Toward the Atmospheric Greenhouse Gas Observing System We Need

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Highly precise and carefully calibrated measurements of greenhouse gases have shown conclusively that their current build-up is caused by human activities. Our laboratory has played a leading role in building authoritative records that can stand the test of time. A second task for the observing system is to help us manage our planet's climate, which includes providing objective, transparent, freely available information about actual emissions. Atmospheric observations are independent of emissions inventories that take into account mostly self-reported estimates. Annual emissions from fossil fuel burning are now larger than total growing season net carbon dioxide (CO_2) uptake by all ecosystems in the northern hemisphere.

The information about emissions/removals of greenhouse gases is embedded in usually very small spatial and temporal gradients of their (dry) mole fraction in the atmosphere. Except for observed global averages, atmospheric transport models are needed to translate gradients into emissions estimates. Those models are also used to merge together different data sets. In this way transport biases get mixed up with systematic errors in data sets, so that a hypothetical perfect data set can be "corrected" away from truth. It is imperative for us to compare data sets directly with calibrated data to the maximum extent possible, with enough information to discover and eliminate systematic errors in observational data. Then we can better evaluate problems with the representation of atmospheric transport and minimize the substantial errors that often arise from model problems.

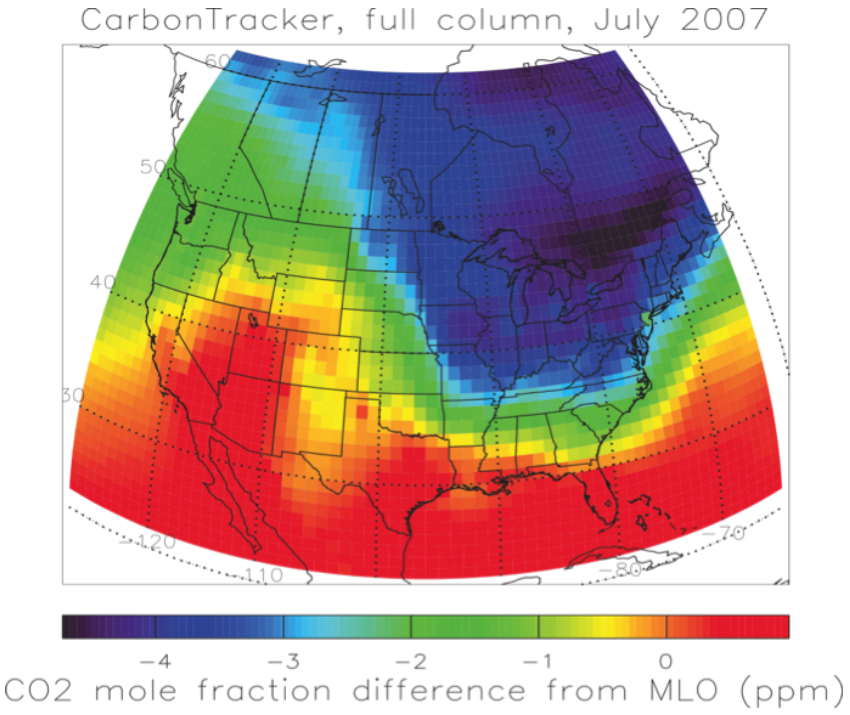

Figure 1. Estimated average July 2007 full-column (surface to top of stratosphere) CO_2 mole fractions by NOAA's CO_2 data assimilation system CarbonTracker. CO_2 is expressed as the difference from the monthly mean CO_2 mole fraction of 384.5 ppm observed at Mauna Loa Observatory, Hawaii.