



Carbon balance of South Asia constrained by passenger aircraft CO₂ measurements

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Quantifying the fluxes of carbon dioxide (CO₂) between the atmosphere and terrestrial ecosystems in all their diversity, across the continents, is important and urgent for implementing effective mitigating policies. Whereas much is known for Europe and North America for instance, in comparison, South Asia, with 1.6 billion inhabitants and considerable CO₂ fluxes, remained an unexplored territory. We use the Civil Aircraft for the Regular Investigation of the atmosphere Based on an Instrument Container (CARIBIC) measurements of atmospheric CO₂ aboard a Lufthansa passenger aircraft between Frankfurt (Germany) and Chennai (India) at cruise altitude, in addition to the existing network sites for 2008, to estimate monthly fluxes using Bayesian inversion and an AGCM-based chemistry-transport model (ACTM) forward simulations. The applicability of model transport parameterisation is confirmed using SF₆, N₂O and CH₄ simulations for the same dataset and independent measurements in separate studies. The annual carbon flux obtained by including the aircraft data is twice as large as the a priori flux model of terrestrial biosphere. We found that South Asia sequestered carbon at a maximum rate of $0.37 \pm 0.20 \text{ Pg-C yr}^{-1}$ for the year 2007 and 2008. The seasonality and the strength of the calculated fluxes are successfully validated using independent vertical CO₂ profile observations aboard Japan Airlines passenger aircraft over Delhi for 2007 under the Comprehensive Observation Network for TRace gases by AIRLiner (CONTRAIL) project. This validation exercise suggests that the monsoon driven ecosystem uptake during June-September months over the South Asia region is quite consistent across years.