CO_2 flux variation in Southeast Asia for 2015 estimated by in-situ aircraft measurements

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The global carbon cycle changes in response to climate changes. However, our understanding of the mechanisms underlying those carbon cycle changes is still not enough and an earth system model with climate–carbon cycle feedback included has significant uncertainties in its global warming prediction. Observations of CO_2 mole fractions in the atmosphere has revealed significantly large impacts of El Nino-Southern Oscillation (ENSO) on the carbon cycle. Anomalous climate events associated with ENSO, such as high/low temperatures, dry/wet conditions and fires, may induce CO_2 flux changes at the earth surface and consequently CO_2 mole fraction changes in the atmosphere. In order to quantitatively estimate spatiotemporal variations of CO_2 fluxes from atmospheric observations, one uses an inversion analysis, which employs an atmospheric transport model to link surface fluxes with atmospheric mole fractions. However, the sparseness of the global CO_2 observation network has limited the reliability of the flux inversion analysis, specifically for tropical areas, where surface fluxes seem to have significant sensitivities to ENSO. In recent years, an in-situ aircraft measurement project named CONTRAIL (Machida et al., 2008) has extended the global CO_2 observation network; especially, the extension to Southeast Asia is noteworthy. In 2015, the year of the biggest El Nino since 1997, a number of fire events in Southeast Asia were clearly captured by satellites, suggesting that significant amount of CO_2 was released into the atmosphere. In this study, we have conducted an inversion analysis using an inversion system named NICAM-TM 4D-Var (Niwa et al., 2016a,b) and estimated CO_2 fluxes in Southeast Asia with a focus on changes related to the El Nino.

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