WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005MT70B

Title: STUDENT FELLOWSHIP: Importance of hydrologic controls on CO2 efflux variability at the catchment scale

Project Type: Research

Focus Categories: Geochemical Processes, Solute Transport, Water Quantity

Keywords: carbon, watersheds, transport

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Congressional District: At Large

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Abstract

Temperate and boreal forests represent an enormous carbon reservoir and are considered an important part of the global carbon budget. The current international attempt for characterizing and quantifying and today's carbon balance has focused on CO2 fluxes to and from atmosphere (Ciais et al 1995; Schimel et al 2002), photosynthetic and respiration interactions (Yi et al 2004; Hibbard et al. in press), weathering, and transport unknowns (Finlay, 2003). However, these components remain to be integrated. I propose a bottom-up approach, which will progress from field point CO2 measurements up to an entire watershed. This information will be tightly coupled with surface and subsurface hydrology, soil moisture, soil temperature, substrate, and topography, in a spatial and temporal model that will simulate respiration, CO2 concentration, and efflux through space and time.

The amount of water contained in the soil can affect both the production and concentration of CO2. Production is affected by either enhancing or inhibiting the

metabolic processes involved in microbial and root respiration. Moisture can affect the soil CO_2 concentration by changing the physical properties influencing diffusion of gas from the soil to the atmosphere. This work will be built on current tools used to 1) predict soil pCO_2 in one dimension through estimates of below ground respiration rates; and 2) quantify the propensity of an area to be wetter or drier than another based on topography and the redistribution of rainfall and snowmelt. Thus, the new information will provide a quantitative model of that will assess the hydrologic controls on CO_2 efflux throughout a small catchment. While many eco-hydrological models typically focus on aboveground vegetation, our modeling approach is unique because it begins with the soil, incorporating topographic, hydrologic, and climatic controls on soil ecological processes with a link to spatial and temporal CO_2 flux. This model will be applied to model of catchment respiration, incorporating soil air pCO_2, vertical soil water transport of dissolved CO_2, and surface CO_2 efflux, and will be useful to assess how hydrologic conditions, soil moisture, soil temperature, topography, and timing of meteorological events impact C cycling and catchment export.