**High-Resolution Fossil Fuel Emissions Estimates in Support of NACP and OCO-Based CO2 measurements and assimilation system**

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A primary goal of the North American Carbon Program and the analysis of planned observations to be made by NASA’s Orbiting Carbon Observatory (OCO) measurements, is to use highly resolved spatiotemporal patterns of atmospheric CO2 to infer regional carbon exchange for the North American and global domain. To quantify that portion of the carbon cycle that is of greatest interest to scientists and policymakers – the *residual* carbon exchange with the land and oceans – the contribution to measured CO2 due to fossil fuel use and cement manufacturing must be accurately quantified. However, use of the currently available fossil fuel CO2 emissions estimates within the planned NACP and/or OCO CO2 measurement and inversion systems will give rise to significant bias, likely defeating the very goal of the expanded CO2 measurements. In order to achieve unbiased estimates of land and oceanic carbon exchange at resolutions consistent with the temporally and spatially dense North American and space-based CO2 measurement programs, significant improvement in quantifying fossil fuel CO2 emissions at smaller space/time scales is essential.

To meet this requirement, we will produce high resolution space and time scale fossil fuel CO2 emissions estimates using an approach that builds upon the already extensive work performed for US air quality investigations. By incorporating CO2 emissions factors into a process-based, data-driven, state-of-the-art, air quality emissions model (CONCEPT) we will generate fossil fuel CO and CO2 emissions at spatial scales of 36 km and timescales of one hour; well within the planned needs of the NACP measurement and inversion work. We propose to quantify spatiotemporally explicit emissions for the United States domain in the current proposed work. The methodologies developed will be extendable to the global domain and hence, support the fossil fuel CO2 emissions requirements of the OCO CO2 measurements and inverse-based flux estimates.

Initial evaluation of the modified CONCEPT (“CONCEPT-CO2”) model CO2 emissions will be made against the top-down inventory CO2 emissions work by aggregating the high resolution CONCEPT-CO2 fluxes to monthly time scales and state emissions totals. This will allow for further adjustment of emission factors and process attributes to ensure consistency with the more coarsely resolved but accurate state-level fossil fuel CO2 emissions estimates.

Emissions estimates will be propagated through a regional atmospheric transport model to predict highly resolved variations in the mixing ratio of CO, which will be evaluated against the MOPITT Earth-observing satellite and *in-situ* observations such as the expanded NACP continuous tower observations and aircraft campaigns.

## This work will produce a fossil fuel CO and CO2 emissions system generating gridded CO and CO2 fluxes for the United States at a spatial scale of 36 km and a temporal scale of 1 hour. It will have been evaluated against a variety of independent observations including remote-sensing products. It will provide immediate support to the NACP and form the foundation for global extension in direct support of OCO CO2 measurements and inversion/assimilation research.

Full Proposal

Final Report

Publications

Students