Carbon cycle dynamics within Oregon's urban-suburban-forested-agricultural landscapes
A NACP Core Project

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Our research team at Oregon State University launched a new NACP core project on the effects of land use and land cover on the exchanges of carbon, water and energy in current and future climates across a gradient of urban-suburban agricultural and forested landscapes across Oregon. The region spans strong gradients from high population/high forest productivity/mesic climate in the west to low population/low productivity/arid climate in the east.

Land use is changing to reduce GHG emissions. The 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. It also addresses the effects of afforestation of idle land and rangelands deemed suitable for forests or poplar plantations under future climate conditions.

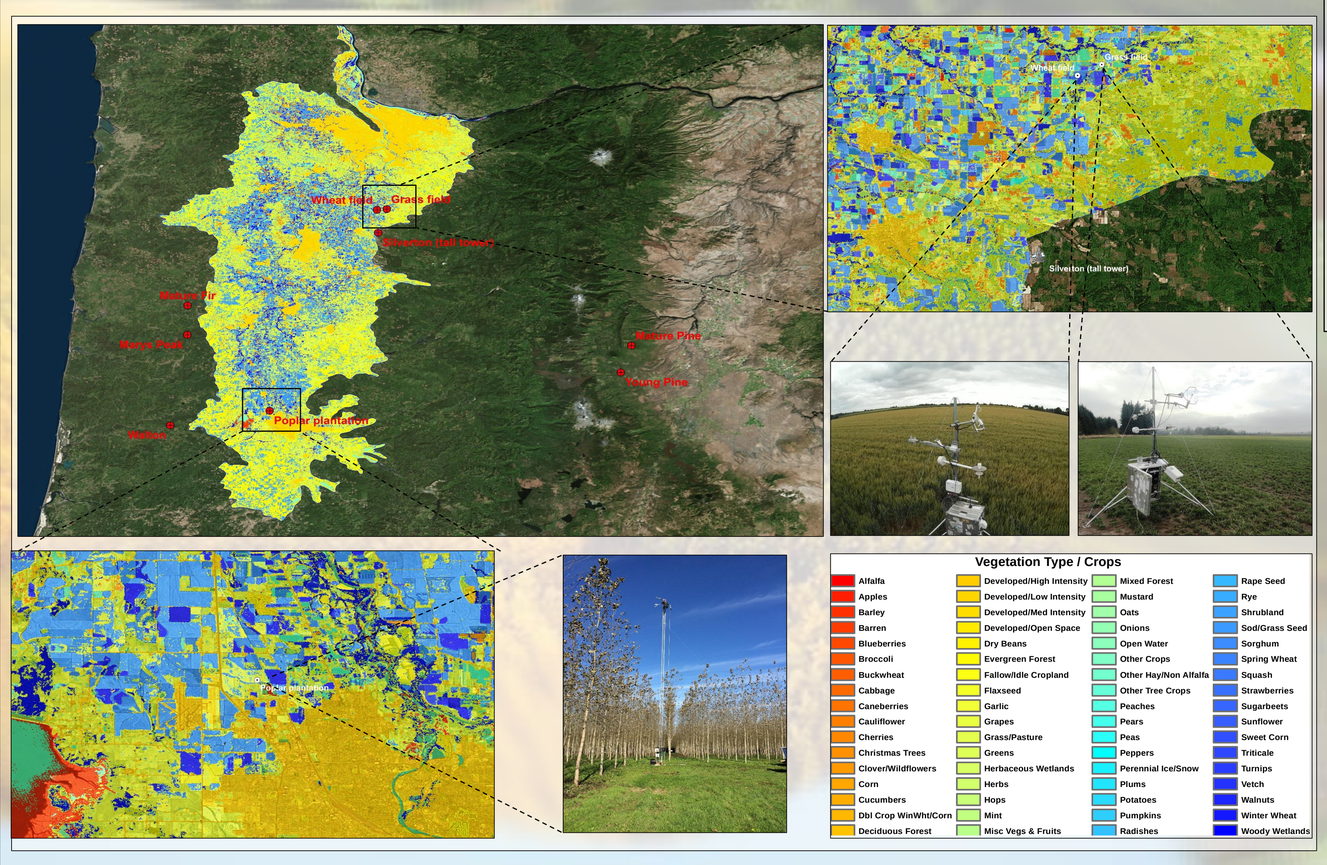

Figure 1: The Oregon domain with its urban-suburban, agricultural, and forested Willamette Valley. The mosaic of land use and various crop types requires a high resolution of land use and land cover information for the modeling of the exchange of carbon, water, and energy and a dense network of measurement towers.

Policy-relevant questions are: How do current land uses and cover affect carbon dynamics, and carbon, water and energy exchanges, including cooling/warming effects? Given possible climate trajectories, what land-use strategies will reduce carbon dioxide emissions while optimizing sustainability of native vegetation and food crops?

Our approach integrates remote sensing data of land-use/land-cover and data from tall tower CO_2 observations and flux sites with comprehensive modeling approaches using the Community Land Model (CLM 4.5).
A goal is to identify policies and management strategies that can sustain ecosystem function while addressing land use changes that are intended to reduce greenhouse gas emissions.

Our observation-driven modeling approach will provide a policy analysis tool for other regions for projections of integrated impacts of land use decisions and climate change on ecosystem carbon and water processes and climate feedbacks.
A total of 9 measurement sites operated by the TERRA-PNW group cover the Oregon domain consisting of eddy flux towers as well as high precision CO_2 observation towers.

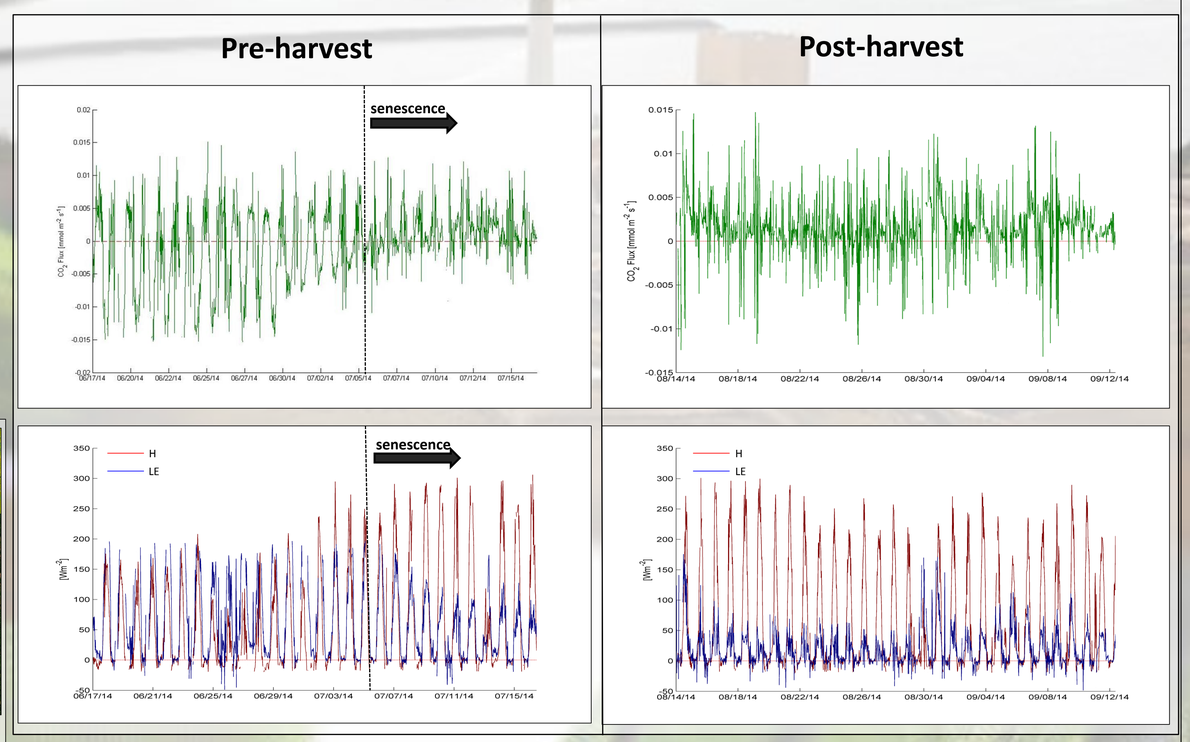

Figure 2: Measured turbulent fluxes of CO_2, latent heat, and sensible heat at the wheat site in late summer 2014. The massive changes in the local energy and water balance is clearly visible. Furthermore the abrupt switch from a CO_2 sink to a CO_2 source after the harvest day (August 9, 2014) is shown.

In summer and fall 2014 we 3 new towers were installed, equipped with eddy covariance flux systems as well as instruments for meteorological measurements such as temperature, humidity, and radiation components (Fig. 1). The new flux towers are located in the agricultural landscape of the Willamette Valley and quantify the carbon exchange for crop types that are most abundant in Oregon's Willamette Valley.
Figure 2 shows results of the first data from one of the new agricultural flux towers located at a wheat field and a fescue grass field, respectively. In addition to the agricultural flux sites, a new 21 m tower was installed at a poplar plantation covering over 410 ha in fall 2014 (Fig. 1).
Plantations for bioenergy fuel materials such as poplar have already been established in the valley and areas with poplar plantations are expected to increase to facilitate the production of the required biofuels. This land use change from grass fields or other crops to poplar trees will be associated with an altered land-atmosphere exchange of carbon, water, and energy in those regions.

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