ECMWF Copernicus Procurement

Invitation to Tender

Copernicus Climate Change Service

Volume II

Operational access to global and regional climate projections and predictions from ESGF

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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 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

The Copernicus Climate Data Store (CDS, https://cds.climate.copernicus.eu) is the C3S infrastructure underpinning user access to its wide range of climate data. The CDS catalogue includes a large set of climate projections created with Global and Regional Climate Models (GCMs and RCMs), as part of the World Climate Research Programme's (WCRP) Coupled Model Intercomparison Project (CMIP) and Coordinated Regional Downscaling Experiment (CORDEX).

CMIP and CORDEX archive the model-simulation data at nodes of the Earth System Grid Federation (ESGF). C3S performs additional quality control on these datasets, at these nodes, and the subset of the data thus selected is provided to users via the CDS. The technical solution underpinning the data provision relies on three European ESGF nodes (operated by STFC, IPSL and DKRZ, respectively) which jointly provide continued and efficient access to the climate model data they host, as well as support to users of the CDS interface.

In the new phase of the Copernicus Programme (Cop2), the climate projections part of the service components of C3S will see a focus on CMIP6 (and post-CMIP6)-generation model output, while maintaining access and some user support for the CMIP5 content of the CDS. Three strands of activities are being set up. The highest priority, throughout, is the operational provision of access to the data in the CDS catalogue. At the outset, the climate-model content of the catalogue includes climate projections from global models, produced as part of CMIP5, CORDEX, regional-model simulations based on CMIP5 boundary conditions and a small subset of data from two of the elements of CMIP6 (https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6; ScenarioMIP and DCPP). Access to these datasets through the CDS will be maintained without interruption at the transition between the two phases of the programme. This topic is dealt with in this ITT.

A second strand of activities will concentrate on the selection and addition of new data from climate model simulations to the CDS catalogue. A final strand will be built on the preparation and implementation of processing software, to offer users improved means of accessing and analysing climate model data near its source. These strands do not form part of this ITT.

3. Contract summary

This ITT covers the service underpinning the access to the ESGF-hosted data published in the CDS, using technical solutions already implemented under Cop1 and in place at the outset of the contract. Throughout Cop2, the access to data included in the CDS catalogue and the operation and maintenance of related software, connected to the CDS, will form the object of this activity. This means that the amount of data/software in scope for the activity will change in time, but the type of tasks, and thus the expertise required of the delivery team, will not. At regular intervals (no more than once a year) new CDS content will be added to the scope of this contract; in order to account for updates to the resources required to deliver the service, dedicated Service Contracts will be negotiated. Years 1 and 2 of the Framework Agreement will

constitute Service Contract 1. During Service Contract 1 any change in scope will not exceed 10% of the baseline as defined below. The first point of change to the content in scope for operational provision is expected 24 months after the start of the Framework Agreement. After a review planned for the end of Year 2, negotiations will take place to determine the exact content for Year 3 and the outline of changes for Year 4 of the Framework Agreement. Year 3 of the Framework Agreement will constitute Service Contract 2, followed by Service Contract 3 to cover Year 4 of the activity.

In view of the above, Tenderers are asked to propose their pricing on a four year term, based on current requirements (the 'baseline') described in section 4, and anticipated increases in volumes for Years 3 and 4 as follows:

Contract term: 4 years
Year 1: Baseline
Year 2: Baseline
Year 3: Baseline plus additional 50%
Year 4: Baseline plus additional 75%

NOTE: The '50%' and '75%' figures for additional content are, at present, an estimate; the actual supplementary content will be re-evaluated during the second half of Years 2 (for Year 3 volumes) and 3 (for Year 4 volumes), and the precise requirement negotiated for the subsequent Service Contracts. Where the changes in the amount of content in scope are different from those quoted for, adjustments to the service price for these years will be negotiated based on the original quote.

4. Technical specification

The C3S Climate Data Store (CDS) provides access to global (CMIP) and regional (CORDEX) climate projection data for its users. At the time of writing this ITT, the following climate projection-data entries are available in the CDS catalogue:

- CMIP5 global climate model data:
  - https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cmip5-monthly-single-levels
  - https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cmip5-monthly-pressure-levels
  - https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cmip5-daily-single-levels
  - https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cmip5-daily-pressure-levels
- CORDEX regional climate model data:
  - https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cordex-domains-single-levels

Two more datasets will be added to the CDS before the end of the present contracts (end of June, 2021): small subsets of CMIP6 global climate model projections and decadal predictions.

The CMIP6 catalogue entry – at the time of writing, awaiting publication in the CDS – will combine the data available in the ESGF data nodes with computational processes which facilitate access to the data. These allow users to select and download only the data of interest (in terms of spatial and temporal extent), regardless of the file structure available in the ESGF archives. By contrast, the current service offers CMIP5 (and CORDEX) data only as collections of the original files held in the archive. This new access protocol requires a more complicated infrastructure behind the CDS catalogue entry.

The present ITT covers the operation and maintenance of all the infrastructure and services listed above, necessary to allow continued and uninterrupted access to all climate projection and prediction data present and expected in the C3S catalogue at the end of June 2021.

In more detail, the proposed activity will:

- Operate and monitor the services (data and web processing services) running at ESGF for the C3S. The access is expected to follow the technical solutions in place at the current phase of C3S;

- Maintain the content of the CDS catalogue entries based on the dedicated C3S ESGF-node connection, including CMIP5, CORDEX and CMIP6 data (including overview, documentation and download tabs).
- Maintain the details of Errata, Persistent Identifiers (PIDs), documentation (ES-DOC) and versioning information;
- Maintain the security level of the relevant software deployed at this infrastructure;
- Upgrade software infrastructure when necessary to ensure compatibility to the general ESGF software environment;
- Provide user support for C3S users, with special emphasis on requests referred for specialist answer by Copernicus User Support Section.

The contract will include technical tasks, maintenance of documentation, support to related C3S activities and to C3S users and contract management. The description below provides details on the objectives and outputs expected to be realised in the work packages of the contract. Formal requirements for labelling and describing the content of the work package are presented in Section 5.2; the division of the technical tasks in work packages is left at the discretion of the tenderer. However all the appropriate deliverables and milestones should be included in the description of the work packages.

The existing technical solution is partly described in the Interface Control Document (ICD) included in the Annex of this Volume II document. At the beginning of the contract a new document explaining the technology and interfaces used for the data published in the CDS shall be prepared by the successful Tenderer. Special attention shall be paid to reflect the interactions between the data and compute processes for the data publication. Particularly, subsetting, averaging and re-gridding should be included and considered as integral part of the infrastructure. Afterwards this document shall be regularly reviewed (e.g. every three months) and updated, if needed.

Continuous monitoring of the Service is expected and regular reports describing the conclusions should be provided every three months. Such reports shall contain the summary of technical problems encountered and their respective solutions and moreover what actions were undertaken in order to prevent the problems happening again.

The contract is expected to provide support to C3S on a number of fronts. First is the technical support to the CDS team, on matters related to the operation of the infrastructure. As this is a service with operational status, this means timely responses in case of problems detected using an efficient workflow to get the answer and the possible fixes quickly. Second is support to specific user questions which relate to the hosting, archiving and the quality control of the original data and which go beyond the expertise of Copernicus User Support (CUS). A procedure should be defined and implemented, to accommodate such requests and provide timely answers. The third aspect is the maintenance of the data documentation, which is provided to the users through the CDS. This information is an integral part of the CDS catalogue entries, and thus needs to be kept up to date.

As this ITT concentrates on the maintenance of all ESGF-originating datasets published in the CDS, it is likely that there will be an expansion of the content of these datasets (e.g. by adding models, variables, experiments, ensembles) .and hence the technical infrastructure should be able to accommodate such increases.

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

Any communication activity related to this work must be agreed with the ECMWF Copernicus Communication team in advance. This includes, but not exhaustively covers, communication planning, branding and visual style, media outreach, website and social media activity, externally facing written and graphical content and events.

The contract management activities shall be managed in separate work package; the structure and content expected from this work package are described in the next section.

5. General requirements

5.1 Implementation schedule

The Framework Agreement will run from 1 July 2021 to 30 June 2025. The Tenderer shall provide a detailed implementation plan of proposed activities for the first two-year period and implementation scenarios for the remaining two years, as described in Section 3 above.

5.2 Deliverables and milestones

Deliverables should be consistent with the technical requirements specified in section 4. 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 contract reports shall be produced in English and be submitted in electronic format, via the Copernicus Deliverables Repository portal.

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.

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.

The following contract management details shall be briefly described in the bid:

- Contractual obligations on reporting on implementation and forward planning.
- Meetings (classified as tasks and listed in a separate table as part of the proposal):
  - ECMWF will host monthly teleconference meetings to discuss C3S service provision, service evolution and other topics.
  - ECMWF will organise a review meeting before the end of the 2-year contract in order to discuss the optional extension activities.
  - Tenderers can propose additional contract internal meetings (e.g. kick-off meeting, regular meetings to monitor contract performance) as part of their response. Most such meeting should be held by remote participation.
  - ECMWF will organise annual C3S General Assemblies. The successful Tenderer is expected to attend these meetings with team members covering the topics that are part of this ITT.
- A check on the quality of the deliverables should be made by the prime contractor before submission to ECMWF (to cover contents, use of relevant ECMWF reporting templates, format, deliverable numbering and naming, punctuation, spelling and grammar, etc).
- Resource planning and tracking using the appropriate tools.
- Implementation of checks, controls and risk management tools for both the prime contractor and subcontractors.
- Subcontractor management, including conflict resolution (e.g. the prime contractor is responsible for settling disagreements, although advice/approval from ECMWF may be sought on the subject).
- A list of subcontractors describing their contribution and key personnel shall be provided, as well as back-up names for all key positions in the contract. The Tenderer shall describe how the Framework Agreement, in particular Clause 2.9 has been flowed down to all their subcontractors.
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 of the Volume V Framework Agreement.

The standard deliverables and milestones of administrative character are listed below.

WP3800 Deliverables				
#	*Responsible*	*Nature*	*Title*	*Due*
D1.y.z-yyyyQq[1]	Tenderer	Report	Quarterly Report QQ YYYY; *QQ YYYY being the previous quarter*	Quarterly on 15/01, 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Report YYYY; *YYYY being the Year n-1*	Annually on 28/02
D0.y.z-YYYY	Tenderer	Other	Preliminary financial form YYYY; *YYYY being the Year n-1*	Annually on 15/01
D0.y.z	Tenderer	Report	Final report, including letter from auditor specific to C3S contract YYYY; *YYYY being the last year of the contract*	60 days after end of contract
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	Tenderer	Report	Updated KPIs (list, targets…) after review with ECMWF	One year after start of contract

WP3800 Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.y.z-Px	Tenderer	Review meeting with ECMWF	Minutes of meeting	Shortly before the end of the 2nd year
M0.y.z	Tenderer	Monthly progress review meetings with ECMWF	Minutes of meeting	Monthly

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which includes the details of deliverables and milestones for all work packages and the schedules for each work package. The list of deliverables and milestones at each work package shall be also inserted into the main tender document.

5.3 Key performance indicators

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

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

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

[1] Deliverables (and Milestones) shall be numbered as per the following format DX.Y.Z (MX.Y.Z), where X is the WP number, Y is the task number and Z is the Deliverable (Milestone) number in this task. Deliverables delivered annually should be numbered DX.Y.Z-yyyy, where yyyy is the year the Deliverable refers to (e.g. DX.Y.Z-2016, DX.Y.Z-2017). Deliverables delivered quarterly should be numbered DX.Y.Z-yyyyQx, where yyyyQx is the quarter of the year the Deliverable refers to (e.g. DX.Y.Z-2016Q1, DX.Y.Z-2016Q2). The same numbering format shall be applied for Milestones. Continuous deliverables at higher frequency can be labelled in the same way as quarterly deliverables.

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

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	2 + 3 per Work package (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	6 (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 that meets at least the following requirements:

- A senior team member with more than 5 years of experience in managing activities related to this ITT (referred to as Service Manager). This person will be the point of contact on technical matters.
- A team member with experience of managing projects and contracts of this type and size (referred to as Contract Manager). This person will be the main point of contact for administrative matters.
- Team members with demonstrated experience in performing activities related to the various aspects of this ITT.

These team members shall be involved in the activities of this ITT at a minimum level of 10% of their total working time.

6.2.4 Technical solution proposed

The Tenderer is expected to provide a short background to the proposed technical solution to demonstrate understanding of the solution proposed, as well as an exhaustive and detailed description of the proposed technical solution and its organisation into work packages.

7. Annex: Interface Control Document (ICD)

Introduction

The Interface Control Document defines the interfaces between the Copernicus Climate Data Store (CDS) and climate projections projects which provide global projections data (CMIP5/CMIP6 - C3S 34f/34g) and regional projections data (CORDEX – C3S 34b and 34d) respectively to the CDS.

For the development of the original system for the C3S 34a and C3S 34b projects, services were built upon the software system from the Earth System Grid Federation, an international collaboration of research centres which runs a globally distributed network of nodes providing access to climate datasets. The system for CDS has been delivered by a consortium of three European institutions CEDA, DKRZ and IPSL.

Since the completion of the original system, it has become clear that the CDS requires only a simple download service for climate projections data. This new version has been commissioned as part of the C3S 34f continuation project to capture these important changes and replaces the original [REF 1]. Note that this ICD now also includes in its scope the delivery of CMIP6 data for the C3S 34g project. Data processing and subsetting services under development for the C3S 34e project may also be incorporated into this document at a later date.

References

[REF 1] Climate Projections Interface Control Document, Philip Kershaw, Version 34 snapshot from Atlassian CDS wiki, 11 September 2018

Review of existing interfaces and changes required

The ESGF software provides the functional baseline for the existing system covering data discovery, data download and access control:

- The ESGF Index Node provides a search catalogue, search web service API
- The ESGF Data Node provides data download services including HTTP, OPeNDAP
- Access control is provided via Identity Provider, Attribute Service, user and role registration services and Authorisation Service. The CDS uses a system of short-lived X.509 credentials with SSL client-based authentication

The table below lists the interfaces and the changes required.

Table 2: Summary of changes to interfaces

Interface	Change	Comments
ESGF Search API	Deprecated	Not needed by CDS. CDS has its own search API. However, the CDS requires a manifest of files in order to index them into its search system. See next item.
File Manifest	New interface	Provides a complete inventory of files served to the CDS. This enables the CDS to index files into its search system.
OPeNDAP	Deprecated	Data sub-setting is not required. Download of complete netCDF files is sufficient. However, it is expected that a separate data subsetting service will be developed as part of the C3S 34e project.
HTTP file download	Retained	This is the sole interface for data access from the CDS.
Access control: user authentication for data access	Deprecated	CMIP5 and CORDEX access restrictions have been relaxed since the original C3S 34a and C3S 34b contracts were awarded. Both datasets now have an open access policy so that access control functionality is no longer required.

Interface	Change	Comments
Access Control: User Registration	Deprecated	See comment above. In order to access CMIP5 data, CDS users first needed to consent to the access agreement and then the CDS sent a registration request to the climate projections system. This is no longer required.
Web Processing Service	Deprecated	WPS processes were developed for C3S 34a and C3S 34b projects as test services. Production services are under development in C3S 34e which will replace these. These are still under development.

From the table then, the interfaces are:

- HTTP data download
- File Manifest

These are considered in the following sections.

Data download

Files are served over HTTP. Access by the client is by HTTP GET request.

File Manifest

A manifest file is provided to the CDS whenever new data is published (Table 3). This consists of a list of the file download URLs. Each file is delimited by a new line character (Line feed - \n). In an addition, a YAML file is provided containing a list of the variables (Table 4).

Table 3: Example Manifest file showing file listing for monthly pressure level files (https://raw.githubusercontent.com/cp4cds/c3s-manifiests/master/monthly_pressure-levels/manifest_C3S-34a-Lot1_cmip5-monthly-pressure-level_http_latest.txt)

```
http://data.mips.copernicus-climate.eu/thredds/fileServer/esg_c3s-cmip5/output1/BCC/bcc-csm1-1-m/amip/mon/atmos/Amon/r1i1p1/ta/v20181201/ta_Amon_bcc-csm1-1-m_amip_r1i1p1_197901-200812.nc

http://data.mips.copernicus-climate.eu/thredds/fileServer/esg_c3s-cmip5/output1/BCC/bcc-csm1-1-m/amip/mon/atmos/Amon/r2i1p1/ta/v20181201/ta_Amon_bcc-csm1-1-m_amip_r2i1p1_197901-200812.nc

http://data.mips.copernicus-climate.eu/thredds/fileServer/esg_c3s-cmip5/output1/BCC/bcc-csm1-1-m/amip/mon/atmos/Amon/r3i1p1/ta/v20181201/ta_Amon_bcc-csm1-1-m_amip_r3i1p1_197901-200812.nc

…
```

Table 4: YAML format file listing variables and units for monthly pressure levels (https://raw.githubusercontent.com/cp4cds/c3s-manifiests/master/monthly_pressure-levels/monthly_pressure-levels_variables.yml)

```
variables:
  Air temperature (ta):
    units: 'K'
    description: 'Temperature of the air.'
  Zonal component of Wind (ua):
    units: 'm.s^-1'
    description: 'Magnitude of the zonal (eastward) component of the two-dimensional horizontal air velocity.'
  Meridional component of Wind (va):
    units: 'm.s^-1'
    description: 'Magnitude of the meridional (northward) component of the two-dimensional horizontal air velocity.'
  Relative humidity (hur):
    units: '%'
    description: 'Amount of moisture in the air divided by the maximum amount of moisture that could exist in the air at a specific temperature and location.'
  Specific humidity (hus):
    units: 'fraction'
```

```
    description: 'Amount of moisture in the air divided by amount of air plus moisture
at that location.'
  Geopotential height     (zg):
    units: 'm'
    description: 'Gravitational potential energy per unit mass normalised by the
standard gravity at mean sea level at the same latitude. It is also used as vertical
coordinate referenced to Earth's mean sea level since its value is proportional to the
elevation above the mean sea level.'
```

Notification to the CDS is provided by raising a JIRA ticket. The files are made available on GitHub in the repository https://github.com/cp4cds/c3s-manifiests/