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Magnitude of gross CO2-biosphere exchange flux during the Indian summer monsoon as evidenced by CARIBIC aircraft CO2 isotope data.

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The project CARIBIC (http://caribic-atmospheric.com) aims to study atmospheric chemistry and transport by regularly measuring many compounds in the free troposphere and the upper troposphere/lowermost stratosphere by using passenger aircraft. Presently an Airbus A340-600 of Lufthansa is used. For the period 2007-2009 high precision carbon and oxygen isotopic composition measurements of CO2 were carried out at JRC-IRMM (Geel, Belgium), thus including samples from flights conducted to Chennai during the Indian summer monsoon in 2008. Previously, Schuck at el. (2010) demonstrated that elevated/depressed GHG levels observed in the monsoon plume can be translated to CH4, N2O and CO2 fluxes from the continent. Negative shifts in d18O(CO2) were detected for these summer monsoon samples, evidencing for CO2 exchange with land biosphere and soils. The magnitude of CO2 exchange flux has been estimated based on a mass-balance box model. The flux appears to be several times the CO2 uptake flux. Critical for the isotope mass-balance is the selection of representative values for the 18O/16O ratio of precipitation as well as the respective values for boundary layer and background air masses. Though our current estimates suffer from several sources of uncertainty, the work demonstrates the benefit of CARIBIC and presents a new approach to estimate gross CO2 fluxes.