The Great Drying of Africa

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Introduction

Located just south of the scorching sands of the Sahara Desert is an expansive, semi-arid region of Africa called the Sahel. This sparsely vegetated area receives an average of four to eight inches of rainfall per year during its July to September monsoon season. During this warm time of year, summer rains are usually abundant with the heating of the sun. However, the Sahel experienced a severe drying trend during the last half of the 20th century that led to devastating drought during the 1970s and 1980s, and resulted in widespread famine and the loss of more than 1,000,000 human lives.

Researchers Martin Hoerling and Jon Eischeid of the NOAA Climate Diagnostics Center (CDC), and James Hurrell of the National Center for Atmospheric Research (NCAR) wanted to find out the reasons for the drying. Learning the cause would not only permit a better understanding of the climate risks in this vulnerable region, but could also lead to improved projections of 21st Century Sahelian rainfall. They would attempt to simulate the African climate including its variations and trends of the 20th century.

"We judged from climate simulations that the ocean was a material factor for the drying over the Sahel," says Hoerling. "And that the oceans also played a leading role in drying of other parts of Africa including an increased incidence of drought over southern Africa during austral summer."

Explaining the Drought

Utilizing state-of-the-art computer models of global climate, simulations were generated from 50 years of observed monthly sea surface temperature measurements. The study began with the actual recorded conditions of the atmosphere in 1950. In each subsequent simulation the starting point of the actual conditions was slightly varied in order to create a collection of equally plausible climate histories. Five different models were used and 80 simulations performed. Surprisingly all 80 simulations produced drying over the Sahel and also over southern Africa, confirming that the truly observed increased incidence of drought was fully determined by the ocean.

For the Sahel, additional focused experiments revealed that the drying was linked to a cooling of the water in the tropical region of the Atlantic just north of the equator relative to warming of the tropical South Atlantic. On the other hand,

southern African drying, though also of ocean origins, was attributed to a progressive warming of the Indian Ocean.

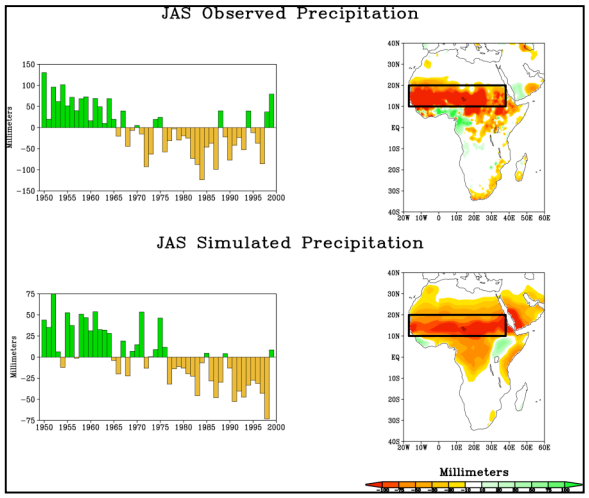

Figure 1. Observed vs. Simulated Conditions *(July-August-September) Left: Seasonal time series of 1950-1999 rainfall departures over Northern Africa. Right: The 1950-1999 seasonal African rainfall trends.*

Concluding Remarks

Understanding the attributable causes of monsoonal changes in Africa is an important step toward advancing a predictive understanding of the monsoons. "Our challenge is to better project 21st century rainfall in Africa, which includes improving our guidance on the uncertainty sources for such projections, together with the physical causes for any expected regional change," says Hoerling.

Therefore, in Hoerling, Hurrell, and Eischeid's on-going analysis of past observations and model projections into the future, they are carefully examining the sensitivity of the Earth's terrestrial climate to likely further changes in ocean surface temperatures.

References

Hoerling, Martin P., James W. Hurrell, and **Jon Eischeid**, 2005: Detection and Attribution of 20th Century Northern and Southern African Monsoon Change. *Journal of Climate*, submitted.

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