

Global and U.S. Southeast Assessment of Precipitation: Comparison of Model Simulations from the Intergovernmental Panel on Climate Change with Reanalysis-based Observations

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Introduction

Climate change may cause or worsen large changes in regional precipitation or extreme precipitation events. These extremes have the potential to produce localized or widespread floods. However, precipitation remains among the most difficult to predict from climate and atmospheric models or observations.

Objectives

- Use statistical analyses to evaluate two widely used climate models from the Intergovernmental Panel on Climate Change (IPCC) : CCSM3 and HadCM3
- Compare climate model simulations with observations and develop uncertainty assessments

Data Resources

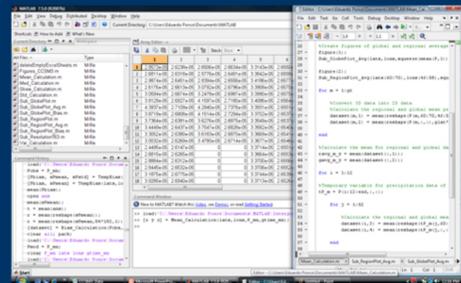


Figure 1. MATLAB 2007 used in statistical methods and graphs for climate data.

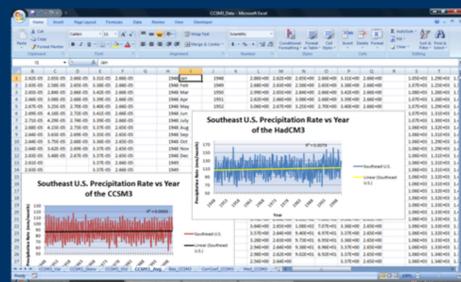


Figure 2. Microsoft Excel 2007 used in calculations and data plotting.

Climate Models
 Community Climate System Model, version 3 (CCSM3)

Hadley Center Coupled Model, version 3 (HadCM3)

Climate Observations
 National Center for Environmental Prediction, reanalysis 1 (NCEP1)

Methodology and Results

- Interpolate data from CCSM3 and HadCM3 with NCEP1
- Southeast U.S. region: Lat 24 °N - 41 °N Lon 95 °W - 74 °W
- Create global and regional graphs
- Statistical analysis with MATLAB® software
 1. Mean
 2. Standard deviation
 3. Variance
 4. Skewness
 5. Median
 6. Bias = observations – model simulations
- Construct visual plots using Microsoft Office Excel 2007

CCSM3
 HadCM3
 NCEP1

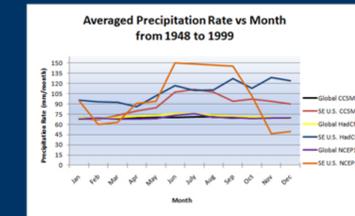


Figure 4. Global and SE U.S. average precipitation rates from 1948 to 1999 per month.

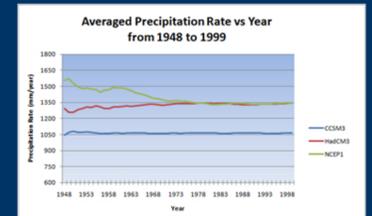


Figure 5. Global and SE U.S. average precipitation rates per year from 1948 to 1999.

	US Southeast			Global		
	CCSM3	HadCM3	NCEP1	CCSM3	HadCM3	NCEP1
Mean	3.37E-05	4.23E-05	4.29E-05	2.66E-05	2.74E-05	2.66E-05
Std. Dev.	1.41E-05	1.90E-05	2.30E-05	2.78E-05	3.23E-05	2.93E-05
Variance	2.31E-10	4.00E-10	6.20E-10	7.76E-10	1.05E-09	8.62E-10
Skewness	0.815352	0.69339	0.639585	2.212217	2.484673	1.877501
Median	3.01E-05	3.91E-05	3.91E-05	1.90E-05	1.77E-05	1.78E-05
Bias	9.20E-06	5.58E-07	1.00E+00	-2.90E-08	-8.22E-07	1.00E+00

Table 1. Southeast U.S. and global statistical results for CCSM3, HadCM3, and NCEP1.

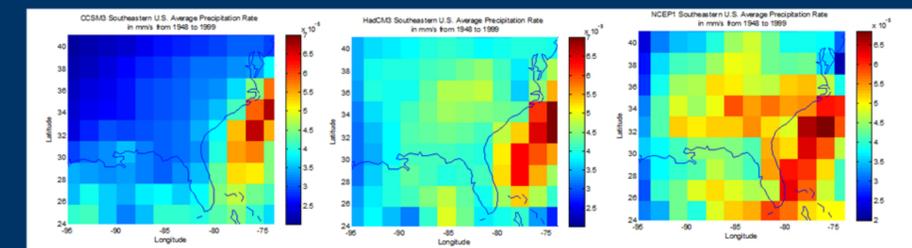


Figure 6. Average precipitation rate in United States Southeast from 1948 to 1999.

- CCSM3 under predicts average precipitation rate in SE U.S.
- HadCM3 under predicts average precipitation rate in SE U.S.

Conclusions

- Global scope
 1. CCSM3 over predicts
 2. HadCM3 over predicts
 3. CCSM3 more accurate
- Southeast U.S.
 1. CCSM3 under predicts
 2. HadCM3 under predicts
 3. HadCM3 more accurate

Future Research

- Test accuracy of CCSM3 and HadCM3 in other regions
- Propose safety measures for areas of high precipitation rates

References

1. Auroop R. Ganguly, Shih-Chieh Kao, Karsten Steinhaeuser, Esther S. Parish, Marcia L. Branstetter, David J. Erickson III, and Nagendra Singh. Uncertainties in the Assessments of Climate Change Impacts on Regional Hydrology and Water Resources. (2009: In Review).
2. Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report: 2007.

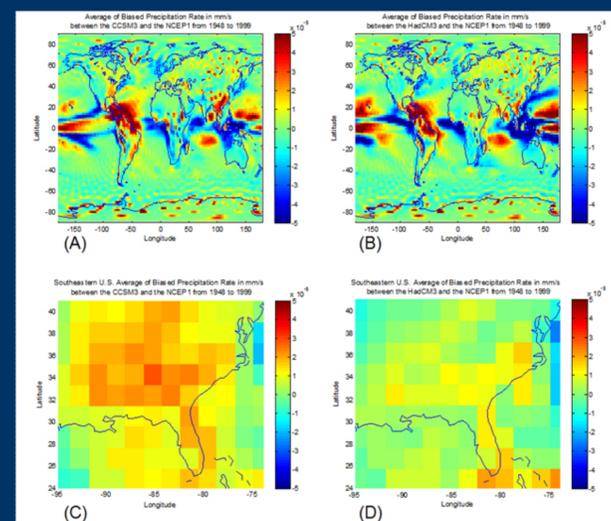


Figure 3. (A, B) Grid-based global analyses of the bias (modeled minus observed) in precipitation rates (CCSM3 and HadCM3 versus NCEP1). (C, D) Bias in precipitation rates in the SE region of the U.S. based on comparisons of climate models with observations (reanalysis).