Validation of NARCCAP climate products for forest resource applications in the southeast United States.

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Abstract

A validation study of North American Regional Climate Change Assessment Program (NARCCAP) climate simulations is conducted for selected United States Forest Service (USFS) sites in the southeastern USA. Preliminary results focus on qualitative comparisons of seasonal and monthly data from NARCCAP simulations to the regional surface air temperature and precipitation data sets developed at the University of Delaware. Additional analyses extend current validation efforts to more quantitative methods incorporating seasonal and monthly time-series plots of both temperature and precipitation for the selected forest sites. This work represents one of the first generation of quantitative assessments of NARCCAP products. These validation studies are precursors to current research to assess the vulnerability of southeastern forest cover and fire loads to climate change. Anticipated outcomes from this research will be useful for decision support and policy development by national, state, and local stakeholders.

Objectives

The ultimate objective was to

- employ NARCCAP results as a first step in performing further downscaling experiments

The initial steps were to

- quantitatively verify the most recently available sample of AOGCM-RCM pairings available from NARCAP

- identify biases and error relative to a well-established climatological dataset

Methodology

- Monthly and seasonal averages of temperature and precipitation fields were determined for the conterminous United States region and for some selected forest sites in the southeastern US, including Desoto, Nantahala and Ocala

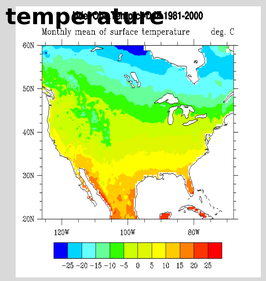
- Spatial plots of the seasonal values of temperature for the various models and for the observations were determined and model time series data for the selected sites were graphically compared to the observations.

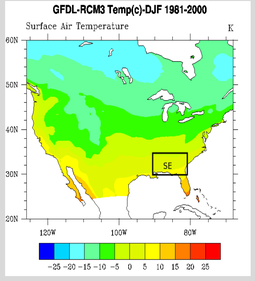
- Time-series of monthly precipitation data from the various GCM-RCM combinations in the southeastern US bounded by latitudes 30° N and 35° N and longitudes 80° W and 90° W (see box SE in the first figure, next column), which is the study area, were compared to observed data.

- The mean absolute biases and correlation coefficients between the simulated and observed temperature and precipitation data were determined

Spatial comparison of observed versus simulated DJF mean temperature

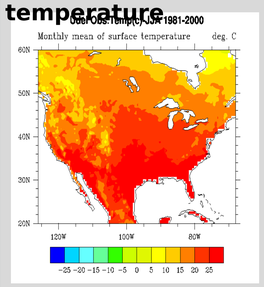
Left: Observed seasonal (DJF) mean temperature obtained from the University of Delaware database (Legates and Willmott) at 0.5° x 0.5°. Right: Corresponding GFDL-RCM3 simulated seasonal mean temperature

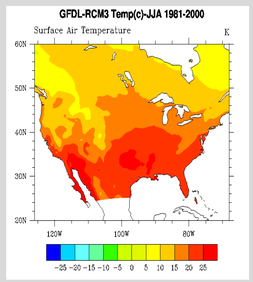




Spatial comparison of observed versus simulated JJA mean temperature

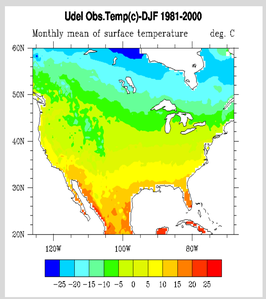
Left: Observed seasonal (JJA) mean temperature obtained from the University of Delaware database. Right: Corresponding GFDL-RCM3 simulated seasonal mean temperature

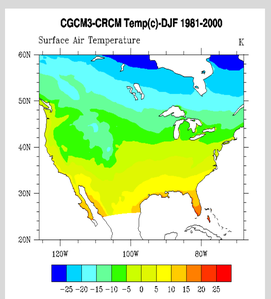




Spatial comparison of observed versus simulated DJF mean temperature

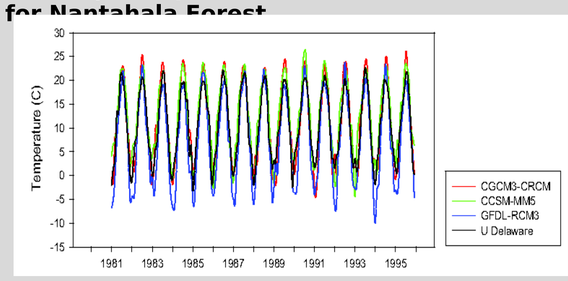
Left: Observed seasonal (JJA) mean temperature obtained from the University of Delaware database. Right: Corresponding CGCM3-CRCM3 simulated seasonal mean temperature

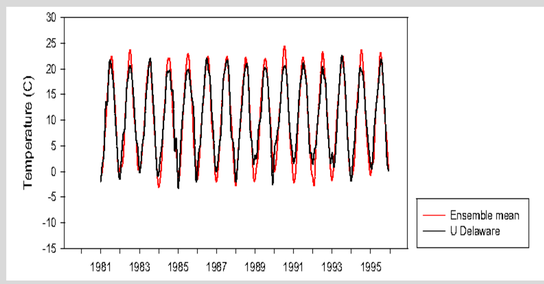




Time-series plots of simulated versus observed temperature

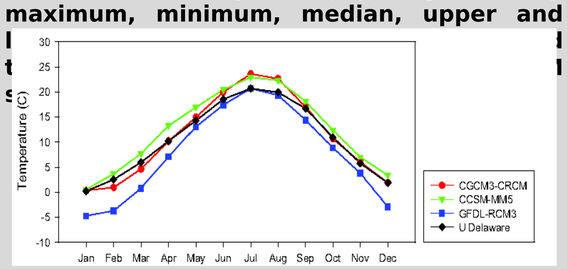
Top: Time-series of simulated mean monthly temperature versus observations for Nantahala Forest.
Bottom: Ensemble mean of simulated mean monthly temperature versus observations for Nantahala Forest

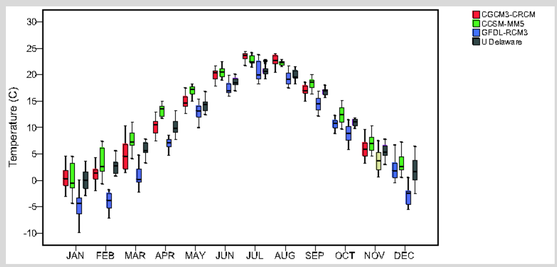




Monthly period mean: simulated versus observed surface temperature

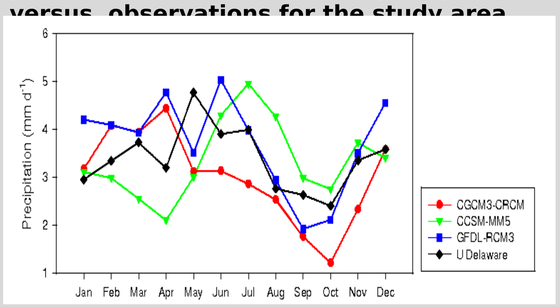
Top: Period (1981-1996) mean for each month of the year for the simulated surface temperatures versus observations for Nantahala Forest
Bottom: A box plot comparing monthly maximum, minimum, median, upper and l[illegible] t[illegible] s[illegible]

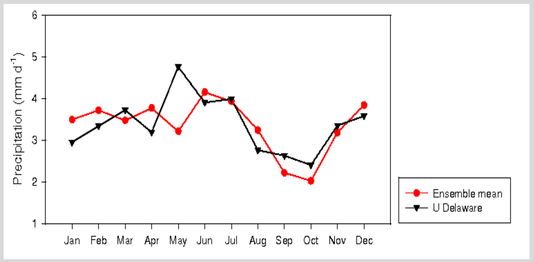




Mean values of monthly precipitation for the study area

Top: Monthly period mean of simulated precipitation versus observations for the study area
Bottom: Ensemble mean of the monthly period mean of simulated precipitation versus observations for the study area





Results

- Comparisons of seasonal (DJF) mean values of observed (Udel) temperatures to the corresponding simulated values from various model combinations for the study area highlighted some biases in the downscaled products. The observed mean temperature (DJF) for the selected region was 8.6°C while the corresponding GFDL-RCM3 simulated value was 2.9° C
- Improved accuracy was obtained from the CCSM-MM5 and CGCM3-CRCM simulated temperatures which was 8.3 °C and 7.1°C DJF mean values respectively
- The time-series analysis and the box plots indicate that the cold bias tapers off as the season progresses from winter to summer-time
- The ensemble mean of the three model combinations performs much better by reducing the mean absolute bias and increasing cross-correlation with the observations at all sites.

Future Work

- More studies are needed to highlight the influence of the driving global model on the regional simulations

- Downscaling of GCM climate products for use in impacts adaptation and vulnerability studies in various regions in the USA