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Assessment of radiocarbon observations for constraining fossil fuel emissions in a comprehensive Carbon Cycle Fossil Fuel Data Assimilation System

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Estimation of greenhouse gas emissions from atmospheric measurement-based "top-down" methods is complicated by strong and uncertain fluxes from natural systems, for example carbon dioxide (CO_2) sources and sinks from the terrestrial biosphere. Additional tracers such as radiocarbon are promising for disentangling the different emission contributions from human activity and natural systems. However, many open questions remain about how different uncertainties in the modeling and observation of these tracers influence the emission estimates.

Here we assess the potential benefits of using radiocarbon observations to constrain global fossil fuel emissions in a Carbon Cycle Fossil Fuel Data Assimilation System (CCFFDAS). We performed sensitivity experiments to quantify how uncertainties in the observations and models affect the uncertainties in the derived emissions, including different prior assumptions about natural and anthropogenic CO_2 fluxes and varying observation networks. Further, we demonstrate how radiocarbon observations can complement the existing CO_2 observation network.