Hestia: Urban scale high resolution quantification of fossil fuel CO_2 emissions

Kevin Gurney[1], Igor Razlivanov[1], Yuyu Zhou[2], Yang Song[1], Jianhua Huang[1], Jocelyn Turnbull[3,4,5], Colm Sweeney[3,4], Anna Karion[3,4], Kenneth Davis[6], Natasha Miles[6], Scott Richardson[6], Thomas Lauvaux[6], Paul Shepson[7], Obie Cambaliza[7], Scott Lehman[4], Pieter Tans[3], Annmarie, Riley, Stan, etc

[1]School of Life Sciences, Arizona State University, Tempe, AZ; 480-965-4556; kevin.gurney@asu.edu
[2]Joint Global Change Research Institute, College Park, MD
[3]NOAA/ESRL, Boulder, CO
[4]University of Colorado, Boulder, CO
[5]Rafter Radiocarbon Laboratory, Lower Hutt, New Zealand
[6]Pennsylvania State University, State College, PA
[7]Purdue University, West Lafayette, IN
[8] Jet Propulsion Laboratory, Pasadena, CA

Quantification of fossil fuel CO_2 emissions from the bottom-up perspective is a critical element in development of a carbon monitoring system. A space/time explicit emissions data product can verify atmospheric CO_2 measurements and offer practical information to authorities in order to optimize mitigation efforts.

Here, we present the Hestia Project, an effort aimed at building a high resolution (eg. building and road link-specific, hourly) fossil fuel CO_2 emissions data product for the urban domain. A complete data product has been built for the city of Indianapolis and work is ongoing in Los Angeles. The work in Indianapolis is now part of a larger effort, INFLUX, aimed at a convergent top-down/bottom-up assessment of greenhouse gas emissions. The work in LA with JPL calleagues is aimed at building an operational carbon monitoring system with focus on global megacities.

Our urban-level quantification relies on a mixture of data and modeling structures. We start with the sector-specific Vulcan Project estimate using Hestia to distribute emissions in space and time. Two components take the majority of effort: buildings and onroad emissions. For the buildings, we utilize an energy building model constrained with multiple local data streams. For onroad emissions, we use a combination of traffic data and GIS road layers maintaining vehicle class information.

In collaboration with our INFLUX colleagues, we are transporting these high resolution emissions through an atmospheric transport model for a forward comparison of the Hestia data product with atmospheric measurements, collected on aircraft and cell towers. In collaboration with our JPL colleagues We are testing the feasilibity of quantifying a megacity domain and how it might integrate with remote sensing and in situ measurement systems.