CopERnIcus climate change Service Evolution

D8.6 Mid-Term Dissemination and Exploitation Report

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The CERISE project (grant agreement No 101082139) is funded by the European Union.

1 Executive Summary

The project's dissemination and exploitation activities present a crucial element in the success of the CERISE 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.

This mid-term Dissemination and Exploitation Report (Month 24) 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 (Month 48).

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

The present deliverable also 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). A table showing the progression of Technical Readiness Level of the outputs to be exploited at each review stage has also been included (Table 3).

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

2.1 Background

The scope of CERISE is to enhance the quality of the C3S reanalysis and seasonal forecast portfolio, with a focus on land-atmosphere coupling.

It will support the evolution of C3S, over the project's 4 year timescale and beyond, by improving the C3S climate reanalysis and the seasonal prediction systems and products towards enhanced integrity and coherence of the C3S Earth system Essential Climate Variables.

CERISE will develop new and innovative ensemble-based coupled land-atmosphere data assimilation approaches and land surface initialisation techniques to pave the way for the next generations of the C3S reanalysis and seasonal prediction systems.

These developments will be combined with innovative work on observation operator developments integrating Artificial Intelligence (AI) to ensure optimal data fusion fully integrated in coupled assimilation systems. They will drastically enhance the exploitation of past, current, and future Earth system observations over land surfaces, including from the Copernicus Sentinels and from the European Space Agency (ESA) Earth Explorer missions, moving towards an all-sky and all-surface approach. For example, land observations can simultaneously improve the representation and prediction of land and atmosphere and provide additional benefits through the coupling feedback mechanisms. Using an ensemble-based approach will improve uncertainty estimates over land and lowest atmospheric levels.

By improving coupled land-atmosphere assimilation methods, land surface evolution, and satellite data exploitation, R&I inputs from CERISE will improve the representation of long-term trends and regional extremes in the C3S reanalysis and seasonal prediction systems.

In addition, CERISE will provide the proof of concept to demonstrate the feasibility of the integration of the developed approaches in the core C3S (operational Service), with the delivery of reanalysis prototype datasets (demonstrated in pre-operational environment), and seasonal prediction demonstrator datasets (demonstrated in relevant environment).

CERISE will improve the quality and consistency of the C3S reanalysis systems and of the components of the seasonal prediction multi-system, directly addressing the evolving user needs for improved and more consistent C3S Earth system products.

2.2 Scope of this deliverable

2.2.1 Objectives of this deliverables

This deliverable D8.6 provides the mid-term update on dissemination and exploitation plan.

The Exploitation Plan initiated in the earlier deliverable, D8.2, explains the exploitation work within the CERISE project by identifying initial exploitation routes and innovation ideas.

The objective of D8.6 is to report on the dissemination activities of the first 24 months and to provide an update, where appropriate, of the dissemination and exploitation plans.

2.2.2 Work performed in this deliverable

In this deliverable the work outlined in The Description of Action (WP8 T8.4).

The aim being to provide a mid-term update on the dissemination activities as well as re-check the potential for exploitation and their routes.

Feedback from the partners pertaining to both dissemination and exploitation will be garnered throughout the project and be presented in subsequent versions of this document

2.2.3 Deviations and counter measures

No deviations have been encountered.

2.2.4 Reference Documents

[1] Project 101082139- CERISE-HORIZON-CL4-2021-SPACE-01 Grant Agreement

[2] Deliverable D8.2 Dissemination and Exploitation Plan

[3] CERISE website https://cerise-project.eu/

2.2.1 CERISE Project Partners:

ECMWF	European Centre for Medium-Range Weather Forecasts
Met Norway	Norwegian Meteorological Institute
SMHI	Swedish Meteorological and Hydrological Institute
MF	Météo-France
DWD	Deutscher Wetterdienst
CMCC	Euro-Mediterranean Center on Climate Change
BSC	Barcelona Supercomputing Centre
DMI	Danish Meteorological Institute
Estellus	Estellus
IPMA	Portuguese Institute for Sea and Atmosphere
NILU	Norwegian Institute for Air Research
MetO	Met Office

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 24 months, CERISE has been presented 24 times at 14 conferences and workshops as well as at another expert meeting.

CERISE held its first in-person General Assembly at ECMWF premises in Reading, 17th to 19th January 2024. This was very well attended with over 50 project partners.

Patricia de Rosnay, CERISE project coordinator opened the General Assembly before introducing the invited speaker Carlo Buontempo, Director of Copernicus Climate Change Service (C3S, https://climate.copernicus.eu/) at ECMWF. The second invited speaker Magdalena Balmaseda, project coordinator of the linked Horizon 2020 project CONFESS (https://confess-h2020.eu/), followed with a talk on CONFESS and the interplays between the overlapping themes.

The project is actively liaising with the C3S Copernicus Service and CONFESS to ensure synergies are identified and developed; The CERISE project was represented at the annual C3S Copernicus Service General Assembly held in June 2024 and Patricia de Rosnay spoke on CERISE at the CONFESS final General Assembly in March 2024.

The CERISE website has provided regular updates and news items.

A restricted web-based environment has been set up at ECMWF that includes a document repository and acts as the project's collaborative platform. The CERISE website acts as the main location to showcase all project information and outputs. The details of this are described in D8.3.

As a reminder and as per the DoA, CERISE dissemination activities are designed around providing/disseminating information to the scientific communities and relevant stakeholders in three areas:

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

There is one publication so far:

Christoph Herbert, Patricia de Rosnay, Peter Weston, David Fairbairn

"Towards unified land data assimilation at ECMWF: Soil and snow temperature analysis in the SEKF"

https://rmets.onlinelibrary.wiley.com/doi/10.1002/qj.4808

Quarterly Journal of the Royal Meteorological Society

b) and c) Conference and Organised Workshops Talks from M1 to M24

Since the start of the project there have been 11 posters and 30 talks at 25 conferences /work-shops.

Table 1: List of talks and posters given at conferences and workshops since the start of the project

Name	Date	Location	Presenter	Talk (T) / Poster (P) title
24th session of WGSIP at WCRP https://www.wcrp-climate.org/wgsip24	27-29 March 2023	ECMWF,Reading, UK	Tim Stockdale	(T) CERISE CopERnIcus climate change Service Evolution. A brief overview
AIMES third annual virtual workshop of the Land DA Community	20-21 June 2023	online	Ewan Pinnington	(T) Technical Aspects of the ECMWF Land Data Assimilation System
4 CERISE slides included in talk at ECMWF Annual Seminar on Earth System Reanalysis	4-8 Sept 2023	ECMWF, Reading UK and online	Patricia de Rosnay	(T) 'Towards Earth system reanalysis'
The First International Symposium on Earth System Modeling and Prediction,	11-12 Sept 2023	CEMC/ CMA, Nanjing, China	Patricia de Rosnay	(T) Coupled data assimilation activities at ECMWF
6th C3S General Assembly	12-14 Sept 2023	Brno, Czechia	Patricia de Rosnay	(T) and (P) CERISE: Copernicus Climate Change Service Evolution
International Earth System Working Group meeting	26-28 Sept 2023	Finnish Meteorological Institute in Helsinki, Finland	Ewan Pinnington	(T) Towards Ensemble Land Data Assimilation at ECMWF
			Patricia de Rosnay	(T) Coupled land-atmosphere data assimilation at ECMWF

Name	Date	Location	Presenter	Talk (T) / Poster (P) title
			Gernot Geppert DWD	(T) one slide on DWD's activities in CERISE for seasonal prediction initialisation in "Progress towards new variational surface analyses at DWD"
9th International Symposium on Data Assimilation	16-20 October 2023	Bologna, Italy	Vanya Romanova DWD	(P) Integrated atmosphere-ocean-land data assimilation for climate analysis and seasonal predictions.
104th American Meteorological Society (AMS) Annual Meeting	28/1/24- 1/2/24	Baltimore, USA	Ewan Pinnington	(T) Towards Ensemble Land Data Assimilation at ECMWF
CONFESS final General Assembly	5-6 March 2024	ECMWF Reading	Patricia de Rosnay	(T) CERISE project synergies
EGU General Assembly 2024	14-19 April 2024	Vienna, Austria	Anaïs Barella-Ortiz	(P) Evaluation of river discharge simulated with CTRIP forced by the CERRA-Land regional reanalysis over Europe. Submitted to HS2.5.1 – Large-scale hydrology
			Pete Weston	(P) Enhanced coupled land-atmosphere data assimilation for reanalysis AS1.1 – Numerical weather prediction, data assimilation and ensemble forecasting
			Pete Weston	(T) Adaptive soil moisture bias correction in the ECMWF land data assimilation system HS6.1 Remote Sensing of Soil Moisture
			Margarita Chougla	(T) Varying lake surface cover for reanalysis application HS10.6 Lakes and Inland Seas under Global Change
ACCORD Surface Working Group Meeting May 2024 Poland.	13-17 May 2024	IMGW, Kraków, Poland	Abhishek Lodh (SMHI)	(T) Investigating Perturbation Growth in Land Surface Variables: A comparative Analysis of Ensemble and Extended Kalman Filter- Based LDAS

Name	Date	Location	Presenter	Talk (T) / Poster (P) title
S2S Community Workshop: Toward Minimizing Early Model Biases and Errors in S2S Predictions	5-7 June 2024	UCAR, Boulder, Colorado, USA	Abhishek Lodh (SMHI)	(T) Ensemble Kalman filter based Land Data Assimilation for the Soil Diffusion based ISBA model
C3S GA meeting June 2024 Brussels	17-19 June 2024	Brussels, Belgium	Patricia de Rosnay	(T) CERISE: towards enhanced coupling in C3S reanalysis
			Núria Pérez-Zanón	(T) SUNSET demonstration
NCMRWF, Ministry of Earth Sciences, India	28 June 2024	Noida (New Delhi), India	Abhishek Lodh (SMHI)	(T) Ensemble versus Extended Kalman filter based Land Data Assimilation for the Soil Diffusion based ISBA-DIF model
International Soil Moisture School 2024	14-17 July 2024	Budapest, Hungary	Pete Weston	(T) Soil Moisture Applications
Finnish Meteorological Institute	26-30 August'24	Helsinki, Finland	Abhishek Lodh	(T) Land Surface Data Assimilation Research at SMHI
25th European Meteorological Society (EMS) Annual Meeting	2-6 Sept 2024	Barcelona, Spain	Christoph Herbert	(P) Outer-loop land-atmosphere coupling (T) Towards a unified LDAS (P) Coupled land-atmosphere DA in CERISE (authors: Patricia de Rosnay et al.)
			Ekaterina Vorobeva	(P) First results of the snow-atmosphere coupling analysis in the CERISE project (T) A series of major sudden stratospheric warming events in winter 2023/2024
			Jonny Day	(T) How well do Dynamical seasonal forecasts capture soil-moisture atmosphere coupling
			Nils Noll	(P) ICON-XPP in the CERISE project: a first set of seasonal hindcasts
			Núria Pérez-Zanón	(P) SUNSET: SUbseasoNal to decadal climate forecast post-processIng and asSEssmenT suite

Name	Date	Location	Presenter	Talk (T) / Poster (P) title
			Constantin Ardilouze	(T) Global river discharge seasonal forecast via a novel two-way AOGCM↔River coupling
ECMWF Workshop on diagnostics for Global Weather Prediction	9-12 Sept	Reading, UK	Jonny Day	(T) How well do Dynamical seasonal forecasts capture soil-moisture atmosphere coupling
46th EWGLAM and 31th SRNWP Meeting	30 Sept - 3 Oct 2024	Prague, Czech Republic	Patricia de Rosnay (online)	(T) ECMWF coupled land-atmosphere data assimilation
			Abhishek Lodh	(T) Using Ensemble Land Data Assimilation Spread for evaluating the impact of Surface Observations in the ISBA coupled Harmonie-Arome model
ELLIIT Focus Period Symposium on Machine Learning for Climate Science 2024	8– 10 Oct, 2024	Linköping, Sweden	Abhishek Lodh	(P) Ensemble Kalman filter based Land Surface Data Assimilation Developments at SMHI
XXXI Latin American Congress of Hydraulics	4 October, 2024	Medellin, Colombia	Gabriel Narváez	(T) Operational system for global discharge seasonal forecast: A zoom in Latin America
6th WCRP International Conference on Reanalysis	28 October - 1 November	Tokyo, Japan	Hans Hersbach	(P) Coupled land-atmosphere data assimilation developments in support of the next generation of Earth system reanalyses: CopERnIcus Climate Change Service Evolution (CERISE)
CESOC DETECT Land and Climate seminar	8 November	Online	Patricia de Rosnay	(T) ECMWF land data assimilation and plans, including slides on CERISE
7th LAKES Workshop	20-22 November	Milan, Italy	Margarita Chougla	(T) TIME-Varying lake surface cover for reanalysis application
8th SALGEE and LSA SAF User Workshop on Monitoring Drought Impacts on Vegetation & Feedback	25-26 November	Darmstadt, Germany (online)	Patricia de Rosnay	(T) Land surface temperature analysis at ECMWF, including slides on CERISE

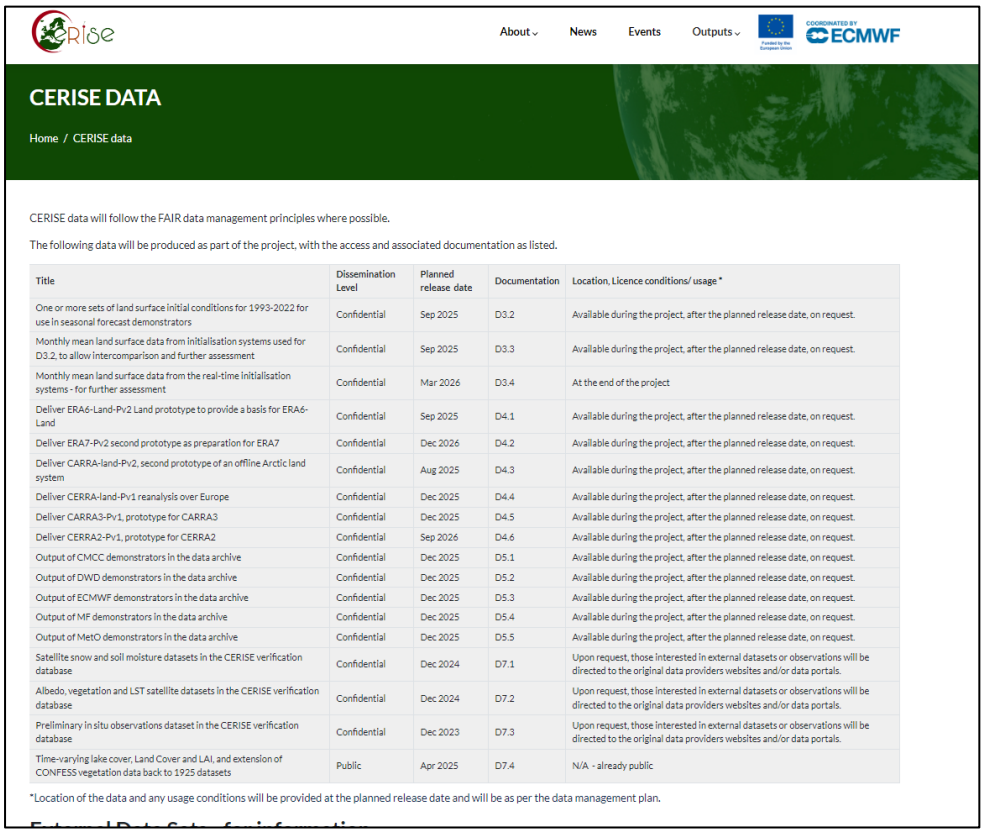
d) Reports to and feedback from Committees and Boards

There have been no reports to or feedback from committees and boards in this timeframe.

3.1.2 Products through dissemination of

a. Datasets and accompanying material (e.g. descriptions, meta data)

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



Title	Dissemination Level	Planned release date	Documentation	Location, Licence conditions/ usage *
One or more sets of land surface initial conditions for 1993-2022 for use in seasonal forecast demonstrators	Confidential	Sep 2025	D3.2	Available during the project, after the planned release date, on request.
Monthly mean land surface data from initialisation systems used for D3.2, to allow intercomparison and further assessment	Confidential	Sep 2025	D3.3	Available during the project, after the planned release date, on request.
Monthly mean land surface data from the real-time initialisation systems - for further assessment	Confidential	Mar 2026	D3.4	At the end of the project
Deliver ERA6-Land-Pv2 Land prototype to provide a basis for ERA6-Land	Confidential	Sep 2025	D4.1	Available during the project, after the planned release date, on request.
Deliver ERA7-Pv2 second prototype as preparation for ERA7	Confidential	Dec 2026	D4.2	Available during the project, after the planned release date, on request.
Deliver CARRA-land-Pv2, second prototype of an offline Arctic land system	Confidential	Aug 2025	D4.3	Available during the project, after the planned release date, on request.
Deliver CERRA-land-Pv1 reanalysis over Europe	Confidential	Dec 2025	D4.4	Available during the project, after the planned release date, on request.
Deliver CARRA3-Pv1, prototype for CARRA3	Confidential	Dec 2025	D4.5	Available during the project, after the planned release date, on request.
Deliver CERRA2-Pv1, prototype for CERRA2	Confidential	Sep 2026	D4.6	Available during the project, after the planned release date, on request.
Output of CMCC demonstrators in the data archive	Confidential	Dec 2025	D5.1	Available during the project, after the planned release date, on request.
Output of DWD demonstrators in the data archive	Confidential	Dec 2025	D5.2	Available during the project, after the planned release date, on request.
Output of ECMWF demonstrators in the data archive	Confidential	Dec 2025	D5.3	Available during the project, after the planned release date, on request.
Output of MF demonstrators in the data archive	Confidential	Dec 2025	D5.4	Available during the project, after the planned release date, on request.
Output of MetO demonstrators in the data archive	Confidential	Dec 2025	D5.5	Available during the project, after the planned release date, on request.
Satellite snow and soil moisture datasets in the CERISE verification database	Confidential	Dec 2024	D7.1	Upon request, those interested in external datasets or observations will be directed to the original data providers websites and/or data portals.
Albedo, vegetation and LST satellite datasets in the CERISE verification database	Confidential	Dec 2024	D7.2	Upon request, those interested in external datasets or observations will be directed to the original data providers websites and/or data portals.
Preliminary in situ observations dataset in the CERISE verification database	Confidential	Dec 2023	D7.3	Upon request, those interested in external datasets or observations will be directed to the original data providers websites and/or data portals.
Time-varying lake cover, Land Cover and LAI, and extension of CONFESS vegetation data back to 1925 datasets	Public	Apr 2025	D7.4	N/A - already public

Figure 1: CERISE Website: Data Page

The public datasets will be uploaded when they are available for use. Other datasets marked as “confidential” will be available on request during the project after the planned release date.

b. Algorithms / Specifications

The Unified land data assimilation system developed in CERISE and published by Herbert et al 2024 (see link in 3.1.1 a)) is being implemented to be used operationally in ERA6, which will benefit the users as soon as the ERA6 production starts.

c. Graphics and animations

None at this time.

3.1.3 Progress information through provision of news items, public deliverables, website and social media

The CERISE website (https://www.cerise-project.eu) has been used for News items and public deliverables to date. (Figures 2 and 3). A page is also available to list the scientific papers (Figure 4).

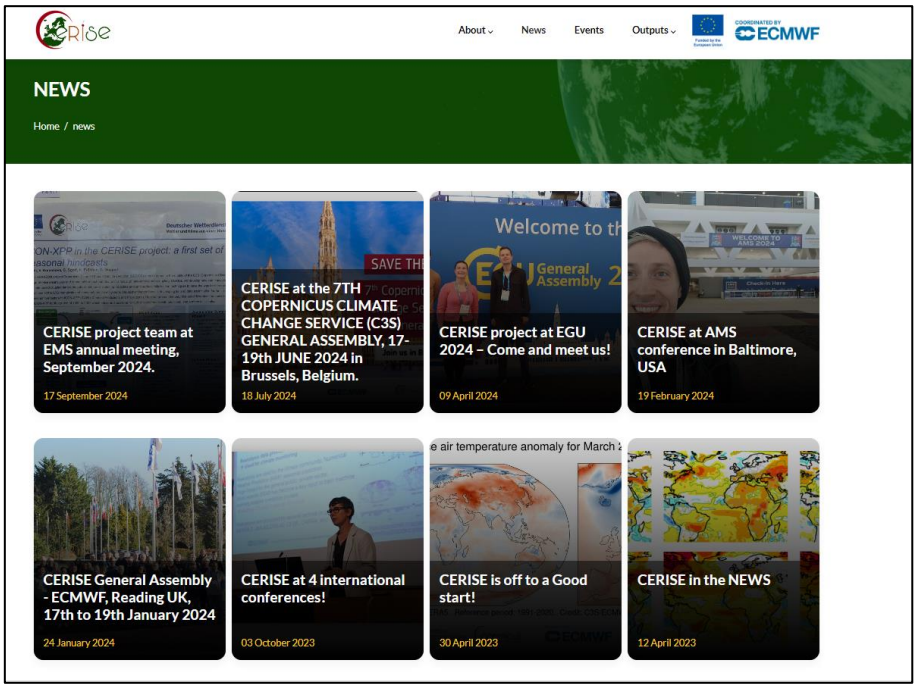


Figure 2: CERISE Website: News Page

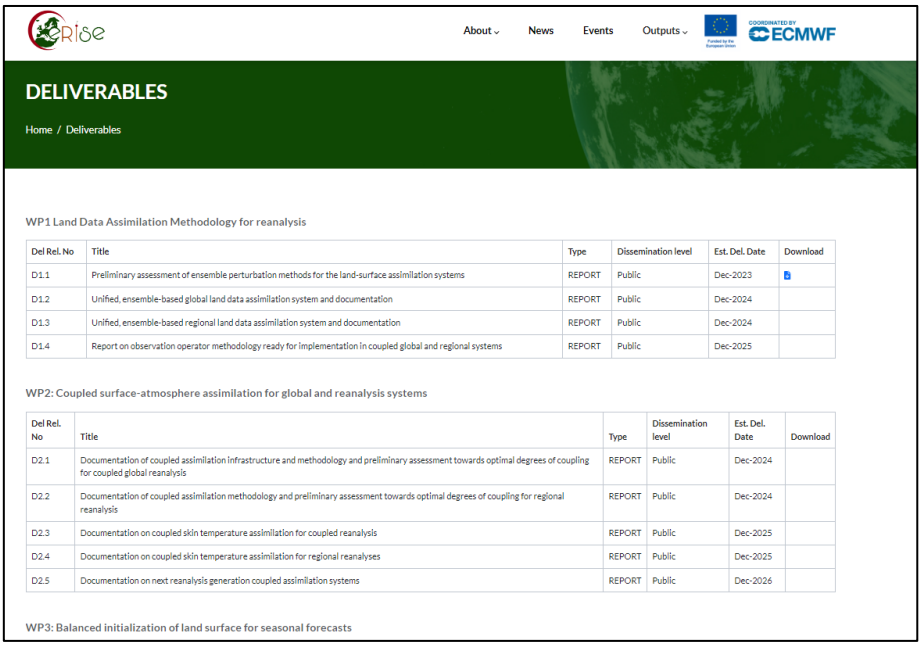


Figure 3: CERISE Website: Deliverables Page

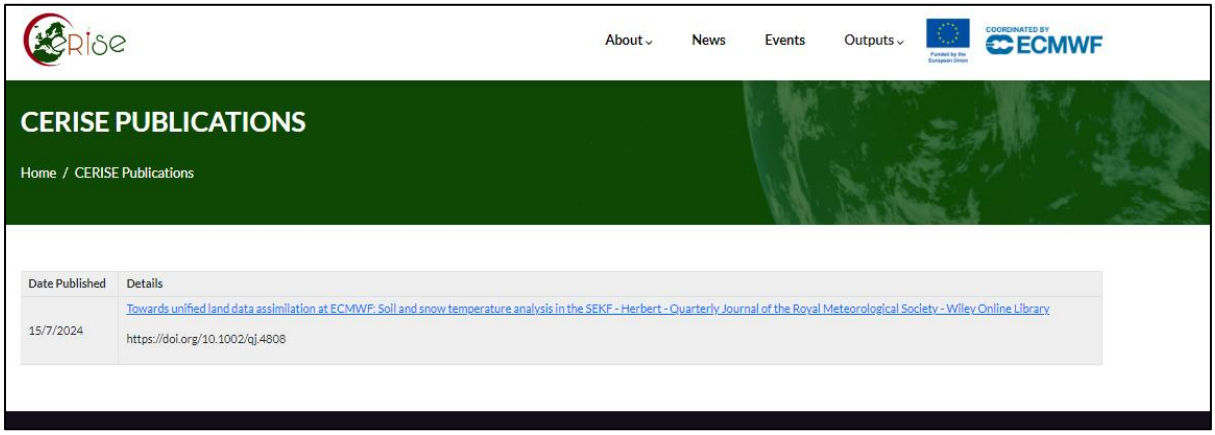


Figure 4: CERISE Website: Publications Page

CERISE 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 CERISE but instead we rely on the established communications channels of C3S and ECMWF. CERISE was one of the projects highlighted by HaDEA attending EGU 2024 (Figure 5) and at C3S General Assembly, June 2024.

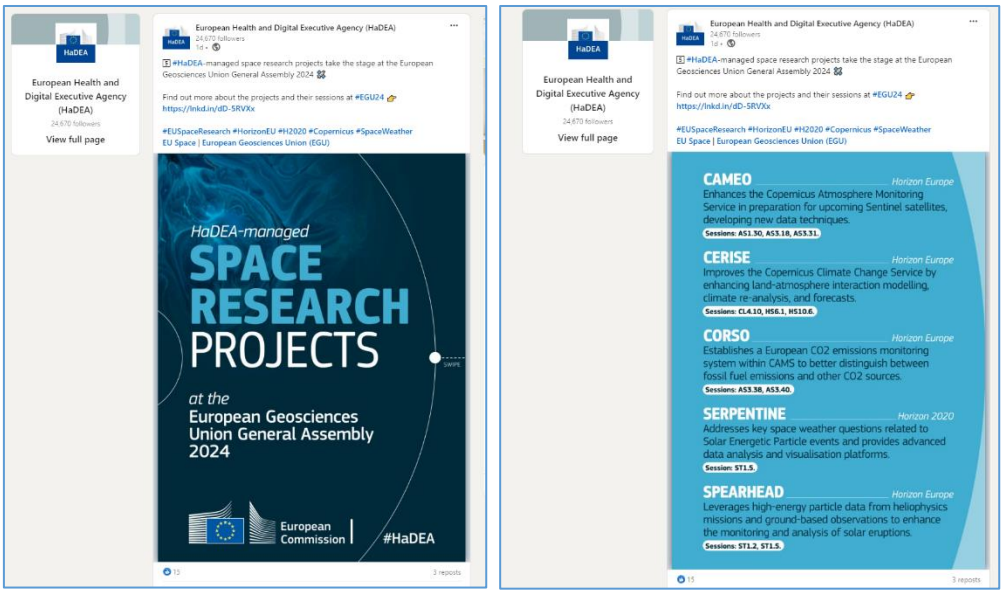


Figure 5: HaDEA announcement on LinkedIn, mentioning the CERISE project

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

Patricia de Rosnay presented CERISE at the C3S General Assembly June 2024 and Nuria Perez-Zanon also demonstrated CERISE work.

Figure 6: C3S General assembly Agenda extract; CERISE project being presented by Patricia de Rosnay and Nuria Perez Zanon demonstrating CERISE work.

The CERISE Website went live May 2023. Google analytics has been used to collect and monitor traffic and users over the last 19 months (May 23 to November 24).

	Session primary...channel group)	Sessions
	Total	318 100% of total
1	Organic Search	187
2	Direct	81
3	Referral	47
4	Organic Social	2
5	Unassigned	1

Figure 7: CERISE Website: Website acquisition,

The majority of users are accessing the website via Organic Search, followed behind by Direct (Figure 7). Proving that the website is easily findable.

The statistics show over 580 users with 590 plus views (Figure 8) and (Figure 9). 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: CERISE Website: Number of users

		Page title and screen class	Views	Active users
☑		Total	593 100% of total	190 100% of total
☑	1	Home | Cerise	212	129
☑	2	Team | Cerise	49	32
☑	3	CERISE data | Cerise	38	26
☑	4	Deliverables | Cerise	34	23
☑	5	Objectives | Cerise	27	15
☐	6	news | Cerise	26	16
☐	7	Consortium | Cerise	21	15
☐	8	Structure | Cerise	21	16
☐	9	About | Cerise	20	16
☐	10	Events | Cerise	18	13

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

The most viewed are the home page and the team page, followed by the CERISE data page (Figure 9).

Figure 10 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.

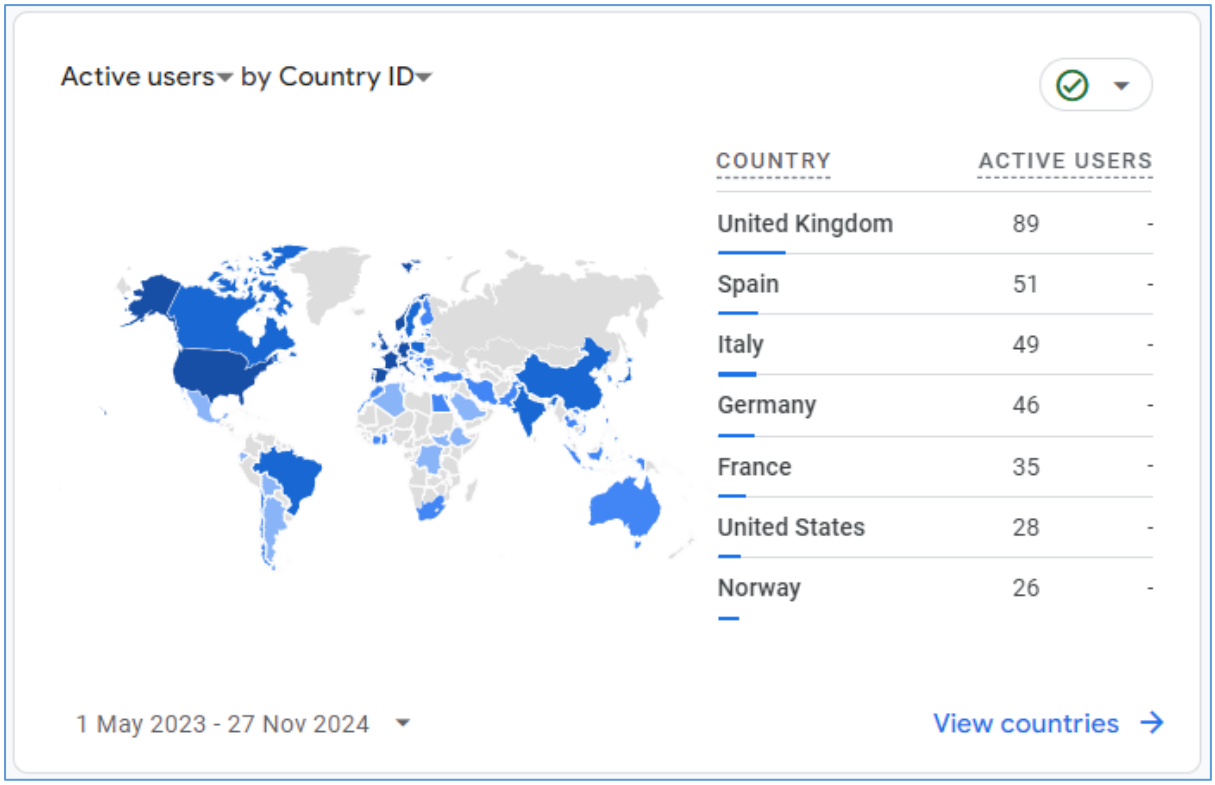


Figure 10: CERISE Website: Users per country.

4 Exploitation Plan

The earlier deliverable, D8.2, already outlined potential exploitation avenues, as per Table 2 below. The exploitation survey to partners, run as part of Deliverable D8.2, shows that the products and activities described remain relevant at this juncture.

As a result of feedback at the M12 review, partners were asked to revise the data that could be made available. This has been reviewed internally and an internal confluence page was used to gather the data that could be made available on request. The website has been updated to reflect this latest status. CERISE data | Cerise

Table 2: Potential exploitation avenues for CERISE

Exploitable Products (in the context of C3S future offerings)	**Data Products:** • Coupled land-atmosphere global and regional scale reanalysis prototypes datasets, • Seasonal forecasts demonstrators datasets with balanced land-atmosphere in initial conditions, • Time varying datasets of lake cover, LAI and land cover back to 1925. **New methodologies**; Innovative C3S coupled land-atmosphere data assimilation approach for reanalysis and seasonal systems. **New AI-based observation operators** to enhance exploitation of surface sensitive Earth system satellite observations, fully integrated in the C3S coupled data assimilation systems. **Novel diagnostic tools and prediction skill metrics** that use new observations and include hydrological variables to assess Earth system coupled reanalysis and seasonal prediction.
Exploitation Activities during the Project	The major activities will be exploited as part of the C3S take-up; • Project reports with recommendations will support uptake/implementation activities in C3S and potentially other frameworks
Exploitation Activities after the end of the Project	**Improved C3S portfolio capabilities;** • Extend C3S portfolio to seamless centennial global fully coupled Earth system reanalyses. • Improved representation of land conditions to improve predictability of continental heatwaves, droughts and water availability forecasts at seasonal timescale. • Any dataset that has been identified as public will be made available to external scientists. • Project reports with recommendations will support uptake/implementation activities in C3S 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 C3S implementation ITTs.

(Any datasets and databases produced will follow the data management plan).

Table 3 shows the current TRL level of the project at Month 24 and the progression since the start of the project.

Table 3: TRL level review at M24

CERISE advances	Initial TRL	Level at RV1 (29/2/24)	Level at RV2 (31/12/24)	Final TRL
Coupled land-atmosphere assimilation capabilities for reanalysis	TRL3	TRL4	TRL6	TRL6/7
AI-based observation operator over land and cryosphere surfaces	TRL3	TRL4	TRL5	TRL5/6
Time varying vegetation and lake cover from 1925 onward	TRL5	TRL5+	TRL6-	TRL6
Balanced land-atmosphere initialisation for multi-system seasonal prediction	TRL4	TRL4+	TRL5	TRL6
Novel diagnostic methods for Earth system reanalysis and seasonal prediction systems	TRL4	TRL4+	TRL5	TRL6

5 Conclusion

This deliverable 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, news items, numerous scientific conference and workshop involvements and scientific papers. This task will continue for the remaining 24 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	Rhona Phipps, Tanya Warnaars, Patricia De Rosnay	November 2024	Initial version
1.0	Updated after internal review	December 2024	Issued

Internal Review History

Internal Reviewers	Date	Comments
Harald Schyberg (Met Norway) and Isabel Trigo (IPMA)	December 2024	Initial version