

ECMWF Copernicus Procurement

Invitation to Tender



Copernicus Climate Change Service

Quality Assurance for C3S Applications, Derived
Datasets and Learning Resources

Volume II: Specification of Requirements

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1 Introduction

The Copernicus Climate Change Service (C3S) implemented by 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 mitigation and adaptation practices for key human and societal activities, and c) promote the development of new applications and services for the benefit of society.

Within its first phase (2015 – 2020), Cop1, the Service consolidated many years of preparatory research and development to deliver a range of operational services. In its second phase (2021 – 2027), Cop2, these services are further consolidated, improved and expanded to address all the existing and emerging societal needs related to climate services.

Evaluation and Quality Control (EQC) is a central component of C3S to establish the service as a trusted source of climate information, delivering quality-assured and authoritative service outputs such as datasets and applications that are traceable and reproducible. The EQC function ensures transparency of the service outputs including their quality attributes and builds the basis for a true operationalisation of climate services and the inclusion of climate data into policies and standards. Quality is a key element to build trust between users and providers.

ECMWF as the Entrusted Entity for the Copernicus Climate Change Service invites tenders for implementation of the EQC function for C3S applications, derived datasets such as indicators, served via the Climate Data Store (CDS), as well as the workflows (batch-processing scripts) and respective code used to produce these. EQC of learning resources is an additional component of this tender. The successful Tenderer shall be responsible for the management and execution of quality assurance and quality assessment for these service outputs.

EQC for baseline datasets (i.e. reanalysis, predictions, projections, satellite and in situ observations) is already addressed by another contractor (C3S2_520). Hence, these datasets are not in scope of this tender.

2 Background Information

The purpose of this section is to clarify the context of this tender and to describe the status of EQC activities as a result of the CDS modernisation. Specific technical requirements for the work to be carried out under this tender are described in Section 3 of this document.

2.1 Climate Data Store (CDS)

The backbone of the C3S is the cloud-based Climate Data Store (CDS) [<https://cds.climate.copernicus.eu/>] that provides users with a single point of access to quality-assured climate and meteorology data. The datasets may be stored in different data centres worldwide or in remote servers, but this complexity is transparent to CDS users. C3S data is offered with open access and is free to use under the Copernicus data licence. Data are properly documented and enriched by appropriate quality attributes provided by the EQC function. All CDS data and tools are accessible from the C3S website as well as via open Application Programming Interfaces (APIs).

The CDS data catalogue provides access to climate datasets and applications via a searchable catalogue. Categories of products include baseline datasets (satellite and in situ observations, reanalyses, predictions and projections), applications and derived datasets such as indicators. Each catalogue entry comes with downloading functionalities as well as access to documentation and quality-related content.

The CDS is currently undergoing a substantial modernisation process that will be completed in 2024. A new Climate Data Store (CDS) and a new Atmosphere Data Store (ADS) powered by a new state-of-the-art software infrastructure, referred to as the Common Data Store Engine, are soon to be launched. A Beta release is scheduled for Q2/2024.

All layers of the CDS and ADS service are being modernised: the front-end web interface, the back-end software engine and the underlying cloud infrastructure hosting the service and core data repositories. The current CDS Toolbox will be discontinued and is not migrated to the new CDS service. New tool packages will be made available (post new CDS launch) to provide software tools for weather and climate workflows that simplify data access, analysis, visualisation and much more.

The functional scope of the CDS Toolbox is superseded by earthkit - an open-source python project led by ECMWF which provides powerful and easy-to-use tools for working with Earth system data. Earthkit users can access CDS and ADS datasets directly and use a range of processing, analysis, and visualisation tools without having to worry about data formats. The development design of earthkit is modular and open-source to encourage contributions from the wider community and contracted partners. The packages are fully documented and available for everyone to use.

2.2 Applications and Derived Datasets

During the first phase of the Copernicus Programme (Cop1), C3S addressed the needs of multiple sectoral users both in Europe and at the global level, mainly through the Sectoral Information System (SIS). Under the second phase of the Copernicus Programme (Cop2), operational SIS activities cover the water, energy, insurance, and agriculture sectors. These activities develop sector-specific indicators and other derived datasets, as well as web-based applications. Additional demand for applications and derived datasets beyond the scope of the operational SISs is expected via the emerging C3S National Collaboration Programme (NCP) and additional partnerships with institutional users, such as EEA, EIB and ENTSO-E, for which ECMWF co-develops turn-key solutions to serve specific data needs in scope of specific decision-making processes.

Web-based applications, indicators and other datasets derived from existing CDS datasets are produced by dedicated ECMWF contractors and delivered following the guidelines provided by ECMWF. The code to develop these products is being implemented and maintained in a way that allows C3S users to re-use the workflows and apply them to other data according to their own needs. Where possible and appropriate, contractors will use and contribute to ECMWF quality-assured software packages (e.g. earthkit). The development of software packages follows the ECMWF Software Strategy¹.

C3S applications follow the ECMWF applications style guide which includes instructions on the components libraries to use. Any new components developed are written generically such that they could be added to an ECMWF software components library. In the back end the applications use python and ECMWF software (e.g. earthkit) for processing the data and calculating metrics. Applications are appropriately documented with a view that this documentation may also be published on user facing websites.

Examples of the relevant categories for this tender are provided in the following table:

Category	Example
Applications	Climate Pulse https://pulse.climate.copernicus.eu/ Climate Atlas https://atlas.climate.copernicus.eu/

¹ <https://www.ecmwf.int/en/elibrary/81334-software-strategy-and-roadmap-2023-2027>

	<p>European Energy and Climate Data Explorer</p> <p>https://cds.climate.copernicus.eu/cdsapp#!/software/app-energy-explorer-europe</p>
Derived datasets	<p>Example climate indicators:</p> <p>https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-biodiversity-cmip5-global?tab=overview</p> <p>Example bias corrected dataset:</p> <p>https://cds.climate.copernicus.eu/cdsapp#!/dataset/sis-ecv-cmip5-bias-corrected?tab=overview</p>

There are currently more than 290,000 registered users of the CDS, with approximately 2,500 active users daily and delivery of 1 petabyte per week. Real-time usage information for the CDS is available at <https://cds.climate.copernicus.eu/live/>.

2.3 Learning Resources

As an operational service, C3S offers training and knowledge transfer in the use of the data and tools in its portfolio. The aim of the C3S training programme is to provide guidance to existing and new users, to equip them with the necessary skills needed to make the most of all products and resources offered by C3S, and to encourage use of best practices. The training programme caters to a wide variety of user types and application domains as identified by targeted user segmentation activities. It also maintains flexibility to rapidly respond to evolving needs for training and knowledge transfer, and to take advantage of opportunities for collaboration as they may arise.

C3S training activities have included training courses, webinars, the development of Jupyter notebook tutorials and e-learning resources, and contribution to Massive Open Online Courses (MOOCs). These activities have often taken place in collaboration with other entities.

All learning resources and activities can be found in the C3S user learning services landing page: <https://climate.copernicus.eu/user-learning-services>. C3S learning resources evolve in line with other ECMWF learning resources to ensure synergies.

2.4 Evaluation and Quality Control

C3S has established an EQC framework for all its products and services. The goal is to ensure that users are served well and that this will continue to be the case as their needs evolve. Previous work by C3S on EQC of CDS datasets has focused on creating comprehensive quality assurance reports, which contain detailed technical information about data, metadata and documentation, assessments of data maturity, results of routine checks on data integrity and completeness, output from various diagnostic tools, and descriptions of relevant use cases. This approach was recently revised for CDS datasets to further enhance the direct relevance and the usability of quality information by the users the service targets.

The main goal for the EQC of CDS datasets is to deliver precise statements about data quality attributes that pertain to well-identified use cases. Those statements, in combination with other documented information about the datasets, constitute a knowledge base that can help users to assess fitness for purpose, given their needs and requirements. The vision is that a user can employ a range of tools for locating, selecting, and accessing climate data, simply by expressing requirements in their own language.

The EQC framework in Cop2 makes a distinction between quality assurance and quality assessment. Quality assurance serves to inform users that data, metadata and documentation comply with a well-defined set of verifiable technical requirements. It provides evidence that this compliance has been checked independently from the producers. Quality assurance for each CDS dataset is implemented by verifying a set of well-defined

technical requirements associated with the dataset. Specific assessment criteria for the respective data streams (e.g. reanalysis, projections) are developed to account for the different nature of these and the different types of checks that may have to be applied to verify the requirement. The role of EQC evaluators is to check these criteria and document the outcome to users. Each requirement is formulated as a verifiable statement about data records, metadata, documentation, or all three combined (see Appendix 1, section 6.1.1). The outcomes of the quality assurance process for each dataset are displayed on the CDS web pages in the form of a summary checklists. The user can click on the checklist to see the actual statements of technical requirements for the dataset, how they are verified, and additional information about non-compliance if needed. Appendix 2 (see section 6.1.2) shows an example of the assessment criteria for a specific data stream that follow the overarching C3S data requirements.

The purpose of quality assessments, on the other hand, is to provide science-based information about accuracy, uncertainties, sources of uncertainty, temporal consistency, strengths, and weaknesses of a dataset in the context of a realistic use cases. In many instances, especially for datasets that are widely used, relevant information is available in the published literature. In either case, it requires a dedicated effort to generate or extract this type of information and present it in a form that is helpful to CDS users. The applications published on the CDS provide examples of real use cases for CDS datasets. A user of an application might ask for information about the accuracy of the parameters in the reference period or the main sources of uncertainty in the data used in the tool, and how those uncertainties affect the results. A thorough assessment of those user questions, based on published literature and additional data analysis if needed, could provide useful information for users of this application as well as related applications based on similar methods.

EQC evaluators are tasked with developing quality assessments that are designed to generate useful statements about fitness for purpose of CDS datasets. The assessments address concrete questions about data quality associated with real use cases. Many of the assessments are implemented in Jupyter notebooks that can be shared, re-used, and modified by users. Assessments can involve multiple CDS datasets and use other sources of reference data. Assessments must build on relevant scientific literature, including published documents developed by producers and users of the datasets.

Taken together, the outcomes of these activities provide the key information needed to determine fitness for purpose (Figure 1).

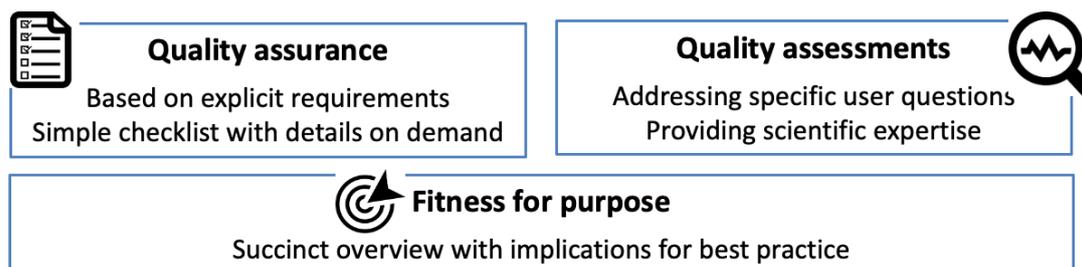


Figure 1: The three pillars of the C3S EQC for Datasets Framework 2.0

A Content Integration Manager (CIM) was developed for EQC and is used to store EQC content and to manage EQC workflows. Different workflows manage the different steps in the EQC content creation process, the actors involved in this process and their responsibilities within each workflow step. The CIM is part of the CDS infrastructure. Documentation about this system will be made available for the successful bidder at the start of the contract.

The next chapter describes the technical requirements for the next phase of EQC for applications, derived datasets and learning resources.

3 Technical Requirements

ECMWF intends to award a single framework agreement for a period of maximum 40 months, which shall be implemented via a single service contract (subject to negotiation) expected to commence in Q3 2024, for the management and implementation of the Evaluation and Quality Control function for the C3S Climate Data Store, addressing applications, climate indicators and other derived datasets, as well as learning resources.

The scope of this contract is on carrying out the operational tasks associated with the EQC function to deliver and update quality-related information in a timely fashion and in line with instructions from ECMWF’s overarching C3S EQC management. While the focus of the work will be on continuation of service and routine activities, some further conceptual evolution of the existing EQC framework, in particular to apply it to the components in scope of this tender, will be required and shall therefore be included in the proposal.

New technical developments of the CDS infrastructure components required to support this EQC function will be carried out under a separate contract (CJS2_211) addressing infrastructure aspects of the CDS. The successful Tenderer will be a user of the provided software platform (i.e. the CIM) and shall provide specific functional requirements in coordination with ECMWF. A close and dynamic interaction between the two contractors will be required.

This Invitation to Tender (ITT) aims to build on the revised EQC concept for quality assurance and quality assessment outlined in section 2.4.

The successful Tenderer shall:

- Assess the technical and scientific quality as well as fitness-for-purpose of the CDS products and learning resources in scope of this tender, following specific requirements and protocols provided by ECMWF.
- Support the CDS catalogue ingestion process by providing timely checks of technical quality of new applications, indicators and other derived dataset ahead of publication.
- Publish outcomes of EQC activities in the “Quality” tab in the CDS catalogue in a user-friendly way and in line with the new approach outlined in section 2.4 of this document.
- Provide requirements for the Content Integration Manager of the CDS EQC infrastructure, liaising closely with its developers.
- Interact with the CDS application providers and the respective data experts at ECMWF, in order to ensure that agreed protocols and processes are in place and adhered to.

The proposal shall include indicative cost estimates for the individual content to be produced under each component.

The following subsections list specific technical requirements and tasks of the EQC contractor for the C3S products addressed by this tender (Figure 2).

Scope	Tasks
<p style="text-align: center;">Applications</p>	<p style="text-align: center;">Quality Assurance</p> <ul style="list-style-type: none"> • Technical quality • Compliance with reqs. • Coding/workflow standards <p style="text-align: center;">Quality Assessment</p> <ul style="list-style-type: none"> • Scientific quality • Good practice • Fitness for purpose
<p style="text-align: center;">Indicators & other derived datasets</p>	
<p style="text-align: center;">Learning resources</p>	

Figure 2: Scope and main tasks of this tender

3.1 WP1: Framework and Operations

The successful Tenderer shall be responsible for the production of EQC content and subsequent publication in the CDS and for the operational management of the respective protocols and workflows for initiating, developing and updating EQC content, including definitions of requirements and procedures for publication of new products in the CDS. The production and regular updating of the requirements and EQC content requires close coordination with ECMWF and third parties. EQC production shall follow a production calendar to be agreed with ECMWF.

The complexity of the expected tasks, in particular the management of the EQC production calendar and liaison with various stakeholders will require the successful Tenderer to propose personnel with high project management and excellent inter-personal communication skills.

The Content Integration Manager (CIM) shall be used as primary tool for creating, managing and storing of EQC content as well as for executing the required workflows including the review and approval process.

EQC content shall focus on new applications and derived datasets delivered through the operational SISs and collaborations with key stakeholders. Existing applications and derived datasets which will not be replaced through new activities but will still be served via the new CDS have less priority.

In order to facilitate Tenderers to estimate the amount of work, the following shall be considered as a rough estimate:

- At least one application per operational SIS (water, energy, agriculture, insurance)
- Approx. five on-demand applications developed within the context of the NCP and through other collaborations with partners
- Approx. five stand-alone applications such as ClimatePulse and the Climate Atlas
- At least one set of indicators per operational SIS (water, energy, agriculture, insurance)
- Approx. five other derived datasets from operational SIS or other activities
- Approx. ten e-learning Jupyter notebooks and ten e-learning web modules

A full list of applications, derived datasets and learning resources to be addressed by this tender will be provided to the preferred bidder at the start of the negotiation process.

The successful Tenderer shall:

- Manage and coordinate the production of EQC, including a roadmap for production of EQC content with input and support from ECMWF.
- Support ECMWF in the checking and testing of applications, indicators, derived datasets and Jupyter notebooks ahead of their publication, and document the outcome of respective checks to users.
- Provide scientific quality assessments and fitness-for-purpose information for selected products.
- Regularly liaise with all actors involved in the EQC production workflow.
- Provide evaluators who have the necessary high-level skills and expertise for this service.
- Monitor and document the status and progress of EQC production via the dashboard functionality of the CIM.

The number of checks to be performed for the quality assurance component will depend on the specific requirements and assessment criteria for the respective artefact (i.e. application, derived dataset, Jupyter notebook). This is expected to be in the order of 15-20 criteria to be evaluated. The scientific quality assessment will also follow clearly defined procedures.

The successful Tenderer shall foresee a period of three months in the beginning of the contract to liaise with ECMWF in order to agree on specific requirements, assessment criteria and types of checks to be applied and to make sure these are manageable and maintainable. A respective milestone shall be included for this. Bids shall include a preliminary proposal of quality assurance requirements.

Deliverables expected:

- Initial set of quality assurance requirements, assessment criteria and verification methods in the first quarter of the contract.
- Description and annual update of EQC framework for applications, derived datasets and learning resources, including list of requirements to be verified for quality assurance and methodologies for the scientific assessments.
- Quarterly reports on roadmap for EQC production, status and progress.
- Bi-annual reports on updates of requirements database in the CIM for the quality assurance component.

3.2 WP2: EQC for Applications

The delivery of applications follows specific protocols defined by ECMWF. The internal ECMWF review process covers many aspects including evaluation of adequateness, usability, accuracy, description of input and output variables, appearance, coding standards and style, functionality, and scientific quality.

The successful Tenderer shall provide support to the existing review process by defining specific and objective quality assurance requirements to be followed by the contractors. The EQC quality assurance concept already in place for datasets should be applied to applications. The outcomes of the evaluation shall inform the internal review process and shall also be documented to users.

The quality assurance requirements and the respective means of verification shall be designed in close coordination with ECMWF.

The quality assurance requirements to be checked by EQC during application development shall include but are not limited to:

- Extensive tests to ensure that the results produced by the application are scientifically sound.
- Ensure python code follows recognised coding standards.
- Ensure a standard ReactJS application structure is used for frontend development using components approved by ECMWF.
- New frontend components are generic and contributed to an ECMWF components library where possible.

While EQC activities are independent from application developers, one EQC representative shall be assigned to each application developer to ensure that quality assurance procedures are followed throughout development. The development phase usually takes several months. EQC evaluators are expected to interact with application developers mainly through the following steps:

1. Formulation of requirements at start of developments. The successful Tenderer may be asked by ECMWF to join progress meetings during the development phase to discuss specific decisions which may affect the quality assurance.
2. Quality check and review before ingestion into the CDS (if relevant), including actions to facilitate publication.
3. Final quality check of application and documentation prior to publication.

Tenders shall also include ideas on how to perform stress tests on an application (e.g. by extensively using and misusing it) and how to document what might get broken from either a scientific, IT or technical point of view. This will help not only the approval process but also in the documentation and user support. The devised approach may eventually be integrated into the quality assurance checklists.

Quality assessments shall be carried out for specific applications, addressing the scientific quality and fitness-for-purpose information. This shall include an evaluation of whether methods in the application are based on good practices in scientific literature and if this is clearly documented and traceable. It shall also include

identification of sources of uncertainty, e.g. data dependencies, and the possible impact on the quality and usability of the application. Where possible, the findings shall be linked to and be consistent with outcomes of EQC for CDS datasets. Further, it shall be assessed whether the purpose of an application is clearly described including guidance on use and thus preventing misuse. This shall also include an evaluation of the scientific methodology, which needs to be clearly discernible from the application and its documentation.

Overall, the EQC review, checking and evaluation process shall address the following aspects of a web application:

- Workflows and code behind an application
- User interface and design of an application
- Documentation of an application
- Usability of an application
- Scientific quality and fitness-for purpose of outputs from an application

Deliverables expected:

- Curated list of requirements for quality assurance of applications.
- Completed quality assurance checklists for applications and publication via the CDS.
- At least one quality assessment on scientific soundness and fitness-for purpose per application and publication via the CDS.

3.3 WP3: EQC for Indicators and other derived Datasets

Indicators and datasets derived from other CDS datasets are being produced by dedicated ECMWF contractors. The code to develop these products are implemented and maintained in a way that allows C3S users to re-use the workflows and apply them to other data according to their own needs. Where possible and appropriate, developers use and contribute to ECMWF quality-assured software packages (e.g. earthkit).

Data delivery includes the provision of data and files containing abstracts, detailed descriptions of dataset, variables, etc., following the integration process detailed in the document referenced in Appendix 3: Guidelines for Data Integration (see section 6.1.3). Once published, tools and data are supported through level 2 support via the Copernicus User Support team.

To ensure quality of the datasets produced by C3S, all workflows and pipelines should have been developed following thorough quality assurance procedures defined by ECMWF. Upon delivery of the dataset and any supporting operational data production workflow, the dataset is reviewed with respect to the quality assurance criteria.

The successful Tenderer shall provide support to the internal review process, apply the EQC quality assurance concept already used for CDS datasets (i.e. projections, predictions, reanalysis, in situ and satellite observations), and document the results to users.

Indicators and other derived datasets can be regarded as an additional dataset category. They are therefore subject to the same quality assurance procedures outlined in section 2.4.

Based on the high-level data requirements, specific assessment criteria which are appropriate for indicators and derived data shall be developed, following the existing approach for quality assurance. The requirements and the respective means of verification for this activity shall be designed in close coordination with ECMWF. Appendix 1 (see section 6.1.1) shows the high-level list of requirements that were established for C3S datasets and Appendix 2 (see section 6.1.2) gives a specific example for the assessment criteria.

The quality assurance procedures followed during the development of workflows for derived datasets shall include:

- Extensive tests included to ensure and demonstrate that the derived data produced are scientifically sound.
- Ensure python code used in the workflows follows recognised coding standards.
- Ensure that Jupyter notebooks are provided that adequately document the steps taken to produce the derived data.

Quality assessments shall be carried out for indicators and derived datasets, addressing the scientific quality and fitness-for-purpose information. This may include science-based information about accuracy, uncertainties, sources of uncertainty, temporal consistency, strengths, and weaknesses of a dataset in the context of a realistic use case. As for applications, it should also be evaluated whether good practices are followed.

Overall, the EQC review, checking and evaluation process shall address the following aspects of indicators and derived datasets:

- Ensure that the workflow development protocols were adhered to
- Landing page of an indicator or other derived dataset
- Documentation of an indicator or other derived dataset
- Usability of an indicator or other derived dataset
- Scientific quality and fitness-for purpose of an indicator or other derived dataset

Deliverables expected:

- Curated list of requirements for quality assurance of indicators and other derived datasets.
- Completed quality assurance checklists for indicators and other derived datasets, and publication via the CDS.
- At least one quality assessment on scientific soundness and fitness-for purpose for each indicator or other derived dataset, and publication via the CDS.

3.4 WP4: EQC for Learning Resources

Quality control procedures are already in place for the generation of learning resources. The respective contractor performs regular tests of learning resources including Jupyter notebooks, Jupyterbooks, elearning modules and any other learning resources to ensure they run correctly.

The successful Tenderer shall provide an additional layer of quality assurance applying the EQC concept outlined in section 2.4. Concrete requirements shall be formulated for the generation of training material to be checked against, and independently certified by, the EQC function. The requirements shall address code, documentation, and content of the learning resources.

The requirements and the respective means of verification shall be designed in close coordination with ECMWF and the user learning service contractor. An initial list of requirements may include:

- The code must be tested to ensure workflows run successfully on various systems.
- The code must be reviewed to ensure it is efficient and makes full use of ECMWF libraries such as Earthkit.
- The content must be scientifically and technically correct.

Quality assessments, as outlined in section 2.4 shall be applied to selected resources where scientific evaluations will provide an added value for users.

Deliverables expected:

- Curated list of requirements for quality assurance of learning resources (such as Jupyter notebooks, elearning modules and other learning resources).
- Completed quality assurance checklists for learning resources.

- At least one quality assessment on scientific soundness and fitness-for purpose per learning resource.

3.5 WP5: User Consultations

EQC is a user-driven component of C3S that responds to current and evolving user needs. Hence, the successful Tenderer shall foresee regular consultations with users to assess evolving EQC needs and collect requirements on the EQC function itself. A small group of champion users shall be established representing the full range of applications, indicators and learning resources. This activity shall be planned for the second half of the contract.

Deliverables expected:

- Terms of reference and composition of group of champion users.
- Bi-annual reports on user feedback.

4 General Requirements

4.1 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. 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.

4.2 Data and IPR

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

All software and products used by the successful Tenderer to produce the Copernicus datasets/software will remain the property of the successful Tenderer, except for those components which are acquired or created specifically for Copernicus purposes, with Copernicus 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.

4.3 Key performance indicators

The successful Tenderers shall report to ECMWF on a set of Key Performance Indicators (KPIs) suitable for monitoring various aspects of service performance.

The table below provides the template to be used by the Tenderer to describe the KPIs, relevant for this ITT, together with performance targets, delivery schedules and explanations, as needed.

All KPIs shall be periodically updated as described in the tables. Tenderers shall provide preliminary versions of the completed tables as part of their bid.

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.

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

KPI	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI_1				
KPI_2				

4.4 Payment Plan

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).
- 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.

5 Tender Format and Content

General guidelines for the tender are described in Volume IIIB. 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.

5.1 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>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 pre-existing IPR 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 1: Page limits

5.2 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.

5.2.1 Executive Summary

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

5.2.2 Track Record

The Tenderer shall demonstrate for itself and for any proposed subcontractors 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.

5.2.3 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 3. The team shall include a Service Manager with at least five 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.

5.2.4 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. 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.

5.2.5 Management and Implementation

The Tenderer shall provide a detailed implementation plan of proposed activities for the duration of the framework agreement. The Tenderer is requested to include management and implementation activities within a dedicated work package (WPO).

Deliverables should be consistent with the technical requirements specified in Section 3. When defining deliverables please consolidate their numbers ideally against one deadline aligned with the proposed payment milestone, where possible.

All contract reports shall be produced in English. The quality of reports and deliverables shall be equivalent to the standard of peer-reviewed publications and practice. Unless otherwise specified in the contract, deliverables in WPO shall be made available to ECMWF in Word or Excel (for Financial Tables) format to help during the review process and PDF the latest approved document via the Copernicus Deliverables Repository system or if explicitly requested via email.

Each Deliverable shall have an associated resource allocation (person-months and financial budget, resource type: payroll only). The total of these allocated resources shall amount to the requested budget associated with payroll (Please see Volume IIIA Template - Pricing and deliverables).

Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery. They should not duplicate deliverables. All document deliverables shall be periodically updated and versioned as described in the tables. Tenderers shall provide list of Deliverables and Milestones as part of their bid.

Minor 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.

The C3S EQC function has now entered an operational phase and timely delivery of services is essential.

The Tenderer shall therefore ensure that the due dates of deliverables and milestones are realistic and achievable.

A set of Key Performance Indicators (KPIs) suitable for monitoring contract performance shall be proposed. The proposed KPIs shall be SMART (specific, measurable, actionable, realistic and time bound). The Contractor shall report to ECMWF on these KPIs as part of the Quarterly and Annual Implementation Reports. The proposed set of KPIs is expected to be updated regularly with ECMWF during the contract.

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

- Reporting shall be provided in accordance with the Framework Agreement Clause 2.3.
- An implementation plan for the year N+1 shall be provided in September of the year N for ECMWF approval.
- Monthly teleconferences with ECMWF and a proposal for involvement of ECMWF in major project 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 payments at intervals of preferably six-months for routine services work packages and shall be based on milestones completion and associated deliverables for development related activities.
- Communication management (ECMWF, stakeholders, internal communication).
- Resources planning and tracking using the appropriate tools.
- Implementation of checks, controls and risk management tools for both the prime contractor and subcontractors.
- Subcontractor management, including conflict 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 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.
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 of the Volume V Framework Agreement.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for Work Package 0 already indicated in the table below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WPO Deliverables				
#	Responsible	Nature	Title	Due
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY <i>QQ YYYY being the previous quarter</i>	On 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report [PART 1] YYYY <i>YYYY being the Year n-1</i>	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report [PART 2] 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	Report	Annual Implementation Plan YYYY <i>YYYY being the Year n+1</i>	Annually on 30/09
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
D0.y.z	Tenderer	Other	Updated KPIs (list, targets...) after review with ECMWF	One year after start of contract

WPO Milestones				
#	Responsible	Title	Means of verification	Due
M0.y.z	Tenderer	Kick-Off meeting	Minutes of meeting	Month 1
M0.y.z-Px	Tenderer	Progress review meetings with ECMWF / Payment milestones	Minutes of meeting	~ Every 6 months

6 Additional Information

6.1 Appendices

6.1.1 Appendix 1: C3S requirements for datasets

<p>1. Data Management</p> <ol style="list-style-type: none"> 1. <i>Accuracy and Consistency:</i> All information provided with the dataset must be accurate and consistent. 2. <i>Reliable Access:</i> Access to all information must be open, free and reliable. 3. <i>Versioning and Archiving:</i> Adequate version control and archiving policies must be in place. <p>2. Data Records</p> <ol style="list-style-type: none"> 1. <i>Consistency:</i> The data must be complete and internally consistent. 2. <i>Uncertainty:</i> The data must include information about uncertainties. 3. <i>Updates:</i> Updates of the data records must be provided on a predictable schedule. <p>3. Metadata</p> <ol style="list-style-type: none"> 1. <i>Discovery and Use:</i> Metadata must include all necessary information for discovery and proper use of the data records. 2. <i>Interoperability:</i> Metadata must comply with relevant international standards. <p>4. Documentation</p> <ol style="list-style-type: none"> 1. <i>Content:</i> The content of data records must be fully documented. 2. <i>Scientific Basis:</i> The scientific methodology used to produce the data must be fully documented. 3. <i>Quality Control:</i> Quality control and validation activities must be fully documented. 4. <i>User Guidance:</i> Detailed information must be available to assist users in using the data.

6.1.2 Appendix 2: Example of assessment criteria and how-to-check instructions for satellite observations

Tenderers should refer to the separate spreadsheet attached. It shows the detailed assessment criteria for each of the main requirements using the example of satellite observations as carried out within the existing EQC for datasets activities. It is provided to facilitate Tenderer's understanding of the nature and type of the specific requirements and detailed checks to be performed.

6.1.3 Appendix 3: Guidelines for Data Integration

Tenderers should refer to the separate document attached. Note that the document includes links to other ECMWF and/or web resources, some of which may not be publicly available. This document is provided to facilitate Tenderers' understanding of the data integration process and to facilitate the assessment and costing of resources which Tenderers should allocate in their response for any such activities. Full access to ECMWF internal resources shall be provided to the Successful Tenderer at the start of the contract.

6.2 Acronyms

API	Application Programming Interface
C3S	Copernicus Climate Change Service
CDS	Climate Data Store
CIM	Content Integration Manager
ECMWF	European Centre for Medium-Range Weather Forecasts
EEA	European Environment Agency
ENTSO-E	European Network of Transmission System Operators for Electricity
EQC	Evaluation and Quality Control
EIB	European Investment Bank
ITT	Invitation To Tender
NCP	National Collaboration Programme
SIS	Sectoral Information System