Geophysical Research Abstracts
Vol. 20, EGU2018-1040, 2018
EGU General Assembly 2018


# Impact of soil moisture on land-atmosphere interactions over spring wheat cropland in India using a coupled atmosphere-crop growth dynamics model

Sarita Kumari (1), Somnath Baidya Roy (1), Prateek Sharma (2), Ankur Srivastava (1), Deeksha Rastogi (3), Vinay Kumar Sehgal (4), and Rajkumar Dhakar (4)

(1) Indian Institute of Technology, Delhi, Indian Institute of Technology, Delhi, Centre for atmospheric sciences, India (saritaladoiya@gmail.com), (2) University of Illinois Urbana-Champaign, USA, (3) Oak Ridge National Laboratory, USA, (4) Indian Agricultural Research Institute, New Delhi

Interactions between the land surface and the atmosphere occurs through simple one-way forcing-response mechanisms as well as complex feedback loops. Interesting yet under-explored regions to study these feedbacks and their effects are croplands. This is because crop growth is strongly regulated by environmental factors yet growing crops also change their own environment. Perhaps these changes are best quantified by looking at the surface-atmosphere fluxes of heat and moisture. In this study we examine the impact of soil moisture on land-atmosphere interactions, including feedbacks, in a spring wheat cropland in northern India. We use a coupled atmosphere-crop growth dynamics model that has been recently developed by coupling the crop growth module from Simple and Universal Crop growth Simulator (SUCROS) model with the Weather Research Forecasting (WRF) mesoscale atmospheric model. Crop growth is computed by using daily averaged maximum and minimum temperature, hourly shortwaves and daily averaged soil moisture simulated by WRF. Net biomass accumulation is calculated as a difference of carbon assimilation and respiration. The accumulated biomass is partitioned into various plant organs depending on the plant growth stage. LAI, NDVI and root depth diagnosed from the biomass in the leaves and roots are fed back to the WRF Noah MP LSM and used to calculate soil moisture uptake and land-atmosphere fluxes. At every stage, the biological processes are governed by environmental factors. The coupled model is calibrated and validated using observed data from a spring wheat field site.

Northern India is an arid region and spring wheat is cultivated by irrigating the fields at regular, pre-determined intervals. We simulate irrigation by setting the soil moisture of the top two layers to 90% of their saturation levels, which are quite close to the observed soil moisture values. Next we conduct experiments by varying the irrigation levels and timing to test the sensitivity of the coupled system to water stress. Results show that increasing irrigation levels reduce water stress and lead to higher crop growth, increase in latent heat flux, decrease in sensible heat flux, and reduction in near-surface air temperature. Preliminary analysis also indicates that the cooling reduces respiration rates and contributes to an increase in LAI and crop yield. Apart from advancing our understanding of land-atmosphere interactions, this study and the model can serve as a platform for a real-world agricultural decision support system tool.