SOIL, WATER, AND CLIMATE
MS DEFENSE SEMINAR

Assessing the Spatially Variability of Net Ecosystem CO_2 Production in the Upper Midwest Using Satellite Remote Sensing Technology

by

Jennifer Corcoran

Advisor: Timothy Griffis

Thursday, July 9, 2009
10:00 – 11:00 am
375 Borlaug Hall

ABSTRACT:

Concerns over the rising concentration of atmospheric carbon dioxide (CO_2) has fueled many research pursuits to better understand the ecological processes controlling the exchange of CO_2 between the biosphere and the atmosphere. Land cover and land use change has changed significantly over the last century, making it increasingly important to understand the role of land cover change on surface fluxes. For example, records from Dakota County, MN Agricultural Census Reports show that since 1860, cultivated lands for agricultural crops have increased over 300%. Continuous measurements of CO_2 flux from towers in areas dominated by agricultural use, such as the trace gas observatory (TGO) in Rosemount, MN, increase our understanding of the carbon sequestration potential of crops and their capability in mitigating the rising concentration of atmospheric CO_2. However, flux towers have a limited spatial representation, making it necessary to develop scalable surface flux models using a combination of sources of information, such as: field scale data, remote sensing, and mathematical modeling.

The goal of this thesis is to research and develop methods to estimate net ecosystem CO_2 production (NEP) of corn and soybean fields in east-central MN using a flux scaling algorithm (FSA) driven by remotely sensed leaf area index (LAI), a key biophysical variable. Chapter 1 provided an overview of previous research and current needs, research objectives, site description, and a thesis outline. Chapter 2 examined a Landsat TM hybrid supervised/unsupervised land cover classification for 2007 and compared the result to the 2007 United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) Cropland Data layer (CDL) product. Results from this chapter suggested that a land cover classification made specifically for this research project would be more accurate than using the USDA/NASS CDL to parameterize the FSA. Chapter 3 examined satellite estimates of LAI and the development of a simple FSA to scale NEP from the field to the landscape scale. Results from the field-scale assessment indicated that a simple FSA driven by remotely sensed LAI can be used to model NEP with reasonable accuracy, provided there is canopy closure. Using the results from Chapters 2 and 3, NEP was estimated for the TGO flux footprint by applying the FSA per-pixel to areas designated corn and soybean. These results were compared to measurements from the TGO and showed that the FSA performed very well during the post-peak period of the season. Chapter 4 provided a summary of the thesis and an overview of the major findings in each chapter. Presuming similar FSAs are developed for other land cover classes across the landscape, such as grassland and forest, a complete carbon budget at the TGO flux footprint scale can be estimated and verified.