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Fossil fuel Carbon Dioxide Emission ($FFCO_2$) uncertainty: An implication for CO_2 tracer transport simulation and flux inversion

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Fossil fuel carbon dioxide (CO_2) emissions ($FFCO_2$) are the largest input to the global carbon cycle over decadal time scales. $FFCO_2$ are often used as a reference in carbon budget analyses, such as transport simulations and flux inversions. Thus, inaccuracies in these specified $FFCO_2$ emissions will propagate into those fluxes that are being computed in inverse models. It is thus essential to quantify the uncertainties in $FFCO_2$ estimates. While the $FFCO_2$ estimates from different emission inventories/datasets often agree well at global and national levels, the spatial distributions of emissions at smaller spatial scales are unique, specific to the emission disaggregation methods employed, and subject to uncertainty. The uncertainty associated with the use of spatial proxy data becomes large at fine spatial scales. In this study, an attempt is made to assess the uncertainty associated with spatial distributions of emissions in gridded $FFCO_2$ inventories/datasets. The $FFCO_2$ uncertainty is computed as a combination of the uncertainties associated with (1) emission estimates and (2) emission disaggregation. Emission distributions from four gridded inventories are compared at a 1×1 degree resolution and these differences are used as a proxy for the estimate of the disaggregation uncertainty. The calculated uncertainties typically range from 30% to 200% at 1×1 degree and are inversely correlated with the emission magnitude. The estimated $FFCO_2$ uncertainty is included in a transport simulation with NASA's GOES model, with the intent of translating the uncertainty estimates in emission magnitude to atmospheric concentration (uncertainty tracer). The $FFCO_2$ uncertainty tracer simulation suggests that the largest uncertainties are confined to the proximity of major source regions at the surface level, and decrease with distance from the source and altitude, where transport and mixing reduce the effect. However, the uncertainty tracer does spread out globally and creates a persistent North-South gradient in the column CO_2 (XCO_2) field. Ongoing work addresses the potential impacts of this $FFCO_2$ uncertainty on flux inversions and use of our uncertainty tracer.