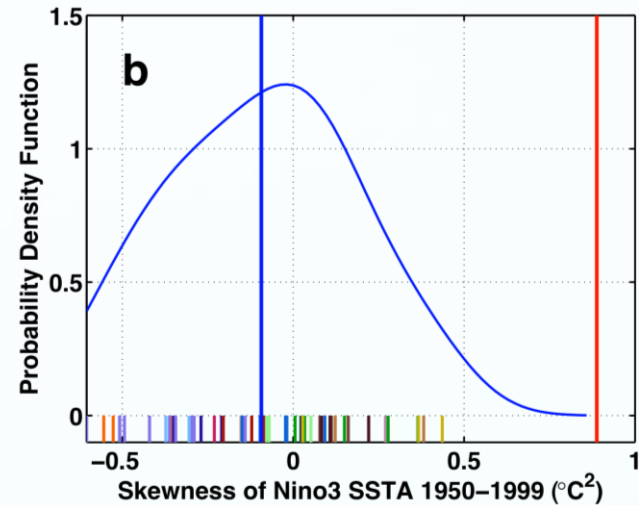
1. Higher maximum SST
2. Larger positive trend in the maximum SST

# ENSO Statistics

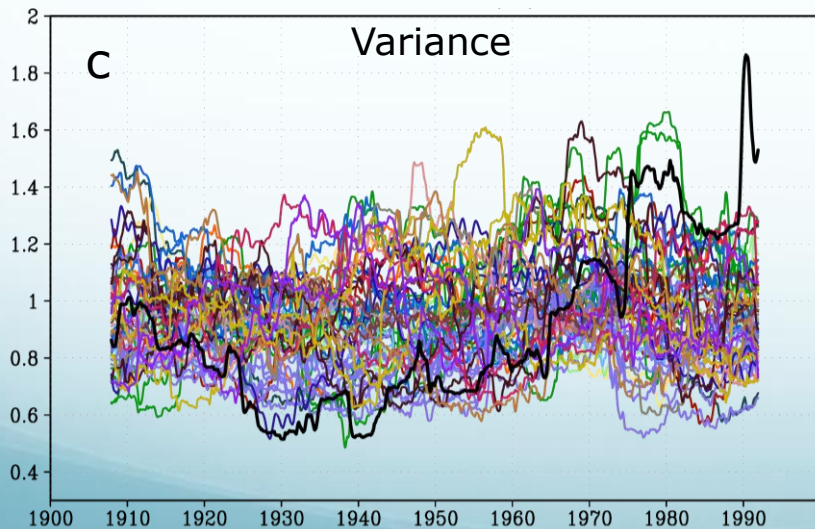
Nino3 Index Distribution



PDF of Nino3 Index Skewness



Variance

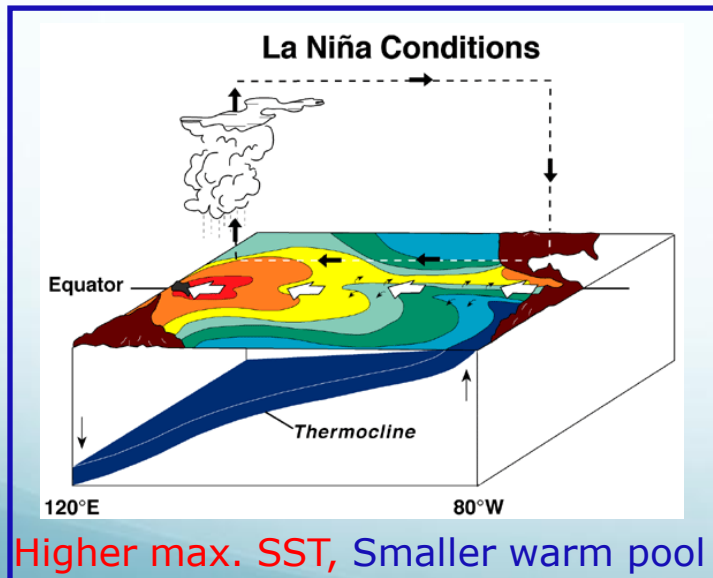
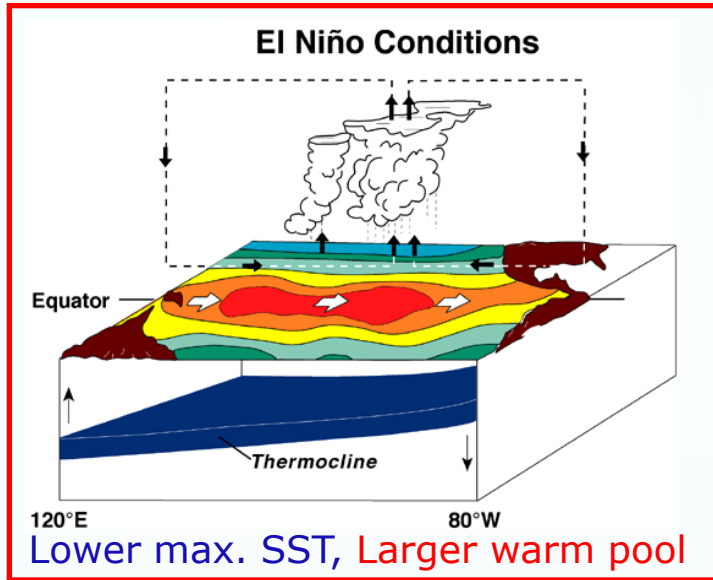


## Model biases:

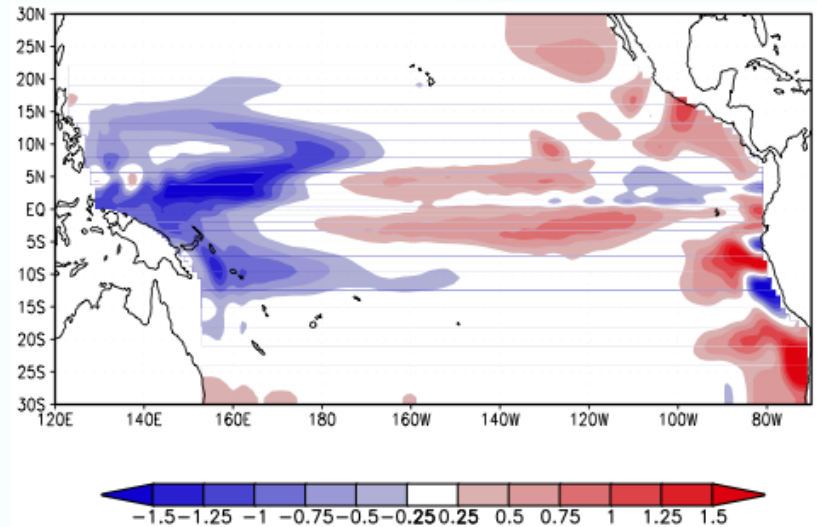
1. Weak ENSO asymmetry
2. The lack of the elevation of ENSO activity in the later part of the 20<sup>th</sup> century



# Explanation



## 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<sup>th</sup> 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

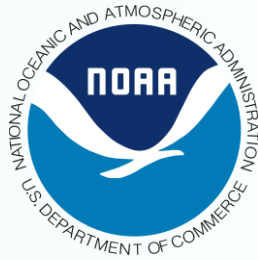
◆ Simulations of the Indo-Pacific warm pool by IPCC models have common biases:

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 20<sup>th</sup> century

◆ The lack of ENSO asymmetry is a root cause of the warm pool simulation biases.



***Thanks!***