Toward a More Nuanced Understanding of Carbon Dioxide Emissions from Fossil Fuel Combustion: Highlights of the Last Year of TES Funding

R. J. Andres[1], A.W. King[2]

[1]Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6290 USA
[2]Environmental Sciences Division and Climate Change Science Institute, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6301 USA

e-mail: andresrj@ornl.gov

Creating gridded uncertainty maps of carbon dioxide emissions from fossil fuel combustion was the focus of much of the last year. Since physical measurements at the appropriate spatial and temporal scales do not exist, all current global maps of fossil fuel carbon dioxide emissions use one or more proxies to distribute emissions. These proxies introduce additional uncertainty into these maps, beyond the uncertainty associated with the undistributed emissions magnitude. This uncertainty, gridded at the same spatial and temporal scales as the emission magnitude maps, includes contributions from the spatial, temporal, proxy, and magnitude components used to create the magnitude map of FFCO2 emissions. This work follows on from the global uncertainty analysis published in 2014 (Andres et al., 2014, Tellus B, 66, 23616. doi:10.3402/tellusb.v66.23616). The gridded uncertainty manuscript will be submitted for publication soon.

In addition to the uncertainty focus, TES funding contributed to revisions and the addition of another year to the CDIAC fossil fuel carbon dioxide time series. The current time series now ends in 2011 and emission year 2012 is now being investigated. These data are available annually and monthly, in tabular form and gridded at one degree scale.

TES funding is also contributing to a better understanding of the influence of changing fossil-fuel ^{13}C emissions on ^{13}C tracer experiments at the SPRUCE site. This requires a highly precise and accurate model of ^{13}C photosynthetic fractionation and fixation. Using the TES-SFA's functional unit testing framework, ecosystem-wide process representations of ^{13}C fractionation and fixation for incorporation into CLM-SPRUCE and other models are being examined, beginning with the Sun and Gu photosynthesis model that incorporates mesophyll conductance in isotopic discrimination. Uncertainty in the parameters of this sophisticated model will propagate into uncertainty in simulated biomass ^{13}C. The functional unit testing allows exploration of this uncertainty and the consideration of alternative formulations which may be less precise in principle but have smaller associated parametric uncertainty.

Peer-reviewed publication of this work continues. Since the last TES presentation one year ago, TES funding has contributed to four major publications (including one in Nature) as well as meeting abstracts, presentations, and interactions. Also of note are continuing efforts toward the Coupled Model Intercomparison Project Phase 6 (CMIP6) activities, the Global Carbon Project Global Carbon Atlas (http://www.globalcarbonatlas.org), cooperative work with Chinese colleagues on better estimating their emissions, and press interactions.