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

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

This Invitation to Tender (ITT) is mainly targeting the CAMS service elements described under items (i) in support for (a), (c) and (d).

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 50 km (natural emissions), 10 km (global) and 5 to 10 km (Europe). The emissions will 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. 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. 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 to CAMS users as products in their own right.

3.2 Work package 6110 – 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 reported emissions data to EMEP, 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 spatial emission reported by the countries to EMEP are re-mapped by the Tenderer with their own proxies, the motivation, methodology and added-value of this re-mapping 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[1], OC[2], SO_4[3], Na[4], Other Minerals for both the fine coarse fractions and total and also providing the share of biofuel in PM2.5 and PM10 by country, activity sector and reporting year), NO_x[5] (with NO[6]/NO_2[7] ratio by country, activity sector and reporting year), NH_3[8] (from both crops and livestock), SO_2[9], DMS[10], NMVOCs[11] (total and split into main individual species), CO[12], CH_4[13] and CO_2[14]. The emissions shall be stratified into main source categories, as defined by the GNFR classification (https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-a-general-guidance-chapters/7-spatial-mapping-of-emissions).

For the purpose of running emissions reduction scenarios, 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.

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 have a gridded horizontal resolution of between 5 and 10 km,

[1] Elemental Carbon
[2] Organic Carbon
[3] Sulfate
[4] Sodium
[5] Nitrogen oxides
[6] Nitrogen monoxide
[7] Nitrogen dioxide
[8] Ammonia
[9] Sulfur dioxide
[10] Dimethyl sulphide
[11] Non-methane volatile organic compounds
[12] Carbon monoxide
[13] Methane
[14] Carbon dioxide

as well as point source information (including release height) whenever possible. 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 2019, adding the latest year to the existing CAMS regional emission data set (https://atmosphere.copernicus.eu/catalogue#/product/urn:x-wmo:md:int.ecmwf::copernicus:cams:prod:an:co_nh3_nmvocs_nox_pm10_pm2.5_so2_warning_multiple_species:pid269), 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 emission reported to EMEP/EEA. This is specifically relevant for the emission related to wood burning in the residential sector, condensable PM emissions 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.

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.

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.

WP6110 Deliverables			
#	*Type*	*Title*	*Due*
D1.Y.Z[15]	Dataset	European emissions dataset for latest year available	Annually

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

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

WP6110 Milestones			
#	*Title*	*Means of verification*	*Due*
M1.Y.Z	Discuss emissions requirements for CAMS Regional Production System	Minutes of meeting	M3
M1.Y.Z			

3.3 Work package 6120 – 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, CO, CH_4, N_2O[16], CO_2, H_2[17], HCN[18] and CH_3CN[19]. 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 and the Convention on Long-Range Transboundary Air Pollution 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 (https://atmosphere.copernicus.eu/sites/default/files/2019-06/cams_emissions_general_document_apr2019_v7.pdf). 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 fires 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. Shipping emissions are covered in WP6140. 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. Point sources shall be spatially distributed using the specific location of the point source. An option is to provide point source emissions (with release heights) as separate files,

format shall be applied for Milestones. Continuous deliverables at higher frequency can be labelled in the same way as quarterly deliverables.

[16] Nitrous oxide

[17] Molecular hydrogen

[18] Hydrogen cyanide

[19] Acetonitrile

as far as possible. Information or advice on how to specify effective emission heights for the gridded data sets suitable for the use in the CAMS Global Production System shall be provided.

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 contact. It is acceptable to use existing datasets as an input and adapt them for the specific purpose of CAMS. 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 2023, adding the latest year to the existing CAMS global emission data sets (https://ads.atmosphere.copernicus.eu/cdsapp#!/dataset/cams-global-emission-inventories?tab=overview) 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. 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, although they should be consistent with the emissions inventory used in CAMS global operations. 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 2023, the successful Tenderer shall provide emissions for the full duration of 2000 until the most recent year, adding new years on an annual basis for the duration of the contract. 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. Special focus shall be paid to the quality and testing of the proposed data set for the full temporal extent (2000 – current).

All data sets shall undergo at least basic Evaluation and Quality Control to detect any clear issues before the dataset is delivered. The outcomes of the this task shall be part of the handover of a new dataset to ECMWF. The successful Tenderer shall also develop and provide a software tool, ideally in Python, to check the format of the delivered datasets, including the units, grids and totals, to ensure consistent quality control between the developers and ECMWF.

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.

WP6120 Deliverables			
#	*Type*	*Title*	*Due*
D2.Y.Z-yyyy	Dataset	Global emissions dataset for latest year available	Annually
D2.Y.Z	Code and documentation	Software for checking/quality control of emissions datasets	M9
D2.Y.Z	Dataset	Global emissions for the CAMS reanalysis EAC5 (2000-2021)	M12
D2.Y.Z	Report	Comparison of global emission dataset for the CAMS reanalysis EAC5 against previous and alternative data sets (e.g., MACCity)	M12
D2.Y.Z-yyyy	Dataset	Global emissions dataset for the CAMS reanalysis EAC5 for latest year available	Annually

WP6120 Milestones			
#	*Title*	*Means of verification*	*Due*
M2.Y.Z	Meeting to discuss emissions requirements for CAMS global modelling aspects	Minutes of meeting	M3

3.4 Work package 6130 - Natural and biogenic emissions for the global domain

As part of this workpackage 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, 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 gridded emission datasets shall principally target the needs for the CAMS global reanalysis (EAC5) including, whenever relevant, inter-annual variability information from 2000 to the latest year covered. Emissions shall be provided as monthly averages (unless specified otherwise) and with a target horizontal resolution of 50 km or better. Based on these multi-year emission data sets, the successful Tenderer shall also provide climatological datasets for all categories (biogenic, soil, ocean, and volcanic outgassing) that can be used in the near-real-time applications of the Global Production System. These climatological emissions shall also be provided as monthly averages and with a target horizontal resolution of 50 km or better

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.

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. 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 workpackage, 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). 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 support to implement the online modelling of natural emissions of NOx, NH3, DMS, and OCS in the IFS based on the recommendations from the current CAMS contract on emissions (CAMS_81).

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.

WP6130 Deliverables			
#	*Type*	*Title*	*Due*
D3.Y.Z	Dataset	Global biogenic emissions dataset (2000-latest year possible)	M12
D3.Y.Z	Dataset	Global soil emissions dataset (2000- latest year possible)	M12
D3.Y.Z	Dataset	Global ocean emissions dataset (2000- latest year possible)	M12
D3.Y.Z	Dataset	Global volcanic outgassing emissions (2000- latest year possible)	M12

D3.Y.Z	Dataset	Global biogenic emissions dataset for latest year possible	Annually
D3.Y.Z	Dataset	Global soil emissions dataset for latest year possible	Annually
D3.Y.Z	Dataset	Global ocean emissions dataset latest year possible	Annually
D3.Y.Z	Dataset	Global volcanic outgassing emissions for latest year possible	Annually
D3.Y.Z	Dataset	Global biogenic emissions dataset (climatology)	M18
D3.Y.Z	Dataset	Global soil emissions dataset (climatology)	M18
D3.Y.Z	Dataset	Global ocean emissions dataset (climatology)	M18
D3.Y.Z	Dataset	Global volcanic outgassing emissions (climatology)	M18
D3.Y.Z	Report	Annual plans for development of online modelling of biogenic emissions	Annually
D3.Y.Z	Report	Annual report on development activities of online modelling of biogenic emissions	Annually

WP6130 Milestones			
#	*Title*	*Means of verification*	*Due*
M3.Y.Z	Meeting with ECMWF and the contractor for the CAMS2_35 contract on natural and biogenic flux modelling	Minutes of meeting	M3

3.5 Work package 6140 – 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. 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[20] 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[21]	Fuel Type[22]	Emission Abatement Technology	Flag[23]	Traffic Type[24]
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 heavy fuel oil (HSHFO)	Selective Catalytic Reduction (SCR)	Non-EU/EFTA	National navigation
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

[20] Emission Control Area
[21] Taxonomy for ship type classification to be reviewed and confirmed together with EMSA.
[22] Taxonomy for the fuel types to be reviewed and confirmed together with EMSA.
[23] Taxonomy for Flags based on Paris MoU flags to be reviewed and confirmed together by EMSA.
[24] Traffic types as defined by UNFCCC and MRV definitions and to be reviewed and confirmed together with EMSA.

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[25] 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 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.

WP6140 Deliverables			
#	*Type*	*Title*	*Due*
D4.Y.Z-yyyy	Dataset	European shipping emissions dataset for latest year available[26]	Annually
D4.Y.Z-yyyy	Dataset	Global shipping emissions dataset for latest year available[27]	Annually
D4.Y.Z-yyyy	Dataset	Global shipping emissions for the CAMS reanalysis EAC5 (2000-latest year available)	M12
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
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

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

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

WP6140 Milestones			
#	*Title*	*Means of verification*	*Due*
M4.Y.Z			
M4.Y.Z			

3.6 Work package 6150 – Service evolution and support to CAMS Production Systems

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. Among the topics to consider are the following:

- Consistency between global and regional emission data sets and use of regional emissions in the global data set
- Uncertainty estimation

In addition, the successful Tenderer shall support the implementation and testing of the emission data set in the operational CAMS Regional and Global Production Systems. Emissions are an integral part of the upgrade process of the CAMS Regional and 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. 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 and Global 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 Global and 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 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.

WP6150 Deliverables			
#	*Type*	*Title*	*Due*
D5.y.z	Report Dataset	…	
…			

WP6150 Milestones			
#	*Title*	*Means of verification*	*Due*
M5.y.z			

3.7 Work package 6160 – User support and documentation of service

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

ECMWF has established a centralised Copernicus Service Desk to provide multi-tiered technical support to all users of CAMS data, products, tools and services. The Service Desk handles user queries through a ticketing system and distributes these queries to specialists when needed. Dedicated staff at ECMWF provide basic support in the form of self-help facilities (FAQs, Knowledge Base, online Forum, tutorials etc.) as well as individualised support on technical queries related to the Atmosphere Data Store (ADS), data formats, data access etc. In addition, ECMWF staff provide specialised scientific support to address questions related to its industrial contributions to CAMS, e.g. in the areas of global forecasting of atmospheric composition.

All CAMS contractors are expected to contribute to the delivery of multi-tiered technical support for the data and/or services they provide. Such specialised user support shall take the form of direct response to individual user queries via the Service Desk facility, as well as contributions to FAQs, Knowledge Base, and user guides. Contractors may also be requested by the CAMS Service Desk to contribute to support questions in the online Forum.

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

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

methodologies and products they deliver for this ITT. The documentation in the Knowledge Base shall be targeted at the general external user community, while the additional detailed reports shall address the needs of expert users.

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

WP6160 Deliverables			
#	*Type*	*Title*	*Due*
D6.y.z-YYYY	Other	Contribution to CAMS Knowledge Base to document products and services as requested in this ITT	With each release of a new dataset
D6.y.z-YYYY	Report	Contribution to documentation of products and services as requested within this ITT	With each release of a new dataset
…			

WP6160 Milestones			
#	*Title*	*Means of verification*	*Due*
M6.y.z	…	…	…
…			

3.8 Work package 6100 – Management and coordination

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

- Contractual obligations as described in the Framework Agreement Clause 2.3 on reporting and planning.
- Meetings (classified as tasks and listed in a separate table as part of the proposal):
  - ECMWF will organise annual CAMS General Assemblies. The successful Tenderer is required to attend these meetings with team members covering the various topics that are part of this ITT.
  - ECMWF will host monthly teleconference meetings to discuss CAMS service provision, service evolution and other topics. The Prime Investigator appointed by the successful Tenderer will represent the successful Tenderer in such meetings.
  - ECMWF will organise six-monthly project review meetings (linked to Payment milestones).
  - Tenderers can propose additional project internal meetings (kick-off meeting, annual face-to-face meeting and monthly teleconferences) as part of their response.
- Quality assurance and control: the quality of reports and Deliverables shall be equivalent to the standard of peer-reviewed publications. The final quality check of the deliverables should be made by the prime contractor (contents, use of ECMWF reporting templates for deliverables and reports (Microsoft Word), format, deliverable numbering and naming, typos…); all reports in this project shall be in English. Unless otherwise specified the specific contract Deliverables shall be made available to ECMWF in electronic format.
- Communication management (ECMWF, stakeholders, internal communication).
- Resources planning and tracking using the appropriate tools.

- Implementation of checks, controls and risk management tools for both the prime contractor and subcontractors.
- Subcontractor management, including conflict resolution, e.g. the prime contractor is responsible for settling disagreements, although advice/approval from ECMWF may be sought on the subject.
- A list of subcontractors describing their contribution and key personnel shall be provided, as well as back-up names for all key positions in the contract. The Tenderer shall describe how the Framework Agreement, in particular Clause 2.9 has been flowed down to all their subcontractors.
- Management of personal data and how this meets the requirements of Clause 2.8 and Annex 6 of the Volume V Framework Agreement

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

WP6100 Deliverables				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.Y.Z-yyyyQx	Tenderer	Report	Quarterly Implementation Report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 15/04, 15/07 and 15/10 (only at the above dates; QIR for Q4 will be part of the AIR)
D0.Y.Z-yyyy	Tenderer	Report	Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually on 28/02
D0.Y.Z-yyyy	Tenderer	Other	Preliminary financial form YYYY *YYYY being the Year n-1*	Annually on 15/01
D0.Y.Z	Tenderer	Report	Final report	60 days after end of contract (Tenderer to include date based on Contract Notice)
D0.Y.Z-yyyy	Tenderer	Report	Finalised Implementation plan 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 YYYY *YYYY being the Year n-1*	Annually
D0.Y.Z	Tenderer	Other	Updated KPIs (list, targets…) after review with ECMWF	One year after start of contract

WP6100 Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.Y.Z-Px	Tenderer	Progress review meetings with ECMWF / Payment milestones	Minutes of meeting	~ Every 6 months

4 General Requirements

4.1 Implementation schedule

The Framework Agreement will run from 1 January 2021 to 30 June 2025. The Tenderer shall provide a detailed implementation plan of proposed activities for the full period.

4.2 Deliverables and milestones

Deliverables should be consistent with the technical requirements specified in section 3. A deliverable is a substantial, tangible or intangible good or service produced as a result of a project. In other words, a deliverable is an outcome produced in response to the specific objectives of the contract and is subject to acceptance by the technical contract officers at ECMWF. When defining deliverable please **consolidate their numbers** against a specific deadline where possible. All contract reports shall be produced in English. The quality of reports and deliverables shall be equivalent to the standard of peer-reviewed publications and practice. Unless otherwise specified in the specific contract, deliverables shall be made available to ECMWF in electronic format (PDF/Microsoft Word/Microsoft Excel or compatible) via the Copernicus Deliverables Repository portal.

In Volume IIIA, List of Deliverables, each Deliverable shall have an associated resource allocation (person-months and financial budget, resource type: payroll only). The total of these allocated resources shall amount to the requested budget associated with payroll. Milestones shall not have an associated budget in Volume IIIA, List of Deliverables.

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

The Tenderer shall ensure that the proposed due dates of deliverables and milestones are realistic and achievable. Any dependencies on input data shall be taken into account in the risk table.

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 Communication

The successful Tenderer shall support ECMWF in its communication activities for the CAMS services, where they are related to the activities described in this ITT. Examples are contributions to the Copernicus State of the Climate report, CAMS web site news items, and CAMS brochures and flyers. All communication activity must be agreed with the ECMWF Copernicus Communication team in advance. This includes, but not exhaustively, communication planning, branding and visual style, media outreach, website and social media activity, externally facing written and graphic content and events. Agreed activity would also need to be evaluated and reported on, once complete, so that success measures and KPIs can be provided to the European Commission.

4.5 Support for user engagement and training activities

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

Requests to support activities may be raised on for example:

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

An indicative maximum budget of 5,000.- EUR shall be allocated in the pricing table to accommodate for these needs. This shall be paid as a fixed price. Details on the required activities shall be refined as part of the Annual Implementation Plans.

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

The successful Tenderer shall provide input to the User Requirements Database (URDB) regarding user requirements that are directly related to activities covered by this ITT. The successful Tenderer shall also support ECMWF and the contractor for User Interaction activities with the analysis of relevant user requirements in the URDB.

The following deliverables are thus to be added to the WP6160 deliverable lists:

WP6160 Deliverables			
#	*Type*	*Title*	*Due*
D6.Y.Z-yyyy	Other	Input to CAMS URDB - YYYY	Checked by ECMWF annually in December
D6.Y.Z	Report	Summary of user engagement activities.	Due 1 month before contract end date
…			

4.6 Data provision and IPR

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 one of two methods:

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

In the case of (a), suppliers will have to agree with ECMWF on the data formats to be used. ECMWF will only accept data in formats that follow internationally recognised standards. Such standards must be open (i.e. non-proprietary), managed by a recognised international standardisation body (e.g. ISO, WMO, OGC, etc.), or any de-facto standard. Open source software should also exist that can read and write files of these standards. Serialisation formats (e.g. NetCDF, XML, JSON) should be supported by standard schemas and conventions. All text-based formats should be encoded in UTF-8. ECMWF will implement tools to check the compliance of the provided data and products to the agreed standards before they are added to the ADS.

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

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

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

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

Provision of processing capabilities:

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

As for data retrievals, invocation of these web services will originate from the Atmosphere Data Store itself as part of a workflow run on behalf of an end user, and ECMWF will need to have the necessary end-user credentials to invoke these services. ECMWF will not provide information on the end user's identity when invoking the web services. ECMWF will nevertheless collect usage statistics.

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

Data and IPR:

It is a condition of EU funding for CAMS that ownership of any datasets developed with CAMS funding passes from the suppliers to the European Union via ECMWF. Ownership will pass from the date of

creation of the datasets. Suppliers will be granted a non-exclusive licence to use the datasets which they have provided to CAMS for any purpose.

All software and products used by the successful Tenderer to produce the CAMS datasets will remain the property of the successful Tenderer, except for those components which are acquired or created specifically for CAMS purposes, with CAMS funding, and which are separable and useable in isolation from the rest of the successful Tenderers' production system. The identity and ownership of such exceptional components will be passed to the European Union via ECMWF annually. The successful Tenderer will be granted a non-exclusive licence to use them for any purpose

4.7 Key performance indicators

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

The table below provides the template to be used by the Tenderer to describe the KPIs, relevant for this ITT, together with performance targets, delivery schedules and explanations if needed. Please note that KPIs should not address the timeliness of Deliverables, but rather the quality of the work delivered.

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_61.1	…	…	…	…

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.