Public Release of Concentration Data (Carbon Dioxide and Methane) Analyzed from GOSAT Observational Data

February 16, 2010

National Institute for Environmental Studies
Japan Aerospace Exploration Agency
Ministry of the Environment

The Ministry of the Environment, the National Institute for Environmental Studies (NIES), and the Japan Aerospace Exploration Agency (JAXA) have been cooperatively carrying out the Greenhouse gases Observing SATellite (GOSAT) Project. The satellite was placed in orbit on January 23, 2009 and has been collecting data since the following April. With recently completed initial data validation, we will start distributing the results of the observational data analyses (concentrations of carbon dioxide and methane) to general users from February 18, 2010.

Initial validation on the atmospheric concentrations of carbon dioxide (CO_2) and methane (CH_4), which were obtained through analyzing GOSAT observational data collected under clear-sky conditions, has been completed recently. We will release these concentration data and cloud coverage information to general users.

Our primary work in the months to come includes further improving the quality of the concentration data and releasing the monthly data of regional CO_2 fluxes. The public distribution of the latter data will start in the first half of 2011.

[How to obtain the data]

The concentration data are downloadable at the GOSAT data distribution website (http://data.gosat.nies.go.jp). For logging in to the website and ordering the data products, prior user registration is necessary. The registered users can specify areas and dates of their interest when ordering the data.

Also available at the website are figures showing the results of the GOSAT data analyses. The global concentration distribution maps of both CO_2 and CH_4 are available. No user registration is required for browsing these figures.

[Contact information]
Regarding the satellite, sensors onboard, and observation status:
Earth Observation Research Center (EORC)
Space Applications Mission Directorate
Japan Aerospace Exploration Agency
JAXA GOSAT Website: http://www.jaxa.jp/projects/sat/gosat/index_e.html
E-mail: gosat@jaxa.jp

Regarding the onboard sensors and results of the data analyses:
GOSAT Project Office
Center for Global Environmental Research

National Institute for Environmental Studies
NIES GOSAT Project Website: http://www.gosat.nies.go.jp/
E-mail: gosat-prj1@nies.go.jp

Attachment: The results of the GOSAT observation data analysis.

Initial validation on the concentrations of carbon dioxide (CO_2) and methane (CH_4), which were retrieved from the spectral radiance data (one of the Level 1B products) obtained by the main sensor of the satellite, TANSO-FTS, has been completed recently. These concentration data, namely the column-averaged volume mixing ratios[1] of CO_2 and CH_4, are stored in the GOSAT Level 2 products. Since these data products are now ready for public release, we start distributing them to general users.

The GOSAT Level 2 products can be downloaded from the NIES GOSAT website. Prior user registration is necessary for accessing the website and downloading the data products. A valid e-mail address is needed for the registration. In the website, the registered users can search, select and order the data products of their interest. For the moment, only the data products generated for the following observation periods are available[2]:

April 6-8, 20-28, 2009
June through July, 2009
October 29, 2009 through January 31, 2010

More information on the data products is available at http://data.gosat.nies.go.jp/.

Cloud-coverage information[3] derived from the data collected by the onboard cloud-aerosol sensor (TANSO-CAI) is also made public this time. This information, named as the GOSAT CAI Level 2 cloud flag product, is downloadable from the above website.

[1] Column-averaged volume mixing ratio: averaged concentration that denotes the ratio between the amount of CO_2 (or CH_4) and dry air in a column extending from the ground surface to the top of the atmosphere (given in parts per million).

[2] The Level 2 products generated from the observation data collected in the month of February 2010 will be provided in the following month (March 2010). All of the Level 2 products released in the months to come will be provided in the same manner. The products for the months of August through October 2009 will be released when they have been made ready.

[3] The data indicating pixel-by-pixel sky clearness calculated from the TANSO-CAI multi-band radiance data. These data are available over the same data periods of the GOSAT Level 2 product. Latest data will be uploaded as soon as data analyses have been completed.

1. Samples of the TANSO-FTS observation points and the Level 2 data products (concentrations of CO_2 and CH_4)

The spectral radiance data obtained by TANSO-FTS are selected by a condition that there is no cloudy pixel within the view field of the FTS instrument. This selection process is performed using the CAI Level 2 cloud flag data. The selected spectral data are used for

retrieving the concentrations of CO_2 and CH_4. The retrieved concentrations are then checked for their qualities. Only those data that passed the quality check are stored as the FTS Level 2 data products. Figures 1 and 2 show global distributions of CO_2 and CH_4 retrieved for clear-sky locations over the months of April, July and November, 2009 and January, 2010.
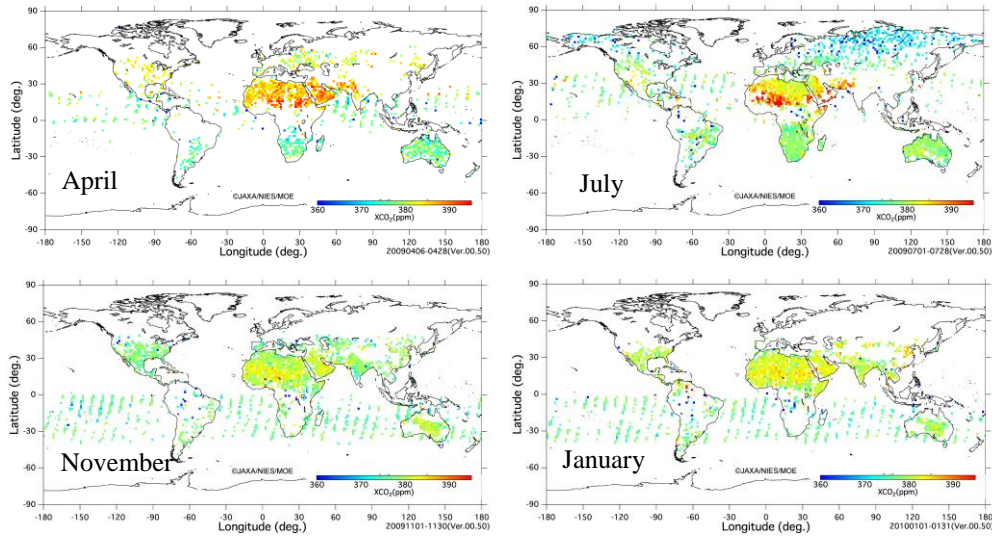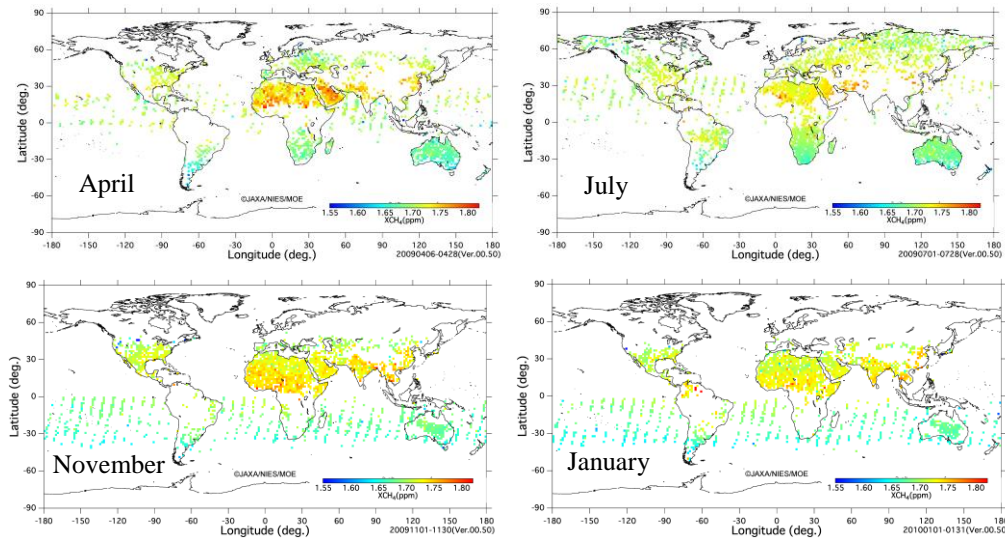

Figure 1. Column-averaged volume mixing ratios of CO_2 over April, July and November, 2009 and January, 2010. Shown above are values averaged over grid cells of $1.5° \times 1.5°$. The April data are 12-day (April 6-8 and 20-28) averaged values.

Figure 2. Column-averaged volume mixing ratios of CH_4 over April, July and November, 2009 and January, 2010. Shown above are values averaged over grid cells of $1.5° \times 1.5°$. The April data are 12-day (April 6-8 and 20-28) averaged values.

As seen in the above figures, the satellite collected data over Siberia (summer), mid-eastern South America (year-round), Australia, Arabian Peninsula (year-round), Deccan Plateau (fall and winter), north-central Africa (year-round), and southern Africa (April and July), all of

which had been nearly considered as blank spots in the ground-based observation network. GOSAT can provide data that are useful in comprehending the spatial and temporal variations of the greenhouse gases over these regions whenever clear-sky conditions are satisfied.

The distributions and seasonal changes of CO_2/CH_4 concentrations are broadly consistent with those found in the conventional ground-based and airborne observation data:

- Concentrations of CO_2 in the Northern Hemisphere during summer are affected by the respirations of ground vegetation and thereby become lower than those during winter and spring. Also, the seasonal variations of CO_2 concentrations in the Southern Hemisphere are smaller compared to those in the Northern Hemisphere. These trends were found in the results of the GOSAT data analysis as well.
- Concentrations of CH_4 in the Northern Hemisphere are known to be higher than those in the Southern Hemisphere throughout the year. This hemispheric difference was also seen in the results of the GOSAT data analysis.

In the initial data validation activities, the results of the GOSAT data analysis were compared to reference data for validation that were obtained by ground-based and airborne instruments. The global distributions and seasonal changes of the results of the GOSAT data analysis were broadly consistent with those of the reference data. However, the column-averaged volume mixing ratios of CO_2 and CH_4 were found to be lower by 2 to 3% than the reference values.

In Figures 1 and 2, areas of elevated concentrations are found in the desert areas of the Arabian Peninsula and northern Africa as well as their surroundings. The extent of the elevated concentration in these areas appears to depend on the season. It is probable that these elevated concentrations were largely influenced by blown dusts of the deserts.

Our primary work in the months to come includes further advancing the algorithm for processing the GOSAT data, removing the data biases, and continuing with the data validation and evaluation activities. By the summer of 2010, we will release new versions of the Level 2 products as soon as we have finished updating the data processing algorithm. Also, we will soon start estimating the monthly values of regional CO_2 fluxes using both the GOSAT data and the ground-based observation data (see Figure 3 for samples). These data will be released in 2011.
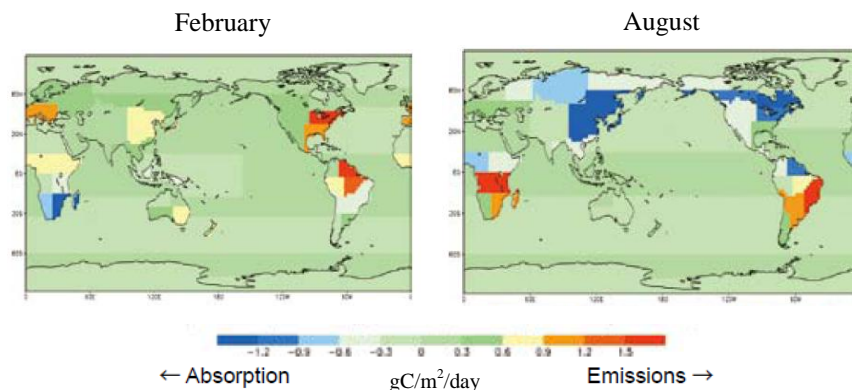

Figure 3. Sample figures showing regional fluxes of CO_2

2. Samples of the cloud-coverage information (the CAI Level 2 data)

The pixel-by-pixel clear-sky confidence levels are calculated from the TANSO-CAI multi-band radiance data. They are provided as the CAI Level 2 cloud flag product. Figure 4 shows samples of the CAI Level 1B data and CAI Level 2 cloud flag product over the vicinity of mainland Japan.
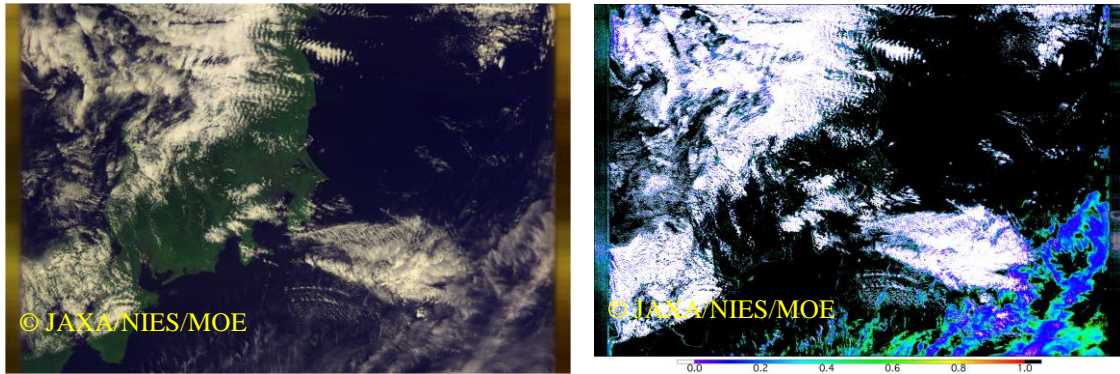

Figure 4. Image of the central mainland Japan captured by TANSO-CAI on April 23, 2009 (left) and the corresponding cloud flag product (right).

In the right panel of Figure 4, the clear-sky confidence levels are color-coded on scale of 0 to 1. Here, the value of 0 indicates that clouds exist within a pixel with a probability of 100%. The value of 1 denotes no chance of cloudiness in the pixel. The numbers between 0 and 1 designate pixels that are difficult to classify as clear or cloudy. Users of this product can distinguish clear-sky pixels among the cloudy ones by setting an appropriate threshold value between 0 and 1.