SERVIR and Seasonal Climate Forecasts

The NASA/USAID SERVIR project is dedicated to developing and improving the capacity of several hub regions to incorporate unique NASA satellite and modeling resources into operational environmental monitoring and planning. Recent and currently served hub regions include Mesoamerica, East Africa (EA), and the Hindu Kush-Himalayan region.

The SERVIR Applied Science Team (AST) has recently been established with the goal of providing enhanced products for use in the hub regions. Currently awarded projects within the AST include (but not limited to) agricultural and hydrologic impact modeling, air quality and landslide assessments.

Another AST team is focused on the evaluation of climate model simulations and the development of downscaled scenarios to be used by AST projects focused on impact modeling. Results presented here focus on the initial development of downscaled seasonal forecasts from the NASA Global Modeling and Assimilation Office (GMAO) GEOS-5 model contribution to the U.S. National Multi-Model Ensemble (NMME) for use in agriculture and hydrologic modeling over East Africa.

**Observed East Africa Rainfall Variability**

Figure 1. (Left) Average monthly rainfall (mm) is shown together with the magnitude of interannual variability (contours) for East Africa during the boreal wet season (DJF) and biannual maxima near equatorial East Africa (SS-SN) in MAM ("long rains") and OND ("short rains"). The topographic influences on seasonal rainfall are pronounced with the largest seasonal rainfall occurring over the interior highlands (see Fig. 3 for elevation). Interannual variability of seasonal rainfall is locked strongly to the seasonal cycle.

**GCM Seasonal Forecast – Raw Model Output**

Figure 2. (Top) 20 year average (1981-2000) skill in EA rainfall by the 9 GCMs of the Multi-Model Ensemble (NMME) for use in agriculture and hydrologic modeling over East Africa

**Forecasting to Impact Modeling Framework**

Figure 3. 3.4 regional sea surface temperatures show significant interannual variability (Fig. 2) which can be corrected through methods such as quantile-quantile mapping (Fig. 4).

**Raw Model Skill and Bias Correction**

Figure 4. Taylor diagrams illustrate downscaled model biases which were corrected for by the linear and nonlinear model bias correction approach. The 10 year average (2001-2010) skill of the corrected model bias correction approach significantly improved the direct model forecasts of EA rainfall (Fig. 6).

**Summary Points**

The NASA/USAID SERVIR Applied Science Team (AST) is currently providing several projects that will make use of downscaled seasonal forecast scenarios in agricultural and hydrologic modeling applications.

- Interannual rainfall variability in equatorial East Africa is prominent, leading to floods and droughts. Variations in both the short and long rains are influenced by ocean-atmosphere teleconnections.
- Seasonal forecasts from the GMAO model show limited inherent skill for direct forecasts of EA rainfall and must be spatially and temporally downscaled for use in impact modeling.

- Matched filter regression, combined with bootstrap resampling of a high-skill historical record (ASIA) has been a useful approach to the development of refined scenarios for use within the SERVIR AST.