CoCO2

Prototype system for a Copernicus CO_2 service

Final Dissemination and Exploitation Report

Tanya Warnaars

coco2-project.eu

Co-ordinated by ECMWF

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D9.8 Final Dissemination and Exploitation Report

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CoCO2: Prototype system for a Copernicus CO_2 service

Coordination and Support Action (CSA)
H2020-IBA-SPACE-CHE2-2019 Copernicus evolution – Research activities in support of a European operational monitoring support capacity for fossil CO2 emissions

Project Coordinator: Dr Richard Engelen (ECMWF)
Project Start Date: 01/01/2021
Project Duration: 36 months

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Table of Contents

1 Executive Summary

To ensure that the CoCO2 project remains visible and results are taken up by the wider community, dissemination and exploitation activities play a major role.

Deliverable 9.8 provides an update of the activities performed by the project partners within the full 36 months of the project, and reviews both dissemination and exploitation plans.

In the past 36 months, the total number of journal papers published has reached 47. In the past 12 months alone, CoCO2 researchers presented their work 22 times in conferences and 4 times in workshops; and hosted one final event to engage with other H2020 projects. One stakeholder engagement event was organised by the project.

Exploitation activities have focused on improving the various scientific elements produced within the CoCO2 project, with the ultimate aim being to establish an anthropogenic CO2 monitoring capacity within the Copernicus framework.

2 Introduction

2.1 Background

To support EU countries in assessing their progress for reaching their targets agreed in the Paris Agreement, the European Commission has clearly stated that a way to monitor anthropogenic CO2 emissions is needed. Such a capacity would deliver consistent and reliable information to support policy- and decision-making processes.

To maintain Europe’s independence in this domain, it is imperative that the EU establishes an observation-based operational anthropogenic CO2 emissions Monitoring and Verification Support (MVS) capacity as part of its Copernicus programme.

The CoCO2 Coordination and Support Action is intended as a continuation of the CO2 Human Emissions (CHE) project, led by ECMWF. In the Work Programme, ECMWF is identified as the predefined beneficiary tasked to further develop the prototype system for the foreseen MVS capacity together with partners principally based on the CHE consortium. In addition, CoCO2 will continue some of the work initiated in the VERIFY project as well.

The main objective of CoCO2 is to perform R&D activities identified as a need in the CHE project and strongly recommended by the European Commission's CO2 monitoring Task Force. The activities shall sustain the development of a European capacity for monitoring anthropogenic CO2 emissions. The activities will address all components of the system, such as atmospheric transport models, re-analysis, data assimilation techniques, bottom-up estimation, in-situ networks and ancillary measurements needed to address the attribution of CO2 emissions. The aim is to have prototype systems at the required spatial scales ready by the end of the project as input for the foreseen Copernicus CO2 service element.

2.2 Scope of this deliverable

2.2.1 Objectives of this deliverables

The objective of D9.8 is to report on the dissemination activities of the past 12 months and provide an update, where appropriate, to the dissemination and exploitation plans for the full duration of the project.

2.2.2 Work performed in this deliverable

Following the same process as the initial deliverable D9.3, plus the report at month 12 (D9.6) and M24 (D9.7) feedback from each partner was collected in the form of questionnaires, identifying the relevant aspects pertaining to both dissemination and exploitation.

2.2.3 Deviations and counter measures

None encountered.

3 Dissemination Activities

3.1 Report on Dissemination Activities

CoCO2 has been active on various dissemination streams, including publications, workshops, conferences, etc.

The list of publications have strongly increased over the past twelve months and a full list of all 47 publications is attached in Annex 1 to this report.

In terms of website statistics, since January 2023 the website has had 31,000 visits as shown in figure 3.1.1. It is interesting to note that visitors are mostly finding the website by an organic search rather than direct or referral, indicating a good level of findability of the website and updating of its content helps with this visibility.

Figure 1 12 month report on users of the CoCO2 website (status on 10/12/2023)

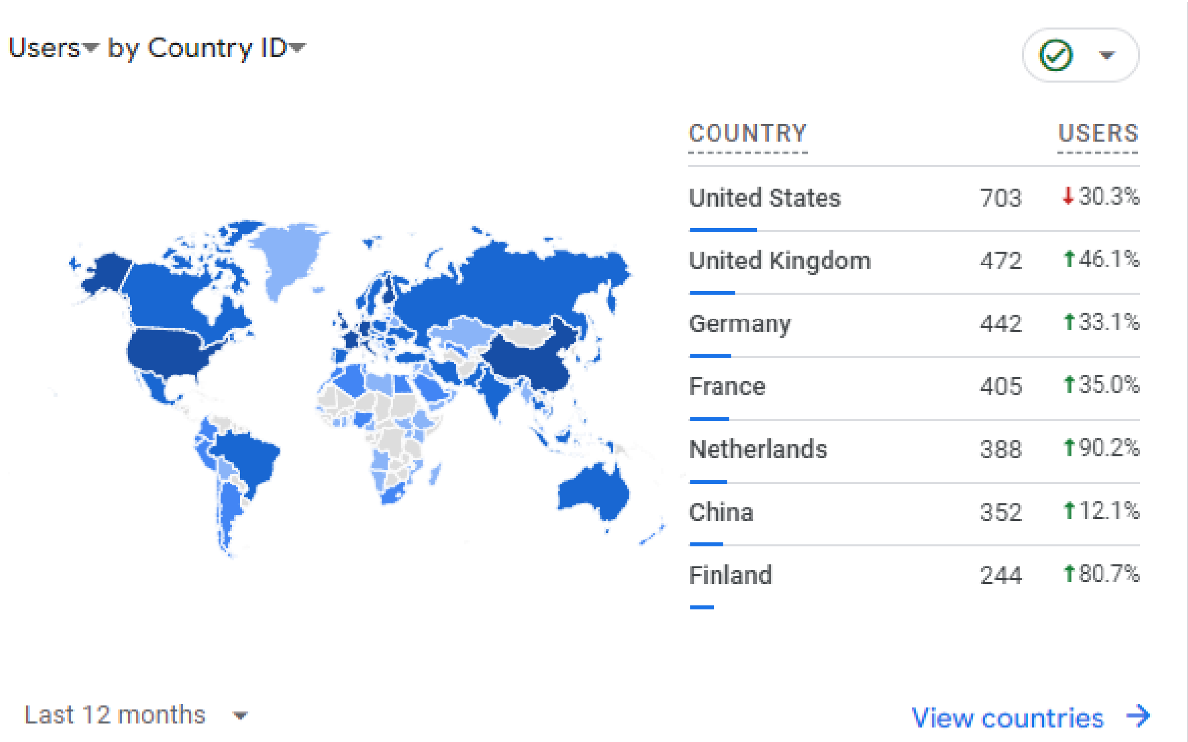

Figure 2: distribution of users by geographic location (status on 10/12/2023)

	Page title and screen class	Views	Users	Views per user	Average engagement time
		13,862 100% of total	4,812 100% of total	2.88 Avg 0%	46s Avg 0%
1	| CoCO2: Prototype system for a Copernicus CO2 service	3,703	2,009	1.84	23s
2	Resources | CoCO2: Prototype system for a Copernicus CO2 service	882	370	2.38	46s
3	CoCO2 Final Meeting and CORSO GA Meeting | CoCO2: Prototype system for a Copernicus CO2 service	771	360	2.14	51s
4	ALL EVENTS | CoCO2: Prototype system for a Copernicus CO2 service	678	363	1.87	15s
5	DATA PORTAL | CoCO2: Prototype system for a Copernicus CO2 service	661	430	1.54	43s
6	CoCO2 Presentation Day | CoCO2: Prototype system for a Copernicus CO2 service	483	251	1.92	37s
7	ABOUT | CoCO2: Prototype system for a Copernicus CO2 service	451	293	1.54	22s
8	CONCEPT | CoCO2: Prototype system for a Copernicus CO2 service	425	287	1.48	36s
9	OBJECTIVES | CoCO2: Prototype system for a Copernicus CO2 service	368	256	1.44	28s
10	Page not found | CoCO2: Prototype system for a Copernicus CO2 service	316	292	1.08	9s

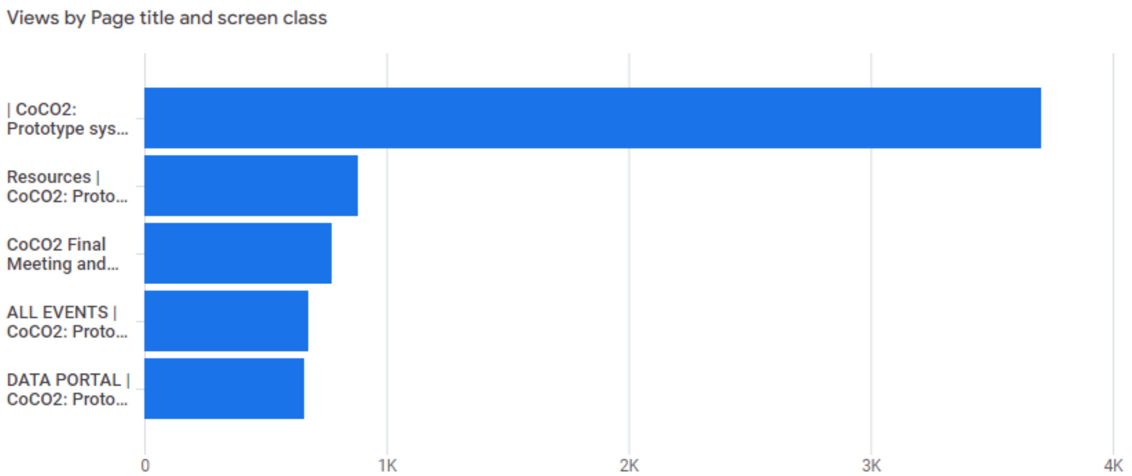

Figure 3: Pages visited by users and time spent per page (status on 10/12/2023)

Further dissemination activities since the start of the project are presented in Table 1.

Table 1: Dissemination Activities

Type of dissemination and communication activities	Description
Conference Participation *Participation to a conference*	**Conference Participation during 3rd year (Jan-Dec2023)** 1. WMO GHG Symposium: 30 Jan - 2 Feb. (Genève, Switzerland) participation of over 800 Scientists • Consistent Monitoring of Greenhouse Gas Emissions: Current Status of the Copernicus CO2MVS Prototype Systems (poster) Nicolas Bousserez et al. 2. WMO IG3IS Stakeholder meeting: 2 Feb, (Genève, Switzerland): presentation by A.M.R. Petrescu et al., "User engagement in the CoCo2 project" 3. EGU:the following poster and oral presentations are (partly) based on CoCO2 research and will show the breadth of the work carried out so far. Mon, 24 Apr, 16:15–18:00 | Hall X5 | X5.21 Evaluation of Daily Temperature Extremes in the ECMWF ERA5 Reanalysis and Operational Weather Forecasts Francisco Lopes, Emanuel Dutra, and Souhail Boussetta Tue, 25 Apr, 16:15–18:00 | Hall A | A.261 Impact of LAI assimilation by LDAS-Monde on modelled photosynthesis and respiration in the ISBA land surface model Bertrand Bonan, Bertrand Decharme, Christine Delire, and Jean-Christophe Calvet Wed, 26 Apr, 10:45–11:05 | Room 0.11/12 CO_2 and CH_4 observation-based budgets in support to future Copernicus CO_2 emissions Monitoring and Verification Support (CO2MVS) capacity user communities Ana Maria Roxana Petrescu, Glen P. Peters, Robbie M. Andrew, Matthew J. McGrath, Philippe Peylin, Frederic Chevallier, and Richard Engelen and the VERIFY and CoCO2 project participants Wed, 26 Apr, 10:45–10:47 | PICO spot 5 | PICO5.1 Global and regional anthropogenic emissions inventories for air quality atlases Antonin Soulie, Thierno doumbia, Sekou Keita, Claire Granier, Hugo Denier Vand der Gon, Jeroen Kuenen, Santiago Arellano, Sabine Darras, Michael Gauss, Marc Guevara, Jukka-Pekka Jalkanen, Cathy Liousse, David Simpson, and Katerina Sindelarova Wed, 26 Apr, 17:40–17:50 | Room -2.31 Recent offline land data assimilation results and future steps

	towards coupled DA at Meteo-France Jean-Christophe Calvet, Bertrand Bonan, and Yiwen Xu Thu, 27 Apr, 09:40–09:50 | Room F2 Bayesian estimation of CO_2 flux divergence maps using joint (CO2M-like) NO_2 and CO_2 images Erik Koene, Gerrit Kuhlmann, Lukas Emmenegger, and Dominik Brunner Thu, 27 Apr, 15:35–15:45 | Room 2.17 Evaluation of global water, energy, and carbon fluxes in ECLand and ISBA models Emanuel Dutra, Francisco Lopes, Jean-Christophe Calvet, Bertrand Bonan, Anna Agusti-Panareda, Souhail Boussetta, and Martin Jung Thu, 27 Apr, 16:15–18:00 | Hall X5 | X5.103 Atmospheric concentrations of carbon dioxide and its isotopic composition in Krakow (Southern Poland) based on one-year CoCO2 measurement campaign Alicja Skiba, Mirosław Zimnoch, Zbigniew Gorczyca, Mikita Maslouski, and Michał Marzec Thu, 27 Apr, 16:15–18:00 | Hall X5 | X5.110 High-resolution simulation of CO_2 dispersion in urban atmosphere of Krakow, Southern Poland Miroslaw Zimnoch, Michał Gałkowski, Piotr Sekula, and Lukasz Chmura Fri, 28 Apr, 09:25–09:35 | Room M2 CO_2 net ecosystem flux in Krakow, Poland Alina Jasek-Kaminska, Miroslaw Zimnoch, Lukasz Chmura, and Jakub Bartyzel 3. CNRM – Meteo-France: GEWEX LIAISE Conference (Lleida, Spain) : 27-29 March 2023: title: *Representing irrigation in the ISBA model* 4. IWGGMS-19. 19th international workshop on greenhouse gas measurements from space. July 4 to 6, 2023 (Paris, France): Thu, 6 July, 11:20-11:35 Benchmarking data-driven methods for the detection of plumes in XCO2 or NO2 satellite images and the quantification of local sources Diego Santaren, Janne Hakkarainen, Gerrit Kuhlmann, Erik Koene, Frédéric Chevallier, Maarten C. Krol, Laïa Amoros, Iolanda Ialongo, Hannakaisa Lindqvist, Janne Nurmela, Johanna Tamminen, Dominik Brunner and Grégoire Broquet "Towards the inversion of plumes from power plants and industrial sites in satellite CO2 images using deep neural networks" J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlmann 5. 20th GEIA Conference, Brussels, 21-23 June 2023 ▪ Urraca R, Janssens-Maenhout G, et al. CoCO2-MOAIC 1.0: a global mosaic of regional gridded CO2 emission inventories ▪ Guevara, M., Jorba, O., Delaert, S., Denier van der Gon, H., et al.: A global catalogue of CO2 emissions and co-emitted species from power plants 6. 5th International Earth Surface Working Group (IESWG), Finnish Meteorological Institute, Helsinki, 26-28 Sep 2023

	• de Rosnay P., D. Fairbairn, S. Garrigues, C. Herbert, Ochi, E. Pinnington, K. Salonen, D. Schepers, P. Weston, G. Arduini, G. Balsamo, R. Engelen, and H. Hersbach: remote oral: Coupled land-atmosphere data assimilation at ECMWF • Weston P., A. Agusti-Panareda, P. de Rosnay, S. Boussetta; oral: "Towards dynamically updated Vegetation in NWP" 7. First International Symposium on Earth System Modeling and Prediction, CEMC/CMA,Nanjing,China, 11-12 September 2023 • de Rosnay P., P. Browne, E. de Boisséson, D. Fairbairn, S. Garrigues, C. Herbert, K. Ochi, E. Pinnington, Salonen, D. Schepers, P. Weston, H. Zuo, invited oral: "Coupled data assimilation activities at ECMWF" 8. International Symposium on Data Assimilation. Bologna, Italy. October 16-20, 2023. • "Towards the inversion of plumes from power plants and industrial sites in satellite CO2 images using deep neural networks" J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlmann • Implementation of a hybrid ensemble-variational inversion system in the Integrated Forecast System (IFS) (oral) Nicolas Bousserez 9. EC-ESA Joint Earth System Science Initiative. Frascati, Italy. November 22-24, 2023 ▪ Papale D. et al. Carbon Science session - ICOS and beyond 10. American Geophysical Union. San Francisco, USA. December 11-15, 2023 • Papale D. et al. Eddy Covariance Energy Balance Non-Closure: Should We Start from the Quality of Measurements? 11. JOINT URBAN REMOTE SENSING EVENT (JURSE), Heraklion Crete, Greece, 17 - 19 May 2023 • FORTH: Oral Presentation 18 May 2023, Heraklion, Greece, Title: Dynamic changes in urban form and function affect Carbon Dioxide Fluxes in a Mediterranean city https://www.researchgate.net/publication/371875833_Dynamic_changes_in_urban_form_and_function_affect_Carbon_Dioxide_Fluxes_in_a_Mediterranean_city 12. 11th International Conference (ICUC11), on Urban Climate, 28 Aug - 1 Sept 2023 | UNSW Sydney • FORTH: Poster Presentation 31 August 2023 at ICUC11 Title: Comparison of urban eddy covariance CO2 and heat fluxes measured at two flux towers in a Mediterranean city. https://www.researchgate.net/publication/374088081_Comparison_of_urban_eddy_covariance_CO2_and_heat_fluxes_measured_at_two_flux_towers_in_a_Mediterranean_city
	Conference Participation during 2nd year (Jan-Dec2022) 1. ICOS /ECMWF: COP27 EO for Climate Action: Mitigation. S. Parampil et al: In situ observations support the Methane Pledge The Nord Stream leaks case study 2. FORTH: ICOS Science Conference 2022, Utrecht, the Netherlands, 14 September 2022, Konstantinos Politakos et

	al., Five years of urban eddy covariance CO2 emissions correlated with dynamic shifts in urban structure and traffic regulations in the city center of Heraklion, Greece 3. UEdin: American Geophysical Union (AGU) Fall Conference 2022, Chicago, IL, USA, 12-16 December 2022, Scarpelli et al., "Estimating combustion and non-combustion fluxes of carbon dioxide using satellite observations over Europe" 4. FMI: LPS 2022, Iolanda Ialongo/Janne Hakkarainen, Analyzing local carbon dioxide and nitrogen oxide emissions from space using statistical methods: An application to the synthetic SMARTCARB dataset 5. EMPA: Annual meeting of the Swiss Physical Society, Bern, 27-30 Jun 2022, D. Brunner, Monitoring and tracking carbon dioxide emissions from satellites. 6. EMPA: ESA Living Planet Symposium, Bonn, Germany, 23-27 May 2022, G. Kuhlmann et al., A Python software library for "Data-Driven Emission Quantification" (ddeq) of cities and point sources in satellite images 7. EMPA: ESA Living Planet Symposium, Bonn, Germany, 23-27 May 2022, E. Koene, Reducing uncertainties in annual CO2 point source emission estimates from CO2M CO2 and NO2 images using computer vision techniques and multi-plume models 8. EMPA: COSMO/ICON User Workshop, [virtual], 13 Jan 2022, E. Koene, A comparison of power plant plume simulations between COSMO-GHG and Large Eddy Simulations 9. ECMWF/All partners: ICOS Science Conference 2022, Utrecht, the Netherlands, 13 September 2022, Anna Agusti-Panareda et al.: The CoCO2 global nature run as an evaluation tool of the integrated earth system model to support the monitoring of greenhouse gas emissions 10. ECMWF/All partners: ICOS Science Conference 2022, Utrecht, the Netherlands, 13 September 2022, Nicolas Bousserez et al.: Towards a Copernicus Monitoring Service for Anthropogenic Greenhouse Gas Emissions: Methodology and First Results from the IFS Global Inversion System 11. ECMWF/IPMA/LSCE: ESA Living Planet Symposium 2022, Bonn, 23-27 May 2022, Anna Agusti-Panareda et al., "Assessing the changes in GPP from the new ecland photosynthesis model associated with changes in LAI, land cover and climate using satellite-based Earth Observation datasets ". 12. ECMWF/IPMA/MPI-BGC/CMCC/LSCE, ESA 4th Carbon from space workshop, ESA-ESRIN Frascati, Italy, Anna Agusti-Panareda et al. "Estimation of terrestrial biogenic CO2 fluxes from IFS model inversions: first results from the CoCO2 project and future prospects for the CAMS global CO2 emission monitoring service". 13. ECMWF/All partners: UNFCCC Earth Information Day at COP27, Sharm El Sheikh, 9 November 2022: https://unfccc.int/event/earth-information-day-2022 (https://unfccc.int/sites/default/files/resource/Poster_COP27_CoCO2-CAMS-ECMWF-Engelen.pdf) 14. LSCE: ICOS Science Conference 2022, Utrecht, the Netherlands, 15 September 2022, E. Potier et al., "Combination of XCO2 imagery and in-situ CO2 and 14CO2 measurements to monitor fossil fuel CO2 emissions at regional to local scales"

	15. CICERO: CO2M Roadmap for Norway, Oslo, 24 October 2022, Glen Peters "CO2 Monitoring and Verification Support" 16. ECMWF/All partners: Final General Assembly of VERIFY, Paris, 9-11 May, 2022: Networking meeting, Richard Engelen "The VERIFY legacy in CoCO2 and CAMS", CoCO2__CAMS_CO2.pdf (ipsl.fr) 17. CEREA / LSCE: Sentinel-5P Mission, October, Taormina: 5 years Anniversary, Dumont Le Brazidec, J., et al. *CO2 plume detection using deep neural networks and simulated XCO2 fields* 18. CEREA / LSCE: Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes , September 27-30, Portugal, Dumont Le Brazidec, J., et al. *CO2 plume detection using deep neural networks and simulated XCO2 fields* 19. CEREA / LSCE: (online) ICOS Science Conference September 13-15, Utrecht, Dumont Le Brazidec, J., et al. *CO2 plume detection using deep neural networks and simulated XCO2 fields* 20. CEREA / LSCE: (online) IWGGMS-18, July 12-14, Dumont Le Brazidec, J., et al. *CO2 plume detection using deep neural networks and simulated XCO2 fields* 21. iLab/ULUND/TNO/VUA: ICOS Science Conference September 13-15, Utrecht, Kaminski et al., *Combined use of atmospheric and other data streams to constrain natural fluxes and anthropogenic fossil fuel emissions through CarbonCycle Fossil Fuel Data Assimilation.* 22. iLab/ULUND/VUA/EMPA/TNO: ESA Living Planet Symposium 2022, Bonn, 23-27 May 2022, Kaminski et al., *Assessing the constraint of the CO2 monitoring mission on fossil fuel emissions from power plants and a city in a regional carbon cycle fossil fuel data assimilation system* 23. iLab/ULUND/ECMWF: ESA Living Planet Symposium 2022, Bonn, 23-27 May 2022, Scholze et al.,Assessments of in-situ and remotely-sensed CO2 observations in a Carbon Cycle Fossil Fuel Data Assimilation System to estimate fossil fuel emissions 24. iLab/ULUND/ECMWF: Swedish Climate Symposium, Norrköping, 17 May 2022, Scholze et al.,Assessments of CO2 observations in a Carbon Cycle Fossil Fuel Data Assimilation System to estimate fossil fuel emissions
	Conference Participation during 1st year (Jan - Dec 2021) 1. FORTH: EGU General Assembly 2021, virtual event, 27 April 2021, Konstantinos Politakos, Carbon dioxide emissions variability monitoring, based on four years of Eddy Covariance measurements in a typical Mediterranean city , https://meetingorganizer.copernicus.org/EGU21/EGU21-7723.html 2. iLab/ULUND: EGU General Assembly 2021, virtual event, 27 April 2021, T Kaminski, M Scholze at al., Assessing the constraint of the CO2 monitoring mission on fossil fuel emissions from power plants and a city in a regional carbon cycle fossil fuel data assimilation system, https://meetingorganizer.copernicus.org/EGU21/EGU21-16139.html 3. iLab/ULUND: EGU General Assembly 2021, virtual event, 27 April 2021, H Chen, M Scholze, T Kaminski at al., Assessment of radiocarbon observations for constraining fossil fuel emissions in a comprehensive Carbon Cycle Fossil Fuel Data Assimilation

	System, https://meetingorganizer.copernicus.org/EGU21/EGU21-13258.html 4. iLab/ ULUND: AOGS2021 virtual, 1-6 August 2021, H Chen, M Scholze, T Kaminski at al., Assessing the Uncertainty in Top-down Greenhouse Gas Emissions Estimates, https://meetmatt-svr.net/Timetable/SlotScheduleAll?cfId=3&dayId=15&slotId=17&sId=1#collapse_13764 5. VUA: IWGGMS-17, online, 14-17 June 2021, “Constraining global methane emissions using TROPOMI data” 6. VUA: Royal Society, Rising Methane: Is warming feeding warming, online, 4-6 December 2021, “The satellite view on global methane” 7. VUA: ESA ATMOS 2021, online, 22-26 November 2021, “Recent change in global methane constrained by TROPOMI and IASI” 8. MF: IGARSS, e-conference, 12 July 2021, Calvet, J.-C., B. Bonan, A. Mucia, D. Shamambo, Y. Zheng, and C. Albergel. Integrating satellite-derived vegetation variables into the ISBA model: A sequential data assimilation approach. https://igarss2021.com/IG21_ProgramGuide.pdf 9. JRC: COP26 Conference, Glasgow, 1/11/21, 14:30-15:30, M. Dowell, “EO for Climate Action: Mitigation, REDD+, and the Global Stocktake”, European Union side events at COP26 (cop26eusideevents.eu) 10. ECMWF: COP26, EO for Climate Action: Mitigation, REDD+, and the Global Stocktake, virtual, 1 November 2021 11. EMPA: ATMOS2021, [virtual], 24.11.2021, Erik Koene, Enhancing and Detecting CO_2 Plumes in Satellite Images Using Computer Vision Denoising, Inpainting, and Ridge Tracing, [no link available] 12. EMPA: Swiss National GAW/GCOS Symposium, Bern, 13-14 Sep 2021, Dominik Brunner, Estimating emissions from ground-based and space-borne trace gas observations, https://www.meteoschweiz.admin.ch/home/forschung-und-zusammenarbeit/internationale-zusammenarbeit/gcos/swiss-national-gaw-gcos-symposium-september-13-to-14th-2021.html 13. EMPA: IWGGMS-17, [virtual], 14-17 Jun 2021, Dominik Brunner, Uncertainties in the simulation of XCO2plumes from power plant emissions: A comparison between 6 high-resolution atmospheric transport models. 14. EMPA: EGU General Assembly 2021, [virtual], 19-30 Apr 2021, Gerrit Kuhlmann, Quantifying CO2 emissions of power plants with the CO2M mission.
Workshop Participation	**Workshop Participation during 3rd year (Jan-Dec2023)** 1. Workshop "Mathematical Approaches of Atmospheric Constituents Data Assimilation and Inverse Modeling" . Banff, Canada. March 19-24, 2023. *Towards CO2 plume detection and inversion from satellites using deep neural networks.* J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlmann

	2. Workshop "SAMA day" ENS, Paris, France. May 26, 2023. "Towards the inversion of plumes from power plants and industrial sites in satellite CO2 images using deep neural networks" J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlmann 3. Workshop "Journées Géostatistiques" Fontainebleau, Paris, France. September 6-8, 2023. "Towards the inversion of plumes from power plants and industrial sites in satellite CO2 images using deep neural networks" J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlmann
	Workshop Participation during 2nd year (Jan-Dec2022**)** 1. ECMWF: CoCO2 presentation during meeting between ECMWF, DWD, and UBA, virtual, 4 February 2022 2. ECMWF: CEOS-AC-VC meeting, virtual, 13 March 2022 3. ECMWF: VERIFY Inventory Agency Networking meeting, Paris, 10 May 2022 4. ECMWF/ULUND: CO2 Task Force, virtual, 13 June 2022 5. ECMWF/ULUND: Lunchtime conference: Observation-based GHG monitoring and verification - key outcomes of the VERIFY project, virtual, 8 July 2022 6. ECMWF: Copernicus User Forum (as part of a CAMS progress presentation), Brussels, 28 September 2022 7. ECMWF/ULUND: IPCC Expert Meeting on Use of Atmospheric Observation Data in Emission Inventories, Geneva, 5 - 7 September 2022 8. ECMWF: CO2M MAG, hybrid, 6 - 7 October 2022 9. iLab/ULUND: 4th ESA Carbon from Space Symposium, 25-28 October 2022 10. CMCC: FACCE-JPI – JPI Climate workshop on the use of emerging science to improve agricultural GHG inventories for the UNFCCC reporting - 19 and 20 October 2022, Brussels
	Workshop Participation during 1st year (Jan - Dec 2021) 1. ECMWF: CO2 Task Force meeting, virtual, 29 January 2021 2. ECMWF: European Parliament Panel for the Future of Science & Technology, Use of AI, big data and space technologies in terrestrial management, virtual, 23 February 2021 3. ECMWF: CAMS user workshop Norway, virtual, 24-25 March 2021 4. ECMWF: CO2M Mission Advisory Group, virtual, 21-22 April 2021 5. ECMWF: ESA EO4UNFCCC workshop, virtual, 15 April 2021 6. ECMWF: ACTRIS Innovation in Atmospheric Sciences Virtual Workshop, virtual, 18 May 2021 7. ECMWF: CAMS General Assembly, virtual, 8-10 June 2021 8. ECMWF: CEOS-AC-VC meeting, virtual, 7-11 June 2021 9. ECMWF: IWGGMS-17, virtual, 14-17 June 2021 10. ECMWF: NASA Carbon Research Program Policy Speaker Series, virtual, 7 June 2021 11. ECMWF: CAMS user workshop France, virtual, 30 June 2021 12. ECMWF: CO2 Task Force meeting, virtual, 31 August 2021

	13. ECMWF: CO2M Mission Advisory Group, virtual, 30 September 2021 14. ECMWF: Copernicus Relay seminar on remote sensing-based GHG assessment in AFOLU, Latvia, virtual, 28 October 15. ECMWF: Earth information day, virtual poster session, 3 November 2021 16. ECMWF: JRC workshop about GHG & AFOLU on Systematic Observation, virtual, 15,18, 19 November 2021 17. ECMWF: CO2M Mission Advisory Group, virtual, 29 November 2021. 18. VUA: COCO2: Workshop int. CH4 intercomparison, online, 11-6-2021 19. VUA: COCO2: User consultation workshop – How can Copernicus CO2MVS capacity support cities?, online, 6-10-2021 20. JRC: VERIFY Mini WORKSHOP on GHG Monitoring and Verification: Exchange of practices between EU, USA, China and Indonesia (25 May 2021, virtual, organised by JRC) 21. JRC: Copernicus-VERIFY WORKSHOP on Advancing GHG emissions of Agriculture, Forestry and Other Land-Use sectors through Earth Observation (or Systematic Observation contributions and synergies for GHG & AFOLU) (15,18, 19 November 2021, virtual organised by JRC) 22. CEA: CoCO2 General Assembly, 16-18 Nov 2021, F Chevallier, G Broquet, WP4 and 6 highlights, https://www.coco2-project.eu/events/1st-general-assembly
Web-site	1. www.coco2-project.eu
Press Release/ Article	**Released during 3rd year (Jan-Dec2023)** 1. National Geogrphic parent edition (USA)following the Italian version also released article titled: Why carbon dioxide is both friend and foe (nationalgeographic.com) 2. ICOS ERIC Bulletin 6 July 2023: title: Carbon emissions and sinks vary between the years (In: FLUXES - European GHG Bulletin) https://www.icos-cp.eu/fluxes/2/carbon-emissions-and-sinks-vary-between-years & link to full Belletin: https://www.icos-cp.eu/fluxes/2
	Released during 2nd year (Jan-Dec2022) 1. ECMWF: National Geographic Italy: ANIDRIDE CARBONICA L'ALTRA FACCIA. publication date 12 Nov. 2022 2. EMPA: Article in newsletter of the Swiss Physical Society, Brunner, D., Meijer, Y. and Crisp, D., Monitoring carbon dioxide emissions from space, SPS communications, no. 68, Oct 2022, p. 19-21. 3. ULUND: Radio Interview, Swedish Radio (SR): Nya satellite avslöjar dolda utsläpp av växthusgaser, 5 Oct. 2022, https://sverigesradio.se/avsnitt/nya-satelliter-avslojar-dolda-utslapp-av-vaxthusgaser
	Released during 1st year (Jan-Dec2021)

	1. EMPA: Newspaper article, Tagesanzeiger, 02.11.2021, Klimakonferenz in Glasgow – Klimaüberwachung aus dem All, https://www.tagesanzeiger.ch/wie-aus-dem-all-die-klimaplaene-kontrolliert-werden-326869502002 2. AGH: Short note at the Krakow tethered balloon touristic viewing platform informing about start of vertical profiles measurement campaign (in polish) – publication date 11.03.2021 http://balonwidokowy.pl/2021/03/11/rozpoczynamy-kampanie-pomiarow-lotniczych-w-ramach-europejskiego-projektu-copernicus/ 3. AGH: Information in English regarding measurement campaigns conducted on tethered balloon touristic viewing platform within CoCO2 project – publication date 2.06.2021 http://balonwidokowy.pl/en/2021/06/02/another-co2-measuring-campaign-during-the-night/ 4. AGH: Next short note about CoCO2 balloon campaigns(in polish) – publication date 26.11.2021 http://balonwidokowy.pl/2021/11/26/listopadowa-dobowa-kampania-pomiarowa/ 5. AGH: Article in “Science in Poland” portal. Information about activities of AGH-UST scientists at touristic balloon including GHG measurements in the frame of CoCO2 project (in polish) – publication date 30.09.2021 https://scienceinpoland.pap.pl/aktualnosci/news%2C89471%2Cbadanie-smog-nad-krakowem-utrzymuje-sie-do-wysokosci-100-metrow.html 6. AGH: Article in “Krakow.pl” portal informing about the collaboration between AGH-UST scientists and Krakow tethered touristic balloon (including CoCO2 measurement campaigns) (in polish) - publication date 24.10.2021 https://www.krakow.pl/aktualnosci/253122,1926,komunikat,naukowcy_zbadali_jakosc_powietrza_na_balonie_widokowym.html?_ga=2.185220268.463519857.1632947100-145003845.1632947100 7. AGH: Article in internet portal for pilots (“dlapilota.pl”). Information about scientific activities at Krakow touristic balloon including CoCO2 vertical CO2 profile measurements (in polish) – publication date 29.09.2021 https://dlapilota.pl/wiadomosci/polska/z-balonu-widokowego-naukowcy-zbadali-jakosc-powietrza
Organisation of a workshop	**Workshop Organised during 3rd year (Jan-Dec2023)** 1. Second CoCO2-ICLEI user workshop on city-scale emission inventories "How can atmospheric observations support city-scale GHG inventories". Presentations by: Richard Engelen, Frédéric Chevallier, A.M. Roxana Petrescu, Glen Peters. Online, 26 May 2023 2. CoCO2 Stakeholder day, hybrid meeting 22 November 2023
	Workshop Organised during 2nd year (Jan-Dec2022) 1. CoCO2 Presentation Day, virtual, 5 December 2022, https://coco2-project.eu/events/coco2-presentation-day

	Workshop Organised during 1st year (Jan-Dec2021) 1. CoCO2 General Assembly, 16-18 November 2021, https://www.coco2-project.eu/events/1st-general-assembly 2. A virtual CoCO2 User consultation workshop: How can atmospheric observations support city-scale GHG inventories?, 6 October 2021, https://www.coco2-project.eu/events/how-can-atmospheric-observations-support-city-scale-ghg-inventories
Participation in activities organised jointly with other H2020 project(s)	**Activities during 3rd year (Jan-Dec2023)** 1. Final CoCO2 GA / CORSO (poster) "Towards the inversion of plumes from power plants and industrial sites in satellite CO2 images using deep neural networks" J. Dumont Le Brazidec, P. Vanderbecken, A. Farchi, M. Bocquet, G. Broquet , G. Kuhlman (oral) CoCO2 WP6 leaders presentation Nicolas Bousserez, Frédéric Chevallier (oral) CORSO WP2 leaders presentation Nicolas Bousserez, Gerrit Kuhlman
	Activities during 2nd year (Jan-Dec2022) 1. ECMWF/ULUND: Verify General Assembly, Paris, 9 - 11 May 2022
	Activities during year 1st year (Jan-Dec2021) 1. VUA: VERIFY General Assembly, 28-29/4 2021 2. ECMWF: VERIFY General Assembly, virtual, 28-29 April 2021

3.1 Update to Dissemination Plan

CoCO2 has, in deliverable D9.3, provided an initial plan for Dissemination and Communication Activities. Figure 4 presents the current status at the end of the project closure. Key international meetings mentioned int the plan, such as EGU, CAMS GA IWGGMS, and C3S GA all had representation by CoCO2.

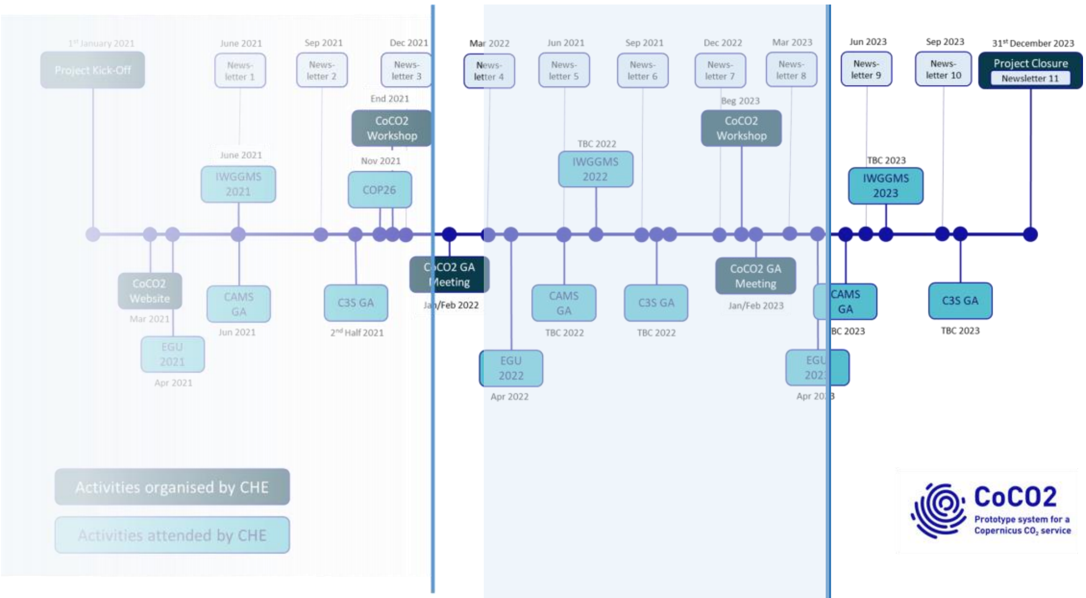

Figure 4: CoCO2 Dissemination Plan – all key events highlighted were achieved

All activities foreseen in the plan to be organised by CoCO2 were realised. The final meeting of the project was a joint event with other relevant H2020 & HEU project. In addition on 22 November there was an event involving members from national Inventory Agencies and the full agenda for this is available on the CoCO2 website: https://coco2-project.eu/events/coco2-final-meeting-and-corso-ga-meeting. The external advisors to CoCO2 were also present both in person and online, given the event was a hybrid meeting.

CoCO2 has had some high-profile achievements the past year, and had a good presence at key events and as well as hosting a final event that included a number of key representatives from the Inventory agencies. Our main dissemination pathway remains the CoCO2 website www.coco2-project.eu which has provided regular updates and news items. This is also the location where our final event was highlighted: CoCO2 Final Meeting and CORSO GA Meeting | CoCO2: Prototype system for a Copernicus CO2 service (coco2-project.eu)

The remainder of the CoCO2 Dissemination Plan remained relevant throughout 2023, with the exception of the newsletters which was not deemed relevant to update regularly as we instead chose to focus on an active presence at key meetings as well as maintaining the Website and Twitter pages. Though this latter communication channel experienced a reduction in activity due to changes in the format of how the Social Media platform X was revised. To date, at the end of the project, we have a high number of publications and deliverable reports that are all publicly available. We have also secured hosing of the website beyond the end date of the project to further support the use and uptake of the outcomes and products from CoCO2.

4 Exploitation

Deliverable D9.3 already outlined potential exploitation avenues, as presented here again in Table 2.

Table 2: CoCO2 Exploitation

Exploitable Products	• Operational production of assimilated ocean pCO2 products • Datasets and publications • Emission datasets • Incorporate the resulting CoCO2 emission datasets in the HERMESv3_GR emission inventory library (https://earth.bsc.es/gitlab/es/hermesv3_gr), so that they can be used by the community of modellers that use chemical transport models • GHG fact sheets per country per sector or city/emission plant level • Improved inversion system that will allow calculations for current and historical CO2 emissions, using top-down methods, on the local scale Krakow), national scale (Poland) and beyond, if possible applicable to other atmospheric constituents • University courses in top-down modelling of greenhouse gases • Material to demonstrate the CO2 MVS capabilities to support discussion with national authorities • CoCO2 nature runs • Foreground elements of the global, regional and local prototype systems and/or their documentation
Exploitation Activities during the Project	• Benchmark analysis, operationalization (2021, 2022) • Links with CAMS (if this can be considered as exploitation) • Integration of the resulting emission datasets into the HERMESv3_GR emission inventory library during the last year of the project • Workshops with stakeholders
Exploitation Activities after the end of the Project	• Operational production of assimilated air-sea pCO2 products • Services for agriculture (2024), Improved land surface conditions in atmospheric models, i.e. numerical weather prediction models, air quality models, and climate models (2025) • Exploitation activities post-CoCO2 will depend on the results of the research conducted in CoCO2 • Within Copernicus CO2MVS this process of consultation with stakeholders will continue and intensify • Further development of the inverse modelling system of CO2 on local and national scale, 2024-2027 • Preparing and performing new university course on data assimilation methods for students based on results obtained in the scope of CoCO2, 2024-2028 • Further development of emission estimation algorithms

	and inverse modeling techniques as well as uncertainty characterization. • Direct implementation of global CO2MVS component in CAMS
Consortium-wide/Joint Exploitation	• Vegetation description component of CAMS • Country-factsheets (D6.1 or further developments of these) • New methodology for GHG emission quantification using atmospheric data; Synthesis • Definition and demonstration of the CO2MVS prototype

The exploitation survey run as part of Deliverable D9.3 shows that the products and activities described above remained relevant throughout the project. The main outcome of the CoCO2 project being especially the foreseen (pre-)operational service in the Copernicus programme.

More generally, CoCO2 has always kept in mind how it could support the ramping-up of the new emission monitoring services in CAMS. Part of the current (and future) CAMS services are directly provided by ECMWF, which is the Entrusted Entity for CAMS, using its Integrated Forecasting System (IFS). The majority of the CAMS services are, however, provided by CAMS contractors in response to competitive Invitation To Tenders (ITTs) published by ECMWF. This funding model also applies to the implementation of the CO2MVS, which means results from CoCO2 cannot always be directly transferred to CAMS. CoCO2 developments directly related to the IFS are directly transferable, but all other developments were meant to significantly increase the expertise and technical infrastructure in Europe in support of future implementation. During the ramp-up phase of the CO2MVS from 2024 onwards, CAMS service procurement will directly benefit from these developments. The large number of peer-reviewed articles, in addition to the publicly available deliverable documents, is also in direct support of sharing the CoCO2 expertise and findings as widely as possible. In this context, CoCO2 made significant progress with the required development of the IFS, both in terms of modelling and data assimilation aspects. This development will continue as part of CAMS itself supported by the CORSO and CATRINE projects. Developments on prior information are also already used in CAMS and will be further picked up in the specific procurements. Significant developments were made for the methodologies for local and national inverse modelling. New code was made publicly available, where possible, and a large number of peer-reviewed papers has been submitted and/or published (Annex 1). The work on uncertainty estimation has also led to activities that can be continued beyond the duration of CoCO2 in terms of IFS development, evaluation tools, and the Community Inversion Framework. The work package on integration has resulted in various significant contributions that have supported the user engagement with various important user communities and stakeholders, also aligned with the specific work package on user engagement. And finally, the different studies on the requirements and availability of in situ observations will support the implementation of the CO2MVS but have also contributed to the implementation plan of the WMO Global Greenhouse Gas Watch. A schematic overview of the exploitation of the different activities within the future CO2MVS is depicted in Figure 5.

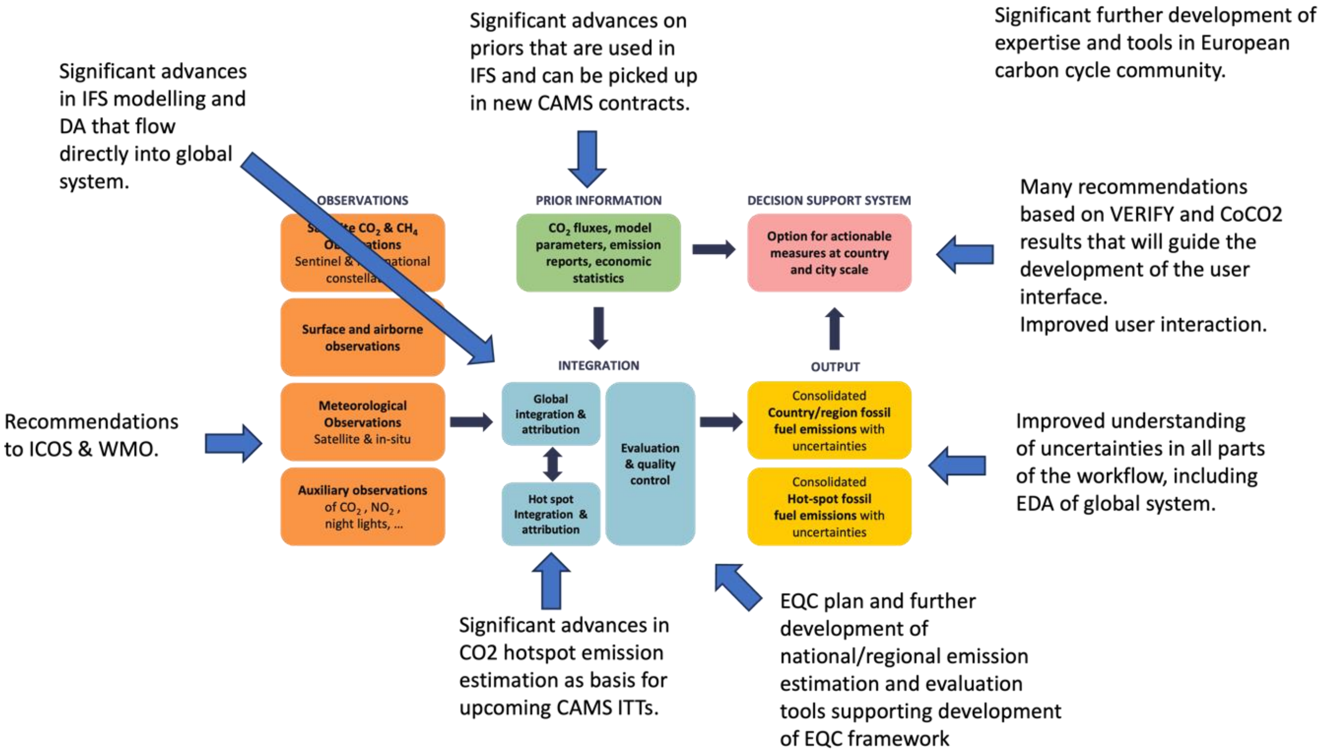

Figure 5 Overview of main exploitation pathways of the CoCO2 activities and results into the CAMS CO2MVS.

5 Conclusion

This Deliverable 9.8 has reported on the dissemination activities performed over the past 36 months of the project, to demonstrate the continued activities of the partners. Furthermore the achievements of the past 12 months have been highlighted. In addition the partners have reviewed the dissemination and exploitation plans to ensure they remain relevant and current to the present.

The exploitation plan has summarised the relevant activities performed during the project. One of the outcomes is our data portal accessible via the website, which is demonstrated by the analytical statistics that show these pages as the most visited. The links to ongoing HEU projects such as CORSO, PARIS, AVENGERS, EYE-CLIMA demonstrate that the legacy from CoCO2 outputs will continue.

ANNEX 1: Publications of CoCO2 for the full 36 months of the project

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
1	Satellite-based estimates of nitrogen oxide and methane emissions from gas flaring and oil production activities in Sakha Republic, Russia	Iolanda Ialongo; Nadezhda Stepanova; Nadezhda Stepanova; Janne Hakkarainen; Henrik Virta; Daria Gritsenko	Atmospheric Environment: X, Vol 11, Iss , Pp 100114- (2021)	10.1016/j.aeaoa.2021.100114
2	Assimilation of atmospheric CO2 observations from space can support national CO2 emission inventories	Thomas Kaminski; Marko Scholze; Peter Rayner; Michael Voßbeck; Michael Buchwitz; Maximilian Reuter; Wolfgang Knorr; Hans Chen; Anna Agusti-Panareda; Armin Löscher; Yasjka Meijer	Environ. Res. Lett.	10.1088/1748-9326/ac3cea
3	Assimilation of passive microwave vegetation optical depth in LDAS-Monde: a case study over the continental US	Mucia, A. and Bonan, B. and Albergel, C. and Zheng, Y. and Calvet, J.-C.	Biogeosciences	10.5194/bg-2021-248
4	Quantifying CO2 Emissions of Power Plants With CO2 and NO2 Imaging Satellites	Kuhlmann Gerrit, Henne Stephan, Meijer Yasjka, Brunner Dominik	Frontiers in Remote Sensing	10.3389/frsen.2021.689838
5	Large CO2 emitters as seen from satellite: Comparison to a gridded global emission inventory	Chevallier, F., Broquet, G., Zheng, B., Ciais, P., & Eldering, A	Geophysical Research Letters	10.1029/2021gl097540
6	How well do we understand the land-ocean-atmosphere carbon cycle?	David Crisp; Han Dolman; Toste Tanhua; Galen A McKinley; Judith Hauck; Ana Bastos; Stephen Sitch; Simon Eggleston; Valentin Aich	Reviews Of Geophysics (8755-1209) (Amer Geophysical Union), 2022-06 , Vol. 60 , N. 2 , P. e2021RG000736 (64p.)	10.1002/essoar.10506293.2
9	Global patterns of daily CO2 emissions reductions in the first year of COVID-19	Liu, Zhu; Deng, Zhu; Zhu, Biging; Ciais, Philippe; Davis, Stephen J.; Tan, Jianguang; Andrew, Robbie M.; Boucher,	Nat. Geosci.	10.1038/s41561-022-00965-8

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Olivier; Ben Arous, Simon; Canadell, Josep G.; Dou, Xinyu; Friedlingstein, Pierre; Gentine, Pierre; Guo, Rui; Hong, Chaopeng; Jackson, Robert B.; Kammen, Daniel M.; Ke, Piyu; Le Quéré, Corine; Monica, Crippa; Janssens-Maenhout, Greet; Peters, Glen P.; Tanaka, Katsumasa; Wang, Yilong; Zheng, Bo; Zhong, Haiwang; Sun, Taochun; Schellnhuber, Hans Joachim Schellnhuber		
10	Global fossil carbon emissions rebound near pre-COVID-19 levels	Jackson, R B; Friedlingstein, P; Le Quéré, C; Abernethy, S; Andrew, R M; Canadell, J G; Ciais, P; Davis, S J; Deng, Zhu; Liu, Zhu; Korsbakken, J I; Peters, G P	Environmental Research Letters	10.1088/1748-9326/ac55b6
12	Direct observations of CO2 emission reductions due to COVID-19 lockdown across European urban districts	Giacomo Nicolini; Gabriele Antoniella; Federico Carotenuto; Andreas Christen; Philippe Ciais; Christian Feigenwinter; Beniamino Gioli; Stavros Stagakis; Erik Velasco; Roland Vogt; Helen C. Ward; Janet Barlow; Nektarios Chrysoulakis; Pierpaolo Duce; Martin Graus; Carole Helfter; Bert Heusinkveld; Leena Järvi; Thomas Karl; Serena Marras; Valéry Masson; Bradley Matthews; Fred Meier; Eiko Nemitz; Simone Sabbatini;	Science of the Total Environment, Elsevier, 2022, 830, ⟨10.1016/j.scitotenv.2022.154662⟩	10.1016/j.scitotenv.2022.154662

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Dieter Scherer; Helmut Schume; Costantino Sirca; Gert-Jan Steeneveld; Carolina Vagnoli; Yilong Wang; Alessandro Zaldei; Bo Zheng; Dario Papale		
13	Comparing national greenhouse gas budgets reported in UNFCCC inventories against atmospheric inversions	Zhu Deng; Philippe Ciais; Zitely A. Tzompa-Sosa; Marielle Saunois; Chunjing Qiu; Chang Tan; Taochun Sun; Piyu Ke; Yanan Cui; Katsumasa Tanaka; Katsumasa Tanaka; Xin Lin; Rona Thompson; Hanqin Tian; Yuanzhi Yao; Yuanyuan Huang; Ronny Lauerwald; Atul K. Jain; Xiaoming Xu; Ana Bastos; Stephen Sitch; Paul I. Palmer; Thomas Lauvaux; Alexandre d'Aspremont; Clément Giron; Antoine Benoit; Benjamin Poulter; Jinfeng Chang; A.M.R. Petrescu; Steven J. Davis; Zhu Liu; Giacomo Grassi; Clément Albergel; Frédéric Chevallier	eISSN: 1866-3516	10.5194/essd-2021-235
14	Global nature run data with realistic high-resolution carbon weather for the year of the Paris Agreement	Anna Agustí-Panareda; Joe McNorton; Gianpaolo Balsamo; Bianca C. Baier; Nicolas Bousserez; Souhail Boussetta; Dominik Brunner; Frédéric Chevallier; Margarita Choulga; Michail Diamantakis; Richard Engelen; Johannes Flemming; Claire Granier; Marc Guevara; Hugo Denier van der Gon;	Scientific Data , Nature Publishing Group, 2022, 9, pp.160. ⟨10.1038/s41597-022-01228-2⟩	10.1038/s41597-022-01228-2

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Nellie Elguindi; Jean-Matthieu Haussaire; Martin Jung; Greet Janssens-Maenhout; Rigel Kivi; Sébastien Massart; Dario Papale; Mark Parrington; Miha Razinger; Colm Sweeney; Alex Vermeulen; Sophia Walther		
15	Analyzing Local Carbon Dioxide and Nitrogen Oxide Emissions From Space Using the Divergence Method: An Application to the Synthetic SMARTCARB Dataset	Janne Hakkarainen, Iolanda Ialongo, Erik Koene, Monika E. Szeląg, Johanna Tamminen, Gerrit Kuhlmann, Dominik Brunner	Frontiers in Remote Sensing	10.3389/frsen.2022.878731
16	Analyzing nitrogen oxides to carbon dioxide emission ratios from space: A case study of Matimba Power Station in South Africa	Janne Hakkarainen, Monika E. Szeląg, Iolanda Ialongo, Christian Retscher, Tomohiro Oda, and David Crisp	Atmospheric Environment:	10.1016/j.aeaoa.2021.100110
17	Complementing XCO₂ imagery with ground-based CO₂ and ¹⁴CO₂ measurements to monitor CO₂ emissions from fossil fuels on a regional to local scale	Elise Potier; Grégoire Broquet; Yilong Wang; Diego Santaren; Antoine Berchet; Isabelle Pison; Julia Marshall; Philippe Ciais; François-Marie Bréon; Frédéric Chevallier	Atmospheric measurement techniques.	10.5194/amt-15-5261-2022
18	Fluxes of Carbon Dioxide From Managed Ecosystems Estimated by National Inventories Compared to Atmospheric Inverse Modeling	Frédéric Chevallier	ISSN: 0094-8276	10.1029/2021gl093565
19	Global Daily CO$_2$ emissions for the year 2020	Liu, Zhu; Deng, Zhu; Ciais, Philippe; Tan, Jianguang; Zhu, Biqing; Davis, Steven J.; Andrew, Robbie; Boucher, Olivier; Arous, Simon Ben; Canadel, Pep; Dou, Xinyu; Friedlingstein, Pierre; Gentine,	Nature Geoscience	10.48550/arxiv.2103.02526

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Pierre; Guo, Rui; Hong, Chaopeng; Jackson, Robert B.; Kammen, Daniel M.; Ke, Piyu; Quere, Corinne Le; Monica, Crippa; Janssens-Maenhout, Greet; Peters, Glen; Tanaka, Katsumasa; Wang, Yilong; Zheng, Bo; Zhong, Haiwang; Sun, Taochun; Schellnhuber, Hans Joachim		
22	Evaluation of simulated CO2 power plant plumes from six high-resolution atmospheric transport models	Brunnner, Dominik; Kuhlmann, Gerrit; Henne, Stephan; Koene, Erik; Kern, Bastian; Wolff, Sebastian; Voigt, Christiane; Jöckel, Patrick; Kiemle, Christoph; Roiger, Anke; Fiehn, Alina; Krautwurst, Sven; Gerilowski, Konstantin; Bovensmann, Heinrich; Borchardt, Jakob; Galkowski, Michal; Gerbig, Christoph; Marshall, Julia; Klonecki, Andrzej; Prunet, Pascal; Hanfland, Robert; Pattantyús-Ábrahám, Margit; Wyszogrodzki, Andrzej; Fix, Andreas	Atmospheric Chemistry and Physics	10.5194/acp-23-2699-2023
23	Global Carbon Budget 2022	Friedlingstein, P.; O'Sullivan, M.; Jones, M. W.; Andrew, R. M.; Gregor, L.; Hauck, J.; Le Quéré, C.; Luijkx, I. T.; Olsen, A.; Peters, G. P.; Peters, W.; Pongratz, J.; Schwingshackl, C.; Sitch, S.; Canadell, J. G.; Ciais, P.; Jackson, R. B.; Alin,	Earth System Science Data	10.5194/essd-14-4811-2022

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		S. R.; Alkama, R.; Arneth, A.; Arora, V. K.; Bates, N. R.; Becker, M.; Bellouin, N.; Bittig, H. C.; Bopp, L.; Chevallier, F.; Chini, L. P.; Cronin, M.; Evans, W.; Falk, S.; Feely, R. A.; Gasser, T.; Gehlen, M.; Gkritzalis, T.; Gloege, L.; Grassi, G.; Gruber, N.; Gürses, Ö.; Harris, I.; Hefner, M.; Houghton, R. A.; Hurtt, G. C.; Iida, Y.; Ilyina, T.; Jain, A. K.; Jersild, A.; Kadono, K.; Kato, E.; Kennedy, D.; Klein Goldewijk, K.; Knauer, J.; Korsbakken, J. I.; Landschützer, P.; Lefèvre, N.; Lindsay, K.; Liu, J.; Liu, Z.; Marland, G.; Mayot, N.; McGrath, M. J.; Metzl, N.; Monacci, N. M.; Munro, D. R.; Nakaoka, S.-I.; Niwa, Y.; O'Brien, K.; Ono, T.; Palmer, P. I.; Pan, N.; Pierrot, D.; Pocock, K.; Poulter, B.; Resplandy, L.; Robertson, E.; Rödenbeck, C.; Rodriguez, C.; Rosan, T. M.; Schwinger, J.; Séférian, R.; Shutler, J. D.; Skjelvan, I.; Steinhoff, T.; Sun, Q.; Sutton, A. J.; Sweeney, C.; Takao, S.; Tanhua, T.; Tans, P. P.; Tian, X.; Tian, H.; Tilbrook, B.; Tsujino, H.; Tubiello, F.; van der Werf, G. R.; Walker, A. P.;		

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Wanninkhof, R.; Whitehead, C.; Willstrand Wranne, A.; Wright, R.; Yuan, W.; Yue, C.; Yue, X.; Zaehle, S.; Zeng, J.; Zheng, B.; Integr. Assessm. Global Environm. Change; Environmental Sciences		
25	National CO₂ budgets (2015–2020) inferred from atmospheric CO₂ observations in support of the global stocktake	Brendan Byrne; David F. Baker; Sourish Basu; Michael Bertolacci; Kevin W. Bowman; Dustin Carroll; Abhishek Chatterjee; Frédéric Chevallier; Philippe Ciais; Noel Cressie; David Crisp; Sean Crowell; Feng Deng; Zhu Deng; Nicholas M. Deutscher; Manvendra K. Dubey; Sha Feng; Omaira E. García; David W. T. Griffith; Benedikt Herkommer; Lei Hu; Andrew R. Jacobson; Rajesh Janardanan; Sujong Jeong; Matthew S. Johnson; Dylan B. A. Jones; Rigel Kivi; Junjie Liu; Zhiqiang Liu; Shamil Maksyutov; John B. Miller; Scot M. Miller; Isamu Morino; Justus Notholt; Tomohiro Oda; Christopher W. O'Dell; Young-Suk Oh; Hirofumi Ohyama; Prabir K. Patra; Hélène Peiro; Christof Petri; Sajeev Philip; David F. Pollard; Benjamin Poulter; Marine Remaud; Andrew Schuh; Mahesh K. Sha; Kei Shiomi;	Earth System Science Data, 2023, 15 (2), pp.963-1004.	10.5194/essd-15-963-2023

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Kimberly Strong; Colm Sweeney; Yao Té; Hanqin Tian; Voltaire A. Velazco; Mihalis Vrekoussis; Thorsten Warneke; John R. Worden; Debra Wunch; Yuanzhi Yao; Jeongmin Yun; Andrew Zammit-Mangion; Ning Zeng		
27	Quantification of methane emissions from hotspots and during COVID-19 using a global atmospheric inversion	McNorton, Joe; Bousserez, Nicolas; Agustí-Panareda, Anna; Balsamo, Gianpaolo; Cantarello, Luca; Engelen, Richard; Huijnen, Vincent; Inness, Antje; Kipling, Zak; Parrington, Mark; Ribas, Roberto	eISSN: 1680-7324	
28	Building a bridge: characterizing major anthropogenic point sources in the South African Highveld region using OCO-3 carbon dioxide snapshot area maps and Sentinel-5P/TROPOMI nitrogen dioxide columns	Janne Hakkarainen; Iolanda Ialongo; Tomohiro Oda; Monika E Szeląg; Christopher W O'Dell; Annmarie Eldering; David Crisp	Crossref	10.1088/1748-9326/acb837
30	Why do inverse models disagree? A case study with two European CO2 inversions	Munassar, Saqr; Monteil, Guillaume; Scholze, Marko; Karstens, Ute; Rödenbeck, Christian; Koch, Frank-Thomas; Totsche, Kai U.; Gerbig, Christoph	eISSN: 1680-7324	
32	Technical note: A view from space on global flux towers by MODIS and Landsat: the FluxnetEO data set	Walther, Sophia; Besnard, Simon; Nelson, Jacob Allen; El-Madany, Tarek Sebastian; Migliavacca, Mirco; Weber, Ulrich; Carvalhais, Nuno; Ermida, Sofia Lorena;	eISSN: 1726-4189	

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
		Brümmer, Christian; Schrader, Frederik; Prokushkin, Anatoly Stanislavovich; Panov, Alexey Vasilevich; Jung, Martin		
33	A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector	Minx, JC; Lamb, WF; Andrew, RM; Canadell, JG; Crippa, M; Doebbeling, N; Forster, PM; Guizzardi, D; Olivier, J; Peters, GP; Pongratz, J; Reisinger, A; Rigby, M; Saunois, M; Smith, SJ; Solazzo, E; Tian, H	1866-3508	
35	Segmentation of XCO₂ images with deep learning: application to synthetic plumes from cities and power plants	Joffrey Dumont Le Brazidec; Pierre Vanderbecken; Alban Farchi; Marc Bocquet; Jinghui Lian; Grégoire Broquet; Gerrit Kuhlmann; Alexandre Danjou; Thomas Lauvaux	https://hal.science/hal-04179050	10.5194/gmd-16-3997-2023
36	Regional CO₂ Inversion Through Ensemble-Based Simultaneous State and Parameter Estimation: TRACE Framework and Controlled Experiments	Hans W. Chen; Fuqing Zhang; Thomas Lauvaux; Marko Scholze; Kenneth J. Davis; Richard B. Alley	Journal of Advances in Modeling Earth Systems, 2023, 15 (3), ⟨10.1029/2022ms003208⟩	10.1029/2022ms003208
37	Segmentation of XCO2 images with deep learning: application to synthetic plumes from cities and power plants	Dumont Le Brazidec, Joffrey; Vanderbecken, Pierre; Farchi, Alban; Bocquet, Marc; Lian, Jinghui; Broquet, Grégoire; Kuhlmann, Gerrit; Danjou, Alexandre; Lauvaux, Thomas	eISSN: 1991-9603	
38	The consolidated European synthesis of CH4 and N2O emissions for EU27 and UK: 1990–2019	Petrescu, Ana-Maria-Roxana; Qiu, Chunjing; McGrath, M.J.; Peylin, Philippe; P. Peters, Glen; Ciais, P.; Thompson, Rona L.; Tsuruta, Aki; Brunner, Dominik; Kuhnert, Matthias; Matthews, Bradley; Palmer,	Earth System Science Data	

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
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39	A global catalogue of CO₂ emissions and co-emitted species from power plants at	Marc Guevara; Santiago Enciso; Carles Tena; Oriol Jorba; Stijn Dellaert; Hugo	eISSN: 1866-3516	10.5194/essd-2023-95

No.	Title	Authors	Title of the Journal/ Proc. Book	DOI
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40	Assessing the Impact of Atmospheric CO2 and NO2 Measurements From Space on Estimating City-Scale Fossil Fuel CO2 Emissions in a Data Assimilation System	Thomas Kaminski; Marko Scholze; Peter Rayner; Sander Houweling; Michael Voßbeck; Jeremy Silver; Srijana Lama; Michael Buchwitz; Maximilian Reuter; Wolfgang Knorr; Hans W. Chen; Gerrit Kuhlmann; Dominik Brunner; Stijn Dellaert; Hugo Denier van der Gon; Ingrid Super; Armin Löscher; Yasjka Meijer	Frontiers in Remote Sensing	10.3389/frsen.2022.887456
41	A comprehensive dataset for global, regional and national greenhouse gas emissions by sector 1970–2019	Jan C. Minx; William F. Lamb; Robbie M. Andrew; Josep G. Canadell; Monica Crippa; Niklas Döbbeling; Piers M. Forster; Diego Guizzardi; Jos Olivier; Glen P. Peters; Julia Pongratz; Andy Reisinger; Matthew Rigby; Marielle Saunois; Steven J. Smith; Efisio Solazzo; Hanqin Tian	eISSN: 1866-3516	10.5194/essd-2021-228
42	Development of a Simple Methodology Using Meteorological Data to Evaluate Concentrating Solar Power Production Capacity	Ailton M. Tavares; Ricardo Conceição; Francisco M. Lopes; Hugo G. Silva	Energies; Volume 15; Issue 20; Pages: 7693	10.3390/en15207693
43	Technical Note: Flagging inconsistencies in flux tower data	Martin Jung; Jacob Nelson; Mirco Migliavacca; Tarek El-Madany; Dario Papale; Markus Reichstein; Sophia Walther; Thomas Wutzler	eISSN: 1726-4189	10.5194/bg-2023-110
45	Assimilation of ASCAT Radar Backscatter Coefficients over Southwestern France	Timothée Corchia; Bertrand Bonan; Nemesio Rodríguez-	Remote Sensing, 2023, 15 (17), ⟨10.3390/rs15174258⟩	10.3390/rs15174258

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		Fernández; Gabriel Colas; Jean-Christophe Calvet		
46	The CO2 Human Emissions (CHE) Project: First Steps Towards a European Operational Capacity to Monitor Anthropogenic CO2 Emissions	Gianpaolo Balsamo; Richard Engelen; Daniel Thiemert; Anna Agusti-Panareda; Nicolas Bousserez; Grégoire Broquet; Dominik Brunner; Michael Buchwitz; Frédéric Chevallier; Margarita Choulga; Hugo Denier van der Gon; Liesbeth Florentie; Jean-Matthieu Haussaire; Greet Janssens-Maenhout; Matthew W. Jones; Thomas Kaminski; Maarten Krol; Corinne Le Quéré; Julia Marshall; Joe McNorton; Pascal Prunet; Maximilian Reuter; Wouter Peters; Marko Scholze	Frontiers in Remote Sensing, Vol 2 (2021)	10.3389/frsen.2021.707247
47	A widely-used eddy covariance gap-filling method creates systematic bias in carbon balance estimates	Vekuri, H., Tuovinen, J.-P., Kulmala, L., Papale, D., Kolari, P., Aurela, M., Laurila, T., Liski, J., Lohila, A.	scientific reports	10.1038/s41598-023-28827-2

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