ANTHROPOGENIC CARBON DIOXIDE EMISSIONS AT THE STATE AND MONTHLY LEVELS

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ABSTRACT

CO_2 emissions from fossil-fuel combustion can be estimated at the state or monthly level even when full data on fuel combustion are not available. Our hypothesis is that a representative proxy can accurately estimate the pattern of CO_2 emissions if a sufficient fraction of the total can be represented, even if the dataset used does not cover all energy consumption sectors. Our approach employs monthly sales data for each state from the U.S. Department of Energy's Energy Information Administration (EIA). This is used to estimate the relative proportions of solid, liquid and gaseous fossil fuels for each state for each month.

To test this approach to subdividing national, annual CO_2 emissions estimates, we have estimated emissions by state and month for the U.S. and compared our results with those based on full fuel-consumption data as reported by Blasing et al. [2004] at the Oak Ridge National Laboratory (ORNL). The similarities in the national monthly totals produced by the two methods are evaluated. In addition, the individual, monthly state results are compared to the annual state totals calculated by Blasing et al. This analysis permits an understanding of the strengths and shortcomings of both estimation techniques.

In general, the University of North Dakota (UND) technique produces estimates that are consistent with those of Blasing et al. At the national level, both methods produce a similar monthly time series for U.S. CO_2 emissions; the Root Mean Squared Error (RMSE) error is close to 2% as seen in Fig. 1. For a state-to-state spatial comparison, the ORNL method produces only an annual time series for each state so the monthly UND data for each state is aggregated. In Figures 2 and 3, choropleth maps generated from each dataset display similar spatial patterns of per capita CO_2 emissions from fossil-fuel consumption for the U.S.

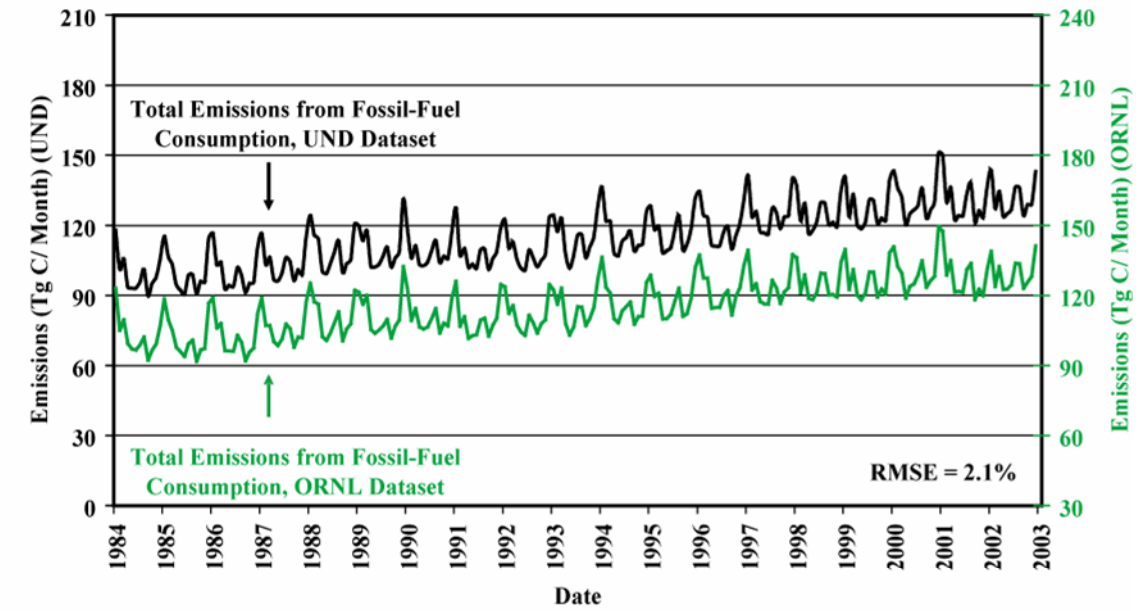

Fig. 1. Comparison of Total CO_2 Emissions from Fossil-Fuel Consumption in the U.S., UND and ORNL Datasets.

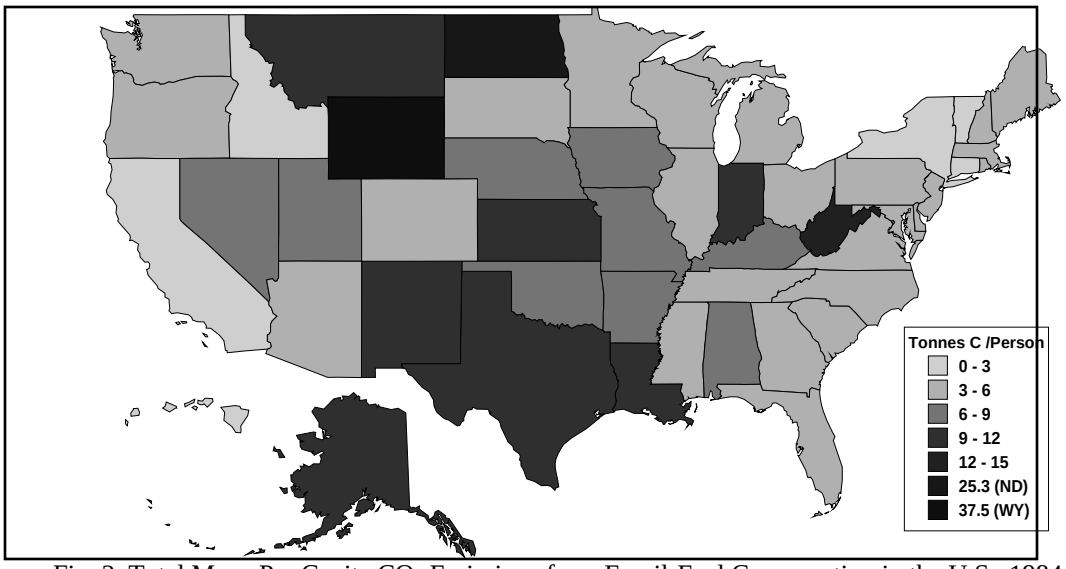

Fig. 2. Total Mean Per Capita CO_2 Emissions from Fossil-Fuel Consumption in the U.S., 1984-2001, UND Dataset.

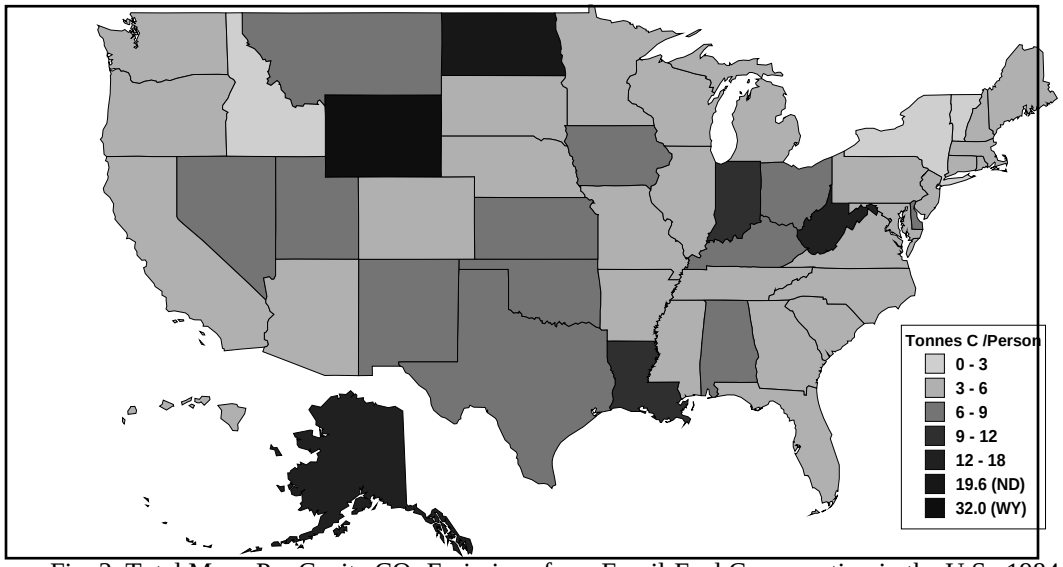

Fig. 3. Total Mean Per Capita CO_2 Emissions from Fossil-Fuel Consumption in the U.S., 1984-2001, ORNL Dataset.

The primary advantages of the UND approach are its ease of implementation, the improved spatial and temporal resolution it can produce, and its universal applicability, even with a dearth of available fuel consumption data. This methodology is currently being applied to the world's top twenty-one CO_2 emitting countries, a set of countries responsible for over 80% of fossil-fuel-related CO_2 emissions. We illustrate the results that can be achieved for countries with various levels of data availability. Even when it is possible to estimate the pattern of national emissions, underlying source data may permit only short time series. Though anthropogenic CO_2 emissions are a challenge to model at finer temporal and spatial resolutions, they are an important component to understanding the total global carbon cycle.

REFERENCE

Blasing, T.J., C.T. Broniak, and G. Marland, 2004. *Tellus: 57*B, 107-115.