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Space-based observational approaches for carbon dioxide emissions treaty assessment

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There is increasing demand for methodologies to support the assessment of international treaties on carbon dioxide (CO_2) emissions. The situation is complicated by the fact that the treaty protocols under consideration require the evaluation of the net global CO_2 emissions (total anthropogenic emissions less sequestration or accumulation in long-term carbon stocks) on spatial scales of nation states ($\sim$100 km). These signals must also be disentangled from the large natural CO_2 sources and sinks with high confidence.

The current state of the art for observationally driven estimates of global CO_2 fluxes comes from the TRANSCOM experiment and is limited to spatial resolutions of order 10,000 km ($\sim$25 global regions). Simulations of satellite data from the Greenhouse Gas Observations Satellite (GOSAT) or the Orbiting Carbon Observatory (OCO) sensors have shown the potential to reduce flux uncertainties by a factor of 10 or more while increasing the number of regions to $\sim$100. We will present a series of flux inversion simulations using constellations of up to 4 OCO-like satellites that demonstrate the ability of space-based measurements to deliver weekly global CO_2 fluxes on a 1º x 2.5º spatial resolution ($\sim$100 km x 200 km or 30,000 global regions) with flux uncertainties that are consistent with those needed to support the assessment of treaties regulating CO_2 emissions.