

Sensitivity of Leaf Area Index in Florida to Temperature Simulation by FSURSM

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Land surface simulation is an important factor for atmospheric models, while precise estimates of land-use and vegetation are still in progress. This research is to investigate the sensitivity of leaf area index (LAI) in the southeast United States to FSURSM (Florida State University Regional Spectral Model) (Cocke and LaRow, 2000) coupled with CLM2 (Community Land Model 2.0) and improvement of the model with a new dataset of LAI in 2001 based on satellite observation by MODIS (Moderate Resolution Imaging Spectroradiometer) (Myneni et al., 2002).

According to a previous study, the FSURSM coupled with CLM2 in the domain of southeast U.S. has a cold bias of about 2 °C in the Florida region, although it was highly improved from the original FSURSM without CLM2 especially in the inland part of the domain (Shin et al., 2006). The CLM2 is mainly built for global models, although the FSURSM uses CLM2 to calculate land surface condition of a smaller domain at a higher resolution. Therefore, the vegetation data (0.5° grid) in CLM2 which is interpolated from 200km grid data accumulated by 1km data to make the data spatially smooth could cause a significant error for regional models. Figure 1 shows (a) monthly climatological LAI of the CLM2 in August and (b) monthly LAI of MODIS in August 2001. The LAI in CLM2 has lower values in Florida peninsula than that of the MODIS LAI. Since larger LAI leads lower albedo which can result in more absorption of solar energy, the model has a possibility to have higher temperatures, when the original LAI is substituted with the new observation. Another problem of the low LAI is that vegetated area in CLM2 is obtained as area where is neither lake nor wetland and vegetation in wetland are not counted for vegetation. According to the prescribed land-use data in CLM2, more than 30% of the southern part of Florida is wetland without vegetation. Thus, the effect of LAI in CLM2 appears essentially less in the southern Florida.

For the experiment, the southeast US region at 20km resolution in March to September, 2001 is simulated using FSURSM with the adjusted LAI by MODIS. Atmospheric boundary conditions are provided from simulation by FSUGSM (Florida State University Global Spectral Model). The new LAI dataset is adjusted with the ratio of vegetated area based on the land-use data in CLM2, and difference between the prescribed monthly CLM2 LAI at 20km resolution and monthly MODIS LAI at 0.25° resolution is distributed to the original prescribed LAI of deciduous trees and grass. Although CLM2 changes LAI dependent on snow depth, no snow cover in Southeast U.S. was assumed for the adjustment of the new LAI because our main interest is in Florida where snow depth is negligible. While the prescribed monthly LAI in CLM2 is based on NDVI (Normalized Difference Vegetation Index) by AVHRR (Advanced Very High Resolution Radiometer) from 1981 to 1991 (Bonan et al., 2002) and the MODIS started in 2000, changes in land-use are ignored in the new dataset, because the original low LAI values in southern Florida implies that lower vegetation was already estimated in the region.

A possible problem about the substitution is inconsistency of land-use data and new LAI. The prescribed LAI data at each grid in CLM2 is divided into up to four categories by the largest four PFT (Plant Functional Type) categories, while the MODIS LAI have only one value for each grid. However, since newer land-use and vegetation data was not available yet, the original data in CLM2 are used.

Figure 2 shows discrepancy between new and original models on (a) minimum temperature and (b) maximum temperature. In the southern Florida, results show higher values in both minimum and maximum temperature throughout the period (Not shown). The discrepancy of temperature between the observation and the modeled value is not fully compensated yet, but this result suggests that low LAI in prescribed data was one of the causes of the cold bias in Florida peninsula. For this experiment, relatively new LAI is used under the original land-use and PFT type data, which are possible to be inconsistent with the new LAI observation. For the future research, new LAI dataset based on newer land-use data and substitution of other surface data will be necessary to improve the model.

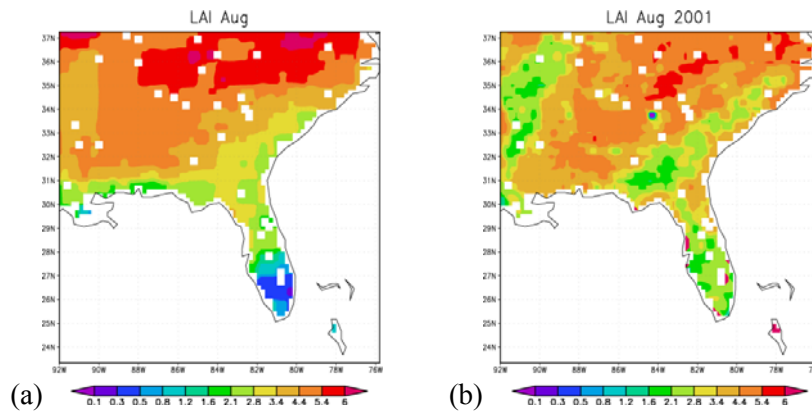


Fig 1. LAI in Southeast United States: (a) prescribed LAI of CLM2 in August and (b) MODIS observed LAI in August, 2001.

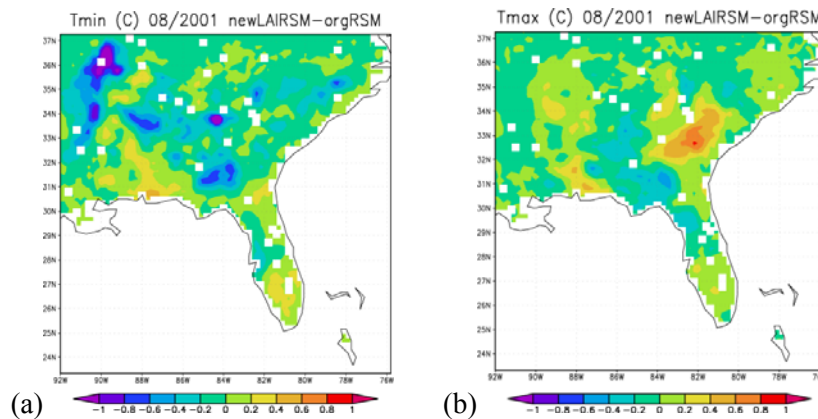


Fig 2. Difference between calculated temperatures by FSURSM coupled with CLM2 with prescribed LAI and that with MODIS LAI in August, 2001 in southeast United States: (a) minimum temperature and (b) maximum temperature.

Acknowledgement

The computations were performed on the IBM SP4 at Florida State University. COAPS receives its support from Applied Research Center, funded by NOAA office of Global Programs awarded to Dr. James J. O'Brien.

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