

ECMWF Copernicus Procurement

Invitation to Tender



Copernicus Atmosphere Monitoring Service

Volume II

Development of the CAMS Global Fire Assimilation System

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1 Introduction

Some of today's most important environmental concerns relate to the composition of the atmosphere. 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 changes the oxidation capacity of the atmosphere and controls 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 affect the land- and marine ecosystems. 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.

The increasing concentration of the greenhouse gases and the various aerosol-weather feedbacks are prominent but often uncertain drivers of climate change. 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) based on inventory data and biogeochemistry models, 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 – 2028, 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 CO₂, CH₄ and N₂O net surface fluxes, allowing the monitoring of the evolution in space and time of these fluxes;
- h) Climate forcing from aerosols and long-lived (CO₂, CH₄) 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 CO₂ and CH₄ for the global domain and emission hotspots.

This Invitation to Tender (ITT) is mainly targeting the CAMS service element described under item j) above.

1.1 Definitions

Definitions specific for this ITT are defined below.

Global Service Provider: ECMWF is the provider of global products

Regional Service Provider: the contractor for the CAMS2_40 contract for Regional Air Quality Products.

Global Production System: the modelling and data assimilation infrastructure used to provide the CAMS global analyses and forecasts of atmospheric composition.

Regional Production System: the modelling and data assimilation infrastructure used to provide the CAMS regional (re)analyses and forecasts of atmospheric composition

Real-Time Global Products: The operational real-time analyses and forecasts from the global CAMS data assimilation and forecasting system, which is run by the Global Service Provider. These analyses and forecasts are produced at least daily and include 3-dimensional fields of aerosols, chemical species, and greenhouse gases with a temporal resolution of at least 6 hours.

Forecast-only Global Products: the outputs of a global CAMS forecasting system that is based on the system used to produce the Real-Time Global Products but without the assimilation of observations of atmospheric composition. The forecasts are produced at least daily and include 3-dimensional fields of aerosols, chemical species, and greenhouse gases with a temporal resolution of at least 6 hours.

Global Reanalysis Products: the outputs of a reanalysis from the global CAMS data assimilation and forecasting system, which is being run by the Global Service Provider. The reanalysis will cover the period between 2003 onwards and provide analyses and forecasts every 12 hours of 3-dimensional fields of aerosols, chemical species, and greenhouse gases with a temporal resolution of at least 6 hours.

Regional Products: the outputs of analyses and forecasts from the regional CAMS data assimilation and forecasting systems, which are run by the Regional Service Provider. The Regional Products consist in the first place of real-time analyses and forecasts. The regional CAMS data assimilation and forecasting systems will comprise at least seven individual systems as well as their model ensemble products. These analyses and forecasts will be produced every 24 hours and include 3-dimensional fields of aerosols and chemical species with a temporal resolution of 1 hour. The Regional Products

also include the outputs from interim re-analyses based on fast-track in-situ observations and re-analyses based on fully validated in-situ observations. Outputs from these reanalyses consist of analyses of chemical species and aerosols with a temporal resolution of 1 hour and will be provided on an annual basis by the Regional Service Provider.

2 Contract Summary

This ITT, entitled “Development of the CAMS Global Fire Assimilation System”, is for providing support for and further development of the CAMS global fire emissions estimation products, which are operated at ECMWF. The system, which is currently based on the Global Fire Assimilation System (GFAS), delivers near-real-time emissions of gases and aerosols from biomass burning and wildfires through data assimilation of multi-satellite FRP retrievals supporting atmospheric composition and air quality forecasts. The Successful Tenderer shall support the operational fire emissions data provision, provide near-real-time Fire Radiative Power (FRP) observations from the GOES and Himawari geostationary satellites, implement new satellite data products including the merging of GEO and LEO satellite FRP products, provide and implement recommendations for service evolution based on the requirements in this ITT, update information on spurious FRP signals, and deliver the required memoranda and reports.

The Successful Tenderer will also advise the team working on the global production system at ECMWF to ensure optimal use of the fire emission data. The Successful Tenderer will have to demonstrate considerable experience in the field of estimation of fire emissions from satellite data.

3 Technical Specification

3.1 General Requirements

The Global Service Provider provides estimates of emissions from wildfires and biomass burning based on the methodology of the Global Fire Assimilation System (GFAS). The CAMS Global Fire Assimilation System uses satellite observations of Fire Radiative Power (FRP) to detect fires and estimate emissions of a large range of pollutants¹. These emissions are key inputs to the CAMS modelling systems that are used for providing the Real-time Global Products, the Forecast-only Global Products, the Global Reanalysis Products and the Regional Products. The fire emissions are also part of the CAMS product portfolio. The emission rates of aerosol and gas species are derived through the use of so-called emission factors for each particular species, which relate the dry matter combustion rate estimated from FRP (based on benchmarking against GFED3) to the actual emission rates of these species². The system also provides an estimate of the injection height of the fire emissions using the IS4FIRES parameterisation. IS4FIRES uses FRP (strength of the fire) as well as meteorological variables to derive the instantaneous vertical transport of the emitted aerosols and gases providing an altitude of maximum injection of these species into the atmosphere³. The CAMS Global Fire Assimilation System currently provides both daily and hourly means of FRP, emission rate and injection height.

The Successful Tenderer shall support the further development of the CAMS system, in coordination with the Global Service Provider, by improving the modelling and data assimilation aspects, by

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<https://confluence.ecmwf.int/display/CKB/CAMS%3A+Global+Fire+Assimilation+System+%28GFAS%29+data+documentation>

² <https://bg.copernicus.org/articles/9/527/2012/bg-9-527-2012.pdf>

³ <https://acp.copernicus.org/articles/17/2921/2017/acp-17-2921-2017.pdf>

providing FRP retrievals from the constellation of geostationary satellites, and by introducing observations from new satellite instruments, as outlined in the work packages in the following sections.

ECMWF is also the computational centre for the Copernicus Emergency Management Service – Fire. This activity is undertaken in collaboration with Météo-France. ECMWF provides fire danger calculations from high-resolution and ensemble forecasts up to 15 days ahead on a daily basis. The data feeds into the European Forest Fire information System (EFFIS) and the Global Wildfire Information System (GWIS). EFFIS was established to support the national authorities responsible for management of forest fires in the European Union and neighbouring countries, as well as to provide the European Commission and the European Parliament with reliable information on trends associated with these incidents. The CAMS and CEMS fire services have their own specific role, but ECMWF aims to exploit synergies between the services, where possible.

The Successful Tenderer shall provide code developments and new parameter definitions in the format used at ECMWF, including current Python coding practices (Python 3) and ECMWF use of GRIB encoding. It is of importance that all new developments shall be directly implemented and tested in the code version used at ECMWF, to which access will be given to the Successful Tenderer.

3.2 Work package 1 (WP1) – Support to the operational implementation of the CAMS global fire emission system

Over the past several years, several developments have been carried out to increase the number of FRP observations by merging observations from Low Earth Orbit (LEO) and Geostationary (GEO) satellite instruments. However, the operational version of the CAMS fire emission system is still based on MODIS observations only, although a new configuration including observations from VIIRS (based on M-band data) is running in parallel in final preparation for operational implementation. In addition, the implementation of observations from other satellite instruments is in various degrees of maturity. These developments need to be further tested and potentially adjusted before their implementation in the operational suite, which is described in WP3. The work in this WP1 is focused on direct support for the operational configuration itself, which provides daily estimates of global fire emissions.

The Successful Tenderer shall provide continued assistance and support to ECMWF in the maintenance and operational implementation of GFAS in case any issues are encountered in the operational production of the GFAS outputs, including changes in the observing system.

In addition, the Successful Tenderer shall monitor the accuracy of the spurious signal mask and provide updates based on new information or user feedback. Satellite observations of FRP are not only sensitive to wildland fires and biomass burning but also to thermal signals from other sources such as volcanoes and gas flaring. These ‘spurious’ signals are accounted for through the use of a spurious signal mask, which can omit the non-fire signals. This consists of available information on active volcanoes, on-shore gas flaring, and urban developments, along with an evaluation of persistent annual emissions in the fire emission output.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall at least 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.

WP1 Deliverables

#	Type	Title	Due
D.1.Y.Z	Data	Updated spurious signal map	Annually and ad-hoc in case a significant issue is reported
D.1.Y.Z	Report	Overview of support given to ECMWF on maintenance and operational implementation of the CAMS global fire emission system	Annually

WP1 Milestones			
#	Title	Means of verification	Due
M1.Y.Z	Establish access to ECMWF computing environment	Agreement with ECMWF	M1

3.3 Work package 2 (WP2) – Provision of FRP retrievals from geostationary satellites

The CAMS global fire emission system has focused historically on the use of FRP observations from the MODIS instruments on the polar orbiting Aqua and Terra satellites. Over the past few years, developments have addressed the capability to utilise FRP observations from VIIRS, Sentinel-3 and geostationary platforms (SEVIRI, GOES-E/-W and Himawari), although most of these instruments are not operationally assimilated yet. Geostationary FRP observations from EUMETSAT’s Meteosat satellites are provided through EUMETSAT’s Land Surface Analysis Satellite Applications Facility (LSA SAF), and a similar mechanism has been established under CAMS to provide FRP retrievals from the American GOES-East and GOES-West satellites and the Japanese Himawari satellites delivered within 3 hours after observation with at least 3-hourly resolution for the full disk GOES/Himawari imagery.

The continued provision of these FRP retrievals shall be provided for the duration of the contract. The geostationary FRP retrievals will ensure high-temporal resolution coverage of a large part of the globe. The Successful Tenderer shall provide Fire Radiative Power (FRP) values from GOES-East, GOES-West and the current Himawari with associated uncertainties, as well as geo-location information for each individual satellite footprint (at least the longitude, latitude, viewing angle and pixel size of the observation). The quality of the retrieval values shall be competitive with international products, such as are for instance available from MODIS, VIIRS and Meteosat. The Tenderer shall indicate the expected timeliness and reliability of its GOES/Himawari FRP data provision. The latter shall take into account operational aspects of the data provision with a focus on risk management (e.g., dependencies on raw satellite data timeliness, potential failure of required hardware, monitoring of processing chain, timely communication of system down-time).

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall at least 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.

WP2 Deliverables			
#	Type	Title	Due

D2.Y.Z	Data & Report	Data provision of GOES-E/-W & Himawari FRP data stream from 1 October 2024 until start of routine daily data provision	At start of daily data provision (see next deliverable)
D2.Y.Z	Data & Report	Daily data provision and quarterly status report of GOES-E/-W & Himawari FRP data stream in near-real-time	Quarterly

WP2 Milestones			
#	Title	Means of verification	Due
M2.Y.Z			

3.4 Work package 3 (WP3) – Operational implementation of new satellite instruments

The current operational version of the CAMS global fire emission system uses FRP satellite observations from the MODIS instruments onboard the Terra and Aqua satellites, while a configuration that includes FRP satellite observations from the VIIRS instrument (M-band data) onboard the S-NPP satellite is under final testing. However, observations from more satellites are available: Sentinel-3 A and B, GOES-E and -W, Himawari-8 and -9, and all their follow up missions as soon as data are available, including VIIRS (M-band and the high resolution I-band based FRP). The Successful Tenderer shall support ECMWF with the operational implementation of these satellite missions with an initial focus on the polar orbiting satellites before including the geostationary satellites as well. This support includes data survey, adapting the gridding software for the specific satellite instruments, implementation in the GFAS code on the ECMWF git repository, estimation of calibration, and successful testing on ECMWF’s HPC system. The choice of satellite retrieval product and geolocation information should fall on official versions distributed by operational agencies as much as possible.

Based on the existing code for MODIS, VIIRS, and the geostationary SEVIRI instruments, code has to be written and tested for each new instrument addressing the following aspects:

- Calculation of the atmospheric correction to consider the atmospheric attenuation of the upwelling thermal signal for FRP products that are not already atmospherically corrected;
- Estimation of FRP per-pixel uncertainty which shall be calculated using standard error propagation considering noise, atmosphere and background error;
- Estimation of non-fire pixel uncertainty in order to include low intensity fires below the FRP detection limit of the sensor. The sensor FRP detection limit shall also be determined;
- Aggregation to a global 0.1 degree grid.

The Successful Tenderer shall test and evaluate the ingestion of the new satellite streams by running year-long experiments in ECMWF’s HPC environment by cloning the ECMWF git repository with the use of the ecFlow workflow manager. The evaluation process shall include the comparison to the current operational production at global, regional, and specific events basis.

The implementation of new observations shall include the estimation of bias correction factors to ensure consistency of the different observations within their error characterizations. Global correction factors are currently used to scale local daytime and nighttime observations of each FRP product before they are assimilated. These scaling factors have been computed to ensure consistent

Fire Radiative Energy compared to the two MODIS FRP budgets. They are globally constant over FRP values and viewing geometry and have been computed using a single year of data. The Successful Tenderer shall evaluate and refine this bias correction scheme used to combine the FRP estimates from multiple satellites. The potential change of baseline from MODIS to VIIRS should also be considered.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall at least 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.

WP3 Deliverables			
<i>#</i>	<i>Type</i>	<i>Title</i>	<i>Due</i>
D3.Y.Z	Code & report	Refinement of the bias correction scheme to enable the combination of polar orbiting and geostationary satellites	Indicated by Tenderer, but during 1 st half of contract
D3.Y.Z	Code & report	Implementation of Sentinel-3A FRP data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of Sentinel-3B FRP data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of SEVIRI data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of GOES-E data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of GOES-W data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of HIMAWARI-8 data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of HIMAWARI-9 data in GFAS code ready for operational usage	Indicated by Tenderer
D3.Y.Z	Code & report	Implementation of VIIRS I-band data in GFAS code ready for operational usage	Indicated by Tenderer

WP3 Milestones			
<i>#</i>	<i>Title</i>	<i>Means of verification</i>	<i>Due</i>
M3.Y.Z	Successful performance of Sentinel-3A FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of Sentinel-3B FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of SEVIRI FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer C

M3.Y.Z	Successful performance of GOES-E FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of GOES-W FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of HIMAWARI-8 FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of HIMAWARI-9 FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer
M3.Y.Z	Successful performance of VIIRS I-Band FRP data in GFAS	Positive test results in pre-operational configuration	Indicated by Tenderer

3.5 Work package 4 (WP4) - Service evolution

Service evolution is a critical part of all CAMS services. The Tenderer shall therefore provide a research and development plan covering the full duration of the contractual agreement that results from this ITT. The proposed developments shall capitalize on the outcomes of the research carried out in previous contracts and shall include the following aspects:

3.5.1 Revision of the gridding software

Currently, GFAS uses the standard-resolution operational MODIS and VIIRS files for detected fires as well as the non-operational coarse-resolution all-pixel files for accounting for the uncertainty of undetected fires. The Successful Tenderer shall adapt the gridding routines of the GFAS software to remove the critical dependency on the coarse geolocation information which might not be sustained in the future for all the active fire products. This is mostly relevant for current missions that will be sustained in the coming years, such as VIIRS.

3.5.2 Improvements to the methodology to derive the biomass burning emission rates from FRP observations

Currently, emission rates of gases and aerosols are estimated in two steps: firstly, FRP is converted into dry matter combustion rate using conversion factors established between MODIS-based GFAS FRP and dry matter (DM) combustion rate for distinct vegetation types taken from the Global Fire Emissions Database v3 data set (GFED3); then, the dry matter combustion rate is converted into emission rates for the various species using emission factors derived from the scientific literature⁴. The main shortcomings of the current approach are the i) uncertainties in the GFED3-based conversion factors and land cover map and ii) uncertainties in the representativity of emission factors.

The Successful Tenderer shall provide a development plan that includes at least the following topics:

- Updated FRP to DM combustion rates based on the latest version of GFED (v5);
- Improved emission factors based on the latest literature. Emission factors vary dynamically with fuel load and environmental conditions, which in turn depend on meteorological conditions. The latest scientific developments therefore provide more accurate emission factors using different approaches for EO- and NWP-constrained fuel modelling. The options

⁴ Latest developments are based on <https://doi.org/10.5194/ACP-19-8523-2019> using six land cover classes.

for applying these developments in GFAS should be investigated and, preferably, dynamic emission factors should be used;

- Improved emission factors based on satellite observations of aerosols, carbon monoxide, NO₂, and potentially other species. These estimates could be based on offline inversion models, but should be verified with simulations of the IFS evaluated against the satellite observations, as there will be some level of model-dependency.

Factors that could improve the fire emission estimates shall be considered, such as deficiencies on land cover types and temporal variability. The Tenderer is also invited to add other innovative methodologies to derive emission estimates from the FRP observations as part of the development plan. All developments shall be evaluated for different regions and compared with other biomass burning emission datasets.

3.5.3 Revision of the Gaussian parametrization of the FRP diurnal cycle

The current version of GFAS with input from low Earth orbiting satellites (LEO) can only distinguish between daytime and night-time fire activity and therefore superimposes a diurnal cycle to provide hourly emission estimates. This is a single parametrization of the diurnal cycle applied at global scale. The Successful Tenderer shall improve this description of the diurnal cycle and especially develop an implementation that is consistent with the implementation of geostationary satellite observations that can better constrain the diurnal cycle than the current polar orbiting satellites. This shall include the challenge of not having geostationary satellite data for all areas of the world at the same time (for example, because of subsequent implementation of the geostationary satellite data).

3.5.4 Fire forecasting

The FRP forecasts during the assimilation in GFAS assume strict persistence in version 1.2 and separate daytime and night-time persistence in version 1.4. To represent the diurnal cycle and longer-term evolution of fires, which is required for merging GEO and LEO observations, an FRP model with hourly resolution is required. This would also enable a short-term forecast of the fire emissions to be used in the global and regional models. An example of such a model can be found at ECMWF's Code for Earth 2023 (<https://codeforearth.ecmwf.int/previous-editions>). Since the modelling of the evolution of fires is an active research area, the applicability of new developments and products shall be evaluated in order to develop an accurate FRP model that can be used in GFAS. Synergies with relevant developments at ECMWF for the Copernicus Emergency Monitoring Service, such as the development of a Probability of Fire (PoF) model in ECMWF's IFS⁵, shall be considered, where meaningful.

The Successful Tenderer shall fine-tune the development plan with ECMWF at the start of the contract to ensure the developments are in line with previous developments and potential operational constraints.

Tenderers shall complete the relevant table in Volume IIIA as part of their bid, which shall at least 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.

⁵ <https://www.ecmwf.int/en/about/media-centre/science-blog/2024/machine-learning-ignites-wildfire-forecasting>; <https://bg.copernicus.org/articles/21/279/2024/>; <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023GL107929?af=R>

WP4 Deliverables			
<i>#</i>	<i>Type</i>	<i>Title</i>	<i>Due</i>
D4.Y.Z-yyyy	Report	Development plan	Annually
D4.Y.Z-yyyy	Report an code	Progress and results of annual developments	Annually

WP4 Milestones			
<i>#</i>	<i>Title</i>	<i>Means of verification</i>	<i>Due</i>
M4.Y.Z			

3.6 Work package 5 (WP5) – 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 contribute to the relevant documentation. 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 GFAS at [https://confluence.ecmwf.int/display/CKB/CAMS+global+biomass+burning+emissions+based+on+fire+radiative+power+\(GFAS\):+data+documentation](https://confluence.ecmwf.int/display/CKB/CAMS+global+biomass+burning+emissions+based+on+fire+radiative+power+(GFAS):+data+documentation)), and, if more detail is required, in reports that will be available to users through the CAMS web site. The successful Tenderer shall therefore support the updates of the relevant documentation based on the latest developments. 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.

WP5 Deliverables			
#	Type	Title	Due
D5.Y.Z-yyyy	Other	Overview of contribution to CAMS Knowledge Base to document products and services requiring expertise specific to the GFAS developments	Annually
D5.Y.Z-yyyy	Report	Contribution to documentation of products and services based on the GFAS developments	Annually
...			

WP5 Milestones			
#	Title	Means of verification	Due
M5.Y.Z
...			

3.7 Work package 0 – Management and coordination

The following management and coordination activities are part of WPO and shall be briefly described, and completed if necessary, in the bid:

- Management, planning and coordination of the different Work Packages activities and corresponding resources, including the appropriate tools used to monitor them.
- Contractual obligations as described in the Volume V Framework Agreement Clause 2.3 “Reporting and Planning” and its Annex 5 “Report content”.
- Meetings organisation and/or attendance (classified as tasks and listed in a separate table as part of the proposal):
 - ECMWF and the Successful Tenderer will organise a Kick-Off Meeting during the first month of implementation of the contract..
 - ECMWF will host monthly teleconference meetings to discuss CAMS service provision, service evolution and other topics (Service Level Board). The Prime Investigator appointed by the Successful Tenderer will represent the Successful Tenderer in such meetings.
 - ECMWF and the Successful Tenderer will organise Progress Review Meetings, linked to Payment Milestones, every six months unless otherwise agreed.
 - ECMWF will organise annual CAMS General Assemblies. The Successful Tenderer is required to attend these meetings with team members covering the various topics that are part of this ITT.
 - Successful Tenderer’s internal meetings.
 - Tenderers can propose additional project internal meetings (annual face-to-face meeting and monthly teleconferences) as part of their response.
- Quality assurance and control: the final quality check of the deliverables should be made by the prime contractor (contents, use of ECMWF’s templates for deliverables and reports, format, deliverables/milestones numbering and naming, typing errors, etc.).

- Implementation of checks, controls and risk management tools for both the prime contractor and its sub-contractors.
- Communication management (ECMWF, stakeholders, internal communication).
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 “Personal Data Protection” of the Volume V Framework Agreement.
- Sub-contractor management, including dispute 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 sub-contractors, if any, describing their contribution and key personnel shall be provided, as well as back-up names for all key positions in the contract. The Tenderers shall describe how the Volume V Framework Agreement, in particular its Clause 2.9 “Sub-contracting”, has been flowed down to all their sub-contractors.

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. All milestones and deliverables shall be numbered as indicated (see also guidelines in Section 4.2). All document deliverables shall be periodically updated and versioned as described in the tables below, and the corresponding due date defined in Volume IIIA for each iteration.

WPO Deliverables				
#	Responsible	Nature	Title	Due
D0.Y.Z-yyyyQx	Tenderer	Report	Quarterly Implementation Report (QIR) yyyyQx <i>yyyyQx being the previous quarter (e.g. 2024Q3 due on 15/10/2024)</i>	Quarterly on 15/04, 15/07 and 15/10
D0.Y.Z-yyyy-Part1	Tenderer	Report / Other	Annual Implementation Report (AIR) for year yyyy - Part 1 including: <ul style="list-style-type: none"> • the Quarterly Implementation Report (QIR) yyyyQ4, and • the preliminary financial information <i>yyyy being the Year n-1</i>	Annually on 15/01
D0.Y.Z-yyyy-Part2	Tenderer	Report	Annual Implementation Report (AIR) for year yyyy - Part 2 <i>yyyy being the Year n-1</i>	Annually on 28/02
D0.Y.Z	Tenderer	Report	Final Implementation Report	Not later than 60 days after the end of contract and once all other activities duly performed
D0.Y.Z-yyyy	Tenderer	Report	Annual Implementation Plan for year yyyy <i>yyyy being the Year n+1</i>	Annually on 30/09
D0.Y.Z-yyyy	Tenderer	Other	Copy of prime contractor's general financial statements and audit report for year YYYY <i>YYYY being the Year n-1</i>	Annually, not later than on 15/12 ⁽¹⁾
D0.Y.Z	Tenderer	Other	Updated KPIs (list, targets, etc.) after review with ECMWF	1 year after start of contract

WPO Milestones				
<i>#</i>	<i>Responsible</i>	<i>Title</i>	<i>Means of verification</i>	<i>Due</i>
M0.Y.Z-KOM	Tenderer	Kick-Off Meeting	Minutes of Meeting	30 days after start of contract
M0.Y.Z-PRMxx	Tenderer	Progress Review Meeting #xx <i>xx being the iteration number of the PRM</i>	Minutes of Meeting	~ Every 6 months
M0Y.Z-SLB ⁽²⁾	Tenderer	CAMS Service Level Board meeting	Attendance	Every month
M0.y.z-CAMSGA-YYYY	Tenderer	CAMS General Assembly YYYY	Attendance	Annually, not later than on 15/12 ⁽¹⁾

⁽¹⁾ These due dates are indicated to frame the corresponding deliverables and milestones schedule only, consequently the following shall be considered by the Tenderer:

- the general financial statements shall be sent by the contractor as soon as available,
- the schedule of the Progress Review Meetings shall be aligned with the different Payment Milestones during the contract negotiation,
- depending on the year, the CAMS General Assembly may take place at a different period of the year.

⁽²⁾ All iterations for this recurring SLB meeting do not need to be listed by the Tenderer, i.e., only one row shall be added in Volume IIIA “Pricing and deliverables” Excel sheet “Deliverables List”.

4 General Requirements

4.1 Implementation schedule

The Framework Agreement will run from 1 February 2025 – 30 June 2028 . The Tenderer shall provide a detailed implementation plan of proposed activities for the full period.

4.2 Deliverables and milestones

The Tenderers shall provide the list of deliverables and milestones (cf. ITT Volume IIIA “Pricing and deliverables”, Excel spreadsheet “Deliverables List”) for each Work Package. All deliverables and milestones must be consistent with the activities and objectives described in Section 3 of this ITT Volume II:

- A deliverable is a substantial, tangible or intangible good or service produced as a result of a project (see also the deliverable definition in this ITT Volume V Clause 1.2 and Clause 3.2). In other words, a deliverable is an outcome produced in response to the specific objectives of the contract and is subject to acceptance by both ECMWF’s Technical Officer (TO) and Contract Management Officer (CMO).
- Milestones should be designed as markers of demonstrable progress in service development and/or quality of service delivery (see also the milestone definition in this ITT Volume V Clause 1.2). They should not duplicate deliverables and shall not attract the budget under Volume IIIA “Pricing and deliverables”, Excel sheet “Deliverables List”.

The following shall apply to the deliverables and milestones:

- The deliverables and milestones should be consistent with the technical requirements specified in Section 0.
- When defining deliverables, please assign clear due dates to each of them.
- All contract reports and deliverables 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. See also Section 4.7 in what regards the data provision.

Volume IIIA “Pricing and deliverables” (cf. Excel sheet “Deliverables List”) of this ITT shall be used by the Tenderer to describe the complete list of deliverables, milestones and schedules for each work package (due dates). Please note that:

- All deliverables and milestones shall be numbered as per the following format DX.Y.Z (for deliverables) and MX.Y.Z (for milestones), where X is the WP number, Y is the task number and Z is the deliverable or 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). 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 the milestones. Continuous deliverables at higher frequency can be labelled in the same way as quarterly deliverables.

- Each deliverable shall have an associated resource allocation and price (cf. column I “Nb of PM allocated” and column J “Estimated price”), while the only resource type to be considered is “payroll” (the total of these allocated resources and prices shall therefore amount to the total price associated with payroll in Volume IIIA spreadsheet “Costs and Prices”). Milestones should not have such associated resource allocation, unless otherwise agreed.
- The Tenderers shall provide a due date for each proposed deliverable and milestone (in accordance with those indicated in Section 3):
 - o The Tenderers shall ensure that the proposed due dates of deliverables and milestones are realistic and achievable. **Any dependencies on input data (whose origin must be specified) shall be detailed and also accounted for in the risk table.**
 - o It is advised to schedule the submission/completion of the last deliverables and/or milestones associated to a Payment Milestone not later than 15 days before the expected date of completion of the said Payment Milestone (i.e. when all deliverables have been submitted by the contractor and all milestones have been completed by the concerned parties).

4.3 Acquisition of necessary data and observations

The Successful Tenderer shall acquire the relevant observational data sets needed for the optimisation and evaluation of the developments of this ITT. The Successful Tenderer shall also acquire the relevant observational data sets needed for the provision of FRP estimates from the GOES and Himawari satellites.

4.4 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.

4.5 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.

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI_1	Delivery of data within agreed timeliness	90%	continuous	
KPI_2	Level of user support service on Service Desk tickets	80% of the assigned specialised user queries being resolved within 15 days after being informed by the CAMS Service Desk.	Annual	
KPI_3	% of deliverables delivered on time or with short delay	100%	Every payment milestone	

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.

<i>Section</i>	<i>Page Limit</i>
<i>Executive Summary</i>	2
<i>Track Record</i>	2 (for general) and 2 (per entity)
<i>Quality of resources to be Deployed</i>	2 (excluding Table 1 in Volume IIIB and CVs with a maximum length of 2 pages each)
<i>Technical Solution Proposed</i>	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)
<i>Management and Implementation</i>	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)
<i>Pricing Table</i>	No limitation

Table 1: Page limits

5.2 Specific additional instructions for the tenderer's response

The following is a guide to the minimum content expected to be included in each section, 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 estimating fire emissions using satellite FRP observations.

An exhaustive and detailed description of the proposed technical solution for all work packages described above 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 and delivering the FRP retrievals for the GOES and Himawari satellites. The Tenderer shall describe the various required and proposed improvements of the CAMS global fire emissions system. Finally, the Tenderer shall describe how they will deliver the required service evolution aspects.