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Monitoring and detection of carbon cycle change using an integrated observation, modeling and analysis system

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There is an increase in number of observational platforms for monitoring atmospheric greenhouse gases (GHGs) such as satellites, aircrafts, ships, and ground stations. However, due to lack in measurement accuracy or observational ”blank area” in time and space high uncertainty remains in carbon budget estimations. Promotion of next-generation GHGs observing satellites is an urgent task for improving the observational data coverage and accuracy. Integrating such reinforced observations into improved data assimilation systems would be indispensable to reduce the carbon source/sink estimation uncertainties.

The purpose of our study is to produce our best estimations of carbon budget, to detect carbon cycle changes that might be appearing globally and in the Asia-Pacific under changing climate, and to timely provide scientific knowledge for developing mitigation and adaptation policies.

We are developing an integrated carbon observation and analysis system based on satellite, airborne, and ground-based observations, and atmospheric and terrestrial carbon cycle models. Aircraft observations of atmospheric CO_2 are strengthened based on the ”Comprehensive Observation Network for TRace gases by AIrLiner (CONTRAIL)” project, particularly for south and southeastern Asia. Atmospheric transport modeling, inverse modeling, and assimilation methods are being tested and improved for better utilization of reinforced observation data from the Asia-Pacific region. Regional net carbon fluxes between atmosphere and land are estimated by both ”top-down” approach (with inverse models) and ”bottom-up” approach (with surface flux observation network data (e.g. AsiaFlux) and terrestrial ecosystem models). Results from different methods are compared, and similarities and differences of estimated carbon budgets are discussed.

We will present current issues for better constraints of global, continental, and regional carbon budgets, detection of carbon cycle change particularly in the Asia-Pacific region, and need of future satellite missions for better understanding of the global and regional carbon cycle.

Keywords: Atmospheric greenhouse gas, Carbon cycle, Integrated analysis system, GHGs observing satellite