6.215 Constraining regional and national fossil fuel CO2 emissions using atmospheric observations of CO2 and 14CO2.

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Abstract:

Recent US policy measures and international commitments, such as the President's Climate Action Plan and the US "Intended Nationally Determined Commitment" (INDC) to the UNFCCC's COP21, call for a reduction in US greenhouse gas (GHG) emissions over the next several decades. For example, the US INDC aims at a reduction of the annual net CO_2 equivalent GHG emission by 25-28% with respect to 2005 levels by 2025. This raises the question of whether the US and other nations have the tools needed in order to detect and verify proposed emission reductions. Here we use the fact that $\Delta^{14}CO_2$ is a largely unbiased tracer of recently-added fossil fuel CO_2 in the atmosphere to construct an atmospheric inverse modelling framework to independently estimate fossil fuel CO_2 emissions from observations of CO_2 and $\Delta^{14}CO_2$. We evaluate present and realistic future observing scenarios in an Observation System Simulation Experiment (OSSE), including the low end National Research Council recommendation of 5,000 $\Delta^{14}CO_2$ measurements per year. We show that given the present day observing scenario, this framework can estimate the US annual total emission to within 5%. Given an augmented yet realistic future observing scenario of 5,000 measurements per year over North America, we can estimate monthly total emissions over the US and several highly emissive regions (such as the Eastern US) with the same accuracy.