

ECMWF Copernicus Procurement

Invitation to Tender



Copernicus Climate Change Service Volume II

Regional Climate Reanalysis Timely Updates

ITT Ref: C3S2_360
ISSUED BY: ECMWF Administration Department Procurement Section
Date: 12 April 2021
Version: Final



Funded by the European Union

Implemented by



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1 Introduction

ECMWF as the Entrusted Entity for the Copernicus Climate Change Service (C3S) invites tenders for production of timely updates of regional reanalyses datasets that have been produced in the first phase of Copernicus Programme (COP1) under the contract C3S 322 (Lot1 for Europe and Lot2 for the Arctic). The aim is to extend further in time the two datasets called respectively Copernicus European Regional Reanalysis ([CERRA](#)) and Copernicus Arctic Regional Reanalysis ([CARRA](#)) until a new generation of regional reanalyses will be available. To preserve the consistency of both datasets the timely updates shall be produced using exactly the same data assimilation systems and forecast models that were utilized in COP1. The regional reanalyses datasets are needed to generate high-resolution, physically consistent, gridded estimates of Essential Climate Variables that will complement the information available from lower-resolution global reanalyses. This document describes the technical requirements for the regional reanalysis products to be delivered, as well as other information needed to prepare the tenders.

This ITT is for two separate contracts to continue to generate and deliver timely updates of regional reanalysis products for Europe (Lot 1) and the Arctic (Lot 2). The same Tenderer may respond to both lots. The scope of activities for each contract includes:

- timely updates of reanalysis products, post-processing and quality assurance;
- preparation and quality control of observations and other input data;
- porting to the new ECMWF HPC (located in Bologna) of the regional reanalysis systems that have already been used for production of CERRA and CARRA datasets, respectively;
- user guidance and user support via the C3S Service Desk;
- management, implementation and coordination.

Tenders will be evaluated based on the requirements described in the following sections. Tenderers are encouraged to submit proposals that demonstrate the ability to deliver high-quality operational services with a strong foundation in science, research and development. An overview of the regional reanalysis activities carried out during COP1 can be found on the webpages below:

- Regional Reanalysis for Europe: <https://climate.copernicus.eu/copernicus-regional-reanalysis-europe-cerra?q=regional-reanalysis-europe>
- Regional Reanalysis for Arctic: <https://climate.copernicus.eu/copernicus-arctic-regional-reanalysis-service>

The results of these activities are available to Tenderers and additional technical clarifications can be provided on request.

2 Technical requirements

Hereafter we give a general overview (Section 2.1) what is required from both Lots (for Europe and for the Arctic, respectively) and then specify requirements, which are unique for the individual Lots (Section 2.2 for Lot1 and Section 2.3 for Lot2). Therefore, Tenderers for Lot1 should consider Section 2.1 together with Section 2.2 and Tenderers for Lot2 should consider Section 2.1 together with Section 2.3.

2.1 Requirements for regional reanalysis for both Lots

Regional reanalysis data products are needed for C3S to provide consistent information on a variety of ECVs for the purpose of monitoring the state of the climate and to support development of climate-related information products for European users with economic interests in the region. Data products shall

- be fully consistent with the already delivered products under the previous C3S 322 contracts (see details in the links above for the two Lots);
- include estimates of multiple ECVs and their uncertainties that are consistent in time and space;

- accurately represent observed climate variability and change;
- be continually updated based on recent observations;
- be delivered on a timely basis with the shortest latency possible with respect to the real time (3 months delay or better; see also in sections 2.2 and 2.3).

The regional reanalysis data products must add value to alternative products derived from observations alone, i.e. they shall provide

- complete and consistent coverage of regional (sub)domains;
- ECV estimates that are physically and dynamically coherent.

They must add value as well to global reanalyses, i.e. they shall

- provide data at a higher spatial resolution (see details in Sections 2.2 for Lot1 and 2.3 for Lot2);
- provide improved estimates of surface parameters by using enhanced model representations of surface fluxes;
- assimilate observations that are not used in ERA5 global reanalysis;
- improve the representation of extreme values and extreme events.

Information content of reanalysis data products shall be transparent and fully traceable, by

- making available a complete documentation of all input data records with full traceability to data source and data set versions;
- as much as possible, making use of input data that can be made available to users and are free of any restrictions;
- for all assimilated observations, feedback information shall be generated during data assimilation, including data departures, data quality indicators, estimated observation errors, estimated bias adjustments, and any other information needed to assess how observations were used in the reanalysis.

The timely updates of the reanalysis should be realised within a short latency behind real time. The Tenderer shall specify in detail what is the optimal delay behind real time for their particular reanalysis system and what are the pros and cons in case of even shorter latency. The final decision on the delay behind real time will be reached during the contract negotiation phase based on the information provided by the Tenderer.

2.2 Additional requirements for Lot 1

ECMWF intends to award a single framework agreement (for a maximum duration of 48 months) for the generation of timely updates of regional reanalysis products for Europe. Proposals will be considered offering solutions based on the already existing pan-European regional reanalysis. In COP1, the contract has consisted of two phases: (i) continuation of the European reanalysis as developed in the UERRA project (www.uerra.eu, 11km grid spacing and 65 levels in the vertical for the atmospheric reanalysis and 5.5km grid for the surface reanalysis) spanning 1961 to July 2019 (now completed and publicly available via the CDS), and (ii) production of a new generation of reanalysis using a newly developed system (CERRA) at higher resolution (5.5km grid spacing, 106 levels in the vertical, plus an uncertainty estimate from a 10-member ensemble of data assimilations at 11km) from 1984 to 2021. In both phases the datasets are produced on a geographical area that includes the EURO-CORDEX domain using the HARMONIE-ALADIN system for the atmospheric reanalysis, and the MSCAN-SURFEX system for the surface.

The following are additional requirements for Lot 1:

- for consistency reasons the reanalysis shall be produced using exactly the same reanalysis systems namely the HARMONIE-ALADIN and MSCAN-SURFEX, and integration domains ($\Delta x = \Delta y = 5.5\text{km}$, $1080 \times 1080 \times 106$ grid points for the high-resolution and $\Delta x = \Delta y = 11\text{km}$, $576 \times 576 \times 106$ grid points for the EDA) used for producing the CERRA dataset;

- the reanalysis production shall be maintained close to real time until a new generation of regional reanalysis will be available;
- the reanalysis products shall be made available on a monthly basis with the shortest latency possible with respect to the real time (3 months delay or better);
- consistent estimates of uncertainty shall be generated using a 10-member ensemble of a 3-dimensional variational data assimilation system;
- a well-defined strategy for ensuring temporal consistency of the reanalysis products shall be implemented;
- well-defined strategies for quality assessment during production and post-production shall be implemented, e.g. based on comparison with alternative C3S ECV products derived from observations and/or global reanalyses.
- daily and monthly means for analysed and forecast parameters shall be provided for the entire CERRA dataset; ensemble means and standard deviations shall be also generated for analysed and forecast parameters.
- at the beginning of the Contract a full evaluation shall be performed of the existing CERRA dataset produced in the C3S_322 Lot1 (COP1) contract that includes the assessment of its main strengths and weaknesses.

2.3 Additional requirements for Lot 2

ECMWF intends to award a single framework agreement (for a maximum duration of 48 months) for the generation of timely updates of regional reanalysis products for the Arctic. Proposals will be considered offering solutions based on the already existing reanalysis for the two European Arctic domains. In COP1, the contract was to produce an Arctic regional reanalysis over two subdomains of interest for Arctic change processes and economic activities in the area using the HARMONIE-AROME system. The reanalysis covers the period 1997 - 2021 with a horizontal grid spacing of 2.5 km.

The following are additional requirements for Lot 2:

- for consistency reasons the reanalysis shall be produced using exactly the same reanalysis system namely the HARMONIE-AROME and integration domains ($\Delta x = \Delta y = 2.5 \text{ km}$, 1000x800x65 grid points for CARRA-East and $\Delta x = \Delta y = 2.5 \text{ km}$, 1280x1080x65 grid points for CARRA-West) used for producing the CARRA dataset;
- the reanalyses shall assimilate the main components of the Arctic observing system, including satellite data;
- the reanalyses shall make good use of complementary data on surface properties in the region, e.g., related to snow, glacier and sea ice;
- the reanalysis products shall be made available on a monthly basis with the shortest latency possible with respect to the real time (3 months delay or better); consistent estimates of uncertainty shall be generated based on explicit statistical assumptions on model errors and observation errors;
- daily and monthly means for analysed and forecast parameters shall be provided for the entire CARRA dataset;
- at the beginning of the Contract a full evaluation shall be performed of the existing CERRA dataset produced in the C3S_322 Lot2 (COP1) contract that includes the identification of its main strengths and weaknesses.
- a well-defined strategy for ensuring temporal consistency of the reanalysis products shall be implemented;
- well-defined strategies for quality assessment during production and post-production shall be implemented, e.g. based on comparison with alternative C3S ECV products derived from observations and/or global reanalyses.

2.4 Specification of work

The following work packages are recommended for each Lot.

2.4.1 Work package 1: System maintenance

Although at the beginning of the contract the near real time production might already start using the present ECMWF HPC (located in Reading) there will be a need to port the reanalysis system to the new ECMWF HPC located in Bologna and to test and optimise the end-to-end regional reanalysis production system. This includes the migration of tools for handling input observations, application of data selection rules, quality control checks and bias adjustments, migration of diagnostic tools for system performance monitoring, definition of output parameters and products, migration of post-processing tools, converting data formats, etc, performing of quality assurance checks on data products, development of operational schedules and routine procedures, response protocols to system failures, changes to input data streams, implementation of system upgrades, etc. This work package shall include the computation of daily and monthly means to the production, which were not provided in COP1, but considered valuable products in the survey conducted during the second User Workshop jointly organized by both Lots in September 2020.

Deliverables required: System maintenance, porting, and test reports, report on daily and monthly mean computations.

2.4.2 Work package 2: Input data preparation

Preparation of all input data for reanalysis production, including observations for data assimilation, boundary conditions and forcing data for the assimilating model, lateral boundary constraints for the regional reanalysis, geographical reference data and any other input data needed for reanalysis production. Gathering, formatting, merging and transformation of data as needed to prepare for data assimilation. Preliminary quality assessments of new input observations types (if applicable), specification of observation errors, development of bias corrections and any other preparations needed to optimise the impact of observations on the reanalysis.

Deliverables required: Input data documentation; test reports; report of all input data records.

2.4.3 Work package 3: Reanalysis production

Scheduling of production tasks, system performance monitoring, fault detection and problem solving. Routine quality assurance of reanalysis output based on a range of diagnostics. Post-processing of reanalysis output and output data management. Delivery of data products necessary for CDS ingestion. Support for publication of data products in the CDS and maintenance of the catalogue entries.

Deliverables required: System performance quarterly reports; datasets needed for CDS ingestion.

2.4.4 Work package 4: User guidance and support

Update of documentation and other material aimed at users of regional reanalysis data products. Development and upkeep of web pages with up-to-date information about the reanalysis production, including known issues with the dataset, displays of production targets and measures of progress. Contribution to development of training material for C3S users. Provision of scientific advice and technical support to users via the ECMWF Support (see Section 3.3.3), support and contribution to the C3S evaluation and quality control function (EQC), contribution to C3S communication and user engagement activities (including providing technical and scientific expertise) and particularly support of climate intelligence activities including annual state of the climate reports.

Deliverables required: full evaluation of the dataset, user guides; user support and related material.

2.4.5 Work package 0: Management and implementation

This work package includes overall responsibility for service management and implementation. See Section 4.2.5 below for general requirements on activities and reporting for this purpose.

In addition to these work packages the Tenderer shall include coordination on a technical level between the C3S European and Arctic reanalysis activities, as well as coordination with the global reanalysis activities taking place at ECMWF. This coordination will be overlooked by the technical officers in charge of the two contracts at the ECMWF side. Coordination of reanalysis activities shall cover a broad range of technical issues including use of observations and other input data, aspects of data assimilation, common performance diagnostics, data formats and data management practices, etc. Use of a common data model for storing input observations and feedback information shall continue. The goal of the coordination is to ensure optimal quality and consistency among the global and regional reanalysis data products delivered to C3S, to avoid duplication of work, and to share resources where possible.

3 General requirements

3.1 Schedule

The successful Tenderer for each Lot is expected to provide a detailed time plan and schedule as part of the tender response. The proposed time plan and schedule should specify what regular steps shall be needed in order to keep the timely updates of the reanalysis up and running in a continuous and reliable manner. Regular (typically quarterly) progress meetings will be held with ECMWF during the contract to assess contract status, risks and actions.

ECMWF has to prepare annual Implementation Plans, which must be approved by the European Commission before they can enter into force. The implementation plans will take full stock of service reviews, performed thoroughly on an annual basis, as well as of the continuously evolving user requirements and corresponding service specifications. The successful Tenderer shall therefore provide each year, for ECMWF approval, an updated detailed plan of proposed activities including Deliverables and Milestones, using the Work Package table template in Volume IIIB, which will form part of this Implementation Plan. The successful Tenderer has to report on a quarterly and annual basis.

3.2 Meetings

ECMWF will organise annual meetings to bring together all C3S service providers. The successful Tenderer is expected to attend these meetings. The Tenderer is also expected to attend teleconference meetings to discuss C3S service provision, service evolution and other topics that cut across different aspects of C3S. The cost of attending these meetings shall be covered by each successful Tenderer and shall be included in the tendered price. The cost of organising and attending any additional meetings specific to each Lot shall also be covered by each successful Tenderer and shall be included in the tendered price. It is recommended to use virtual online meetings as much as possible.

3.3 Deliverables

Deliverables required for each task for both Lots are outlined in section 2 (though the list there might not be exhaustive and should be considered as general guideline). These can be in the form of documents or reports, datasets or databases, web services and user support. Requirements for each type are described in the following subsections.

3.3.1 Documents and reports

All reports shall be produced in English. Unless otherwise specified in the specific contract, deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel or compatible).

3.3.2 Datasets

Regional reanalysis data products generated by the Tenderers shall be uploaded to MARS or other designated servers at ECMWF and made available via the CDS. The Tenderer shall assist in the data integration process for the CDS. Data formats to be used shall be the same as agreed with ECMWF during the previous regional reanalysis production. Every dataset and/or service provided shall be documented using the appropriate metadata standards (e.g. ISO 19115).

Data and IPR: It is a condition of EU funding for C3S that ownership of any datasets developed with C3S funding passes from the suppliers to the European Union via ECMWF. Ownership will pass from the date of creation of the datasets. Suppliers will be granted a non-exclusive licence to use the datasets which they have provided to C3S for any purpose.

All software and products used by the successful Tenderer to produce the C3S datasets will remain the property of the successful Tenderer, except for those components which are acquired or created specifically for C3S purposes, with C3S funding, and which are separable and useable in isolation from the rest of the successful Tenderers' production system. The identity and ownership of such exceptional components will be passed to the European Union annually. The successful Tenderer will be granted a non-exclusive licence to use them for any purpose.

3.3.3 User support

ECMWF has established a centralised ECMWF Support to provide multi-tiered technical support to all users of C3S data, products, tools and services. The ECMWF Support is used for ticketing user requests and distributing these requests to specialists as needed. Dedicated staff at ECMWF provides basic support in the form of self-help facilities (FAQs, knowledge bases, tutorials etc.) as well as individualised support on technical queries related to the CDS, data formats, data access etc.

All C3S contractors are expected to contribute to the delivery of multi-tiered technical support for the data and/or services they provide. Such specialised user support shall take the form of direct response to individual user queries via the ECMWF Support facility, as well as contributions to FAQs, user guides and knowledge bases.

As part of the bid, tenderers shall describe the level of user support service on ECMWF Support tickets (for example, 90% of Tier-2 requests answered within 5 working days), with sufficient flexibility to be improved depending on user requirements. Tenderers might also address development of user guides and any other form of user support or user learning services, such as video tutorials, training materials, user workshops, etc.

3.4 Communication

All communication activity must be agreed with the ECMWF Copernicus Communication team in advance. This includes, but not exhaustively, communication planning, branding and visual style, media outreach, website and social media activity, externally facing written and graphic content and events. Agreed activity also need to be evaluated and reported on once complete so that success measures and KPIs can be provided to the European Commission. Depending on its latency, the near real time update datasets might be used for the monthly climate summaries prepared by C3S and particularly for the annual State of the Climate communications.

3.5 Key Performance Indicators

The KPIs shall be designed to quantify different aspects of quality of service against the requirements described in this document.

As part of the bid, the Tenderer shall specify a proposed set of KPIs appropriate for the service, e.g. relating to data access, user support, user satisfaction, etc. These initial specifications shall be refined together with ECMWF during the first 6 months of the contract.

4 Tender Format and Content

Each Lot shall have its own response. If responding to both Lots, Tenderers should make it clear though where synergies exist between the responses.

General guidelines for the tender are described in Volume IIIB. Specific requirements to prepare the proposal for this particular tender are described in the next sub-sections.

4.1 Page limits

As a guideline, it is expected that individual sections of the Tenderer’s response do not exceed the page limits listed below. These are advisory limits and should be followed wherever possible, to avoid excessive or wordy responses.

<i>Section</i>	<i>Page Limit</i>
<i>Track Record</i>	2 (for general) and 2 (per entity)
<i>Quality of resources to be Deployed</i>	2 (excluding Table 1 in Volume IIIB and CVs with a maximum length of 2 pages each)
<i>Technical Solution Proposed</i>	30 (Table 2 in Volume IIIB, the section on references, publications, patents and any pre-existing IPR is excluded from the page limit and has no page limit)
<i>Management and Implementation</i>	10 (excluding Table 4 and Table 5 in Volume IIIB) + 2 per each Work package description (Table 3 in Volume IIIB)
<i>Pricing Table</i>	No limitation

Table 1: Page limits

4.2 Specific additional instructions for the Tenderer’s response

The following is a guide to the minimum content expected to be included in each section, additional to the content described in the general guidelines of Volume IIIB. This is not an exhaustive description and additional information may be necessary depending on the Tenderer’s response.

4.2.1 Executive summary

The Tenderer shall provide an executive summary of the proposal, describing the objectives, team and service level.

4.2.2 Track Record

The Tenderer shall demonstrate that they are able to maintain and operate the same data assimilation system and forecast model, which was used to produce the current regional reanalysis dataset.

4.2.3 Quality of Resources to be Deployed

The Tenderer shall propose a team providing the skills required for providing operational services that meet the technical requirements set out in section 2. The team shall include a Service Manager with at least 5 years of experience in management of similar projects. The Tenderer shall describe the experience of the Service Manager and the technical project team in performing activities related to the various aspects of this tender.

4.2.4 Technical Solution Proposed

The Tenderer shall give a short background to the proposed solution to demonstrate understanding of that solution and of the C3S context. Particularly the continuity and full compatibility with respect to contracts C3S 322 Lot1 and Lot2 should be emphasised and ensured. This section shall also include information on any

other third-party suppliers that are used as part of the technical solution, and a statement of compliance for each requirement formulated throughout this document, describing how the proposed solution maps to the requirements. Any optimisation and efficiency improvements compared to the original C3S 322 contracts can be considered in the bid. This can be also related to the interaction between the two Lots and also with ECMWF global reanalysis activities.

4.2.5 Management and Implementation Plan

For each Lot, the Tenderer shall provide a detailed implementation plan of proposed activities for the duration of the framework agreement. Deliverables should be consistent with the technical requirements specified in section 2. The number of milestones is not restricted, but they should be designed as markers of demonstrable progress in service development and/or quality of service delivery. Adjustments to the proposed implementation plan can be made on an annual basis depending on needs for service evolution, changed user requirements, or other requirements as agreed between the European Commission and ECMWF.

As part of the general service management description the Tenderer shall consider the following elements (this is not an exhaustive list):

- Teleconferences with ECMWF and a proposal for involvement of ECMWF in major contract reviews shall be provided as part of the management plan.
- A proposed payment plan shall be provided as part of the proposal. The payment plan shall be based on payment milestone completion upon successful approval of associated deliverables by ECMWF.
- The following management aspects shall be described: task and resources planning and tracking, quality assurance and control, communication management (ECMWF, stakeholders, internal communication), conflict resolution, subcontractor management, personal data management (i.e. how this meets the requirements of Clause 2.8 and Annex 6 of the Volume V Framework Agreement) and risk assessment and mitigation plans.
- A list of sub-contractors describing their contribution and key personnel, legal names and addresses shall be provided. The Tenderer shall describe how the Framework Agreement, in particular Clause 2.9 has been flowed down to all their sub-contractors.

As part of the general contract management description, the Tenderer shall include the following elements in line with the reporting and planning requirements as laid down in the Terms and Conditions of the Framework Agreement. The table below provides the template to be used by the tenderer to describe the complete list of deliverables, milestones and schedules for the management work package (eg.WPO, cf. template in Volume IIIB Section 5.4). All milestones and deliverables shall be numbered as indicated and document deliverables shall be periodically updated and versioned as described in the table.

Deliverables for work package 0 shall include the following administrative and programmatic reports:

WPO Contractual Obligations				
#	Responsible	Nature	Title	Due
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY <i>QQ YYYY being the previous quarter</i>	Quarterly on 15/01, 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY <i>YYYY being the Year n-1</i>	Annually on 28/02
D0.y.z	Tenderer	Report	Final report	60 days after end of contract

D0.y.z-YYYY	Tenderer	Other	Preliminary financial information YYYY <i>YYYY being the Year n-1</i>	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Draft Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY <i>YYYY being the Year n-1</i>	Annually

Table 2. Administrative and Programmatic Deliverables.

Tenderers shall provide preliminary versions of the completed tables as part of their bid.

5 List of Acronyms

C3S	Copernicus Climate Change Service
CARRA	Copernicus Arctic Regional ReAnalysis
CDS	Climate Data Store
CERRA	Copernicus European Regional ReAnalysis
COP1	Current phase; Copernicus Delegation Agreement until June 2021
COP2	Next phase; Copernicus Contribution Agreement starting in July 2021
EURO-CORDEX	Coordinated Downscaling Experiment, European domain
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
EDA	Ensemble of Data Assimilations
ERA5	European ReAnalysis generation 5
EU	European Union
FAQ	Frequently Asked Question
HPC	High Performance Computing system
ISO	International Organization for Standardization
ITT	Invitation to tender
KPI	Key Performance Indicator
MARS	ECMWF Meteorological Archival and Retrieval System
PDF	Portable Document Format
SMHI	Swedish Meteorological and Hydrological Institute
UERRA	Uncertainties in Ensembles of Regional ReAnalyses
WP	Contract Work Package