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Contributions of the Orbiting Carbon Observatory (OCO) to the detection of anthropogenic CO_2 emissions

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When the Orbiting Carbon Observatory (OCO) was originally proposed to the NASA Earth System Science Pathfinder (ESSP) Program in 2001, its objective was to return space based estimates of the column-averaged atmospheric CO_2 dry air mole fraction, X_{CO2}, with the sensitivity, resolution, and accuracy needed to characterize CO_2 fluxes (sources and sinks) on regional scales over the globe. The OCO proposal emphasized the detection of natural CO_2 sinks because the predominant carbon cycle science question at that time was the identification of the so-called "missing" terrestrial sink [Fan et al. (2000); Bousquet et al. (2001)]. The OCO instrument was therefore optimized for sensitivity, spatial resolution, and coverage because natural sinks tend to produce X_{CO2} signatures that are spatially diffuse and relatively weak compared to anthropogenic CO_2 sources, which are generally more localized and intense. Immediately after the OCO spacecraft was lost due to a malfunction of its launch system, NASA encouraged the OCO Science Team to work closely with GOSAT and other space based CO_2 monitoring missions to exploit the calibration, retrieval algorithm, and validation capabilities developed for OCO. The U.S. Congress has since instructed NASA to begin implementing an OCO reflight. While OCO-2 will be a "carbon copy" of the original observatory, there is now a much greater emphasis on the detection of anthropogenic CO_2 emissions. Here, we summarize the lessons learned from GOSAT data and show how future OCO capabilities still provide an essential contribution to the suite of space-based CO_2 measurements from SCIAMACHY, GOSAT, AIRS, and IASI. We discuss the merits and complementarities of each sensor for detecting anthropogenic emissions and outline several potential paths forward as space-based CO_2 remote sensing transitions from investigative science to operational monitoring.
Fan, S., et al., Science 282, 442, 1998.; Bousquet, P., et al., Science 290, 1342, 2000.