

Monitoring Carbon Cycle Change using an Integrated Observation, Modeling and Analysis System - Project summary

*Nobuko Saigusa¹, Toshinobu Machida¹, Prabir Patra², Yosuke Niwa³, Kazuhito Ichii²

1. National Institute for Environmental Studies, 2. Japan Agency for Marine-Earth Science and Technology, 3. Meteorological Research Institute

We conducted a three-year research project to develop 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) were strengthened based on the “Comprehensive Observation Network for TRace gases by AirLiner (CONTRAIL)” project. Atmospheric transport modeling, inverse modeling, and assimilation methods have also been developed and improved for better utilization of observational data from the Asia-Pacific region. Global and regional surface fluxes were estimated by both “top-down” approach using inverse models and “bottom-up” approach using surface flux observation network data and upscaling with either empirical models or terrestrial ecosystem models.

The main progress over the past three years (FY 2014-2016) have been the better constraints of global, continental and regional carbon budgets, and detection of terrestrial carbon cycle change particularly in the Asia-Pacific region.

- 1) Multiple approaches including different types of top-down models and bottom-up upscaling techniques contributed to designate uncertainties in the estimates of large emissions (e.g. fuel use and land use changes).
- 2) Key target regions and events were indicated as potential hot-spots in the Asia-Pacific where we need further targeted research. (e.g. potential increase in terrestrial carbon sink in Siberia and East Asia, uncertainty in the recent rapid growth of anthropogenic GHG emissions in East Asia, emissions from land use change and El Niño-induced extreme forest fires in Southeast Asia)
- 3) A prototype system was developed and tested for future operational monitoring of changes in regional, continental, and global GHGs budgets based on integration of observation and modeling.
- 4) Scientific knowledge transfer and educational outreach were provided through domestic and international society activities, training seminars, lectures, and publications.

We also discuss remaining issues and the way to solve them in the next steps (e.g. strategies of intensive observations in targeted area, and a platform for multi-model ensemble)

Acknowledgements. This project was conducted with participation and collaboration of the following members: Maksyutov S., Ito A., Takigawa M., Matsueda H., Sawa Y., Maki T., Shirai T., Hirata R., Umezawa T., Rajesh J.A., Ishizawa M., Saeki T., Tsuboi K., Idehara K., Nakamura T., Kondo M., and Yanagi Y.

Keywords: Monitoring Carbon Cycle Change, Integrated Observation, Modeling and Analysis