CO2MVS RESEARCH ON SUPPLEMENTARY OBSERVATIONS

D5.7 Mid-Term Dissemination and Exploitation Plan

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1 Executive Summary

The project's dissemination and exploitation activities present a crucial element in the success of the CORSO project, as they ensure that results are taken up by the wider community and are sustainable beyond the initial funding period, thus providing value for money.

D5.3 was the first version of this Dissemination and Exploitation (D&E) Plan and provided the initial plans for the D&E work.

This mid-term Dissemination and Exploitation Report D5.7 provides an update of the dissemination and exploitation activities half way through the project, whilst a final Dissemination and Exploitation Report with detailed descriptions of dissemination activities, exploitable results and related activities will be produced towards the end of the project.

The dissemination plan identifies instruments and targets. These include activities organised by CORSO (including workshops, website, news items, etc.) as well as important events attended by CORSO members (i.e. workshops, conferences, seminars, etc.).

The present deliverable provides the potential exploitation avenues in terms of outputs as well as respective exploitation activities during and after the end of the project, thus fulfilling the requirements of the Description of Action (DoA).

The dissemination and exploitation plans are to be considered living documents as new avenues might become important to the project over its lifetime. Thus, both will be updated regularly as the need arises.

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2 Introduction

The following builds on the details of the initial plan for the project's visual identity, and describes the promotional exploitation options and communication channels that have been used in CORSO. The D5.7 aims at supporting partners' communication and dissemination activities and efforts in promoting the project as well as providing a review of the exploitation and dissemination activities of the CORSO project.

2.1 Background

To enable the European Union (EU) to move towards a low-carbon economy and implement its commitments under the Paris Agreement, a binding target was set to cut emissions in the EU by at least 40% below 1990 levels by 2030. European Commission (EC) President von der Leyen committed to deepen this target to at least 55% reduction by 2030. This was further consolidated with the release of the Commission's European Green Deal on the 11th of December 2019, setting the targets for the European environment, economy, and society to reach zero net emissions of greenhouse gases in 2050, outlining all needed technological and societal transformations that are aiming at combining prosperity and sustainability. To support EU countries in achieving the targets, the EU and EC recognised the need for an objective way to monitor anthropogenic CO_2 emissions and their evolution over time.

Such a monitoring capacity will deliver consistent and reliable information to support informed policy- and decision-making processes, both at national and European level. To maintain independence in this domain, it is seen as critical that the EU establishes an observation-based operational anthropogenic CO_2 emissions Monitoring and Verification Support (MVS) (CO2MVS) capacity as part of its Copernicus Earth Observation programme.

The CORSO research and innovation project will build on and complement the work of previous projects such as CHE (the CO2 Human Emissions), and CoCO2 (Copernicus CO2 service) projects, both led by ECMWF. These projects have already started the ramping-up of the CO2MVS prototype systems, so it can be implemented within the Copernicus Atmosphere Monitoring Service (CAMS) with the aim to be operational by 2026. The CORSO project will further support establishing the new CO2MVS addressing specific research & development questions.

The main objectives of CORSO are to deliver further research activities and outcomes with a focus on the use of supplementary observations, i.e., of co-emitted species as well as the use of auxiliary observations to better separate fossil fuel emissions from the other sources and sinks of atmospheric CO_2. CORSO will deliver improved estimates of emission factors/ratios and their uncertainties as well as the capabilities at global and local scale to optimally use observations of co-emitted species to better estimate anthropogenic CO_2 emissions. CORSO will also provide clear recommendations to CAMS, ICOS, and WMO about the potential added-value of high-temporal resolution $^{14}CO_2$ and Atmospheric Potential Oxygen (APO) observations as tracers for anthropogenic emissions in both global and regional scale inversions and develop coupled land-atmosphere data assimilation in the global CO2MVS system constraining carbon cycle variables with satellite observations of soil moisture, LAI, SIF, and Biomass. Finally, CORSO will provide specific recommendations for the topics above for the operational implementation of the CO2MVS within the Copernicus programme.

2.2 Scope of this deliverable

2.2.1 Objectives of this deliverables

The Deliverable 5.7 provides the mid term update for the dissemination and exploitation plan.

The Exploitation Plan initiated in D5.3 explains the exploitation work within the CORSO project by identifying initial exploitation routes and innovation ideas.

The objective of D5.7 is to report on the dissemination activities of the first 18 months and to provide an update, where appropriate, of the dissemination and exploitation plans.

2.2.2 Work performed in this deliverable

As per the DoA, D5.7 should “outline the dissemination activities as well as identify the potential for exploitation and their routes”.

The work to create the plans included collection of feedback from the partners in form of questionnaires and the identification of the relevant aspects pertaining to both dissemination and exploitation.

2.2.3 Deviations and counter measures

No deviations have been encountered.

2.3 Project partners:

Partners	
EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS	ECMWF
AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE	AGH
BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION	BSC
COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA
KAMINSKI THOMAS HERBERT	iLab
METEO-FRANCE	MF
NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO	TNO
RIJKSUNIVERSITEIT GRONINGEN	RUG
RUPRECHT-KARLS-UNIVERSITAET HEIDELBERG	UHEI
LUNDS UNIVERSITET	ULUND
UNIVERSITE PAUL SABATIER TOULOUSE III	UT3-CNRS
WAGENINGEN UNIVERSITY	WU
EIDGENOSSISCHE MATERIALPRUFUNGS- UND FORSCHUNGSANSTALT	EMPA
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH	ETHZ
UNIVERSITY OF BRISTOL	UNIVBRIS
THE UNIVERSITY OF EDINBURGH	UEDIN

3 Project Communication & Dissemination

3.1 Report on Dissemination activities

As a project, we have taken an active role in conferences, workshops and seminars explaining the project aims and initial results. International liaison work also continues to be an important aspect to the project.

In this first 18 months, CORSO has been presented 8 times at conferences and workshops.

The project has presented at ICOS Atmosphere Monitoring station assembly, IWGGMS 19, ICOS-D and at EC-ESA joint earth system science initiative workshop.

The project is liaising with other Horizon Europe Projects, (E.g. CAMEO and CATRINE, amongst others) to ensure synergies are identified and developed. The project Coordinator Richard Engelen presented the CORSO updates recently at the CAMEO GA (14-15 May 2024), in addition the CATRINE Project lead is an invited observer to all the CORSO Executive Board meetings.

The project is also liaising with the Copernicus Services, CAMS and C3S and is represented at their annual General Assemblies, June 2024.

Throughout the project, the coordinator has presented CORSO progress at the CO2M Mission Advisory Group meetings and meetings of the CO2 Monitoring Task Force.

CORSO results are also used, when relevant, in CAMS interactions with international stakeholders, such as WMO, ICOS, UNEP, and Commission DGs.

The CORSO management decided to not set up a formal Advisory Board. Instead, some collaboration with specific experts outside the consortium was seen as more productive, as the CORSO project is addressing 4 specialised topics without a harmonization phase at the end. The latter will happen as part of the CO2MVS implementation within CAMS, which is guided by the CO2 Monitoring Task Force. Examples of interaction with external experts are Heather Graven, Imperial College London, and Ralph Keeling, Scripps Institution of Oceanography, both of them are involved in WP3.

Finally, the first General Assembly of CORSO was co-organised with the final Assembly of the CoCO2 project to encourage the exchange of information between the two projects, while they were still both active. This GA happened 20 – 22 November 2023 and more information can be found here: https://www.corso-project.eu/events/corso-ga-meeting-and-coco2-final-meeting. During this GA, representatives from the EYE-CLIMA, PARIS, and AVENGERS projects were also invited as part of a dedicated session with national inventory agencies.

The CORSO website has provided regular updates and news items along with information on our recent publications; 1 journal publication thus far, 1 in review and 1 accepted.

As a reminder, our dissemination methods are listed as

1. Scientific and technical results through
    a. Scientific Publications
    b. Conference Talks
    c. Organised Workshops, providing updates on the project results
    d. Reports to and feedback from Committees and Boards
2. Products through dissemination of
    a. Datasets and accompanying material (e.g. descriptions, meta data)
    b. Algorithms / Specifications
    c. Graphics and animations
3. Progress information through provision of
    a. News items

b. Public Deliverables
c. Dissemination Materials (brochures, posters, flyers)
d. Website and social media

3.1.1 Scientific and technical results

a) Scientific Publications – article in Journal

Title/ DOI	Authors	Title of Journal	Status
Assimilation of ASCAT Radar Backscatter Coefficients over Southwestern France https://doi.org/10.3390/rs15174258	Timothée Corchia, Bertrand Bonan, Nemesio Rodríguez-Fernández, Gabriel Colas, Jean-Christophe Calvet	*Remote Sens.* **2023**, *15*(17), 4258;	Published: 30 August 2023
A light-weight NO2 to NOx conversion model for quantifying NOx emissions of point sources from NO2 satellite observations s://doi.org/10.5194/egusphere-2024-159	Meier, S., Koene, E., Krol, M., Brunner, D., Damm, A., and Kuhlmann, G.	EGUsphere [preprint]	2024
The ddeq Python library for point source quantification from remote sensing images (Version 1.0) https://doi.org/10.5194/egusphere-2023-2936	Kuhlmann, G., Koene, E. F. M., Meier, S., Santaren, D., Broquet, G., Chevallier, F., Hakkarainen, J., Nurmela, J., Amorós, L., Tamminen, J., and Brunner, D.	EGUsphere [preprint]	2024

b) Conference Talks

Name	Date	Location	Presenter	Presentation title
GEIA Conference	21-23 June 2023	Brussels, Belgium	Thierno DOUMBIA	Quantification of the uncertainties on surface emissions within the CORSO and CAMEO projects (poster)
CORSO slide included in talk at ECMWF Annual Seminar on Earth System Reanalysis	4-8 September 2023	ECMWF, Reading UK and online	Patricia de Rosnay	'Towards Earth system reanalysis'

Name	Date	Location	Presenter	Presentation title
The First International Symposium on Earth System Modeling and Prediction,	11-12 September 2023	CEMC/ CMA, Nanjing, China	Patricia de Rosnay	Coupled data assimilation at ECMWF

c) Workshops, providing updates on the project results

Name	Date	Location	Presenter	Presentation title
IWGGMS 19 (https://iwggms19.com/)	4-6 July 2023	Paris, France	Gerrit Kuhlmann	ddeq - A Python library for data-driven emission quantification of hot spots
EC-ESA JOINT EARTH SYSTEM SCIENCE INITIATIVE workshop (https://essi2023.esa.int)	22nd-24th November 2023	ESRIN, Frascati	Gianpaolo Balsamo will present on behalf of the project.	CORSO project
Machine Learning Based Observation Operators to assimilate Microwave and SIF Satellite Observations into the ECMWF Integrated Forecast System. ESA-ECMWF Workshop	7-10th May 2024	ESRIN, Frascati	Sebastian Garrigues	CORSO project
ICOS Atmosphere Monitoring Station Assembly	15. - 17. May 2023	Brussels, Belgium	Samuel Hammer	The flask sampling strategy to minimize nuclear 14CO2 contributions
Land DA Community's 4th annual virtual workshop on Developments in Land Data Assimilation	Tuesday, June 25th.	online	Sebastien Garrigues and MF	Machine learning-based observation operators to assimilate microwave and SIF satellite observations into the ECMWF integrated forecast system

d) Reports to and feedback from Committees and Boards

Name	Date	Location	Presenter	Presentation title
International Earth System Working Group meeting	26-28th September 2023	Finnish Meteorological Institute in Helsinki, Finland	Patricia de Rosnay	Coupled land-atmosphere data assimilation at ECMWF (incl 1 slide o CORSO)
ICOS-D Annual meeting	24-26th October 2023	Max Planck, BGC Jena, Germany	Samuel Hammer	Global Radiocarbon Background compilation

3.1.2 Products through dissemination of

a. *Datasets and accompanying material (e.g. descriptions, meta data)*
b. *Algorithms / Specifications*
c. *Graphics and animations*

Figure 1 shows the dedicated page on the CORSO website for CORSO produced public datasets.

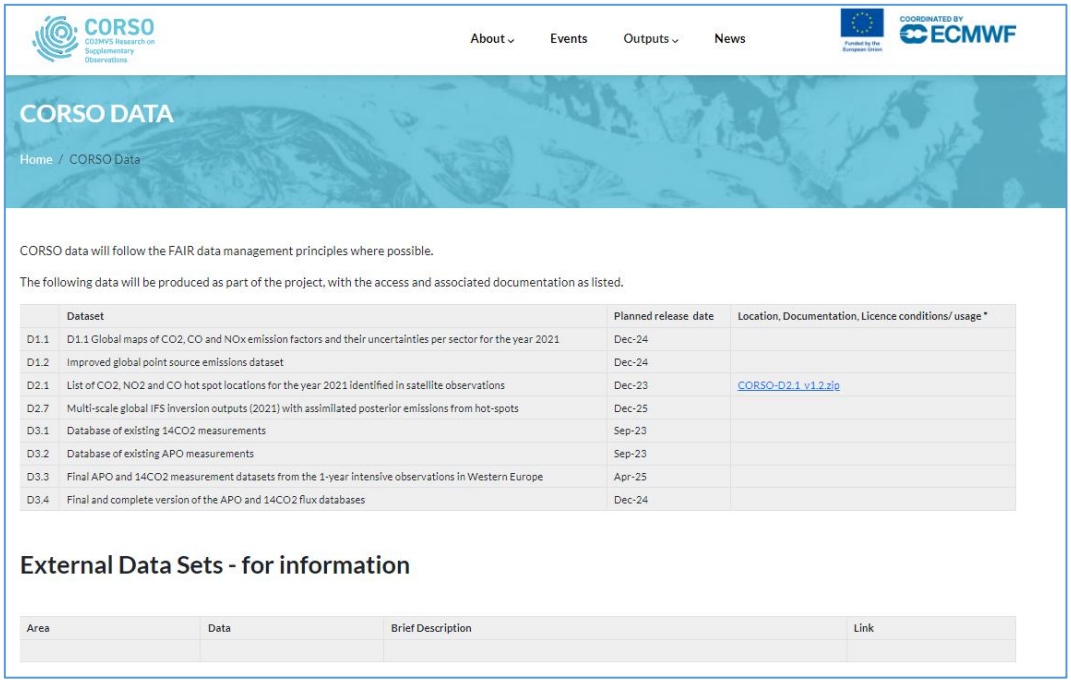

Figure 1: CORSO Website: Data Page

These datasets will be uploaded when they are available for use/ made public. Algorithms, graphics and animations have not been produced yet.

3.1.3 Progress information through provision of

a. *News items*
b. *Public Deliverables*
c. *Dissemination Materials (brochures, posters, flyers)*
d. *Website and social media*

The CORSO website has been used for News items, public deliverables and listing the scientific papers (Figures 2, 3 and 4 respectively).

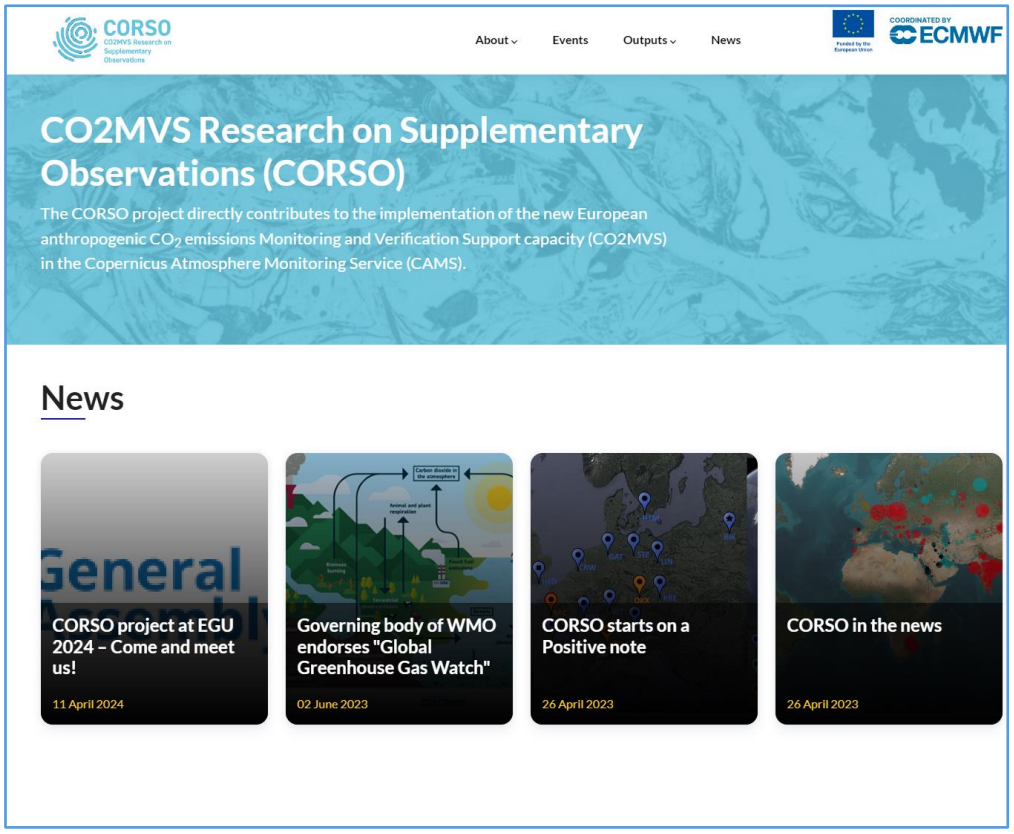

Figure 2: CORSO Website: News Page

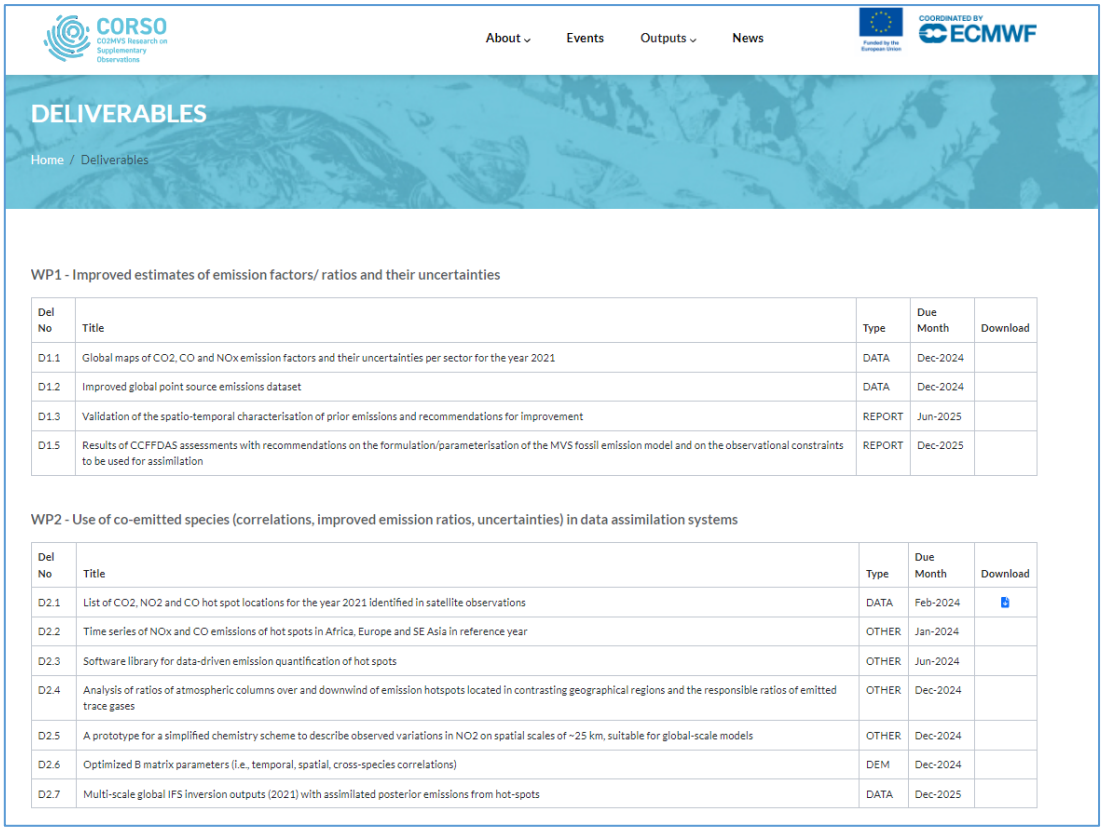

Figure 3: CORSO Website: Deliverables Page

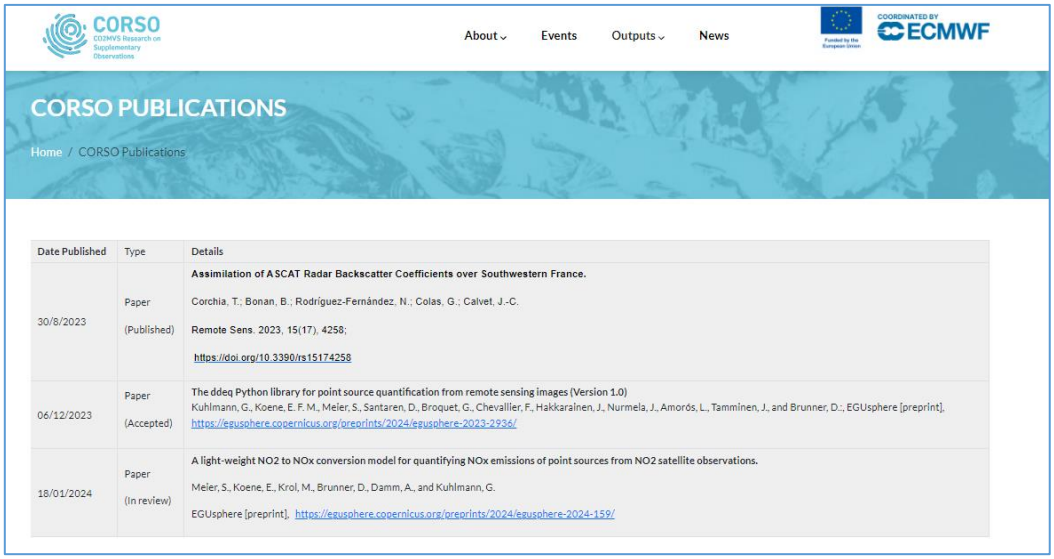

Figure 4: CORSO Website: Publication Page

Other instruments used by the CORSO project to disseminate its results have included:

- Web / wiki pages
- Dissemination of information through relevant social media,
- Linked communication with the CAMS communication sites

CORSO uses the confluence pages for communication and dissemination within the project. Social media, (Linkedin and X (formerly known as “Twitter”) are not used directly by CORSO but instead we rely on the established communication channels of CAMS and ECMWF.. CORSO was one of the projects highlighted by HaDEA attending EGU 2024 (Figure 5) and at CAMS General Assembly, June 2024.

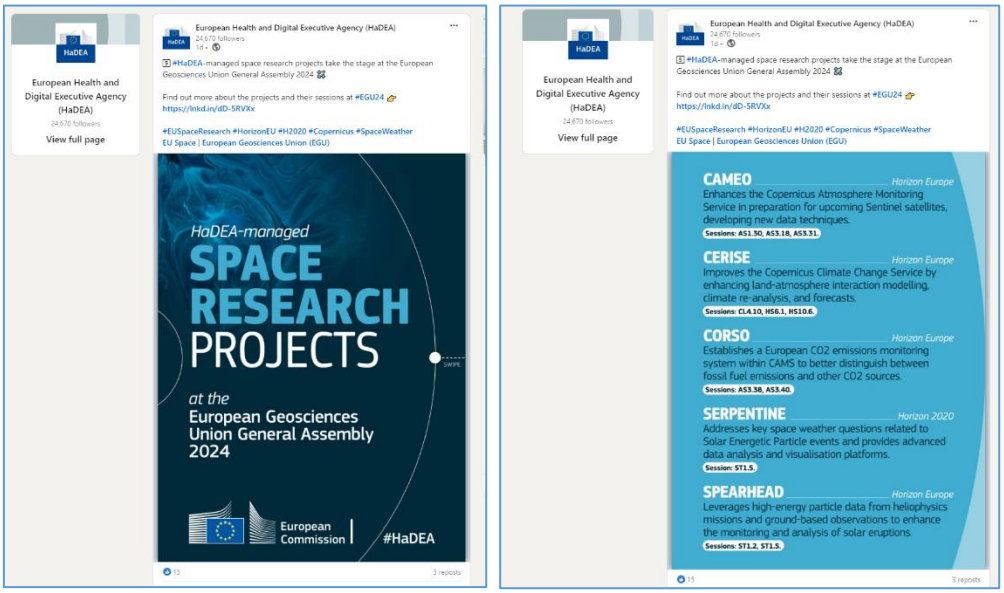

Figure 5: HaDEA announcement on LinkedIn, mentioning the CORSO project

ECMWF and Copernicus social media accounts are being used to like/ follow project updates.

CORSO was also one of the projects presented at the CAMS General Assembly June 2024.

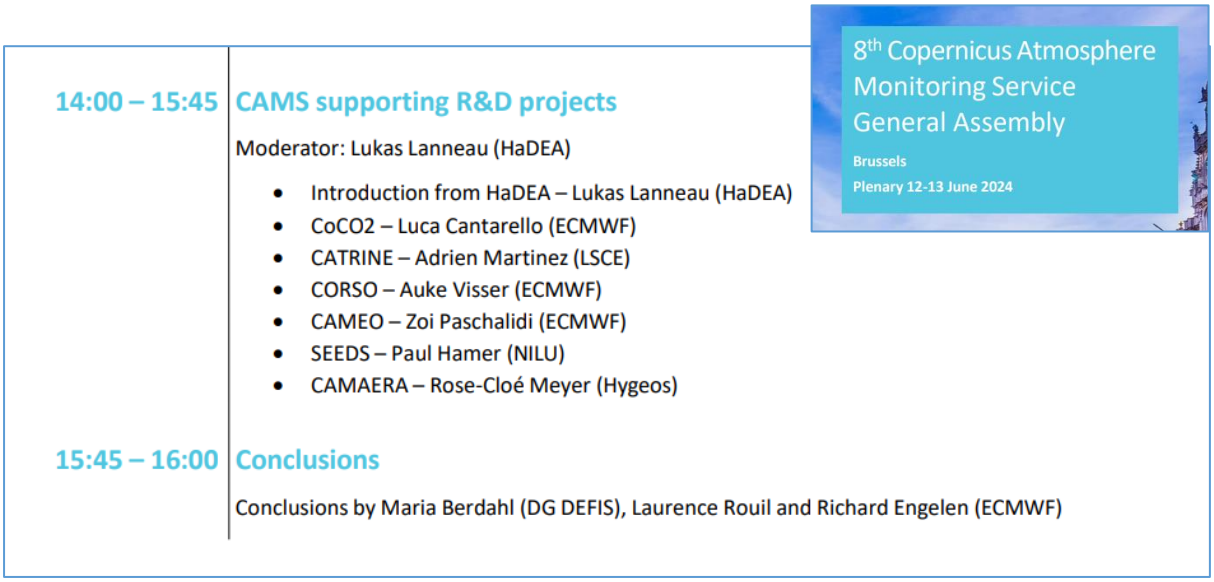

Figure 6: CAMS General assembly Agenda extract; CORSO project

The CORSO Website went live May 2023. Google analytics has been used to collect and monitor traffic and users over the last 13 months.

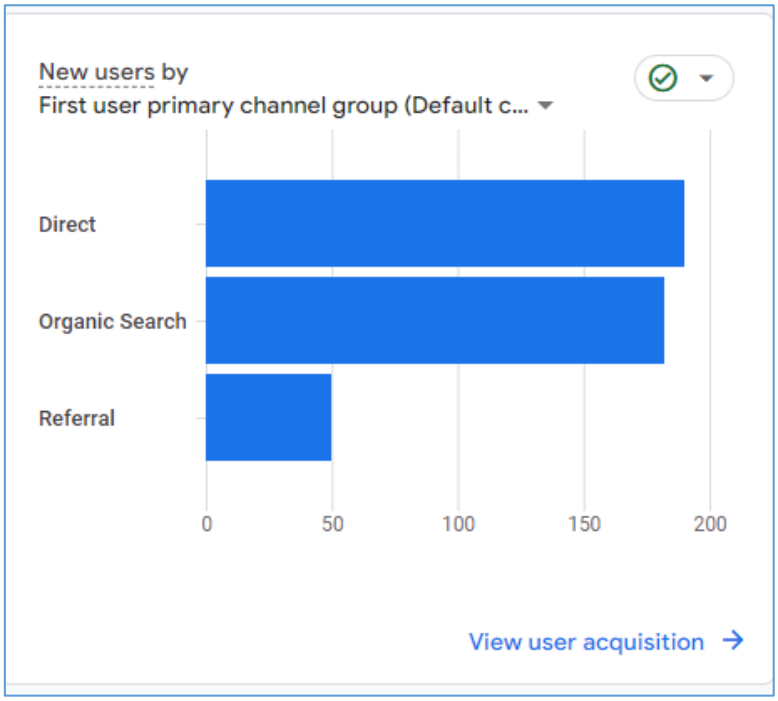

Figure 7: CORSO Website: Website acquisition,

The majority of users are accessing the website via Direct acquisition, followed closely behind by Organic search (Figure 7). Proving that the website is easy to reach.

The stats show over 430 users with 1600 plus views (Figure 8). Although this is a strong start, we expect these results to increase as we progress through the project and upload the deliverables and datasets when they become available.

Figure 8: CORSO Website: Number of users

	Page title and screen class	Views	Users
		1,674 100% of total	436 100% of total
1	Home | CORSO	511	287
2	CORSO GA Meeting and CoCO2 Final Meeting | CORSO	328	123
3	Events | CORSO	96	61
4	Objectives | CORSO	96	58
5	CORSO Data | CORSO	70	48
6	Consortium | CORSO	60	41
7	Deliverables | CORSO	59	31
8	About | CORSO	56	41
9	CORSO in the news | CORSO	55	46
10	Team | CORSO	54	42

Figure 9: CORSO Website: Number of views and top pages accessed

The most views after the home page, are on the CORSO joint GA and CoCO2 Final Meeting page, followed by the Events page (Figures 9 and 10).

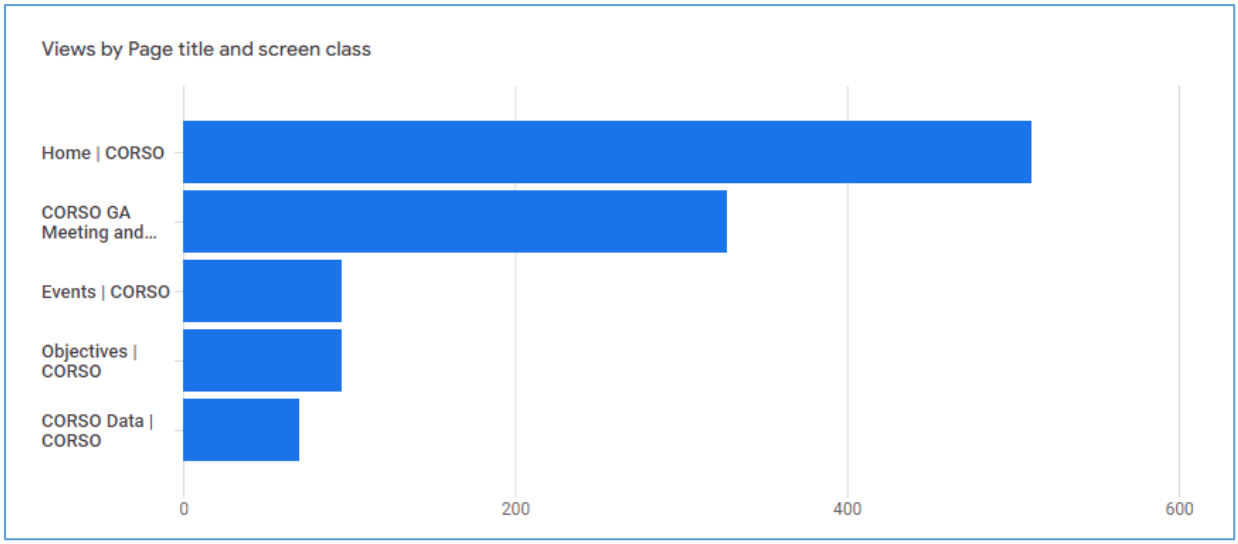

Figure10 : CORSO Website: Data Page

Figure 11 shows the users per country. Overall there is good access from around the world, but the data shows that most are within the European continent.

Figure 11: CORSO Website: Users per country.

6 Exploitation Plan

Deliverable D5.3 already outlined potential exploitation avenues, as per the table below.

Table: Summary of Exploitation Findings

Exploitable Products	• Global maps of CO2, CO and NOx emission factors and their uncertainties per sector • Improved global point source emissions dataset • List of CO2, NO2 and CO hot spot locations for the year 2021 identified in satellite observations • Time series of NOx and CO emissions of hot spots in Africa, Europe and SE Asia • Software library for data-driven emission quantification of hot spots • A prototype for a simplified chemistry scheme to describe observed variations in NO2 on spatial scales of ~25 km, suitable for global-scale models • Database of existing 14CO2 measurements • Database of existing APO measurements • APO and 14CO2 measurement datasets from the 1-year intensive observations in Western Europe • APO and 14CO2 flux databases • Estimates of the annual fossil fuel CO2 emissions at the continental to national scales over a decade, and specifically for 2024 in Europe • Improved land surface forward operators for SIF and low frequency MW data • Reports with recommendations for the implementation of the Copernicus CO2MVS
Exploitation Activities during the Project	• Any dataset that has been identified as public will be made available to external scientists. Several of these datasets are innovative and should create significant interest. • Project reports with recommendations will support uptake/implementation activities in CAMS, ICOS, and potentially other frameworks, already during the project.
Exploitation Activities after the end of the Project	• Any dataset that has been identified as public will be made available to external scientists. Several of these datasets are innovative and should create significant interest. • Project reports with recommendations will support uptake/implementation activities in CAMS, ICOS, and potentially other frameworks.
Consortium-wide/Joint Exploitation	• While outputs will be shared publicly as much as possible through documentation and peer-reviewed literature, the project will also support its consortium members to be better prepared for any upcoming CO2MVS implementation ITTs.

(Any datasets and databases produced will follow the Data Management Plan (D5.5)).

The exploitation survey to partners, run as part of Deliverable D5.7, shows that the products and activities described above remained relevant throughout the project.

The main outcome of the CORSO project being the foreseen (pre-)operational service in the Copernicus programme

7 Conclusion

This deliverable, D5.7 has provided a mid-term update of the dissemination and exploitation activities to the Dissemination and Exploitation Report.

For the dissemination we have achieved our aims to disseminate via a set of identified instruments namely a website, (4) news items, (10) scientific conference, workshop and committee/board meetings and work on (3) scientific papers.

The dissemination task will continue for the remaining 18 months.

Exploitation updates were solicited from all partners and represents the current state of exploitation activities.

The Exploitation Plan will be revisited regularly and is thus to be understood as a living document, as developments during the course of the project may open up new avenues for exploitation.

Document History

Version	Author(s)	Date	Changes
0.1	Tanya Warnaars, Rhona Phipps (ECMWF)	June 2024	Initial version
1.0	Rhona Phipps (ECMWF), Samuel Hammer (UHEI), Thomas Kaminski (iLAB), Tanya Warnaars (ECMWF	June 2024	Issued version

Internal Review History

Internal Reviewers	Date	Comments
Samuel Hammer (UHEI), Thomas Kaminski (iLAB), Tanya Warnaars (ECMWF)	June 2024	Minor comments and additions