

ECMWF Copernicus Procurement

Invitation to Tender



Copernicus Climate Change Service

ECV Products and Services for the Atmospheric
Composition Domain

Volume II: Specification of Requirements

ITT Ref: C3S2_313a
ISSUED BY: ECMWF Administration Department Procurement Section
Date: 8 January 2024
Version: Final



Funded by the European Union

Implemented by



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1 Introduction

The Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF) on behalf of the European Union, develops and delivers authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide. It aims to a) inform policy development to protect citizens from climate-related hazards such as high-impact weather events, b) improve the planning of adaptation practices for key human and societal activities, and c) promote the development of new applications and services for the benefit of society.

To support these goals, C3S provides reliable, open, and free access to a wide variety of datasets via its Climate Data Store (CDS), including Climate Data Records (CDRs) consistently derived from satellite observations, together with “Interim” extensions of those Climate Data Records (ICDRs) based on recent observations that can be used to monitor climate change.

C3S and its partners in Europe have made substantial progress in enhancing the capabilities for sustained generation of CDRs. The role of C3S is to facilitate the transition from research to operations by ensuring reliable access to the CDRs and all information needed to use them effectively. C3S relies on third parties for the development, production and updating of CDRs and ICDRs, together with technical documentation and specialist support as needed.

The CDRs and ICDRs currently available on the CDS include a range of Essential Climate Variables (ECV) products (see GCOS-245) in five domains: atmospheric physics, atmospheric composition, the ocean, land hydrology and cryosphere, and land biosphere. New Invitations to Tender (ITT) for provision of ECV products and services in each of the five domains will be issued in 2024.

Continuity of service is a key requirement for C3S. In addition, the main goals for the new ITTs are:

- To ensure the highest possible quality for all ECV products, based on GCOS requirements and best practices.
- To achieve Full Operational Capacity for all ECV products currently available on the CDS.
- Provide access to additional ECV products if operational capability is sufficiently advanced.

Operational capacity for CDR generation shall be assessed by applying the maturity model introduced by Bates and Privette (2012), addressing technical readiness of software, metadata, documentation, product validation, public access, and utility. In particular, Full Operational Capacity shall be achieved when each of the maturity levels have reached 5 or 6 (Bates et al., 2016).

This Invitation to Tender (ITT) is for the provision of ECV products and services in the domain of atmospheric composition, specifically for:

- **Carbon Dioxide and Methane,**
- **Ozone,**
- **Aerosols Properties.**

Details on scope and technical requirements are described in Section 2.

2 Technical Requirements

2.1 Service scope and requirements

This ITT pertains to the provision of operational services aimed at ensuring dependable access to high-quality, consistent, and globally homogeneous satellite climate data products via the CDS in the domain of atmospheric composition. The services shall include the following technical activities:

- Operation and maintenance of processing systems to generate CDR / ICDR datasets (unless these

- operations are supported by other initiatives).
- Implementation and/or improvement of operational production chain components as needed to achieve Full Operational Capacity, as defined in Section 1.
 - Provision of access to datasets via the CDS.
 - Quality assurance and validation of the resulting datasets.
 - Provision of supporting documentation that describes the operational algorithms employed in dataset generation, outlines the results of quality assessments, and a user guide to assist users in the appropriate utilisation of the datasets.
 - Maintenance of metadata describing CDR datasets and their associated documentation.
 - Provision of user support services.
 - Contribution to the European State of the Climate, contingent upon the maturity and latency of the ECV data, or an alternative form of support for climate intelligence.

The Tenderer shall clarify ownership and use licenses for all ECV products to be provided, including any pre-agreed arrangements with product owners related to interfaces, documentation, user support, user statistics, licenses, product identification/citation, etc.

The Tenderer shall also clarify any dependencies on third parties for any of the activities listed here, including processing, provision of input data, research and development, or any other elements needed to fulfil the requirements for this ITT.

2.2 Dataset Characteristics

All datasets shall meet the following criteria:

- Be of sufficient length, consistency, homogeneity, and continuity to represent past climate variability and change and have global or near-global coverage.
- Be derived primarily from satellite observations.
- Offer the best achievable spatial coverage and resolution for climate applications, while maintaining the necessary data quality for ECVs, considering the quality of available input observations.
- Incorporate meaningful estimates of uncertainty, encompassing both accuracy and precision.
- Include comprehensive metadata detailing data provenance to ensure full traceability of information.

Data Processing Level: Priority shall be given to higher level (level 3/4) ECV products that span at least 20 years. Proposals for lower-level and/or shorter data records must be justified based on well-identified user requirements.

Frequency of updates: ICDR datasets using newly acquired input data shall be updated at a predictable frequency. The Tenderer shall propose update frequencies that align with the dataset's temporal resolution and allow sufficient time for comprehensive quality control.

Reprocessing: Datasets shall be reprocessed when enhanced algorithms and/or newly available input data, such as data from newly launched satellites, enable significant improvements in product quality for end users in terms of long-term consistency, temporal/spatial resolution, accuracy, or precision. **The Tenderer shall include potential reprocessing options in their proposals.**

GCOS requirements: For each proposed CDR, the Tenderer shall include in the proposal a preliminary assessment against GCOS quality requirements as documented in GCOS-245.

Maturity levels: For each proposed CDR, the Tenderer shall include in its proposal a brief assessment of current maturity levels as described in the supplementary material of Bates and Privette (2012).

Moreover, all datasets shall be:

- Delivered using data formats, metadata and protocols as described in Section 3.4.

- Fully documented in line with deliverables detailed in Section 2.3.2.
- Backed up with specialised user support as described in Section 2.3.3.

2.3 Work to be undertaken

The successful Tenderer shall carry out the following tasks:

- **Operational System Resilience:** Maintain (or implement for new ECV products) a robust operational system with well-defined operating schedules and procedures. Address routine operation, strategy for delivering timely and frequent updates of ICDRs, swift responses to system failures, interruptions in input data, system upgrades to stay at the forefront of technological advancements (e.g., incorporating improved algorithms, new data sources), and reprocessing requirements.
- **Data Supplier Arrangements:** Establish and maintain necessary arrangements with input data suppliers to meet the operational production requirements, data delivery, and regular updates.
- **Product Specification Maintenance:** Maintain product specifications that align with target requirements for all CDRs and ICDRs to be delivered, using GCOS requirements as a baseline, but also ensuring that these specifications reflect C3S user needs, the availability and timeliness of input observations, current state of research (e.g., CCI outcomes), technical capabilities, etc.
- **Metadata Management:** Maintain metadata for data products using tools provided by ECMWF.
- **Product Generation and Data Handling:** Maintain and/or implement processes and systems for product generation and data management to facilitate the delivery of CDRs and ICDRs to C3S users through the CDS, taking advantage of existing capabilities to the fullest extent possible.
- **Scientific Quality Assurance:** Implement a systematic approach to ensure the highest scientific quality of data products. This includes input data quality control, routine monitoring of data production, and ongoing assessment of CDRs for continuity, accuracy, and stability.
- **Documentation:** Update, expand or establish links to informative documentation encompassing data products, quality assessments, and guides to users.
- **User Support:** Offer specialised user support for all products through the C3S Service Desk.
- **Climate Information:** Contribute to development of data information products for the annual European State of the Climate and/or provide regular climate information related to ECV data products.

2.3.1 Data production and access

The bulk of the work to be undertaken is concentrated in this task. The primary objective is to attain Full Operational Capacity of production chains for CDRs and ICDRs. The successful Tenderer shall ensure the timely generation and technical and scientific quality of ICDRs, and implement all processes or systems needed for generating (or brokering) new versions of quality controlled CDRs. The successful Tenderer shall ensure reliable and timely access to all data products and associated documentation through the CDS. Information on data integration and publishing mechanisms and expected interaction with the CDS technical team is given in section 3.4.

Deliverables shall include:

- **Dataset Registration (DR):** Accurate description of all product characteristics needed to integrate the dataset into the CDS. The successful Tenderer shall maintain this information for the duration of the contract. A document template and/or access to Content Management Systems shall be provided by ECMWF.
- **ECV Data Product(s):** Provision of the associated data record to the ECV product.

- **Interim Climate Data Records (ICDRs):** These are CDRs that have been forward-processed in time using the associated baselined CDR algorithm and processing environment.

2.3.2 Documentation

The objective of this task is to provide high-quality, up-to-date and consistent documentation for all data products.

Deliverables shall include:

- **Dataset Documentation Package (DDP):**
 - **Algorithm Theoretical Basis Document (ATBD):** Describes the physical and mathematical basis of algorithms and systems used to generate data products, e.g., data dependencies; use and source of auxiliary data; all aspects of data processing and quality control; calibration and bias adjustment; filtering, interpolation, transformation; uncertainty estimation, etc. It shall contain sufficient detail to be able to serve as a reference document for implementing the production systems, including **the choice of the Fundamental Data Record used as baseline reference for L3/L4 products, and ensure full traceability to the source.**

To avoid extra work, the ATBD, or parts of it, may incorporate or refer to **existing open-access peer-reviewed papers**, or existing consolidated documents (e.g., ESA-CCI equivalent ATBDs) on the condition that it comprehensively addresses all sections of the template that will be provided by ECMWF.
 - **Product Quality Assessment Report (PQAR):** Describes the approach to product quality assurance and methods used for product validation, as well as the assessments performed on the provided datasets, including any application-specific assessments if available. Dataset validation should follow best practices protocols where available.
 - **Product User Guide and Specification (PUGS):** This document shall be designed and written for non-specialist C3S users with varying backgrounds. It shall contain descriptions of all data products and the observing instruments used to produce them, and any information needed for traceability (e.g. algorithm name and version, processing level, etc.). It shall include the data specification, and any specific information and aspects to consider when using the data, including data format and file names, product content and attributes, quality indicator and flags, data masks and filtering (including information on gap filling strategy). **This document shall also include any known issues and limitations, data disclaimers and/or suitability for specific sectors/applications, as well as best practices to use the dataset for climate variability and trend analysis.**
- **Target Requirements - Gap Analysis Document (TR-GAD):** This document shall be delivered 6 months before the conclusion of the contract. It shall address gaps and limitations to data fitness-for-purpose and identify scientific research needs. The document shall explore opportunities for exploiting new observations, in particular from the Sentinel family of satellites. The document may for example highlight limitations in existing coverage, processing algorithms, or methods for estimating uncertainties. The TR-GAD is a crucial document that may be shared with data providers and research funding agencies to underscore the significance of ongoing research activities to maintain a state-of-the-art operational system.

Use of Confluence: All new documentation and updates shall be created in the Confluence-based documentation workspace dedicated to this project, prior to publication in the C3S Knowledge Base (CKB). ECMWF will provide guidelines to develop documentation in this reserved space.

ICDR documentation: Dedicated documentation for ICDRs is not required, except to register significant events and their impact on data quality, e.g. due to changes in satellite instruments, algorithms, or quality

assurance methods. The associated documentation should be cumulative, preserving relevant content from prior versions whenever possible.

Re-use of existing documentation: Where feasible, ECV contractors are encouraged to maximize and provide updates to existing documentation, as long as they are available in the Confluence-based workspace.

Brokered datasets: In case of fully documented datasets provided by third parties, it is sufficient to provide links to those documents if appropriate. The successful Tenderer shall ensure that those links are correct and accessible for the duration of the contract.

Templates: ECMWF will provide templates for each of the documents described in this section to the successful Tenderer at the start of the contract.

2.3.3 User support and climate intelligence

The objective of this task is twofold: to provide specialised support to users of the delivered products and services, and to contribute to the overall C3S climate intelligence efforts.

User support: ECMWF has a well-established centralised User Support to provide multi-tiered technical support to all users of C3S data, products, tools and services. A service desk system is used for ticketing user requests and distributing these requests to specialists as needed. Dedicated staff at ECMWF promote and maintain self-help facilities (knowledge base (CKB), user forum, FAQs and tutorials etc.) and also provide individualised support on technical queries related to the CDS, data formats, data access etc. In addition, ECMWF staff members provide specialised scientific support to address questions related to its industrial contributions to C3S, e.g., in the areas of global reanalysis and seasonal forecasting.

All C3S contractors are expected to contribute to the delivery of multi-tiered technical support for the data and/or services they provide. The successful Tenderer shall provide expert (Level-2) support through a) the Jira ticketing system with agreed KPIs (for example, 85% of Level-2 tickets should be resolved within 15-working days) and/or b) the user forum (<http://copernicus-support.ecmwf.int/forum>) by monitoring topics and providing responses.

Climate Intelligence: As part of its Climate Intelligence activities, C3S produces information and knowledge products based on the data stored in the CDS. Once the ECV demonstrates maturity as an indicator of long-term changes in climate, the successful Tenderer is expected to contribute with products and interpretation derived from the appropriate dataset in the CDS for the annual European State of the Climate. In cases where this is not feasible, the Tenderer shall propose an alternative form of contribution that showcases the long-term trends (if any) of the product or impact in climate, subject to agreement with ECMWF. The aspiration is to incorporate these contributions into a future ECV's dashboard providing climate information with recent data. The proposed update frequency for these products should align with the latest available information.

Other forms of climate intelligence (for instance, use cases demonstrating the value of the data records to specific economic sectors) may also be considered.

2.4 Work Packages (WPs)

The successful Tenderer shall provide access to datasets for each of the ECV Products listed in the WPs below, representing the minimum set of products expected within the Tenderer's proposal. The successful Tenderer for these ECVs shall, in accordance with the requirements described in Section 2.2 and 2.3, ensure consistency with the datasets currently available via the CDS. Reference definitions for these products can be found in the third column of Tables 1-3, and they adhere to the GCOS definition as specified in the 2022 GCOS ECVs Requirements document (GCOS-245). Nonetheless, proposals suggesting new products or technical solutions to replace any of the products in these tables may also be considered.

2.4.1 WP1: Carbon Dioxide and Methane

This Work Package shall include all technical activities required for generation, access, documentation, and support services as described in this ITT, for the ECV Products listed in Table 1.

The Tenderers shall propose an implementation plan for this Work Package that contains a detailed specification of tasks, together with estimates of person-months required for each task.

The Tenderers shall provide a self-assessment of current maturity levels for each proposed ECV product, based on the maturity matrix presented in Bates and Privette, (2012), together with a plan for increasing maturity levels in order to attain Full Operation Capacity for each product.

ECV	ECV product	Reference GCOS-245
Carbon Dioxide, Methane and Other Greenhouse Gases	CO ₂ mole fraction	Sect.3.1.2
	CO ₂ Column Average Dry Air Mixing Ratio	Sect.3.1.3
	CH ₄ Mole Fraction	Sect.3.1.4
	CH ₄ Column Average Dry Air Mixing Ratio	Sect.3.1.5

Table 1: Minimum set of ECV products required for Carbon Dioxide, Methane and Other Greenhouse Gases ECV

Priority must be given to the production and delivery of multi-decadal, merged L3 Greenhouse Gases products with the highest possible resolution, to enable assessment of long-term climate variability and trends. These include column-average dry-air CO₂ and CH₄ mixing ratios, as well as their mid-tropospheric mixing ratios. These estimates may be derived (but it is not limited), respectively, from 1) nadir-viewing sensors with high sensitivity in the near infrared and shortwave infrared, such as SCIAMACHY onboard Envisat, TANSO-FTS on board GOSAT, TANSO-FTS-2 onboard GOSAT-2 or OCO-2 (for CO₂ only) and 2) hyperspectral infrared sounders such as IASI (for both CO₂ and CH₄) and AIRS (CO₂ only). The proposed products must benefit from the advances made in the ESA-CCI Greenhouse Gases project or other relevant projects in this context.

2.4.2 WP2: Ozone

This Work Package shall include all technical activities required for generation, access, documentation, and support services as described in this ITT, for the ECV Products listed in Table 2.

The Tenderers shall propose an implementation plan for this Work Package that contains a detailed specification of tasks, together with estimates of person-months required for each task.

The Tenderers shall provide a self-assessment of current maturity levels for each proposed ECV product, based on the maturity matrix presented in Bates and Privette (2012), together with a plan for increasing maturity levels in order to attain Full Operation Capacity for each product.

ECV	ECV product	Reference GCOS-245
Ozone	Ozone Mole Fraction in the Troposphere	Sect.3.2.1
	Ozone Mole Fraction in the Upper Troposphere/ Lower Stratosphere	Sect.3.2.2
	Ozone Mole Fraction in the Middle and Upper Stratosphere	Sect.3.2.3
	Ozone Tropospheric Column	Sect.3.2.4
	Ozone Stratospheric Column	Sect.3.2.5
	Ozone Total Column	Sect.3.2.6

Table 2: Minimum set of ECV products required for Ozone ECV

Priority must be given to L3 and L4 products enabling multi-decadal assessment of ozone evolution. These include total column estimates or vertical profiles derived from nadir viewing sensors such as OMI, GOME, SCIAMACHY, GOME-2, IASI and TROPOMI and limb viewing sensors, including for instance ACE, GOMOS, MIPAS OMPS, OSIRIS, SAGE-2 and SCIAMACHY. Merged products using multi-sensor approaches are encouraged. The proposed products must benefit from the advances made in the ESA-CCI Ozone project or other relevant projects in this context.

2.4.3 WP3: Aerosols

This Work Package shall include all technical activities required for generation, access, documentation, and support services as described in this ITT, for the ECV Products listed in Table 3.

The Tenderers shall propose an implementation plan for this Work Package that contains a detailed specification of tasks, together with estimates of person-months required for each task.

The Tenderers shall provide a self-assessment of current maturity levels for each proposed ECV product, based on the maturity matrix presented in Bates and Privette, (2012), together with a plan for increasing maturity levels in order to attain Full Operation Capacity for each product.

ECV	ECV product	Reference GCOS-245
Aerosols Properties	Aerosol Light Extinction Vertical Profile (Troposphere)	Sect.3.4.1
	Aerosol Light Extinction Vertical Profile (Stratosphere)	Sect.3.4.2
	Multi-wavelength Aerosol Optical Depth	Sect.3.4.3
	Aerosol Single Scattering Albedo	Sect.3.4.7

Table 3: Minimum set of ECV products required for Aerosols ECV

Priority must be given to monthly average L3 and L4 products enabling multi-decadal assessment of aerosols evolution. These include datasets derived from different type of instruments and measurement principles such as 1) nadir-view imager spectrometers such as MERIS or OLCI 2) dual-view imagers such as ATSR-2, AATSR or SLSTR, 3) Thermal infrared hyperspectral sounders such as IASI, 4) polarimetric sensors such as POLDER or 5) star occultation instruments such as GOMOS. Merged products using multi-sensor approaches are encouraged. The proposed products must benefit from the advances made in the ESA-CCI Aerosols project or other relevant projects in this context.

2.5 Schedule of technical deliverables

The Tenderers shall propose for the WPs 1, 2 and 3 a coordinated schedule of deliverables that incorporates new versions of data products and their temporal extensions, based upon advances in algorithms and newly available input observations. The successful Tenderer shall prepare and deliver all technical/scientific deliverables listed in Table 4, in accordance with the indicated naming convention.

Deliverable name	Deliverable ID	Contents / Purpose	Primary Audience	Release schedule	Attached to
Dataset Registration (DR)	WP[1-3]-DR-ECV-[SENSOR/SATEL LITE/algorithm]-[version]	To specify all the information needed about the dataset to enable its integration into the CDS	ECMWF	Per major product release (including reprocessing)	Dataset
ECV Data Product	WP[1-3]-CDR-ECV-	The CDR associated to this ECV.	Dataset users	Per major product release	Dataset

	[SENSOR/SATEL LITE/algorithm]-[version]			(including reprocessing)	
Interim Climate Data Record (ICDR)	WP[1-3]-ICDR-ECV-[SENSOR/SATEL LITE/algorithm]-[version]	Temporal extension of a CDR, using the baseline algorithm of the associated CDR	Dataset users	Ongoing (tenderer should specify the frequency of delivery)	Dataset
Dataset Documentation Package (DDP)	WP[1-3]-DDP-ECV-[SENSOR/SATEL LITE/algorithm]-[version]	ATBD: To describe the algorithms used to generate the ECVs in sufficient detail to allow informed users to understand the applicability of the resulting products for their needs. Note that for brokered datasets the delivery of associated documents may simply be a link to the source documentation. PQAR: To describe the results of the quality assessment. PUGS: A user guide for the dataset allowing users to understand the essential characteristics of the data, its applicability and how to access it. Can reference the ATBD and PQAR for more details	Dataset users	Per major product release (including reprocessing)	Dataset
Target Requirements / Gap Analysis Document	WP[1-3]-TR/GAD-ECV	To provide an overview of the target requirements for an ECV, the current state of performance in meeting those requirements, and a roadmap of future actions to improve performance	Dataset users, data providers and funding agencies	Once, 6 months before the end of the contract	Individual ECVs
User Support	WP[1-3]-US-ECV	Specialised user support via the C3S Service Desk – To respond to user support queries requiring expertise specific to the ECV products provided	Dataset Users	Ongoing, reported quarterly in the Quarterly Implementation Report (QIR)	
Climate Intelligence	WP[1-3]-CI-ECV	Specific data summary extracts, commentary and interpretation from selected datasets chosen to be represented in the European State of the Climate report or in a future ECV's dashboard.	Dataset Users	Q1 for the ESOTC or To-Be-Defined for other type of contribution	Dataset

Table 4: List of technical deliverables for WP1-3

2.6 WPO: Management and coordination

All management and coordination activities for the services shall be included in a single work package. The following activities shall be listed in the Tenderer's proposal:

- Planning, coordination, and monitoring of all technical Work Packages.
- Contractual obligations as described in the Volume V Framework Agreement Clause 2.3 "Reporting and Planning" and Annex 5 "Report content".
- Organising and attending meetings:
 - ECMWF and the successful Tenderer will organise a Kick-Off Meeting, within the first month of the contract's implementation, at ECMWF premises in Bonn, Germany.
 - ECMWF and the successful Tenderer's Service Manager and Technical Lead will organise Progress Review Meetings, linked to Payment Milestones, on a quarterly basis unless otherwise agreed.
 - ECMWF will organise a maximum of two ad-hoc cross-CDR meetings per year (cf. Section 3.3).
 - ECMWF will organise an annual C3S General Assembly. The successful Tenderer is required to attend these meetings with team members representing the different ECVs that are part of this ITT.
 - The successful Tenderer will organise annual in-person Service Readiness Review meetings, where at least a representative per ECV will be required. The main purpose is to conduct a thorough review of the status of every ECV component of the operational system. The meeting also aims to identify any potential issues and make decisions about moving forward based on the findings and recommendations presented.
 - ECMWF will host regular ad-hoc teleconference meetings to discuss this C3S service provision and other topics. The Project Manager appointed by the successful Tenderer, as well as a representative of the WP under discussion, will represent the successful Tenderer in such meetings.
 - The Tenderer can propose additional project meetings as part of their Tender.
- Quality assurance and control: the final quality check of the deliverables should be made by the prime contractor (contents, use of ECMWF's templates for deliverables and reports, format, deliverables/milestones numbering and naming, typing errors, etc.).
- Implementation of checks, controls, and risk management tools for both the prime contractor and its sub-contractors.
- Communication management (ECMWF, stakeholders, internal communication).
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 "Personal Data Protection" of the Volume V Framework Agreement.
- Sub-contractor management, including dispute resolution, e.g., the Prime contractor is responsible for settling disagreements, although advice/approval from ECMWF may be sought on the subject.
 - A list of Sub-contractors, if any, describing their contribution and key personnel shall be provided, as well as back-up names for all key positions in the contract. The Tenderer shall describe how the Volume V Framework Agreement, in particular Clause 2.9 "Sub-contracting", has been flowed down to all their Sub-contractors.

The table hereinafter provides the Tenderers with the complete list of deliverables and milestones, as well as the corresponding schedule and due dates, for WPO:

Deliverable / Milestone ID	Responsible	Nature	Deliverable / Milestone title	Due date
List of deliverables				
WPO-QIR-YYYYQQ	Tenderer	Report	Quarterly Implementation Report YYYYQQ <i>YYYYQQ being the previous quarter (e.g. 2024Q3)</i>	Quarterly on 15/04, 15/07 and 15/10
WPO-AIR1-YYYY	Tenderer	Report / Other	Annual Implementation Report for year YYYY – Part 1 including both: <ul style="list-style-type: none"> · the Quarterly Implementation Report YYYY Q4 and · the requested preliminary financial information for year YYYY <i>YYYY being the Year n-1</i>	Annually on 15/01
WPO-AIR2-YYYY	Tenderer	Report	Annual Implementation Report for year YYYY – Part 2 <i>YYYY being the Year n-1</i>	Annually on 28/02
WPO-FIR	Tenderer	Report	Final Implementation Report	Not later than 60 days after the end of contract and once all other activities duly performed
WPO-AIP-YYYY	Tenderer	Report	Annual Implementation Plan for year YYYY <i>YYYY being the Year n+1</i>	Annually on 30/09
WPO-FIN-YYYY	Tenderer	Other	Copy of Prime Contractor’s general financial statements and audit report for year YYYY <i>YYYY being the Year n-1</i>	Annually, not later than on 15/12 ⁽¹⁾
List of milestones				
WPO-KOM	Tenderer	Presentation and MoM	Kick-Off Meeting	Not later than 30 days after the start of contract
WPO-PRMxx	Tenderer	Presentation and MoM	Progress Review Meeting #xx <i>xx being the iteration number of the PRM</i>	Circa every 3 months ⁽¹⁾
WPO-XCDR-YYYY-xx	Tenderer	Attendance	cross-CDR meeting YYYY #xx <i>xx being the iteration number of the X-CDR</i>	on 31/05 and 30/11 ⁽¹⁾ (circa every 6 months)
WPO-SRR-YYYY	Tenderer	Presentation and MoM	System Readiness Review YYYY	Annually, not later than on 15/12 ⁽¹⁾
WPO-C3SGA-YYYY	Tenderer	Attendance	C3S General Assembly YYYY	Annually, not later than on 15/12 ⁽¹⁾

Table 5: WPO deliverables and milestones

⁽¹⁾ These due dates are indicated to frame the corresponding deliverables and milestones schedule only, consequently the following shall be considered by the Tenderer:

- the general financial statements shall be sent by the contractor as soon as available,
- the schedule of the Progress Review Meetings shall be aligned with the different Payment Milestones during the contract negotiation (i.e. each Payment Milestone shall have at least one corresponding Progress Review Meeting),
- the cross-CDR may take place at different dates depending on the respective availabilities of all concerned parties,
- the SRR may take place on different annual due dates as agreed between parties during the contract negotiation, and
- depending on the year, the C3S General Assembly may take place at a different period of the year.

3 General requirements

3.1 Implementation schedule

ECMWF intends to award a single Framework Agreement for a period of maximum 44 months, which shall be implemented via a single Service Contract expected to commence in May 2024.

The Tenderer shall provide a detailed implementation plan of proposed activities for the full period of the contract.

3.2 Deliverables and milestones

The Tenderers shall provide the list of deliverables and milestones (cf. ITT Volume IIIA “Pricing and deliverables”, Excel spreadsheet “Deliverables List”) for each Work Package. All deliverables and milestones must be consistent with the activities and objectives described in Section 2 of this ITT Volume II:

- A deliverable is a substantial, tangible or intangible good or service produced as a result of a project (see also the deliverable definition in this ITT Volume V Clause 1.2 and Clause 3.2). In other words, a deliverable is a verifiable outcome produced in response to the specific objectives of the contract and is subject to approval by both ECMWF’s Technical Officer (TO) and Contract Management Officer (CMO) before being considered as contractually approved. All document deliverables shall be periodically updated and versioned as described in Tables 4 and 5 above.
- Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery during the contract implementation (see also the milestone definition in this ITT Volume V Clause 1.2). They should not duplicate deliverables.

The following shall apply to the deliverables and milestones:

- The deliverables and milestones should be consistent with and meet the technical requirements specified in Section 2 of this ITT Volume II;
- All contract deliverables shall be produced in English;
- The quality of reports shall be equivalent to the standard of peer-reviewed publications and practice;
- Regarding the format of the deliverables, unless otherwise specified in the contract, or requested by ECMWF during the contract implementation:
 - For the WPO, the deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel/HTML or compatible, while all other formats - if any - must be agreed during the contract negotiation), via the Copernicus Deliverables Repository portal.
 - For the other WPs, the deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel/HTML or compatible, while all other formats - if any - must be agreed during the contract negotiation) via the platform agreed between parties for the other

WPs deliverables and milestones. Furthermore, when necessary, the successful Tenderer shall make the outputs of their work available on a server accessible by ECMWF using standard protocols such as FTP or https. The data formats to be used shall be agreed during the contract negotiation. ECMWF will only accept data in formats that follow internationally recognised standards. Such standards must be open (i.e. non-proprietary), managed by a recognised international standardisation body (e.g. ISO, WMO, OGC, etc.), or any de-facto standard. Open-source software should also exist that can read and write files of these standards. Serialisation formats (e.g. NetCDF) should be supported by standard schemas and conventions.

The following shall apply in ITT Volume IIIA “Pricing and deliverables” (cf. Excel spreadsheet “Deliverables List”):

- Deliverables and milestones shall respectively follow the referencing system used in Sections 2.5 and 2.6 of this ITT Volume II. Any additional deliverables and milestones shall follow the same referencing system.
- Each deliverable shall have an associated resource allocation and price (cf. column I “Nb of PM allocated” and column J “Estimated price”), while the only resource type to be considered is “payroll” (the total of these allocated resources and prices shall therefore amount to the total price associated with payroll in Volume IIIA spreadsheet “Costs and Prices”).
- Milestones shall not attract the budget under Volume IIIA in the Excel spreadsheet “Deliverables list”.

The Tenderers shall provide a due date for each proposed deliverable and milestone (in accordance with those indicated in Section 2 for each Work Package):

- ECV-related Copernicus services are running in operational mode and timely delivery of services is essential. **The Tenderer shall therefore ensure that the proposed due dates for all deliverables and milestones are realistic and achievable**, i.e. the Tenderer shall also consider dependencies*, the source of original data and assess the risk accordingly.
- It is advised to schedule the submission/completion of the last deliverables and/or milestones associated to a Payment Milestone not later than 15 days before the expected date of completion of the said Payment Milestone (i.e. when all deliverables have been submitted by the contractor and all milestones have been completed by the concerned parties).

(Please note that any dependencies on input data, whose origin must be specified, shall be detailed by the Tenderer, and also accounted for in the risk register (cf. ITT Volume IIIB Section 5.6).*

3.3 ECV Cross-CDR Working Group

ECMWF has a well-established ECV Cross-Climate Data Records (X-CDR) Working Group whose main purposes are the following ones:

- To ensure that all ECV contractors are fully informed of C3S developments and requirements.
- To share information among the different ECV thematic hubs and contractors (e.g. issues faced, and solutions proposed, procedures and processes).
- To identify common requirements and technical specifications for ECV product generation.
- To share expertise and lessons-learned regarding the ECVs to avoid duplication of work.

A maximum of two ad-hoc X-CDR sessions will occur annually, each lasting approximately 1,5h. The contract Service Manager and Technical Lead, as well as the technical leads of each technical WP, are expected to participate in those respective meetings.

3.4 Data Access via the CDS

The CDS has been designed as a distributed system that provides access to datasets and tools through a

unified web interface. A general description of the design and functionality can be found in Raoult et al. (2017). The contractor shall provide the data in a way that is compatible with the working practice of the CDS, but this is not limited to the data format and standard but also covers metadata and documentation.

3.4.1 Dataset registration

Dataset suppliers to the CDS shall provide a comprehensive description of their datasets at least two months prior to delivery, using a dataset registration process established by ECMWF. The corresponding deliverable (DR) is part of the list of deliverables for each WP. The successful Tenderer will be required to submit details of the products to be generated, including the temporal scope, input data to be used and summary metadata for the products, as well as to maintain details of the scientific documentation related to the products. Exact details of the registration process, which serves to collect all CDS relevant information (to define metadata, landing page user forms and necessary adaptors), will be provided to the preferred Tenderer during negotiation.

3.4.2 Access methods

Data access to CDRs, ICDRs and documentation can be implemented in the CDS distributed infrastructure either by:

- (a) **Push mode:** uploading datasets to a designated ECMWF CDS server.
- (b) **Pull mode:** providing datasets via web services.

ECMWF has a strong preference for push mode. In case pull mode is implemented, the contractor shall ensure that the data products are stored in one or more EU members countries. The contractor is responsible for storing the data for at least 6 years after the contract has come to an end.

The Tenderers are encouraged to distribute the data in non-proprietary file format (NetCDF, csv, shape files, etc.) provided through a web service and accessible by simple commands like `wget`. The “*ECMWF metadata recommendations for NetCDF*” document, available at <https://confluence.ecmwf.int/x/9lsjDQ>, provides recommendations for encoding the datasets in NetCDF. Requests for access to those web services will originate from the CDS, as part of a workflow run on behalf of an end-user. ECMWF will therefore need to have the necessary credentials to invoke these services. ECMWF will not provide information on the end user’s identity when invoking the web services, nevertheless it will collect usage statistics for all aspects of C3S.

3.4.3 Publication of Data Catalogue Entries

The main result of the data integration and data publication processes is a Data Catalogue Entry. Data suppliers shall contribute to those processes. A Data Catalogue Entry is a hypertext document providing access to a collection of data or datasets. Typically, the entry has its own Digital Object Identifier (DOI) and citation (which can differ from the DOIs and citations associated with the underlying data or datasets).

More information on the **Data Integration** and **Data Publication Processes**, as well as on the **Deprecation and Replacement of datasets** in the CDS is available at:

<https://confluence.ecmwf.int/display/COPCO/Dataset+integration+in+the+Catalogue%3A+pre-publication%2C+publication+and+post-publication>.

3.5 Communication

The successful Tenderer shall support ECMWF in its communication activities for the C3S services, where they are related to the activities described in this ITT, especially in what regards the contributions to the European State of the Climate report. Additional activities such as C3S website news items, C3S brochures and flyers, may be discussed on a case-by-case basis during the contract implementation.

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. Such agreed communication activity would also need to be evaluated and reported on, once complete, so that success measures and KPIs can be provided to the European Commission.

3.6 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 Tenderer's production system. The identity and ownership of such exceptional components will be passed to the European Union via ECMWF annually. The successful Tenderer will be granted a non-exclusive licence to use them for any purpose.

A distinction ought to be made between:

- those datasets (or relating documentation) specifically created as a result of this ITT, which, as Deliverables, will be fully owned by the EU, and
- pre-existing datasets (or documentation), which are simply brokered / made accessible as part of the services.

Such brokered datasets (or documentation) will continue to be owned by their original owner. The successful Tenderer will licence the relevant brokered data/documentation to ECMWF/EU or will procure on behalf of ECMWF a licence directly from the owner. Such licence will ensure the best available terms of accessibility and redistribution, bearing in mind the purpose of the Copernicus Programme and the free and open terms of accessibility and redistribution, established for Copernicus products in the Copernicus Data Regulation (see respective definition in Volume V Clause 1.2). At a minimum, the successful Tenderer shall grant, or procure on behalf of ECMWF, the right for the brokered datasets (or documentation) to be made available via the Climate Data Store (CDS) on terms consistent with any applicable specifications of ECMWF and the Copernicus Data Regulation. The successful Tenderer will be responsible to provide the license terms to ECMWF in a suitable format in order for ECMWF to make the brokered datasets (or documentation) available via the CDS. The successful Tenderer will inform ECMWF of any updates to such terms. In this case, ECMWF is procuring a service, rather than the datasets (or the documentation) themselves.

The proposal shall thus provide a clear distinction between both cases by setting the nature of:

- the datasets (or relating documentation) specifically created as a result of this ITT to "Dataset" or "Report",
- the brokered datasets (or relating documentation) made accessible as part of the service to "Brokerage Dataset" or "Brokered Report".

Please note that, in both cases, the bidder shall warrant that it has all necessary rights to either pass on ownership to the ECMWF/EU or, alternatively, that it has all necessary rights to grant the required license to ECMWF and the EU in respect of brokered datasets (or documentation), as described above. Please refer to the ITT Volume V (Framework Agreement) for further details of the license required.

The source datasets of each ECV product and associated Intellectual Property Rights (IPR) shall, in addition, be detailed as follows in the proposal:

<i>Deliverable name</i>	<i>ECV title</i>	<i>Product title</i>	<i>Version number</i>	<i>Source</i>	<i>Description of IPR on the source dataset (e.g. licensing)</i>
...	Brokered from xxx / Produced in house based on datasets from xxx	...
...

Foreseen Assets, Background IPR, Improvements and Brokerage Datasets (as defined in the ITT Volume V Clause 3) shall also be described in the proposal.

Detailed contractual terms, including terms to give effect to the arrangements described above, are set out in the ITT Volume V.

3.7 Key Performance Indicators (KPIs)

The successful Tenderer shall report to ECMWF on a set of Key Performance Indicators (KPIs) suitable for monitoring the following aspects of the service performance:

- Data and service quality (accuracy, stability, coverage, maturity).
- User support.
- Contract management.

The tables below provide examples of KPIs that may be used by the Tenderers, along with examples of performance targets, frequency of delivery and explanations, to build their Tenders. Note that KPI.D1, KPI.D2, KPI.U1 and KPI.C1 in the tables below must be part of the contract. The Tenderers may propose additional KPIs suitable for their specific ECVs but shall limit them to the sole KPIs whose reporting may help to optimize the performance of the contract in case of deviation per comparison with the performance targets.

- List of **data and service quality KPIs**:

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI.D1	Self-assessment of the operational system's maturity		Once per year	Include a maturity matrix, as in the supplementary material of Bates, J. J. and Privette, J. L., (2012), to enable self-assessment of the service's operational capability.
KPI.D2	System Quality Assessment & Reliability	Percentage fixed within one week (guideline 100%)	Quarterly	Report the occurrences of production system failures and subsequent fixed made

KPI.D3.1	<i>Accuracy</i> ECV Product #1 in latest Quarter	According to Target Requirements (TRs)	Per major product release	TRs can evolve over time
KPI.D3.2	<i>Stability</i> ECV Product #1 in latest Quarter	According to Target Requirements (TRs)	Per major product release	TRs can evolve over time
KPI.D4.1	....	....	....	....
KPI.D4.2	....	....	....	....
KPI.D4	....	....	....	....

- List of **user support KPIs**:

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI.U1	User Support ticket response during last quarter	85% within 15 working days	Quarterly	Resolve user issue
KPI.Ux	....	....	....	....

- List of **contract management KPIs**:

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI.C1	Deliverables submitted on time for review during last quarter	100%	Quarterly	Due dates are the deadlines (inclusive) for the deliverables to be submitted for review by ECMWF
KPI.Cx	....	....	....	....

All KPIs shall be labelled and numbered as indicated in the tables above.

During the contract implementation, all KPIs shall be duly reported by the contractor in the Quarterly Implementation Reports (QIR) in accordance with their frequency of delivery.

For the sake of clarity, the Tenderers shall provide preliminary versions of the completed tables as part of their Tender.

3.8 Payment Plan

The Tenderers can propose a Payment Plan in ITT Volume IIIA “Pricing and deliverables” (cf. Excel spreadsheet “Payment Plan preparation”):

- The Payment Milestones should relate to the deliverables and milestones delivered during the corresponding Payment Milestone period (e.g. the payment covering the period January-June would only relate to the deliverables and milestones whose due dates are part of the same period).

- It is recommended to have Payment Milestones, and therefore payments, with an anticipated date of completion every 6 months.
- The frequency of Progress Review Meetings might be adapted to synchronise with the anticipated date of completion of each Payment Milestone.
- In case of request for a payment at contract signature, please note that this should be duly substantiated (e.g. in terms of necessary investment prior to implementation or during first weeks/months for ensuring the initial set up of the project). It is necessary to relate this payment to activities subject to other Payment Milestones.

4 Tender Format and Content

General guidelines for the Tender are described in Volume IIIB of this ITT. This section describes specific requirements to prepare the proposal for this particular Tender, along with guidelines for minimum content expected to be included in the proposal, 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.

4.1 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.

Section	Page Limit
<i>Executive Summary</i>	2
<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>	20 (Table 2 in Volume IIIB, the section on references, publications, patents and any background IP is excluded from the page limit and has no page limit)
<i>Management and Implementation</i>	6 (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 6: 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 for itself and for any proposed Sub-contractors that they have experience with relevant projects in the public or private sector at national or international level. ECMWF may ask for evidence of performance in the form of certificates issued or countersigned by the competent authority.

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 large-scale 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 the state-of-the-art in the C3S context and hence justify their proposed solution. The description of the technical solution shall include:

- A review of the current provision of (I)CDRs within the CDS and their performance against requirements (e.g. from existing TR-GADs and/or with reference to GCOS requirements, GCOS-IP 2022).
- For each ECV product, a brief assessment of the maturity of the operational system, following the model proposed in the supplementary material of Bates and Privette (2012).
- Identify those CDRs which are meeting requirements (or are close) and propose to continue the time series as-is.
- Identify those CDRs where the Tenderers can make significant improvements and propose updates to the processing (or where new data is available).
- Identify those CDRs that should not continue to be developed for justified reasons (e.g. no data source, poor performance, complete state-of-the-art data set already available in the CDS).
- Identify those products that can be consolidated (e.g. where several different products are provided for one ECV).

The Tenderer shall present an analysis of fitness for purpose of each CDR (in terms of quality, uniqueness, etc.) and present options in line with the available budget. Where brokered ECV products are proposed as part of the technical solution, their inclusion shall be justified, and the agreement of the third-party supplier shall be detailed.

This section shall also provide a statement of compliance for each requirement formulated throughout this document, describing how the proposed solution maps to the requirements. Additionally, **where equivalent data products are also available through other Copernicus services or major research programmes, the Tenderer should detail the differences that justifies the production in C3S.**

4.2.5 Management and Implementation

As part of the general project management description, and in addition to the guidance provided in Volume IIIB, Tenderers shall consider the elements described in section 2.6 above. Note that costs associated with fulfilling WPO requirements shall not exceed 10% of the total price of the Tender.

Furthermore, should any Sub-contractors be proposed in the Tender, in order to ensure a comprehensive and realistic proposal, it is a mandatory requirement for the Tenderer to actively involve all such Sub-contractors in the development of the proposal. This involvement should include, but is not limited to, collaborative planning, clear communication of project timelines, and agreement on deliverables and deadlines. The Tenderer must provide documented evidence of this collaboration, demonstrating that each Sub-contractor has been consulted and has agreed to their respective roles, responsibilities, and deadlines as outlined in the proposal. This requirement is instituted to promote a cohesive and feasible project plan, reflecting a true and committed partnership among all participating entities.

5 Additional information

5.1 References

- GCOS-245: The 2022 GCOS ECVs Requirements. Available at: <https://library.wmo.int/idurl/4/58111>
- Bates, J. J. and Privette, J. L., (2012), A maturity model for assessing the completeness of climate data records, *Eos Trans. AGU*, 93(44), 441. <https://doi.org/10.1029/2012EO440006>
- J.J. Bates, J.L. Privette, E.J. Kearns, W. Glance, X. Zhao, (2016), Sustained production of multidecadal climate records: lessons from the NOAA climate Data Record Program, *Bull. Am. Meteorol. Soc.*, 97 (2016), pp. 1573-1581, 10.1175/BAMS-D-15-00015.1
- Raoult, B., C. Bergeron, A. López Alós, J-N. Thépaut, D. Dee, 2017: Climate service develops user-friendly data store. *ECMWF Newsletter No. 151*, 22-27. Available at <https://www.ecmwf.int/sites/default/files/elibrary/2017/17181-newsletter-no-151-spring-2017.pdf>

5.2 Acronyms

ATBD	Algorithm Theoretical Basis Document
CCI	Climate Change Initiative
CDR	Climate Data Record
CDS	Climate Data Store
CKB	Copernicus Knowledge Base
C3S	Copernicus Climate Change Service
DDP	Dataset Documentation Package
DOI	Digital Object Identifier
DR	Dataset Registration
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
ESOTC	European State of The Climate
EU	European Union
FAQ	Frequently Asked Questions
FTP	File Transfer Protocol
GCOS	Global Climate Observing System
GCOS-IP	GCOS Implementation Plan
HTML	Hyper Text Markup Language
ICDR	Interim Climate Data Record
ISO	International Organization for Standardization
ITT	Invitation to tender
KPI	Key Performance Indicator
MoM	Minutes of Meeting
NetCDF	Network Common Data Form
OGC	Open Geospatial Consortium
PDF	Portable Document Format
PQAR	Product Quality Assessment Report
PUGS	Product User Guide and Specification
QIR	Quarterly Implementation Report
SRR	System Readiness Review
TR-GAD	Target Requirement – Gap Analysis Document
WMO	World Meteorological Organisation
WP	Work Package
X-CDR	Cross-Climate Data Records