

ECMWF Copernicus Procurement

Invitation to Tender



Copernicus Climate Change Service

Evaluation and Quality Control for Datasets in
the Climate Data Store

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, delivers authoritative and quality-assured climate information to support policy, adaptation planning, and innovation in climate-related applications and services. As a user-driven service, C3S places strong emphasis on understanding and addressing the evolving needs of its users, with a particular focus on ensuring transparency, consistency, and clarity regarding data quality, limitations, and suitability for use.

To support informed and responsible use of Climate Data Store (CDS) datasets, C3S has established an Evaluation and Quality Control (EQC) framework that combines quality assurance, scientific quality assessment, and fitness-for-purpose guidance. The EQC framework is designed as an operational component of the CDS, ensuring that quality-related information is maintained over time, aligned with the evolving CDS catalogue, and made accessible to users in a consistent and transparent manner. EQC activities shall support both direct user access to quality information and integration with an emerging LLM-based search and discovery service.

The successful Tenderer shall contribute to the delivery and operation of EQC activities as an integrated CDS service, supporting consistency, transparency, and sustainability across datasets and services. In particular, the successful Tenderer shall:

- support the planning, coordination, and operational delivery of EQC activities across all CDS dataset categories;
- contribute to the production, maintenance, and review of authoritative quality and fitness-for-purpose information;
- ensure that EQC outputs are aligned with CDS governance, dataset roadmaps, best practices, validation protocols, technical standards and scientific review processes;
- support the effective communication of quality-related information to users and user-facing services;
- produce ad-hoc quality assessment on specific topics as requested by ECMWF.

2 Background Information

2.1 The C3S Evaluation and Quality Control Framework

2.1.1 Overall Concept

The EQC framework is described in detail in Dee et al. (2024), which outlines an operational approach to quality evaluation for climate services that goes beyond technical validation alone and explicitly addresses user needs and decision contexts.

The EQC framework is structured around three complementary pillars:

1. *Quality Assurance*, checking for compliance with data requirements (refer to Section 7.2) based on user needs, addressing the technical integrity, documentation, metadata, versioning, and accessibility of datasets → presented as interactive checklists
2. *Quality Assessment*, providing scientifically grounded evaluation of dataset behaviour in the context of specific use cases through reproducible analyses and diagnostics → presented as Jupyter Notebooks [<https://ecmwf-projects.github.io/c3s2-eqc-quality-assessment/intro.html>]
3. *Fitness-for-Purpose*, translating quality information into clear, use-case-oriented statements that describe strengths, limitations, uncertainties, appropriate applications, and recommendations for correct usage → presented as factsheets or similar.

EQC is not intended to function as a formal certification or compliance scheme. Instead, it provides expert-based assessment and guidance to support informed and responsible use of climate data, recognising that data quality and suitability are inherently context-dependent. The framework emphasises transparency,

reproducibility, and proportional communication of uncertainty, in line with best practice in climate services and Earth system science (Dee et al., 2024).

Within C3S, EQC is implemented as an operational service integrated into the CDS. EQC outputs are maintained over time, aligned with dataset updates, and presented through multiple user-facing channels, including catalogue checklists, quality assessment notebooks, and fitness-for-purpose summaries. Together, these elements ensure that users can access authoritative quality information at different levels of detail, depending on their needs and expertise.



Figure 1: EQC Framework (adapted from Dee et al. 2024)

Recent user experience surveys across all major C3S dataset categories confirm that the Evaluation and Quality Control (EQC) framework is highly valued by users and supports informed dataset selection and application. Users report strong appreciation for Fitness for Purpose guidance, quality assessment use cases, and supporting Jupyter notebooks, while also highlighting the need for clearer interpretation, broader coverage across datasets, and improved integration into user workflows. These findings directly inform the requirements of this ITT, which aims to consolidate, extend and further operationalise EQC across the Climate Data Store.

2.1.2 EQC Infrastructure and Workflows

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

The EQC workflow in the CIM starts with the initiation of an EQC task (previously referred to as a QAR) by an EQC evaluator who should be an expert on the field of work and fully independent of the dataset production team. After an initial internal review, the EQC task progresses through data stream manager (ECMWF) and contract service manager (referred to as QAR manager in Figure 2) reviews, with inputs from technical officers and data providers as needed. The EQC manager at ECMWF (or a designated technical officer) performs the final review, after which the workflow can be closed (with subsequent publication of the EQC report in the CDS). The task may be reopened at any time to address feedback or incorporate the most recent dataset or documentation updates, ensuring iterative quality control, traceability, and alignment with

technical and data governance requirements (Figure 2). Note that the review process on contractor's side is expected to change (refer to WP6).

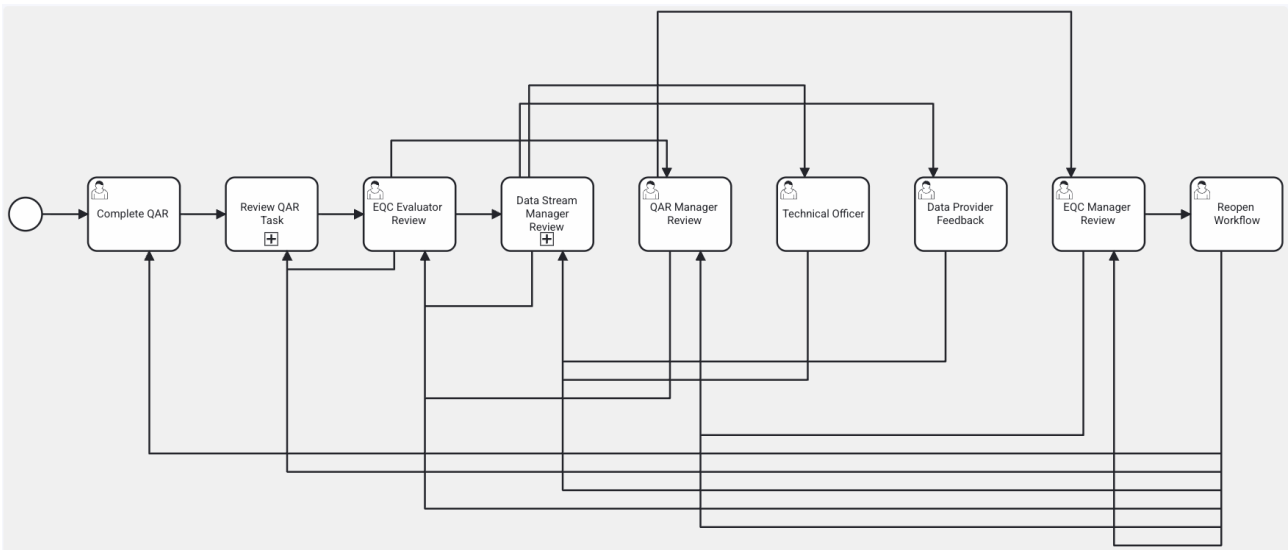


Figure 2: Current EQC Workflow in the Content Integration Manager

2.1.3 Evolution of the EQC Framework

The existing EQC framework has received positive feedback from users, as evidenced by recent user surveys and engagement activities. Users value the structured presentation of quality-related information and the availability of supporting material through the CDS. At the same time, experience from operational use indicates that the framework should evolve further to better support user decision-making, improve clarity of roles between EQC components, and strengthen integration with emerging user interaction mechanisms.

In particular, what is currently referred to as *quality assessment* often combines two distinct elements:

- i. scientific assessments of dataset characteristics (e.g. accuracy, uncertainty, consistency, representation of key phenomena),
- ii. fitness-for-purpose considerations, which translate those characteristics into guidance relevant to specific user questions and application contexts.

Conversely, the information currently presented under *fitness for purpose* in the CDS often acts as a synthesis layer, drawing on both quality assurance and quality assessment outputs, and frequently contains the most directly actionable information for users.

Under this ITT, the EQC framework is expected to evolve towards a clearer separation of roles, while maintaining strong coherence between components. In particular, the *fitness-for-purpose* component is expected to become the primary user-facing entry point for EQC, providing concise, use-oriented factsheets that synthesise relevant quality assurance and quality assessment information. These factsheets should guide users towards appropriate datasets for given applications, highlight key limitations and uncertainties, and act as a natural access point for future interaction with the CDS LLM-based user service (refer to Section 2.2).

To support this evolution, EQC factsheets are expected to be made available through dedicated EQC web pages on the C3S website, which will serve as a central entry point to EQC content. These pages shall provide clear navigation to:

- fitness-for-purpose factsheets,
- detailed quality assessment material hosted in the Quality Assessment Hub (Jupyter Book),

As a consequence, the quality tabs within the CDS catalogue are expected to evolve towards a more concise, signposting role, focusing on high-level summaries and clear pointers to the relevant EQC web pages, factsheets, and quality assessment material, rather than duplicating detailed content.

This evolutionary direction is intended to preserve the strengths of the current EQC framework while improving usability, clarity, and extensibility, and to prepare EQC for closer integration with the CDS LLM-based user service.

2.2 LLM-based Search and Discovery Service in the Climate Data Store

In parallel to the development of Evaluation and Quality Control (EQC) activities, ECMWF is advancing an LLM-based search and discovery service within the Climate Data Store (CDS), as defined in a previous tender (<https://climate.copernicus.eu/c3s2523-llm-based-data-search-and-discovery-service-climate-data-store>).

This service is intended to support users in discovering, understanding, and navigating CDS content through natural-language interaction, complementing existing documentation and support channels.

The LLM-based user service is conceived as a user-facing service layer, rather than as a source of scientific judgement or data evaluation. Its primary role is to help users identify relevant datasets, documentation, workflows, and guidance, and to place information in context depending on the user's question and point of entry into the CDS. The service is expected to build on curated and authoritative knowledge sources provided by C3S, rather than generating new scientific assessments.

Within this architecture, EQC outputs play a key role as authoritative and trusted inputs to the LLM-based service, particularly for user questions related to data quality, limitations, uncertainty, and suitability for specific applications. As emphasised in Dee et al. (2024), expert-based evaluation and quality control are essential for ensuring that quality information is transparent, traceable, and scientifically sound. The LLM-based user service is therefore expected to reference EQC material, such as quality assurance checklists, quality assessment results, and fitness-for-purpose statements, while clearly preserving the separation between AI-based guidance and expert scientific assessment.

The LLM-based service is not expected to replace domain-specific EQC content, detailed documentation, or expert review processes. Instead, it shall act as an entry point and navigation aid, guiding users towards the most relevant EQC information, datasets, and tools within the CDS. In cases where users seek detailed interpretation of quality or fitness-for-purpose aspects, the service shall point users to the relevant EQC material and, where appropriate, to more specialised C3S services.

This complementary design ensures that the LLM-based service enhances usability and accessibility of CDS content while maintaining the integrity, authority, and transparency of EQC activities, in line with the principles outlined in the C3S EQC framework (Dee et al. 2024) and the objectives of the C3S LLM-based Search and Discovery Service.

3 Technical Requirements

ECMWF intends to award a single multi-annual framework contract, with a maximum duration of 24 months, for the provision of Evaluation and Quality Control (EQC) activities for datasets made available through the Climate Data Store (CDS).

The aim of the EQC activities is to ensure that CDS datasets are subject to consistent quality assurance, scientific quality assessment, and fitness-for-purpose guidance, supporting informed and responsible use of climate data across a wide range of application contexts. EQC outputs are expected to be authoritative, transparent, traceable, and maintained as part of the operational CDS service.

EQC activities shall cover the following CDS dataset categories:

- Reanalyses;

- Climate projections;
- Seasonal forecasts;
- In situ observations;
- Satellite observations (Atmosphere, Land, Ocean).

EQC activities under this ITT are structured around three complementary pillars: (i) Quality Assurance, (ii) Quality Assessment, and (iii) Fitness-for-Purpose, as defined in the C3S EQC framework.

Expected approach and service context

EQC activities under this ITT are expected to be delivered as an operational service within the CDS, rather than as a collection of standalone or one-off assessments. EQC shall provide consistent and maintained information on various aspects of data quality, integrated directly into CDS workflows and user interfaces.

EQC is intended to support users by framing guidance in a use-case-oriented manner. Uncertainty information is expected to be communicated transparently and proportionately, focusing on dominant sources of uncertainty, scale dependence, and known limitations, rather than on full quantitative uncertainty characterisation. This approach reflects current best practice in climate services, which emphasises the need to frame uncertainty in relation to the specific questions users are asking and the decisions they seek to support (Gruber et al. 2025).

In designing and delivering EQC outputs, tenderers are expected to take into account recent work highlighting the importance of scale in the definition and communication of uncertainty for climate services and decision-making contexts (Bulgin et al. 2025), as well as studies of uncertainty propagation in Earth observation and climate data production chains that underline the need for pragmatic, operationally feasible uncertainty descriptions suitable for downstream users (Woolliams et al. 2025).

EQC activities are expected to operate in close interaction with existing CDS governance and service components. This includes structured and regular interaction with ECMWF Technical Officers, including Data Stream Managers (who are responsible for managing the EQC workflows of their respective CDS datasets on ECMWF side), to support scientific review of EQC content, alignment with the CDS dataset roadmap, and timely integration of new or updated datasets.

EQC planning and prioritisation are also expected to take into account documented user needs through structured interaction with the C3S User Requirements Database (URDB). EQC activities remain distinct from user-requirements collection and management; however, EQC outputs may provide feedback relevant to the URDB where quality-related constraints or limitations affect documented user needs.

EQC outputs shall serve as authoritative input for the LLM-based search and discovery serviced for the CDS. This service is expected to reference EQC content when responding to user queries related to data quality and fitness for purpose. The successful Tenderer shall ensure close and continuous liaison with the contractor responsible for the CDS LLM-based user service. This liaison shall aim to ensure consistency, mutual learning, and effective reuse of outputs across the two contracts. EQC material produced under this contract, including quality assurance checklists, quality assessment notebooks, and fitness-for-purpose statements, shall be provided in a structured and maintainable form suitable for use as authoritative training and reference content for the LLM, in accordance with agreed governance and data handling arrangements.

In designing and operating EQC, ECMWF seeks alignment with emerging best practice in climate services, particularly with respect to transparency, traceability, and consistency of quality-related information. Ongoing European initiatives, including the Climateurope2 project and related activities on climate service standardisation, have highlighted the importance of clear documentation of data provenance, transparent communication of uncertainty, and consistent description of dataset limitations and applicability. EQC activities under this ITT should therefore take into account relevant developments in climate service standardisation and best practice guidance, while maintaining the flexible, expert-driven character of the C3S

EQC framework. EQC is not intended to constitute a formal certification or compliance scheme; rather, it provides a structured, operational approach to quality assessment and guidance that can support comparability and convergence of practices over time.

The successful Tenderer shall:

- operate Evaluation and Quality Control (EQC) activities as a coherent and sustained service within the Climate Data Store;
- deliver authoritative, transparent, and consistently structured EQC outputs covering quality assurance, scientific quality assessment, and fitness-for-purpose guidance;
- ensure that EQC outputs are maintained over time and remain aligned with the evolving CDS dataset portfolio (including already published quality assessments);
- support clear and use-case-oriented communication of data quality, uncertainty, and fitness for purpose, in line with the principles outlined above;
- ensure that EQC content is scientifically reviewed, traceable, and governed in interaction with ECMWF Technical Officers;
- ensure that EQC outputs are integrated into CDS workflows, interfaces, and publication mechanisms;
- provide EQC content in a form suitable for direct user access and for use as authoritative input to user-facing services, including the CDS LLM-based user service;
- support structured interaction and information exchange with other C3S components, including the User Requirements Database (URDB), where relevant to EQC planning and context.

ECMWF seeks a flexible, streamlined and efficient approach to the activities under this ITT. Tenderers are expected to avoid unnecessary deliverables and reporting, and to focus on efficient execution and concise, high-value outputs that directly support the CDS service and its users.

Given the operational and scientific complexity of the EQC framework, robust management capacity is considered essential to the success of this contract. Tenderers shall propose a management structure comprising distinct key roles with clearly defined responsibilities covering scientific oversight, EQC roadmapping, and operational production and delivery.

The following subsections list the specific requirements for the different work packages.

3.1 WP1: EQC Management, Planning and Operational Governance

WP1 shall establish and operate the management, planning, and governance framework required to deliver EQC activities as an operational service. This work package shall provide the operational backbone for EQC, including the development and maintenance of an EQC roadmap and production calendar, the day-to-day coordination of EQC production, and the monitoring of EQC status and integration across CDS datasets. WP1 shall ensure prioritisation, maintenance, and alignment of EQC outputs with CDS dataset evolution and governance, as well as structured interaction with key service interfaces (ECMWF Technical Officers, URDB, and the CDS LLM-based user service).

WP1 shall include the coordination of EQC activities with the C3S LLM-based user service, including regular exchanges to ensure that EQC material is provided in a structured, maintainable form suitable for use as authoritative training and reference content, and that feedback from LLM-based user interactions informs EQC prioritisation and communication. In line with recent user feedback, WP1 shall ensure that the EQC framework evolves in a controlled and transparent manner, with particular attention to the clarity, language, coverage, and usability of fitness for purpose guidance and quality assessment material.

The successful Tenderer shall:

- plan, coordinate, and oversee EQC activities across all dataset categories covered by this contract;

- develop and maintain an EQC roadmap and an EQC production calendar, allowing for reprioritisation according to ECMWF dataset release schedules;
- establish and operate the governance framework for EQC review processes, including coordination with the independent review activities defined under WP6;
- establish regular coordination meetings with ECMWF Technical Officers, including Data Stream Managers, to ensure alignment with the CDS dataset roadmap (including new datasets and updates);
- ensure the planning, prioritisation, and coordination of ad-hoc quality assessments requested by ECMWF, including adjustment of priorities within the EQC Roadmap and Production Plan;
- determine, in coordination with relevant Data Stream Managers, and C3S Technical Officers, the most effective allocation of effort between updating existing EQC material and producing new EQC material, taking into account scheduled dataset updates, new dataset publications, and available pre-production information;
- assume overall operational responsibility for all EQC material published in the CDS, including quality assessment notebooks and related content produced under previous contracts, and ensure their continued maintenance, update, or, where justified, deprecation or archiving in coordination with ECMWF;
- maintain the Quality Assessment Hub (Jupyter Book) as one central access point for EQC content and supporting material;
- maintain quality checklists integrated in the CDS catalogue;
- curate, maintain, and periodically review the quality requirements underpinning EQC quality assurance checklists, including an initial review at the start of the contract, and apply formal versioning and change control to these requirements and associated checklists;
- ensure coordination and harmonisation of EQC quality assurance requirements with C3S2_521 on EQC for derived datasets and indicators;
- maintain fitness-for-purpose statements, ensuring that they are visible on CDS dataset pages and suitable as authoritative input for the CDS LLM-based user service;
- maintain and operate a CIM dashboard showing the status of EQC integration across CDS datasets (e.g. coverage, review status, publication state);
- ensure structured information exchange with the URDB to support prioritisation and framing, and to feed back quality-related constraints relevant to user needs;
- ensure consistent treatment and presentation of data quality and fitness-for-purpose information across dataset categories, and compatibility with evolving climate-services best practice (including the Climateurope2 context), without implementing formal certification or standardisation schemes.
- ensure that the selection and prioritisation of quality assessments are driven both by user needs identified through WP7 and by identified gaps in existing EQC material, including the conduct of an initial gap and needs assessment at the start of the contract to identify missing, outdated, or insufficient quality assessments across dataset categories;
- ensure coordination across EQC production activities to support cross-dataset quality assessments, including prioritisation based on user needs and resolution of dependencies between WP3–WP5;
- consider ARCO-related dataset transformations as part of EQC prioritisation and roadmap planning.

Expected deliverables and milestones:

- EQC Roadmap and Production Plan – a living document defining the application of the EQC workflow, standard production stages and indicative timelines, dataset-class-specific strategies for initial EQC production and updates, and procedures for coordination with data providers and C3S Technical Officers; maintained and updated over the contract duration.
- Quality Assessment Hub (Jupyter Book) – maintained access to EQC quality assessment material.
- Quality Assurance Checklists in the CDS Catalogue – maintained and updated.
- Fitness-for-Purpose Factsheets in the CDS Catalogue – maintained and updated.

- Summary of lessons learned (six months before end of contract).

3.2 WP2: Technical and Operational Support for EQC

WP2 shall provide the technical enablement and support required for the operational production, review, publication, and maintenance of EQC content within the CDS. This work package focuses on the use and operational integration of existing CDS technical platforms, in particular the Content Integration Manager (CIM) and the CDS Jupyter environment, and on providing sustained technical support to EQC production activities under WP3–WP5.

The Content Integration Manager (CIM) is developed and maintained by a third-party contractor. The successful Tenderer shall therefore use CIM as an operational management and planning tool for EQC, and shall act as the technical liaison between EQC operations and the CIM development contractor, ensuring that EQC requirements are clearly formulated, communicated, and supported as CIM evolves into a full operational management tool.

WP2 also covers the technical maintenance, integration, and reproducibility of EQC-related Jupyter notebooks, including responsibility for existing notebooks and the operation of the Quality Assessment Hub (Jupyter Book).

Where appropriate, ECMWF may provide dedicated virtual machines or equivalent computational resources to support EQC-related Jupyter notebook activities under WP3–WP5 (e.g. for development, testing, or execution of quality assessment notebooks). The successful Tenderer shall coordinate with ECMWF on the use of such resources and shall ensure that EQC workflows remain reproducible and portable across environments.

The successful Tenderer shall:

- use the Content Integration Manager (CIM) as the primary tool for managing EQC content creation, review, approval, and publication workflows;
- liaise closely with the third-party CIM development contractor and ECMWF to formulate, document, and prioritise EQC-related technical requirements, including workflows, content structures, and dashboard needs, to support the evolution of CIM for EQC operational use;
- configure and use the CIM dashboard to support operational monitoring and management of EQC production, providing WP1 leads and ECMWF service management with clear visibility of EQC production status, review stages, dependencies, and integration into the CDS, including tracking against the EQC Roadmap and Production Plan;
- provide technical support for EQC-related Jupyter notebooks hosted within the CDS environment, including support to EQC producers for notebook creation, execution, troubleshooting, and publication;
- maintain and operate the Quality Assessment Hub (Jupyter Book), ensuring EQC quality assessment notebooks remain technically functional, up to date, and accessible over the contract duration;
- ensure that EQC Jupyter notebooks are based on reproducible Python code, rely on open-source software, and make systematic use of Earthkit libraries (<https://github.com/ecmwf/earthkit>) wherever appropriate for data access, processing, and visualisation;
- assume responsibility for the technical maintenance of existing EQC quality assessment notebooks, including updating code to ensure continued functionality, fixing bugs, refactoring where necessary, and deprecating or archiving notebooks when maintenance is no longer feasible, in coordination with ECMWF;
- structure, document, and maintain EQC technical outputs to support their reuse within the CDS and their interaction with the CDS LLM-based search and discovery service;

- explore and, where appropriate, apply automated or semi-automated data checking tools to support EQC quality assurance activities, such as checks on dataset completeness, structural consistency, temporal coverage, and availability of required metadata, without replacing scientific quality assessment or expert judgement;
- coordinate with ECMWF on the use of ECMWF-provided computational resources (e.g. virtual machines) for EQC-related Jupyter notebook activities, where applicable.

Expected deliverables and milestones:

- CIM EQC coordination and requirements inputs – maintained EQC-related requirements and priorities provided to the CIM development contractor.
- Meeting reports of coordination with the CIM developer – evidence of regular coordination meetings and agreed follow-up actions.
- Operational Quality Assessment Hub – maintained Jupyter Book publishing EQC quality assessment outputs.
- Supported EQC Jupyter notebooks – technically supported, reproducible EQC quality assessment notebooks (new and existing).

3.3 EQC Production

EQC production under this contract shall be structured around three complementary components, applied consistently across dataset types:

- I. Quality Assurance (QA): checklist-based verification of data management practices, metadata, documentation, versioning, and update procedures, integrated into the CDS catalogue and maintained over time. This includes reporting of results of checks as well as documenting the verification criteria and detailed outcomes.
- II. Quality Assessment: production of use-case-driven Jupyter notebooks addressing clearly defined user questions on how and how well a dataset can be used in specific application contexts, considering a range of quality attributes (see below) using reproducible diagnostics and narrative interpretation suitable for CDS users.
- III. Fitness for Purpose: concise, CDS-integrated statements derived from QA and quality assessment outputs, summarising strengths, limitations, uncertainty implications, and appropriate application contexts.

Quality attributes within the quality assessments can refer to:

- accuracy/precision
- model performance
- uncertainties
- completeness (spatial / temporal)
- resolution (spatial, temporal)
- stability (inc. consistency between CDRs and corresponding ICDRs)
- extremes detection
- quality flags
- physical consistency among different datasets
- timeliness
- etc.

EQC production shall follow the EQC workflow described in Section 2.1.2, ensuring traceability, transparency, and consistency from initial scoping through review and operational publication.

Prior to the start of EQC production for a given dataset, the successful Tenderer shall organise a planning meeting involving the responsible C3S Technical Officer, the EQC production team and, if available, the relevant data provider. This meeting shall be used to confirm scope, user-driven quality assessment priorities, roles and responsibilities, dependencies, and an agreed production timeline.

For each dataset, the successful Tenderer shall define and maintain a clear EQC production timeline covering the main stages of the workflow. As guidance, typical durations are expected to be:

- Scoping and kick-off (including provider/TO meeting): ~2–3 weeks
- EQC production (QA checklists, quality assessment notebooks, fitness-for-purpose drafting): ~6–10 weeks for a new dataset
- Internal review and consolidation: ~2–4 weeks
- Submission to ECMWF for technical officer review and iteration: ~4–6 weeks

Timelines may be adjusted depending on dataset complexity and availability of inputs, but shall be explicitly agreed at the start of each EQC activity and tracked throughout production.

EQC activities under this contract are expected to be initiated as early as possible in the dataset lifecycle, including during dataset pre-production phases where feasible. The successful Tenderer shall work with data providers and C3S Technical Officers to support early EQC input prior to dataset publication in the CDS, with the aim of identifying quality, documentation, or usability issues at an early stage and enabling timely refinement before public release.

EQC production shall distinguish clearly between:

- new datasets, requiring full QA, quality assessment, and fitness-for-purpose material; and
- updates to existing datasets, for which EQC material shall be reviewed and updated proportionally to the scope of the change (e.g. new version, reprocessing, extended temporal coverage, methodological change).

The successful Tenderer shall propose and maintain dataset-category-specific EQC update strategies (e.g. reanalyses, projections, satellite observations, in situ observations), defining expected review and update frequencies and criteria triggering EQC updates. These strategies shall be applied consistently across datasets and maintained over the contract duration. The definition, maintenance, and application of EQC update strategies, including associated workflows and timelines, shall be coordinated and governed under WP1 to ensure alignment with CDS governance, dataset lifecycle management, and available resources.

The selection and prioritisation of quality assessments and associated Jupyter notebook use cases shall be driven by user needs identified through WP7, rather than by evaluator preference or exploratory scientific interest. User needs shall determine which datasets, variables, and quality questions are addressed, while scientific expertise shall determine how assessments are implemented, validated, and interpreted within the EQC framework.

EQC production shall retain sufficient flexibility to accommodate new datasets, dataset extensions, or emerging priorities introduced during the contract period. Where such needs cannot be predicted in advance, the successful Tenderer shall be prepared to initiate EQC production for additional datasets or updated dataset versions when requested by ECMWF, following the EQC production principles and workflow defined in this section.

EQC production shall support cross-dataset quality assessments, where a single user use case or quality question requires the combined consideration of multiple dataset categories (e.g. reanalyses, satellite observations, or projections). A limited but meaningful number of such cross-dataset assessments shall be delivered, as driven by user needs identified through WP7, with appropriate coordination between the

relevant EQC production activities. Regular cross-WP coordination meetings shall be held to identify, scope, and monitor such cross-dataset quality assessments.

EQC production shall also include ECV-specific synthesis assessments related to the Essential Climate Variables (ECVs) defined by the Global Climate Observing System (GCOS). For each ECV relevant to datasets available through the CDS, these assessments shall provide an independent overview of the main observational data sources currently available through the CDS, including satellite and in situ datasets, and place them in context with other commonly used sources of information for the same variable, such as reanalyses, model-based estimates, or other operational data products. The objective of these syntheses is to assess, from a climate-quality perspective, how well the CDS observational datasets currently represent each ECV and to what extent they are suitable for climate monitoring and related applications. This may include comparisons of key performance characteristics such as error characteristics, temporal stability, consistency across observing systems, and agreement with independent reference datasets where available. The assessments shall provide a transparent indication of the maturity and suitability of the available CDS observational datasets for each ECV, highlighting strengths, limitations, and areas where other data sources currently provide complementary or more established information. The purpose is not to establish formal rankings or certification of datasets, but to support users and ECMWF in understanding the current capabilities of observational datasets for monitoring different components of the climate system.

As part of the ongoing evolution of the Climate Data Store infrastructure, an increasing number of CDS datasets are expected to be made available in ARCO (Analysis-Ready Cloud-Optimised) formats, including Zarr-based data representations. While these transformations improve accessibility and enable cloud-based analysis workflows, they may introduce differences compared to the original dataset formats, for example due to reprojection, resampling, interpolation or encoding choices. EQC activities under this contract shall therefore include the assessment and communication of potential implications of such transformations for dataset use. The successful Tenderer shall investigate, where relevant, the potential order-of-magnitude effects of format transformations and rejections on selected datasets, particularly where such effects may influence user interpretation or downstream analysis. The objective of this activity is not to validate or certify the ARCO transformation pipeline, but to provide transparent guidance to users on potential sources of dataset distortion or transformation-induced differences and their practical implications for typical CDS use cases.

In terms of quality assessments, use cases and user questions shall be formulated independently of specific datasets where possible, and quality assessments may explicitly compare or contrast multiple datasets in order to guide users towards the most suitable dataset for a given application.

EQC material, in particular quality assessments, may also be produced by third parties outside this contract. Such material may take the form of Jupyter notebooks or other suitable formats. Where appropriate, the successful Tenderer shall assess, adapt, and integrate third-party EQC material into the established EQC structure and tooling (e.g. the Quality Assessment Hub / Jupyter Book), ensuring consistency, traceability, and alignment with the EQC framework.

3.3.1 WP3: EQC for Reanalyses

This work package shall apply the EQC production principles defined in Section 3.3 to all reanalysis datasets available in the CDS during the contract period, including those listed in Appendix 7.1.1 such as ERA5, ERA5-Land, and regional reanalyses such as CARRA and CERRA, as well as any new or updated reanalysis datasets introduced during the contract. Future datasets such as ERA6 will also fall within the scope of this contract.

EQC production shall include the creation and maintenance of Quality Assurance (QA) checklists, quality assessment notebooks addressing user-relevant questions, and corresponding fitness-for-purpose statements, in accordance with the EQC framework described in Section 3.3.

Quality assessment activities for reanalysis datasets shall focus on user-relevant questions specific to reanalysis use. Reanalysis datasets are also expected to play an important role in many of the cross-dataset quality assessments described in Section 3.3.

The successful Tenderer shall also assess and document potential implications of ARCO-based dataset transformations (e.g. reprojection or resampling effects) where relevant for the datasets covered under this work package.

Expected deliverables and milestones:

- CDS-integrated quality assurance checklists for reanalysis datasets;
- Quality assessment Jupyter notebooks;
- Fitness-for-purpose factsheets.

The Tenderer shall propose a quarterly fixed-price deliverable, including suggested means of verification, which covers entire WP3 service provision.

3.3.2 WP4: EQC for Projections and Predictions

This work package shall apply the EQC production principles defined in Section 3.3 to all climate projection and prediction datasets available in the CDS during the contract period, including those listed in Appendix 7.1.3, such as seasonal forecasts, global climate projections (e.g. CMIP6), and regional climate projections (e.g. CORDEX), as well as any new or updated projection or prediction datasets introduced during the contract period.

EQC production shall include the creation and maintenance of Quality Assurance (QA) checklists, quality assessment notebooks addressing user-relevant questions, and corresponding fitness-for-purpose statements, in accordance with the EQC framework described in Section 3.3.

Quality assessment activities for projections and predictions shall focus on user-relevant questions specific to model-based datasets, including aspects such as ensemble behaviour, skill, biases, sources of uncertainty, and the interpretation of climate signals across spatial and temporal scales. Projection and prediction datasets are also expected to contribute to cross-dataset quality assessments described in Section 3.3 where user questions require comparison or combined interpretation across multiple dataset categories.

The successful Tenderer shall also assess and document potential implications of ARCO-based dataset transformations (e.g. reprojection or resampling effects) where relevant for the datasets covered under this work package.

Expected deliverables and milestones:

- CDS-integrated Quality Assurance checklists for projections and predictions;
- Quality assessment Jupyter notebooks;
- Fitness-for-purpose factsheets.

The Tenderer shall propose a quarterly fixed-price deliverable, including suggested means of verification, which covers entire WP4 service provision.

3.3.3 WP5: EQC for Observations

This work package shall apply the EQC production principles defined in Section 3.3 to all observational datasets available in the CDS during the contract period, including those listed in Appendix 7.1.2, covering both in situ observations and satellite-based datasets, as well as any new or updated observational datasets introduced during the contract period.

EQC production shall include the creation and maintenance of Quality Assurance (QA) checklists, quality assessment notebooks addressing user-relevant questions, and corresponding fitness-for-purpose statements, in accordance with the EQC framework described in Section 3.3.

Quality assessment activities for observational datasets shall focus on user-relevant questions related to aspects such as spatial and temporal coverage, representativeness, sampling characteristics, uncertainty, and consistency across datasets and observing systems. Observational datasets are also expected to play an important role in cross-dataset quality assessments described in Section 3.3.

The successful Tenderer shall also assess and document potential implications of ARCO-based dataset transformations (e.g. reprojection or resampling effects) where relevant for the datasets covered under this work package.

Further, the successful Tenderer shall perform ECV-specific EQC synthesis assessments comparing CDS observational datasets with other commonly used sources of information for the same variables, in order to summarise their current strengths, limitations, and suitability for climate monitoring.

Expected deliverables and milestones:

- CDS QA checklists for observational datasets. In the case of Satellite Observations, the evaluators will have access to the reports produced in C3S2_120a_bis (Technical Support for the Management of ECMWF's ECVs Contracts), which already check for compliance with EQC requirements regarding product documentation;
- Quality assessment Jupyter notebooks;
- Fitness-for-purpose factsheets;
- Synthesis of observational capabilities for ECVs.

The Tenderer shall propose a quarterly fixed-price deliverable, including suggested means of verification, which covers entire WP5 service provision.

3.4 WP6: Review of EQC material

The successful Tenderer shall ensure robust internal quality control of all EQC content prior to submission for ECMWF review. An independent review process shall be implemented whereby EQC material is reviewed by suitably qualified experts who have not authored the content and who are independent from the teams responsible for EQC production and technical implementation activities under other work packages.

This review function shall be carried out by a dedicated review team, separate from the teams delivering EQC material (WP3–WP5), and may be implemented via a subcontracted external entity (e.g. consultancy or specialist organisation). The purpose of this work package is to provide an independent, structured, and repeatable quality assurance layer prior to ECMWF technical officer review.

Draft, incomplete, or unreviewed material shall not be submitted to ECMWF. Only internally reviewed and quality-assured EQC content, suitable for technical officer assessment and potential operational publication, shall be provided.

During the initial phase of the contract, WP6 shall include a consolidation phase aimed at reviewing existing EQC content across the CDS. This phase is intended to establish a consistent and reliable baseline by identifying issues related to correctness, internal consistency, redundancy, gaps, and overall coherence of EQC material prior to further refinement, user testing, or extension.

The successful Tenderer shall:

- conduct, during the initial months of the contract, a systematic consolidation review of existing EQC content to assess correctness, internal consistency, redundancy, gaps, and overall coherence, and

use the outcomes of this review to inform subsequent EQC updates, refinements, and prioritisation activities;

- implement an independent review process for EQC content, ensuring that all material submitted to ECMWF has undergone review by suitably qualified reviewers not involved in its production;
- assess clarity, scientific correctness and consistency with EQC guidance and CDS governance expectation;
- document review outcomes, recommendations, and required revisions in a traceable manner.

Expected deliverables and milestones:

- Bi-annual EQC Review Report: A concise report summarising EQC review activities conducted during the reporting period, including datasets reviewed, key findings, common issues identified, recommendations provided, and confirmation that only reviewed content was submitted to ECMWF.

3.5 WP7: User Testing, Communication, Needs Assessment and Interaction with the CDS LLM-based User Service

WP7 shall ensure that EQC outputs are understandable, visible, and effectively used by the CDS user community, and are correctly interpreted via the CDS LLM-based user service. The work package shall strengthen user confidence through structured user testing, targeted needs assessment, communication, and training activities, including linkages with the CDS Jupyter notebook hub.

WP7 shall also support the visibility and accessibility of EQC through dedicated EQC web pages on the C3S website, which shall act as a primary entry point to EQC content, linking users to fitness-for-purpose information, quality assessment notebooks, and related CDS resources, in addition to access via CDS catalogue entries.

WP7 shall explicitly capture and analyse user needs related to quality assessment, uncertainty information, and fitness-for-purpose guidance, and shall ensure that these needs directly inform the refinement of EQC content and quality assessment approaches developed under WP3–WP5.

The successful Tenderer shall:

- conduct user testing of EQC content clarity, structure, and presentation within the CDS;
- carry out targeted user surveys and/or interviews to assess user needs and expectations related to quality assessment, uncertainty communication, and fitness-for-purpose information;
- test interaction between EQC content and the CDS LLM-based user service, with particular focus on quality-, uncertainty-, and fitness-for-purpose-related queries;
- collect, analyse, and synthesise user feedback and needs assessment results, and use them to refine EQC templates, presentation, and guidance;
- contribute to the design, content, and maintenance of EQC-related web pages on the C3S website, ensuring clear user-oriented presentation and coherent linking to fitness-for-purpose statements and the Quality Assessment Hub (EQC Jupyter Book);
- ensure that user-derived requirements relevant to quality assessment are communicated in a structured and traceable manner to WP3–WP5;
- prepare EQC communication material, including an annual EQC overview report presented in a clear, accessible, and visually engaging format;
- organise and deliver a series of thematic webinars on quality and fitness-for-purpose topics relevant to CDS datasets;
- support the use of the CDS Jupyter notebook hub to illustrate EQC concepts and appropriate data use, in coordination with relevant CDS teams;

- prepare user-oriented guidance explaining potential impacts of ARCO-based dataset transformations (e.g. reprojection, resampling, or encoding changes) on CDS datasets and their implications for typical analysis workflows.

Expected deliverables and milestones:

- User testing and user needs assessment results and analysis;
- Refined EQC presentation and guidance elements informed by user feedback;
- Webinar materials and recordings;
- Recommendations for improving interaction between EQC content and the CDS LLM-based user service, including quality and uncertainty aspects;
- Guidance on dataset transformation effects in ARCO formats .

4 General Requirements

4.1 Implementation Schedule

ECMWF intends to award a single Framework Agreement, with a maximum duration of 24 months, which shall be implemented via a single multi-annual Service Contract, expected to commence in Q3 2026.

Tenderers are expected to provide a detailed time plan and schedule as part of the tender response. The proposed time plan and schedule shall address the main tasks, inputs, outputs, intermediate review steps, milestones, deliverables and dates. Regular progress meetings will be held with ECMWF during the contract to assess project status, risks and actions.

4.2 WPO: Management and Coordination

This work package includes overall responsibility for day-to-day service management and coordination.

The following contract management aspects shall be considered and as needed briefly described in the proposal:

Meetings:

- Kick off meeting (by videoconference)
- Quarterly Progress review meetings (by videoconference)
- ECMWF organises the annual C3S General Assembly. The Successful Tenderer is expected to attend these meetings with maximum two contract team members and contribute to discussions related to the topic of this ITT.
- **Travel Prices:** Travel prices for physical meetings should be based on the [European Commission's calculator](#) [Table 3: Unit cost per distance band for air or combined air/rail travel, Commission Decision C(2024)5405], and consider a daily subsistence allowance not to exceed €300. Travel prices must reflect estimated actual costs and **must not include any profit margin**. If the proposed travel prices deviate from these reference values, a clear justification must be provided.

Quality assurance and control: the quality of reports and Deliverables shall be equivalent to the standard of peer-reviewed publications. The timely delivery as well as final quality check of the deliverables shall be ensured by the Successful Tenderer (in terms of content, use of ECMWF reporting templates for deliverables and reports (Microsoft Word), format, deliverable numbering and naming, typos...); all reports in this project shall be provided in English. Unless otherwise specified the specific contract Deliverables shall be made available to ECMWF in electronic format, via the relevant deliverable repository system.

Communication management (incl. external and internal communication). Any external 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 text and graphical content and events. Agreed activity would also need to be evaluated and reported on once complete so that success measures and KPIs could be provided to the European Commission (cf. Clause 2.4.6 of the Framework Agreement).

Set of Key Performance Indicators (KPIs) suitable for monitor contract performance. The proposed KPIs shall be SMART (specific, measurable, actionable, realistic and time bound). The Successful Tenderer shall report to ECMWF on these KPIs as part of the Quarterly and Annual Implementation Reports. The proposed set of KPIs may need to be updated regularly with ECMWF during the contract. The template to be used by the Tenderers to describe the KPIs is included in Volume IIIB of the ITT “Template for Tenderers”. Further details are provided in Section 4.6 of this document.

Risk Management: The proposal shall include a risk register that describes identified risks for each work package, along with a mitigation strategy for each of the identified risks. This mitigation strategy shall be composed by both preventive and corrective measures. The risk register shall be updated regularly by the Successful Tenderer, and any update (related to new risks, likelihood or impact) shall be reported during the progress review meeting, as well as part of the quarterly and annual implementation reports.

Resources planning and tracking using the appropriate tools.

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 subcontractors describing their contribution and key personnel shall be provided, as well as backup names for all key positions in the contract. Tenderers shall describe how the Framework Agreement; in particular Clause 2.9 on Sub-contracting has been flowed down to all their subcontractors.

Management of personal data and how this meets the requirements of Clause 2.8 on Personal Data Protection and Annex 6 of the Framework Agreement.

List of minimum deliverables and milestones required as part of WPO, covering the contractual and financial reporting obligations towards ECMWF in line with the Terms and Conditions of the Framework Agreement (cf. Clause 2.3 and Annex 5):

WPO Deliverables

<i>Deliverable#</i>	<i>Title</i>	<i>Due</i>
DO.y.z-YYYYQQ	Quarterly Implementation Report QQ YYYY <i>QQ YYYY being the previous quarter</i>	Quarterly on, 15/04, 15/07 and 15/10
DO.y.z-YYYY	Annual Implementation Report YYYY [Part 1] <i>YYYY being the Year n-1. Shall include:</i> <ul style="list-style-type: none"> • Quarterly Implementation Report Q4 YYYY ; <i>YYYY being the Year n-1</i> • <i>Preliminary financial information YYYY ; YYYY being the Year n-1</i> 	Annually on 15/01
DO.y.z-YYYY	Annual Implementation Report YYYY [Part 2] <i>YYYY being the Year n-1</i>	Annually on 28/02
DO.y.z-YYYY	Annual Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 30/09
DO.y.z-YYYY	Copy of prime contractor's general financial statements and audit report YYYY <i>YYYY being the Year n-1</i>	Annually (no associated cost)
DO.y.z	Final report	At the end of the contract

Table 1: WPO Deliverables

WPO Milestones

<i>Milestone#</i>	<i>Title</i>	<i>Means of verification</i>	<i>Due</i>
M0.1.1.MX	Progress Review meeting with ECMWF	Minutes of meeting	Quarterly
M0.1.2.MX	Kick off meeting	Minutes of meeting	Month 1
M0.1.3.MX	Attendance to XXX meeting (e.g. General Assembly)	Minutes of meeting / Technical Note	Due one month after the meeting

Table 2: WPO Milestones

4.3 Deliverables and Milestones

Deliverables should be consistent with the technical requirements specified in this document. A deliverable is a substantial, tangible or intangible good or service produced as a result of the contract. In other words, a deliverable is an outcome produced in response to the specific objectives of the contract. Deliverables are subject to acceptance by the technical contract officers at ECMWF. All contractual deliverables, reports and documentation for this ITT 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 specific contract, deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel or HTML) via the indicated ECMWF Deliverables Repository portal. The details will be agreed at the negotiation stage.

Each Deliverable shall have an associated price and resource allocation (person-months and financial budget). The total of these allocated resources shall amount to the requested budget associated with payroll/personnel cost.

Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery, as applicable. They should not duplicate deliverables.

Tenderers shall complete the relevant table in Volume IIIA as part of their Tender, which includes the details of deliverables and milestones for all work packages and the schedules for each work package. Volume IIIA will be used by Tenderers 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.

ECMWF will provide the templates for reports and plans at the beginning of the contract. Reporting documents should be short and factual, following the guidance which will be provided by ECMWF during negotiations with the Successful Tenderer. The effort allocated to Contract management and technical coordination (WPO) is expected to amount to approx. 7-10% of the planned use of the resources.

4.4 Contribute to L2 support to Copernicus User Support Team

The objective of this task is to provide specialised support to users of the delivered products and services.

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 (Copernicus 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-business days), and/or b) the [ECMWF Forum](https://forum.ecmwf.int/)¹ by monitoring topics and providing responses. The Successful Tenderer shall provide an email address which acts as the single contact point.

4.5 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. 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.

4.6 Key Performance Indicators

The Successful Tenderer shall report to ECMWF on a set of Key Performance Indicators (KPIs) suitable for monitoring various aspects of service performance, by using the template included in Volume IIIB (cf. also Section 4.2 on management and coordination). The KPIs shall be designed to quantify various aspects of quality of service against the requirements described in this document. As part of the Tender, Tenderers shall specify a proposed set of KPIs appropriate for the service, e.g., relating to operational service delivery, quality, data access, user support, user satisfaction, etc., aligned with the requirements expressed above. These initial specifications and KPIs may need to be refined together with ECMWF during contract implementation.

For this contract, KPIs are expected to focus primarily on the operational performance and effectiveness of EQC as a CDS service. Relevant KPIs may include, for example, indicators related to EQC production and internal review turnaround times, adherence to agreed EQC production timelines, traceability and status tracking of EQC items within the CIM, and the extent to which quality assessments are demonstrably linked to user needs identified through WP7.

4.7 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 and due dates 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.

¹ <https://forum.ecmwf.int/>

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 3: 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.

Particular attention should be paid on track record in relevant EU policy activities with proven hands-on experience working with EU institutions and agencies in scope of policy preparation and evaluation activities.

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

As part of the general project management description, and in addition to the guidance provided in Volume IIIB, the Tenderer shall consider the elements described in Section 4.2 above.

6 Additional Information

6.1 Acronyms

AI	Artificial Intelligence
ARCO	Analysis-Ready Cloud Optimised
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmosphere Monitoring Service
CDS	Climate Data Store
CIM	Content Integration Manager
CKB	Copernicus Knowledge Base
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
ECV	Essential Climate Variable
EQC	Evaluation and Quality Control
EU	European Union
GCOS	Global Climate Observing System
IPCC	Intergovernmental Panel on Climate Change
ITT	Invitation to Tender
LLM	Large Language Model
ML	Machine Learning
MS	Member States
NLP	Natural Language Processing
NMHS	National Meteorological and Hydrological Service
NWP	Numerical Weather Prediction
QA	Quality Assurance
SIS	Sectoral Information System
TPA	Third Party Activity
URDB	User Requirements Database
WMO	World Meteorological Organization
WP	Work Package

6.2 References

Bulgin, C.E., Green, P., Gruber, A. et al. The Importance of Scale in the Definition of Uncertainties: How do we Best Communicate this to Data Users?. *Surv Geophys* (2025). <https://doi.org/10.1007/s10712-025-09908-5>

Dee, D., A. Obregon, and C. Buontempo, 2024: Are Our Climate Data Fit for Your Purpose?. *Bull. Amer. Meteor. Soc.*, 105, E1723–E1733, <https://doi.org/10.1175/BAMS-D-23-0295.1>.

Gruber, A., Bulgin, C.E., Dorigo, W. et al. Making Sense of Uncertainties: Ask the Right Question. *Surv Geophys* (2025). <https://doi.org/10.1007/s10712-025-09889-5>

Woolliams, E., Cox, M., Loizeau, X. et al. A Metrological Framework for Addressing Uncertainty in Satellite and In Situ Earth Environmental Observations. *Surv Geophys* (2025). <https://doi.org/10.1007/s10712-025-09916-5>

7 Appendices

7.1 List of CDS datasets in scope of this tender

7.1.1 Reanalysis

Existing datasets in scope:

Global reanalyses

- ERA5 hourly data on single levels from 1940 to present
- ERA5 hourly data on pressure levels from 1940 to present
- ERA5 monthly averaged data on pressure levels from 1940 to present
- ERA5 monthly averaged data on single levels from 1940 to present
- ERA5-Land hourly data from 1950 to present
- ERA5-Land monthly averaged data from 1950 to present

Regional Reanalyses for the Arctic

- Arctic regional reanalysis on height levels from 1991 to present
- Arctic regional reanalysis on model levels from 1991 to present
- Arctic regional reanalysis on pressure levels from 1991 to present
- Arctic regional reanalysis on single levels from 1991 to present

Regional Reanalyses for Europe

- CERRA sub-daily regional reanalysis data for Europe on single levels from 1984 to present
- CERRA-Land sub-daily regional reanalysis data for Europe from 1984 to present
- CERRA sub-daily regional reanalysis data for Europe on height levels from 1984 to present
- CERRA sub-daily regional reanalysis data for Europe on model levels from 1984 to present
- CERRA sub-daily regional reanalysis data for Europe on pressure levels from 1984 to present

Ocean Reanalysis:

- ORAS5 global ocean reanalysis monthly data from 1958 to present

Expected updates:

ECMWF is currently developing ERA6, the next-generation global climate reanalysis intended to succeed ERA5 (full rollout in 2027). ERA6 will provide higher resolution and better accuracy by leveraging advancements in Earth system modelling and data assimilation.

7.1.2 Observations

In situ:

The names of the datasets are exact at the time of writing, as they get extended/updated, the names may change.

- Alpine gridded monthly precipitation data since 1871 derived from in-situ observations
- E-OBS daily gridded meteorological data for Europe from 1950 to present derived from in-situ observations
- Nordic gridded temperature and precipitation data from 1961 to present derived from in-situ observations
- Comprehensive Upper-air Observation Network from 1901 to present
- In-situ observations of water vapour and atmospheric delay from the ground-based GNSS network from 1996 to present

- In situ temperature, relative humidity and wind profiles from 2006 to March 2020 from the GRUAN reference network
- In situ observations of meteorological variables from the Integrated Global Radiosounding Archive and the Radiosounding Harmonization dataset from 1978 onward
- In situ observations of meteorological and soil variables from the US Climate Reference Network near the surface from 2006 to present
- Global land surface atmospheric variables from 1755 to present from comprehensive in-situ observations
- Global marine surface meteorological variables from 1850 to present from comprehensive in-situ observations
- In situ total column ozone and ozone soundings from 1924 to present from the World Ozone and Ultraviolet Radiation Data Centre

Satellite ECVs:

C3S provides access to satellite based ECV products via a series of independent external contracts, that are broadly organized by physical domain. Different contracts are at different stages of implementation by the time this ITT is published. The tables below provide an overview of the expected major updates for each ECV Product during the implementation phase of the currently ongoing contracts. They include the foreseen updates for contracts that are still under negotiation. For the latter, optional activities should be proposed, and the decision for their activation during the implementation phase shall be taken together with ECMWF. All these dates may suffer adjustments during the implementation phase as they depend on the constraints faced during the execution of the upstream projects. They should therefore be regarded as indicative and a flexible approach is continuously required to accommodate those changes. Finally, we acknowledge that not all the ECV product updates have equal complexity. Therefore, we provide an indicative classification of each update based on the information provided by each data provider, as follows:

Heavy	Multi-dataset/variable update; documentation major update; change of algorithms; completely new validation; new documents / changes to confluence pages
Intermediate	Regular update, possible small changes in algorithm, possibly multi dataset/variable update, new validation exercise
Light	Light update, temporal extension of existing material, new validation, single dataset

ECV Product / Dataset collection	Update 1	Update 2	Update 3	Update 4
Atmospheric Composition				
Methane Total Column	Q4 2024	Q4 2025	Q4 2026	Q4 2027
Methane Mid-Tropospheric	Q4 2024	Q4 2025	Q4 2026	Q4 2027
CO2 Total Column products	Q4 2024	Q4 2025	Q4 2026	Q4 2027
CO2 Mid-Tropospheric products	Q4 2024	Q4 2025	Q4 2026	Q4 2027
Ozone GOME-like Nadir Profiles	Q3 2025			
Ozone GOME-like Total Column	Q3 2027			
Ozone GTO/Merged Product	Q3 2027			
Ozone IASI-based Total/Tropospheric Column	Q3 2027			
Ozone GOME-like Total Column	Q3 2027			
Ozone Limb Profiles (inc. merged products)	Q3 2027			

Aerosols Dual View (A)ATSR/SLSTR	Q3 2025	Q3 2027		
Aerosols GOMOS	Q3 2027			
Aerosols Dual View products	Q3 2025			
Aerosols IASI-based products	Q3 2025	Q3 2027		
Aerosols Nadir Radiometer products	Q3 2027			
Aerosols POLDER Polarimeter	Q3 2027			
Atmospheric Physics				
TCWV over ocean (1988-2020)	No updates foreseen in C3S2_313b			
TCWV over land+ocean (2002-2017)	No updates foreseen in C3S2_313b			
Upper Tropospheric Humidity	No updates foreseen in C3S2_313b			
Temperature Profiles (GNSS-RO)	Q3 2026			
Tropospheric Humidity Profiles (GNSS-RO)	Q3 2026			
Precipitation GPCP	Q1 2025	Q3 2025		
Precipitation COBRA	No updates foreseen in C3S2_313b			
Precipitation GIRAFE	No major updates foreseen in C3S2_313b (only ICDR extensions)			
Earth Radiation Budget - Total Solar Irradiance	No major updates foreseen in C3S2_313b (only ICDR extensions)			
Earth Radiation Budget - Solar Spectral Irradiance	Q1 2025			
Earth Radiation Budget - CERES EBAF	No major updates foreseen in C3S2_313b (only ICDR extensions)			
Earth Radiation Budget - HIRS OLR	No major updates foreseen in C3S2_313b (only ICDR extensions)			
Earth Radiation Budget - CCI (AATSR/SLSTR)	Q4 2025			
Earth Radiation Budget - CLARA-A3	No major updates foreseen in C3S2_313b (only ICDR extensions). We may get CLARA-A3.5, so please add an optional 'heavy' deliverable			
Surface Radiation Budget - CCI (AATSR/SLSTR)	Q4 2025			
Surface Radiation Budget - CLARA-A3	No major updates foreseen in C3S2_313b (only ICDR extensions). We may get CLARA-A3.5, so please add an optional 'heavy' deliverable			
Clouds Properties - CCI (AATSR/SLSTR)	Q4 2025			
Clouds Properties - CLARA-A3	No major updates foreseen in C3S2_313b (only ICDR extensions). We may get CLARA-A3.5, so please add an optional 'heavy' deliverable			
Land Cryosphere				
Gravimetric Mass Balance (Ice Sheets)	No major updates in C3S2_313c			
Ice Sheet Velocity	Q3 2026	Q4 2026		
Ice Sheet Surface Elevation Change	Q4 2024	Q3 2026		
Glaciers (Randolph Glacier Inventory for year 2000)	Q4 2025			
Glacier mass change	Q2 2026			

Snow Water Equivalent	Q2 2025			
Snow Cover Extent	Q2 2025			
Permafrost - Temperature	? - please add optional activities	?		
Permafrost - Active Layer Thickness	?	?		
Permafrost - Extent	?	?		
Land Hydrosphere				
Surface Soil Moisture	Q2 2025	Q2 2026	Q2 2027	
Root Zone Soil Moisture	Q2 2025	Q2 2026	Q2 2027	
Freeze / Thaw	Q2 2025	Q2 2026	Q2 2027	
Terrestrial Water Storage Anomaly	Q2 2025	Q4 2027		
Groundwater Storage Change	Q1 2026	Q1 2027		
Lake Water Levels	Q1 2026			
Lake Water Levels - Single Track	Q1 2026			
Lake Surface Water Temperature	Q4 2026			
Lake Water Leaving Reflectance	Q1 2026			
Lake Ice Cover	Q1 2026			
Land Biosphere				
Burned Areas - SYNERGY Pixel & Grid Products	Q3 2025	Q1 2026		
Burned Areas - FireCCI60	Q2 2027			
Active Fires and Fire Radiative Power	No major updates foreseen in C3S2_313e (only ICDR extensions). Because coverage of this product was poor in C3S2_520, please add an optional light deliverable.			
Land cover	Q2 2027			
Surface Albedo	Q1 2027			
LST	Q2 2025			
LAI/FAPAR	Q1 2027			
Ocean and Sea Ice				
Sea Level (Global)	Q4 2027			
Ocean Color	Q1 2027			
Sea Surface Temperature (CCI)	No major updates foreseen in C3S2_313f (only ICDR extensions). We might still need an optional deliverable.			
Sea and Sea Ice Surface Temperature (Global)	No major updates foreseen in C3S2_313f (only ICDR extensions). We might still need an optional deliverable.			
Sea and Sea Ice Surface Temperature (Polar)	Q2 2026			
Sea Surface Temperature (GMPE)	No updates foreseen			
Sea Ice Edge and Type	Q2 2026 (same processing chain version, but a necessary change in			

	sensor from SSMIS to AMSR)			
Sea Ice Drift	Q1 2028			
Sea Ice Thickness - L3 Product	Q1 2026	Q1 2028		
Sea Ice Thickness - L4 Product	Q4 2025	Q2 2027		
Sea Ice Concentration	Q4 2025			
Sea Ice Index	No major updates foreseen in C3S2_313f (only ICDR extensions). Was not covered in C3S2_520			
Sea State	Q2 2026	Q2 2027		
Sea Surface Salinity	Q2 2026	Q1 2028 (optional)		

7.1.3 Predictions and Projections

Seasonal Forecasts

These data are currently available from 9 different forecast systems across 7 catalogue entries. There is extensive documentation on the forecast systems, datasets, and products available on [Confluence](#). The daily and subdaily data represent the original data received from the producing centres by ECMWF, quality controlled, and archived in Grib format in MARS. These data are then processed by ECMWF into monthly statistics and anomalies which are also archived in Grib format in MARS. The ocean variables entry data is stored in NetCDF format. Each month new forecasts are made available in all of the catalogue entries, and corresponding hindcasts are available.

Existing datasets in scope:

- Seasonal forecast daily and subdaily data on single levels
- Seasonal forecast subdaily data on pressure levels
- Seasonal forecast monthly statistics on single levels
- Seasonal forecast monthly statistics on pressure levels
- Seasonal forecast anomalies on single levels
- Seasonal forecast anomalies on pressure levels
- Monthly averages of ocean variables

Expected updates:

Updates to three forecast systems are anticipated in the next two years, which would require rechecking the quality assurance criteria. Updates to some quality assessments to reflect the latest forecasts systems should also be considered and a strategy agreed.

Decadal Predictions

Currently a decadal prediction catalogue entry on the CDS hosts DCP data from CMIP6 which were used to produce prototype services. A new activity has started which will provide 10 year decadal predictions each year, as well as corresponding hindcasts. These data will be made available in a new catalogue entry in 2026, for which all three tiers of EQC information will need to be produced. This will be similar to the prototype entry, but with an increased list of forecast systems (5 in total) and variables, and much more extensive documentation.

Expected updates:

Annual updates to forecasts each year, and updates to hindcasts when forecast systems are upgraded to CMIP7 over the next 3 years (and corresponding updates to documentation).

Climate projections

C3S publishes [climate projection data](#) on the CDS via an infrastructure contract with partner ESGF nodes, under which additional curation, sub-selection and quality control of the data are performed. Some of the data are served via a web-processing-service (WPS) which allows users to subset the data in space and time. These datasets provide a complex matrix of models, scenarios and variables, and may be updated in response to documented issues with the underpinning data, or retractions or updates, at ESGF.

Existing datasets in scope:

- [Global climate projections \(CMIP6\)](#)
- [Regional climate projections \(CMIP5-CORDEX\)](#)

Expected updates:

The CMIP6 catalogue entry will be updated twice in the next year, resolving consistency issues and adding new data. The CORDEX-CMIP5 entry will be updated to use the WPS. These updates will require rechecking the quality assurance criteria. A new CORDEX-CMIP6 entry is expected to be published in the next year, in a new catalogue entry for which all three tiers of EQC information will need to be produced.

7.2 C3S requirements for datasets

1. Data Management

1. *Accuracy and Consistency:* All information provided with the dataset must be accurate and consistent.
2. *Reliable Access:* Access to all information must be open, free and reliable.
3. *Versioning and Archiving:* Adequate version control and archiving policies must be in place.

2. Data Records

1. *Consistency:* The data must be complete and internally consistent.
2. *Uncertainty:* The data must include information about uncertainties.
3. *Updates:* Updates of the data records must be provided on a predictable schedule.

3. Metadata

1. *Discovery and Use:* Metadata must include all necessary information for discovery and proper use of the data records.
2. *Interoperability:* Metadata must comply with relevant international standards.

4. Documentation

1. *Content:* The content of data records must be fully documented.
2. *Scientific Basis:* The scientific methodology used to produce the data must be fully documented.
3. *Quality Control:* Quality control and validation activities must be fully documented.
4. *User Guidance:* Detailed information must be available to assist users in using the data.