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The validation of the Yonsei CArbon Retrieval algorithm with improved aerosol information using GOSAT measurements

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Although several CO_2 retrieval algorithms have been developed to improve our understanding about carbon cycle, limitations in spatial coverage and uncertainties due to aerosols and thin cirrus clouds are still remained as a problem for monitoring CO_2 concentration globally. Based on an optimal estimation method, the Yonsei CArbon Retrieval (YCAR) algorithm was developed to retrieve the column-averaged dry-air mole fraction of carbon dioxide (XCO_2) using the Greenhouse Gases Observing SATellite (GOSAT) measurements with optimized a priori CO_2 profiles and aerosol models over East Asia. In previous studies, the aerosol optical properties (AOP) are the most important factors in CO_2 retrievals since AOPs are assumed as fixed parameters during retrieval process, resulting in significant XCO_2 retrieval error up to 2.5 ppm. In this study, to reduce these errors caused by inaccurate aerosol optical information, the YCAR algorithm improved with taking into account aerosol optical properties as well as aerosol vertical distribution simultaneously. The CO_2 retrievals with two difference aerosol approaches have been analyzed using the GOSAT spectra and have been evaluated throughout the comparison with collocated ground-based observations at several Total Carbon Column Observing Network (TCCON) sites. The improved YCAR algorithm has biases of 0.59 ± 0.48 ppm and 2.16 ± 0.87 ppm at Saga and Tsukuba sites, respectively, with smaller biases and higher correlation coefficients compared to the GOSAT operational algorithm. In addition, the XCO_2 retrievals will be validated at other TCCON sites and error analysis will be evaluated. These results reveal that considering better aerosol information can improve the accuracy of CO_2 retrieval algorithm and provide more useful XCO_2 information with reduced uncertainties. This study would be expected to provide useful information in estimating carbon sources and sinks.