Overcoming the problem of scale: Evaluating an agroecosystem model using cosmic-ray neutron soil moisture.

Benjamin Carr, Brian Hornbuckle
Department of Agronomy, Iowa State University

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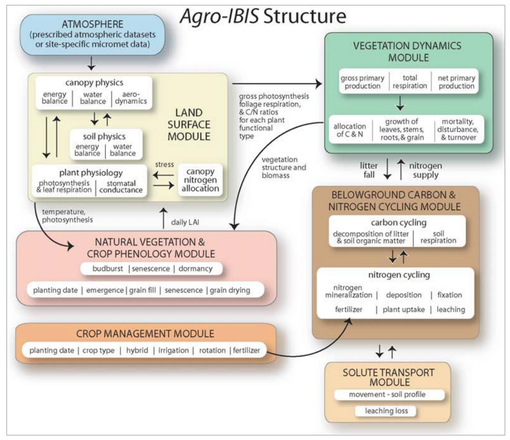
Introduction

Interactions between the land surface and the atmosphere are important in many aspects. For example, weather and climate models need to have information regarding surface conditions of soil moisture, which affects latent and sensible heat flux as well as the infiltration of precipitation. However, the data used to evaluate land surface models is often collected at a single point that may not represent the actual spatial scale that is desired. Our goal for this poster is to show that a cosmic-ray neutron detector can provide soil moisture information that more closely matches the field scale at which land surface models need to be evaluated.

Model Background

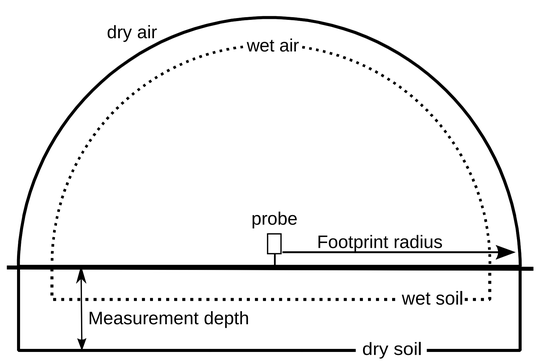
Agro-IBIS was developed from IBIS, Integrated BIosphere Simulator, to simulate agricultural crops of maize, soybean, and wheat in an dynamic global vegetation model (Kucharik, 2003). Agro-IBIS is prognostic with vegetation, allowing it to respond to environmental changes with time.



Site Information

Our field site just outside of Ames, IA has been instrumented with soil moisture sensors, precipitation gauges, a flux tower, wells and a COSMOS cosmic-ray detector. It is maintained in a traditional corn-soybean rotation with chisel plow tillage.

Soil moisture sensor (CS616)

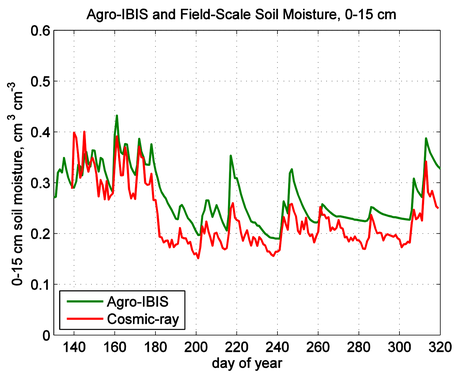


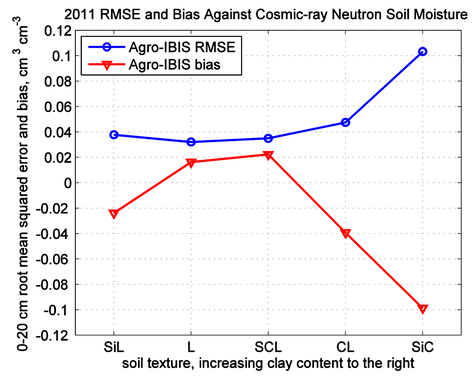
A diagram of the sensitivity of the cosmic-ray neutron detector. Adapted from Ochsner et al. (2013).

COSMOS sensor

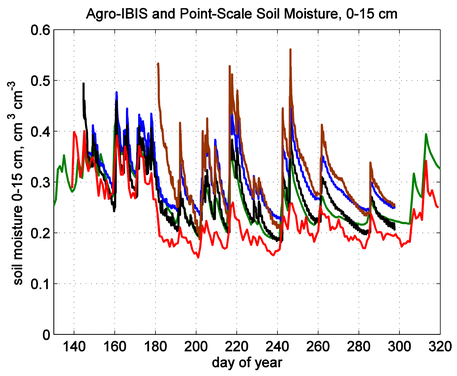
Results

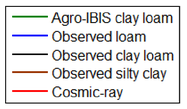
Soil Moisture and Maize Yield



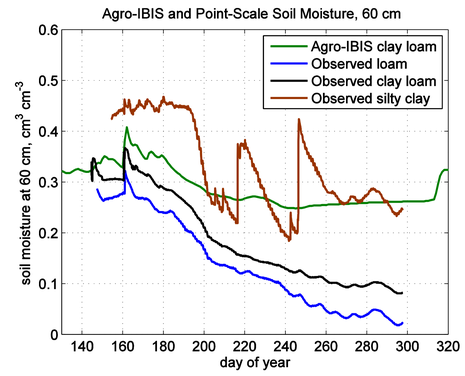


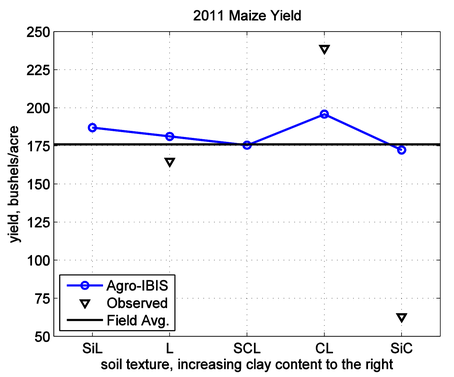
Shallow soil moisture





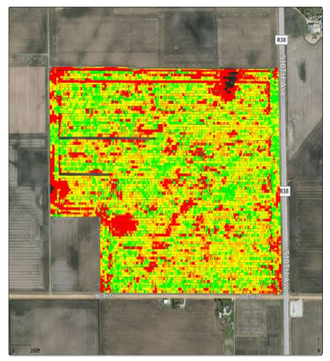
Deeper soil moisture





Agro-IBIS captures observed average yield well.

Field average



Precision yield monitor; green = high, red = low

Conclusions and Next Steps

- The cosmic-ray neutron soil moisture is able to observe soil moisture at a spatial scale that can not be captured by point measurements.
- Agro-IBIS compares well against the cosmic-ray neutron soil moisture for several soil textures.
- Agro-IBIS predicted yield close to the field average. There is significant point variability with yield at our site.
- Biomass, LAI, and latent heat flux will be used in the evaluation of Agro-IBIS.

Acknowledgements: Special thanks to Sally Logsdon, Gavin Simmons, Samantha Irvin, Jason Patton and Chris Kucharik for their help in this work.

Contact me! Benjamin Carr, bcarr@iastate.edu