Project title: Carbon cycle dynamics in Oregon's urban-suburban-forested-agricultural landscapes

Andres Schmidt (presenter), Beverly E. Law (PI), Chris Still, Thomas Hilker

Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331

Abstract:

The combined effects of changes in land-use and land cover (LULC) and climate on carbon and water cycling need to be assessed at regional scales. LULC changes over time have many drivers such as expanding urban areas, exploration of new agricultural areas due to overused natural resources of current agricultural areas (e.g. degraded soil), economical reasons, or policy changes that encourage the use of alternative energy resources. Our study is focused on the effects of conversion of semi-arid sagebrush and Willamette Valley agricultural crops to bioenergy production on carbon, water and energy cycling, and resulting heating or cooling effects. Our project focusses on Oregon, where agricultural crops, significant forest area, and urban expansion are coupled with a strong spatial climate gradient that allows us to examine influences on carbon sequestration by the terrestrial biosphere. Our inverse modeling results with the CO_2 tower observations showed that CLM4.5, parameterized by species groups instead of standard PFTs, underestimated NEE in the highly productive western Douglas fir forests by more than 50%. Further diagnosis suggests the soils data inputs do not capture the high nitrogen and soil water holding capacity of the highly productive forests in the Coast Range. By integrating remote sensing LULC data, eddy covariance data from flux sites, tall tower CO_2 observations, biomass estimates from field samples, and the improved CLM4.5, we predict current and future statewide carbon sequestration with unprecedented accuracy. Using inventories and tower flux data, we determined the effect of conversion of hay and grass seed cropland (323,200 ha) to hybrid poplar and found the state NEP increased from 4 $TgCO_2$ per year to 13 $TgCO_2$ per year for that area. The last coal power plant in the state (Boardman) is in the process of switching from coal combustion to biofuel burning to meet the state's goal for the reduction of greenhouse gas emissions. Our results show that the 7816 tons of biomass per day to keep the 518 MW power plant running at base load would amount to 35,000 hectares of poplar per year under current climate conditions. The improved CLM4.5 model will be used to evaluate the impacts of this land use change on the net ecosystem carbon balance (NECB) and net emissions to the atmosphere under future climate conditions. We will also examine water vapor feedback effects on the energy budget.