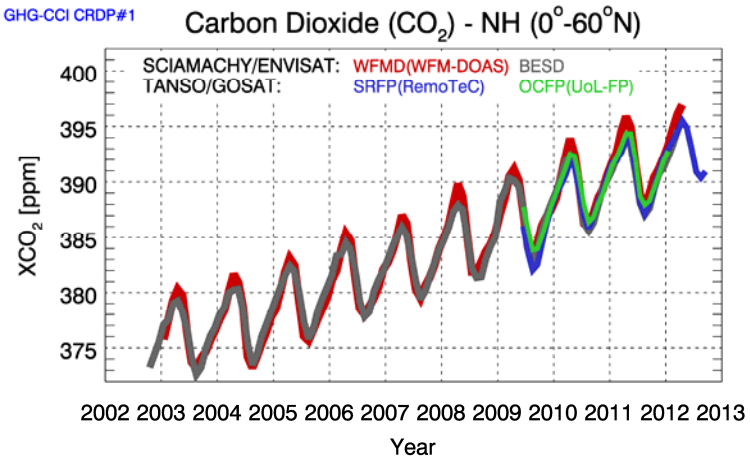
→ CLIMATE CHANGE INITIATIVE

GHG CCI Newsletter

Issue 4 | August 2013

Carbon dioxide (CO_2) over the Northern Hemisphere during 2003-2012 as retrieved from SCIAMACHY/ENVISAT and TANSO/GOSAT using four GHG-CCI retrieval algorithms. As can be seen, CO_2 continues to increase by about 0.5%/year despite international efforts to reduce carbon emissions:



In this issue:

GHG-CCI at ESA's Living Planet Symposium, Edinburgh, 9-13 September 2013

The focus of GHG-CCI is to generate global data sets of carbon dioxide (CO_2) and methane (CH_4), which are the two most important anthropogenic greenhouse gases (GHGs). Satellite observations combined with modelling provide important missing global information on regional CO_2 and CH_4 sources and sinks required for better climate prediction. This application requires appropriate retrieval algorithms. The focus of the first 3 years of the GHG-CCI project was to improve various state-of-the-art algorithms and use them to generate global long-term consistent greenhouse gas time series.

GHG-CCI results will be presented at ESA's Living Planet Symposium in September 2013 in Edinburgh. Here some oral presentations (all on 11th of Sept.):

8:20, CCI-5: O. Schneising: A decade of atmospheric carbon dioxide and methane retrieved from SCIAMACHY onboard ENVISAT

10:50, CCI-6: M. Buchwitz: The Greenhouse Gas project of ESA's Climate Change Initiative (GHG-CCI): Phase 1 achievements

10:10, GHG-1: J. P. Burrows: From SCIAMACHY to CarbonSat and SCIA-ISS

11:10, GHG-1: R. Parker: GOSAT retrievals of CH_4 and CO_2 and their comparison to global Chemistry Transport Models

11:30, GHG-1: I. Aben: Reduced carbon uptake during the 2010 Northern Hemisphere summer as observed by GOSAT

13:10, GHG-2: G. Monteil: Identifying model and observational biases in inverse modelling of CH_4 observations

13:30, GHG-2: K. Byckling: How well can we validate and characterise GOSAT XCH_4 and XCO_2 Retrievals?

13:50, GHG-2: C. Crevoisier: A View on Mid-Tropospheric CH_4 and CO_2 in the Tropics: 6 Years from MetOp-A/IASI

14:30, GHG-2: S. Noel: Time Series of CH_4 and CO_2 Profiles derived from SCIAMACHY Solar Occultation Measurements with Onion Peeling DOAS

and many more, e.g., various poster, CarbonSat talks in Session "Earth Explorer 8 (EE8) Candidates" on 12 Sept., etc.

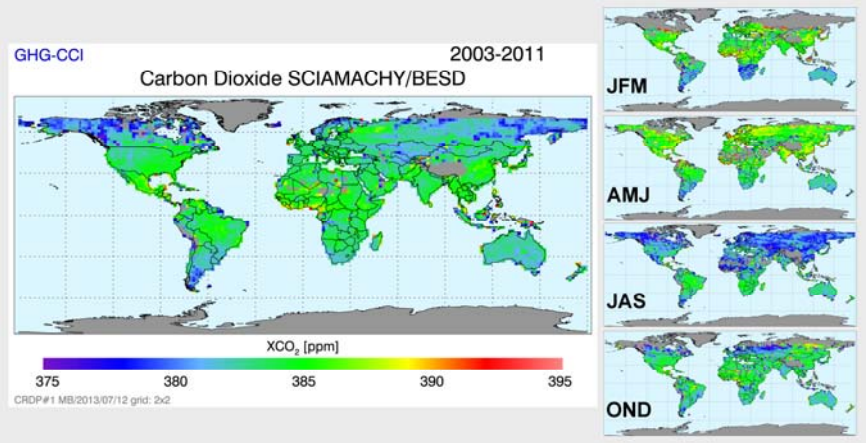
GHG-CCI: Status & outlook

The currently ongoing Phase 1 of the GHG-CCI project started in Sept. 2010 and will end in Dec. 2013. Initially, the user requirements have been formulated (see GHG-CCI User Requirements Document (URD) available from http://www.esa-ghg-cci.org/ -> Documents). The focus of the first two years was to further develop European retrieval algorithms (in competition) as needed to generate data products, which fulfil the demanding user requirements. The results of this so-called Round Robin exercise are described in detail in Buchwitz et al., 2013 (see http://www.esa-ghg-cci.org/ -> Publications and page 3 of this Newsletter). The selected algorithms have been used to generate the Climate Research Data Package (CRDP, see page 4 of this Newsletter). The CRDP is the first version of the Essential Climate Variable (ECV) data base for Greenhouse Gases.

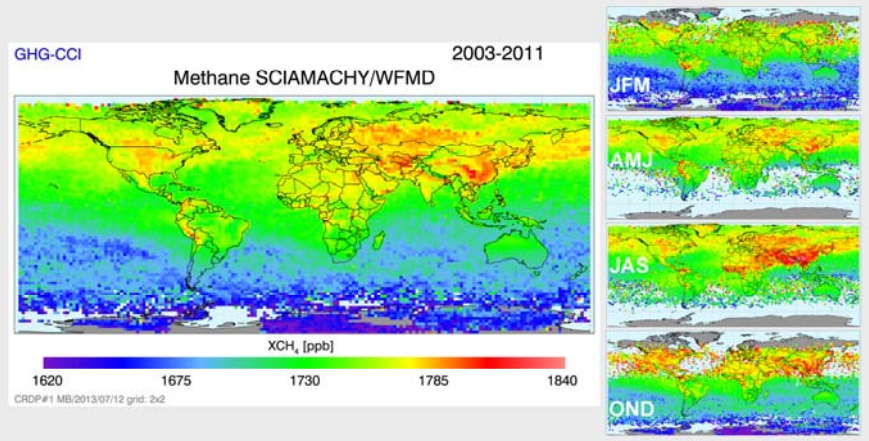
Phase 2 of GHG-CCI will start in January 2014. During this follow-on phase the time series will be extended, the quality and error characterization of the data products will be improved, and more users will be involved to exploit the information content of the satellite observations for carbon and climate related applications.

Examples of the GHG-CCI data products are shown below for carbon dioxide (top) and methane (bottom). Please visit http://www.esa-ghg-cci.org/ for more information on our data products.

Global distribution of atmospheric carbon dioxide as retrieved from SCIAMACHY on ENVISAT. Shown are only retrievals over land due to the typically low reflectivity of water in the shortwave-infrared spectral region used for retrieval. Data gaps over land are primarily due to clouds. In summer, CO_2 is low (blue) due to uptake of CO_2 by growing vegetation:



Global distribution of atmospheric methane as retrieved from SCIAMACHY on ENVISAT. Major source regions can be typically identified by high local methane concentrations (red), e.g., China (methane emissions from wetlands, rice cultivation, etc.). Note however that high values are also observed remote from source regions due to atmospheric transport. This needs to be considered when interpreting the data in terms of methane emissions:



GHG-CCI: Scientific publications

Scientific publications based on or related to GHG-CCI data products:

Basu, S., S. Guerlet, A. Butz, et al., Global CO_2 fluxes estimated from GOSAT retrievals of total column CO_2, Atmos. Chem. Phys. Discuss., 13, 4535-4600, 2013.

Buchwitz, M., M. Reuter, O. Schneising, et al., The Greenhouse Gas Climate Change Initiative (GHG-CCI): comparison and quality assessment of near-surface-sensitive satellite-derived CO_2 and CH_4 global data sets, Remote Sensing of Environment, in press, 2013.

Buchwitz, M., Reuter, M., Schneising, O., et al., The GHG-CCI project of ESA's Climate Change Initiative: Overview and Status, proceedings of ESA ATMOS 2012 conference, ESA Special Publication SP-708 (CD-ROM), Bruges, Belgium, 18-22 June 2012.

Butz, A., S. Guerlet, O. Hasekamp, et al., Toward accurate CO_2 and CH_4 observations from GOSAT, Geophys. Res. Lett., 38, L14812, doi:10.1029/2011GL047888, 2011.

Butz, A., O.P. Hasekamp, C. Frankenberg, et al., CH_4 retrievals from space-based solar backscatter measurements: performance evaluation against simulated aerosol and cirrus loaded scenes, J. Geophys. Res., doi:10.1029/2010JD014514, 2010.

Chevallier, F., and C. W. O'Dell, Error statistics of Bayesian CO_2 flux inversion schemes as seen from GOSAT, Geophys. Res. Lett., doi: 10.1002/grl.50228, 2013.

Cressot, C., F. Chevallier, P. Bousquet, et al., On the consistency between global and regional methane emissions inferred from SCIAMACHY, TANSO-FTS, IASI and surface measurements, Atmos. Chem. Phys. Discuss., 13, 8023-8064, 2013.

Crevoisier, C., D. Nobileau, R. Armante, et al., The 2007–2011 evolution of tropical methane in the mid-troposphere as seen from space by MetOp-A/IASI, Atmos. Chem. Phys., 13, 4279-4289, 2013.

Frankenberg, C., I. Aben,P. Bergamaschi, et al., Global column-averaged methane mixing ratios from 2003-2009 as derived from SCIAMACHY: Trends and variability, J. Geophys. Res., doi:10.1029/2010JD014849, 2011.

Fraser, A., Palmer, P. I., Feng, L.,et al., Estimating regional methane surface fluxes: the relative importance of surface and GOSAT mole fraction measurements, Atmos. Chem. Phys., 13, 5697-5713, doi:10.5194/acp-13-5697-2013, 2013.

Guerlet, S., S. Basu, A. Butz, et al., Reduced carbon uptake during the 2010 Northern Hemisphere summer from GOSAT, Geophys. Res. Lett., doi: 10.1002/grl.50402, 2013.

Guerlet, S., A. Butz, D. Schepers, et al., Impact of aerosol and thin cirrus on retrieving and validating XCO_2 from GOSAT shortwave infrared measurements, J. Geophys. Res., doi: 10.1002/jgrd.50332, 2013.

Heymann, J., O. Schneising, M. Reuter, et al., SCIAMACHY WFM-DOAS XCO_2: comparison with CarbonTracker XCO_2 focusing on aerosols and thin clouds, Atmos. Meas. Tech., 5, 1935-1952, 2012.

Heymann, J., H. Bovensmann, M. Buchwitz, et al., SCIAMACHY WFM-DOAS XCO_2: reduction of scattering related errors, Atmos. Meas. Tech., 5, 2375-2390, 2012.

Hollmann, C.J. Merchant, R. Saunders, et al., The ESA Climate Change Initiative: satellite data records for essential climate variables, Bulletin of the American Meteorological Society (BAMS), 0.1175/BAMS-D-11-00254.1, 2013.

Noël, S., K. Bramstedt, A. Rozanov, et al., Stratospheric Methane Profiles from SCIAMACHY Solar Occultation Measurements derived with Onion Peeling DOAS, Atmos. Meas. Tech. Discuss., 4, 4801-4823, 2011.

Parker, R., Boesch, H., Cogan, A., et al., Methane Observations from the Greenhouse gases Observing SATellite: Comparison to Ground-based TCCON data and Model Calculations, Geophys. Res. Lett., 38, L15807, doi:10.1029/2011GL047871, 2011

Reuter, M., H. Boesch, H. Bovensmann, et al., A joint effort to deliver satellite retrieved atmospheric CO_2 concentrations for surface flux inversions: the ensemble median algorithm EMMA, Atmos. Chem. Phys., 13, 1771-1780, 2013.

Reuter, M., H. Bovensmann, M. Buchwitz,et al., Retrieval of atmospheric CO_2 with enhanced accuracy and precision from SCIAMACHY: Validation with FTS measurements and comparison with model results, J. Geophys. Res., doi: 10.1029/2010JD015047, 2011.

Ross, A. N., Wooster, M. J., Boesch, H., Parker, R., First satellite measurements of carbon dioxide and methane emission ratios in wildfire plumes, Geophys. Res. Lett., 40, 1-5, doi:10.1002/grl.50733, 2013.

Schepers, D., S. Guerlet, A. Butz,et al., Methane retrievals from Greenhouse Gases Observing Satellite (GOSAT) shortwave infrared measurements: Performance comparison of proxy and physics retrieval algorithms, J. Geophys. Res., 117, D10307, doi:10.1029/2012JD017549, 2012.

Schneising, O., J. Heymann, M. Buchwitz, et al., Anthropogenic carbon dioxide source areas observed from space: assessment of regional enhancements and trends, Atmos. Chem. Phys., 13, 2445-2454, 2013.

Schneising, O., P. Bergamaschi, H. Bovensmann, et al., Atmospheric greenhouse gases retrieved from SCIAMACHY: comparison to ground-based FTS measurements and model results, Atmos. Chem. Phys., 12, 1527-1540, 2012.

Schneising, O., Buchwitz, M., Reuter,et al.: Long-term analysis of carbon dioxide and methane column-averaged mole fractions retrieved from SCIAMACHY, Atmos. Chem. Phys., 11, 2863-2880, doi:10.5194/acp-11-2863-2011, 2011.

Sussmann, R., A. Ostler, F. Forste e al.,, First intercalibration of column-averaged methane from the Total Carbon Column Observing Network and the Network for the Detection of Atmospheric Composition Change, Atmos. Meas. Tech., 6, 397-418, 2013.

Please visit

http://www.esa-ghg-cci.org/

for updates & links to the publications

"Climate Research Data Package" (CRDP)

The CRDP is the first version of the "Essential Climate Variable" (ECV) Greenhouse Gases data base. The CRDP contains the satellite-derived carbon dioxide and methane GHG-CCU data products. Currently ongoing activities are the validation of the CRDP and an initial user assessment. Once these activities are finished (in October 2013 or earlier) the CRDP along with its documentation will be made publicly available. The unvalidated data are available already now for interested users: please visit http://www.esa-ghg-cci.org -> CRDP for details.

Overview CRDP:

GHG-CCI Climate Research Data Package (CRDP)															
Product ID	**Product (Level 2, mixing ratios)**	**Years processed**													
		2003	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
ECV Core Algorithm (ECA) Products															
XCO2_SCIA	**XCO_2**	■	■	■	■	■	■	■	■	■	■				
XCH4_SCIA	**XCH_4**	■	■	■	■	■	■	■	■	■	■				
XCO2_GOSAT	**XCO_2**							■	■	■	■				
XCH4_GOSAT	**XCH_4**							■	■	■	■				
XCO2_EMMA	**XCO_2**							■	■						
Additional Constraints Algorithm (ACA) Products															
CO2_AIRS	**CO_2 (1)**	■	■	■	■	■	■	■	■						
CO2_IASI	**CO_2 (1)**					■	■	■	■	■	■				
CH4_IASI	**CH_4 (1)**					■	■	■	■	■	■				
CH4_SCIAOCC	**CH_4 (2)**	■	■	■	■	■	■	■	■	■	■				
CH4_MIPAS	**CH_4 (2)**			■	■	■	■	■	■	■	■				
CO2_ACEFTS	**CO_2 (2)**		■	■	■	■	■	■	■						

Comments:
(1) Mid / upper tropospheric column
(2) Upper tropospheric / stratospheric profile

ECA Algorithms:
XCO2_SCIA: BESD, (WFMD)
XCH4_SCIA: WFMD, IMAP
XCO2_GOSAT: SRFP(RemoTeC), OCFP(UoL-FP)
XCH4_GOSAT: SRFP(RemoTeC), OCPR(UoL-PR)
XCO2_EMMA: Various (SCIA & GOSAT merged)

The CRDP website provides access to the data products and various browse images to illustrate how the various products "look like". Below two CRDP browse image example figures are shown for two months (left: October 2003; right: October 2010). Shown are satellite-derived distributions of atmospheric methane (large maps on the left). The data are displayed at a resolution of 10°x10° (which is much coarser than the individual satellite observations which are ~50 km for SCIAMACHY (left) and ~10 km for GOSAT (right)). The three smaller maps shown for each month provide information on the number of individual observations per grid cell, the (mean) reported uncertainty of the retrieved methane and its standard deviation:

Methane October 2003	Methane October 2010