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Evaluations of carbon fluxes in tropical regions estimated by top-down and bottom-up approaches

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Many researchers have been trying to reveal distribution of carbon flux for understanding global carbon cycle dynamics. There are two approaches of estimating carbon fluxes using satellite observation data, and these are generally referred to as top-down and bottom-up approaches. These approaches are different in that the top-down approach estimates the carbon flux by using the distributions of CO_2 concentration and an atmospheric transport model, on the other hand, the bottom-up approach estimates the flux by using the ground surface information (e.g. leaf area, surface temperature) from the satellite data and a biosphere model. However, many uncertainties are still remain in carbon flux estimations, because the true values of carbon flux are still unclear and the estimations vary with the type of the model (e.g. a transport model, a terrestrial biosphere model) and input data (e.g. satellite data, climate data). But the satellite-based carbon flux estimations with reduced uncertainty will be very efficient for identifications of large emission area and terrestrial carbon stock regions. In this study, we evaluated the carbon flux estimations in tropical regions from two approaches. We used GOSAT L4A CO_2 flux data as top-down approach estimations, CarbonTracker (CT2013) flux data as top-down approach estimations (used no satellite data, only ground observations), and net ecosystem productions (NEP) estimated by the diagnostic type biosphere model BEAMS as bottom-up approach estimations. GOSAT (Greenhouse gases Observing SATellite) launched on January 2009 is first satellite to measure the concentrations of GHGs (CO_2, CH_4) from space. GOSAT have two sensors that TANSO-FTS (Thermal And Near infrared Sensor for carbon Observation - Fourier Transform Spectrometer) is measuring CO_2 and CH_4 column amount, and TANSO-CAI (Thermal And Near infrared Sensor for carbon Observation - Cloud and Aerosol Imager) is imaging the states of atmosphere and land surface and return to same place at three days intervals. GOSAT L4A data product is the monthly CO_2 flux estimations for 64 sub-continental regions and is estimated by using GOSAT FTS SWIR L2 XCO_2 data. CT2013 estimated the surface CO_2 fluxes using atmospheric CO_2 sampling observations and the atmospheric transport model. BEAMS NEP is estimated by MODIS data and climate data. This flux is only natural land CO_2 flux, so we used anthropogenic and biomass burning CO_2 emissions same as used in GOSAT L4A data. We compared with results of these approaches in tropical regions from June 2009 to October 2012. These regions are little observation data and are high uncertainties about flux estimations. The temporal patterns for this period were indicated similar trends between GOSAT, CT2013, and BEAMS in many sub-continental regions. But annual net carbon fluxes averaged three years (2009/06 – 2012/05) were difference in these estimations (GOSAT: 2.5 GtC/year, CT2013: 1.0 GtC/year, BEAMS: 2.0 GtC/year).