ECMWF Copernicus Procurement

Invitation to Tender

Copernicus Atmosphere Monitoring Service

Volume II

Global and European emission inventories

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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 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.

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) 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 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 supporting most of the CAMS service elements described 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 (re)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.

2 Contract Summary

This ITT, entitled "Global and European emission inventories", is to provide gridded distributions of anthropogenic (global and Europe) and natural emissions (global only) for reactive gases, aerosols and greenhouse gases in direct support of CAMS production chains, with target resolutions of 25 km (natural emissions), 10 km (global) and 5 km (Europe). The emissions shall include aerosol, reactive gases, and greenhouse gases. They must also be stratified into headline activity sectors, where relevant. The emission data sets shall cover the requirements of both the CAMS reanalyses products and the CAMS near-real-time products, as further specified in the sections below. Besides the yearly totals, the successful Tenderer will deliver monthly, weekly and diurnal temporal profiles, so that variations can be accounted for in the CAMS systems. The successful Tenderer shall also provide activity-based emission estimates of CO2 and related species as close to real-time as possible. Furthermore, the provision of an up-to-date global point source emission database shall be part of the activities. Improving the representation of the temporal variations of emissions and investigating modelling methodologies to calculate certain emissions as a function of meteorological parameters (including forecasted ones) or of other proxies will be in scope of the developmental aspects of the work as are further development activities to improve the emission data sets.

3 Technical Specification

3.1 General Requirements

This ITT asks for the provision of natural, anthropogenic and biogenic emissions as input for the CAMS regional and global production systems, including the new emission monitoring services that are being implemented. Emissions form a key component of the CAMS production systems and underpin the time evolution of pollutants in the atmosphere. The aim of this ITT is to ensure a consistent and harmonized provision of all the emission data sets needed for the Global and

Regional Production Systems. The Successful Tenderer shall therefore closely interact with the Global Service Provider and Regional Service Provider and provide them with accurate and timely emissions on the relevant horizontal scales as defined below. The emission data sets will also be part of the CAMS services and therefore it is required that all the datasets can be made freely available on the Atmosphere Data Store to CAMS users as products in their own right. The Tenderer shall also take into account recent relevant developments within CAMS supporting Horizon 2020 and Horizon Europe projects, such as CoCO2[1], CORSO[2], and CAMEO[3], as documented in the respective Deliverable documents and datasets.

3.2 Work package 1 (WP1) – Anthropogenic emissions for the CAMS regional domain

As part of this work package the Successful Tenderer shall provide data sets of anthropogenic emissions to be used by the Regional Service Provider and delivered also as CAMS products. The anthropogenic emissions shall primarily consider the officially gridded reported emissions data to the Convention on Long Range Transboundary Air pollution (CLRTAP) with respect to the Gothenburg Protocol and consolidated in the EMEP programme for the UN-ECE domain[4], with a possibility to combine them with other estimates where needed to address gaps, inconsistencies or suspected errors, while maintaining consistency with national-level budgets. The Tenderer shall describe in the technical solution proposed the methodology which will be used.

In the case that the gridded emissions reported by the countries and processed by the EMEP centre[5] responsible for the compilation of gridded emission inventories are re-mapped by the Tenderer with their own proxies, the motivation, methodology and added-value of this re-mapping shall be documented. Similarly, gridded methodology and proxies used in areas where no data is reported shall be documented.

The minimum set of species shall consist of aerosol (at the minimum, segregated by country, activity sector and reporting year into EC[6], OC[7], SO_4[8], Na[9], Other Minerals for both the fine coarse fractions and total and also providing the share of biofuel in $PM_{2.5}$ and PM_{10} by country, activity sector and reporting year), ultrafine particles, NO_x[10] (with NO[11]/NO_2[12] ratio by country, activity sector and reporting year), NH_3[13] , SO_2[14], DMS[15], NMVOCs[16] (total and split into main individual species according

[1] https://coco2-project.eu/
[2] https://corso-project.eu/
[3] https://cameo-project.eu/
[4] Economic Commission for Europe of the United nations
[5] Centre on emission inventories and projections (CEIP) : https://www.ceip.at/
[6] Elemental Carbon
[7] Organic Carbon
[8] Sulfate
[9] Sodium
[10] Nitrogen oxides
[11] Nitrogen monoxide
[12] Nitrogen dioxide
[13] Ammonia
[14] Sulfur dioxide
[15] Dimethyl sulphide
[16] Non-methane volatile organic compounds

to a speciation justified by the bidder), CO[17], CH_4[18], CO_2[19], and N_2O[20]. The emissions shall be stratified into main source categories, as defined by the GNFR classification[21].

The regional emissions from road transport shall be further segmented into exhaust (gasoline vehicles), exhaust (diesel vehicles), exhaust (LPG/ natural gas vehicles), gasoline evaporation and tire/brakes/road wear.

The non-road transport emissions shall at least distinguish between emissions from shipping and from aircraft.

The fugitive emissions should include in particular emissions of reactive gases and methane from shale gas extraction as well as leaks and industry.

Emissions from soil (both agricultural lands and natural ecosystems) should be carefully documented for each country and activity sector to allow modelers to avoid duplication in their estimation of biogenic emissions. The emissions shall target a gridded horizontal resolution of 5 km, as well as point source information (including release height) whenever possible, consistent with IEPR and E-PRTR[22]. The geographical domain shall at least include the CAMS European domain (25°W-45°E, 30°N-72°N) and emissions shall be estimated for the entire corresponding land and maritime domains (e.g., including over the regions of North Africa and the Middle East which are covered).

Gridded emissions shall be provided at the surface for all sources except for emissions by aircraft, for which information on the vertical distribution is needed.

Each year, the successful Tenderer shall deliver a new one-year data set, starting from 2023, adding the latest year to the existing CAMS regional emission data set as soon as new officially reported emissions data become available. In the case that significant changes to the methodology to compile the data set relative to the current CAMS regional emissions are proposed, a new reprocessed data set shall be made available covering at least the period 2010 until the latest year available. Temporal variations shall be accounted for, so that variations at hourly, daily and monthly timescales can be modelled, preferably providing country (or gridded), activity sector (differentiating crop and livestock for the agriculture sector), and year-dependent temporalization factors. The successful Tenderer shall provide guidance on how to best apply the latest emissions available for use in the Regional Production for the current year, by recommending scaling factors and/or proxy- based approaches.

The successful Tenderer shall provide alternative emission datasets based on expert knowledge for the activity sectors and harmonized methodologies between countries where well documented shortcomings exist in the official emissions reported according to the EMEP/EEA methodology. This is specifically relevant for the condensable PM emissions related to wood burning in the residential sector, from industry, and agricultural waste burning. All data sets shall undergo sufficient Evaluation and Quality Control, which shall be described in short reports. This shall include the provision of total emission budgets for all species, which can be used to verify the proper uptake of the emissions in the Regional Production Systems.

[17] Carbon monoxide
[18] Methane
[19] Carbon dioxide
[20] Nitrous oxide
[21] https://www.eea.europa.eu/en/analysis/publications/emep-eea-guidebook-2019
[22] https://environment.ec.europa.eu/topics/industrial-emissions-and-safety/industrial-emissions-portal-regulation-iepr_en

The successful Tenderer shall also deliver a reprocessed data set, based on the latest methodology and input data sets, covering at least the period 2010 until the latest year available by the end of the contract.

The emission data sets shall include information about their uncertainties and the Tenderer shall outline in their proposal what level of uncertainty information is achievable.

In addition, the successful Tenderer shall support the implementation and testing of the emission data sets in the operational CAMS Regional Production Systems. Emissions are an integral part of the upgrade process of the CAMS Regional Production Systems. These production systems will normally use the latest emissions datasets delivered as part of the work in this ITT in their annual upgrades. However, the use of new emission data sets has to be extensively tested to avoid unexpected negative impacts on the forecast results. The successful Tenderer shall allocate resources for actively communicating with CAMS Regional Service Providers to establish specific requirements in relation to aerosol, reactive gases and greenhouse gases, and estimating uncertainties in the emissions. The resources should also cover taking part in discussions with the Regional Service Providers about the results from trial runs, for identifying issues with the provided emissions as they are used in specific model configurations and for adjusting datasets as needed in case issues with emissions are identified. The successful Tenderer shall also provide timely expert input in the case of significant events, such as in the case of a major volcanic eruption or unforeseen anthropogenic emissions changes.

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*
D1.Y.Z-yyyy	Dataset	European emissions dataset for latest year available	Annually
D1.Y.Z	Dataset	Reprocessed European emissions dataset for at least 2010 until latest year available.	M32

WP1 Milestones			
#	*Title*	*Means of verification*	*Due*
M1.Y.Z	Discuss emissions requirements for CAMS Regional Production System	Minutes of meeting	Quarterly
M1.Y.Z	…	…	

3.3 Work package 2 (WP2) – Anthropogenic emissions for the global domain

As part of this work package the Successful Tenderer shall provide data sets of anthropogenic emissions to be used by the Global Service Provider and delivered also as a CAMS product. The anthropogenic emissions shall be derived from official reported emission data by source category to the extent possible and combined with other estimates where needed. Synergies with international

initiatives on global emissions would be an advantage. The Tenderer shall describe in the technical solution proposed the methodologies which will be used for deriving these emissions.

The minimum set of species shall consist of aerosol (segregated at least into Organic Carbon and Black Carbon), NO_x, NH_3, SO_2, NMVOCs (total and split into main individual species), CO, H_2[23], HCN[24] and CH_3CN[25]. The Tenderer shall also consider potential anthropogenic emissions of halogenic species that impact tropospheric chemistry. To support the increasing CAMS portfolio for greenhouse gas emissions and atmospheric concentrations, the following species shall also be included: CO_2, CH_4, N_2O[26].

Specific datasets shall be provided to support the global and European modelling of radiocarbon ($^{14}CO_2$), building on the work performed in the CORSO project[27]. The Tenderer shall propose activities to improve the relevant natural fluxes and emissions that are currently available from the CORSO dataset. The successful Tenderer shall also interact with the future provider of the CAMS2_26 contract, ICOS[28], which will support the provision of radiocarbon emissions from all major European nuclear facilities.

Emissions from additional species may be required in the CAMS Global Production System in the future and the successful Tenderer shall discuss these requirements with the Global Service Provider to assess if they can be included in subsequent releases of the emission data sets. The emissions for each species shall be stratified into main source categories, following as much as possible the definitions from the Intergovernmental Panel on Climate Change (IPCC) and the Convention on Long-Range Transboundary Air Pollution (LRTAP) as well as the GNFR classification used for the regional emissions. The sectors used for the current CAMS global emissions can be used as guideline and are documented in Table 3.2 of the CAMS documentation[29]. One specific requirement is the separation of emissions from agricultural waste burning and, for NO_2, agricultural soils to avoid double-counting, since these may also be estimated based on active fire observations in the CAMS Global Fire Assimilation (GFAS) emission products.

The emissions shall have a horizontal resolution of 10 km. The geographical domain shall cover the entire globe.

The non-road transport emissions shall at least include emissions from aircraft. The specifications for shipping emissions are covered in WP4. The fugitive emissions shall include, in particular, emissions of reactive gases and methane from shale gas extraction as well as leaks. Gridded emissions shall be provided at the surface for all sources except for emissions by aircraft, for which information on the vertical distribution is needed. Emissions from point sources are addressed in WP6.

The methodology for deriving the inventory of emissions shall be described in the technical solution and further elaborated within the first 3 months of the contract.

[23] Molecular hydrogen
[24] Hydrogen cyanide
[25] Acetonitrile
[26] Nitrous oxide
[27] See D3.4 on https://www.corso-project.eu/deliverables
[28] Integrated Carbon Observation System (ICOS) is one of the European Research Infrastructures selected as an ESFRI landmark.
[29] https://atmosphere.copernicus.eu/sites/default/files/publications/CAMS261_2021SC1_D6.1.2-2022_202306_Docu_v1_APPROVED_Ver1.pdf

The use of existing datasets (e.g., EDGAR, CEDS) as an input is encouraged, but they should be adapted for the specific requirements of this ITT. This could include the merging with other (regional) emission data sets as long as a comprehensive quality check is carried out and the consistency for the global domain is ensured as much as possible. The improvements to the original global datasets shall also be shared with the developers of these datasets.

If different sources are used for the same emissions process but different emitted species, some justification of the consistency between the different species' emissions must be provided. The reported data shall be analysed by sector in detail, and completed with alternative emission estimates, as needed, ensuring a complete emission inventory for all countries worldwide. The emission dataset shall be spatially distributed consistently across all countries. The successful Tenderer shall evaluate the consistency of the developed emissions against previous versions of CAMS emissions datasets, and national-level totals and other emissions datasets, where possible.

Each year, the successful Tenderer shall deliver a new 1-year data set, starting from 2027, adding the latest year to the existing CAMS global emission data sets[30] for testing by the CAMS global model developers and eventual implementation in the operational CAMS Global Production System. In the case that significant changes to the methodology to compile the data set relative to the current CAMS global emissions are proposed, a new reprocessed data set shall be made available covering the period 2000 until the latest year available. The Tenderer shall indicate in their proposal their expectations for such reprocessing taking into account that the number of new versions shall be limited and agreed with ECMWF to manage version control. As each new year will represent future emissions and no official data yet exists, the successful Tenderer shall describe their proposed methodology for providing the most accurate emission estimates for those years. This can be based on credible, scientifically accepted emission projections but does not have to be. If projections are used, they shall start as much as possible from the most recent reported national emission data. The changes relative to the previous year shall be documented to support the assessment needed before data can be used in the Global Production System. The temporal resolution shall be at least monthly means and further information about mean diurnal (hourly) and weekly cycles shall be provided, in such a way that it can be easily implemented in a global model.

The successful Tenderer shall also provide the emission data sets needed for the new CAMS global reanalysis. For this new CAMS global reanalysis (EAC5), the production of which is planned to start in 2025, the successful Tenderer shall provide emissions for the near-real-time production of the reanalysis, starting from 2025 and adding new years on an annual basis for the duration of the contract. The data shall be as consistent as possible with the reanalysis emission dataset for 2000-2024, which was produced in the previous CAMS2_61 contract and which can be made available to the Successful Tenderer. The Tenderer shall describe their proposed methodology for this data set. The temporal resolution shall be at least monthly means and further information about mean diurnal (hourly) and weekly cycles shall be provided, in such a way that it can be easily implemented in a global model.

The emission data sets shall include information about their uncertainties and the Tenderer shall outline in their proposal what level of uncertainty information is achievable.

All data sets shall undergo at least basic Evaluation and Quality Control to detect any clear issues before the dataset is delivered. This shall include checking the format of the delivered datasets, including the units, grids and total emissions. Special attention shall be paid to correct naming of

[30] https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-emission-inventories?tab=overview

files and variables, fully consistent with IFS and ADS requirements. The outcomes of this task shall be part of the handover of a new dataset to ECMWF.

In addition, the successful Tenderer shall support the implementation and testing of the emission data sets in the operational CAMS Global Production Systems. Emissions are an integral part of the upgrade process of the CAMS Global Production Systems. These production systems will normally use the latest emissions datasets delivered as part of the work in this ITT in their annual upgrades with the constraint that the impact of these new emissions should be neutral or positive. However, the use of new emission data sets has to be extensively tested to avoid unexpected negative impacts on the forecast results. The successful Tenderer shall allocate resources for actively communicating with CAMS Global Service Provider to establish specific requirements in relation to aerosol, reactive gases and greenhouse gases, and estimating uncertainties in the emissions. The resources should also cover taking part in discussions with the Global Service Provider about the results from trial runs, for identifying issues with the provided emissions as they are used in specific model configurations and for adjusting datasets as needed in case issues with emissions are identified. The successful Tenderer shall also provide timely expert input in the case of significant events, such as in the case of a major volcanic eruption or unforeseen anthropogenic emissions changes.

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-yyyy	Dataset	Global emissions dataset for latest year available	Annually
D2.Y.Z	Dataset	Global emissions for the CAMS reanalysis EAC5 for latest year available (2025 - 2028)	Annually
D2.Y.Z-yyyy	Dataset	Global emissions dataset for 2000 – latest year available based on improved methodology	TBC

WP2 Milestones			
#	*Title*	*Means of verification*	*Due*
M2.Y.Z	Meeting to discuss emissions requirements for CAMS global modelling aspects	Minutes of meeting	Quarterly

3.4 Work package 3 (WP3) - Natural and biogenic emissions for the global domain

As part of this work package the successful Tenderer shall provide a set of emissions from natural and biogenic sources to be used by the Global Service Provider as well as contribute to the further development and implementation of on-line simulation of natural and biogenic emissions in the Global Production System.

The natural sources to be covered comprise vegetation (biogenic), soil and non-frozen land surfaces, snow/ice, oceans, and volcanoes. Dust, sea salt and lightning emissions are out of the scope of this ITT as the sources of aerosol and nitrogen oxides, respectively, are already modelled in the CAMS Global Production System. Biomass burning emissions are also out of the scope of this ITT, as they are covered in a separate CAMS contract. Finally, CO_2 fluxes from vegetation and CH_4 emissions from wetlands are also covered separately and need not to be addressed here.

The successful Tenderer shall provide NMVOC emissions from vegetation, which are consistent with the meteorological conditions. ECMWF will provide gridded meteorological information as an input for this. NMVOCs shall be split into main individual species and the total of all NMVOCs shall be provided as well. In addition to inter-annual and monthly values, average hourly diurnal values shall be provided.

Natural halogenic emissions from oceans (e.g., CH_3BR, CH_3CL and CH_3I, and CH_2Br_2) and snow/ice should be provided as a data set and if possible as a parameterisation applicable for the on-line calculation in the Global Production System.

The successful Tenderer shall provide NO_x, NH_3, OCS (carbonyl sulphide), and Radon-222 emissions from soil and non-frozen land surfaces.

The successful Tenderer shall provide DMS (Dimethyl Sulphide) and halogen species from the oceans (e.g., CCl4, CH3Cl). The Tenderer shall also indicate the feasibility to include OCS and nitrogen species (N_2O and NH_3).

The successful Tenderer shall provide emissions from continually emitting/outgassing volcanoes. Datasets for SO_2, CO_2 as well as for main halogen species shall be included. The methodology used for calculating these volcanic emissions shall be based on in situ and satellite observations to provide a dataset that covers all outgassing volcanoes that are relevant for the Global Production System.

As a second main element of this work package, the successful Tenderer shall allocate resources to support the further development of online modelling of biogenic and natural emissions in the CAMS Global Production System in collaboration with the contractor for global aerosol and chemistry developments (CAMS2_35_bis). The Tenderer shall describe initial ideas on the topics listed below with a detailed development plan to be agreed between ECMWF and the successful Tenderer within the first 3 months of the Framework Agreement taking into account the final development reports delivered by the current CAMS contractor in charge of providing emissions. The following development topics shall be addressed:

- Provide support to implement the modelling of biogenic emissions using an on-line approach in the CAMS Global Production System for the total or only the diurnal and day-to-day variability imposed by meteorological variables on top of monthly prescribed emissions.
- Provide global data set of emissions potential for BVOC species as input to the on-line model in IFS and the ECMWF land surface model
- Provide support to implement the online modelling of natural emissions of NO_x, NH_3, DMS, and OCS in the Global Production System taking into account recommendations from the current CAMS contract on emissions (CAMS_61).
- Provide support for the on-line simulation of natural halogenic emissions from oceans and snow covered areas.

The emission data sets shall include information about their uncertainties and the Tenderer shall outline in their proposal what level of uncertainty information is achievable.

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			
#	*Type*	*Title*	*Due*
D3.Y.Z	Dataset	Global biogenic emissions dataset (2000-latest year possible)	M30
D3.Y.Z	Dataset	Global soil emissions dataset (2000- latest year possible)	M30
D3.Y.Z	Dataset	Global ocean emissions dataset (2000- latest year possible)	M30
D3.Y.Z	Dataset	Global volcanic outgassing emissions (2000- latest year possible)	M30
D3.Y.Z	Dataset	Global biogenic emissions dataset (climatology)	M6
D3.Y.Z	Dataset	Global soil emissions dataset (climatology)	M6
D3.Y.Z	Dataset	Global ocean emissions dataset (climatology)	M6
D3.Y.Z	Dataset	Global volcanic outgassing emissions (climatology)	M6
D3.Y.Z	Report	Annual plans for development support of online modelling of biogenic emissions	Annually
D3.Y.Z	Report	Annual report on development support activities of online modelling of biogenic emissions	Annually

WP3 Milestones			
#	*Title*	*Means of verification*	*Due*
M3.Y.Z	Meeting with ECMWF and the contractor for the CAMS2_35_bis contract on natural and biogenic flux modelling	Minutes of meeting	Twice per year

3.5 Work package 4 (WP4) – Shipping emissions

Resulting from different onboard combustion and energy transformation processes, most notably for propulsion and energy production, ships represent sources of different pollutants to the atmosphere. Sulphur Oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM), carbon dioxide (CO_2), and other pollutants are emitted to the atmosphere as a direct result. Collectively, ship generated emissions can be significant in areas subject to heavy marine traffic leading to concerns regarding air quality, both

at local level, in coastal areas, or on a more global level, regarding to CO_2 emissions leading to Greenhouse Gas emissions and contributing to global warming.

ECMWF, as Entrusted Entity for CAMS, is working closely with the European Maritime Safety Agency (EMSA), whose Sustainability Unit is responsible for providing technical, operational and scientific advice and assistance to the European Commission and the Member States in the development, implementation and enforcement of European and International legislation within the environmental domain. In particular, they support a coherent implementation of legal requirements and best practices through the organization of working groups on specialised subjects and the provision of technical reports, guidance and training. EMSA, together with the European Environment Agency (EEA), has developed the European Maritime Transport Environmental Report (EMTER), and as part of this effort EMSA requires annual and monthly products (maps and datasets) of ship emissions on a regular basis, to further develop and the resulting indicators on pressures from the maritime transport.

To fulfil the various user requirements the successful Tenderer shall provide 3 types of shipping emissions data sets that shall be as consistent as possible using the same or similar methodologies. The first two, global and European shipping emissions, shall be delivered as part of the delivery of the regional and global anthropogenic emission data sets and follow the same general requirements as described in sections 3.1 and 3.2.

In addition, the successful Tenderer shall provide data and georeferenced raster maps with annual, seasonal and monthly absolute total emission values and annual and seasonal change/delta values. These products shall include the following emitted species: NO_x, SO_x, CO_2, CO, CH_4, N_2O, PM, Black Carbon, NMVOCs, and Heavy Metals. The following geographical areas (regions) shall be covered: Global, Europe, North Sea, Northeast Atlantic, Baltic Sea, Black Sea, Mediterranean Sea, Arctic, North American ECA[31] and US Caribbean Sea ECA. The data and maps shall be stratified according to the categories defined in Table 1. Note that all these criteria shall be applied to all combinations of emitted species and geographical areas (regions), ship types, fuel types, emission abatement technology, flags and traffic type, as defined in Table 1.

Table 1 Stratification criteria for shipping emissions

Region	Ship Type[32]	Fuel Type[33]	Emission Abatement Technology	Flag[34]	Traffic Type[35]
Global	All Traffic	Marine gas oil (MGO)	Exhaust Gas Cleaning System (EGCS)	All	International maritime navigation
Europe	Container ships	Marine diesel oil (MDO)	Exhaust Gas Recirculation (EGR)	All EU+EFTA	International inland waterways
North East Atlantic	Chemical carrier	Marine fuel oil (MFO): Residual marine fuel (RM) High sulphur	Selective Catalytic Reduction (SCR)	Non-EU/EFTA	National navigation

[31] Emission Control Area
[32] Taxonomy for ship type classification to be reviewed and confirmed together with EMSA.
[33] Taxonomy for the fuel types to be reviewed and confirmed together with EMSA.
[34] Taxonomy for Flags based on Paris MoU flags to be reviewed and confirmed together by EMSA.
[35] Traffic types as defined by UNFCCC and MRV definitions and to be reviewed and confirmed together with EMSA.

		heavy fuel oil (HSHFO)			
North Sea	Oil Tankers	Very low sulphur fuel oil (VLSFO)		Individual (for EU+EFTA) – only on demand	Outgoing EEA voyages
Baltic Sea	Gas Carriers	Ultra-low sulphur fuel oil (ULSFO)			Incoming EEA voyages
Mediterranean Sea	Bulk carriers	Bio-diesels			Intra EEA voyages
Black Sea	General cargo	Liquefied petroleum gas (LPG)			At berth
Arctic	Ro-ro	Liquefied natural gas (LNG)			
North American ECA	Fishing vessels	Methyl Alcohols			
US Caribbean Sea ECA	Passenger Ships	Ammonia			
	HSC Passenger	Hydrogen			
	HSC Cargo	Synthetic fuels			
	Ro-Pax	All Other			
	All Other				

For each of the atmospheric species NO_x, SO_x, CO_2, CO, CH_4, N_2O, PM, Black Carbon, NMVOCs, and Heavy Metals, access shall be provided to the following graphical outputs (maps):

- Annual, seasonal and monthly maps of total ship emissions for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1), from 2020 until the latest possible year within the duration of the contract.
- Maps with difference of total annual and seasonal ship emissions between subsequent years from 2020 until the latest possible year within the duration of the contract (e.g., 2022 – 2021) for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1). Note that this requirement is based on specific needs from EMSA for their annual reports and not all possible combinations of figures will be needed each time. However, the successful Tenderer shall be able to provide the subset of figures.
- Maps with difference of total annual and seasonal ship emissions between 2020 and the latest possible year within the duration of the contract for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1). Note that this requirement is based on specific needs from EMSA for their annual reports and not all possible combinations of figures will be needed. However, the successful Tenderer shall be able to provide the subset of figures.

In addition, for each of the atmospheric species NO_x, SO_x, CO_2, CO, CH_4, N_2O, PM, Black Carbon, NMVOCs, and Heavy Metals, access shall be provided to the following data outputs:

- Total monthly accumulated amounts for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1) from 2020 until the latest possible year within the duration of the contract.

The impact of sea ice, wind, waves and sea currents[36] on vessel performance, and thereafter on the emission of the aforementioned atmospheric species, is considered an advantage.

The Tenderer shall provide an accurate estimate of the expected delivery schedule for the above products based on the timelines and availability of the required input data. However, if required to improve the timeliness of the relevant deliverables, EMSA can provide complementary vessel position data (Automatic Identification System - AIS) covering European seas to the successful Tenderer. The AIS data will, inter alia, consist of position, speed and ship identifier (IMO/MSSI/Callsign/etc.) data. In addition, EMSA can also complement necessary and relevant ship particulars data, including IMO/MMSI number; flag, ship type, keel date; engine type; fuel type; engine revolutions per minute (RPM); maximum continuous rate (installed engine power) (MCR), service speed (speed at 75% MCR), and installed emission abatement technology (i.e., EGCS, EGR and SCR).

All data sets shall undergo sufficient Evaluation and Quality Control, which shall be described in short reports. This shall include the provision of total emission budgets for all species, which can be used to verify the proper uptake of the emissions in the Regional Production Systems.

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.

WP4 Deliverables			
#	*Type*	*Title*	*Due*
D4.Y.Z-yyyy	Dataset	European shipping emissions dataset for latest year available[37]	Annually
D4.Y.Z-yyyy	Dataset	Global shipping emissions dataset for latest year available[38]	Annually
D4.Y.Z-yyyy	Dataset	Global shipping emissions for the CAMS reanalysis EAC5 for latest year available	Annually
D4.Y.Z-yyyy	Dataset	Total monthly accumulated amounts for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1) from 2020 until the latest possible year within the duration of the contract.	Annually in March

[36] For example, as made available through the Copernicus Marine Service.
[37] Can be delivered as part of the regional anthropogenic emissions data set
[38] Can be delivered as part of the global anthropogenic emissions data set

D4.Y.Z-yyyy	Graphics	Annual, seasonal and monthly maps of total ship emissions for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1), from 2020 until the latest possible year within the duration of the contract.	Annually in March
D4.Y.Z-yyyy	Graphics	Maps with difference of total annual and seasonal ship emissions between subsequent years from 2020 until the latest possible year within the duration of the contract (e.g., 2022 – 2021) for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1).	Annually in March
D4.Y.Z	Graphics	Maps with difference of total annual and seasonal ship emissions between 2020 and the latest possible year within the duration of the contract for each Region, Ship Type, Fuel Type, Emission Abatement Technology, Flag and Traffic Type (as defined in Table 1).	End of contract

WP4 Milestones			
#	*Title*	*Means of verification*	*Due*
M4.Y.Z			
…			

3.6 Work package 5 (WP5) – Provision and further development of activity-based emission estimates

CAMS collaborates with Carbon Monitor to provide regularly updated estimates of daily CO_2 emissions based on activity data for six sectors. Carbon Monitor monitors the variations of CO_2 emissions from fossil fuel combustion and cement production since 1 January 2019 at national level with near-global coverage. Daily CO_2 emissions are estimated from a diverse range of activity data, including hourly to daily electrical power generation data of 29 countries, monthly production data and production indices of industry processes of 62 countries/regions, and daily mobility data and mobility indices of road transportation of 416 cities worldwide. Individual flight location data and monthly data are utilised for aviation and maritime transportation sectors estimates. In addition, monthly fuel consumption data that are corrected for daily air temperature of 206 countries were used for estimating the emissions from commercial and residential buildings. Carbon Monitor data show the dynamic nature of CO_2 emissions through daily, weekly and seasonal variations as influenced by workdays and holidays. The data are available from the CAMS website[39].

For this Work Package the Tenderer shall provide a detailed plan for the continuation of the provision of activity-based CO_2 emissions similar to what is currently available from CAMS. This shall

[39] https://atmosphere.copernicus.eu/ghg-services/carbon-monitor-europe

include the provision as close to real-time as possible of daily CO_2 emissions from activity data at national scale for as many countries around the world as is feasible. The countries shall include the EU as a whole and each EU27 country as well as the UK, Norway and Switzerland using national scale near-real-time activity data. Daily 10-km CO_2 emissions maps, based on the GRACED[40] or similar methodology for the period 2019 onwards shall also be provided. These gridded data shall be delivered at least every 6 months with a maximum latency of 6 months after the day of emission. Support for the visualization of the data on the CAMS website shall also be provided. This may include sharing existing software for the web visualization.

Periodical evaluation of the activity-based emissions is required to assess biases and uncertainties. There is no other daily near-real-time emission dataset, but some countries have started to publish quarterly bulletins of emissions from preliminary data, with some sectorial details. The IEA produces 6-monthly updates of global fuel use, with some details for groups of countries. These data have a latency of one to six months compared to Carbon Monitor and shall be collected for producing systematic and regularly updated comparison statistics of past emissions changes for monthly or quarterly averages. In addition, the daily gridded maps shall be compared against the CAMS global and European emissions data from WP1 and WP2 until the latest year available.

The emission data sets shall include information about their uncertainties and the Tenderer shall outline in their proposal what level of uncertainty information is achievable.

The Tenderer shall also provide a detailed plan for further evolution of the service. This shall not only focus on improving the CO_2 emission estimates, but also assess the potential of adding other species (e.g., NO_2 and CO) to the service. The plan shall include clear deliverables throughout the duration of the contract resulting from this ITT.

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.

WP5 Deliverables			
#	*Type*	*Title*	*Due*
D5.Y.Z-yyyyQx	Dataset	Daily fossil CO_2 emissions	At least every two months
D5.Y.Z-yyyyQx	Dataset	Daily 10-km global fossil CO_2 emissions maps	At least every six months
D5.Y.Z-yyyy	Report	Report with detailed comparison of activity-based national emissions against available data sets from other sources, including specific countries, where available	Annually
D5.Y.Z-yyyy	Report	Report with detailed evaluation of activity-based gridded emission maps against CAMS global and European emissions data sets	Annually

[40] Dou et al. (2021)

WP5 Milestones			
#	*Title*	*Means of verification*	*Due*
…			

3.7 Work package 6 (WP6) – Provision of emission point source data bases

During the Horizon 2020 project CoCO2, a first version of a global point source database was created. This dataset contains a global emission catalogue of CO_2 and co-emitted species (NO_x, SO_2, CO, CH_4) from thermal power plants for the year 2018. The dataset contains annual emission information for individual thermal power plants at their exact geographical location. Each facility is linked to a specific temporal (i.e., monthly, day-of-the-week and hourly) and vertical distribution profile to derive spatial- and temporal-resolved emissions for modelling efforts. The dataset is available from the CAMS website.[41]

During the Horizon Europe funded CORSO project, which runs till December 2025, an updated version has been created, providing emissions of CO_2 and co-emitted species (NO_x, CO, SO_2, CH_4) for powerplants by fuel type (coal, natural gas, oil, biomass and waste), cement plants and iron and steel plants at their exact geographical location for the year 2021, as well as associated temporal (i.e., monthly, weekly, hourly) and vertical distribution profiles to support modelling efforts. While this dataset is still being finalised, a document[42] is already available that presents the methodologies and sources of information considered to construct the catalogue of point sources, their emissions and associated profiles, as well as an overview of the results, including intercomparisons against independent existing bottom-up and top-down emission inventories.

The successful Tenderer shall provide an update of the point source database for the most recent year possible given the expected date of delivery using the same or similar methodologies and resulting in at least the same outputs as the database from the CORSO project, including the associated temporal profiles. The Tenderer shall consider additional species, such as PM10 and PM2.5. The successful Tenderer shall also evaluate the results against independent bottom-up global, regional, national and plant-level emission inventories, as well as estimates derived from satellite observations.

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.

WP6 Deliverables			
#	*Type*	*Title*	*Due*

[41] https://atmosphere.copernicus.eu/node/1065
[42] Deliverable D1.2 at https://www.corso-project.eu/deliverables

D6.Y.Z	Dataset	Improved global point source emission dataset for 2024	2027
D6.Y.Z	Code and documentation	Documentation and evaluation of point source emission dataset for 2024	2027

WP6 Milestones			
#	*Title*	*Means of verification*	*Due*
M6.Y.Z			
…			

3.8 Work package 7 (WP7) – Service evolution

As part of this Work Package, the Tenderer shall include in the Tender their proposal for future service evolution. It is envisaged that this will be in the form of investigations and subsequent developments either to improve the current service or to enable potential new and beneficial directions into which to take the service. However, it is left to the discretion of the Tenderer to outline the proposed evolution taking into account the budget and length of the contract. However, the following topics shall be included:

- Further improvement of a globally consistent dataset based on the best available emission data.
- Further improvement of uncertainty estimation of emissions, emission factors and ratios for the species that are foreseen to be included in CAMS observation-based emission monitoring (CO_2, CH_4, NO_x, CO, and HCHO). The proposed work shall take into account results from the CORSO and CAMEO projects. The main purpose of the uncertainty data is the application within the emission inversion framework.

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.

WP7 Deliverables			
#	*Type*	*Title*	*Due*
D7.y.z	Report Dataset	…	
…			

WP7 Milestones

#	Title	Means of verification	Due
M7.y.z			

3.9 Work package 8 (WP8) – 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 include in their proposal 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.

The Successful Tenderer shall contribute to the relevant documentation. Documentation of CAMS 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. The Successful Tenderer shall therefore support the updates of the Knowledge Base based on the latest developments.

The Successful Tenderer shall accommodate for eventual needs in providing technical and scientific expertise in support of CAMS communication and training activities. The Tenderer 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 Massive Open Online Courses (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 User Requirements Database (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;

If applicable, a small budget may be proposed to cover such resources. Details on the expected activities and the budget shall be refined during the negotiation/contract preparation phase.

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.

WP8 Deliverables			
#	*Type*	*Title*	*Due*
D8.Y.Z-yyyy	Other	Contribution to CAMS Knowledge Base to ensure up-to-date information about products and services covered under this contract	Annually
D8.Y.Z	Report	Summary of support to CAMS user support, communication and training activities.	Due 1 month before contract end date
…			

WP8 Milestones			
#	*Title*	*Means of verification*	*Due*
M8.Y.Z	…	…	…
…			

3.10 Work package 0 (WP0) – Management and coordination

The following management and coordination activities are part of WP0 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. Additional interim/ad-hoc progress meetings might be required. All meetings shall be classified as “Milestones” under Volume IIIA “Pricing and deliverables” Excel sheet, tab “Deliverables List”.
    - ECMWF will host monthly teleconference meetings to discuss CAMS service provision, service evolution and other topics (Service Level Board). The Prime Investigator and/or Service Manager 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 prior the submission to ECMWF 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.
- 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.

WP0 Deliverables				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.Y.Z-yyyyQx	Tenderer	Report	Quarterly Implementation Report (QIR) yyyyQx *yyyyQx being the previous quarter (e.g. 2024Q3 due on 15/10/2024)*	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: • the Quarterly Implementation Report (QIR) yyyyQ4, and • the preliminary financial information *yyyy being the Year n-1*	Annually on 15/01
D0.Y.Z-yyyy-Part2	Tenderer	Report	Annual Implementation Report (AIR) for year yyyy - Part 2 *yyyy being the Year n-1*	Annually on 28/02
D0.Y.Z	Tenderer	Report	Final Report	By the end of contract
D0.Y.Z-yyyy	Tenderer	Report	Annual Implementation Plan for year yyyy *yyyy being the Year n+1*	Annually on 30/09
D0.Y.Z-yyyy	Tenderer	Other	Copy of prime contractor's general financial statements and audit report for year YYYY	Annually, not later than on 15/12[(1)]

			YYYY being the Year n-1	
D0.Y.Z	Tenderer	Other	Updated KPIs (list, targets, etc.) after review with ECMWF	1 year after start of contract

WP0 Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.Y.Z-KOM	Tenderer	Kick-Off Meeting	Minutes of Meeting	30 days after start of contract
M0.Y.Z-PMxqqYY	Tenderer	Progress Review Meeting #PMx being the Payment milestone number, #qq - the quarter and #YY - a year during which the Payment Milestone is due *xx being the iteration number of the PRM*	Minutes of Meeting	~ as a minimum linked to the Payment Milestone.
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]
M0.Y.Z-Interim-QQYY	Tenderer	Interim progress review meeting if payment period is 6 months or longer	Minutes of Meeting	Regular intervals

[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 November 2025 to 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 **the precise** dates (DD/MM/YYYY) 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):
    - 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**.
    - 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 emission inventory and observational or ancillary data sets and make them available for use in all CAMS activities related to the provision of emission estimates for the regional and global production systems and for distribution to users.

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 in line with the Terms and Conditions of the Framework Agreement

It is expected that data sets (including databases) generated or acquired by the successful Tenderer will be delivered 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 uploading their data and products to a designated server. 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 are data uploaded to the ADS in WMO GRIB edition 1 and 2, NetCDF files conforming to CF-1.6, or greater.

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

Particular attention shall be paid to the file naming convention to ensure consistency between the various ADS datasets. The specific details shall be agreed with the ADS team at ECMWF during the kick-off meeting of the contract.

4.5 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.

4.6 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_1				
KPI_2				
KPI_3				
KPI_4				
KPI_5				
KPI_6				

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 2: *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, the current state of forecasting of global atmospheric composition and regional air quality, and the current state of building comprehensive and consistent data sets of emissions.

An exhaustive and detailed description of the proposed technical solution for all work packages described above shall be given. The Tenderer shall indicate which data sets it intends to use and how it will acquire the relevant data. The Tenderer shall describe the proposed method for producing the various emissions data sets requested as part of this ITT. Finally, the Tenderer shall describe how they anticipate to address the needs for service evolution.