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Impact of assimilating CO_2 observations in the Korean Peninsula on surface carbon flux estimation in East Asia and comparison of the estimated carbon flux with emission inventory data

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CarbonTracker is a widely-used inverse modeling system, which estimates surface carbon fluxes from observed CO_2 concentration data using Ensemble Kalman Filter. Due to lack of observation sites, there may be more uncertainties in estimating surface carbon fluxes in Asian region compared to North America and Europe. To reduce those uncertainties, it is required to assimilate more CO_2 observation data in Asia. In this study, two observation datasets from the Korean Peninsula (Anmyeon-do (AMY) and Gosan (GSN)) are newly introduced to CarbonTracker system, and proper model-data mismatch (i.e., MDM) values for those observations are investigated. Appropriate MDM used in assimilation process makes observations to be well-reflected in the model. Here, two different MDM values are considered: 3 ppm (assigned to continuous observation type) and 5 ppm (ascribed to Tae-ahn Peninsula (TAP) observation data, already assimilated in CarbonTracker). Each assimilation experiment is independently conducted, applying different combinations of MDM values to AMY and GSN. Experimental period is from 2004 to 2008, and the first one year is excluded in analysis as a spin-up.

Compared with dependent (i.e., assimilated) observations of TAP and Mt. Waliguan (WLG) sites, the root mean square error (RMSE) is the minimum when MDM is set to 3 ppm for both sites. The verification with independent Comprehensive Observation Network for Trace gases by Airliner (CONTRAIL) observations around the Korean Peninsula shows the minimum RMSE when MDM is 3 ppm. For other independent surface observation sites in East Asia, the minimum RMSEs seem to be related to the ecosystem types of observation sites rather than MDM settings. Uncertainty reduction of estimated surface carbon fluxes in East Asia shows the maximum value when MDM of AMY and GSN is 3 ppm. The innovation χ^2 is in the acceptable range for both 3 and 5 ppm MDM for both sites, although the innovation χ^2 is closer to 1 when MDM of both sites is set to 5 ppm. Considering all features comprehensively, assigning 3 ppm to AMY and GSN sites is appropriate to optimize surface carbon fluxes in East Asia.

In addition, the inverse modeling result can be adapted to complement the CO_2 emission inventory. This study will cover the comparison between National Inventory Report (NIR) and East Asian surface carbon fluxes optimized with the determined MDM values. More detailed results will be presented in the meeting.

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