

# ECMWF Copernicus Procurement

## Invitation to Tender



## Copernicus Climate Change Service

Development of C3S Decadal Prediction Service

## Volume II: Specification of Requirements

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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 data and information services for a range of environmental and security applications. The [Copernicus Climate Change Service](#)<sup>1</sup> (C3S) responds to environmental and societal challenges associated with climate change, by providing access to data and information for monitoring and predicting climate change, to support efforts towards adaptation and mitigation.

ECMWF, as the Entrusted Entity for C3S, invites tenders for the development and implementation of the components of a service for climate predictions targeting the time horizon of years to decades ahead, to complement current C3S operational activities on seasonal prediction.

This initiative is driven by requirements from a variety of users of the Copernicus services and encouraged by the recent expansion in quasi-operational activities on decadal climate prediction supported by WMO.

## 2. Background

### 2.1. The Components of C3S

C3S is designed around a cloud-based [Climate Data Store](#)<sup>2</sup> (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 distributed on cloud-based platforms, but this is transparent to users of the CDS. All data are open and free and can be used by anyone for any purpose. In addition to standardisation of data formats and metadata, extensive documentation is provided to aid correct interpretation. The CDS deploys data volume reduction tools for many of its datasets, as well as example workflows and applications to extract information from the data; further tools are currently under development. More complex applications allowing users to 'interrogate' the content of the CDS are also provided (e.g., the [C3S Interactive Climate Atlas](#)<sup>3</sup>). Climate data contained in the CDS are also further tailored to requirements of users from a variety of socio-economic sectors, in the service's Sectoral Information System (SIS).

The content of the CDS spans timescales from past, present to future, and consist of observations, reanalyses, predictions and climate projections. The current tender targets initialised predictions covering years to decades into the future.

### 2.2. The Scoping of a Decadal Service Prototype

To identify the necessary elements of a decadal prediction service and priorities for implementation, in 2019 C3S held a workshop to scope the prototype for a service targeting decadal climate timescales. Based on the recommendations of the workshop, C3S identified the following priorities:

- robust definition and adoption of methods for post-processing of forecast data and evaluation of derived products. While the scientific community has made steps towards understanding the complexity of these topics, application of such methods to real user applications has not been extensive to date;
- progress on the technical infrastructure required by ensemble climate predictions. This includes the definition and adoption of standards for encoding such data, compatible with the currently established practices in the climate science community;

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<sup>1</sup> <https://climate.copernicus.eu>

<sup>2</sup> <https://cds.climate.copernicus.eu>

<sup>3</sup> <https://atlas.climate.copernicus.eu/atlas>

- production of real-time forecasts for 5-10-20 years ahead, and that of associated retrospective forecasts (here referred to as ‘hindcasts’).

A contract (C3S\_34c) was set up during the first phase of the Copernicus programme to address the most pressing of these priorities, with a focus on demonstrating applicability of predictive information on decadal timescales to user questions from a variety of economic sectors. The outcomes are documented on the C3S website (<https://climate.copernicus.eu/sectoral-applications-decadal-predictions>).

These first developments, though amounting to significant progress, did not cover all required steps towards operational implementation. For example, while enhancements to data encoding standards, to address shortcomings in the netCDF metadata for climate model simulations, specific to the context of initialised ensemble predictions, were formulated and proposed to the relevant community, these have not yet been adopted as standard. Also, while the example applications resulting from the previous contract caught the attention of users, scaling up or extrapolating these examples beyond the specific user contexts they were developed for was not possible at that stage. The data used in the example applications was published in the CDS, but only as a proof of concept, without continual real-time updates.

Arguably the most valuable output of this first phase of development was the lessons learnt by approaching the subject from the user perspective. A summary of these findings is included in the last section of this document.

### 3. Service Scope and Contract Summary

This Invitation to Tender (ITT) seeks development of a new C3S component, to build on the achievements of C3S\_34c and take another step towards operational, user-relevant services for decadal time scales. This must be meaningfully connected to, and complement current decadal prediction activities conducted, in research mode, under the World Climate Research Programme (WCRP), as well as WMO-led activities which form the scope of its Lead Centre for Annual to Decadal Prediction, using technical solutions and infrastructure in place at C3S. The focus will be on robust technical solutions for data access, post-processing tools for user-relevant applications, and real-time predictions.

ECMWF intends to award a single Framework Agreement for a period of 33 months, which shall be implemented via a single Service Contract expected to commence in Q3 2025, for developing or improving elements of infrastructure towards an operational decadal prediction service, targeting standardisation, quality control, timely production and publication of real-time predictions as well as example workflows for user-relevant applications.

### 4. Technical Requirements

Tenderers are invited to propose a set of activities which will address the remaining obstacles to operational user services. Areas of work in scope and expected deliverables are described below.

#### 4.1. Areas of Work

**Technical aspects.** Further progress is sought towards making the enhanced encoding standards part of the ESGF infrastructure, in time for CMIP7. The work could include update of encoding and checker software to account for additional metadata recommended for initialised ensemble predictions by C3S\_34c (deliverable available on request). Also in scope is development of/enhancement to software to streamline the encoding of data according to ESGF rules (e.g. CMOR for DCP), to speed up submission of decadal prediction data to

ESGF, and thus make timely access to this data possible for users like C3S. Coordination with technical solutions implemented, or under development, at the WMO LC-ADCP is desirable.

It is required that any data found, by the analysis taking place in this activity, to be useable for products and services (on account of quality and availability in real time), be published in the Climate Data Store, as part of this activity. This will use a similar set up as that in place for DCPD data already published through the CDS (<https://cds.climate.copernicus.eu/datasets/projections-cmip6-decadal-prototype?tab=overview>).

**Data production.** The main source of decadal prediction data for C3S services is intended to be CMIP's Decadal Prediction Project (DCPP). DCPD-A remains the place of reference for hindcasts; however, DCPD-B (real-time forecasts) content seems not to be as rigorously kept up to date between 'active phases' of CMIP as at the peak of these phases (e.g. CMIP6). WMO's Lead Centre does oversee the provision of real-time decadal predictions through the network of Global Producing Centres (GPCs), and may be used as a source of data for real-time updates. However, since contributions to the Lead Centre are not secured through funding, this may not be a sufficiently robust solution for a sustained supply of real-time predictions. For C3S purposes, a sustainable solution is required, which is why production of predictions in real-time mode is within the scope of this tender. Improvements to documentation – related to models, forecast systems, external forcing data – are also in scope.

As confirmed by analysis in C3S\_34c, a multi-system framework is critical for skilful prediction products, and it is required for the purposes of C3S. However, production of hindcasts for updates/upgrades of decadal prediction systems is out of scope for this tender.

Investigation into requirements for performing on demand predictions in the event of a large volcanic eruption may be considered. This could include proposing and testing an implementation scheme, which would need to provide timely aerosol forcing information for use in real-time predictions.

**Data publication.** Prediction data which underpins the products to be generated in this contract – as well as a wider range of decadal predictions from operational systems participating in either DCPD or the WMO Lead Centre's activities – will be made available to users through the C3S Climate Data Store. The publication will follow the method employed currently at C3S: data is to be submitted by the producing centre to ESGF (formatted to standards compliant with ESGF requirements), then subjected to further quality control and selection criteria set by C3S prior to making it available via the CDS. A limited set of decadal predictions is already available to CDS users, at <https://cds.climate.copernicus.eu/datasets/projections-cmip6-decadal-prototype?tab=overview>. The current implementation delivers C3S users data formats consistent with the enhanced metadata standards recommended by C3S\_34c; the description of these enhancements is available in the [CDS documentation](#)<sup>4</sup>. This upgrade to the decadal prediction provision in the CDS catalogue can follow the same procedure in the relatively short term; for the longer-term, Tenderers are invited to propose improvements to this solution, aimed at improving consistency of formatting between C3S and ESGF catalogues, without loss of valuable standardised information to users.

Access to the CMIP-related predictions and projections in the CDS is implemented, maintained and routinely operated as part of the C3S2\_380 contract; new data is added to the catalogue content in separate contracts (currently, C3S2\_382). The workflow involves C3S2\_382 identifying and selecting such data of interest to users and developers of climate services identified by C3S, checking this data against ESGF-set standards and additional C3S standards, and supporting members of the C3S team in the publication of this data under the respective catalogue entry in the CDS. Once published in the CDS, the maintenance of access to this data is handed over to C3S2\_380. In the case of prediction data which forms the object of the current tender, whether the pre-publication steps summarised above are performed in this contract or as a separate piece of work is open to negotiation.

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<sup>4</sup><https://confluence.ecmwf.int/display/CKB/CMIP6%3A+Decadal+climate+predictions#CMIP6:Decadalclimatepredictions-In-filemetadatamodifications>

**Tools and methods.** Development of new tools and methods for analysis of prediction outputs, for skill assessment and product generation purposes, is a strong requirement. These tools will be made available to users; it is required that the software be fully documented and consistent with [ECMWF's software development strategy](#)<sup>5</sup> and, wherever possible, use ECMWF software packages (e.g. [Earthkit](#)<sup>6</sup>). Methods for analysis could also be provided – to be shared with users – as a detailed description of steps, with precise references, even if not (fully) implemented into software.

**Examples/case studies/products.** Case studies, examples, or products, similar to those developed in the past contract and published on the C3S website, are in scope. As before, a clear, real use case should be the starting point; the conclusions of the analysis should be clearly presented and documented, whether the outcome is a success or not. It is very valuable to understand and document circumstances when a user question cannot be properly addressed with this type of predictions. For successful case studies, it is expected that the output be formulated as a product to be updated, yearly, with real-time predictions. For sustained-mode production, the processing will need to be implemented on the ECMWF computing infrastructure, and the Successful Tenderer will be expected to contribute significantly to this transfer of technology. Therefore, the software development should take place in consultation with ECMWF staff and will need to follow the principles mentioned above. Where appropriate, software allowing other users to replicate and adapt the processing steps in these case studies is expected to be made available via C3S (e.g. as Jupyter Notebooks).

## 4.2. Deliverables

The expectation is that at the end of the contract, users will 'have access' to:

- **Prediction data and products**, in the CDS catalogue and through the C3S website respectively. This means the Successful Tenderer should set up continual (production, if applicable, and) provision of real-time forecasts – and associated hindcasts – including, specifically, variables for which there is reasonable expectation of skill, from models with skill in key aspects of decadal climate variability.

If feasible, updates to the case studies created in previous C3S contract are of interest.

- **Software.** This should include workflows for evaluation of key model outputs ('generic' evaluation of skill) and verification of any products generated for users. The software will be documented in sufficient detail to allow users to adapt the procedure for related purposes. (For example, there is interest in using the software documentation and tutorial created in this contract as starting point for work under the C3S National Collaboration Programme<sup>7</sup>.)
- **Documentation** of content to be published in the CDS is required. If possible, contribution to C3S training materials on multi-year predictions.

It is desirable to also have achieved further progress on technical infrastructure related to encoding of ensemble (initialised) predictions – e.g. tables for CMIP7's DCP.

Tenderers are invited to propose a set of deliverables which achieve the key outcomes described above, following the guidelines in the following sections of this document.

## 5. General Requirements

### 5.1. Implementation Schedule

Tenderers shall provide a detailed implementation plan and schedule (Pert and Gantt charts) in the tender response. The proposed time plan and schedule shall address the main tasks, inputs, outputs, intermediate

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<sup>5</sup> <https://www.ecmwf.int/en/elibrary/81334-software-strategy-and-roadmap-2023-2027>

<sup>6</sup> <https://www.ecmwf.int/en/newsletter/179/computing/introducing-earthkit>

<sup>7</sup> <https://climate.copernicus.eu/c3s2461-c3s-national-collaboration-programme-call-actions-2024>

review steps, milestones, deliverables and dates.

## 5.2. Work Packages

The work proposed by the Tenderer should be organised in work packages aligned to the main objectives of the proposal. The design of the work package structure is left to the discretion of the Tenderer, with one notable exception: the work package on contract management, the content of which is prescribed by ECMWF, as described below.

## 5.3. 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:

**Plans** for the mandatory reporting on implementation and forward planning.

**Meetings (classified as tasks and listed in a separate table as part of the proposal):**

- Organise quarterly teleconference meetings to discuss C3S service provision, service evolution and other topics, prepare corresponding summary minutes of these meetings and maintain a list of agreed actions and their status.
- ECMWF organises annual C3S General Assemblies. The Successful Tenderer is expected to attend these meetings with maximum 3 team members and contribute to discussions related to the topic of this ITT.
- 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 meetings should be held by remote participation.

**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 in English. Unless otherwise specified the specific contract Deliverables shall be made available to ECMWF in electronic format.

**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 is expected to be updated regularly with ECMWF during the contract.

**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):

<b>WPO Deliverables</b>				
<i>Deliverable#</i>	<i>Responsible</i>	<i>Nature</i>	<i>Title</i>	<i>Due</i>
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY <i>QQ YYYY being the previous quarter</i>	Quarterly on, 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY [Part 1] <i>YYYY being the Year n-1. Shall include:</i> <ul style="list-style-type: none"> <li>• Quarterly Implementation Report Q4 YYYY ; YYYY being the Year n-1</li> <li>• Preliminary financial information YYYY ; YYYY being the Year n-1</li> </ul>	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY [Part 2] <i>YYYY being the Year n-1</i>	Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Annual Implementation plan YYYY <i>YYYY being the Year n+1</i>	Annually on 30/09
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY <i>YYYY being the Year n-1</i>	Annually around June (no associated cost)
D0.y.z	Tenderer	Report	Final report	60 days after end of contract

<b>WPO Milestones</b>			
<i>Milestone#</i>	<i>Title</i>	<i>Means of verification</i>	<i>Due</i>
M0.1.1.MX	Progress Review meeting with ECMWF / Payment milestones	Minutes of meeting	At each Payment Milestone due date (~every 6 months)
M0.1.2.MX	Kick off meeting	Minutes of meeting	Month 1
M0.2.1	Updated KPIs (list, targets...) after review with ECMWF	Technical note	One year after start of contract

#### 5.4. 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 contract 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 Copernicus Deliverables Repository portal. The details will be agreed at the negotiation stage.



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.

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. Contract management and technical coordination is expected to amount to approx. 7% of the planned use of the resources.

## 5.5. Data and IPR

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

All software and products used by the Successful Tenderer to produce the Copernicus datasets/software will remain the property of the Successful Tenderer, except for those components which are acquired or created specifically for Copernicus purposes, with Copernicus funding, and which are separable and useable in isolation from the rest of the Successful Tenderer's 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 license to use them for any purpose.

## 5.6. 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). 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 shall be refined together with ECMWF during the first 6 months of the contract.

## 5.7. 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 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.

## 5.8. Ad hoc Support

Whilst communications and user engagement, training and support activities are not part of the scope of this ITT, the Tenderer shall make provisions for possible requirements for technical and scientific expertise in ad hoc support of these activities. The Tenderer shall specify in the Tender the experts available to provide this support. If applicable, a small budget may be proposed to cover such resources.

## 6. 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.

### 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.

<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*

### 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

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

#### 6.2.2. Track record

Tenderers shall demonstrate for themselves 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

Tenderers shall propose a team that meets at least the following requirements:

- A senior team member (Principal Investigator) with more than 5 years of experience in managing activities related to this ITT.
- At least two additional senior team members with more than 5 years of 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. Tenderers shall also appoint a Service Manager, which will be their primary contact for contractual delivery and performance aspects.

### 6.2.4. Technical Solution Proposed

Tenderers are 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.

### 6.2.5. Management and Implementation

As part of the general project management description, and in addition to the guidance provided in Volume IIIB, Tenderers shall consider the elements described in section 5.3 above.

## 7. Additional Information

### 7.1. Lessons learnt from first C3S decadal prediction prototype (C3S\_34c)

The first phase of development towards a decadal prediction service at C3S investigated applicability of such predictions in user applications, with examples based on four case studies (see <https://climate.copernicus.eu/sectoral-applications-decadal-predictions>). A number of valuable findings of this activity are summarized below.

**A wide range of potential users means a range of ‘products’ is required, from direct model output to ‘calibrated information’**

#### **Case studies (user feedback and conclusions of study)**

- **User questions** are diverse, complex and ‘ambitious’; they **go well beyond global average temperature, or trends**. Available prediction skill is at odds with some users’ expectations.
- **Production schedule** needs to be tightened up (some decisions have deadlines attached – e.g. re-insurance).
- Some users do not ‘like’ large ensembles – to convey the ‘correct’ forecast message, **calibrated products** will be needed.
- Downscaling GCM output does not ‘create’ skill; **understanding where the skill comes from is essential for product generation** (e.g. case study used country-region GCM atmospheric variables to create river basin-scale, 5km rainfall predictions, without improvement in skill).
- User contexts do not neatly differentiate between timescales; this means two things: for users, distinctions between ‘decadal’ and ‘seasonal’ are artificial, and as are distinctions between initialised and uninitialised model runs.

#### **Data encoding and processing**

- To fully describe the attributes of decadal predictions – and allow users to interpret the data correctly – new metadata is needed in the (netCDF) data files, to describe the second time coordinate, the initialisation method and the ensemble ‘dimension’. Adapting current encoding standards to

accommodate this information, while retaining consistency with CMIP-endorsed encoding **takes time and effort but offers benefits.**

## 7.2. Acronyms

C3S	Copernicus Climate Change Service
CDS	Climate Data Store
CMIP	Coupled Model Intercomparison Project
CMOR	Climate Model Output Rewriter
DCPP	Decadal Climate Prediction Project
ECMWF	European Centre for Medium-Range Weather Forecasts
ESGF	Earth System Grid Federation
EU	European Union
GCM	General circulation model
GPC	Global Producing Centre
IPR	Intellectual Property Rights
ITT	Invitation to Tender
KPI	Key performance indicator
LC-ADCP	Lead Centre – Annual to Decadal Climate Prediction
SIS	Sectoral Information System
WMO	World Meteorological Organisation
WP	Work package