

# ECMWF Copernicus Procurement

## Invitation to Tender



## Copernicus Climate Change Service

### Volume II

The link between the CDS Toolbox and the ESGF compute nodes: design and implementation

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## 1 Introduction

ECMWF as the Entrusted Entity for the Copernicus Climate Change Service (C3S) invites tenders for designing an interface between the C3S Climate Data Store (CDS) Toolbox and the WPS (Web Processing Service) processes running at the ESGF (Earth System Grid Federation) nodes, to provide diagnostics based on the climate projection datasets available in the CMIP and CORDEX archives. The agreed design will be implemented and the functionality of the interface extended, taking into account user needs and outcomes of related C3S contracts. Fundamental to the design is the principle that the processing should run at the ESGF nodes (as Web Processing Services), next to the location of the data, with the CDS toolbox invoking these processes to execute workflows constructed by users, within its environment. This would ensure that only a small amount of processed data (if any) has to be transferred from the ESGF nodes to the CDS and the diagnostics thus implemented could operate on the latest available datasets. The newly designed CDS interface should be general enough to be used for other WPS processes running at other computing nodes. The work would connect with and expand on the activities performed in past or ongoing C3S contracts which are described in Section 2. The scope of activities and detailed technical requirements for this tender are described in Section 3 of this document. Section 4 lists contractual requirements and Section 5 the required format of the tender document.

## 2 Background

The purpose of this section is to describe the context of this tender including the relevant outcomes of current activities inside C3S related to this topic.

### 2.1 The C3S Climate Data Store

The backbone of the C3S services is a cloud-based Climate Data Store (CDS) that provides users with a single point of access to quality-assured data on climate. The datasets may be physically located at various data centres around the world, or they may be distributed in the data cloud, but this is transparent to users of the CDS. All C3S-generated data are open and free and can be used by anyone for any purpose. The content of the CDS spans timescales from past, present to future, and consists of observations, reanalyses, predictions and climate projections. Climate data contained in the CDS is further tailored to requirements of users from a variety of socio-economic sectors, in the service's Sectoral Information System (SIS). (For more details on the CDS, see <https://www.ecmwf.int/en/newsletter/151/meteorology/climate-service-develops-user-friendly-data-store>. The user interface of the CDS is accessible at <https://cds.climate.copernicus.eu>.) All CDS data and tools are accessible from the C3S website as well as via open Application Programming Interfaces (APIs).

To facilitate the transformation of data into tailored information products, the CDS features a toolbox (CDS Toolbox) for creating workflows and applications, using C3S datasets. The Toolbox contains a variety of software tools for combining C3S datasets and performing basic operations on the data. The Toolbox is designed to be extendable. The Toolbox uses a Common Data Model to represent different types of datasets available in the CDS catalogue and allow data and tools to be combined into workflows that can be executed on-line.

### 2.2 Related C3S activities

Several C3S contracts are in place to prepare global and regional climate projection data for the CDS. These contracts address:

- Global climate projections: data access (C3S\_34a Lot1: Provision of support to one Earth

System Grid Federation (ESGF) node in Europe)

- Regional climate projections (C3S\_34b Lot1: Access to CORDEX simulations for the European domain and C3S\_34b Lot2: Definition and generation of a '3-D matrix' of RCM projections),
- Evaluation and quality control of climate projections (C3S\_51 Lot4: Data Evaluation for Climate Models.)

**C3S\_34a Lot1** (Science and Technology Facilities Council, Centre for Environmental Data Analysis, STFC, UK) provides quality assured global climate projection data for the CDS at ESGF nodes, together with necessary compute services. The access to the data is reliable and robust. In addition to being available for download, this data can be directly used for processing through the CDS. The contract also provides processing services running at the ESGF computing nodes, able to perform basic diagnostic computations on the available climate projections data in the associated data nodes. This contract will be completed in December 2019.

**C3S\_34b Lot1** (Institut Pierre Simon Laplace, IPSL, France) provides quality assured CORDEX regional climate projection data for the CDS at the ESGF nodes and access to boundary conditions for Regional Climate Model (RCM) runs. The resulting data is available for download or can be directly used in the CDS Toolbox. Only the EURO-CORDEX and MED-CORDEX domains are in scope for this contract. Additional domains will become available in the future. This contract will also provide processing services on the ESGF compute nodes, with the notable example of interpolation of global climate model (GCM) data to achieve boundary conditions for RCM runs. The contract will be completed in April 2021.

*These two contracts (34a Lot1 and 34b Lot1) have clear and important synergies with the activities described in the present ITT: the processing functionality demonstrated during the current projects should be tested, adapted and implemented for operational use, and the range of operations extended to complete a meaningful set of data-reduction processing for use within the CDS Toolbox.*

**C3S\_34b Lot2** (Swedish Meteorological and Hydrological Institute, SMHI, Sweden) provides an enhanced set of regional climate simulations designed to better quantify uncertainties in CORDEX simulations for the benefit of climate services and makes them available at the ESGF nodes for the CDS. The additional RCM runs will be made available to the users of the CDS through C3S\_34b Lot1. This contract will be completed in April 2021.

The **C3S\_51 Lot4** (Finnish Meteorological Institute, FMI, Finland) - completed at the end of 2018 - investigated user requirements related to climate projection data and examined availability of such data from CMIP and CORDEX, identifying the gap between the two. In the process of gathering user requirements and performing scientific assessment, this contract created a standalone software package which offers simple diagnostics and visualisation options; these tools have proven popular with users in the context of this contract. The main outcome of this part of the contract can be accessed at <https://decn.copernicus-climate.eu/> portal.

*The diagnostics developed by this contract should be replicated by the successful tenderer in the extension of the CDS Toolbox diagnostics tools.*

Any relevant deliverables of these contracts, which are essential for the execution of C3S\_34e will be provided by ECMWF to the successful tenderer at the start of the contract.

### 3 Technical Requirements

ECMWF intends to award a contract for designing an interface between the CDS Toolbox and processing facilities available at a remote location, with a particular focus on Web Processing Services (WPS). This design will be implemented for the WPS functionality available at the 'operational' ESGF

node created for the use of C3S. Also, the range of processing options currently available there will be enhanced, to achieve meaningful and robust data reduction functionality for the benefit of the CDS and its Toolbox.

The successful tenderer shall:

- in close cooperation with the C3S CDS team, design an interface connecting the Toolbox and the remote compute nodes (ESGF for climate projections), consistent with the current architecture of the CDS;
- set up the connection between the CDS Toolbox and the WPS processes already running at the ESGF compute nodes;
- enhance the range of processing functionality at the C3S ESGF node, consistent with this architecture;
- develop a general CDS Toolbox interface which can connect with any WPS (or similar) processes run outside the CDS Toolbox, and maintain this interface during the lifetime of the contract taking into account specifics of new datasets (e.g. CMIP6 or newly available CORDEX data);
- replicate a small set of diagnostics already developed in other C3S projects (see some examples below) using this infrastructure, making it possible to deploy them on online data from the C3S ESGF node.

All the work described above should be performed in close cooperation with the ECMWF C3S staff in general and the CDS team in particular. It is preferable that developers from the successful Tenderer's team regularly visit and spend time at ECMWF for this purpose, working directly with the CDS experts. (The precise amount of time depends on the solution proposed, but monthly visits during the period dedicated to design and implementation are expected).

The expected activities can be grouped in two areas: the design of the Toolbox interface to WPS - which will form part of the infrastructure of the CDS at ECMWF - and the development of WPS processes at ESGF, to achieve the required data reduction goals.

The work plan of the project should encompass the following tasks:

- Design and develop the interface between the CDS and ESGF: this task would include designing and building a software environment, which is capable to run processes at the ESGF nodes (or generally outside the CDS). The system should be scalable as part of the architectural design. This task would also include the design of a test suite to support this feature of the toolbox with the use of global and regional climate projections made available through the C3S ESGF nodes.
- Build new WPS processes at ESGF or enhance existing ones, to enable 'operational' use. The anticipated basic WPS processes would allow sub-setting (in space, time, or according to specific, relevant ESGF facets), averaging and re-gridding. More complex processes (e.g. calculation of empirical orthogonal functions) should also be considered.
- Test and validate code on the full range of processes implemented, both in the development environment and in the CDS.
- Develop and implement diagnostics which are of direct relevance for climate service users as, for example:
  - Calculate and display the seasonal cycle for temperature and precipitation (based on GCMs and RCMs) for a range of pre-defined domains, scenarios, and periods (recent past (e.g. 1981-2010), near future (2021-2050) and end of century (2071-2100)) with options to show all or a subset of simulations,
  - Model biases: bias with respect to a reference (e.g. reanalysis) in monthly mean temperature and precipitation for a variety of scenarios, models and periods.

- Changes in seasonal cycle between present (or past) and future, for a variety of scenarios, models and periods.
- Deploy beta version of the WPS services developed, get feedback from the beta-users and update the infrastructure accordingly.
- Deploy operational production version of the developed processes.

The ESGF WPS thus developed must comply with the following set of principles, which underpin the CDS infrastructure:

- The computations called from the CDS Toolbox should not include data transfer from the remote location. The download of the data can be activated on request, but the default outputs expected are URLs on the remote server (where the data are located).
- The system should be scalable and ready for parallel execution: multiple users can initiate processes at the same time and multiple processes (minimum 10) can be executed in parallel.
- The system should be able to create a “function tree”, (i.e. it should be possible to chain several processes for several datasets/sub-setting in a single WPS call). An example is the computation of differences between the means of two datasets.
- The service should allow the option to pass sub-setting information together with a dataset (ESGF facets, time, level and geographical location).

Proposed list of deliverables:

- Design of interface between the CDS Toolbox and the compute processes running at the ESGF nodes. Form of deliverable: design document agreed with the CDS team of ECMWF.
- Fully tested WPS processes running at the ESGF nodes. Form of deliverable: running software, list of processes, documentation of processes.
- Implemented link between the CDS Toolbox and the ESGF processes (based on the design document). Form of deliverable: working processes called from the CDS Toolbox.
- Implemented WPS-based diagnostics of direct relevance of climate service users. Form of deliverable: working applications in the CDS Toolbox.

The timing of the deliverables should match the following objectives: complete and agree the design of the interface within three months of the start of the contract, implement the interface within the following three months and make fully-working WPS processes for sub-setting available through the CDS toolbox within nine months of the start of the contract.

## 4 Contractual Requirements

### 4.1 Schedule

ECMWF intends to award a single framework contract running from 1 November 2019 until mid-2021. A detailed time plan and schedule (Pert and Gantt charts) shall be included in the Tender response. The proposed time plan and schedule shall address the main tasks, inputs, outputs, intermediate review steps, milestones, deliverables and dates. The Tenderer is encouraged to include milestones in the implementation plan.

### 4.2 Reporting

Regular (monthly) progress meetings will be held with ECMWF during the contract to assess progress, and risks and set actions. The successful tenderer will have to report on a quarterly and annual basis and provide contributions to C3S reporting for past and future activities, to an agreed schedule (described in Volume V Framework Agreement for this ITT).

### 4.3 Meetings

Regular coordination is expected with C3S\_34a Lot1 and C3S\_34b Lot1 contracts, most likely by remote-participation meetings. ECMWF organises annually C3S General Assembly meetings which all C3S service providers, including the successful tenderer of this ITT, are expected to attend.

An intermediate contract review will be organised at ECMWF (Reading, UK), where the status and plans would be discussed with the C3S team.

The cost of all meetings shall be covered by the successful Tenderer and should be included in the price.

## 5 Tender Format

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.

### 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>	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)
<i>Management and Implementation</i>	10 (excluding Table 4 and Table 5 in Volume IIIB) + 2 per each Work package description (Table 3 in Volume IIIB)
<i>Pricing Table</i>	No limitation

Table 1: Page limits

### 5.2 Specific additional instructions for the tenderer's response

The following is a guide to the minimum content expected to be included in each section, additionally to the content described in the general guidelines of Volume IIIB. This is not an exhaustive description and additional information may be necessary depending on the Tenderer's response.

#### 5.2.1 Executive Summary

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

#### 5.2.2 Track Record

The tenderer shall demonstrate for itself and for any proposed subcontractors that they have experience with relevant projects in the public or private sector at national or international level. ECMWF may ask for evidence of performance in the form of certificates issued or countersigned by the competent authority.

#### 5.2.3 Quality of Resources to be Deployed

The tenderer shall propose a team having 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 experience in large multi-partnered projects. The Tenderer shall describe the experience of the Service Manager and of 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 the requirements 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 on the requirements.

#### 5.2.5 Management and Implementation

The tenderer shall provide a detailed implementation plan of proposed activities for the duration of the framework agreement. Deliverables should be consistent with the technical requirements specified in Section 3. Milestones should be proposed, to monitor progress on the activities agreed, or as points of decision on choices (of priorities or content) to be agreed with ECMWF before implementation.

Adjustments to the proposed implementation plan can be made on an annual basis depending on needs for service evolution, changed user requirements, or other requirements as agreed between the European Commission and ECMWF.

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 Article 2.3.
- An implementation plan for the year N+1 shall be provided in February of the year N for ECMWF approval.
- Monthly teleconferences with ECMWF and a bid for involvement of ECMWF in major project reviews shall be provided as part of the management plan.
- A proposed payment plan shall be provided as part of the bid. The payment plan shall be based on milestones completion and associated deliverables for development related activities.
- 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.

Volume III C will be used by the Tenderer to describe the minimum list of contractual deliverables to be submitted in line with the Terms and Conditions (cf. Volume IV). All 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.

The tenderer is requested to include all management and implementation activities within a dedicated work package (WPO). Deliverables for this work package shall include at least the following reports:

<b>Contract management deliverables (not limited):</b>				
#	Responsible	Nature	Title	Due
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY <i>QQ YYYY being the previous quarter</i>	Quarterly on 15/01, 15/04, 15/07 and 15/10



D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY <i>YYYY being the Year n-1</i>	Annually on 28/02
D0.y.z	Tenderer	Report	Final report	60 days after end of contract
D0.y.z-YYYY	Tenderer	Other	Preliminary financial information YYYY <i>YYYY being the Year n-1</i>	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Draft Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY <i>YYYY being the Year n-1</i>	Annually
D0.y.z-YYYY	Tenderer	Other	Letter from auditor specific to C3S contract YYYY <i>YYYY being the Year n-1</i>	Annually

### 5.2.6 Price and payment specifications

The tendered price shall not exceed the price as indicated in Contract Notice and shall include the personal costs, travel expenses and other costs for all work, tasks and deliverables proposed in the provided Pricing Table template in Volume IIIA.

Payments shall be conducted on a cost-reimbursement basis. Payment milestones shall be aligned with the implementation milestones as proposed in the implementation plan.