



greenhouse
gases
cci

GHG-CCI+ Project



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Universität Bremen

Project lead, OCO-2 XCO₂,
Sentinel-5 Precursor XCH₄



TanSat XCO₂



GOSAT-2 XCO₂ & XCH₄



Validation



LSCE

CRG lead,
user assessments XCO₂



DLR

System
engineering

Max-Planck-Institut
für Biogeochemie

User assessments XCH₄

Overview

Focus of GHG-CCI+ Phase 1

(March 2019 – February 2022):

- R&D to develop and/or improve satellite GHG ECV retrieval algorithms and to generate new ECV data products useful for C3S and other climate and carbon services and applications.

GHG-CCI+ data products:

- Two „types“ of satellite-derived data products:

- XCO₂: Column-averaged dry-air mole fraction of atmospheric carbon dioxide (CO₂)
- XCH₄: Column-averaged dry-air mole fractions of atmospheric methane (CH₄)
- Each product has a Product ID:

PAR_SAT_ALGO

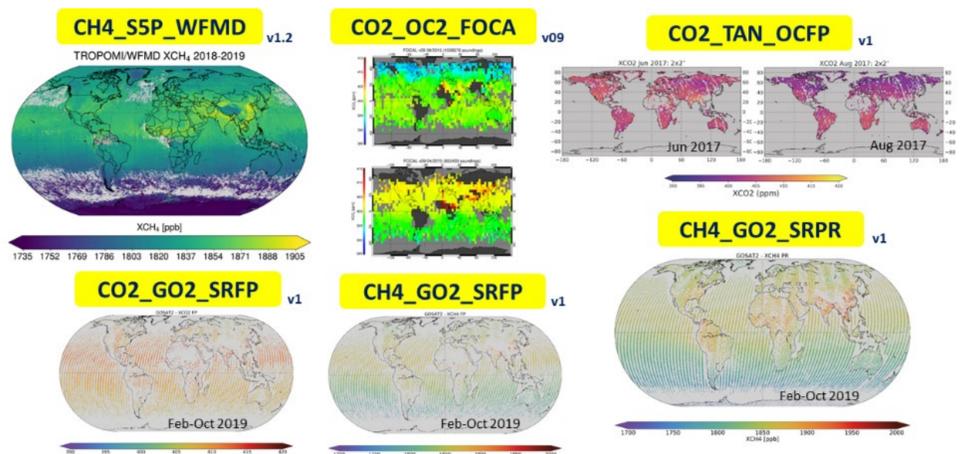
CO₂
CH₄

OC2: Orbiting Carbon Observatory 2 (NASA)
S5P: Sentinel-5-Precursor (ESA)
TAN: TanSat (China)
GO2: GOSAT-2 (JAXA)

FOCA: FOCA (IUP-UB)
WFMD: WFM-DOAS (IUP-UB)
OCFP: Univ.Leicester Full Physics
SRFP: SRON Full Physics
SRPR: SRON Proxy

CRDP	Date completion (#)	Product ID (version)	Temporal & spatial coverage
CRDP#5	28-Feb-2020 (end of year 1)	CO ₂ _OC2_FOCA (v08) CH ₄ _S5P_WFMD (v1.2) CO ₂ _TAN_OCFP (v1)	Available (*) 2015 - 2017, global 11.2017 - 12.2018, global 3.2017 - 5.2018, at 20 TCCON sites
CRDP#6	28-Feb-2021 (end of year 2)	CO ₂ _OC2_FOCA (v09) CH ₄ _S5P_WFMD (v1.2) CO ₂ _TAN_OCFP (v1) CO ₂ _GO2_SRFP, CH ₄ _GO2_SRFP, CH ₄ _GO2_SRPR (v01.0.0)	Available (*) 1.2015 - 5.2020, global 11.2017 - 4.2020, global June & August 2017, global land 2.2019 - 10.2019, global
CRDP#7	28-Feb-2022 (end of year 3)	CO ₂ _OC2_FOCA (v10) CH ₄ _S5P_WFMD (v1.5) CO ₂ _TAN_OCFP (v1) CO ₂ _GO2_SRFP, CH ₄ _GO2_SRFP, CH ₄ _GO2_SRPR (v01.0.0)	In preparation 2015 - 2020, global 11.2017 - 12.2020, global 3.2017 - 5.2018 (entire period), global land 2.2019 - 10.2020, global

(*) Data available via CEDA archive (<https://catalogue.ceda.ac.uk/>) thanks to cooperation with CCI Open Data Portal Team (<https://climate.esa.int/en/odp/#/project/ghgs>); the date given corresponds to the completion of the data products including documentation (availability via CEDA archive typically somewhat later); additional information see also <https://climate.esa.int/en/projects/ghgs/Data/>



GHG-CCI+ and C3S

... are complementary projects:

- GHG-CCI+ focusses on retrieval algorithm R&D and C3S on operational ECV product production
- Past GHG-CCI project (2010-2018) ECV products are now generated by C3S; mature GHG-CCI+ products are used as input for C3S products

ECV Greenhouse Gases (CO₂, CH₄):

GHG-CCI (2010 - 2018)

Pre-cursor project: GHG-CCI

- Algorithms & corresponding satellite ECV products:
 - main products: XCO₂ and XCH₄ from SCIAMACHY & GOSAT („XGHG“)
 - additional products: mid tropospheric columns: AIRS & ACE-FTS CO₂, IASI CO₂ & CH₄; stratos. profiles: MIPAS CH₄, SCIAMACHY solar occultation CO₂ and CH₄

C3S

Operational
production

Operational ECV production:

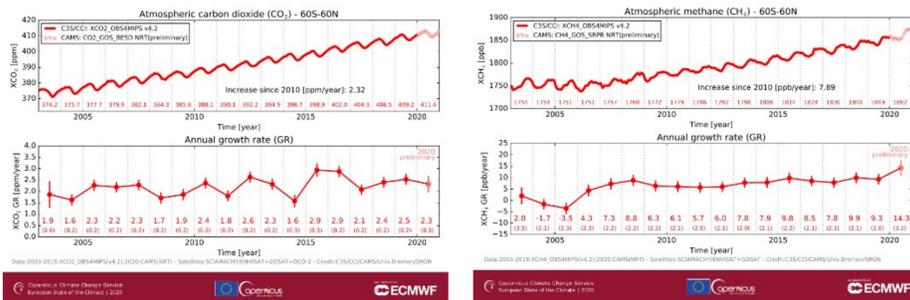
- GHG-CCI products now generated operationally via C3S (XGHG & IASI products) -> Data available via Copernicus Climate Data Store (CDS)

GHG-CCI+

R&D

New aspects covered by GHG-CCI+:

- R&D to generate new ECV products; potential for improved future C3S products thereby improving Copernicus services:
 - XCO₂ from OCO-2, TanSat, GOSAT-2
 - XCH₄ from TROPOMI/S5P, GOSAT-2
- Product generation, validation, user assessments
- Cooperation with other CCI+ ECV projects and ESA (incl. CSWG, DEWG, ...)



<https://climate.copernicus.eu/climate-indicators/greenhouse-gas-concentrations>

GHG-CCI+ documents:

- URD, ATBDs, PUGs, E3UB, PVIR, CAR: Available from <https://climate.esa.int/en/projects/ghgs/key-documents/>

Selected publications:

- All publications please see: <https://climate.esa.int/en/projects/ghgs/publications/>
- Buchwitz et al., Global satellite observations of column-averaged carbon dioxide and methane: The GHG-CCI XCO₂ and XCH₄ CRDP3 data set, RSE, 2017.
- Buchwitz et al., Computation and analysis of atmospheric carbon dioxide annual mean growth rates from satellite observations during 2003-2016, ACP, 2018.
- Parker et al., Evaluating year-to-year anomalies in tropical wetland methane emissions using satellite CH₄ observations, RSE, 2018.
- Reuter et al., A Fast Atmospheric Trace Gas Retrieval for Hyperspectral Instruments Approximating Multiple Scattering - Part 2: Application to XCO₂ Retrievals from OCO-2, RS, 2017.
- Reuter et al., Towards monitoring localized CO₂ emissions from space: co-located regional CO₂ and NO₂ enhancements observed by the OCO-2 and S5P satellites, ACP, 2019.
- Reuter et al., Ensemble-based satellite-derived carbon dioxide and methane column-averaged dry-air mole fraction data sets (2003-2018) for carbon and climate applications, AMT, 2020.
- Schneising et al., A scientific algorithm to simultaneously retrieve carbon monoxide and methane from TROPOMI onboard Sentinel-5 Precursor, ACP, 2019.
- Schneising et al., Remote sensing of methane leakage from natural gas and petroleum systems revisited, ACP, 2020.
- Yang et al., Toward High Precision XCO₂ Retrievals from TanSat Observations: Retrieval Improvement and Validation against TCCON Measurements, JGR, 2020.



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<https://climate.esa.int/en/projects/ghgs/>

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European Space Agency