Assimilation of GOSAT XCO2 data to optimize surface CO2 flux in East Asia

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Because East Asia is the third-largest source region of CO2 after North America and Europe, there is a need to estimate surface CO2 fluxes accurately over East Asia. Nevertheless, since the number of surface CO2 observations in East Asia is relatively small compared to that in North America and Europe, the estimation of surface CO2 fluxes in East Asia has relatively large uncertainties. To supplement sparse surface CO2 observations, satellite observations can be used.

In this study, the column-averaged dry-air mole fraction (XCO2) concentration data from the Greenhouse gas Observing SATellite (GOSAT) Project was used to estimate the surface CO2 fluxes in East Asia. CarbonTracker developed by Earth System Research Laboratory was used as an inverse modeling system. To assimilate GOSAT XCO2 data in CarbonTracker, the observation operator for GOSAT XCO2 data was developed. To determine the appropriate Model-Data-Mismatch (MDM) for GOSAT XCO2 data, a sensitivity test was conducted. The experiment assimilating GOSAT data showed lower BIAS and RMSE than that without assimilating GOSAT data. In addition, the experiment using 2 ppm MDM for GOSAT data showed lower BIAS and RMSE than that using 3 ppm MDM.

The surface CO2 fluxes over East Asia from the experiments with and without GOSAT data were also compared. By assimilating GOSAT observations, the absorption of surface CO2 fluxes in the ocean became strong and that in land became weaker. Especially, the absorption of surface CO2 fluxes in the Eurasian Boreal region became much weaker than in other regions. The uncertainty reduction was also the largest in the Eurasian Boreal region where the surface CO2 observations are sparse.

Therefore GOSAT XCO2 data have a profound impact on estimating the surface CO2 fluxes in East Asia where the surface observations are insufficient.

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