Mid-Term Dissemination and Exploitation Report 1

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CoCO2

Prototype system for a Copernicus CO₂ service

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CoCO2: Prototype system for a Copernicus CO₂ 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)
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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.

D9.6 provides an update of the activities performed by the project partners within the first 12 months of the project, and reviews both dissemination and exploitation plans.

To-date, 3 journal papers have been published; CoCO2 researchers presented their work in t14 times in conferences and 22 times in workshops; and participated in one event organised by other H2020 projects. Two workshops were organised by the project.

Exploitation activities remain 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, ECMWF 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 D9.6 is to report on the dissemination activities of the first 12 months and provide an update, where appropriate, to the dissemination and exploitation plans.

2.2.2 Work performed in this deliverable

As per the initial deliverable D9.3, feedback from the partners 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 following publications have been prepared to-date:

1. Kaminski, T., Scholze, M., Rayner, P., Voßbeck, M., Buchwitz, M., Reuter, M., Knorr, W., Chen, H., Agustı-Panareda, A., Löscher, A., and Meijer, Y.: Assimilation of atmospheric CO2 observations from space can support national CO2 emission inventories, Environmental Research Letters, URL http://iopscience.iop.org/article/10.1088/1748-9326/ac3cea, 2021.

2. Mucia, A., Bonan, B., Albergel, C., Zheng, Y., Calvet, J.-C.: Assimilation of Passive Microwave Vegetation Optical Depth in LDAS-Monde: A Case Study over the Continental US, submitted to Biogeosciences, 2021. https://doi.org/10.5194/bg-2021-248

3. Kuhlmann, G.; Henne, S.; Meijer, Y.; Brunner, D. Quantifying CO2 emissions of power plants with CO2 and NO2 imaging satellites. Front. Remote Sens. 2021, 2, 689838 (18 pp.). https://doi.org/10.3389/frsen.2021.689838

In terms of website statistics, since January 2021, the website had over 12,000 visits, averaging over 1,000 visits a month.

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
Participation to a conference	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.
Participation to a workshop	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, <u>virtual</u>, 7-11 June 2021 9. ECMWF: IWGGMS-17, <u>virtual</u>, 14-17 June 2021 10. ECMWF: NASA Carbon Research Program Policy Speaker Series, <u>virtual</u>, 7 June 2021 11. ECMWF: CAMS user workshop France, <u>virtual</u>, 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	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 CO_2 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	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)	1. VUA: VERIFY General Assembly, 28-29/4 2021 2. ECMWF: VERIFY General Assembly, virtual, 28-29 April 2021
Other Activities	1. Project Newsletter 2. Paraview animations of global and regional CO2-simulations contributed to "Climate now" news brief on Euronews TV channel https://www.euronews.com/green/2021/11/15/when-will-cop26-decisions-have-an-impact-on-our-planet

3.1 Update to Dissemination Plan

CoCO2 has, in deliverable D9.3, provided an initial plan for Dissemination and Communication Activities. Figure 1 presents the current status.
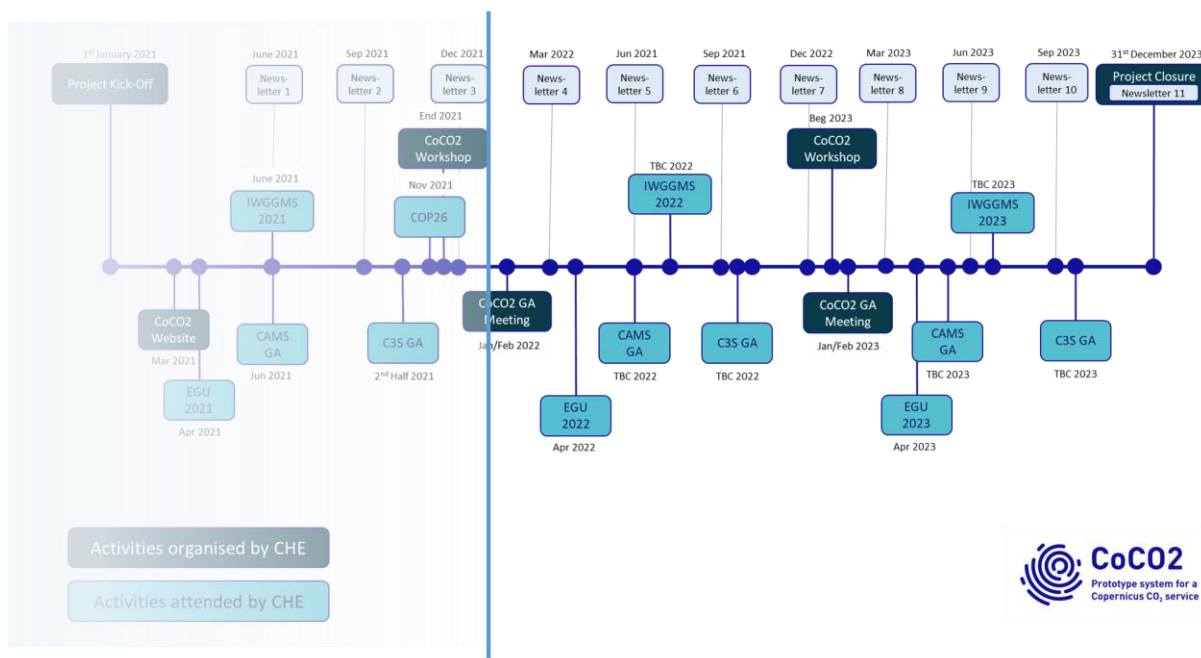
Figure 1: CoCO2 Dissemination Plan

All activities foreseen in the plan to be organised by CoCO2 were realised. The workshop was postponed to not coincide with other activities, including the General Assembly that took place in November 2021 rather than the planned January 2022. To-date, one newsletter has been released. However, the CoCO2 website www.coco2-project.eu has provided regular updates and news items with around 10 articles and events published.

The remainder of the CoCO2 Dissemination Plan remains relevant with the timing and number of newsletters to be decided based on availability of news items. It is planned that the number of publications will increase significantly with the initial results of the WPs 1 to 8 becoming available.

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

An update to the exploitation survey run for Deliverable D9.3 has confirmed that the products and activities described above remain relevant, with the main outcome of the CoCO2 project being an operational service for monitoring of anthropogenic CO2 emissions.

5 Conclusion

D9.6 reported on the dissemination activities performed in the first 12 months, and reviewed the dissemination and exploitation plans.

The exploitation plan will be revisited towards the end of the project with a view of establishing the relevant activities to be performed after the end of the project, and providing a definitive IPR register to serve as a reference point for project partners.

Document History

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0.1	Daniel Thiemert (ECMWF)	06/12/2021	Initial version with all inputs
1.0	Daniel Thiemert (ECMWF)	7/12/2021	Final version

Internal Review History

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Richard Engelen	7/12/2021	Approved with comments

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