ECMWF Copernicus Procurement

Invitation to Tender

COPERNICUS PROJECT

CAMS_50 Regional production

METEO-FRANCE PROPOSAL
Annex 2 to the Framework agreement

ITT Ref: CAMS_50
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1 Executive Summary

1.1.1 The purpose of CAMS_50.II

The present tender concerns the continuation of the CAMS Regional production service (CAMS_50) for the period 2018-2021. The purpose of the Service will remain to produce numerical data and mapping products providing information on air quality and atmospheric composition on the European scale, with the aim of making it freely and easily accessible to the various user communities.

As with the current CAMS_50 that is nearing completion (September 2018):

- The CAMS_50 outputs will consist in the following streams: daily near-real time (NRT) forecasts, daily NRT analyses, annual re-analyses based on in-situ observations in an interim stage of validation and annual re-analyses based on fully validated in-situ observations.
- Acquisition of data, production of analyses, re-analyses and forecasts, verification of the outputs, data dissemination services and support to the users will form the bulk of the activities.
- A multi-model ensemble approach will be implemented.
- User satisfaction will be a central focus, which will be reflected through a strong emphasis on production quality and through user support activities.
- Important development efforts will underpin the Service, not only to allow for regular individual and Ensemble upgrades meant to improve the Service, but also to allow for a potential small-scale extension of the pool of Regional systems taking part in the operational production.

For the 2018-2021 period, new challenges for CAMS_50 will arise, among others:

- The delivery of the Regional products to the ECMWF Copernicus Data Store, with a transition period expected to start in 2018.
- The addition of two Regional systems bringing the pool of models contributing to the operational Ensemble.
- The extension of the geographical domain.
- The addition of aerosol parameters proposed as outputs to present impact of residential burning emissions and secondary organic production on air quality.
- The acquisition of new types of air quality observations through ECMWF.

1.1.2 Proposed consortium

Table 1 on the next page displays the consortium proposed to undertake these activities. It brings together twelve partners, including Meteo-France as lead partner, ten tier-1 subcontractors and one tier-2 subcontractor. This will allow nine Regional operational systems and two Regional candidate systems to take part in the follow-up CAMS_50 (CAMS_50.II).

Note that the research and development component of the services to deliver and its close link with the expected operational service for 2018-2021 has led Meteo-France to compose this group of subcontractors without public procurement proceedings. References of these subcontractors out of which eight already contribute to the current CAMS_50 service (CAMS_50.I) are presented in Chapter 2 Track Record.

Table 1. The proposed consortium

FRANCE	**Meteo-France** French national meteorology and climate service	Prime contractor	MOCAGE
	INERIS French National Institute for Industrial Environment and Risks	Tier 1 subcontractor	CHIMERE
FINLAND	**FMI** Finnish Meteorological Institute	Tier 1 subcontractor	SILAM
GERMANY	**FZJ-IEK8** Forschungszentrum Julich GmbH - Institute of Energy and Climate Research – Troposphere	Tier 1 subcontractor	EURAD-IM
THE NETHERLANDS	**KNMI** Royal Netherlands Meteorological Institute	Tier 1 subcontractor	LOTOS-EUROS
	TNO Netherlands Organization for Applied Scientific Research	Tier 2 subcontractor	
NORWAY	**MET Norway** Norwegian Meteorological Institute	Tier 1 subcontractor	EMEP
SWEDEN	**SMHI** Swedish Meteorological and Hydrological Institute	Tier 1 subcontractor	MATCH
DENMARK	**AU** Aarhus University	Tier 1 subcontractor	DEHM
POLAND	**IEP-NRI** The Institute of Environmental Protection – National Research Institute	Tier 1 subcontractor	GEM-AQ
SPAIN	**BSC** Barcelona Supercomputing Center	Tier 1 subcontractor	NMMB-MONARCH
ITALY	**ENEA** Italian National Agency for New Technologies, Energy and Sustainable Economic Development	Tier 1 subcontractor	MINNI

1.1.3 Service level

Most of the partners have already been active in the decade-long series of research projects precursor to CAMS; they also currently participate in CAMS_50.I, either as operational teams or as new teams candidate to join the CAMS_50.I operations. Acquisition of data, production of analyses, re-analyses and forecasts, verification of the outputs, data dissemination services and support to the users are therefore activities that are familiar to the proposed consortium. **Key highlights of CAMS_50.I** are for instance:

- Daily NRT products (individual and Ensemble): analyses at all levels delivered for all ITT-required species, olive and grass pollen forecasts delivered as experimental products and ragweed pollen forecasts under preparation for operational implementation in the near term.
- Annual products (individual and Ensemble): IRAs 2016 and 2017 completed, VRAs 2014 and 2015 completed.
- Data store and WMS/WCS geo-services implemented.
- Continuous user support with good SLA results.

This demonstrates the operational capacity of the seven “original” modelling teams in the CAMS_50 context and their mindfulness in terms of production availability, reliability and performance in line with user needs.

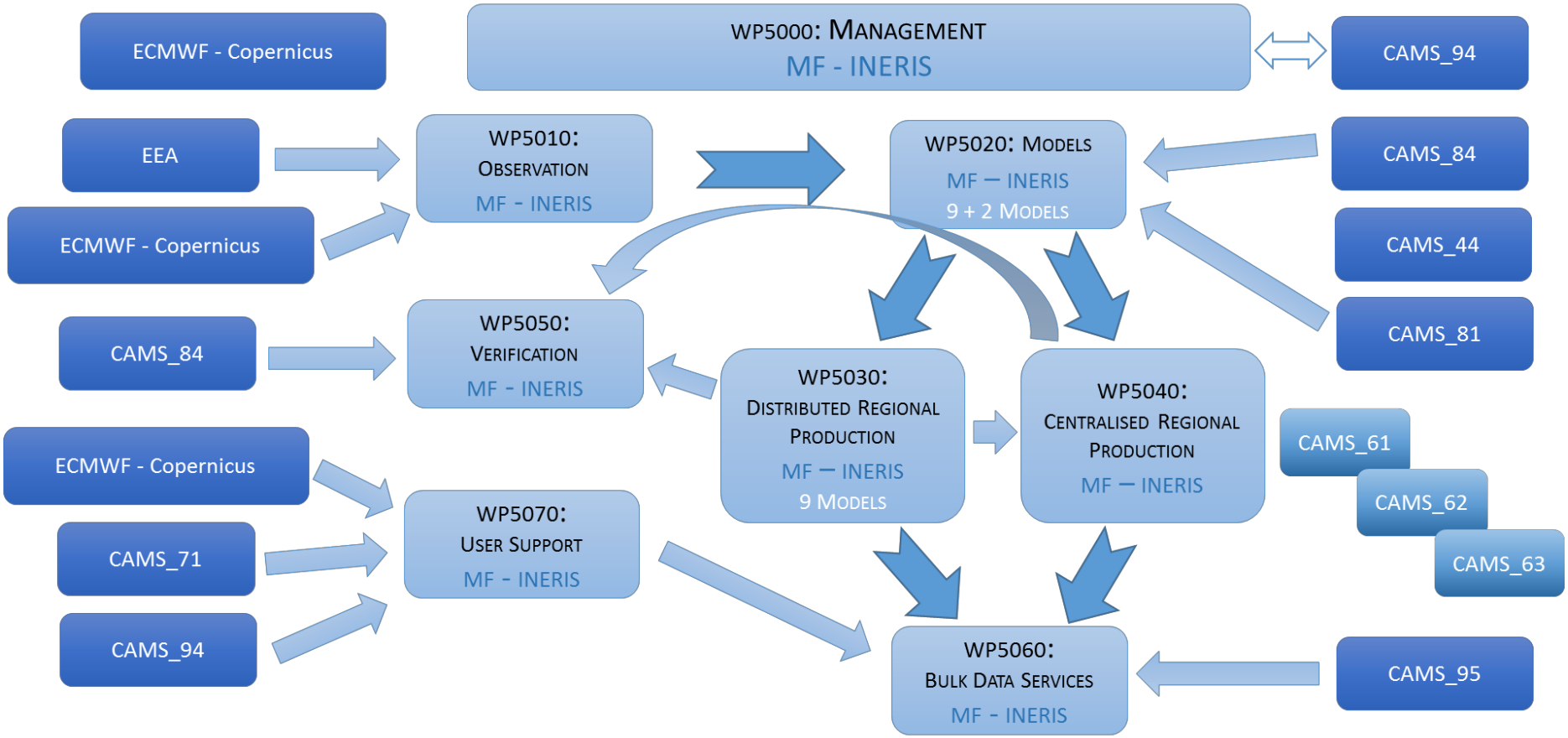
The two new systems (DEHM and GEM-AQ) that have been selected to join the operational production have proved, during CAMS_50.I, their capacity to develop a CAMS-compliant model configuration. The assessment of their results and of the benefits for the Ensemble system confirmed the conclusion to include them in the system, after a ramp-up phase.

We are therefore confident that service level will continue under CAMS_50.II as a two-sided effort (from Meteo-France as Prime contractor and from the operational modelling teams), both in a reactive and proactive manner. All the individual operational assimilation and forecast systems are mature, well validated and operated by their main developers. The operators will be able to directly maintain a continuous workflow of changes to the numerical systems, in order to include new research developments, to make corrections reflecting findings from verification and validation activities, as well as to implement changes to better meet user requirements.

It is foreseen that the KPIs will be closely monitored to track service level.

Finally, it should be noted that Meteo-France is certified ISO 9001.

1.1.4 The work-packages and interactions



2 Track Record

2.1 The consortium as a whole

2.1.1 Consortium description and skills

The consortium members were carefully selected based on their match to the scope of the ITT.

The proposed consortium is made up of well-established European meteorological organisations, research institutes, a university and environmental bodies which are leading players in the field of air quality in Europe. They all have a solid track record over the past decades contributing to multi-partner projects in these fields, both at a national level and within multi-country frameworks. All of them are equipped with high-performance IT facilities.

The tasks to be performed across the WPs of CAMS_50 2018-2021 call for a mix of hands-on skills and knowledge that are well represented within the teams. Staff members mostly hold permanent positions and are experts with a scientific, engineering, IT or managerial profile. Examples of skills are: atmospheric physics, chemistry and mathematics, meteorology, operational forecasting and analysis, observations acquisition and processing, data assimilation, air quality numerical modelling, model evaluation against observational datasets, ensemble methods, scientific programming (Python etc.), IT architectures, user support and associated tools such as JIRA, management and coordination skills. Note that those skills entail analytical skills and the ability to trouble-shoot problems, which will be key for smooth CAMS_50 operations. Finally, the broad knowledge of CAMS and involvement of most of the partners in current CAMS services is important. Importantly, another major asset of the proposed consortium is that it includes the modelling teams already active in the current Regional production service, which will prevent service interruption during the transition to CAMS_50.II.

2.1.1 Complementarity of partners

The request for a “multi-model” system made up of eight to ten individual models requires the participation of at least ten different modelling teams, “geographically spread” across Europe, that is to say at least a dozen of bodies that develop and continuously operate air quality assimilation and forecasts models. This concern has been properly taken into account when constituting the consortium. It is indeed a combination of eleven partners spread across Europe, which expertise on specific problems addressed in their region will benefit to the CAMS Regional service. Note that the teams are distributed across ten countries of Europe.

- The collaboration between INERIS and Meteo-France will allow to take the most of their skills:
    - Control and sustainability with regard to the management of operational systems by Meteo-France, that naturally leads to managing the NRT aspects of the ITT. Close ties with ECMWF allowing the best possible use of input data and associated tools.
    - Expertise in assessment and analysis of risks arising from air pollution, relationships and communication on air quality with industrial stakeholders and public authorities, making INERIS the best player for the management of re-analyses and the assessment of the various models taking part in the Regional service.

- FMI expertise on pollen forecasts that form an original component of the Regional service. FMI will provide the various modelling teams with the parameterisations related to emissions of the different species of pollen to be taken into account by the models. Additionally, it is envisaged that FMI will handle their assessment and comparison with observations, thanks to its contacts with EAN, the European Aeroallergen Network, and the various health organisations concerned by such topic.

2.2 Track records of individual consortium members

Please note that selected relevant publications of the individual consortium members can be found in Appendix 1.

2.2.1 Meteo-France (Prime contractor)

Meteo-France[1] being the French national meteorology and climate service, its core mandate is to ensure the meteorological safety of people and goods. Its primary activities range from developing and maintaining a network of observation stations, collecting and processing climate data, delivering weather forecasts, to developing climate projections and conducting research in the fields of meteorology and climatology.

From the outset, Meteo-France has been delivering operational weather and climate products at a national level and overseas. It covers all fields of operational research at all scales of time and space, thereby steadily improving the quality of its operational products. Cross-fertilisation between the work of engineers and that of scientists is a major asset, as is the user-oriented spirit underlying its daily operations. Users of Meteo-France productions are the public sector including policy-makers, armed forces, aviation and academics, large businesses and SMEs, and citizens.

Meteo-France enjoys a solid reputation across the world and is a strong player in major international and European organisations: WMO, ECMWF, EUMETSAT and EUMETNET.

Regarding air quality, Meteo-France coordinates the current CAMS Regional production service and provides the outputs of its chemistry-transport model MOCAGE. Additionally, Meteo-France actively contributes to PREV'AIR, the French ministry-driven service delivering operational air quality forecasts and maps concerning the world, Europe and France.

Air quality modelling and pollutant dispersion research has been conducted for more than 20 years. The National Centre for Meteorological Research (CNRM), a joint Meteo-France-CNRS laboratory, performs the research activities in the fields of chemistry, aerosols and air quality, mostly with MOCAGE.

Staff members and their role in CAMS_50.II

Gaelle Collin has been leading defence projects related to meteorology during 13 years at Meteo-France, in connection with NATO. As Head of the Atmospheric Environment and Health Team of the Meteorological Services Direction, she oversees the Meteo-France operational activities related to air quality, ash and nuclear pollutant dispersion. Gaelle coordinates the current CAMS Regional service; she will serve the same function under CAMS_50.II.

Marion Pithon has worked in the Meteo-France IT Department for 18 years, where she gained a strong experience in operational production systems and user support. At the Meteorological Services Direction she in charge of environmental issues and their health impacts. Following her technical involvement in the MACC projects, she leads the CAMS_50.I Distributed Regional Production WP. Under CAMS_50.II, she will serve as Production manager.

Helene Pech has worked in IT production environments for more than 30 years. Her areas of expertise include networking, security, and IT infrastructure. She has been largely involved in many IT-related projects, from conception to day-to-day management. She joined Meteo-France in 2015 and works as an IT architect. She leads WP5060 Bulk data services of the current CAMS_50. She will be involved as an IT architect in WP5060 of CAMS_50.II.

Sebastien Rouzeau joined Meteo-France in 2011; he is specialised in GIS field and in the output production of operational meso-scale model regarding atmospheric transport and dispersion. He has

[1] http://www.meteofrance.com

been involved since 2013 in the MACC projects as well as in the current CAMS_50, for which he contributes to the development of the Regional website and to specifications and implementation of CAMS metadata. In CAMS_50.II, he will lead WP5060.

Dr. Matthieu Plu is head of the research team on chemistry modelling and assimilation at CNRM. He obtained a PhD in meteorology in 2008 and Habilitation in 2017. He has been involved in the European air quality applications since 2013, being strongly involved in the MACC-II, MACC-III project, and holding the 'Scientific Manager' position of CAMS_50 until September 2018. In CAMS_50.II, he will be involved in the development of the scores and in MOCAGE.

Dr. Joaquim Arteta joined CNRM in 2009 as a post-doctoral researcher in the MACC projects, following a PhD in atmospheric chemistry. His expertise lies in numerical modelling of atmospheric composition (including air quality). He is largely involved in the development of MOCAGE; he will take part under CAMS_50.II in the implementation of new CAMS features into this model and their validation, as in the current CAMS_50; he will serve as manager of MOCAGE.

Dr. Mathieu Joly joined CNRM in 2005. He obtained a PhD in meteorology in 2007, with a strong expertise in statistical analysis of numerical simulations. Since then, he has been working on air quality modelling and verification. He was involved in the MACC, MACC-II and MACC-III projects and currently takes part in the current CAMS_50. He will be involved in the WP5010 and WP5050 of CAMS_50.II, thanks to his expertise in observation processing and scores.

Key facilities, infrastructure and equipment

Meteo-France is equipped with high-performance computing and storage facilities.

- **Hardware**: Bull supercomputer and operational production chain (“Soprano”). The deployment of 2 supercomputers has multiplied by 3 the actual power calculating system in comparison to the previous configuration installed in 2014. Total peak power: above 5 Petaflops.

- **Software**: MOCAGE model in different configurations and “Openwis” software.

Involvement in projects relevant to CAMS_50.II

Meteo-France is the Prime contractor for CAMS_50.I and takes part in 16 other Copernicus projects including C3S and CMEMS. It has been involved in CAMS_42 (inclusion of MOCAGE chemistry scheme in IFS) and CAMS_43 (aerosol development in IFS). It took part in the FP7 IMPACT2C project dedicated to the assessment of future air quality over Europe, and in some research projects for the preparation of future satellite missions such as ESA ISOTROP for the Sentinel-4 and Sentinel-5 missions. It terms of coordination, apart from CAMS_50.I Meteo-France manages the operational programmes EUMETNET E-SURFMAR and the EUMETSAT Satellite Application Facility on Ocean and Sea Ice.

Summary of proposed participation in CAMS_50.II

Involved in: all WPs, including WPs 5020 and 5030 for the development and production activities of the operational model MOCAGE. **Specific role:** overall Service coordination and day-to-day management (Prime contractor, Service coordinator and Service Office), Service technical coordination jointly with INERIS (Production manager / IT architect). **Activities main location:** Toulouse, France. **Provisional budget share:** €2,141,858.55 (≈ 36.6% of total provisional budget).

2.2.2 INERIS

The French National Institute for Industrial Environment and Risks (INERIS)[2] is a public industrial and commercial undertaking founded in 1990. A large part of the activity of the Institute is devoted to air quality: metrological and modelling tools are developed and assessed to contribute to a better understanding and management of atmospheric pollution. The INERIS expertise relies on both local sources (industrial, urban...) and transboundary air pollution. INERIS is involved in a large number of European working groups related to air quality assessment and air pollution impact, and provides technical support to national decision-makers in the field of air quality management.

Within this framework, INERIS brings its expertise to the Ministry for the Ecological and Inclusive Transition during the phases of negotiation and implementation of the Directives and protocols. INERIS develops, in partnership with the National Scientific Research Centre the chemistry transport model CHIMERE (www.lmd.polytechnique.fr/chimere/). INERIS ensures the continuous development of this model and the improvement of its capacities and performances through European research projects. INERIS operates the PREv'AIR system (www.prevair.org), the national air quality forecasting platform, since 2003 in cooperation with Meteo-France and the National Scientific Research Centre. INERIS runs operationally the CHIMERE model for PREV'AIR, which produces on a daily basis up to three days forecasts of ozone, particles and nitrogen dioxides concentrations at the global, European and French scales.

INERIS leads a number of technical and scientific projects that help to implementing coordinated actions related to strategic, methodological, technical aspects of air quality measurement and the modelling, including indoor air quality.

Staff members and their role in CAMS_50.II

Dr. Laurence Rouil is the head of the "Environmental modelling and decision-making" department at INERIS. Her main area of expertise is air quality modelling. Since 20 years, she has developed skill and competence being the leader of research activities closely linked to operational applications – the PREV'AIR system for instance. She participates actively to the definition of the air quality monitoring strategy in France. Since 2014, she is the chair of the EMEP Steering Body, EMEP being the programme which supports the work of the UN Convention on long Range transboundary air pollution. She takes part to management board activities related to several research EU projects. She will act as External Relations manager under CAMS_50.II.

Dr. Augustin Colette is Head of the Atmospheric Modelling and Environmental Mapping Unit. He has co-authored more than 60 peer-reviewed articles in the field of atmospheric modelling, with a specific interest in past and future evolution of air pollution. Since 2015, Augustin is chair of the Task Force on Measurement and Modelling in support of the UN Convention on Long Range Transboundary of Air Pollution. He is also a member of the Scientific Committee of the French Primequal Research Programme and editor for the journal Geosciences Model Development. He will act as Scientific advisor under CAMS_50.II.

Dr. Frederik Meleux is a R&D engineer who joined INERIS in 2005. At INERIS, he is in charge of the modelling activities in the framework of the PREV'AIR operational system that he coordinates since 2008. He is also responsible for its evolution and quality assurance. To this need, he supervises a number of activities and projects related to data assimilation and model evaluation. He participated to the Copernicus/GMES-atmosphere projects (GEMS, PROMOTE, MACC suite). He also works on the

[2] https://www.ineris.fr/fr/presentation

analysis of the climate change impacts on future air quality through European projects like ATOPICA. He will act as Re-analysis manager under CAMS_50.II.

Dr. Anthony Ung is R&D engineer who joined INERIS in 2007. His doctoral thesis dealt with air quality mapping using multi-sources data. At INERIS, he is involved in several national and European air quality projects such as PREV'AIR, CITEAIR2 and the Copernicus/GMES projects. His field of expertise is data assimilation, mapping and scripting tools for operational post-processing and validation of modelled data. Under CAMS_50.II, he will contribute to observation acquisition and processing and will support the technical activities for the re-analysis processing.

Key facilities, infrastructure and equipment

For its activities in air quality modelling, INERIS relies on two high performance computing clusters, one for the daily operational activities and the other one for development and operational activities with less time constraint. The first one, which is the PREV'AIR cluster, is made of 400 cpus with more than 100 To of rapid storage and is hosted at Meteo-France and benefits from a specific IT team dedicated to the supervision of HPC activities including all the system monitoring in 24/7. The second one is part (1.5 %) of the large computing centre of CEA (French Alternative Energies and Atomic Energy Commission) which is called CCRT made of several computers for a total of more than 500 Tflops with a large storage capacity associated.

Involvement in projects relevant to CAMS_50.II

INERIS has been involved in all the projects that prepared the implementation of the operational Copernicus Atmosphere services from GEMS (FP6) and PROMOTE (ESA service Elements) to the MACC suites. In this framework, INERIS led the production of yearly-validated air quality re-analyses concerning Europe. Activities that INERIS has continued to have in charge during the CAM50.I services.

CITEAIR2: INERIS developed robust methodologies to improve air quality forecasts over Europe, especially to obtain more accurate predictions of the urban background concentrations. This is now implemented in the official forecast within the PREV'AIR system.

EURODELTA III: The scope of EURODELTA III coordinated by INERIS is to assess model performances against the EMEP field measurement campaigns. It also includes a retrospective analysis of air quality over the policy horizon of the Convention on Long Range Transport taking 1990 as a starting point.

EC4MACS: a consortium of leading scientific institutions who has developed a toolbox to explore the synergies and interactions between climate change, air quality and other policy objectives.

ETC/ACM: the Topic Centre on Air pollution and Climate Change Mitigation of the European Environment Agency. Since 2011, INERIS is one of the members of the Topic centre providing expertise in the field of air quality modelling and mapping, and also contributes to air quality monitoring strategies.

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5000, 5010, 5040, 5050, 5070, as well as WPs 5020 and 5030 for the development and production activities of the operational model CHIMERE. **Specific role:** overall Service coordination jointly with Meteo-France (Laurence Rouil as external Relations manager), Service technical coordination jointly with Meteo-France (Frederik Meleux as Re-analysis manager), Service scientific coordination (Augustin Colette as Scientific manager). **Activities main location:** Paris and Toulouse, France. **Provisional budget share:** €821,268.25 (≈ 14% of total provisional budget).

2.2.3 FMI

The Finnish Meteorological Institute (FMI)[3] is designated by the Finnish government as national air quality expert with a mandate to produce information and forecasts on the state of the atmosphere and its characteristics, with the aim of promoting safety and serving various needs of the public, industry and commerce, as well as contributing to scientific ends. FMI makes observations of physical state of the atmosphere, its chemical composition, and electromagnetic phenomena. FMI also develops and applies numerical models – from urban to global scales – in order to analyse and forecast various atmospheric physical and chemical processes. FMI employs about 550 people, about 150 of which are involved in research. The modelling teams have extensive experience in developing and implementing various numerical systems, from urban pollution models up to global stratospheric ozone studies.

Scientists from the Atmospheric Composition Research and Production departments of FMI will be involved in CAMS_50. The Atmospheric Composition research division has as its main task to investigate, monitor, model and report on air quality and its influencing factors. The Finnish government has designated FMI as the national air quality expert.

FMI is involved in numerous international co-operative, research and assessment efforts. Current projects involve the following activities: monitoring of air quality and atmospheric composition (e.g., EMEP, HELCOM/EGAP, WMO/GAW, AMAP), research and development in air chemistry and aerosol physics (including in particular one National and two Nordic Centres of Excellence, ACCENT, EC/Environment), assessment and modelling of the dispersion, transformation and deposition of airborne pollutants from the local to the continental scale (AirQast, PAPILA, EUNADICS, MarcoPolo, PASODOBLE, HIALINE, TRANSPHORM, PESCADO, PEGASOS, CAIR4HEALTH, ACCENT, GEOmon, ESA GlobEmis, EUMETSAT O3M SAF and others; contributed to the AQ assessments within IPCC, UN/ECE EMEP and IM, HELCOM, WMO/GAW, AMAP, GEOSS, etc.).

FMI is the designated institute in Finland for monitoring air quality. It performs AQ measurements over the country territory, maintains the infrastructure and databases, and reports the data to European Environment Agency and other international bodies.

Key team members

Research Prof., Dr. Mikhail Sofiev has over 25 years of experience in atmospheric composition research and model development, coordinator of the SILAM team, deputy leader of the FMI AQR Modelling Group and Adjunct Professor at University of Helsinki. He has an extensive experience in development and application of air pollution models at various scales – from meso- to hemispheric scales – and for various compounds – acidifying, toxic, aerosol, and radioactive accidental releases – and in related fields: model verification, statistical methodology, data analysis, computer experiments, etc. He coordinated FMI modelling work in numerous international projects, coordinated Finnish national projects POLLEN, IS4FIRES, and ASTREX, was a leader of the PASODOBLE AQ sub-project DS-PUBLIC, etc. M.Sofiev is author of over 211 scientific publications (h-index 35), 114 of which in peer-reviewed journals and series. M.Sofiev is a member of WMO Scientific Advisory Group on Applications, European Aerobiological society, European Academy of Allergology and Clinical Immunology, Board member of European Aeroallergen Network, member of Finnish emergency preparedness team, and

[3] http://en.ilmatieteenlaitos.fi/

has contributed into policy advisory boards. His role in CAMS_50.II will be coordination of SILAM team, pollen modelling and data assimilation.

Adj.Prof. Dr. A. Karppinen has over 30 years of experience in AQ research and model development. He is currently leading a research group (20 researchers) on Atmospheric Dispersion Modelling. The research group is working in 15 internationally funded (EU, ESA, ESF) and 10 nationally funded research and networking projects. He is the author of more than 300 scientific publications; 70 of these in refereed international journals (h-index 29). He has been working in 19 EU-funded projects, including vice-coordinator position in EU/MARQUIS project and scientific and technical coordination of EU/PESCaDO project. His role in CAMS_50.II will be coordination of the modelling work, data assimilation and fusion techniques.

Dr. Rostislav Kouznetsov has over 15 years of experience in atmospheric physics, in observational and modelling aspects. He is currently on of the main SILAM developers, responsible for its operational applications, also strongly contributing to its scientific agenda, in particular, numerical aspects and physical parameterizations. R.Kouznetsov is an author of over 100 scientific publications, 40 of which are published in peer-reviewed journals, books and series (H-index 15). In CAMS_50.II he will be responsible for the SILAM model activities falling under WP5030, also will also contribute to model development and evaluation.

Key facilities, infrastructure and equipment

The FMI supercomputer facility consists of two identical Cray XC40 systems with 172 compute nodes of 28 (56 hyperthreading) cores. Each node has 128GB RAM. Peak performance is 1035 GFLOP per node, or 178 TFLOP in total. It is accompanied with 960-TB fast-access storage and a tape archive of essentially unlimited capacity. The system is equipped with all necessary software for large-scale computations, data processing, archiving, visualization and dissemination.

Involvement in projects relevant to CAMS_50.II

CAMS_50 (2015-2018) regional AQ forecasting ensemble, one of the regional models, responsible for pollen line development. GLORIA (2017-2020) Global health risks related to atmospheric composition and weather. Finnish Academy. Long-term re-analysis of global/European AQ and pollen exposure. BATMAN (2015-2018) Environmental impact assessment of airborne particulate matter: the effects of abatement and management strategies. Academy of Finland. High-resolution (1km) AQ assessment for Finland. EUNADICS-AV (2016-2019) European Natural Airborne Disaster Information and Coordination System for Aviation. EU Horizon 2020. Responsible for the data assimilation developments WP. NeGI NCOE (2014-2017). Ensemble-based methods for environmental monitoring and prediction. Responsible for atmospheric applications. CarboNord (2014-2016) Impact of black carbon on air quality and climate in Northern Europe and Arctic. Nordic Ministry of Research. Project coordination and one of the models. Ragweed (2011-2012). Assessing and controlling the spread and the effects of common ragweed in Europe. Responsible for the modelling part of the project.

Summary of proposed participation in CAMS_50.II

Involved in: WP5050, as well as WPs 5020 and 5030 for the development and production activities related to the operational model SILAM. **Specific role:** advisor for pollen-related tasks. **Activities main location:** Helsinki, Finland. **Provisional budget share:** €395,203.33 (≈ 6.8% of total provisional budget).

2.2.4 FZJ-IEK8

Forschungszentrum Julich GmbH (FZJ-IEK8)[4] is a large research institution within the Helmholtz Society. As part of it, Institute IEK-8 explores the chemistry of the troposphere, performs global observations, and simulates atmospheric chemistry and transport processes by numerical models. IEK-8 investigates the physical and chemical processes in the troposphere, which have a major impact on the chemical composition of the atmosphere. The processes include (1) the natural and anthropogenic emissions of trace substances at the earth's surface, (2) the chemical transformation of compounds in the atmosphere, and (3) the distribution of pollutants by atmospheric transport. The research focusses on the long-term observation of atmospheric trace gases, the understanding of atmospheric self-cleaning, and the formation and aging of aerosols. Observations and experimental results form the basis for the development of improved atmospheric models that are being used for predictions of regional air quality, and atmospheric chemistry and climate interactions.

Scientists who are partner in this proposal are members in the research group “Data Assimilation and regional modelling”.

The institute has now more than 10 years of experience regarding the development and application of chemistry-transport modelling (EURopean Air pollution Dispersion-Inverse Model, EURAD-IM). During this period, some advanced features were first developed worldwide: European scale aqueous phase chemistry in tight coupling with the cloud module of the meteorological driver model in the framework of the EUROTRAC programme, nesting technique from hemispheric scale down to 1 km grid resolution on a local scale. Furthermore, the implementation of a parallel model version with full dynamic load balancing allows for an efficient integration on massively parallel computer platforms. With the development of the aerosol modules MADE (Modular Aerosol Dynamics for EURAD/Europe) and SORGAM (Secondary ORGanic Aerosol Module) advanced aerosol dynamics and chemistry features were introduced to multiscale chemistry transport modelling with anthropogenic and biogenic emissions. Other modelling groups over Europe and meanwhile the US now broadly adopt both modules. Most importantly for this proposal, with the development of the adjoint EURAD-IM model and associated system components, EURAD-IM is still one of the very few research groups with chemical four-dimensional variational data assimilation system for the troposphere worldwide, which could prove its beneficial effects for ozone and other constituent forecasts in case studies. Emphasis is placed on the assimilation of aerosol retrievals obtained from the combination of the SCIAMACHY and AATSR sensors onboard of ENVISAT.

Key team members

Dr. Hendrik Elbern received this PhD in meteorology in 1990. In 2001, he received his habilitation (associate professor). He is currently a senior scientist in the Rhenish Institute for Environmental Research at the Univ. of Cologne (and affiliated with the research centre Julich). His special research areas are chemical data assimilation and inverse problems in the atmosphere, where he delivered pioneering contributions by introducing 4Dvar technics, and soils, parallel computing and numerical solution of atmospheric transport- diffusions- reaction equations, dynamics of stratospheric-tropospheric exchange. He has acted as PI for several national, ESA and EC funded projects (starting with FP 4 ongoing), mostly in the realm of data assimilation for GMES activities. He has coordinated the consortium of the national funded project EURAD-IM regional inverse modelling development with adjoint modelling, and SACADA, introducing novel techniques to stratospheric data assimilation. He is also engaged in scientific education at the University of Cologne, by lecturing and supervising

[4] http://www.fz-juelich.de/portal/EN/

PhD students. Hendrik Elbern is also affiliated with the Institute of Energy and Climate Research 8 (Troposphere) of the Research Centre Julich. In CAMS_50.II, he will act as scientific advisor for the FZJ-IEK8 team.

Dr. Elmar Friese received his Ph.D. in Geophysics at the University of Cologne in 2008 and joined the Rhenish Institute for Environmental Research in 1997. His main field of Research is the formation and transport of atmospheric particles and their interaction with the gas phase and clouds. He participated in the Aerosol Research Focus (AFS) of the BMBF and in several projects of the environmental agency of Northrhine-Westfalia (LANUV) and the German Environmental Agency (UBA). He worked within the EU projects ASSET, GEMS, PASODOBLE, and MACC (I-III) on air quality forecasting and assimilation of chemical data. A special field of interest is the development of numerical schemes for chemistry transport models, including the parallelization of numerical codes, and the development of air quality forecasting systems. He is author and co-author of several articles in scientific journals. In CAMS_50.II, he will be involved as model manager in WP5020 and WP5030 as in CAMS_50.I.

Key facilities, infrastructure and equipment

Hardware: IEK-8 exclusively disposes of a medium size Intel Xeon Linux Cluster under permanent technical attendance and scientific supervision. Twelve nodes of this cluster with 512 cores in total-connected via Infiniband - are dedicated to the CAMS 50 air quality service. The cluster has been extended in several steps, according to the needs invoked by EC MACC and CAMS 50.I projects and has proven very high reliability.

The IEK-8 has access to ECMWF's High Performance Computing Facility (HPCF), were fully autonomous backup runs of IEK-8's CAMS 50 air quality service are performed. The super computer JURECA at the Julich Super Computer Centre (JSC) is used for the production of CAMS 50 re-analyses.

Software: Key software is the EURopean Air pollution Dispersion-Inverse Model (EURAD-IM), developed at the Rhenish Institute for Environmental Research at the University of Cologne (RIUUK) since the late 80th, now also used at IEK-8 and operated by EURAD-IM developers with long-time experience in air quality modelling. EURAD-IM includes all state-of-the-art process describing modules, most prominently dynamic and thermodynamic aerosol module MADE, secondary organic aerosol module SORGAM and adjoint components. The system has been developed and matured through participation in GMES and Copernicus projects GEMS, PASODOBLE, MACC I-III, and CAMS.

Involvement in projects relevant to CAMS_50.II

As partners in projects GEMS, MACC I-III, CAMS_50, PROMOTE I-II and PASODOBLE, the research group was part of the operational air quality forecast and earth observation efforts of the European Union and ESA from its outset.

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model EURAD-IM. **Activities location:** Julich, Germany. **Provisional budget share:** €385,021.74 (≈ 6.6% of total provisional budget).

2.2.5 KNMI

The Royal Netherlands Meteorological Institute (KNMI)[5] is the national meteorological service of the Netherlands and an integral part of the Ministry of Infrastructure and Environment. The institute combines in house operational as well as strategic research tasks. KNMI provides on a day-to-day to multi-annual basis advice on weather, climate, air quality and seismological risks to national, regional and local authorities. For this, it maintains national geophysical observational networks and it develops models.

The division R&D Modelling develops regional weather forecast (Hirlam/Harmonie), climate (Racmo, Harmonie) and air quality (Lotos-Euros) models and it is involved in the further development of the global climate model EC-Earth and the global chemistry models TM5 and C-IFS.

The division Information and Chain Management is responsible for keeping the KNMI infrastructure (supercomputer, network, etc.) at De Bilt operational on 24/7 basis. The Dutch national air quality model Lotos-Euros is run operationally there by them to produce the daily air quality forecasts for the Netherlands that are presented on the website of the Environmental Institute (RIVM, lml.rivm.nl) and the European air quality forecasts that are presently part of the CAMS_50 regional ensemble.

The division R&D Satellite Observations is strongly involved in satellite observations of atmospheric composition, formerly as co-PI of GOME and SCIAMACHY and presently as PI of the OMI and TROPOMI instruments. The latter is planned to be launched in 2016 as part of the Sentinel 5-Precursor mission. The OMI observations are presently assimilated in LOTOS-EUROS and TROPOMI observations are planned to be assimilated in the near future.

Key team members

Dr. Henk Eskes is a senior scientist with extensive expertise on chemical data assimilation and retrieval of satellite observations e.g. of ozone and NO_2. He has set up the operational air quality forecasting system for the Netherlands and has been involved in the series of precursor projects that have developed the models and data assimilation capabilities for CAMS, namely the EU projects GEMS, MACC, MACC-II and MACC-III. He has been a member of the management team in these projects, and is co-ordinating the validation sub-project in MACC-II-III and currently CAMS_84. He has also participated in many other EU projects (SODA, DARE, GODIVA, ASSET, EVERGREEN, GOA). He will contribute to the evaluation of the KNMI WP5030 output and to the development activities in WP5020.

Dr. John Douros is a scientist specializing in meteorological and photochemical dispersion modelling. He has been actively involved in several EU funded projects in the past, including the FP7 projects MEGAPOLI, TRANSPHORM and APPRAISAL. He currently performs most of the CAMS_50 activities at KNMI and is also involved in CAMS_84. He will perform most of the activities in WP5030 and contribute to the development activities in WP5020.

Dr. Peter van Velthoven is a senior scientist with more than 30 years of experience in atmospheric research, mostly on atmospheric chemistry and transport topics. He has more than 140 peer-reviewed publications. He advises the Dutch Ministry of Infrastructure and the Environment on issues related to the Montreal and Kyoto Protocols and he is a member of the Impacts and Science Group (ISG) that advises ICAO-CAEP on climate and air quality impacts of aviation. Since 1990 he has been involved in

[5] https://www.knmi.nl/over-het-knmi/about

numerous EU funded projects, most recently as PI in I-GAS, QUANTIFY, AMMA, and GEOMON, and as coordinator of HYMN. He will coordinate the KNMI contribution to the project.

Key facilities, infrastructure and equipment

Hardware: Supercomputer (Bull), storage (disk/tape archive), network and internet facilities available (monitored) 24 hrs/7 days.

Software: LOTOS-EUROS Air Quality Model including Data Assimilation and required software libraries (netcdf, hdf, etc.) and Software shell for running KNMI's operational applications

Additional capabilities brought by TNO (KNMI IT solutions provider):

The modelling team has access to TNO's Dell High Performance Cluster with 350 cores and access to storage facilities. No accounting is needed, and batch jobs are executed almost without delay. Operational services of TNO are run on KNMI facilities, see E-capability KNMI.

Summary of proposed participation in CAMS_50.II

Apart from CAMS, the KNMI team has since 2001 been involved in a large number of EU projects related to CAMS, including SODA, GOA, ASSET, PROMOTE, GEMS, PASODOBLE, and MACC1-3.

KNMI participated in the MACC (Monitoring Atmospheric Composition and Climate) projects where they provided air quality forecasts for the European regional model ensemble, provided OMI satellite observations, and contributed to the development of C-IFS. KNMI participates in several CAMS subprojects a.o. CAMS_50, _42, and _84.

PASODOBLE (Promote Air quality Services integrating Observations -Development Of Basic Localised Information for Europe) was an FP7-SPACE-2009-1 project that developed and demonstrated user-driven downstream information services for the regional and local air quality sectors. These services are still operational.

KNMI is the PI of the presently operational Ozone Monitoring Instrument (OMI) and Tropospheric Ozone Monitoring Instrument (TROPOMI).

KNMI led work-package 2 of the EU I-GAS project, which develops the use of IAGOS passenger aircraft observations for use in CAMS and for Copernicus satellite validation.

Contribution foreseen to CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model LOTOS-EUROS. **Activities main location:** De Bilt, The Netherlands. **Provisional budget share:** €385,134.93 (≈ 6.6% of total provisional budget).

2.2.6 TNO (subcontractor to 05a KNMI)

The Netherlands Organization for Applied Scientific Research (TNO)[6], with its Head Quarters based in The Hague, is The Netherlands' largest knowledge organization, with approximately 3000 employees, servicing companies, government bodies and public organizations. TNO had a an annual turnover of more than 500 million euros.

TNO is an independent research organization whose expertise and research make an important contribution to the competitiveness of companies and organizations, to the economy and to the quality of society as a whole. The Climate, Air and Sustainability (CAS) department has a strong track record on air quality and natural and anthropogenic emissions. The department investigates the emissions and processing of anthropogenic pollutants in the atmosphere and their influence on the environment and climate change. For this, the department developed, tested and applied the modelling system LOTOS-EUROS, that is capable of assimilation of in situ observations and satellite data.

Within the department global and European emission inventories are constructed for air pollutants, such as NH_3, NOx, SO2, NMVOC, PM10, metals and persistent organic pollutants (POPs). TNO is responsible for the European anthropogenic emission data (within CAMS-81) used in the CAMS_50 project.

Key team members

Within the CAS department, the air quality modelling team is primarily focusing on the use of the LOTOS-EUROS chemistry transport model for air quality applications. These applications include air quality forecasts and analyses over the Netherlands and Europe in collaboration with Dutch Institute for health protection and the environment (RIVM) and Royal Dutch Meteorological Institute (KNMI). More recently a model version applicable over other regions outside Europe such as China and Brazil has been developed. Other examples of applications produced by the team are: emission (trend) estimates from combined use of the model with (satellite) observations, source apportionment of limit value exceedances, scenario studies, deposition studies and the study of air quality and climate interactions.

The team is responsible for the continuous development and improvement of the LOTOS-EUROS model and its data assimilation system (based on the ensemble Kalman filter approach). The LOTOS-EUROS regional air quality model is one of the 7 models in the Copernicus regional air quality (and MACC) ensemble since 2008, and is operated as a joint effort between KNMI (Royal Netherlands Meteorological Institute) and TNO. Daily operational forecasts and data-assimilated analyses are performed, as well as yearly re-analysis of past air quality.

The key staff members from TNO that will be involved in this work are:

Richard Kranenburg (TNO): Richard Kranenburg has more than 10 years of experience in air quality modelling on regional and local scales. He contributed to the development of the LOTOS-EUROS model with respect to the physical parameterizations, the numerical methods, and the source apportionment capabilities. In the CAMS_50.II project he will contribute to the development of the LOTOS-EUROS model and the operational performance.

Dr. Arjo Segers (TNO): Arjo Segers is a leading expert on data assimilation in atmospheric chemistry modelling. He has 20 years of experience as a research scientist in the field of atmospheric chemistry

[6] https://www.tno.nl

modelling. During this period, he worked with and contributed to the regional LOTOS-EUROS model, as well as the global TM5 model and their various data assimilation systems. In CAMS_50.II, he will work on further development and implementation of the LOTOS-EUROS model, the data assimilation system and the production of the air quality re-analyses.

Dr. Renske Timmermans (TNO): Renske Timmermans is working in the field of atmospheric measurements, dynamics and chemistry for 20 years. Currently as scientist and project leader on regional air quality modelling at TNO. She has participated in both national and international projects with a focus on air quality forecasts and data assimilation of both ground based and satellite observations. In CAMS_50.II, she will coordinate the TNO activities and contribute to the model evaluation.

All three members are at fixed positions within TNO.

Key facilities, infrastructure and equipment

Please refer to the KNMI track record.

Involvement in projects relevant to CAMS_50.II

MACC II /MACC III/CAMS: The Monitoring Atmospheric Composition and Change (MACC) and Copernicus Atmosphere Monitoring Service (CAMS) projects represent the atmospheric core service of the EU Copernicus programme. TNO is participating in CAMS_50, CAMS_71 and CAMS_81. CAMS_50 combines state-of-the-art atmospheric modelling with Earth observation data to provide services covering European air quality for recent years, present conditions and forecasts of the distribution of key constituents for a few days ahead. TNO is active within CAMS_50 through the provision of re-analyses and forecasts of atmospheric pollution with the LOTOS-EUROS model. Within CAMS_81 TNO is providing the emission data on European anthropogenic and natural aerosol components used by all the regional modelling teams. Within CAMS-71 TNO provides information on source contributions to exceedances of air quality limit values based on the LOTOS-EUROS model and a source apportionment tool.

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030, to contribute to the development and production activities related to the operational model LOTOS-EUROS. **Activities main location:** Utrecht, the Netherlands. **Provisional budget share:** N/A (subcontracting expenditure included in KNMI's provisional budget).

2.2.7 MET Norway

The Norwegian Meteorological Institute (MET Norway)[7] is the national meteorological service of Norway and represents Norway in ECMWF, EUMETSAT, EUMETNET, WMO and other international forums. It takes part in international projects - funded by the EU and other bodies - on marine and atmospheric research, including climate change and air pollution research. The institute employs about 400 persons, among them 80 scientists doing research within numerical weather prediction, ocean modelling, remote sensing, air pollution, product development, instrumentation, climatology and climate research. MET Norway has extensive experience in developing methods and operational applications, which have led to innovation and added value for both the private and public sectors.

Air pollution research is performed within the Division of Climate Modelling and Air Pollution, which is part of the Research and Development Department at MET Norway. The division has a strong operational component turning research findings into products to meet the needs of policy makers, public authorities nationally or internationally, as well as the research community and the general public. These products include not only daily operational air pollution forecasts and analyses, but also emergency modelling in the case of volcanic eruptions or nuclear accidents.

MET Norway hosts MSC-W (Meteorological Synthesizing Centre - West), which is one of the scientific centres within the European Monitoring and Evaluation Programme (EMEP) under the UN ECE Convention on Long-range Transboundary Air Pollution (CLRTAP). EMEP provides the technical underpinning for air pollution policies within CLRTAP and also for the EU. Through its long-term involvement in EMEP and its support of the EU Thematic Strategy on air pollution, MET Norway has the capability and mission to provide services in air pollution abatement and in the understanding of the coupling of climate/weather variability and air pollution, beyond the duration of single projects.

As the national meteorological service of Norway, the institute has extensive and stable access to high performance computing resources in Norway.

Key team members

Dr. Michael Gauss received his PhD in atmospheric chemistry in 2003 at the University of Oslo, where he continued working in the field of atmospheric science until 2010. He has been employed at MET Norway since 2006 and was acting Head of the Division of Climate Modelling and Air Pollution in 2010 and 2011. He has co-authored more than 40 peer-reviewed publications and has contributed to two IPCC assessments. He has gained international experience through his participation in more than twenty EU-funded projects focusing on atmospheric chemistry and climate change, and the EMEP programme funded by the UN ECE. He coordinated the EU FP7 project CityZen and the policy support sub-projects of MACC-I/II/III. He is now coordinating the Norwegian-Chinese collaboration project AIRQUIP which is a downstream user of CAMS products. In CAMS_50.II, his main role will be to plan and coordinate the MET Norway team contribution (IT, scientific developments, operational work).

Dr. Alvaro Valdebenito received his PhD in natural sciences in 2008 at the University of Hamburg for his work at the Max Planck Institute for Meteorology between 2004 and 2007. He has been employed at MET Norway since 2008, where he has worked on the development of the EMEP MCS-W model and the implementation of air pollution forecasting and analysis capabilities. He has been strongly involved in the development parts of GEMS, the MACC projects and in CAMS_50, in addition to the national efforts for emergency (volcanic eruptions, nuclear accidents) modelling and forecasting. For CAMS_50.II, he will be the main technician at MET Norway and the main developer of the data

[7] https://www.met.no/en

assimilation system and the EcFlow scripting that controls MET Norway's operational products. He is also main responsible for the pollen modelling and for keeping the EMEP model up to date.

Mrs. Anna Benedictow received her Master of Science in fluid mechanics in 2000 at the University of Oslo, and has been employed at the Norwegian Meteorological Institute since 2001. Mainly involved in the work of the EMEP Centre MSC-W she has been very active in the modelling and reporting work for the EMEP programme under the UN LRTAP convention. In particular she has been involved in producing and analysing meteorological fields, inter alia from ECMWF-IFS, for air pollution modelling, and in the implementation and operationalization of the EMEP forecast chain during MACC-III and CAMS_50.I. In CAMS_50.II, she will be mainly involved in the daily routine work and will assist Alvaro Valdebenito in the daily monitoring of the operational chain as well as software maintenance.

Key facilities, infrastructure and equipment

As the national meteorological service of Norway, and as a governmental body, MET Norway has extensive and stable access to High Performance Computing resources. Currently, we are using Alvin (https://www.nsc.liu.se/systems/alvin/) at the National Supercomputer Centre at Linköping University, which is operated for MET Norway for weather forecasting and other operational services. It is used by both SMHI and MET Norway through the 'MetCoOp' collaboration project. The Alvin cluster has a LINPACK performance of approximately 108 Teraflop/sec using all 6,880 compute cores. We are using the EcFlow scripting system. As software, the EMEP MSC-W model is used (Simpson et al., 2012).

Involvement in projects relevant to CAMS_50.II

MET Norway was partner in the GEMS project, all the MACC projects, and has been one of the operational model teams in CAMS_50. MET Norway is also involved in other CAMS contracts (43, 71, 81, and 84), in some of them with WP leader roles.

MET Norway, as host of the Meteorological Synthesizing Centre – West under the European Monitoring and Evaluation Programme (funded by the UN ECE), receives continuous funding for model development and maintenance to support its work for the UN Convention on Long-Range Transported air pollution. This is long-term funding, which helps MET Norway to keep the EMEP air quality model up-to-date with respect to new research findings.

MET Norway has received funding from the Norwegian Airport operator Avinor and the Norwegian Radiation Protection Authority to develop the eEMEP forecasting suite, that can be used at short notice for dispersion modelling, e.g. after volcanic eruptions or nuclear accidents. Synergies between eEMEP and the operational air pollution forecasts have been fully exploited during the MACC projects and CAMS_50/71 (e.g. with respect to the operational provision of meteorological data).

MET Norway participates in a large number of research projects, where the EMEP model is continuously evaluated against measurements of a large number of chemical parameters, and applied for cutting edge research. As the coordinator of the Norwegian-Chinese collaboration project AirQuip, and partner of the EU-H2020 project PAPILA, MET Norway also acts as a user of CAMS products.

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model EMEP. **Activities location:** Oslo, Norway. **Provisional budget share:** €385,277.50 (≈ 6.6% of total provisional budget).

2.2.8 SMHI

The Swedish Meteorological and Hydrological Institute (SMHI)[8] has about 650 employees and is an expert agency under the Environment and Energy Ministry with a mandate to work with meteorology, climatology, hydrology and oceanography. With the help of supercomputers, computational models, statistics and research our experts produce forecasts, decision support, climate scenarios and investigations relating to physical and chemical processes in the geo-biosphere.

SMHI's Research Department develops knowledge and tools to describe the key processes in the atmosphere, in the ocean and on land. Our researchers develop advanced models and techniques to use observations for making forecasts and model-based analyses. SMHI has lead and participated in a range of Copernicus developments projects and precursor EU framework programme projects, such as GEMS and MACCI/II/III air quality, EURO4M and UERRA on historical climatology, SWICCA, on sectorial information systems for C3S. SMHI currently leads one research service on global climate services for the water sector and one service for European climate projections in C3S. The Air Quality Research Unit is the main developer of the MATCH CTM. Within the proposed project, researchers from the Air Quality unit will work to further develop the MATCH following new requirements and modules available from CAMS model development activities.

SMHI's Core Services operates the meteorological, hydrological and oceanographic infrastructure in Sweden. The department operates several observation systems and is responsible for making data accessible according to EU open data strategy and the INSPIRE directive. Within the proposed project Core Services will operate the daily production of air quality forecasts. SMHI core services currently runs the EFAS dissemination centre in EMS. They also lead the European re-analysis service in C3S and participate in the Baltic part of both operational and development of the marine services in CMES.

SMHI's Professional Services provides a wide range of forecasting and professional services tailored to the needs of different users. In addition to industry-specific forecasting services, a large part of the assignments deal with climate and environmental issues related to air and water. Customers can be found nationally and internationally in the areas of social structure, energy, environment, shipping, media and capacity development. Target groups include commercial customers, agencies and individuals. Within the proposed project Professional services will be responsible for the production of re-analysis products.

Key team members

Lennart Robertson (role System responsibility) is a senior meteorologist and is one of the key persons behind the MATCH model.
Professor Michael Kahnert (role Scientific Support**)** is a physicist working with more long experience in atmospheric optics, radiative transfer, and inverse modelling.
Dr Robert Bergström (role Scientific Support) is a chemist and physicist, a key person for the chemistry in MATCH including biomass combustion, anthropogenic and biogenic VOCs and sea salt.
Associate Professor Joakim Langner (role Scientific Support) is a senior air quality researcher with long experience of atmospheric modelling on regional and global scales.
Helene Alpfjord (role Re-analysis responsibility) is an engineering mathematician working with air quality modelling involving regional re-analysis and dispersion modelling with the MATCH CTM.

[8] https://www.smhi.se/en

Dr. Erik Engström (role Project Manager) is an atmospheric chemist working as project manager and with customer relations in the air quality sector at SMHI.
Ana Cristina Carvalho (role Model assessment of new developments) is a senior researcher with experience with both regional air quality and weather models.

Key facilities, infrastructure and equipment

The key facilities used by SMHI are: 1) Linux based compute-, storage- and network servers at SMHI with secure and high bandwidth connections to the National Supercomputer Centre in Linköping, NSC, and to ECMWF as well as general purpose high bandwidth Internet connection. 2) Super computer resources at NSC consist of access to dedicated computer nodes for running 3Dvar analyses: 3) Access to compute cluster and servers at ECMWF, currently running CRAY Linux based compute clusters, where the MATCH forecasts are run.

Involvement in projects relevant to CAMS_50.II

CAMS_50 (ongoing): SMHI is participating in the regional part of CAMS – Copernicus Atmospheric Monitoring System. The involvement is contributions to the operational services regarding chemical weather forecasts and analyses.

MACC-II/III (2008-2015): SMHI has been participating in the different projects from GEMS to MACC-III with development of, and operation of forecasting and data assimilation of chemically reactive substances for the European region.

Emergency preparedness system (ongoing). SMHI is running an emergency preparedness system (BAPS) on behalf of Swedish Radiation Security Authority and Swedish Civil Contingencies Authority and applied to nuclear power accidents, volcanic eruptions, forest fires and airborne animal infections. Both automatic and on-demand simulations may be handled by the system. The BAPS system is used in multiple projects at SMHI, including 24/7 preparedness systems.

Environment surveillance (ongoing). Regional background concentrations and depositions of ozone, nitrogen dioxide and sulfur dioxide are assessed yearly as a part of the Swedish National Environmental Monitoring Program on behalf of the Swedish Environmental Protection Agency.

NordicWelfAir (ongoing): The project aim towards understanding the link between Air pollution and Distribution of related Health Impacts and Welfare in the Nordic countries.

EUNADICS-AV H2020 (ongoing): The project EUNADICS-AV undertakes to develop and test a unique system to provide consistent and coherent information to aviation authorities, airlines and pilots in the event of a natural disaster affecting the airspace, which, if successful, would greatly enhance the resilience of one of the most critical infrastructures of the 21st century.

SIMAIR (ongoing): SIMAIR, the Swedish national air quality system, is a coupled model system with a user-friendly web-based interface that can be used by Swedish municipalities to calculate concentration levels in comparison with the limit values according to the EU Air Quality Directive (2008/59/EC).

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model MATCH. **Activities main location:** Norrkoping, Sweden. **Provisional budget share:** €385,514.29 (≈ 6.6% of total provisional budget).

2.2.9 AU

The Aarhus University (AU)[9], Denmark is a leading university with 40,000 students; about 1,800 PhD students and close to 900 postdoctoral scholars together with 11,500 employees. AU has been establishing itself as a university for cutting-edge research, and has been moving up the most important university ranking lists. Department of Environmental Science (ENVS-AU), is the sole operator of the Danish national air quality monitoring network (ISO 17025), and responsible for managing the national air quality databases. A unique expertise at ENVS-AU is the assessment of human exposure to airborne pollutants through the routinely applied air pollution forecasting and assessment system THOR, and the integrated model system EVA (Economic Valuation of Air pollution) for assessment of health impacts and related society cost from air pollution. Central for the THOR and EVA systems is the Danish Eulerian Hemispheric Model (DEHM) developed by the modelling group at ENVS. DEHM is a three-dimensional, offline, large-scale, Eulerian, well-validated atmospheric chemistry transport model, that has been continuously developed since the early 1990's and used for a number of applications e.g. including data assimilation. As part of CAMS_50 it has been setup for Europe and e.g. developed to include pollen as well as input data from CAMS and ECMWF.

Key team members

The Atmospheric Modelling Section (ATMO) of ENVS-AU consists of ca. 10 scientists as well as a number of PhD/master students. Five of the permanent staff members in the group is primarily working on the continuous development, validation and operation of DEHM and the model system, THOR. This system includes several meteorological and air pollution models capable of operating for different applications and different scales down to individual street canyons in cities. Through these developments, the ATMO groups has built up competences necessary for producing timely air pollution forecasts and re-analyses. As part of the developments in CAMS_50, this has been extended to also include the data streams (in- and outputs) related to the regional production.

Dr. Ole Hertel is Professor and Head of the ATMO Section. He is taking part in the overall strategic development of the institute, the research areas and the advisory service, including customer service. He will be involved in the overall management of AU's part of CAMS_50_II.

Dr. Jesper H. Christensen has developed the DEHM model, which is central in the international Arctic Monitoring (AMAP) and the national monitoring programme as well as in many of the modelling activities at ENVS-AU. His key qualifications are atmospheric modelling, especially in development of chemical atmospheric transport and weather forecast models and application of models for air quality assessments. Jesper has been a key person in the development and maintenance of the operational version of DEHM in the current CAMS_50. He will continue this in WP5020 and WP5030 of CAMS_50_II.

Dr. Camilla Geels has contributed to the development and application of DEHM for about 18 years. She has experience from several international model intercomparisons, with focus on model differences and uncertainties. Camilla is an experienced project leader and is currently coordinating the large NordForsk project NordicWelfAir together with Prof. Jørgen Brandt. She has been and will be in charge of the coordination of AUs activities in CAMS_50 and now in CAMS_50_II and contribute to WP5020 and WP5030 of CAMS_50.II.

Dr. Ulas Im has been employed as a scientist in the modelling group since 2014. Before that he was engaged as a Post-Doc at the University of Crete, and at the Joint Research Centre (JRC). Has

[9] http://www.au.dk/en/

experience with e.g. computer science, statistics, validation, evaluation and visualization techniques for use in meteorological and air pollution models at all scales. He is one of the leading forces behind the AQMEII3 - Air Quality Modelling Evaluation International Initiative and is involved in CAMS_84. Will in CAMS_50_II be responsible for the evaluation of DEHM as part of WP5020.

Dr. Kaj Mantzius Hansen has also been contributing to the development of DEHM for more than 15 years. His main research interests are modelling of atmospheric transport/deposition and the impact of climate change as well as the environmental fate of contaminants. He is leading AUs work in CAMS_84. He has experience with assimilation of chemical data and will continue this work in CAMS_50_II.

Key facilities, infrastructure and equipment

The modelling group at Department of Environmental Science, Aarhus University applies the following facilities and hardware in order to carry out the described activities:

Linux cluster: 2x72core intel (196Gbyte RAM), 2x36core intel (132Gbyte RAM), 1x28core intel (265Gbyte RAM), 1x24 core intel (132Gbyte RAM), 11x48 core opteron (64Gbyte RAM), 2x64 core opteron (132GbyteRAM). File server with 180Tbyte disk capacity and a daily backup and we have planned to invest in a new file server with 300TByte.

The software components include the DEHM model code, netCDF/grib processing software packages, as well as CENTOS linux distribution 6.5, Portland fortran compiler, Intel fortran and C compiler, Intel MPI library.

Involvement in projects relevant to CAMS_50.II

CAMS_50 (ongoing): AU is participating in the regional part of CAMS as one of the new models. Funded through Copernicus.

CAMS_84 (ongoing): AU is responsible for collecting Arctic observations used in the global and regional a posteriori evaluation and quality assurance. Funded through Copernicus.

NordicWelfAir: AU is coordinating the interdisciplinary project: Understanding the link between Air pollution and Distribution of related Health Impacts and Welfare in the Nordic countries. Is e.g. in charge of high-resolution (1 km x 1 km) and decadal long air-quality modelling and health assessments. Funded through NordForsk.

EPITOME (ongoing): AU is coordinating the project: Emissions from shiPs and the Impacts on human healTh and envirOnMEnt in the nordic and Arctic - now and in the future and is responsible for air quality modelling and health assessments using the combined DEHM and EVA system. Funded by the Nordic Council of ministers (NMR).

NOVANA (ongoing): continuous monitoring and modelling of air quality as part of the Danish national Monitoring program for aquatic and terrestrial environment. Funded by the Danish Ministry of the Environment.

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model DEHM (former candidate system under CAMS_50.I). **Activities main location:** Roskilde, Denmark. **Provisional budget share:** €385,001.24 (≈ 6.6% of total provisional budget).

2.2.10 IEP-NRI

The Institute of Environmental Protection has a designation of a National Research Institute in the areas of environmental impact assessment, mitigation, atmospheric and climate modelling, emission management. The Institute is designated, as a primary provider in the area of air quality assessments and forecasts (Act of the Parliament of Poland, January 2018). The newly formed Department of Atmospheric and Climate Modelling employs highly qualified personnel that conducts research and applications in the areas of atmospheric processes modelling, air quality assessment and forecast, as well as urban meteorology. Also, the Institute participates in the EMEP Program (TFMM - Puszcza Borecka station) and acts as the National Reference Centre for air emissions and climate change data with respect to EEA and the EIONET network.

Members of the Department carried out operational air quality forecasting with the GEM-AQ model Poland. During the CAMS_50 project conducted in 2015-2018, the GEM-AQ model achieved the compliance with ITT requirements as set for the operational models. Developments of data assimilation system for O_3 and PM10 as well as the development of birch and olive pollen modules were undertaken. Evaluation of hindcast experiments over the European domain demonstrated a satisfactory model performance.

Key team members

Professor Jacek W. Kaminski, PhD DSc, (Senior Scientist, Project Manager) will be responsible for the overall project coordination and all scientific and operational aspects for IEP-NRI. He was Executive Director of the Multiscale Air Quality Modelling Network that developed the GEM-AQ model; was key model architect and developer in the CAMS_50 project; was PI of a project to investigate the impact of electromobility deployment on air quality in Poland (Grant from the Polish-Norwegian Cooperation Program). Currently, is a holder of a grant from the National Science Centre for further development and application of the chemical weather model GEM-AQ/AC for the national AQ policy applications. He is advising the Ministry of Environment, the National Inspectorate for Environmental Protection, in the field of air quality assessment and forecasting. Also, he is a member of the Mission Advisory Group for Sentinel 4 and 5 satellites at the European Space Agency.

Dr. Joanna Struzewska (Senior Scientist) is a co-author of the GEM-AQ model, has experience in numerical modelling of transport and transformation of air constituents, with a focus on meteorological processes. Participated in 10 grants from the Polish Committee of Science/ National Centre of Science/ Ministry of Science (PI for 4 projects). Is acting as an expert at Ministry of Environment - implementation of Stockholm Convention, FAIRMODE. Coordinator of several R&D projects on air quality forecasting and assessment. National delegate to the COST Actions connected with atmospheric composition modelling. Committee Member on behalf of PKN (Poland) of two Technical Committees within the European Committee for Standardization (CEN/TC 264/WG 43 and CEN/TC 264/WG 44) related to air quality policy. She is Principal Investigator of the CAMS_50 project at Warsaw University of Technology (2015-2018).

Dr. Lech Lobocki (Senior Scientist) has over 36 years of experience in atmospheric modelling at different scales. Is a member of TF HTAP, COSMO-LM Scientific Steering Committee, and AQMEII. Was PI on a number of national and international atmospheric modelling projects. His primary research interest is in the area of boundary layer processes that pertain to fluxes and exchange of mass. His research interests are directly applicable to the said ITT.

Dr. Karol Szymankiewicz (Scientist) has five years of experience working with atmospheric satellite observations focusing on a comparison between satellite data and results from the GEM-AQ model. He will be responsible for data assimilation aspects in CAMS_50.II.

Ms Aneta Gienibor (Senior Computer Engineer) – will be responsible for IT support, model execution and output processing in CAMS_50.II.

Key facilities, infrastructure and equipment

The Institute has a computational cluster with 360 physical cores (10 nodes with dual Intel Gold 6140 processors, interconnected with a QDR InfiniBand switch) to carry out numerical modelling. The total disk array has 500TB of storage.

Involvement in projects relevant to CAMS_50.II

During the last several years the project team participated in a number of scientific an R&D projects focused on air quality forecasting and assessment.

Current and completed projects at the Institute and carried out by the project team

- Operational urban air pollution forecast for Opole
- High resolution operational air quality forecast for Southern Poland
- Contributions to the FAIMODE activities
- Air pollution assessment for 2016
- Development of bottom-up emission inventory for Poland
- Development of climate change indexes for Poland based on the EuroCORDEX model simulations
- Origin and evolution of selected PM10 episodes in 2013-2016 based on modelling and backward trajectory analysis

Completed projects, carried out by the project team

- Air pollution forecast (Ozone, NO_2, SO_2, CO, PM10, PM2.5) over Malopolska, Podkarpackie
- Air pollution assessment in Poland for 2012 and 2013
- Operational ozone forecast for Poland
- CAMS_50 Regional Production, Development and testing of the GEM-AQ model for operational implementation (2015-2018)
- Spatial and seasonal variability of atmospheric pollutants concentrations in the context of meteorological conditions over the European continent. Funded by NCN, 2010-2013, related to the AQMEII-1 project
- Air pollution assessment in current and future climate over Central Europe according to RCP emission estimation, calculated with the interactive GEM-AC climate and chemistry model
- iAREA - Impact of absorbing aerosols on radiative forcing in the European Arctic, European Economic Area and Norway Grants (2013-2016) – WP5 - Modelling of chemical and optical properties of the Arctic aerosols (at the regional scale) for campaign support and post analysis
- Definition of air quality index used by Chief Inspectorate of Environmental Protection
- Data provision for two air quality smartphone apps

Summary of proposed participation in CAMS_50.II

Involved in: WPs 5020 and 5030 for the development and production activities related to the operational model WUT (former candidate system under CAMS_50.I). **Activities main location:** Warsaw, Poland. **Provisional budget share:** €385,125.00 (≈ 6.6% of total provisional budget).

2.2.11 BSC

The Barcelona Supercomputing Center (BSC)[10] is a research centre active at both national and international levels. The BSC combines unique high performance computing facilities and in-house top research departments on computer, life, and Earth sciences, and in computational applications in science and engineering. The BSC is the main provider of public supercomputing services in Spain. The BSC represents Spain in international initiatives such as PrACE, the Research Data Association and the Big Data Value Association. The BSC has a total staff of about 480 employees.

Established in 2006, the Earth Sciences Department of the BSC, hereafter ES-BSC, worked on atmospheric composition modelling. The designation of Professor Francisco J. Doblas-Reyes as Director of BSC-ES in 2014 initiated the merging of the Climate Forecast Unit of the Institut Català de Ciències del Clima, which he was leading and that in a short time became a main European actor in the development of climate services based on climate prediction, into the Department. This merging has created a more efficient and competitive Department that holds a sufficient critical mass to compete with the top international research groups in environmental forecasting and Earth system services. ES-BSC is structured around four groups (Climate Prediction, Atmospheric Composition, Computational Earth Sciences, and Earth System Services), with more than 70 employees, including technical and support staff.

The department has a wide experience in running operational atmospheric forecasting systems and delivering timely and quality forecasts, observations, information and knowledge to users. The department also facilitates knowledge and technology transfer of state-of-the-art research and develops services for renewable energy, urban development, infrastructure, transport, insurance, health and agriculture. Another major activity in the ES-BSC is the development of the Multiscale Online Nonhydrostatic Atmosphere Chemistry model (NMMB-MONARCH, formerly known as NMMB/BSC-CTM) and the developement of high resolution anthropogenic emission models (i.e HERMESv3, HERMES-Mex) in collaboration with the Spanish Ministry for Environment and the Mexico City's Secretariat of the Environment.

Key team members

Dr. Carlos Perez Garcia-Pando is head of the Atmospheric Composition Group of the BSC, AXA Professor on Sand and Dust Storms. Before, he worked in the US where he was Associate Research Scientist at the NASA Goddard Institute for Space Studies and Columbia University. He served as PI and co-PI in competitive research projects funded by the Department of Energy, NASA and NOAA. His research focuses on understanding the physical and chemical processes controlling atmospheric aerosols, and evaluating their effects upon climate, ocean biogeochemistry, air quality and health. He conceived the NMMB-MONARCH model that is further developed by the Atmospheric Composition group at BSC. In 2017 he has been awarded with an ERC Consolidator Grant starting in October 2018. Under CAMS_50.II, he will be in charge of the MONARCH developments on aerosols to fulfil the CAMS_50.II requirements.

Dr. Oriol Jorba is co-group leader of the Atmospheric Composition Group of the BSC. His research expertise includes high resolution mesoscale meteorology and air quality, atmospheric chemistry studies and environmental impact assessment. He has lead the research project on the development of the multiscale chemical weather forecasting system NMMB-MONARCH at BSC. He is a member of the management committee of COST Action, and is part of the International Technical Meeting on Air

[10] https://www.bsc.es/

Pollution Modelling and its Application scientific committee since 2012. He is a member of the International Cooperative for Aerosol Prediction initiative and a modeller contributing to AQMEII activities. He will be the coordinator of the BSC activities to put the MONARCH model in operational for CAMS_50.II. He will also be in charge of configuring the MONARCH model to fulfil the CAMS_50.II requirement on domain and inputs data.

Dr. María Teresa Pay is a post-doctoral researcher of the Atmospheric Composition Group since 2006. She played a seminal role on the successful implementation of the first air quality forecast system at high spatial and temporal resolution for Spain (CALIOPE system). She has experience in cutting-edge HPC, statistical analysis and evaluation of air quality models at regional and urban scale. She is a EURODELTA member contributing to the Task Force on Measurements and Modelling under the UNECE. Under CAMS_50.II, he will be in charge of the post-processing of the outputs and MONARCH evaluation.

Dr. Dene Bowdalo is a post-doctoral researcher in the Atmospheric Composition Group, who started in April 2018. Before that, he was employed as a Post-Doc at the University of York, applying novel spectral methods tailored for the identification of systematic biases for surface ozone in a state-of-the-art global chemical transport model (GEOS-Chem). He is currently working on improving the regional representation of aerosols in MONARCH. Under CAMS_50.II, he will be in charge of the MONARCH developments on aerosols to fulfil the CMAS50 requirements.

Key facilities, infrastructure and equipment

The BSC infrastructure and support consists on: a 13 PFlops supercomputer, a long-term storage, commodity computational facilities with both physical and virtualised environments, a solid project management team, and the outstanding collaborations with researchers in computing sciences. BSC hosts the Mare Nostrum IV is one of the 7 Tier-0 PRACE systems currently available for European scientists. Its peak power is 11.15 Petaflops, and has a total of 165,888 processors and a main memory of 390 Terabytes. The operational products are located in a Big Data storage system of 2 PBytes that will be accessible through THREADS technology in the near future.

Involvement in projects relevant to CAMS_50.II

CALIOPE (www.bsc.es/caliope). The BSC implemented an air quality forecast system for Spain working operationally since 2006.

The WMO Regional Center Northen Africa-Middle East-Europe for the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) (http://sds-was.aemet.es/) and the Barcelona Dust Forecast Centre (http://dust.aemet.es/). BSC centralizes and manages both centers on Dust forecast.

AQFS-MexDF (http://www.aire.cdmx.gob.mx/pronostico-aire/). BSC developed an emission model and implemented an air quality forecast system in the city of Mexico based on the CALIOPE system.

CAMS84 on evaluation and CAMS81 on global and regional emissions. BSC is in charge of the aerosols evaluation and temporal desegregation of emissions, respectively.

Summary of proposed participation in CAMS_50.II

Involved in: WP5020 for the development activities related to the candidate modelling system NMMB-MONARCH. **Activities main location:** Barcelona, Spain. **Provisional budget share:** €91,464.79 (≈ 1.6% of total provisional budget).

2.2.12 ENEA

ENEA[11] (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) is a public body aimed at research, technological innovation and the provision of advanced services to enterprises, public administration and citizens in the sectors of energy, the environment and sustainable economic development (article 4, Law no. 22 of 28 December 2015)". It employs about 2500 researchers and technologists.

The Atmospheric Pollution Laboratory operates in the Division Models and Technologies for Risks Reduction of the Department of Sustainability. It is focused on research and innovation on air pollution modelling, chemical transformation of gases and aerosols in the lower atmosphere, measurement and chemical and physical characterization of atmospheric particulate matter. It develops models for simulating concentration and deposition fields of air pollutants at different scales - from street canyons to the national and continental scales - in order to evaluate their impact on human health, ecosystems and cultural heritage. The Laboratory employs 19 researchers plus 2 temporary employees and 1 research grant (as of 30 April 2018) who work prevalently in the Research Center of Bologna where the activities for CAMS_50 Regional Production will be developed.

The Italian Air Quality (AQ) National Modelling System, MINNI (www.minni.org), has been developing for 15 years on behalf of the Italian Ministry of the Environment. ENEA model is entrusted by italian Air Quality Laws (D.Lgs.155/2010) with national reference simulations for regulatory purposes and for providing technical assistance to Ministry in international negotiations and subsequent commitments (now the National Air Pollution Control Programme under the new National Emissions Ceilings Directive) developing emission/concentration scenario analyses and simulations. The Laboratory is co-developer of the FARM CTM model, which is the core of MINNI system.

Key team members

Mario Adani got the degree in Environmental Science in 2002, the Ph.D. in Geophysics in 2007. In 2008 he had a position as a scientific consultant at the Euro-Mediterranean Centre for Climate Change and in the same year, a position as a researcher at the National Institute of Geophysics and Volcanology. From 2013 he is researcher at ENEA. Since 2004 he has worked as oceanographer in the modeling and data assimilation fields. He actively participated in the development team of oceanographic model consortium NEMO and in several European projects. Since 2013 is working in air pollution modeling and data assimilation field. He will be the Main Contact as Development Manager for ENEA model inside CAMS_50.II.

Luisella Ciancarella is a physicist and head of Atmospheric Pollution Laboratory from 2010. She developed specific experience on integrated modeling tools on atmospheric pollution for current and future scenario analysis, using the most appropriate emissions inventories. She worked with environmental impact assessment and cost-effectiveness analyses models to identify strategies and specific policies for short and long-term environmental sustainability and to support decision making process. Under CAMS_50.II, she will coordinate the Italian model group helping the main contact in relation to management.

Lina Vitali is a physicist and she has been working at ENEA as a researcher since 2000. Her research interests and expertise mainly focus on air quality modelling (both at national and local scales), environmental and health impact of industrial sources, back trajectories modelling (M-TraCE

[11] http://www.enea.it/en

development), spatial representativeness of monitoring station, validation of modelling results against observations data. Under CAMS_50.II, she will be involved in validation and reporting activities.

Mihaela Mircea is a physicist who joined ENEA in 2009. She received a PhD in Physics from the University of Bucharest in 2000. She worked at National Institute of Meteorology and Hydrology, Bucharest, Romania and at Italian National Research Council. She co-authored more than 60 peer-reviewed articles in the field of atmospheric modelling,. She has participated to 8 European projects among which GEMS. She is participating as a national expert at Task Force on Measurements and Modelling (TFMM) and at Forum for air quality modelling in Europe (FAIRMODE) and performs reviewer activities for European programs and many international journals. She currently works on the development and verification of air quality modelling systems, on health and ecosystems impacts. Under CAMS_50.II, she will be involved in validation and reporting activities.

Guido Guarnieri got the degree in Computer Engineering in 2004 with specialization in industrial automation and control of physical processes. From 2007 he is working as a researcher at ENEA. He is one of the administrators of Cresco HPC system, the high performance computing facilities installed in the Enea research center of Portici and managed by ICT unit. His activity involves HPC systems design and installation, hardware and software resources management, parallel programming, user support, middleware design and implementation. Under CAMS_50.II, he will be the System Engineer for ENEA.

Key facilities, infrastructure and equipment

ENEA HPC (www.eneagrid.enea.it/www.cresco.enea.it, centered on Portici Research Center, has computational and storage resources of about 800 TFlops and 1.2 PB respectively, 350Tb of which are dedicated to MINNI projects

Involvement in projects relevant to CAMS_50.II

VIIAS (Integrated Assessment of the Atmospheric Pollution Impact on the Environment and Health) is a national project, funded by the Ministry of Health and ended in 2015, that carried out for the first time the integrated assessment of air pollution and health impact in Italy.

EU LIFE MEDHISS project (2013-2016), demonstrated the feasibility of setting up a low-cost European surveillance system of long-term effects of air pollution based on cohorts data already available in 4 Member States. The exposure to air pollution was derived from national dispersion models (MINNI for Italy) opportunely post processed.

URBESS, a pathfinder project funded by EIT Climate–KIC aimed to investigate the feasibility of a service for the implementation of urban nature based solutions, helping Administrations to solve urban challenges as growing air quality deterioration. Air Quality simulations at high spatial resolution have been performed introducing in MINNI model chain a micro-scale lagrangian model (Parallel MicroSwift SPRAY-PMSS) instead of the chemical transport model (FARM).

CityTree Scaler Project, funded by EIT Climate–KIC , aimed to prove the effectiveness of a green solution (the biotechnological “CityTree”) in an urban environment, with regards to its ability to face air pollution, improve biodiversity and reduce heat island effects. PMSS simulations will be developed in some CityTree mode of operations (in progress).

Summary of proposed participation in CAMS_50.II

Involved in: WP5020 for the development activities related to the candidate modelling system MINNI. **Main activities location:** Bologna, Italy. **Provisional budget share:** €91,037.48 (≈ 1.6% of total provisional budget).

3 Quality of Resources to be Deployed

3.1 Description of Resources

Table 2. HR profiles (key staff members)

Title	Broad description of work in relation to Service	List of personnel who fit the profile and whose CVs are submitted with tender	Qualifications	Effort / engagement in months
Meteo-France				
Operational unit manager Senior engineer	Service coordinator	Gaelle Collin	Graduated from the French School of Meteorology – equivalent to MSc	11
Operational unit deputy manager Senior engineer	Production manager	Marion Pithon	Graduated from the French School of Meteorology – equivalent to MSc	12.14
Senior engineer	IT architect	Helene Pech	Graduated in Industrial IT from the leading engineering school in France – equivalent to MSc	3.39
Senior scientist	Within WPs 5030 and 5050, will be in charge of implementing new features for MOCAGE and of their validation	Joaquim Arteta	PhD Meteorology	3.30
Senior scientist	Will be involved in WP5010 and 5050	Matthieu Joly	PhD Atmospheric science	1.65
Senior contract manager	Service manager	Alain Gradot	Trained at an IRA (well-established French school for civil servants)	0 (free contribution, no personnel costs will be claimed)
INERIS				
Department manager	External Relations manager Main contact for CHIMERE re-analysis matters	Laurence Rouil	PhD Computational Fluid Dynamics	3
Scientic team manager	Scientific advisor	Augustin Colette	PhD Atmospheric Physics and Chemistry	7
Senior scientist	Re-analysis manager Main contact for CHIMERE	Frederik Meleux	PhD Atmospheric Physics and Chemistry	7

	development and production matters			
Senior scientist	Will contribute to all steps related to the reanalysis	**Anthony Ung**	PhD Atmospheric Physics and Chemistry	18
FMI				
Senior scientist	Pollen advisor Coordination of SILAM activities	Mikhail Sofiev	PhD Atmospheric Physics and Chemistry	8.74
Scientist	Deputy coordinator of SILAM activities	Rostislav Kouznetsov	PhD Atmospheric Physics and Mathematics	21
FZJ-IEK8				
Senior scientist	Deputy coordinator of EURAD-IM activities	Hendrik Elbern	PhD Meteorology	0 (free contribution, no personnel costs will be claimed)
Senior scientist	EURAD-IM model manager	Elmar Friese	PhD Geophysics	33
KNMI				
Senior scientist	Deputy coordinator of LOTOS-EUROS activities (KNMI) Will contribute to the evaluation of the KNMI WP5030 outputs and to the development activities in WP5020	Henk Eskes	PhD Physics	2
Senior scientist	Coordinator for LOTOS-EUROS activities (KNMI) Will perform most of the activities in WP5030 and contribute to the development activities in WP5020	John Douros	PhD Mechanical Engineering	15
TNO				
Senior scientist	Coordinator of LOTOS-EUROS activities (TNO side)	Arjo Segers	PhD Applied Mathematics	5
Senior scientist, team coordinator	Deputy coordinator of LOTOS-EUROS activities (TNO side)	Renske Timmermans	PhD Atmospheric Dynamics	3
Senior scientist	Developer for LOTOS-EUROS model	Richard Kranenburg	MSc Applied Mathematics	2
MET Norway				
Senior scientist	Main contact for EMEP development	Michael Gauss	PhD Atmospheric chemistry	6.25

	production and re-analyses matters coordinate the MET Norway team contribution to the project. Takes care of reporting.			
Senior scientist	Deputy contact 2 for EMEP development production and re-analyses matters,main technician at MET Norway and the main developer of the data assimilation system.Main responsible for the pollen modelling and for keeping the EMEP model up to date.	Alvaro Valdebenito	PhD Meteorology	11
Senior scientist	Deputy contact 1 for EMEP development production and re-analyses matters. Mainly involved in the daily routine work and daily monitoring of the operational chain as well as software maintenance.	Anna Benedictow	MSc Programming and Mathematics	9
SMHI				
Senior scientist	MATCH model manager, main contact for production matters, deputy for developments	Lennart Robertson	BSc Meteorology	5
Senior engineer	Re-analysis responsibility for MATCH	Helene Alpfjord	MSc Engineering Mathematics	9
Senior scientist Project manager	Project manager for MATCH Main contact for the development of MATCH	Erik Engstrom	PhD Atmospheric chemistry	2.02

Senior scientist	MATCH assessment for new developments	Ana Cristina Carvalho	PhD Sciences Applied to the Environment	6
AU				
Senior scientist	Key person in the development and maintenance of the operational version of DEHM	Jesper Christensen	PhD Geophysics and Atmospheric Science	14.3
Senior scientist	Coordination of AU activities within CAMS_50.II and contribute to the development activities in WP5020.	Camilla Geels	PhD Geophysics and Atmospheric Science	2.5
Senior scientist	Chemical data assimilation work lead	Kaj Hansen	PhD Meteorology and atmospheric sciences	2.5
IEP-NRI				
Senior scientist	Coordination of GEM-AQ activities within CAMS_50.II	Joanna Struzewska	PhD Environmental Engineering and Air Quality	8
Senior scientist	For IEP-NRI, overall coordination of IEP-NRI participation	Jacek W. Kaminski	DSc (higher doctoral degree) Environmental Engineering	17
BSC				
Senior scientist Head od unit	Will be in charge of the MONARCH developments on aerosols to fulfill the CAMS_50 requirements	Carlos Perez	PhD Environmental Engineering	1.01
Senior scientist Group leader	Coordinator of the BSC activities to put the MONARCH model in operational for CAMS_50.II. Will also be in charge of configuring the MONARCH model to fulfill the CAMS_50.II requirement on domain and inputs data	Oriol Jorba	PhD Environmental Engineering	1.83
Post-doc	Will be in charge of the post-processing of the outputs and MONARCH evaluation	Maria Teresa Pay	PhD Environmental Engineering	3.50

Post-doc	Will be in charge of the MONARCH developments on aerosols to fulfill the CAMS_50.II requirements	Dene Bowdalo	PhD Atmospheric Chemistry	5
ENEA				
Scientist	ENEA development manager, main contact person for ENEA	Mario Adani	PhD Geophysics	2.5
Engineer	System engineer for CAMS_50.II activities	Guido Guarnieri	Degree in Computer Engineering	2.3
Senior Scientist	Deputy contact person for ENEA, helping the main contact in relation to management	Luisella Ciancarella	MSc Physics	0 (free contribution, no personnel costs will be claimed)

3.2 CVs of Key Personnel

CVs of the key staff members can be found in Appendix 2

4 Technical Solution Proposed

4.1 Introduction

4.1.1 Context

The core purpose of the CAMS Regional production is to provide a set of products relevant for the monitoring and forecasting of air quality at the European scale in order to meet user needs of enhanced environmental information. This includes support to policy makers, businesses and citizens. The proposed service consists in the provision of daily near-real-time maps (analyses and forecasts) and annual reanalyses of major air pollutants regulated and/or monitored over Europe. It is based on the development activities that were conducted as part of CAMS_50.I, following early work in the MACC, MACC-II, MAC-III, GEMS and PROMOTE projects. For the Regional production, an ensemble of state-of-the-art modelling and data assimilation systems following a common forecasting protocol will be used. The multi-model ensemble approach has proved to yield better performances than individual air quality models and allows uncertainties arising from model formulation to be assessed. Product qualilty will be evaluated using independent data relevant for air quality, i.e. air quality monitoring surface sites available in Europe and not used in production.

4.1.2 Technical solution overall description

The CAMS Regional production will rely on a set of nine Regional air quality models that have proved their production quality, reliability and punctuality during the MACC-II and MACC-III projects[12] and during the CAMS_50.I contract. During CAMS_50.II, these models will be further developed to improve their production. At the beginning of the contract, they will meet the following characteristics required in the ITT:

- The domain covered must be at least (25°W-45°E, 30°N-72°N).
- The system horizontal resolution shall be finer than or equal to 0.2° by 0.2°, or the equivalent resolution in kilometres.
- Transport and physical processes must be driven by ECMWF's high-resolution operational meteorological forecasts (using the most recent available forecast), either directly in the case of chemistry-transport models or by means of nudging or similar techniques.
- The system will use the regional emissions dataset (other than fire) provided by the CAMS_81 contract.
- The system will use fire emissions as well as chemical boundary conditions provided by the CAMS Global Service Provider (aerosol, reactive gases and greenhouse gases -if accounted for) using the most recent available products.
- The system must have the capability to forecast atmospheric pollutants regulated at the European and national levels in Europe, gases and particulate, as well as pollens (if the source term is externally provided).

[12] Marécal et al, 2015

- The system must have a documented data assimilation capability for surface Air Quality observations (at the minimum).
- The system must have an existing track record of providing daily forecasts with evidence of performance (quality, timeliness/completeness of the output…) as documented in peer-reviewed publications, reports or technical notes.

All nine models have the proven capabilities to run NRT forecasts (up to 96-hours ahead) and analyses, and also reanalyses over the last year period. They are able to provide their output with the timeliness requirements that are stated in the ITT. The characteristics of these Regional air quality models are presented in Appendix 3.

The technical proposition relies on these nine operational models and on the development of two new models that can prove sufficient documentation and significant track records of quality and of operational capabilities. The participation of new models will help to supplement the range of models and to widen the geographic distribution. They may also offer more flexibility for substitution in case of failure of one model of the Regional system. At the end of the contract, the quality and punctuality of these two models will be assessed.

These models are MONARQUE, which is developed and operated by the Barcelona Supercomputing Center, BSC (Barcelona, Spain) and MINNI, which is developed and operated by ENEA (Italy).

NRT production description of the nine individual systems

To insure reliability and compliance with the required delivery time, an operational suite described in Appendix 4 will process each individual production.

Reanalyses production

Yearly reanalyses aimed at describing some air quality indicators, relevant for both regulatory (according to the Air quality directives) and health exposure purposes. They are based on the individual model configurations used for the NRT productions, and data assimilation system suited for yearly productions. The Service will have two data streams for reanalyses, so-called ‘interim’ and ‘validated’. ‘Interim production’ relies on reanalyses for year Y produced at the beginning of year Y+1 with available data, validated or not by the producers, at the time of the computation. ‘Validated production’ for year Y will be available before mid-year Y+2, once the observations data used for assimilation are validated by their producers. The main source of data is the official database maintained by the European Environment Agency (EEA) from regulatory reporting according to the Air quality directive. The stringent protocol applied to those data makes the validated data streams released only at the beginning of year Y+2 for the year Y. This is the main constraint of the CAMS Regional reanalyses.

4.2 WP5010 Observational data acquisition

Observations datasets are essential for the Regional air quality systems for two reasons:

- For the assimilation by the models producing analyses and re-analyses.
- For the verification of model outputs (regardless of the production chain).

Consequently, two datasets should be maintained in the operational production chains, one devoted to data assimilation and the other one to verification. For analyses and re-analyses, these should not overlap (to avoid biased comparison). A basic list of stations for analysis verification will be defined at the beginning of the contract and will be updated at the beginning of each year. The first source of observational data will be the European Environment Agency (EEA) databases which contain regulatory observations reported by the Member States according to Air quality Directive 2008/50/CE and the Air Quality Directive Implementation provisions or IPR (2011/850/EU), defining the so-called 'AQ e-reporting' process[13]. The EIONET network (European Environment and Information Network) is a partnership network of EEA that supports environmental data collection and organisation[14]. It supports the implementation of such reporting regulations and a large part of the observational in-situ data used by CAMS_50 will come from this network. Regulatory databases are available on the AQ-portal of the Agency designated as 'AQ e-reporting DB'.

Since January 1st, 2015, all EU Member States have to report so-called 'Up-to-date' data (E2 flux in the Implementation provisions) which correspond to near-real-time observations. The CAMS Regional production will benefit directly from the availability of such data. Validated data (so-called 'E1 flux') are reported by the Member States by September 30th of year Y+1 for year Y. Usually EEA releases validated data at the beginning of the following year and this process will constrain the re-analyses production, as discussed below.

The bulk of surface data used for Regional production and obtained from EEA are the hourly concentrations of the pollutants O_3, NO_2, SO_2, CO and hourly or daily concentrations PM10 and PM2.5 (depending on the adopted measurement device). Their acquisition and distribution for analyses and verification are described below.

Other more specific sources of surface observations will be processed in other CAMS services, such as CAMS_21a for ACTRIS observations and CAMS_24b for observations from the EMEP network. The acquisition of these data will only be set up in CAMS_50 provided that the operational level of the availability is established. These data streams will benefit from the basic checking running for the EEA databases.

Other types of information (satellite, data from research infrastructures and networks such as EAN, AERONET and IAGOS) will be acquired by ECMWF and will be available for the service providers. Regional production will obviously benefit from these facilities. A thorough description of the list of observations used for assimilation by individual models will be provided in the model documentation. A selection of surface observation data (other chemical species with regard to the bulk verification set) will also be proposed for the corresponding verification (see Task 5053 and 5054 of WP5050).

[13] http://www.eea.europa.eu/data-and-maps/data/aqereporting
[14] https://www.eionet.europa.eu/

For data assimilation as well as for verification purposes, the set of selected data should be consistent and representative with the model simulation. For instance, it is obvious that with a 10km resolution, the Regional models cannot approximate air pollutant concentrations near busy roads where local emissions have a strong influence. Therefore, the representativeness of the observation sites is an essential point for the approach relevance. In the AQ e-reporting database, meta- information contains fields related to the site area (rural, suburban, urban, etc.) and to the type (background, traffic or industrial). This gives indicative information but our previous experience showed that this is sometimes not enough, because of its somehow subjective and heterogeneous definition. This is the reason why in the MACC project a new approach to qualify classification of monitoring stations was developed (Joly and Peuch, 2012[15]) and updated in September 2017 during CAMS_50.I. This objective classification allows accounting for historical concentration records and is more appropriate to data assimilation purposes, with a classification index ranging from 1 to 10 (from remote sites to sites close to emissions sources). It will be considered for the air pollution data used in the Regional air quality production streams.

The current classification refers to the period 2007-2014: it will be updated during the project (M1.1) to account for new sites and typologies that could be added or situations with significant changes.

4.2.1 Task 5011: Acquisition of NRT data

For the production of daily analyses and verification of the NRT forecasts and analyses, the 'up-to-date' (UTD) surface observations from regulatory automatic networks collected at the European level by EEA will be used. The regulatory pollutants: O_3, NO_2, SO_2, CO, PM10 and PM2.5 will be acquired. To ensure consistency between the nine analysis solutions, Meteo-France will collect these observations from EEA, will pre-process them and will make them available in near-real time to the Regional systems for NRT analyses. The data will also be made available to the other models (involved in WP5020) in delayed mode for their own validation purposes.

The NRT data process will consist in the following main steps:

- Meteo-France will download daily UTD observation data from EEA, for the previous day. To improve the provision of data and to get a sufficient amount of observations, downloads from EEA will be scheduled four times a day: at 3:00, 6:00, 7:00 and 23:00UTC.
- The data will be merged into the operational database for observations at Meteo-France, which is also used for meteorological observations. Before their entry into the database, blacklisted stations will be removed. This blacklisting will also be applied for stations whose data has been identified as unrealistic for the previous month. Moreover, each pollutant at each station will be flagged according to its class type (from 1 to 10, or 0 if missing), defined in the above-mentioned classification. Only data with class between 1 and 5 will be considered as representative of the background air quality and will be made available for assimilation and verification of the Regional NRT production.
- Observation provision for the individual model NRT analyses will be performed at 7:20 UTC every day, using a unique csv file provided on the ftp.meteo.fr server on a password-protected account. Following previous work during MACC-II, 7:00 UTC for the database extraction has been considered the best time for a compromise between a sufficient amount of observations for the

[15] See Chapter 4.10 References

day before and an early enough delivery of analyses. Stations used for analysis verification will be filtered out from the dataset distributed for analyses.

- Observation provision for forecast verification will be performed at 23:00 UTC for the day before. Waiting until the end of the day will ensure a significantly better dataset than earlier in the day. Observations for analysis verification will be the subset corresponding to the list of stations for analyses verification, ensuring no overlap with the dataset used for assimilation.

On a quarterly basis, a report on data acquisition activities will be produced (D1.1.2-QQ) and will describe:

- The number of observations acquired daily by Meteo-France.
- The number of observations distributed for NRT analyses.
- The number of observations used for the verification of NRT analyses.
- The number of observations used for the verification of NRT forecasts.

All this information will be sorted by country, species and by hour of the day. Quarterly indicators of the mean amount of observations acquired will be reported and analysed.

Changes for integration of new observation datasets that may be requested by users and that will require significant resources (IT, budget or human resources) will not be considered, unless ECMWF agrees to provide the updated resources that are needed.

4.2.2 Task 5012: Acquisition of interim data

The “Interim data” phrase designates observations that will be used for the Regional interim production. Because validated re-analyses will be produced with a significant delay (see above), and in order to comply with user needs, it is requested to propose an interim production by the beginning of each year regarding the previous year situation. The interim report will neither be based on up-to-date data, nor on validated data, but on data with an “interim status”. The regulatory reporting process requests that Member States update the quality status of the data they submit once they have proceeded to QA/QC controls. If a Member State verifies, validates or invalidates a data, the latter is resubmitted with the correct status. Generally, the data operators control their data within few weeks after their production. Therefore, it is expected that data resubmitted through this process will allow an interim re-analyses production of good quality.

During the former CAMS_50 Service, a twenty-day delay was selected as a good compromise for the daily interim re-analysis production regarding the quality and the amount of available observations in the air quality e-reporting database. The timeline for the acquisition of interim observations will continue with this twenty-day delay between the observation data retrieval from EEA and the day for which the data are requested for the daily interim re-analysis production.

4.2.3 Task 5013: Acquisition of a posteriori validated data

Similarly to NRT production, the first source of observation data for validated re-analyses will be the European regulatory AQ e-reporting database maintained by EEA. The Member States have to send validated observed data for each regulatory pollutant by September 30th of year Y+1 for year Y. The regulatory pollutants: O_3, NO_2, SO_2, CO, PM10 and PM2.5 will be acquired.

Re-analyses will be produced once the validated data are made available by EEA, usually during first half of year Y+2. INERIS will upload and process the validated data and will distribute it to all modelling teams. As for NRT production, only data representative of the models’ resolution will be considered

by excluding local traffic or industrial stations. AQ e-reporting DB will be split into two groups of data, one for data assimilation and the other one for verification without overlap between both.

Additional data at the surface (from the ACTRIS and EMEP networks provided that the operational level of their availability is established) will be considered for verification, in particular in order to assess model performances during pollution episodes. In addition, individual teams which have the capabilities to operationally assimilate other information (IASI or OMI observation for instance) could do it. This will be documented in Deliverable D1.3.2-YYYYQQ and those data will not be included in the verification datasets. The integration of additional observation data in the verification datasets will be performed by INERIS, in cooperation with the modelling teams and with the observations-related CAMS services.

4.3 WP5020 Continuous Model Development

The activities in WP5020 aim at introducing relevant evolutions into the nine Regional operational systems (Task 5021) and also into the ensemble processing centres at Meteo-France and INERIS (Task 5023), in order to keep Regional production at the state-of-the-art quality level and to introduce new products. All evolutions will be fully validated before being introduced into the Regional production suite.

Seven of the nine Regional operational systems were involved in the MACC-II and MACC-III pre-operational Regional air quality sub-projects (CHIMERE, EMEP, EURAD-IM, LOTOS-EUROS, MATCH, MOCAGE, SILAM). Their capacity to continuously upgrade and to incorporate results from new research has been one of the key point for the success of these sub-projects. These seven models were used as operational models in CAMS_50.I.

Two of the nine Regional operational systems (DEHM and GEM-AQ) have qualified during CAMS_50.I, which led to the conclusion that they complied with the quality requirements to be included in the operational modelling suites.

Introducing new models coming from new countries may help to improve the Regional Ensemble activities. Two additional models, which are operated by their main developers and that can prove significant track records of quality and operational capabilities, will be tested during the period of the contract: MINNI and MONARCH, respectively developed and operated by ENEA (Italy) and BSC (Spain). During the 33-month contract, these two models will develop their system to reach the targets required to be part of the operational production (recalled in the 'Technical Solution Overall Description').

The Regional production developments will be mostly driven by:

- The need to fulfill the ITT requirements for each model, which will be done during the first months of the contract (Phase 1, see below).
- User requirements, as presented in the RAD.
- Evolutions of the input data streams in the Regional systems (IFS, C-IFS, emission inventories over Europe, biomass burning emissions), among which some changes may require validation and choices to be made.
- The introduction of recent developments in each Regional system, coming from their own research and collaborations ; the validation reports of the Regional systems in the free troposphere issued by CAMS_84 will be considered in order to identify the shortcomings of each model and possible research paths to address them.
- The outcomes from the Regional Research and Development component of CAMS (CAMS_61, comprising both modelling and data assimilation aspects) and CAMS_63 for ensemble methods.

A yearly development plan will be elaborated for each operational model participating in the Ensemble, and also for the Centralised Regional production. It will be delivered each year in January for review by ECMWF. The accomplished developments, the results of their validation and the developments planned to be conducted over the months following will be reported in deliverables D2.1.1.{model}-YYYYS1/S2 and D2.3.1.

The development activities will be organised into two main phases:

- Phase 1 (M1-M15): introduce changes in models so that all of them meet the requirements described in the ITT to enter in production during the first system upgrade of the contract and in the model suites for interim re-analyses. The main milestones concern the extension of the geographical domain toward Northern Europe, and the delivery of additional aerosol parameters as outputs.

- Phase 2 (M16-M33): address the additional items (if available and relevant) to ensure high product quality, in particular those provided by the Research & Development component of CAMS (CAMS_61) and ensemble methods (CAMS_63).

We expect this plan to be regularly revised, after discussion with ECMWF regarding the user requirements that may be integrated, considering new research material (in particular from CAMS_61 and CAMS_63) that is validated and mature enough to be implemented in the Regional systems, and taking into account the human and computer resources that the teams from the Regional systems may sustain.

Changes that may be requested by other CAMS projects and that will require significant resources (IT, budget or human resources) will not be considered unless ECMWF agrees in providing the additional resources that are needed.

4.3.1 Task 5021: Development of the nine operational Regional systems

The purpose of this Task is, for each Regional system, to:
- update the model configurations in order to comply with the operational requirements during the Phase 1 period,
- improve continuously the quality of model outputs, regarding verifications done by CAMS_5050 and by CAMS_84, needs expressed for CAMS_94 and ECMWF through SES and RAD documents,
- deliver new model outputs for the operational implementation into WP50.3, to contribute to new products delivered by the ensemble production (in relation with Task 5023).

All these developments will be driven by ECMWF and user needs. The management procedures are detailed in the project management plan, and will be discussed during Phase 1 with ECMWF.

- Phase 1 will be organised as a ramp up phase with milestones for specific new developments accompanied by a thorough evaluation process. The complete implementation plan for specific new developments until Month15 is provided in the list of milestones in Chapter 5. The two main activities for operational models are:Extension of the geographical domain up to 72N
- Delivery of additional aerosol concentrations as outputs: total mineral dust concentrations, primary biomass burning, primary PM10 and PM2.5 attributed to anthropogenic combustion as well as secondary organic aerosol in the PM2.5 fraction.

These developments will be thoroughly validated by the subcontractor who develops this system, before it may be implemented in the Regional Production suite. The validation of the new model developments will be reported on a half yearly basis in Deliverable D2.1.1.{model}-YYYYS1/S2 documenting the rationale for the corresponding request for change, together with plans for future development. The implementation of a newly-developed suite into the NRT Regional Production will

follow the e-suite procedure described in WP50.3, once a year. It is important to note that the new model developments will serve the re-analyses production as well. Therefore, the new model versions run for NRT production suites (forecasts and analyses) must be the same as the ones run a posteriori (re-analyses). Some differences may occur in the data assimilation part. They will be tracked and explained in the model documentation.

The developments in Phase 2 will address the items provided in CAMS Research and Development Contracts. The main topics will regard:

- Ongoing model development achieved in CAMS_61 for the improvement of performances for all species (including pollens), in particular with regards to the evaluation performed in CAMS_50.5 and CAMS_84
- Implementation of data assimilation development achieved in CAMS_61
- Implementation of new emission fluxes produced within CAMS_81
- Implementation of changes in C-IFS boundary conditions or IFS meteorological forcing, if any
- Production of additional output diagnostics as per user request and new ensemble strategies achieved in CAMS_63

These plans are expected to be improved with time thanks to external changes and research results. The SES will evolve accordingly. As in Phase 1, the outcome of those developments and the plans for the following months will be reported on a half yearly basis in deliverable D2.1.1.{model}-YYYYS1/S2.

4.3.2 Task 5022: Development of two new models

The purpose of this Task is, for two new models that could be part in the future of the Regional Production, MINNI and MONARCH, to develop their modelling and assimilation systems in order to fulfil the requirements of the ITT at the end of the three-year contract. These systems will also have the opportunity to implement the results from the research part (CAMS_61 and CAMS_63).

A complete development plan until Month15 is in the list of milestones in Chapter 5. During this phase, these two models should develop a configuration over the domain using the required set of input data (meteorological forcings, boundary conditions, emissions). The assessment of these models in a configuration for forecasts over several months will be done in comparison of the ensemble and of the other models.

The outcome of the developments and the plans will be reported yearly in deliverable D2.2.2.{new_model}-YYYYS2. A first assessment of the added value of these 2 models (D2.2.3) will be done at Month16. At Month 17, a meeting with ECMWF will be planned for a first evaluation of the forecast delivery of the 2 models. This evaluation will verify the quality of their output and will assess the added value of adding these models to the Regional production. The statistics used will be the ones described in WP50.5 for the quarterly and annual reports. The capacity of these partners to deliver the products of their Regional System on time will also be assessed. This evaluation will be reported in deliverable D2.2.3.

4.3.3 Task 5023: Development of the ensemble production

The purpose of this Task is to develop the ensemble production chain processed at METEO-FRANCE for the daily production and at INERIS for the re-analyses. The evolutions of this processing system may arise from:

- New products (species, levels, etc.) or new diagnosis (from the ensemble of Regional Systems) to meet some users requirements specified in the RAD.
- New methods for ensemble processing, provided by the research conducted in CAMS_63.

A complete development plan until Month15 is provided in the list of milestones in Chapter 5.

The outcome of new developments, the validation and the plans for the ensemble will be reported quarterly in deliverable D50.2.3.

4.4 WP5030 Distributed Regional production

The distributed regional production will be processed by the nine modelling centres listed above. Each of them will run its own chemistry-transport model operationally to fulfil the requirements, in terms of expected outputs, of three numerical data streams:

- On a daily basis, analyses for the previous day and forecasts up to +96h.
- Delayed production for the interim re-analyses.
- Delayed production for the validated re-analyses.

Meteo-France will be the Central Regional Production Unit (CRPU) for NRT production (forecasts and analyses). INERIS will act similarly for re-analysis (interim and validated) production. The role of the CRPU will be to collect and combine the individual model data to form a multi-model ensemble system.

The data stream organisation described below has acquired a fully operational status during the CAMS_50.I service. The model characteristics are detailed in Appendix 3.

On a daily basis, forecasts of the requested atmospheric pollutants, for each hour up to 96h ahead and analyses for the previous day, are produced by the nine centres and sent to Meteo-France to be stored in the operational analyses and forecast database that hosts the Numerical Weather Production results.

Similarly, daily contribution to interim re-analyses will be performed each day for the twentieth day before. According to the CAMS_50.I experience, it is considered as an appropriate delay for the production, considering the quality and the amount of the up-to-date data. Daily interim re-analyses will be sent to INERIS on a regular basis by the individual teams.

Finally, validated re-analyses will be performed, by each individual centre, more than one year after the target year, once validated observation data from AQ e-reporting is available. Individual validated re-analayses will then be collected and processed by INERIS.

Please note that, for the DEHM and GEM-AQ models that have been assessed during the CAMS_50.I contract, a ramp-up phase is planned to enable their full integration to the operational system (see details of this phase on each of the stream detailed below).

4.4.1 Description of individual productions

The models will deliver their results according to the specifications listed in the ITT:

- GRIB2 data format for NRT production and Netcdf format for re-analyses streams.
- On eight vertical levels (surface, 50m, 250m, 500m, 1000m, 2000m, 3000m, and 5000m above ground).
- For the geographical domain: 25°West-45°East, 30°North-72°North.
- Parameters provided:
    - O_3, NO_2, NO, PM10, PM2.5, SO_2, CO, NH_3, PANs, NMVOC.
    - In a second phase, additional aerosol parameters: total mineral dust, total biomass burning, PM10 fraction of anthropogenic combustion primary production, PM2.5 fraction of

anthropogenic combustion primary production, PM2.5 fraction of secondary organic production.
    - Birch, olive, grass and ragweed pollens (forecast data only).
- All these individual productions have an operational status.

Each model will track the observations it uses for NRT, interim or annual analyses and re-analyses. At least there should be in-situ data from AQ e-reporting (EEA). For re-analyses, the EEA interim and validated observation datasets used for data assimilation should be consistent with the one elaborated each year by INERIS (see WP5010 description) to avoid overlap with the datasets used for verification. This information will be compiled and analysed in the quarterly Evaluation and Quality Assurance dossiers. The impact of the assimilation of observations will be assessed using the WP5050 verification statistics in the same document.

4.4.2 General description of system upgrades

One of the main issues with operational production is to deal with the QA/QC processes that could ensure quality, traceability and transparency of the data delivered. It means that stringent rules will be implemented to ensure that changes will have no impact on the system reliability and quality, whatever the data stream. The main principles are described below.

Upgrade processes will be performed once a year. The period of upgrade, for individual evolutions, will be defined with Meteo-France in autumn. The individual validation of these evolutions will be reported in Request For Changes (RFC) documents filled by each modelling team to describe the changes and their evaluation.

Then, the implementation of a new chain will follow the steps outlined below:

- The new model version will be largely tested, validated and documented on the partner side in both forecasting and re-analysis set-up (tests over past periods). These test results will be reported in the RFC documents.
- The new grib files will then be delivered on a test directory at Meteo-France or at ECMWF (depending on the site where the model runs).
- These files will be included into the Meteo-France integration database, to check, during several days, that formats are consistent and that the downstream ensemble processing works properly.
- The e-suite will replace the operational suite when everything is technically validated.
- The system documentation will be upgraded and a change log will be recorded.

To include the DEHM and GEM-AQ models in the operational chain in a most secure and efficient way, a ramp-up phase of nine months is planned, for a fully operational status. At the end of this ramp-up phase, all the current operational models will also have to deliver their results on the new required domain.

Note that the new model version will also be used for validated re-analyses provided every year for the production of the year Y-2.

However, this set-up will not hold for interim re-analysis production of a given year, which, according to the terms of the ITT, should be run with a frozen model configuration similar to the one adopted on January the 1st of each year Y. The evolution plan for the distributed Regional production will be

established with ECMWF and with the Regional Models' providers. It will be closely linked with the development of the models in WP5020.

4.4.3 Delivery of individual NRT production to the CRPU

The centres will provide analysis and forecast data in GRIB2 format with JPEG compression, in order to optimise the data transfer time.

Results from four models (CHIMERE, EMEP, LOTOS-EUROS and SILAM) will be uploaded, using the standard ftp protocol, to the operational ftp server at Meteo-France where the operational transmission system will send them to the database pre-processing system. Data from two models (EURAD-IM and MATCH), running at ECMWF, will be distributed using the ECMWF general purpose data transmission system (ECPDS) over the Internet. The configured destination will be the operational transmission system at Meteo-France. The Meteo-France MOCAGE model will be running locally on the HPC system and the results directly sent to the database. The DEHM and GEM-AQ result delivery method will be studied during the ramp-up phase to determine the most efficient one regarding the required timeliness.

The resilience of the operational database will be ensured by equipment redundancy. In fact, two systems (operational and backup) will receive the data simultaneously, so that the backup system can take over immediately in case of failure of the operational one. These systems will benefit from the 24/7 monitoring of all operational systems at Meteo-France.

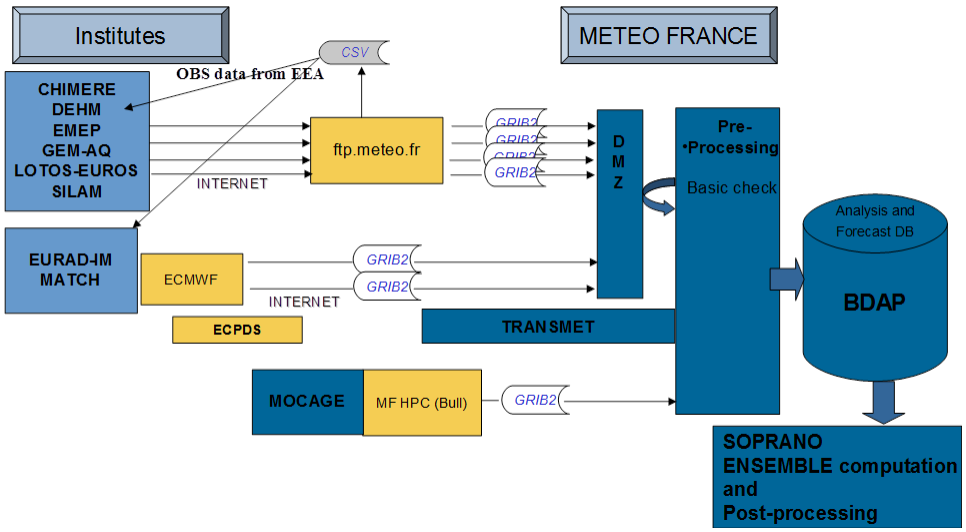


Figure 1. Data flow of the daily Regional production

The arrivals of individual model results in the database (time-steps grouped by day) will immediately trigger the production of all graphical or numerical products available to users and the ensemble computation. This will optimize the production timeliness to meet the target time requirements. The data flow for the daily production is presented in the figure above.

We set up a system (ensemble median, validation and test-suite process) that will be sufficiently robust to be little sensitive to quality failures. However, to identify underperforming models, we propose to monitor and warn, on a regular basis, outlier models and to report on model performance during the six-monthly Service review meetings planned by ECMWF.

Concerning the NRT CRPU, some basic checks will be implemented in order to avoid publishing charts or providing data from models which could have a temporarily issue leading to unrealistic values or geographical misplacement. During office hours, a 'basic' daily monitoring of charts produced (individual models and ensemble, mean/max values, list of outliers values) will be performed; it could lead within 5 working days to a temporarily suppression of one model.

4.4.4 Task 5031 Daily European NRT air quality analyses: detailed description

Each individual regional system will provide analyses results with the specific features:

- Temporal resolution of one hour for the past day (time step of 1h form 0:00 to 24:00).
- For all parameters and levels already mentioned.

4.4.5 Task 5032 Daily European NRT air quality forecasts: detailed description

Except for FZJ-IEK8 which will initialise EURAD-IM forecasts with the results of a first analysis run, done with a reduced set of observations, for the other eight models the two NRT production suites (analyses and forecast) will be independent, because of timeliness requirements. The forecast will be initialised by the 24-hour forecasts of the previous day and not by the analyses. A potential delay in the delivery of a sufficient set of observation data may prevent the analyses to be run on time for initialising the forecasts.

Each individual Regional system will provide forecast results with the common characteristics required by the ITT (see above) and with a temporal resolution of one hour up to four days ahead (time step of 1h from 0h to 96h).

4.4.6 Task 5033 European air quality interim re-analyses: detailed description

Interim re-analyses of year Y will be delivered by INERIS in February of year Y+1 at the latest. Those re-analyses will be performed on a daily basis integrating the observation dataset issued from the regulatory “up-to-date” data stream implemented by the Member States to comply with the Air Quality Directive (see section WP5010).

This production will keep the conclusion of the previous CAMS_50.I Service for the definition of the delay in the production of the daily interim re-analysis.

It means that each partner will have to deliver each day hourly re-analyses for the day twenty days before. The files including concentrations for all levels and for all pollutants, even those for which no data assimilation is performed, will be delivered on the INERIS ftp server.

A progressive upgrade of the production is proposed to meet the ITT requirements. A first phase corresponding to the production of interim re-analysis for 2019 will integrate the additional species (NO, SO_2, CO, NH_3, PANs, NMVOC) at the surface only. Then a second phase will be to produce year 2020 over the enlarged domain, for all levels and the five new aerosol parameters.

A CRPU script will check the availability of the files on a regular basis, to get them and to proceed to further processing.

Then INERIS will check and process the data, following which the interim ensemble will be produced for that day. The time for the individual delivery will be no later than mid-afternoon. A tracking of the data assimilated will be regularly provided by each team to the CRPU.

To comply with the ITT requirements, the interim re-analyses of year Y will be computed with the version of the model implemented on 1st January of year Y. This means that a frozen version of the model should be maintained for the whole year.

4.4.7 Task 5034 European air quality re-analyses: detailed description

According to the terms of the ITT, we will deliver ensemble validated re-analyses of year Y, four months after the validated observation data of this target year will be released by EEA. Generally, the release of the validated observation dataset occurs during the first half of year Y+2, according to the regulatory process for air quality reporting (see section WP5010).

Considering the timeframe constraints, a two-month period will be devoted to the individual productions of the validated re-analysis for the year Y-2, once validated observation are available. To start production, a document will be provided to the individual teams including all the details related to the design of the runs to carry out, especially with the input datasets to use, specifically provided for such production (in-situ observations and global boundary conditions).

Each team will have to provide its production in daily netcdf files uploaded on INERIS ftp server by the end of this two-month period. The files should contain the requested pollutants (even those for which no data assimilation is performed) and the requested levels. Due to the significant changes requested by the ITT, two phases are planned to reach this new production:

- The first phase will be for the production of year 2019 (i.e. for re-analysis of the year 2017) with all requested species (with the exception of the new aerosol parameters) at the surface only
- The second phase will be the full production as requested in the ITT for the 2020 production (i.e. for re-analysis of year 2018).

4.5 WP5040 Centralised regional production

To provide the most realistic representation of air pollution fields, the ensemble approach has been assessed to be very useful and relevant (Galmarini et al, 2004). The use of Ensemble products, indeed, provides generally better performance than the individual models and the spread between the different members gives information about the model uncertainties. Meteo-France will be in charge of the ensemble processing of NRT production (forecasts and analyses), and INERIS will be in charge of the ensemble processing of re-analysis production (interim and validated).

4.5.1 Processing of the individual productions to provide the NRT ensemble

For each parameter and vertical level, the individual model analyses or forecasts available will be retrieved from the operational database with the 0.1° resolution (see WP5030).

Then, the median value for each grid point will be computed. The median is the model value separating the higher half from the lower half of the nine individual models. The median is known to have better scores computed over long data series than each individual model. This method is also able to filter outliers and is cost efficient, which is important for the delivery timeliness. This simple methodology has proved its quality and robustness but it might change, at a later stage, depending on recommendations of CAMS_63 and following ECMWF approval.

The ensemble calculation will be regarded as correct when at least five members are available. If less than five members are available, the ensemble will be computed but flagged as “degraded”. This status will be mentioned in a text report, available to the end-user. During the CAMS50.I contract, in the last two years, this case occurred only three times: the Ensemble analyses were then computed with only four members. The ability to calculate the ensemble although several members are absent will grant this product a high level of availability.

The NRT analysis and forecast ensemble production will follow the process illustrated by the diagram in the next page.

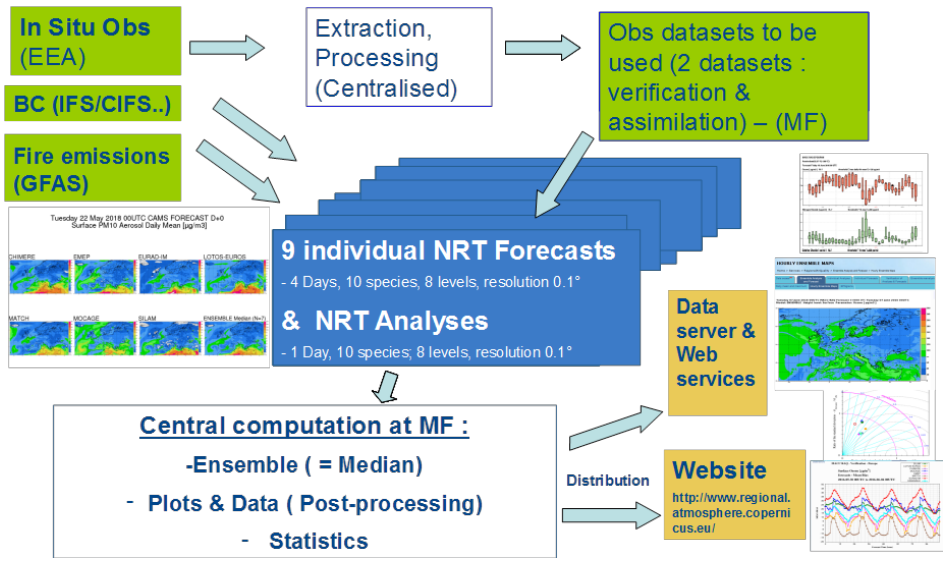


Figure 2. Process for The NRT analysis and forecast Ensemble production

All central computation tasks will have an operational status and will run in the operational production line at Meteo-France. Result datasets will then be stored in the same operational database, the ensemble being considered as a new model.

A log and report will be kept, including production timeline and the number of members used to make the ensemble results, for each parameter. This information will be included in quarterly logs provided two weeks after the end of each quarter. The impact of the observation assimilation will be assessed using the WP5050 verification statistics and reported in the quarterly EQA dossiers for NRT analyses, in the relevant quarterly reports for interim re-analyses and validated re-analyses.

4.5.2 Task 5041 Daily European air quality ensemble analyses

All required parameters (O_3, NO_2, NO, PM10, PM2.5, SO_2, CO, NH_3, PANs, NMVOC) will be provided at all eight vertical levels (surface, 50m, 250m, 500m, 1000m, 2000m, 3000m, and 5000m above ground), as analysis ensemble products. In order to guarantee the provision of the ensemble results at the required times, the computing task will be triggered at the latest acceptable time (currently 11:00UTC), regardless of the number of models present in the database at that time. The result availability to users is indicated in Table 8.

Table 3. Availability times of Ensemble analysis results provided to users

Ensemble analyses	Availability on Web server or download platform	Requested target times
ENSEMBLE	11:30 UTC	**12:00 UTC**

4.5.3 Task 5042 Daily NRT European air quality forecasts

Ensemble data, for all the required parameters (O_3, NO_2, NO, PM10, PM2.5, SO_2, CO, NH_3, PANs, NMVOC), at the eight vertical levels (surface, 50m, 250m, 500m, 1000m, 2000m, 3000m, and 5000m above ground) will be calculated and provided with hourly steps, up to 96 hours ahead. Birch, olive, grass and ragweed pollen forecasts will be provided, on surface level, during the corresponding seasons.

The current time limit configured for triggering the production of the ensemble forecast has been chosen to allow the maximum opportunity for individual models to be available and to participate in the ensemble. Currently, these time limits are set to 05:50 UTC for D0-D1 and 07:30 UTC for D2-D3. The result availability to users is indicated in Table 9.

To provide a probabilistic interpretation of the ensemble products for specific locations, EPSgrams for four-days forecasts for the four main pollutants (O_3, NO_2, SO_2 and PM10) will be provided for 70 large European cities, which are the European capitals and some other most populated conurbations. They will be plotted every three hours as bars, which will indicate the range of forecasts of individual ensemble members (minimum, maximum and percentiles 10, 25, 50, 75 and 90).

These EPSgram products will provide information about uncertainty of the ensemble at the Regional scale and not at the local/urban scale. This will be stated in the website documentation, and a disclaimer on the webpage will specifically address this limitation.

Table 4 - Availability times of ensemble forecast data provided to users

Ensemble forecasts	D0-D1 forecast availability on Web server or download platform (UTC)	D2-D3 forecast availability on Web server or download platform (UTC)	Requested target times for D0-D1/ D2-D3 (UTC)
ENSEMBLE	06:45	08:30	**08:00 / 10:00**

4.5.4 Task 5043 European air quality ensemble interim re-analyses

The interim re-analysis chain will continue with the same set-up developed during the previous CAMS_50.I service. In particular, the data will be daily collected and processed to check its availability and quality. With the work undertaken in WP5050, basic scores will be computed to check the quality; it is proposed as part of the verification to send them to the individual teams on a daily basis. This process will allow the individual teams in case of missing data or of poor performance due to a malfunction of their assimilation system to provide a new production for that day. Based upon the individual interim re-analyses, an ensemble interim re-analysis will be computed for all pollutants and all levels on a daily basis. The computing method will be the median value (same as for the NRT production) but it could change during the Service to follow recommendations issued from CAMS_63. This ensemble production can be used to make a preliminary assessment of the air quality on a daily basis. In case an individual model shows too poor performance, the subcontractor will be warned and required to re-run the interim re-analyses within a requested schedule considering the same set-up as initial (especially regarding the dataset to assimilate), to ensure a fair production for all models. In case the requested improvement cannot be achieved, the results will not be included in the ensemble

runs. ECMWF will be informed about the selected ensemble composition in case all models are not involved in it.

The entire production (hourly re-analyses for the whole year) for a given year will be made available to users no later than the end of February of the next year through the Meteo-France dedicated data discovery and download system (see 5060).

On a quarterly basis, a report will be prepared including information about this system, the members involved in the production for each day, their timeliness and including a track record of the data assimilated and also a short summary on the results (in particular comparing with the NRT production suite).

Regarding the ITT requirement, two phases are proposed to upgrade the production. The first one will be related to the production of an Ensemble for year 2019 with all requested species (with the exception of aerosol parameters) at surface only and the second phase will be to move to the full production requested (for all species and for all levels) for the ensemble related to year 2020.

4.5.5 Task 5044 European air quality ensemble re-analyses

The production suite for the validated ensemble re-analyses is designed with many similarities with the interim re-analyses. The main differences will be the use of validated data in the assimilation systems, the shorter time dedicated to the individual model production and collection which will occur within the agreed time limits as defined in the tasks 5012 and 5032. Following what has been done in the previous CAMS_50 Service, a thorough data analysis of the individual productions will be performed to assess the consistency between requirements and results.

Based upon the individual re-analyses, a re-analyses ensemble will be computed by the CRPU (INERIS) for all pollutants and levels for the whole year expected following a computation of median values which could evolve according to the outcomes of the work undertaken within CAMS_63.

The entire production will be made available to users no later than four months after the delivery of the observation database, and a report will detail the information regarding the production process with the ensemble member characteristics as well as the conclusion regarding the ensemble results and uncertainties, assessed using the spread between the ensemble members for each pollutant. These uncertainties related to the model resolution will be representative of the background concentrations uncertainties, it will not be possible to use them to represent for instance roadside concentrations uncertainties. Associated statements (disclaimer on webpages) to the delivery of this product to users will remind the use limitations.

If an individual model shows too poor performance, the subcontractor will be warned as soon as possible. However, the production delays could be too short for re-running. Then, the choice to include or not this (these) re-analyse(s) in the ensemble production will be made after a sensivity analysis on the ensemble scores (comparing ensemble compositions with and without low performance re-analyses). ECMWF will be informed about the selected ensemble composition in case all models are not involved in it. It is important to note that such a situation should actually not occur. Each modelling team will have to deeply check and validate its results before sending them to INERIS. The quality criteria will be shared and each team should know whether they are satisfied or not.

Regarding the ITT requirement, two phases are proposed to upgrade the production. The first one will be related to the production of an ensemble for year 2017 with all requested species (with the

exception of the aerosol parameters) at surface only; the second phase will be to move to the full production requested (for all species and for all levels) for the ensemble related to year 2018.

4.6 WP5050 Evaluation and Quality Assessment

The verification of the Regional products will be performed by comparing the WP5030 (distributed) and WP5040 products (centralised) productions (NRT forecasts, NRT analyses, interim re-analyses and re-analyses) with the observations at the surface, using statistical scores. The observation datasets used for verification, which may be different for each type of product, will be issued from WP5010, ensuring that verification will be performed against independent data. The statistics will be computed for the species for which a sufficient number of observations is available, which are O_3, NO_2, SO_2, CO, PM10 and PM2.5. The surface observations from other networks and infrastructures that could be collected under WP5010 will also be used for model verification.

It should be noted that scientific evaluation of the Regional production in the free troposphere will be covered by the CAMS_84 activities. Close cooperation will be established between CAMS_50 verification activities and CAMS_84 to optimise efforts and fully share benefits from the validation work. At the beginning of the contract, the scores will be based on the metrics that have been used in the CAMS_50.I Service, which are the bias, the normalized modified mean bias (NMMB), the root mean square error (RMSE), the correlation and the fractional gross error (FGE). *Interactions with CAMS_84 and recommendations from the FAIRMODE initiative, coordinated by the Joint Research Centre (JRC) and dedicated to model evaluation in the context of long-term air quality assessment, will be considered for the evolution of the verification of the Regional products.*

For NRT products (forecasts and analyses of all the nine models involved in the Regional production and the production of the Ensemble), performance statistics will be published using graphics displayed on the Regional website described in WP5060. The statistics plots that will be featured on the website are listed in Appendice 2. They will be daily updated. The statistics will also be computed quarterly by Meteo-France to provide input for the quarterly verification reports for each of the nine individual models and for the ensemble. Each report will present the verification of both the analyses and the forecasts for the past quarter. In these reports, the trend of model performance will be analysed in relation with the model developments. The reports will be delivered no later than 2 months after the end of the corresponding quarter.
Investigation and analyses of these performances will be developed in yearly reports (one for each stream) that will be delivered no later than two months after the numerical production has been delivered. It is important to note that the evaluation will be performed with a selected set of observation data that are not used to compute the reanalyses. This is critical for the relevance of the approach and also to assess the added value of the data assimilation process. This point will be discussed in each report.

From the verification scores described below for each type of products, a set of synthetic indicators are proposed as Key Performance Indicators (KPI) for the quality of our ensemble products.

4.6.1 Task 5051 EQA of NRT forecasts

The list of verification plots and companion datasets for NRT forecasts that will be displayed on the website is presented in Appendix 2. It will include, in a comprehensive and synthetic manner, verification of all the nine models involved in the Regional Production and the ensemble with regards to surface observations, for the past days, the past weeks and the past 3 months. The O_3, NO_2, CO , SO_2, PM10, PM2.5 species will be routinely verified. Verification plots for the last 30 days will be available as well as aggregated maps of forecasts and plotted observations for the previous day These charts are available daily for every 3 hour forecasts from 0 to 21UTC. Taylor diagrams of the individual

models and the Ensemble, based on statistical indicators (standard deviation and correlation) of the 0-24h forecast averaged over a week or 3 months, are also provided daily for the six main pollutants.

The quarterly verification reports for NRT forecasts (D5.1.1.{model}_YYYYMMM and D5.1.2.ENSEMBLE_YYYYMMM) will present statistics for the O_3, NO_2, CO , SO_2, PM_{10}, $PM_{2.5}$ species, for each model and for the ensemble, respectively. Two types of verification graphics will be displayed and discussed:

- The scores (NMMB, RMSE and correlation) over the quarter as a function of forecast term (from 0h to 96h).
- The RMSE (of daily maximum for O3 and NO2, of daily mean for other species) over the quarter and over the 1-day forecast term, together with the value of the same score for the previous quarters. This value for the ensemble and for some quarters will be reported as a KPI.

On these plots, each model forecast will be displayed together with the ensemble forecast.
Attached to these reports, companion numerical datasets are provided with the corresponding quarterly statistics for the main pollutants on all the observational sites used.

4.6.2 Task 5052 EQA of NRT analyses

Verification of analyses is done against unassimilated observations.
Daily maps analysis at the surface produced by each of the individual models or from the ensemble on a 3-hourly basis, overlaid with in-situ observations as coloured dots will be available for the past 30 days. For a quick overview of the comparison between analysis and forecast results, maps of the daily maximum at the surface for the six different pollutants (O_3, NO_2, CO , SO_2, PM_{10}, $PM_{2.5}$ aerosols) from the analysis together with the forecasts for Day 0, Day 1, Day 2 and Day 3 will be available for each of the individual model and the Ensemble, for the past 30 days.

The quarterly verification reports for NRT analyses (D5.1.1.{model}-YYYYMMM) will present statistics for the O_3, NO_2, CO , SO_2, PM_{10}, $PM_{2.5}$ species, for each model and for the ensemble. Two types of verification graphics will be displayed and discussed:

- The scores (NMMB, RMSE and correlation) over the quarter as a function of the hour of validity of the analyses (from 0h to 23h).
- The RMSE (of daily maximum for O3 and NO2, of daily mean for other species) over the quarter and over the 1-day forecast term, together with the value of the same score for the previous quarters. This value for the ensemble and for some quarters will be reported as a KPI.

On these plots, each model analysis will be displayed together with the ensemble analysis. In order to assess the impact of the assimilation on the pollutant concentrations, the scores for analyses will also be compared to scores of the 1-day forecast using the same set of verifying observations.

4.6.3 Task 5053 EQA of interim re-analyses

The annual verification reports for interim re-analyses (D5.3.1-YYYY) will be performed using non-assimilated observations. They will include the following list of maps and scores (provided as graphics and companion datasets in D.5.3.2-YYYY):

Plot	Type of indicator	Period covered	Species
analyses vs observations	Concentration maps	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Mean scores	Bias, MMB, FGE, RMSE, Correlation	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Scores on exceedances	Contingency table to compare simulated and observed exceedances	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Taylor Diagrams	Taylor diagram	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5

4.6.4 Task 5054 EQA of re-analyses

The annual verification reports for re-analyses (D5.4.1-YYYY) will be performed using non assimilated observations. They will include the following list of maps and scores (provided as graphics and companion datasets):

Plot	Type of indicator	Period covered	Species
analyses vs observations	Concentration maps	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Mean scores	Bias, MMB, FGE, RMSE, Correlation	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Scores on exceedances	Contingency table to compare simulated and observed exceedances	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5
Taylor Diagrams	Taylor diagram	Seasonal and annual of the target year	O_3, NO_2, CO , SO_2, PM10, PM2.5

4.6.5 Task 5055 Further development of the EQA products

The methods of verification will be refined and further developed during the contract, following user requirements, in the limit of the resources that are allocated to WP50.5.
The metrics proposed by FAIRMODE for the evaluation of models used in the context of air quality assessment will be tested for the Interim and Validated reanalyses individual operational systems as well as the ensemble. A first implementation test in early 2019 for the 2017 VRA will be published in a dedicated deliverable (D5.5.1) and, if relevant, integrated in the EQA of VRA and IRA products from 2020 onwards.
A new web-based interactive tool will be developed by the end of the contract and documented in a dedicated deliverable (D5.5.2). It will allow the visualisation of the performances of individual regional

system as well as the ensemble at every surface station by zooming on a map of Europe using the statistics published in quarterly verification reports.

4.7 WP5060 Data services for Regional products

Meteo-France plans two steps for delivering products as required by Work Package 5060 :

- Phase 1: this phase will start at the beginning of the contract and lasts until the Copernicus Data Store is fully implemented. During this period, two actions will be simultaneously carried out:
    - Meteo-France will continue and update delivery of regional products to the Copernicus users, relying on the existing technical platform.
    - Meteo-France will work to deliver Regional products to Copernicus Data Store. Firstly, Meteo-France and ECMWF will have to work together on the specification of the required interfaces. This will allow a solution meeting ECMWF needs and which is technically achievable in the short time frame of the contract to be elaborated. Then, Meteo-France will implement the validated solution.
- Phase 2 will start when the Copernicus Data Store is fully implemented and will last until the end of the contract.

4.7.1 Phase 1

4.7.1.1 Continue and update delivery of regional products to the users

- User data access during this phase will rely on the same technical platform implemented in CAMS_50.I:
    - A data discovery and download plateform.
    - A dedicated Web server.

- Through a dedicated data discovery and download plateform which has been recognized as an offical DCPC, users will access predefined data sets for data up to fifteen days old. These data sets include individual (for each of the individual Regional systems) and Ensemble analysis and forecasts. GRIB2 files and NETCDF files will be available for ensemble products, and NETCDF files will be proposed for individual products. Two access modes will be offered for downloading these predefined data sets:
    - Request mode (or PULL mode) to get a product on a customer request.
    - Subscribe mode (or PUSH mode) to obtain a product after subscription. Files will be pushed using FTP protocol onto the user server.

  This DCPC is based on the OpenWIS software and associated metadata prepared for all products is in conformance with WMO Metadata Core Profile 1.3.

- Through a dedicated web server, user will access:
    - Dynamic images display and ‘on demand’ data downloading, up to five days old, via OGC Web Services (WMS and WCS). This data downloading is limited to GRIB2 format. This web front-end will help users building the WMS and WCS queries but it must be noted that WMS and WCS will be used directly.

- Archive data through a webservice using KVP based API. Access to CAMS_50 data up to three years, will be available in the archive. As before, the KVP queries will be used directly, without using the web front-end.
- Static images, as png and/or pdf files, for data up to fifteen days old.

It must be noted that access to predefined data sets will be also available through this dedicated web server, as well as using the Download web service directly.

The figure below describes all foreseen dataflows and data accesses:

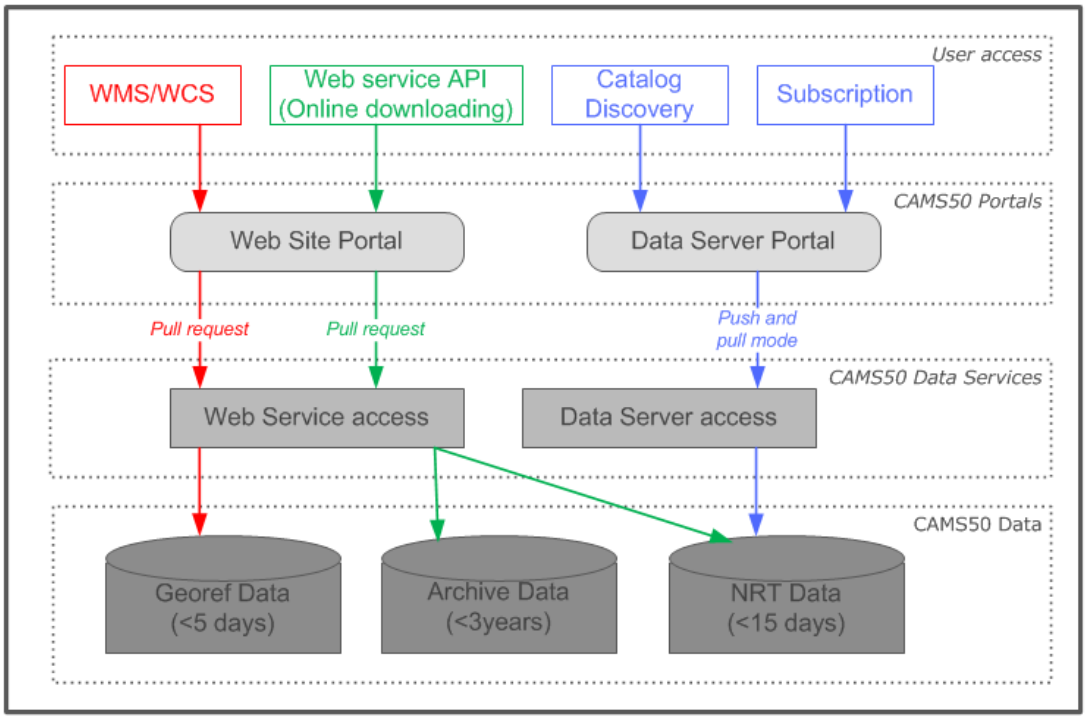


Figure 3. IT organisation for the CAMS_50 production

This Copernicus production is integrated into Meteo-France IT environment. It is using well known software as:

- OpenWIS which provides a discovery portal, authentication and authorization for users.
- Soprano which is the production line of Meteo-France Information System.
- Synergie Web/Synopsis which is a key element of Meteo-France infrastructure services. It is currently being used by Meteo-France for its own forecast and its product dissemination system. Consequently, the implemented technical architecture already fulfills necessary security and service availability high level of requirements.
- DIFMet Software which offers a PUSH service to registered customers.

All the tasks required to deliver CAMS_50 products use Meteo-France state-of-the art IT production environment. The solutions are based on tools that are currently being used by Meteo-France for its own forecast and product dissemination system. All the systems that are part of thes services are integrated in our 24/7 production environment which is monitored 24/7.

The overall architecture of the solution is as follows:

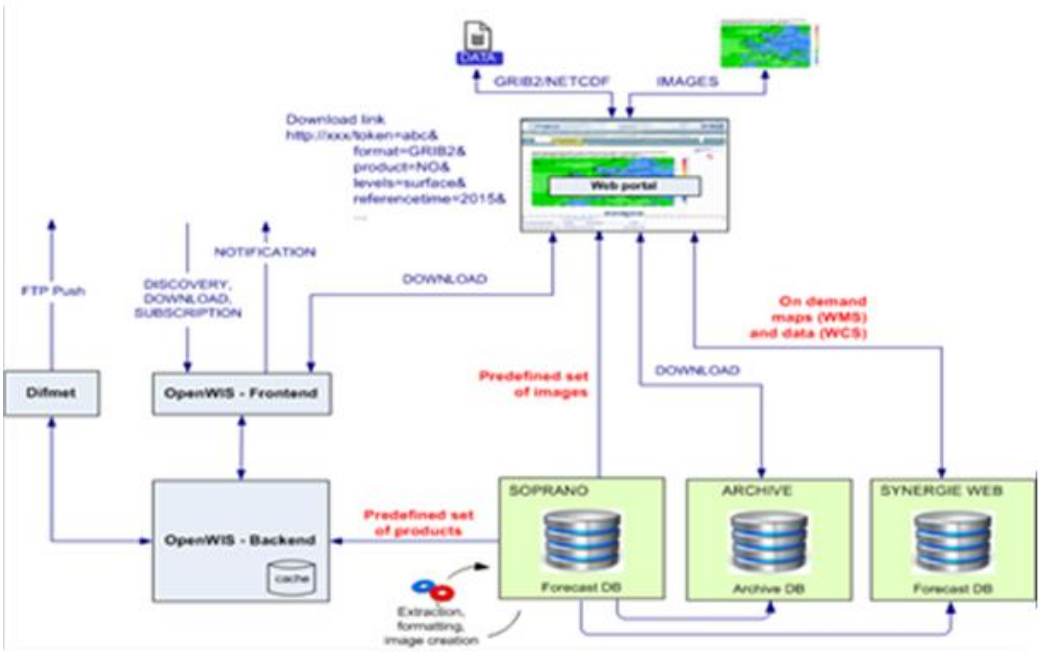


Figure 4. IT architecture

From the beginning of the contract to June 2019, only the seven individual regional models that participated to the operational part of CAMS_50.I will deliver their results according to the specifications listed in the previous tender (concerning covered domain and parameters provided). During this period, Meteo-France will update its production capacities to include the two new individual regional models and a larger covered domain (25° W-45° E, 30°N-72°N).

In June 2019, the new specifications listed above will be integrated into our production.

Concerning the five new aerosol parameters, they will be integrated into regional products in November 2019, as required in tender.

4.7.1.2 CDS specifications and implementation

The CDS has been designed as a distributed system that provides access to datasets and tools through a unified web interface. A general description of the design and functionality has been done, by ECMWF, in newsletter N°151-spring-2017. Meteo-France will be able to propose a technical solution that will implement CAMS data products in CDS distributed infrastructure either by push mode or pull mode. A combination of this two modes is to be considered, depending on the use cases and is to be discussed with ECMWF.

To implement pull mode, Meteo-France proposes both an FTP access mechanism using the KVP based API (describe in 4.7.1) and also OGC Web Coverage Service. This protocol is an internationally recognised standard as required and the implementation of such services is currently being used by Meteo-France for its own architecture.

Interfacing our Web Coverage Services with the CDS will require to carefully define the integration mechanism. For example, we need to agree on an authentication mechanism. It is proposed that ECMWF and Meteo-France to work together to define the most suitable solution and to agree on

detailed specifications. They will have to meet ECMWF needs and the required service level agreements. It should also be consistent with the proposed architecture :

- Maximum necessary bandwidth 150 Mb/s
- 150 concurrent transactions maximum

It must be noted that any ECMWF need that would require a main update of Meteo-France operational infrastructures, will be considered outside the scope of this proposal.

Once these common specifications have been defined, it will take 6 months for Meteo-France to implement and validate the agreed solution.

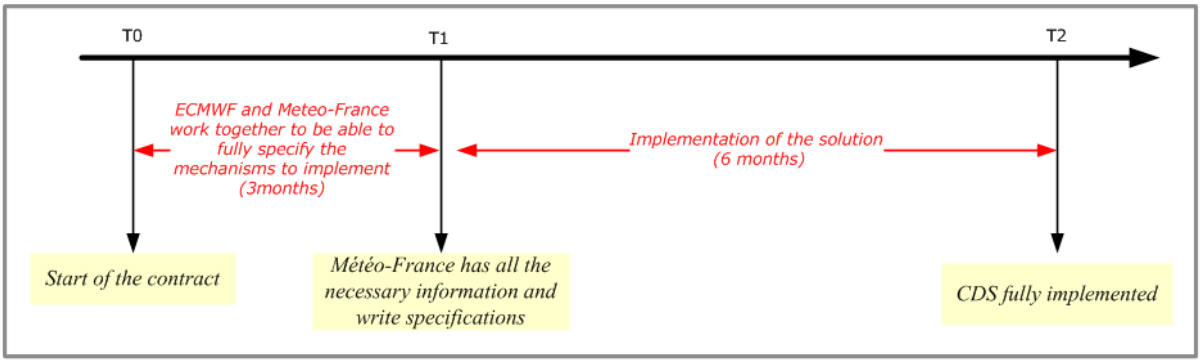
So, for reaching the target (to pull access method to regional products by Copernicus Data Store with WCS), Meteo-France proposes the following timeline:

- T0 : Start of the contract. Regular exchanges between ECMWF and Meteo-France will allow to fully specify the mecanisms to implement.
- T1(= T0 + 3 months): A document defining interfaces between Meteo-France services and CDS, and the integration mechanism will be written by Meteo-France.
- T2 (= T1 + 6 months): Once T1 is done, up to 6 months will be necessary to “glue” the CDS and our WCS service.

The anticipated milestones regarding the implementation of the Copernicus Data Store interface are as follow:

- T1= 01/01/19
- T2(= T1 + 6 months) = 30/06/19 : Operational release date.

It must be noted that the operational release date may be revised (moved forward or delayed) according to the outcome of the bilateral exchanges which have to take place regularly until T1.



4.7.2 Phase 2

All the Copernicus products will be delivered through the ECMWF Copernicus Data Store.

4.8 WP5070 User support

One of the main objective of the Copernicus program is to provide users with data and products operationally and according to their needs. Therefore, the management team will closely work with other users-related CAMS projects (CAMS_71 and CAMS_94 for example) in order to maintain a strong connection with the end users and to possibly anticipate their needs.

All activities in this proposal are organized in two parts:

- The first one are all NRT activities support, with requirements in term of reliability, timeliness, completeness and dedicated monitoring activities in relation with these requirements.
- The second one is about user's support, in terms of technical or scientific issues, data, products, website, species...

User support is provided in WP5070 as a complement to the support provided by the CAMS Service Desk provided by ECMWF. This Service Desk is used for ticketing user requests and distributing these requests to specialists as needed. Dedicated staff at ECMWF provide basic support in the form of self-help facilities (FAQs, knowledge bases, tutorials etc.) as well as individualised support on technical queries related to the CDS, 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.

4.8.1 Proposed organisation

Following the description of users support in the ITT and the coordination by ECMWF and CAMS_94 on the matter, the following organization is defined in order to ensure the service.

Using a traditional three-level support mechanism, it is assumed that CAMS_50 will provide level 2 and 3 support, and that the main support activities (level1) will be conducted by ECMWF or CAMS_94.

This organisation is based on a pre-defined availability of human resources for this activity as described in the implementation plan. As the activity and the number of requests are not known, the delay for answering may increase during the contract if there is an increased charge for level 2 and 3 support activities.

For specific queries, Meteo-France and INERIS ensures level 2 and 3 support for NRT and re-analysis products respectively. INERIS is also proposed as level 2 and 3 support for queries in relationship with Policy Users, with support of other CAMS_50 partners and in particular Meteo-France. Concerning pollens related issues, Meteo-France and INERIS delegate this activity to FMI.

No off line data provision will be considered in this workpackage.

Considering the type of support described here (it will be available only during business hours) and the resources allocated to this workpackage, we plan to provide answers within three weeks after the request as been received. This delay may be reviewed depending on the number of requests and their complexity.

4.8.2 Task 5071 NRT Production: Monitoring and Communication

The NRT Production is an essential part of the production, timeliness is an important issue for users

as some may run follow-up processes using CAMS_50 data or products.
Considering that the most important production, in terms of users' needs, is the ensemble one, we plan having a specific monitoring for these productions tasks. Being a production center, Meteo-France is very familiar with monitoring systems. Meteo-France have a dedicated monitoring centre working 24/7. For the Ensemble, as described in the WP5040, the suite runs on the operational system, in the IT centre.

For the Ensemble production, quality of Ensemble is described in a specific product, related to the Ensemble dataset. This product contains the number of models used for the ensemble calculation and if the ensemble quality is deteriorated. Consequently, users will be aware if the ensemble is missing or late.

These process and monitoring activities could be different in the different phases described in WP 5060.

The CRPU will be able to communicate, at least one month in advance on upcoming evolutions and their impacts. This process is not applicable for the correction of bugs.

4.8.3 Task 5072 Contribution to CAMS User Support

As level 2 and 3, CAMS_50 Team contributes to users support under the coordination of ECMWF and CAMS_94.

The tracking software Jira is mentioned in the ITT for this activity. Jira is well known at Meteo-France as it is used in several projects. It has already been used in the CAM_50.I Service. We will need two months to update/agree with ECMWF and CAMS_94 the procedures that are needed to effectively support the users.

In addition, we will work on help sections, documentations and tutorials available on the CAMS website, regarding the usage of the tools, data and products and other subjects related to this contract, in order to minimize the helpdesk workload (Level 0 of CAMS User Support).

We will use an audience measurement software (measuring probes). The goal is to gain a better understanding of user behaviour and requirements. This experiment will be done by using a license already available at Meteo-France but will only be possible for a limited use (it will also depend on the audience of the CAMS_50.II website). In the case of high volumes of access, a proposal could be made to ECMWF in an Annual implementation plan, in order to acquire a license for that specific purpose.

The internet bandwidth used by data server and website will also be measured permanently, as the bandwidth allocated is defined in this proposal (see WP 5060), a high usage of data server or website will not cause any disruption onto these systems, but download times could become longer in case of saturation of bandwidth.

If necessary a new higher bandwidth allocation could be submitted (including the additional cost) in the Annual implementation plan.

4.9 Summary of equipment

Table 5: Equipment (including hardware and software) to be used for provision of the Service

Equipment	Describe Relevant Function	List each work package for which equipment will be used	Status
Meteo-France			
HPC	Hardware for running the QA model	WP5020	To be Leased
Central IT Production	Used for Ensemble production, pre and post-processing	WP5030, WP5040	Owned by MF; part used by CAMS50 charged
Storage	For all model datasets storage	WP5030	Owned by MF; part used by CAMS50 charged
Bandwidth	Bandwidth	WP5060	To be Leased
Measuring Probes	Software to monitor Website operation and utilization	WP5060	To be Leased
MOCAGE model	Software for AQ modelling	WP5020, WP5030	Owned, not charged to the project
INERIS			
Cluster of 400 cpus	HPC for model running and service post-processing	WP5030, WP5040	In leasing
CHIMERE	Software code for air quality modelling	WP5020, WP5030, WP5040	Owned
GMT	Graphic software	WP5040, WP5050	Owned
R	Statistics and graphics software	WP5050	Owned
FMI			
CRAY XT40 supercomputers	Simulations of atmospheric composition, production of forecasts, analyses and re-analyses,	WP5020, WP5030	Owned
Stornext archiving system	Data archiving	WP5020, WP5030	Owned
Personal computers	Model development	WP5020	Owned
FZJ-IEK8			
Intel Xeon Cluster at FZJ	NRT forecast, analysis, interim re-analysis	WP5030	Owned
ECMWF Super computer	NRT forecast, analysis	WP5030	Owned
Super computer JURECA at JSC	Re-analysis, CAMS_50.II development	WP5020, WP5030	Owned
KNMI			
4752 core BullX B500 HPC	Operational production and development	WP5020, WP5030	Leased
6 blade server	Post-processing	WP5020, WP5030	Leased
TNO			
350 core HPC	Development	WP5020	Owned
LOTOS-EUROS model	Air quality simulations and assimilation	WP5020, WP5030	Owned
MET Norway			

Alvin cluster at Linköping university	Hardware to run air quality forecasts and analysis	WP5030	Owned
Lustre PPI (post-processing infrastructure) at MET Norway	Hardware for preprocessing of input data and post-processing of model output, transfer from ECWMF and to Meteo France	WP5030	To be leased 4 x1750
EMEP MSC-W model	Software to calculate air quality forecasts	WP5020, WP5030	Owned
SMHI			
ECMWF super computer	NRT forecasts	WP5020	Owned
HPC Linux cluster at NSC Linköping University (Frost)	NRT and interim re-analyses	WP5020, WP5030	Owned
HPC Linux cluster at NSC Linkoping University (Bi)	Validated re-analyses	WP5030	Owned
Linux server	Scheduler for analyses	WP5020, WP5030	Owned
MATCH model	Software for air quality forecasts and analyses	WP5020, WP5030	Owned
AU			
Linux cluster, Intel Gold 6140. 240Tbyte storage. A new file server with 300TByte	Air quality forecasts and analysis	WP5030	Owned A new file server with 300TByte will be purchased
Linux cluster, Intel Gold 6140 and personal work stations	Developments, data assimilation and processing of model in- and outputs	WP5020	Owned
DEHM model	Model code for calculating air quality forecasts and analyses. Various codes for post-processing.	WP5020, WP5030	Owned
IEP-NRI			
10 node cluster, Intel Gold 6140, 360 cores, 500 TB storage	Forecast production data assimilation	WP5030	Owned
Dell T630, Intel E5-2699-v3, 36 cores, 20TB storage	Development, data assimilation and post-processing	WP5020, WP5030	Owned
Personal work stations	Development, post-processing	WP5020, WP5030	Owned
BSC			
20 nodes (960 cores) in Marenostrum4 supercomputer, Intel Xeon Platinum 8160, 20TB storage in GPFS HPC disk	Developments, data assimilation and processing of model in- and outputs	WP5020	Owned
600 Tb Storage in GPFS archive	Data archiving	WP5020	Owned
CTE-POWER, cluster based on IBM Power9	Development, post-processing	WP5020	Owned

processors using GPFS HPC storage			
MONARCH model	Software code for air quality modelling/forecast	WP5020	Owned
ENEA			
400 cores Intel E5-2670 2.6 GHz , 375 Tb storage	Developments, data assimilation and processing of model in- and outputs	WP5020	Owned
MINNI/FORAIR	Software code for air quality modelling/forecast	WP5020	Owned as co-developer (CTM code: FARM free)

4.10 References

Joly, M. and V.-H. Peuch, 2012. Objective classification of air quality monitoring sites over Europe, *Atmos. Env.*, 47, 111-123.

Galmarini, S., R. Bianconi, R. Addis, S. Andronopoulos, P. Astrup, J.C. Bartzis, R. Bellasio, R. Buckley, H. Champion, M. Chino, R. D'Amours, E. Davakis, H. Eleveld, H. Glaab, A. Manning, T. Mikkelsen, U. Pechinger, E. Polreich, M. Prodanova, H. Slaper, D. Syrakov, H. Terada, L. Van der Auwera, Ensemble dispersion forecasting—Part II: application and evaluation, *Atmospheric Environment*, Volume 38, Issue 28, September 2004, Pages 4619- 4632, ISSN 1352-2310, http://dx.doi.org/10.1016/j.atmosenv.2004.05.031.

Marécal, V., Peuch, V.H., et al., A regional air quality forecasting system over Europe: the MACC-II daily ensemble production, Geosci. Model Dev. 8(2015), pp. 2777-2813.

5 Management and implementation plan

5.1 Introduction

The project will be responsible for the establishment of the physical and organisational structure to carry out the functions and services requested in this ITT.

Applicable documents will be:

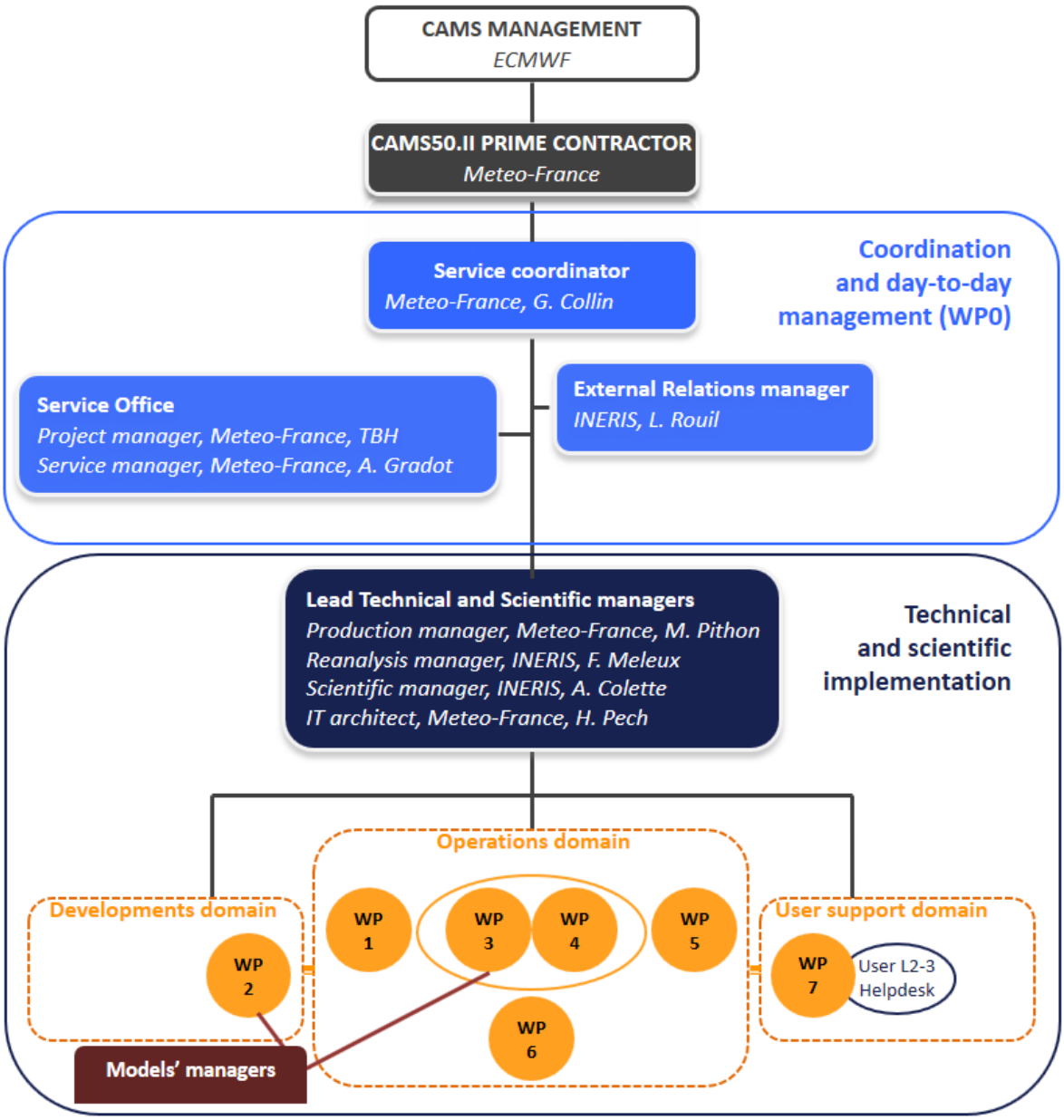
- The CAMS_50 tender and then CAMS_50 contract should this tender be selected.
- All generic CAMS documentation or interfacing documentation agreed upon with others CAMS projects would become applicable.
- The quality standard sof Meteo-France will be applied.

The main management structure is described below and is defined as Work-package 5000 Management.

The CAMS_50 management team will maintain an effective working relationship and coordination between subcontractors within WPs 5020 and WP5030. The management team will also facilitate the sharing of management-related information, through mailing lists, meetings, and easy access to the CAMS_50 documentation (see below the description of Service management tools).

5.2 Organigram

The proposed management structure for CAMS_50.II is outlined in the figure on the next page.



5.3 Management team

The following section describes the CAMS_50 Management team activities and the responsibilities of each WP leader. Work-packages are detailed in the next section.

The CAMS_50 Management team will maintain strong interactions with at least CAMS_61, CAMS_63, CAMS_71, CAMS_84 and CAMS_94, in order to prepare evolutions and address user needs. It will be composed of eight members, reflecting the two CRPUs built for this ITT: an NRT CRPU led by Meteo-France and a re-analysis CRPU led by INERIS.

5.3.1.1 The Service coordinator

- Will coordinate and control the overall Service activities
- Will coordinate and control the drafting of commitments and / or contracts with countries / partner organisations and their execution
- Will report to CAMS Management (Service-Level Boards)
- Will follow budget and risks issues
- Will be responsible for WPs 5000 Management and 5070 User Support, and for the associated deliverables

Considering the large number of partners and work-packages, good coordination will be critical for the success of CAMS_50.II. For this reason, the Service coordinator will be assisted in these activities by a **Service Office** (Project manager and Service manager), **an External Relations manager** and **four Technical managers** (Scientific manager, Re-analysis manager, Production manager and IT architect).

5.3.1.2 The Project manager

- Will organise coordination between the subcontractors and the WPs.
- Will assist the Service manager for the elaboration of efficient management and reporting systems
- Will assist WP leaders in coordinating their WPs (in particular for WP 5020, 5030, 5050 and 5070)
- Will organise the CAMS_50 meetings
- Will follow and maintain the CAMS_50 Annual implementation plans
- Will oversee and coordinate reporting activities across the WPs

5.3.1.3 The Service manager / Project support

- Will handle administrative and budgetary issues
- Will be responsible for contract and subcontract monitoring and for financial reporting to ECMWF

5.3.1.4 The External relations manager

- Will be responsible for the development of a cooperative framework within CAMS (and with other CAMS projects) to ensure consistency between CAMS services and products, especially regarding input data (emissions, boundary conditions, etc.), validation and verification and users management
- Will be responsible for the development of a cooperative framework outside the CAMS community as well, to support promotion of the CAMS_50 products and services and to contribute to their improvement, facilitating access to new networks and datasets for instance
- Will assist the Service coordinator for the communication and dissemination aspects

5.3.1.5 The Scientific manager

- Will be responsible for WPs 5020 and 5050, and for the associated deliverables

- Will coordinate the development activities among the modelling teams and with ECMWF (particularly regarding the evolution of input data for Regional production), with the support of the pollen advisor
- Will validate the scientific choices of the Service, in line with recommendations and evolutions from ECMWF, from user needs and from the other CAMS services related to model development and validation (CAMS_61, CAMS_63, CAMS_84 at least)
- Will maintain and update the multi-year development plan of the Regional systems, as part of the Service Evolution Strategy that will be managed by ECMWF
- Will monitor the KPI regarding the quality of the daily Ensemble forecasts and analyses and will propose actions to improve results, should this be necessary, or new KPIs
- Will monitor progress related to scientific developments (and especially the scientific validation of these developments)

5.3.1.6 The IT architect

- Will validate the technical choices of the project, in line with recommendations and constraints from Meteo-France and ECMWF on these matters
- Will define the interfaces with the Copernicus Data Store
- Will liaise the WP5060 leader and the IT advisor, who will oversee developments in terms of metadata discovery and data access through the existing architecture at Meteo-France (before and after interfacing with Copernicus Data Store)

5.3.1.7 The Production manager

- Will be responsible for WPs 5030 and 5040, and for the associated deliverables
- Will establish and maintain regular contacts between the partners' production teams and the CRPU regarding the NRT production (notification in case of production issue, exchange of technical documentation, information on all planned updates through mailing lists or technical meetings)
- Will monitor the operational production activities (operational updates for example)
- Will propose and follow the KPIs related to operational production
- Will validate and monitor all evolutions regarding the robustness of the operational production and possible impacts
- Will maintain internal communication with the Meteo-France IT division, regarding the monitoring of the production tasks, resource usage and the implementation of changes

5.3.1.8 The Re-analysis manager

- Will be responsible for WP5010
- Will monitor re-analysis productions
- Will work on re-analysis-related KPIs and propose new KPIs or evolutions to the existing KPIs if necessary
- Will validate all proposed evolutions regarding re-analysis activities

5.3.1.9 The Model manager(s)

- Will monitor all activities regarding his/her model with respect to the CAMS_50 requirements
- Will develop updates of the model (s)he is in charge of, regarding the development plan validated with CAMS_50
- Will report to the CAMS_50 Management team
- Will monitor budget and risks issues related to the development plan (s)he is responsible for and the model (s)he is in charge of in the framework of CAMS_50
- Will monitor indicators related to his/her model: quality, compliance with requirements
- Will produce all deliverables requested by the WP leaders as identified in the implementation tables

The persons anticipated to act as model managers and their deputie(s) are listed in the table below.

Institute (Model)	**Development manager**	**Production manager**	**Re-analysis manager**
INERIS (CHIMERE)	F. Meleux (main contact) L. Rouïl (deputy)		
MET Norway (EMEP)	M. Gauss (main contact) A. Benedictow (deputy 1) A. Valdebenito (deputy 2)		
FZJ-IEK8 (EURAD-IM)	E. Friese (main contact) H. Elbern (deputy) K. Krajsek K. Kasradze		
KNMI-TNO (LOTOS-EUROS)	J. Douros (main contact) H. Eskes (deputy)		
SMHI (MATCH)	E. Engstrom (main contact) L. Robertson (deputy) J. Langner	L. Robertson (main contact) R. Bergström (deputy) E. Engstrom	H. Alpfjord (main contact) F. Windmark (deputy) E. Engstrom L. Robertson
FMI (SILAM)	M. Sofiev (main contact) R. Kouznetsov (deputy)		
AU (DEHM)	C. Geels (main contact) K. M. Hansen (deputy)		
IEP-NRI (GEM-AQ)	J. Kaminski (main contact) J. Struzewska (deputy)		
MONARQUE (BSC)	Oriol Jorba (main contact) Maria-Teresa Pay (deputy) Dorota Chmielewska	N/A	N/A
MINNI (ENEA)	Mario Adani Luisella Ciancarella	N/A	N/A

5.3.1.10 WPs management

As specified in the ITT, the work breakdown structure is made up of seven work-packages, and a management work-package has been added.

Strong relationships will exist between all the work-packages, as these will address components of the same operational system, from data acquisition to user support. Each work-package will need to exchange with others in a fully transparent manner. Each work-package will have its own specific day-to-day management, and rwill report on a monthly basis via web conferencing or email, focusing on important issues and changes.

Meteo-France and INERIS will conduct the key management tasks in close collaboration.

5.4 Management procedures

Project management tools

The anticipated tools to facilitate information sharing are as follow:

- A wiki supplied by Meteo-France and to be used by all partners. It will be the reference for all meetings reports, implementation plans and other documentation and will allow interactive work on documents.
- CAMS_50 meetings, mainly through webconferencing (Webex sessions) allowing presentations to be shown and discussed.
- A project management software (Projeqtor) to be used by Meteo-France to keep track of all CAMS_50 activities and prepare reports and other related matters for communication towards ECMWF. Being an internal tool, neither the subcontractors nor ECMWF will be able to access it. Note that no associated cost will be claimed to ECMWF although it will be heavily used.

Project Meetings

Title	Aim	Participants	Frequency
CAMS_50 Management team meetings	Short monthly meetings to report about daily project management, with follow-up of actions	(part of) Management team	Monthly
Work-packages meetings	Meetings to address various subjects (technical issues, scientific issues, delays, etc.)	Under the responsibility of each WP leader	On demand
CAMS_50 meetings	Internal CAMS_50 meetings (Webexes or face-to-face)	CAMS_50 Management team and 1 or 2 representatives per modelling team	One every 2 months

CAMS Management meetings	Teleconferences during which progress will be reported to ECMWF	CAMS_50 Service coordinator or representative + Project manager	Monthly
User needs meetings or specific meetings (with other CAMS projects)	Meeting organised by other CAMS projects connected to CAMS_50	Required CAMS_50 coordinators or managers	On opportunity
CAMS General assembly	To represent the CAMS_50 Service	CAMS_50 main participants	Yearly

Subcontractors Management

Given the large number of subcontractors and geographic distance, Meteo-France will apply a carefully-devised subcontractor management strategy. Its key features are specified below:

- Legally-binding subcontracts with clear provisions concerning deliverables, milestones, performance obligations and budgetary constraints.
- A cohesive work environment conducive to open discussion between Meteo-France and the subcontractors. Easy communication channels.
- Appropriate information allowing subcontractors to have a good picture of the overall CAMS_50 activities and interactions with other CAMS services, and of where their contributions fit.
- Smooth payment flows and assistance to subcontractors concerning invoicing and payment matters. This matter should not be overlooked since finances are key considerations for any subcontractor.
- Subcontractor performance regularly monitored through regular meetings and reports to ensure activities are being completed according to plan.
- Back-up contact person assigned by each subcontractor for all relevant domains (development activities / operational NRT production / operational re-analysis production). This will ensure Meteo-France stays up-to-date on progress made and any potential roadblock.

Conflict resolution

As with CAMS_50, the co-ordination team will facilitate a cooperative working environment where the modelling teams will be able to discuss healthy conflicts in depth and express different points of view. Additionally, most of the modelling teams have long worked together through CAMS_50 and the precursor projects, which should mitigate the risk of a critical conflict situation occurring and adversely affecting the success of CAMS_50.II.

Should such situation arise, it should be stressed that dispute provisions will be included in all subcontracts, both in terms of formal dispute settlement and in terms of performance continuity during pendency of dispute. However, Meteo-France stands firm on the need to firstly explore all possible avenues and help the teams concerned find win-win solutions before escalading a conflict this way.

A risk of conflict could stem from the new modelling teams potentially feeling isolated as compared to the operational teams. However, the current CAMS_50 has proven that new modelling teams successfully integrated within the operational modelling teams, through exchange of information and sharing of experience. We are confident that the same will happen for BSC and ENEA.

Concerning potential conflicts with other CAMS services connected to CAMS_50.II, we will seek to work together on good terms provided the activities fall within the scope of the ITT and within budgetary constraints.

5.5 Other aspects

Geographical balance

Whilst the EU Nordic countries are rather predominant in the current CAMS_50 endeavour, the inclusion of the Spanish and Italian modelling teams in CAMS_50.II will ensure a well-balanced geographical distribution of the teams across the European Union.

Outreach towards users

Although outreach towards users does not lie at the heart of the ITT, limited communication actions will be performed by CAMS_50.II Management, by means of presentations during the CAMS General assemblies or CAMS National user days in France, press articles and news releases through the Meteo-France and INERIS websites for instance. Proper acknowledgement of EU Copernicus funding will be displayed on these occasions and in scientific publications resulting from CAMS_50.II.

Gender representation within the project

Gender glass ceiling does not exist in the proposed tender. The consortium exhibits a good female-to-male ratio at the various work levels and more than 50% of the key staff members are women. Equally noteworthy is the fact that three of them will serve in the highest executive positions (Service coordinator, External intra-CAMS relations manager, Production manager). Gender-biased practices or language will not be permitted in the Service day-to-day operations. Lastly, all partner institutes strive to maintain a supportive environment for a gender-balanced workforce.

5.6 Gantt chart and PERT chart

Please see next pages.

VPs and tasks		Month 2 Nov 2018		Month 4 Jan 2019		Month 6 Mar 2019		Month 8 May 2019		Month 10 Jui 2019		Month 12 Sep 2019		Month 14 Nov 2019
WP5000 Management and coordination														
T5001 Overall co-ordination of the project, and links with other CAMS projects	M0.1.4		M0.1.6		M0.1.6	M0.1.3	M0.1.6		M0.1.6		M0.1.6	M0.1.3	M0.1.6	
T5002 Reporting and day-to-day Regional production Service administration														
WP5010 Observational data acquisition														
T5011 Acquisition of NRT data														
T5012 Acquisition of interim data														
T5013 Acquisition of a posteriori validated data (uncertainty in the date of EEA release)														
WP5020 Continuous model development (M2.1.4 et M3.1 floating)														
T5021 Development of the nine Regional operational systems						M2.1.1					M2.1.3			
T5022 Development of two new models						M2.2.1						M2.2.2		
T5023 Development of the ensemble production														
WP5030 Distributed regional production														
T5031 Daily European NRT air quality analyses from individual models									M3.1.1 M3.1.2 M3.1.3					
T5032 Daily European NRT air quality forecasts from individual models									M3.1.1 M3.1.2 M3.2.1					
T5033 European air quality interim re-analyses from individual models				M3.3.1										
T5034 European air quality re-analyses from individual models								M3.4.1 M3.4.2						
WP5040 Centralised regional production														
T5041 Daily European NRT air quality ensemble analyses									M4.1.1					
T5042 Daily European NRT air quality ensemble forecasts									M4.2.1					
T5043 European air quality ensemble interim re-analyses														
T5044 European air quality ensemble re-analyses											M4.4.1			
WP5050 Evaluation and Quality Assessment														
T5051 EQA of NRT forecasts														
T5052 EQA of NRT analyses														
T5053 EQA of interim re-analyses														
T5054 Verification of re-analyses														
T5055 Further development of the EQA products														
WP5060 Data services for Regional Products														
T5060 Coordination														
T5061 Delivery of products through CAMS50 technical platform														
T5062 Update delivery to incorporate new requirements														
T5063 Definition of the interfacing solution with Copernicus Data Store														
T5064 Implementation of the solution and tests				M6.3.1										
T5065 Delivery of Regional products in CDS										M6.5.1 to 4				
T5066 Update delivery to incorporate five aerosol parameters														
WP5070 User support														
T5071 NRT Production: monitoring and communication		M7.1.1							M7.1.2					
T5072 Contribution to CAMS User support														

WPs and tasks		Month 16 Jan 2020		Month 18 Mar 2020		Month 20 May 2020		Month 22 Jui 2020		Month 24 Sep 2020		Month 26 Nov 2020
WP5000 Management and coordination												
T5001 Overall co-ordination of the project, and links with other CAMS projects	M0.1.6		M0.1.6	M0.1.3	M0.1.6		M0.1.6		M0.1.6	M0.1.3	M0.1.6	
T5002 Reporting and day-to-day Regional production Service administration												
WP5010 Observational data acquisition												
T5011 Acquisition of NRT data										M50.1.1		
T5012 Acquisition of interim data												
T5013 Acquisition of a posteriori validated data (uncertainty in the date of EEA release)												
WP5020 Continuous model development (M2.1.4 et M3.1 floating)												
T5021 Development of the nine Regional operational systems												
T5022 Development of two new models	M 2.2.3											
T5023 Development of the ensemble production												
WP5030 Distributed regional production												
T5031 Daily European NRT air quality analyses from individual models												M3.1.4
T5032 Daily European NRT air quality forecasts from individual models												M3.2.2
T5033 European air quality interim re-analyses from individual models		M3.3.2 M3.3.3										
T5034 European air quality re-analyses from individual models						M3.4.3						
WP5040 Centralised regional production												
T5041 Daily European NRT air quality ensemble analyses												M4.1.2
T5042 Daily European NRT air quality ensemble forecasts												M4.2.2
T5043 European air quality ensemble interim re-analyses			M4.3.1									
T5044 European air quality ensemble re-analyses									M4.4.2			
WP5050 Evaluation and Quality Assessment												
T5051 EQA of NRT forecasts												
T5052 EQA of NRT analyses												
T5053 EQA of interim re-analyses												
T5054 Verification of re-analyses												
T5055 Further development of the EQA products	M5.5.1											M5.5.2
WP5060 Data services for Regional Products												
T5060 Coordination												
T5061 Delivery of products through CAMS50 technical platform												
T5062 Update delivery to incorporate new requirements												
T5063 Definition of the interfacing solution with Copernicus Data Store												
T5064 Implementation of the solution and tests												
T5065 Delivery of Regional products in CDS												
T5066 Update delivery to incorporate five aerosol parameters												
WP5070 User support												
T5071 NRT Production: monitoring and communication												M7.1..2
T5072 Contribution to CAMS User support												

WPs and tasks		Month 28 Jan. 2021		Month 30 March 2021		Month 32 May 2021	
WP5000 Management and coordination							
T5001 Overall co-ordination of the project, and links with other CAMS projects	M0.1.6		M0.1.6	M0.1.3	M0.1.6		M0.1.6
T5002 Reporting and day-to-day Regional production Service administration							
WP5010 Observational data acquisition							
T5011 Acquisition of NRT data							
T5012 Acquisition of interim data							
T5013 Acquisition of a posteriori validated data (uncertainty in the date of EEA release)							
WP5020 Continuous model development (M2.1.4 et M3.1 floating)							
T5021 Development of the nine Regional operational systems							
T5022 Development of two new models							
T5023 Development of the ensemble production							
WP5030 Distributed regional production							
T5031 Daily European NRT air quality analyses from individual models							
T5032 Daily European NRT air quality forecasts from individual models							
T5033 European air quality interim re-analyses from individual models							
T5034 European air quality re-analyses from individual models							
WP5040 Centralised regional production							
T5041 Daily European NRT air quality ensemble analyses							
T5042 Daily European NRT air quality ensemble forecasts							
T5043 European air quality ensemble interim re-analyses			M4.3.2				
T5044 European air quality ensemble re-analyses							
WP5050 Evaluation and Quality Assessment							
T5051 EQA of NRT forecasts							
T5052 EQA of NRT analyses							
T5053 EQA of interim re-analyses							
T5054 Verification of re-analyses							
T5055 Further development of the EQA products							
WP5060 Data services for Regional Products							
T5060 Coordination							
T5061 Delivery of products through CAMS50 technical platform							
T5062 Update delivery to incorporate new requirements							
T5063 Definition of the interfacing solution with Copernicus Data Store							
T5064 Implementation of the solution and tests							
T5065 Delivery of Regional products in CDS							
T5066 Update delivery to incorporate five aerosol parameters							
WP5070 User support							
T5071 NRT Production: monitoring and communication							
T5072 Contribution to CAMS User support							

5.7 Summary of Work packages and Deliverables

Please see next pages.

Work package	Deliverable Reference + Title	Effort in person-months	Budget (K€)
WP5000	D0.1.1-YYYY Draft Implementation Plan YYYY *YYYY being the Year n+1*	3	30
WP5000	D0.1.2-YYYY Finalised Implementation Plan YYYY *YYYY being the Year n+1*	4	40
WP5000	D0.1.3 Updated KPIs (list, targets...) after review with ECMWF	4	40
WP5000	D0.2.1-YYYYQQ Quarterly Implementation report QQ YYYY *QQ YYYY being the previous quarter*	16.7	166
WP5000	D0.2.2-YYYY Annual Implementation report YYYY *YYYY being the Year n-1*	4	40
WP5000	D0.2.3 Final Implementation Report, including letter from auditor specific to CAMS contract YYYY *YYYY being the last year of the contract*	4	40
WP5000	D0.2.4-YYYY Copy of Meteo-France general financial statements and audit report YYYY *YYYY being the Year n-1*	4	40
WP5000	D0.2.5-YYYY Letter - auditor's opinion specific to CAMS most recent Annual Implementation Report YYYY *YYYY being the Year n-1*	4	40
	TOTAL WP5000 (Management) Effort	**43.7**	**435 (VAT non included)**
WP5010	D1.1.1 Provision of NRT surface observations to the Regional operational systems	2.5	35
WP5010	D1.1.2-QQ Quarterly reports on the acquisition of NRT data from EEA and the ACTRIS and EMEP programmes	3.5	49
WP5010	D1.1.3 Update in the best use of EIONET observation database for assimilation and verification of the NRT Regional production	3.35	46
WP5010	D1.2.1 Provision of interim surface observations to the Regional operational systems	0.75	10
WP5010	D1.2.2-QQ Quarterly reports on the acquisition of interim data from EEA and the ACTRIS and EMEP programmes	2	28
WP5010	D1.2.3-YYYY Annual report on the acquisition of interim surface observations from EEA, EMEP and ACTRIS for year N	0.5	7
WP5010	D1.3.1-YYYY Provision of validated surface observations to the Regional operational systems	0.75	10
	TOTAL WP5010 Effort	**13.35**	**185**
WP5020	D2.1.1.{model}-YYYYS1/S2 Half-yearly reports on the development activities of each of the Regional operational systems {model being one of the 9 operational models}	102.13	1316

WP5020	D2.1.2.{model}-YYYYS2 Note confirming the status of the development milestones planned for YYYYS2 for each of the Regional operational systems, {model being one of the 9 operational models}	1	13
WP5020	D2.1.3{model} Update of the documentation of each of the Regional systems {model being one of the 9 operational models}	4	52
WP5020	D2.2.1.{new_model}-YYYYS1/S2 Half-yearly reports on the development activities of each of the candidate Regional systems, {new model being one of the 2 new models}	25	220
WP5020	D2.2.2.{new_model}-YYYYS2 Note confirming the status of the development milestones planned for YYYYS2 for each of the candidate Regional systems, {new model being one of the new models}	1	9
WP5020	D2.2.3 Assessment of the added value for users of the new models	2	26
WP5020	D2.2.4 Evaluation of the new modelling systems developed	2	26
WP5020	D2.3.1.ENSEMBLE-YYYYS1/S2 Half-yearly reports on the development activities of the Regional Ensemble system	21	271
WP5020	D2.3.2.ENSEMBLE-YYYYS2 Note confirming the status of the development milestones planned for YYYYS2 for the CAMS Regional Ensemble system	1	13
WP5020	D2.3.3.ENSEMBLE Update of the documentation of the CAMS Regional ensemble	1	13
	TOTAL WP5020 (Continuous model development) Effort	**160.13**	**1958**
WP5030	D3.1.1.{model} Provision of individual NRT analyses from each of the operational systems	55.41	634
WP5030	D3.1.2-YYYYQX Log of daily provision of NRT analyses covering all the operational systems (including percentages of result provision and dates of missing data)	1	11
WP5030	D3.2.1.{model} Provision of individual forecasts (up to 96h) from each of the operational systems	55	630
WP5030	D3.2.2.-YYYYQX Log of daily provision of forecasts for all the operational systems (including percentages of result provision and dates of missing data)	1	11
WP5030	D3.3.1.{model}-YYYY Provision of the annual interim re-analysis for Year N from each of the operational systems	40	458
WP5030	D3.3.2-YYYY Log of the delivery of the interim re-analysis for Year N for all the operational systems	1	11
WP5030	D3.4.1.{model}-YYYY Provision of the annual re-analysis for Year N-1 from each of the operational systems	34	389

WP5030	D3.4.2-YYYY Log of the delivery of the annual re-analysis for Year N-1 for all the operational systems	1	11
	TOTAL WP5030 (Distributed Regional production) Effort	**188.41**	**2157**
WP5040	D4.1.1 Provision of Ensemble NRT analyses (hourly outputs)	6	80
WP5040	D4.1.2-YYYYQX Log of daily provision of NRT analyses covering all the operational systems (including percentages of result provision and dates of missing data)	0.5	7
WP5040	D4.2.1 Provision of Ensemble NRT forecasts (hourly outputs up to 96h) and other products (EPSgrams, Mean/Max values)	6	80
WP5040	D4.2.2.-YYYYQX Log of daily provision of forecasts for all the operational systems (including percentages of result provision and dates of missing data)	0.5	7
WP5040	D4.3.1-YYYY Provision of the annual Ensemble interim re-analysis for Year N	7.65	102
WP5040	D4.3.2-YYYY Log of the delivery of the annual Ensemble interim re-analysis for Year N	0.5	7
WP5040	D4.4.1-YYYY Provision of the annual Ensemble re-analysis for Year N-1	3	40
WP5040	D4.4.2-YYYY Log of the delivery the annual Ensemble re-analysis for Year N-1	0.5	7
	TOTAL WP5040 (Centralised Regional production) Effort	**24.65**	**328**
WP5050	D5.1.1.{model}_YYYYMMM Quarterly report on the verification of NRT forecasts and analyses, for each of the operational systems	5	46
WP5050	D5.1.2.ENSEMBLE_YYYYMMM Quarterly report on the verification of NRT forecasts and analyses, for each of the operational systems	0.5	5
WP5050	D5.1.3-YYYYMMM Companion numerical dataset (detailed performance statistics) of the quarterly reports on the verification of NRT forecasts and analyses, for each operational model and the Ensemble	0.5	5
WP5050	D5.3.1-YYYY Annual report on the verification of the interim re-analysis for Year N (Ensemble and individual operational systems)	0.5	5
WP5050	D5.3.2-YYYY Companion numerical dataset (detailed performance statistics) of the verification of the interim re-analysis for Year N (Ensemble and individual operational systems)	0.5	5
WP5050	D.5.4.1-YYYY Annual report on the verification of the re-analysis for Year N-1 (Ensemble and individual operational systems)	3	28
WP5050	D.5.4.2-YYYY Companion numerical dataset (detailed performance statistics) of the verification	1	9

	of the re-analysis for Year N-1 (Ensemble and individual operational systems)		
WP5050	D5.5.1 Verification plots for the past day, past week and past 3 months	4.43	41
WP5050	D5.5.2 Presentation of NRT analyses and forecasts site-level verification statistics for the past 8 quarters (Ensemble and individual operational systems)	4	37
TOTAL WP5050 (Evaluation and Quality Assessment) Effort		**19.93**	**183**
WP5060	D6.0.1-web Web-based graphics on regional Products and their verification	5.84	44
WP5060	D6.0.2-YYYYQX Quarterly report on the delivery of CAMS Regional products	4	30
WP5060	D6.0.3-YYYYQX Quarterly report on the delivery of web-based graphics on Regional Products and their verification	4	30
WP5060	D6.1.1-analyses NRT analyses available through CAMS_50 technical platform	3	23
WP5060	D6.1.2-forecasts Forecasts available through CAMS_50 technical platform	3	23
WP5060	D6.3.1-CDS Interfaces Specification Detailed Interface specifications for CDS	5	38
WP5060	D6.5.1-analyses NRT analyses available in CDS	11	84
WP5060	D6.5.2-forecasts NRT forecasts available in CDS	11	84
WP5060	D6.5.3-interim re-analyses Users can discover corresponding data in the CDS Infrastructure	3	23
WP5060	D6.5.4-re-analyses Annual Re-analyses since 2010 available in CDS	2	16
TOTAL WP5060 (Data services for Regional products) Effort		**51.84**	**395**
WP5070	D7.2.1 Specialised user support via the CAMS Service Desk	7	60
WP5070	D7.2.2 Quarterly report on Specialised user support	7.65	66
Total WP5070 (User support) Effort		**14.65**	**127**
OVERALL TOTAL		**516.66**	**5767** (VAT not included in for WP5000 MGT in this table)

5.7.1 WP5000

Work package #	WP5000	Start/End date	M1-M33
Work package title	Management and coordination		
Participants (person months)	43.69 (=37.44 (Meteo-France) + 6.25 (INERIS))		
Other main direct cost elements	Travel: €19 200 (Meteo-France) + €9 600 (INERIS) Workshop : €13 000 (MF) (excluding VAT)		

Main objectives

This work package is dedicated to the overall coordination of CAMS_50, entailing regular interactions with subcontractors and ECMWF, as well as linkages with other CAMS projects. This coordination work will fall within the responsibilities of Meteo-France and INERIS.

Description of activities

Task 5001: Overall co-ordination of the project, and links with other CAMS projects

This tasks will consist in:

- Following up the Service contract implementation and carrying out risk and performance monitoring, implying regular interactions with all subcontractors (bimonthly web conferences, etc.).
- Overseeing the strategic directions of CAMS_50 and drafting annual implementation plans, closely together with all subcontractors and CAMS Management.
- Maintaining linkages with other relevant CAMS projects.
- Reporting to ECMWF on the CAMS_50 progress and any major existing or anticipated difficulties, for instance through Service Level Boards and review meetings with CAMS Management.

Task 5002: Reporting and day-to-day Regional production Service administration

This task will consist in the administrative and financial coordination of the contract, including:

- Supervising and facilitating the delivery of reports.
- Ensuring maintenance of internal communication tools.
- Handling contractual matters (Service contract and subcontracts).
- Managing cash flow.
- Managing the project internal documentation.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D0.1.1-YYYY	Meteo-France	Report	Draft Implementation Plan YYYY *YYYY being the Year n+1*	Annually on 28/02

D0.1.2-YYYY	Meteo-France	Report	Finalised Implementation Plan YYYY *YYYY being the Year n+1*	Annually on 31/10
D0.1.3	Meteo-France	Other	Updated KPIs (list, targets...) after review with ECMWF	One year after start of contract
D0.2.1-YYYYQQ	Meteo-France	Report	Quarterly Implementation report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 15/01, 15/04, 15/07 and 15/10 (civil quarter)
D0.2.2-YYYY	Meteo-France	Report	Annual Implementation report YYYY *YYYY being the Year n-1*	Annually on 28/02
D0.2.3	Meteo-France	Report	Final Implementation Report, including letter from auditor specific to CAMS contract YYYY *YYYY being the last year of the contract*	60 days after end of the last contract service
D0.2.4-YYYY	Meteo-France	Other	Copy of Meteo-France general financial statements and audit report YYYY *YYYY being the Year n-1*	Annually
D0.2.5-YYYY	Meteo-France	Other	Letter - auditor's opinion specific to CAMS most recent Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M0.1.1	Meteo-France	CAMS General Assembly	Participation to the meeting	Annually
M0.1.2	Meteo-France	Monthly telecons with ECMWF	Participation to the meeting	Monthly
M0.1.3	Meteo-France	Progress review meetings with ECMWF / Payment milestone	Minutes of meeting	Every 6 months

		s		
M0.1.4	Meteo-France	CAMS_50 kick-off meeting	Agenda with list of attendees	M1
M0.1.5	Meteo-France	Internal face-to-face project meetings	Agenda with list of attendees	Annually
M0.1.6	Meteo-France	Internal project telecons	Note listing the telecons that took place with brief indication of the key item discussed	Every 2 months

5.7.2 WP5010

Work package #	WP5010	Start/End date	M1-M33
Work package title	Observational data acquisition		
Participants (person months)	13.35 (=11.85 (Meteo-France) + 1.5 (INERIS))		
Other main direct cost elements	Travel: €19,200 for Meteo-France only		

Main objectives

The main objective of this work-package is to propose and deliver sets of observations to be used in WP5030 (for operational analyses, re-analyses) and in WP5050 (for verification at the surface). Special care will be taken to deliver independent datasets for analyses and verifications. Classification and filtering will apply to the observation datasets, and some evolutions and updates will be in the scope of this work-package. The main observation datasets will be downloaded from EEA, and observations from other sources will be investigated.

Description of activities

Task 5011: Acquisition of NRT data

This task will consist in acquiring 'Up-to-Date' observation datasets from EEA on a daily basis, filtering and applying classification for representativeness and providing these datasets, both for NRT analyses from the nine operational models (D1.1.1) and for the verification of forecasts and analyses. Acquisition of NRT observations will be reported quarterly in D1.1.2-YYYYMMM. An update of the classification of stations, of the timeline for acquisition and of the number of stations to be selected per pollutant for NRT Production will be reported in D1.1.3.

Task 5012: Acquisition of interim data

This task will consist in acquiring 'interim' observation datasets from EEA and providing them both for re-analyses from the operational models (D1.2.1) and for forecast and analysis verification. The time lag (DD+20) for downloading the interim data was set out during CAMS_50.I. Interim data acquisition will be reported on a quarterly basis in D1.2.2-YYYYMMM. An update on the acquisition and on the best use of EIONET interim data for daily Regional production will be reported in D1.2.3.

Task 5013: Acquisition of a posteriori 'validated' data

This task will consist in acquiring 'validated' observation datasets from EEA and providing them both for re-analyses from the operational models (D1.3.1-YYYY) and for verification of forecasts and analyses. The validated dataset is usually available at the beginning of year Y+2. The acquisition of 'validated' data and of supplementary data will be reported in the annual report D1.3.2-VRAYYYY.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D1.1.1	Meteo-	Data	Provision of NRT surface observations to the Regional	Daily

	France		operational systems	
D1.1.2-YYYYMMM	Meteo-France	Report	Quarterly reports on the acquisition of NRT data from EEA and the ACTRIS and EMEP programmes	2 months after each production quarter
D1.1.3	Meteo-France	Report	Update in the best use of EIONET observation database for assimilation and verification of the NRT Regional production	M24
D1.2.1	INERIS	Data	Provision of interim surface observations to the Regional operational systems	Daily
D1.2.2-YYYYQQ	INERIS	Report	Quarterly reports on the acquisition of interim data from EEA and the ACTRIS and EMEP programmes	2 months after each production quarter
D1.2.3	INERIS	Report	Update of the best use of EIONET observation database for daily Regional interim production	…
D1.3.1-YYYY	INERIS	Data	Provision of validated surface observations to the Regional operational systems	Annually (1 month after release of EEA validated database)
D1.3.2-VRAYYYY	INERIS	Report	Annual report on the acquisition of validated surface observations from EEA, EMEP and ACTRIS for year N	End of February year N+1

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M1.1	Meteo-France	Update of the classification - NRT	New list of stations reported in deliverable D1.1.3	M24
M1.2	INERIS	Update of the classification - interim	Reported in D1.2.3	…

5.7.3 WP5020

Work package #	WP5020	Start/End date	M1-M33
Work package title	Continuous model development		
Participants (person months)	160.13 = 28.94 (Meteo-France) + 15.2 (INERIS) +10.74 (FMI) 14.85 (FZJ-IEK8)+ 8.3 (KNMI)+18.75 (MET Norway)+ 9.91 (SMHI) + 10.06 (AU) +22 (IEP-NRI)+ 11.34 (BSC) + 10.04 (ENEA)		
Other main direct cost elements	Travel: €4800 (Meteo-France) €2000 (INERIS) + €12086 (FMI) + 4800 (FZJ-IEK8)+€ 3600 (KNMI)+ 14 400 (MET Norway)+ €7200 (SMHI) + €10284 (AU) + €6000 (BSC) + €7200(ENEA) Computing: €16190= €7 376 for Meteo-France, €8814 for SMHI) Other (subcontract) : €118 499 (KNMI)		

Main objectives

The activities in WP5020 will aim at introducing relevant evolutions into the nine Regional operational systems and also into the Ensemble processing centres at Meteo-France and INERIS, so as to keep Regional production at the best possible level of quality and to introduce new products. Some activities are also designed to prepare for the introduction of two new models in the Regional production.

Description of activities

Task 5020: Coordination

This task will consist in the overall coordination work with the operational teams. Updates to the WP5020 development plan will fall within the scope of this task, as well as the assessment of the added value of the new models for users and the evaluation of the modelling systems developed. A special role will be assigned to the pollen advisor to provide insight for the development of pollen modelling as well as validation.

Task 5021: Development of the nine Regional operational systems

For each of the nine Regional operational systems, the purpose of this task will be to:

- Update the model configurations to meet the requirements of the ITT as soon as possible.
- Continuously improve the quality of model outputs, regarding verifications performed by WP5050 and by CAMS_84, needs expressed for CAMS_94 and ECMWF through SES and RAD documents.
- Deliver new model outputs for operational implementation into WP5030, to contribute to new products delivered by the Ensemble production (in relation to Task 5023 and CAMS_63 requirements).

Task 5022: Development of the two new models

The purpose of this task will be, for the new models that could be part of the Regional production, to develop their modelling and assimilation systems in order to fulfil the requirements of the ITT at the end of the 33-month contract. These systems will also have the opportunity to implement the

results from research (CAMS_61) or other CAMS projects (CAMS_81 and CAMS_44). Model developments will be planned yearly and reported twice a year.

Task 5023: Development of the CAMS Regional Ensemble production

The purpose of this task will be to develop the Ensemble production chain processed at Meteo-France for daily production and at INERIS for re-analyses. Evolutions of this processing system may arise from:

- New products (species, levels, etc.) or new diagnosis (from the ensemble of Regional systems) to meet some user requirements specified in the RAD.
- New methods for Ensemble processing, provided by the research conducted in CAMS_63.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D2.1.1.{model}-YYYYS1/S2	Each of the 9 operational modelling teams	Report	Half-yearly reports on the development activities of each of the Regional operational systems, {model} being one of the 9 operational models	End of February and end of August each year
D2.1.2.{model}-YYYYS2	Each of the 9 operational models	Note	Note confirming the status of the development milestones planned for YYYYS2 for each of the Regional operational systems, {model} being one of the 9 operational models	End of December each year
D2.1.3{model}	Each of the 9 operational models	Report	Update of the documentation of each of the Regional systems, {model} being one of the 9 operational models	With each change of operational configuration
D2.2.1.{new_model}-YYYYS1/S2	Each of the 2 new models	Report	Half-yearly reports on the development activities of each of the Regional candidate systems, {new model} being one of the 2 new models	End of February and end of August each year
D2.2.2.{new_model}-YYYYS2	Each of the 2 new models	Note	Note confirming the status of the development milestones planned for YYYYS2 for each of the Regional candidate systems, {new model} being one of the new models	End of December each year

D2.2.3	Meteo-France	Report	Assessment of the added value for users of the new models	M16
D2.2.4	Meteo-France	Report	Evaluation of the new modelling systems developed	M33
D2.3.1.ENSEMBLE-YYYYS1/S2	Meteo-France	Report	Half-yearly reports on the development activities of the Regional Ensemble system	End of February and end of August each year
D2.3.2.ENSEMBLE-YYYYS2	Meteo-France	Note	Note confirming the status of the development milestones planned for YYYYS2 for the CAMS Regional Ensemble system	End of December each year
D2.3.3.ENSEMBLE	Meteo-France	Report	Update of the documentation of the CAMS Regional Ensemble	With each change of operational configuration

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M2.1.1.{model}	Each of the 9 operational modelling teams	Extended geographical domain tested in pre-operational phase	Email sent to CAMS Management by Meteo-France, informing of the completion of the pre-operational upgrade	M6
M2.1.3.{model}	Each of the 9 operational modelling teams	Output available for model parameters: total mineral dust concentrations, primary biomass burning, primary PM10 and PM2.5 attributed to anthropogenic combustion as well as secondary organic aerosol in the PM2.5 fraction tested in pre-operational phase	Email sent to CAMS Management by Meteo-France, informing of the completion of the pre-operational upgrade	M15
M2.1.4.{model}	Each of the 9 operational modelling teams	Operational upgrade of the Regional System {model} including changes prepared in M2.1.1, M2.1.2, M2.1.3	Email sent to the users informing of completion of the operational upgrade	At each operational upgrade
M2.2.1.{new_model}	Each of the 2 new modelling teams	Model set-up forecasts over CAMS domain	Contribution to D.2.2.2.{new_model}-YYYYS2	M6
M2.2.2.{new_model}	Each of the 2 new modelling teams	Introduction of required input data (emission, meteorology, boundary conditions)	Contribution to D.2.2.2.{new_model}-YYYYS2	M12
M2.2.3.{new_model}	Each of the 2 new modelling	Hindcast experiment completed and	Contribution to D2.2.3	M15

	teams	output delivered		
M2.3.1.ENSEMBLE	Meteo-France	Operational upgrade of the Regional Ensemble system	Email sent to the users informing of the completion of the operational upgrade	At each operational upgrade

5.7.4 WP5030

Work package #	WP5030	**Start/End date**	**M1-M33**
Work package title	**Distributed regional production**		
Participants (person months)	188.41 = 34.13 (Meteo-France) + 16.6 (INERIS)+ 21 (FMI) + 18.15 (FZJ-IEK8)+7.44 (KNMI)+ 10.75 (MET Norway)+ 12.11 (SMHI) + 12.23 (AU))+ 56 (IEP-NRI)		
Other main direct cost elements	Travel: €1200 (MF) +€27530 (FMI) + €2400 (FZJ_IEK8)+ € 7200 (SMHI) + € 19500 (IEP-NRI) Computing: €334 155 (=€ 204 858 for Meteo-France, €28400 for INERIS, 66000 for KNM, €6125 for MET Norway, €10772 for SMHI) Other (subcontract): €39 501 (KNMI)		

Main objectives

WP5030 aims at providing to both CRPUs (Meteo-France for NRT analyses and forecasts, INERIS for interim and 'validated' re-analyses), the results of the seven to nine operational models. For two of the models (DEHM and GEM-AQ), a ramp-up phase will be set up to enable them to become fully operational for all the required streams. Monitoring activities will therefore be an important part of the tasks carried out by this work-package. As a general principle, individual production upgrades will be carried out once a year, in November.

Description of activities

Task 5030: Coordination

This is a joint task of Meteo-France and INERIS. It will comprise the overall coordination work with the operational modelling teams and ECMWF. To reach a high level of reliability, key to this task will be the close monitoring of each individual production, with alerts to the relevant operational modelling teams in the event of outputs missing or showing unrealistic values.

A nine-month ramp up phase is planned to enable the DEHM and GEM-AQ models to achieve an adequate level of reliability and stability in terms of timeliness. During this phase, the two modelling teams will work on the operationalisation of the input data acquisition process and optimisation of the model execution time, to fulfill the timeliness and reliability requirements. In a first stage, results will be provided through the e-suite to check compliance to these requirements.

Task 5031: Daily European NRT air quality analyses

For each of the nine operational modelling teams, this task will consist in providing NRT analyses every day to Meteo-France (CRPU), for the required species and levels (D3.1.1.{model}). Meteo-France will then make these analyses available to users no later than 12 UTC. The NRT data effectively assimilated each day per model, and their impact on analyses will be reported in the quarterly

Evaluation and Quality Assessment (EQA) dossiers to inform users about analysis production (percentages, reasons for delays or failures, etc.).

Task 5032: Daily European NRT air quality forecasts

For each of the nine operational modelling teams, this task will consist in providing NRT forecasts every day to Meteo-France (CRPU), for the required species and levels (D3.2.1.{model}). Meteo-France will then make these forecasts available to users no later than 8 UTC (0-48h) and 10 UTC (49-96h). The NRT forecasts effectively delivered each day will be reported in the quarterly Evaluation and Quality Assessment (EQA) dossiers (see WP5000) to inform users about forecast production (percentages, reasons for delays or failures, etc.).

Task 5033: European air quality interim re-analyses

For each of the nine operational modelling teams, this task will consist in providing interim re-analyses on time to INERIS (CRPU), for the required species and levels (D3.3.1.{model}-IRAYYYY).

Task 5034: European air quality 'validated' re-analyses

For each of the nine operational modelling teams, this task will consist in providing annual re-analyses on time to INERIS (CRPU), for the required species and levels (D3.4.1.{model}-VRAYYYY).

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D3.1.1.{model}	Meteo-France	Graphics and data	Provision of individual NRT analyses from each of the operational systems	Daily (before 12 UTC)
D3.1.2-YYYYQX	Meteo-France	Note	Log of daily provision of NRT analyses covering all the operational systems (including percentages of result provision and dates of missing data)	Quarterly, 2 weeks after the end of each production quarter
D3.2.1.{model}	Meteo-France	Graphics and Data	Provision of individual forecasts (up to 96h) from each of the operational systems	Daily (before 08 UTC for D and D+1; before 10 UTC for D+2 and D+3)
D3.2.2.-YYYYQX	Meteo-France	Note	Log of daily provision of forecasts for all the operational systems (including percentages of result provision and dates of missing data)	Quarterly, 2 weeks after the end of each production quarter

D3.3.1.{model}-IRAYYYY	INERIS	Graphics and Data	Provision of the annual interim re-analysis for Year N from each of the operational systems	End of February of Year N+1
D3.3.2-IRAYYYY	INERIS	Note	Log of the delivery of the interim re-analysis for Year N for all the operational systems	End of February of Year N+1
D3.4.1.{model}-VRAYYYY	INERIS	Data	Provision of the annual re-analysis for Year N-1 from each of the operational systems	During Year N+1, no later than four months after 'validated' observations for Year N-1 have been released by the EEA
D3.4.2-VRAYYYY	INERIS	Note	Log of the delivery of the annual re-analysis for Year N-1 for all the operational systems	During Year N+1, no later than four months after 'validated' observations for Year N-1 have been released by the EEA

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M3.1.1	DEHM	DEHM Operational implementation of NRT analysis and forecast	New data available for users (graphics, Netcdf)	M9
M3.1.2	GEM-AQ	GEM-AQ Operational implementation of NRT analysis and forecast	New data available for users (graphics, Netcdf)	M9
M3.1.3	All operational	New domain for NRT analyses	New domain displayed on charts and available in Netcdf	M9

	models		data	
M3.1.4	All operational models	NRT analysis November upgrade	New parameters available for users Update of the documentation of each relevant Regional System	M26
M3.2.1	All operational models	New domain for NRT forecasts	New domain displayed on charts and available in Netcdf data	M9
M3.2.2	All operational models	NRT forecast November upgrade	New parameters available for users Update of the documentation of each relevant Regional system	M26
M3.3.1.{model}	All operational models	Operational production of Interim re-analyses for new species (NO, CO, SO_2 NH_3, PANs, NMVOC)	Contribution to the Ensemble computation for these species	M4
M3.3.2.{model}	All operational models	Operational production of Interim re-analyses over the enlarged domain	Contribution to the Ensemble computation over the new domain	M16
M3.3.3.{model}	All operational models	Operational production of Interim re-analyses for all levels and all parameters	Contribution to the Ensemble computation for these species and for all levels	M16
M3.4.1.{model}	All operational models	Operational production of annual re-analyses for the new species (NO, CO, SO_2, NH_3, PANs, NMVOC)	Contribution to the Ensemble computation for these species	M8

M3.4.2.{model}	All operational models	Operational production of re-analyses over the enlarged domain	Contribution to the Ensemble computation over the new domain	M8
M3.4.3.{model}	All operational models	Operational production of re-analyses for all levels and all parameters	Contribution to the Ensemble computation for these species and for all levels	M20

5.7.5 WP5040

Work package #	WP5040	**Start/End date**	**M1-M33**
Work package title	**Centralised Regional production**		
Participants (person months)	24.65 = 21.38 (MF) +3.27 (INERIS)		
Other main direct cost elements	Travel: €1200 (MF) € (INERIS) Computing: €77000 (for Meteo-France only)		

Main objectives

WP5040, which is strongly linked to WP5030, will be in charge of the Regional Ensemble production, built upon the individual outputs of the operational models. Meteo-France will handle the computation and supply of the Ensemble NRT products on a daily basis, while INERIS will handle the computation and supply of the Ensemble interim and 'validated' re-analyses products on an annual basis.

Ensemble results will be displayed on a web platform or delivered on a data server, with a high level of availability and reliability.

At the beginning of the contract, the operational Ensemble will be computed with seven models. After a ramp-up phase, the DEHM and GEM-AQ will join the operational system for an Ensemble of nine members.

Description of activities

Task 5040: Coordination

This is a joint task of Meteo-France and INERIS. It will comprise the overall coordination work with the operational modelling teams, ECMWF and other CAMS projects (CAMS_61, CAMS_63 and CAMS_84).

In the first year of the project, the Ensemble will evolve and will be conputed from a set of nine models instead of seven. As a general principle, upgrades of the Ensemble production will be carried out once a year.

Task 5041: Daily European NRT air quality Ensemble analyses

This task will consist in computing and delivering on a daily basis the Ensemble NRT analyses before 12 UTC and will be responsible for the monitoring of this production.

Output data will be made available to users in 2 formats: GRIB2 and NetCDF.

Task 5042: Daily European NRT air quality Ensemble forecasts

This task will consist in computing and delivering on a daily basis the Ensemble NRT forecasts before 8 UTC (0-548h) and 10UTC (49-96h) and will be responsible for the monitoring of this production. Output data will be made available to users in two formats: GRIB2 and NetCDF.

The outputs from the different Ensemble members will also be used to produce, on a daily basis, EPSgrams for four-day forecasts, on major European cities, for the four main pollutants (O_3, NO_2, SO_2 and PM10). These plots will illustrate the spread of the forecasts on specific locations.

The daily mean and maximum values or the four-day forecasts will also be displayed as maps, at surface level, for six parameters (O_3, NO_2, SO_2, CO, PM10 and PM2.5) and pollen species.

Task 5043: European air quality Ensemble interim re-analyses

The purpose of this task will be to compute an ensemble based upon the nine individual interim re-analyses and to provide the outcome for year Y before the end of February of year Y+1 (D4.3.1-IRAYYYY).

Task 5044: European air quality Ensemble annual re-analyses

The purpose of this task will be to compute an ensemble based upon the nine individual 'validated' re-analyses and to provide the outcome to users no later than four months after the release of the validated observation dataset (D4.4.1-VRAYYYY).

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D4.1.1	Meteo-France	Graphics and data	Provision of Ensemble NRT analyses (hourly outputs)	Daily (before 12 UTC)
D4.1.2-YYYYQX	Meteo-France	Note	Log of daily provision of NRT analyses covering all the operational systems (including percentages of result provision and dates of missing data)	Quarterly, 2 weeks after the end of each quarter
D4.2.1	Meteo-France	Graphics and Data	Provision of Ensemble NRT forecasts (hourly outputs up to 96h) and other products (EPSgrams, Mean/Max values)	Daily (before 08 UTC for D and D+1; before 10 UTC for D+2 and D+3)

D4.2.2.-YYYYQX	Meteo-France	Note	Log of daily provision of forecasts for all the operational systems (including percentages of result provision and dates of missing data)	Quarterly, 2 weeks after the end of each quarter
D4.3.1-IRAYYYY	INERIS	Data	Provision of the annual Ensemble interim re-analysis for Year N	End of February of Year N+1
D4.3.2-IRAYYYY	INERIS	Note	Log of the delivery of the annual Ensemble interim re-analysis for Year N	End of February of Year N+1
D4.4.1-VRAYYYY	INERIS	Data	Provision of the annual Ensemble re-analysis for Year N-1	During Year N+1, no later than four months after 'validated' observations for Year N-1 have been released by the EEA
D4.4.2-VRAYYYY	INERIS	Note	Log of the delivery the annual Ensemble re-analysis for Year N-1	During Year N+1, no later than four months after 'validated' observations for Year N-1 have been released by the EEA

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M4.1.1	Meteo-France	9-member Ensemble analysis with new domain	New data available for users (graphics, Netcdf)	M9
M4.1.2	Meteo-France	Provision of new parameters for Ensemble analyses	Information release for users	M26
M4.2.1	Meteo-France	9-member Ensemble forecast with new domain	New data available for users (graphics, Netcdf)	M9

M4.2.2	Meteo-France	Provision of new parameters for Ensemble forecasts	Information release for users	M26
M4.3.1	INERIS	Production of the ENSEMBLE interim reanalyse (with 9 members) for the new species (NO, CO, SO2 NH3, PANs, NMVOC) over the new domain	These data will be in the dataset made available for users	M17
M4.3.2	INERIS	Production of the ENSEMBLE interim reanalyse for all levels and for all parameters	These data will be in the dataset made available for users	M29
M4.4.1	INERIS	Production of the ENSEMBLE annual reanalyse (with 9 members) for the new species (NO, CO, SO2 NH3, PANs, NMVOC) over the new domain	These data will be in the dataset made available for users	M11
M4.4.2	INERIS	Production of the ENSEMBLE annual reanalyse for all levels and for all parameters	These data will be in the dataset made available for users	M23

5.7.6 WP5050

Work package #	WP5050	Start/End date	M1-M33
Work package title	Evaluation and Quality Assessment (EQA)		
Participants (person months)	19.93 = 15.88 (MF) + 4.05 (INERIS)		
Other main direct cost elements	Travel: €4,800 for Meteo-France only		

Main objectives

WP5050 will be performed by comparing the WP5030 (Regional models) and WP5040 products (NRT forecasts, NRT analyses, interim re-analyses and annual 'validated' re-analyses) with independent observations at the surface (from WP5010). The statistics will be computed for the species for which a sufficient number of observations is available, which are O3, NO_2, SO_2, CO, PM10 and PM2.5. The scores will be based on the metrics that have been used in CAMS_50.I, which are the bias, the normalized modified mean bias (NMMB), the root mean square error (RMSE), the correlation and the fractional gross error (FGE). The scores for NRT products will be made available according (WP5060) and published in quarterly reports. The scores for re-analyses will be published in annual reports. Synthetic indicators for some pollutants and for every period will help to track the performance of the operational models and of the Ensemble. Interactions with CAMS_84 and recommendations from FAIRMODE will be considered for the evolution of the verification of the Regional products.

Description of activities

Task 5051: EQA for NRT forecasts

The verification plots for NRT forecasts will be displayed on the website. It will include, in a comprehensive and synthetic manner, verification of all the nine models involved in the Regional Production and the ensemble with regards to surface observations, for the past day, the past week and the past 3 months.

The quarterly verification reports for NRT forecasts (D5.1.1.{model}_YYYYMMM and D5.1.2.ENSEMBLE_YYYYMMM) will present statistics for the O_3, NO_2, CO, SO_2, PM10, PM2.5 species, for each model and for the Ensemble:

- The scores (NMMB, RMSE and correlation) as a function of forecast term.
- The RMSE over the quarter and over the one-day forecast term, together with the value of the same score for the previous quarters.

Task 5052: EQA for NRT analyses

The verification plots for NRT analyses will be similar to the ones for NRT forecasts.

The quarterly verification reports for NRT analyses will be combined with the quarterly verification reports for forecasts (D5.1.1.{model}-YYYYMMM and D5.1.2.ENSEMBLE_YYYYMMM) will include

similar statistics as for the forecasts. In order to assess the impact of the assimilation on the pollutant concentrations, the scores for analyses will also be compared to scores of the 1-day forecast using the same set of verifying observations.

Task 5053: EQA of interim re-analyses

Based on the non-assimilated dataset, evaluations of the re-analyses will be performed using similar statistics as for the forecasts and additional scores related to specific indicators. These performances will be reported annually.

Task 5054: EQA for validated re-analyses

Based on the non-assimilated dataset, evaluations of the re-analyses will be performed using similar statistics as for the forecasts, and additional scores related to specific indicators. These performances will be reported annually.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D5.1.1.{model}_ YYYYMMM	Meteo-France	Report	Quarterly report on the verification of NRT forecasts and analyses, for each of the operational systems	2 months after each production quarter
D5.1.2.ENSEMBLE_YYYYMMM	Meteo-France	Report	Quarterly report on the verification of NRT forecasts and analyses, for each of the operational systems	2 months after each production quarter
D5.1.3-YYYYMMM	Meteo-France	Data	Companion numerical dataset (detailed performance statistics) of the quarterly reports on the verification of NRT forecasts and analyses, for each operational model and the Ensemble	2 months after each production quarter
D5.3.1-YYYY	INERIS	Report	Annual report on the verification of the interim re-analysis for Year N (Ensemble and individual operational systems)	At the end of May of Year N+1
D5.3.2-YYYY	INERIS	Data	Companion numerical dataset (detailed performance statistics) of the verification of the interim re-analysis for Year N (Ensemble and individual operational systems)	At the end of May of Year N+1
D.5.4.1-YYYY	INERIS	Report	Annual report on the verification of the re-analysis for Year N-1 (Ensemble and individual operational systems)	During Year N+1, no later than 7 months after 'validated' observations for Year N-1 have been

				released by the EEA
D.5.4.2-YYYY	INERIS	Data	Companion numerical dataset (detailed performance statistics) of the verification of the re-analysis for Year N-1 (Ensemble and individual operational systems)	During Year N+1, no later than 7 months after 'validated' observations for Year N-1 have been released by the EEA
D5.5.1	Meteo-France	Online graphics	Verification plots for the past day, past week and past 3 months	Updated daily
D5.5.2	Meteo-France	Online system	Presentation of NRT analyses and forecasts site-level verification statistics for the past 8 quarters (Ensemble and individual operational systems)	01/10/2019

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M5.5.1	INERIS	Introduction of FAIRMODE new metrics for VRA 2017	Report Delivery	M15
M5.5.2	Meteo-France	New Web-base interactive tool for companion datasets	Information release for users	M26

5.7.7 WP5060

Work package #	WP5060	Start/End date	M1-M33
Work package title	Data services for Regional Products		
Participants (person months)	51.84 (Meteo-France)		
Other main direct cost elements	Travel: €2400 (MF) Computing: €43230 for Meteo-France only		

Main objectives

The objective of WP5060 is to provide access to CAMS_50 production data through the Copernicus Data Store (CDS). To reach this goal without any trouble, two phases are planned:

- Adapt the Regional products delivery to users of Copernicus, through the existing technical platform. At the same time, specify the CDS interfaces with ECMWF.
- Deliver Regional products through Copernicus Data Store unified web interface.

Description of activities

Task 1 5060: Coordination

This task will comprise the coordination work with the technical teams and ECMWF.

Task 5061: Delivery of products through the CAMS_50 technical platform

Meteo-France will provide production data through their existing web server and data discovery and download platform according to the specifications listed in the previous tender. Predefined datasets and plots will be available for data up to fifteen days old.

Task 5062: Update delivery to incorporate new requirements

Meteo-France will provide production data through the existing web server and data discovery and download platform. The new requirements will be included into these products:

- A larger domain (25° W-45° E, 30°N-72°N).
- Two new individual Regional systems.

Task 5063: Definition of the interfacing solution with the Copernicus Data Store

The purpose of this task will be to carefully define the integration mechanism between the CDS and Meteo-France's production. To this end, regular exchanges will be necessary and an agreed upon specifications document will be drafted.

Task 5064: Implementation of the solution and tests

According to the above-mentioned specification document, Meteo-France will implement and validate the solution providing access to datasets through the CDS.

Task 5065: Delivery of the Regional products into the CDS

Meteo-France will provides forecasts, analyses, interim re-analyses and annual 'validated' re-analyses through the CDS.

Task 5066: Update delivery to incorporate five aerosol parameters

This task will consist in updating production data specified in Task 5065, to include the five aerosol parameters which are required in the ITT.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D6.0.1-web	Meteo-France	Web pages	Web-based graphics on regional Products and their verification	From the start of the contract, then continuous
D6.0.2-YYYYQX	Meteo-France	Report	Quarterly report on the delivery of CAMS Regional products	Quarterly (civil quarter)
D6.0.3-YYYYQX	Meteo-France	Report	Quarterly report on the delivery of web-based graphics on Regional Products and their verification	Quarterly (civil quarter)
D6.1.1-analyses	Meteo-France	Service	NRT analyses available through CAMS_50 technical platform	From the start of the contract, until Month 11
D6.1.2-forecasts	Meteo-France	Service	Forecasts available through CAMS_50 technical platform	From the start of the contract, until Month 11
D6.3.1-CDSInterfacesSpecification	Meteo-France	ECMWF Document	Detailed Interface specifications for CDS	Month 4
D6.5.1-analyses	Meteo-France	Service	NRT analyses available in CDS	Month 9, then continuous
D6.5.2-forecasts	Meteo-France	Service	NRT forecasts available in CDS	Month 9, then continuous
D6.5.3-interimre-analyses	Meteo-France	Service	Annual Interim re-analyses for the last 3 years available in CDS	Month 9, then continuous
D6.5.4-re-analyses	Meteo-France	Service	Annual Re-analyses since 2010 available in CDS	Month 9, then continuous

Milestones

#	*Responsible*	*Title*	*Means of verification*	*Due*
M6.3.1-CDSInterfacesSpecification	Meteo-France	Specifications established for the	specification document concerning the CDS interface	Month 4

		CDS interface		
M6.5.1-analyses	Meteo-France	NRT analyses available in CDS	Users can access analyses in CDS Infrastructure	Month 9
M6.5.2-forecasts	Meteo-France	Forecasts available in CDS	Users can access analyses in CDS Infrastructure	Month 9
M6.5.3-interimre-analyses	Meteo-France	Interim re-analyses available in CDS	Users can discover corresponding data in the CDS Infrastructure	Month 9
M6.5.4-re-analyses	Meteo-France	Re-analyses available in CDS	Users can discover corresponding data in the CDS Infrastructure	Month 9

5.7.8 WP5070

Work package #	WP5070	Start/End date	M1-M33
Work package title	User support		
Participants (person months)	14.65 = 12.1 (MF) + 2.55 (INERIS)		
Other main direct cost elements	Travel: €2400 (MF)		

Main objectives

The objective of WP5070 is to perform specific monitoring of the NRT-related production and to provide users with acquisition or access assistance related to product usage (plots and data) and data services (technical support for using the various interfaces when the responsibility falls to Meteo-France). This will be done through Levels 2 and 3 Helpdesk support, under the coordination of ECMWF and CAMS_94. Regular interactions with ECMWF and CAMS_94 will take place.

Description of activities

Task 5071: NRT production – monitoring and communication

This task will consist in informing, with sufficient notice, registered users of the NRT Regional products of operational issues that may result in a noticeable delay or degradation and of planned system upgrades. Defining and updating procedures for time-critical communication to the registered users regarding production-related matters will also fall within the scope of this task.

Task 5072: Contribution to CAMS User support

This task will consist in providing second- and third-level user support, using the JIRA tracking software.

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D7.2.1	Meteo-France	Other	Specialised user support via the CAMS Service Desk (Respond to user support queries requiring expertise specific to the Regional air quality products provided)	Continuous
D7.2.2	Meteo-France	Report	Quarterly report on Specialised user support	Quarterly (civil quarter)

Milestones

#	Responsible	Title	Means of verification	Due
M7.1.1	Meteo-France	Link with CAMS User Support team established; Service Desk set-up completed	Specialised Service Desk up and running	Month 2
M7.1.2	Meteo-France	Update of FAQs and documentation for users at each yearly Production upgrade	Summary note on updates made to FAQ and documentation	At every production upgrade

5.8 Intellectual Property Rights

In this sub-section, the Tenderer will complete Table 6 below, following instructions in sub-section 5.1 above.

Table 6: Intellectual Property Rights

Pre-existing Technology		
Title	***Type***	***Description***
None		
Assets (tangible and intangible)		
Title	***Type***	***Description***
None		
Integrated Technology		
Title	***Type***	***Description***
None		

5.9 Key Performance Indicators.

Table 7: Key Performance Indicators

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
KPI_50.1.1	Data server uptime in latest quarter	95%	Quarterly	-
KPI_50.1.2	Web pages uptime in latest quarter	95%	Quarterly	-
KPI_50.2.1	Volume of data downloaded by users in latest quarter	(increase)	Quarterly	-
KPI_50.2.2	Number of Regional systems and Ensemble verification reports downloaded during the latest quarter	(increase)	Quarterly	-
KPI_50.3.1	Production on time of NRT analyses and forecasts with all N operational models / with N-2 models in latest quarter	90% / 98%	Quarterly	-
KPI_50.3.2	Root-Mean Square Error of the daily maximum of the O_3 concentration for NRT 1-day Ensemble	< 30 µg/m^3	Quarterly	-

	analyses / forecasts in latest quarter			
KPI_50.3.3	Root-Mean Square Error of the daily maximum of the NO_2 concentration for NRT 1-day Ensemble analyses / forecasts in latest quarter	<18 µg.m^{-3}	Quarterly	-
KPI_50.3.4	Root-Mean Square Error of the daily mean of the PM10 concentration for NRT Ensemble 1-day analyses / forecasts in latest quarter	<16 µg.m^{-3}	Quarterly	-
KPI_50.3.5	Root-Mean Square Error of the daily mean of the PM2.5 concentration for NRT 1-day analyses / forecasts in latest quarter	< 30 µg/m^3	Quarterly	-
KPI_50.4.1	User Support ticket acknowledgement in latest quarter	<18 µg.m^{-3}	Quarterly	-
KPI_50.4.2	User Support ticket response in latest quarter	<50%	Quarterly	-
KPI_50.4.3	Number of tickets in latest quarter	<50%	Quarterly	-
KPI_50.5.1	Number of active unique users of the Regional Products during the quarter	<50%	Quarterly	-
KPI_50.5.2	Number of estimated unique visitors to the web pages	50%	Quarterly	-
KPI_50.8.1	User satisfaction regarding support	<50%	Quarterly	-
KPI_50.10.1	Deliverables delivered on time during last Quarter	<50%	Quarterly	-
KPI_50.11.1	Number of surface sites used for NRT production and verification of ozone / NO_2 / PM10 / PM2.5	< 30 µg/m^3	Quarterly	-
RMSE_O3_IRAE	Root-Mean Square Error of the daily maximum of the O_3 concentration for ENSEMBLE interim re-analyses	<18 µg.m^{-3}		-
RMSE_NO2_IRAE	Root-Mean Square Error of the daily	<16 µg.m^{-3}	< 30 µg/m^3	-

	maximum of the NO_2 concentration for ENSEMBLE interim re-analyses			
RMSE_PM10_IRAE	Root-Mean Square Error of the daily mean of the PM10 concentration for Ensemble interim re-analyses	< 30 µg/m^3	<18 µg.m^{-3}	-
RMSE_O3_VRAE	Root-Mean Square Error of the daily maximum of the O_3 concentration for ENSEMBLE validated re-analyses in JJA	<18 µg.m^{-3}	<16 µg.m^{-3}	-
RMSE_NO2_VRAE	Root-Mean Square Error of the daily maximum of the NO_2 concentration for Ensemble validated re-analyses in DJF	<50%	< 30 µg/m^3	-
RMSE_PM10_VRAE	Root-Mean Square Error of the daily mean of the PM10 concentration for Ensemble validated re-analyses in DJF and in MAM	<50%	<18 µg.m^{-3}	-
RBIAS_NO2_ANNUAL_IRAE	Absolute value of the relative bias of the surface annual averaged NO_2 concentrations from Interim Re-analysis Ensemble	<50%	<50%	-
RBIAS_PM10_ANNUAL_IRAE	Absolute value of the relative bias of the surface annual averaged PM10 concentrations from Interim Re-analysis Ensemble	50%	<50%	-
RBIAS_PM2.5_ANNUAL_IRAE	Absolute value of the relative bias of the surface annual averaged PM2.5 concentrations from Interim Re-analysis Ensemble	<50%	<50%	-
RBIAS_NO2_ANNUAL_VRAE	Absolute value of the relative bias of the surface annual averaged NO_2 concentrations from Validated Re-analysis	<50%	50%	-

	Ensemble			
RBIAS_PM10_ANNUAL_VRAE	Absolute value of the relative bias of the surface annual averaged PM10 concentrations from Validated Re-analysis Ensemble	< 30 µg/m^3	<50%	-
RBIAS_PM2.5_ANNUAL_VRAE	Absolute value of the relative bias of the surface annual averaged PM2.5 concentrations from Validated Re-analysis Ensemble	<18 µg.m^{-3}	<50%	-

Please note that the CDS-related interfacing will involve changes in some of the KPIs listed above. The delivery of these KPIs could be affected by the implementation of the CDS.

5.10 Risk management

Table 8: Risk Register for each Work package

Work-package: WP5000					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Subcontracting	Risk that some contractors will not sign the contract.	3	2	Clause 5.9.2 should be negotiated to reduce the indemnities (BSC not willing to sign if they remain to 4 times).	M1-M33
Delays on hiring staff	Risk lies in: - Administrative delay, and the possible difficulty to find the right profile in relation with the contract offered. - The potential early departure of the recruited staff members. - Having difficulties to coordinate 7 Work packages and 11 subcontractors.	4	4	A single service contract for the whole period shall be negotiated to significantly reduce this risk.	M1-M33
Incompleteness of reports' sections	Risks that some deliverables or reports may be incomplete, due to technical issues or a failure of one of	3	2	When such difficulties are encountered, explanations will be provided to CAMS Management and the full deliverables will be	M1-M33

	the participants, or the delivery of new templates from ECMWF.			produced as soon as possible. Concerning the use of new reporting templates proposed by CAMS Management, substantial efforts will be made to match the templates, which will entail guiding the staff members involved. If new templates are regularly produced, a few items will occasionally not match the templates: in such cases, reports will be updated accordingly whenever possible. Note that adapting to new templates would be time-consuming considering the number of milestones and deliverables in CAMS_50, which could result in delays.	
Underestimation of the work to be done	Risk of having underestimated the amount of work to be provided, in relation to evolutions that could be asked from other CAMS projects and the reporting calendar.	4	3	This situation would be discussed with CAMS Management and representatives of the other CAMS project concerned. Evolutions will be prioritised during the preparation of the SES document and the annual implementation plan as well as over the year, keeping CAMS Management informed. Top priority will be given to having the operational production maintained for all partners.	M1-M33
Subcontractor leaving	Risk of a subcontractor leaving the project for financial, human resources or other reasons.	3	4	Accept: The technical solution includes 2 new partners that could replace one leaving partner, as soon as they fulfil all operational requirements.	M1-M33
Misunderstanding of the project by the WP teams	Risk that a project team misinterpret the project goals and requirements,	2	3	Project execution will be monitored tightly thanks to a range of communication channels	M1-M33

	which may lead to irrelevant expectations on the work to be done.			supporting information exchange within CAMS_50: - Visio-conferences every two months bringing together representatives of each WP, and providing an update of progress status and plans for the next month. - An online software for project collaboration and documentation. - A project-wide mailing list. Should a team still misunderstand the project requirements, ad hoc teleconferences will be held for further explanations (minutes circulated).	
Inaccurate project estimates and forecasts	Risk of errors in estimates and forecasts with regard to spending, resources and schedule.	2	3	Meteo-France will use a proper project management software (Projeqtor) to keep track of project progress. As an ongoing process, forecasts will be regularly updated on this software.	M1-M33
Poor deliverable quality	Risk that deliverables do not meet the quality level required by the overall CAMS management team.	2	3	In case a report is not considered of acceptable quality, its delivery will be postponed to make the necessary changes. Feedbacks received from ECMWF following the delivery of the first reports will be taken into account for future deliverables.	M1-M33
Late delivery of reports	Risk of reporting delays in the months when there is a conjunction of reports to be produced (several reporting periods, reports due within several WPs, inputs from several institutes, late delivery of	4	2	Expected inputs and internal deadlines will be planned well ahead of official delivery deadlines, and announced to partners during visio conferences and on the wiki.	M1-M33

	templates from ECMWF or difficulties with the templates layout, or late comments on previous deliverables by ECMWF).				
Cash-flow difficulties	Risk of cash shortages due to a mismatch between cash flow and payment dates, and difficulties arising from the VAT issue.	5	4	Transfer: The VAT exemption issue that concerns INERIS could be solved by a direct payment. Early acceptance of deliverables could help for respecting payment due dates by ECMWF -	M1-M33

Work-package: WP5010					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Delay in the delivery of validated data	Risk of late availability of EEA validated observations, which may defer validated reanalyses outputs from individual models and the Ensemble.	3	3	CAMS_50 Management team shall interact directly with EEA.	M1-M33
Additional data at the surface (from ACTRIS and EMEP networks	Risk of trouble in getting the data	3	3	ACTRIS and EMEP networks will be used provided that the operational level of their availability is established.	M1-M33
Request for new observations	Risk of having a request for an important evolution (new observations, etc.), that will have a financial impact.	2	4	Transfer: In case of such important evolution, a technical and financial proposal will be made to ECMWF.	M1-M33

Work-package: WP5020					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Development failure	Failure of an individual model to implement developments required to add new products in the Ensemble or to	3	3	As long as the impact is low on the Ensemble performance: if a team is not able to address the problem on its own, scientific or technical collaboration among the	M1-M33

	continue model improvements.			modelling partners will be encouraged.	
Lack of research upstream and uptake	If some of the CAMS research lots start too late (for instance CAMS_61-63), the development of models will be slowed down and their performance may stagnate or even decrease.	3	3	Mitigation strategy to be discussed with ECMWF.	M1-M33
Research upstream and uptake	If too many outputs come from CAMS research lots, CAMS_50 teams will not be able to implement all the developments in their models.	3	3	Mitigation strategy to be discussed with ECMWF.	M1-M33

Work-package: WP5030					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Central system failure	Risk of an important failure of the central system.	1	5	Reduce: Meteo-France computing centre is closely monitored to ensure a very high service level.	M1-M33
Individual system failure	Risk of an important failure of an individual model.	3	3	All models are running in an operational way and are monitored. However, the main product is the Ensemble. When a production problem occurs, the relevant institute will be contacted promptly.	M1-M33
Delivery failure	No daily delivery of interim reanalyses from one or several teams, affecting the computation of the Ensemble reanalyses, which is performed every day.	3	3	The teams concerned will be requested to deliver the missing data later, but no later than the end of the year.	M1-M33
IFS or C-IFS operational changes	Risk that IFS or C-IFS-related operational changes may affect outputs from models and the Ensemble (testing	2	4	Reduce: Secure interactions with ECMWF. However, each change could have an impact on production and entails	M1-M33

	data and disseminated data are two different things).			extra work from the modelling teams. All teams will be properly informed of IFS and C-IFS changes well ahead. CAMS Management will be informed of possible impacts and of feedbacks from modelling teams through Service Level Board reports.	
Lack of validated boundary conditions for reanalyses	Risk of missing validated data regarding boundary conditions, which may affect the quality of reanalyses.	3	3	Reanalyses will be produced with a lower quality.	M1-M33
Interim models updates, due to technical changes or interim changes in IFS/ C-IFS.	Risk associated to an operational update: failure in the production chain (central or individual).	2	3	Ask for individual tests. - Request For Change forms will be used to trace modifications. - Specific production monitoring will be performed during this period.	M1-M33

Work-package: WP5040					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Ensemble calculation failure	Risk of non-production of Ensemble NRT.	2	4	Ensemble will be produced using 5 to 9 models. However, in case of failure of some models or delay, it could be produced with less than 5 models or with the Ensemble forecast of the previous day, in order to ensure production.	M1-M33
Interim models updates: due to technical changes or interim changes in IFS / C-IFS	Risk associated to an operational update: failure in the production chain (central or individual).	2	3	Reduce: Ask for individual tests. - Request For Change forms will be used to trace modifications. - Specific production monitoring will be performed during this period.	M1-M33

Work-package: WP5050

Risk Name	Description	Likelihood	Impact	Response Strategy	Period
Non-Improving quality of models	Non-improving model quality with regard to the metrics used for model evaluation.	3	3	Model weaknesses will be analysed and new developments proposed to address the issue.	M1-M33
Non-accurate scores	Risk of problems in the calculation of scores or in the choice of metrics that could lead to misinterpretation of results.	2	4	Possible solutions based on FAIRMODE inter alia will be analysed.	M1-M33

Work-package: WP5060					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Technical infrastructure is unable to meet customer expectations	Risk of inability of the technical infrastructure to meet customer expectations due to an underestimate of user's numbers. May result in delay with long downloading time for images or predefined datasets.	2	4	Meteo-France risk mitigation plan will consist in monitoring and supervising all CAMS_50 resources. Lengthy download problems experienced by a user would be bypassed by encouraging multiple small transfer requests. Operational constraints (bandwidth, etc.) are well known.	M1-M33
Delay in the availability of deliverables	Risk of delay in the availability of some deliverables due to technical problems and additional requests from other CAMS projects. May result in delay in the availability of agreed images and/or datasets.	2	4	Meteo-France risk mitigation will rely on adequate allocation of skilled human resources together with technical solutions based on mature architecture and well-known components. Moreover, at every phase change, the previous architecture could remain available during the new phase. Thus, images and/or datasets could remain accessible through it.	M1-M33
Inadequate interfacing between Copernicus Data store and Meteo-France developments	Risk of inadequate interfacing between CAMS	2	4	Meteo-France risk mitigation proposal is an early involvement of Meteo-France	M1-M33

	Data store and Meteo-France developments due to interoperability issues. May result in availability delays regarding images and data sets from CAMS Data store.			in the specifications for the CAMS Data store.	
Specifications/ developments for interfacing between Copernicus Data Store and MF	Risk of extra delay for spec & developments in case of lack of human resources at the beginning of the contract	3	4	Meteo-France plans to hire 1 fixed-term contract who cannot be selected before the contract is signed.	M1-M33
Risk of bandwidth saturation	Risk associated with the provision of complete datasets for NRT analyses and reanalyses.	3	4	Reduce: Complete datasets for reanalyses postponed.	M1-M33

Work-package: WP5070					
Risk Name	**Description**	**Likelihood**	**Impact**	**Response Strategy**	**Period**
Support workload	Risk of having underestimated the workload to ensure helpdesk.	3	4	A common approach will be validated during the first 2 months / good interaction with the Copernicus support team, workload to monitor.	M1-M33
Helpdesk	Risk of having delay in answering user queries due to important solicitations. Risk of a delayed response time due to a high number of incoming users queries.	3	2	Delays will be strongly related to human resources & type of questions	M1-M33
Risk of data misinterpretation from users	Risk associated with the provision of complete	3	2	Updated documentation will be provided, and new products will be	M1-M33

	datasets for NRT analyses and reanalyses.			presented as ‘tests products’.	

6 Appendices

6.1 Appendix 1 - Relevant publications from individual consortium members

6.1.1 Meteo-France (Prime contractor)

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6.2 Appendix 2 - Products available to users

6.2.1 Graphical products provided to users on the Website

Product	Model	Species	Vertical levels	Time steps	Format
Ensemble maps Forecasts	ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5, Birch, Olive, Grass and Ragweed Pollen	surface, 500m, 1000m, 3000m	Hourly (0h +96h)	Png + PDF
Ensemble maps Analyses	ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5	surface,	Hourly (–24h -1h)	Png + PDF
EPSgrams on 67 cities	ENSEMBLE	O3, NO2, SO2, PM10,		Daily	Png + PDF
Daily Mean And Max	ALL + ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5, Pollens	surface	Daily	Png + PDF
Individual Analyses	ALL	O3, NO2, CO, SO2, PM10, PM2.5	surface	Hourly (-24h -1h)	Png + PDF
Individual Forecasts	ALL	O3, NO2, CO, SO2, PM10, PM2.5, Birch, Olive, Grass and Ragweed Pollen	surface	Hourly (0h +96h)	Png + PDF
NRT Observations		O3, NO2, CO, SO2, PM10, PM2.5	surface	Hourly (1h +24h)	Png + PDF
Analyses versus Observations	ALL	O3, NO2, CO, SO2, PM10, PM2.5	surface	Every 3 hours For D1	Png + PDF
Forecasts versus Observations	ALL	O3, NO2, CO, SO2, PM10, PM2.5	surface	Every 3 hours For D1	Png + PDF
Analyses versus Forecast	ALL	O3, NO2, CO, SO2, PM10, PM2.5	surface	Daily max for D1, D2, D3	Png
Mean scores (forecasts)	Bias MMB FGE RMSE Corr	O3, NO2, CO, SO2, PM10, PM2.5	surface	1 week & 3 months	Png + PDF
Time series (3h and 15h)	Bias MMB FGE RMSE Corr	O3, NO2, CO, SO2, PM10, PM2.5	surface	1 week & 3 months	Png + PDF
Taylor diagrams (24h forecasts / All models)	Bias MMB FGE RMSE Corr	O3, NO2, CO, SO2, PM10, PM2.5	surface	1 week & 3 months	Png + PDF
Concentration maps Re-analyses	ENSEMBLE	O3, NO2, PM10, PM2.5,CO, SO2	surface	Annual and seasonal + statistical indicators	Png
Ensemble spread Re-analyses	ENSEMBLE	O3, NO2, PM10, PM2.5, CO, SO2	surface	Annual and seasonal	Png
Indicator maps Re-analyses	ENSEMBLE	O3, PM10, PM2.5	surface	Annual and for restricted periods	Png
Concentration maps for Significant events Re-analyses	ENSEMBLE	O3, NO2, PM10, PM2.5, CO, SO2	surface	Daily and for restricted periods	Png

6.2.2 Numerical data provided to users on the data server

Product	Model	Species	Vertical levels	Time steps	Format
Ensemble Analyses	ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5, NO, NH3, PANs, NMVOC *	Surface	Hourly (–24h -1h)	GRIB2 + Netcdf
Ensemble Forecasts	ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5 + Birch, Olive, Grass and Ragweed Pollen	Surface	Hourly (0h +96h)	GRIB2 + Netcdf
Ensemble Analyses And Forecasts	ENSEMBLE	O3, NO2, CO, SO2, PM10, PM2.5, NO, NH3, PANs, NMVOC *	surface, 50m,250m, 500m, 1000m, 2000m, 3000m, 5000m	Hourly (–24h +96h)	GRIB2 + Netcdf
Individual Forecasts	CHIMERE, EMEP, EURAD-IM, LOTOS-EUROS, MATCH, MOCAGE, SILAM	O3, NO2, CO, SO2, PM10, PM2.5, NO, NH3, PANs, NMVOC	Surface, 50m,250m 500m, 1000m, 2000m, 3000m, 5000m	Hourly (0h +96h)	Netcdf
Individual Forecasts	CHIMERE, EMEP, EURAD-IM, LOTOS-EUROS, MATCH, MOCAGE, SILAM	O3, NO2, CO, SO2, PM10, PM2.5 + Birch Pollen	surface	Hourly (0h +96h)	Netcdf
Individual Analyses	CHIMERE, EMEP, EURAD-IM, LOTOS-EUROS, MATCH, MOCAGE, SILAM	O3, NO2, CO, SO2, PM10, PM2.5 *	surface, 50m,250m, 500m, 1000m, 2000m, 3000m, 5000m	Hourly (-24h -1h)	Netcdf
Individual Analyses	CHIMERE, EMEP, EURAD-IM, LOTOS-EUROS, MATCH, MOCAGE, SILAM	O3, NO2, CO, SO2, PM10, PM2.5 *	surface	Hourly (-24h -1h)	Netcdf
Hourly Re-Analyses Interim,then Validated	ENSEMBLE	O3, NO2, PM10, PM2.5, CO, SO2 NO, NH3, PANs, NMVOC *	surface, 50m,250m, 500m, 1000m, 2000m, 3000m, 5000m	Annual From 1st jan. to 31 dec. year Y	Netcdf
Mean values (annual and Seasonal)	ENSEMBLE	O3, NO2, PM10, PM2.5, CO, SO2	surface	annual and Seasonal	Netcdf
Numbers of Threshold Exceedances	ENSEMBLE	O3, NO2, PM10, PM2.5, CO, SO2	surface	annual mean, Daily mean, Daily max,...	Netcdf
Additional AQ Indicators	ENSEMBLE	SOMO35, AOT60, AOT40	surface	annual	Netcdf

* Note that, for the analyses, some species will be missing at the beginning of the contract for some models and the ensemble.

6.3 Appendix 3 - Individual model characteristics

Model	Operated and developed by	Horizontal resolution	Vertical levels	Assimilation	Observations assimilated (NRT)	Observations assimilated (renalyses)
CHIMERE	INERIS	0.1° x 0.1°	9 levels top at 500 hPa	Kriging based approach	In situ observations for O3, NO2 PM10 and PM2.5 (CO and SO2 also in a near future)	In situ observations for O3, NO2 PM10 and PM2.5 (CO and SO2 also in a near future)
DEHM	AARHUS UNIVERSITY	DEHM	AARHUS UNIVERSITY	18 km at 60°N (polar stereographic)	29 Top at 100 hPa	Optimal interpolation
EMEP	MET NORWAY	0.25°lon x 0.125°lat (from autumn 2018: 0.125°lon x 0.0625°lat	20 levels (top at 100hPa)	3D-Var (for PM from autumn 2018: optimal interpolation)	stations (ozone, NO_2, SO_2), OMI NO_2 col. (from autumn 2018: also CO and PM from stations)	stations (ozone, NO_2, SO_2), OMI NO_2 col. (from autumn 2018: also CO and PM from stations)
EURAD-IM	FZJ	15 km (Lambert)	23 levels top at 100 hPa	3d-var and 4d-var	Stations (O_3, NO, NO_2, SO_2, CO, $PM_{2.5}$, PM_{10}), OMI, GOME-2 NO_2, SO_2 columns, IASI CO profiles	Same as NRT, additionally IAGOS, MOPITT CO profiles

GEM-AQ	IEP-NRI	0.1 x 0.1	28, top at 10hPa	OI	O_3, NO_2, PM_{10}, $PM_{2.5}$, SO_2, CO	All requested
LOTOS-EUROS	KNMI- TNO	0.25x0.125	5 levels upto 5,5 km	EnKF	Stations (O3,PM10, NO2), OMI NO2	Stations (O3,PM10, NO2), OMI NO2
MATCH	SMHI	0.2° *0.2°	47 levels Top at 300 hPa	3D-Var	Stations (O3, NO2)	Stations (O3, NO2)
MOCAGE	METEO-FRANCE	0.1° x 0.1° for FCST 0.2° x 0.2° for ASSIM	47 levels Top at 5hPa	3D-Var	Stations (O3, NO2, PM10)	Stations (O3, NO2, PM10)
SILAM	FMI	0.1x0.1	10levels up to 9km	3D-Var	O3, NO2, SO2, CO, PM2.5, PM10	Stations O3, NO2, SO2, CO , PM2.5, PM10

6.4 Appendix 4 – Operational reliability characteristics of the models

Models	Operation and monitoring of the service
CHIMERE	- Daily forecast and analyses run on a dedicated cluster monitored 24/7 with a high level of availability. -In addition the production for CAMS50 benefits from the INERIS daily supervision operated for the national PREV'AIR system to check the sequence of computation and the quality of the outputs.
DEHM	-Analysis and forecast production will be run on a dedicated cluster system and be monitored by scripts that communicate by email and SMS. AU have long term experience in running AQ forecasting system with such kind of monitoring. -Test will be made to find the best schedules for the full chain from downloads of input data to delivery of the required outputs.
EMEP	-The production chain is part of the operational service lines of MET Norway (being monitored 24/7) and its reliability is only limited by occasional hardware failures/maintenance. YO minimize the risk of non-delivery, the service can be run n another HPC cluster which serves a backup system. -The very fast execution time enables delivery on time
EURAD-IM	- Forecasts and analyses are operated simultaneously and independently at ECMWF and at FZJ-IEK 8 (with contracted maintenance staff) to insure a backup in case of failure. Operational monitoring is implemented via SMS and ECflow. - Interim analyses are run at FZJ-IEK 8 and are daily monitored. - Validated re-analyses are operated at the Jülich Super Computer Center (JSC). The re-analyses are internally validated.
GEM-AQ	The GEM-AQ model will be run on a dedicated HPC cluster that has a fully mirrored backup site. GEM-AQ has been run operationally since 2010. Production runs are monitored by Nagios scripts and operators. Tuning of the production schedule (data transmission and model execution) will be done at the implementation stage.
LOTOS-EUROS	-The analyses and forecasts operational processing is performed by the IT department of KNMI on a dedicated computing hardware for AQ forecasting. This infrastructure has a fully operational status (two identical copies) which insures high availability. -Start time were chosen to be on schedule.
MATCH	-The forecasts are run at ECMWF with a backup run at SMHI operations compute cluster at the National Supercomputer Center (NSC) in Linköping. Analysis is run at NSC. -Early start of forecast and analysis enables delivery on time Operational

	24/7 monitoring will be implement using ECflow.
MOCAGE	-The two independent chains (analysis and forecast) have a fill operational status (redundancy of all equipements and is 24/7 monitored by the IT department of Meteo-France. This covers the whole chains from the input data acquisition to the final results delivery. -Production hours have been adjusted to meet the schedule requirements;
SILAM	Analysis and forecast production chains are running on FMI technical infrastructure and monitored by duty operators of FMI. The suites are controlled by ecflow and designed to be runnable on a backup supercomputer as well. Both, operational and backup computer receive all input data needed for daily suites. Early start and model efficiency allow for on-time delivery. Fall-back hooks for several types of failures have been implemented in the suites to secure the delivery.

6.5 Appendix 5 – CVs of key staff members

europass Curriculum Vitae

PERSONAL INFORMATION

Gaëlle COLLIN

METEO-FRANCE, DSM/EC/ENV, 42 av. G.Coriolis, 31057 TOULOUSE CEDEX

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Sex F | Date of birth 24/04/1976 | Nationality French

POSITION

Head of Atmospheric Environment and Health Division

WORK EXPERIENCE

From December 2017

Head of Atmospheric Environment and Health team, in End-User Departement

METEO-FRANCE, Toulouse, FRANCE

- Management of an operational and development team (~7 team members)
- In charge of operational models and tools for atmospheric pollution and dispersion (short and long distance models, used for VAAC and CMRS), in cooperation with research teams
- Coordination of air quality studies or post-accident dispersion studies, in relation with other teams or insitutes

Business or sector Management, Operational production, Atmospheric Environment, Air Quality

From October 2003 to November 2017

Project Manager, Consulting & Studies Team

METEO-FRANCE, Toulouse, FRANCE

- From 2003: Project Manager in charge of the Defence R&D projects (Main customers : French Defence Procurement Agency & Defence Industrial Groups) :
  - Large projects : up to 40 people/ 1000 person-days
  - Coordination with different Meteo-France teams & Management of contracting
- From 2006: representative in NATO Working Groups & Panels : expert at the Military Meteorology Panel, and French point of contact at the NATO Armament Met Kernel Project Review ; lead of sub-groups dealing with NATO met format evolutions
- From 2012: trainer on met data formats & support to met format users
- From 2016: lead of Work Package 3 “Supply & demand energy balance” in the COPERNICUS C3S CLIM4ENERGY project, led by CEA

Business or sector Project management, tranverse management, representation at international level (NATO), COPERNICUS C3S CLIM4ENERGY work package lead, training, consulting activity, meteorology

From August 2000 to September 2003

Head of the Essonne Departmental Team, Meteo-France delegate

METEO-FRANCE, Centre d’Essais en Vol, Brétigny, FRANCE

- Management of a mixed (Civilian/ Military) forecasting team
- Reporting to the local authorities and institutional & commercial met users
- Conferences for general audiences (climate change)

Business or sector Management, production, representation of Meteo-France, forecasting and meteorology

EDUCATION AND TRAINING

January-June 2000

Research training on Climate Change

Nansen Environmental and Remote Sensing Center, Bergen, NORWAY

- Impact of the climate change on the North Atlantic Oscillation (simulations and modeling)

1997-2000

Engineer in Meteorology

Ecole National de la Météorologie, Toulouse, FRANCE

- Meteorology, atmospheric science

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
	Replace with name of language certificate. Enter level if known.				
Spanish	A2	B2	A2	A2	B1
	Replace with name of language certificate. Enter level if known.				

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Solid communication skills gained through my experience as Project leader, interactions with Meteo-France institutional and commercial users, internal reporting
- Strong experience in representation at international level, contribution ot international working groups

Organisational / managerial skills

- Extensive experience in management and coordination of complex and transverse projects
- Team manager (currently responsible for a team of 7 people, and previous experience of management with a 8 person-team)

Job-related skills

- Very familiar with project management (14 years experience), reporting, subcontracting and tender processes
- Familiar with COPERNICUS processes (C3S CLIM4ENERGY)
- Good knowledge in operational production systems and processes

Other skills

- Proficient i Microsoft Office™ tools
- Basics in IT development (shell, ...)

Driving licence B

europass Curriculum Vitae

PERSONAL INFORMATION

Marion Pithon

METEO FRANCE- DSM/EC/ENV – 42 avenue Gaspard Coriolis 31057 Toulouse Cédex

+33 5 61078098

marion.pithon@meteo.fr

Sex Female | Date of birth 15/10/1962 | Nationality French

POSITION

Environment Division Deputy Manager

WORK EXPERIENCE

Sept 2009 - Present

R&D Engineer in Environmental and Health Science

Meteo France – Environment division

- Deputy management of an eight-person team since beginning 2015
- Involved in Copernicus Atmosphere Monitoring Service- Regional Production (CAMS50) as Production Manager since 2015.
- Involved in MACC-II and MACC-III project since 2011: transfer of the research production to operational (AQ French model and ENS system).
- Contact point for the Heath Commission of CSM (Meteo France Council of Meteorology)
- Development of services and tools in response to requests of health organizations.

Sept 1993 – Sept 2009

HPC System Administrator and User Support

Meteo France – IT department – HPC division

- main duty: operating system administration, job scheduling, performance analysis, user support, in a time critical environment.
- 2000-2009 ECMWF Member States Computing Representative for France
- Twice in 1996-1997 and 2005-2006, involvement in the procurement process for the replacement of Meteo France HPC system (in charge of technical aspects : OS, configuration, software tools). Participation in the ITT writing and analysis of the offers.

Mar. 1990 – Aug.1992

User support on Cray System and Data Archiving

Meteo France – IT department – Development division

- Assisted in the move of Meteo France Computing Centre from Paris to Toulouse.

Aug. 1986 – Sept 1990

Operational Suite Management

Meteo France – Forecasting Department

- Operation of numerical models on CRAY: development of the suite under Unix system.

EDUCATION AND TRAINING

1992-1993

Advanced Master in Computer Science

EQF 7

ISAE – Sup'Aero – Toulouse – France

Operating systems and Networks – Programming Language Theory

6 months internship : development of a distributed application for the administration of multiple CRAY systems.

1986

Engineer in Meteorology

EQF 7

Ecole Nationale de la Météorologie – Toulouse – France

Meteorology – Atmospheric Science

PERSONAL SKILLS

Mother tongue(s): French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	B2	B2	B2
	Cambridge Certificate level B				
Spanish	A2	A2	A1	A1	A1
German	A2	A1	A1	A1	A1

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Strong communication and negotiation skills (experience as contact point with computer manufacturers, experience of managing relationship with health agencies).
- Experience in writing user documentation and reporting.

Organisational / managerial skills

- Leading working groups and reporting (document writing)
- Deputy manager (for a team of 8 people)
- Organization of technical seminars and European workshops : involvement in conference organisation (co-organiser of Fujitsu User Group in 1998 in Toulouse and of the CAMS50 workshop in 2018 in Toulouse).

Job-related skills

- Involved in process of transfer from research to operational in MACC-II and MACC-III: coordinating technical aspects.
- Strong experience in Meteo France operational production systems.

Computer skills

- Unix, shell command languages, FORTRAN, C.

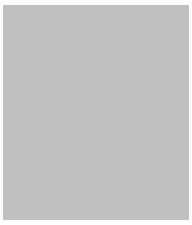
Other skills

- Experience at giving presentation to large audiences and in teaching (training courses in computer science and Biometeorology at “Ecole de la Meteorologie”)
- Experience in writing articles related to Air Quality, for the general public, in website or in general audience magazines.

Driving licence: B

PERSONAL INFORMATION

Hélène PECH



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Sex F | Date of birth 23/12/1960 | Nationality French

POSITION

IT Architect

WORK EXPERIENCE

From February 2015 — IT Architect

METEO-FRANCE- IT Division - Toulouse

- Technical architectures
- IT Cartography
- Member of CAMS_50 Project for WP 50.6

Business or sector National Meteorological Service

From September 2004 to January 2015 — Expert Network and Telecommunications / Project Manager

Education Nationale/Rectorat-IT Division-Toulouse

- ToIP Project manager : Design and Implementation of a solution spread across 60 remote sites
- In charge of design and implementation of network architectures for interconnecting remote sites
- In charge of monitoring and implementation of national security policy for the protection of minors in schools (250 secondary schools , 300 primary schools)

Business or sector Education

From September 2002 to August 2004 — IT Teacher

Education Nationale

- Training courses for higher technical section : Object language (C++), Unified Modelisation Langage, Operating system….

Business or sector Education

2001 — IT Project Manager

Network Infrastructure Solutions, Cap Gemini Ernst and Young, Toulouse

- Studies customers specifications
- Design technical and financial solutions
- Response to tenders

Business or sector Network Infrastructure Solutions

From September 1985 to August 2000 — Member then Head of Network and Telephony team

SOFINCO-IT Division- Evry

- Head of two four-person teams for five years (4 engineers and 4 technicians)
- In charge of all network and telephony infrastructures (80 interconnected sites, 10 Automatic Call distributors,…)
- In charge of network and telephony budget management

Business or sector Bank and finance

EDUCATION AND TRAINING

2003 **Certificat d'Aptitude Professionnelle à l'Enseignement Technique**

Education Nationale, France

- Training courses to specific audiences
- Lead and motivate pupils

1985 **Ingenieur en Informatique Industrielle** EQF7

Institut National des Sciences Appliquées, Toulouse, France

- Sciences Engineering
- Computer skills (Operating System, Real Time Process, Programming Languages…)
- 4 months Internship at IBM Montpellier

PERSONAL SKILLS

Mother tongue(s): French

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B1	B2	B1	B1	B2
German	A1	A1	A1	A1	A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills
- Strong communication and negociation skills (experience of managing relationship with suppliers, tecnicians and users, during ToIP project).
- Experience in reporting and projects presentations

Organisational / managerial skills
- Management of technical teams
- Project management
- Budget and planning management

Job-related skills
- Proficient in IT project and in design architecture

Computer skills
- Operating systems : Linux and Windows
- Networks, telecommunication and security: TCP/IP, ToIp, Switching Level 2/3
- Security: VPN, VLANs, Firewalls

Other skills
- Experience in teaching

Driving licence: B

PERSONAL INFORMATION

Joaquim Arteta

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Sex Male | Date of birth17/02/1979 | Nationality French

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR
PERSONAL STATEMENT

Atmospheric Scientist

WORK EXPERIENCE

Since 2013

Atmospheric Scientist

CNRM-GAME, Météo-France, 42 Avenue G. Coriolis, 31057 Toulouse Cedex, (France)

- Member of the CARMA (Atmospheric Chemistry, Researches in Modelling and Assimilation) group

From 2009 to 2013

Post-Doctorate Fellow

CNRM-GAME, Météo-France, 42 Avenue G. Coriolis, 31057 Toulouse Cedex, (France)

- Projects MACC/MACC-II/MACC-III: development of the MOCAGE version of the C-IFS model

From 2007 to 2009

Post-Doctorate Fellow

LPC2E, Avenue de la recherche scientifique, 45000 Orléans, (France)

- SCOUT-O3 (EU-FP6) Project: Modelling of convective transport and troposphere-stratosphere exchange

From 2006 to 2007

Post-Doctorate Fellow

WCAS, University of Waterloo, Waterloo (Canada)

From 2005 to 2006

Post-Doctorate Fellow

LaMP, University Blaise-Pascal, 63170 Aubière, (France)

- ESCOMPTE Project: regional air quality

EDUCATION AND TRAINING

From 2005 to 2006

PhD

LaMP, University Blaise-Pascal, 63170 Aubière, (France)

- ESCOMPTE Project: regional air quality

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Job-related skills

- Expert knowledge of FORTRAN, IDL, Python, Shell scripting, parallel programming, handling of large datasets; Unix/Linux and Windows operating systems and software

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient User	Indepenbdant User	Basic User	Basic User	Proficient User

Levels: Basic user - Independent user - Proficient user
Digital competences - Self-assessment grid

Driving licence B

PUBLICATIONS

1. Marécal, V., Peuch, V.-H., Andersson, C., Andersson, S., Arteta, J., Beekmann, M., Benedictow, A., Bergström, R., Bessagnet, B., Cansado, A., Chéroux, F., Colette, A., Coman, A., Curier, R. L., Denier van der Gon, H. A. C., Drouin, A., Elbern, H., Emili, E., Engelen, R. J., Eskes, H. J., Foret, G., Friese, E., Gauss, M., Giannaros, C., Guth, J., Joly, M., Jaumouillé, E., Josse, B., Kadygrov, N., Kaiser, J. W., Krajsek, K., Kuenen, J., Kumar, U., Liora, N., Lopez, E., Malherbe, L., Martinez, I., Melas, D., Meleux, F., Menut, L., Moinat, P., Morales, T., Parmentier, J., Piacentini, A., Plu, M., Poupkou, A., Queguiner, S., Robertson, L., Rouïl, L., Schaap, M., Segers, A., Sofiev, M., Thomas, M., Timmermans, R., Valdebenito, Á., van Velthoven, P., van Versendaal, R., Vira, J., and Ung, A.: A regional air quality forecasting system over Europe: the MACC-II daily ensemble production, Geosci. Model Dev. Discuss., 8, 2739-2806, doi: 10.5194/gmdd-8-2739-2015, 2015.
2. Sič, B., El Amraoui, L., Marécal, V., Josse, B., Arteta, J., Guth, J., Joly, M., and Hamer, P. D.: Modelling of primary aerosols in the chemical transport model MOCAGE: development and evaluation of aerosol physical parameterizations, Geosci. Model Dev., 8, 381-408, doi: 10.5194/gmd-8-381-2015, 2015.
3. Sofiev, M., Berger, U., Prank, M., Vira, J., Arteta, J., Belmonte, J., Bergmann, K.-C., Chéroux, F., Elbern, H., Friese, E., Galan, C., Gehrig, R., Khvorostyanov, D., Kranenburg, R., Kumar, U., Marécal, V., Meleux, F., Menut, L., Pessi, A.-M., Robertson, L., Ritenberga, O., Rodinkova, V., Saarto, A., Segers, A., Severova, E., Sauliene, I., Siljamo, P., Steensen, B. M., Teinemaa, E., Thibaudon, M., and Peuch, V.-H.: MACC regional multi-model ensemble simulations of birch pollen dispersion in Europe, Atmos. Chem. Phys., 15, 8115-8130, doi:10.5194/acpd-15-8115-2015, 2015.
4. Flemming, J., Huijnen, V., Arteta, J., Bechtold, P., Beljaars, A., Blechschmidt, A.-M., Diamantakis, M., Engelen, R. J., Gaudel, A., Inness, A., Jones, L., Josse, B., Katragkou, E., Marecal, V., Peuch, V.-H., Richter, A., Schultz, M. G., Stein, O., and Tsikerdekis, A.: Tropospheric chemistry in the Integrated Forecasting System of ECMWF, Geosci. Model Dev., 8, 975-1003, doi:10.5194/gmd-8-975-2015, 2015.
5. Arteta J., Marecal V., Riviere E., Regional modelling of tracer transport by tropical convection, Part 1: sensitivity to convection parameterization, Atmospheric Chemistry and Physics, 9, 7081-7100, doi: 10-5194/acp-9-7081-2009, 2009.
6. Arteta J., Marecal V., Riviere E., Regional modelling of tracer transport by tropical convection, Part 2: sensitivity to model resolutions, Atmospheric Chemistry and Physics, 9, 7101-7114, doi: 10-5194/acp-9-7101-2009, 2009.

PROJECTS

1. FP6 MACC/ FP7 MACC-II/ H2020 MACC-III project

PERSONAL INFORMATION

Mathieu Joly

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Sex Male | Date of birth 11/12/1978 | Nationality French

POSITION

Atmospheric Scientist

WORK EXPERIENCE

Since 2008 — **Atmospheric Scientist**

CNRM-GAME, Météo-France, 42 Avenue G. Coriolis, 31057 TOULOUSE cedex 1, France

- Member of the GMGEC-PLASMA team

EDUCATION AND TRAINING

2005-2008 — **PhD**

CNRM-GAME, Université Paris-Est

Role of the oceans in the interannual variability of the African monsoon

2002-2005 — **Master's Degree in Engineering**

Ecole Nationale de la Météorologie, TOULOUSE, France

PERSONAL SKILLS

Mother tongue(s): French

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
Italian	B1	B1	B1	B1	B1

ADDITIONAL INFORMATION

Publications

- Guth, J., B. Josse, V. Marécal, M. Joly, and P. D. Hamer, 2016 : First implementation of secondary inorganic aerosols in the MOCAGE version 2.15.0 chemistry transport model. Geoscientific Model Development, Volume : 9, Issue : 1, Pages : 137-160, Doi : 10.5194/gmd-9-137-2016. Published : 2016.
- Marécal., V., V.-H. Peuch, C. Andersson , S. Andersson, J. Arteta, M. Beekmann, A. Benedictow, R. Bergström, B. Bessagnet, A., Cansado, F. Chéroux, A. Colette, A. Coman, R.L. Curier, H. A. C. Denier van der Gon, A Drouin, H. Elbern, E. Emili, R. J. Engelen, H. J. Eskes, G. Foret, E. Friese, M. Gauss, C. Giannaros, J. Guth, M. Joly, E. Jaumouillé, B. Josse, N. Kadygrov, J. W. Kaiser, K. Krajsek, J. Kuenen, U. Kumar, N. Liora, E. Lopez, L. Malherbe, I. Martinez, D. Melas, F. Meleux, L. Menut, P. Moinat, T. Morales, J. Parmentier, A. Piacentini, M. Plu, A. Poupkou, S. Queguiner, L. Robertson, L. Rouïl, M. Schaap, A. Segers, M. Sofiev, M. Thomas , R. Timmermans, Á. Valdebenito, P. van Velthoven, R. van Versendaal, J. Vira, A. Ung, 2015: A regional air quality forecasting system over Europe: the MACC-II daily ensemble production. Geoscientific Model Development, Volume: 8, Issue: 9, Pages: 2777-2813, Doi : 10.5194/gmd-8-2777-2015. Published: 2015.
- Sic, B., L. El Amraoui, V. Marécal, B. Josse, J. Arteta, J. Guth, M. Joly, and P. Hamer, 2015 : Modelling of primary aerosols in the chemical transport model MOCAGE: development and evaluation of aerosol physical parameterizations. Geoscientific Model Development, Volume: 8, Issue: 2, Pages: 381-408, Doi : 10.5194/gmd-8-381-2015. Published : 2015.
- Foret, G., Eremenko, M., Cuesta, J., Sellitto, P., Barré, J., Gaubert, B., Coman, A., Dufour, G., Liu, X., Joly, M., and others, 2014: Ozone pollution: What can we see from space? A case study. Journal of Geophysical Research: Atmospheres, volume 119, number 13, pages=8476-8499, year 2014.
- Lacressoniere, G., V.-H. Peuch, J. Arteta, B. Josse, M. Joly, V. Marecal, D. Saint-Martin, M. Deque, and L. Watson, 2013 : How realistic are air quality hindcasts driven by forcings from climate model simulations? Geoscientific Model Development, Volume : 5, Pages : 1565-1587, DOI:10.5194/gmd-5-1565-2012.
- Joly, M., and V.-H. Peuch, 2012 : Objective classification of air quality monitoring sites over Europe. Atmospheric Environment, Volume 47, Pages 111–123.
- Rodriguez-Fonseca, B., S. Janicot, E. Mohino, T. Losada, J. Bader, C. Caminade, F. Chauvin, B. Fontaine, J. Garcia-Serrano, S. Gervois, M. Joly, I. Polo, P. Ruti, P. Roucou, and A. Voldoire, 2011 : Interannual and decadal SST-forced responses of the West African monsoon. Atmospheric Science Letters, Volume : 12, Issue : 1, Special Issue: Sp. Iss. SI Pages : 67-74 Published: JAN-MAR 2011. Doi :10.1002/asl.308.
- Joly, M., and A. Voldoire, 2010 : Role of the Gulf of Guinea in the interannual variability of the West African monsoon: what do we learn from CMIP3 coupled simulations? International Journal of Climatology, Volume : 30, Issue : 12, Pages : 1843-1856, Published : OCT 2010. Doi : 10.1002/joc.2026.
- Joly, M., and A. Voldoire, : Influence of ENSO on the West African monsoon: temporal aspects and atmospheric processes. Journal of Climate, Volume : 22, Issue : 12, Pages : 3193-3210, Published : JUN 2009. Doi : 10.1175/2008JCLI2450.1.
- Joly, M., 2008: Rôle des océans dans la variabilité climatique de la mousson africaine. Thèse de doctorat de l'Université Paris-Est, soutenue le 27 novembre 2008 au CNRM-GAME, 194 pp.
- Joly, M., A. Voldoire, H. Douville, P. Terray, and J.-F. Royer, 2007 : African monsoon teleconnections with tropical SSTs:validation and evolution in a set of IPCC4 simulations. Climate Dynamics, Volume : 29, Issue : 1, Pages : 1-20, Published : JUL 2007. Doi : 10.1007/s00382-006-0215-8.

europass Curriculum Vitae

PERSONAL INFORMATION

Alain Gradot

Météo-France, avenue G. Coriolis, Toulouse, France

+33 561078024

alain.gradot@meteo.fr

Sex M | Date of birth 15/06/1965 | Nationality French

WORK EXPERIENCE

From 01/12/2005 to present

Administrative manager

Météo-France, Toulouse, France

Main activities in relation to R& D activities and/or projects

- preparation and formalization contracts and/or agreements
- recruitment and management of non-permanent staff
- purchase
- reporting
- billing coordination

From 01/03/2001 to 30/11/2005

Responsible of the payroll department, Météo-France, Human Resources Directorate, Paris, France

- team management (10 collaborators)

From 01/09/1997 to 28/02/2001

Redactor in charge of statutory matters for civil servants from civil aviation directorate, Direction générale de l'aviation civile, Paris, France

From 01/02/1987 to 31/08/1996

Administrative officer in various services belonging to ministry of education

EDUCATION AND TRAINING

From 1996-1997

Regional Institute of Administration (Lyon, France)
(French public school for civil servants)

- public management (human resources, finance, accounting, law, regulation)

From 1983-1985

Diploma in management, specialization accounting and finance (University Institute of Technology, Toulouse III, France).

PERSONAL SKILLS

Mother tongue(s): French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B1	B1	B1	B1	B1

Communication skills

- Regular pratice in written communication in relation to my professional experience

Organisational / managerial skills

- Currently responsible for financial management of several projects (in particular : FP/7, H2020, FEDER, SESAR, CLEAN SKY….)

Job-related skills

- General profile, ability to handle different matters under administrative functions

Computer skills

- Office / Open Office

PERSONAL INFORMATION

Laurence ROUÏL

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte - FRANCE

(+33) 344-55-61-13 (+33) 626-39-53-28

Laurence.rouil@ineris.fr

www.ineris.fr

Sex Female | Date of birth 18/12/1968 | Nationality French

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR

Air quality management and decision support

WORK EXPERIENCE

May 2008 - Onwards

Head of the "Environmental Modelling and Decision Making" Department

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte – France

Nature of duties:

- Management of a 40 people department working in the field of environmental databases development, air quality modelling, statistical analysis, decision making and economical analysis
- Coordination of high-level national projects related to the implementation of environmental policies; coordination of air quality modelling activities supporting the implementation of the French air quality monitoring and forecasting system; belongs to several technical and policy-supporting working groups
- Chair of the Steering Body of the EMEP cooperative program (UN-ECE) under the Convention on Long Range Transboundary Air Pollution (2014). The EMEP program aims at providing scientific basis in the fields of air quality emissions, monitoring, modelling and integrating assessment for the implementation of International regulation for the management of long range air pollution in Europe
- Until 2014 Chair of the Task Force on Measurement and Modelling of the EMEP cooperative program (UN-ECE) under the Convention on Long Range Transboundary Air Pollution. The Task Force is in charge of the definition and the implementtation of the EMEP monitoring strategy throughout Europe. It assesses and promotes use of modelling tools in support of the implementation of emission control policies.
- Belongs to the management board of several European research projects related to the implementation of integrated air quality monitoring and modelling systems : MACC and MACC-II (FP7), and related to the impact of urban emissions on air quality and climate change CITYZEN (FP7)

Business or sector: French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology.

February 2006 – May 2008

Head of the Modelling and Economical Analysis Unit

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte – France

Nature of duties:

- Management of the activity of 13 engineers, researchers and economists working in the field of environmental risk assessment, especially in the air and water pollution domains.
- Coordination of technical projects related to air quality monitoring, trends analysis and forecasting developed for the French Ministry in charge of Ecology within the framework of the negotiations of European Directives (Air quality, national emission ceilings) and international protocols (Convention on Long Range Transboundary Air Pollution of the United Nations Economical Commission for Europe - UNECE).

Business or sector: French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology.

June 1998 –February 2006

Researcher & Project Manager - Leader of the Air Quality modelling team (5 people)

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte – France

Responsible for Research and Development programs and service contracts in the field of air pollution

- Technical support to the Ministry of Environment within the framework of the european negotiations

related to the transboundary air pollution
- Project leader of the PREV'AIR program delivering on the web site (www.prevair.org) regional air quality forecasts and maps
- Technical support to local agencies in charge of the air quality monitoring network

Responsible for atmospheric impact assessment studies for industrial manufacturers

Business or sector: French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology

1996-1998 **Engineer & Project Manager**

ADULIS
- Development of numerical algorithms for high performance computing
- Technical support to the commercial team

Business or sector: Numerical Computing Consultant

EDUCATION AND TRAINING

1992-1995 **PhD**

University Bordeaux 1- 351 Cours de la Libération - 33400 Talence
- Computationnal Fluid Dynamics, applied mathematics and High Performance

PERSONAL SKILLS

Mother tongue(s): French

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C2	C1	C1	C1

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills
- good communication skills gained through my experience as sales manager

Technical skills and competences
- Computational fluid dynamics (PhD)
- Applied mathematics (PhD)
- Air quality modelling and atmospheric chemistry (acquired during more than 10 years experience at INERIS)

Organisational / managerial skills
- As a head of Department: administration and coordination of technical and non technical people (about 40), budgets management, development and implementation of a strategy for the development of the department I am in charge
- Organization of national and European technical seminars related to air quality

Computer skills
- Fortran and Parallel languages (university diploma)

Driving licence
- B

ADDITIONAL INFORMATION

Publications
Presentations
Projects
Conferences
Seminars
Honours and awards
Memberships
References

- Mediating skills: coordination of projects and contracts involving contributors from different professional culture : researchers, policy makers and industrial people
- Contribution to the European negotiations related to air quality management (EMEP and CAFE programs, NEC and Air Quality Directives)
- Chairing of European working groups under the EMEP framework and within scientific networks

PERSONAL INFORMATION

Augustin COLETTE

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte - FRANCE

+33 3 44 55 64 82 +33 7 78 82 01 46

augustin.colette@ineris.fr

www.ineris.fr

Sex Male | Date of birth 03/04/1978 | Nationality French

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR

Atmospheric science for air quality management

WORK EXPERIENCE

Since Sep 2009

Head of Unit - Atmospheric Modelling and Environmental Mapping

INERIS, Parc Technologique ALATA - 60550 Verneuil-en-Halatte - FRANCE

- Head of a team of 10 scientists specialised in atmospheric sciences, high performance computing and statistics, in addition to several PhD and Post Doctoral interns.
- Chair of the Task Force on Measurement and Modelling of the Convention on Long Range Transboundary Air Pollution. The Task Force is in charge of the definition and the implementation of the EMEP monitoring strategy throughout Europe. It assesses and promotes use of modelling tools in support of the implementation of emission control policies.
- Lead of the Air quality trends work of the European Topic Centre on Air Quality and Climate Mitigation in support of the European Environment Agency.
- Member of Scientific Committee of the French Primequal Research programme, and the French Steering Committee on Climate Services.
- Editor for the Scientific journal Geoscientific Model Development.

Skills

- Management of a team of qualified scientist involved in numerous national and international projects
- Long term evolution of air quality and interlinkages with climate change.
- Development and advanced use of the open source chemistry transport model CHIMERE
- Advanced use of the mesoscale meteorological WRF model for forecasting and regional climate projections.
- Forecaster for the French air quality forecasting platform PREV'AIR
- Participation in several international research projects (FP7 CITYZEN MEGAPOLI, ATOPICA, EURODELTA), including coordination experience
- PhD Advisor

Business or sector: French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology

2007-2009

Senior Catastrophe Risk Modeller

Risk Management Solutions, London UK
- Hurricane Cat-Risk Model Development

Business or sector Private, Insurance industry

2007

Post-Doctoral Fellow

Institut Pierre Simon Laplace, Palaiseau, France
- Chemistry-Transport Model Development

Business or sector Academia

2006 **Consultant**

UNESCO, Paris, France
- **Advice to Policy on climate change impact on the World Heritage**

Business or sector Institutional

2001-2002 **Research Assistant**

Stanford University, CA, USA
- **Mesoscale Meteorological Model Development**

Business or sector Academia

EDUCATION AND TRAINING

2002 – 2005 **Ph.D.with Honors**

Université Pierre et Marie Curie, Paris, France
- Atmospheric Physics and Chemistry

1998-2000 **Batchelor, Master of Science and Master of Engineering**

Ecole Centrale, Lyon, France
- Major in fluid mechanics and environment

PERSONAL SKILLS

- 30yr of musical practice, upright bass, cello.

Mother tongue(s): French

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C2	C1	C1	C1
Spanish	A1	A1	A1	A1	A1

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills
- Good communication skills developed through oral presentations in conferences and chairing international working group of experts
- Media interviews on air quality

Organisational / managerial skills
- Synthetic and analytic thinking
- Professional expertise in a variety of contexts (institutional, business, academia both national and international)
- Manager of a team of 10 qualified scientists

Computer skills
- Extended knowledge of programming, including in high-performance computing environment.

Driving licence
- B

ADDITIONAL INFORMATION

About 50 ISI publications

Most relevant publications in the occupational field :

- A. Colette et al., Is the ozone climate penalty robust in Europe?, Environmental Research Letters 10(2015), p. 084015.
- A. Colette et al., European atmosphere in 2050, a regional air quality and climate perspective under CMIP5 scenarios, Atmos. Chem. Phys. 13(2013), pp. 7451-7471.
- A. Colette et al., Future air quality in Europe: a multi-model assessment of projected exposure to ozone, Atmos. Chem. Phys. 12(2012), pp. 10613-10630.

PERSONAL INFORMATION

MELEUX Frédérik

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frederik.meleux@ineris.fr

www.prevair.org

Sex: Male | Date of birth: 23/08/1973 | Nationality: French

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR

Air quality forecasting and management

WORK EXPERIENCE

From June 2005 – onwards

Research engineer for Air quality Monitoring and Forecasting over Europe and France

INERIS – Parc Technologique Alata – 60550 Verneuil en Halatte – France - www.ineris.fr

- Prev'Air technical coordination
- Coordinator of the cross-cuting task dedicated to forecasting in FAIRMODE
- Research project manager in:
  - Operational air quality short term forecast with the CHIMERE air quality model for: public body, decision-makers, and public awareness in France and Europe (www.prevair.org; www.gmes-atmosphere.eu/services/raq)
  - Long term prediction to assess climate changes impact on air quality
  - Modelling developments for data assimilation from satellite aerosol observations

French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology

From November 2004 to May 2005

Visiting scientist

ICTP, Strada Costiera 11, I-34014 Trieste - www.ictp.it

- Research activity on Modelling tool for long term air quality predictions over Europe

Abdus Salam International Centre for Theoretical Physics (ICTP) operates under the aegis of two United Nations Agencies: UNESCO and IAEA (www.ictp.it)

From April 2004 to October 2004

Research engineer for Air quality Monitoring and Forecasting over Europe and France

INERIS – Parc Technologique Alata – 60550 Verneuil en Halatte – France - www.ineris.fr

- Air quality short term forecast for: public body, decision-maker, and public awareness

French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology

From December 2002 to July 2003

Research engineer for nuclear pollutant modelling

IRSN, BP 3- F-13115 Saint-Paul-Lez-Durance Cedex (www.irsn.fr)

- Development of a modelling tool to monitor the fate of hazardous nuclear pollutants in the biosphere, Assessment of the human exposure in case of accidental nuclear emissions

Public establishment of an industrial and commercial nature placed under the joint authority of the Ministries of the Environment, Health, Industry, Research and Defence

EDUCATION AND TRAINING

From 1998 to 2002

PhD

Université Paul Sabatier - 118 Route de Narbonne, 31400 Toulouse

- Thesis subject: Air pollution modelling at various scales, from local to continental.
- Modelling about atmospheric dynamics (pollutant transport) and tropospheric chemistry, with a focus over a complex zone: The Marseille area.
- Programming activities in Fortran. Preparation of experimental campaign (Escompte).
- Teaching in mathematics

From 1997 to 1998

DEA in Oceanography; Atmospheric and Biosphere

Université Paul Sabatier - 118 Route de Narbonne, 31400 Toulouse

- Meteorology, atmospheric dynamics, tropospheric chemistry, interactions between media, climate change

PERSONAL SKILLS

Mother tongue(s): French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	B2	B2	B2

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Good working ability in a team, good capacity to communicate in a foreign context, attendance and participation to European workshops and conferences

Organisational / managerial skills

- Research manager for several French and European Research projects in air quality. Technical manager for the Prev'Air system (air quality monitoring and forecasting system in France and Europe)

Computer skills

- Robust programming skills in Fortran, C++, and mapping software language (Matlab ….)
- Knowledge of office software

Driving licence

- B

ADDITIONAL INFORMATION

Most relevant publications in the occupational field :

- Marecal, V., Peuch, V.-H., Andersson, C., Andersson, S., Arteta, J., Beekmann, M., Benedictow,A., Bergstrom, R., Bessagnet, B., Cansado, A., Cheroux, F., Colette, A., Coman, A.,Curier, R. L., Denier van der Gon, H. A. C., Drouin, A., Elbern, H., Emili, E., Engelen, R. J.,Eskes, H. J., Foret, G., Friese, E., Gauss, M., Giannaros, C., Guth, J., Joly, M., Jaumouille, E.,Josse, B., Kadygrov, N., Kaiser, J. W., Krajsek, K., Kuenen, J., Kumar, U., Liora, N.,Lopez, E., Malherbe, L., Martinez, I., Melas, D., Meleux, F., Menut, L., Moinat, P., Morales,T., Parmentier, J., Piacentini, A., Plu, M., Poupkou, A., Queguiner, S., Robertson, L.,Rouil, L., Schaap, M., Segers, A., Sofiev, M., Thomas, M., Timmermans, R., Valdebenito, A.,van Velthoven, P., van Versendaal, R., Vira, J., and Ung, A.: A regional air quality forecasting system over Europe: the MACC-II daily ensemble production, *Geosci. Model Dev. Discuss.*, 8, 2739-2806, doi:10.5194/gmdd-8-2739-2015, 2015
- Hamaoui-Laguel, L., **Meleux, F**., Beekmann, M., Bessagnet, B., Génermont, S., Cellier, P,. Létinois, L. Exploring a way to improve ammonia emissions in air quality models in France, Atmospheric environment (2014),
- Bessagnet, B., Beauchamp, M., Guerreiro, C., de Leeuw, F., Tsyro, S., Colette, A., **Meleux, F**., Rouïl, L., Ruyssenaars, P., Sauter, F., Velders, G. J. M., Foltescue, V. L., van Aardennee, J. Can further mitigation of ammonia emissions reduce exceedances of particulate matter air quality standards?, Environmental Science & Policy 44, 149-163 (2014),
- Menut L, Bessagnet, B., Khvorostyanov, D., Beekmann, M., Blond, N., Colette, A., Coll, I.,Curci, G., Foret, G., Hodzic, A., Mailler, S., **Meleux, F**., Monge, JL., Pison, I., Siour, G., Turquety, S., Valari, M., Vautard, R., Vivanco,MG. CHIMERE 2013: a model for regional atmospheric composition modelling, Geoscientific Model Development 6, 981-1028 (2013),
- Colette, A, Granier, C, Hodnebrog, O, Jakobs, H, Maurizi, A, Nyiri, A, Bessagnet, B, D'Angiola, A, D'Isidoro, M, Gauss, M, **Meleux, F**,. Memmesheimer, A, Mieville, Rouil, L, Russo, F, Solberg, F, Stordal, F, Tampieri, F. Air quality trends in Europe over the past decade: a first multi- model assessment, Atmospheric Chemistry and Physics 11, 11657-11678 (2011),
- Rouil L., Honore C, Vautard R, Beekmann M, Bessagnet B, Malherbe L, **Meleux F**, Dufour A, Elichegaray C, Flaud J-M, Menut L, Martin D, Peuch A, Peuch VH, Poisson N. PREV'AIR: an operational forecasting and mapping system for air quality in Europe, Bulletin of the American Meteorological Society 90, 73-83 (2009),
- Honoré C, Rouil L, Vautard R, Beekmann M, Bessagnet B, Malherbe L, **Meleux F**, Dufour A. Elichegaray C, Flaud J-M, Menut L, Martin D, Peuch V-H, Poisson N. Predictability of regional air quality in Europe: the assessment of three years of operational forecasts and analyses over France, Journal of Geophysical Research, Atmospheres 113, D04301 (2008),
- **Meleux F.,** Solmon F., Giorgi F. Increase in summer European ozone amounts due to climate change, Atmospheric Environment 41, 7577-7587 (2007),

PERSONAL INFORMATION

UNG Anthony

INERIS – Parc Technologique Alata – 60550 Verneuil en Halatte - France

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anthony.ung@ineris.fr

www.prevair.org

Sex Male | Date of birth 20/08/1976 | Nationality French

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR
PERSONAL STATEMENT

Research engineer for Air Quality Monitoring and Forecasting

WORK EXPERIENCE

2007- onwards

Research engineer for Air Quality Monitoring and Forecasting

Institut National de l'Environnement Industriel et des Risques (INERIS)

Parc Technologique Alata BP2, 60550 Verneuil-en-Halatte, FRANCE

- Development and maintenance of the operational air quality short term forecast with the CHIMERE air quality model (www.prevair.org).
- Development of the analysis tools dedicated to several European research projects: GEOMON (FP6), GEMS (FP6), and MACC (FP7).
- Development of the common air quality index forecast for CITEAIR2 (INTERREG IVC).

Business or sector French public research body of an industrial and commercial character under the aegis of the French Ministry for Ecology

EDUCATION AND TRAINING

2000-2004

PhD

Ecole des Mines de Paris, Sophia Antipolis, France

- Thesis subject: Air quality monitoring over urban area using multisource and remotely sensed data.

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1

Communication skills

- Attendance and participation to European project workshops and conferences

Job-related skills

At MOCA unit (Modelling and Mapping), in charge of the development of the Prevair (http://www2.prevair.org) and associated CAMS (Copernicus Atmosphere Monitoring Service) products and services.
In CAMS_50: contribution to the observation acquisitions and observation processing. Provision assistance to the partners for using the observations in the reanalysis productions.

- Good working ability in a team.
- Good capacity to communicate in a foreign context.
- Air quality modeling and atmospheric chemistry

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving

- Windows & Linux platform;
- Advanced Bash scripting;
- Advanced Fortran programming;
- Advanced R-base statistics computing;
- Build/Connect/Install/Configure Computer;
- good command of office suite (word processor, spread sheet, presentation software);
- good command of photo editing software gained as an amateur photographer.

Driving licence

No driving license

ADDITIONAL INFORMATION

Publications

- UNG, Anthony, WALD, Lucien, RANCHIN, Thierry, WEBER, Christiane, HIRSCH, Jacky, PERRON, Gilles, KLEINPETER, Joseph, 2002. Satellite data for the air pollution mapping over a city - The use of virtual station. In Proceedings of the 21th EARSeL Symposium, Observing our environment from space: new solutions for a new millenium, Paris, France, 14-16 may 2001, Gérard Begni editor, A. A. Balkema,, Lisse, Abingdon, Exton (PA), Tokyo, pp. 147-151.
- UNG A., Ranchin T., Wald L., Weber C., Hirsch J., Perron G., Kleinpeter J., 2002, Cartographie de la pollution de l'air : une nouvelle approche basée sur la télédétection et les bases de données géographiques. Application à la ville de Strasbourg. PhotoInterprétation, 2000 3/4, pp. 53-64
- UNG A., Meleux F., Rouil L., Kacenelengen M., Leon J.F., Chiapello I., Lifermann A. - the use of polder satellite data for chimere chemistry transport model - egu general assembly, 15-20 avril 2007, vienne, autriche. [Poster], geophysical research abstracts, 2007, vol. 9, 01033
- FORET, G., M. Beekmann, M. Eremenko, L. Hamaoui, C. Schmechtig, C. Keim, G. Dufour, A. Boynard, and A. Ung, Evaluating the potential of IASI ozone observations to constrain simulated surface ozone concentrations, Atmos. Chem. Phys. Discuss., 9, 12829-12856, 2009

PERSONAL INFORMATION

Mikhail Sofiev

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+358 295395433 +358503290578
Mikhail.sofiev@fmi.fi

Sex male | Date of birth 06/08/1967 | Nationality Finland, Russia

WORK EXPERIENCE

1999 - c.m.

Research Professor since 2017, senior scientist 1999-2016, deputy leader of modelling group since 2015

Finnish Meteorological Institute

- Mathematical modelling of atmospheric composition. Development and application of air pollution models for various scales – from meso- to globe – and compounds – acidifying, toxic, aerosols, radio-active accidental releases, etc. Related fields – model evaluation, data assimilation, statistical methodology, ensemble prediction, data analysis, computer experiments, etc.
- Managing of international scientific and application projects.

Business or sector Government research institute

1997 - 1999

Infrastructure manager

Procter and Gamble

- Manager in the IT department of Moscow subsidiary of Procter and Gamble, infrastructure manager of Novomoskovskbythim chemical plant; manager of the infrastructure group. Responsible for the computer infrastructure (~300 computers) and telecommunication systems of the plant.

Business or sector Transnational production company

1992 - 1997

Senior scientist, chief engineer

Meteorological Synthesising Centre East of the UN ECE European Monitoring and Evaluation Programme (EMEP)

- Mathematical modelling of atmospheric composition. Development and application of air pollution models for various scales – from meso- to globe – and compounds – acidifying, toxic, aerosols, radio-active accidental releases, etc. Related fields – model evaluation, data assimilation, statistical methodology, ensemble prediction, data analysis, computer experiments, etc.
- Management of computing centre: organizational issues, infrastructure planning and development, hard- and software acquisition, installation and maintenance.

Business or sector International computing centre

EDUCATION AND TRAINING

2007

Adjunct Professor of Physics

University of Helsinki

1996

Oxford International Business English, executive level

Oxford International English Courses, Moscow

- English language and communication skills

1994

Doctor of science in technology (PhD)

Moscow Institute of Program Systems, Russian Academy of Sciences

- Atmospheric physics, chemistry and modelling of atmospheric composition, as well as related areas

Replace with dates (from - to)

Master of Science, applied mathematics and physics

Moscow Institute of Physics and technology

- Higher education in the field of applied mathematics and physics

PERSONAL SKILLS

Mother tongue(s): Russian

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
	Replace with name of language certificate. Enter level if known.				
Finnish	B1	B1	B1	B1	A2
	Replace with name of language certificate. Enter level if known.				

Communication skills

- Extensive communication skills acquired through many years of work experience senior researcher positions, over 300 presentations and lectures in various international meetings, organization and follow-up of international projects, negotiations, managing conferences, schools, etc.

Organisational / managerial skills

- Co-ordination and management of a group of people. Practical experience in organization of work on the model development and application by the team of researchers and programmers; management of IT support and infrastructure groups.
- Management of computing centre at a position of a chief engineer. Practical experience in organizational issues, infrastructure planning and development, hard- and software acquisition, installation and maintenance. A 1.5-year experience at IT managerial positiony, incl. Infrastructure Manager position at the chemical plant Novomoskovskbythim.

Job-related skills

- Extensive practical experience in development and application of air pollution models for various scales – from meso- to globe – and compounds – acidifying, toxic, aerosols, radio-active accidental releases, etc. Extensive experience in the related fields – model evaluation, data assimilation, statistical methodology, ensemble prediction, data analysis, computer experiments, etc.
- Established an atmospheric composition modelling course at University of Helsinki

Computer skills

- Computer expert. Extensive practical experience in setup of computers on various platforms and operation systems; installation, configuration and application of office and professional software, information systems, telecommunications, Internet. Programming experience on 6 languages.

Other skills

- Master of sport of radio-controlled ship models

Driving licence

- B

ADDITIONAL INFORMATION

Publications
212 scientific publications; 115 of these have been published in refereed journals and books.

Presentations
Over 400 lectures and presentations: at scientific and application conferences, workshops, etc.

Projects
Participated and coordinated 35 international research projects during last 10 years

Conferences
Over 300 lectures and presentations: at scientific and application conferences

Seminars
Lecturer: IAEA Regional Training Courses (2); MetPD course of FMI (1); Summer schools under various umbrellas: 6, Director of two, organiser and co-organiser of four of them; evening computer course: one

Memberships

- Board Member of Eurpoean Aeroallergen Network
- Member of International Biometeorological Society, European Aerobiological Society, European Academy of Allergology and Clinical Immunology.
- Member of Editorial board of Aerobiologia
- Member of Emergency Response team of Finnish Meteorological Institute

References

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PERSONAL INFORMATION

Rostislav Kouznetsov

Erik Palmenin Aukio 1, 00560, Helsinki, Finland

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rostislav.kouznetsov@fmi.fi

Gender Male | Date of birth 28 August 1977

Nationality Finland, Russia

WORK EXPERIENCE

Jun 2009 – Present

Senior Research Scientist

Air Quality Research, Finnish Meteorological Institute

- Parametrizations of physical processes in atmospheric models
- Development of a Chemical Transport Model Silam
- Operational and emergency-response applications of Silam
- Polar atmospheric boundary layers observations

Business or sector Government research institute

2005–2009

Senior Research fellow 2007-2009, Research fellow 2005-2007

A.M. Obukhov Institute of Atmospheric Physics, Moscow, Russia

- Experimental studies of the boundary-layer turbulence
- Ground-based remote sensing
- Co-supervision of master students

Business or sector Academy

EDUCATION AND TRAINING

2000-2005

Doctor of Physics and Mathematics (PhD) - Thesis Title: 'Remote determination of a turbulent momentum flux in the atmospheric boundary layer (in Russian)', atmospheric and oceanic physics

A.M. Obukhov Institute of Atmospheric Physics, Moscow, Russia

1994–2000

M.Sc., Physics

M.V. Lomonosov Moscow State University (MSU)

PERSONAL SKILLS

Mother tongue: Russian

Other languages

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Finnish	B1	B1	B1	B1	A2

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference (CEF) level

Communication skills
- Extensive communication skills acquired through many years of work experience senior researcher positions, over 150 presentations and lectures in various international meetings, lecturing at scientific schools, etc.

Organisational / managerial skills
- organization of research projects

Computer skills
- Advanced *NIX user
- Development and maintenance of operational suites on high-performance computer systems
- Have experience in development in C, Fortran, Python, IDL, Shell etc., including high-performance and distributed systems

Other skills
- Electronics and atmospheric observation techniques
- Observational field campaigns, including 3 antarctic ones

Driving licence: B

ADDITIONAL INFORMATION

Publications
- Author of over 100 scientific publications, 40 of them in peer reviewed journals and books
- According to *Google Scholar* (pooled 30.04.2018) the papers cited 522 times (360 since 2013), H-index is 15 (11 since 2013) and i10-index is 20 (13 since 2013).

PERSONAL INFORMATION

Hendrik Elbern

Schaffhausener Str. 21,50935 Köln, Germany
+492461613104 +4916090265099
h.elbern@fz-juelich.de

Sex male | Date of birth 12/07/1953 | Nationality German

Participtionin CAMS20 II

WORK EXPERIENCE

Replace with dates (from - to)

Research group leader

Forschungszentrum Jülich GmbH

Institute for Energy and Climate Research (Troposphere) IEK-8

Wilhelm-Johnen-Straße

52428 Jülich

EDUCATION AND TRAINING

Replace with dates (from - to)

[Add separate entries for each course. Start from the most recent.]

Scientific degree: PhD in meteorology/ University of Cologne (1990)
Previous positions: Cologne

Replace with EQF (or other) level if relevant

Habiltation (2000)	Meteorology, Faculty of math./nat. sciences Univ. Cologne
1991-1993	PostDoc, chemistry modeling group EURAD, Cologne
since 1994	Group leader Chemical data assimilation at the Rhenish Institute for Environmental Research at the University of Cologne, (now in parallel to Jülich affiliation)
1997	German Weather Service (guest scientist)
1998	Laboratoire de Météorologie Dynamique at Ecole Normale Superieure, Paris (guest scientist)
2000	German National Centre for Scientific Computing SCAI, St. Augustin, (Visiting Scientist)

Current position: Group leader Inverse and Regional Modelling, Research Centre Jülich, IEK-8 (Director at Rhen. Inst. Environmental Research at the University of Cologne)

PERSONAL SKILLS

Mother tongue(s) german

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	Enter level	Enter level	Enter level	Enter level	Enter level
	proficient				
French	Enter level	Enter level	Enter level	Enter level	Enter level
	basic.				

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills Replace with your communication skills. Specify in what context they were acquired. Example:
- good communication skills gained through my experience as research group head and academic lecturer (Privatdozent)

Organisational / managerial skills
- leadership (currently responsible for a team of 15 people)

Job-related skills
- researcher, exact sciences, proficient programming skills, FORTRAN95, C, computer algebra languages, paralle programming, …
- *Data assimilation and Inverse Modelling in atmospheric chemistry*
- *regional modelling of atmospheric chemistry*
- *numerical solvers of the transport-reaction-diffusion equation and its adjoint*
- *tropopause dynamics*
- *observability conditions and predictability for atmospheric chemistry*
-

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Enter level	Enter level	Enter level	Enter level	Enter level

high performance computing. numeric, programming,

Replace with name of ICT-certificates

- good command of office suite (word processor, spread sheet, presentation software)
-

Other skills Replace with other relevant skills not already mentioned. Specify in what context they were acquired. Example:
- carpentry

Driving licence Replace with driving licence category/-ies. Example:
motor cycle, car, lorry

ADDITIONAL INFORMATION

Wu, X., Elbern, H., and Jacob, B.: The degree of freedom for signal assessment of measurement networks for joint chemical state and emission analysis, Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2017-220, in review, 2017.

Wu, Xueran, B. Jacob, and H. Elbern: Optimal control and observation locations for time-varying systems on a finite-time horizon, SIAM J. Control Optim., 54, 291-316 , 2016.

Goris, N. and Elbern, H.: Singular vector based targeted observations of chemical constituents: description and first application of the EURAD-IM-SVA, Geosci. Model Dev., 8, 3929-3945, doi:10.5194/gmd-8-3929-2015, 2015.

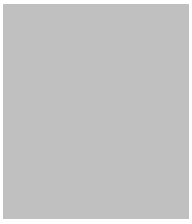
Bocquet, M., Elbern, H., Seigneur, C. et al., Data assimilation in atmospheric chemistry models: current status and future prospects for coupled chemistry meteorology models, Atmos. Chem. Phys. Discuss., 14, 32233-32323, doi:10.5194/acpd-14-32233-2014, 2014.

Hoppe, C. M., Elbern, H., and Schwinger, J.: A variational data assimilation system for soil-atmosphere flux estimates for the Community Land Model (CLM3.5), Geosci. Model Dev., 7, 1025-1036, doi:10.5194/gmd-7-1025-2014, 2014.

ANNEXES

PERSONAL INFORMATION

Elmar Friese



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ef@eurad.uni-koeln.de

Sex male | Date of birth 27/06/1966 | Nationality German

WORK EXPERIENCE

2008 - 2018
1998 - 2008

Senior scientist
Scientific assistant

Rhenish Institute for Environmental Research at the University of Cologne

Aachener Str. 209

50931 Cologne

Germany

Model development, air quality forecast and analysis

Business or sector Air quality, Geophysics

EDUCATION AND TRAINING

1998
2008

Diploma in Geophysics
PhD in Geophysics

Faculty of mathematics and natural sciences, Univ. of Cologne, Germany

- Aerosol dynamics and thermodynamics
- Air quality modelling
- Numerical solution of the atmospheric equations of motion

PERSONAL SKILLS

Mother tongue(s): German

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	PROFICIENT	PROFICIENT	PROFICIENT	PROFICIENT	PROFICIENT

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Good communication skills

Job-related skills

- Researcher
- Regional modelling of atmospheric gas and aerosol chemistry
- Data assimilation and inverse modelling in atmospheric chemistry
- Numerical solvers of atmospheric chemistry mechanisms

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient	Proficient	Independent	Independent	Independent

Levels: Basic user - Independent user - Proficient user
Digital competences - Self-assessment grid

- Proficient programming skills in Fortran, C, Shell scripting, Python, IDL, parallel programming
- Good command of office suite (word processor, spread sheet, presentation software)

Driving licence

B

ADDITIONAL INFORMATION

Publications

- Sofiev, M., Ritenberga, O., Albertini, R., Arteta, J., Belmonte, J., Bonini, M., Celenk, S., Damialis, A., Douros, J., Elbern, H., Friese, E., Galan, C., Gilles, O., Hrga, I., Kouznetsov, R., Krajsek, K., Parmentier, J., Plu, M., Prank, M., Robertson, L., Steensen, B. M., Thibaudon, M., Segers, A., Stepanovich, B., Valdebenito, A. M., Vira, J., and Vokou, D.: Multi-model ensemble simulations of olive pollen distribution in Europe in 2014, Atmos. Chem. Phys. 17, 12341-12360, 2017.
- Marécal., V., V.-H. Peuch, C. Andersson , S. Andersson, J. Arteta, M. Beekmann, A. Benedictow, R. Bergström, B. Bessagnet, A., Cansado, F. Chéroux, A. Colette, A. Coman, R.L. Curier, H. A. C. Denier van der Gon, A Drouin, H. Elbern, E. Emili, R. J. Engelen, H. J. Eskes, G. Foret, E. Friese, M. Gauss, C. Giannaros, M. Joly, E. Jaumouillé, B. Josse, N. Kadygrov, J. W. Kaiser, K. Krajsek, J. Kuenen, U. Kumar, N. Liora, E. Lopez, L. Malherbe, I. Martinez, D. Melas, F. Meleux, L. Menut, P. Moinat, T. Morales, J. Parmentier, A. Piacentini, M. Plu, A. Poupkou, S. Queguiner, L. Robertson, L. Rouïl, M. Schaap, A. Segers, M. Sofiev, M. Thomas , R. Timmermans, Á. Valdebenito, P. van Velthoven, R. van Versendaal, J. Vira, A. Ung, A regional air quality forecasting system over Europe : the MACC-II daily ensemble production, *Geosci. Mod. Dev.* **8**, 2777-2813, 2015.
- Sofiev. M., U. Berger, M. Prank, J. Vira, J. Arteta, J. Belmonte, K.-C. Bergmann, F. Cheroux, H. Elbern, E. Friese, C. Galan, R. Gehrig, R. Kranenburg, V. Marécal, F. Meleux, A.-M. Pessi, L. Robertson, O. Ritenberga, V. Rodinkova, A. Saarto, A. Segers, E. Severova, I. Sauliene, B. M. Steensen, E. Teinemaa, M. Thibaudon, V.-H. Peuch, Multi-model simulations of birch pollen in Europe by MACC regional ensemble, *Atmos. Chem. Phys.*., **15**, 8115-8130, 2015.
- Elbern, H., A. Strunk, E. Friese, and L. Nieradzik, Assessment of Source/Receptor Relations by Inverse Modelling and Chemical Data Assimilation, in Persistent Pollution Past, Present and Future School of Environmental Research - Helmholtz-Zentrum Geesthacht, Quante, M.; Ebinghaus, R.; Flöser, G. (Eds.) 1st Edition, ISBN 978-3-642-17420-9, 2011.
- Friese, E. and A. Ebel, Temperature dependent thermodynamic model of the system H^+-NH_4^+-Na^+-SO_4^{2-}-NO_3^--Cl^--H_2O, *J. Phys. Chem. A*, **114**, 11595-11631, 2010.

Projects

- Global and Regional Earth-System Monitoring using Satellite and In-Situ Data (GEMS), EU FP6 (2005-2008)
- Promote Air Quality Services Integrating Observations – Development of Basic Localised Information for Europe (PASODOBLE), EU FP7 (2010-2012)
- Monitoring Atmospheric Composition and Climate (MACC I-II), EU FP7 (2009-2013)
- Monitoring Atmospheric Composition and Climate Interim Implementation (MACC-III), H2020 (2014-2015)
- Copernicus Atmosphere Monitoring Service (CAMS), H2020 (2015-2018)

PERSONAL INFORMATION

Henk Eskes

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eskes@knmi.nl
www.knmi.nl

Sex Male| Date of birth 11/02/1964 | Nationality Dutch

WORK EXPERIENCE

1997—now

Senior Scientist, KNMI

KNMI, Research. Experience includes:

- Development of data assimilation algorithms. Application to stratospheric ozone. Stratospheric ozone reanalyses. OSSE studies (ISOTROP project).
- Development of retrieval algorithms: NO2 ("DOMINO" algorithm for instruments TROPOMI (S5P), OMI, SCIAMACHY), Ozone column retrieval ("TOSOMI" for SCIAMACHY)
- Development of an operational air quality forecast for the Netherlands.
- Coordinator of several projects, including the EU "GOA" project.
- Management team member of the GEMS, MACC, MACC-II and MACC-III projects
- Coordinator of the validation subproject in MACC-II and MACC-III.
- Management of the CAMS-84 validation subproject, 2015-2018.

1987—1997

Researcher (PhD, post-doc)

Groningen, Stuttgart, Great Malvern, Leiden University

- Theoretical solid state physics
- Superconductivity
- Correlated electron systems

EDUCATION AND TRAINING

1982 – 1987

Study Theoretical Physics

- University of Groningen, The Netherlands

PERSONAL SKILLS

Mother tongue(s) Dutch

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C2	C1	C1	C2

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Organisational / managerial skills

Project leader, team co-ordinator, supervisor

- Management of the CAMS-84 project.
- Experienced as project leader and team leader for groups of highly educated researchers in many projects, national and European.
- Setting up a Dutch collaboration on air quality, together with TNO and RIVM. Finding support and raising awareness for the national air quality forecasts.
- Supervisor of master students and PhD students.

Computer skills
- Programming skills in Fortran, Python, R, IDL
- Office Suites and LaTeX

Other skills
Research, publications
Validation (satellite, model)
Method development, theory

ADDITIONAL INFORMATION

Publications

- Miyazaki, K., Eskes, H., Sudo, K., Boersma, K. F., Bowman, K., and Kanaya, Y., *Decadal changes in global surface NOx emissions from multi-constituent satellite data assimilation,* Atmos. Chem. Phys., 17, 807-837, doi:10.5194/acp-17-807-2017, 2017.
- Abida, R., Attie, J.-L., El Amraoui, L., Ricaud, P., Lahoz, W., Eskes, H., Segers, A., Curier, L., de Haan, J., Kujanpaa, J., Nijhuis, A. O., Tamminen, J., Timmermans, R., and Veefkind, P., *Impact of spaceborne carbon monoxide observations from the S-5P platform on tropospheric composition analyses and forecasts,* Atmos. Chem. Phys., 17, 1081-1103, doi:10.5194/acp-17-1081-2017, 2017.
- Boersma, K. F., Vinken, G. C. M., and Eskes, H. J.: Representativeness errors in comparing chemistry transport and chemistry climate models with satellite UV-Vis tropospheric column retrievals, Geosci. Model Dev., 9, 875-898, doi:10.5194/gmd-9-875-2016, 2016.
- Eskes, H. et al., *Validation of reactive gases and aerosols in the MACC global analysis and forecast system*, Geosci. Model Dev. Discuss., 8, 1117-1169, doi:10.5194/gmdd-8-1117-2015, 2015.
- Miyazaki, K., Eskes, H. J., and Sudo, K., *A tropospheric chemistry reanalysis for the years 2005-2012 based on an assimilation of OMI, MLS, TES and MOPITT satellite data,* Atmos. Chem. Phys. Discuss., 15, 8687-8770, doi:10.5194/acpd-15-8687-2015, 2015.
- van der A, R. J., Allaart, M. A. F., and Eskes, H. J., *Extended and refined multi sensor reanalysis of total ozone for the period 1970-2012,* Atmos. Meas. Tech. Discuss., 8, 3283-3319, doi:10.5194/amtd-8-3283-2015, 2015.
- Belmonte Rivas, M., Veefkind, P., Eskes, H., and Levelt, P., *OMI tropospheric NO2 profiles from cloud slicing: constraints on surface emissions, convective transport and lightning NOx,* Atmos. Chem. Phys. Discuss., 15, 8017-8072, doi:10.5194/acpd-15-8017-2015, 2015.
- Inness, A., Blechschmidt, A.-M., Bouarar, I., Chabrillat, S., Crepulja, M., Engelen, R. J., Eskes, H., et al.: Data assimilation of satellite retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS, Atmos. Chem. Phys. Discuss., 15, 4265-4331, doi:10.5194/acpd-15-4265-2015, 2015.
- Bocquet, M., Elbern, H., Eskes, H., Hirtl, M., Zabkar, R., Carmichael, G. R., Flemming, J., Inness, A., Pagowski, M., Perez Camano, J. L., Saide, P. E., San Jose, R., Sofiev, M., Vira, J., Baklanov, A., Carnevale, C., Grell, G., and Seigneur, C., *Data assimilation in atmospheric chemistry models: current status and future prospects for coupled chemistry meteorology models*, Atmos. Chem. Phys. Discuss., 14, 32233-32323, doi:10.5194/acpd-14-32233-2014, 2014.
- Vlemmix, T., Eskes, H. J., Piters, A. J. M., Schaap, M., Sauter, F. J., Kelder, H., and Levelt, P. F., *MAX-DOAS tropospheric nitrogen dioxide column measurements compared with the Lotos-Euros air quality model,* Atmos. Chem. Phys., 15, 1313-1330, doi:10.5194/acp-15-1313-2015, 2015.
- Curier, R.L., R. Timmermans, S. Calabretta-Jongen, H. Eskes, A. Segers, D. Swart, M. Schaap, *Improving ozone forecasts over Europe by synergistic use of the LOTOS-EUROS chemical transport model and in-situ measurements*, Atmospheric Environment, 60, 217-226, doi:10.1016/j.atmosenv.2012.06.017, 2012.
- Veefkind, P., et al *TROPOMI on the ESA Sentinel-5 Precursor: A GMES mission for global observations of the atmospheric composition for climate, air quality and ozone layer applications*, Remote Sensing of the Environment, doi:10.1016/j.rse.2011.09.027, 2012.
- Boersma, K. F., H. J. Eskes, R. J. Dirksen, R. J. van der A, J. P. Veefkind, et al., *An improved tropospheric NO2 column retrieval algorithm for the Ozone Monitoring Instrument,* Atmos. Meas. Tech. Discuss., 4, 2329-2388, doi:10.5194/amtd-4-2329-2011, 2011.
- Hollingsworth, A., and Coauthors, *Toward a Monitoring and Forecasting System For Atmospheric Composition: The GEMS Project,* Bull. Amer. Meteor. Soc., 89, 1147-1164 doi:10.1175/2008BAMS2355.1, 2008.
- H.J. Eskes, and K.F. Boersma, *Averaging Kernels for DOAS Total-Column Satellite Retrievals*, Atmos. Chem. Phys., 3, 1285-1291, 2003.
- Henk Eskes, Peter van Velthoven, Pieter Valks and Hennie Kelder, *Assimilation of GOME total ozone satellite observations in a three-dimensional tracer transport model*, Q.J.R.Meteorol.Soc. 129, 1663, 2003.

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PERSONAL INFORMATION

John Douros

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ntouros@knmi.nl

www.knmi.nl

Sex Male | Date of birth 4 Jul 1974 | Nationality Greek

WORK EXPERIENCE

1 Jun 2001–15 Jun 2014 — Research associate

Laboratory of Heat Transfer and Environmental Engineering, Mechanical Engineering Department, Aristotle University of Thessaloniki, Thessaloniki (Greece)

- Meteorological and air photochemical dispersion modelling from the regional to the local scale.

15 Jun 2014–15 Jan 2015 — Member of the Laboratory and Teaching Staff of the University of Thessaloniki

Mechanical Engineering Department, Aristotle University of Thessaloniki

15 Jan 2015–Present — Post Doc

KNMI (The Netherlands)

- Involvement in CAMS activities (CAMS_50 on regional production and operational delivery of the European-scale air quality, CAMS_84 on a posteriori model validation)
- Regional and air quality model development and evaluation.

EDUCATION AND TRAINING

16 Sep 2003–13 Nov 2012 — PhD — EQF level 8

Mechanical Engineering Department, Aristotle University of Thessaloniki, Thessaloniki (Greece)

10 Oct 1998–10 Sep 1999 — MSc in Environmental Technology — EQF level 7

ICCET, Imperial College of Science Technology and Medicine, University of London, London (United Kingdom)

10 Oct 1993–10 Jun 1998 — BSc in Physics — EQF level 6

Physics Department, Aristotle University of Thessaloniki, Thesssaloniki (Greece)

PERSONAL SKILLS

Mother tongue(s): Greek

Foreign language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C1	C1	C2
	Certificate of Proficiency in English				
French	B2	B2	B2	B1	B2

DELF B2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Organisational / managerial skills

Substantial experience at working in teams and coordinating smaller teams dealing with atmospheric science issues.

Job-related skills

Numerical model development, evaluation and use for the purposes of air quality assessment studies.

Participation, since September 2001 in research projects, mainly EU funded but also nationally funded, dealing with the development of modelling tools for the improved assessment of air quality, mainly in urban areas. Examples of such projects: MEGAPOLI (Megacities: Emissions, urban, regional and Global Atmospheric POLlution and climate effects, and Integrated tools for assessment and mitigation), TRANSPHORM (Transport related Air Pollution and Health impacts - Integrated Methodologies for Assessing Particulate Matter), NEEDS (New Energy Externalities Developments for Sustainability); Air4EU (Air for Europe); APPRAISAL (Integrated assessment for regional and local air quality policies); CAMS_50 Regional air quality production, CAMS_84 A posteriori model validation

Digital skills

Programming skills in Fortran, Python and the Mathematica (TM) symbolic programming language. Good knowledge of Unix type operating systems.

ADDITIONAL INFORMATION

Publications

Publication in peer reviewed journals:

Manders, A. M. M., Builtjes, P. J. H., Curier, L., Denier van der Gon, H. A. C., Hendriks, C., Jonkers, S., Kranenburg, R., Kuenen, J. J. P., Segers, A. J., Timmermans, R. M. A., Visschedijk, A. J. H., Wichink Kruit, R. J., van Pul, W. A. J., Sauter, F. J., van der Swaluw, E., Swart, D. P. J., Douros, J., Eskes, H., van Meijgaard, E., van Ulft, B., van Velthoven, P., Banzhaf, S., Mues, A. C., Stern, R., Fu, G., Lu, S., Heemink, A., van Velzen, N., and Schaap, M.: Curriculum vitae of the LOTOS–EUROS (v2.0) chemistry transport model, Geosci. Model Dev., 10, 4145-4173, https://doi.org/10.5194/gmd-10-4145-2017, 2017.

Sofiev, M., Ritenberga, O., Albertini, R., Arteta, J., Belmonte, J., Bernstein, C. G., Bonini, M., Celenk, S., Damialis, A., Douros, J., Elbern, H., Friese, E., Galan, C., Oliver, G., Hrga, I., Kouznetsov, R., Krajsek, K., Magyar, D., Parmentier, J., Plu, M., Prank, M., Robertson, L., Steensen, B. M., Thibaudon, M., Segers, A., Stepanovich, B., Valdebenito, A. M., Vira, J., and Vokou, D.: Multi-model ensemble simulations of olive pollen distribution in Europe in 2014: current status and outlook, Atmos. Chem. Phys., 17, 12341-12360, https://doi.org/10.5194/acp-17-12341-2017, 2017.

Thunis, P., Miranda, A., Baldasano, J.M., Blond, N., Douros, J., Graff, A., Janssen, S., Juda-Rezler, K., Karvosenoja, N., Maffeis, G., Martilli, A., Rasoloharimahefa, M., Real, R., Viaene, P., Volta, M., White, L., Overview of current regional and local scale air quality modelling practices: Assessment and planning tools in the EU, Environmental Science & Policy, Volume 65, November 2016, Pages 13-21, ISSN 1462-9011, http://dx.doi.org/10.1016/j.envsci.2016.03.013.

Carnevale, C., Douros, J., Finzi, G., Graff, A., Guariso, G., Nahorski, Z., Pisoni, E., Ponche, J-L., Real, E., Turrini, E., Vlachokostas, Ch., Uncertainty evaluation in air quality planning decisions: a case study for Northern Italy, Environmental Science & Policy, Volume 65, November 2016, Pages 39-47, ISSN 1462-9011, http://dx.doi.org/10.1016/j.envsci.2016.02.001.

Tsegas, G., Moussiopoulos, N., Barmpas, F., Akylas, V., Douros, I., An integrated numerical methodology for describing multiscale interactions on atmospheric flow and pollutant dispersion in the urban atmospheric boundary layer, Journal of Wind Engineering and Industrial Aerodynamics, Volume 144, September 2015, Pages 191-201, ISSN 0167-6105, http://dx.doi.org/10.1016/j.jweia.2015.05.006.

Kukkonen, J., Karl, M., Keuken, M. P., Denier van der Gon, H. A. C., Denby, B. R., Singh, V., Douros, J., Manders, A., Samaras, Z., Moussiopoulos, N., Jonkers, S., Aarnio, M., Karppinen, A., Kangas, L., Lützenkirchen, S., Petäjä, T., Vouitsis, I., and Sokhi, R. S.: Modelling the dispersion of particle numbers in five European cities, Geosci. Model Dev., 9, 451-478, doi:10.5194/gmd-9-451-2016, 2016.

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PERSONAL INFORMATION

Arjo Segers

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Sex Male | Nationality Dutch

WORK EXPERIENCE

01/01/2011 — **Post-doctoral researcher**

TNO
P.O. Box 80015, NL-3508TA Utrecht (The Netherlands)

Regional air quality modelling, assimilation of ground- and satllite observations, support for computing infrastructure.

Business or sector Research Institute

01/11/2009–31/12/2010 — **Post-doctoral researcher**

European Commission Joint Research Centre
Via E. Fermi 2749, I-21027 Ispra (Italy)

Greenhouse gas modelling, assimilation of ground- and satellite measurements, computing infrastructure support

Business or sector Research institute

15/02/2007–31/10/2009 — **Post-doctoral researcher**

TNO
P.O. Box 80015, NL-3508TA Utrecht (The Netherlands)

Regional air quality modeling, assimilation of ground- and satellite-measurements, computing infrastructure support.

Business or sector Research Institute

01/04/2006–14/02/2007 — **Post-doctoral researcher**

KNMI
P.O. Box 201, De Bilt NL-3730AE (The Netherlands)

Coupling of atmospheric and chemistry model.

Business or sector national meterological center

01/01/2006–31/03/2006 — **Post-doctoral researcher**

ECMWF
Shinfield Park, RG2 9AX Reading (United Kingdom)

Coupling atmosphere and chemistry model.

Business or sector meteorological center

01/02/2001–31/12/2005 — **Post-doctoral researcher**

KNMI
P.O. Box 201, NL-3730 AE De Bilt (The Netherlands)

Ozone layer modelling, assimilation of satellite observations, validation of satellite data.

Business or sector national metorological center

EDUCATION AND TRAINING

01/01/1997–31/01/2001

Ph.D. in applied mathematics

ISCED 6

Delft University of Technology
P.O. Box 5, 2600 AA Delft (The Netherlands)

Numerical modelling. Data assimilation techniques.

01/09/1992–31/12/1996

Engineer in applied mathematics

ISCED 5

Delft University of Technology
P.O. Box 5, NL-2600AA Delft (The Netherlands)

Mathematical modelling, numerical simulation techniques.

PERSONAL SKILLS

Mother tongue(s) Dutch

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
German	B1	B1	A2	A2	A2
Italian	A2	A2	A2	A2	A2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Digital competence Scientific programming (Fortran, Python), parallel computing (MPI, OpenMP), visualization (Python)

Driving licence B

ADDITIONAL INFORMATION

Abida, R., Attié, J.-L., El Amraoui, L., Ricaud, P., Lahoz, W., Eskes, H., Segers, A., Curier, L., de Haan, J., Kujanpää, J., Nijhuis, A. O., Tamminen, J., Timmermans, R., and Veefkind, P. Impact of spaceborne carbon monoxide observations from the S-5P platform on tropospheric composition analyses and forecasts. Atmos. Chem. Phys., 17, 1081-1103, doi:10.5194/acp-17-1081-2017, 2017

Fu, G., Prata, F., Lin, H. X., Heemink, A., Segers, A., and Lu, S. Data assimilation for volcanic ash plumes using a satellite observational operator: a case study on the 2010 Eyjafjallajökull volcanic eruption. Atmos. Chem. Phys., 17, 1187-1205, doi:10.5194/acp-17-1187-2017, 2017

Fu, G., Heemink, A., Lu, S., Segers, A., Weber, K., and Lin, H.-X. Model-based aviation advice on distal volcanic ash clouds by assimilating aircraft in situ measurements. Atmos. Chem. Phys., 16, 9189-9200, doi:10.5194/acp-16-9189-2016, 2016.

Lu, S., H. X. Lin, A. Heemink, A. Segers, and G. Fu (2016). Estimation of volcanic ash emissions through assimilating satellite data and ground-based observations. J. Geophys. Res. Atmos., 121, 10,971-10,994, doi:10.1002/2016JD025131

Koffi, E. N., Bergamaschi, P., Karstens, U., Krol, M., Segers, A., Schmidt, M., Levin, I., Vermeulen, A. T., Fisher, R. E., Kazan, V., Klein Baltink, H., Lowry, D., Manca, G., Meijer, H. A. J., Moncrieff, J., Pal, S., Ramonet, M., Scheeren, H. A., and Williams, A. G.: Evaluation of the boundary layer dynamics of the TM5 model over Europe, Geosci. Model Dev., 9, 3137-3160, doi:10.5194/gmd-9-3137-2016, 2016.

Lu, S., Lin, H. X., Heemink, A. W., Fu, G., and Segers, A. J. Estimation of volcanic ash emissions using trajectory-based 4D-Var data assimilation. Monthly Weather Review, 2015, e-View, doi:10.1175/MWR-D-15-0194.1

G. Fu, H.X. Lin, A.W. Heemink, A.J. Segers, S. Lu, T. Palsson, Assimilating aircraft-based measurements to improve forecast accuracy of volcanic ash transport. Atmospheric Environment, Volume 115, August 2015, Pages 170-184, 10.1016/j.atmosenv.2015.05.061

Marécal, V., Peuch, V.-H., Andersson, C., Andersson, S., Arteta, J., Beekmann, M., Benedictow, A., Bergström, R., Bessagnet, B., Cansado, A., Chéroux, F., Colette, A., Coman, A., Curier, R. L., Denier van der Gon, H. A. C., Drouin, A., Elbern, H., Emili, E., Engelen, R. J., Eskes, H. J., Foret, G., Friese, E., Gauss, M., Giannaros, C., Guth, J., Joly, M., Jaumouillé, E., Josse, B., Kadygrov, N., Kaiser, J. W., Krajsek, K., Kuenen, J., Kumar, U., Liora, N., Lopez, E., Malherbe, L., Martinez, I., Melas, D., Meleux, F., Menut, L., Moinat, P., Morales, T., Parmentier, J., Piacentini, A., Plu, M., Poupkou, A., Queguiner, S., Robertson, L., Rouïl, L., Schaap, M., Segers, A., Sofiev, M., Thomas, M., Timmermans, R., Valdebenito, Å., van Velthoven, P., van Versendaal, R., Vira, J., and Ung, A. A regional air quality forecasting system over Europe: the MACC-II daily ensemble production. Geosci. Model Dev., 8, 2777-2813, doi:10.5194/gmd-8-2777-2015, 2015

Sofiev, M., Berger, U., Prank, M., Vira, J., Arteta, J., Belmonte, J., Bergmann, K.-C., Chéroux, F., Elbern, H., Friese, E., Galan, C., Gehrig, R., Khvorostyanov, D., Kranenburg, R., Kumar, U., Marécal, V., Meleux, F., Menut, L., Pessi, A.-M., Robertson, L., Ritenberga, O., Rodinkova, V., Saarto, A., Segers, A., Severova, E., Sauliene, I., Siljamo, P., Steensen, B. M., Teinemaa, E., Thibaudon, M., and Peuch, V.-H. MACC regional multi-model ensemble simulations of birch pollen dispersion in Europe. Atmos. Chem. Phys., 15, 8243-8281, doi:10.5194/acp-15-8115-2015, 2015.

Alexe, M., Bergamaschi, P., Segers, A., Detmers, R., Butz, A., Hasekamp, O., Guerlet, S., Parker, R., Boesch, H., Frankenberg, C., Scheepmaker, R.A., Dlugokencky, E., Sweeney, C., Wofsy, S.C., Kort, E.A. (2015), Inverse modelling of CH4 emissions for 2010-2011 using different satellite retrieval products from GOSAT and SCIAMACHY, Atmospheric Chemistry and Physics, 15 (1), pp. 113-133. DOI:10.5194/acp-15-113-2015

Banzhaf, S., Schaap, M., Kranenburg, R., Manders, A. M. M., Segers, A. J., Visschedijk, A. J. H., Denier van der Gon, H. A. C., Kuenen, J. J. P., van Meijgaard, E., van Ulft, L. H., Cofala, J., and Builtjes, P. J. H., 2015. Dynamic model evaluation for secondary inorganic aerosol and its precursors over Europe between 1990 and 2009, Geosci. Model Dev., 8, 1047-1070, doi:10.5194/gmd-8-1047-2015

Bergamaschi, P., Corazza, M., Karstens, U., Athanassiadou, M., Thompson, R.L., Pison, I., Manning, A.J., Bousquet, P., Segers, A., Vermeulen, A.T., Janssens-Maenhout, G., Schmidt, M., Ramonet, M., Meinhardt, F., Aalto, T., Haszpra, L., Moncrieff, J., Popa, M.E., Lowry, D., Steinbacher, M., Jordan, A., O'Doherty, S., Piacentino, S., Dlugokencky, E. (2015), Top-down estimates of European CH4 and N2O emissions based on four different inverse models, Atmospheric Chemistry and Physics, 15 (2), pp. 715-736. DOI:10.5194/acp-15-715-2015

Popa, M.E., Segers, A.J., Denier van der Gon, H.A.C., Krol, M.C., Vischedijk, A.J., Schaap, M., Röckmann, T., 2015. Impact of a future H2 transportation on atmospheric pollution in Europe, Atmospheric Environment, 86, DOI:10.1016/j.atmosenv.2015.03.022

Curier, R.L., Kranenburg, R., Segers, A.J.S., Timmermans, R.M.A., Schaap, M., 2014. Synergistic use of OMI NO2 tropospheric columns and LOTOS-EUROS to evaluate the NOx emission trends across europe. Remote Sensing of Environment 149, 58-69. doi:10.1016/j.rse.2014.03.032

Mues, A., Kuenen, J., Hendriks, C., Manders, A., Segers, A., Scholz, Y., Hueglin, C., Builtjes, P., Schaap, M., 2014. Sensitivity of air pollution simulations with LOTOS-EUROS to the temporal distribution of anthropogenic emissions. Atmospheric Chemistry and Physics 14, 939-955. doi:10.5194/acp-14-939-2014

Van Noije, T.P.C., Le Sager, P., Segers, A.J., Van Velthoven, P.F.J., Krol, M.C., Hazeleger, W., Williams, A.G., Chambers, S.D. (2014), Simulation of tropospheric chemistry and aerosols with the climate model EC-Earth, Geoscientific Model Development, 7 (5), pp. 2435-2475. DOI:10.5194/gmd-7-2435-2014

R.M.A. Timmermans, H.A.C. Denier van der Gon, J.J.P. Kuenen, A.J. Segers, C. Honoré, O. Perrussel, P.J.H. Builtjes, M. Schaap. Quantification of the urban air pollution increment and its dependency on the use of down-scaled and bottom-up city emission inventories. Urban Climate, 6, p. 44-62, December 2013, doi:10.1016/j.uclim.2013.10.004.

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PERSONAL INFORMATION

Renske M.A. Timmermans

Princetonlaan 6, 3584 CB Utrecht (The Netherlands)

(+31) 88 866 2080 (+31) 6 52803661

renske.timmermans@tno.nl

Sex Female | Date of birth 17/11/1973 | Nationality Dutch

PERSONAL STATEMENT

Renske Timmermans is a dedicated **research scientist and project coordinator** at TNO with 20 years of experience in the field of **atmospheric composition**. She has extensive experience in **regional air pollution modeling** and the synergetic use of (**satellite) observations** with model simulations. She is one of the leading experts on **Observing System Simulation Experiments** (OSSEs). She has gained this knowledge in a wide range of national and international projects focusing on the assessment of past, current and future state of the atmosphere. Her mission is to provide solutions for improvement of air quality and reduction of its impact on human health and ecosystems.

As a **project leader** Renske has coordinated several national and international TNO projects on air quality modelling over Europe and she has been workpackage leader in the EU project PASODOBLE. As **team coordinator** she is responsible for the organisation of work within the Climate, Air quality and Earth Observation team at TNO.

WORK EXPERIENCE

1 Jul 2005–Present — Research scientist and project/team coordinator

TNO department Climate, Air and Sustainability, Utrecht (Netherlands)

- Atmospheric composition modelling
- Data analysis
- Air quality forecasting
-
- Use of satellite observations in combination with modeling
- Observing System simulation experiments
- Project coordination
- Coordination of activities from climate, air and earth observation team

1 Jan 2001–1 Apr 2001 — Visiting Scientist

NIWA, New Zealand Institute for Water and Atmosphere, Omakau, Central Otego (New Zealand)

- Determination of diabatic descent in polar vortices using satellite measurements of N2O.
- Analysis of water vapour measurements.

1 Jan 1997–1 Jun 2005 — Scientific researcher in atmospheric composition division

KNMI (Royal Netherlands Meteorological Institute),, de Bilt (Netherlands)

- Analysis and validation of satellite measurements of ozone and other atmospheric constituents
- Scientific Secretary of Sciamachy validation team

EDUCATION AND TRAINING

1 Jan 2000–1 Jun 2005 — PhD ('doctoraal') in Atmospheric Dynamics

Technical University Eindhoven, Eindhoven (Netherlands)

Studies of atmospheric dynamics from space

- The analysis of Kelvin waves in satellite observations of ozone
- Determination of diabatic descent in polar vortices using satellite measurements of N2O

1 Aug 1991–1 Jun 1996 **Meteorology and Physical Oceanography** MSc ISCED 1997 level 5A

University of Utrecht, Utrecht (Netherlands)

PERSONAL SKILLS

Mother tongue(s) Dutch

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
French	B2	B2	B1	A2	B1
German	B2	B2	A2	A2	A2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Communication skills

Good social and communication skills acquired during 20 years of international and inter- and multi-disciplinary collaboration, during complex projects in the Netherlands as well as in multinational projects. Large experience in oral and written communication through presentations at (international) conferences and (peer-reviewed) publications.

Organisational / managerial skills

Good organisational and coordination skills gained as project coordinator of several national and international TNO projects on air quality modeling (2006 up till now), workpackage leader in the EU project PASODOBLE (2008-2013) and scientific secretary of the SCIAMACHY validation group (1997-2005).

Currently responsible for the coordination of work within the climate, air and earth observation team.

Job-related skills

Renske is an expert in the field of Observing System Simulation Experiments (OSSEs) for air pollution applications. She has applied this technique to a number of future ESA and EUMETSAT satellite missions to assess their added value for air quality applications and improved emission estimates

Renske has a wide experience in large EU projects through her contribution to several EU projects on air quality: PROMOTE, MACC, MEGAPOLI, Marcopolo and in PASODOBLE as work package leader. She is currently involved in the production of (operational) air quality forecasts and analyses over Europe within the current Copernicus Atmosphere Monitoring Service (CAMS).

She is part of the scientific committee of the International Technical Meeting on air pollution modelling and its Application (ITM), the European Association for the Science of Air Pollution (EURASAP) and GLOREAM (GLObal and REgional Atmospheric Modelling).

Digital competence

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Independent user	Proficient user	Independent user	Independent user	Independent user

Digital competences - Self-assessment grid

Experience with Fortran, IDL, Excel, Word, Powerpoint

ADDITIONAL INFORMATION

Relevant Publications

Timmermans, R.M.A., W.A. Lahoz, J.-L. Attié, V.-H. Peuch, R.L. Curier, D.P. Edwards, H.J. Eskes, P.J.H. Builtjes, Observing System Simulation Experiments for air quality, Atmospheric Environment 05/2015; 115. DOI:10.1016/j.atmosenv.2015.05.032, 2015.

Marécal, V, V.-H. Peuch, C. Andersson, S. Andersson, J. Arteta, M. Beekmann, A. Benedictow, R. Bergström, B. Bessagnet, A. Cansado, F. Chéroux, A. Colette, A. Coman, R. L. Curier, H. A. C. Denier van der Gon, A. Drouin, H. Elbern, E. Emili, R. J. Engelen, H. J. Eskes, G. Foret, E. Friese, M. Gauss, C. Giannaros, J. Guth, M. Joly, E. Jaumouillé, B. Josse, N. Kadygrov, J. W. Kaiser, K. Krajsek, J. Kuenen, U. Kumar, N. Liora, E. Lopez, L. Malherbe, I. Martinez, D. Melas, F. Meleux, L. Menut, P. Moinat, T. Morales, J. Parmentier, A. Piacentini, M. Plu, A. Poupkou, S. Queguiner, L. Robertson, L. Rouïl, M. Schaap, A. Segers, M. Sofiev, M. Thomas, **R. Timmermans**, Á. Valdebenito, P. van Velthoven, R. van Versendaal, J. Vira, and A. Ung, A regional air quality forecasting system over Europe: the MACC-II daily ensemble production, Geosci. Model Dev. Discuss., 8, 2739-2806, 2015.

Curier, R.L., Kranenburg, R., Segers, A.J.S., **Timmermans, R.M.A**., Schaap, M., 2014. Synergistic use of OMI NO2 tropospheric columns and LOTOS-EUROS to evaluate the NOx emission trends across Europe. Remote Sensing of Environment 149, 58-69

Timmermans, R., H. Denier van der Gon, J. Kuenen, A. Segers, C. Honore, O. Perrussel, P. Builtjes, M. Schaap, (2013), Quantification of the urban air pollution increment and its dependency on the use of down-scaled and bottom-up city emission inventories, Urban Climate, vol. 6, dec.2013, p44-62., http://dx.doi.org/10.1016/j.uclim.2013.10.004

Schaap, M., Kranenburg, R., Curier, L., Jozwicka, M., Dammers, E., **Timmermans, R**., 2013. Assessing the sensitivity of the OMI-NO2 product to emission changes across Europe. Remote Sensing 5, 4187-4208.

Curier, R.L.,, H. Eskes, S.Calabretta-Jongen, **R. Timmermans**, M. Schaap, D. Swart (2011), Improving ozone forecasts over Europe by synergistic use of the LOTOS-EUROS model and measurements Atmospheric Environment, Volume 60, December 2012, Pages 217-226, ISSN 1352-2310, 10.1016/j.atmosenv.2012.06.017

Timmermans, R. M. A., A. J. Segers, P. J. H. Builtjes, R. Vautard, R. Siddans, H. Elbern, S. A. T. Tjemkes, M. Schaap (2009), The Added Value of a Proposed Satellite Imager for Ground Level Particulate Matter Analyses and Forecasts, IEEE- JSTARS (Journal of Selected Topics in Applied Earth Observations and Remote Sensing, pp. 271-283, doi: 10.1109/JSTARS.2009.2034613

R. M. A. Timmermans, M. Schaap, H. Elbern, R. Siddans, S. A. T. Tjemkes, R. Vautard, P.J.H. Builtjes (2009), An Observing System Simulation Experiment (OSSE) for Aerosol Optical Depth from satellites, Journal of Atmospheric and Oceanic Technology, 26, 2673-2682

Schaap, M., Apituley, A., **Timmermans, R. M. A**., Koelemeijer, R. B. A., and de Leeuw, G. (2009), Exploring the relation between aerosol optical depth and PM2.5 at Cabauw, the Netherlands, Atmos. Chem. Phys., 9, 909–925, 2009, http://www.atmos-chem-phys.net/9/909/2009/.

Schaap, M., **Timmermans, R.M.A.,** Roemer, M., Boersen, G.A.C., Builtjes, P.J.H., Sauter, F.J., Velders, G.J.M., Beck, J.P., 2008. The LOTOS-EUROS model: Description, validation and latest developments. International Journal of Environment and Pollution 32, 270-290.

Schaap, M., **Timmermans, R.M.A.,** Koelemeijer, R.B.A., de Leeuw, G., Builtjes, P.J.H., 2008. Evaluation of MODIS aerosol optical thickness over Europe using sun photometer observations. Atmospheric Environment 42, 2187-2197.

Stern, R., Builtjes, P., Schaap, M., **Timmermans, R**., Vautard, R., Hodzic, A., Memmesheimer, M., Feldmann, H., Renner, E., Wolke, R., Kerschbaumer, A., 2008. A model inter-comparison study focussing on episodes with elevated PM10 concentrations. Atmospheric Environment 42, 4567-4588.

PERSONAL INFORMATION

Richard Kranenburg

6 Princetonlaan,
3584 CB Utrecht,
The Netherlands
+31(0) 8886627 43
richard.kranenburg@tno.nl

Sex Male | Date of birth 20/09/1982| Nationality Dutch

PROPOSED POSITION

WORK EXPERIENCE

2011-now

Junior Research Innovator Climate, Air and Sustainability
TNO department Climate, Air and Sustainability
Princetonlaan 6
3584 CB Utrecht, The Netherlands
Use and Development LOTOS-EUROS model
Data assimilation

Business or sector Research

EDUCATION AND TRAINING

2002-2010

Master of Science

t

Technical University of Delft
Applied Mathematics, Numerical Applications

PERSONAL SKILLS

Mother tongue(s): Dutch

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
Dutch	C2	C2	C2	C2	C2
English	C1	C1	C1	C1	C1

Communication skills
Good communication skills (both oral and written) gained through working in projects in a professional capacity

Job-related skills
Experience with air quality modelling on local and regional scale
Experience with data assimilation
Experience with Satellite retrieval products

Computer skills
Good knowledge and use of program languages Fortran and Python
good command of Microsoft Office™ tools (Word™, Excel™ and PowerPoint™)

Driving licence No

Publications & Reports

Using a Kalman filter to improve a real time air pollution, 2010, TNO-Report TNO-034-UT-2010-02193_RPT-ML

Statistische onzekerheidsanalyse van het Real Time URBIS voor het Rijnmondgebied, 2009, TNO-Report 2009-01347

Source apportionment using LOTOS-EUROS, module description and evaluation. 2013, Geoscientific Model Development, volume 6, 721-733

Hendriks, C., Kuenen, J.J.P., Kranenburg, R., Scholz, Y., Schaap, M., 2015. A shift in emission time profiles of fossil fuel combustion due to energy transitions impacts source receptor matrices for air quality. Environmental Science: Processes & Impacts 17, 510-524

Hendriks, C. , Kranenburg, R., Kuenen, J., van Gijlswijk, R., Wichink Kruit, R., Segers, A., Denier van der Gon, H., Schaap, M., 2013. The origin of ambient particulate matter concentrations in the Netherlands. Atmospheric Environment 69, 289-303

Schaap, M., Denier van der Gon, H.A.C., Gijlswijk, R.N. van , Kuenen, J.J.P. , Kranenburg, R., Hendriks, C., 2012. Establishing the origin of particulate matter concentrations in the Netherlands. TNO report TNO-060-UT-2012-00474

Sofiev, M., Berger, U., Prank, M., Vira, J., Arteta, J., Belmonte, J., Bergmann, K.-C., Chéroux, F., Elbern, H., Friese, E., Galan, C., Gehrig, R., Khvorostyanov, D., Kranenburg, R., Kumar, U., Marécal, V., Meleux, F., Menut, L., Pessi, A.-M., Robertson, L., Ritenberga, O., Rodinkova, V., Saarto, A., Segers, A., Severova, E., Sauliene, I., Siljamo, P., Steensen, B. M., Teinemaa, E., Thibaudon, M., and Peuch, V.-H., 2015
MACC regional multi-model ensemble simulations of birch pollen dispersion in Europe
Atmos. Chem. Phys., 15, 8243-8281

Curier, R.L., R. Kranenburg, A.J. Segers, R.M.A. Timmermans, M. Schaap
Synergistic use of OMI NO2 tropospheric columns and LOTOS–EUROS to evaluate the NOx emission trends across Europe, 2014
Remote Sensing of Environment, Volume 149, June 2014, Pages 58-69

Schaap, M. , Kranenburg, R. , Curier, L. , Jozwicka, M. , Dammers, E. , Timmermans, R., 2013
Assessing the sensitivity of the OMI-NO2 product to emission changes across Europe.
Remote Sensing, 5 (9), 2013, pp. 4187-4208

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PERSONAL INFORMATION

Michael Gauss

Meteorologisk institutt, Allégaten 70, 5007 Bergen (Norway)

(+47) 55236689 (+47) 40017737

michael.gauss@met.no

Sex Male | Date of birth 2 Jun 1970 | Nationality German

WORK EXPERIENCE

2006–Present — **Researcher**

Norwegian Meteorological Institute

- Air quality modelling
- Project management
- Acting Head of Division for Climate Modelling and Air Pollution (2010-2011)

2004–2010 — **Researcher**

University of Oslo

- Chemistry Transport Modelling
- Climate Modelling

1999–2003 — **Research fellow**

University of Oslo

- Chemistry Transport Modelling
- Chemistry transport model development

1997–1998

Norwegian Institute for Air Research (NILU)

- Chemistry transport model development

EDUCATION AND TRAINING

1999–2003 — **Doctorate (dr.scient.)**

University of Oslo

Atmospheric chemistry, chemistry transport modelling

1994–1998 — **Master of science (cand.scient.)**

University of Oslo

Meteorology, atmospheric chemistry

1991–1993 — **Bachelor degree (Vordiplom)**

Ludwig-Maximilians Universität München

Physics, solid Earth physics

PERSONAL SKILLS

Mother tongue(s) German

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
Norwegian	C1	C2	C1	C2	C1
English	C1	C1	C1	C2	C1
French	B2	B2	B1	B2	B1
Estonian	A2	A2	A2	A2	A2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Communication skills

- Experience in writing scientific articles and reports
- Presentations at scientific conferences
- Experienced presenter of animated power points
- Communication through social media
- Cofounder of ESPERE to communicate climate science (www.espere.net)

Organisational / managerial skills

- Experience in research group management from position as acting Head of Division (17 employees) in 2010/11
- Experience in project management experience from leading MET Norway's contribution to more than ten international research projects during the last 5 years.
- Experience in project coordination from several research projects (EU project CityZen project - coordinator; EU project MACC - subproject leader, member of management board; EU projects PANDA and PAPILA - Work package leader; etc.)

Job-related skills

- Experience in coordination of international projects (both at project level and at task level)
- Experience in presenting scientific results to a scientific and non-scientific audiences.

Digital skills

- Fortran programming and matlab
- experienced user of UNIX and Windows platforms
- good command of Microsoft Office ™ tools
- basic knowledge of shell scripting, html, and several content management systems

ADDITIONAL INFORMATION

Projects

- EU-H2020 MACC-III (subproject leader and Management Board member)
- EU-H2020 PAPILA (work package leader and Management Board member)
- Norwegian Research Councel project AIRQUIP (coordinator)
- COST action ES1004 (working group leader and Core Group member)
- EU-FP7 CityZen (project coordinator)
- EU-FP7 Impact2C (performing EMEP model calculations on air quality climate interactions)
- iCACGP member

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PERSONAL INFORMATION

Alvaro Valdebenito

Harald Hårfagres gate 12A, 0363 Oslo (Norway)

94784834 45011971

alvarov@met.no

WORK EXPERIENCE

01/01/2008–Present

Research scientist

Norwegian Meteorological Institute, Oslo (Norway)

01/03/2004–31/10/2007

PhD student

Max Planck Institute for Meteorology, Hamburg (Germany)

EDUCATION AND TRAINING

01/03/2004–29/10/2008

PhD in Meteorology (Dr. Naturwissenschaften),

University of Hamburg, Hamburg (Germany)

01/03/1995–27/06/2003

Mathematical Civil Engineer

University of Chile, Santiago (Chile)

01/03/1995–31/12/2002

BSc Engineering (Mathematics)

University of Chile, Santiago (Chile)

PERSONAL SKILLS

Mother tongue(s): Spanish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Norwegian (Bokmal)	B1	B1	B1	B1	A2

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Digital skills

- Programming languages: Fortran, C, C++, Python, Lua.
- Scripting languages: LaTeX, HTML, JavaScripts, bash/sh/ksh, makefile.
- Special Packages/Libraries: MPI, NetCDF, GRIB2.

ADDITIONAL INFORMATION

Publications

Sofiev et al.: Multi-model ensemble simulations of olive pollen distribution in Europe in 2014, Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1189, in review, 2017.

Blechschmidt et al.: Comparison of tropospheric NO2 columns from MAX-DOAS retrievals and regional air quality model simulations, Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1003, in review, 2017.

Steensen et al (2017): The operational eEMEP model version 10.4 for volcanic SO2 and ash forecasting, Geosci. Model Dev., 10, 1927-1943, doi:10.5194/gmd-10-1927-2017, 2017.

Marécal et al.: A regional air quality forecasting system over Europe: the MACC-II daily ensemble production, Geosci. Model Dev., 8, 2777–2813, doi:10.5194/gmd-8-2777-2015, 2015.

Simpson et al.: The EMEP MSC-W chemical transport model – technical description, Atmos. Chem. Phys., 12, 7825-7865, doi:10.5194/acp-12-7825-2012, 2012.

Zyryanov et al.: 3-D evaluation of tropospheric ozone simulations by an ensemble of regional Chemistry Transport Model, Atmos. Chem. Phys., 12, 3219-3240, doi:10.5194/acp-12-3219-2012, 2012.

Behrendt et al.: A novel approach for the characterization of transport and optical properties of aerosol particles near sources – Part I: Measurement of particle backscatter coefficient maps with a scanning UV lidar, Atmospheric Environment, 45, 2795-2802, doi:10.1016/j.atmosenv.2011.02.061, 2011.

Valdebenito et al.: A novel approach for the characterisation of transport and optical properties of aerosol particles near sources – Part II: Microphysics–chemistry-transport model development and application, Atmospheric Environment, 45, 2981-2990, doi:10.1016/j.atmosenv.2010.09.004, 2011.

Huijnen et al.: Comparison of OMI NO2 tropospheric columns with an ensemble of global and European regional air quality models, Atmos. Chem. Phys., 10, 3273-3296, doi:10.5194/acp-10-3273-2010, 2010.

Jonson et al.: A multi-model analysis of vertical ozone profiles, Atmos. Chem. Phys., 10, 5759-5783, doi:10.5194/acp-10-5759-2010, 2010.

Projects

Key developer in the following projects

- GEMS
- MACC-I, MACC-II, MACC-III
- CAMS50 first phase
- CAMS71 first phase

Main tasks

- Operationalization
- Data Assimilation
- Source code maintainer

europass Curriculum vitae

PERSONAL INFORMATION

Anna Benedictow

Henrik Mohns plass 1, 0313 Oslo (Norway)

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anna.benedictow@met.no

WORK EXPERIENCE

01/06/2001–Present

Scientist

Norwegian Meteorological Institute, Oslo (Norway)

- Meteorological fields for air pollution modelling
- Air pollution forecasting
- Aerosols analysis

EDUCATION AND TRAINING

15/09/1997–15/06/2000

Master of science (cand. scient)

Department of Mathematics, University of Oslo, Oslo (Norway)

- Programming and Mathematics

PERSONAL SKILLS

Mother tongue(s): Norwegian (Bokmal)

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
Norwegian	C2	C2	C2	C2	C2
English	C2	C1	C1	C1	C1
French	A1	A1	A1	A1	A1

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Communication skills

- Experience in writing reports
- Presentations at scientific conferences

Job-related skills

- Experience in presenting scientific results to scientific and non-scientific audiences

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient user	Proficient user	Proficient user	Proficient user	Proficient user

Digital skills - Self-assessment grid

- good command of programming and scripting languages: Fortran, R, NCL, Perl, Python, Unix Shell

ADDITIONAL INFORMATION

Publications

- V. Marecal et al., *A regional air quality forecasting system over Europe: the MACC-II daily ensemble production*, gmdd-8-2739-2015
- H. Eskes et al., *Validation of reactive gases and aerosols in the MACC global analysis and forecast system*, gmdd-8-1117-2015
- H. Fagerli et al., *Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components*, EMEP Status Report 1/2017
- D. Simpson et al., *The EMEP MSC-W chemical transport model - technical description*, acp-12-7825-2012

Projects

- EMEP
- MACC-III, MACC-II, MACC-I, GEMS
- CAMS50 (maintenance of daily operational service, model development, reporting)
- CAMS84 (analyses and reporting)

PERSONAL INFORMATION

Lennart Robertson

SMHI, SE-60176 Norrköping, Sweden
+46 11 4958281 +46 708 484853
lennart.robertson@smhi.se

Sex Male | Date of birth 29/09/1975 | Nationality Swedish

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR
PERSONAL STATEMENT

WORK EXPERIENCE

1988-Presen

Researcher

Swedish Meteorological and Hydrological Institute, Norrköping, Sweden, http://www.smhi.se

- Research in air quality modelling
- Numerical model development
- Methods in variational data assimilation
- System development for operational implementation

- RODOS, https://resy5.iket.kit.edu/RODOS, Realltime Online Decision Support System for nuclear emergency management.
  - Integration of the regional transport model MATCH into the decision support system.

- PREVIEW - Prevention Information and Early Warning, http://www.copernicus.eu/projects/preview,
  - Implementation of local scale dispersion models for risk management

- GEMS, http://gems.ecmwf.int, Global and regional Earth-system (Atmosphere) Monitoring using Satellite and in-situ data.
  - Development and integration of the regional chemical transport model MATCH into the GEMS pre-operational suite.

- MACC, http://www.copernicus-atmosphere.eu, Monitoring Atmospheric Composition and Climate,
  - A continuation GEMS towards an interim implementation of an operational Copernicus service for air quality and climate.

- CAMS, http://www.copernicus-atmosphere.eu, Copernicus Atmospheric Monitoring Service,
- An operational Copernicus service for air quality and climate

- Cooperation on nuclear emergency with the Swedish Radiation Security Agency.
  - Central role in model development for accidental releases and for operational implementation.

Business or sector Govenvent agency

1986-1988t

Consultant

Swedish Meteorological and Hydrological Institute, Norrköping, Sweden, http://www.smhi.se

- Consultancy Services within the field of local scale air pollution

Business or sector Govenvent agency

EDUCATION AND TRAINING

1982-1986

Bachelor of Science in Meteorology ant

Mathematics, Physics, Computer Science and Meteorology, Uppsala University, Sweden

PERSONAL SKILLS

Mother tongue(s): Swedish

English

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	
C2	C2	C2	C2	C2

Communication skills

- Good communication skills through long experience in international projects and presentations of research.

Organisational / managerial skills: Acted as chairman of the local scientist union at SMHI

Job-related skills: Expert in modelling of air pollutants with a special interest transport dynamics and system design.

- Taken part in developing graphical user interfaces for web applications
- Software development for parallel computing
- Data management and storage technologies

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient user	Proficient user	Proficient user	Proficient user	Proficient user

Other skills: Having almost 30 years of experience as professional software developer with focus on research and operational tools working with the following technologies: Linux, Fortran, C/C++, Python, Java, JavaScript, HTML, CSS. PHP

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Driving licence: AB

ADDITIONAL INFORMATION

Publications

Andersson, A., Alpfjord, H., Robertson, L., Karlsson, P-E, Engardt, M.: Reanalysis of and attribution to near-surface ozone concentrations in Sweden during 1990-2013. **Atmospheric Chemistry And Physics**, ISSN 1680-7316, E-ISSN 1680-7324, Vol. 17, nr 22, 2017.

Andersson, C., Bergström, R., Bennet, C., Robertson, L., Thomas, M., Korhonen, H., Lehtinen, K. E. J. Kokkola, H.: MATCH-SALSA - Multi-scale Atmospheric Transport and CHemistry model coupled to the SALSA aerosol microphysics model - Part 1: Model description and evaluation: **Geoscientific Model Development,** ISSN 1991-959X, E-ISSN 1991-9603, Vol. 8, nr 2, s. 171-189, 2015.

Galmarini, S.,Bonnardot, F., Jones, A., Potempski, S., Robertson, L., Martet, M. : Multi-model vs. EPS-based ensemble atmospheric dispersion simulations: A quantitative assessment on the ETEX-1 tracer experiment case. **Atmospheric Environment**, ISSN 1352-2310, E-ISSN 1873-2844, Vol. 44, nr 29, s. 3558-3567, 2010.

Huijnen, V. et al. : Comparison of OMI NO2 tropospheric columns with an ensemble of global and European regional air quality models. **Atmospheric Chemistry And Physics**, ISSN 1680-7316, E-ISSN 1680-7324, Vol. 10, nr 7, s. 3273-329, 2010.

Kovalets, I. V., Robertson, L., Persson, .C , Didkivska, S. N., Ievdin, I. A., Trybushnyi, D., Calculation of the far range atmospheric transport of radionuclides after the Fukushima accident with the atmospheric dispersion model MATCH of the JRODOS system. **International Journal of Environment and Pollution**, ISSN 0957-4352, E-ISSN 1741-5101, Vol. 54, nr 2-4, s. 101-109, 2014.

Robertson, L., Langner, J., Engardt, M. An Eulerian limited-area atmospheric transport model. **Journal of applied meteorology** (1988), ISSN 0894-8763, E-ISSN 1520-0450, Vol. 38, nr 2, s. 190-210, 1999.

ANNEXES

PERSONAL INFORMATION

Heléne Alpfjord Wylde

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helene.alpfjord.wylde@smhi.se

Sex Female | Date of birth 29/06/1988 | Nationality Swedish

WORK EXPERIENCE

March 2014 - ongoing

Consultant within air quality modelling

Air Quality Unit, SMHI, Sweden

- I do regional scale air quality modelling within the national environmental monitoring and do reanalyses within CAMS50 using the MATCH model. I participate as a national expert in the standardisation work within CEN concerning modelling quality objectives within the Air Quality Directive. This work was iinitialized by FAIRMODE, Forum for Air Quality Modelling in Europe. I also project manage the national data hosting of air quality data.

Business or sector Governmental agency

June 2013 – Aug 2013

Summer employment in the model and methodology development group

Model and methodology development group, SMHI, Sweden

- I did statistical postprocessing of wind power data and implemented a non-linear Kalman filter.

Business or sector Governmental agency

EDUCATION AND TRAINING

Aug 2008 – Jan 2014

Master of Science in Engineering Mathematics

Lund University, Faculty of Engineering, Sweden

- I specialized in statistics and risk analysis. I wrote my Master's thesis at SMHI, called "Statistical postprocessing of the air quality model SIMAIR".
- I studied Biotechnology one year and finished basic chemistry courses.

PERSONAL SKILLS

Mother tongue(s) Swedish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	9	9	8	8	8
	8/9 at IELTS academic exam, 2015				
Spanish	B1	B1	B1	B1	B1
	Lund University / Spanish course, level III, Universidad de Cienfuegos, Cuba, 2013				

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills
- Good communication skills gained through my experience as project manager

Organisational / managerial skills
- Project management (currently responsible for several complex technical projects)

Other skills
- Programming experience in Matlab, bash and Python. I have experience in Linux and Windows.

Driving licence B

ADDITIONAL INFORMATION

Publications
Presentations
Projects
Conferences
Seminars
Honours and awards
Memberships
References
Citations
Courses
Certifications

- Andersson, C., Robertson, L., Alpfjord, H., Karlsson, P.E. and Engardt, M (2017). Long-term trends and extreme values in near-surface ozone in Sweden. Atmos. Chem. Phys. 17, 13869-13890, https://doi.org/10.5194/acp-17-13869-2017.
- Alpfjord, H. and Häggkvist, K (2015). PREDO – PREdiction of DOses from normal releases of radionuclides to the environment. Methodology for air dispersion and deposition calculations. Vattenfall report.
- Invited presentation to the FAIRMODE technical meeting in Aveiro, Portugal, June 2015. The statistical post-processing technique Support Vector Regression within modelling and monitoring.
- Training course in data assimilation, ECMWF, March 2015.

PERSONAL INFORMATION

Erik Engström

Syrenvägen 26, 61831 Kolmården, Sweden

+46-11-495 86 97

Erik.engstrom@smhi.se

Sex Male Male | Date of birth 12/09/1976 | Nationality Swedish

POSITION

Air Quality Market Manager at SMHI

WORK EXPERIENCE

2016-now Air quality market manager

Swedish Meteorological and Hydrological Institute

- Manager of air dispersion service for the Swedish Radiation Safety Authority.
- Manager of the contribution from SMHI to the CAMS-50 European air quality forecast service.
- Manager of SMHIs UV-index and surface ozone forecast services.

2010-2016 Climate Communicator

Swedish Meteorological and Hydrological Institute

- Generate information about the present, past and future climate and communicate it to the Swedish society through web sites, articles and seminars.

EDUCATION AND TRAINING

2004-2009 PhD in Atmospheric Chemistry

Replace with EQF (or other) level if relevant

Stockholm University

- Dynamic meteorology and the atmospheric general circulation
- Air chemistry
- Biogeochemical cycles
- Aerosols
- University teaching
- Climate change, causes and impacts

1997-2002 Fil Mag in Analytical Chemistry

Replace with EQF (or other) level if relevant

Linköping University

- General chemistry
- Organic chemistry
- Inorganic chemistry
- Biochemistry
- Physical chemistry
- Analytical chemistry

PERSONAL SKILLS

Mother tongue(s) Swedish

Other language(s)

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Replace with name of language certificate. Enter level if known.				
German and French	A2	A2	A2	A2	A2
Replace with name of language certificate. Enter level if known.				

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Good communication skills gained through my experience as climate communicator, university teaching and pedagogical courses.

Organisational / managerial skills

- Leadership (currently responsible for several projects and products involving around 20 staff at SMHI)
- Manager of the Nordic cooperation in homogenization of historical meteorological observations.
- Manager of the Swedish Air quality reference laboratory for modelling calcuations.

Job-related skills

- Writing, publishing and review pre-reviewed scientific articles.

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient	Proficient	Independent	Independent	Proficient

Levels: Basic user - Independent user - Proficient user
Digital competences - Self-assessment grid

- Good command of office suite (word processor, spread sheet, presentation software)
- Good command of programming languishes as matlab, R and python and are different OS as Windows and Linux.

Driving licence B

ADDITIONAL INFORMATION

Publications

- Engström, J. E.; Leck, C. 2011. Reducing uncertainties associated with filter-based optical measurements of light absorbing carbon particles with chemical information. ATMOSPHERIC MEASUREMENT TECHNIQUES, Volume: 4, Issue: 8, Pages: 1553-1566.
- Engström, J. E.; Leck, C. 2017. Seasonal variability in atmospheric black carbon at three stations in South-Asia. TELLUS SERIES B-CHEMICAL AND PHYSICAL METEOROLOGY. Volume: 69 Article Number: 1331102.
- Mueller, T.; Henzing, J. S.; de Leeuw, G.; et al. (39 co-authors, incl. Engström E). 2011. Characterization and intercomparison of aerosol absorption photometers: Result of two intercomparison workshops. ATMOSPHERIC MEASUREMENT TECHNIQUES, Volume: 4, Issue: 2, Pages: 245-268.
- Engström, J. E.; Leck, C. 2017. Seasonal variability in atmospheric black carbon at three stations in South-Asia. TELLUS SERIES B-CHEMICAL AND PHYSICAL METEOROLOGY. Volume: 69 Gustafsson, Orjan, et al. (9 co-authors, incl. Engström E). 2009. Brown Clouds over South Asia: Biomass or Fossil Fuel Combustion? SCIENCE, Volume: 323, Issue: 5913, Pages: 495-498.
- Granat, L.; Engström, J. E.; Praveen, S.; et al. 2010. Light absorbing material (soot) in rainwater and in aerosol particles in the Maldives. JOURNAL OF GEOPHYSICAL RESEARCH ATMOSPHERES, Volume: 115, Article Number: D16307.
-

Projects

Indecis (Integrated approach for the development across Europe of user oriented climate indicators for GFCS high-priority sectors: agriculture, disaster risk reduction, energy, health, water and tourism.)

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ANNEXES

Replace with list of documents annexed to your CV. Examples:

- copies of degrees and qualifications;
- testimonial of employment or work placement;
- publications or research.

Curriculum Vitae

PERSONAL INFORMATION

Ana Cristina Caldeira da Silva Gouveia Carvalho

Albrektsvägen, 159, Lgh 1002. 60353 Norrköping. Sweden.

Replace with telephone number +46764957719

ana.carvalho@smhi.se

Sex Female | Date of birth 16/08/1968 | Nationality Portuguese

JOB APPLIED FOR
POSITION
PREFERRED JOB
STUDIES APPLIED FOR
PERSONAL STATEMENT

WORK EXPERIENCE

January 2017 - Present

Air Quality Researcher

Swedish Meteorological and Hydrological Institute.

- supporting the activitites in the CAMS 50 Copernicus Service
- supporting the research goals proposed in the EUNADICS – V, H2020 European project
- supporting the activivities promoted by the URBANSIS Climate Copernicus Service

Business or sector Governmental organisation

July 2009 – June 2014

Air Quality and Climate Researcher

Center for Environmental and Sustainability Research – CENSE. Faculty of Sciences and technology. Nova University of Lisbon. Caparica, Portugal

- Principal Investigator of two projects funded by the Portuguese Science Foundation
  - Total column and surface ozone variability over the Iberian Peninsula: Dynamical and Chemical atmospheric factors - DYNOZONE. Refa PTDC/CTE- ATM/105507/2008, (https://www.fct.pt/apoios/projectos/consulta/vglobal_projecto.phtml.pt?idProjecto=105507&idElemConcurso=2703)
  - High-resolution Rainfall EroSivity analysis and fORecasTing - RESORT. Ref PTDC/CTE-ATM/111508/2009, (https://www.fct.pt/apoios/projectos/consulta/vglobal_projecto.phtml.pt?idProjecto=111508&idElemConcurso=3577)
  - Supporting other research activities in CENSE
  - Organizer and moderator of the CENSE monthly meetings (March 2010 – July 2013)
  - Supervisions and co-supervisor of research grants, master and PhD students.

Business or sector Governmental organisation

July 2009 – June 2014

Post-Doc

Department of Physics. University of Aveiro. Portugal.

Ensemble meteorological model in atmospheric-soil interactions

Business or sector Governmental organisation

September 2006 – August 2007

Post-Doc

Laboratoire de Météorologie Dynamique, École polytechinque, Paris, France

Evaluation de l'incertitude de la prévision de la qualité de l'air par méthodes d'ensembles utilisant les modèles ARPEGE et CHIMERE
Programme Pessoa (2007) – French-Portuguese Integrated Action (Laboratoire de Météorologie Dynamique- University of Aveiro). Dossier Égide n 14705WH, "Developpement d'un system de évaluation et gestion de la qualite de l'air au Portugal", as a french member team.

Business or sector Governmental organisation

December 1994 – August 2006

Reserch granter

Department of Environment and Planning. University of Aveiro. Portugal

Consecutive research grants under 11 Portuguese, 6 European projects and 3 bilateral actions (with Germany, Spain). The main topics covered air quality driven by forest fires, climate change and mesoscale processes.

Business or sector Governmental organisation

EDUCATION AND TRAINING

2006

PhD on Sciences Applied to the Environment.

February 2006. University of Aveiro, Portugal.

Quality and Climate Changes over Portugal.

2004

Meteorology and Oceanography Physics (pre-Bologna four year degree)

University of Aveiro, Portugal.

1995

Environmental Engineering (pre-Bologna five year degree)

University of Aveiro, Portugal.

PERSONAL SKILLS

Mother tongue(s) Portuguese

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
French	C1	C2	B2	B2	B2
Spanish	C2	C2	C2	C2	C1
English	C2	C2	C2	C2	C1
Swedish	A1	A1	A1	A1	A1
Arabic	A1	A1	A1	A1	A1
	Arabic Learning Centre. Dubai.Unitad Arab Emirates				

Communication skills

- Good communication skills gained through my experience as a teacher, conference presentation of reaserch project results and proejct meeitngs;
- Bringging together researchers from different areas in the same project

Organisational / managerial skills

- Leadership as principal investigator of two projects and students mentoring
- Coordinating reaserch project proposals at the national level
- Elaboration of discipline contents at the university level

Job-related skills

Analytical and computer skills using:
Numerical Weather prediction models: MEMO, MM5, WRF
Chemistry transport models: MARS, CAMx, CHIMERE, EURAD-IM, WRF/Chem, MATCH
Computer languages and software: Fortran, python, matlab, R open-air, nco, bash

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficiency	Proficiency	Basic user	Independent user	Basic user

Other skills

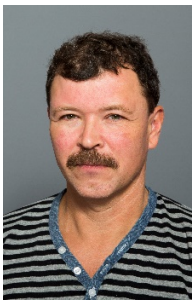
Adaptability to different environments and cultures aquired when living in Spain (1993/1994), France (2006/2007), Australia (2013/2014), the Unitade Arabe Emirats (2014/2017) and Sweden (2017 onwards)

Driving licence

B

PERSONAL INFORMATION

Jesper Heile Christensen



Frederiksborgvej 399, 4000 Roskilde,, Denmark
+45 30183130
jc@envs.au.dk
http://pure.au.dk/portal/en/jc@envs.au.dk

Sex M | Date of birth 18/11/1963 | Nationality Danish

WORK EXPERIENCE

2011-Present Senior Scientist

Department of Environmental Science, Aarhus University, Denmark

- Chemical transport modelling, model development, retrospective modelling, forecast modelling
- Weather forecast modelling, model development, retrospective modelling, forecast modelling
- Development and maintenance of operational systems
- Linux administrator

Business or sector Research and development

1997-2010 Senior Scientist

Department of Atmospheric Environmental, National Environmental Research Institute, Denmark

- Chemical transport modelling, model development, retrospective modelling, forecast modelling
- Weather forecast modelling, model development, retrospective modelling, forecast modelling
- Development and maintenance of operational systems
- Linux administrator

Business or sector Research and development

1994-1997 Research Physicist

Department of Atmospheric Environmental, National Environmental Research Institute, Denmark

- Chemical transport modelling, model development, retrospective modelling, forecast modelling
- Unix/Linux administrator

Business or sector Research and development

EDUCATION AND TRAINING

1995 PhD degree in Geophysics (Atmospheric science)

Geophysical Institute, Faculty of Science, University of Copenhagen

- Thesis topic: Transport of air pollution in the troposphere to the Arctic

1983-1990 Master of Science in Physics, Mathematics and Computer Science

Faculty of Science, University of Copenhagen

- Fundamental skills in mathematics, numerical methods, statistics
- Fundamental skills in computer science, programming and optimisation of computer programs for the hardware: sequential and parallel performance
- Advance skills in Physics
- Thesis topics: Deconfinement Phase Transition of SU(2) Lattice Gauge Theori in (2+1) Dimensions, development of Lattice Gauge model and application of the model in order to study phase transitions

PERSONAL SKILLS

Mother tongue(s) Danish

Other language(s)	*UNDERSTANDING*		*SPEAKING*		*WRITING*
	Listening	*Reading*	*Spoken interaction*	*Spoken production*	
English	*C2*	*C2*	*C2*	*C2*	*C2*

Communication skills

- Good communication skills gained by attending project meetings, conferences, workshops and seminars
- Good communication skills attained by 6 months Post Doc in USA

Organisational / managerial skills

- Project leadership of many projects since the PhD time

Job-related skills

- Large experience in development, maintenance and applying of comprehensive mathematical computer models for chemical transport and weather forecast in a UNIX/Linux environment: DEHM, MM5, ETA and WRF models.
- Large experience in development and maintenance operational systems at servers. This includes air quality forecasts and reanalysis at the European (CAMS_50 regional production) and national scale.
- Large experience in processing measurements, emissions. Land-use and meteorological data

Computer skills

- UNIX/Linux administrator
- Large experience with Fortran language and minor with C
- Large experience with unix/linux shells
- Large experience with Windows operational system and Microsoft office

Driving licence Car type B

ADDITIONAL INFORMATION

Publications
Conferences
Memberships

Many scientific publications, more than 100 peer reviewed in international journals, which have been cited 3517 times per 16/4-2018 in Scopus (292 citations in 2017). H-index is 37.

Attended numerous conferences, seminars and workshops.

I am national key expert in pathways and atmosphere models for the Arctic Monitoring and Assessment Program (AMAP) since the first AMAP assessment in 1998. I have been member since 2010 of the AMAP expert group about Short Lived Climate Forcers (SLCF) with main focus on atmospheric transport of SLCF to the Arctic and ship emissions of SLCF in the Arctic, and he have contribute to the AMAP assessments reports about SLCF. Finally he is National Expert in EMEP programme and National Expert in Task Force on Hemispheric Transport of Air Pollution under UNECE.

ANNEXES

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PERSONAL INFORMATION

Camilla Geels

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cag@envs.au.dk
http://pure.au.dk/portal/en/cag@envs.au.dk
Skype name: camilla.geels

Sex Female | Date of birth 14/05/1972 | Nationality Danish

WORK EXPERIENCE

2011-present	Senior scientist at Department of Environmental Science, Aarhus University
January 2009-October 2009	Maternity leave
2007-2011	Senior scientist at Department of Atmospheric Environment, National Environmental Research Institute (NERI/ATMI)
June 2004-April 2005	maternity leave
2002-2007	Scientist at Department of Atmospheric Environment, National Environmental Research Institute (NERI/ATMI)

EDUCATION AND TRAINING

2002	Ph.D degree (December, 20), University of Copenhagen, Niels Bohr Institute for Astronomy, Physics and Geophysics
1999	M.Sc in geophysics, glaciology and atmospheric science, University of Copenhagen

PERSONAL SKILLS

Mother tongue(s): Danish

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Swedish	C1	C1	B2	B2	B2
Norwegian	C1	C1	B2	B2	B2
German	A2	A2	A1	A1	A1

Communication skills

I have been involved in a large number of international project and have presented my research at international conferences on a regular basis – whereby I have gained good communication skills. As part of my PhD work I had a 5 month stay at the National Center for Atmospheric Research, Climate and Global Dynamics Division, Boulder, Colorado, US, and this has also improved my English skills. I have contributed to more than 40 scientific papers and more than 20 reports.

Organisational / managerial skills

I am an experienced project leader and have through the years been coordinating a number of projects and been WP leader or the local PI in other projects.

Examples of current/recent projects (last 5 years):

2016-2019 Emissions from shiPs and the Impacts on human healTh and envirOnMEnt in the nordic - now and in the future (EPITOME) (**Coordinato**r). Funded by Nordic Council of ministers (NMR).

2015-2018 Copernicus, Atmospheric Monitoring Service, CAMS_50 Regional production (**PI**), funded by EU.

2015-2020 Understanding the link between Air pollution and Distribution of related Health Impacts and Welfare in the Nordic countries (**Co-manager and WP leader**). Funded by NordForsk (30 mill. Nkr).

2012-2014 FutureAirNordic; Impact of combined emission and climate changes on air pollution and the related health effects and costs in the Nordic region (**Coordinator**). Funded by Nordic Council of ministers (NMR).

2011-2016 ECLAIRE; Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems (**PI and task leader**). Funded by EU.

2001-2014 ECOCLIM; Ecosystems Surface Exchange of Greenhouse Gases in an Environment of Changing Anthropogenic and Climate forcing (**WP leader**). Funded by the Danish Council for Strategic Research.

2010-2014 EnsClim; Robustness of predictions of climate change impact on dispersion and effects of airborne pollutants in northern Europe. Funded by NMR.

Job-related skills

Development and application of air chemistry models - on local to hemispheric scale for both forecasts, analyses and reanalyses. Statistical analysis of model simulations and measurements. Experience from several international model intercomparisons, with focus on model differences and uncertainties. Interested in global change and the interaction between air pollution and climate as well as climate mitigation and adaptation. Is currently focusing on assessments of air quality and the related health impacts and the cost for society.

ADDITIONAL INFORMATION

Publications & Presentations

41 peer-reviewed journal articles (Times cited via Web of Science: 1104 and h-index 21. Google Scholar: times cited 2067 and h-index 26. As of April, 2018). Contributes regularly to DCE science based technical reports (in Danish) and consultancy publications - like the yearly DCE report on Atmospheric Deposition: has contributed to >20 technical and consultancy publications. Presents the newest research at international conferences at a regular basis. Gave e.g. a key-note presentation at the International Conference on Air Quality - Science and Application, Milan, Italy, 2016.

Other skills

Collaborates with a number of modelling groups across Europe (The Max Planck Institute for Biogeochemistry; Laboratoire des sciences du climat et l'environnement (LSCE); Finnish Meteorological Institute; Swedish Meteorological and Hydrological Institute; Norwegian Meteorological Institute; Lund University, University of Worcester, Centre for Ecology & Hydrology). Experience with supervising of master and PhD students and has been in a PhD evaluation committee three times. Reviewer for a number of high impact journals like Atmospheric Environment and Science of the Total Environment.

PERSONAL INFORMATION

Kaj Mantzius Hansen

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http://pure.au.dk/portal/en/kmh@envs.au.dk
Skype name: kaj.mantzius.hansen

Sex Male | Date of birth 03/06/1974 | Nationality Danish

WORK EXPERIENCE

2014-present	Affiliated to the Arctic Research Centre, Faculty of Science and Technology, AU
2011-present	Senior scientist at Department of Environmental Science, Aarhus University
2009-2011	Senior scientist at Department of Atmospheric Environment, National Environmental Research Institute (NERI/ATMI).
2005-2009	Scientist at Department of Atmospheric Environment, National Environmental Research Institute (NERI/ATMI).

EDUCATION AND TRAINING

2002-2006	PhD in meteorology and atmospheric sciences from the Copenhagen Global Change Initiative (COGCI) PhD school, University of Copenhagen and NERI/ATMI. Main subjects: development of an Eulerian atmospheric chemistry transport model for transport, dispersion, deposition, and chemical transformation of persistent organic pollutants. Thesis handed in for defence November 2005 and defended February 2006
1998-2001	MSc in geophysics. Main subjects of master thesis: glaciology, semi-automatic measurements of ice crystal size, shape and orientation. Degree from the Department of Geophysics, Niels Bohr Institute for Astronomy, Physics and Geophysics (NBIfAFG), University of Copenhagen
1994-1998	BSc in physics at NBIfAFG, University of Copenhagen

PERSONAL SKILLS

Mother tongue(s): Danish

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Swedish	C1	C1	B2	B2	B2
Norwegian	C1	C1	B2	B2	B2
French	C1	C1	B2	B2	B2
German	A2	A2	A1	A1	A1

Communication skills

I have contributed to more than 100 publications including 26 articles in peer reviewed journals, 33 scientific reports and 60 popular articles. I have participated in more than 30 international conferences and workshops, where I have given 30 oral presentations, 9 of them invited as well as presented 21 conference posters as first author. My presentations at conferences, workshops and seminars always receive positive feedback.

Organisational / managerial skills

Trade union representative (2009-present) and staff representative of the Liaison Committee and head of education committee (2017-present) at the Department of Environmental Science. Co-convenor at three conference sessions and organiser of one workshop. Project leader of six research projects.

Job-related skills

I have worked with model development, process parameterization, model application and evaluation for more than 15 years. My main research interests are modelling of atmospheric transport and environmental fate of persistent organic pollutants (POPs) both with focus on individual environmental processes and on the large scale fate. I have especially worked with the processes describing the exchange of POPs between air and snow. I have also worked with modelling of atmospheric deposition of nutrients to marine systems and contributed to an interdisciplinary project on improving the ecological status of the Baltic Sea. I have also worked with modelling of particulate matter in the atmosphere as well as with the influence of climate change on atmospheric transport and chemistry. My research interests also cover atmospheric short- and long-range transport modelling and integrated high-resolution forecasting of weather and air pollution in general. I have developed the POP version of the Danish Eulerian Hemispheric Model, a 3-D Eulerian atmospheric chemistry transport model used to study the atmospheric transport and environmental fate of POPs in the Northern Hemisphere. I also participated in the development of other versions of the DEHM model for studying transport, chemical transformations, deposition and fluxes of many chemical compounds. I have also experience from work with local scale atmospheric pollution models as well as forecasting of air quality and data assimilation. As part of Copernicus's Atmosphere Monitoring Service: CAMS_50 Regional production, I have implemented a data assimilation module in the operational version of the DEHM model. I have given lectures on air pollution, meteorology and modelling on PhD schools in Denmark, Greenland, Norway and the Czech Republic.

ADDITIONAL INFORMATION

Publications & Presentations

26 peer reviewed journal articles in international journals with more than 769 citations and an h index of 15 (WoS, as of 1/4-2018). 17 proceeding papers, 33 scientific reports (4 in Danish & 29 in English), 60 popular articles. 30 oral presentations (9 of which were invited) and 21 poster presentations at international conferences and workshops.

Other skills

Participation in the education committee of the Department of Environmental Science, Faculty of Science and Technology, Aarhus University as well as the education committee of the Arctic Research Centre (representing the Department of Environmental Science), Faculty of Science and Technology, Aarhus University.

PERSONAL INFORMATION

Joanna Strużewska

Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering, Nowowiejska 20 street, 00-653 Warsaw, Poland
+48 22 234 55 03
joanna.struzewska@pw.edu.pl

Sex F | Date of birth 11/05/1973 | Nationality Polish

POSITION

Assistant professor

Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering; Environmental Protection and Management Division, Meteorology Group

- Management of operational forecast for National Inspectorate of Environmental Protection and voivodships
- Management of R&D projects related to air quality assessment for central and regional administration
- Research in the field of atmospheric chemistry-dynamics feedbacks - coupled modelling
- Co-supervision of doctoral research in the field of air quality and climate modelling
- Supervision of masters and bachelor dissertation in the field of air quality, renewable energy and climate modelling
- Lectures and training labs in Polish and English (Meteorology, Applied climatology, Forecasting of meteorological hazards, Forecasting techniques in environmental protection, Technical meteorology and air pollution control)

Chief specialist

Institute of Environmental Protection – National Research Institute

- Management of climate change scenarios analysis for Poland
- Impact assessment analysis of air pollution in Poland

WORK EXPERIENCE

From May 2017 — Chief specialist - Institute of Environmental Protection – National Research Institute, Department of Atmosphere and Climate Modelling

From October 2003 — Assistant professor at Warsaw University of Technology, Faculty of Environmental Engineering

2002-2003 — Assistant at Warsaw University of Technology, Faculty of Environmental Engineering

EDUCATION AND TRAINING

2002 — PhD dissertation (in environmental engineering – air quality) at Warsaw University of Technology, Faculty of Environmental Engineering

1997-2002 — PhD studies at Warsaw University of Technology, Faculty of Environmental Engineering

- Advanced atmospheric modelling (Eulerian models: MC2-AQ, GEM-AQ, CMAQ, ETA)
- Satellite data processing
- Emission modelling
- 2001 – scholarship at York University, Toronto, Canada

1992- 1997 — Master of Science (in Applied Meteorology and Air Protection) at Warsaw University of Technology, Faculty of Environmental Engineering

- Modelling of pollutants dispersion (Gaussian models)
- 1D modelling of PBL
- Field measurements of meteorological parameters and pollutants concentrations
- SYNOP/METAR data processing

PERSONAL SKILLS

Mother tongue(s): Polish

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B2	B2	B2	B2	B2
	CAE				
Spanish	A2	A2	A2	A2	A1
	-				

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills
- Excellent communication skills developed through cooperation with decision makers in a number of R&D projects
- Excellent communication skills developed through teaching at graduate and undergraduate levels (15 years of experience)
- Excellent communication skills developed through cooperation in research grants

Organisational / managerial skills
- Management and of Principal Investigator CAMS50 project at WUT (2015-2018)
- Principal Investigator of 4 research grants and 10 R&D project (2002-2015) responsible for project management, budget and reporting (team of 6-8 persons)
- WP co-leader in COST728
- Coordination of proposals preparation (including budget planning)
- Coordination and organisation of projects' meetings

Job-related skills
- Good knowledge on end-user needs (air quality assessment and forecast)
- Good knowledge on atmospheric models performance measures
- Ability to develop model code
- Ability to process and analyse large data sets

Computer skills

- FORTRAN programming
- Pascal programming
- Linux shell script programming
- R programming
- NCL programming and other graphics software packages
- GIS software

Driving licence

- B

ADDITIONAL INFORMATION

International initiatives

- CEN/TC 264/WG 43 Working group Model quality objectives and CEN/TC 264/WG 44 Working group Source apportionment - Committee Member on behalf of PKN, Poland
- FAIRMODE – national expert on behalf of the Ministry of Environment
- COST723, COST728, COSTES0602, COSTES1004 – representative to Management Committee on behalf of the Ministry of Science
- ACCENT-network – on behalf of the Institute for Environmental Protection

Honours and awards

WUT Rector's 1st Class Awards for scientific achievements (individual – 2009; team – 2014, team - 2016)

Cooperation in Poland

Institute of Geophysics University of Warsaw, Institute of Geophysics – Polish Academy od Science, Institute of Oceanology - Polish Academy od Science, Poland-AOD network, Institute of Meteorology and Water Management

PERSONAL INFORMATION

Jacek W. Kamiński

Institute of Environmental Protection – National Research Institute, Warsaw, Poland

+48 22 307 13 96, +48 518 214 650

jkaminski@ecoforecast.eu

Sex M | Date of birth August 6, 1956 | Nationality Polish

POSITION

Senior Scientist, Institute Plenipotentiary for International Cooperation

WORK EXPERIENCE

2017 – present	Senior Scientist, Institute of Environmental Protection, Warsaw, Poland
2016 – present	Associate Professor, Institute of Geophysics, Polish Academy of Sciences
2011 – present	Chair, EcoForecast Foundation, Warsaw, Poland
2010 – 2011	Visiting Research Scientist, Environment Canada
2007 – 2016	Adjunct Professor, Centre for Research in Earth and Space Science, York Uni.
2002 – 2007	Executive Director, Multiscale Air Quality Modelling Network, York Uni, Canada
1987 – 2002	President, Atmospheric Research and Modelling Consultants, Canada
1981 – 1987	Atmospheric Scientist, Meteorological Environmental Planning Ltd., Canada

EDUCATION AND TRAINING

2012	D.Sc.	Warsaw University of Technology, 2012. (Habilitation).
1994	Ph.D.	Centre for Research in Earth and Space Science, York University, Toronto
1980	M.Sc.	Environmental Engineering, Warsaw University of Technology

PERSONAL SKILLS

Mother tongue(s): Polish

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
	CAE				
Russian	A1	A1	A1	A1	A1
	-				

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Excellent communication skills developed through management, working groups and advisory panels for national and international agencies.

Organisational / managerial skills

- Principal developer of the Global Environmental Multiscale Air Quality model (GEM-AQ)
- Management of operational forecasts for the National Inspectorate of Environmental Protection and voivodships in Poland.
- Management of a research network (Multiscale Air Quality Modelling Network) that involved 10 institutions and 30 researchers with a budget of about 10 M€.

Job-related skills
- Good knowledge of air quality legislations
- Good knowledge of atmospheric modelling and climate change modelling

Computer skills
- Fortran, shell script, NCL

Driving licence
- B

ADDITIONAL INFORMATION

International initiatives
- Member, Mission Advisory Group for Sentinel 4 and 5 satellite instruments, appointed by the European Space Agency (2013 – present).
- Co-Investigator, iAREA (Impact of absorbing aerosols on radiative forcing in the European Arctic), Modelling of chemical and optical properties of the Arctic aerosols for campaign support and post analysis. European Economic Area and Norway Grants (2013-2016).
- Co-Investigator, NOMAD (Nadir and Occultation for MArs Discovery) (2010 – present).
- Co-Investigator, PARTNER (Partnership for Air Transportation Noise and Emissions Reduction), Center of Excellence for Aircraft Noise and Aviation Emission Mitigation, (partner.mit.edu)

Selected Publications
- Struzewska J., M. Jefimow, J.W. Kaminski, Application of Model Output Statistics to the GEM-AQ high resolution air quality forecast – accepted for publication in Atmospheric Research, 2016.
- Lisok, J., et al., Study of aerosol physical and chemical properties during iAREA 2014 campaign on Spitsbergen. Atmospheric Environment, doi:10.1016/j.atmosenv.2016.05.051, 2016.
- Struzewska et al., Evaluation of the GEM-AQ model in the context of the AQMEII Phase 1 project, Atmos. Chem. Phys., 15, 3971-3990, doi:10.5194/acp-15-3971-2015, 2015.
- Szymankiewicz, K., Kaminski, J.W. and Struzewska, J.: Interannual variability of tropospheric NO2 column over Central Europe - observations from SCIAMACHY and GEM-AQ model simulations, Acta Geophysica, vol. 62, 915-929 DOI: 10.2478/s11600-014-0211-z, 2014.
- Heilliette et al., Assimilation of Infrared Radiances in the Context of Observing System Simulation Experiments. J. Appl. Meteor. Climatol., 52, 1031–1045. 2013.
- Gong et al., GEM-AQ/EC, an on-line global multi-scale chemical weather modelling system: model development and evaluation of global aerosol climatology, Atmos. Chem. Phys., 12, 8237-8256, doi:10.5194/acp-12-8237-2012, 2012.
- Struzewska, J. and J.W. Kaminski, Impact of urban parameterization on high resolution air quality forecast with the GEM – AQ model, Atmos. Chem. Phys., 12, 10387-10404, 2012.
- Lupu, A. et al., Hydrogen cyanide in the upper troposphere: GEM-AQ simulation and comparison with ACE-FTS observations, Atmos. Chem. Phys., 9, 54301-4313, 2009.
- Kaminski et al., GEM-AQ, an on-line global multiscale chemical weather modelling system: model description and evaluation of gas phase chemistry processes. Atmos. Chem. Phys., 8, 3255-3281, 2008.
- Struzewska, J. and J.W. Kaminski: Formation and transport of photooxidants over Europe during the July 2006 heat wave - observations and GEM-AQ model simulations, Atmos. Chem. Phys., 8, 721-736, 2008.

europass Curriculum vitae

PERSONAL INFORMATION

Dene Bowdalo

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Gender Male | Date of birth 28/01/1990

Nationality English

POSITION

Postdoctoral Researcher

WORK EXPERIENCE

July 2016–December 2016

Postdoctoral Research Associate

Department of Chemistry, University of York, York, United Kingdom

- Application of novel spectral methods tailored for the identification of systematic biases in global atmospheric chemistry models.
- Work focused on the minimisation of surface ozone biases in a state of the art global chemical transport model (GEOS-Chem).

EDUCATION AND TRAINING

October 2012–July 2016

Ph.D. in Atmospheric Chemistry

Department of Chemistry, University of York, York, United Kingdom

- Thesis entitled: *"Spectral analysis of atmospheric composition: application to surface ozone"*.
- A spectral methodology was developed for the analysis of atmospheric composition. This methodology was applied to identify biases in surface ozone in global chemical models, with respect to observations.
- Research culminated in 3 first author papers (2 in prep.), as well as 3 other co-authorships.
- Key findings were presented at numerous international venues (e.g. AGU - San Francisco, University of Columbia - New York).
- Research methodologies employed required extensive mathematical/computer science skills: high-level data analysis (Python, R); model compilation (FORTRAN, Bash); big data management (NetCDF, HDF) and machine learning (scikit-learn).

September 2009–July 2012

B.Sc. in Environmental Science (1st class honours)

School of Earth and Environment, University of Leeds, Leeds, United Kingdom

- Dissertation entitled: *"How the sensitivity of the climate feedback mechanism to phytoplankton has changed over time"*.
- Courses focused on climate, atmospheric and Earth chemistry.
- Courses such as "Practical Weather Forecasting" taught programming skills (e.g. Bash and IDL).

PERSONAL SKILLS

Mother tongue English

Other languages

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	

Spanish	B2	B2	B2	B2	B2
French	A2	A2	A2	A2	A2

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference (CEF) level

Communication skills

- **Demonstrator on Python for Postgraduate Biologists, University of York. July 2016–December 2016**. The course ranged from teaching basics to concluding with advanced topics such as object-oriented programming. The role involved assisting a range of student queries in tutorials.
- **Demonstrator/Material Writer for Linux for Postgraduate Chemists, University of York. Autumn 2014 & 2015**. The course was designed to teach fundamentals in Linux with students applying more advanced skills learnt to their own research as tutorials progressed. I co-wrote the course material – a 60 page handbook and tutorial problems. The demonstrator role involved assisting students' issues in tutorials and giving class demonstrations.

Organisational / managerial skills

- **Student supervision, University of York. October 2012–July 2016**. Throughout my PhD I provided day to day support for 4+ summer placement, M.Chem and Ph.D. students undertaking projects for Prof. Mathew Evans. This support encompassed both scientific and technical computing expertise.
- **NCAS – Visiting Scientist Award. March 2014**. Won a research award to enable study at an overseas university with the aim of providing invaluable research experiences to early career scientists. Subsequently I was invited to work as a research fellow for 1 Month at Peking University (Beijing) working with Prof. Tzung-May Fu's research group. This involved writing a detailed research plan, extensive liaisons with Peking University, and personally organising my living arrangements in China.

Computer skills

- Expert programmer in: Python, R, FORTRAN, Bash, UNIX/Linux, HTML, CSS, LaTeX, Git
- Advanced programmer in: IDL, MATLAB, JavaScript, CSS, SVG, SQL
- Extensive experience with Big Data Management formats: NetCDF, HDF, JSON, GRIB
- Advanced experience with Graphic Design tools: Illustrator, Photoshop, InDesign

Other skills

- Play guitar and piano
- Avid 10km runner; football, squash and tennis player.

Driving licence B1,B

ADDITIONAL INFORMATION

Publications

- **D. R. Bowdalo**, M. J. Evans and E. D. Sofen, "Spectral analysis of atmospheric composition: application to surface ozone model-measurement comparisons", *Atmos. Chem. Phys.*, vol. 16, pp. 8295-8308, 2016, doi:10.5194/acp-16-8295-2016
- E. D. Sofen, **D. R. Bowdalo** and M. J. Evans, "How to most effectively expand the global surface ozone observing network", *Atmos. Chem. Phys.*, vol. 16, pp. 1445-1457, 2016, doi:10.5194/acp-16-1445-2016
- E. D. Sofen, **D. R. Bowdalo**, M. J. Evans, F. Apadula, P. Bonasoni, M. Cupeiro, R. Ellul, I. E. Galbally, R. Girgzdiene, S. Luppo, M. Mimouni, A. C. Nahas, M. Saliba and K. Tørseth, "Gridded global surface ozone metrics for atmospheric chemistry model evaluation", *Earth Syst. Sci. Data*, vol. 8, pp. 41-59, 2016, doi:10.5194/essd-8-41-2016
- S. Wang, J. A. Schmidt, S. Baidar, S. Coburn, B. Dix, T. K. Koenig, E. Apel, **D. R. Bowdalo**, T. L. Campos, E. Eloranta, M. J. Evans, J. P. DiGangi, M. A. Zondlo, R. Gao, J. A. Haggerty, S. R. Hall, R. S. Hornbrook, D. Jacob, B. Morley, B. Pierce, M. Reeves, P. Romashkin, A. ter Schure and R. Volkamer, "Active and widespread halogen chemistry in the tropical and subtropical free troposphere", *PNAS*, vol. 112, pp. 9281-9286, 2015, doi:10.1073/pnas.1505142112

PERSONAL INFORMATION

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http://www.bsc.es/

Sex Male | Date of birth 25/06/1977 | Nationality Spanish

WORK EXPERIENCE

10/2016- present	Head of Atmospheric Composition Group AXA Professor on Sand and Dust Storms Ramon y Cajal Fellow ERC Consolidator Grantee Earth Sciences Department, Barcelona Supercomputing Center, Spain.
10/2011-9/2016	Associate Research Scientist NASA Goddard Institute for Space Studies & Department of Applied Physics and Applied Mathematics - Columbia University (New York).
9/2009-9/2011	Earth Institute Fellow The Earth Institute – Columbia University, NASA Goddard Institute for Space Studies & International Research Institute for Climate and Society – Columbia University (New York).
2/2009-6/2009	Visiting Scientist NOAA/National Centers for Environmental Prediction, Camp Springs (Maryland).
1/2006-7/2009	Research Scientist and Mineral Dust Group Leader Earth Sciences Department. Barcelona Supercomputing Center (Spain).

EDUCATION AND TRAINING

2006	Ph.D. in Environmental Engineering. Universitat Politècnica de Catalunya, Spain.
2003	Diploma of Advanced Studies. Environmental Engineering. Universitat Politècnica de Catalunya, Spain.
2001	Industrial Engineer - Environmental Option. ETSEIB (Barcelona). Universitat Politècnica de Catalunya, Spain.
2001	Ingénieur des Arts et Manufactures. École Centrale Paris, France.

PERSONAL SKILLS

Organisational / managerial skills

- International project leader, team coordinator, supervisor
- Coordinator of a group of ~20 scientists and support engineers working on atmospheric chemistry and emission modeling
- Selected Projects as *Project Director (PD), Principal (PI) or Co-Principal Investigator (Co-PI):*
  PD/PI. *ERC Consolidator Grant*. *"FRontiers in dust minerAloGical coMposition and its Effects upoN climaTe"* FRAGMENT. Granted by: European Commission. 2.000.000 €. Starting in October 2018.
  PI. *MINECO – RETOS 2017*. "*QuaNtifying the present and fUTure atmospheric deliveRy of bIoavailablE iroN to The ocean"*. Granted by: Ministry of Economy, Industry and Competitiveness of Spain. 72.000 €.
  PD. AXA Research Fund. "AXA Chair on Sand and Dust Storms". Barcelona

Supercomputing Center. 1,700,000 Euro.
PD and Institutional PI. Department of Energy (DoE DE-SC00671). “Improving the representation of soluble iron in climate models”. Collaborative Project between Columbia University, NASA and Cornell University. NASA-Columbia PI: Carlos Pérez García-Pando. Cornell PI: Natalie Mahowald. $750,000 (10/2011-10/2014).
Co-PI. NASA ROSES Modeling, Analysis and Prediction Program. “Contribution to radiative forcing and climate by anthropogenic sources of dust aerosol”. PI: Ron L. Miller. Co-I’s from NASA, Columbia University, Geophysical Fluid Dynamics Laboratory and Princeton University. $1,020,000 (07/2014-07/2017).
Co-PI. R2O Initiative for the Next Generation Global Prediction System (NGGPS), NOAA. “Implementation and testing of dust models for regional and global forecasting”. PI: Paul Ginoux (GFDL). $200,000 (2015-2016).
PI. Earth Institute Cross-Cutting Initiative (CCI). “Atmospheric aerosol impacts on health in sub-Saharan Africa”. $45.000 (09/2010-to present).
PI. Ministry of Science and Technology, Spain. Contract CGL2006-11879/CLI. “Improvement of the Dust Regional Atmospheric Model (DREAM) for prediction of Saharan dust events in the Mediterranean and the Canary Islands”. 130,000 Euro. (10/2006–09/2009).

Computer skills

- Programming skills in Fortran, R, bash, Linux, Mac-OS X
- Experience in ESM model developments in supercomputer infrastructures
- Experience in different data formats, including NetCDF, Raster, CSV, GRIB

Other skills

- I have led and/or contributed to the development of several models and operational forecast systems: BSC-DREAM8b model (Pérez et al., 2006a, Pérez et al., 2006b), NMMB/BSC-Dust model (Pérez et al., 2011), NNMB/BSC-CTM (Spada et al., 2013, Jorba et al. 2013), NASA Earth System ModelE (Miller et al., 2014), Dust forecasts (http://sds-was.aemet.es, http://dust.aemet.es), Air quality forecasts (http://www.bsc.es/caliope/es)
- Evaluation of models using satellite and ground-based observations

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

Google scholar citations (3491), h-index (29), i10-index (50) - as of May 15, 2018

- Badia, A., Jorba, O., Voulgarakis, A., Dabdub, D., Pérez García-Pando, C., Hilboll, A., Gonçalves, M., and Janjic, Z.: Description and evaluation of the Multiscale Online Nonhydrostatic AtmospheRe CHemistry model (NMMB-MONARCH) version 1.0: gas-phase chemistry at global scale, Geosci. Model Dev., 10, 609-638, https://doi.org/10.5194/gmd-10-609-2017, 2017.
- Pérez García-Pando, C., R.L. Miller, J.P. Perlwitz, S. Rodríguez, and J.M. Prospero, 2016. Predicting the mineral composition of dust aerosols: Insights from elemental composition measured at the Izaña Observatory. Geophysical Research Letters, 43, no. 19, 10520-10529.
- Perlwitz, J.P.*, C. Pérez García-Pando* R.L. Miller* (*Equal contribution), 2015. Predicting the Mineral Composition of Dust Aerosols. Part I: Representing Key Processes. Atmospheric Chemistry and Physics, 15, 11593-11627.
- Hickman, J.E., R.J. Scholes, T.S. Rosenstock, C. Pérez García-Pando, J. Nyamangara, 2014. Assessing non-CO2 climate-forcing emissions and mitigation in sub-Saharan Africa. Current Opinion in Environ. Sustain., 10, 65-72.
- Pérez García-Pando, C., M.C. Stanton, P.J. Diggle, S. Trzaska, R.L. Miller, J.P. Perlwitz, J.M. Baldasano, E. Cuevas, P. Ceccato, P. Yaka and M.C Thomson, 2014. Soil dust aerosols and wind as predictors of seasonal meningitis incidence in Niger. Environmental Health Perspectives. doi:10.1289/ehp.1306640
- Miller, R.L., G.A. Schmidt, L.S. Nazarenko, N. Tausnev, S.E. Bauer, A.D. Del Genio, M. Kelley, K.K. Lo, R. Ruedy, D.T. Shindell, I. Aleinov, M. Bauer, R. Bleck, V. Canuto, Y.-H. Chen, Y. Cheng, T.L. Clune, G. Faluvegi, J.E. Hansen, R.J. Healy, N.Y. Kiang, D. Koch, A.A. Lacis, A.N. LeGrande, J. Lerner, S. Menon, V. Oinas, C. Pérez García-Pando, J.P. Perlwitz, M.J. Puma, D. Rind, A. Romanou, G.L. Russell, Mki. Sato, S. Sun, K. Tsigaridis, N. Unger, A. Voulgarakis, M.-S. Yao, and J. Zhang 2014. CMIP5 historical simulations (1850-2012) with GISS ModelE2. Journal of Advances in Modeling Earth Systems.
- Schulz, M., J.M. Prospero, A.R. Baker, F. Dentener, L. Ickes, P.S. Liss, N.M. Mahowald, S. Nickovic, C. Pérez, S. Rodríguez, M. Manmohan Sarin, I. Tegen, and R.A. Duce, 2012. The atmospheric transport and deposition of mineral dust to the ocean: Implications for research needs. Environmental Science and Technology, 46, 10390-10404.

PERSONAL INFORMATION

Oriol Jorba Casellas

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Sex Male | Date of birth 09/07/1975 | Nationality Spain

POSITION

Co-Group Manager of the Atmospheric Composition group
Earth Sciences Department,
Barcelona Supercomputing Center

WORK EXPERIENCE

2016-2017	Senior Researcher of the Atmospheric Composition group, Barcelona Supercomputing Center
2008-2016	Group Manager of the Atmospheric Modelling group, Barcelona Supercomputing Center
2005-2008	Junior Researcher, Barcelona Supercomputing Center
2004-2005	Lecturer, Universitat Politècnica de Catalunya

EDUCATION AND TRAINING

2000-2005 **PhD in Environmental Engineering**
Universitat Politécnica de Catalunya (Spain)

1993-1999 **Bsc and Msc Industrial Engineering**
Universitat Politécnica de Catalunya (Spain)

PERSONAL SKILLS

Communication skills

- Advanced graphic design skills gained through intensive use of Illustrator and InDesign during the PhD studies
- Proficient use of Power point for presentations and posters gained in both research and communication professional experience.
- Good oral communication skills acquired by giving university lectures, conferences and seminars.
- Strategic and operational knowledge on social networks.

Organisational / managerial skills

- Experience in organization of scientific conferences and workshops (Member of the Steering Committee of the ITM Air Pollution Modelling and its Applications.
- Leadership (I have coordinated a team of up to 15 people)
- Experience in collaborative tasks within European Funded projects (IS-ENES, FIELD_AC, MACC)

Job-related skills

- Teaching
- PhD advisor
- Atmospheric Sciences modelling

Computer skills

- Experience user of Illustrator, Photoshop
- Advanced user of R
- Experience in ACCESS Data Bases
- Advanced user in command of Microsoft Office™ tools
- Advanced skills in programming languages and data analysis (Fortran 77/95, Bash/Shell SL, UNIX/Linux, Python)
- Familiar with all popular file formats (NetCDF, GRIB, HDF, HDF-EOS5)

Other skills

- Piano
- Horsemanship

Driving licence

- B

RESEARCH

Projects and grants

- AXA Chair on Sand and Dust Storms. AXA Research Fund. Carlos Pérez García-Pando. (Centro Nacional de Supercomputación). 01/10/2016 - 30/08/2031. 1.587.906,57 €.
- Aerosol and Climate Response to NH3 in the NMMB/BSC Inter-Scale Model (ACRoNNIM). European Commission. Oriol Jorba Casellas. (Centro Nacional de Supercomputación). 12/09/2017 - 30/09/2019. 170.121,6 €.
- Dust Storms Assessment for the development of user-oriented Climate Services in Northern Africa, Middle East and Europe (DustClim). ERA4CS. Sara Basart. (Centro Nacional de Supercomputación). 01/09/2017 - 30/09/2019. 319.125 €.
- Severo-Ochoa. Mateo Valero. (Centro Nacional de Supercomputación). 2012-2019. 8.000.000 €.
- Aerosol forecasting and assessment of radiative forcing on weather and climate applications with the online NMMB/BSC-CTM model. Ministerio de Economía y Competitividad. Oriol Jorba Casellas. (Centro Nacional de Supercomputación). 2014-2016. 170.610 €.
- APPRAISAL: Air Pollution Policies foR Assesement of Integrated Strategies At regional and Local scales. European Commission. Maria Luisa Voltaue. (Centro Nacional de Supercomputación). 2012-2014. 999.989 €.
- Implementación de un mecanismo químico acoplado on-line dentro del modelo atmosferico UMO/DREAM. Ministerio de Ciencia e Innovación. Oriol Jorba Casellas. (Centro Nacional de Supercomputación). 2009-2011. 127.292 €.

Publications last 5 years

- Obiso, V., Jorba, O.: Aerosol-radiation interaction in atmospheric models: Idealized sensitivity study of simulated short-wave direct radiative effects to particel microphysical properties (2018) J. Aerosol Science, 115, 46-61.
- Obiso, V., Pandolfi, M., Ealo, M., and Jorba, O. Impact of aerosol physical properties on mass scattering cross sections (2017) J. Aerosol Science, 112, 68-82.
- Marti, A., Folch, A., Jorba, O., and Janjic, Z. Volcanic ash modeling with the online NMMB-MONARCH-ASH v1.0 model: model description, case simulation, and evaluation (2017) Atmos. Chem. Phys., 17, 4005-4030, doi:10.5194/acp-17-4005-2017.
- Di Tomaso, E., N.A.J. Schutgens, O. Jorba and Pérez García-Pando, C. Assimilation of MODIS Dark Target and Deep Blue observations in the dust aerosol component of NMMB-MONARCH version 1.0 (2017) Geoscientific Model Development, 10, 107-1129, doi:10.5194/gmd-10-1107-2017.
- Badia, A., O. Jorba, A. Voulgarakis, D. Dabdub, C. Pérez García-Pando, A. Hilboll, M. Gonçalves and Janjic, Z. Description and evaluation of the Multiscale Online Nonhydrostatic AtmospheRe CHemistry model (NMMB-MONARCH) version 1.0: gas-phase chemistry at global scale (2017) Geoscientific Model Development, 10, 609-638, doi:10.5194/gmd-10-609-2017.
- Marras, S., Kelly, J.F., Moragues, M., Müller, A., Kopera, M.A., Vázquez, M., Giraldo, F.X., Houzeaux, G., Jorba, O. A Review of Element-Based Galerkin Methods for Numerical Weather Prediction: Finite Elements, Spectral Elements, and Discontinuous Galerkin (2016) Archives of Computational Methods in Engineering, 50 p. Volume 23, Issue 4, pp 673–722.
- Sessions, W.R., Reid, J.S., Benedetti, A., Colarco, P.R., Da Silva, A., Lu, S., Sekiyama, T., Tanaka, T.Y., Baldasano, J.M., Basart, S., Brooks, M.E., Eck, T.F., Iredell, M., Hansen, J.A., Jorba, O.C., Juang, H.-M.H., Lynch, P., Morcrette, J.-J., Moorthi, S., Mulcahy, J., Pradhan, Y., Razinger, M., Sampson, C.B., Wang, J., Westphal, D.L.: Development towards a global operational aerosol consensus: Basic climatological characteristics of the International Cooperative for Aerosol Prediction Multi-Model Ensemble (ICAP-MME) (2015) Atmospheric Chemistry and Physics, 15 (1), pp. 335-362.
- Spada, M., Jorba, O., Pérez García-Pando, C., Janjic, Z., Baldasano, J.M.: On the evaluation of global sea-salt aerosol models at coastal/orographic sites (2015) Atmospheric Environment, 101, pp. 41-48.
- Im, U., Bianconi, R., Solazzo, E., Kioutsioukis, I., Badia, A., Balzarini, A., Baró, R., Bellasio, R., Brunner, D., Chemel, C., Curci, G., Denier van der Gon, H., Flemming, J., Forkel, R., Giordano, L., Jiménez-Guerrero, P., Hirtl, M., Hodzic, A., Honzak, L., Jorba, O., Knote, C., Makar, P.A., Manders-Groot, A., Neal, L., Pérez, J.L., Pirovano, G., Pouliot, G., San Jose, R., Savage, N., Schroder, W., Sokhi, R.S., Syrakov, D., Torian, A., Tuccella, P., Wang, K., Werhahn, J., Wolke, R., Zabkar, R., Zhang, Y., Zhang, J., Hogrefe, C., Galmarini, S.: Evaluation of operational online-coupled regional air quality models over Europe and North America in the context of AQMEII phase 2. Part II: Particulate matter (2014) Atmospheric Environment, . Article in Press.
- Brunner, D., Savage, N., Jorba, O., Eder, B., Giordano, L., Badia, A., Balzarini, A., Baro´, R., Bianconi, R., Chemel, C., Curci, G., Forkel, R., Jime´nez-Guerrero, P., Hirtl, M., Hodzic, A., Honzak, L., Im, U., Knote, C., Makar, P., Manders-Groot, A., van Meijgaard, E., Neal, L., Pe´rez, J.L., Pirovano, G., San Jose, R., Schro¨der, W., Sokhi, R.S., Syrakov, D., Torian, A., Tuccella, P., Werhahn, J., Wolke, R., Yahya, K., Zabkar, R., Zhang, Y., Hogrefe, C., Galmarini, S.: Comparative analysis of meteorological performance of coupled chemistry-meteorology models in the context of AQMEII phase 2 (2014) Atmospheric Environment, . Article in Press.
- Giordano, L., Brunner, D., Flemming, J., Hogrefe, C., Im, U., Bianconi, R., Badia, A., Balzarini, A., Baró, R., Chemel, C., Curci, G., Forkel, R., Jiménez-Guerrero, P., Hirtl, M., Hodzic, A., Honzak, L., Jorba, O., Knote, C., Kuenen, J.J.P., Makar, P.A., Manders-Groot, A., Neal, L., Pérez, J.L., Pirovano, G., Pouliot, G., San José, R., Savage, N., Schröder, W., Sokhi, R.S., Syrakov, D., Torian, A., Tuccella, P., Werhahn, J., Wolke, R., Yahya, K., Žabkar, R., Zhang, Y., Galmarini, S.: Assessment of the MACC reanalysis and its influence as chemical boundary conditions for regional air quality modeling in AQMEII-2 (2014) Atmospheric Environment, . Article in Press.
- Badia, A., Jorba, O.: Gas-phase evaluation of the online NMMB/BSC-CTM model over Europe for 2010 in the framework of the AQMEII-Phase2 project (2014) Atmospheric Environment, . Article in Press.
- Im, U., Bianconi, R., Solazzo, E., Kioutsioukis, I., Badia, A., Balzarini, A., Baró, R., Bellasio, R., Brunner, D., Chemel, C., Curci, G., Flemming, J., Forkel, R., Giordano, L., Jiménez-Guerrero, P., Hirtl, M., Hodzic, A., Honzak, L., Jorba, O., Knote, C., Kuenen, J.J.P., Makar, P.A., Manders-Groot, A., Neal, L., Pérez, J.L., Pirovano, G., Pouliot, G., San Jose, R., Savage, N., Schroder, W., Sokhi, R.S., Syrakov, D., Torian, A., Tuccella, P., Werhahn, J., Wolke, R., Yahya, K., Zabkar, R., Zhang, Y., Zhang, J., Hogrefe, C., Galmarini, S.: Evaluation of operational on-line-coupled regional air quality models over Europe and North America in the context of AQMEII phase 2. Part I: Ozone (2014) Atmospheric Environment, . Article in Press.
- Pandolfi, M., Querol, X., Alastuey, A., Jimenez, J.L., Jorba, O., Day, D., Ortega, A., Cubison, M.J., Comerõn, A., Sicard, M., Mohr, C., Prévôt, A.S.H., Minguillõn, M.C., Pey, J., Baldasano, J.M., Burkhart, J.F., Seco, R., Peñuelas, J., Van Drooge, B.L., Artiñano, B., Di Marco, C., Nemitz, E., Schallhart, S., Metzger, A., Hansel, A., Lorente, J., Ng, S., Jayne, J., Szidat, S.: Effects of sources and meteorology on particulate matter in the Western Mediterranean Basin: An overview of the DAURE campaign (2014) Journal of Geophysical Research: Atmospheres, 119 (8), pp. 4978-5010.
- Baklanov, A., Schlünzen, K., Suppan, P., Baldasano, J., Brunner, D., Aksoyoglu, S., Carmichael, G., Douros, J., Flemming, J., Forkel, R., Galmarini, S., Gauss, M., Grell, G., Hirtl, M., Joffre, S., Jorba, O., Kaas, E., Kaasik, M., Kallos, G., Kong, X., Korsholm, U., Kurganskiy, A., Kushta, J., Lohmann, U., Mahura, A., Manders-Groot, A., Maurizi, A., Moussiopoulos, N., Rao, S.T., Savage, N., Seigneur, C., Sokhi, R.S., Solazzo, E., Solomos, S., Sørensen, B., Tsegas, G., Vignati, E., Vogel, B., Zhang, Y.: Online coupled regional meteorology chemistry models in Europe: Current status and prospects (2014) Atmospheric Chemistry and Physics, 14 (1), pp. 317-398.
- Markomanolis, G.S., Jorba, O., Baldasano, J.M.: Performance analysis of an online atmospheric-chemistry global model with Paraver: Identification of scaling limitations (2014) Proceedings of the 2014 International Conference on High Performance Computing and Simulation, HPCS 2014, art. no. 6903763, pp. 738-745.
- Spada, M., Jorba, O., Pérez García-Pando, C., Janjic, Z., Baldasano, J.M.: Modeling and evaluation of the global sea-salt aerosol distribution: Sensitivity to emission schemes and resolution effects at coastal/orographic sites (2013) Atmospheric Chemistry and Physics, 13 (23), pp. 11735-11755.
- Marras, S., Moragues, M., Vázquez, M., Jorba, O., Houzeaux, G.: Simulations of moist convection by a variational multiscale stabilized finite element method (2013) Journal of Computational Physics, 252, pp. 195-218.
- Jorba, O., Pérez, C., Haustein, K., Janjic, Z., María Baldasano, J., Dabdub, D., Badia, A., Spada, M.: Multiscale Air Quality with the NMMB/BSC Chemical Transport Model (2013) NATO Science for Peace and Security Series C: Environmental Security, 137, pp. 315-320.
- Bricheno, L.M., Soret, A., Wolf, J., Jorba, O., Baldasano, J.M.: Effect of high-resolution meteorological forcing on nearshore wave and current model performance (2013) Journal of Atmospheric and Oceanic Technology, 30 (6), pp. 1021-1037.
- Jorba, O., Pandolfi, M., Spada, M., Baldasano, J.M., Pey, J., Alastuey, A., Arnold, D., Sicard, M., Artiñano, B., Revuelta, M.A., Querol, X.: Overview of the meteorology and transport patterns during the DAURE field campaign and their impact to PM observations (2013) Atmospheric Environment, 77, pp. 607-620.
- Loridan, T., Lindberg, F., Jorba, O., Kotthaus, S., Grossman-Clarke, S., Grimmond, C.S.B.: High Resolution Simulation of the Variability of Surface Energy Balance Fluxes Across Central London with Urban Zones for Energy Partitioning (2013) Boundary-Layer Meteorology, 147 (3), pp. 493-523.
- Marras, S., Moragues, M., Vázquez, M., Jorba, O., Houzeaux, G.: A variational multiscale stabilized finite element method for the solution of the Euler equations of nonhydrostatic stratified flows (2013) Journal of Computational Physics, 236 (1), pp. 380-407.
- Ritter, M., Müller, M.D., Jorba, O., Parlow, E., Liu, L.-J.S.: Impact of chemical and meteorological boundary and initial conditions on air quality modeling: WRF-Chem sensitivity evaluation for a European domain (2013) Meteorology and Atmospheric Physics, 119 (1-2), pp. 59-70.

PERSONAL INFORMATION

María Teresa Pay Pérez

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maria.pay@bsc.es

Sex Female | Date of birth 20/04/1982 | Nationality Spanish

WORK EXPERIENCE

2015-present Associate Lecturer at the University of Barcelona. Department of Genetics, Microbiology and Statistics.

2015-present Post-doctoral Research Scientist

Earth Science Department, Barcelona Supercomputing Center:

- Air quality modelling for Europe and Spain: forecast, evaluation and improvement
- Environmental impact assessment to support air quality policies

2013-2015 Post-doctoral Research Scientist

Laboratoire de Météorologie Dynamique, École Polytechnique, Palaiseau Cedex (France).

- Dynamical assessment of air pollution in Spain using CTMs: CMAQ and CHIMERE
- Application of models to assess about plans and measures to control air quality exceedances in Europe and Spain.

2012-2013 Post-doctoral Research Scientist

Earth Science Department, Barcelona Supercomputing Center

- Application of model to forecast air quality

2006-2011 Pre-doctoral Research Scientist

Earth Science Department, Barcelona Supercomputing Center

- Evaluation of regional air quality modeling system.
- Studying of bias-correction techniques for improving air quality forecast models.

EDUCATION AND TRAINING

2008-2011 PhD in Environmental Engineering
(Degree of European Doctor, Special Doctoral Award)
Technical University of Catalonia, Spain. Dissertation title: *Regional and urban evaluation of an air quality model in the European and Spanish domains*. Qualification: Cum Laude

2006-2008 Diploma of Advanced Studies (DEA) in Environmental Engineering
Technical University of Catalonia, Spain. Thesis title: *Regional and urban evaluation of an air quality model in the European and Iberian Peninsula domains*.

2000-2006 B.S. in Chemical Engineering
University of Murcia, Spain

PERSONAL SKILLS

Mother tongue(s): Spanish

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
	Official Languages School				

Levels: A1/2: Basic user - B1/2: Independent user - C1/2 Proficient user
Common European Framework of Reference for Languages

ADDITIONAL INFORMATION

Publications	**24 peer-reviewed papers (92% in Q1; h-index: 10; number of citations: 362, Scopus), 8 chapters in books/proceedings/reports, and 58 contributions to conferences/workshops (90% oral).** ▪ Pay, M.T., Gangoiti, G., Guevara, M., Napelenok, S., Querol, X., Jorba, O., Pérez García-Pando, C., 2018. A source apportionment assessment of ozone concentration in peak summer events over the Iberian Peninsula. Atmos. Chem. Phys., submitted. ▪ Schaap, M., Cuvelier, K., Hendriks, C., Bessagnet, B., Baldasano, J.M., Colette, A., Thunis, P., Karam, D., Fagerli, H, Graff, A., Kranenburg, R, Nyiri, A., Pay, M.T., Rouil, L., Schulz, M., Simpson, D., Stern, D., Terrenoire, E., Wind, P., 2015. Performance of European Chemistry Transport Models as function of horizontal resolution. Atmos. Environ., 112. ▪ Valverde, V., Pay, M.T., Baldasano, J.M., 2014. Circulation-type classification derived on a climatic basis to study air quality dynamics over the Iberian Peninsula. International Journal of Climatology ▪ Pay, M.T., Martínez, F., Guevara, M., Baldasano, J.M., 2014. Air quality forecasts at kilometer scale grid over Spanish complex terrains. Geosci. Model Dev., 7, 1979–1999 ▪ Guevara, M., Pay, M.T., Martínez, F., Soret, A., Denier van der Gon, H.A.C., Baldasano, J.M., 2014. Inter-comparison between HERMESv2.0 and TNO-MACC-II emission data using the CALIOPE air quality system (Spain). Atmos. Environ., 98, 134-145 ▪ Aguilera, I., Basagaña, X., Pay, M.T., Agis, D., Bouso, L., Foraster, M., Rivera, M., Baldasano, J.M., Künzli, N., 2013. Evaluation of the CALIOPE air quality forecasting system for epidemiological research: the example of NO2 in the province of Girona (Spain). Atmos Environ., 72, 134-141 ▪ Monteiro A, Carvalho A, Ribeiro I, Scotto M, Barbosa S, Alonso A, Baldasano JM, Pay MT, Miranda, AI, Borrego C, 2012. Trends in ozone concentrations in the Iberian Peninsula by quantile regression and clustering. Atmos Environ, 56, 184-193 ▪ Pay MT, Jiménez-Guerrero P, Baldasano JM, 2012. Assessing sensitivity regimes of secondary inorganic aerosol formation in Europe with the CALIOPE-EU modeling system. Atmos Environ, 51, 146-164. doi:10.1016/j.atmosenv.2012.01.027 ▪ Basart S, Pay MT, Jorba O, Pérez C, Jiménez-Guerrero P, Schulz M, Baldasano JM, 2012. Aerosol in the CALIOPE air quality modelling system: validation and analysis of PM levels, optical depths and chemical composition over Europe. Atmos Chem Phys, 12, 3363-3392 ▪ Pay MT, Jiménez-Guerrero P, Jorba O, Basart S, Pandolfi M, Querol X, Baldasano JM, 2012. Spatio-temporal variability of levels and speciation of particulate matter across Spain in the CALIOPE modeling system. Atmos Environ, 46, 376-396 ▪ Sicardi V, Ortiz J, Rincón A, Jorba O, Pay MT, Gassó S, Baldasano JM, 2012. Assessment of Kalman filter bias-adjustment technique to improve the simulation of ground-level ozone over Spain. Sci Total Environ, 416, 329-342 ▪ Borrego C, Monteiro A, Pay MT, Ribeiro I, Miranda AI, Basart S, Baldasano JM, 2011. How bias-correction can improve air quality forecast over Portugal. Atmos Environ, 45, 6629-6664 ▪ Jiménez-Guerrero P., Jorba O, Pay MT, Montávez JP, Jerez S, Gomez-Navarro JJ, Baldasano JM, 2011. Comparison of two different sea-salt aerosol schemes as implemented in air quality models applied to the Mediterranean basin. Atmos Chem Phys, 11, 4833-4850 ▪ Baldasano JM, Pay MT, Jorba O, Gassó S, Jiménez-Guerrero P, 2011. An annual assessment of air quality with the CALIOPE modeling system over Spain. Sci Total Environ, 409, 2163-2178 ▪ Pay MT, Jiménez-Guerrero P, Baldasano JM, 2011. Implementation of resuspension from paved roads for the improvement of CALIOPE air quality system in Spain. Atmos Environ, 45, 802-807 ▪ Pay MT, Piot M, Jorba O, Basart S, Gassó S, Jiménez-Guerrero P, Gonçalves M, Dabdub D, Baldasano JM, 2010. A full year evaluation of the CALIOPE-EU air quality system in Europe for 2004: a model study. Atmos. Environ, 44, 3322-3342
Honours and awards	▪ 2014: Special Doctoral Award from the Technical University of Catalonia (http://doctorat.upc.edu/tesis/premios-extraordinarios/convocatoria-2014-1) ▪ 2014-2016: Marie Curie fellow under the Beatriu de Pinós programme (BP-DGR 2011) ▪ 2007-2011: Competitive PhD fellowship form the Spanish Ministry of Science and Innovation for the Formation of Researchers (FPI)
Memberships	▪ Forum for air quality modelling in Europe (FAIRMODE)
Projects	**I have participated in 20 international and national projects (8 as PI). I have co-advised 2 PhD students (1 in progress).** ▪ **Title:** EURODELTA-III/**Participant institutions:** INERIS, TNO, EMEP, JRC, BSC among others / **Principal researcher:** Bertrand Bessagnet / **Funding agency:** no funding / **Duration:** from 01/2013 until present ▪ **Title:** Photochemical modelling to attribute emission sources and source regions to high particulate matter concentration in urban areas in Spain / **Participant institutions:** BSC / **Principal researcher:** Maria Teresa Pay / **Funding agency:** Spanish Ministry of Economy and Competitiveness / **Duration:** 01/01/2017 - 31/12/2019 ▪ **Title:** APPRAISAL: Integrated assessment of air pollution supporting the revision of EU air quality legislation / **Participant institutions:** Universidad de Brescia, JRC, BSC-CNS, among others. / **Principal researcher:** Maria Luisa Volta / **Funding agency:** European Commission (FP7) / **Duration:** from 01/2012 until 06/2013

PERSONAL INFORMATION

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https://impatti.sostenibilita.enea.it/en/people/mario-adani

Skype: madani_asa

Sex Male | Date of birth 04/08/1977 | Nationality Italian

WORK EXPERIENCE

12/2012-up to now:

Researcher

Italian National Agency for New Technologies, Energy and Sustainable Economic Development . (ENEA)

- Research activity in air quality modelling systems and data assimilation

Business or sector Public research Agency

04/2008-12/2012:

Researcher

National Institute for Geophysics and Volcanology (INGV)

- Research activity in ocean wave coupling systems

Business or sector Public research Institute

01/2008-3/2008:

Researcher

Euro-Mediterranean Center for Climate Change. (CMCC)

- Research activity in ocean data assimilation systems

Business or sector Research foundation

10/2002-09/2004:

Student fellowship

National Institute for Geophysics and Volcanology (INGV)

- Ocean data analysis

Business or sector Public research Institute

EDUCATION AND TRAINING

01/2005-12/2007

Ph.D Student in Geophisics

University of Bologna (UNIBO)

- Development of oceanographic re-analysis applied to Mediterranean Sea

01/2005-12/2007 8

Ph.D Student in Geophisics

University of Bologna (UNIBO)

- Thesis title: Reanalysis Techniques for the numerical modelling of the Mediterranean Sea Circulation

01/2005-12/2007 7

Degree in Marine environmental Science

University of Bologna (UNIBO)

- Thesis title: La variabilità della circolazione nel Mare Mediterraneo tramite l'analisi multivariata della varianza (The Mediterranean sea variability using multivariate variance analysis technique)

PERSONAL SKILLS

Mother tongue(s): Italian

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	B1	B1	B1	B1	B1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills

- Good communication skills acquired during national and international projects

Job-related skills

Good programming skills using Unix/Linux operating system Fortran, Matlab, NCL and related tools
Experience in High Performance computing and parallel programming
Experience using different Numerical Models: Ocean General Circulation Model NEMO, wave model WAM and WaveWatch III, Atmospheric Model WRF and WRF-CHEM, Chemical Transport Model FARM, Regional Climate Model RegCM.

ADDITIONAL INFORMATION

Selected Peer Review Publications not included in Annex

- Pinardi N., Zavatarelli M., Adani M., Coppini G., Fratianni C., Oddo P., Tonani M., Lyubartsev V., Dobricic S. and Bonaduce A., (2013) Mediterranean Sea large-scale low-frequency ocean variability and water mass formation rates from 1987 to 2007: a retrospective analysis, Progress in Oceanography, 132,318-332,doi: doi:10.1016/j.pocean.2013.11.003
- Adani M, Dobricic S, Pinardi N (2011). Quality Assessment of a 1985-2007 Mediterranean Sea Reanalysis. Journal of Atmospheric and Ocean Technology, vol. 28, p. 569-589, ISSN: 0739-0572, doi: 10.1175/2010JTECHO798.1.
- Pujol M.-I., Dobricic S., Pinardi N., Adani M. (2010): Multi-altimeter sea level assimilation in a numerical model : Impact on mesoscale structures in the Mediterranean Forecasting Model, Journal of Atmospheric and Ocean Technology, vol. 27, p. 2065-2082, ISSN: 0739-0572, doi: 10.1175/2010JTECHO715.1
- Oddo P., Adani M., Pinardi N., Fratianni C., Tonani M., Pettenuzzo D. (2009): A nested Atlantic-Mediterranean Sea general circulation model for operational forecasting, Ocean. Sci., 5,491-473.
- Dobricic S., Pinardi N., Adani M., Tonani M., Fratianni C., Bonazzi A., Fernandez V. (2006): Daily oceanographic analysis by the Mediterranean basin scale assimilation system. Ocean Sci., 3, 149–157.
- Dobricic S, Pinardi N, Adani M, Bonazzi A., Fratianni C, Tonani M (2005). Mediterranean Forecasting System: An improved assimilation scheme for sea-level anomaly and its validation. Q.J. Roy. Meteor. Soc., vol. 131, p. 3627-3642, ISSN: 0035-9009, doi: 10.1256/qj.05.100
- Dobricic S., Pinardi N., Adani M., Tonani M., Fratianni C. (2005): Mediterranean Forecasting System: An improved assimilation scheme for sea-level anomaly and its validation. Q.J. Roy. Meteor. Soc. 131,3627-3642, doi:.10.1256/qj.05.100

Projects

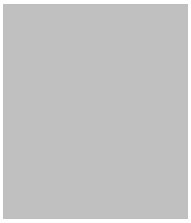
- NEMO Development Team
- MYOcean2 Reanalysis Production
- MyOcean: Development of wave-ocean interaction
- CIRCE: Development of a reanalysis tools.
- MFSTEP: Assesment of Mediterranean sea analysis and forecast
- Mersea St-1: Development of analysis tools for inter-comparison of model skills

Curriculum Vitae

GUIDO GUARNIERI

PERSONAL INFORMATION

Guido Guarnieri



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guido.guarnieri@enea.it

www.researchgate.net/profile/Guido_Guarnieri

Sex Male | Date of birth 09/11/1973| Nationality Italian

WORK EXPERIENCE

From November 2012

Researcher at ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development)
Research Center of Portici (NA) Italy

- Administration of Cresco HPC sytem (www.cresco.enea.it)

Research – High Performance Computing

EDUCATION AND TRAINING

04/02/2004

Computer Engineering Degree (101/110)

Università degli Studi del Sannio, Benevento, Italy

- Computer Technologies, Automation, Control of Physical Processes

PERSONAL SKILLS

Mother tongue(s) Italian

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	Good	Good	Good	Good	Good

Communication skills Good communication skills gained through my experience as researcher

Organisational / managerial skills Good attitude in group working

Job-related skills HPC sytems administration, Computer programming, Control Process Design, Parallel Programming

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient user	Indipendent user	Basic user	Proficient user	Proficient user

Driving licence B

ADDITIONAL INFORMATION

Publications The list of pubblication is avavilable at: www.researchgate.net/profile/Guido_Guarnieri

Presentations

Projects Cresco Project, Tedat Project

Conferences ISC 2013 in Leipzig, ISC 2017 in Frankfurt – ISC International Super Computing Conference

Seminars

Honours and awards

Memberships

References

Citations

Courses

Certifications

PERSONAL INFORMATION

LUISELLA CIANCARELLA

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https://impatti.sostenibilita.enea.it/en/people

Sex F | Date of birth 14/06/1957 | Nationality Italian

POSITION

Research Manager – ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development

WORK EXPERIENCE

2010 - present

Research Manager

ENEA -V.le Martiri di Monte Sole 4- 40128 BOLOGNA (I) (https://impatti.sostenibilita.enea.it/en/structure)

Head of Atmospheric Pollution Laboratory (ex Air Quality Laboratory)

The Unit develops state-of-the art integrated modeling tools on atmospheric pollution for current and future scenario analysis, using the most appropriate emissions inventories; both natural and anthropogenic emissions are considered. Integration with environmental impact assessment and cost-effectiveness analyses models allows to identify strategies and specific policies for short and long-term environmental sustainability and to support decision making process.
The Unit performs laboratory analysis and field experiments on air quality for the chemical and physical characterization of atmospheric pollutants, for the analysis of interaction between meteorology and aerosols and for the validation of the models.
Business or sector Air Pollution Modelling

2005 - 2010

Researcher

ENEA V.le Martiri di Monte Sole 4- 40128 BOLOGNA (I)

Impact and effectiveness assessment of air quality measures adopted by Regions in their Air Quality Management Plans to meet environmental targets. Application of Integrated Assessment Model (IAM) GAINS_ Italia, national version of GAINS Europe model developed by IIASA (International Institute for Applied Systems Analysis), modified by ENEA and applied on national domain with regional resolution.
Business or sector Air Pollution Modelling

2001 - 2005

Researcher

ENEA V.le Martiri di Monte Sole 4- 40128 BOLOGNA (I)

Responsible for the task “Methods and Technologies for the Environmental Assessment of Projects” in Management of Water Resources Unit in ENEA
Environmental assessment and pre-feasibility studies have been performed for water works and infrastructures designed in the Unit
Business or sector Environmental Impact Assessment

1986 - 2001

Researcher

ENEA V.le Martiri di Monte Sole 4- 40128 BOLOGNA (I)

Partecipation to European and National Projects always with the objective to put in place operationally the environmental sustainability concept in land and urban planning and to develop tools able to support environmental impact assessment:

- European Science Foundation (ESF) GISDATA Project (Geographic Information Systems, Data Integration And Database Design).
- Proyecto De Apoyo Al Desarollo Industrial Del Paraguay De Cara A Su Insercion En El Mercosur - II Stage (UE Cooperation Project with South America MERCOSUR Countries among which Paraguay).

1986 - 2001

– Fragile Ecosystems Project: national sites of particular relevance (Framework Agreement Ministry of University and Research-ENEA1997-1999).
– ALLIANCE Project – (Employment NOW 1997 – 2000)
– SUSTAINABLE CITIES PROJECT (Framework Agreement Ministry of Environment-ENEA).
– 21 AGENDA FOR SMALL SIZE CITIES (Framework Agreement Ministry of Environment-ENEA).

Business or sector Environmental Impact Assessment

1984 - 1986

Researcher
ENEA V.le Martiri di Monte Sole 4- 40128 BOLOGNA (I)
Environmental Impact Assessment of fast reactor PEC (Test of Fuel Elements) at the ENEA Research Center of Brasimone (BO). Research and development of Environmental Impact Assessment models both in normal operating conditions and incidental ones.
Business or sector Environmental Impact Assessment

EDUCATION AND TRAINING

1983 - 1988

License

Italian Ministry of Welfare
Physical surveillance of protection from radiations. Licensed to practice Radiation Protection Qualified Expert profession (2° level of authorization)

1982

Specialization School in Sanitary Physics

University of Bologna

1981

Degree in Physics

Alma Mater Studiorum, University of Bologna – Bologna - Italy

PERSONAL SKILLS

Mother tongue(s): Italian

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	B1	B1	C1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2 Proficient user
Common European Framework of Reference for Languages

Communication skills: ABILITY TO COMMUNICATE SCIENTIFIC THEMES AND RESULTS. EXPERIENCES OF PARTECIPATED DECISION PROCESSES AND KNOWLEDGE OF FACILITATION TECHNIQUES

Organisational / managerial skills: COORDINATIONS OF SCIENTIFIC ACTIVITIES AND GROUPS HAS BEEN REPORTED IN THE WORK EXPERIENCE SECTION

Job-related skills: GOOD ATTITUDE TO TEAMWORK.

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Independent user	Proficient user	Independent user	Independent user	Independent user

Levels: Basic user - Independent user - Proficient user
Digital competences - Self-assessment grid

- Operating systems: Windows
- Microsoft Office tools: Word, Excel, PowerPoint.
- GIS tools: ESRI ArcGIS; QGis

Driving licence: B

ADDITIONAL INFORMATION

Publications: A list of the relevant publications of ENEA–SSPT–MET –INAT Laboratory is annexed.