Combining CO_2 Observations from Towers, Aircraft Profiles and a Car-mounted Instrument Using a Combination of Transport Modeling and Neural Networks

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The CO_2 observation network in Oregon has been enhanced by three new towers in 2012. Equipped with PICARRO Cavity Ring-Down Spectrometers (CRDS), these towers provide very accurate CO and CO_2 measurements. In addition to towers representing a variety of typical ecoregions in the Pacific Northwest, the tallest tower in the network is located in Silverton in the Willamette Valley, which is the urban-suburban-forested-agriculture corridor of Oregon. We will present data from the first year of measurements at the Silverton tower showing the effects of urban plumes on the different measurement levels (30, 50, 120 and 270 meters above ground).

In 2012, we conducted a measurement campaign using a car-mounted PICARRO CRDS CO_2/CO analyzer. Over three days, the instrument was driven more than 1000 miles throughout the northwestern portion of Oregon including main highways, back roads, and Oregon's biggest urban centers. Furthermore, three flight campaigns were conducted that covered all tower locations from the arid High Desert area in eastern Oregon to the towers in the western Coast Range. While these additional campaigns provide valuable information about the CO/CO_2 ratios, spatially integrated CO_2 signals, and boundary layer heights, it remains challenging to correlate all the measurements conducted over different temporal and spatial scales.

Here, we present a geo-statistical approach using neural networks and Weather Research and Forecasting - Stochastic Time-Inverted Langrangian Transport modeling to combine these campaigns with the continuous data at the Silverton tower for a high resolution 3D concentration field over time. This information can be used to initialize conditions for carbon cycle modeling over an area highly affected by varying anthropogenic CO_2 emissions.

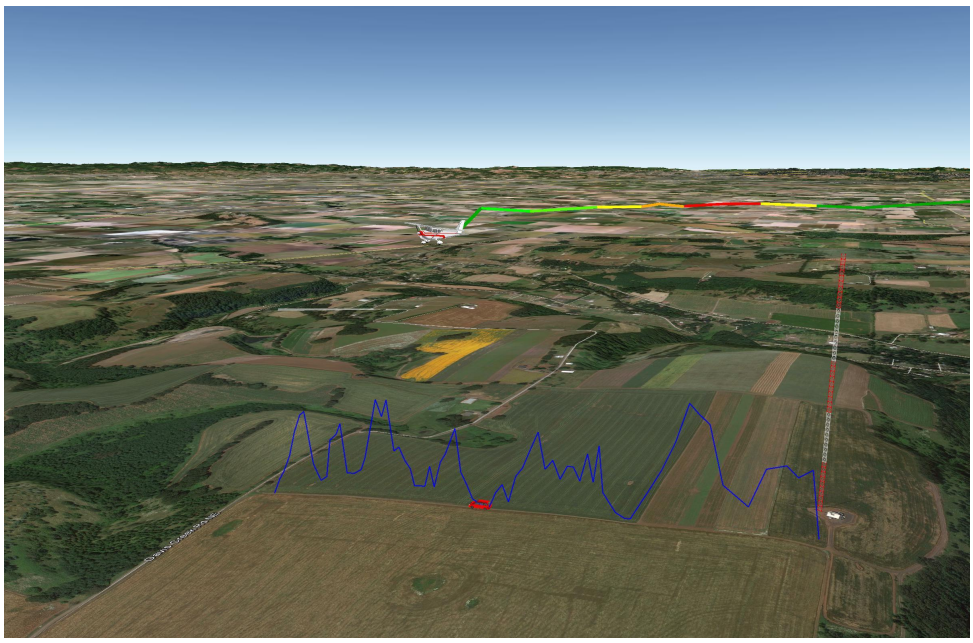

Figure 1. The different measurements at the 270 m CO_2/CO/CH_4 observation tower in Silverton, OR measured during several campaigns in summer and fall 2012.