

Michael.Buchwitz@iup.physik.uni-bremen.de

GHG-CCI Quarterly Report

Reporting period: Jan-Mar 2011

Version: 5 Apr 2011 (Version 2)

GHG-CCI QSR Jan-Mar 2011

Project Status

The GHG-CCI project has been kicked-off on 1. Sept. 2010. Therefore, this is the second Quarterly Report of the GHG-CCI project. The GHG-CCI project proceeded as planned and significant progress has already been made as explained below. No major problems have been encountered so far.

During the reporting focus was

- on generating first versions of key documents such as User Requirements Document (URDv1), Data Access Requirements Document (DARDv1) and Product Specification Document (PSDv1). First versions have been finalized during the reporting period as planned. They are publicly available from the GHG-CCI website (<http://www.esa-ghg-cci.org>).
- on generating a first version of the Round Robin Evaluation Protocol (RREP), which is also publicly available from the GHG-CCI website.
- on preparing for and participating at the CCI Integration Meeting at ECMWF, 14-16 March 2011.
- on preparing for PM2 which will be held during EGU on 7 April 2011. CMUG has been invited.
- on updating the GHG-CCI website.
- on algorithm development, data processing and evaluation of the resulting data products. A first detailed comparison of all the data products generated with the GHG-CCI ECV Core Algorithms (ECAs) has been initiated and first very encouraging results have been obtained (to be presented at EGU and PM2). Also significant progress has been made on the Additional Constraints Algorithms (ACAs). For example, a detailed comparison of the new methane profile data product retrieved from SCIAMACHY occultation measurements at IUP, Univ. Bremen, with the MIPAS product of KIT has been initiated. First results will be presented at PM2.

In addition, the following peer-reviewed publications of GHG-CCI team members appeared during the reporting period (or at the end of the previous period):

- Butz, A., O.P. Hasekamp, C. Frankenberg, J. Vidot, and I. Aben, CH₄ retrievals from space-based solar backscatter measurements: performance evaluation against simulated aerosol and cirrus loaded scenes, *J. Geophys. Res.*, 115, D24302, doi:10.1029/2010JD014514, 2010.
- Frankenberg, C., I. Aben, P. Bergamaschi, E. J. Dlugokencky, R. van Hees, S. Houweling, P. van der Meer, R. Snel, and P. Tol, Global column-averaged methane mixing ratios from 2003-2009 as derived from SCIAMACHY: Trends and variability, 116, D04302, doi:10.1029/2010JD014849, *J. Geophys. Res.*, 2011.

- Georgoulas A.K., Kourtidis K.A., Buchwitz M., Schneising O., Burrows J.P., A case study on the application of SCIAMACHY satellite methane measurements for regional studies: the Greater Area of the Eastern Mediterranean, *International Journal of Remote Sensing*, 32(3), 787-813, doi:10.1080/01431161.2010.517791, 2011
- Reuter, M., H. Bovensmann, M. Buchwitz, J. P. Burrows, B. J. Connor, N. M. Deutscher, D. W. T. Griffith, J. Heymann, G. Keppel-Aleks, J. Messerschmidt, J. Notholt, C. Petri, J. Robinson, O. Schneising, V. Sherlock, V. Velazco, T. Warneke, P. O. Wennberg, and D. Wunch, Retrieval of atmospheric CO₂ with enhanced accuracy and precision from SCIAMACHY: Validation with FTS measurements and comparison with model results, *J. Geophys. Res.*, 116, D04301, doi:10.1029/2010JD015047, 2011.
- Schneising, O., Buchwitz, M., Reuter, M., Heymann, J., Bovensmann, H., and Burrows, J. P., Long-term analysis of carbon dioxide and methane column-averaged mole fractions retrieved from SCIAMACHY, *Atmos. Chem. Phys.*, 11, 2863-2880, 2011.

Data Requirements

A first version of the Data Access Requirements Document (DARD) has been compiled during the reporting period. It is available via the GHG-CCI website. The GHG-CCI team has access to all needed satellite data, e.g., to all SCIAMACHY and GOSAT data from launch to end of 2010. The GHG-CCI team has also access to all relevant model data (e.g., TM5 from JRC and CarbonTracker from NOAA). Also TCCON data are available and have already been used for initial comparisons. Parts of year 2010 data are still needed and will be added to the data base in the coming months. During the generation of the DARD a very good co-operation with ECMWF has been established to define the ECMWF data needs and how GHG-CCI can get access to this data set.

User Requirements

A first version of the URD has been generated as planned (URDv1). It is publicly available from the GHG-CCI website (<http://www.esa-ghg-cci.org>). The URD has been evaluated by CMUG. The CMUG findings are very positive. In the CMUG evaluation report (CMUG Deliverable 2.1) one can read: "This URD serves as exemplary model for other ECV teams" and that "No major issues have been identified".

It is expected that all requirements can be met with the possible exception of the accuracy requirements, which are very demanding (sub-percent for XCO₂ and XCH₄). Even the threshold requirements are very demanding. Threshold means "minimum useful". For the GHG-CCI user the focus here is on "useful", not on "minimum". This means that even if the threshold requirements are not met, one cannot conclude that the data are useless. Under these conditions it is however unlikely that the data are very useful all the time for all locations. It has also been pointed out in the URD that what matters are the details of the spatial-temporal error structure which cannot be well characterized using a single number or a small set of numbers. It has therefore been highlighted in the URD that the numerical values given in the URD only give an indication but should by no means be over-interpreted.

The availability of URDv1 has been announced by informing a large community (including the teams in the US and Japan being part of the OCO and GOSAT science teams). The GHG-CCI CRG is considered an international representative user for the use of satellite CO₂ and CH₄ data products for regional surface flux inverse modeling. The process of establishing links to (other) international science bodies, most notably the Global Carbon Project (GCP) and IGBP, has been initiated. Initial comments on the URD from outside the CCI project have been obtained and will be considered for future updates. This is also true for the recommendations made by CMUG. CMUG especially would like to see the longer term perspective added (next 5 and 10 years). Also this will be added to the

next version of the URD. Here it will be pointed out that there is high risk for significant EO data gaps, due to the very limited number of approved satellite missions with sensitivity to near surface GHG variations. In this context planned and proposed future European missions such as Sentinel-5P (CH₄ but no CO₂), MERLIN (CH₄ but not CO₂) and CarbonSat (CO₂ and CH₄) have an important role to play.

Products specification

A first version of the PSD has been generated as planned (PSDv1). It is publicly available from the GHG-CCI website. The GHG-CCI Climate Research Group (CRG) has reviewed the PSD. Initial CRG comments have been included in the PSD. Additional comments have been provided after submission of PSDv1. For example, the users would like to see the entire state vector in the product and not only parts of it. These comments will be considered for the next update. It is planned to use NetCDF as also foreseen for the other CCI projects. The detailed definition is still ongoing, including aspects such as CF naming conventions. GHG-CCI will benefit from adhering to these standards. The users will in particular benefit from more information to be incorporated in the products compared to the currently existing products. The products will meet the user requirements on product content. To what extent the products will meet other requirements, most notably the very demanding relative accuracy requirements, still needs to be assessed. GHG-CCI is still at the beginning of the 2 year Round Robin phase, where algorithms are being improved.

Scientific cooperation

A strong link has been established and further strengthened during the reporting period with the EU project MACC (Monitoring Atmospheric Composition and Climate). MACC is considered to be one of the key users for the GHG data products to be generated within GHG-CCI.

Cooperations with other international projects and partners have also been further strengthened during the reporting period, for example with a new ECV related project in the US led by Dr. Susan Kulawik, JPL, which aims at a detailed characterization of satellite CO₂ retrievals including SCIAMACHY and GOSAT. It has been agreed to deliver the GHG-CCI SCIAMACHY XCO₂ data product generated with the BESD algorithm (Reuter et al., 2011) for external evaluation and to exchange information on all relevant findings to see if the two projects reach consistent conclusions on the data quality.

Next Steps

During April – June 2011, i.e., month 8 – 10 of the GHG-CCI project, focus will be on further improving the GHG-CCI retrieval algorithms, data processing, and analysis of the resulting data products. A major focus will also be the generation of the Product Validation Plan (PVP) which is due month 9. Work on several other documents will also be carried out, most notably ATBDv0, and AIECARv0 (Algorithm Intercomparison and Error Characterization and Analysis Report).

Work started on compiling the so-called Data Base Task 2 (DBT2) which will contain a data base of validation data (due month 9). Available satellite retrievals will be part of the Round Robin Data Package (RRDP) (month 6-12 (initial version), to be continued after month 12).

Several abstracts on GHG-CCI (overall and specific topics) have been submitted to the EGU 2011 conference in Vienna and the International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-7) in Edinburgh. They have all been accepted for (oral and poster) presentation.