

# CO<sub>2</sub> Retrieval over East Asia using CAI aerosol information

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## Abstract

Large portion of  $X_{CO_2}$  retrievals using the GOSAT measurements data are typically screened out during the quality control process, in East Asia, where aerosol concentrations are consistently high throughout the year. Various strategy for handling aerosol information was attempted with the aim of reducing those retrieval errors of  $X_{CO_2}$  induced by aerosol information. In this study, the  $X_{CO_2}$  was retrieved from GOSAT TANSO-FTS measurements using aerosol retrievals from TANSO-CAI measurements. CAI aerosol algorithm provides aerosol type and AOD information simultaneously for the same geometry and optical path along the FTS. The developed YCAR algorithm is based on optimal estimation method and VLIDORT V2.6 was used. The retrieval results were evaluated by comparing with ground-based TCCON measurement and operational GOSAT  $X_{CO_2}$  retrieval (NIES, ACOS, and UoL). YCAR algorithms provided increased number of  $X_{CO_2}$  retrieval compared to the operational product by 35 – 90%. The error analysis of result shows retrieval error by 1.1ppm.

## CO<sub>2</sub> retrieval Algorithm

Table 1. State vectors and A priori information of current algorithm

State vector	Quantity	A Priori	Notes
CO <sub>2</sub>	20 levels	Carbon Tracker - Asia (1° × 1°)	VMR on each level
H <sub>2</sub> O Scaling Factor	1	ECMWF (0.125° × 0.125°)	Multiplier to a priori H <sub>2</sub> O profile
Temperature shift	1	ECMWF	Offset to a priori T profile
Aerosol	9 layers	GOSAT-CAI aerosol algorithm	AOD profiles on each level for defined types
Surface Albedo	3 × 2	FTS measurement	Albedo at band center and slope
Wavenumber shift & squeeze	3 × 2	FTS measurement	Spectral shift
Surface Pressure	1	ECMWF	Surface pressure

Current algorithm use 44 parameters as state vector. Zero level offset will be added as state vector soon, and aerosol optical properties will be added in the future.

## Algorithm performance test

### [ Forward model ]

Vector Linearized Discrete Ordinate Radiative Transfer (VLIDORT, Version 2.6) is utilized as forward model of this algorithm.

### [ CAI Aerosol ]

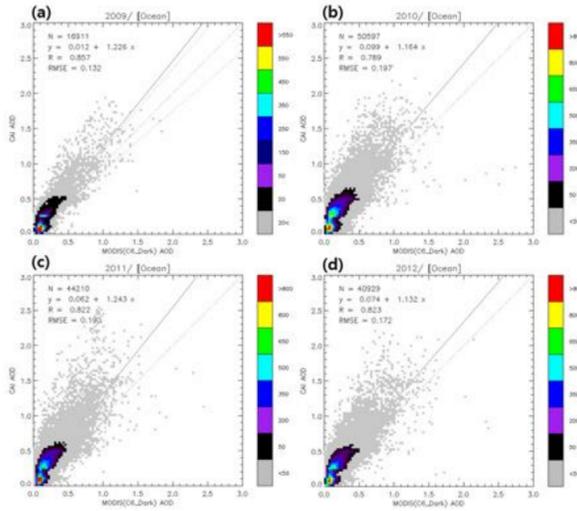


Figure 1. Comparisons of retrieved AOD from MODIS and CAI over Ocean in (a) 2009, (b) 2010, (c) 2011, (d) 2012, and (e) 2013. The color represent frequency of compared results.

### [ Retrieval results ]

Ver. 201201 GOSAT L1B data from Aug 2010 to Dec 2012 are used for YCAR retrieval. Retrieved result are validated with TCCON GGG2014 data at Tsukuba and Saga site. It is also compared with other GOSAT  $X_{CO_2}$  retrieval results (NIES L2 v2.21, ACOS L2 v3.4, UoL-FP v5.2).

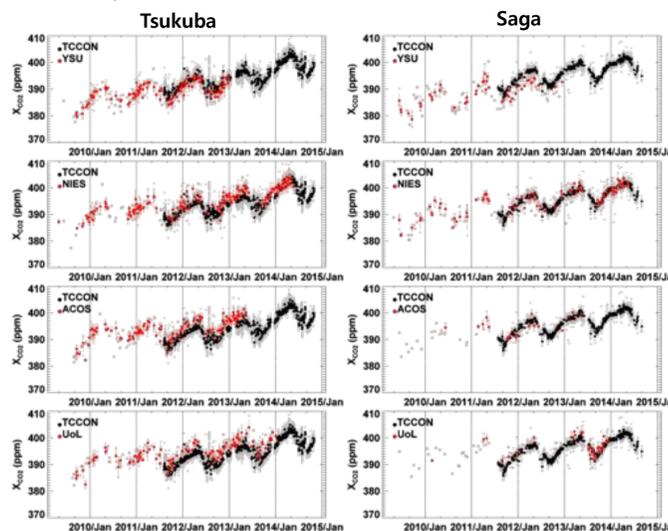


Figure 2. Time series of retrieved  $X_{CO_2}$  from four GOSAT algorithms (YCAR, NIES, ACOS and UoL) and those from two TCCON site Tsukuba (left) and Saga (right). TCCON retrieved : small gray dot, daily average TCCON  $X_{CO_2}$  : large black dot, single sounding data : light red dot, daily average : large red dot.

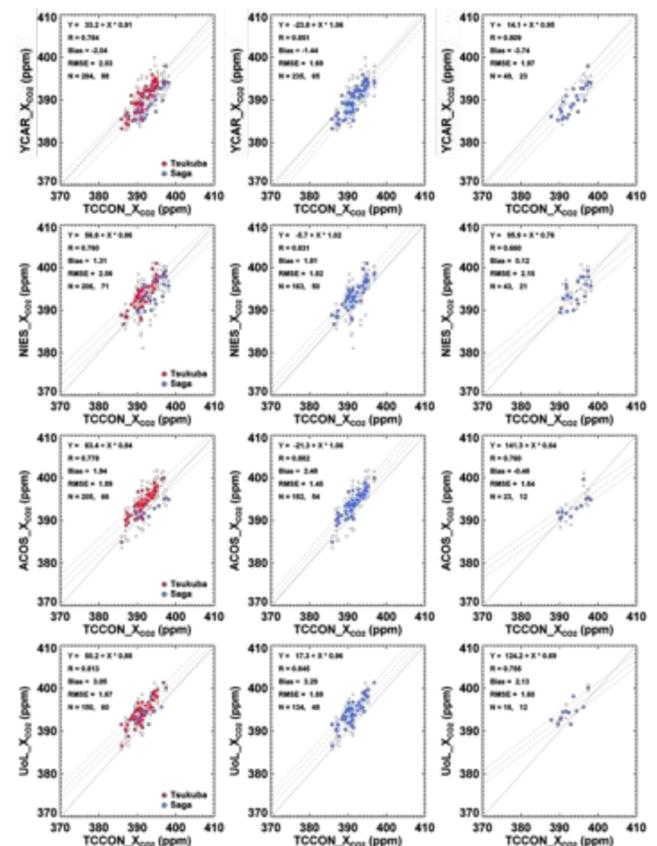


Figure 3. Comparison of retrieved  $X_{CO_2}$  from four GOSAT algorithms with TCCON  $X_{CO_2}$ . All single sounding : small faintest dot, daily average : large dot.

## Conclusion & Further study

This presentations shows a preliminary results of YCAR algorithm. The validation results with TCCON data shows the reliability of YCAR algorithm. Compared to operational algorithms, the available data number of YCAR algorithm was higher than operational algorithms by 35 – 90% with comparable regression analysis results. In further study, the accuracy of YCAR algorithm will be improved and the validation will be conducted over wider area

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## Reference

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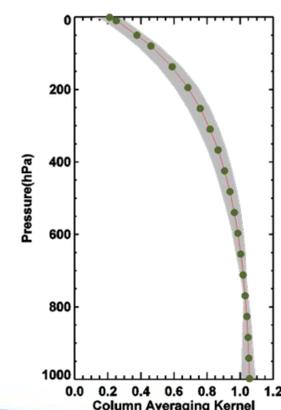


Figure 4. Averaging kernel of CO<sub>2</sub> retrieval. The shaded area shows the range of the column averaging kernel over Tsukuba and Saga TCCON site