A Tall Order: Climate Models Fall Short in Predicting African Sahel Rainfall

Research Highlight

In 1984, the Sahel region of Africa witnessed one of the worst droughts of the century, with millions of acres of land all but blowing away in the dry Saharan breezes. Rainfall has increased in the last ten years, raising hopes that the region can recover from the previous drought. However, with global mean temperatures increasing as well, scientists question the accuracy of rainfall predictions, while the many affected countries in the region struggle to plan for future that could be feast or famine.

Scientists often turn to climate models for predictions, but many models fail to capture major features of the Sahel's climatology and variability. To determine how well the new generation of models simulates rainfall in the Sahel, a recent study reported in the Journal of Climate looked to the models in the Coupled Model Intercomparison Project (CMIP5) of the World Climate Research Programme.

The French research team evaluated more than 40 climate models from over 20 scientific organizations such as the U.S. Department of Energy, NASA, the National Oceanic and Atmospheric Administration, and the National Science Foundation in the U.S., and their counterparts in Australia, Canada, China, France, Germany, Italy, Japan, Korea, Norway, and the UK. The team examined how each model behaved at a range of time scales, from climate change projections over many decades to seasonal and daily fluctuations. To ensure consistency, the team relied on observational data gathered from several studies ranging from the Gulf of Guinea northward to the Sahara. These data included information gathered by the U.S. Department of Energy's Atmospheric Radiation Measurement Mobile Facility during a 1-year deployment in Niamey in 2006, as a contribution to the African Monsoon Multidisciplinary Analysis.

"The availability of these datasets, as well as the better understanding of some key processes at work in the West African monsoon, provided a unique opportunity to evaluate how the CMIP5 models simulate the monsoon system and rainfall associated with it," said Dr. Romain Roehrig, who led the effort.

The analysis indicated that CMIP5 models had not yet reached a degree of maturity to reliably predict climate changes and their impacts over the Sahel, especially with regard to rainfall. Temperature changes were equally difficult for the models to predict. The team advised the research and modeling communities to investigate in greater depth the mechanisms at play in model errors over West Africa. They also recommended that the observational data sets should form the backbone of future studies to help improve the ability of climate models to represent rainfall and climate in critical areas such as the Sahel.

The wealth of data available from field campaigns between the Gulf of Guinea and the Sahara Desert allowed scientists to evaluate the ability of climate models to accurately predict rainfall in the area.

Reference(s)

Roehrig R, D Bouniol, F Guichard, F Hourdin, and JL Redelsperger. 2013. "The present and future of the West African Monsoon: A process-oriented assessment of CMIP5 simulations along the AMMA transect." Journal of Climate, 26(17), doi:10.1175/jcli-d-12-00505.1.

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Cloud-Aerosol-Precipitation Interactions