Bayesian Optimization of the Net Ecosystem Exchange (NEE) in Oregon Using a New CO_2 Observation Tower Network, Transport Modeling, and the Community Land Model

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The high precision CO_2 observation tower network in Oregon comprises 4 towers equipped with PICARRO Cavity Ring-Down Spectrometers and 2 towers that are equipped with eddy flux systems. These towers provide very accurate CO and CO_2 measurements used for our inverse modeling setup. In addition to towers representing a variety of typical ecoregions in the Pacific Northwest (Coast Range, East Cascades, Northern Great Basin), the tallest tower in the network is located in Silverton in the Willamette Valley, which is the urban-suburban-forested-agriculture corridor of Oregon.

Obtaining the regional NEE in this area is challenging due to the land cover heterogeneity and anthropogenic influences on CO_2, which affect inverse modeling of the land surface sources. To account for traffic emissions, we used a mobile campaign during which the CO:CO_2 emission ratios were measured for the types of roads that can be found in the footprint area of the tall tower in Silverton (Fig. 1) so that we could remove anthropogenic sources from the vegetation CO_2 signal.

A spatial matrix containing the type of road, traffic amount, its abundance in the grid cell, and the associated emission ratios was derived. We corrected CO_2 mixing ratios measured at the Silverton tower using the Weather Research & Forecasting-Stochastic Time-Inverted Langrangian Transport model. Three-hourly fluxes calculated with Community Land Model (CLM)4.5 were optimized using a classical Bayesian approach and CO_2 observations from the tower network all over Oregon. This enabled us to adjust the model to carbon processes within the various ecoregions and reduce uncertainties of the modeled fluxes and derived values such as annual Gross Primary Production. We will present the results for the optimized modelled fluxes using this framework that can be applied in other regions that exhibit a similar variety in land use and land cover.

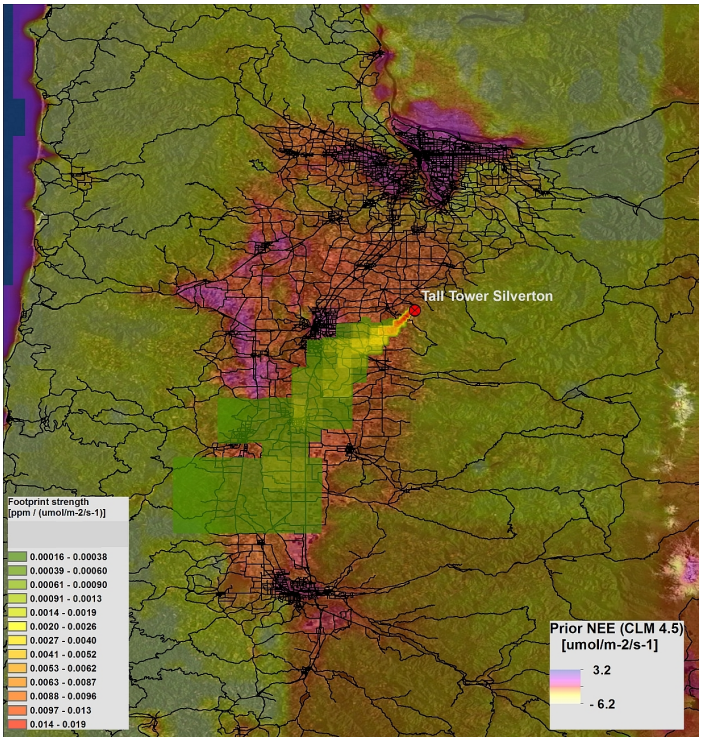

Figure 1. Prior NEE, modeled with CLM 4.5, in the highly inhomogeneous landscape of the Willamette Valley, Oregon for July 5, 2012. The corresponding footprint area at the tall tower in Silverton indicates the influences of urban areas and roads on the CO_2 mixing ratios measured at the tall tower in Silverton, OR and used for the inverse model optimization.