ECMWF Copernicus Procurement

Invitation to Tender

Copernicus Atmosphere Monitoring Service
Volume II

Greenhouse-gas fluxes

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1 Introduction

Some of today's most important environmental concerns relate to the composition of the atmosphere. The increasing concentration of the greenhouse gases and the cooling effect of aerosol are prominent drivers of a changing climate, but the extent of their impact is often still uncertain.

At the Earth's surface, aerosols, ozone and other reactive gases such as nitrogen dioxide determine the quality of the air around us, affecting human health and life expectancy, the health of ecosystems and the fabric of the built environment. Ozone distributions in the stratosphere influence the amount of ultraviolet radiation reaching the surface. Dust, sand, smoke and volcanic aerosols affect the safe operation of transport systems and the availability of power from solar generation, the formation of clouds and rainfall, and the remote sensing by satellite of land, ocean and atmosphere.

To address these environmental concerns there is a need for data and processed information. The Copernicus Atmosphere Monitoring Service (CAMS) has been developed to meet these needs, aiming at supporting policymakers, business and citizens with enhanced atmospheric environmental information.

The Service consolidates many years of preparatory research and development and delivers the following operational services:

a) Daily production of real-time analyses and forecasts of global atmospheric composition
b) Reanalyses providing consistent multi-annual global datasets of atmospheric composition with a stable model/assimilation system
c) Daily production of real-time European air quality analyses and forecasts with a multi-model ensemble system
d) Reanalyses providing consistent annual datasets of European air quality with a frozen model/assimilation system, supporting in particular policy applications
e) Products to support policy users, adding value to "raw" data products in order to deliver information products in a form adapted to policy applications and policy-relevant work
f) Solar and UV radiation products supporting the planning, monitoring, and efficiency improvements of solar energy production and providing quantitative information on UV irradiance for downstream applications related to health and ecosystems
g) Greenhouse gas surface flux inversions for CO_2, CH_4 and N_2O, allowing the monitoring of the evolution in time of these fluxes
h) Climate forcing from aerosols and long-lived (CO_2, CH_4) and shorter-lived (stratospheric and tropospheric ozone) agents

This Invitation to Tender (ITT) is targeting the CAMS service elements described under item g above.

2 Contract Summary

This ITT, entitled "Greenhouse-gas fluxes", is for providing quantitative estimates of net surface fluxes of greenhouse gases, which are key drivers of the Earth's climate evolution. Ground-based and now satellite remote-sensing observations allow these fluxes to be monitored. The data provided so far by CAMS have delivered time-series of CH_4, CO_2 and N_2O surface flux fields of high quality. The successful Tenderer shall extend the time-series, both forwards and backwards (as far as possible) in time, while maintaining their quality at the highest international standard. Periodically, the successful Tenderer will reprocess the whole period in order to reflect improvements in spatial resolution as well as in modelling and data assimilation techniques used for the atmospheric flux inversions. The

documentation of associated errors and comparison with independent observations as well as with similar products that are produced outside of CAMS will also form part of the activities.

3 Technical Specification

3.1 General Requirements

The successful Tenderer shall provide flux estimates of CH_4, CO_2 and N_2O using state-of-the-art flux inversion systems. The Tenderer shall define the proposed spatial and temporal resolution for the flux inversions defined in the work packages below with the constraint that the detail and accuracy of the flux estimates shall be at least reflecting the performance of the current CAMS products on greenhouse gas fluxes as described in the Validation documents for the Supplementary Services on Greenhouse Gas Flux Inversions on the CAMS web site.

The successful Tenderer shall validate the flux estimates with independent observations and also participate in international intercomparison projects, such as Transcom (https://transcom.lsce.ipsl.fr/), the Regional Carbon Cycle Assessment and Processes (RECCAP) from the Global Carbon Project (http://www.globalcarbonproject.org/reccap/), and the North American Carbon Program (http://www.nacarbon.org/nacp/index.html), to ensure the produced estimates are of high quality.

As described in section 4.6, the data provided as part of this ITT will be included in the CAMS data store (CDS). Until the CDS is fully established, the successful Tenderer shall provide the produced data files to ECMWF within one month of production to be included in the CAMS data portal.

3.2 Work package 7310 – Flux estimates of CO_2

The successful Tenderer shall provide annually updated global flux estimates of CO2 at a resolution sufficient to characterize at least the mean carbon balance of large regions of the globe at the scale of continents and large ocean basins. The successful Tenderer shall use a flux inversion system with a proven track record to provide the flux estimates. The flux estimates shall be based on observations from international ground-based networks (e.g., the NOAA Earth System Research Laboratory archive and the World Data Centre for Greenhouse Gases archive) and satellite observations (e.g., GOSAT and OCO-2) on the condition that the accuracy of the observations is sufficient for providing competitive flux estimates. Within the first year covered by this ITT, the successful Tenderer shall provide an initial flux inversion covering at least the period 1979 – 2018, showing equal or better performance than the current CAMS CO2 flux estimates. The Tenderer shall further propose a strategy for providing at least annually updated flux estimates, either by reanalysing the whole period or by carefully extending the existing period to include the latest set of available observations. In the latter case, the Tenderer shall indicate potential issues with consistency of the whole data set. The successful Tenderer shall also provide uncertainty estimates of all flux estimates and provide a validation report (using independent observations of atmospheric CO2 and/or CO2 fluxes) with each new release of the flux estimates.

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

WP7310 Deliverables Template			
#	*Type*	*Title*	*Due*
D1.y.z[1]-YYYYtoYYYY	Data set	Flux inversion for CO_2 – Period at least 1979-2018	During Year 1
D1.y.z-YYYY or D1.y.z-YYYYtoYYYY	Data set	Flux inversion for CO_2 for YYYY or Flux inversion for CO_2 – Reprocessing of whole period – YYYY to YYYY	Annually
D1.y.z-YYYY	Report	Evaluation and Quality Control document for CO_2 flux inversion YYYY (Period covered YYYY to YYYY)	Annually
D1.y.z-YYYY	Report	Description of the CO_2 inversion production chain - YYYY	Annually
…			

WP7310 Milestones Template			
#	*Title*	*Means of verification*	*Due*
M1.y.z			
…			

3.3 Work package 7320 - Flux estimates of CH_4

The successful Tenderer shall provide annually updated global flux estimates of CH_4 at a resolution sufficient to characterize the main CH_4 source and sink patterns (e.g., wetlands, rice fields, cattle, atmospheric loss processes). The successful Tenderer shall use a flux inversion system with a proven track record to provide the flux estimates. The flux estimates shall be based on observations from international ground-based networks (e.g., the NOAA Earth System Research Laboratory archive and the World Data Centre for Greenhouse Gases archive) and satellite observations (e.g., SCIAMACHY, GOSAT, Sentinel-5p) on the condition that the accuracy of the observations is good enough for providing competitive flux estimates. Within the first year covered by this ITT, the successful Tenderer shall provide an initial flux inversion covering at least the period 1990 – 2018, showing equal or better performance than the current CAMS CH_4 flux estimates. The Tenderer shall further propose a strategy for providing at least annually updated flux estimates, either by reanalysing the whole period or by carefully extending the existing period to include the latest set of available observations. In the latter case, the Tenderer shall indicate potential issues with consistency of the whole data set. The successful Tenderer shall also provide uncertainty estimates of the fluxes and provide a validation report (using independent observations of atmospheric CH_4 and/or CH_4 fluxes) with each new release of the flux estimates.

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

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

WP7320 Deliverables Template			
#	*Type*	*Title*	*Due*
D2.y.z-YYYYtoYYYY	Data set	Flux inversion for CH_4 – Period at least 1990-2018	During Year 1
D2.y.z-YYYY or D2.y.z-YYYYtoYYYY	Data set	Flux inversion for CH_4 for YYYY or Flux inversion for CH_4 – Reprocessing of whole period – YYYY to YYYY	Annually
D2.y.z-YYYY	Report	Evaluation and Quality Control document for CH_4 flux inversion YYYY (Period covered YYYY to YYYY)	Annually
D2.y.z-YYYY	Report	Description of the CH_4 inversion production chain - YYYY	Annually
…			

WP7320 Milestones Template			
#	*Title*	*Means of verification*	*Due*
M2.y.z			
…			

3.4 Work package 7330 - Flux estimates of N_2O

The successful Tenderer shall provide annually updated global flux estimates of N_2O at a resolution sufficient to characterize the main N_2O source and sink patterns (e.g., natural soils, agricultural soils, oceans, cattle). The successful Tenderer shall use a flux inversion system with a proven track record to provide the flux estimates. The flux estimates shall be based on observations from international ground-based networks (e.g., the NOAA Earth System Research Laboratory archive) and satellite observations on the condition that the accuracy of the observations is good enough for providing competitive flux estimates. Within the first year covered by this ITT, the successful Tenderer shall provide an initial flux inversion covering at least the period 1996 – 2017, showing equal or better performance than the current CAMS N_2O flux estimates. The Tenderer shall further propose a strategy for providing at least annually updated flux estimates, either by reanalysing the whole period or by carefully extending the existing period to include the latest set of available observations. In the latter case, the Tenderer shall indicate potential issues with consistency of the whole data set. The successful Tenderer shall also provide uncertainty estimates of the fluxes and provide a validation report (using independent observations of atmospheric N_2O and/or N_2O fluxes) with each new release of the flux estimates.

The tables below provide templates to be used by the contractor to describe the complete list of deliverables, milestones and schedules for this work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as

described in the tables. Tenderers shall provide preliminary versions of the completed tables, which include the deliverables and milestones already indicated in the tables below, as part of their bid.

WP7330 Deliverables Template			
#	*Type*	*Title*	*Due*
D3.y.z-YYYYtoYYYY	Data set	Flux inversion for N_2O – Period at least 1996-2017	During Year 1
D3.y.z-YYYY or D3.y.z-YYYYtoYYYY	Data set	Flux inversion for N_2O for YYYY or Flux inversion for N_2O – Reprocessing of whole period – YYYY to YYYY	Annually
D3.y.z-YYYY	Report	Evaluation and Quality Control document for N_2O flux inversion YYYY (Period covered YYYY to YYYY)	Annually
D3.y.z-YYYY	Report	Description of the N_2O inversion production chain - YYYY	Annually
…			

WP7330 Milestones Template			
#	*Title*	*Means of verification*	*Due*
M3.y.z			
…			

3.5 Work package 7340 - Service evolution

The Tenderer shall provide an outline of tasks to improve the service related to greenhouse gas flux estimates. This plan shall address at least the use of new satellite instruments, the improvement of the flux inversion transport model (e.g., mass conservation, physical parameterizations, resolution), and the improvement of the flux inversion algorithm. The successful Tenderer shall also investigate longer-term developments, such as use of isotopes, separation of surface flux components (e.g., through the use of a (simple) Carbon Cycle Data Assimilation System (CCDAS)), etc., taking into account developments in the wider scientific community. The successful Tenderer shall provide a report describing these possible future directions.

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

WP7340 Deliverables Template			
#	*Type*	*Title*	*Due*
D4.y.z-YYYY	Report	Annual development plan for the Year YYYY	Annually in September
D4.y.z-YYYY	Report	Annual report on the developments achieved during the Year YYYY	Annually in December
…			

WP7340 Milestones Template			
#	*Title*	*Means of verification*	*Due*
M4.y.z			
…			

3.6 Work package 7350 - User support and documentation of service

The objective of this work package is to provide specialised support to users of the delivered products and services.

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

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

As part of the bid, Tenderers shall describe the level of user support service on CAMS Service Desk tickets they can provide.

Tenderers shall also address development of user guides. Documentation of the CAMS services is an integral part of the service provision. The technical and scientific specification of each service shall be documented in reports that will be available to users through the CAMS web site. The successful Tenderer shall therefore produce documentation reports describing in detail the methodologies and products it delivers for this ITT.

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

WP7350 Deliverables Template			
#	*Type*	*Title*	*Due*
D5.y.z	Other	Specialised user support via the CAMS Service Desk (Respond to user support queries requiring expertise specific to the Greenhouse gas flux products provided)	Continuous
D5.y.z-v1	*Other*	*Specialised User Support - Period 1*	*At Payment milestone 1*
D5.y.z-v2	*Other*	*Specialised User Support - Period 2*	*At Payment milestone 2*
D5.y.z	Report	Documentation of CO_2 flux service	Annually

D.5.y.z	Report	Documentation of CH_4 flux service	Annually
D.5.y.z	Report	Documentation of N_20 flux service	Annually
…			

WP7350 Milestones Template			
#	*Title*	*Means of verification*	*Due*
M5.y.z	Link with CAMS User Support team established; service desk set-up completed	Specialised Service Desk up and running	Month 2
…			

3.7 Work package 7300 - Management and coordination

The following management aspects shall be briefly described in the bid:

- Contractual obligations as described in the Framework Agreement Clause 2.3 on reporting and planning.
- Meetings:
  - ECMWF will organise annual CAMS General Assemblies within EU member states. The successful Tenderer is expected to attend these meetings with team members covering the various topics that are part of this ITT.
  - ECMWF will host monthly teleconference meetings to discuss CAMS service provision, service evolution and other topics. The Prime Investigator appointed by the successful Tenderer will represent the successful Tenderer in such meetings.
  - ECMWF will organise six-monthly project review meetings (linked to Payment milestones).
  - Tenderers should propose additional project internal meetings (kick-off meeting, annual face-to-face meeting and monthly teleconferences) as part of their response.
- Quality assurance and control: the quality of reports and Deliverables shall be equivalent to the standard of peer-reviewed publications. The final quality check of the deliverables should be made by the prime contractor (contents, 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 (ECMWF, stakeholders, internal communication).
- Resources planning and tracking using the appropriate tools.
- Implementation of checks, controls and risk management tools for both the prime contractor and subcontractors.
- Subcontractor management, including conflict resolution, e.g. the prime contractor is responsible for settling disagreements, although advice/approval from ECMWF may be sought on the subject.
- A list of subcontractors describing their contribution and key personnel shall be provided, as well as back-up names for all key positions in the contract. The Tenderer shall describe how the Framework Agreement, in particular Clause 2.9 has been flowed down to all their subcontractors.
- Personal data management (name, ID and contact details of prime contractor's data controller in line with Clause 2.8).

The tables below provide templates to be used by the contractor to describe the complete list of deliverables, milestones and schedules for this work package. All milestones and deliverables shall be

numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables. Tenderers shall provide preliminary versions of the completed tables, which include the deliverables and milestones already indicated in the tables below, as part of their bid.

WP7300 Deliverables Template				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 15/01, 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually on 28/02
D0.y.z	Tenderer	Report	Final report, including letter from auditor specific to CAMS contract YYYY *YYYY being the last year of the contract*	60 days after end of contract
D0.y.z-YYYY	Tenderer	Report	Draft Implementation plan YYYY *YYYY being the Year n+1*	Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY *YYYY being the Year n+1*	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY *YYYY being the Year n-1*	Annually
D0.y.z-YYYY	Tenderer	Other	Letter auditor's opinion specific to CAMS most recent Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually
D0.y.z	Tenderer	Other	Updated KPIs (list, targets…) after review with ECMWF	One year after start of contract

WP7300 Milestones Template				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.y.z	Tenderer	CAMS General Assembly	Participation to the meeting	Annually
M0.y.z	Tenderer	Monthly teleconference meetings with ECMWF	Participation to meeting	Monthly
M0.y.z	Tenderer	Progress review meetings with ECMWF / Payment milestones	Minutes of meeting	~ Every 6 months
M0.y.z	Tenderer	Kick-Off meeting	Minutes of meeting	Month 1
M0.y.z	Tenderer	Internal face to face project meetings	Minutes of meeting	Annually
M0.y.z	Tenderer	Internal project monthly teleconferences	Meetings happened	Monthly

4 General Requirements

4.1 Implementation schedule

The Framework Agreement will run from 1 December 2018 until 31 December 2021. The Tenderer shall provide a detailed implementation plan of proposed activities for the period until 30 June 2021. However, note that by Q4 2019 the level and duration of activities for the full year of 2021 will be communicated by ECMWF to the successful Tenderer based on the Copernicus programme review by the European Commission.

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

4.2 Deliverables and milestones

Deliverables should be consistent with the technical requirements specified in section 3.

All contract reports shall be produced in English. The quality of reports and deliverables shall be equivalent to the standard of peer-reviewed publications and practice. Unless otherwise specified in the specific contract, deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel or compatible) via the Copernicus Deliverables Repository portal.

Each Deliverable shall have an associated resource allocation (person-months and financial budget). The total of these allocated resources shall amount to the entire requested budget.

Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery. They should not duplicate deliverables.

4.3 Acquisition of necessary data and observations

The successful Tenderer shall acquire the relevant observational data sets and make them available for use in all CAMS activities related to the provision of greenhouse gas flux estimates. In the case of the acquisition of satellite observations, the successful Tenderer shall coordinate efforts with the Global Service Provider to avoid duplication of efforts.

4.4 Communication

The successful Tenderer shall support ECMWF in its communication activities for the CAMS services, where they are related to the activities described in this ITT. Examples are contributions to the Copernicus State of the Climate report, CAMS web site news items, and CAMS brochures and flyers.

4.5 User requirements

As part of CAMS, the database and three documents described below will be maintained. The successful Tenderer shall provide input to the User Requirements Database (URDB) regarding user requirements that are directly related to activities covered by this ITT. The successful Tenderer shall also support ECMWF and the contractor for CAMS_94 (User Interaction) with the analysis of relevant user requirements in the URDB. Finally, in case the successful Tenderer provides service elements that are listed in the Service Product Portfolio (SPP), the successful Tenderer shall provide input on product lines and their metadata to ECMWF to ensure the SPP is up-to-date.

User Requirements Database (URDB) and Requirement Analysis Document (RAD)

User requirements are collected in this database in a structured and traceable way, and links to entries in the Service Product Portfolio (see below) are provided, when appropriate. The URDB, which tracks all requirements emanating from a wide variety of user fora, surveys, and support panels, is complemented by a Requirements Analysis Document (RAD) which captures the stratification of user requirements per domain, importance and feasibility. The RAD constitutes the basis for distilling, filtering and translating user requirements into technical specifications for the Service. The URDB and RAD are maintained and continually updated by ECMWF and its contractor for CAMS_94 (User Interaction).

Service Product Portfolio (SPP)

Both data and value-added products are presented in this document in a structured way, providing key technical aspects, when appropriate, such as geophysical parameter, temporal resolution and coverage, spatial resolution and coverage, data formats, time availability, expected quality, data format together with a direct link to detailed information on methodology and quality monitoring for each specific product or services.

Service Evolution Strategy (SES)

The appropriateness of the list of emerging and existing user requirements, the routinely updated Requirement Analysis Document and the existing Service Product Portfolio, are continually monitored by ECMWF and feed into a Service Evolution Strategy (SES) document. The SES document is produced on an annual basis and provides, in addition to the annual implementation plan focussing on year n+1 service Deliverables, a proposed longer term (typically 4 years) perspective for forthcoming service upgrades and extensions, the expected benefits and costs, together with recommendations for potential research needs outside Copernicus operations. This document allows informed discussions to be opened on specific proposed service upgrades and extensions with the stakeholders.

The following deliverables are thus to be added to the WP7300 and WP7340 deliverable lists:

WP7300 Deliverables Template			
#	*Type*	*Title*	*Due*
D0.y.z-YYYY	Report	Input to CAMS SPP - YYYY	Annually in September
…			

WP7340 Deliverables Template			
#	*Type*	*Title*	*Due*
D4.y.z	Other	Input to CAMS URDB	Continuous
D4.y.z-YYYY	*Other*	*Input to CAMS URDB - YYYY*	*Checked by ECMWF annually in December*
…			

4.6 Data access via the CDS

It is expected that datasets generated as part of this ITT will be delivered to the CAMS Data Store (CDS). It is expected that the implementation of all CAMS products in the CDS will take place in Q4

2018. While the CDS is under development, CAMS continues to use the data portal that is currently in place on the CAMS web site.

The CDS has been designed as a distributed system that provides access to datasets and tools through a unified web interface. A general description of the design and functionality can be found in Raoult et al. (2017) (available at https://www.ecmwf.int/sites/default/files/elibrary/2017/17181-newsletter-no-151-spring-2017.pdf).

Note that the requirements below will strictly apply when the CDS is fully implemented.

4.6.1 Dataset registration

Dataset suppliers to the CDS shall provide a comprehensive description of their datasets at least one month prior to delivery, using a dataset registration process established by ECMWF. Details of the registration process, which serves to collect all CDS relevant information (to define metadata, user forms and necessary adaptors) will be provided to the preferred bidder during negotiation.

4.6.2 Access methods

Data access to CAMS data products, ancillary data and metadata, can be implemented in the CDS distributed infrastructure either by:

(a) **Push mode:** uploading datasets to a designated ECMWF CDS server.

ECMWF will not accept data in push mode if the initial volume exceeds 1 TB or if the annual increase in volume exceeds 0.5 TB. Upper bounds on data volume are subject to change and may be negotiable in exceptional circumstances.

(b) **Pull mode:** providing datasets via web services.

ECMWF has a strong preference for pull mode, which is consistent with the distributed architecture of the CDS and simplifies management of access, traceability and updates of an evolving data collection. However, the master copies of the Deliverables must be stored and archived only in places where the Copernicus Regulation and related delegation legislation such as the Copernicus Data Policy can be enforced up till six years after the end of the Framework Agreement.

ECMWF strongly prefers the use of the OPeNDAP protocol to implement pull mode. Tenderers who propose an alternative protocol shall justify the reasoning in their bids.

4.6.3 Use of standards

ECMWF will only accept service protocols that follow internationally recognised standards. Such standards must be open (i.e. non-proprietary), managed by a recognised international standardization process (e.g. ISO, WMO, OGC, etc), or be a de-facto standard such as OPeNDAP. ECMWF will consider using bespoke web-based APIs to access data and products if they implement very simple protocols (e.g. REST), as long as the results returned by these APIs are compatible with the results of a dataset upload via push mode. It should be noted that requests for these web services will mostly originate from the CDS itself, as part of a workflow run on behalf of an end-user. ECMWF will therefore need to have the necessary credentials to invoke these services. ECMWF will not provide information on the end user's identity when invoking the web services. ECMWF will nevertheless collect usage statistics for all aspects of CAMS.

4.6.4 Data formats

ECMWF will only accept data in formats that follow internationally recognised standards. Such standards must be open (i.e. non-proprietary), managed by a recognised international standardization

body (e.g. ISO, WMO, OGC, etc.), or any de-facto standard. Open source software that can read and write files following these standards must be available. Serialization formats (e.g. NetCDF, XML, JSON) should be supported by standard schemas and conventions. All text-based formats should be encoded in UTF-8. ECMWF will implement tools to check the compliance of the provided data and products to the agreed standards before they are added to the CDS catalogue.

ECMWF strongly recommends that datasets be encoded in NetCDF according to the recommendations described in the "*ECMWF metadata recommendations for NetCDF*" document, available at https://software.ecmwf.int/wiki/display/DGOV/ECMWF+Convention. Tenderers who propose an alternative protocol shall justify the reasoning in their bids.

4.6.5 Data ownership

It is a condition of EU funding for CAMS that ownership of any Deliverable (including datasets and their documentation) developed with CAMS funding passes from the suppliers to the EC, via ECMWF. Ownership will pass on delivery of the Deliverable. In return, the suppliers will be granted a non-exclusive licence to use the Deliverable which they have provided to CAMS for any purpose except one which conflicts with the aims of CAMS.

All software and products used by the successful Tenderer to produce the CAMS datasets will remain the property of the successful Tenderer, except for those components which are acquired or created specifically for CAMS purposes, with CAMS 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 EC via ECMWF annually, but in return the successful Tenderer will be granted a non-exclusive licence to use them for any purpose except one which conflicts with the aims of CAMS.

The source datasets of each product and associated Intellectual Property Rights (IPR) shall in addition be detailed as follows in the proposal:

FOR IN-HOUSE PRODUCED DATASETS				
	Input files needed	**Input files legal data (IPR, licenses, compliance with license)**	**Algorithms needed**	**Algorithms legal data (IPR, licenses, compliance with license)**
Description	Please list the needed input files	For each input dataset, indicate who owns the IPR, describe the license and confirm you comply with this license.	Please list the needed algorithms	For each algorithm, indicate who owns the IPR, describe the license and confirm you comply with this license.
Example	1. GOSAT 2. …	1. IPR: JAXA; Free license after registration; Comply 2. …	1. LMDZ model 2. …	1. IPR: …; Comply 2. …

Pre-existing Technology, foreseen Assets, and Integrated Technology (as defined in Framework Agreement Clause 3) shall also be described in the proposal, following the template below:

Pre-existing Technology		
Title	***Type***	***Description***
Assets (tangible and intangible)		
Title	***Type***	***Description***

Integrated Technology		
Title	***Type***	***Description***

4.7 Key performance indicators

Contractors shall report to ECMWF on a set of Key Performance Indicators (KPIs) suitable for monitoring various aspect of service performance. These will be used in the overall monitoring of the CAMS programme for which the following KPI categories have been identified:

- KPI1 Service availability
- KPI2 Products usage
- KPI3 Products quality
- KPI4 User support
- KPI5 User statistics
- KPI6 Service audience
- KPI7 User engagement
- KPI8 User satisfaction
- KPI9 Contracts
- KPI10 Deliverables
- KPI11 data usage

The table below provides the template to be used by the Tenderer to describe the KPIs, relevant for this ITT, together with performance targets, delivery schedules and explanations if needed. Please note that the listed KPIs form part of the overall set of KPIs comprising the full CAMS service portfolio; the successful Tenderer therefore might have to provide KPI values for a KPI in support of services outside this ITT.

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

The list of KPIs shall be reviewed with ECMWF in the second year of the contract and updated if necessary.

Service availability KPI #	**KPI Title**	**Performance Target and Unit of Measure**	**Frequency of Delivery**	**Explanations / Comments**
KPI_73.1.3	Completeness of production for each product	95%	Quarterly	Percentage of outputs delivered vs expected for each product defined in the SPP (running average over the past calendar year). This percentage is computed in terms of data volume

KPI_73.1.4	Timeliness of production for each product	90%	Quarterly	Percentage of products delivered completely and on time if delivery time is specified in the SPP (running average over the past calendar year).
KPI_73.10.1	% of deliverables delivered on time or with short delay	%	Quarterly	
KPI_73.11.1	Number of satellite data streams used		Quarterly	
KPI_73.11.2	Number of in situ data streams used		Quarterly	

5 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.

5.1 Page Limits

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

Section	*Page Limit*
Executive Summary	2
Track Record	2 (for general) and 2 (per entity)
Quality of resources to be Deployed	2 (excluding Table 1 in Volume IIIB and CVs with a maximum length of 2 pages each)
Technical Solution Proposed	2 + 3 per Work package (Table 2 in Volume IIIB, the section on references, publications, patents and any pre-existing IPR is excluded from the page limit and has no page limit)
Management and Implementation	6 (excluding Table 3, Table 5, Table 6 and Table 7 in Volume IIIB) + 2 per each Work package description (Table 4 in Volume IIIB)
Pricing Table	No limitation

Table 1: Page limits

5.2 Specific additional instructions for the tenderer's response

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

5.2.1 Executive Summary

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

5.2.2 Track Record

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

5.2.3 Quality of Resources to be Deployed

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

- A senior team member (Prime 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 on 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. The Tenderer shall also appoint a Service Manager, which will be its primary contact for contractual delivery and performance aspects.

5.2.4 Technical Solution Proposed

The Tenderer is expected to provide a short background to the proposed technical solution to demonstrate understanding of the solution proposed. This should include background of the Tenderer's understanding of the Copernicus Atmosphere Monitoring Service, the current state of monitoring of global atmospheric composition, and the current state of greenhouse gas flux inversions.

An exhaustive and detailed description of the proposed technical solution for all work packages described above, including any ramp-up or mobilization phase, shall be given. The Tenderer shall indicate which observational data sets it intends to use and how it will acquire the relevant data. The Tenderer shall describe the proposed method for producing the flux estimates outlining in some detail the proposed flux inversion system(s). The Tenderer shall indicate the spatial and temporal resolution of the flux estimates and how their accuracy will be competitive within existing international collaboration frameworks. The Tenderer shall also describe its intended procedure for annually updating the data products.