ECMWF Copernicus Procurement

Invitation to Tender

Copernicus Climate Change Service

Volume II

Operational Seasonal Predictions

ITT Ref: C3S2_370
ISSUED BY: ECMWF Administration Department Procurement Section
Date: 17 March 2021
Version: Final

Funded by the European Union

Implemented by ECMWF

Table of Contents

1 Introduction

Copernicus is the European Union's flagship Earth-observation programme created to achieve operational monitoring of the atmosphere, oceans, and continental surfaces. It aims to provide reliable, validated information services for a range of environmental and security applications. The Copernicus Climate Change Service (C3S) responds to environmental and societal challenges associated with climate change. The service gives access to information for monitoring and predicting climate variability and change and thus helps support adaptation and mitigation. C3S produces and brokers a wide range of data and products describing the past, present and future of the climate system. This includes global and regional reanalyses, Essential Climate Variables (ECVs), near-term climate predictions, climate projections and a variety of sectoral climate information. The data are offered to users through the C3S Climate Data Store (CDS).

2 Context

Since 2016, C3S has included a service component based on seasonal predictions, at first placing the focus on graphical products published on the C3S website. In 2018 the seasonal prediction component became operational and added to its content a data service through the C3S Climate Data Store (CDS, https://cds.climate.copernicus.eu).

C3S offers its users multi-system global ensemble climate predictions, updated each month, each extending for at least 6 months. At a predetermined date every month, a large set of data at a variety of temporal resolutions is published in the CDS, alongside a number of higher-value data products. Example graphical products are derived at C3S and published through its website for free and open access (https://climate.copernicus.eu/charts/c3s_seasonal/). The data used as input to this service is produced by a number of institutions from around the world, all operators of state-of-the-art seasonal prediction systems; indeed, of the seven current participants in the C3S multi-system, six are designed by WMO as Global Producing Centres of long-range forecasts. Once transferred to C3S, this data is further processed, archived and published in the CDS, for users to download or use in the CDS toolbox. Like all CDS catalogue entries, the seasonal forecast data is accompanied by detailed documentation and its use is supported with expert advice. The operational procedures and schedule – with reliable timing, standardized and well documented formats – offer a valuable tool in decision making supporting adaptation to climate variability and change.

3 Contract summary

This ITT covers the provision of high-quality seasonal prediction data to underpin the C3S operational service for the next four years.

The production of real-time predictions, to an operational schedule, and the associated support to the C3S seasonal prediction component and to C3S users constitute the core of the requirement. In addition, development activities with a clear path to enhancing the quality of the providers' operational seasonal predictions systems, proposed by the tenderers, will be considered.

The complex nature of the activity and the likely dependencies on technical infrastructure – hardware and software – may make adjustments to development plans necessary during the period of the contract. Around the end of the second year, a review will take place, for the contractor and the C3S team to analyse such needs and decide on the most effective use of the available resources in the second half of the contract. At this point amendments to change the priorities, or repurpose developments, will be considered.

It is foreseen that a multi-system setup with several contributors will be agreed. As in the current phase of the service, C3S will take ownership of the data products delivered by these contracts, create further data and graphical products, including multi-system combinations, and make them available to the public without charge.

Tenderers should submit proposals that demonstrate their ability to deliver high-quality operational services

with a strong foundation in science, research and development. The proposals will be evaluated on the basis of criteria related to scientific quality, documented expertise and ability to fulfil operational requirements. Technical requirements are described in the following sections.

4 Technical specification

The successful Tenderers selected under this procurement will have existing well-established seasonal forecasting systems, with a proven track record of operational seasonal forecast production and delivery, and ability to provide the required data (section 4.1) from 1 August 2021. The systems will be state-of-the-art and fully compliant with the C3S requirements defined in this section.

The tender includes a minimum required contribution – the provision of the operational forecast data – and optional development contributions.

The mandatory minimum contribution consists of:

- regular and timely supply of global seasonal forecasts – real time and retrospective forecasts (hindcasts) - produced to specified requirements and standards and transmitted according to agreed protocols (see sections 4.1-4.9);
- timely support to C3S seasonal prediction multi-system operations, in accordance with agreed KPIs;
- provision of inputs to data and product documentation and to C3S evaluation and quality assurance material and activities, on request from C3S;
- timely response to requests for provision of specialist support to C3S users, when required by C3S;
- maintenance of high-quality real-time forecast system and production procedures;
- contribution to C3S communication and outreach activities related to seasonal predictions initiated by C3S.

Optional development contributions will be considered on a case-by case basis. Tenderers are invited to propose one or several of the following activities, with a clear explanation of the role they are expected to play in the improvement of the C3S service to its users:

- upgrades to forecast system, towards improvements in forecast quality;
- developments – to initialisation datasets or techniques, ensemble generation, uncertainty quantification, or model components - geared towards improvements in forecast quality;
- investigation into upgrades to production schedule (e.g. increased frequency of initialisation of predictions), quantifying likely benefits of such approaches, to inform upgrades in product generation schedule;
- investigation into skill of predictions at time ranges beyond 6 months. With careful consideration of affordability, contributions to the design of experiments aimed at extending the prediction horizon to multi-year timescales will be invited. The design will be coordinated by C3S, and will involve all participants in the C3S seasonal predictions service and (the separate) interannual-to-decadal prediction service.
- investigation into new products or post-processing techniques;
- contributions to C3S toolbox applications, using climate prediction data;
- innovative contributions to material for C3S outreach or learning.

Generic model development is out of scope in this activity, as are developments of methodology without prospect of implementation within the time horizon of the proposal.

Any proposals for a subset of the optional development activities listed above (or similar) must rank these in the order of preference, informed by internal institutional priorities at the providers' institutions and resource availability. As part of the evaluation of proposals, ECMWF will consider these options and rate them based on a convergence of priorities (among providers and C3S), capabilities, user requirements and value for money. The selection of the activities to be included will be agreed at the contract negotiation stage

with the preferred bidder(s) and may be revised during the contract term. To allow efficient negotiations and minimise the complexity of any future adjustments, each development activity should be formulated, as far as possible, as a self-contained module detailed in its own work package.

The following sections describe specific requirements from several perspectives: technical (in terms of what data must be delivered), service-related and quality-related.

4.1 Specified data stream

A comprehensive set of model output variables with daily (or in some cases sub-daily) temporal resolution is required; the list is available at https://confluence.ecmwf.int/display/COPSRV/List+of+requested+variables. Unavoidable deviations from this list will need to be agreed with the C3S operator. For example, fields may need to be substituted for the nearest model equivalent (e.g. 1.5m temperature instead of 2m temperature).

Additional fields may be requested during the evolution of the service, but will not be mandatory during the period covered by this contract. For example, it is anticipated that wind components and temperature in the stratosphere will be added to the list, once the precise details on the pressure level(s) favoured by users become clear.

Data are to be supplied on a 1x1 degree grid or finer, or on the original model grid; the choice should be proposed by the tenderer and will be agreed in the contract with each supplier.

4.2 Real-time data delivery requirements

The data is to be delivered to C3S reliably according to an operational schedule, initially, by 12Z on the 6th day of each month, or earlier if feasible, for product release on the following 10th. If operationally feasible and according to user demand, in the future this delivery date may be shifted towards the start of the month. Real-time data may be produced in "burst mode" (forecasts initialized on the 1st of the month) or using a lagged-average technique (forecasts initialized at various dates, initially up to and including the 1st of the month).

4.3 Re-forecast (hindcast) data delivery requirements

A comprehensive set of re-forecasts are required for each model to be used in the C3S seasonal forecast service. Re-forecasts must be made with an identical model version, and in as similar a way as possible to the real-time forecasts. Re-forecasts may be produced as a fixed set when a new model is introduced, or may be produced in a continuous fashion. In all cases, re-forecast data must be supplied at least one month in advance of the corresponding real-time forecasts.

4.4 Forecast/re-forecast length

Forecasts and re-forecasts must cover at least 6 full calendar months from the nominal start date for all ensemble members (see 4.7). In the case of lagged-start ensembles, the effective time coverage of the products must be at least 6 months.

4.5 Re-forecast period

The forecast products from C3S currently use a calibration period of 1993-2016; during the period of the proposed contract, efforts will be made to extend the calibration period to 2020.

To achieve this, contractors are expected to provide re-forecasts for the period 1993-2020 in any future upgrades to their C3S-contributing forecast systems.

4.6 Model resolution

Ideally, the horizontal grid resolution of the atmosphere model used should be around 50km or better, preferably with comparable resolution in the ocean component. It is also desirable for the models to have

stratosphere-resolving vertical resolution. However, coarser resolution models are acceptable, provided that the forecasting system quality can be assessed as comparable with state-of-the-art systems (see 4.8).

4.7 Ensemble size

The target for real-time forecasts is around 50 members with a maximum of about 100; target for re-forecasts is 25-50 members. Some flexibility will be allowed if justified as necessary by the tenderer. The ensemble size for each model version must in any case be agreed with the C3S operator, and be stable over time.

4.8 Forecasting system quality

The quality of existing seasonal forecasting systems will be used to discriminate between tenderers that otherwise meet the requirements to be a provider. The two primary performance indicators to be assessed will be ENSO forecast skill and the quality of the model climate. Available information about other indicators will be assessed and weighted according to its assessed statistical significance. Details on how information on forecasting system quality should be provided are given in section 6.2.4.1.

4.9 Additional requirements for data

4.9.1 Data transfer and data formats

Providers will make the output of their work available to ECMWF, who will then act as a "data supplier" to the C3S Climate Data Store (CDS). It is from the CDS that the data will be made available to users.

The preferred transfer solution is for data suppliers to upload their data to a designated server at ECMWF (the ECPDS system), via FTP. The data providers will also provide a corresponding checksum file (SHA256) for each data file uploaded, to verify that the files have been uploaded without corruption. If necessary, alternatives to this transfer system can be proposed. In order to ensure that the operational service deadlines are met, additional support may be needed from the data providers (for example, they may need to produce a 'manifest' of all files produced over a given period). All these aspects should be included in tenderers proposals and will be discussed in detail during the negotiation phase.

The data files themselves must be encoded in netCDF4-classic and follow the C3S-specific standard available from: https://software.ecmwf.int/wiki/display/C3SS/Guide+to+NetCDF+encoding+for+C3S+providers.

Software will be made available by C3S to check conformance to this standard (see next section).

This approach is a continuation of the practices established during the current phase of the service as it proved successful.

4.9.2 Quality control, support and documentation

Quality control procedures (including automatic procedures) shall be put in place to check the quality of forecast data before transmission to ECMWF. The precise methods should be proposed by the Tenderer and will be agreed as part of the negotiations. In the case of ECMWF detecting possible problems with the data, providers are expected to give timely support to resolve problems quickly, and at the latest 24 hours before the product release date.

Each forecasting system version needs to be documented, at a level which defines how the data were produced, and allows users to understand version changes. The datasets themselves will also need to be documented to allow discovery by users via the CDS. The data providers will be responsible for making this documentation available as required.

4.9.3 Data and IPR

It is a condition of EU funding for C3S that ownership of any datasets developed with C3S funding passes from the suppliers to the European Union via ECMWF. Ownership will pass from the date of creation of the

datasets. Suppliers will be granted a non-exclusive licence to use the datasets which they have provided to C3S for any purpose.

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

5 General requirements

5.1 Implementation schedule

The Framework Agreement will run from 1 August 2021 to 31 July 2025.

The successful 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 and deliverables. Regular progress meetings will be held with ECMWF during the contract to assess contract status, risks and actions.

5.2 Meetings

ECMWF will organise annual meetings to bring together all C3S service providers. The successful Tenderers are expected to attend these meetings. The Tenderers are also expected to attend monthly teleconference meetings to discuss C3S service provision, service evolution and other topics that cut across different aspects of C3S. The cost of attending these meetings shall be covered by each successful Tenderer and shall be included in the tendered price.

In addition, the seasonal forecast providers for C3S are expected to participate in a technical working group – which will also include C3S and relevant collaborators – aimed at discussing issues related to forecast production and product generation. These discussions will be convened at regular intervals, and most of them will take place by remote participation. In-person meetings organised for this sole purpose are not anticipated to take place more than once a year.

5.3 Deliverables and milestones

Deliverables expected are determined by the requirement outlined above. They can be in the form of documents or reports, datasets and support to users or other, related C3S activities. Requirements related to delivery of data have been described above (e.g. section 4.9); requirements for all other types are described in the following subsections.

Each deliverable shall have an associated resource allocation (person-months and financial budget). The total of these allocated resources shall amount to the requested budget associated with payroll as detailed in Volume IIIA of this ITT.

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.

5.3.1 Documents and reports

All project 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 specific contract, deliverables shall be made available to ECMWF in electronic format (Microsoft Word/PDF/Microsoft Excel or compatible), via the Copernicus Deliverables Repository portal; the details will be agreed at the negotiation stage.

Please refer to Clause 2.3 and the Annex 5 of the Framework Agreement for details on Reporting Obligations.

5.3.2 User support

ECMWF has established a centralised Service Desk to provide multi-tiered technical support to all users of C3S data, products, tools and services. The C3S Service Desk is used for ticketing user requests and distributing these requests to specialists as needed. Dedicated staff at ECMWF provides basic support in the form of self-help facilities (FAQs, knowledge bases, tutorials etc.) as well as individualised support on technical queries related to the CDS, data formats, data access etc. In addition, ECMWF staff will provide specialised scientific support to address questions related to its contributions to C3S, e.g. in the design and implementation of seasonal forecast products.

The C3S contractors are expected to also contribute to the delivery of technical support for the data and/or services they provide. Such specialised user support shall take the form of direct response to individual user queries referred via the C3S Service Desk facility, as well as contributions to FAQs, user guides and knowledge bases.

As part of the bid, tenderers shall describe the level of user support service on C3S Service Desk tickets (for example, 90% of Tier-2 requests answered within 5 working days), with sufficient flexibility to be improved depending on user requirements.

5.3.3 Other related C3S activities

Support is also required for related C3S activities, including the C3S Evaluation and Quality Control (EQC) function, communication and training and outreach. While in most cases such calls on this contract are expected to be minimal, consideration should be given to allowing resources to cover these aspects.

In addition to data quality checks described in previous sections, the contractors will be required to provide material for the standardised quality assurance reports (QARs) which form part of the C3S EQC output and to review EQC material produced independently. An example of such QAR is available for climate projection datasets in the CDS (https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cordex-domains-single-levels?tab=eqc).

Outreach activities related to seasonal predictions may be organised during the period of the contract; in such instances, the contractors may be approached by ECMWF for support in developing and delivering content, if appropriate (e.g. the event takes place in the contractor's country). Similarly, C3S may require from the contractors small contributions to training material on seasonal climate predictions for the Copernicus User Learning Services or to communication pieces.

Any communication activity related to this work, initiated by contractors, must be agreed with the ECMWF Copernicus Communication team in advance and comply with Clause 3.2.5.2 of the Framework Agreement. This includes, but does not exhaustively cover, communication planning, branding and visual style, media outreach, website and social media activity, externally facing written and graphical content and events.

6 Tender format and content

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

6.1 Page limits

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

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

Table 1: Page limits

6.2 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.

6.2.1 Executive summary

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

6.2.2 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.

6.2.3 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 4. The team shall include a Service Manager with at least 5 years of experience in management of large-scale projects. The Tenderer shall describe the experience of the Service Manager and the technical project team in performing activities related to the various aspects of this tender.

6.2.4 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.

6.2.4.1 Existing capabilities

Tenderers should present information outlining the strength of their present capabilities in the following form:

- A brief description of the scientific heritage of their forecasting model and initialization system, describing the current level of maturity.
- Publications or internal documentation describing forecast performance and model climate of the present forecasting system.
- Tenderers must provide as part of their tender, monthly mean forecast data (SST, T2m, MSLP and Z500) from individual ensemble members, for a set of re-forecasts from 1 May and 1 Nov starts, with minimum requirements for ensemble size and forecast length as described in the section on technical requirements

(with a preference for at least 20 years of start dates in the period 1993-present). Data should be made available either by providing a reference in this section to existing datasets accessible by ECMWF, or by arranging to supply data to ECMWF, in GRIB or, preferably, netCDF format compatible with the C3S standard. Data should be from production systems. This data will allow ECMWF to produce some summary statistics, in line with established practice for assessing seasonal forecasting systems, for consideration as part of the evaluation of the bid.

6.2.4.2 Planned development of forecasting system

Tenderers should describe the plan to maintain or update existing capabilities during the course of the contract. If any scientific developments are seen as necessary during this period, these could also be described, for context, even when they do not qualify for funding under this contract (see in- and out-of-scope topics in section 4).

6.2.4.3 Computing and data handling resources

Tenderers should provide information about the computer systems expected to be used to run the forecasting systems, and the capabilities of those systems to meet the requirements of the contract, in terms of CPU and I/O, data storage and data transmission.

The estimate of the cost associated to computing needs to be accompanied by information on the elements included in this cost, in as much detail as possible.

6.2.5 Management and implementation plan

The Tenderer shall provide a detailed implementation plan of proposed activities for the duration of the framework agreement. Deliverables should be consistent with the technical requirements specified in section 4.

The Tenderer is requested to include management and implementation activities within a dedicated work package (WP0). The number of milestones is not restricted, but they should be designed as markers of demonstrable progress in service development and/or quality of service delivery. Adjustments to the proposed implementation plan can be made, depending on needs for service evolution, changed user requirements, or other requirements as agreed between the European Commission and ECMWF.

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

- Quarterly, annual and final reports shall be provided in accordance with the Framework Agreement Clause 2.3.
- An implementation plan for the year N+1 shall be provided in February of the year N for approval by ECMWF.
- Monthly teleconferences with ECMWF and a proposal for involvement of ECMWF in major project reviews shall be provided as part of the management plan.
- If relevant, a list of sub-contractors and details of their contribution, key personnel, legal names and addresses shall be provided. The tenderer shall describe how the Framework Agreement, in particular Clause 2.9, has been communicated down to all their sub-contractors.

The table below provides the template to be used by the contractor to describe the complete list of deliverables, milestones and schedules for this work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the table. Tenderers shall provide preliminary versions of the completed tables as part of their bid.

Deliverables for this work package shall include the following reports:

WP0 Contractual Obligations Template				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 20/01, 20/04, 20/07 and 20/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually on 28/02
D0.y.z	Tenderer	Report	Final report	60 days after end of contract
D0.y.z-YYYY	Tenderer	Other	Preliminary financial information YYYY *YYYY being the Year n-1*	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Draft Implementation plan YYYY *YYYY being the Year n+1*	Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY *YYYY being the Year n+1*	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY *YYYY being the Year n-1*	Annually
D0.y.z-YYYY	Tenderer	Other	Letter from auditor specific to C3S contract YYYY *YYYY being the Year n-1*	Annually

6.2.6 Key performance indicators

Contractors shall report to ECMWF on a set of Key Performance Indicators (KPIs) suitable for monitoring various aspect of service performance, including (but not limited to):

- Data quality
- Service delivery
- Contract management
- User support

The KPIs defined by the Tenderer are subject to review by ECMWF and may be updated if necessary.