Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-01 Room:201A Time:May 22 09:05-09:25

Development of GEOSS and GEO Grid

Koki Iwao[1*]

[1]National Institute of Advanced Industrial Science and Technology

Global Earth Observation System of Systems "GEOSS" aimed to build the "system of systems" or the global earth observation collaboration where all satellite, aircraft, and in-situ observations of earth, which were individually gathered by countries, and all observation systems, earth datasets, prediction models, and services for earth are combined. The GEOSS 10-year Implementation Plan was drafted in Brussels in 2005, and its ultimate goal was to reflect the scientific findings obtained through earth observation collaboration in policies. Specifically, nine societal benefit areas including disaster, health, energy, climate, weather, water, ecology, biodiversity, and agriculture were selected, and immediate issues that must be solved within 10 years were extracted. While the GEO Grid, which is the AIST initiative, its concept and goal are similar to that of GEOSS. In the presentation, these activities and the relationships will be introduced.

Keywords: Global Earth Observation System of Systems, Group on Earth Observations, GEO Grid, GEO task

MSD03-02 Room:201A Time:May 22 09:25-09:40

GEO CL-02 task and activity of EMTech/AIST related to GEO carbon task

Hiroaki Kondo[1*]

[1]National Institute of Advanced Industrial Science and Technology

As shown in the web site of GEO (http://www.earthobservations.org/about_geo.shtml) GEO (Group on Earth Observation) is a voluntary partnership of governments and international organizations for the period 2005 to 2015. The Research Institute of Environmental Management Technology/AIST joined the carbon task of GEO since 2009. The carbon task is under the ”climate” area, which is one of the nine social benefits areas. Now is in the last term and the strategic target of this area is,

Before 2015, GEO aims to: Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle.

There are two tasks under the climate area and one of them is ”CL-02, Global carbon observation and analysis”, which has only one sub-task ”CL-02-C1: Integrated Global Carbon Observation and Analysis System”. For this sub-task, Expected Achievements by 2015 is declared as follows.

-Global carbon monitoring networks improved and coordinated, toward a sustained and operational Integrated Global Carbon Observation and Analysis System by 2020.

-A Carbon portal (linked to the GEO Portal) as a single access point to the global carbon cycle data, containing a geo-referenced database and complying with the GEOSS Data Sharing Principles.

-Updates of global and regional carbon (CO2 and CH4) budgets, considering also fossil fuel emissions, provided annually, with a continuously reduced uncertainty.

-Improved methodologies for measuring and analysing carbon cycle data: develop agreed standards, improve Global Carbon Cycle Data Assimilation Systems (CCDAS); calibrate and validate space based observations.

-Provide easily understandable and accessible information and products, useful for decision makers and the general public.

The coordinator of this task is Antonio Bombelli (CCMS, Italy). However the coordination of the communities related above achievement is not always good, as pointed out at the work plan symposium at Geneva last year not only in Japan but in the world.

Keywords: Group on Earth Observation, carbon task

MSD03-03 Room:201A Time:May 22 09:40-10:00

GEO Carbon Observations and Analysis System and the idea of Asian contribution

Osamu Ochiai[1]*, Masakatsu Nakajima[1]

[1]Japan Aerospace Exploration Agency

Recognizing the growing need for improved Earth observations, over 130 governments and leading international organizations are collaborating through the Group on Earth Observations (GEO) to establish a Global Earth Observation System of Systems (GEOSS) by the year 2015. They are contributing their respective Earth monitoring systems to GEOSS and interlinking these systems so that they work together better.

GEO through its Members and Participating Organizations, has begun work to implement a global carbon observation and analysis system addressing the three components of the carbon cycle (atmosphere, land and ocean) to provide high quality information on carbon dioxide (CO?) and methane (CH?) concentrations, and emission variations. By combining observations, reanalysis and product development we will be able to develop tools for carbon tracking and carbon storage evaluation, including improved global networks of atmospheric CO2 observations, airsurface exchange flux networks, as well as surface ocean CO2 and related marine biochemistry observations.

GEO Members and Participating Organizations: Australia, Canada, France, Japan, Netherlands, Norway, UK, Italy, USA (NASA,NOAA,USGS,USDA), Committee on Earth Observation Satellites (CEOS), European Space Agency (ESA), Food and Agriculture Organization (FAO) Global Climate Observing System (GCOS), Global Terrestrial Observing System (GTOS), World Meteorological Organization (WMO) and the World Climate Research Program (WCRP) are supporting the development of an integrated global carbon observation system.

In close collaboration with national governments, space agencies, and relevant technical experts, GEO will demonstrate this capability through the establishment of robust methodologies, satellite acquisition plans and a series of regional pilot studies, which will provide a template for a consistent and reliable global carbon monitoring system.

One of major activities is to foster the use of space-based greenhouse gas (GHG) observations and consolidate data requirements for the next-generation GHG monitoring missions. By establishing close cooperation with CEOS and the GEO Carbon Community of Practice plans will be 5 implemented for the end-to-end utilization of space-based GHG data, particularly those of Japan's GOSAT mission and NASA's replacement OCO mission, and other GHG observation missions being prepared in Europe.

The global carbon cycle determines the amount of carbon dioxide and methane that accumulates in the atmosphere, increasing the Earth's greenhouse effect. It is therefore a key component of the global climate system. The carbon cycle also responds to climate change, and understanding the ability of the carbon cycle to continue to act as a partial sink of fossil fuel emissions into the future will be a vital factor in determining the "allowable" fossil fuel emissions, while keeping concentration below certain levels.

Current uncertainties on the space-time distribution of CO2 and CH4 fluxes are very large. For well informed policy action aiming to curve down the future increase of CO2 and CH4, these uncertainties must be reduced, by establishing an Integrated Global Carbon Observing system (IGCO). The main goal of this report is to describe the building blocks and coordinated implementation of such an Integrated Global Carbon Observing system.

In Japan, IBUKI(GOSAT) satellite has been launched and been monitoring global atmospheric GHG since 2009. In asian region, Japan has been strongly promoted to develop the AsiaFlux network. Furthermore, Japan is active to develop integrated global carbon cycle model. It will propose the way towards more integrated approach in order to integrate each Japanese activity for contributing as Asia component of the integrated global carbon observations and analysis system.

Keywords: GEO, GEOSS, Carbon, CEOS, GOSAT

MSD03-04 Room:201A Time:May 22 10:00-10:15

Contribution of GOSAT Project to global carbon observation and carbon flux estimation

Tatsuya Yokota[1*], GOSAT Project members[1]

[1]Center for Global Environmental Research, National Institute for Environmental Studies

The GOSAT (Greenhouse gases Observing SATellite) Project is a joint effort being promoted by Japan Aerospace Exploration Agency, National Institute for Environmental Studies, and the Japanese Ministry of the Environment. The primary objective of the Project is to observe the global distributions of the two major greenhouse gases and their temporal variations. Nearly four-years-worth of observational data was collected with the satellite by now, and the concentration data, retrieved from the GOSAT observational data, were found to effectively fill out gaps in the distribution of CO_2 and CH_4 data collected in ground-based monitoring networks. The latest version of the Level 2 CO_2 and CH_4 concentration data products (version 02.**) are now publicly available. Through data validation activities, the uncertainties of both the CO_2 and CH_4 concentrations were now found to be less than 1%, which is smaller than originally targeted. Seasonal variations and annual growth trends were found from the four-year-long datasets; the data will be further analyzed together with more data to be accumulated. The concentration data are also being utilized for estimating regional CO_2 fluxes. The result of the estimation for the period between June 2009 and May 2010 was recently released to the public in December 2012 as the Level 4A data product. Efforts in improving the quality of these data products, which are the results from one of the "top-down" approaches to reveal global carbon cycle, will be continued. We herein summarize the progress of the Project.

Keywords: greenhouse gases, carbon dioxide, methane, global distribution, atmospheric transport modeling, CO_2 flux estimation

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-05 Room:201A Time:May 22 10:15-10:30

Validation of GOSAT column-averaged mole fractions of CO2 and CH4 over the sea with ground- and ship-based spectrometers

Hirofumi Ohyama[1*], KAWAKAMI, Shuji[1], SHIOMI, Kei[1], NAKAJIMA, Masakatsu[1], NAKANO, Yoshiyuki[2], MIWA, Tetsuya[2], FUKAMACHI, Takuya[3], TAURA, Choyo[3], ARAI, Kohei[3], OKUMURA, Hiroshi[3]

[1]Japan Aerospace Exploration Agency, [2]Japan Agency for Marine-Earth Science and Technology, [3]Graduate School of Science and Engineering, University of Saga

To accurately predict future atmospheric greenhouse gas concentrations and their impacts on climate, it is necessary to quantify the global distribution and temporal variations of greenhouse gas sources and sinks. Greenhouse gases Observing SATellite (GOSAT) has observed the global distribution of the atmospheric greenhouse gases such as carbon dioxide (CO_2) and methane (CH_4) since April 2009. Thermal And Near infrared Sensor for carbon Observation-Fourier Transform Spectrometer (TANSO-FTS), which is one of the sensors onboard the GOSAT, measures the sunlight backscattered by the Earth's surface and atmosphere as well as the thermal radiance emitted from the Earth. Column-averaged mole fraction of CO_2 (XCO_2) and CH_4 (XCH_4) are derived from the sunlight spectra by an optimal estimation retrieval approach. Over the ocean, the GOSAT measures sunglint region because the reflectance is higher than other ocean region. In terms of treatment of surface reflection, the retrieval algorithm is different between the land and ocean scenes. Therefore, it is desirable to validate the XCO_2 and XCH_4 values separately for the land and ocean scenes. We obtain direct sunlight spectra with a high-resolution FTS (Bruker IFS 125HR) not only on the ground but also onboard the research vessel (R/V) owned by the JAMSTEC, and indicate that the XCO_2 and XCH_4 could be retrieved from the spectra with precisions needed to validate the GOSAT data.

We performed the observations with the high-resolution FTS onboard the R/Vs in the three cruises operated by the JAMSTEC: the R/V *Kaiyo* cruise (4?13 August 2010), the R/V *Kairei* cruise (10 September?5 October 2010), and the R/V *Mirai* cruise (14 April?5 May 2011). Then, the high-resolution FTS was located in Saga in June 2011, and has acquired continuously the validation data over the land. The high-resolution FTS is a large instrument and make it difficult to carry many times. An automated compact measurement system is developed for acquiring more data over the ocean. The new equipment consists of a solar tracker and an optical spectrum analyzer (OSA: Yokogawa AQ6370C) as described in Kawasaki et al. [2012]. Sunlight is introduced into the OSA through optical fiber. We obtain the solar spectra whenever the solar elevation angle is greater than 10 degrees, weather permitting. The system has obtained the validation data over the ocean in the 2013 world cruise with the R/V *Yokosuka*.

The residual between the observed and the calculated spectra fluctuates with respect to the scan time (i.e., along the wavenumber direction). This is likely due to limit of tracking speed of the solar tracker. In the case of a larger wave, the motors of the solar tracker could no longer keep the image of the Sun on the center of optical fiber inlet. The intensity variation in the measured spectrum is corrected by a low-frequency correction method [Keppel-Aleks et al., 2007]. Total column abundances are retrieved from the measured spectra with a nonlinear least squares spectral fitting algorithm, which scales an a priori profile to produce a synthetic spectrum that achieves the best fit to the measured spectrum. In the case of OSA system, it is found that measurement accuracy is reduced by vibration transmitted from the ship and insufficient tracking performance, which is the issue to be improved. The GOSAT XCO_2 and XCH_4 are compared with the ground-based and the ship-based validation data. For our coincidence criteria, we find GOSAT measurements within 2 hours of the high-resolution FTS measurement time and within plus or minus 5 degrees latitude and plus or minus 10 degrees longitude of the high-resolution FTS location. The seasonal trends of the retrieved XCO_2 are consistent with those of the validation data. The TANSO-FTS XCO_2 retrievals exhibit a negative bias of ˜1 ppm with a root-mean-square difference of ˜2 ppm compared to the high-resolution FTS measurements.

Keywords: carbon dioxide, methane, remote sensing

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-06 Room:201A Time:May 22 10:30-10:45

Global monitoring of greenhouse gases using various earth observation platforms

Hitoshi Mukai[1], Yukihiro Nojiri[1], Toshinobu Machida[1], Nobuko Saigusa[1*]

[1]National Institute for Environmental Studies

Center for Global Environmental Research (CGER), National Institute for Environmental Studies (NIES) has established a fundamental infrastructure for strategic monitoring of global environment with an emphasis on climate change since the early 1990s. The monitoring covers the atmosphere, ocean, and terrestrial biosphere particularly in Asia and the Pacific regions. The data have been acquired from different kinds of earth observation platforms such as ground-based stations, ships, and airplanes. A large number of studies have been conducted based on the datasets to detect changes in the atmospheric greenhouse gas concentrations and in the carbon exchanges among the atmosphere, surface oceans, and terrestrial biosphere.

The long-term datasets help to estimate temporal and spatial variations of regional and global carbon budgets, to clarify the mechanisms of essential processes of carbon cycle, and to predict future climate changes and its uncertainties. Since the dataset obtained from the monitoring would be an essential source of knowledge for global carbon cycle studies as well as a valuable validation dataset for earth system modeling and remote sensing, further efforts are still required to establish more effective data acquisition, quality control, and data sharing systems.

Keywords: Greenhouse gas concentration, carbon budget, atmosphere, ocean, terrestrial

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-07 Room:201A Time:May 22 11:00-11:20

Expectations for carbon cycle observation from a global warming projection modeler

Michio Kawamiya[1]*

[1]JAMSTEC

The protocol for 5th Phase of Coupled Model Intercomparison Project (CMIP5) includes experiments which require earth system models (ESM), i.e., climate models with biogeochemical components. As of February, 2013, projection data produced by ESMs have been submitted by institutes from across the world. Analysis on those data revealed significant of land use change by human activities on future behavior of global carbon cycle, critical importance of interactions between nitrogen and carbon cycle, and possible regulation on feedback intensity by formulation of photosynthetic rate on terrestrial vegetation, which may serve to prioritize research targets for observational planning. Also, well-formatted gridded observational data with sufficient self-explanation are often indispensable for validating model results. Indeed, Carbon Strategy by Group on Earth Observations (GEO) emphasizes the vital importance of metadata. Necessity of systematic metadata design has been claimed in modeling community, and it may be a common issue for observation and simulation community.

Keywords: Carbon cycle, Modeling, Global warming

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-08 Room:201A Time:May 22 11:20-11:35

Importance of long-term and ground truth observations on the regional carbon budget evaluation by Satellite RS

Yoshinobu Harazono[1*], Hiroki Iwata[2], Motoi Otsuki[3], Toru Iwata[3], Masahito Ueyama[4], Hirohiko Nagano[1]

[1]International Arctic Research Center, UAF, [2]Kyoto University, [3]Okayama University, [4]Osaka Pref. University

We are conducting tower-based flux observations and ground truth measurements over boreal forests in Interior Alaska. Disturbances by wildfire and environmental stresses have affected the carbon budget of boreal forests. The accurate estimation of regional carbon budget is important issue, and satellite remote sensing (RS) is a powerful tool to reveal the change in vegetation status regionally under current global warming. However, there are still problems to apply RS data for these estimations, because the available ground truth data and long-term datasets have been limited.

Observations are conducted at a mature black spruce forest in UAF's campus (UAF-site, 10 years observation records), and two burned forests (PF-site: 8th year after wildfire with 5 years observation records, and CR-site: 2nd year after wildfire with 2 years observation records). Observed gross primary productivity (GPP) at each site was related empirically with satellite derived parameters such as, fraction of absorbed PAR (FPAR), and enhanced vegetation index (EVI), in order to apply the light-use efficiency (E) model for regional GPP estimation. E and other parameters of the model are determined for both cases of disturbed and undisturbed forests by synthesizing the long-term datasets by field observations, ground truth, and satellite data. The scaling factor among tower-based flux, LANDSAT (30m grids) and MODIS (250m grids) was also determined by fine ground truth observations for regional RS application.

The determined relationships on parameters reproduced RS-products (PAR, FPAR, and EVI) well for both PF- and CR- sites. GPP at PF-site was estimated by the light-use efficiency model with determined parameters, MOD02-band1, MOD13-EVI and NCEP/NCAR weather data. The model outputs reproduced the seasonal variations in GPP for PF-site, and the daily/seasonal amounts were well agreed to those observed over snow-free periods in both 2010 and 2011. Comparing to original GPP estimation, the accuracy of the GPP estimation was improved by the well parameterized E and other RS parameter-observation relationships.

The model with determined parameters were applied to obtain GPP-distribution over black spruce forests in Alaska. GPP was estimated lower at disturbed area and the regional average including fire-disturbance was 5.62 $gCm^{-2}d^{-1}$ in late June, 2011, while that was 6.08 $gCm^{-2}d^{-1}$ for excluding the fire-disturbance. Estimated regional average GPP was about 8% lower for the case including the disturbance-effect. Within the disturbed area, estimated GPP was higher at pixels where wildfire occurred during 1960 and 1990 than those burned recently, which suggested the vegetation changes such as growth of deciduous trees and/or shift to black spruce. The surface change during vegetation recovery processes after wildfire could be detected well as combination of MOD13-EVI and other MODIS products. The results show better performances of satellite based model for carbon budget estimation regionally. Another important result in this study is that the ground truth indexes were well parameterized with satellite derived parameters. The high quality ground truth data were obtained by careful field observations. Availability of long-term field data, ground truth, and RS-data and their synthesis are important.

We hope the field data archived in this study are used for wide range of science and social (public) interests. The studies were supported by multi-funding resources of IJIS (IARC-JAXA-Information System), JSPS (Kakenhi) , NSF, and others.

Keywords: ground truth, long-term observation, regional estimation, terrestrial carbon budget, satellite remote sensing

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-09 Room:201A Time:May 22 11:35-11:50

Long-term observations of carbon budget in forest ecosystems at AIST stations and their data analyses

Shohei Murayama[1*], Hiroaki Kondo[1], MAEDA, Takahisa[1], Shigeyuki Ishidoya[1], Nobuko Saigusa[2], YAMAMOTO, Susumu[1]

[1]AIST, [2]NIES

Impacts of climate change on the activity of terrestrial biosphere have been predicted in recent studies. In East Asia and Southeast Asia strongly influenced by Asian Monsoon, changes not only in temperature but also in amounts of precipitation and length of the rainy season associated with the climate change could have much influence on the carbon budget in the terrestrial biosphere. However, responses of the terrestrial biosphere to climate change are not yet fully understood. For the better understanding of the responses, further analyses using long-term measurement data of the carbon budget in terrestrial ecosystem are necessary.

National Institute of Advanced Industrial Science and Technology (AIST) has made long-term systematic measurements of CO2 flux between the atmosphere and forest ecosystem and the related parameters in collaboration with some research groups, in a cool-temperate deciduous forest at Takayama (36.13degN, 137.42degE, 1420 m a.s.l.), Japan since 1993, and in seasonal tropical forests at Mae Klong (mixed deciduous forest, 14.58degN, 98.85degE, 231 m a.s.l.) and at Sakaerat (dry evergreen forest, 14.50degN, 101.92degE, 543 m a.s.l.), Thailand since 2001. Takayama is the longest monitoring site in the AsiaFlux network, while Mae Klong and Sakaerat are the longest AsiaFlux monitoring sites in Thailand. The CO2 concentration data at Takayama have also been submitted to the World Data Centre for Greenhouse Gases of WMO. In this presentation, our research activities and some of the results obtained from the long-term measurements will be introduced. Some results of analyses of inter-annual variation of the carbon budget observed at our sites and environmental factors governing the variation will also be presented. Furthermore, improvement of methodology of measurement and data analyses will be discussed.

Keywords: Carbon budget, Forest ecosystem, AsiaFlux, Long-term measurement, Data analyses

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-10 Room:201A Time:May 22 11:50-12:05

Space-based Carbon Monitoring by GOSAT and GOSAT-2: Towards better accuracy of XCO2 and XCH4 observation

Hiroshi Suto[1*], KUZE, Akihiko[1], SHIOMI, Kei[1], NAKAJIMA, Masakatsu[1]

[1]Japan Aerospace Exploration Agency

To observe the global column concentration of carbon dioxide (CO_2) and methane (CH_4) from space, the Greenhouse gases Observing SATellite (GOSAT) was launched on January 23, 2009, and has started the operational observation. Thermal and Near Infrared Sensor for Carbon Observation ? Fourier Transform Spectrometer (TANSO-FTS) has been continuously measuring CO_2 and CH_4 distributions globally, and the retrieved column CO_2 and CH_4 data have been distributed to the public. Over four-years operational periods, the useful scientific data sets and interesting articles for carbon source/sink evaluation were produced and published, and these results have been supporting to well understanding of carbon cycle. Currently, the importance of space-based carbon observation has been approved and desired the continuous observation in toward. Through the TANSO-FTS operation with the radiometric, geometric and spectroscopic characterizations, we learned how to improve the accuracy of X_{CO2} and X_{CH4} based on short-wavelength FTS. The correction procedures for micro-vibration from companion components, non-linear response of analogue and digitizing circuit are key role on the current on-board operating TANSO-FTS. These procedures were applied on operational level-1 processing algorithm. On instrumental aspects, the robustness and improvements will be required on the future mission to obtain the better spectral quality, and it will be able to lead more accurate X_{CO2} and X_{CH4} retrievals. The current retrieval accuracy of X_{CO2} by GOSAT spectra is around 2 ppm, which is determined by comparing with ground- and aircraft- sampling measured dataset. It suggests that the accuracy of space-based carbon observation is much smaller than 4 ppm of the GOSAT mission target. The improvement of retrieval algorithm for X_{CO2} and X_{CH4} is also important both of the accuracy and the processing speed. To elucidate the carbon cycle more precisely, our experiences have to be summarized and applied in the future missions. To continue and improve the space-based carbon monitoring, the conceptual design work of GOSAT-2 has been started. The science and technical highlight of GOSAT and the preliminarily design of GOSAT-2 will be presented with current status.

Keywords: GOSAT, GOSAT-2, CO2, CH4

MSD03-P01 Room:Convention Hall Time:May 22 18:15-19:30

Usage of synergetic band spectra observed by TASO-FTS/GOSAT to estimate CO2 concentration in the boundary layer

Ryoichi Imasu[1*], HAYASHI, Yoji[1], SOMEYA, Yu[1], SAITOH, Naoko[2], MATSUEDA, Hidekazu[3], SAWA, Yousuke[3], NIWA, Yosuke[3]

[1]Atmosphere and Ocean Research Institute, The University of Tokyo, [2]Center for Environmental Remote Sensing, Chiba University, [3]Meteorological Research Institute, Japan Meteorological Agency

CO2 concentration near the surface is an important parameter for estimating the uptake speed into the forests and oceans, and/or emission strength over the urban areas. The greenhouse gas observing satellite (GOSAT) dedicated to observe atmospheric CO2 concentration was launched in 2009 and has been operated for more than four years. The main band of its sensor can measure the columnar concentration of CO2, however, they cannot be directly converted into the concentration near the surface. The objective of this study is to propose a method to estimate the CO2 concentration in the lower atmosphere, particularly in the boundary layer based on the synergetic usage of thermal infrared (TIR) and short wavelength infrared (SWIR) band data. Generally, CO2 emission and uptake occur near the surface, and the air is well mixed in the boundary layer during the daytime keeping the columnar concentration of the gas. However, CO2 mixing ration in the boundary layer is not determined only from the columnar concentration, i.e. the thickness of the boundary layer is necessary. It can be estimated from temperature (or potential temperature) profiles retrieved from TIR band spectra as well as the tropopause height. By combining CO2 columnar concentration retrieved from SWIR band spectra, upper air concentration retrieved from TIR spectra, and the tropopause height and boundary layer thickness, CO2 mixing ration in the boundary layer can be estimated assuming the concentration in the stratosphere based on the yearly trend. We applied this method to a dataset obtained over the Kanto Plain during the GOSAT specific observation periods, and the results were validated using CO2 mixing ration data operationally observed at a ground based observation site of the meteorological research institute (MRI/JMA) in Tsukuba.

Keywords: carbon dioxide, GOSAT, boundary layer, retrieval

MSD03-P02 Room:Convention Hall Time:May 22 18:15-19:30

Comparison of CO2 column concentrations calculated from GOSAT SWIR and balloon-borne CO2 instrument measurements

Mai Ouchi[1*], Kouhei Miyaji[1], Yutaka Matsumi[1], Tomoki Nakayama[1], Ryoichi Imasu[2]

[1]Solar-Terrestrial Environmental Laboratory, Nagoya University, [2]Atmosphere and Ocean Research Institute, The University of Tokyo

The Greenhouse gases observing satellite (GOSAT), launched on January 23, 2009, has monitored atmospheric carbon dioxide (CO_2) and methane (CH_4) globally from space.The objectives are to understand the global distribution of CO_2 and CH_4, and the causes of their variability with seasons, years and locations. The Thermal And Near infrared Sensor for carbon Observation-Fourier Transform Spectrometer (TANSO-FTS) onboard GOSAT has two detectable regions; Short-Wavelength Infrared (SWIR) and Thermal Infrared (TIR). TANSO-FTS observe sunlight reflected from the earth's surface in SWIR region and radiation emitted from the ground and atmosphere in TIR region. The global distribution of column-averaged dry air mole fractions of CO_2 (XCO_2) and CO_2 profile, called as GOSAT products, are retrieved from SWIR spectra and TIR spectra, respectively. It is essential to validate GOSAT in order to clarify the uncertainty of GOSAT products intended to get higher precision for use to find out the CO_2 sources and sinks and to assess its impact on climate change.

In this study, we compared to the XCO_2 derived from GOSAT and calculated from an originally developed balloon-borne CO_2 instrument (CO_2 sonde) which can measure CO_2 vertical profile up to the altitude of 10 km. XCO_2 calculated from the CO_2 sonde were extrapolated CO_2 mixing ratio provided from Nakazawa et al, Tohoku University.

Four CO_2 sonde data observed in 13:00-14:00 at three sites synchronized with GOSAT overpass were used for comparison; January 7, 2011 at Ichihara, January 31, 2011 at Moriya, June 30, 2012 at Moriya, and July 30, 2012 at Shirako.

As a result, in the comparison to the observations of CO_2 sonde in 2011 at Ichihara and Moriya, we report that there is roughly agreement taking account to the bias of GOSAT L2 product (V.2.XX) -1.20 +- 1.97 ppm which is temporary value reported by Morino et al[1)]. In the comparison of XCO_2 from GOSAT and the observations of CO_2 sonde in 2012 at Moriya and Shirako, it was found that the distance between the site of CO_2 sonde launched and the point observed by GOSAT made difference 0.3-4.1 ppm. In the Future, we plan to observe the CO_2 at various locations to contribute validation of GOSAT products by using the CO_2 sonde.

[1)] Morino et al, 2012: GOSAT TANSO-FTS SWIR products retrieved from improved algorithm and its validation analysis, The 18th Symposium on Atmospheric Chemistry, A-2-13 (in Japanese abstract).

Keywords: carbon dioxide, balloon-borne measurement, validation for satellite

MSD03-P03 Room:Convention Hall Time:May 22 18:15-19:30

Remote sensing of CO2 to evaluate the CO2 emission from forest/peat-land fires

Masahiro Kawasaki[1]*, Gen Inoue[2], Masafumi Ohashi[3]

[1]RIHN, [2]University of Tokyo, [3]Kagoshima Univeristy

The evaluation of CO2 emission especially from peat-land is one of key issues of MRV (Measurement, Reporting and Verification). The surface temperature of peat-land fire is relatively low and it is frequently discounted in fire hot-spot data. The amount of carbon loss or CO2 emission is difficult to estimate from the carbon stock change because it is accompanied by inhomogeneous and small subsidence. The loss in peat-lands occurs underground in some cases. So, the loss estimation from the flux observation superiors to the stock-change measurement.

The flux observation over forest is usually conducted by flux tower measurement (Eddy covariance method) for carbon budget of ecosystem which includes tree and soil processes. However, this measurement is limited to the homogeneous process, which is not the case for tropical peatland fire.

The CO2 flux from fire can be measured by observing the CO2 concentration and wind speed surrounding the area of interest. The remote sensing of CO2 column amount (integrated CO2 amount from surface to the space) can be done either from space on a satellite (GOSAT) or on the ground observing the direct solar spectrum. The authors have developed a fully automated optical fiber system to observe CO2 emission continuously. Two instruments were installed at Banjar Baru and Palangka Raya in Augutst-October, 2011. The CO2 concentration difference between south/north sites and its diurnal variability will be discussed.

Observation of carbon-mono-oxide CO is expected to be a useful tool to identify between above and below-ground fires. Preliminary observation has been tried at Palangka Raya as well.

We thank M. Yamaguchi, K. Yamaguchi, T. Asanuma, K. Yoshikawa, K. Shibata (Meisei Electrics Co.), Y. Matsubara, T. Abe (Sumitomo Co.), E. Muhammad and A. Sulaiman (BPPT), A. Usup (UNPAR) and A. Hadi(UNLAM) for their help and financial support from JST and GRENE-ei.

Keywords: Green house gas, Tropical area, Kalimantan, Indonesia, Latent Flux, MRV

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-P04 Room:Convention Hall Time:May 22 18:15-19:30

Analysis of Net Biome Productivity (NBP) from vegetation models and application to global atmospheric CO2 inversion

Misa Ishizawa[1*], Shamil Maksyutov[1], Stephen Sitch[2], Anders Ahlstrom[3], Mark Lomas[4], Peter Levy[5], Sam Levis[6], Sonke Zaehle[7], Nicolas Viovy[8], Ning Zeng[9]

[1]NIES, Japan, [2]University of Exeter, UK, [3]Lund University, Sweden, [4]University of Sheffield, UK, [5]Centre for Ecology and Hydrology, UK, [6]NCAR, USA, [7]MPI- Biogeochemistry, Germany, [8]LSCE, France, [9]University of Maryland, USA

The "top-down" estimation of the carbon flux through atmospheric CO2 inversion relies on prior CO2 flux information between the atmosphere and the earth surface, as well as the atmospheric CO2 concentration measurements. Among the prior information, the terrestrial biosphere remains in large uncertainties. To provide better constraint of CO2 inversion estimates, the modelled results of net biome productivity (NBP) from TRENDY project were analyzed and examined to apply for atmospheric CO2 inversion.

In TRENDY, a number of the DGVMs (Dynamic Global Vegetation Models) were driven globally by common climate forcing and historical atmospheric CO2 record to simulate for the period of 1901-2010, with three different scenarios aiming at reducing the uncertainties of land carbon budget. For our purpose, the modelled NBPs from the 8 DGVMs with scenario S2 (time-varying CO2 and climate) were analyzed to derive the mean feature of contemporary terrestrial biospheric net carbon budget and mean response to the changing climate system/recent global warming.

On a global scale, the model-averaged NBP show inter-annual variations correlated with inter-annual climate phenomenon/ENSO, and also an upward trend which suggests a regime shift around 1970 towards an increase in land carbon gains. EOF analysis to the average TRENDY-NBP also shows an increasing trend in the principal component of EOF1 over the recent three decades along with inter-annual variations. That indicates the leading EOF spatial pattern might respond to a long-term change as well as inter-annual variability in the climate system. While the modelled NBP are increasing globally, the variance among the models is also increasing with time, reflecting the model divergence in the processes relevant to the climate change. By examining multiple EOF patterns, in conjunction with global characterises of NBP distribution and its uncertainties, we explore the application of information from the model-ensemble results to atmospheric CO2 inversion.

Keywords: CO2, terrestrial ecosystem, inverse modelling, climate change

Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

MSD03-P05 Room:Convention Hall Time:May 22 18:15-19:30

Precise observations of the atmospheric O2/N2, Ar/N2 and their stable isotopes for understandings of the climate system

Shigeyuki Ishidoya[1*], Shohei Murayama[1], Satoshi Sugawara[2], Shinji Morimoto[3], Shoichi Taguchi[1], Kazuhiro Tsuboi[4], Hidekazu Matsueda[4], Daisuke Goto[5], Hiroaki Kondo[1], Shuji Aoki[5], Takakiyo Nakazawa[5], Yousuke Sawa[4], Yosuke Niwa[4], Yasunori Tohjima[6], Nobuko Saigusa[6], Nobuyuki Aoki[1], Kenji Kato[1], Prabir Patra[7], Hideyuki Honda[8]

[1]National Institute of Advanced Industrial Science and Technology (AIST), [2]Miyagi University of Education, [3]National Institute of Polar Research, [4]Meteorological Research Institute, [5]Tohoku University, [6]National Institute for Environmental Studies, [7]Japan Agency for Marine-Earth Science and Technology, [8]Japan Aerospace Exploration Agency (JAXA)

Precise observations of the atmospheric O2/N2 ratio (delta(O2/N2)) have been developed since early 1990s to elucidate the global CO2 budget (e.g. Manning and Keeling, 2006), which have been noted by the IPCC. The atmospheric Ar/N2 ratio (delta(Ar/N2)) is expected to be one of the promising indicators for the exchange of heat fluxes between atmosphere and ocean (e.g. Blaine, 2005), which may improve the delta(O2/N2)-based estimation of the global CO2 budgets (e.g. Ishidoya et al., 2012a). It has been also reported that the gravitational separation of gas materials in the stratosphere can be detected with the observations of the delta(Ar/N2), the stable isotopic ratios of N2, O2, and Ar, and that the secular trends in the Brewer-Dobson circulation would be detectable by using the observed gravitational separation (Ishidoya et al., 2013). Recently, we have developed an ultra-precision continuous measurement system of the atmospheric delta(O2/N2), delta(Ar/N2), stable isotopic ratios of N2, O2 and Ar, using a mass spectrometer at the AIST and are applying it to the following studies;

1. Continuous observations of the atmospheric delta(O2/N2), delta(Ar/N2), CO2 concentration, stable isotopic ratios of N2, O2 and Ar at Tsukuba, Japan.

2. Analyses of the delta(O2/N2), delta(Ar/N2), stable isotopic ratios of N2, O2 and Ar of the balloon-borne stratospheric air samples, in cooperation with Tohoku Univ., Miyagi Univ. of Education, National Institute of Polar Research and JAXA.

3. Observations of the mid-tropospheric delta(O2/N2) over the western North Pacific by analyzing the air samples collected using a cargo aircraft C-130H, in cooperation with Japan Meteorological Agency and Meteorological Research Institute.

4. Observations of the atmospheric delta(Ar/N2) at Hateruma, Japan, in cooperation with National Institute for Environmental Studies.

5. Development of the high precision gravimetric standard air for the measurements of the atmospheric O2/N2 ratio and the O2 concentration, in cooperation with National Metrology Institute of Japan, AIST.

We have also developed a continuous measurement system of the atmospheric delta(O2/N2) using a fuel cell analyzer in cooperation with the National Institute of Polar Research and Tohoku Univ. (Goto et al., 2013), and tested in the temperate deciduous forest site at Takayama, Japan. Further, we are analyzing the causes of the temporal-spatial variation of atmospheric delta(O2/N2) with the atmospheric transport models developed by the AIST and JAMSTEC (Ishidoya et al., 2012a, b). Integration of these studies will lead to a better understanding of the mechanisms for climate changes.