

Inter-comparison and Evaluation of Monthly Temperature from Climate Models Used by the Intergovernmental Panel on Climate Change (IPCC)

Jonathan C. Rann, North Carolina A&T
Research Alliance in Math and Science

Computational Sciences and Engineering Division, Oak Ridge National Laboratory
Mentor: Auroop R. Ganguly Collaborators: Karsten Steinhauser and Shih-Chieh Kao
jcrann84@gmail.com http://wiki.ornl.gov/sites/rams09/j_rann/Pages/default.aspx

RESEARCH OBJECTIVES

- Compare and evaluate IPCC climate model simulations
 - Average monthly temperature from 1948 – 1999
 - Grid-based comparisons of global and Southeast U.S.
- Enumerate model performance and visualize bias maps
 - Multiple statistical metrics
 - Regional and global maps

OBSERVATIONS

- National Center for Environmental Prediction (NCEP) reanalysis data

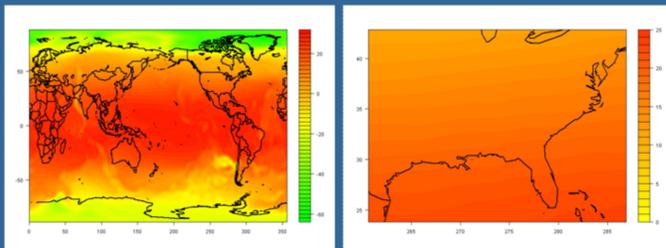


Figure 1. Global (left) and Regional (Southeast United States: right) maps plotted from the NCEP reanalysis data. The latitude and longitude are denoted on the left side and at the bottom respectively. The temperature (in Celsius) is on the right legend.

DATA ANALYSIS PROCESS

- Extract temperature, latitude, longitude, time
- Interpolate temperature in space
- Compute bias (model – observation)
- Compute average bias in space



R - an open source software environment for statistical computing and graphics used in this research to analyze climate data and develop visual representations

Image and R information: <http://www.r-project.org/index.htm>

CLIMATE MODELS UTILIZED

- Hadley Center Coupled Model, version 3 (HadCM3): U.K.
- Community Climate System Model, version 3 (CCSM3): U.S.A.
- The 5th Generation European Center Hamburg Model (ECHAM5): Europe
- Model for Interdisciplinary Research On Climate, version 3 (MIROC3): Japan

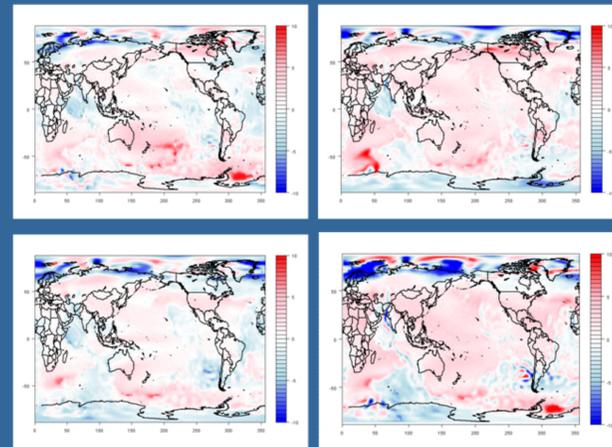


Figure 2. Global biases from HadCM3 (top left), CCSM3 (top right), ECHAM5 (bottom left), and MIROC3 (bottom right) climate models. Red (positive values) denotes over-prediction, blue (negative values) denotes under-prediction, and white (zero) denotes no temperature difference compared to NCEP.

SE U.S. BIAS ANALYSIS

- CCSM3 appears most accurate
- HadCM3 appears least accurate
- HadCM3 has maximum temperature variation
- HadCM3 under-predicts northern region of SE U.S. and over-predicts southern regions
- MIROC3 over-predicts temperature more than other models in south-eastern region of the map
- Little overall consistency between the models

GLOBAL BIAS ANALYSIS

- ECHAM5 appears most accurate
- HadCM3 appears least accurate
- HadCM3 appears to over-predict temperature the most
- ECHAM5 under-predicts the most
- HadCM3 and MIROC3 share an 'Antarctic red spot'
- HadCM3 over-predicts Antarctic temperature
- HadCM3 and ECHAM5 under-predict Atlantic Ocean temperature
- All models consistent in Arctic region

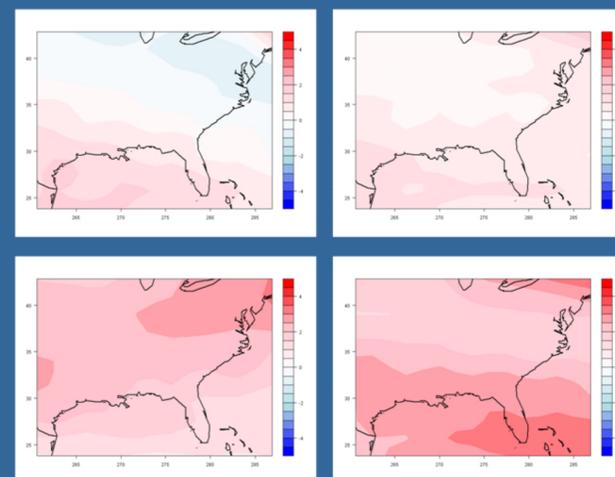


Figure 3. Regional biases of the Southeast United States from HadCM3 (top left), CCSM3 (top right), ECHAM5 (bottom left), and MIROC3 (bottom right) climate models.

RESULTS: STATISTICAL METRICS

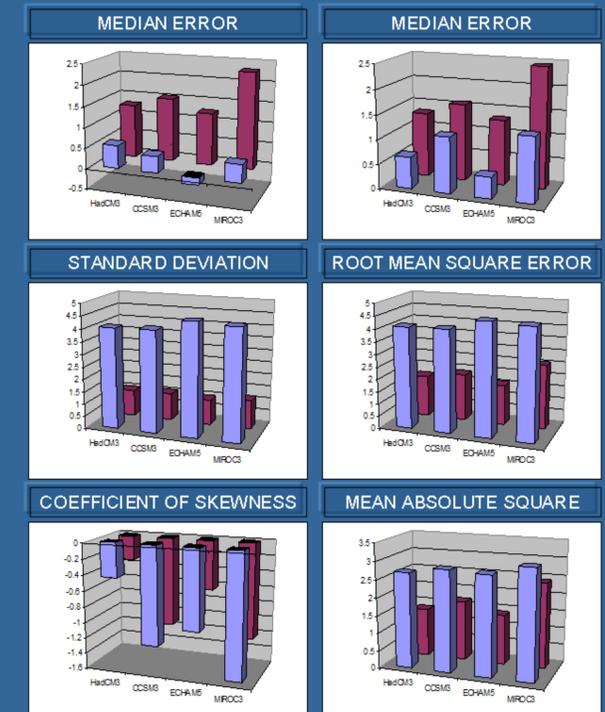


Figure 4. Statistical metrics of both global and regional (SE U.S.) biases. Blue bars denote global performance metrics; Red bars denote SE U.S. metrics. The bias numbers on the left of each graph indicate temperature difference.

DISCUSSION

- Significant variation between models
- CCSM3 global bias map visually conveys information not evident from statistical performance metrics
- ECHAM5 appears most accurate overall
- HadCM3 appears least accurate overall
- All models under-predict global and over-predict SE U.S. temperature

REFERENCES

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