ECMWF

Invitation to Tender

Destination Earth Initiative

Machine-Learning Demonstrators

Volume II: Specification of Requirements

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1. Introduction

Destination Earth (DestinE) is an initiative of the European Commission under the EU Digital Europe programme [RD1]. By pushing the limits of computing, weather and climate sciences, DestinE is a cornerstone of the European Commission's efforts to boost Europe's digital capabilities and the Green Deal actions on climate change and to prevent environmental degradation. It aims at supporting climate change adaptation policies and decision-making for reducing the impacts of climate change and extreme events, contributing to European autonomy in related technology and assessment.

DestinE deploys several highly accurate thematic digital replicas (digital twins) of the Earth system to simulate natural and human activities as well as their interactions, to develop and test scenarios that would enable more sustainable developments and support European policy making. DestinE is intended to unlock the potential of both physics-based and data-driven models and the capacity of leading European supercomputers of the EuroHPC Joint Undertaking to achieve a breakthrough in the resolution and realism of the simulation of Earth-system components.

The European Centre for Medium-Range Weather Forecast (ECMWF) implements two high-priority digital twins for DestinE – one on climate change adaptation and one on weather-induced extremes. These are developing enhanced simulation systems, informed by observations, based on a new generation of Earth system models. These enhanced systems aim at representing the Earth system more realistically, but also produces information at precisely those scales where many of the impact of climate change and extremes are felt and where key processes are observed. This allows users from impact-sectors to access and exploit such information for their specific application.

Rooted in both the European Commission's Green Deal and the Digital Strategies, DestinE will contribute to solving a range of societal challenges in Europe and globally. Sectors anticipated to benefit from DestinE data, information and tools are those where timely and spatially detailed weather and climate data and information can support decision-making, including management or planning in agricultural, forestry, renewable energy, water, air quality, urban development, maritime or air transport, biodiversity, disaster risk mitigation, and others.

The confluence of high-quality, well-structured data and computing resources characterising DestinE makes it an attractive resource and hub for developing or implementing machine-learning approaches for simulations and decision-support in the sectors benefitting from DestinE. In response to a previous Invitation to Tender (ITT)[1] ECMWF is now developing such approaches in the domains of energy systems management, flood risk management, and data assimilation techniques. In addition, a set of use cases already in the early development phase of DestinE, and pilot services have been exploring additional impact sector applications[2].

Expanding on this initial set of ML demonstrators, this ITT aims at demonstrating the added-value of applying Artificial Intelligence/Machine Learning (AI/ML) based approaches in the context of DestinE in three additional domains. In particular, contracts awarded under this ITT should produce impact-sector relevant information in the domains of water resilience and food security, and implement an approach for optimally combining DestinE DT Climate data with other, heterogeneous climate projections.

Effective guidance of the development and implementation by relevant users and other stakeholders are an essential element in the co-design approach adopted in DestinE.

[1] https://ted.europa.eu/en/notice/-/detail/159270-2022
[2] https://destine.ecmwf.int/destine-uses/

1.1. Definitions

General definitions can be found in Volume I. Definitions specific for this Invitation to Tender (ITT) are given below. For a general DestinE glossary please refer to the Destination Earth Glossary [RD2].

Core User: DestinE User from a European entity or institution interested in exploiting DestinE capabilities for fulfilling a public mandate or tasks.

Demonstrator: An explorative implementation of an Application to test and/or showcase its viability for future further development or implementation.

2. Background

2.1. DestinE structure and implementation

DestinE is funded by the European Union's Digital Europe programme and is implemented by ECMWF, the European Space Agency (ESA), and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). The objective of this initiative is to develop – on a global scale – a highly accurate digital replica of the Earth to enhance the abilities to respond and adapt to the environmental challenges posed by climate change and extreme events. In doing so, DestinE supports the European Union in achieving sustainable development objectives and contributes to the European Green Deal and Digital Strategies.

The main building blocks of the infrastructure of the DestinE System are:

- The DestinE core Service Platform (DESP; responsibility ESA, available at https://platform.destine.eu/) A platform that provides a large number of users with tools, applications and services, based on an open, flexible, scalable and evolvable secure cloud-based architecture. DESP federates access to users' platforms, European cloud and HPC infrastructures and integrates access to Digital Twins. It allows users to customise the platform, integrate their own data and develop their own applications.
- The DestinE Data Lake (DEDL; responsibility EUMETSAT) provides discovery, access, and big data processing services to the DestinE data portfolio [RD3], including required data storage. It provides seamless access to datasets via GUIs or APIs to data in accordance to the DestinE Data Portfolio, regardless of data type and location. DEDL big data processing allows near-data processing and by this conceptually supports ML/AI applications executed on the DEDL. The DEDL federates with existing data holdings as well as complementary data from diverse sources like in-situ, socio-economic, or data-space data.
- The Digital Twin Engine (DTE; responsibility ECMWF) is a software-defined environment to operate DestinE's DTs and manage their corresponding control and data flows across distributed high-performance computers (HPC) and cloud computing resources. Moreover, it creates a framework for the fusion of observations with Earth-system simulations and the integration of applications targeting specific impact-sectors via selected use cases. The engine enables the porting and optimization of codes, developing and managing the digital twin workflows, and provides the data handling and model interaction and interactivity capabilities that run on diverse HPC and cloud infrastructures including the Data Warehouse hosted on the data bridges.
- The two high-priority Digital Twins (DTs; responsibility ECMWF) for generating high-quality simulations and combining simulations and observations of the Earth system at unprecedented accuracy to serve the EU's Green Deal policy priorities:
  - Weather-induced extremes DT ("Extremes DT") for providing capabilities for the assessment and prediction of environmental extremes at very high spatial resolution and close to real-time decision-making support at continental, country, coastline, catchment and city scales in response to meteorological, hydrological and air quality extremes.

- Climate change adaptation DT ("Climate DT") for providing capabilities to support climate adaptation policy and scenario testing at multi-decadal timescales aiming at a real breakthrough at the level of reliability at regional and national levels.

Already during the first phase of DestinE a number of use cases were realized, which demonstrated how DestinE may be used for different applications. Examples include the applications in hydrology, renewable energy production and energy system modelling, air quality and urban heat extremes, among others. Further Pilot Services have been selected to expand the delivery of information products to selected user groups from 2025 onward. Application examples funded in DestinE can be viewed at [RD4].

2.2. DestinE DT capabilities

ECMWF and its partners are implementing the two high-priority DTs, on weather-induced extremes ("Extremes DT")[3] and on climate change adaptation ("Climate DT")[4]. The digital twin capabilities have been demonstrated at scale in the first phase of DestinE, and are now being continuously enhanced and transitioned towards operations. Digital twin data has been accessible via the DestinE platform since October 2024.

The Extremes DT delivers a substantial evolution of existing Earth-system simulation in terms of grid-spacing, observational uptake capabilities, integration of weather, hydrology and air quality models in a unified workflow relying on the Digital Twin Engine, workflow configurability and interactivity. The DT operates at weather time scales producing high-quality information for assessing and predicting weather, hydrology and air quality extremes, both routinely and on-demand.

A global component of Extremes DT produces regular simulations at a spatial resolution of 4,4 km on a timescale of 4 days ahead.

A regional configurable component that can be activated "on-demand" as extreme events unfold over Europe produces simulations at a spatial resolution of 500 to 700m, on a timescale of 2 days ahead.

Details of the data portfolio of the Extremes DT can be found at [RD5].

The Climate DT delivers a substantial evolution of existing climate projection capabilities at multi-decadal timescales. The main breakthroughs lie in the operationalisation and the regular production of high-quality climate information, in the streaming of this information to applications from important impact-sectors like forestry, urban environments, hydrology, hydro-meteorology, and energy, and in developing further interactivity elements in particular in support of performing "what-if" scenarios. The DT provides globally consistent and co-located climate, weather and impact-sector information at much higher data output rates (5 to 10 km resolution for the different earth-system components, globally, hourly to monthly) than presently available for different emission scenarios for the next few decades (up to 2050).

At this time (April 2025) prototype climate projections are available for the SSP3.70 scenario (Shared Socio-economic Pathway), covering the period 2020-2040 for IFS[5]-NEMO[6] and ICON. Simulations for historical periods (starting in 1990) are also available for the two models (12 and 30 years, respectively), and control experiment (starting in 1990), which allow to assess model drift will become available in the next months[4]. For selected time periods "storyline" simulations are also available, which compute how selected weather events would have played out at different historical or future times[7].

[3] https://destine.ecmwf.int/weather-induced-extremes-digital-twin-1/
[4] https://destine.ecmwf.int/climate-change-adaptation-digital-twin-climate-dt/
[5] https://www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model
[6] https://www.nemo-ocean.eu/
[7] https://destine.ecmwf.int/news/replaying-extreme-weather-how-storyline-simulations-help-us-prepare-for-climate-change/

Both DT already include elements of co-design with component models from impact sectors. An uncertainty quantification framework for the DT is being developed gradually throughout the DestinE phases.

Details on the Climate DT are available at the ECMWF Destination Earth webpages and the Explanation of Destination Earth Digital Twin on Climate Change Adaptation [RD6] and of the data portfolio of the Climate DT at [RD7].

Technical information on the interfaces provided by the Digital Twin Engine is available in the documentation of the Digital Twin Engine [RD8].

2.3. Related activities and projects

The work to be contracted under this ITT benefits from other initiatives, past and present, though no formal dependencies are foreseen between the contracts concluded under this Tender and these other activities.

ECMWF, ESA, and EUMETSAT have been realising a number of DestinE use cases for different impact sectors, including renewable energy, air quality, and flood risk management as well as flood risk assessment. Impact-sector applications are included in the development of the Extremes DT and Climate DT [RD4].

A collection of use cases and demonstrators has also been realised in the context of ECMWF Copernicus activities [RD9, RD10].

ECMWF is developing training material and opportunities for ML in the context of DestinE, which will start in 2025[8].

In the context of the Copernicus Climate Change Service (C3S), ECMWF is establishing an operational water service[9], providing multi-model hydrologic information for different timescales. Similarly, a service providing tailored, operational climate data products and tools to the agricultural community is currently being established[10].

In addition, the European Commission has been supporting a number of research and development projects aimed specifically at developments that might feed into the future evolution of DestinE. These include in particular BioDT[11], DT Geo[12], Intertwin[13], the Weather Generator[14], UrbanAIR[15], and TerraDT[16].

Further developments of digital twin components or applications connecting to DestinE are funded in national and European research programmes.

2.4. Reference resources

[RD1] Destination Earth websites of the Commission and joint DestinE website

https://digital-strategy.ec.europa.eu/en/policies/destination-earth

https://www.destination-earth.eu

[RD2] Destination Earth Glossary https://destination-earth.eu/glossary/

[8] https://destine.ecmwf.int/ml-training/
[9] https://climate.copernicus.eu/c3s2411-operational-copernicus-climate-change-water-service
[10] https://climate.copernicus.eu/c3s2414-operational-copernicus-climate-change-agriculture-service
[11] https://biodt.eu/
[12] https://dtgeo.eu/
[13] https://www.intertwin.eu/
[14] https://www.ecmwf.int/en/about/media-centre/news/2024/weathergenerator-project-aims-recast-machine-learning-earth-system
[15] https://www.urbanair-project.eu
[16] https://terradt.eu/

[RD3] DestinE Data Portfolio

https://destine-data-lake-docs.data.destination-earth.eu/en/latest/dedl-discovery-and-data-access/DestinE-Data-Portfolio/DestinE-Data-Portfolio.html?highlight=collections

[RD4] Overview of use case contracts implemented by ECMWF, ESA, and EUMETSAT

https://destination-earth.eu/use-cases/

[RD5] Data Portfolio of the DT Extremes

https://confluence.ecmwf.int/pages/viewpage.action?pageId=414583259

[RD6] ECMWF Destination Earth webpages https://destine.ecmwf.int/

Explanation of Destination Earth Digital Twin on Climate Change Adaptation

https://destine.ecmwf.int/news/the-fast-development-of-destines-climate-change-adaptation-digital-twin/

[RD7] Data Portfolio of the DT Climate

https://confluence.ecmwf.int/pages/viewpage.action?pageId=414254710

[RD8] Documentation for Digital Twin Engine

https://digital-twin-engine.readthedocs.io/en/latest/#documentation

[RD9] Sectoral impacts of the Copernicus Climate Change Service

https://climate.copernicus.eu/sectoral-impacts

[RD10] Use cases of the Copernicus Atmosphere Monitoring Service

https://atmosphere.copernicus.eu/use-cases

3. Summary of contracts to be placed

This ITT aims to place three separate contracts implementing DestinE ML-based demonstrators. Each contract shall demonstrate an ML-based, interactive solution for clearly identified user groups, expanding the exploitation of DestinE capabilities beyond current groups. Any demonstrator contracted under this ITT shall have the potential to be developed into a service in the future.

Demonstrators shall respond to broadly identified user needs. They shall complement existing data or services currently available (e.g. provided by national meteorological services or Copernicus) or under development at national, regional, local, or pan-national level in Europe. Demonstrators proposed shall offer a clear added value vis-à-vis existing products or services.

Contracts are expected to implement ML Demonstrators on different topics, addressing needs in different domains. To this end, contracts will be placed in different Lots:

Lot 1: Supporting water resilience in Europe

Lot 2: Demonstrating DestinE in the domain of food security

Lot 3: Combining heterogeneous climate projections for climate adaptation

ECMWF intends to award a single contract under each of these Lots. Contracts will be awarded to the highest-ranking Tenders submitted in response each of the Lots, provided that they have passed the minimum threshold of 60% in the evaluation.

Each of the contracts in Lots 1-3 shall deliver a functional demonstrator from 12 months after the start of the contract, which shall be maintained, tested and continuously improved until the end of the contract. Tenderers may propose a different timeline, but should justify this in the Tenders.

ML-based demonstrators should develop compelling examples of serving sectoral users with information obtained using ML approaches based on DT data and access mechanisms. The approach should represent a step-change in terms of user benefit in the target sector, which should be fully explained and quantified in the bid.

Criteria for selection will include the technical capacity of the Tenderer to implement the Demonstrator, the relevance of the Application, as well as the potential impact and improvement vis-à-vis the status quo.

The ML demonstrators will also serve to grow the DestinE user bases and contribute to the co-design of the DestinE System components. Successful Tenderers will be expected to contribute to relevant workshops and requirement definitions, including at technical level.

Each contract must be led by one prime contractor, which may engage with one or more subcontractors. Tenderers may submit, or may participate in a subcontractor capacity in, more than one Tender for any of the Lots described in this document.

ECMWF expects each contract individually to not exceed a maximum total price of €350,000. However, Tenders above these limits can be considered, if duly justified by the exceptional value and added-benefit of the Tender. ECMWF intends to use an overall budget of €1 Mio for contracts placed under this ITT.

4. Technical specification

This ITT addresses Tenderers that build on the DestinE DT data and capabilities to develop technical solutions to support decision-making in different domains:

Lot 1: Supporting water resilience in Europe

The European Water Resilience Strategy[17], planned to be formally adopted by the Commission in the second quarter of 2025 aims at ensuring that water sources are properly managed, that scarcity, pollution and water-related risks are addressed, and that innovation in the water industry is enhanced to foster the competitiveness of Europe's water industry. The strategy focuses on freshwater management. DestinE could support this strategy in different ways, including (i) supporting the management of water quantity, equitable use, and adaptation to flood and water scarcity challenges under climate change, and (ii) supporting the management of water quality, including development of effective adaptation measures.

Tenders under this Lot may target the implementation of a Demonstrator that supports a selected, clearly defined stakeholder group in their freshwater management tasks. The solution should make use of one or more state-of-the-art ML models or tools and allow investigation of "what-if" scenarios to serve user decisions. Solutions proposed should provide an interactive interface for their users. It is generally expected that this interface will be exposed on the DESP, though other solutions can be considered if justified by Bidders.

Examples for a demonstrator topic may be training an ML model to predict water quality (water temperature, or concentrations of nutrients, pesticides, PFAS, or litter) or related indices (stress on selected species, etc) based on input data from DestinE DT (Climate or Extremes) and other data (e.g., land cover, land use), which may then be used to test different feasible strategies for improving water quality (e.g., different agricultural practices, extraction limitations, management of dams). DestinE's

[17] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14491-European-Water-Resilience-Strategy_en

interactive features would also allow users to understand the impact of specific scenarios, e.g. how water quality would be affected by intense rainfall following a prolonged dry spell.

Bids under this lot shall outline the specific use case for their demonstrator, i.e., whom they expect to serve with this, what question/challenge that user will be supported in answering, where in the decision making process the demonstrator will be used and how.

Concrete decisions supported may include investment planning and siting of new grey infrastructure, cost/benefit analyses of infrastructure or nature-based solutions, management of hydropower facilities, or related needs. Bids are expected to explain where in the decision process their proposed solution aims to be used. Tenders are expected to rely on data from the Extremes DT, the Climate DT, or both, and clearly articulate the added-value expected from their use.

Lot 2: Demonstrating DestinE in the domain of food security

The European "Farm to Fork" Strategy, an element of the EU Green Deal, aims to accelerate the transition of the food system to a more sustainable, healthier future. At the same time, the system must remain resilient to disruptions and stresses, ensuring stable access to a healthy and sustainable food supply. As agriculture is dependent on meteorological and climatic conditions, information at different timescales can support decision-making of stakeholders from farmers to policy-makers.

Tenders under this Lot may target the implementation of a Demonstrator that supports a clearly defined stakeholder group in their tasks linked to agricultural market information systems, food security mechanisms, or resilience planning. They may address adaptation strategies with respect to agriculture and food production, typically at larger scale (e.g., suitability of certain crops for regions), covering issues along the production chain, as well as nature-based adaptation strategies (e.g, diversification, agroforestry). With respect to food access and stability, a possible example for a demonstrator topic may be training an ML model to predict market prices or trade volumes of key crops or related indices (e.g., crop distributions) based on input data from DestinE DT and other data. This may then be used to test different strategies for responding to selected events (e.g., simultaneous crop failures in different producing regions, disruption of trade routes) and related adaptation responses at national and European levels. Demonstrators focusing on food utilisation and safety aspects, including demand side solutions as well as risks to nutrients and quality contents as well as food safety monitoring may also be proposed.

In general solutions should make use of state-of-the-art ML models or tools and allow investigation of "what-if" scenarios to serve user decisions. Solutions should provide an interactive interface for their users. It is generally expected that this interface will be exposed on the DESP, though other solutions can be considered if justified by Bidders.

Bids under this lot shall outline the specific use case for their demonstrator, i.e., whom they expect to serve with this, what question/challenge that user will be supported in answering, where in the decision making process the demonstrator will be used and how.

Concrete decisions supported may include investment in irrigation infrastructure, cost/benefit analyses of infrastructure or nature-based solutions, management of food reserves, or related needs. Bids are expected to explain where in the decision process their proposed solution aims to be used. Tenders are expected to rely on data from the Extremes DT, the Climate DT, or both, and clearly articulate the added-value expected from their use.

Lot 3: Combining heterogeneous climate projections for climate adaptation

European countries are actively working to implement adaptation measures to mitigate the impact and improve resilience against the unavoidable consequences of climate change. During 2025 and 2026 the European Commission is working to establish a European Climate Adaptation Plan, an element under the EU Adaptation Strategy.

Climate adaptation strategies and measures are usually based on estimates of the evolution of the climate and the impact of this evolution on the local to global level. This is typically derived from ensembles of climate projections, which also provide an estimate of the uncertainties inherent in the projections. The DestinE Climate DT aims to operationalize climate projections at high resolution to enhance the realism of these simulations, in particular at local to regional levels. However, due to the high computational cost of such projections, only a small ensemble (3 models) can be provided at present.

To fully integrate the high spatial and temporal granularity in climate services and consultancies that have been using ensembles of existing climate simulations, Tenders under this Lot shall develop an ML-based demonstrator that optimally combines a flexible selection of climate projections deriving uncertainty estimates, to support the exploitation of the various sources of climate information. Relevant data sets should include, in addition to DT Climate, the CMIP and EURO-CORDEX datasets, thus including sets at different spatial and temporal resolutions.

Bidders should involve relevant stakeholder groups who exploit climate projection data in their decision-making in this development, aiming to gain trust in the approach. Solutions should make use of state-of-the-art ML techniques.

Requirements for any lot

Demonstrator delivery under any Lot must exploit the data, services and capabilities of the DestinE DTs and should integrate to the extent possible with DestinE System Components. They must anticipate a clear and well-explained complementarity and added-value vis-à-vis existing services, which Tenderers must highlight in their Tenders. Tenders should also identify relevant links to national or international initiatives.

Demonstrators under this ITT must include the ability for user interaction. This may be implemented at different levels, e.g. allowing users to initiate or configure model runs, support scenario planning, visualize output data fields, initiate or configure post-processing of impact sector runs, insert user-provided data into the workflow, etc.

Specific key tasks for each ML-based demonstrator contract include:

1. Detailed user scenario and demonstrator definition
2. Demonstrator development, including configuration, dataset preparation and model training
3. User demonstration and evaluation
4. Support to user engagement and communication

These are described in detail in subsections 4.11-4.34.

Successful Tenderers to any Lot will also be required to support ECMWF in DestinE stakeholder engagement and communication activities for DestinE.

4.1. User scenario and demonstrator definition

Demonstrators shall be based on a concrete user scenario that

- defines the user group, which the demonstrator aims to serve,
- identifies their needs, and how these groups are expected to benefit from the functional demonstrator.
- Explains at what point in the decision process users will use the demonstrator and how they will exploit the results (i.e., what information will they obtain and how will they integrate this in their decisions/tasks).

Successful Tenderers shall engage selected, representative users during their work, notably to validate the definition of the demonstrator and its result. These representative users to be involved shall be identified already in the Tender and Tenderers shall provide proof of the user group's willingness to participate (e.g., via including them as subcontractors or including a letter of support). Where possible, successful tenderers shall aim at encouraging cooperation among relevant user groups, e.g. regionally or across boundaries. ECMWF may propose further core users to be included in the core user group during potential negotiations or the duration of any subsequent contract.

Successful Tenderers shall assess the anticipated improvement with respect to the current information sources available, and thus the added-value of the proposed demonstrator should be defined. The demonstrator should be defined at a technical level, including data portfolio, timeliness, format, interfaces, and expected quality.

The demonstrator definition shall include the ML-based approach, tools, training data and computational requirements and resources used, as well as technical and user interfaces. Particular attention shall be given to the requirements for DestinE data, interfaces or other capabilities needed. Where additional resources are required, including training data, these should be explained and their sources defined, including any existing restrictions on access or use.

For bids submitted under Lot 1 or Lot 2, a user interface shall be implemented on DESP, maximizing the integration in DestinE. If alternative interfaces are proposed, Tenderers shall also include exposing the ML Demonstrator as a service on DESP, i.e. register a service access point in the DESP service catalogue.

The demonstrator definition must include a description of the approach foreseen for validation. Tenderers shall outline this approach already in their Tender.

Successful Tenderers shall deliver a User Scenario and Demonstrator Definition document as output of this work. This shall describe the

- The user groups targeted, including their needs to be addressed
- The usage scenario (what type of users would be using the service, when, to do what)
- The demonstrator to be implemented (portfolio, user interaction, inputs and outputs including their sources – for the training and inference phases, technical platform(s), ML methodologies used, etc.)
- The tests foreseen to be conducted to validate the demonstrator.

4.2. Demonstrator development, including implementation and training

Successful Tenderers shall implement a fully functional, interactive demonstrator according to the Demonstrator Definition as accepted by ECMWF. To the extent possible this shall make optimal use of the capabilities available in the DestinE system components, i.e. exploit data from one or both DT, access via the DTE components, the DEDL and the DESP.

Tenderers shall provide an estimate of resource requirements (compute, data storage, license fees) in their Tender and identify how they propose to meet those. In particular, any resource requirements for DestinE System components (DESP, DEDL, DTE, DT) shall be identified and, if necessary, budgeted for. For estimating the cost for hosting a web application on the DESP, please refer to https://www.ovhcloud.com/en-ie/public-cloud/prices/

For any software developed or used for DestinE Demonstrators open source solutions should be favoured, but to be noted that if such is proposed in the Tender, the Tenderer shall be prepared to provide more information and details on the respective open-source software license, the benefit for EU and the DestinE from such an open-source license, as well as confirmation that there will be no substantial risks for DestinE. The Tenderer shall warrant that the Tenderer has the full capacity and authority for such an open source licence to be granted. If open source developments are agreed in the contract, they shall be managed as an open-source project on a public repository (e.g., on GitHub, GitLab, etc.), and hosted under a dedicated

domain to be agreed with ECMWF. Where Tenderers propose proprietary software to be used they shall identify the corresponding software in their Tender and include any license cost necessary for the Demonstrator in their Tender.

The Demonstrator should be fully deployed at KO+12 months and should be tested and validated following the validation approach agreed in the Demonstrator Definition (see section 4.1).

A Demonstrator Implementation and Test Report shall document successful implementation with appropriate reference to the user requirements and Service definition.

4.3. User demonstration and evaluation

ECMWF aims to grow and mature the DestinE user community. The ML Demonstrators to be implemented following this ITT are intended to contribute to engaging user communities in the impact sectors covered.

The Tenderers are, therefore, expected to include effective user engagement as part of their work. This must include setting up a dedicated **Core User group** for the Demonstrator and maintaining regular interactions. These activities shall be agreed upon and coordinated with ECMWF. ECMWF shall be invited to participate in core user group meetings.

Tenderers shall also propose actions to reach out to further potentially interested user groups over the duration of the contract, e.g. through contributions to domain-specific conferences, meetings or exchanges, publications, dedicated webinars, etc.

Successful Tenderers are further expected to support ECMWF and the European Commission in overarching DestinE user engagement, communication, and training activities. To this end, Successful Tenderers will be required to:

- Support workshops and other events organised by ECMWF, the Commission or other parties by presenting their work. At a minimum, Tenderers shall foresee participation in the regular DestinE User eXchange meetings (spring 2026, spring 2027) and ECMWF DestinE Annual Meetings (September 2025 and 2026).
- Advertise the ML demonstrators in relevant fora and communications (publications, websites, newsletters, social media, workshops, conferences, etc.) within the relevant sectors.
- Contribute to the ECMWF and European Commission communication work on DestinE as required.
- Provide input to e-learning material for use in DestinE Machine-Learning training activities as required.

Specifically, the Successful Tenderers shall deliver at a minimum:

- A description of the ML demonstrator suitable for presentation on the web to generalised audiences, including text and visuals (updated regularly);
- Presentation material on the Demonstrator and the progress of implementation to be maintained up-to-date over the duration of the contract;
- Regular posts on/for relevant social media channels within the impact sector;
- One fact sheet aimed at general public/policy audiences outlining the work of the contract
- A short video (approximately 90 seconds) presentation of the ML demonstrator for inclusion on a DestinE web presence and support to training activities.
- Material supporting ECMWF training actions (a Jupyter notebook and accompanying walkthrough webinar with possibility for Q&A).
- Support to inter-contract communication

A plan for community engagement and communication activities carried out by the Tenderers shall be included in the Tender. An initial version will be agreed with ECMWF during negotiation and will form part of

the contract. The implementation of this plan and any subsequent updates will need to be agreed upon with ECMWF regularly during the contract implementation. This includes, but does not exhaustively cover, communication planning, contributions to DestinE media outreach, websites and social media activity, externally facing written and graphical contents and events.

4.4. Deliverables and milestones

At a minimum the Successful Tenderers are expected to deliver:

Deliverable	Section reference	Format	Due	Applicable to Tenders in Lots
User Scenario and Demonstrator Definition	4.1	Document	KO + 3 months	all
Demonstrator Implementation and Test	4.2	Document	KO + 12 months	2
Communication material to support ECMWF communication: – Website content – Factsheet – Presentation – Social media content – Video	4.3	 text and visuals ppt or compatible posts video	 KO + 1 month (plus regular updates, as needed) As needed end of contract	all

Further deliverables should be defined by the Tenderer based on the requirements above, as needed.

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 capability development and/or quality of capability delivery, as applicable. They should not duplicate deliverables and should not have any cost associated to them.

5. General requirements

5.1. Implementation schedule

ECMWF intends to award up to a maximum of one contract for a duration of 18 months under each of the Lots 1-3. These contracts are expected to commence in November 2025, indicatively, depending on how negotiations with preferred Tenderers progress. For the purposes of preparing responses, Tenderers should consider 1 November 2025 as the indicative start date for the contract. The actual contract start date, as well as necessary adjustments, will be agreed with the preferred Tenderers during the negotiation phase.

The Tenderer is expected to provide a detailed schedule as part of the Tender. The proposed schedule shall address the main tasks, milestones and deliverables. Regular progress meetings will be held with ECMWF during the contract to assess contract status, risks and actions.

5.2. Meetings

5.2.1. Physical / face-to-face meetings

A kick-off (KO) meeting will be held no later than one month after contract start date.

One physical meeting at ECMWF (Bonn) should be budgeted for in Tenders submitted.

Tenderers should also foresee active participation in at least three relevant physical events over the duration of the contract in the DestinE context. This must include participation in the DestinE User eXchange meetings, which should be assumed to take place in Q2/2026 (Brussels) and Q2/2027 (tbc, Europe), and one annual ECMWF DestinE meeting in Q2/26 in Bonn. Contributions to further meetings may be proposed to support user engagement and outreach objectives. Such meetings should be chosen to maximize impact and relevance in the specific impact sector communities.

5.2.2. Regular meetings by web-conference

The Successful Tenderers are expected to organize monthly progress meetings with ECMWF by videoconference, prepare corresponding summary minutes of these meetings and maintain a list of agreed actions and their status.

Successful Tenderers may also be requested by ECMWF to contribute to additional technical working groups on issues relating to the requirements and evolution of DestinE. These are expected to be held generally by web-conference.

5.3. Documents and reports

All project reports shall be produced in English. 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 DestinE Deliverables Repository portal; the details will be agreed at the negotiation stage.

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

5.4. Graphical material and content for communication, user outreach and training activities

All content shall be produced at least in English, unless specifically agreed by ECMWF. Additional languages may be used if justified. The Successful Tenderers shall ensure that all material (text, visuals, videos, etc.) is duly licensed for use by ECMWF and the European Commission.

Outreach activities will be organised by ECMWF during the period of the contract. In such instances, the Successful Tenderers will be approached by ECMWF for support on developing and delivering contents.

Successful Tenderers shall not establish their own brand for the selected projects but rely on and use DestinE and ECMWF pre-defined wording and branding. A communications package (including guidelines, logos and templates) will be provided by ECMWF at the start of the contract.

5.5. Data and IPR

It is a condition of EU funding for DestinE that the ownership of any deliverable (as defined in Volume V Agreement) developed with DestinE funding passes from the Successful Tenderers to the European Union via ECMWF. Ownership will pass from the date of the creation of the deliverable.

All pre-existing materials (e.g. software and products) used by the Successful Tenderer to produce the DestinE deliverables and Pilot Service or ML Demonstrator will remain the property of the Successful Tenderer. The Successful Tenderers will have to provide a royalty-free, non-exclusive, worldwide, perpetual and irrevocable license to those pre-existing materials to the European Union and ECMWF.

Developments or modifications to pre-existing materials that constitute results and are acquired or created specifically for DestinE purposes will be owned by the European Union.

Upon request, the Successful Tenderer may be granted a non-exclusive licence, at the discretion of ECMWF and subject to the approval by the European Commission, to use the deliverables which they have provided to DestinE.

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 1 (per entity)
Quality of resources to be Deployed	1 (excluding Table 1 in Volume IIIB and CVs with a maximum length of 2 pages each)
Technical Solution Proposed	10 (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	4 (excluding Table 4 and Table 5 in Volume IIIB) + 1 per each Work package description (Table 3 in Volume IIIB)
Pricing Table	No limitation
Requirements Compliance Table	No limitation

Table 1: Page limits

6.2. Specific additional instructions for the Tender

The following is a guide to the minimum content expected to be included in each section of the Tender, 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 Tender.

6.2.1. Executive summary

The Tenderer shall provide an executive summary of the proposal, describing the objectives, team and summarising the proposed demonstrator and the added-value it derives from DestinE, developments and operations, as well as user engagement.

6.2.2. Track record

The Tenderer shall demonstrate for themselves and for any proposed subcontractors that they have experience and knowledge relevant for the proposed solution. This includes experience in relevant projects in the public or private sector at national or international level as well as engagement with – and access to – relevant user communities in the targeted impact sector of the pilot service.

If and where Tenderers plan to build on results from previous EU-funded instruments (notably under the Digital Europe or Horizon Europe Programmes), these shall be mentioned and the exploitation of results explained.

User institutions that are part of the Tender shall describe their mandates and roles, including in formal and informal impact sector fora.

Institutions proposed to be included in the core user group that are not included in the as contractors or subcontractors shall be requested to confirm their interest and availability to serve in that role in a letter of support to the Tender.

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 developing, demonstrating and evaluating the solutions complying with technical requirements set out in Section 4. The team shall include a dedicated Project Manager with experience in the technical management of similar-size projects. The Tenderer shall describe the experience of the Project Manager and the technical project team in performing activities related to all aspects of this Tender.

6.2.4. Technical solution proposed

6.2.4.1. Introduction

The Tenderer shall give an introduction to demonstrate their understanding of the DestinE context and the specific requirements of this Tender.

The Tenderer shall describe the objective and scope of the ML demonstrator, relevant policy or decision-making context, define the user groups involved and specify their addressable needs that the ML demonstrator is targeting.

6.2.4.2. ML demonstrator functionality and usage scenario

The Tenderer shall describe the intended ML demonstrator functionality and user interactions. This should list data and information products, including aspects of information layers/parameters, frequency, timeliness, resolution, etc..

The usage scenario shall be outlined, including a description of the user needs, decision process and how users are envisioned to support their decision(s) using the demonstrator capabilities. The functions of the user interface and its interactive features shall also be outlined.

It is understood that details may be modified based on the user interactions during the first months of the contract and will be finalized in the User scenario and demonstrator definition document. Hence, Tenderers should provide their initial expectation in this sub-section.

6.2.4.3. Technical solution

This section shall describe the proposed technical solution, including a description of ML approach, methods, models, and datasets. Information on required data (both for training and inference) and their sources should be included in a separate table, including data from the DestinE data portfolio, data that might be provided by the Extremes DT or Climate DT simulations but are not currently included in the DestinE portfolio, data from openly accessible sources, data proposed to be provided by the Tenderer, and data Tenderers propose to be provided by users of the demonstrator.

This section shall also present an estimate of the demonstrator's resource requirements (computing, data holding, network) and how they are proposed to be met.

This section shall also include information on other third-party suppliers that are proposed for delivering the technical solution.

6.2.4.4. Added-value of the ML demonstrators

Tenderers shall identify the qualitative and quantitative improvements expected from the ML demonstrator vis-à-vis current approaches, putting forward in particular the impact of exploiting DestinE capabilities. I.e., this section should not only present the demonstrator's added value, but should also set out how the

exploitation of DestinE DT data, functions, capabilities are enabling this and how these contribute to the result.

6.2.4.5. Complementarity to existing Services

ECMWF will not fund work which duplicates existing services in Europe. A separate sub-section shall discuss how the demonstrator complements existing services, notably in the context of Copernicus and relevant national services. Tenderers shall also make due reference to results obtained during previous Horizon Europe or Digital Europe funded actions.

This sub-section shall also discuss how the proposed ML demonstrator respects relevant institutional mandates at the level of the countries affected.

6.2.4.6. User engagement

A separate sub-section shall be included on user engagement to describe how the Tenderers will ensure effective links with relevant user communities, including the core user group and relevant communities beyond.

6.2.4.7. Exploitation plan

A sub-section shall be included to outline Tenderers view on the possible exploitation of results beyond the end of the contract. This should include a concept for continued operation, e.g. via transfer to existing services or development into a self-standing, independently resourced offer.

6.2.5. Management and implementation plan

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

The Tenderer is requested to structure the work in four Work Packages (WP):

	Tenders shall include
WP0	Management and implementation activities, as well as communications.
WP1	ML demonstrator definition and user exchanges.
WP2	ML demonstrator implementation and testing.
WP3	ML demonstrator user validation.

The number of milestones is not prescribed, but they should be designed as markers of demonstrable progress in capabilities development and/or quality of capability delivery to keep progress monitoring manageable.

Adjustments to the proposed implementation plan can be proposed by the Successful Tenderer during the contract, but they must be agreed to by ECMWF.

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

- Semestrial, annual and final reports shall be provided in accordance with the Volume V Agreement Clause 2.3 and Annex 5.
- The work plan for 2026 shall be provided within 14 days of the contract start date.
- Monthly video-conferencing with ECMWF and a proposal for involvement of ECMWF in major project reviews shall be provided as part of the management plan. The contractor is responsible for the

organisation of such meetings, including proposing specific topics of discussion, presenting, provision of minutes and maintaining a list of agreed actions.

- If relevant, a list of sub-contractors and details of their contribution, key technical personnel involved in the contract, legal names and addresses shall be provided. The Tenderer shall describe how the Volume V Agreement, in particular Clause 2.9, has been communicated to all their sub-contractors.
- The Tenderer shall describe in the Proposal the management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 of Volume V Agreement.

Please also refer to section 4.4 above for further deliverable required.

The table below provides the template to be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for WP0. 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 Tender.

Deliverables for WP0 shall include the following reports:

WP0 Contractual Obligations Template			
#	*Nature*	*Title*	*Due*
D0.y.z-YYYY	Report	Semestrial Implementation Report (January-June YYYY) YYYY being the Year n This includes a specific Financial Report	Annually on 15/07
D0.y.z-YYYY	Report	Annual Implementation Report YYYY YYYY being the Year n-1 This includes a specific Financial Report	Annually on 15/01
D0.y.z	Report	Final Implementation Report	60 days after end of contract
D0.y.z-YYYY	Report	Annual Work Plan YYYY YYYY being the Year n+1	Annually on 31/08
D0.y.z-YYYY	Other	Copy of prime contractor's general financial statements and audit report YYYY, YYYY being the Year n-1	Annually (no-cost associated)

6.2.6. Key performance indicators

The Successful Tenderers shall report to ECMWF on a set of Key Performance Indicators (KPIs) and performance targets for the activities covered by this ITT and taking the requirements described above into account. The KPIs and performance targets, to be proposed by the Tenderer in the Tender, will be agreed in contract negotiation and may be updated by mutual agreement, if necessary.

KPIs shall be measurable indicators on the key outputs of the work. These shall include as a minimum:

KPI name	Means of verification	Target	reported
Technical			
Demonstrator fully functional and available to users	Test report	Achieved	KO+12
Demonstrator output in line with specified performance targets	To be proposed by Tenderers	Achieved	KO+15, KO+18
User satisfaction	User feedback collected	Positive feedback from users	End of the contract

User engagement			
Number of core users involved in the core user group	Meeting protocols	To be proposed by Tenderer	Every 3 months
Number of users engaged for Demonstrator definition and validation	Summary minutes of exchanges	To be proposed by Tenderer	Every 3 months
Number of presentations at workshops, events	References	To be proposed by Tenderer	Every 3 months
Communication			
Number of social media posts, likes and shares	Analytics	To be proposed by Tenderer	Every 3 months
Contract management			
Timely implementation of the contract	Dates of milestones and timely submission of deliverables	100% on time	monthly

Tenderers should propose additional KPIs to fully cover the focus of their Tender. These should cover aspects of Service throughput, usage, and quality.

6.2.7. Requirements compliance table

This table summarizes the requirements that the Successful Tenderer shall meet. The Successful Tenderer shall include in their Tender a Requirements Compliance Table, confirming for each of the requirements that their Tender fulfils. Any deviations shall be noted and justified.

Requirement	Description	Compliance (Y/N or "n/a" if not applicable to this Tender/Lot) Reference to Tender section and WP
Technical requirements		
Scope		
Req-101	The ML demonstrator user scenario is fully described, including in terms of data or information provided, user group, timeliness, frequency of delivery, access mechanisms, IT infrastructures and input or training data needed	
Req-102	ML demonstrator will implement a data-driven, interactive system for impact sector users. Qualitative and quantitative added-value above currently available systems are described in the Tender.	
Req-103	The training approach for ML demonstrators is described in the Tender, including methods used. An estimate of resource requirements (compute, data storage, license fees) is provided in the Tender, as well as how these are met. Any resource requirements for DestinE System components (DESP, DEDL, DTE, DT) are identified and budgeted.	

Req-104	The ML demonstrator will be fully implemented at 12 months after the start of the contract.	
Req-105	The Tender includes an outline of the envisaged approach to uncertainty quantification and quality control.	
Req-106 (lots 1 and 2 only)	A protocol for generating “what-if” scenarios shall be defined.	
Req-107	The ML demonstrator is complementary to existing services (national, Copernicus, etc). Tenderers confirm and explain this in their Tender.	
Integration with DestinE		
Req-201	ML demonstrator exploits the novel data, services and capabilities of the DestinE DT. The impact of this exploitation is outlined in the Tender.	
Req-202	ML demonstrator will be integrated with DestinE System Components (Digital Twin Engine, Data Lake, Service Platform).	
Req-203	ML demonstrator includes the ability for user interaction. The interaction opportunities are described in the Tender.	
Req-204 (lots 1 and 2 only)	Access to the Demonstrator via a front-end user interface is possible. This front-end should generally be implemented on DESP, unless otherwise justified by user requirements or technical considerations. In any case, the Service must be visible also from the DESP, i.e. an access point shall be registered in the DESP service catalogue.	
Req-205	New software developments favour open source licenses and are managed as an open-source project on a public repository (e.g., on GitHub, GitLab, etc.) and hosted under a dedicated domain to be identified by – or agreed with – ECMWF. (More information and details may be required by the Tenderer. The Tenderer warrants that the Tenderer has the full capacity and authority for such an open source licence to be granted).	
Req-206	Any proprietary software to be used is identified in the Tender, including any license cost necessary for the operation of the Pilot Service.	
Req-207	The bid references results obtained in previous EU-funded actions, notably including actions funded under the EU Digital Europe and Horizon Europe programmes that are exploited for the work proposed.	
Demonstration period		
Req-301	The demonstrator will be available to its users from 12 months after the start of the contract until at least the end of the contract.	
Req-302	An estimate of resource requirements during the demonstration period (compute, data storage, license fees) is provided in the Tender, as well as how these are met. Any resource requirements for DestinE System components (DESP, DEDL, DTE, DT) are identified and budgeted.	
Req-303	Bidder commit to fixing issues identified during the demonstration period in a timely fashion.	
User involvement		
Req-401	Work includes an analysis of user needs and definition of qualitative and quantitative user requirements. This forms the basis of Pilot Service development and implementation.	

Req-402	The Tender identifies users to be engaged in defining the ML demonstrator and evaluating it. Their availability to engage with the work has been confirmed.	
Req-403	A core user group for the Demonstrator will be set up that will co-define how the Demonstrator could support their work. Members of the core user group are identified in the Tender. Their willingness to participate in the co-design is demonstrated, e.g. via their inclusion as subcontractors or letter of support.	
Req-404	The (core) user group will test and validate the Demonstrator.	
Management requirements, including engagement and communications		
Req-001	The Management Plan provided foresees monthly video-conferencing with ECMWF and involvement of ECMWF in major project meetings.	
Req-002	The Tender includes the required contributions to the overall DestinE stakeholder engagement, including the dedicated User exchanges, and training activities.	
Req-003	The Tender proposes adequate key performance indicators (KPI) covering all aspects of the work proposed, including those listed the KPI in section 6.2.6 above.	
Req-004	The Tender includes a realistic perspective on the exploitation of results, including a possible continued operation of the service beyond the end of the contract.	
Req-005	The Tender includes contributions to DestinE communications activities, notably - Content for website - Factsheet - Presentations - Social media - Video (lots 1 and 2 only) - Support to inter-contract communication - Support to ECMWF training activities (e.g., Jupyter notebook, webinar)	

6.2.8. Diversity and inclusion

If multiple Tenderers present equally qualified Tenders (discrepancy lower than 1%), ECMWF will take into consideration the diversity and gender balance of each Tenderer's organisation as a tiebreaker when making the final decision. We recognise that diversity and a collaborative environment are essential for advancing scientific discovery and innovation, and we are dedicated to creating a culture that encourages and supports the contributions of individuals from all backgrounds. These varied backgrounds are particularly influential in adopting a holistic view of ethical AI and representing European values. As part of this commitment, we encourage Tenders from Tenderers who share our values and demonstrate a commitment to diversity and inclusion in their own organisations. We believe that working with suppliers who support our efforts to create a more inclusive and diverse community is key to achieving our goals and driving progress forward in all our areas of activities. Therefore, the Centre encourages all potential Tenderers to take these values into consideration when submitting proposals.