ECMWF
Copernicus
Procurement

Invitation to Tender

Copernicus Atmosphere Monitoring Service

Volume II

Provision of global inversion-optimised greenhouse gas fluxes and concentrations

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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 various aerosol-weather feedbacks are prominent but often uncertain drivers of climate change. Ozone distributions in the stratosphere influence the amount of ultraviolet radiation reaching the surface.

In the troposphere, 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. The variable abundance of the reactive gases change the oxidation capacity of the atmosphere and control therewith also the abundance of long-lived greenhouse gases. The composition of the troposphere and the associated deposition fluxes are major components of the biogeochemical cycles of carbon, nitrogen and sulphur and iron, which effect the land- and marine eco systems. Dust, 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.

In the wake of the agreement signed in Paris at the UNFCCC's 21st Conference of the Parties (COP-21) in December 2015, the need to monitor and to inform about the effectiveness of mitigation efforts for anthropogenic emissions of key greenhouse gases has become more acute and prominent. With its global coverage (or regional in the case of geostationary platforms), Earth Observation has a decisive role to play within such a monitoring system, complementing ground-based observations, "bottom-up" estimates of the emissions (included in official reporting) and atmospheric transport modelling.

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.

Within its first phase (2015 – 2020), Cop1, the Service consolidated many years of preparatory research and development to deliver a range of operational services. In its second phase (2021 – 2027), Cop2, these services are further consolidated, improved and expanded to address all the existing and emerging societal needs related to the atmospheric environment. The CAMS service portfolio consists of the following service elements:

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 atmospheric inversions for CO_2, CH_4 and N_2O net surface fluxes, 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;
i) Anthropogenic and natural emissions, based on inventory data and modelling, for the global and European domains;
j) Observation-based emission estimates of atmospheric pollutants for the global and European domains;
k) Observation-based anthropogenic emission estimates of CO_2 and CH_4 for the global domain and emission hotspots.

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

2 Contract Summary

This ITT, entitled "Provision of global inversion-optimised greenhouse gas fluxes and concentrations", 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 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 atmospheric inversion systems. The Tenderer shall define the proposed spatial and temporal resolution for the atmospheric 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 Evaluation and Quality Control documents for the Supplementary Services on Greenhouse Gas Fluxes on the CAMS web site (https://atmosphere.copernicus.eu/supplementary-services). In addition, under the relevant WPs the Tenderer shall include a plan to improve the spatial resolution of the atmospheric inversions relative to the current CAMS atmospheric inversions with a target resolution of 1° by 1° within the duration of this contract.

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.

3.2 Work package 5510 – 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 an atmospheric 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. In the case of using satellite data products, the Tenderer shall indicate if these will be used in an combined atmospheric inversion or in separate parallel atmospheric inversions. Within the first year covered by this ITT, the successful Tenderer shall provide an initial atmospheric inversion covering at least the period 1979 – 2021, 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 an Evaluation & Quality Control (EQC) report (using independent observations of atmospheric CO2 and/or CO2 fluxes) with each new release of the flux estimates.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5510 Deliverables			
#	*Type*	*Title*	*Due*
D1.X.Z-yyyy[1]	Data set	Observation-based flux estimates for CO_2 – Period at least 1979-2021	During first year
D.1.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based CO_2 flux estimates for the period 1979 - 2021	During first year
D.1.X.Z-yyyy	Data	Observation-based flux estimates for CO_2 for YYYY or Observation-based flux estimates for CO_2 – Reprocessing of whole period 1979-YYYY	Annually
D.1.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based CO_2 flux estimates for the period 1979 - YYYY	Annually

[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.

WP5510 Milestones			
#	*Title*	*Means of verification*	*Due*
M1.X.Y	title		

3.3 Work package 5520 – 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 an atmospheric 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(-2), Sentinel-5p, IASI) on the condition that the accuracy of the observations is good enough for providing competitive flux estimates. In the case of using satellite data products, the Tenderer shall indicate if these will be used in an combined atmospheric inversion or in separate parallel atmospheric inversions. Within the first year covered by this ITT, the successful Tenderer shall provide an initial atmospheric inversion covering at least the period 1990 – 2021, 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 an Evaluation & Quality Control (EQC) report (using independent observations of atmospheric CH_4 and/or CH_4 fluxes) with each new release of the flux estimates.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5520 Deliverables			
#	*Type*	*Title*	*Due*
D2.X.Z-yyyy	Data set	Observation-based flux estimates for CH_4 – Period at least 1979-2021	During first year
D.2.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based CH_4 flux estimates for the period 1979 - 2021	During first year
D.2.X.Z-yyyy	Data	Observation-based flux estimates for CH_4 for YYYY or Observation-based flux estimates for CH_4 – Reprocessing of whole period 1979-YYYY	Annually
D.2.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based CH_4 flux estimates for the period 1979 - YYYY	Annually

WP5520 Milestones

#	Title	Means of verification	Due
M2.X.Y	Title		

3.4 Work package 5530 – 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 an atmospheric 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 (e.g., IASI) on the condition that the accuracy of the observations is good enough for providing competitive flux estimates. In the case of using satellite data products, the Tenderer shall indicate if these will be used in an combined atmospheric inversion or in separate parallel atmospheric inversions. Within the first year covered by this ITT, the successful Tenderer shall provide an initial atmospheric inversion covering at least the period 1996 – 2020, 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 an Evaluation & Quality Control (EQC) report (using independent observations of atmospheric N_2O and/or N_2O fluxes) with each new release of the flux estimates.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5530 Deliverables			
#	Type	Title	Due
D3.X.Z-yyyy	Data set	Observation-based flux estimates for N_2O – Period at least 1979-2020	During first year
D.3.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based N_2O flux estimates for the period 1979 - 2020	During first year
D.3.X.Z-yyyy	Data	Observation-based flux estimates for N_2O for YYYY or Observation-based flux estimates for N_2O – Reprocessing of whole period 1979-YYYY	Annually
D.3.X.Z-yyyy	Report	Evaluation and Quality Control document for observation-based N_2O flux estimates for the period 1979 - YYYY	Annually

WP5530 Milestones			
#	Title	Means of verification	Due
M3.X.Y	Title		

3.5 Work package 5540 – 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 (insofar they have not already been included in the service provision of the above work packages), the potential to extract more information about human-induced emissions, and the improvement of the efficiency and accuracy of the atmospheric inversion algorithm. The successful Tenderer shall also align their activities with other relevant CAMS activities, especially in the framework of the ramping up of a new Copernicus anthropogenic CO_2 emissions monitoring & verification support capacity, where meaningful for the provision of the services of this contract. Main examples are the harmonisation of prior flux and emission data sets and the Evaluation and Quality Control activities for CO_2 and other emissions.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5540 Deliverables			
#	*Type*	*Title*	*Due*
D4.Y.Z.yyyy	Report	Annual development plan for the Year YYYY	Annually
D4.Y.Z.yyyy	Report	Annual report on the developments achieved during the Year YYYY	Annually

WP5540 Milestones			
#	*Title*	*Means of verification*	*Due*
M4.Y.Z	Title		

3.6 Work package 5550 – User support and documentation of service

The objective of this work package is to provide 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 Service Desk handles user queries through a ticketing system and distributes these queries to specialists when needed. Dedicated staff at ECMWF provide basic support in the form of self-help facilities (FAQs, Knowledge Base, online Forum, tutorials etc.) as well as individualised support on technical queries related to the Atmosphere Data Store (ADS), 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 Service Desk facility, as well as contributions to FAQs,

Knowledge Base, and user guides. Contractors may also be requested by the CAMS Service Desk to contribute to support questions in the online Forum.

Tenderers shall describe the level of user support service on Service Desk tickets as a specific Key Performance Indicator (KPI) with a target value of 80% of the assigned specialised user queries being resolved within 15 days after being informed by the CAMS Service Desk.

Tenderers shall also address development of user guides. Documentation of the CAMS services is an integral part of the service provision and is directly linked to the Atmosphere Data Store. The technical and scientific specification of each service shall be documented in the CAMS Knowledge Base as linked from the Atmosphere Data Store (see example for the CAMS global reanalysis at https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-reanalysis-eac4?tab=doc), and, if more detail is required, in reports that will be available to users through the CAMS web site. The successful Tenderer shall therefore produce documentation describing in detail the methodologies and products they deliver for this ITT. The documentation in the Knowledge Base shall be targeted at the general external user community, while the additional detailed reports shall address the needs of expert users.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5550 Deliverables			
#	*Type*	*Title*	*Due*
D5.y.z-YYYY	Other	Overview of contribution to CAMS Knowledge Base to document products and services as provided within the scope of this contract	Annually
D5.y.z-YYYY	Report	Contribution to documentation of products and services as provided within the scope of this contract	Annually
…			

WP5550 Milestones			
#	*Title*	*Means of verification*	*Due*
M5.y.z	…	…	…
…			

3.7 Work package 5500 – 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 (classified as tasks and listed in a separate table as part of the proposal):
  - ECMWF will organise annual CAMS General Assemblies. 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 can 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.
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 of the Volume V Framework Agreement.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall include the deliverables and milestones for this work package already indicated in the tables below. Volume IIIA will be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package. All milestones and deliverables shall be numbered as indicated. All document deliverables shall be periodically updated and versioned as described in the tables.

WP5500 Deliverables				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 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-YYYY	Tenderer	Other	Preliminary financial form YYYY *YYYY being the Year n-1*	Annually on 15/01
D0.y.z	Tenderer	Report	Final report	60 days after end of contract
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY *YYYY being the Year n+1*	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY *YYYY being the Year n-1*	Annually
D0.y.z	Tenderer	Other	Updated KPIs (list, targets…) after review with ECMWF	One year after start of contract

WP5500 Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.y.z-Px	Tenderer	Progress review meetings with ECMWF / Payment milestones	Minutes of meeting	~ Every 6 months

4 General Requirements

4.1 Implementation schedule

The Framework Agreement will run from 1 November 2021 to 31 October 2023. The Tenderer shall provide a detailed implementation plan of proposed activities for the full period.

4.2 Deliverables and milestones

Deliverables should be consistent with the technical requirements specified in section 0. A deliverable is a substantial, tangible or intangible good or service produced as a result of a project. In other words, a deliverable is an outcome produced in response to the specific objectives of the contract and is subject to acceptance by the technical contract officers at ECMWF. When defining deliverable please **consolidate their numbers** against a specific deadline, where possible. 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, resource type: payroll only). The total of these allocated resources shall amount to the requested budget associated with payroll. The milestones shall not be directly associated with the detailed budget specification (under Volume IIIA, tab “List of deliverables”).

Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery. They should not duplicate deliverables. Apart from the payment milestone review meetings, all foreseen meetings shall not be classified as milestones but listed in a separate overview table for each work package.

CAMS is a fully operational service and timely delivery of services is essential. The tenderer shall therefore ensure that the proposed due dates of deliverables and milestones are realistic and achievable, i.e., the Tenderer shall consider dependencies, such as the source of original data, and assess the risk accordingly.

4.3 Acquisition of necessary data and observations

The Successful Tenderer shall acquire the relevant observational data sets needed for the provision of the services of this ITT. Where possible, use shall be made of the observational data sets provided by the Copernicus Climate Change Service (C3S), CAMS, and the Climate Change Initiative programme from the European Space Agency (ESA-CCI). The Successful Tenderer shall also acquire the relevant

observational data sets needed for the optimisation and evaluation of the developments of this ITT. Where possible, use shall be made of the observational data sets under the CAMS2_2000 in situ support contracts.

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. All communication activity must be agreed with the ECMWF Copernicus Communication team in advance. This includes, but not exhaustively, communication planning, branding and visual style, media outreach, website and social media activity, externally facing written and graphic content and events. Agreed activity would also need to be evaluated and reported on, once complete, so that success measures and KPIs can be provided to the European Commission.

4.5 Support for user engagement and training activities

While user engagement and training activities are not part of the scope of this ITT, the Tenderer shall accommodate for eventual needs in providing technical and scientific expertise in support of these activities. The bidder shall specify in the bid the experts intended to be allocated to provide this support.

Requests to support activities may be raised on for example:

- Contribute with content specific input to training, education and capacity building material: development and/or review of learning resources in the domain of the contract, participation in train-the-trainer events and MOOCs;
- Contribute with content specific input to user-oriented communication material such as slides, story maps and user testimonials;
- Contribute and attend User Uptake workshops and stakeholder meetings. Presentations in your mother tongue may be asked to be provided;
- Input to the URDB with user requirements (cf. template as provided during the negotiation process) as well sharing needs and aspirations as raised by potential new user communities;

An indicative maximum budget of 5,000.- EUR shall be allocated in the pricing table to accommodate for these needs. This shall be paid as a cost-reimbursement against a fixed fee rate/day]. Details on the expected activities and the budget shall be refined during the negotiation/contract preparation phase.

As part of the CAMS user interaction, user requirements are continually collected in a User Requirements Database (URDB) in a structured and traceable way. This URDB tracks all requirements emanating from a wide variety of user fora, surveys, user support and direct interactions between service providers and their users. The entries of the URDB are analysed on a regular basis in terms of user requirements per domain, importance and feasibility. This analysis constitutes the basis for distilling, filtering and translating user requirements into technical specifications for the Service and its evolution.

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 of User Interaction activities with the analysis of relevant user requirements in the URDB.

The following deliverables are thus to be added to the WP5550 deliverable lists:

WP5550 Deliverables			
#	*Type*	*Title*	*Due*
D5.y.z-YYYY	Other	Input to CAMS URDB - YYYY	Checked by ECMWF annually in November
…			

4.6 Data provision and IPR

It is expected that data sets (including databases) generated or acquired by the successful Tenderer will be delivered to the users via the Atmosphere Data Store (ADS). The section below indicates generic requirements for these datasets in terms of standards and conformity.

Provision of data and products:

Suppliers will make the output of their work available to CAMS users via the ADS, by one of two methods:

a) uploading their data and products to a designated server,
b) providing them via web services.

In the case of (a), suppliers will have to agree with ECMWF on the data formats to be used. 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 standardisation body (e.g. ISO, WMO, OGC, etc.), or any de-facto standard. Open source software should also exist that can read and write files of these standards. Serialisation 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 ADS.

Examples of case (a) are data uploaded to the ADS in WMO GRIB edition 1 and 2, NetCDF files conforming to CF-1.6, or greater.

In the case of (b), suppliers will have to agree with ECMWF on the protocols to be used to invoke the web services. ECMWF will only accept protocols that follow internationally recognised standards. Such standards must be open (i.e. non-proprietary), managed by a recognised international standardisation 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 the data and products if they implement very simple protocols (e.g. REST), as long as the results returned by these APIs are compatible with (a). It should be noted that requests for these web services will mostly originate from the ADS 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.

Examples of case (b) are OGC standards (WMS, WCS, WFS, etc), OpenDAP, etc. Other protocols could be considered as the system evolves.

Every dataset and/or service provided shall be documented using the appropriate metadata standards (e.g. ISO 19115, INSPIRE Directive 2007/2/EC).

Provision of processing capabilities:

The successful Tenderer will (when appropriate) implement specific web-service-based data manipulation facilities. These will make it possible to run some agreed reduction and/or analysis algorithms directly on the data and products located on the suppliers' systems, and to return the results of said algorithms.

As for data retrievals, invocation of these web services will originate from the ADS itself as part of a workflow run on behalf of an end user, and ECMWF will need to have the necessary end-user 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.

ECMWF will ensure that these services are invoked in a controlled fashion, to prevent any misuse of the system. This web services will be implemented with OGC's WPS standards or will be based on simple web-based REST API or equivalent. The results returned by these services will have to be in formats compatible with options (a) or (b) described above.

Data and IPR:

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

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 Tenderers' production system. The identity and ownership of such exceptional components will be passed to the European Union via ECMWF annually. The successful Tenderer will be granted a non-exclusive licence to use them for any purpose.

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.

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.

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI_55.1	Quality of the CO2 product - bias	…	For each product release	Mean absolute bias between the posterior simulation and a large set of independent

				aircraft measurements in the free troposphere
KPI_55.2	Quality of the CO2 product – standard deviation	…	For each product release	Mean standard deviation between the posterior simulation and a large set of independent aircraft measurements in the free troposphere
KPI_55.3	Quality of the CO2 product - bias	…	For each product release	Mean absolute bias between the posterior simulation and a large set of independent aircraft measurements in the free troposphere
KPI_55.4	Quality of the CO2 product – standard deviation	…	For each product release	Mean standard deviation between the posterior simulation and a large set of independent aircraft measurements in the free troposphere
KPI_55.5	Quality of the CO2 product - bias	…	For each product release	Mean absolute bias between the posterior simulation and a large set of independent aircraft measurements in the free troposphere
KPI_55.6	Quality of the CO2 product – standard deviation	…	For each product release	Mean standard deviation between the posterior simulation and a large set of independent aircraft measurements in the free troposphere

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 successful 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 and the current state of atmospheric inversions to estimate greenhouse gas fluxes.

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 atmospheric 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.