Radiative and Dynamical Forcing of El-Niño-Related Global Temperature Anomalies in the Observations and in CMIP5 Models

Tae-Won Park\textsuperscript{1}, Yi Deng\textsuperscript{1}, and Ming Cai\textsuperscript{2}

\textsuperscript{1}School of Earth and Atmospheric Science, Georgia Institute of Technology, Atlanta, Georgia, USA
\textsuperscript{2}Department of Earth, Ocean, and Atmospheric Science, Florida State University, Tallahassee, Florida, USA

Introduction

Temperature response to ENSO
- Tropical Gill-type response
- PNA pattern
- High-latitude atmospheric warming

ENSO-related Feedback
- Water vapor feedback
- Cloud feedback
- Albedo feedback
- Ocean dynamics and sensible/latent heat flux
- Atmospheric dynamics - atmospheric bridge

Climate Feedback Responses Analysis Method (CFRAM) in observations

Deng et al. (2012), Park et al. (2012)

Suggested Question: How about ENSO-related temperature decomposition in the CGCMs?

Methods

CFRAM Formulation
- The total energy balance at M atmospheric layers and one surface (M+1) layer
- LW radiation flux
- The difference between two climate states
  - changes in energy storage
  - changes in horizontal transport
  - atmospheric dynamics
  - Radiative and Dynamical Forcing

Decomposition Procedure
- Define Neutral, El Niño, La Niña cases
- Partial temperature changes
- Total temperature change
- Energy perturbation terms

Input for Radiative transfer model
- Solar insolation
- Cloud liquid/ice water
- Cloud albedo
- Vertical Distribution of PAP

Data

• Observation: The ERA-interim
  - Period: 1979–2010, Only DJF data are analyzed
  - CMIPS Models
  - Historical run of 1861–2005. Only DJF data are analyzed

Validation of CFRAM

Difference of SAT between El-Niño and Neutral winters

Decomposition Results

Temperature response over PNA region

Quantification of Relative Contributions

PAP over Eqt. Pacific

Vertical Distribution of PAP

PAP over PNA region

Vertical Distribution of PAP

Vertical Distribution of PAP