

## **Temporal, Spatial, and Uncertainty Aspects of Carbon Dioxide Emissions from Fossil Fuel Combustion: Highlights of the Last Year of TES Funding**

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Continued TES funding has led to improvements in understanding fossil fuel carbon dioxide (FFCO<sub>2</sub>) emissions, especially in terms of their temporal distribution, spatial distribution, and uncertainties associated with those emissions. Research continues in all three of these areas with TES support.

Temporally, monthly inventories of FFCO<sub>2</sub> emissions have been completed from January 1950 to December 2010. Emission year 2011 data are being calculated at the time of this writing. Nations are the basic spatial unit of data (which can be summed to global totals). One of the primary results of this research is the global monthly time series is statistically different from a uniform annual distribution.

Spatially, the annual and monthly data are gridded at one degree latitude by one degree longitude. This data format has proven so useful to the broader community that others have made attempts to improve upon the gridding methodology originally published in 1996 (Andres et al., *Global Biogeochem. Cycles* 10:419-429). Each of these gridding attempts suffer from spatial, temporal and/or coverage uncertainties.

Research on uncertainties associated with FFCO<sub>2</sub> emissions has been concentrated in global totals and gridded distributions. A new global uncertainty analysis has been published (Andres et al., 2014, *Tellus B*, 66, 23616. doi:10.3402/tellusb.v66.23616). The analysis includes three separate uncertainty assessments, resulting in a multifaceted examination of the uncertainty associated with FFCO<sub>2</sub> emission estimates. The three assessments collectively give a range that spans 1.0 to 13% (2 sigma). Greatly simplifying the assessments to obtain one value gives a global FFCO<sub>2</sub> uncertainty value of 8.4% (2 sigma).

Uncertainty assessments on gridded distributions are nearing publication. Individual component uncertainties from geography, national emission estimates, and distribution proxies have been considered.

Future work will continue efforts already begun as well as make a renewed push to better integrate FFCO<sub>2</sub> emissions into our understanding of the terrestrial biosphere. A. W. King will lead these efforts. Currently under consideration is how variations in atmospheric <sup>13</sup>C might introduce uncertainty in <sup>13</sup>C as a tracer of carbon transfers in the biosphere.

Peer-reviewed publication of this work continues. Since the last TES presentation one year ago, TES funding has contributed to five major publications as well as meeting abstracts, presentations, and interactions. Also of note are a contributing authorship to IPCC AR5 Working Group III chapter 5, preliminary efforts toward the Coupled Model Intercomparison Project Phase 6 (CMIP6) activities, the Global Carbon Project Global Carbon Atlas (<http://www.globalcarbonatlas.org>), and press interactions.