

Achievements and Future Visions: Monitoring Carbon Cycle Change using an Integrated Observation, Modeling and Analysis System

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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 greenhouse gases (GHGs) are strengthened based on the "Comprehensive Observation Network for TRace gases by AIrliner (CONTRAIL)" project. Atmospheric transport modeling, inverse modeling, and assimilation methods are being developed and improved for better utilization of observational data from the Asia-Pacific region. Global and regional surface fluxes are estimated by both "top-down" approach using inverse models and "bottom-up" approach using surface flux observation network data (e.g. AsiaFlux) and upscaling with terrestrial ecosystem models.

We will present current progress for better constraints of global, continental, and regional carbon budgets, and detection of carbon cycle change particularly in the Asia-Pacific. We also would like to raise following questions and discuss how to solve them in the next steps.

- 1) How can the current capabilities of top-down and bottom-up approaches contribute to reduce uncertainties in the estimates of large anthropogenic emissions? (e.g. fuel use, land use changes, and rapid urbanization)
- 2) What are the key target regions or events in the Asia-Pacific that we need to focus on? (e.g. El Niño-induced droughts, extreme forest fires in Southeast Asia, and peat degradations in tropical and boreal regions)
- 3) How should the current capabilities of observation, modeling and analysis systems be integrated into an operational system for long-term monitoring of changes in regional, continental, and global GHGs budgets?
- 4) What are the urgent requirements to realize such system? (e.g. strategies of more intensive observations in targeted area, and a platform for multi-model ensemble)
- 5) How can we provide scientific knowledge and data timely for evaluating mitigation and adaptation policies?

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