Contribution of temperature, precipitation, and solar radiation from dynamically downscaled global climate model to predicting peanut yields in the SE USA.

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The impact of the El Niño-Southern Oscillation (ENSO) on the seasonal climate in Alabama, Florida, and Georgia has been well documented for temperature and precipitation and can influence the yields of a variety of field crops grown in the region. The use of ENSO climatology to drive a process based crop model such has those found in the DSSAT 4.0 cropping system models provides the state-of-the-art means to forecast crop yields. However, the ENSO signal in the southeast is weak during the critical period JJAS and ENSO climatology based yield forecasts have more variability than is desirable.

Improvements in numerical climate models at both the global (GCM) and regional (RCM) scales suggest an opportunity to enhance yield forecasts. The CROPGRO CSM model was parameterized for Georgia Green peanut with a 24 Apr planting date, rainfed conditions, and local soil profiles. Sensitivity analyses were made for the period 1994 through 2003 at nine sites across AL, FL, and GA. Two convection schemes were employed, the SAS (Simplified Arakawa-Schubert, Pan and Wu 1994) scheme from NCEP and the RAS (Relaxed Arakawa-Schubert) scheme from NRL (Rosmond 1992). The RCM daily output was bias corrected as described by Wood et al. (2002) and consists of remapping the exceedence probabilities (percentiles) of the predicted data to those of the observed data. This step is particularly important for precipitation, because the regional climate model tends to produce a large number of wet days with small precipitation amounts. For each site and year, peanut growth and development were simulated using observed weather conditions, the conditions forecast by the FSU RCM, a synthetic forecast comprised of both observed conditions and FSU RCM output for temperature, precipitation, and solar radiation, and the conditions associated with ENSO phases.

The results indicate that the temperature and solar radiation fields contributed least to errors (RMSE) in peanut yield forecasts (kg ha^{-1}). Yield prediction errors from these two fields exhibited low temporal and spatial variability with little impact attributable to convection schema. Yield prediction errors from precipitation were larger and were more temporally and spatially variable (Figures 1 & 2). Overall, the RCM with RAS convection had the lowest RMSE peanut yield across all years and sites. For temporal variability, the RCM SAS was comparable to ENSO climatology in some years and superior in 1994, 1997, 1998 (Fig 3). The effect of bias correction on forecast error in peanut yields was small for all climate fields. These results suggest that application of RCM forecasts have the greatest immediate potential for use in crop developmental models that are most sensitive to temperature. Better bias correction approaches and the implementation of ensemble yield forecasts may improve the reliability of RCM forecasts when applied to crop yield forecasts. More forecast years may allow better resolution of conditions where RCM forecasts are superior to ENSO climatology

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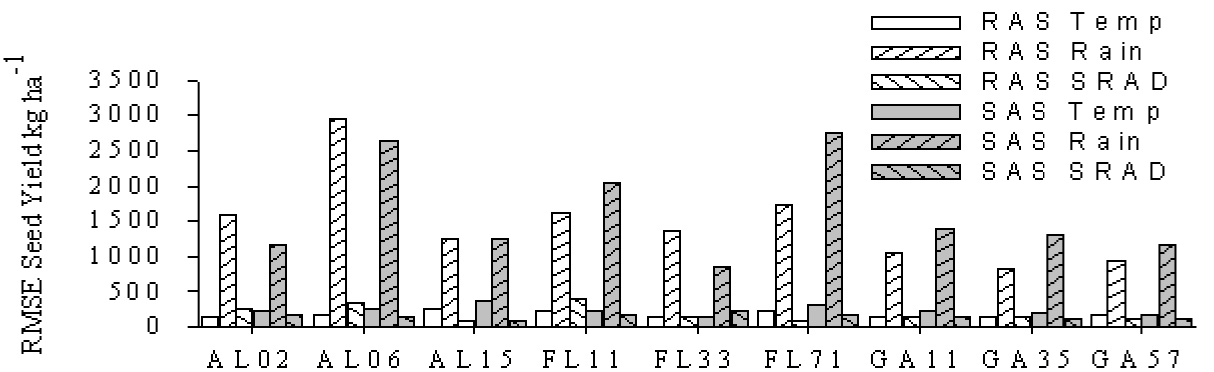

Fig 1. Contribution of FSU RCM RAS-SAS climate fields to mean error in dry peanut seed yield at nine SE sites.

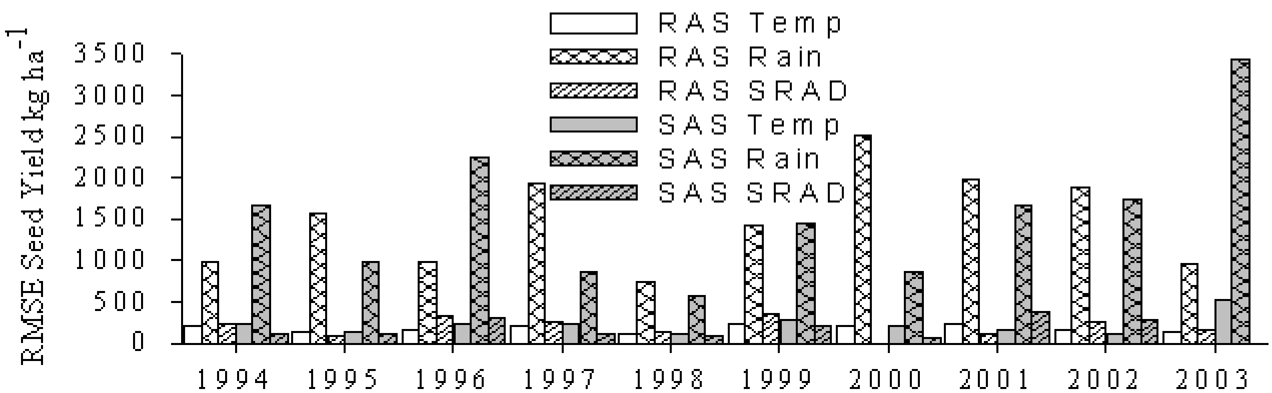

Fig 2. Contribution of FSU RCM RAS-SAS fields to mean error in dry peanut yield 1994-2003

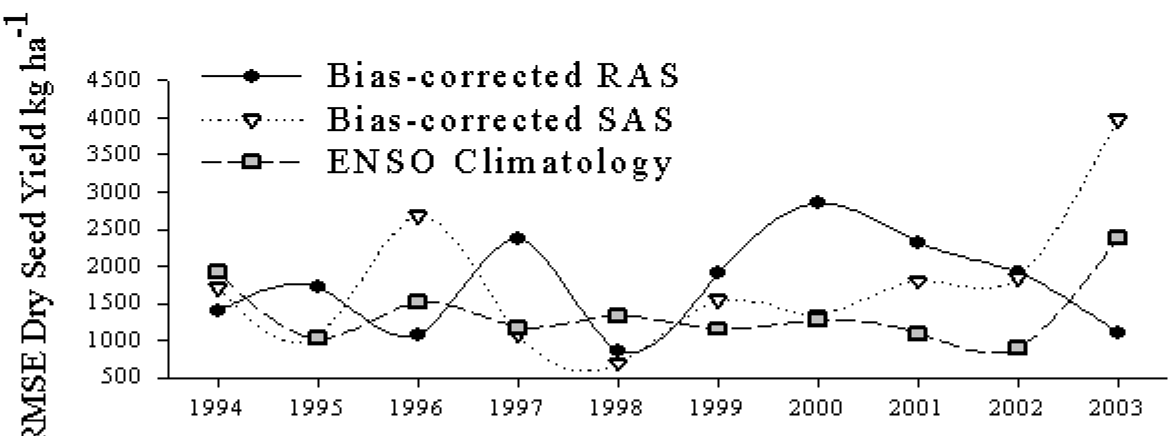

Fig 3. Error in dry peanut yield in FSU RCM RAS-SAS forecasts compared to yield forecasts using historical ENSO Climatology