ECMWF
Copernicus



**CAMS2\_83\_METNorway**

**ANNEX 3B**

**to the Framework Agreement**

**Service contract 1**

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| ISSUED BY: Michael Gauss, MET Norway |
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# Description of work

*The work to be carried out during Service Contract 1 corresponds to the first 20 months of the implementation plan of the main proposal (see Annex 2 to the Framework Agreement), i.e. the period 1 November 2021 to 30 June 2023.*

CAMS2\_83 deals with the Evaluation and Quality Control (EQC) of the regional models used in CAMS2\_40 (the Regional Service Provider) for forecasts and analyses of air pollution in Europe. The regional models, and the Ensemble, are evaluated against measurements regularly, and the results of the evaluation are published via web pages but also in quarterly and annual reports. The model evaluation is done against both *surface* and *above-surface* measurements. Furthermore, the uptake of *boundary conditions* (from the global CAMS product will) in the regional models is assessed, and possible issues are identified and conveyed to the modelling teams of CAMS.

The CAMS2\_83 project gathers experts in model evaluation both from the scientific and the technological side and builds, to a large extent, on existing tools which were developed in earlier CAMS projects but will evolve further during CAMS2\_83. Special emphasis is put on merging and harmonizing the evaluation tools into one web interface, a ‘one-stop shop’, where both users and providers can find information relevant to their work easily and in a timely manner.

Species to be evaluated are O3, NO2, SO2, CO, PM10, PM2.5 and pollen, as provided by the Regional Service Provider. Statistics such as bias, normalized modified mean bias, root mean square error, correlation and fractional gross error are computed as a function of forecast hour and season, averaged over the CAMS regional domain, individual countries, and at site-level. In addition, metrics and diagrams suggested by FAIRMODE (Forum for Air quality Modeling) will be included in the evaluation during Service Contract 1. In regard to pollen, the availability of measurement data will determine whether or not the evaluation can be shown already for the pollen season of 2023, i.e. within Service Contract 1.

The annual evaluation reports include the EQC reports for the interim and validated reanalyses. During Service Contract 1, EQC reports will be delivered for the validated reanalyses of 2019 and 2020 and for the interim reanalyses of 2021 and 2022.

User engagement activities will occur on request within the allocated budget. In any case, user queries received through the Copernicus helpdesk will be handled in a timely manner, and input to the CAMS Knowledge Base and the URDB will be provided.

# Main objectives to be reached

The main objectives of CAMS2\_83 are to:

* ensure a seamless transition of regional evaluation services from previous CAMS projects (in particular CAMS\_50 and CAMS\_84) and enhance them with new metrics (FAIRMODE) and new species to be evaluated against measurements (pollen);
* continuously evaluate the regional models of CAMS in near-real time against large volumes of surface and above-surface measurement data;
* check the uptake of chemical boundary conditions from the CAMS global product in the regional models;
* convey the results of the evaluation to both users and providers timely and in a convenient format, through comprehensive reports, a harmonized web interface, and different sorts of user engagement.

The main development during Service Contract 1 will be to:

* build a new evaluation service at MET Norway, to be operational by the end of Service Contract 1;
* include the above-surface evaluation and boundary condition assessment, as well as new chemical components, in the regional EQC reports (both quarterly and annual reports);
* implement FAIRMODE metrics in the evaluation.

# Work packages description

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| **Work package #** | WP CAMS2\_8300 | **Start/End date** | M1-M42 |
| **Work package title** | Management and coordination |
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| **Main objectives*** Ensure a smooth workflow and timely provision of deliverables
* Ensure optimal collaboration between contractors
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| **Description of activities**Task 8301 : This WP has one task - management and coordination of the project team. The deliverables consist of quarterly implementation (progress) reports, annual implementation (progress) reports, preliminary financial forms (each year), and annual implementation plans. In addition, the key performance indicators will be updated with ECMWF after the first year of the project. To ensure that the progress of the project is in line with ECMWF’s expectations, review meetings will be held with ECMWF about every 6 months. Regular meetings will also occur among the contractors of CAMS2\_83, at least once every quarter, and most probably by video-conferencing.  |
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| **Deliverables** |
| *#* | *Responsible* | *Nature* | *Title* | *Due* |
| D0.1.1-2022Q1[[1]](#footnote-1) | MET Norway | Report | Quarterly Implementation Report Q1 2022 (covering Jan/Feb/Mar 2022) | 15/04/2022 |
| D0.1.1-2022Q2 | MET Norway | Report | Quarterly Implementation Report Q2 2022 (covering Apr/May/Jun 2022) | 15/07/2022 |
| D0.1.1-2022Q3 | MET Norway | Report | Quarterly Implementation Report Q3 2022 (covering Jul/Aug/Sep 2022) | 15/10/2022 |
| D0.1.1-2023Q1 | MET Norway | Report | Quarterly Implementation Report Q1 2023 (covering Jan/Feb/Mar 2023) | 15/04/2023 |
| D0.1.2-2021 | MET Norway | Report | Annual Implementation Report for 2021 | 28/02/2022 |
| D0.1.2-2022 | MET Norway | Report | Annual Implementation Report for 2022 | 28/02/2023 |
| D0.1.3-2021 | MET Norway | Other | Preliminary financial form for 2021 | 15/01/2022 |
| D0.1.3-2022 | MET Norway | Other | Preliminary financial form for 2022 | 15/01/2023 |
| D0.1.4-2023 | MET Norway | Report | Implementation plan for 2023 | 30/09/2022 |
| D0.1.5-2021 | MET Norway | Other | Copy of prime contractor's general financial statements and audit report 2021 | 30/06/2022 |
| D0.1.5-2022 | MET Norway | Other | Copy of prime contractor's general financial statements and audit report 2022 | 30/06/2023 |
| D0.1.6 | MET Norway | Other | Updated KPIs (list, targets...) after review with ECMWF | 30/11/2022 |
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| **Milestones** |
| *#* | *Responsible* | *Title* | *Means of verification* | *Due* |
| M0.1.1 | MET Norway | Progress review meeting with ECMWF / Payment milestones | Minutes of meeting | 30/04/2022 |
| M0.1.2 | MET Norway | Progress review meeting with ECMWF / Payment milestones | Minutes of meeting | 31/10/2022 |
| M0.1.3 | MET Norway | Progress review meeting with ECMWF / Payment milestones | Minutes of meeting | 30/04/2023 |

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| **Work package #** | WP CAMS2\_8310 | **Start/End dat** | M1-M42 |
| **Work package title** | EQC of daily Regional Products |
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| **Main objectives*** Issue quarterly reports on the performances of the CAMS regional models and the ensemble
* Include both surface and above-surface evaluation
* Assess the correct uptake of boundary conditions and compare performances between the regional and global models of CAMS
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| **Description of activities**Task 8311 : Surface evaluationScores and graphs for the surface evaluation of the CAMS regional models and the Ensemble will be produced at Meteo France (until 2023) and MET Norway (from 2023 at the latest) and be included in the quarterly EQC reports of Task 4. They will also feed into the web interface of WP CAMS2\_8330.Task 8312 : Above-surface evaluationScores and graphs for above-surface evaluation will be produced at KNMI (with help from CNRS-LAERO) and be included in the quarterly EQC reports of Task 4. They will also feed into the IRA/VRA evaluation reports and the web interface of WP CAMS2\_8330.Task 8313 : Effect of boundary conditionsGraphs illustrating the uptake of boundary conditions by the CAMS regional models will be produced at KNMI and be included in the quarterly EQC reports of Task 4.Task 8314 : Production of quarterly EQC reportsIn total, 6 quarterly EQC reports for the NRT forecasts and analyses will be produced at MET Norway over the course of Service Contract 1, with input from the three previous tasks, containing scores and graphs for each of the operational systems as well as the Ensemble. The reports will also contain comparisons of performance between the CAMS regional and global models, as well as illustrations of the uptake of boundary conditions by the regional models. Towards the end of Service Contract 1, the evaluation of pollen will be included, and, most likely much earlier, new metrics suggested by FAIRMODE will be used. The new Model Output Statistics (MOS), as recommended by CAMS\_63, will be included in the evaluation in 2023. It is not clear yet whether this will be done at the end of Service Contract 1 or at the beginning of Service Contract 2.The first report will be issued in February 2022 and cover the period SON2021, while the last report of Service Contract 1 will be due in April 2023 and cover the period DJF 2022/23. |
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| **Deliverables** |
| *#* | *Responsible* | *Nature* | *Title* | *Due* |
| D1.4.1-2021Q4 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for SON 2021) | 28/02/2022 |
| D1.4.1-2022Q1 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for DJF 2021/2022) | 30/04/2022 |
| D1.4.1-2022Q2 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for MAM 2022) | 31/07/2022 |
| D1.4.1-2022Q3 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for JJA 2022) | 31/10/2022 |
| D1.4.1-2022Q4 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for SON 2022) | 31/01/2023 |
| D1.4.1-2023Q1 | MET Norway | Report | Quarterly EQC report for the NRT forecasts and analyses, for each of the operational systems as well as the ensemble (for DJF 2022/2023) | 30/04/2023 |

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| **Work package #** | WP CAMS2\_8320 | **Start/End date** | M1-M42 |
| **Work package title** | EQC of regional (annual) reanalyses |
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| **Main objectives*** Perform a detailed evaluation of the CAMS regional systems’ interim and validated reanalysis results after these have been provided by CAMS2\_40
* Issue annual reports on the results from this evaluation, both for the interim reanalysis (spring each year, for the year before) and the validated reanalysis (autumn each year, for two years before)
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| **Description of activities**Task 8321 : Evaluation of the interim reanalysis results from each regional model and the Ensemble2 reports will be issued from this task by INERIS during Service Contract 1, containing the evaluation results from all regional models for the interim reanalysis for 2021 and 2022, respectively. The reports will be provided by the end of May in the year after the year they refer to. In addition to surface evaluation, the reports will also include an evaluation against above-surface evaluation provided by KNMI. The species to be evaluated are O3 (daily max), NO2 (daily max), SO2(daily mean), CO (daily mean), PM10 (daily mean), and PM2.5 (daily mean). Scores to be shown are bias, correlation and RMSE, averaged over the whole domain but also for regions (Northern, Eastern, Southern, Western Europe). Performances for representing the threshold exceedances are also assessed. FAIRMODE metrics will be definitely implemented during 2022 in the EQC report for IRA 2021.Task 8322 : Evaluation of the validated reanalysis results from each regional model and the Ensemble2 reports will be issued from this task by INERIS during Service Contract 1, containing the evaluation results from all regional models for the validated reanalysis for 2019 and 2020, respectively. The first report will be provided in January 2022, while the second one will be provided in October 2022. In addition to surface evaluation, the VRA reports (except the first one) will also include an evaluation against above-surface evaluation provided by KNMI. The species to be evaluated are O3 (daily max), NO2 (daily max), SO2, CO, PM10 (daily mean), and PM2.5 (daily mean). Scores to be shown are bias, correlation and RMSE, averaged over the whole domain but also for regions (Northern, Eastern, Southern, Western Europe). Performances for representing the threshold exceedances are also assessed. FAIRMODE metrics will be definitely implemented during 2022 in the EQC report for VRA 2020. |
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| **Deliverables** |
| *#* | *Responsible* | *Nature* | *Title* | *Due* |
| D2.1.1-2021 | INERIS | Report | Annual EQC report for the interim reanalysis for 2021, for each of the operational systems as well as the ensemble | 31/05/2022 |
| D2.1.1-2022 | INERIS | Report | Annual EQC report for the interim reanalysis for 2022, for each of the operational systems as well as the ensemble | 31/05/2023 |
| D2.2.1-2019 | INERIS | Report | Annual EQC report for the validated reanalysis for 2019, for each of the operational systems as well as the ensemble | 31/01/2022 |
| D2.2.1-2020 | INERIS | Report | Annual EQC report for the validated reanalysis for 2020, for each of the operational systems as well as the ensemble | 31/10/2022 |
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| **Milestones** |
| *#* | *Responsible* | *Title* | *Means of verification* | *Due* |
| M2.1.1-2021 | INERIS | IRA 2021 model data available from Regional Service Provider | Model database at INERIS | 31/03/2022 |
| M2.1.1-2022 | INERIS | IRA 2022 model data available from Regional Service Provider | Model database at INERIS | 31/03/2023 |
| M2.2.1-2019 | INERIS | VRA 2019 model data available from Regional Service Provider | Model database at INERIS | 30/11/2021 |
| M2.2.1-2020 | INERIS | VRA 2020 model data available from Regional Service Provider | Model database at INERIS | 31/08/2022 |

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| **Work package #** | WP CAMS2\_8330 | **Start/End date** | M1-M42 |
| **Work package title** | Provision of web-based evaluation graphics |
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| **Main objectives*** Maintain a web interface showing evaluation of CAMS regional model and Ensemble results daily (for the past day, past week, and past 3 months) and averaged over the regional model domain
* Maintain a web interface showing evaluation of CAMS regional model and Ensemble results per season (for the past 8 seasons: DJF, MAM, JJA, SON, …), averaged over the regional model domain, but also at country- and (measurement)site-level
* Provide quarterly updated reports about uptime statistics of the web interface
* During a transition phase of about 18 months, harmonize the different visualizations developed during previous CAMS projects (CAMS\_50, CAMS\_61, CAMS\_84) in AeroVal, to be embedded in the CAMS website.
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| **Description of activities**Task 8331 : Evaluation for the past day, past week and past 3 months of the NRT regional analyses and forecastsMaintenance of daily updated evaluation graphics and provision of quarterly reports about uptime statistics during the last 3 months. This task will deal with all near real time evaluations for the whole domain.Task 8332 : Seasonal evaluation (DJF, MAM, JJA, SON) for the past 8 (fully elapsed) seasonsMaintenance of daily updated evaluation graphics and provision of quarterly reports about uptime statistics during the last 3 months. This task will deal with seasonal evaluations (last 8 quarters plus the quarter that has started, up to the present day), on country and site level.Task 8333: This task will run in parallel with the first two tasks and is about the development of the AeroVal web interface, which will replace the evaluation pages developed in earlier projects into one harmonized web interface to be embedded in the CAMS website. |
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| **Deliverables** |
| *#* | *Responsible* | *Nature* | *Title* | *Due* |
| D3.1.1-2021Q4 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Jan 2022) | 28/02/2022 |
| D3.1.1-2022Q1 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Apr 2022) | 31/05/2022 |
| D3.1.1-2022Q2 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Jul 2022) | 31/08/2022 |
| D3.1.1-2022Q3 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Oct 2022) | 30/11/2022 |
| D3.1.1-2022Q4 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Jan 2023) | 28/02/2023 |
| D3.1.1-2023Q1 | MET Norway | Online graphics & report | Quarterly report showing examples and documenting the relevant KPIs for evaluation graphics for the past day/week/3 months/past 8 quarters of the NRT FC/AN (contract start to Apr 2023) | 31/05/2023 |
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| **Milestones** |
| *#* | *Responsible* | *Title* | *Means of verification* | *Due* |
| M3.1.1 | Meteo-France | Implementation of daily evaluation graphics for the past day, past week and past 3 months of the NRT regional analyses and forecasts (continuation from CAMS\_50.II) | Graphics available via CAMS website via Meteo France | 30/11/2021 |
| M3.1.2 | MET Norway | Implementation of daily evaluation graphics for the past day, past week and past 3 months of the NRT regional analyses and forecasts (complete and fully operational) | Graphics available via CAMS website via MET Norway (AeroVal, fully operational) | 30/04/2023 |
| M3.2.1 | Meteo-France | Implementation of daily updated graphical presentation of NRT analyses and forecasts site-level evaluation statistics for the past 8 quarters (continuation from CAMS\_50.II) | Graphics available via CAMS website via Meteo France | 30/11/2021 |
| M3.2.2 | MET Norway | Implementation of daily updated graphical presentation of NRT analyses and forecasts site-level evaluation statistics for the past 8 quarters (complete and fully operational) | Graphics available via CAMS website via MET Norway (AeroVal, fully operational) | 30/04/2023 |
| M3.3.1 | MET Norway | Implementation of daily evaluation graphics for the past day, past week and past 3 months of the NRT regional analyses and forecasts (prototype) | Graphics available via CAMS website via MET Norway (AeroVal, prototype) | 30/04/2022 |
| M3.3.2 | MET Norway | Implementation of daily updated graphical presentation of NRT analyses and forecasts site-level evaluation statistics for the past 8 quarters (prototype) | Graphics available via CAMS website via MET Norway (AeroVal, prototype) | 30/04/2022 |
| M3.3.3 | MET Norway | Decision on where to run the evaluation scripts once AeroVal goes from ‘prototype’ to ‘fully operational’. | Outcome of discussions available on request | 31/07/2022 |

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| **Work package #** | WP4 CAMS2\_8340 | **Start/End date** | M1-M42 |
| **Work package title** | User support and documentation of service |
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| **Main objectives*** Detailed documentation of CAMS2\_83 products
* Answering user queries in a timely manner
* Keep track of user requirements
* Contribute to user engagement activities
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| **Description of activities**Task 8341 : Collect and update documentation of statistics used in this contract. Formulas for how they are calculated and which data are used. Documentation as to how we calculate scores and which data we use will be collected and kept up to date and be available to/at the CAMS Knowledge Base. This will also include the new (FAIRMODE) statistics.Task 8342 : Answer user queries as they are raised (e.g. through Copernicus Helpdesk at ECMWF / JIRA)User queries about CAMS2\_83 products and services, received through the Copernicus Helpdesk, will be answered in a timely manner by relevant CAMS2\_83 contractors.Task 8343 : Collect input for the User Requirements Data Base (URDB)Here we will make sure that any CAMS2\_83-relevant user requirement that comes to our attention will be conveyed to CAMS\_94 and the User Requirements Data Base.Task 8344 : User engagement activitiesThis task accommodates for eventual needs in providing technical and scientific expertise in support of user engagement and training activities. |
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| **Deliverables** |
| *#* | *Responsible* | *Nature* | *Title* | *Due* |
| D4.1.1-2022 | MET Norway | Other | Contribution to CAMS Knowledge Base to ensure up-to-date information about products and services covered under this contract, status 2022. | 30/06/2022 |
| D4.1.1-2023 | MET Norway | Other | Contribution to CAMS Knowledge Base to ensure up-to-date information about products and services covered under this contract, status 2023. | 30/06/2023 |
| D4.3.1-2022 | MET Norway | Other | Input to CAMS URDB - 2022 | 30/11/2022 |
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| **Milestones** |
| *#* | *Responsible* | *Title* | *Means of verification* | *Due* |
| M4.1.1 | MET Norway | Plan for how to update CAMS Knowledge Base established | e-mail exchange can be made available | 31/01/2022 |
| M4.2.1 | MET Norway | Plan for how to handle user queries established | e-mail exchange can be made available | 31/12/2021 |

# Recapitulative table of deliverables and milestones (in chronological order)

The Recapitulative table of deliverables and milestones have been submitted as a separate MS Excel file in attachment to Annex 3B.

1. Deliverables (and Milestones) are 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 are 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 are 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 is applied for Milestones. [↑](#footnote-ref-1)