Geophysical Research Abstracts
Vol. 15, EGU2013-6601, 2013
EGU General Assembly 2013

A numerical study of mesoscale vegetation-atmosphere feedbacks using a new dynamically coupled vegetation-atmosphere model

Deeksha Rastogi (2) and Somnath Baidya Roy (1)

(1) University of Illinois at Urbana-Champaign, Atmospheric Sciences, Urbana, United States (sbroy@atmos.uiuc.edu), (2) Oak Ridge National Laboratory, Oak Ridge, TN, USA

Vegetation is an integral component of the earth system. Vegetation-atmosphere interactions go beyond a simple forcing-response system and include nonlinear feedback loops. Any change in land-use/land-cover acts as a forcing that elicits a response from the atmosphere. This response in turn goes on the affect the land-cover, thereby completing the feedback loop. A number of numerical modeling studies have explored these feedbacks over climate scales but mesoscale studies are limited due to the lack of appropriate modeling tools. In this project, a computationally efficient modeling tool, WRFCROP, has been developed to study these feedbacks at high spatio-temporal resolution. WRFCROP consists of the well-known Weather Research and Forecasting (WRF) model with a new vegetation submodule derived from a crop growth model SUCROS. WRFCROP is used to investigate seasonal-scale feedbacks, primarily focusing on near-surface air temperatures in croplands of the Midwestern United States. The WRFCROP model is evaluated using FLUXNET and MODIS data for soybean crops in Illinois and Nebraska. Results show that crop growth modifies surface heat, moisture and momentum fluxes that affect local temperature, cloud cover and precipitation. These meteorological parameters affect crop growth thereby generating positive and/or negative feedback loops. For example, an increase in cloud cover reduces incoming shortwave radiation and hence photosynthesis, exerting a negative feedback. However, more clouds also lead to increased precipitation that reduces water stress and promotes growth, resulting in a positive feedback. WRFCROP simulations are able to identify a number of feedback loops that affect near-surface air temperature. The primary driver of this feedback is the decrease in Bowen ratio due to increase in Leaf Area Index during the growing season. Currently, the capability of WRFCROP to simulate feedbacks in tropical South America is being explored.