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Copernicus Atmosphere Monitoring Service

Proposal for CAMS-81:
Global and Regional Emissions

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1 Track Record

The coordinating institute (CNRS) and all the institutes who are partners of this project have a strong experience in the fields included in the call, i.e. the quantification of anthropogenic and natural emissions, their evaluation and consistency, and in providing access to different types of emissions through user-friendly databases. All partners have a large experience in the delivery of datasets and their associated documentation in a timely manner. Many of the partners have also worked together previously in different national and international projects, which will ensure excellent collaborations between the members of the group. Through their involvements in several international bodies, the partners will furthermore ensure a strong synergy between the work done as part of CAMS-81 and international programs.

Six out of the nine consortium members were involved in the previous projects which prepared the Copernicus Atmospheric Service, i.e. the GEMS, MACC, MACC-II and MACC-III projects. The emissions datasets that have been developed as part of these projects, such as MACCity, TNO-MACC, MEGAN-MACC have become a reference for many international projects and have now a very large number of users.

Many of the consortium partners are also providers in different CAMS service elements, which will ensure good communications between the CAMS-81 work (development and delivery of emissions data, evaluation of their consistency) and the users of the datasets in the other service elements: CNRS-Laboratoire d'Aérologie, MET Norway and BSC are providers in CAMS-84 (Validation activities), TNO is a provider in CAMS-73 (Greenhouse gases fluxes), MPIC is coordinating the CAMS-44 element (Fires Developments). MET Norway and FMI are providers in CAMS-50 (Regional Production), MET Norway is a provider in CAMS-43 (Aerosol developments), TNO and MET Norway are providers in CAMS-71 (Products in support of policy users) and FMI is a provider in CAMS-72 (Solar radiation). All these involvements of the CAMS-81 partners in other CAMS service elements will provide links and synergies and improve the use of the data developed in CAMS-81 for the entire CAMS system. BSC is furthermore involved in the Copernicus Climate Change Services (i.e. C3S 34a Lot 2, C3S 52 Lot 2, C3S 441 Lot 2).

The CAMS-81 partnership consists of the following institutes, which have all a proven experience in developing emission datasets, in their analysis and delivery, as shown in Sections 1.2 to 1.11:

1 The National Centre for Scientific Research (CNRS)
  - CNRS – LA: Laboratoire d'Aérologie
  - CNRS – OMP: Midi-Pyrénées Observatory
2 The Netherlands Organisation for Applied Scientific Research (TNO)
3 The Norwegian Meteorological Institute (MET Norway)
4 The Charles University (CUNI)
5 The Finnish Meteorological Institute (FMI)
6 The Barcelona Supercomputing Center (BSC)
7 The Max-Planck Institute for Chemistry (MPIC)
8 The Environment Agency Austria (EAA)
9 The Chalmers University of Technology (Chalmers)

As described in more detail in the following sections, all the members of the consortium have been involved for a long time in the determination of surface emissions of different types. The partners have been carefully selected, based on their experience in the determination of anthropogenic and

natural emissions, and on their access and contacts with the users of the datasets. They all have complementary experience in the different themes of the project, which ensures the success of the project and the delivery of all deliverables in a timely manner.

CNRS has a large experience in the quantification of surface emissions in different parts of the world, and in the use of emissions datasets in atmospheric chemistry modelling. **CNRS-LA** has also coordinated international projects dealing with surface emissions, the analysis of atmospheric composition, and the interactions with users. CNRS has developed the MACCity global inventory which was used in the simulations of the MACC projects. MACCity is also used in different European and international projects.
CNRS-OMP has developed the ECCAD database, which has now more than 2,500 users and was essential in having the inventories developed as part of MACC (MACCity, TNO-MACC and MEGAN-MACC) considered as reference datasets in several international projects.
TNO has a very long experience in quantifying emissions from different sources, in the development of inventories and in the quantification of the impact of legislation on emissions. TNO has developed the TNO-MACC, TNO-MACCII and TNO-MACCIII inventories which are now used in the CAMS regional simulations and in several other European and international projects.
The strengths and experience of **MET Norway** lie mainly within the parameterization of natural emissions and air quality modelling. They have several decades of experience under the LRTAP convention and the science-policy interface and operational services.
The Department of Atmospheric Physics of **CUNI** has a strong experience in the quantification of natural emissions at the global scale, and in the impact of regional emissions on air quality and climate using chemistry-transport modelling.
FMI is one of the most experienced groups in Europe in the quantification of ship emission inventories based on actual ship movements. This work allows the determination of full geographical and temporal variation of ship emissions on a global level.
BSC has a wide experience in global and regional atmospheric chemistry modelling and particularly in the development of high spatial and temporal resolution emission models, as well as in the parameterizations of anthropogenic emissions.
MPIC is leading the CAMS service element CAMS-44, on the determination of the emissions from fires. MPIC has a long experience in the determination of fire emissions, and is leading the development of the operational GFAS fire product.
Umweltbundesamt (EAA) has a long time experience in processing of air emission inventory data (air pollutants and GHGs) like collection, management and review, including expert estimates and spatial resolution of emissions. Through hosting EMEP/CEIP and being partner in the European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM), it is in the position to act as an interface between science and policy in the area of air emission reporting and can use its direct contacts to the air emission inventory community to feedback results of the project to an important user group.
Chalmers is expert in the development of instruments and measurement strategies for volcanic gas measurements, and in the determination of emissions from volcanoes

1.1 Track record of the National Centre for Scientific Research (CNRS) CNRS-Laboratoire d'Aérologie (CNRS-LA) and CNRS-Observatoire Midi-Pyrénées (CNRS-OMP)

The National Centre for Scientific Research (in French: Centre National de la Recherche Scientifique) is a public organisation for scientific and technological research and is under the authority of the French Ministry for Research. CNRS is the largest fundamental research organisation in Europe. Measured by the amount of human and material resources it commits to a great range of disciplines, CNRS is clearly the hub of research activity in France. It is also an important breeding ground for scientific and technological innovation. The main tasks of CNRS are: the development of knowledge, its transfer to and its application in enterprises and all domains contributing to the progress of society, the dissemination of information and of scientific and technical culture to the public, and especially towards young people, the participation in early training and life-long training, training by research, and quality in the research management. CNRS was the first French research organisation to sign the European "Charter of Researcher" in 2005.
The scientists leading the CAMS-81 consortium and working in the project are part of two different groups, the "Laboratoire d'Aérologie", and the "Observatoire Midi-Pyrénées:

- CNRS-LA: the Laboratoire d'Aérologie (LA), is a Joint Research Unit of University between CNRS and the University of Toulouse. The laboratory has a long and well-known experience in the field of atmospheric sciences. The scientific objectives of LA concern the observation, the understanding and the numerical modelling of dynamic, physical and chemical processes controlling the evolution of the atmosphere. The LA is well recognized internationally for its long experience in the development of emission inventories from regional to global scales and for the analysis of atmospheric modelling studies. The reputation of LA lies in the innovation and maintenance of observing networks, such as the observation of tropospheric gases aboard commercial aircrafts (IAGOS) and the INDAAF African network.
  The Laboratoire d'Aerologie, has been involved in the series of CAMS precursors projects, i.e. GEMS, MACC, MACC-II, and MACC-III. Claire Granier has been the coordinator of the emissions sub-project in all these projects. She was also the deputy-coordinator of MACC, MACC-II and MACC-III.
  CNRS-LA scientists have been involved in the preparation, management and exploitation of international scientific programs such as the AMMA EU-FP6 and the on-going DACCIWA (EU-FP7) projects in West Africa or MISTRALS (2011-2015) in the Mediterranean region. The emission dataset under development as part of DACCIWA for Africa will be used in CAMS-81. CNRS-LA is coordinating the ECOINNOV (European regional project on the emissions from residential fuelwood combustion
  CNRS-LA has also been part of the management teams of the European ACCENT and ACCENT-Plus networks (2005-2014), and in the CityZEN, PEGASOS, and PANDA FP-7 projects, where they were in charge of the coordination of the work concerning surface emissions.

- CNRS-OMP (Midi-Pyrénées Observatory) is a group of CNRS laboratories dedicated to research on the Universe, the Earth, and the environment. These missions cover a large panel from research, observation, education, diffusion of scientific knowledge, to international cooperation. CNRS-OMP is a unit under the umbrella of CNRS and its National Institute for Earth Sciences and Astronomy (INSU), of the French National Center for Space Studies (CNES), of the French National Research Institute for Sustainable Development (IRD), and the French Meteorological Center (Meteo-France). One of the height units of OMP is SEDOO (Observatoire Midi-Pyrénées Data

Service, SEDOO): this service data centre is dedicated to environmental data management and data distribution for international and multidisciplinary projects. It was for example involved in European FP6 and FP7 projects such as AMMA (African Monsoon Multidisciplinary Analyses) and the ACCENT and ACCENT-Plus networks. SEDOO has also developed the website and database for the MISTRALS (Mediterranean Integrated Studies at Regional and Local Scales) multidisciplinary project. The CNRS-OMP team is specialized in the development of web applications and generic databases that enable to store and distribute datasets (field campaign observations, long term monitoring networks) through data portals. CNRS-OMP is in charge of the IAGOS (In-Service Aircraft for a Global Observing System) international portal and database. IAGOS is a research program conducting long-term observations of atmospheric composition, aerosol and cloud particles on a global scale from commercial aircraft of internationally operating airlines. The near-real time IAGOS observations are used in the CAMS-84 (Validation) service element.

Both CNRS-LA and CNRS-OMP teams are also strongly involved in the Global Emissions InitiAtive (GEIA) international program on emissions: C. Granier is the GEIA databases manager, and C. Granier and C. Liousse are both members of the GEIA steering committee.

CNRS-LA and CNRS-OMP have been in charge of the development of the ECCAD (Emissions of Atmospheric Compounds & Compilation of Ancillary Data) portal for the past years. ECCAD is the data base of the international GEIA program (Global Emission InitiAtive) and allows an easy access to global and regional emission inventories and tools for on-line data analysis and comparison. C. Granier and C. Liousse are the scientific directors of the ECCAD (Emissions of Atmospheric Compounds and Compilation of Ancillary Data) database. Sabine Darras and François André are responsible for the technical development of ECCAD. The ECCAD database has been developed during the past ten years. It is now well established, and has about 2500 users from more than 800 institutions countries all over the world. A new version of the ECCAD database will be launched in December 2016, with more functionalities and tools: this new version of the database will be used in CAMS-81.

1.2 Track record of the Netherlands Organisation for Applied Scientific Research (TNO)

TNO is the Netherlands Organisation for Applied Scientific Research. TNO is the largest fully independent Research, Development and Consultancy organisation in the Netherlands with a staff of about 3,000 and a total annual turnover of more than 500 million Euros. It derives a significant portion of its contract R&D from foreign private sector, governments and international organisations. TNO's primary tasks are to support and assist trade and industry including SME's, governments and others in technological innovation and in solving problems by rendering services and transferring knowledge and expertise. TNO participates in many EU programmes aiming at technological development. TNO has conducted co-operation agreements with many foreign research institutes and companies in Western, Central and Eastern Europe, USA, Canada, Japan and India.

The expertise group Climate, Air and Sustainability (CAS) is an expert centre and contract research unit for industry and government in the field of sustainable development and environmentally oriented process innovation. The expertise group investigates the processing of anthropogenic pollutants in the atmosphere and their influence on the environment and climate change. TNO has multiple decades of experience in quantifying emissions from various technologies and their characteristics, constructing emission inventories using all this input, and the impacts of legislation on the emission characteristics. TNO also has decades experience in translating emissions into air pollution concentrations at local, national and European scale as well as impact assessments using various modelling tools, including local and regional scale air quality models at European level. TNO has ample experience with the use of observed air pollutant concentrations in ambient air, amongst others in comparison to modelled values.

The emission expertise of the expertise group CAS is built up in research projects (many funded by FP7/H2020 e.g. ENERGEO, MEGAPOLI, EUCAARI, MACC) where a.o. high resolution gridded emission data on the European scale were prepared as input for air quality modellers. Furthermore, since 1974 TNO has been strongly involved in the annual compilation of the Dutch emission inventory. TNO is commissioned by the National Institute for Public Health and heavily involved in development of new methodologies and the international reporting of emission figures to the EU, UNECE and UNFCCC. Translating emissions into air pollution concentrations at local, national and European scale as well as impact assessments using various modelling tools (a.o. Lotos-Euros, CAR) is another key strength of TNO.

This expertise is applied in research and policy evaluation assessment studies for national and European wide organisations (a.o. EU DG Environment/DG Climate Action, DG RTD, various national governments in Europe, local and regional governments).

The professional staff is active in the following fields related to air pollution, i.e. emission inventories and reporting, policy development and evaluation, air quality modelling, impact assessment, cost benefit analysis, protection technologies.

The three members of TNO who will work on the CAMS-81 project, H. Denier van der Gon, J. Kuenen and A. Visschedijk have a long experience in the development of inventories, in the analysis of emissions from a large variety of sources and in the interactions of users. They have developed the TNO-MACC, TNO-MACCII and TNO-MACCIII inventories, which are now used as a reference in the CAMS regional models and in other European projects.

1.3 Track record of the Norwegian Meteorological Institute (MET Norway)

The Norwegian Meteorological Institute (MET Norway) is the national meteorological service of Norway and represents Norway in ECMWF, EUMETSAT, EUMETNET, WMO and other international forums. It takes part in numerous international projects 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 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, e.g. daily operational air pollution forecasts and analyses as well as emergency modelling in the case of volcanic eruptions or nuclear accidents. 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 on global to regional scales, following, e.g. volcanic eruptions or nuclear accidents.

For several decades, MET Norway has been hosting the Meteorological Synthesizing Centre – West (MSC-W), which is one of the scientific centres within the European Monitoring and Evaluation Programme (EMEP) under the UN Convention on Long-range Transboundary Air Pollution (CLRTAP). EMEP provides the technical underpinning for air pollution policies within CLRTAP and also for the EU. Until 2006 MET Norway was the main responsible for collecting officially reported emission data from the Parties to CLRTAP and for gap filling emission data. Since then MET Norway has continued its work on biogenic emission modelling and estimations of other emissions e.g. from volcanoes, nuclear accident emissions, sea salt, wind-blown dust, etc. It also participated in the emission sub-projects of the MACC projects. MET Norway also hosts the AeroCom project, which is a platform of model and observational data but also collects emission data for multi-model experiments.

MET Norway was involved in all precursor projects of CAMS (from GEMS to MACC-III), mainly taking part in the establishment of the Regional Air Quality service (air quality forecasting and analyses, both operational tasks and R&D), but also contributing substantially to the policy interface (which MET Norway was coordinating), and to aerosol modelling and model evaluation.

At least three employees will contribute to CAMS-81 in the proposed project. D. Simpson has a long track-record in air quality modelling and biogenic emissions. H. Fagerli is the leader of the Division of Climate Modelling and Air Pollution at MET Norway, and she is also the coordinator of the national volcanic ash project. M. Gauss has substantial experience with MACC (former member of management board) and CAMS (leader of MET Norway contribution to CAMS-50), but also with emissions e.g. from ships (in 2016 he wrote a chapter about European ship emissions to the EMEP status report to CLRTAP). Experienced technical staff includes people involved in volcanic ash modelling and Earth system modelling for natural emissions from oceans.

1.4 Track record of the Charles University (CUNI)

Charles University (CUNI) is the largest university institution in Czech Republic covering education in the full spectrum of fields including medicine, law, theology, art, natural sciences, mathematics and physics. CUNI is a platform for broad research activities as it supports research teams at individual faculties, enhances collaboration with international research institutions, supports participation in national and international research projects and promotes incorporation of research results into teaching.

The Department of Atmospheric Physics is part of the Faculty of Mathematics and Physics and provides education and training in meteorology, climatology, atmospheric chemistry and physics. Its research activities focus on studying climate variability in the past and in the future by analysing observational data and simulating climate with regional and global models. The department has a strong base in modelling atmospheric transport and chemistry, linking atmospheric chemistry to climate, studying impacts of emissions on regional air quality, forcing of urban land-surfaces and long-term impact of urban emissions. Other research activities focus on numerical modelling of turbulent flow including modelling of air-pollution transport in complex terrain and direct eddy simulations in street canyons.

The department played an active role in several international European research projects of the 6th and 7th European Framework Programmes. These projects focused on regional climate modelling, impact of climate change on regional scale (CECILIA), development of an ensemble prediction system for climate change based on regional and global models (ENSEMBLES), quantifying the impact of transportation on climate in Europe (QUANTIFY), assessment of the impact of transport emissions on climate change and ozone depletion (ATTICA), studying interactions between megacities, air quality and climate (MEGAPOLI). Recently, the department was involved in project sponsored by the Central Europe Program of EU, which monitored and evaluated the interactions of urban heat islands of metropolitan areas in Central Europe with global climate change (UHI).

Former post-doc and long-term collaborator of the Department of Atmospheric Physics, Katerina Sindelarova, has participated on the MACC-II and MACC-III projects as a member of an emission sub-project group (post-doc at LATMOS-UPMC, France). She worked on the development of the long-term global inventory of biogenic VOC emissions (MEGAN-MACC), studied sensitivity of BVOCs on environmental factors and impact of these compounds on atmospheric chemical composition. She also participated on evaluation of global and regional anthropogenic and biomass burning emissions datasets.

1.5 Track record of the Finnish Meteorological Institute (FMI)

FMI conducts research of a high international standard in the fields of meteorology, marine sciences, air quality, space physics and earth observation ad also carries out competitive business specialised in expert services, both in Finland and abroad, and contributes actively to national and international cooperation in its field. It also works to keep decision-makers, industry and the general public constantly informed of issues associated with the atmosphere, seas and near space.
Atmospheric composition research unit studies and observes the physical and chemical properties of aerosol particles and trace gases effecting climate and air quality. The main research themes of the unit include also the development of air quality models and their validation; the modelling of urban air quality and exposure, the regional and long-range transport of pollutants, accidents involving hazardous and radioactive materials and the integration of meteorological models and measurements with air quality modelling systems (data fusion).
Current projects of the Atmospheric Composition Unit involve 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 a National and two Nordic Centres of Excellence), and assessment and modelling of airborne pollutants (including also pollen, volcanic ash, smoke from forest fires) from the local to the continental scale. FMI/Dispersion Modelling Group has a very strong expertise in recent and ongoing European Research projects including: EU/FUMAPEX, EU/OSCAR, EU/PROMOTE, EU/CAIR4HEALTH, EU/MARQUIS, EU/HENVINET, EU/HIALINE, EU/MEGAPOLI, EU/PESCaDO, EU/PEGASOS EU/TRANSPHORM, EU/BSR InnoShip, ESA/Samba, ESA/Atila, EU/Interreg/SNOOP, EU/PASODOBLE, EU/PBL-PMES, ESA/VAST, ESA/SMASH, EU/MarcoPolo, NordicCenterofExcellence/EmblA, NordForsk/Nordic Welfair, BSR/Bonus/Sheba, EU/Interreg/EnviSum, ESA/GlobalEmission, EU/Copernicus User Uptake, EU/GEMS; EU/MACC I,II and III , CAMS:Regional production (CAMS_50).
Dispersion modelling team has participated in the development of European Air Quality Monitoring and Forecasting Service (CAMS_50) from the very beginning (GEMS-> MACC I-II-III) and is now one of the teams providing operatively model results (SILAM-FMI) for the European-scale air quality forecast based on the model ensemble. In these projects FMI has had a very important role especially in modelling the global scale shipping emissions, forest fire emissions, sea salt emissions and regional scale pollen emissions

Dr. Jukka-Pekka Jalkanen has worked as the leader of ship emission modelling team within the dispersion modelling group of the FMI for a decade. Dr Jalkanen and Mr Lasse Johansson represent the state of the art development in ship emission research with strong contribution to maritime environmental policy support. The annual emission reporting of Baltic Sea shipping for Helcom member states, background studies for NOx Emission Control Areas applications for both the Baltic Sea and the North Sea regions and the 3rd IMO GHG study had significant contribution from FMI ship emission research.

1.6 Track record of the Barcelona Supercomputing Centre (BSC)

The Barcelona Supercomputing Centre (BSC) is the Spanish national supercomputing facility and a hosting member of the PRACE distributed supercomputing infrastructure. The Centre houses MareNostrum, one of the most powerful supercomputers in Europe. The mission of BSC is to research, develop and manage information technologies in order to facilitate scientific progress. BSC combines HPC service provision, and R&D into both computer and computational science (life, earth and engineering sciences) under one roof.

The BSC Earth Sciences Department (ES-BSC) focuses on high-resolution air quality and meteorological modelling, global and regional mineral dust modelling as well as global and regional climate modelling. 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 ES-BSC currently hosts the CALIOPE air quality forecast system (http://www.bsc.es/caliope), the Barcelona Dust Forecast Centre (http://dust.aemet.es/) and 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/). 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 online multi-scale NMMB/BSC Chemical Transport Model, which has participated in the AQMEII-Phase2 intercomparison exercise and provides routine products of global aerosols to the ICAP multi-model ensemble. The ES-BSC has developed high resolution anthropogenic emission models (i.e HERMES, HERMES-Mex) in collaboration with the Spanish Ministry for Environment and the Mexico City's Secretariat of the Environment. The resulting models constitute the emission core of operational air quality forecast systems (e.g. CALIOPE) and are also used to perform emission scenario analysis for the evaluation of air quality management strategies.

The group has a strong experience in the combination of bottom-up and top-down emission estimation approaches, as well as in the development of spatial, temporal and speciation profiles for creating air quality model-ready emissions. The ES-BSC has performed emission intercomparison exercises using MACC products (i.e. TNO_MACC emission inventories). The spatial and temporal adaptation of emission datasets to evaluate the performance of air quality models at the global and regional scales (e.g. EURODELTA III exercise) is another strength of the group. The ES-BSC has also developed global dust and sea salt emission schemes under research projects financed by the Spanish Commission of Science and Technology.

The expertise of the ES-BSC in atmospheric chemistry modelling is the result of the group's participation in several European and international projects, including: FIELD_AC (FP7-SPACE-2009-1), ACTRIS (FP7-INFRASTRUCTURES-2010-1), APPRAISAL (FP7-ENV-2012-one-stage), IS-ENES2 (FP7-INFRASTRUCTURES-2012-1), RethinkBig (FP7-ICT-2013-11), ACTRIS-2 (H2020-INFRAIA-2014-2015), AQFS-MexDF (Mexico City's Secretariat of the Environment 2015, public grant). BSC has participated in MACC (i.e. MACC/O-INT/01) and is currently involved in the CAMS-84 as well as in several Copernicus Climate Change Services (i.e. C3S 34a Lot 2, C3S 52 Lot 2, C3S 441 Lot 2).

Dr. Marc Guevara is the coordinator of the emission modelling research line at ES-BSC, and he is also the co-chair of the Urban Emission Working Group under FAIRMODE. Dr. Oriol Jorba has a long track-record in meteorology and air quality modelling. Dr. Carlos Pérez is the leader of the Atmospheric Composition group at ES-BSC, and he is also an AXA Professor on Sand and Dust Storms and a Ramón y Cajal Fellow.

1.7 Track record of The Max-Planck Institute for Chemistry (MPIC)

The Max Planck Institute for Chemistry (MPIC, www.mpic.de) is one of the 82 research institutes of the Max Planck Society for the Advancement of Science (MPG, www.mpg.de). The MPG is an independent, non-profit research organisation, which was founded in 1948. The Max Planck Institutes focus on excellence in research. The Max Planck Society has a world-leading reputation as a science and technology research organisation. Since its establishment, 18 Nobel laureates have emerged from the ranks of its scientists. The more than 15,000 publications each year in internationally renowned scientific journals are proof of the outstanding research work conducted at Max Planck Institutes. Max Planck Institutes focus on research fields that are particularly innovative, or that are especially demanding in terms of funding or time requirements. They perform fundamental research in the interest of the general public in the natural sciences, life sciences, social sciences, and the humanities.
The Max Planck Institute for Chemistry (MPIC, www.mpic.de) in Mainz is the oldest institute of the MPG. It has pioneered research in atmospheric chemistry since the 1960s and in emissions from biomass burning since the 1980s, and it still occupies a world-leading position in these fields. Its former director Prof. Paul Crutzen received the Nobel Prize for Chemistry in 1995. Current research at the Max Planck Institute for Chemistry in Mainz aims at an integral understanding of chemical processes in the Earth system, particularly in the atmosphere and biosphere. Investigations address a wide range of interactions between air, water, soil, life and climate in the course of Earth history up to today's human-driven epoch, the Anthropocene.

The Atmospheric Chemistry department investigates the large-scale atmospheric environment using mobile platforms, especially aircraft, to gain insight into interdependencies between emissions, chemical conversions and atmospheric transport. The scientists use and develop highly advanced instruments and methods. Laboratory and field measurements are accompanied by model calculations to understand the controlling processes, integrate their effects and help identify key feedback mechanisms. A hierarchy of local process to regional and global modelling is employed to use the measurement data in studies of atmospheric composition change on a range of scales. A recent focus is on impacts on global air quality and climate.

The Fire Emissions group of Dr. Kaiser has recently been created in the Atmospheric Chemistry department of MPIC to continue research on biomass burning at the interface of the different departments and independent groups that make up MPIC.

1.8 Track record of the Environment Agency Austria (EAA)

The Environment Agency Austria (EAA; Umweltbundesamt) deals with all environmental issues. Beside developing environmental strategic perspectives in order to provide support to environmental policy in Austria, EAA with its roughly 480 employees acts as partner and adviser of international organisations such as the EU Commission, the European Environment Agency, UNEP, OECD and ECE.

In the area of air emissions EAA has many years of experience in air emission inventory data (air pollutants and GHGs) collection, management and review through being partner in the ETC/ACM (European Topic Centre for Air Pollution and Climate Change Mitigation hosting) and through hosting the European Monitoring and Evaluation Programme (EMEP) Centre on Emission Inventories and Projections (CEIP). The EMEP is a scientifically based and policy driven programme under the CLRTAP (Convention on Long-range Transboundary Air Pollution) for international co-operation to solve transboundary air pollution problems.

The EEA staff involved in the CAMS-81 proposal all work for CEIP. The main tasks of CEIP are (1) collecting emissions and projections of acidifying air pollutants, heavy metals, particulate matter and photochemical oxidants from Parties to the LRTAP Convention, (2) reviewing submitted inventories in order to improve the quality of reported data (and keeping a long term record of review findings from the detailed checks), (3) preparing gridded data sets as input for long-range transport models, (4) providing support to the Parties, the UNECE secretariat and EMEP Implementation Committee. CEIP also operates the UNECE/EMEP emission database (WebDab) which contains information on emissions and projections from all Parties to the LRTAP Convention. The new EMEP domain covers the geographic area between 30°N-82°N latitude and 30°W-90°E longitude. CEIP closely cooperates on the improvement of gridded data sets from international modellers as well as with organisations like IIASA, JRC, TFEIP and AMAP. In addition, EAA has experience with the review of E-PRTR data (since 2007) and its use in spatial distribution of emissions.

The data EAA/CEIP is processing for the EMEP domain are

- official sectoral emissions of 21 air pollutants as submitted by Parties,
- emissions as used in EMEP models (reported data gap-filled with expert estimates),
- reported gridded emissions in 50x50km² and 0.1° x 0.1° (long-lat) resolution on GNFR sector level,
- gap-filled gridded emissions as used in EMEP models for SO_x, NO_x, NMVOC, NH_3, CO, $PM_{2.5}$, PM_{10} and PM_{coarse} in 0.1° x 0.1° (long-lat) geographical coordinates on GNFR sector level and in 50x50km² on SNAP sector level (1990 onwards),
- information on black carbon (BC) emissions from 29 European countries,
- data set of large point sources (LPS),
- officially reported activity data and emission factors

Katarina Mareckova has been an air quality and GHG expert for over 40 years and worked within different organisations, among them IPCC, UNOPS and the Umweltbundesamt GmbH. Since 2008 she leads the EMEP centre CEIP. Sabine Schindlbacher has plenty of experience in the compilation and management of international air emission inventory datasets, as a lead author of the European Union LRTAP Convention Inventory Report and the European Union NEC Directive Status Report for several years and through writing papers and preparing data sets for the EMEP Centre CEIP. Robert Wankmüller is the data manager, software-developer and system-administrator of the EMEP Centre of CEIP since 2008. He is responsible for the emission database, the preparation of datasets for long-range transport models, communication to the parties and the development of the EMEP gridding system for sectoral emissions.

1.9 Track record of the Chalmers University of Technology (Chalmers)

Chalmers University is one of Sweden's leading technical universities with about 10 000 students and 3000 employees. The Department of Earth and Space Sciences conducts basic and applied research related to remote sensing of Earth and space using spectroscopic methods throughout the electromagnetic spectrum. A main activity is radio astronomy conducted at Onsala Space Observatory. Other research includes satellite studies of the atmospheric composition and studies of sea ice and biomass using airborne radar systems.

The Optical Remote Sensing group (ORS) is working with development and application of ground-based optical remote sensing methods for atmospheric research. The work is very international and field oriented, and spans a large variety of disciplines, including research related to stratospheric ozone depletion, urban air chemistry, biogenic climate gas emissions and emissions from industry and shipping. During the last 15 years an important activity has been the development of instruments and measurement strategies for volcanic gas measurements. This includes coordinating the EU projects DORSIVA (*Development of Optical Remote Sensing Instruments for Volcanic Applications, 2002-2005*) and NOVAC (*Network for Observation of Volcanic and Atmospheric Change, 2005-2010*). In the DORSIVA project new instruments and measuring strategies for volcanic gas monitoring were developed. One of these instruments, the scanning mini-DOAS, made possible automatic, real-time, time-resolved measurement of SO_2 gas flux from volcanoes, thereby providing a new parameter for volcano research and risk assessment. Chalmers versions of this instrument are today in routine operation at 38 volcanoes worldwide. Data from this network (NOVAC) is collected in an archive at Chalmers that today comprises more then 4 million emission measurements acquired during the past 10 years.
Since 2014 the group is also involved in the DECADE (*Volcanic Deep Earth Carbon Degassing*) project. This is an international initiative aiming at significantly improving our knowledge about emission of CO_2 from volcanoes (https://deepcarbon.net/group/decade-volcanic-deep-earth-carbon-degassing). The strategy chosen is to measure the ratio CO_2/SO_2 with in-situ instruments located in the volcanic gas plume, and then measure the emission of SO_2 using ScanDOAS technique. By scaling the CO_2 emission is obtained. Until today about 10 NOVAC volcanoes have been studied, and the number is increasing.
Halogens from volcanoes can also be measured with ground based remote sensing. BrO can be derived from NOVAC spectra, while HCl and HF can be measured with different FTIR techniques. Chalmers also has experience on this and have so far obtained data on halogens from about 10 of the NOVAC volcanoes.
Chalmers main task in this project is to provide the data on volcanic SO_2 emission from the NOVAC archive to the CAMS-81 data-base. To derive the gas emission, knowledge of the plume speed at plume height is needed. This will be provided in an accurate and consistent way by using data from meteorological modelling obtained from MET Norway. Regarding emission of CO_2 and halogens we will provide estimates from the NOVAC volcanoes, based on the own data available, complemented by a literature survey.
Dr. Bo Galle, leader of the ORS, has 40 years' experience in development and application of various ground based remote sensing techniques for atmospheric studies, including Lidar, FTIR and DOAS spectroscopy. He has coordinated 2 EU-projects related to volcanic gas emissions and is the coordinator of the NOVAC network. He is also member of the board of directors of the DECADE project. Dr. Santiago Arellano is an expert on evaluation of volcanic gas emissions from optical remote sensing instruments, with more than 10 years' experience in the field.

1.10 Letters of Commitment

Letters of commitment have been received from all partners: they have been signed by the official representative for each partners.

All these letters can be found at the end of the document, in Annex 2, which starts page 121.

2 Quality of Resources to be Deployed

2.1 Introduction

As shown in the previous section, and in the CVs of the partners involved in the project (given in Annex 1), the group of partners has a large experience in all the components of the project. Several groups have been working together for many years as part of GEMS, MACC, MACC-II and MACC-III. In order to fulfil the requirements for the project, new groups have been added: these groups have been selected, based on their expertise and their willingness to work as part of the CAMS-81 project, in order to deliver the best products as possible to the other CAMS providers.
The team is composed of nine European institutions that have a long experience in the quantification of emissions, their analysis, and in the interactions with groups from different backgrounds who are using these emission data for their work.

The datasets and database developed by several partners have become over the years the reference emission datasets for MACC, as well as for many other international projects. For example:

- The European anthropogenic inventories TNO-MACC, TNO-MACC-II and TNO-MACC-III have been developed and used in the MACC, MACCII and MACCIII regional forecasts and reanalysis by all groups involved in these projects. This inventory is also used in projects dealing with changes in the air quality in Europe, such as EuroDelta or FAIRMODE.
- The MACCity global anthropogenic emissions inventory has been developed as part of GEMS, MACC and MACC-II. It has been used in the global forecasts and reanalysis of MACC, MACCII and MACCIII. This inventory is now considered as a reference and is used in different international projects such as the CCMI (Chemistry-Climate Model Initiative) project of the International Global Atmospheric Project (IGAC) and of the Stratosphere-Troposphere Processes and Their Role in Climate (SPARC).
- The MEGAN-MACC inventory of biogenic volatile organic compounds has been developed as part of MACC, MACC-II and MACC-III. This dataset is also used as a reference for CCMI and other international and European projects.

All these datasets have been made available to the MACC, MACC-II and MACC-III partners and users through the ECCAD (Emissions of Chemical Compounds and Compilation of Ancillary Data) database (http://eccad.aeris-data.fr). This database was developed by the CNRS-OMP and CNRS-LA groups: ECCAD has now more than 2,500 users, and has contributed greatly to promote the TNO-MACC, MACCity and MEGAN-MACC datasets and to their very large number of users.

The persons involved in this project are:

1 CNRS: Claire Granier, Catherine Liousse, Sabine Darras, François André
2 TNO: Hugo Denier van der Gon, Jeroen Kuenen, Antoon Visschedijk
3 MET Norway: David Simpson, Michael Gauss, Hilde Fagerli
4 CUNI: Katerina Sindelarova
5 FMI: Jukka-Pekka Jalkanen, Lasse Johansson
6 BSC: Marc Guevara, Carlos Pérez, Oriol Jorba
7 MPIC: Johannes Kaiser
8 EAA: Sabine Schindlbacher, Katarina Mareckova, Robert Wankmüller
9 Chalmers University: Bo Galle, Santiago Arellano

A summary of the role of each of these contributors and their qualifications are detailed in table 1.

Table 1: HR Profiles

Title	Broad description of work in relation to Service	List of personnel involved in the project	Qualifications	Effort / engagement in months
Team Leader	Coordinator of CAMS-81; Leader of WP81.2 and WP81.8 Contributor to WP81.4, WP81.6 and WP81.7	Dr. Claire Granier, CNRS-LA	Coordinator of the emissions sub—project in GEMS, MACC, MACC-II and MACC-III Expert in the development of inventories, their analysis, databases and relations with users. Links with international projects.	3.6
Co-Investigator	Development of global anthropogenic emissions Contributor to WP 81.2, WP81.4, WP81.6 and WP81.7	Dr. Catherine Liousse, CNRS-LA	Expert in global emissions of aerosols, and anthropogenic emissions in Africa and Asia.	0.4
Co-Investigator	Development and evaluation of the global emissions Contributor to WP81.2, WP81.3, WP81.4, WP81.5, WP81.6, WP81.7 and WP81.8	To be hired	Expert to be hired, with experience in emissions inventories and their analysis, and writing documentation on datasets.	28.9
Service Manager	Service manager Leader of WP 81.4 and WP 81.5 Contributor to WP81.8	Ing. Sabine Darras, CNRS-OMP	Expert in databases and in data formatting. She had led the technical development of the ECCAD database and has a large experience in managing services to users.	3
Technical support	Data distribution Contributor to WP81.5	Ing. François André, CNRS-OMP	Expert in the development of databases and in data distribution	0.3
Co-Service Manager	Data formatting, metadata, user interactions Contributor to WP81.2, WP81.4, WP81.5, WP81.7 and WP81.8	To be hired	Expert to be hired, with experience in data formats, web-based tools and interactions with users	20.2

Co-Investigator	Coordination of European anthropogenic emissions Leader of WP81.1, contributor to WP81.4, WP81.6, WP81.7, WP81.8	Dr. Hugo Denier van der Gon, TNO	Leader of the development of the TNO-MACC, TNO-MACCII and TNO-MACCIII European inventories. Expert in interactions with agencies and users.	3.14
Co-Investigator	Development of European anthropogenic emissions Contributor to WP81.1, WP81.4, WP81.5 and WP81.7	MSc. Jeroen Kuenen TNO	Expert in the development of regional inventories of greenhouse gases and pollutants, and in emissions scenarios. Expert in data formatting.	7.5
Co-Investigator	Development of European anthropogenic emissions Contributor to WP81.1	MSc. Antoon Visschedijk, TNO	Expert in the development of regional inventories of greenhouse gases and pollutants, and in emissions scenarios. Expert in emissions reporting.	4.6
Co-Investigator	Biogenic and oceanic emissions Contributor to WP81.3	Dr David Simpson, MET Norway	Expert in biosphere-atmosphere exchanges, in biogenic volatile organic compounds and oceanic emissions.	9
Co-Investigator	Oceanic emissions and interactions with users Leader of WP81.7 Contributor to WP81.3	Dr. Michael Gauss, MET Norway	Expert in surface emissions and their impact on the atmospheric composition. Expert in interactions with EMEP and users.	3.5
Co-Investigator	Volcanic emissions Contributor to WP81.3 and WP81.5	Dr Hilde Fagerli, MET Norway	Expert in emissions from volcanoes: leader of the operational volcanic ash forecasting in Norwegian air space.	1
Co-Investigator	Volcanic and oceanic emissions Contributor to WP81.3 and WP81.5	To be hired MET Norway	Expert to be hired, with experience in volcanic and/or oceanic emissions.	1.5
Co-Investigator	Natural emissions Leader of WP81.3 Contributor to WP81.2, WP81.5, WP81.6 and WP81.8	Dr. Katerina Sindelarova, CUNI	Leader of the development of the MEGAN-MACC emissions dataset. Expert in the emissions of biogenic volatile organic compounds, and in exchange between the surface and the atmosphere.	20

Co-Investigator	Natural emissions Contributor to WP81.3, WP81.6 and WP81.7	To be hired CUNI	Expert to be hired, with experience in BVOC emissions, in natural soil emissions and in data formatting	18
Co-Investigator	Ship emissions Contributor to WP81.1 and WP81.2	Dr. Jukka-Pekka Jalkanen, FMI	Leader of the ship emission modelling team at FMI. Expert in maritime environmental policy.	2
Co-Investigator	Ship emissions Contributor to WP81.1, WP81.2, WP81.5 and WP81.7	MSc. Lasse Johansson, FMI	Expert in the development of ship emission models, and in policy support for national emission reporting	9
Co-Investigator	Development of emission processing systems, spatial proxies, temporal profiles Leader of WP81.6 Contributor to WP81.2, WP81.4, WP81.5, WP81.7 and WP81.8	Dr. Marc Guevara, BSC	Leader of the BSC emissions modelling research line. Expert in local/regional emission inventories and spatial, temporal and speciation profiles for creating air quality model-ready emissions.	14.5
Co-Investigator	Residential wood combustion emissions, temporal profiles Contributor to WP81.6	Dr. Carlos Pérez, BSC	Leader of the BSC atmospheric composition group. Expert in the emissions of particles and temporal profiles.	2
Co-Investigator	Parametrization of emissions as function of meteorology Contributor to WP81.6	Dr. Oriol Jorba, BSC	Group manager of the BSC atmospheric modelling group. Expert in the response of emissions to changes in meteorology.	2
Co-Investigator	Consistency between land-use and vegetation maps used in CAMS-81 and CAMS-44 Contributor to WP81.4	Dr. Johannes Kaiser, MPIC	Coordinator of the CAMS-44 (Fire developments) project. Expert in the development of fire emissions.	3
Co-Investigator	Availability of regional emission inventories and interactions with users Contributor to WP81.1 and WP81.7	Dr. Sabine Schindlbacher, EAA	Expert in the compilation and management of emission inventory datasets. Lead author of international reports.	0.8
Co-Investigator	Regional emission inventories, interaction with users and EMEP Contributor to WP81.1 and WP81.7	Dr. Katarina Mareckova, EAA	Leader of the CEIP emissions center for EMEP. Expert in emissions for studies of air quality and greenhouse gases.	0.9

Co-Investigator	Spatial distribution of emission data, interaction with users Contributor to WP81.1 and WP81.7	Ing. Robert Wankmuller, EAA	Expert in data management and software development for the CEIP center of EMEP.	0.4
Co-Investigator	Volcanic emissions Contributor to WP81.3	Dr. Bo Galle, Chalmers	Expert in measurement strategies for studies of volcanic gas emissions. Coordinator of the NOVAC volcanoes network	0.5
Co-Investigator	Volcanic emissions Contributor to WP81.3	Dr. Santiago Arellano, Chalmers	Expert in the analysis of data for the NOVAC volcanoes network. Expert in volcanic emissions	2

2.2 List of CVs of key personnel involved in this proposal

The CVs of the key personnel can be found in Annex 1, which starts page 75.

3 Technical Solution Proposed

The goal of this project is to provide gridded distributions of European and global anthropogenic emissions, as well as global natural emissions for the CAMS regional and global production chains. The emissions for a large set of atmospheric compounds will be developed from 2000 to the present, with addition of one additional year every year. These developments will be achieved through a close collaboration among the partners, and with the Global Service Provider and Regional Service Provider. Interactions with different types of users will also be developed.

During the past few years, several emissions inventories were developed as part of the GEMS, MACC, MACCII and MACCIII projects, i.e.:

- The TNO-MACC, TNO-MACCII and TNO-MACCIII regional inventories for Europe, which cover the 2000-2011 period at a 7x7 km^2 spatial resolution
- The MACCity global anthropogenic inventory, which was developed during the MACC projects, and is based on inventories developed more than ten years ago, as well as on IPCC AR5 scenarios which are based on emissions for the year 2000.
- The MEGAN-MACC global emissions of biogenic volatile organic compounds (BVOCs) inventory, which was recently extended to 2015. It is however not fully consistent with the CAMS global model since it is based on different meteorology. Furthermore, the dataset needs to be improved with updated emission factor maps corresponding to detailed land cover and recent measurements.

The work proposed in CAMS-81 will improve significantly the emissions datasets used as input in the CAMS regional and global models. At the regional scale, the dataset will cover more recent years and will account for the changes in emissions during the past years. A lot of work has been done by different international groups on global emissions in the past years, which will be taken into account for a better representation of global anthropogenic emissions, more particularly in world regions with an important economic growth.

The work done in CAMS will also ensure a good consistency between the emissions of greenhouse gases, reactive gases and particles and their precursors. The natural emissions will consider not only the emissions of BVOCs, but also the emissions from soils, oceans and volcanoes. Analysis of these different datasets will be performed, together with consistency analysis between regional, global anthropogenic and natural emissions, as well as with emissions from fires.

CAMS-81 has been organised around seven workpackages plus one workpackage dedicated to management. Figure 1 shows the different workpackages, as well as their interactions. The details of the work to be done in each workpackage is detailed in the following paragraphs. Section 4 details the implementation plan and gives details on the tasks defined in each of the workpackages to achieve the goals of the project.

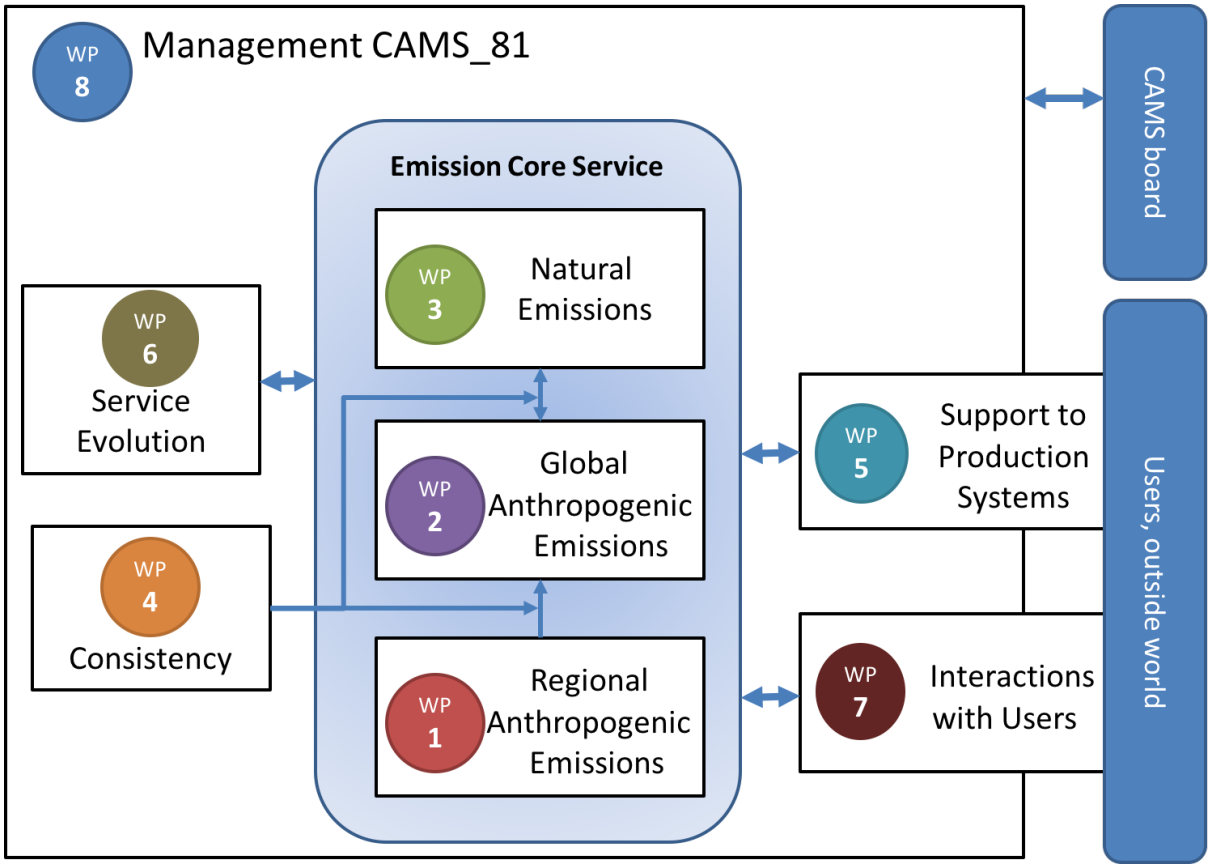

Figure 1: The CAMS-81 workpackages and their interactions

3.1 WP 81.1: Anthropogenic emissions for the CAMS regional domain

This work package will deliver high resolution anthropogenic emissions data to be used in regional CAMS projects (e.g., CAMS_50 and CAMS_71) and as a stand-alone CAMS product to support the wider modelling, emission inventory and policy support communities. A first dataset covering the year 2014 (or posterior if available) will be delivered within the first 6 months of the contract. Next, a consistent time series 2000-2014 will be delivered as a gridded data set within the first 12 months, together with a documentation of the dataset.

CAMS-81 regional emissions inventory

Parties to the Convention for Long-Range Transboundary Air Pollution (http://www.unece.org/env/lrtap/) have to annually submit their emissions of air pollutants for the latest year for which data are reported, which is generally 2 years before the current year, which we will call year t-2. The parties also report all historic years to EMEP (Co-operative Program for monitoring and evaluation of long-range transmission of air pollutants in Europe). The official submitted data are collected by the Centre for Emission Inventories and Projections (CEIP) maintained by the EAA partner. The reported emissions often provide the most accurate estimate for a country but may contain gaps and errors. Within CAMS-81, we will process and cross-check the data at the most detailed level to identify errors and data gaps, which will be subsequently corrected following a procedure developed by TNO. For further documentation we refer to Kuenen et al. (2014) and Pouliot et al. (2012, 2015). The dataflow in CAMS-81 will be further streamlined by having both TNO and EAA as partners. This is necessary because of the annual updates of the latest year (t-2) that will be delivered to the CAMS modelling teams under CAMS-81. It is proposed not to update the entire time series (2000 to year t-2) every year but do this in year 1 and year 3 of the project and clearly document the changes for these time series.

In year 2, only the latest new year (t-2) will be added to the time series developed in year 1. This is most cost effective because it delivers the most recent year (t-2) annually but avoids the time consuming process of analyzing the full time series each year. A 2-3 year period between revisions of the long time series resulted indeed in relevant changes (see Pouliot et al., 2015).

The following species will be included in the CAMS regional emissions dataset: CH_4, CO, NOx, SO_2, NMVOC, NH_3, PM_{10}, $PM_{2.5}$ (air pollutants), starting from the country reporting to EMEP/CLRTAP (except for CH_4). For consistency DMS emissions for the regional domain will be covered in WP 81.3.

For the greenhouse gases (GHGs), CH_4 and CO_2, the CAMS-81 emission data set will start from the National Inventory Reports (NIR) to UNFCCC and reporting of GHGs to the EU under the Monitoring Mechanism Regulation (No 525/2013). A first TNO-CAMS-CO_2 emission dataset was developed in MACC-III and in service continuity contracts: this dataset will be improved and expanded in the present CAMS-81 regional workpackage. The emission data sets constructed in WP81.1 will have a transparent versioning system (detailed in WP 81.7) and will be accompanied by documentation including emissions totals by country. WP81.1 will closely cooperate with WP81.5 for the delivery of regional datasets for the production systems, correct formats and data interoperability (including adding to CDS and ECCAD). WP81.1 will also contribute to future UNECE HTAP emissions activities upon request as was done for the HTAPv2.2 data set (Janssens-Maenhout et al., 2015).

Source sector categories

The emissions of air pollutants and GHGs will be stratified into main source categories with a breakdown into sub-source categories for selected categories (see Table 2). The source sector system is different from the TNO-MACC dataset (Kuenen et al., 2014) and in line with the current official gridding nomenclature for reporting (GNFR). For specific policy relevant sectors, a further split of sector C will be provided for residential wood combustion since this is a major and increasing source of urban PM emissions (Denier van der Gon et al., 2015) and a relevant source of non-fossil CO_2. In addition, emissions from road transport emissions will be broken down by fuel type to

understand the contribution of different fuels, especially for PM and NOx emissions and evaporation from road transport fuels for NMVOC. Finally, the wear emissions are health relevant and become increasingly important for urban PM exposure (Denier van der Gon et al., 2013).

Table 2: Description of proposed new CAMS-81 Regional source categories and connection to the Gridding Nomenclature for reporting (GNFR) code system used in reporting of air pollutant emissions to EMEP/CEIP. (Note that the lettering will avoid confusing with the SNAP sector numbering)

CAMS-81 source sector	**Source description**	**GNFR14 Code**
A	Public electricity and heat production	A_PublicPower
B	Industrial combustion and processes	B_Industry
C	Residential, commercial, institutional, agricultural and other small stationary combustion plants	C_OtherStationaryComb
C1	*Wood and wood waste*	
C2	*Other fuels*	
D	Fugitive and flaring emissions from fossil fuel production and distribution	D_Fugitive
E	Emissions from solvent use	E_Solvents
F	Road Transport	F_RoadTransport
F1	*Exhaust (gasoline fuelled vehicles)*	
F2	*Exhaust (diesel fuelled vehicles)*	
F3	*Exhaust (LPG/ natural gas fuelled vehicles)*	
F4	*Evaporation of gasoline*	
F5	*Tyre, brake and road wear*	
G	Inland shipping and Coastal shipping	G_Shipping
H	Aviation (airport and LTO emissions up to 1000 m)	H_Aviation
I	Other mobile machinery, including rail transport	I_OffRoad
J	Waste disposal (except agricultural)	J_Waste
K	Agriculture (livestock emissions)	K_AgriLivestock
L	Agriculture (non-livestock emissions)	L_AgriOther
P	Shipping	P_IntShipping
X	Land use, Land-use Change and Forestry (LULUCF)	*(not in GNFR since only relevant for GHG emissions)*

Compared to the SNAP source categorization used in the TNO_MACC inventories (Kuenen et al. 2014), the non-road transport emissions (previously SNAP 8) will be split to identify separately airport emissions (H), (national) shipping (G), other non-road transport (I) and international shipping (P). For a treatment of the international shipping emission we refer to the next section. A new source category compared to TNO-MACC will be added for the emissions from Land Use, Land Use Change and Forestry (labelled X in Table 2). These emissions will be adopted from the official GHG reporting to EU and UNFCCC.

Recently, attention was drawn to the leakage of CH_4 and NMVOCs from oil and gas production (O&G), especially since the start of the large scale shale gas exploitation in the US (source sector D in Table 2). Currently (2016) there is no commercial shale gas exploitation in the EU. However, if this would change in the coming years a distinction between emissions from shale gas and conventional O&G exploitation in source sector D in the gridded regional emissions data could be proposed as a service evolution option. This will not affect the budget and planning of the task.

Emissions from ships
Emission inventories for shipping using the Automatic Identification System (AIS) data from both terrestrial and satellite networks will be quantified by FMI. Data from AIS allows for tracking of ships as well as emission and energy consumption modelling of the global fleet based on actual vessel movements using the Ship Traffic Emission Assessment Model (STEAM; Jalkanen et al, 2009, 2012, Johansson et al., 2013). This approach builds on the design principles of naval architecture, and takes technical features of individual ships and relevant legislative changes (sulphur content restrictions in Emission Control Areas, EU sulphur directive) into account. FMI already has global ship activity datasets for 2014, 2015 and 2016 which can be used in this work, extending the time period covered in the Third IMO GHG study (Smith et al, 2014), in which FMI also participated. It should be noted that the cost of the data to extend the emissions after 2016 is too large to be covered by the CAMS-81 budget (the cost of AIS data + IHS Fairplay licence is about 60 000 euros/year). For 2017 and 2018 we will propose a scaling based on expertise and the 2014-16 data. The same dataset will be used for the quantification global emissions (WP81.2) assuring data consistency.

Profiles for PM, NMVOC, CO2, vertical and temporal emissions profiles
For PM a source sector and country specific split will be made in line with the approach described in Kuenen et al. (2014). A split profile of NMVOCs, specific for each source sector, will be provided based on earlier TNO profiles and updated with new NMVOC profiles from JRC/EDGAR team which will be available to the project (Personal Communication with G. Maenhout/JRC, Oct. 2016; see Annex 3). Anthropogenic CO_2 emission will be split into fossil CO_2 (fossil fuel combustion and cement) and short cycle CO_2 (biofuel and LULUCF). For the vertical emission distribution of point sources, the vertical profiles developed by Bieser et al. (2011) are proposed. As part of the service evolution we will update these profiles where necessary, starting with the development of a vertical profile for airport emissions (sector H).

Spatial distribution
The final step in the inventory is the distribution of the complete emission dataset across the European emission domain at 0.125° x 0.0625° longitude-latitude resolution. For each of the underlying 76 source categories gridding proxies are identified: an overview per sector is given in the supplementary material of Kuenen et al. (2014). Where necessary, proxies will be updated, notably residential combustion, road transport, large point sources and international shipping. The E-PRTR database (http://prtr.ec.europa.eu/) which provides annual information on the emissions of the major industrial facilities in Europe will be used for point sources to make a dynamic emission map for multiple years. A similar dynamic approach will be applied for airports. For the other point sources, TNO's own point source database (see Denier van der Gon et al., 2010) and/or JRC/EDGAR data will be used as default, while new information e.g., from satellites will be taken up as it becomes available. The CAMS-81 regional product will be extended with emissions for North Africa and Middle East to cover the entire CAMS regional domain, starting from the EDGAR emissions and proxies that will be available to the project (see the letter from the Joint Research Center in Annex 3). Next, we aim to improve some of the key source sector emissions for this region as part of the service evolution (see also WP81.6).

Updates for year t and t-1 with scaling factors and proxies
A major improvement of regional emissions data by CAMS-81 is foreseen by developing preliminary regional emission data sets for the current year (t) and the previous one (t-1). Preliminary approximation of the year t and t-1 emissions will be made using the 2005-2015 time series and trends and relations of the emissions to other proxies like climate variables (temperature). Upon evaluation and in consultation with the CAMS regional products group, the t-1 and year t data will be added to the CAMS service (M36).

3.2 WP 81.2: Anthropogenic emissions for the global domain

For now, the CAMS global simulations use the MACCity emissions dataset: this dataset was developed at the beginning of the MACC project (Granier et al., 2011), based on the ACCMIP dataset published in 2010 (Lamarque et al., 2010) which provided emissions until 2000. MACCity provides emissions up to 2016, through an interpolation between the ACCMIP 2000 emissions and the emissions provided by one of the future scenario developed for the IPCC AR5 report, i.e. RCP8.5. These scenarios and therefore MACCity do not take into account the most recent information on the emissions available for different parts of the world. A new dataset will therefore be developed for CAMS, which could be called CAMS-AG (CAMS – Anthropogenic Global).

The strategy to develop the CAMS-AG global emissions over the three years of the project is shown on Figure 2. Each year, new global and regional datasets will be analysed, and a new version of the CAMS-AG dataset will be developed, which will include the most recent available data in different world regions.

The first version of the CAMS-AG inventory will be based on three emissions datasets recently developed, i.e. ECLIPSE (Klimont at al., 2016), EDGAR4.3 which was developed by the European Joint Center (Crippa et al., 2016) and the CEDS emissions (Smith et al., 2015) recently released to provide emissions for the next IPCC report, AR6. Characteristics of these three datasets are shown in Table 3. It should be noted that CNRS is a co-author of the papers describing the EDGAR4.3 dataset and is a member of the steering committee of the CEDS emissions project. As indicated in this table, the only inventory that provides all the required species is EDGAR4.3+EDGAR4.2FT2012: this inventory will be therefore used as a basis for the first version of the CAMS-AG inventory.

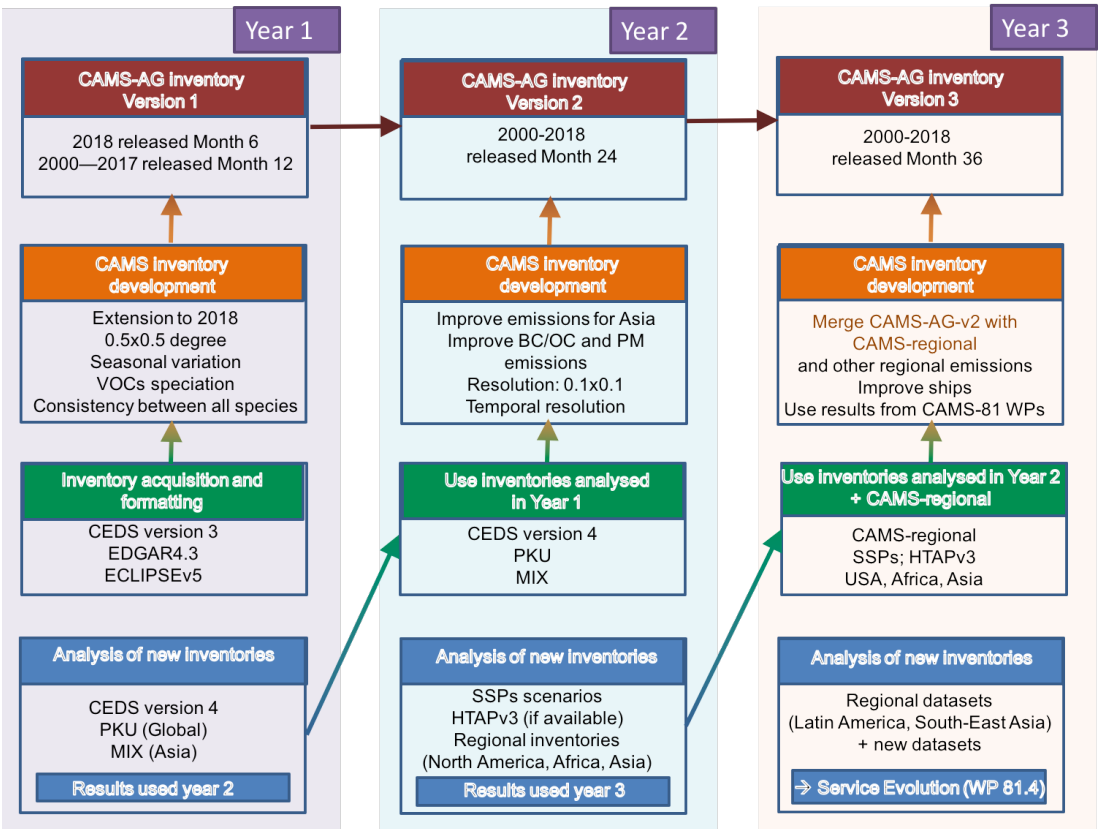

Figure 2: Methodology for developing the anthropogenic global emissions during the three years of the project.

Name of inventory	Species considered	Period covered	Spatial resolution	Future scenarios
ECLIPSEv5	BC, OC, NOx, NH_3, SO_2, NMVOC, $PM_{2.5}$, PM_{10}, CO, CH_4	1990-2010	0.5x0.5 degree	yes, 2015 and 2020
EDGAR4.3	BC, OC, NOx, NH3, SO2, NMVOCs, CO	1970-2010	0.1x0.1 degree	No
	CO2 (from EDGAR4.2FT2012)	1990-2014		
	CH4 and N2O (from EDGAR4.2FT2012)	1990-2012		
CEDSv3	BC, OC, NO_x, NH_3, SO_2, NMVOC, CO, CH_4, CO2	1850-2014	0.5x0.5 degree	No

Table 3: List of inventories which will be used to develop the new CAMS-AG dataset

Year 1: Extension of EDGAR4.3 to 2018

During the first three months of the project, version 3 of the CEDS inventory will be used to extend the EDGAR4.3 inventory up to 2014. For each emission category for the period 2010-2014 (2012-2014 for greenhouse gases), yearly totals for each country/region provided by CEDS will be calculated. The ratio between the emissions for each year and each country and year 2010 (or 2012) will then be applied to each grid point in each country considered in EDGAR4.3 2010 (or 2012) emissions to get the gridded emissions for each species from 2010 to 2014. Emissions from EDGAR4.3 are provided as yearly-averaged emissions. The seasonal variation developed for the MACCity dataset used in MACC, MACC-II and MACC-III will be applied, in order to obtain monthly averaged emissions. EDGAR4.3 provides only the emissions for the total volatile organic compounds. We will use the same speciation for the quantification of the emissions of individual VOCs as the one used in MACCity, i.e. from the RETRO project (Schultz et al., 2008). As soon as it is available, we will analyse and then use the new VOCs speciation developed by the Joint Research Center group. We will provide the emissions of all species included in the chemical schemes of the models used by the Global Production group. This work will lead to the development of the CAMS-AG global emissions for 2010-2014.

As required in the tender, emissions for 2018 will be then generated during the first six months of the project. The emissions for 2018 will be generated using the same methodology as before (calculation of the changes in emissions at the country level between two years and use of these ratios to get emissions for other years), using the CAMS-AG emissions for 2010-2014, and the 2015 and 2020 emissions from the ECLIPSE v5 scenarios. The same seasonal variation and VOCs speciation developed for CAMS-AG will be used. CO_2 emissions are not provided in the ECLIPSE dataset: the CO_2 emissions for 2014-2018 will be determined through a linear extrapolation from the 2010-2014 emissions. The emissions will be gridded at a 0.5x0.5 degree spatial resolution for this version of CAMS-AG, as in the CEDS and ECLIPSEv5 emissions. For this inventory developed at the beginning of the project, the spatialisation will be based on the MACCity one.

The emissions will be provided for the different source categories indicated in Table 4: all these categories are available in EDGAR4.3. It should be noted that neither the ECLIPSE nor the CEDS datasets distinguish between road and non-road emissions. Both inventories consider just transportation. The CEDS dataset does not include the fugitive emissions from fuel use neither the land-use change emissions. In the generation of the first version of the 2018 emissions, the emissions for these specific sectors will be kept constant to the 2010 EDGAR4.3 levels.

Ships emissions represent a large source of pollution in many countries: as part of the work done in WP81.1, FMI will develop an emission dataset for shipping. The method which will be used is detailed in the description of WP81.1. The global ship emission inventories are available at a 10 km resolution and three hour update rate. The available dataset for 2015 has been tested with the STEAM model (Sofiev et al., 2016, Sofiev, Winebrake, Johansson, et al., Global health and climate impacts from international shipping, in review for Nature Climate Change). Regional emissions for EU sea areas were recently reported (Jalkanen et al, 2016). All global and regional ship emission datasets will be generated using the STEAM model, which ensures consistency and continuity between emission grids. The 2018 ships emissions will be developed on the basis of the AIS (Automatic Identification System) for 2014, 2015 and 2016. The emissions will be provided on the same grid as the EDGAR4.3 emissions, and on a monthly-average basis.

Source Category		Source Category	
1	Industrial combustion	6	Industrial processes
2	Residential heating	7	Solvent and other product use
3	Road transport	8	Agriculture (crops, manure, fertilizer)
4	Non-road transport and ships	9	Land use, forestry, land-use change
5	Fugitive emissions from fuel use	10	Waste

Table 4: Source categories provided in the CAMS-AG inventory

Significant differences have already been identified between the CEDS and EDGAR4.3 inventory, more particularly for China and India: the CEDS dataset has been developed very recently (released in the summer of 2016), and has not been evaluated in details: a new version (CEDSv4) should be available in the coming months, which will be evaluated during year 1. Another global inventory, PKU (Huang et al., 2014) will also be analysed, as well as the most recent version of the MIX inventory for Asia (Li et al., 2015).

Year 2: Version 2 of CAMS-AG

During year 2, the results of the inventory analyses performed during year 1 will be combined to develop a new version of the CAMS-AG dataset. This will lead to a better definition of the emissions in different regions of the world. These new datasets will also provide more information for a better temporal resolution of the emissions. The most recent information on the emissions related to shale gas extraction will be obtained from the US colleagues who are currently analysing several observation campaigns related to this type of emissions, such as the SONGNEX (Shale Oil and Natural Gas Nexus) campaign and other observations (Peischl et al., 2016).

This version of CAMS-AG will be gridded at a 0.1x0.1degree resolution: this high resolution gridding will benefit from the proxies already developed by the EDGAR/JRC group, who has agreed to provide to the CAMS-81 partners all the proxies at 0.1x0.1 degree, as indicated in Annex 3.

A new set of inventories will be analysed during year 2, i.e. the emissions for 2010 and 2020 from the SSPs (IPCC AR6 new scenarios) and the HTAPv3 inventory (if available). Discussions will also be organised with countries and regions which are currently working on regional datasets, i.e. the USA, Canada, Latin America, Africa, China, India and South-East Asia. Representatives of some of these groups will be invited to the yearly CAMS-81meeting at the beginning of year 2: these groups will inform us of their most up-to-date datasets, which will be further analysed and provide input for another version of the inventory. Information on release heights will also be provided, based on vertical profiles provided by EMEP for Europe (Bieser et al., 2011), EPA in the USA, and other regions.

Year 3: Version 3 of CAMS-AG

During year 3, a new version of CAMS-AG will be developed, based on the results of the analysis of new inventories performed during year 2. The datasets will be analysed for consistency and completeness, when considered a significant improvement (expert judgement) they will be merged

into the global dataset. This will include the regional European inventory developed in WP81.1, which will be merged, at a 0.1x0.1 degree resolution, into the global inventory. This work will include a detailed study of the emissions for the different sectors, which are significantly different between regional and global datasets. The resulting dataset will be fully consistent in Europe.
In order to prepare the evolution of the service for the global emissions, several new inventories will be gathered and analysed, based on discussions with international colleagues: several will be invited at the CAMS-81 annual meeting at the beginning of Year 3.

Versioning system
Each release of the CAMS-AG emissions will be accompanied by a detailed documentation, specifying the methodology, the format, and an evaluation of the dataset. All datasets will be released in the NetCDF-CF format, or any other format depending on the format chosen for the CDS data store at ECMWF, following discussions which will take place in WP81.5. A versioning system will be developed, which will include the documentation of the 1st version of the CAMS-AG inventory. Each time corrections/improvements will be applied to the system, as well as when new releases of the dataset are done, the information will be included in the versioning system, which will ensure a good traceability of the changes applied to the dataset.

3.3 WP 81.3: Natural emissions for the global domain

Emissions from vegetation
The NMVOC emissions from vegetation will be simulated using the MEGAN model (Model for Emissions of Gases and Aerosols from Nature v2.1; Guenther et al., 2012). This model has been successfully used during the MACC-II and MACC-III projects. It was employed to create a global inventory of biogenic VOCs called MEGAN-MACC (Sindelarova et al., 2014), which is currently used in the C-IFS system. It is available at a 0.5x0.5 degree resolution for the period of 1980-2015. However, the inventory is based on the MERRA reanalysed meteorological fields (NASA Goddard Space Flight Center). Biogenic VOC emissions are strongly linked to meteorological conditions, especially to temperature and solar radiation, therefore in this sense MEGAN-MACC is not fully consistent with the global model.
As required in the tender, the NMVOC emissions will be calculated with ECMWF meteorological fields. Forcing the MEGAN model with ERA-Interim data has already been tested during the extension of the MACC-III project. The model will use spatial distribution of 16 plant functional types based on Lawrence and Chase (2007) and monthly mean gridded values of leaf area index (LAI) derived from observations of the MODIS satellite instrument (Yuan et al., 2011).
We will provide emissions of more than 140 species of NMVOCs including isoprene, speciated monoterpenes, sesquiterpenes, methanol, alkane and alkene species, ketones and other oxygenated species. These can be lumped to comply with the chemical mechanism of the global model. An example of output species included in the MEGAN-MACC inventory together with an estimate of global annual total (Tg(species) year^{-1}) is shown in Table 5. We will also provide a total of all emitted NMVOCs.
The MEGAN model will calculate emissions as monthly averaged daily profiles. We will therefore provide monthly mean values as well as monthly averaged hourly diurnal emissions.
In the first version of the NMVOC dataset, we will use global emission factor maps for isoprene, the main monoterpene species and MBO (2-Methyl-3-Buten-2-ol) which were developed together with the MEGAN model and took into consideration global ecosystem distributions and species-specific emission factors. The rest of the modelled species will be calculated with emission factors assigned to plant functional types (PFT) categories. For the second version of the NMVOC dataset we will work on the update of MEGAN input maps of emission factors for isoprene, monoterpene and sesquiterpene species using high-resolution land cover maps with detailed description of tree

species composition for Europe (e.g. Skjoth et al., 2008). The updated maps will rely on available measurements of these species across Europe. Based on the literature survey we will provide a comprehensive description of selected emission factors as well as estimates of uncertainty. These updated emission factor maps will be used in the MEGAN model for calculation of a second version of the NMVOC emission dataset.

Species	Annual total [Tg(species) yr^{-1}]	Species	Annual total [Tg(species) yr^{-1}]
Isoprene	594	Ethanol	19
Monoterpenes	95	Acetaldehyde	19
α-pinene	*32*	Propene	15
β-pinene	*18*	Formaldehyde	4.6
Sesquiterpenes	20	Formic acid	3.5
Methanol	130	Acetic acid	3.5
Acetone	37	2-methyl-3-buten-2-ol	1.6
Ethene	29	Toluene	1.5

Table 5. Annual global totals of selected NMVOC species and categories present in the MEGAN-MACC inventory. Note that monoterpene group already includes α-pinene and β-pinene (in italics).

We will collaborate with the group of Dr. Alex Guenther (University of California – Irvine, US) who is currently working on the new version of the MEGAN model (MEGANv3). If MEGANv3 is released during the CAMS project, we will employ the new code and provide additional emission dataset calculated with this revised methodology (including e.g. impact of drought stress on emissions).
At the end of the first year, we will deliver gridded emissions of NMVOCs covering the period of the year 2000 to the most recent year, depending on availability of meteorological data to be provided by ECMWF. The meteorological forcing for the year 2018 will be discussed with the ECMWF production group. Emissions will first be gridded to 0.5x0.5 degree horizontal spatial resolution and we will gradually increase the resolution to 0.1x0.1 degree in the following years.

Emissions of methane from termite nests
Methane emissions from the digestive system of termites represent approximately 4% of the total global methane flux. Emissions will be calculated following methodology presented in previously published studies. We will work with 16 vegetation types that were identified as termite habitats by Sanderson (1996) and we will apply termite biomasses assigned to each vegetation type and methane emission fluxes (per termite biomass) (Sanderson, 1996; EPA AP42, 1995). We will introduce the seasonal variation as recommended by EPA AP42 (1995) and take into account the findings of Sugimoto et al. (1998) who estimated that half (or even 80%) of methane emissions from termite colonies building mounds is oxidized already inside the mound. As reported by Anderson et al. (2010) and Martius et al. (1996), overall the total emission remains relatively constant. We will therefore provide gridded monthly mean emissions of methane from termite nests for one year, which we believe will be representative for the whole period considered in the CAMS project.

Emissions from soils
A number of methodologies and data-sets for the emissions of NO, N_2O and NH_3 are available, with various levels of time-resolution, sophistication and data-requirements. These estimates typically rely on land-cover maps, estimates of nitrogen inputs (fertilizer, deposition) to the soils, combined with meteorological modifying factors such as temperature, soil water and/or precipitation. All such soil-N emission estimates are highly uncertain, especially at high time-resolution, since the factors which influence e.g. microbial activity, production and loss are many and complex (e.g. Butterbach-Bahl et al., 2013, Fowler et al., 2015, Hertel et al, 2012, Simpson et al., 1999), and the underlying data (e.g. agricultural practices, soil textures, moisture) is difficult to assess. Therefore, an important component of this work will be to examine and elucidate the uncertainties in these emissions, and to

seek a pragmatic merge of existing methodologies suitable for use in regional and chemical transport models.
In a first step we will build upon the global data available for soil-NO emissions present in the MEGAN model framework, to be consistent with the BVOC approach, and also on the recent NH3 emissions of Paulot et al. (2015). The MEGAN scheme (itself based upon Yienger and Levy, 1995) will be compared with the soil N emissions from several currently available data sets and parameterisations, in order to evaluate which are best suited for the CAMS-81 deliverables. Although the processes of NO, N_2O and NH_3 emissions are different, the algorithms share many of the same features, needing maps and time-series of activity statistics, underlying data (eg soil moisture, N-application). We will harmonise the approach and data-used across all gases as far as possible. The data and methods to be examined include those used by OCN (Zaehle et al., 2010, as used in the EMEP MSC-W model, Simpson et al, 2012), CMAQ (Rasool et al., 2016) and in various regional and global estimates (e.g Bouwman et al., 2013; Paulot et al., 2014; Shcherbak et al., 2014; Stehfest and Bouwman, 2006; Steinkamp and Lawrence, 2011; Syakila and Kroeze, 2011).
Through participation in the EU projects NitroEurope, NOFRETE and ECLAIRE, MET Norway already has good cooperation with institutes and scientists involved in soil-N emissions estimates, and as the project progresses we will make use of the algorithms and European-specific data-sets arising from those projects to improve the CAMS deliverables for the European domain.
Soils and vegetation emit a number of other gases which are of interest for climate studies, such as OCS or DMS. Although the basis for estimating emissions of such gases seems to be in the early stages (e.g. Ogee et al. 2016), we will evaluate the feasibility of estimating these emissions for CAMS.
Rn-222 is widely used as a tracer for atmospheric transport and mixing processes. This species is naturally emitted from land surfaces. As indicated by Szegvary et al. (2009), a constant and homogenous ^{222}Rn source of 1 atom cm^2/s is generally assumed, sometimes less in northern latitudes. A review of the most recent studies will be performed in this WP and summarized in a report, including recommendations on the best values to use.

Emissions from oceans
Emissions of the main halogens (bromoform, dibromomethane, and methyl iodide) will be calculated based on meteorological parameters from ECMWF (used directly in the EMEP model, or nudged to in the NorESM model) and on the climatological data of Ziska et al. 2013. The Ziska et al., 2013 climatology contains halogen concentrations in ocean water based on measurements made during the years 1989-2011 and is publicly available.
Emissions of DMS from the ocean will be calculated based on meteorological data (same approach as for halogens) and on climatological DMS ocean water concentrations used in the NorEMS model (Lana et al., 2011). A subset of regional emissions could be made upon request from WP81.1.
OCS emissions will be based on data published by Lennartz et al. (2016), calculated as monthly mean emissions from satellite CDOM (chromophoric dissolved organic matter) and ERA-Interim data and valid for the 2002-2014 period. The resolution is 2.8x2.8 degrees but will be regridded to the resolution required by the C-IFS model, though without adding finer-scale information.
We will evaluate the feasibility of estimating N_2O emissions. After the first year of the project we will provide a summarizing report on data available in the literature (Martinez-Rey et al., 2015). We will then work on a more detailed study that will lead to gridded emissions based on literature review and data from available models (e.g. NEMO-PISCES, HAMOCC).

Emissions from volcanoes
During the first year of the project, Chalmers University will provide SO_2 emission rates (kg(S)/day) for 20 continually degassing volcanoes worldwide obtained during the time span 2005 to 2010. The emission rates will be calculated from SO_2 measurements performed during the EU-project NOVAC (http://www.novac-project.eu), coordinated by Chalmers, and using meteorological data from

ECWMF (Galle et al, 2010). During the second year, the data set will be extended to 35 volcanoes and up to the recent past (2016). These 35 volcanoes contribute a significant part of the total emission of SO_2 from continually degassing volcanoes worldwide.
During the third year the data base will be updated to contain up to 50 volcanoes as the NOVAC network is growing. By the end of the project measures will be taken to facilitate continued delivery of operational data. Chalmers University will receive meteorological data from MET Norway (global wind data on up to 0.1x0.1degree resolution). The data will also be compared to official data reported by countries, which MET Norway has access to under the LRTAP convention, and which are available for all years back to 2000. During the third year a report will be provided where the measured SO_2 data will be compared to previous estimates of SO_2 emission from the same volcanoes. In order to extend the SO_2 data set MET Norway and Chalmers University will consult the AeroCom and CMIP6 databases and, subject to agreement with the data providers, use these data to fill in for degassing volcanoes that are not included in Chalmers' database.
CO_2, BrO and HCl emissions can be calculated based on in situ measurements of the ratios of these species to SO_2. These data, which will for some of the volcanoes become available during the course of the project through international collaborations (e.g. the DECADE project), will then be multiplied with the SO_2 data from NOVAC to yield CO_2 and halogen emissions. In case these data are insufficient or delayed, a literature survey on CO_2 and halogen emissions from the same set of volcanoes will be performed and be subject of a report to be delivered in the third year of the project.

For each source the methodology of emissions estimation will be described in a specific report. The consistency of the land cover maps used for GFAS in CAMS-44 with the land use maps used in this WP will be assessed in order to guide future developments.

3.4 WP 81.4: Consistency between regional and global emission datasets

Emissions at the regional and global scale will be developed by different groups and different methodologies. During the full duration of the project, we will analyse the different datasets that will be developed, and identify possible reasons for differences. This information will be useful for developing and improving the different versions of the inventories, and will be provided to the users of the different datasets.
It should be noted that the ship emission datasets generated in CAMS-81 will rely on global activity data sent by ships. The same data and modelling tools will be used both for global and regional emission inventories, which makes transition from global to regional scale consistent. The STEAM approach is built for general applicability regardless of the inventory scale.
During the MACCIII project, a discussion started between the Emissions and Fires subprojects on the consistency of the emissions of agricultural fires. This work will start as part of CAMS-81, since it could also link to inconsistencies or double-counting in the emission files. The consistency between the vegetation maps used to determine the natural emissions and the ones used to calculate the emissions from fires will also be assessed.

Preparation of the regional and global emissions for comparisons
The regional and global anthropogenic emissions will be regridded to a common spatial resolution, so that they can be easily compared. During the first year of the contract, the common grid will be 0.5x0.5 degree, and 0.1x0.1 degree during the following years.
The definitions of emission sectors are different in the regional and global anthropogenic emissions: the emissions will be grouped in similar large source sectors, to make sure that the values are comparable. An example is the emissions from transportation, which will group all road, non-road and shipping emissions.

Comparison of the regional and global anthropogenic emissions
The totals emitted in the different countries in the considered common domain, i.e. at least 25°W-45°E, 30°N-70°N, will be calculated for all years available for all species and the common sectors. Tables will be generated for all species, and comparisons will be done for each released version of the regional or global emissions. When possible, regional gridded emissions will be compared with spatial distribution provided by countries.
Comparisons of the gridded data will also be performed, using the emissions on the common grid. These comparisons will mostly focus on the countries and sectors for which significant differences will be identified for a specific species. Maps showing the differences between the regional and global emissions will be generated, as well as scatter plots, in order to identify the location of the main differences.
For these specific locations, the proxies used to estimate the emissions will be obtained and evaluated. The gridding of the emissions is depending on the proxies used to distribute spatially the emissions. Several proxies will be provided by the Joint Research Center, who has developed proxies to define the gridding of the EDGAR4.3 emissions (see Annex 3). This group has agreed to provide their 0.1x0.1 degree proxies to the CAMS-81 partners. Different proxies will be also obtained from Geographical Information Systems.
A tool for interactive calculation of combustion emissions under development at CNRS-LA will be used to help provide insights on the reasons for differences in anthropogenic emissions, which could be related to activity data and emission factors.
A comparison report between regional and global emissions will be provided with each main release of global and/or regional anthropogenic datasets. During the analysis of the comparisons, the possibility of adapting the methodologies for a better consistency between the regional and global emissions will be assessed.

Evaluation of the consistency of vegetation maps and agricultural waste burning
The emissions from agriculture waste burning are determined on the basis of the distribution of agriculture fields, on the amount of biomass burnt in different countries at the end of the crop season, and on agriculture practices in different countries.
In Europe, most countries have banned such practices, but local agriculture waste burning still occurs in a few countries. These fires can be detected by satellite, and are available in the CAMS-44 fire products. We will compare the agriculture waste burning distribution in the regional and global domain for the European region, and find out if some double counting of this source of emissions could take place.
Different maps providing the spatial distribution of vegetation and agriculture land are used in WP81.1, WP81.2 and WP81.3, as well as in CAMS-44. We will gather these different vegetation maps, and assess their consistency: for example, we will make sure that urban areas as consistent among all these maps, as well as forested areas and agriculture land. A report on the consistency of all these maps and the emissions from agricultural waste burning will be written, which will help define new activities for a good consistency of all emissions used in CAMS.

3.5 WP 81.5: Support to Production Systems

Preparation of the global and regional datasets for the production systems
For each release of the regional and global datasets (as indicated in WP 81.1 WP81.2 and 81.3), discussions will take place with ECMWF and the CAMS production groups, to make sure the datasets are in the right format and cover the right period, and that all the compounds necessary for the simulations are available. Discussions will also include the gridding issues, in order to adapt as best as possible the resolution of the inventories to the different regional and global models resolution.

The datasets will be made available on the CDS and ECCAD databases, following the results of the discussions.

Production of standardized datasets
In order to make the datasets available to the production system, a standardized format that follows internationally recognized standards will be defined: this format will be specified in details after discussions with ECMWF. This format will be based on the ISO (International Organisation for Standardization) standards and OGC (Open Geospatial Consortium) for data exchange. In more details, the format of the data will be based on the NetCDF format, with the Climate and Forecasts convention CF1.6. Extraction and analysis tools of the emissions will be developed through a JSON (JavaScript Object Notation) format. All the datasets will include detailed Metadata, which could be exported in a standard XML format.
Several datasets (vertical profiles, diurnal and weekly variation, etc.) will be provided into an ASCII UTF-8 format.

Delivery of data through webservices
The datasets developed as part of WP 81.1, 81.2 and 81.3 will be made available to ECMWF and the CAMS users through the ECCAD database (http://eccad.aeris-data.fr). ECCAD has the possibility of making the data available to a restricted group, for example the CAMS providers, or the CAMS providers and users, or the full community. It is also possible to give only an access to the visualization of the data, or to give also an access to the download of the datasets. Access to ECCAD and its restrictions will be discussed with ECMWF.
The data available in the ECCAD database follow the OPenDAP framework, and makes the emissions datasets accessible to remote locations regardless of local storage format. The SEDOO servers which host ECCAD provides a REST (Representation State Transfer)-compliant service.

Major volcano eruption
Within one week after a sudden major eruption in Europe, ash emission rates (including ejection heights) will be made available by MET Norway based on emission inversion of ash products from the SEVIRI satellite. In order to estimate the vertical profile of the ash emissions (over time), an emission inversion module (e.g. Eckhardt et al., 2008) has recently been coupled to the eEMEP atmospheric transport model (Steensen et al., 2016). This inversion method combines satellite-observed total ash columns and eEMEP to utilize the fact that winds change with altitude – thus, the position and shape of the volcanic ash plume contain information on the volcanic ash emission altitude. The method finds the vertical ash emission distribution which minimizes the total difference between eEMEP simulated and satellite observed ash columns while also considering *a priori* information. Currently, ash products from SEVIRI (but by the end of 2017 also IASI) can be used operationally for Europe in the eEMEP-emission inversion routines, which are a part of the operational ash forecasting for Norwegian air space (operated by MET Norway). For volcano eruptions outside Europe, default estimates can be provided based on the Mastin et al. (2009a, b) database containing parameters for about 1500 volcanoes worldwide, but ash products of satellite observations NRT are not necessarily available outside Europe within one week.
For reliable estimates on SO_2 emissions, ground-based measurements may be necessary, because satellite emissions may not be reliable due to volcanic ash contamination or weather conditions during the eruption. Chalmers has the equipment, expertise and possibility to perform such measurement campaigns on a short notice: for example, during the Bardarbunga/Holuhraun eruption on Iceland winter 2014/2015, yielding SO_2 emissions exceeding 100 000 t/d, Chalmers provided measurements from day 2 of the eruption until the end of the eruption 6 months later. These data are regarded as the most reliable data from this important eruption (Gislasson et al, 2015). If Chalmers should undertake such measurements additional funding is needed (cost mainly

depending on the remoteness of the eruption). In cases where NRT satellite SO_2 observations are available and judged reliable, emission estimates will be made by MET Norway.

3.6 WP 81.6: Service Evolution

The main objective of this WP is to provide a research and development plan aiming at improving emissions inventories and emissions modelling for global and regional scales. The plan will cover the full duration of the tender. The results developed under this WP will be used to give input, suggestions and feedback to the WP in charge of developing anthropogenic and natural emissions (WP 81.1., 81.2 and 81.3).

Assessment of the feasibility of adapting the CHTESSEL land-vegetation-carbon model
We will investigate the integration of the algorithm for on-line calculation of NMVOCs inside the CHTESSEL model. The NMVOC module will be adapted to correspond with plant functional type categories simulated by CHTESSEL. We will study overlaps between parameters in the CHTESSEL and NMVOC model and, where appropriate, CHTESSEL variables will be used directly in the NMVOC emission calculation (e.g., leaf area index, leaf temperature, direct and diffuse radiation inside the canopy). We will collaborate with other global and regional production groups in order to assess results of NMVOC emissions simulated by other land-vegetation-carbon models such as Community Land Model (University of California, Irvine, US), LPJ-GUESS (Lund University, Sweden), ORCHIDEE (LSCE-IPSL, France). Collected data will be used for evaluation and comparison with NMVOC emissions calculated on-line with CHTESSEL.

Investigation of short-term temporal profiles for global and regional scales
The default current temporal profiles applied to obtain hourly, weekly and monthly anthropogenic emissions are mostly based on outdated information and largely neglect the variation of emission strength with activity patterns, region, species, emission process and meteorology. In order to improve temporal representativeness, detailed profiling for key pollutant source categories will be developed using meteorological parameters and sector-specific statistics. The source categories that are envisaged to be selected include residential combustion, agriculture and road traffic, following the recommendations of previous MACC deliverable reports (Denier van der Gon et al., 2011).
A critical review of the work done in previous MACC projects will be performed together with an assessment of the temporal profiles currently available for the different source categories and countries/regions of the world. The review will include the most widely used datasets, which include the temporal allocation factor files developed by the U.S. Environmental Protection Agency (Moody et al., 1995) and the GENEMIS project (Friedrich and Reis, 2004), as well as other sets of temporal profiles currently used by the consortium members in WP81.1 and 81.2. For some specific areas such as Latin America, Africa, China, India and South-East Asia information on current used profiles will be obtained from the groups invited in the discussions organised by WP81.2. The reviewing process will be complemented with an identification of shortcomings and gaps of the methodologies currently used.
Once this step has been accomplished, recognised and emerging state of the art methodologies for the temporal disaggregation of emissions will be explored and reviewed, including but not limited to: meteorologically driven functions (e.g. Gyldenkaerne et al., 2005; Adelman et al., 2012; Terrenoire et al., 2015), use of observational data (e.g. Menut et al., 2012) and use of sector-specific open-access data (e.g. on-line available real-time traffic data; Leduc., 2008). This process will end up with a summary of methodologies with different levels of detail and accuracy. According to the availability of information, a selection of the best available methodologies will be performed for each country/region.

New monthly, weekly and diurnal temporal profiles will be developed for the selected source categories at the country/region level. The resulting dataset will include: (i) meteorology-based gridded temporal profiles and (ii) numerical factors (i.e. between 0 and 1) indicating per country/region how much of the annual (monthly, daily) total emissions to allocate to each month (day, hour). The meteorological and gridded profiles will be developed using meteorological data provided by ECMWF and the spatial resolution of the grid will be in line with the ones proposed in WP 81.1 and 81.2. A comparison with the temporal profiles currently used will be performed in order to analyse the differences.

Parameterisations for anthropogenic emissions as a function of meteorological parameters:
Emission inventories are usually estimated from activity data reported by countries and consequently lag behind actual conditions by several years (i.e. the time to complete country reporting, compile all the information and develop the emissions estimates). This task will analyse emission sources that may be linked to meteorological data and subsequently parametrised to quantify them with a much shorter delay or even to forecast them. Following the suggestions of the tender, the task will focus on residential/commercial use of heating/air conditioning and evaporation from cars.
A critical review of current methodologies used to adjust emissions as a function of meteorological parameters will be performed. This review will include studies and work where the relationship between meteorological parameters and emissions has been performed (e.g. Rubin et al., 2006)
During the course of the project, we several parameterizations will be tested, and their results will be summarized in a report. We will then discuss with ECMWF and the regional and global modelling groups, in order to assess the potential integration of the selected parametrizations into the existing CAMS forecasting system

Ship emissions
We will also investigate the inclusion of emissions of VOCs from non-combustion shipping sources. These include volatile liquid cargo transport, unloading/loading operations in oil/chemical transport terminals and fugitive emissions of methane during Liquid Natural Gas (LNG) operation of ships. It is expected that the share of LNG powered ships will increase in the future because of tightening environmental legislation of ship emissions.

Investigation of emission factors, spatial proxies and wood usage classification for residential wood combustion emissions
The use of wood and other biomass in residential small combustion installations has been enhanced during the last years by several greenhouse gas strategies and the increase of other fuel prices typically used in the residential sector. As a consequence, residential wood combustion (RWC) has become a major contributor to PM emissions. At the same time, PM emissions from RWC are subject to large uncertainties. This task aims at investigating the characterization of RWC emissions focussing on three key aspects: emission factors (EF), spatial proxies and wood usage classification (i.e. heating or cooking).
The first part of the work will focus on studying the origin of PM EF used in the global and regional anthropogenic emissions (WP81.1 and WP81.2) and determining whether or not they account for the semi-volatile components of the emissions. PM emission factors that take into account condensable organic material will be collected and proposed if necessary to improve the emissions estimates, in line with the work done by Denier van der Gon et al. (2015).
Regarding the mapping of RWC emissions, the spatial proxies used to generate the gridding of RWC emissions in WP81.1 and 81.2 will be analysed and compared with up-to-date spatial disaggregation methodologies based on information regarding building type and primary and supplementary heating installations (Plejdrup et al., 2016) and crowdsourcing methods (López-Aparicio, 2016), among others. Potential uncertainties associated with the proxies currently used (e.g. non-

consideration of local factors such as legal restrictions) will be listed and specific alternatives will be proposed as a function of the input data requirements and level of methodological complexity. The study will focus on those countries where the use of biofuels has a clear dominance within the residential sector. In this sense, the International Energy Agency (IEA) energy balance statistics will be used as guidance. The temporal characterisation of RWC may vary significantly as a function of the purpose for which the wood is used (i.e. emissions related to heating purpose are linked to meteorological conditions whereas emissions associated to cooking purpose present a flatter distribution). Hence, this task will also focus on the development of regional/national factors to split RWC as a function of its purpose (i.e. heating or cooking). International information sources such as the IEA energy balance statistics or the WHO Household energy database will be used for this purpose. The results obtained in this action will be taken into consideration when developing the improved temporal profiles.

Use of inverse modelling results

The International Global Atmospheric Chemistry Project (IGAC) and the Global Emissions InitiAtive (GEIA) projects have started a new activity in the fall of 2016 called "Assessment of the use of inverse modelling for the improvement of emissions". The goal of this new project is to write a detailed assessment of what has been learned using inverse modelling techniques in the past few years. This IGAC and GEIA assessment is co-chaired by Claire Granier (CNRS-LA) and Gregory Frost (NOAA, USA).

A preliminary workshop to define this project took place at the end of September 2016, where several international colleagues started to share their ideas on the outcome of this project, which will be likely a set of peer-reviewed papers. Several discussions focusing either on the inverse techniques or on the results obtained for the emissions of different species (greenhouse gases, reactive gases and particles) will take place during the coming months, to define the leaders of each paper and the co-authors. A second meeting of the community interested in this assessment is planned in September 2017 in Hamburg, Germany. The papers are expected to be all finalized at the end of 2019, i.e. during the CAMS-81 project.

Since the CAMS-81 coordinator is also the co-chair of the assessment project, all the papers discussing the assessment will be easily accessible to the CAMS-81 partners. The main findings from all these papers will be summarized in a CAMS-81 report, and the possibility of using inverse modelling results in the evolution of the CAMS-81 project will be detailed.

Service evolution strategy (SES)

Using the continually updated RAD document, ECMWF will develop a SES document on an annual basis. The CAMS-81 consortium will discuss this document in details during its annual meetings, and define the tasks to be added or adapted for the requested service upgrades and extensions. If these upgrades or extensions are requested during the CAMS-81 contract and require a change to the tasks and deliverables, we will organise a discussion with ECWMF about the changes in the contract.

3.7 WP 81.7: User interactions

This work package is about the interface between users and CAMS-81, including user-friendliness of the products to be provided as well as user support.

User feedback system

As indicated in the ITT, ECMWF will provide a first level of support, i.e. answer simple questions on emissions issues. CNRS will implement a user forum on the ECCAD website with two levels of accessibility, depending on the type of user request. The first type of questions/answers will be made available to the full ECCAD users network, a second one will be accessible to ECMWF and

CAMS providers only. All the CAMS-81 providers will have access to all the questions asked by the users. Questions will be forwarded by CNRS and MET Norway to the partner(s) in possession of the most relevant expertise, and answers will be given within five working days. The forum will also welcome feedback from users for improvement of CAMS-81, which, if possible and reasonable, will be implemented in upcoming versions of the products.
The detailed set-up of this forum, including the procedures for time-critical communication, will be decided with ECMWF at the beginning of the project.

Input to the user requirements database (URDB) and Requirement Analysis Document (RAD)
CAMS-81 will contribute to the user requirements database developed by ECMWF. We will be in contact with ECMWF and CAMS-94 (User Interactions), and regularly access the RAD document to adapt the working plan (if necessary) after written agreement from ECMWF.

Service Product Portfolio
We will contribute to the CAMS service product portfolio (SPP). An internal document with descriptions of all CAMS-81 products (including old versions) will be regularly updated, corresponding to the release of the different versions of the regional and global anthropogenic and natural emissions. These documents will include information on the atmospheric compounds, the temporal resolution and coverage, the spatial resolution and coverage, the data formats, as well as the methodology used to generate the data. Access to scientific papers discussing the evaluation and quality of the data will also be detailed. The latest versions will be listed and described in the SPP.

Versioning system
A versioning system will be developed, which will include the documentation of each version of the inventories providing anthropogenic regional and global emissions as well as natural emissions. Each time corrections/improvements will be applied to the system, as well as when new releases of the datasets are done. The information will be included in the versioning system, which will ensure a good traceability of the changes applied to each dataset. All data sets, including obsolete versions, will be listed and briefly described in a document kept up-to-date continuously. Each data set will be uniquely labelled by a version number for the ease of identification. During the kick-off meeting of CAMS-81, we will discuss the options for this versioning system. The documentation describing the different versions of the datasets could be made available to all users of the data on the ECCAD data base. The versioning system can also be included in the web-based collaboration tool developed in WP8.

Synergies with international initiatives
Several CAMS-81 partners (Claire Granier, Catherine Liousse, Hugo Denier van der Gon) are members of the steering committee of the Global Emissions InitiAtive (GEIA). The link with GEIA will ensure very good connections with different groups who are working on the development and analysis of surface emissions in different parts of the world.
For example, the emissions datasets developed in CAMS-81 will be included in the ECCAD (Emissions of Chemical Compounds and Compilation of Ancillary Data), which will make this dataset very visible and used by a very large number of groups. ECCAD has currently 2500 users, and many of them could be users of the CAMS-81 emission inventories. ECCAD is managed by the CNRS group.
H. Denier van der Gon is the co- chair of the GEIA working group on "NMVOCs" emissions. This group is coordinating the efforts on the evaluation and improvement of the representation of non-methane volatile organic compounds (NMVOCs) in emission inventories, including speciation, sector contributions, and total emissions. The "NMVOC group" is very new (started officially in September 2016), and the links with this group could provide very useful information for the CAMS-81 project.

MET Norway and CEIP, being scientific centres under the UN LRTAP convention, will ensure that CAMS-81 data and knowledge will be useful for LRTAP, but also convey feedback received from LRTAP to improve CAMS-81 products.
Links with the International Maritime Organization will also be established to ensure that the methodology applied in ship emissions research of CAMS-81 is compliant with the 3rd IMO greenhouse gas study, and the CAMS-81 products will be beneficial for further studies of this group.

3.8 WP 81.8: Project Management

Coordination of the project
The first activity of the coordinator will be to set-up the sub-contracts for the different partners of the project: this will be done with the assistance of the CNRS administration. CNRS-LA is already a partner in CAMS-84: therefore, the CNRS administration has already a good knowledge of the details of the establishment of sub-contracts.
The coordinator will also work with the CNRS administration to make sure that the invoices are submitted to ECMWF and that the budget is delivered to all partners.
Several mailing lists will be established: one will include all the partners involved in the project. The coordinator will send an email to all partners every month, to inform them of all the information that could be interested to CAMS-81 partners. A second mailing list will be established, which will also include the names of the administrative representative of each partner: this email list will be used to send administrative and financial information to all partners. The third email list will contain the names of the users of CAMS-81: it will be established after discussions with ECMWF and the different CAMS providers. These lists will be available from the web-based collaboration tool (see Section 4.1) developed by the coordinator and the system manager at the beginning of the project.
Regular teleconferences will be organised by the coordinator, about every three months, about two weeks before each quarterly report is due to ECMWF. During these teleconferences, each partner will present the work they have done since the last teleconference, and a review of the status of the planned deliverables will be done. If, for some reason, the work is experiencing some delays, teleconferences will be organised twice a month with the partners involved in the work, in order to find efficient solutions to the problems encountered. At the end of each teleconference, the coordinator and the system manager will write a summary of the discussions and the decisions taken. These summaries will be made available to all partners.

Organisation of yearly meetings
A kick-off meeting will be organised in Toulouse during the first three months of CAMS-81, after all the sub-contracts are in place for all partners. During this meeting, we will review the work plan, discuss in details the work to be done during the first year, and review all the deliverables. All CAMS service providers will be informed of this kick-off meeting: if some providers propose to attend the CAMS-81 kick-off meeting, an extra day will be added where discussions will take place on specific requests of each service provider. A summary of the kick-off meeting will be written.

At the start of or just before year 2, a meeting of all CAMS-81 partners will be organised in a location to be determined. Representatives of groups developing emissions in other parts of the world will be invited, i.e. from North America, South America, Africa and Asia: we will discuss the exchange of information and datasets with these groups, which are essential to keep the global anthropogenic emissions up-to-date. The developers of the EDGAR4 inventory (Joint Research Center) will also be invited to this meeting. A specific budget for funding the travel of these colleagues is included in the coordinator budget (30 keuros for the full duration of CAMS-81).

The CAMS-81 partners will also attend the CAMS yearly assembly: the coordinator will inform all partners about these meetings, and make sure that all the CAMS-81 work is well represented during these meetings of all CAMS partners.

Monitoring and reporting

The coordinator will ensure a timely production and delivery of deliverables, as indicated in the work plan. If needed, the coordinator will discuss with the CAMS management about possible changes in the work plan: this could happen when new datasets become available, new studies show the very high or very low importance of a specific source, or if specific events occur in a specific country, etc.

The coordinator will gather the necessary material for the quarterly and annual reports: she will contact all partners in advance to get a written report on the work done during the period, and collect the deliverables that have been completed during the reporting period. Each quarterly report will provide information on the work done, the achieved deliverables and milestones, and possible deviations from the implementation plan.

A preliminary list of key performance indicators is provided in Section 4.6, and will be developed further by the coordinator after discussions with the ECMWF management. This list will be made available to all CAMS-81 partners. It will be monitored during the project.

As detailed later in Section 4, a web-based collaboration tool will be developed by the coordinator and the system manager, which will allow an efficient monitoring of the project.

Interactions with other CAMS projects

Regular discussions with other CAMS projects will be important to the success of the CAMS-81 project: the interested CAMS partners will be invited to the CAMS-81 kick-off. Discussions will also take place during the CAMS yearly assemblies, and we will organise regular teleconference with the CAMS subprojects interested in collaborations. These discussions will help better define the details of the datasets needed for each subproject and issues found by users of each dataset. Feedbacks from the users of the CAMS-81 products will be beneficial, and will help define newer versions of the regional anthropogenic, global anthropogenic and natural emissions.

At the beginning of CAMS-81, the coordinator will contact each of the subprojects and make a list of the subprojects interested in a collaboration. This list will give some details on the different products each CAMS subproject is interested in. As indicated above, a mailing list with all users from the different CAMS projects will be established, in order to keep our CAMS colleagues informed about the CAMS-81 work.

Meetings with others CAMS providers could be organised when necessary, in order to discuss specific issues or requests.

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4 Management and implementation plan

4.1 Introduction

The project will be managed by Claire Granier (CNRS-LA), who was already the coordinator of the GEMS, MACC, MACCII and MACCIII subprojects focusing on emissions. She will be assisted by a service manager (Sabine Darras, CNRS-OMP): S. Darras has been the head of the technical group which has developed the ECCAD database and has a long experience in the development of management tools for collaborative work.
The service manager will implement a Web-based collaboration tool (for example a Trello board): this board allows an agile interactive management in real-time and will be accessible by all partners. The data in this board are private **(**full control over who sees the board) and secure (encryption technology connection and off-site backups). All the CAMS-81 partners will be able to consult the same board, and will be able to edit it.
This board will include information on the dates the availability of the different partners to answer any questions from ECMWF, CAMS partners or questions for different users. We will make sure that at any time of the year, there is always at least one person able to answer questions or requests either on regional anthropogenic, or global anthropogenic or natural emissions: the name of these persons will be shown clearly on the collaboration tool.
The board will also include the list of deliverables and their date of delivery: every time a delivery is due, an automatic notification of the date and content of the deliverable will be sent to the partner responsible for the delivery, to the coordinator and the system manager.
As indicated in Section 2, regular teleconferences will be organised either for a single workpackage or for the full consortium. The board will include the dates and time of all these teleconferences, and send reminders to all concerned partners a week and a day before they take place.

4.2 Organigram

The work packages and their tasks will be managed by different groups of the consortium: the responsibility for each task and all its associated deliverables has been assigned to different partners. The organigram shown in Figure 3 shows the different workpackages of the project, and the names of the leader of each of these WP.

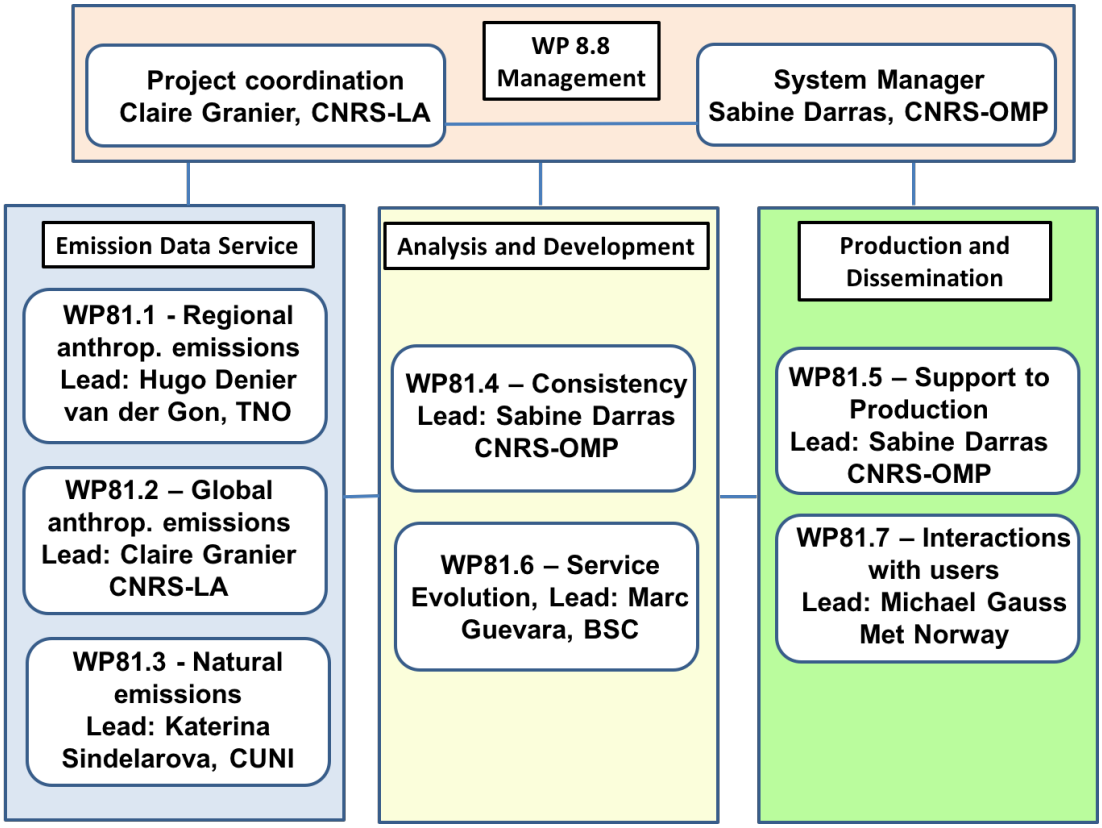

Figure 3: CAMS-81 workpackages and their leaders

4.3 Gantt chart

The following chart indicates the start and end for each task in each workpackage.

	Year 1				Year 2				Year 3			
WP1												
Task 81.1.1												
Task 81.1.2												
Task 81.1.3												
Task 81.1.4												
Task 81.1.5												
WP2												
Task 81.2.1												
Task 81.2.2												
Task 81.2.3												
Task 81.2.4												
Task 81.2.5												
Task 81.2.6												
WP3												
Task 81.3.1												
Task 81.3.2												
Task 81.3.3												
Task 81.3.4												
Task 81.3.5												
Task 81.3.6												
Task 81.3.7												
Task 81.3.8												
Task 81.3.9												
Task 81.3.10												
Task 81.3.11												
Task 81.3.12												
Task 81.3.13												
WP4												
Task 81.4.1												
Task 81.4.2												
Task 81.4.3												
Task 81.4.4												
Task 81.4.5												
Task 81.4.6												
WP5												
Task 81.5.1												
Task 81.5.2												
Task 81.5.3												
Task 81.5.4												
Task 81.5.5												
Task 81.5.6	Depends on the occurrence of a major eruption											

WP6												
Task 81.6.1												
Task 81.6.2												
Task 81.6.3												
Task 81.6.4												
Task 81.6.5												
Task 81.6.6												
Task 81.6.7												
Task 81.6.8												
Task 81.6.9												
WP7												
Task 81.7.1												
Task 81.7.2												
Task 81.7.3												
Task 81.7.4												
WP8												
Task 81.8.1												
Task 81.8.2												
Task 81.8.3												
Task 81.8.4												
Task 81.8.5												
Task 81.8.6												

4.4 Summary of Work packages and Deliverables

Table 6: Summary of Work packages and Deliverables

Work package	Deliverable Reference	Effort in person-months
WP81.1: Anthropogenic emissions in the CAMS regional domain		
	D81.1.1: European emissions dataset: 2014, and then updated annually to latest year	4
	D81.1.2: European emissions time series: 2000-2014, and then updated annually to latest year	4.2
	D81.1.3: Documentation of temporal and vertical profiles for use in CAMS regional models	3
	D81.1.4: Emissions for the year t and t-1	4
Total WP1		15.2
WP81.2: Anthropogenic emissions for the global domain		
	D81.2.1: Methodology to develop the CAMS_AG emissions for 2000-2018	1.2
	D81.2.2: Make the EDGAR4.3, ECLIPSEv5 and CEDS datasets available to the consortium	1.2
	D81.2.3: Emissions for all compounds for year 2018	4.1
	D81.2.4: Emissions for all compounds for year 2000-2017	5.3
	D81.2.5: Improved ship emissions for the most recent years available	3
	D81.2.6: Report on the characteristics of regional emissions for the USA, Canada, Latin America, China, India and South-East Asia	3.8
	D81.2.7: Improved CAMS_AG emissions using regional emissions for different parts of the world	4.6
	D81.2.8: Analysis of available proxies to better grid the emissions and point sources	2.8
	D81.2.9: Include the CAMS_AG emissions in ECCAD and in the CDS store, about every six months	2.8
Total WP2		28.8

WP81.3: Natural emissions for the global domain		
	D81.3.1: Gridded speciated and total NMVOCs emissions for the most recent year for which meteorological fields are available	3.8
	D81.3.2: Gridded speciated and total NMVOCs emissions for 2000-present	4.8
	D81.3.3: Report describing the methodology of NMVOCs emissions estimation and comparison with other available datasets	4.5
	D81.3.4: Update of potential map for Europe based on detailed land cover	1.2
	D81.3.5: Updated NMVOCs emissions for Europe based on detailed land cover	4
	D81.3.6: Gridded CH_4 emissions from termites	2
	D81.3.7: Report on availability of data, and methodology for development of CAMS soil-N emissions, 1st approach	3.2
	D81.3.8: Soil N emissions for 2000-present	2.6
	D81.3.9: Radon-222 emissions	1.2
	D81.3.10: Halogens, DMS and OCS emissions from the oceans	2
	D81.3.11: Halogens and DMS emissions from the oceans, 1st and 2nd update	2.2
	D81.3.12: Soil-N emissions (and where possible other gases) using updated land-cover and activity statistics	2.6
	D81.3.13: SO_2 emissions from volcanoes	1
	D81.3.14: SO_2 emissions from volcanoes, 1st and 2nd update	1
	D81.3.15: Report on available data on CO_2, BrO and HCl emissions from volcanoes	0.3
	D81.3.16: Report comparing data on SO_2 emissions with historical data on the same volcanoes	0.2
Total WP3		36.6
WP81.4: Consistency between regional and global emission datasets		
	D81.4.1: Gridding of regional and anthropogenic emissions to a common spatial resolution; grouping of some sectors if necessary	4
	D81.4.2: Comparisons of the total emitted in each country of the regional domain, for each species and common sector	4
	D81.4.3: Comparisons of the gridded emissions, where significant differences in national totals exist	6
	D81.4.4: Gathering of the data that are used as proxies for the spatialisation, and extraction of comparable data from GIS systems	2
	D81.4.5: Evaluation of the agriculture waste burning emissions in CAMS-81 and CAMS-44	3.2
		4

	D81.4.6: Evaluation of the vegetation maps used in the CAMS-81 and CAMS-44 projects	
Total WP4		23.2
WP81.5: Support to Production systems		
	D81.5.1: Anthropogenic emissions formatted for use in the regional models	2.2
	D81.5.2: Anthropogenic emissions formatted for use in the global models	2.2
	D81.5.3: Natural emissions formatted for use in the global models	2.2
	D81.5.4: Report providing details on the standard formats used for the delivery of emissions data	1
	D81.5.5: Report providing details on updates of the standard formats used for the delivery of emissions data	2.7
	D81.5.6: Anthropogenic and natural regional and global emissions delivered to the ECCAD database	2
	D81.5.7: Report on the inclusion of the emissions data in the CDS	2
	D81.5.8: Emission rates for ash (including emission heights) upon a major volcanic eruption	0.5
Total WP5		14.8
WP81.6: Service evolution		
	D81.6.1: Assessment of the feasibility of the CHTSSEL land-vegetation-carbon model	6
	D81.6.2: Report on emission temporal profiles for the regional and global scales	2.9
	D81.6.3: Improved monthly, weekly and diurnal emission temporal profiles for key source categories at the country/region level	3
	D81.6.4: Report on parameterisations to estimate and forecast anthropogenic emissions using meteorological parameters	4
	D81.6.5: Report on emission factors, spatial proxies and wood usage classification for residential wood combustion emissions	4
	D81.6.6: Report on the possibility of using emissions optimized by using inverse modelling techniques	3
	D81.6.7: Report on the inclusion of non-combustion ship emissions	1
Total WP6		23.9

WP81.7: Interaction with users		
	D81.7.1: Definition of procedures for timely critical communication	1.5
	D81.7.2: Establishment of a CAMS-81 product portfolio (to be regularly updated)	2
	D81.7.3: Forum for Help Desk available on ECCAD (to be regularly updated)	2.3
	D81.7.4: Synergies with international activities: participate in the 2017 and 2019 conferences of the GEIA project and in the 2018 IGAC conference	1.57
Total WP7		7.27
WP8.8: Management		
	D81.8.1: Set-up of the CAMS sub-contracts	1.5
	D81.8.2: Implementation of the web-based collaboration tool	1
	D81.8.3: Establishment of different mailing lists	1
	D81.8.4: Organization of the kick-off meeting in Toulouse, and of the CAMS-81 annual meeting before the start of year 2 and before the start of year 3	3
	D81.8.5: Teleconferences of the CAMS-81 partners, organized two or three weeks before the quarterly and yearly reports	1
	D81.8.6: Delivery of quarterly and yearly reports to ECMWF	4.27
Total WP8		11.97

4.5 Work packages description

The following pages give the main objectives of each workpackage, the different task in each workpackage and the deliverables. For each task, we have indicated in brackets the group who will lead each of these tasks.

Work-package #	**81.1**		**Start/End Date**		**M1/M36**
Work-package title	**Anthropogenic emissions for the CAMS regional domain (Lead: TNO)**				
Budget (k€)	**Total**	**Year 1**	**Year 2**	**Year 3**	
	234,814 €	105,255€	68,287€	61270€	
Participants (person-months)	TNO(9.8), FMI (3.9), CEIP (1.5)				

Main objectives

- Construction of a consistent European high resolution (~7x7 km) dataset of anthropogenic emissions set for 2014 (year t-2) and time series (2000 to t-2) (annual updated) for use by other CAMS Regional Service Providers and as stand-alone CAMS product.
- Stratification of emissions data in policy relevant (sub)source sectors, improved spatial distribution, temporal and vertical profiles, consistency between global and regional products
- Development of a methodology for predicting current year emissions

Description of activities

Task 81.1.1: CAMS-81 regional emission inventory data set for 2000- 2014 (or posterior) (TNO)
Task 81.1.2: Speciation of anthropogenic NMVOCs, PMs and CO2, related temporal and vertical emission profiles (TNO)
Task 81.1.3: Emissions from shipping (FMI)
Task 81.1.4: Extensions of the regional domain and consistency with global emissions (TNO)
Task 81.1.5: Developing regional emission data sets for current year t and t-1. (TNO)

Deliverables

#	Responsible	Nature	Title	Due
D81.1.1	TNO	Report and Dataset	European emissions dataset (2014) (updated annually to latest year)	M6, M18, M30
D81.1.2	TNO	Report and Dataset	European emissions time series 2000-2014 (updated once to latest year)	M12, M32
D81.1.3	TNO	Report	Documentation of temporal emission profiles and vertical profiles for use in CAMS regional models	M24
D81.1.4	TNO	Report and Dataset	Emissions for the year t and t-1	M36

Milestones				
#	Responsible	Nature	Means of verification	Due
M81.1.6	FMI	Dataset Regional emissions from shipping(2014)	Included in regional emission time series data set	M5
M81.1.2	TNO	Dataset	Delivery of produced Regional Emission Inventory data files to ECMWF to be included in the currently existing CAMS data portal	M7, M13, M19, M31, M33
M81.1.3	TNO	report	Test product “forecast” year t-2 validated with the “real” year t-2 emissions	M24

Work-package #	81.2			Start/End date	M1/M36
Work-package title	Anthropogenic emissions for the global domain Lead: CNRS-LA				
Budget (k€)	Total	Year 1	Year 2	Year 3	
	175,803€	58,558€	58,484€	58,762€	
Participants (person months)	CNRS-LA (17.6); CNRS-OMP (1.6), CUNI (3.5), FMI (4.1), BSC (2)				

Main objectives

- Provide anthropogenic emissions datasets to be used by the Global Service Provider
- Provide gridded global emissions for different source categories for the following species (BC and OC, NOx, NH3, SO2, NMVOCs, CO, CH4, N2O, CO2)
- Provide information to users about the methodology used to generate the emissions
- Provide the datasets in the CAMS data store and in the ECCAD database

Description of activities

Task 2.1: Access the EDGAR4.3, ECLIPSEv5 and CEDS/CMIP6 and make them available to the consortium (CNRS-OMP)

Task 2.2: Extend the EDGAR4.3 emissions at a 0.1x0.1degree resolution to the year 2014 using the CEDS inventory, and then to the year 2018 using the ECLIPSEv5 scenarios, and generate the CAMS-AG (Anthropogenic global) dataset for the 2000-2018 period (CNRS-LA, CUNI)

Task 2.3: Improve the ship emissions applying the FMI approach to emission modelling. Generation of suitable temporal profiles (FMI)

Task 2.4: Improve the CAMS-AG emissions using regional emissions for the USA, Canada, Latin America, Africa, China, India and South-East Asia (CNRS-LA)

Task 2.5: Improve the gridding of the emissions using different proxies, and provide information on point sources (CNRS-LA)

Task 2.6: Include the CAMS-AG emissions in the CAMS Data Store and in the ECCAD database (CNRS-OMP)

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D81.2.1	CNRS-LA	Report	Methodology to develop the CAMS_AG emissions for 2000-2018	M3
D81.2.2	CNRS-OMP	Dataset	Emissions datasets EDGAR4.3, ECLIPSEv5 and CEDS available to the consortium	M4
D81.2.3	CNRS-LA	Dataset	CAMS_AG missions for all compounds for year 2018	M6
D81.2.4	CNRS-LA	Dataset	CAMS_AG emissions for all compounds for years 2000-2017	M12

D81.2.5	CNRS-LA	Dataset	Improved ship emissions for the most recent years available	M24
D81.2.6	CNRS-LA	Report	Report on the characteristics of regional emissions for the USA, Canada, Latin America, Africa, China, India and South-East Asia	M18
D81.2.7	CNRS-LA	Dataset	Improved CAMS-AG emissions using regional emissions for different parts of the world	M36
D81.2.8	CNRS-LA	Report	Analysis of available proxies to better grid the emissions and point sources	M24
D81.2.9	CNRS-OMP	Database	Include the CAMS-AG emissions in the CDS and ECCAD, about every 6 months	M3, M6, M12, M18, M24, M30, M36

Milestones				
#	*Responsible*	*Title*	*Means of verification*	*Due*
M81.2.1	CNRS-OMP	global and regional datasets available for analysis	Data available on a server	M2,M14,M26
M81.2.2	CNRS-LA	Emissions dataset	Delivery of global emissions datasets	M6, M12, M36
M81.2.3	FMI	Emissions dataset	Improved global ship emissions	M24

Work-package #	81.3		Start/End date		M1/M36
Work-package title	Natural emissions for the global domain Lead: CUNI				
Budget (k€)	Total	Year 1	Year 2	Budget (k€)	Total
	277,591€	144,320€	74,839€	61270€	277,591€
Participants (person months)	CUNI (20), CRNS-LA (0.6), MET Norway (13.5), Chalmers (2.5)				

Main objectives

- Provide global natural emissions from vegetation, soils, termites, oceans and volcanoes to be used by the Global Service Provider.
- Provide information to users about the methodology used to generate the emissions

Description of activities

Task 81.3.1: Provide gridded and speciated NMVOC emissions for the period of 2000 to recent year based on ECMWF meteorology (CUNI)

Task 81.3.2: Create updated emission factor map for NMVOC species in Europe based on detailed land-cover distribution maps (MET Norway)

Task 81.3.3: Evaluate estimated NMVOC emissions by comparison with other available datasets and update emission estimates with detailed land-cover (CUNI)

Task 81.3.4: Provide gridded CH4 emissions from termite nests (CUNI)

Task 81.3.5: Compile and compare openly available global data-sets and methodologies for NO, N_2O, and NH_3 soil emissions (and underlying data such as N-inputs) (MET Norway)

Task 81.3.6: Adapt datasets/methods from Task 81.3.5 for CAMS land-cover and produce 1st emission data-sets for soil-N emissions (CUNI)

Task 81.3.7: Evaluate the feasibility of improving other emissions from soils (OCS, DMS, Rn-222) (MET Norway)

Task 81.3.8: Adapt global data-sets to make use of more detailed land-cover and activity-data over Europe, to provide better temporal resolution and updated emissions of BVOCs and soil emissions (CUNI)

Task 81.3.9: Create a multi-year data set of DMS emissions from the ocean (2000-2014) based on climatology of Lana et al., 2011, and flux calculations using meteorological parameters from ECMWF (MET Norway)

Task 81.3.10: Create a multi-year data set of halogen emissions from the ocean (2000-2014) based on climatology of Ziska et al., 2013, and flux calculations using meteorological parameters from ECMWF (MET Norway)

Task 81.3.11: Create a multi-year data set of OCS emissions from the ocean (2002-2014) based on monthly mean emissions of Lennartz et al., 2016 calculated from satellite data and ERA-Interim meteorological data (MET Norway)

Task 81.3.12: Create data files on SO_2 emissions from 20 continually degassing volcanoes for the period 2005-2010. To be extended during the course of the project (Chalmers) Task 81.3.13: Access data bases (e.g. deep carbon observatory) and perform literature survey on volcanic emissions on CO_2 and main halogens (Chalmers)

Deliverables

#	Responsible	Nature	Title	Due
D81.3.1	CUNI	Dataset	Gridded speciated and total NMVOC emissions for the most recent year for which meteorological fields are available	6
D81.3.2	CUNI	Dataset	Gridded speciated and total NMVOC emissions for 2000 - present	12
D81.3.3	CUNI	Report	Report describing the methodology of NMVOC emission estimation and comparison with other available datasets	24
D81.3.4	MET Norway	Data	Update of emission potential map for Europe based on detailed land-cover	24
D81.3.5	CUNI	Data	Updated NMVOCs emissions, including emissions for Europe based on detailed land cover	36
D81.3.6	CUNI	Data	Gridded CH4 emissions from termites	12
D81.3.7	MET Norway	Report	Report on availability of data, and methodology for development of CAMS soil-N emissions, 1st approach.	6
D81.3.8	MET Norway	Dataset	Soil N emissions for 2000-present	12
D81.3.9	CUNI	Report	Radon-222 emissions	18
D81.3.10	MET Norway	Dataset	Halogens, DMS and OCS from oceans	12
D81.3.11	MET Norway	Dataset	Halogens, DMS from oceans 1st and 2nd updates	24, 36
D81.3.12	MET Norway	Dataset	Soil-N emissions (and where possible other gases) using updated land-cover and activity statistics	36
D81.3.13	Chalmers	Dataset	SO2 emissions from volcanoes	12
D81.3.14	Chalmers	Dataset	SO2 emissions from volcanoes 1st and 2nd updates	24, 36
D81.3.15	Chalmers	Report	Report on available data on CO_2, BrO and HCl emissions from volcanoes	36
D81.3.16	Chalmers	Report	Report comparing data on SO_2 emissions delivered to the project with historical data on the same volcanoes	36

Milestones

#	Responsible	Title	Means of verification	Due
M81.3.1	CUNI	Acquisition of meteorological data	Data available	M3

M81.3.2	CUNI	BVOCs gridded emissions available and updates	Data available	M12, M36
M81.3.2	CUNI	Acquire vegetation maps from other WPs and from CAMS-44	Data available	M12
M81.3.3	MET Norway	Define methodology from soils emissions and report	Input for deliverable	M11, M35
M81.3.4	Chalmers	Acquisition of data from outgassing volcanoes	Data available	M10, M22, M34
M81.3.5	MET Norway	Emissions from oceans available	Data available	M12

Work-package #	81.4			Start/End date	M1/M36
Work-package title	Consistency between regional and global emissions datasets Lead: CNRS-OMP				
Budget (k€)	Total	Year 1	Year 2	Year 3	
	144,587€	37,023€	72,339€	35,225€	
Participants (person months)	CNRS-OMP (6), CNRS-LA (8.4), TNO (0.8), CUNI (3), BSC (2), MPIC (3)				

Main objectives

The consistency between the regional and global anthropogenic emissions in the European domain will be analysed. This information will be useful for developing the different versions of the inventories and their improvements, and will be provided to the users of the different datasets.
This WP will also analyse the consistency between the agriculture waste burning in the CAMS-81 and CAMS-44 fires subproject. The consistency between the vegetation maps used for the regional and global emissions, as well as in CAMS-44 will also be analysed.

Description of activities

Task 81.4.1: Preparation and regridding of the regional and global anthropogenic emissions datasets for a consistency analysis and grouping of sectors when necessary (CNRS-OMP)

Task 81.4.2: Comparisons of the regional and global emissions: calculation of the totals for each country included in the domain (CNRS-LA)

Task 81.4.3: Comparisons of regional and global gridded emissions, and identification of the regions and grid points where significant differences exist in the totals for each country (CNRS-OMP)

Task 81.4.4: Comparisons of the proxies used for gridding the different types of emissions, and with data from GIS systems (CNRS-LA)

Task 81.4.5: Evaluation of the agriculture waste burning emissions in the anthropogenic emissions datasets and in the CAMS-44 fire emissions (MPIC)

Task 81.4.6: Analysis and comparisons of the vegetation maps used in the development of the anthropogenic and natural emissions, as well as in CAMS-4 (CUNI)

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D81.4.1	CNRS-OMP	Data	Gridding of regional and global anthropogenic emissions to a common spatial resolution; grouping of some sectors if necessary	M14, M26, M36
D81.4.2	CNRS-OMP	Report	Comparisons of the total emitted in each country of the regional domain, for each species and common sector	M14, M26, M36

D81.4.3	CNRS-LA	Report	Comparisons of the gridded emissions, where significant differences in national totals exist	M16, M28, M36
D81.4.4	CNRS-OMP	Data	Gathering of the data that are used as proxies for the spatialisation, and extraction of comparable data from GIS systems	M18
D81.4.5	MPIC	Report	Evaluation of the agriculture waste burning emissions in CAMS-81 and CAMS-44	M24
D81.4.6	CUNI	Report	Evaluation of the vegetation maps used in the CAMS-81 and CAMS-44 subprojects	M30

Milestones

#	Responsible	Title	Means of verification	Due
M81.4.1	CNRS-OMP	Gridding of datasets to the same resolution	Data available	M15, M27, M36
M81.4.2	CNRS-LA	Calculation of totals for each country and sector, for the regional and global datasets	Tables of totals available	M14, M26, M36
M81.4.3	CNRS-OMP	Gathering of proxies used for the spatialisation of the datasets	Data available	M18
M81.4.4	MPIC	Gathering of the data concerning agriculture waste burning from CAMS-44 and comparisons with the CAMS-81 data	Data available	M23
M81.4.5	CUNI	Gathering of the vegetation maps used in CAMS-81 and CAMS-44	Data available	M28

Work-package #	81.5			Start/End date	M1/M36
Work-package title	Support to production systems Lead: CNRS-OMP				
Budget (k€)	Total	Year 1	Year 2	Year 3	
	97,290€	37,268€	32,446€	27,575€	
Participants (person months)	CNRS-OMP (8.8), CNRS-LA (0.6), TNO (1.2), MET Norway (0.5), CUNI (1.5), FMI (1.2), BSC (1)				

Main objectives

Regional and global anthropogenic and natural emissions will be provided regularly to regional and production systems. The latest emissions versions of the emissions will be delivered, and the CAMS-81 partners will support the preparation of the files for the different models. The partners will also have regular discussions with the global and regional service providers and make the necessary adjustments or corrections if needed. In a major volcanic eruption occurs, estimates for the emissions of SO2 and ashes together with estimates of the injection height will be provided.

Description of activities

Task 81.5.1: Preparation and formatting of the datasets of regional anthropogenic emissions for use in the simulations for the regional domain (CNRS-OMP)

Task 81.5.2: Preparation and formatting of the anthropogenic emissions for use in the global simulations (CNRS-OMP)

Task 81.5.3: Preparation and formatting of the natural emissions for use in the global simulations (CNRS-OMP)

Task 81.5.4: Standards for the regional and global emissions products: definition and discussions with ECMWF (CNRS-OMP)

Task 81.5.5: Delivery of the regional and global emissions to the ECCAD database. Discussions with ECMWF about the CDS system (CNRS-OMP)

Task 81.5.6: Estimates for ashes and injection height (and SO_2) if a major eruption occurs (MET Norway)

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D81.5.1	TNO	Data	Anthropogenic emissions formatted for use in the regional models	M6, M12, M24, M36
D81.5.2	CNRS-LA	Data	Anthropogenic emissions datasets formatted for use in the global models	M6, M12, M24, M36
D81.5.3	CUNI	Data	Natural emissions formatted for use in the global models	M6, M12, M24, M36
D81.5.4	CNRS-OMP	Report	Report providing details on the standard formats used for the delivery of emissions data	M6

D81.5.5	CNRS-OMP	Report	Report providing details on updates on the standard formats used for the delivery of emissions data	M24
D85.5.6	CNRS-OMP	Data	Anthropogenic and natural regional and global emissions delivered to the ECCAD database	M12, M24, M36
D85.5.7	CNRS-OMP	Report	Report on the inclusion of the emissions data in the CDS	M12 (depending on the development of CDS)
D81.5.8	MET Norway	Data	Emission rates for ash (including emission heights) upon a major volcanic eruption.	One week after the eruption

Milestones

#	Responsible	Title	Means of verification	Due
M81.5.1	CNRS-OMP	Agreement on the format of the emissions data	Report on formatting information	M4
M81.5.2	CNRS-OMP	Updates on the formatting of the emissions data	Update on the formatting information	M22
M81.5.3	CNRS-LA	Discussions with ECMWF on the CDS	Summary of the discussions	M6 (depending on the availability of the CDS)
M81.5.4	MET Norway	Group teleconference in the case of a major volcanic eruption	Summary of the teleconference	When an eruption starts

Work-package #	81.6			Start/End date	M1/M36
Work-package title	Service Evolution Lead: BSC				
Budget (k€)	Total	Year 1	Year 2	Year 3	
	155,904€	30,862€	62,903€	62,138€	
Participants (person months)	BSC (11.5), CNRS-LA (1.8), TNO (2.6), CUNI (7), FMI (1)				

Main objectives

- Assess the feasibility of adapting the CHTESSEL land-vegetation-carbon model to compute online biogenic NMVOC emissions and compare the resulting approach with other offline solutions.
- Investigate monthly, weekly and diurnal temporal profiles for global and regional scales to improve the temporal representativeness of the anthropogenic emissions
- Assess the feasibility of developing modelling methodologies and test of several algorithms to estimate and forecast anthropogenic emissions using meteorological parameters
- Investigate the possibility of including non-combustion sources of VOCs from shipping.
- Investigate emission factors, spatial proxies and wood usage classification (i.e. heating or cooking) to improve the characterisation of residential wood combustion emissions
- Assess the possible use of results from inverse modelling to improve the emissions of greenhouse gases, reactive compounds and aerosols
- Discuss the specific proposed service upgrades and extensions contained in the SES document developed by the ECMWF

Description of activities

Task 81.6.1 Adaptation of the CHTESSEL model to compute on-line biogenic NMVOC emissions and comparison with other off-line solutions (CUNI)
Task 81.6.2 Critical review of current state of the art methodologies and available databases, including meteorologically driven functions, to characterize the temporal patterns of emissions (BSC)
Task 81.6.3: Development of improved monthly, weekly and diurnal temporal profiles for key source categories at the country/region level (BSC)
Task 81.6.4: Critical review of current methodologies used to adjust emissions (residential/ commercial use of heating or air conditioning and evaporation from cars) as a function of meteorological parameters for emission sources that maybe linked to meteorological data (BSC)
Task 81.6.5: Assessment of the potential integration of the selected parametrisations into the existing CAMS forecasting system (BSC)
Task 81.6.6: Investigation on emission factors, spatial distribution proxies and wood usage classification for improving the characterisation of residential wood combustion emissions (BSC)
Task 81.6.7: Assessment of the use of inverse modelling for the improvement of emissions: discussion of the results of the new IGAC/GEIA international activity (CNRS-LA)
Task 81.6.8: Discussion of the specific proposed service upgrades and extensions contained in the SES document developed by the ECMWF (CNRS-LA)
Task 81.6.9: Assessment on inclusion of non-combustion VOC emissions from ships (FMI)

Deliverables				
#	Responsible	Nature	Title	Due
D81.6.1	CUNI	Report	Assessment of the feasibility of adapting the CHTSSEL land-vegetation-carbon model	M24
D81.6.2	BSC	Report	Report on emission temporal profiles for the global and regional scales	M18
D81.6.3	BSC	Dataset	Improved monthly, weekly and diurnal emission temporal profiles for key source categories at the country/region level	M36
D81.6.4	BSC	Report	Report on parameterisations to estimate and forecast anthropogenic emissions using meteorological parameters	M36
D81.6.5	BSC	Report	Report on emission factors, spatial proxies and wood usage classification for residential wood combustion emissions	M36
D81.6.6	CNRS-LA	Report	Report on the possibility of using emissions optimized by inverse modelling techniques	M36
D81.6.7	FMI	Report	Report on the inclusion of non-combustion ship emissions	M36

Milestones				
#	Responsible	Title	Means of verification	Due
M81.6.1	CUNI	Discussions with ECMWF on how to access the CHTSSEL model	Summary of discussion	M18
M81.6.2	BSC	Gather data concerning monthly, weekly and diurnal temporal profiles	Input for deliverable	M15
M81.6.3	BSC	Discussion of the methodology for the parameterisation to estimate anthropogenic emissions using meteorological parameters	Summary of discussion	M30
M81.6.4	BSC	Gathering of data concerning the EF, spatial proxies and wood usage classification for residential wood combustion emissions	Input for deliverable	M30
M81.6.5	CNRS-LA	Attend the meetings of the IGAC inverse modelling assessment project	Summary of meeting	M7, M19, M31

Work-package #	81.7			Start/End date	M1/M36
Work-package title	Interactions with users Lead: MET Norway				
Budget (k€)	Total	Year 1	Year 2	Year 3	Total
	54,432€	19,797€	17,444€	17,191€	
Participants (person months)	MET Norway (1), CNRS-LA (0.9), CNRS-OMP (0.9), TNO (0.57), CUNI (1.5), FMI (0.8), BSC (1), EAA (0.6)				

Main objectives

- Establish and regularly update an internal document briefly describing all data sets produced in CAMS-81 (including version numbers).
- Optimize the user interface (user support, user-friendliness of products), in coordination with ECMWF and CAMS-94.
- Provide ECMWF with information on CAMS-81 developments relevant to the RAD, SPP, and SES documents.
- Ensure synergies with international initiatives on emissions.

Description of activities

- Task 81.7.1: Establishment of a user forum on ECCAD which will continuously provide users support. On this forum, users will be able to ask questions concerning CAMS-81 products, and answers will be provided by relevant CAMS-81 partners within 5 working days (CNRS-OMP)
- Task 81.7.2: Establishment of a document listing all CAMS-81 data sets (including old versions) with brief descriptions, metadata and references. The document will be kept up-to-date. Descriptions of the latest versions will also be sent to ECWMF as input to the SPP (CNRS-OMP)
- Task 81.7.3: Provide information to ECMWF regularly to keep the Requirement Analysis Document, the Service Product Portfolio, and the Service Evolution Strategy up-to-date. Information will be on a format suitable for these documents (MET Norway)
- Task 81.7.4: Establishment of interactions with international initiatives, such as GEIA and TFEIP (the Task Force on Emission Inventories and Projections under the LRTAP convention), to ensure a two-way flow of information relevant to emission data. Some of the CAMS-81 partners will attend relevant meetings to inform about CAMS-81 products and to obtain feedback in regard to possible improvements (CNRS-LA)

Deliverables

#	Responsible	Nature	Title	Due
D81.7.1	MET Norway	Report	Definition of procedures for timely critical communication	M3
D81.7.2	MET Norway	Report (working document)	Establishment of a CAMS-81 product portfolio (to be regularly updated)	M6, M36

D81.7.3	CNRS-OMP	Web page (forum)	Forum for Help desk available on ECCAD (regularly updated)	M7 and continuous
D81.7.4	CNRS-LA	Meeting	Synergies with international activities: Participate in the 2017 and 2019 conferences of the GEIA project and of the 2018 IGAC conference	M7, M19, M31

Milestones				
#	Responsible	Title	Means of verification	Due
M81.7.1	MET Norway	CAMS-81 portfolio initiated	Portfolio available	M5
M81.7.2	CNRS-OMP	Forum for Help Desk active	Forum available	M6
M81.7.3	CNRS-LA	Start discussions with the IGAC and GEIA international projects to initiate collaboration	Summary of first teleconference	M3

Work-package #	81.8			Start/End date	M1/M36
Work-package title	Management Lead: CNRS-LA				
Budget (k€)	Total	Year 1	Year 2	Year 3	
	148,712€	40,281€	58,200€	50,231€	
Participants (person months)	CNRS-LA (3), CNRS-OMP (6.2), TNO (0.27), CUNI (1.5), BSC (1)				

Main objectives

- Coordinate the CAMS-81 project, organise the yearly meetings of the project, as well as regular teleconference for all partners
- Develop a web-based collaboration tool, which will make easier the monitoring of the project and its deliverables
- Gather the material needed for the quarterly and yearly reports
- Establishment of links with other CAMS subprojects

Description of activities

Task 81.8.1: Set-up of the CAMS sub-contracts for all partners (CNRS-LA)

Task 81.8.2: Implementation of a web-based collaboration tools, visible and editable by all partners (CNRS-LA)

Task 81.8.3: Organisation of regular teleconferences to monitor the project: these teleconferences will take place two to three weeks before the quarterly reports (CNRS-LA)

Task 81.8.4: Organisation of the kick-off and yearly meetings (CNRS-LA)

Task 81.8.5: Monitoring of the deliverables and delivery of the quarterly and yearly reports (CNRS-OMP)

Task 81.8.6: Development of interactions with other CAMS projects (CNRS-LA)

Deliverables

#	*Responsible*	*Nature*	*Title*	*Due*
D81.8.1	CNRS-LA	Other	Set-up of the CAMS sub-contracts	M1
D81.8.2	CNRS-OMP	Web tool	Implementation of the web-based collaboration tool	M2
D81.8.3	CNRS-LA	Other	Establishment of different mailing lists	M1
D81.8.4	CNRS-LA	Meeting	Organisation of the kick-off meeting in Toulouse, and of the CAMS-81 annual meeting before the start of year 2 and before the start of year 3	M2, M11, M23

D81.8.5	CNRS-LA	Web-based Meeting	Teleconferences of the CAMS-81 partners, organised two to three weeks before the quarterly and yearly reports	M3, M6, M12, M15, M18, M21, M24, M27, M30, M33
D81.8.6	CNRS-LA	Reports	Delivery of quarterly and yearly reports to ECMWF	M3, M6, M12, M15, M18, M21, M24, M27, M30, M33, M36

Milestones				
#	Responsible	Title	Means of verification	Due
M81.8.1	CNRS-LA	Start of the set-up of the subcontracts	Sub-contracts written	M1
M81.8.2	CNRS-OMP	Start of the implementation of the web-based collaboration tool	1st tests of the tool	M2
M81.8.3	CNRS-LA	Organization of the kick-off meeting	Meeting organized	M2
M81.8.4	CNRS-LA	Organisation of regular CAMS-81 teleconferences	Summaries of the teleconferences	M3, M6, M12, M15, M18, M21, M24, M27, M30, M33, M36

4.6: Key Performance Indicators

Several performance indicators (KPI) have been defined. These indicators will be reviewed each year by the CAMS-81 partners and the CAMS providers. They will be mentioned explicitly when needed in the deliverables.

Table 3: Key Performance Indicators

KPI #	KPI Title	Performance Target and Unit of Measure	Frequency of Delivery	Explanations / Comments
1	Timely delivery	Emissions provided accordingly to the schedule detailed in the WP tables	According to WP tables	
2	Formatting	Emissions files provided in the format and periods required by the regional and global service provider	With each release of a dataset	The format specifications will be defined with the service providers during the first 6 months of the project
3	Users	Answers to users are provided in a timely manner	Within 5 working days after questions are received	
4	Database	Emissions files available on the ECCAD database and, when available on the CAMS Data Store	After the release of a dataset	
5	Documentation	Emission datasets are provided with a detailed documentation	After the release of a dataset	

4.7 Risk Register

As a general rule, the partners will attempt to minimize all risks through frequent and regular communication among project partners and with the different CAMS providers using the data generated as part of CAMS-81.

Risk Name	Description	Likelihood	Impact	Response Strategy
Personnel	Unavailability of key personnel (retirement, resignation, sickness, childbirth, death)	Low	High	Involvement of more than one person on each task. In several groups, the work will be done by permanent staff. Backup staff members will be identified for each WP.
Data access	Unavailability of critical input data	Low	Medium	Use of multiple data sources
Equipment	Critical equipment failure (Storage, IT infrastructure)	Low	High	Regular data backup procedures, physical transfer of data
Late delivery	Risk of not being able to deliver datasets, documentation or reports	Low	Medium	Most groups have been part of predecessor projects or are part of other CAMS projects. They all are used to delivering datasets and report in a timely manner. The coordinator and the system manager will make sure that all planned deliveries are on time.
Poor quality of input data	The project will collect, analyse and use different types of data	Low	Medium	Most of the necessary input data to be used in the project have already been carefully checked by the groups who have developed them. If some issues are found, these groups will be contacted and corrections will be applied.
Request for other emissions data	The regional and global service providers might request additional data that were not indicated in the call.	Medium	Medium	Such requests will lead to changes in the work plan. Such changes will have to be discussed with ECMWF and other CAMS providers, since additional work might lead to the removal of other deliverables.

4.8 Payment plan

We propose to have the payments every 6 months, after all deliverables during the corresponding period have been sent to ECMWF.

Annex 1: CVs of partners involved in the project

List of CVs of partners involved in the project:

1.	CNRS-LA	:	Claire GRANIER
2.	CNRS-LA	:	Catherine LIOUSSE
3.	CNRS-OMP	:	Sabine DARRAS
4.	CNRS-OMP	:	François ANDRE
5.	TNO	:	Hugo DENIER van der GON
6.	TNO	:	Jeroen KUENEN
7.	MET Norway	:	David SIMPSON
8.	MET Norway	:	Michael GAUSS
9.	MET Norway	:	Hilde FAGERLI
10.	CUNI	:	Katerina SINDELAROVA
11.	FMI	:	Jukka-Pekka JALKANEN
12.	FMI	:	Lasse JOHANSSON
13.	BSC	:	Marc GUEVARA
14.	BSC	:	Carlos PEREZ
15.	BSC	:	Oriol JORBA
16.	MPIC	:	Johannes KAISER
17.	EAA	:	Sabine SCHINDLBACHER
18.	EAA	:	Katarina MARECKOVA
19.	EAA	:	Robert WANKMULLER
20.	Chalmers	:	Bo GALLE
21.	Chalmers	:	Santiago ARELLANO

Curriculum Vitae

PERSONAL INFORMATION

Claire Granier

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http://www.aero.obs-mip.fr/

Sex Female | Date of birth 24/01/1957 | Nationality French

WORK EXPERIENCE

[

2001- present Senior Scientist,
CNRS (French National Center for Scientific Research)
Laboratoire d'Aerologie, Toulouse (2016 – present); LATMOS, Paris (2001 – april 2016)

- Development of global emissions inventories (anthropogenic and fires); evaluation of emission distributions and their trends.
- Co-chair of the Global Emissions Initiative (GEIA) international project from 2004 to 2100, Director of the GEIA project databases (2011-present), and Scientific Director of the ECCAD emissions database (> 2500 users)
- Deputy coordinator of the MACC, MACC-II and MACC-III projects; member of the management board of the GEMS project
- Sub-project leader of the Emissions sub-project in GENS, MACC, MACC-II and MACC-III
- Quantification of the global budget of tropospheric chemical species and analysis of observations of tropospheric compounds from space
- Quantification of the impact of human activities on the composition of the atmosphere

1982 - 2001 Scientist, CNRS (French National Center for Scientific Research), LATMOS, Paris

- Development of global chemistry-transport models
- Studies of the global budgets of carbon monoxide, methane and stratospheric ozone
- Development of lidar systems to monitor the troposphere, stratosphere and mesosphere

EDUCATION AND TRAINING

1982 - 1988 PhD (Thèse d'Etat), Physics, University Pierre and Marie Curie, Paris
1980 – 1982 PhD (Thèse 3ème cycle), University Pierre and Marie Curie, Paris
1979 - 1980 Master, Mathematics, University Pierre and Marie Curie, Paris

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
German	A2	A2	A2	A2	A1

Organisational / managerial skills

- Project leader, team coordinator, supervisor
- Experience in managing large international research teams as either a project coordinator, deputy coordinator or theme leader
- Experience in the management of international projects: co-chair of the Global Emissions Initiative (GEIA) during 2004-2011, member of the steering committee of several international projects
- Experience in the management of databases: scientific director of the ECCAD emissions database (about 2500 users) since 2005
- Experience in the organisation of large conferences, such as the conference of the International Global Atmospheric Chemistry Project (about 530 attendees in September 2016)
- Experience in the organisation of international interdisciplinary training courses (last one: international summer school with 80 attendees in Guangzhou in China in August 2016)

Computer skills

- Programming skills in Fortran, IDL, NCL, Linux, Mac-OS X
- Experience in different data formats, NetCDF, Raster, CSV
- Word, Powerpoint, Excel

Other skills

- Research publications, metadata development, training documents
- Evaluation of models using satellite and ground-based observations
- Teaching on emissions, modelling and analysis

ADDITIONAL INFORMATION

Memberships

- 2014 – present: Member of the Task Team on Observational Requirements and Satellite Measurements of the World Meteorological Organization
- 2014 – present: Chair of the Education Exchange Committee of the European-Chinese PANDA project (Partnership with China on Space Data)
- 2012 – present: Member of the steering committee of the GEIA (Global Emissions IntiAtive) international project, and Director of GEIA emissions databases
- 2011 – present: Member of the Scientific Steering Committee of the IGAC (International Global Atmospheric Chemistry Project) international project
- 2011 – 2015: Member of the steering group of the FP7 PEGASOS (Pan-European Gas-AeroSol-climate interaction Study) project
- 2010 – 2015: Member of the managing committee of the ACCENT-Plus (Atmospheric Composition Change: The European Network) FP7 project
- 2004 – 2012: Member of the International Ozone Commission (IO3C)
- 2005 – 2011: Co-chair of the GEIA (Global Emissions Inventory Activity) international project of AIMES/IGBP and IGAC/IGBP
- 2005- 2010: Member of the Scientific Steering Committee of the AIMES (Analysis, Integration and Modeling of the Earth System) project of the International Geosphere-Biosphere Program (IGBP)
- 2004 – 2009: Member of the Managing Committee of the European Network of Excellence ACCENT
- 1997 – 2005: Member of the Scientific Steering Committee (SSC) of the SPARC (Stratospheric Processes and their role in Climate) project of the World Climate Research Program (WCRP).
- 2000-2005: Member of the Advisory Science Panel on Atmospheric Chemistry of the European Commission

Selected Publications

- Hassler, B., B.C. McDonald, G.J. Frost, A. Borbon, D.C. Carslaw, K. Civerolo, C. Granier, et al., Analysis of long-term observations of NO x and CO in megacities and application to constraining emissions inventories, Geophys. Res. Lett., 43, 9920–9930, doi:10.1002/2016GL069894, 2016.
- Granier, C., T. Doumbia, L. Granier, K. Sindelarova, G. Frost, I. Bouarar, C. Liousse, S. Darras and J. Stavrakou, Anthropogenic surface emissions in Asia, submitted to the peer-reviewed book "Persistent Regional Air Pollution in Asia", Springer - ISSI Series, 2016.
- Crippa, M., Janssens-Maenhout, et al., Forty years of improvements in European air quality: the role of EU policy–industry interplay, Atmos. Chem. Phys., 16, 3825-3841, doi:10.5194/acp-16-3825-2016, 2016
- Messina, P., Lathière, J., Sindelarova, K., Vuichard, N., Granier, C., Ghattas, J., Cozic, A., and Hauglustaine, D. A.: Global biogenic volatile organic compound emissions in the ORCHIDEE and MEGAN models and sensitivity to key parameters, Atmos. Chem. Phys. Discuss., 15, 33967-34033, doi:10.5194/acpd-15-33967-2015, 2015.
- Monks, P. S., Archibald, A. T., Colette, A., Cooper, O., Coyle, M., Derwent, R., Fowler, D., Granier, C.,.Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer, Atmos. Chem. Phys., 15, 8889-8973, 2015.
- Sindelarova, K., Granier, C., Bouarar, I., Guenther, A., Tilmes, S., Stavrakou, T., Müller, J.-F., Kuhn, U., Stefani, P., and Knorr, W.: Global dataset of biogenic VOC emissions calculated by the MEGAN model over the last 30 years, Atmos. Chem. Phys., 14, 9317-9341, 2014.
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- Frost, G.J, P. Middleton. L. Tarrasón, C. Granier, A. Guenther. B. Cardenas. H. Denier van der Gon, G. Janssens-Maenhout, J. W. Kaiser. T. Keating, Z. Klimont, J.-F. Lamarque, C. Liousse, S. Nickovic, T. Ohara, M. G. Schultz, U. Skiba, J. van Aardenne, Y. Wang, New Directions: GEIA's 2020 Vision for Better Air Emissions Information, Atmos. Env., 81, 710-712, 2013.
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- Brioude, J., R. Portmann , et al., Variations in ozone depletion potentials of very short-lived substances with season and emission region, Geophys. Res. Lett., 37, L19804, doi: 10.1029/2010GL0448562010, 2010.
- Liousse, C., Guillaume, et al., Updated African biomass burning emission inventories in the framework of the AMMA-IDAF program, with an evaluation of combustion aerosols, Atmos. Chem. Phys., 10, 9631-9646, doi:10.5194/acp-10-9631-2010, 2010.
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- Mieville, A., C. Granier, C. Liousse, B. Guillaume, F. Mouillot, J.F. Lamarque, J.M. Grégoire, G. Pétron, Emissions of gases and particles from biomass burning during the 20th century using satellite data and an historical reconstruction, Atmospheric Environment, Atmos. Env., 44, 11, 1469-1477, 2010.

PERSONAL INFORMATION

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Sex Female | Date of birth 22/04/1966 | Nationality French

WORK EXPERIENCE

[

2011- present — Senior Scientist, CNRS (French National Center for Scientific Research)
Laboratoire d'Aerologie

2000- 2011 — Scientist, CNRS (French National Center for Scientific Research)
LSCE, Gif sur Yvette

1994 - 2000 — Scientist, CNRS (French National Center for Scientific Research)
LSCE, Gif sur Yvette

- Development of Emission inventories for fossil fuel and biomass burning sources at global and regional scales with focus on Africa and Mediterranean areas. Past, present and future scenarii (1860-2100) (link with socioeconomists)
- Experimental characterization of emissions on field and in combustion chambers
- Emission test within global and regional models
- International Emission Intercomparaisons
- International GEIA Emission database (ECCAD)
- Carbonaceous aerosol Impacts (measurements and modelling). *Radiative and Climatic impacts with global (TM) and regional (RegCM) models. *Health impacts: focus on African megacities in West, Central and South Africa (link with biologists, epidemiologists and sociologists). *Scenarios and Mitigation effects on health and climate.

EDUCATION AND TRAINING

2007	Habilitation à diriger des recherches (HDR), Toulouse University
1994	Post-doctoral position (Lawrence Livermore Laboratory, Livermore, USA)
1990 - 1993	PhD in Pollution Chemistry and Environment physics (University Paris 7). PhD thesis topic: Biomass burning carbonaceous aerosol emissions in Africa, University Paris 7, Paris
1989 - 1990	Master Pollution chemistry and Environment physics, University Paris 7, Paris

PERSONAL SKILLS

Mother tongue(s): French

Other language(s)

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

Organisational / managerial skills

- Head of EDI (Emissions, Deposition, Impacts) team of LA (20 persons).
- Head of Environnement/Health/Society Axis at Observatoire Midi-Pyrénées, Toulouse. (20 persons, 3 laboratories).
- Member of GEIA international steering committee
- Head of DACCIWA-WP2 (Air pollution and Health in West Africa) european program Head of GRDI ARSAIO (Air Pollution and Impacts in South Africa) (PI : H. Bencherif)
- Co-head of atmospheric chemistry ORE-INDAAF network (Africa).
- Co-head of ECCAD database.
- Experience in the organisation of workshops and conferences.

Teaching and training

- Classes on pollution and health at Toulouse Master
- Classes on Emissions at various summer schools (ACCENT-GEIA 2007, MACC2-GMES 2013 ..)
- Classes on Emissions and Air pollution and Health at Univ. Felix Houphouet Boigny, Abidjan doctorate school.
- Supervisor of 7 african PhD students, 3 post doctorates and 4 masters
- Reviewer for many papers and PhD committees.

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

- West, J., A. Cohen, F. Dentener, B. Brunekreef, T. Zhu, B. Armstrong, M. Bell, M. Brauer, G. R. Carmichael, D. Costa, D. Dockery, M. J. Kleeman, M. Krzyzanowski, N. Kunzli, C. Liousse, wt al., What we breathe impacts our health: improving understanding of the link between air pollution and health, DOI: 10.1021/acs.est.5b03827, 2016.
- Knippertz, P., M. Evans, P. Field, A. Fink, C. Liousse, and J. Marsham, Local air pollution - a new factor for climate change in West Africa?, accepted in Nature Climate Change, 2015.
- Liousse C., E. Assamoi, P. Criqui, C. Granier and R. Rosset, African combustion emission explosive growth from 2005 to 2030, Environ. Res. Lett., 9, 035003 doi:10.1088/1748-9326/9/3/035003, 2014.
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- Val S., C. Liousse, T. Doumbia, A. Baeza-Squiban, Corinne Galy-Lacaux, Hélène Cachier, Nicolas Marchand' Inflammatory and adaptative responses of human bronchial epithelial cells due to aerosol urban pollution in Bamako and Dakar in Africa, *Particle and Fibre Toxicology 2013,* **10***:10, 2013.*
- Zhu T., Melamed M.L., Parrish D., Gauss M., Gallardo Klenner L., Lawrence M., Konare A. and Liousse C., WMO/IGAC Impacts of Megacities on Air Pollution and Climate, GAW Report No. 205, WMO edition, 1-314pp, 2013.
- Doumbia T., C. Liousse, C. Galy-Lacaux, A. Ndiaye, B. Diop, M. Ouafo, V. Yoboué, E. Gardrat, P. Castera, R. Rosset, L. Sigha, Real time Black Carbon measurements in West and Central Africa urban sites, Atmos. Env. 54, 529-537, 2012.
- Granier, C., B. Bessagnet, T. Bond, A. D'Angiola, H. Denier van der Gon, G. Frost, A. Heil, J. Kaiser, S. Kinne, Z. Klimont, J.-F. Lamarque, C. Liousse, T. Masui, F. Meleux, A. Mieville, T. Ohara, K. Riahi, M. Schultz, S. Smith, A. M. Thomson, J. van Aardenne, and G. van der Werf, Evolution of anthropogenic and biomass burning emissions at global and regional scales during the 1980-2010 period, Climatic Change, doi 10.1007/s10584-011-0154-1, 2011.
- Liousse C., B. Guillaume, J.M. Grégoire, M. Mallet, C. Galy, V. Pont, A. Akpo, M. Bedou, P. Castéra, L. Dungall, E. Gardrat, C. Granier, A. Konaré, F. Malavelle, A. Mariscal, A. Mieville, R. Rosset, D. Serça, F. Solmon, F. Tummon, E. Assamoi, V. Yoboué, and P. Van Velthoven, Updated African biomass burning emission inventories in the framework of the AMMA-IDAF program, with an evaluation of combustion aerosols, Atmos. Chem. Phys., 10, 7347-7382, 2010.
- Junker C. and C. Liousse, A Global Emission Inventory of Carbonaceous Aerosol including Fossil Fuel and Biofuel sources for the Period 1860 – 1997, ACP, 8, 1-13, 2008.

PERSONAL INFORMATION

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Sex Female | Date of birth 06/08/1963 | Nationality French

WORK EXPERIENCE

from 2006 to present — Engineer at CNRS /OMP

CNRS/OMP 14 Avenue Edouard Belin, 31400 Toulouse

- Project manager for the development of ECCAD database and website
  ECCAD: 2540 users from 900 institutes across the world
- Coordination of the developments, project requirements and specifications
- Formatting and standardization of the data into the database and data archiving
- Development of analysis tools

from 2000 to 2002 — Engineer at CNES

CNRS/OMP 14 Avenue Edouard Belin, 31400 Toulouse

- Project manager for the ISIS program Incentive for the scientific use of images from the SPOT system

from 1994 to 1996 — Engineer at IGBP-DIS

- Analysis and comparison of global wetland,
- Compilation of a regional satellite Fire

from 1989 to 1992 — Project manager of the « Mediterranean Oceanic Database »

CNES, 18 Avenue Edouard Belin, 31400 Toulouse

- Development of visualisation tools and data analysis
- Data formatting
- Contact with data providers

from 1989 to 1992 — Engineer at the Center for the Study of the Biosphere from Space (CESBIO)

13 avenue du Colonel Roch , 31400 Toulouse

- Responsible of the methodology and use of earth observation satellites and meteorological satellites for crop yield assessment in semiarid environments
- Data processing
- Study of a new vegetation index

EDUCATION AND TRAINING

1992 Master's degree in Remote sensing techniques

1988 Engineering degree from the National High School for Agronomy of Toulouse (ENSAT)

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	B2	B2	C1
	Proficiency of Cambridge.				
Italian	C2	C2	B2	B2	A2

Organisational / managerial skills
- Team coordination

Job-related skills
- Broad experience in remote sensing data processing and analysis
- Experience in GIS
- Teaching in summer schools

Computer skills
- Programming skills in C, Java, HTML, CSS, NCO
- Experience in different data formats, NetCDF, Raster, CSV
- Word, Powerpoint, Excel

Other skills
- Easy contact

PERSONAL INFORMATION

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Sex Female | Date of birth 06/08/1963 | Nationality French

WORK EXPERIENCE

from 2016 to present — Technical Director CNRS/OMP

CNRS/OMP 14 Avenue Edouard Belin, 31400 Toulouse

- Development of the technical structure
- Interoperability between different services
- Development of the common webportal
- Access to datasets
- Organisation and management of technical meetings

from 2015 to 2016 — Technical Director – Data Services

- Technical coordination of different data portal services
- Definition of the architecture of the data services
- Development of data portals and interoperability tools
- Participation in EnvriPlus and Eurochamp European projects

from 2012 to 2015 — Project leader at OMP

- Development of a data portal for the RESIF research infrastructure
- Development of a metadata portal
- Management of the sedoo OMP group

from 2011 to 2012 — Group leader at OMP

- Leader of the group "Functional and transversal applications"
- Responsible for the operational maintenance of the group applications
- Definition of the technological orientations
- Responsible for the group dealing with users

from 2003 to 2011 — Group leader – Ministry of agriculture

13 avenue du Colonel Roch , 31400 Toulouse

EDUCATION AND TRAINING

1998	Engineer Diploma (Ingénieur civil des Mines), Paris, France
1997 – 1998	Concordia University, Montreal, Canada
1995-1997	Mines engineer school, St Etienne, France

PERSONAL SKILLS

Mother tongue(s) French

Other language(s)

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

Organisational / managerial skills

- Team coordination

Computer skills

- Framework Eclipse : SWT, Jface (y.c. Data binding), UI Forms, développement de plugins et d'applications RCP, Xtext, OSGI
- Swing, JNI
- Server and JEE: GWT, JSP/Servlets, JDBC, JSF, Hibernate/JPA, Spring (Core, MVC, Batch, Boot, ROO)
- Data flux: Apache Camel, Apache Nifi
- Distributed architecture : Web Services (Jersey, CXF, JAXWS, Axis)
- Other: Junit, javaCC/JJTree, SLF4j/log4j, SAX/DOM/JDOM, Castor
- Web technologies: HTML, CSS, Javascript (Ajax, Jquery), PHP, Web Components (Polymer), OpenLayers, Api Google
- Languages: C/C++, Shell-scripts, SQL, XML, XSL
- Databases: MySQL, PostgreSQL, HsqlDB, Sybase, Oracle, Access
- Tools: Eclipse, Maven/Ant, Git/SVN, Jenkins/Sonar (Cobertura, PMD, Checkstyle,...), Tomcat, Flash, Docbook, NSIS, suites Office

PERSONAL INFORMATION

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Profile: Google Scholar profile Hugo Denier van der Gon

Sex Male | Date of birth 26/05/1961 | Nationality Dutch

WORK EXPERIENCE

2001-present Senior Researcher and project leader, TNO Department Climate, Air and Sustainability

- Policy-supporting research on air pollution
- Experience in international project management.
- Particulate matter (PM) and carbonaceous particulate emissions
- Priority air pollutants:
- Preparation of model-ready emission inventories
- Use of Earth observation data to validate and improve emission inventories
- Heavy metal and Persistent organic Pollutant emissions
- Climate change, greenhouse gas emissions and ecosystems

1995-2000 Postdoctoral Researcher and project co-ordinator, University Research Center, Laboratory of Soil Science anf Geology, Wageningen, The Netherlands

1990 – 1994 Researcher, Wageningen Agriculture University

1988 – 1990 Researcher, RIVM National Institute of Public Health and the Environment, Bilthoven, The Netherlands

EDUCATION AND TRAINING

1990 - 1994 Wageningen Agriculture University, Wageningen The Netherlands
International Rice Research Institute, The Philippines

- Methane emissions from wetland rice fields;
- Bio-geochemical cycles, emissions of non-CO2 greenhouse gases from ecosystems

1979 – 1987 MSc Environmental sciences, specialization soil pollution (cum laude)

Wageningen Agricultural University, The Netherlands

Wetland Biogeochemistry Insitute, Louisiana State University, Baton Rouge, U.S.A.

PERSONAL SKILLS

Mother tongue(s): Dutch

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
French	A2	B1	A2	A2	
German	B1	B2	B1	B1	A1

Organisational / managerial skills

Experience in international project management.
Work Package leader emissions in EU FP6, FP7, H2020 integrated projects (e.g., EUCAARI, MEGAPOLI, TRANSPHORM, MACC I-III)
Organizer of international workshops

Job-related skills and Miscellenaous

- Steering group member of GEIA (Global Emission Inventory Activity)
- Coordination group member of AQMEII (Air Quality Model Evaluation and Intercomparison Initiative) responsible for European emissions
- Expert reviewer IPCC 2006 and Rapporteur and expert in IPCC (Intergovernmental Panel on Climate Change) expert meeting on good practice in inventory preparation
- Review activities for ~ 10 different scientific journals and funding agencies

Selected Projects

- Monitoring Atmospheric Composition and Climate (MACC, MACC-II, EU FP7/DG Research, MACC-III EU Horizon 2020)
- EUCAARI (2007-2010). EC DG Research
- Condensable organic aerosols - a missing component in the Dutch PRTR particulate matter emission inventory? (2012-2013) Ministry of Infrastructure and Environment
- TRANSPHORM (2010-2014), European Commission DG Research (FP7)
- Review of measurement techniques suitable for ships that inform on black carbon emissions (Concawe).

Publications

- Denier van der Gon, H. A. C., Bergström, R., Fountoukis, C., Johansson, C., Pandis, S. N., Simpson, D., and Visschedijk, A. J. H.: Particulate emissions from residential wood combustion in Europe – revised estimates and an evaluation, Atmos. Chem. Phys., 15, 6503-6519, 2015.
- Fuzzi, S., Baltensperger, U., Carslaw, K., Decesari, S., Denier van der Gon, H., et al., Particulate matter, air quality and climate: lessons learned and future needs, Atmos. Chem. Phys., 15, 8217-8299, doi:10.5194/acp-15-8217-2015, 2015.
- Pouliot G., H. A.C. Denier van der Gon; J. Kuenen; J. Zhang; M. Moran; P. Makar, Analysis of the Emission Inventories and Model-Ready Emission Datasets of Europe and North America for Phase 2 of the AQMEII Project, Atmospheric Environment 115, 345–360, 2015
- Denier van der Gon, H. M. E. Gerlofs-Nijland, R. Gehrig, M. Gustafsson, et al., The Policy Relevance of Wear Emissions from Road Transport, Now and in the Future – An International Workshop Report and Consensus Statement, American Journal of the Air & Waste Management Assoc., 63; 136-149, 2013.
- Kuenen, J. J. P., A. J. H. Visschedijk, M. Jozwicka, and H. A. C. Denier van der Gon.2014. TNO-MACC_II emission inventory: a multi-year (2003–2009) consistent high-resolution European emission inventory for air quality modelling, Atmos. Chem. Phys., 14, 10963-10976, 2014
- Timmermans, R. H.A.C. Denier van der Gon, J.J.P. Kuenen, A.J. Segers, C. Honoré, et al., 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 (2013) 44–62, 2013
- Passaanen, P., A. Asmi, T. Petäjä, M.K. Kajos, M. Äijälä, H. Junninen, Thomas Holst, J. P. D. Abbatt, A. Arneth,W. Birmili, H. Denier van der Gon, A. Hamed, et al., Observations of the organic aerosol - climate feedback mechanism, Nature Geosciences,DOI: 10.1038/NGEO1800, 2013
- Granier, C. ,Bessagnet, B., ,Bond, T., ,D'Angiola, A., ,Denier van der Gon, H. ,et al., Evolution of anthropogenic and biomass burning emissions at global and regional scales during the 1980-2010 period, Climatic Change, 109, 163-190, DOI: 10.1007/s10584-011-0154-1, 2011
- Denier van der Gon, H.A.C , WAJ. Appelman, Lead emissions from road transport in Europe, A revision of current estimates using various estimation methodologies, Sci. Tot. Env., 407, 2009.
- Denier van der Gon, HAC, M. van het Bolscher, A. Visschedijk and P. Zandveld, Emissions of Persistent Organic Pollutants and eight candidate POPs from UNECE-Europe in 2000, 2010 and 2020 and the emission reduction resulting from the implementation of the UNECE POP Protocol, Atmospheric Environment, 41, 9245-9261, 2007

PERSONAL INFORMATION

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jeroen.kuenen@tno.nl

Sex Male | Date of birth 08/01/1981 | Nationality Dutch

WORK EXPERIENCE

2006 - present — Research scientist, TNO

Tasks and responsibilities centered around emission calculations, for greenhouse gases and air pollutants, for use research and policy support studies. Main areas of work and expertise are:

- Designing and compilation of emission inventories for both greenhouse gases and air pollutants using state-of-the-art emission estimation methodologies;
- Development of gridded emission inventories for as input for air quality models in Europe in various EU funded research (FP7, H2020) projects, using large database systems and SQL applications, now being applied in the EU Copernicus programme.
- Development of emission scenarios for future years using large databases, reflecting the impact of policy measures or other changes for greenhouse gases and air pollutants at various scales: from the level of cities or urban regions to global impact
- Actively participating in the UNECE Task Force on Emission Inventories and Projections for 10 years and co-chairing the Expert Panel on Combustion & Industry therein. Main responsibilities are maintaining and improving of the EMEP/EEA Emission Inventory Guidebook, with focus on the sectors industry and product use, therefore having an excellent overview of the main emission sectors, the guidance available for estimating emissions, and some of the issues countries face in developing their inventories.
- Development of guidance material for emission inventorying (e.g. EMEP/EEA Emission Inventory Guidebook, Emission Factor Database).
- Participating in the Stage 3 review under LRTAP in 2014 as Energy expert, reviewing the countries' emission inventories submitted to UNECE and the EU.
- Research toward future technologies to be applied in industrial sectors for greenhouse gas reduction both at direct and indirect level, while at the same time reducing air pollution emissions (achieving co-benefits where possible)
- Air emissions modeling for various purposes, e.g. for linking environmental extensions to economic input-output modeling, but also as inputs to atmospheric dispersion modeli

EDUCATION AND TRAINING

1999-2006 — M.Sc. degree in Applied Physics

PERSONAL SKILLS

Mother tongue(s) Dutch

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
German	B2	B2	B1	B1	B1

Organisational / managerial skills

- Project management: IPMA D certified
- Internal management of projects
- Management of the internal TNO knowledge program on emissions and air quality (2012-2014)

Job-related skills

- Nominated reviewer for UNECE LRTAP Stage 3 review
- Good knowledge and understanding of models and tools for data visualisation
- Understanding of current and future technologies used in European industry
- Ability to quickly absorbe new information and understand main issues

Computer skills

- Working with large databases and data information flows
- Development of databases for air quality applications
- Experience in atmospheric dispersion modeling
- Good knowledge of the main MS Office components, especially MS Excel and MS Access
- Knowledge of SQL programming for database applications
- Experience in programming in C/C++, FORTRAN and HTML

ADDITIONAL INFORMATION

Most relevant past projects

- EU FP7 MACC, MACC-II and Horizon-2020 MACC-III projects
- Updates to selected chapters of the EMEP/EEA Air Pollutant Emission Inventory Guidebook
- Technical support for developing the profile of certain categories of Large Combustion Plants regulated under the Industrial Emissions Directive
- Major update and restructuring of the EMEP/EEA Guidebook
- Dutch roadmap 2050: A project to develop pathways to a 80% reduction in GHG emissions in the Netherlands in 2050.
- Modelling the future pathways for aluminium industry in the EU

Selected publications

- Kuenen, J. J. P., Visschedijk, A. J. H., Jozwicka, M., & Denier van der Gon, H. A. C. (2014). TNO-MACC_II emission inventory; a multi-year (2003–2009) consistent high-resolution European emission inventory for air quality modelling. Atmospheric Chemistry and Physics, 14(20), 10963-10976.
- Dröge, R., Kuenen, J. J. P., Pulles, M. P. J., & Heslinga, D. C. (2010). The revised EMEP/EEA Guidebook compared to the country specific inventory system in the Netherlands. Atmospheric Environment, 44(29), 3503-3510.
- Timmermans, R. M. A., Denier van der Gon, H. A. C., Kuenen, J. J. P., et al. (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*, *6*, 44-62.
- Tukker, A., de Koning, A., Wood, R., Hawkins, T., Lutter, S., Acosta, J., ... & Kuenen, J. (2013). Exiopol–Development and Illustrative Analyses of a Detailed Global MR EE SUT/IOT. *Economic Systems Research*, *25*(1), 50-70.
- Wood, R., Stadler, K., Bulavskaya, T., Lutter, S., Giljum, S., de Koning, A., Kuenen, J., ... & Tukker, A. (2014). Global sustainability accounting—developing EXIOBASE for multi-regional footprint analysis. *Sustainability*, *7*(1), 138-163.
- Hendriks, C., Kranenburg, R., Kuenen, J., van Gijlswijk, R., Wichink Kruit, R., Segers, A., et al. (2013). The origin of ambient particulate matter concentrations in the Netherlands. *Atmospheric Environment*, *69*, 289-303.
- Bosch, P., & Kuenen, J. (2009). Greenhouse gas efficiency of industrial activities in EU and Non-EU. TNO-report

PERSONAL INFORMATION

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00 31 88 866 20 87
Antoon.visschedijk@tno.nl

Sex Male | Date of birth 15/03/1969 | Nationality Dutch

PROPOSED POSITION

Contributing scientist

WORK EXPERIENCE

1996 - present

Scientific researcher

TNO, Princetonlaan 6, 3584 CB Utrecht

The Netherlands

Research topics include

- Greenhouse gas emissions
- Industrial energy use
- Resource flow modelling
- Emissions of particulate matter, heavy metals, persistent organic pollutants etc.

Business or sector Research and Development – Environmental Sector

EDUCATION AND TRAINING

1987 - 1993

MSc degree in Chemical Engineering

University of Technology, Delft

The Netherlands

Chemical Engineering

PERSONAL SKILLS

Mother tongue(s) Dutch

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
German	B2	B2	B2	B2	B2
French	B2	B2	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 and internationally oriented

Organisational / managerial skills
- Sometimes acts as project leader in research projects

Job-related skills
- See "Other skills"

Computer skills
- Good command of Microsoft Office tools, database software (MS Access, SQL Server), UNIX

Other skills

Senior scientist/consultant with (international) in-depth experience in many of the scientific aspects of air pollution, GHGs, energy research, resource flow modelling and waste generation. Air pollution-related activities have ranged from developing estimation methodologies for anthropogenic and natural emission sources, identifying emission abatement measures and quantifying cost/benefits hereof, advice on and impact assessment of environmental policy strategies (e.g. EU legislation such as the IED), environmental benchmarking of industries, to analyzing and interpreting large measurement datasets, conducting literature studies and developing emission scenarios in relation to economic activity. Energy-related activities include extensive investigation of energy use reduction technologies in many sectors within the heavy (energy-intensive) industry in cooperation with industrial interest organisations, and developing energy/fuel use scenario's and integration in economic models. Regarding resource flows he has developed models for estimating local (sub-national) consumption/production of energy, fuels and other utilities, intermediate and end products, scarce elements and a large number of waste types.

Mr Visschedijk is among the leading experts in the field of international air emission inventories with a scope ranging from global to local or sectoral). This expertise covers greenhouse gasses, particulate matter and components thereof (e.g. UF, OC/EC, HMs, PAHs), non-methane volatile organic components, a wide range of persistent organic pollutants, ozone-precursors and ozone-depleting, acidifying and toxic substances. Furthermore, he has an advanced understanding and skill in environmental and macro-economical informatics.

Mr Visschedijk regularly publishes in scientific literature, and he lectures at expert meetings. He has worked as a consultant to/member of expert panels for international non-profit organizations such as the EU-EC, UN-ECE, WHO, UNEP, OSPARCOM, CORINAIR, as well as multinational commercial enterprises and industrial interest organizations. He maintains a close co-operation with other North European research organizations dealing with air pollution, energy research and resource flow modelling..

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ADDITIONAL INFORMATION

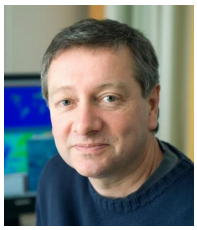
Senior scientific staff member. Due to his experience and capabilities he commonly acts as project designer, being responsible for the scientific and practical research strategy. In addition, he co-ordinates the set tasks within projects and is typically one of the core research contributors in projects.

Authored numerous TNO reports on emissions, abatement strategies, cost and scenario studies, industrial energy efficiency, urban resource flow modelling, and many peer-reviewed scientific journal articles and contributions to conference proceedings on these subjects.

Curriculum vitae

PERSONAL INFORMATION

David Simpson



Norwegian meteorological Institute, NO-0313 Oslo (Norway)

david.simpson@met.no

www.emep.int www.met.no

Sex Male | Date of birth 20/03/1961 | Nationality British

WORK EXPERIENCE

2008–Present

Adj. Prof. , Dept. Earth & Space sciences, Chalmers University of Technology, Gothenburg, Sweden

- Supervision of Post-Docs, Master and Bachelor Student projects, in field of biosphere-atmosphere exchange, and chemistry/aerosol models.
- Board member for Chalmers and participant in Swedish Strategic Research Initiative Merge (Modelling the Regional and Global Earth System, www.merge.lu.se)

1990–Present

Senior scientist, EMEP MSC-W, Norwegian Meteorological Institute, Oslo, Norway

- Main developer of EMEP MSC-W chemical transport model system.
- Special interests include biosphere-atmosphere exchange (BVOC and soil emissions, ozone deposition and N-exchange), ozone chemistry, and secondary organic aerosol
- EU projects: INFOS, MERLIN, NOFRETETE, CARBOSOL, EUCAARI, NitroEurope, PEGASOS and ECLAIRE.
- On Executive Steering Committee and co-component/WP leader within the FP7 ECLAIRE project (Effectsof climate change on air pollution impacts and response strategies for European ecosystems), 2011-2015.
- Developed emission inventories for BVOC and soil-NO emissions within EMEP (1990-2014). Soil-NH_3 work in-progress.
- Chairman of the "Nature Panel", within the UN-ECE Task Force on Emission Inventories. (1996–2000)

1982–1989

Scientist (last post: Higher Scientific Officer), Warren Spring Laboratory, Stevenage, England

- Ozone modelling with Lagrangian photochemical model.
- Modelling of NOx over the UK with dispersion model and EMEP NOx model.
- 'contribution-in-kind' to EMEP activities, payed for by the U.K. Dept. of the Environment. Helped in development of EMEP NOx model. Initial development of EMEP ozone model.

PERSONAL SKILLS

Mother tongue(s) English

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
Swedish	C2	C2	C1	C1	A2

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

- Supervision of Post-Docs, Master and Bachelor Students, in field of biosphere-atmosphere

exchange, and chemistry/aerosol models

- Supervisory role and software control for EMEP MSC-W chemical model system

Digital competence

- Programming with fortran, python, perl, bash, linux, version control (cvs, svn, git), supercomputing
- Generally self-sufficient (admister own linux computers)

Other skills

- 89 peer-reviewed publications, H-index 37, avg. citations 65 per article, see http: http://www.researcherid.com/rid/A-3313-2009.
- Numerous (>100) report chapters, book contributions

ADDITIONAL INFORMATION

Selection of peer-reviewed publications

- Bergström, R. et al, Modelling of organic aerosols over Europe (2002–2007) using a volatility basis set (VBS) framework: application of different assumptions regarding the formation of secondary organic aerosol, Atmos. Chem. Physics, 12, 8499–8527, doi:10. 5194/acp-12-8499-2012, http://www.atmos-chem-phys.net/12/8499/2012/, 2012.
- Denier van der Gon, H.A.C., et al., Particulate emissions from residential wood combustion in Europe - revised estimates and an evaluation, Atmospheric Chemistry and Physics, 15, 6503–6519, doi:10.5194/acp-15-6503-2015, http://www.atmos-chem-phys.net/15/6503/2015/, 2015.
- Flechard, C.R., et al., Advances in understanding, models and parameterizations of biosphere-atmosphere ammonia exchange, Biogeosciences, 10, 5183–5225, doi:10.5194/bg-10-5183-2013, http://www.biogeosciences. net/10/5183/2013/, 2013.
- Fowler, D., et al., Atmospheric composition change: Ecosystems-Atmosphere interactions, Atmos. Environ., 43, 5193–5267, doi:10.1016/j.atmosenv.2009.07.068, 2009.
- Hallquist, M., Wenger, J.C., Baltensperger, U., Rudich, Y., Simpson, D., et al., The formation, properties and impact of secondary organic aerosol: current and emerging issues, Atmos. Chem. Physics, 9, 5155–5236, 2009.
- Hertel, O., et al., Governing processes for reactive nitrogen compounds in the European atmosphere, Biogeosciences, 9, 4921–4954, doi:10.5194/bg-9-4921-2012, http://www.biogeosciences.net/9/4921/2012/, 2012.
- Kesik, M., et al., Inventory of N_2O and NO emissions from European forest soils, Biogeosciences, 2, 353–375, 2005.
- Kesik, M., Future scenarios of N_2O and NO emissions from European forest soils, J. Geophys. Res. - Biogeosciences, 111, 14pp, doi:10.1029/2005JG000115, 2006.
- Simpson, D.: Biogenic emissions in Europe 2: Implications for ozone control strategies, J. Geophys. Res., 100, 22 891–22 906, 1995.
- Simpson, D., Guenther, A., Hewitt, C., and Steinbrecher, R.: Biogenic emissions in Europe Estimates and uncertainties, J. Geophys. Res., 100, 22 875–22 890, 1995.
- Simpson, D., Winiwarter, W., Börjesson, G., Cinderby, S., Ferreiro, A., Guenther, et al., Inventorying emissions from Nature in Europe, J. Geophys. Res., 104, 8113–8152, 1999.
- Simpson, D., Butterbach-Bahl, K., Fagerli, H., et al., Deposition and Emissions of Reactive Nitrogen over European Forests: A Modelling Study, Atmos. Environ., 40, 5712–5726, doi:10.1016/j.atmosenv.2006.04.063, 2006a.
- Simpson, D., Arneth, A., Mills, G., Solberg, S., and Uddling, J.: Ozone - the persistent menace; interactions with the N cycle and climate change, Current Op. Environ. Sust., 9-10, 9–19, doi:http://dx.doi.org/10.1016/j.cosust.2014.07.008, sI: System dynamics and sustainability, 2014.
- Simpson, D., Christensen, J., Engardt, M., et al., Impacts of climate and emission changes on nitrogen deposition in Europe: a multi-model study, Atmos. Chem. Physics, 14, 6995–7017, doi:10.5194/acp-14-0073-2014, URL http://www.atmos-chem-phys.net/14/0073/2014/acp-14-0073-2014.html, 2014.
- Sutton, M.A., et al., Towards a climate-dependent paradigm of ammonia emission and deposition, Philosophical Transactions of the Royal Society B: Biological Sciences, 368, doi: 10.1098/rstb.2013.0166, 2013..

Curriculum vitae

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 and regular reporting
- 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

1997–1998

Research fellow

Norwegian Institute for Air Research (NILU)

EDUCATION AND TRAINING

1999–2003

Doctorate (dr.scient.)

University of Oslo

Atmospheric chemistry, chemistry transport modelling

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

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

ADDITIONAL INFORMATION

Projects (selected)

- EU Copernicus Atmosphere Monitoring Service (leading MET Norway's contribution to regional air quality forecasts)
- EU-H2020 MACC-III (subproject leader and Management Board member)
- EU-FP7 PANDA (work package leader and Management Board member)
- AMAP Expert Group on Methane (topic leader)
- COST action ES1004 (working group leader and Core Group member)
- EU-FP7 CityZen (project coordinator)
- EU-FP7 Impact2C (EMEP model calculations on air quality climate interactions)

Publications (since 2010, selected)

- Watson, L., et al.: Impact of emissions and +2 °C climate change upon future ozone and nitrogen dioxide over Europe, Atmospheric Environment, 142, pp.271-285, doi:10.1016/j.atmosenv.2016.07.051, 2016.
- Lacressonnière, G., et al.: Impacts of regional climate change on air quality projections and associated uncertainties, Climatic Change, DOI 10.1007/s10584-016-1619-z, 2016.
- Baklanov, A., L.T. Molina, M. Gauss: Megacities, air quality and climate, Atmospheric Environment, 126, 235-249, http://dx.doi.org/10.1016/j.atmosenv.2015.11.059, 2016.
- Gauss, M., et al.: Chapter 8: Modeling the climate response to methane, in AMAP Assessment 2015: Methane as an Arctic climate forcer. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway, viii+139pp, ISBN 978-82-7971-091-2, 2015.
- Marécal, V., 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.
- Jonson, J. E., J. P. Jalkanen, L. Johansson, M. Gauss, and H. A. C. Denier van der Gon, Model calculations of the effects of present and future emissions of air pollutants from shipping in the Baltic Sea and the North Sea, Atmos. Chem. Phys., 15, 783–798, doi:10.5194/acp-15-783-2015, 2015.
- Kong, X., et al.: Analysis of Meteorology-Chemistry Interactions During Air Pollution Episodes Using Online Coupled Models Within AQMEII Phase-2, Atm. Env., doi:10.1016/j.atmosenv.2014.09.020, 2014.
- Williams, J., et al.: The influence of future non-mitigated road transport emissions on regional ozone exceedences at global scale, Atmospheric Environment, Volume 89, Pages 633–641, doi:10.1016/j.atmosenv.2014.02.041, 2014.
- Baklanov, A., et al.: Online coupled regional meteorology chemistry models in Europe: current status and prospects, Atmos. Chem. Phys., 14, 317–398, doi:10.5194/acp-14-317-2014, 2014.
- Colette, A., et al.: Future air quality in Europe: a multi-model assessment of projected exposure to ozone, Atmos. Chem. Phys., 12, 10613–10630, doi:10.5194/acp-12-10613-2012, 2012.
- Langner, J., et al.: A multi-model study of impacts of climate change on surface ozone in Europe, Atmos. Chem. Phys., 12, 10423–10440, doi:10.5194/acp-12-10423-2012, 2012.
- Simpson, D., et al.: The EMEP MSC-W chemical transport model – technical description, Atmos. Chem. Phys., 12, 7825–7865, 2012.
- Olivié, D. J. L., et al.: Modeling the climate impact of road transport, maritime shipping and aviation over the period 1860–2100 with an AOGCM, Atmos. Chem. Phys., 12, 1449–1480, 2012.
- Colette, A., et al.: Air quality trends in Europe over the past decade: a first multi-model assessment, Atmos. Chem. Phys., 11, 11657-11678, 2011.
- Uherek, E., et al.: Transport impacts on atmosphere and climate: Land transport, Atmospheric Environment (2010), p. 4772-4816, 2010.
- Balkanski, Y., G. Myhre, M. Gauss, G. Rädel, E. J. Highwood, and K. P. Shine, Direct radiative effect of aerosols emitted by transport: from road, shipping and aviation, Atmos. Chem. Phys., 10, 4477-4489, 2010.

Europass Curriculum Vitae

Personal information

Surname(s) / First name(s)	**Fagerli, Hilde**
Address(es)	The Norwegian Meteorological Institute (MET Norway) P.O. Box 43, Blindern, Norway
Telephone(s)	+ 47 22 96 30 00
Fax(es)	+ 47 22 96 30 50
E-mail	Hilde.Fagerli@met.no
Nationality	Norwegian
Date of birth	29 July 1971, Bodø, Norway
Gender	Female

Desired employment / Occupational field

Work experience

Dates	2009 ->
Occupation or position held	Head of Division of Climate Modelling and Air Pollution and of EMEP/MSC-W at the Research and Development Department
Name and address of employer	The Norwegian Meteorological Institute (MET Norway) P.O. Box 43, Blindern, Norway
Type of business or sector	Governmental
Dates	2007- 2009
Occupation or position held	Senior scientist at the section for Air Pollution at the Research and Development Division
Name and address of employer	The Norwegian Meteorological Institute (MET Norway) P.O. Box 43, Blindern, Norway
Type of business or sector	Governmental
Dates	2000-2007
Occupation or position held	Research Fellow at the Research and Development Division, for work related to the air pollution section (EMEP project)
Name and address of employer	The Norwegian Meteorological Institute (MET Norway) P.O. Box 43, Blindern, Norway
Type of business or sector	Governmental

Education and training

Dates	29.09.2000
Title of qualification awarded	Dr. Scient
Name and type of organisation providing education and training	Department of Chemistry, University of Tromsø, Norway

Mother tongue(s)	**Norwegian**
Other language(s)	**English**

Self-assessment	Understanding		Speaking		Writing
European level (*)	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1

(*) Common European Framework of Reference for Languages

Technical and organisational skills and competences

Dr. Hilde Fagerli has many years of experience in modelling the long-range atmospheric transport of air pollutants. Since the beginning of 2009 she is head of the Air Pollution section (since January 2011: Division of Climate Modelling and Air Pollution) at the Norwegian Meteorological Institute and leader for the Meteorological Synthesizing Centre –West of the EMEP (EMEP/MSC-W). The work of EMEP/MSC-West supports the development of emission control Protocols under the Convention on Long RangeTransboundary Air Pollution (CLRTAP) and has also supported emission control development under the European Commission. In the EMEP project, Fagerli has the responsibility to deliver calculations of atmospheric pollution transport and source-receptor calculations from the most relevant version of the EMEP/MSC-W model, tracing progress towards existing emission control Protocols and supporting the design of new Protocols, when necessary. Fagerli is also the project leader of the operational volcanic ash forecasting in Norwegian air space.

Dr. Hilde Fagerli has been working at the Norwegian Meteorological Institute (MET Norway) since 2000 on the development, evaluation and application of the EMEP/MSC-W model. She has been working on various aspects of the model, mostly related to chemistry and dry deposition, but also trend studies and emission modeling. She has participated in numerous national, Nordic and EU-projects.

Additional information

Recent projects: CAMS71, Measurement and modelling of volcanic ash in Norwegian air space(now operational), NFR project CLIMATRANS, CLRTAP Assessment Report

Peer-reviewed literature (2012-present)

Clappier, A., Fagerli H. and Thunis, P. Screening of the EMEP source receptor relationships: application to 5 European countries. Accepted for publication in Air Quality, Atmosphere & Health., 2016. DOI: 10.1007/s11869-016-0443-y

Steensen, B. M., Schulz, M., Theys, N., Fagerli, H. A model study of the pollution effects of the first 3 months of the Holuhraun volcanic fissure: comparison with observations and air pollution effects. Atmos. Chem. Phys., 16, 9745-9760, 2016

Bessagnet, B. and Pirovano, G. and Mircea, M. and Cuvelier, C. and Aulinger, A. and Calori, G. and Ciarelli, G. and Manders, A. and Stern, R. and Tsyro, S. and Garcia Vivanco, M. and Thunis, P. and Pay, M.-T. and Colette, A. and Couvidat, F. and Meleux, F. and Rouil, L. and Ung, A. and Aksoyoglu, S. and Baldasano, J. M. and Bieser, J. and Briganti, G. and Cappelletti, A. and D'Isidoro, M. and Finardi, S. and Kranenburg, R. and Silibello, C. and Carnevale, C. and Aas, W. and Dupont, J.-C. and Fagerli, H. and Gonzalez, L. and Menut, L. and Prevot, A. S. H. and Roberts, P. and White, L. Presentation of the EURODELTA III intercomparison exercise -- evaluation of the chemistry transport models' performance on criteria pollutants and joint analysis with meteorology. Atm. Chem. Phys. 16(19), 12667—12701, 2016

Schaap, M., Cuvelier, C., Hendriks, C., Bessagnet, B.,Baldasano, Colette, Karam, D., Fagerli, H., Graff, A., Kranenburg, R., Nyiri, A., Pay, M. T., Rouil, L., Schulz, M., Simpson, D., Stern, R., Terrenoire, E., Wind, P. Performance of European chemistry transport models as function of horizontal resolution. Atm. Env. 112, 90-105, 2015

Kiesewetter, G., Borken-Kleefeld, J., Schoepp, W., Heyes, C., Thunis, P., Bessagnet, B., Terrenoire, E., Fagerli, H., Nyiri, A., Amann, M. Modelling street level PM10 concentrations across Europe: source apportionment and possible futures. Atmos. Chem. Phys. 15 (3), 1539-1553, 2015

Schroeder, W., Pesch, R., Schoenrock, S., Harmens, H., Mills, G., Fagerli, H. Mapping correlations between nitrogen concentrations in atmospheric deposition and mosses for natural landscapes in Europe. Ecolog. Ind. 36, 563-571, 2014

Aas, W.,Tsyro, S., Bieber, E., Bergstrom, R., Ceburnis, D., Ellermann, T., Fagerli, H., Frolich, M., Gehrig, R., Makkonen, U., Nemitz, E., Otjes, R., Perez, N., Perrino, C., Prevot, A.S.H., Putaud, J.P., Simpson, D., Spindler, G., Vana, M., Yttri, K.E. Lessons learnt from the first EMEP intensive measurement periods. Atmos. Chem. Phys. 12 (17), 8073-8094, 2012

A. Jeričević, H. Fagerli and B. Grisogono. Exploring the properties of local and non-local vertical diffusion schemes in the EMEP model using 222Rn Data'. Int. J. of Env. And Poll. 48 (1-4), 231-243, 2012

Simpson, D., Benedictow, A., Berge, H., Bergstrom, R., Emberson, L. D., Fagerli, H., Flechard, C. R., Hayman, G. D., Gauss, M., Jonson, J. E., Jenkin, M. E., Nyiri, A., Richter, C., Semeena, V. S., Tsyro, S., Tuovinen, J-P., Valdebenito, A., Wind, P. The EMEP MSC-W chemical transport model - technical description. Atmos. Chem. Phys. 12 (16), 7825-7865, 2012

Curriculum vitae

PERSONAL INFORMATION

Kateřina Šindelářová

Pod Vodárenskou věží 4, 182 08 Praha (Czech Republic)

(+420) 266 052 267

sindelarova@utia.cas.cz

Sex Female | Date of birth 11/08/1982 | Nationality Czech

Maiden name Zemánková

WORK EXPERIENCE

2015–Present Research Assistant

Czech Academy of Sciences, Institute of Information Theory and Automation, Prague (Czech Republic)

- Biogenic emissions of volatile organic carbons compounds
- Regional transport model for the purposes of inverse modelling of radionuclides in Europe

2012–2015 Postdoctoral Researcher

University of Pierre and Marie Curie, LATMOS, Institute Pierre Simone Laplace, Paris (France)

- Global modelling of biogenic VOC emissions, application of the MEGAN model, development of global historical emission inventory,
- Comparison of different modelling approaches to biogenic VOC estimation
- Analysis and comparison of global and regional anthropogenic and biomass burning emission inventories
- Studying the impact of isoprene on global and regional atmospheric composition

2011–2012 Postdoc Junior Scientist

Charles University, Faculty of Mathematics and Physics, Prague (Czech Republic)

- Modelling regional biogenic VOC emissions and investigating their impact on European air quality, especially on tropospheric ozone

EDUCATION AND TRAINING

2000–2005 Master, Atmospheric Physics

Charles University, Faculty of Mathematics and Physics, Prague (Czech Republic)

2005–2010 PhD, Atmospheric Physics - Study of links between biogenic VOC emissions and concentration of tropospheric ozone

Charles University, Faculty of Mathematics and Physics, Prague (Czech Republic)

PERSONAL SKILLS

Mother tongue(s) Czech

Other language(s)	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C1	C1	C1
	Certificate of Advanced English				
French	B2	B2	B2	B1	B1

Organisational / managerial skills

- Management of national research projects
- Experience with organisation of international conferences and summer schools
- Good organisational and team-leading skills gained as scout volunteer leader

Digital competence

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Independent user	Proficient user	Proficient user	Proficient user	Proficient user

Digital competences - Self-assessment grid

- Programming skills with Fortran, Matlab, NCL, Linux (Bash)
- Efficient user of data analysis software (ArcGIS, GrADS, Statistica) and word-processing programs (LaTeX, Office-like)

ADDITIONAL INFORMATION

Publications

Bauwens, M., Stavrakou, T., Müller, J.-F., De Smedt, I., Van Roozendael, M., van der Werf, G. R., Wiedinmyer, C., Kaiser, J. W., Sindelarova, K., and Guenther, A.: Nine years of global hydrocarbon emissions based on source inversion of OMI formaldehyde observations, Atmos. Chem. Phys., 16, 10133-10158, doi:10.5194/acp-16-10133-2016, 2016.

Crippa, M., Janssens-Maenhout, G., Dentener, F., Guizzardi, D., Sindelarova, K., Muntean, M., Van Dingenen, R., and Granier, C.: Forty years of improvements in European air quality: regional policy-industry interactions with global impacts, Atmos. Chem. Phys., 16, 3825-3841, doi:10.5194/acp-16-3825-2016, 2016.

Granier C., T. Doumbia, L. Granier, K. Sindelarova, G. Frost, I. Bouarar, C. Liousse, S. Darras and J. Stavrakou, Anthropogenic surface emissions in Asia, submitted to the peer-reviwed book "Persistent Regional Air Pollution in Asia", Springer - ISSI Series, 2016.

Messina, P., Lathière, J., Sindelarova, K., Vuichard, N., Granier, C., Ghattas, J., Cozic, A., and Hauglustaine, D. A.: Global biogenic volatile organic compound emissions in the ORCHIDEE and MEGAN models and sensitivity to key parameters, Atmos. Chem. Phys. Discuss. (accepted for ACP), 15, 33967-34033, doi:10.5194/acpd-15-33967-2015, 2015.

Von Schneidemesser, E., Monks, P. S., Allan, J. D., Bruhwiler, L., Forster, P., Fowler, D., Lauer, A., Morgan, W.T., Paasonen, P., Righi, M., Sindelarova, K., and Sutton, M.: Chemistry and linkages between air quality and climate change, Chemical Reviews, 115 (10), 3856-3897, doi: 10.1021/acs.chemrev.5b00089, 2015.

Sindelarova, K., Granier, C., Bouarar, I., Guenther, A., Tilmes, S., Stavrakou, T., Müller, J.-F., Kuhn, U., Stefani, P., and Knorr, W.: Global dataset of biogenic VOC emissions calculated by the MEGAN model over the last 30 years, Atmos. Chem. Phys., 14, 9317-9341, doi:10.5194/acp-14-9317-2014, 2014.

Huszar, P., Halenka, T., Belda, M., Zak, M., Sindelarova, K., and Miksovsky, J.: Regional climate model assessment of the urban land-surface forcing over central Europe, Atmos. Chem. Phys., 14, 12393-12413, doi:10.5194/acp-14-12393-2014, 2014.

Zemankova K. and Brechler J.: Emissions of biogenic VOC from forest ecosystems in central Europe: Estimation and comparison with anthropogenic emission inventory, Environmental Pollution, Vol. 158, Issue 2., p.462-469, doi: 10.1016/j.envpol.2009.08.032, 2010.

Curriculum Vitae

PERSONAL INFORMATION

Jukka-Pekka Jalkanen

Finnish Meteorological Institute, Atmospheric Composition Research, P.O. Box 503 FI-00101 Helsinki, Finland

+358 509 195 455

jukka-pekka.jalkanen@fmi.fi

http://www.fmi.fi

Sex Male | Date of birth 19/02/1973 | Nationality Finnish

WORK EXPERIENCE

[

2006- present Senior Researcher, Finnish Meteorological Institute, Atmospheric Composition Research, Helsinki, Finland

- Development of ship emission modelling tools based on actual traffic data and ship design principles.
- Development of ship emissions inventories, evaluation of emission distributions and their trends
- Annual ship emission reporting for the Baltic Sea countries within the intergovernmental Marine Environment Protection Committee for the Baltic Sea (HELCOM)
- Comprehensive knowledge of electronic navigation aids to ship traffic based on terrestrial and satellite systems
- Modeling of waterborne and underwater noise emissions from ships

2005-2006 Scientist, University of Helsinki, Physical Chemistry Laboratory

- Modeling studies of adsorption of metallic nanoclusters on graphite surfaces

2003-2005 Scientist, Universita di Bologna, Dipartimento di Chimica "G. Ciamician", Bologna, Italy

- Development of modelling tools for adsorption of organic molecules on metallic surfaces

EDUCATION AND TRAINING

1988 - 2003 PhD, Theoretical Chemistry, University of Eastern Finland, Joensuu

1992-1998 MSC, Physical Chemistry, University of Eastern Finland, Joensuu

PERSONAL SKILLS

Mother tongue(s) Finnish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C1	C1	C2
Swedish	A2	A2	A2	A2	A2

Organisational / managerial skills

- Project leader, Team coordinator, supervisor of theses, PhD committee member
- Experience in managing international research teams as work package leader
- Invited expert; The Commission of the Environment, The Commission of Transport and Economy, Finnish Parliament
- Advisor to Finnish delegation to the International Maritime Organisation
- FMI team leader of several large international projects

Computer skills

- Programing skills in Fortran, Perl, Windows, Linux/Unix scripting
- Experience in different data formats, NetCDF, CSV, BUFR
- Microsoft Office

Other skills

- Research publications, scientific reports
- Policy support
- Understanding of the basic principles of naval architecture and ship design

ADDITIONAL INFORMATION

Selected Publications

- Jalkanen, J.-P., Johansson, L. and Kukkonen, J., A comprehensive inventory of ship traffic exhaust emissions in the European sea areas in 2011, Atmos. Chem. Phys., 16, 71-84, 2016.
- Marelle, L., Thomas, J. L., Raut, J.-C., Law, K. S., Jalkanen, J.-P., Johansson, L., Roiger, A., Schlager, H., Kim, J., Reiter, A., and Weinzierl, B., Air quality and radiative impacts of Arctic shipping emissions in the summertime in northern Norway: from the local to the regional scale, Atmos. Chem. Phys., 16, 2359-2379, 2016.
- Jonson, J. E., Jalkanen, J.-P., Johansson, L., Gauss, M., Denier van der Gon, H., Model calculations of the effects of present and future emissions of air pollutants from shipping in the Baltic Sea and the North Sea", Atmos. Chem. Phys., 15, 783-798, 2015.
- Smith, T. W. P., Jalkanen, J.-P., Anderson, B. A., Corbett, J. J., Faber, J., Hanayama, S., O'Keeffe, E., Parker, S., Johansson, L., Aldous, L., Raucci, C., Traut, M., Ettinger, S., Nelissen, D., Lee, D. S., Ng, S., Agrawal, A., Winebrake, J. J., Hoen, M., Chesworth, S., Pandey, A., "The Third IMO GHG Study 2014", International Maritime Organisation (IMO) London, UK, June 2014.
- Jalkanen, J.-P., Johansson, L. and Kukkonen, J., A comprehensive inventory of the ship traffic exhaust emissions in the Baltic Sea from 2006 to 2009, Ambio, 43, 311-324, 2014.
- Johansson, L., Jalkanen, J.-P., Kalli, J. and Kukkonen, J., The evolution of shipping emissions and the costs of recent and forthcoming emission regulations in the northern European emission control area, Atmos. Chem. Phys.,13, 11375-11389, 2013.
- Raudsepp, U., Laanemets, J., Maljutenko, I., Hongisto, M., Jalkanen, J.-P., An evaluation of the ship-born nitrogen deposition impact on the Gulf of Finland ecosystem, Oceanalogia, 55, 837- 857, 2013.
- Jalkanen, J.-P., Johansson, L., Brink, A., Kalli, J., Kukkonen, J. and Stipa, T., Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide, Atmos. Chem. Phys., 12, 2641-2659, 2012.
- Berg, N., Mellqvist, J., Jalkanen, J.-P., and Balzani, J., Ship emissions of SO2 and NO2: DOAS measurements from airborne platforms, Atmos. Meas. Tech., 5, 1085-1098, 2012.

PERSONAL INFORMATION

Lasse Johansson

Air quality research, Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland

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lasse.johansson@fmi.fi

http://en.ilmatieteenlaitos.fi/

Sex Male | Date of birth 10/04/1985 | Nationality Finnish

WORK EXPERIENCE

[

2011- present Research scientist, doctoral student, Air quality modelling

Development and design of FMI-ENFUSER air quality model.

Development of (STEAM) ship emission model, policy support for national emission reporting.

Task leadership in several multinational projects

Representative of staff (Atmospheric composition unit, approx.. 80 persons, in the Finnish Meteorological Institute, since 2012 September.

EDUCATION AND TRAINING

2011 M. Sc.
Major: Optimization, simulation, modelling, decision making, programming, theoretical physics and mathematics.
Minor: industrial management, production systems, marketing, project management.
Aalto University (former Helsinki University of Technology, Finland), Faculty of technical physics and mathematics

PERSONAL SKILLS

Mother tongue(s) Finnish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Swedish	A2	A2	A2	A2	A2

Social skills and competences
- Flexible, friendly, eager

Organisational skills and competences
- Fast learner, analytic, efficient

Computer skills

- Skilful in installation of IT hardware and software, experience in electric circuit building.
- Expert in Java programming: especially algorithms, 3D/2D programming, GUI, image processing, ICT applications.
- Fluent programming with Fortran, Matlab and Perl. Linux/Unix/Windows expertise, expert in MS Office programs (Word, Excel, PowerPoint)

Other skills

- Acquired knowledge of international requirements for shipping (IMO Marpol Annex VI), requirements of EU directives for ship emissions, basic understanding of naval ship architecture

Additional information

- Lead development and design of a novel FMI-ENFUSER air quality model, which has been utilized in multinational projects such as EU/PESCaDO and TEKES/CLEEN MMEA.
- Development of Ship Traffic Emission Assessment Model (STEAM) of the Finnish Meteorological Institute, responsible for improvements and revisions since 2011.
- Participation in the 3rd IMO Greenhouse Gas study (2014)
- Design and implementation of a shortest path algorithm for large node networks, using satellite terrain images (to be used in STEAM for intelligent route deduction).

Selected Publications

- Johansson, L., Jalkanen, J-P., Kalli, J., and Kukkonen, J. The evolution of shipping emissions and the costs of recent and forthcoming emission regulations in the northern European emission control area. Atmos. Chem. Phys., 13, 11375–11389, 2013, www.atmos-chem-phys.net/13/11375/2013/, doi:10.5194/acp-13-11375-2013 doi:10.5194/acpd-13-16113-2013
- Johansson, L., Epitropou, V., Karatzas, K., Karppinen, K., Wanner, L., Vrochidis, S., Bassoukos, A., Kukkonen, J. and Kompatsiaris I. Fusion of meteorological and air quality data extracted from the web for personalized environmental information services. Environmental Modelling & Software, Elsevier, 64 (2015) 143-155.
- Jalkanen, J.-P., Johansson, L., Kukkonen, J., Brink, A., Kalli, J. and Stipa, T. Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide. Atmos. Chem. Phys., 12, 2641–2659, 2012.
- Jalkanen, J.-P., Johansson, L., and Kukkonen, J. A comprehensive inventory of the ship traffic exhaust emissions in the Baltic Sea from 2006 to 2009. 2013. AMBIO. 2013.
- Jalkanen, J.-P., Johansson, L., and Kukkonen, J.: A comprehensive inventory of ship traffic exhaust emissions in the European sea areas in 2011, Atmos. Chem. Phys., 16, 71-84, doi:10.5194/acp-16-71-2016, 2016.
- Kalli, J., Jalkanen, J.-P., Johansson, L and Repka, S, Atmospheric emissions of European SECA shipping: Long Term Projections, WMU Journal of Maritime Affairs, October 2013, Volume 12, Issue 2, pp 129-145, 2013
- Jonson JE, Jalkanen J, Johansson L, Gauss M, Denier van der Gon H, Model calculations of the effects of present and future emissions of air pollutants from shipping in the Baltic Sea and the North Sea, Atmos. Chem. Phys. Discuss., 14, 21943-21974, 2014 .
- Beecken J, Mellqvist J, Salo K, Ekholm J, Jalkanen J, Johansson L, Litvinenko V, Volodin K, Frank-Kamenetsky D-A,Emission Factors of SO2, NOx and Particles from Ships in Neva Bay from Ground-Based and Helicopter-Borne Measurements and AIS-Based Modeling, Atmos. Chem. Phys. Discuss., 14, 25931-25965, 2014
- Ialongo I, Hakkarainen J, Hyttinen N, Jalkanen J.P, Johansson L, Boersma K.F, Krotkov N, Tamminen JCharacterization of OMI tropospheric NO2 over the Baltic Sea region, Atmospheric Chemistry and Physics Vol. 14 p. 7795-7805. doi: 10.5194/acp-14-7795-2014.
- Wanner L, Bosch H, Bouayad-Agha N, Casamayor G, Ertl T, Hilbring D, Johansson L, Karatzas K, Karppinen A, Kompatsiaris I, Koskentalo T, Mille S, Moßgraber J, Moumtzidou A, Myllynen M, Pianta E, Rospocher M, Serafini L, Tarvainen V, Tonelli S, Vrochidis S, Getting the environmental information across: from the Web to the user, Expert Systems (2014) , DOI: 10.1111/exsy.12100, 2014.

PERSONAL INFORMATION

Marc Guevara Vilardell

Barcelona Supercomputing Center, Earth Science Department, 29, Jordi Girona Street, 08034, Barcelona Spain

+34 934137725

marc.guevara@bsc.es

https://www.bsc.es/ - https://www.researchgate.net/profile/Marc_Guevara

Sex Male | Date of birth 29/12/1986 | Nationality Spanish

WORK EXPERIENCE

2015 - present Postdoctoral researcher, Barcelona Supercomputing Center, Earth Science Department

- Head of the emission modelling research line
- Development of regional emission models (anthropogenic), evaluation of emission inventories, emission scenario analysis and emission benchmarking
- Development of spatial, temporal and speciation profiles for creating air quality model-ready emissions
- Co-chair of the Urban Emission Working Group under FAIRMODE (Forum for Air Quality Modelling in Europe; http://fairmode.jrc.ec.europa.eu/)
- Project coordinator of the Air Quality Forecast System for Mexico DF project, funded by the Mexico City's Secretariat of the Environment
- Participation in European projects (RethinkBig, H2020)

2010 –2014 Research support engineer, Barcelona Supercomputing Center, Earth Science Department

- Use of Geographic information systems
- Execution and evaluation of Earth Science Models (i.e. WRF, CMAQ)
- Support tasks in environmental impact studies with public administrations and private companies
- Participation in European projects (APPRAISAL, FP7) and National projects (CALIOPE-And, Environmental Agency of the Regional Government of Andalusia)

EDUCATION AND TRAINING

2012 –2014 PhD, Environmental Engineering, Polytechnic University of Catalonia (UPC), Doctoral School, Barcelona

2004 –2010 Bachelor's degree in Industrial Engineering, Polytechnic University of Catalonia (UPC), The School of Industrial Engineering of Barcelona, Barcelona

PERSONAL SKILLS

Mother tongue(s) Spanish, Catalan

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
	Cambridge English: Advanced (CAE)				

Organisational / managerial skills

- Project leader, supervisor
- Experience in training course: Participation in training courses on Air Quality Modelling for public administrations (e.g. Mexico City's Secretariat of the Environment)

Computer skills

- Programming skills in R, CDO, Python, Linux
- Good command of ArcGIS Desktop ®
- Experience in different data formats (NetCDF, Raster, Shapefile, DBF, CSV)
- Good command of Microsoft Office™ tools

Other skills

- Research publications, international conferences, training documents
- Evaluation of models using ground-based observations

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

- Thunis, P., Degraeuwe, B., Cuvelier, K., Guevara, M., Tarrason, L., Clappier, A., 2016. A novel approach to screen and compare emission inventories, Air Quality Atmosphere & Health, 9.
- Borrego, C., Monteiro, A., Martins, H., Ferreira, J., Fernandes, A.P., Rafael, S., Miranda, A.I., Guevara, M., Baldasano, J.M., 2015. Air quality plan for ozone: an urgent need for North Portugal. Air Quality Atmosphere & Health. doi: 10.1007/s11869-015-0352-5.
- Guevara, M., Soret, A., Arévalo, G., Martínez, F., Baldasano, J.M., 2014. Implementation of plume rise and its impacts on emissions and air quality modelling, Atmospheric Environment, 99, 618-629.
- Soret, A., Guevara, M., Baldasano, J.M., 2014. The potential impacts of electric vehicles on air quality in the urban areas of Barcelona and Madrid (Spain), Atmospheric Environment, 99, 51-63.
- 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), Atmospheric Environment, 98, 134-145.
- Pay, M.T., Martínez, F., Guevara, M., Baldasano, J.M., 2014. Air quality forecasts at kilometer scale grid over Spanish complex terrains. Geoscientific Model Development, 7, 1979-1999.
- Baldasano, J.M., Soret, A., Guevara, M., Martínez, F., Gassó, S., 2014. Integrated assessment of air pollution using observations and modelling in Santa Cruz de Tenerife (Canary Islands). Science of the Total Environment, 473–474, 576-588
- Guevara, M., Martínez, F., Arévalo, G., Gassó, S., Baldasano, J.M., 2013. An improved system for modelling Spanish emissions: HERMESv2.0, Atmospheric Environment 81, 209-221.
- Ferreira, J., Guevara, M., Baldasano. J.M., Tchepel, O., Schaap, M., Miranda, A.I., Borrego, C., 2013. A comparative analysis of two highly spatially resolved atmospheric emission inventories that are available in Europe. Atmospheric Environment, 75, 43-57.

Chapters in books

- Guevara, M., Airborne Particulate Matter: Sources, Atmospheric Processes and Health, ed. R. M. Harrison, R.E. Hester X. Querol, Royal Society of Chemistry, UK, Chapter 1: Emissions of Primary Particulate Matter, 2016. The Royal Society of Chemistry, ISBN: 978-1-78262-491-2.

PERSONAL INFORMATION

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http://www.bsc.es/

Sex Male | Date of birth 09/07/1975 | Nationality Spanish

POSITION

Senior Researcher of the Atmospheric Composition group
Earth Sciences Department,
Barcelona Supercomputing Center

WORK EXPERIENCE

2008-2014 Group Manager of the Atmospheric Modelling group, Barcelona Supercomputing Center, Spain

2005-2008 Junior Researcher, Barcelona Supercomputing Center, Spain

- Mesoscale air quality modelling. Set up of an Air quality forecasting system for Spain

2004-2005 Lecturer, Universitat Politècnia de Catalunya, Spain

- Conducting classes in the Escuela Técnica Superior de Ingenieros Industriales de Terrassa. Lectures on Engineering projects.

EDUCATION AND TRAINING

2000-2005 PhD in Environmental Engineering, Universitat Politècnica de Catalunya, Spain

- Atmospheric Sciences, air quality, mesoscale modelling

1993-1999 Bsc and Msc Industrial Engineering, Universitat Politècnica de Catalunya, Spain

- Math, physics, mechanics, engineering, nuclear engineering

PERSONAL SKILLS

Mother tongue(s) Catalan, Spanish

Other language(s)

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

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 and Experience in collaborative tasks within European Funded projects (IS-ENES, FIELD_AC, MACC)

Computer skills

- Experience user of Photoshop
- Advanced user of R
- Experience in ACCESS Data Bases
- 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)

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

- Di Tomaso, E., Schutgens, N. A. J., Jorba, O., and Pérez García-Pando, C.: Assimilation of MODIS Dark Target and Deep Blue observations in the dust aerosol component of NMMB/BSC-CTM version 1.0 (2016) Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-206, in review.
- Badia, A., Jorba, O., Voulgarakis, A., Dabdub, D., Pérez García-Pando, C., et al., Gas-phase chemistry in the online multiscale NMMB/BSC Chemical Transport Model: Description and evaluation at global scale (2016) Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-141, in review.
- 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 (2015) Archives of Computational Methods in Engineering, 50 p, doi:10.1007/s11831-015-9152-1.
- Sessions, W.R., et al.: 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., et al., 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 (2015) Atm. Env., 115, 421–441
- Brunner, D. et al., Comparative analysis of meteorological performance of coupled chemistry-meteorology models in the context of AQMEII phase 2 (2015) Atmospheric Environment, 115, 470–498
- Giordano, L., et al., Assessment of the MACC reanalysis and its influence as chemical boundary conditions for regional air quality modeling in AQMEII-2 (2015) Atmospheric Environment, 115, 371–388
- 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 (2015) Atmospheric Environment, 115, 657–669
- Im, U., et al., 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 (2015) Atmospheric Environment, 115, 404–420
- Pandolfi, M., et al., Effects of sources and meteorology on particulate matter in the Western Mediterranean Basin: An overview of the DAURE campaign (2014) J. Geophys. Res., 119 (8), 4978-5010
- Baklanov, A., et al., 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) Proc. 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
- 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
- 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

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
Earth Sciences Department, Barcelona Supercomputing Center, Spain.

- Development of multi-scale chemical weather modeling systems and air quality forecasts
- Research on aerosols, atmospheric chemistry and climate
- Understanding and quantification of dust effects upon weather, climate, atmospheric chemistry and ocean biogeochemistry
- Improvement and develop dust forecasts, predictions and reanalysis datasets
- Assessment and mitigation of dust impacts on key sectors of society and economy

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

Mother tongue(s): Spanish and Catalan

Other language(s)

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

Organisational / managerial skills

- International project leader, team coordinator, supervisor
- Coordinator of a group of ~12 scientists and support engineers working on atmospheric chemistry and emission modeling

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

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

Google scholar citations (2705), h-index (27), i10-index (42) - as of November 2nd, 2016

- 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, doi:10.1002/2016GL069873.
- 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, et al. 2014. CMIP5 historical simulations (1850-2012) with GISS ModelE2. Journal of Advances in Modeling Earth Systems, doi: 10.1002/2013MS000266.
- Schulz, M., J.M. Prospero, A.R. Baker, F. Dentener, L. Ickes, P.S. Liss, N.M. Mahowald, S. Nickovic, C. Pérez, et al. 2012. The atmospheric transport and deposition of mineral dust to the ocean: Implications for research needs. Environmental Science and Technology, 46, 10390-10404. doi:10.1021/es300073u.
- Pérez, C., K. Haustein, Z. Janjic, O. Jorba, N. Huneeus, J.M. Baldasano, T. Black, S. Basart, S. Nickovic, R.L. Miller, J.P. Perlwitz, M. Schulz, and M. Thomson, 2011. Atmospheric dust modeling from meso to global scales with the online NMMB/BSC-Dust model — Part 1: Model description, annual simulations and evaluation. Atm. Chemistry and Physics, 11, 13001-13027. doi:10.5194/acp-11-13001-2011.
- Seifert, P., Ansmann, A., Mattis, I., Wandinger, U., Tesche, M., Engelmann, R., Müller, D., Pérez, C., and Haustein, K., 2010. Saharan dust and heterogeneous ice formation: Eleven years of cloud observations at a central–European EARLINET site. Journal of Geophysical Research, 115, D20201. doi:10.1029/2009JD013222.
- Basart, S., Pérez, C., Cuevas, E., Baldasano, J. M., and Gobbi, G. P., 2009. Aerosol characterization in Northern Africa, Northeastern Atlantic, Mediterranean Basin and Middle East from direct-sun AERONET observations, Atmospheric Chemistry and Physics, 9, 8265-8282. www.atmos-chem-phys.net/9/8265/2009/. doi:10.5194/acp-9-8265-2009.

PERSONAL INFORMATION

Dr. Johannes W. Kaiser

Max-Panck Institute for Chemistry, Hahn-Meitner 1, Mainz, Germany

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j.kaiser@mpic.de

skype joanrala

Sex Male | Date of birth 03/04/1969 | Nationality German

WORK EXPERIENCE

2014—present Research Group Leader

Max Planck Institute for Chemistry (MPIC), Department for Atmospheric Chemistry, Fire Emissions Group, Mainz, Germany

- Lead of fire emission service in the Copernicus project
- Research on data assimilation of Fire Radiative Power observations
- research on biomass burning and gas flaring, and its impact on the atmosphere
- lead of BMBF project on the development of gas flare emission products for Sentinel-3
- lead of fire emission service development in MACC-III and CAMS
- lead of Climate Research Group in ESA Fire CCI project, phase 2
- lead of WMO's, IGAC's and iLEAPS' joint Interdisciplinary Biomass Burning Initiative (IBBI)

2012—2014 Research Associate (part-time)

King's College London (KCL), Department of Geography, London, UK

- error characterisation of fire radiative power products from MET-10, GOES-East/West & MODIS

2005—2014 Scientist

European Centre for Medium-range Weather Forecasts (ECMWF), Reading, UK

- lead of FIR sub-projects in EU's MACC and MACC-II projects, which implemented and delivered real-time and retrospective services for the atmosphere based on satellite observations of atmospheric composition and open fire activity
  - formation and development of team for the scientific development of the novel fire emission service *Global Fire Assimilation System* (GFAS)
  - product design, evolution and assessment in liaison with user communities
  - liaison with input data providers: EUMETSAT LSA SAF, ESA, NASA and NOAA
- prototyping and pre-operational implementation of GFAS

2002—2005 Wissenschaftlicher Mitarbeiter (PostDoc)

University of Zurich, Remote Sensing Laboratory (RSL), Zurich, Switzerland

EDUCATION AND TRAINING

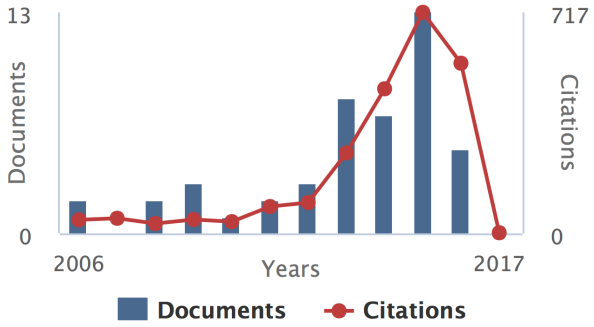
1997—2001 Doktor rer. nat. (equiv. PhD) Environmental Physics, University of Bremen, Germany

1989–1991, 1993—1996 Physik-Diplom (equiv. MSc) Astrophysics and Philosophy

1992 Physics, University of Canterbury, New Zealand,

ADDITIONAL INFORMATION

Publication and citation history



source: www.scopus.com on 26/10/2016

Lists of publications

- http://www.researcherid.com/rid/A-7057-2012 (h-index: 20)
- http://www.scopus.com/authid/detail.url?authorId=55898041200 (h-index: 20)
- http://scholar.google.com/citations?user=w43lRJUAAAAJ (h-index: 26)

Current memberships

- EU Copernicus Atmospheric Monitoring Service : Service Level Board Member
- EU FP7 Project Advanced Forest Fighting (AF3): Member Advisory Board
- WMO/GAW Scientific Advisory Group – Applications : Member
- WMO/IGAC/iLEAPS Interdisciplinary Biomass Burning Initiative (IBBI) Co-chair
- UN ISDR Wildland Fire Advisory Group Science Representative
- IGAC Global Emissions InitiAtive (GEIA) Steering Committee

PERSONAL SKILLS

Languages

German: mother tongue, **English**: fluent, **French**: independent user

Social & communication skills

I have collaborated with scientific and operational organisations as well as small and large industrial enterprises in several projects. This has opened my perception for different approaches to a problem and for differences in motivation and interests. My communication and inter-personal skills have been expanded by living abroad in three different countries for a total of eleven years, and by working in an international organisation for nine years. I very much appreciate the rich and varied perspectives that come with the intercultural exchange.

Organisational / managerial skills

- As leader of the FIR sub-projects in MACC-I/-II/-III, I have successfully applied my analytical and interpersonal skills within the team at my host institution as well as between the teams of five European partner institutions. The projects have thus achieved rapid pre-operational implementation of cutting edge research.
- As co-chair of the Interdisciplinary Biomass Burning Initiative (IBBI), which is supported by WMO, IGAC and iLEAPS, I have successfully applied my synthesising interpersonal skills to fostering novel research approaches in a worldwide interdisciplinary collaboration.
- I have negotiated and decided financial budgets with the project partners.
- I have organised several workshops and various scientific conference sessions.

Computer skills

- Fortran77/90/95, C, C++, Python, IDL, Matlab
- UNIX, Linux, OSX, Windows
- Git, Perforce, CVS, RCS
- IBM POWER6/7 clusters, CRAY, Alpha cluster, PC cluster, SUN, SGI, DEC VAX, PC, Mac

PERSONAL INFORMATION

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www.umweltbundesamt.at

Sex Female | Date of birth 21/10/1979 | Nationality Austrian

WORK EXPERIENCE

December 2007 onwards — Air Emission Expert

Umweltbundesamt GmbH (Environment Agency Austria), Vienna, Austria

Current activities and responsibilities: Work for the EMEP Centre on emission inventories and projection (CEIP) and Project Coordinator Assistant for the DG Clima service contract "Comprehensive review of Member States' greenhouse gas inventories under the Effort Sharing Decision in 2016

June 2004-October 2007 — Scientific staff

Swedish University of Agricultural Sciences (SLU), Umea, Sweden

Research, Data analysis, Experimental planning, Laboratory work (Isotope Ratio Mass Spectrometry)

EDUCATION AND TRAINING

June 2004-May 2007 — PhD — ISCED 6

Swedish University of Agricultural Sciences (SLU), Umeå, Sweden

- Ecology, Soil Sciences, Plant Soil Interactions, Soil Respiration, Statistics
- Thesis: "On the Tree-Root-Soil-Continuum-Temporal and Spatial Coupling of the Belowground Carbon Flux"

1998-2004 — Master of Science in Biology (Mag. rer. nat.) — ISCED 5

University of Vienna

- Ecology, Chemical Physiology of Plants,
- Master Thesis: "Carbon isotope composition of soluble carbohydrates and starch: from canopy leaves to roots systems"

PERSONAL SKILLS

Mother tongue(s) German

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C2	C2	C2
Swedish	C1	C1	B2	B2	B1
Spanish	B1	B2	B1	B1	B1

Computer skills

- good command of Microsoft Office™ tools, Graphical and statistical software (Statgraphics, Minitab, Sigmaplot), Bi
bliographic software (EndNote), Adobe Connect

ADDITIONAL INFORMATION

Publications

EEA, 2013: NEC Directive Status Report 2012, Technical Report No 6/2013, European Environment Agency

EEA, 2013: European Union emission inventory report 1990–2011 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), Technical Report No 10/2013, European Environment Agency

EEA, 2013: Annual European Union greenhouse gas inventory 1990–2011 and inventory report 2013, Submission to the UNFCCC Secretariat, Technical Report No 8/2013, European Environment Agency.

EEA, 2011: Annual European Union greenhouse gas inventory 1990–2009 and inventory report 2011, Submission to the UNFCCC Secretariat, EEA Technical report No 2/2011, European Environment Agency.

EEA, 2011: NEC Directive Status Report 2010, EEA Technical Report, No 3/2011, European Environment Agency

EEA, 2011: European Union emission inventory report 1990–2009 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), EEA technical report No. 9/2011, European Environment Agency

Umweltbundesamt, 2011: Austria´s Annual Greenhouse Gas Inventory 1990-2009.Wien, 2011. (Reports; REP-0306)

EEA, 2010: NEC Directive Status Report 2009, EEA Technical Report, No 10/2010, European Environment Agency

EEA 2010: Air pollution — SOER 2010 thematic assessment, European Environment Agency

EEA, 2010: European Union emission inventory report 1990–2008 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), EEA technical report No. 7/2010, European Environment Agency

EEA, 2010: Annual European Union greenhouse gas inventory 1990–2008 and inventory report 2010, Submission to the UNFCCC Secretariat, EEA Technical report No 6/2010, European Environment Agency.

EEA, 2009: NEC Directive Status Report 2008, EEA Technical Report, No 11/2009, European Environment Agency

EEA, 2009: Greenhouse gas emission trends and projections in Europe 2009, Tracking progress towards Kyoto targets, EEA Report No 9/2009, European Environment Agency.

EEA, 2009: European Community emission inventory report 1990–2007 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), EEA technical report No. 8/2009, European Environment Agency

EEA, 2009: Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009, Submission to the UNFCCC Secretariat, EEA Technical report No 4/2009, European Environment Agency.

europass

Curriculum Vitae

PERSONAL INFORMATION

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www.umweltbundesamt.at, www.ceip.at

Sex F | Date of birth 26/10/1951 | Nationality Slovak

WORK EXPERIENCE

09/2006 – present	Project leader of EMEP Centre on emission inventories and projections (CEIP) Task leader in European Topic Center on Air and Climate Mitigation (CLRTAP/NECD review and E-PRTR informal review)
06/2003 – 07/2006	UNDP GEF Regional project manager, Copenhagen, Denmark
10/1999 – 05/2003	Senior expert (Head of Air Quality Dept 2001-2003)
01/1999 – 09/1999	Consultant 2 at OECD
08/1975 – 12/1998	Expert / Senior Expert, Department of Air Qualit

EDUCATION AND TRAINING

1982 – 1983	RNDr. Comenius University Bratislava, faculty of Natural Sciences, Slovak Republic, Physics
1970 – 1975	MSc, Comenius University Bratislava, faculty of Natural Sciences, Slovak Republic, Physics, major concentration: Meteorology
1995	Training on Policies and measures to mitigate GHG emissions, 2 weeks. US EPA - Berkley University, USA

PERSONAL SKILLS

MOTHER TONGUE(S) Slovak

OTHER LANGUAGE(S)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C	C	C	C	C
Czech	C	C	C	C	C
German	C	C	C/B	B/C	B/C
Russian	B	B	A/B	A/B	A

JOB-RELATED SKILLS

- All aspect of emission inventories and inventory systems for EU MS, UNFCCC Annex 1 and non-Annex 1 Parties , EMEP countries.
- Review of emission inventories
- Development of national inventory systems, QA/QC plans, AQ monitoring network, archiving systems, databases, inventory software.
- Air quality monitoring and assessment, integrated systems, partly mitigation and climate change. EU directives related to Air Quality and Air Emissions.
- Reporting obligations under UNFCCC, CLRTAP, E-PRTR and EU directives.
- Passed all tests for UNFCCC Lead reviewers

ORGANISATIONAL/ MANAGERIAL SKILLS

- Experience with management/supervision of department, projects, consultants and contractors. Development of short term and long term strategies.
- Project development and implementation. Project evaluation.
- Set-up of capacity building programs and trainings.
- Workshop organization and event management.
- Budgeting, time management, promotion of results.

PUBLICATIONS

1. Transboundary particulate matter, photo-oxidants, acidifying and eutrophying components" , Joint MSC-W & CCC & CEIP Report; EMEP status report 2014/1
2. Mareckova K,, Lorenz Moosmann, Stephan Poupa, Katrin Seuss, Wim van der Maas, Jeroen Kuenen, Rianne Dröge, Chris Dore; *E-PRTR Assessment Report on Incompleteness*, ETC/ACM Technical paper 2014/2, Dec 2014
3. Manfred Clara, Simone Haider, Stephan Poupa, Katarina Mareckova, Katrin Seuss, Georg Windhofer, Andreas Zechmeister (Umweltbundesamt GmbH), Christian Fischer, Morten Ryberg (Copenhagen Ressource Institute), Peter Hofbauer, Milos Milunov, Nicole Seyring (BiPRO GmbH)*Three years of implementation of the E-PRTR ,* Supporting study for EC, Ref ENV.C.3/SEr/2010/0056, Vienna April 2012
4. Mareckova K., R.Wankmueller, M.Anderl, K.Pazdernik, R.Joebstl, S.Poupa. M.Purzner, A.Zechmeister, M.Adams *Inventory review 2010, Review of emission data reported under LRTAP Convention and NEC Directive,* EMEP-CEIP Technical report 1/2010, pg96, UBA Vienna 2010
5. Marečková K.&all,. *Annual European Community LRTAP Convention emission inventory report ,1990-2006*, pg78. EEA Topic report, July 2008,
6. *Capacity Building for Improving the Quality of Greenhouse Gas Inventories in Europe/Commonwealth of Independent States , UNDP-NCSP* technical report, Sept 2006
7. *2006 IPCC Guidelines for National GHG Inventories*, Lead author of chapter Reporting and chapter Waste, IPCC 2006
8. Justin Goodwin, Katarína Marečková. *Emissions of atmospheric pollutants in Europe ,1990-1999*, EEA Topic report, July 2002, pg. 105
9. Marečková K.: *Report on existing system for preparing national GHG inventories in NL*, technical report for UNFCCC secretariat, pp12, Bratislava 2000.
10. *Good practice Guidance and Uncertainty management in National GHGs* Inventories, contribution to chapters Energy, Industry, Uncertainty management, and Glossary, IPCC report, 2000.
11. Pulles T., K.Marečková, J.Svetlík, M.Linek, J.Skákala: CollectER Installation and user Guide, EEA Technical report No 31, pp 52, 1999.
12. Marečková K., M.Tichý.: *Methods used by parties to estimate and report GHG emissions*, Technical report for UNFCCC secretariat, pp 45, Bratislava 1998..

PERSONAL INFORMATION

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www.umweltbundesamt.at

Sex M | Date of birth 28/01/1971 | Nationality Austria

WORK EXPERIENCE

02/2005 – present

IT-Analyst and Software Engineer;
EMEP data manager, Umweltbundesamt GmbH (Environment Agency Austria), Spittelauer Lände 5, A – 1090 Vienna, Austria

- Requirements Engineering und Business Analysis in the field of Water- and Waste management;
- Data manager, Software-Developer and System-Administrator of the EMEP Centre CEIP (Centre on Emission Inventories and Projections), responsible for the emission database, the preparation of datasets, the development of improvements and additional functionality to the EMEP system and the communication to the parties. Development of a new EMEP gridding system for the spatial disaggregation of sectoral emissions (GNFR) to a 0.1°x 0.1° resolution grid;
- Development of a web application for a nationwide register of radioactive sources (Austrian Register of Radioactive Sources);
- Development of an application for aggregating and analyses of emission data (CRF-Aggregator)

08/2000 – 11/2004

Software Engineer , TechniData AG (Markdorf, Germany)

- Development of an emissions management system with main focus on emission calculations and data extraction to SAP Business Warehouse;
- Development of a facility database for the German Emission Trading Center (DEHSt) in Berlin with main focus on emission calculations as a basis for the allocation of emission authorizations;
- Development of a prototype system for the international online exchange of radiological data and information in case of a nuclear emergency;
- Technical project management and customer training

06/1992 – 09/1996

Electrical engineering technician, KLUG Elektroinstallationen GmbH&Co.KG, St. Pölten, Austria

- Project management and cooperation at several electric installation projects;
- Preparation of offers for electric installation projects;
- Administrative work at the internal computer network infrastructure;
- Cooperation on the implementation of a software for project monitoring

EDUCATION AND TRAINING

10/1996 – 05/2000

Graduated Engineer in Computer Science — Level 5

University of Applied Sciences Wiener Neustadt (FHWN), Austria

- Computer Technology, High Precision- and System Engineering

09/1985 – 05/2000

-

Secondary Technical Testing and Training Institute in St. Pölten (HTL), Austria

- Power Engineering and Power Electronics

PERSONAL SKILLS

MOTHER TONGUE(S) German

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

JOB-RELATED SKILLS

- Certified Professional for Requirements Engineering (CPRE, Level 2)
- Knowledge in the development of systems for environmental data (Austrian radiation warning system, Austrian Register of Radioactive Sources, EMEP database)
- Knowledge in electrical engineering and electronics;

ORGANISATIONAL/ MANAGERIAL SKILLS

- Experience in technical project management
- Experience in international projects

COMMUNICATION SKILLS

- Intercultural skills: Worked for an EU-Project with partners from Germany, Russia, Belarus, Ukraine and Hungary; Work for EMEP (European Monitoring and Evaluation Programme)

COMPUTER SKILLS

- Operating System: Windows, Linux
- Development Tools: Eclipse, Jbuilder, SAP NetWeaver, Visual Studio, Rational Rose
- Programming Knowledge: Java, J2EE, C/C++, Perl, Hibernate, XML, Corba, SQL, HTML, JavaScript, VisualBasic, UML, OOA, OOD
- Databases: MySQL, MS SQL-Server, MaxDB, Oracle, PostgreSQL
- Webserver/Applicationserver: Apache HTTP-Server, Apache Tomcat, SAP-WAS

ADDITIONAL INFORMATION

PUBLICATIONS

Mareckova K., Wankmueller R., Anderl M., Muik B., Poupa S., Wieser M., 2008. ETC-ACC Emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Status of Gridded data, EEA and CEIP technical report, 1/2008, ISBN 3-85457-973-X.
Mareckova K., Wankmueller R., Pazdernik K., Purzner M., Zechmeister A., 2010. Review of emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Status of Gridded data and LPS data, EEA and CEIP technical report, 1/2010, ISBN 978-3-99004-095-9.
Mareckova K., Wankmueller R. et al., 2011. Review of emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Review of emission inventories from shipping, Status of Gridded and LPS data, EEA and CEIP technical report, 1/2011, ISBN 978-3-99004-143-7.
Mareckova K., Wankmueller R., Whiting R, Pinterits M., 2012. Review of emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Review of emission inventories from shipping, Status of Gridded and LPS data, EEA and CEIP technical report, 1/2012, ISBN 978-3-99004-201-4.
Mareckova K., Wankmueller R., Pinterits M., Moosmann L, 2013. Methodology Report – Review of emission data reported under the LRTAP Convention and NEC Directive.
MARECKOVA, K., R. WANKMÜLLER, L. MOOSMANN, M. PINTERITS (2013): Inventory Review 2013 – Review of emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Status of gridded and LPS data, EEA and CEIP technical report, 1/2012, ISBN 978-3-99004-248-9.
MARECKOVA, K., R. WANKMÜLLER, L. MOOSMANN, M. PINTERITS, M. TISTA (2014): Inventory Review 2014 – Review of emission data reported under the LRTAP Convention and NEC Directive, Stage 1 and 2 review, Status of gridded and LPS data, EEA and CEIP technical report, 1/2012, ISBN 978-3-99004-300-4.

PERSONAL INFORMATION

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http://www..chalmers.se/rss/EN

Sex male | Date of birth 25/12/1952 | Nationality Swedish

WORK EXPERIENCE

1999- present Senior Scientist, Professor, Chalmers University of Technology, Department of Earth and Space Sciences, Gothenburg, Sweden

- Development of ground-based remote sensing instruments and measurement strategies for atmospheric studies including LIDAR, DOAS and FTIR.
- Studies of megacity air pollution using DOAS and FTIR
- Development of instruments and measurement strategies for studies of volcanic gas emissions.
- Coordinator of EU-project DORSIVA (Development of Optical Remote Sensing Instruments for Volcanic Applications)
- Coordinator of EU-project NOVAC (Network for Observation of Volcanic and Atmospheric Change)
- Fieldwork related to volcanic gas emissions on more than 30 volcanoes in Chile, Colombia, Ecuador, Costa Rica, El Salvador, Guatemala, Nicaragua, Mexico, Alaska, Montserrat, Iceland, Italy, D.R. Congo, Reunion Iceland, Phillipines, Papua New Guinea and Kamchatka.
- Coordinator of the NOVAC network (after the end of the EU-project NOVAC)

1980 - 1999 Scientist, Swedish Environmental Research Institute (IVL), Gothenburg, Sweden

- Development of optical remote sensing instruments and measurement strategies for atmospheric studies including LIDAR, DOAS and FTIR.
- Principal Investigator in several EU-projects
- Fieldwork related to studies of: stratospheric ozone depletion, emission of climate gases from various ecosystems, industrial emissions, urban air pollution, industrial hygiene, long range transport of air pollution
- P.I. of NDSC and NDACC site Harestua in Norway

EDUCATION AND TRAINING

1980 - 1999 PhD in Environmental Physics, Chalmers University of Technology, Gothenburg, Sweden
1976 – 1980 Master, Engineering Physics, Chalmers University of Technology, Gothenburg, Sweden

PERSONAL SKILLS

Mother tongue(s) Swedish

Other language(s)

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

Organisational / managerial skills

- Project leader, team coordinator, supervisor
- Experience in managing large international research teams as project coordinator/leader
- Experience in the management of international projects: coordinator of the EU-projects DORSIVA (2002-2005) and NOVAC (2005-2010), member of the steering committee of several international projects
- Coordinator of the NOVAC network (after the end of the EU-project NOVAC)
- Group leader, Optical Remote Sensing, Chalmers University of Technology

Computer skills

- Programming skills in Fortran and Pascal
- Word, Powerpoint, Excel

ADDITIONAL INFORMATION

Selection of peer-reviewed publications

- Galle B B., Oppenheimer C., Geyer A., McGonigle A., Edmonds M. and Horrocks L., "A miniaturised ultraviolet spectrometer for remote sensing of SO2 fluxes: a new tool for volcano surveillance". J. of Volc. and Geotherm. Res., Issues 1-4, 1 January 2003, Pages 241-254.
- Bobrowski N, Hönninger G., Galle B. And Platt U., Detection of bromine monoxide in a volcanic plume. Nature, vol 423, No 6937 , 273-275, 2003.
- Edmonds M., R.A. Herd, B. Galle and C. Oppenheimer, "Automated, high time-resolution measurements of SO2 flux at Soufrière Hills Volcano, Montserrat". Bull. Volc., 65, 578, 2003.
- Galle, B., M. Johansson, C. Rivera, Y. Zhang, M. Kihlman, C. Kern, T. Lehmann, U. Platt, S. Arellano, and S. Hidalgo (2010), Network for Observation of Volcanic and Atmospheric Change (NOVAC)—A global network for volcanic gas monitoring: Network layout and instrument description, J. Geophys. Res., 115, D05304, doi:10.1029/2009JD011823. 2010.
- Dingwell A., Rutgersson A., Claremar B., Arellano S., Yalire M., and Galle B. (2016), Seasonal and diurnal patterns in the dispersion of SO2 from Mt. Nyiragongo, Atmos. Environ., 132, 19-29
- Bobrowski, N., von Glasow R., Giuffrida G. B., Tedesco D., Aiuppa A., Yalire M., Arellano S., Johansson M., and Galle B. (2015), Gas emission strength and evolution of the molar ratio of BrO/SO2 in the plume of Nyiragongo in comparison to Etna, J. Geophys. Res. Atmos., 120, 277.
- Di Muro A., Métrich N., Allard P., Aiuppa A., Burton M., Galle B., Staudacher T. (2015), Magma degassing at Piton de la Fournaise Volcano, "Active Volcanoes of the World" series, Springer, Bachelery, P., Lenat, J.F, Di Muro, A., Michon L., Editors, doi:10.1007/978-3-642-31395-0.
- Gíslason, S.R. et al. (2015), Environmental pressure from the 2014–15 eruption of Bárðarbunga volcano, Iceland. Geochem. Persp. Let. 1, 84-93.
- Lübcke P., Bobrowski N., Arellano S., Galle B., et al. (2014), BrO/SO2 molar ratios from scanning DOAS measurements in the NOVAC network, Solid Earth, 5, 409-424.
- Conde V., Bredemeyer S., Duarte E., Pacheco J., Miranda S., Galle B., Hansteen T. (2014), SO2 degassing from Turrialba Volcano linked to seismic signatures during the period 2008–2012, International Journal of Earth Sciences, 103, 7, 1983-1998.
- de Moor M. et al., Turmoil at Turrialba Volcano (Costa Rica): Degassing and eruptive processes inferred from high-frequency gas monitoring, Journal of Geophysical Research: Solid Earth, Volume 121, Issue 8, August 2016, Pages: 5761–5775,
- Conde V. S. Bredemeyer, J. Saballos, B. Galle and T. H. Hansteen. (2015), Linking SO2 emission rates and seismicity by continuous wavelet transform: implications for volcanic surveillance at San Cristóbal volcano, Nicaragua. Int J Earth Sci., DOI 10.1007/s00531-015-1264-1
- Kern, C., J. M. de Moor, and B. Galle (2015), Monitoring gas emissions can help forecast volcanic eruptions, Eos, 96, doi:10.1029/2015EO034081. Published on 12 August 2015.
- Zelenski M., Y. Taran and B. Galle. High emission rate of sulfuric acid from Bezymianny volcano, Kamchatka. Geophysical Research Letters, 10.1002/2015GL065340
- Hidalgo S., et al., SO2 degassing at Tungurahua volcano (Ecuador) between 2007 and 2013: Transition from continuous to episodic activity, Journal of Volcanology and Geothermal Research, Volume 298, 1 June 2015, Pages 1–14.
- Conde V., D. Nilsson, B. Galle, R. Cartagena and A. Muñoz. A rapid deployment network for monitoring volcanic SO_2 emissions based on DOAS – a study case from Telica volcano, Geosci. Instrum. Method. Data Syst., 3, 127–134, 2014

PERSONAL INFORMATION

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santiago.arellano@chalmers.se

https://www.chalmers.se/rss/EN

Sex Male | Date of birth 12/03/1981 | Nationality Ecuadorian

WORK EXPERIENCE

2015 - present Postdoc, Optical Remote Sensing, Department of Earth and Space Sciences, Chalmers University of Technology, Gothenburg, Sweden

- Data analysis, instrument assembling and technical support for the Network for Observation of Volcanic and Atmospheric Change (NOVAC)
- Development of radiative transfer algorithm for NOVAC measurements
- Installation and field measurements in Colombia, Ecuador and Papua New Guinea
- Update of database for NOVAC/DECADE (Deep Carbon Degassing) volcanoes

2003 - 2008 Junior Volcanologist, Instituto Geofísico de la Escuela Politécnica Nacional, Quito, Ecuador

- In charge of volcanic gas remote sensing (DOAS, FTIR)
- Scientist in charge of Tungurahua Volcano Observatory
- Geophysical modelling of deformation and degassing measurements
- Maintenance of monitoring instrumentation

EDUCATION AND TRAINING

2009 - 2014 PhD/Lic.Phil., Earth and Space Sciences, Chalmers University of Technology, Gothenburg

2000 - 2005 MS., Physics, Escuela Politécnica Nacional, Quito

PERSONAL SKILLS

Mother tongue(s) Spanish

Other language(s)

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C2	C2	C1	C1	C2
Swedish	B2	B2	B1	A2	A2

Organisational / managerial skills

- Experience in managing small groups in volcanological observatories
- Experience coordinating field work
- Experience supervising Master students
- Experience in organizing small courses

Computer skills

- Programming skills in C++, MatLab, Python
- Experience with large databases
- Scientific programs for spectroscopic analysis (DOASIS, QDOAS, MALT)
- Windows, MAC, Office programs

ADDITIONAL INFORMATION

Selection of peer-reviewed Publications

- **S. Arellano**, M. Yalire M., B. Galle, N. Bobrowski, A. Dingwell, M. Johansson, P. Norman, (2016), Long-term monitoring of SO2 quiescent degassing from Nyiragongo's lava lake, Journal of African Earth Sciences, doi:10.1016/j.jafrearsci.2016.07.002.
- N. Bobrowski, G. B. Giuffrida, D. Tedesco, M. Yalire, **S. Arellano**, C. Balagizi, S. Calabrese, M. Liotta, P. Lübcke, B. Galle, Multi-component gas emission measurements of the active lava lake of Nyiragongo, DR Congo, Journal of African Earth Sciences, Available online 26 July 2016, ISSN 1464-343X, doi:10.1016/j.jafrearsci.2016.07.010.
- P. Lübcke P., J. Lampel, **S. Arellano**, N. Bobrowski, F. Dinger, B. Galle, et al. (2016), Retrieval of absolute SO_2 column amounts from scattered-light spectra – Implications for the evaluation of data from automated DOAS Networks, Atmos. Meas. Tech., doi:10.5194/amt-2016-24,
- A. Dingwell, A. Rutgersson, B. Claremar, **S. Arellano**, M. Yalire, B. Galle (2016), Seasonal and diurnal patterns in the dispersion of SO2 from Mt. Nyiragongo, Atmospheric Environment, 132, 19-29, doi:10.1016/j.atmosenv.2016.02.030.
- S.R. Gíslason, et al. (2015), Environmental pressure from the 2014–15 eruption of Bárðarbunga volcano, Iceland, *Geochemical Perspectives Letters* v1, n1, doi: 10.7185/geochemlet.1509.
- S. Hidalgo, J. Battaglia, **S. Arellano**, A. Steele, F. Vásconez, J. Bourquin, S. Arráis, B. Galle, (2015), SO2 degassing at Tungurahua volcano (Ecuador) between 2007 and 2013: transition from continuous to episodic activity, *J. Volcanol. Geotherm. Res.*, 298, 1-14, doi:10.1016/j.jvolgeores.2015.03.022.
- N. Bobrowski, R. von Glasow, G. Giuffrida, D. Tedesco, A. Aiuppa, M. Yalire, **S. Arellano**, M. Johansson, B. Galle, Gas emission strength and BrO/SO_2 evolution in the plume of Nyiragongo in comparison to Mt Etna, *J. Geophys. Res.,* 120-1, 277-291, 2015, doi:10.1002/2013JD021069.
- P. Lübcke, N. Bobrowski, **S. Arellano**, B. Galle, G. Garzón, L. Vogel, U. Platt, (2014). BrO/SO_2 molar ratios from scanning DOAS measurements in the NOVAC network. *Solid Earth*, 5, 409–424, 2014, doi:10.5194/se-5-409-2014.
- B. Smets, K. Karume, D. Kavotha, F. Kervyn, F. Lukaya, N. d'Oreye, D. Tedesco, C. Wauthier, **S. Arellano**, S. Carn, T. Darrah, J. Fernández, B. Galle, M. Kervyn, GVO team (2011), Detailed multidisciplinary monitoring reveals pre- and co-eruptive signals at Nyamulagira volcano (North Kivu, D.R.C.), *Bull. Volcanol.*, 76:787, 2014, doi:10.1007/s00445-013-0787-1.
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Annex 2: Letters of understanding from all CAMS-81 partners

Letter from the TNO partner

TNO innovation for life

Urbanisation
Princetonlaan 6
3584 CB Utrecht
P.O. Box 80015
3508 TA Utrecht
The Netherlands

www.tno.nl

T +31 88 866 42 56

Return address: P.O. Box 80015, 3508 TA Utrecht, The Netherlands

CNRS, Laboratoire d`Aerologie
Attn.: Mrs. Claire Granier
Toulouse
FRANCE

Date
10 November 2016

Our reference
0100301103

E-mail
paul.vanruiten@tno.nl

Direct dialling
+31 88 866 30 06

Subject:
Letter of Understanding (LOU)

Dear Mrs. Granier,

Preamble
Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

Whereas for the purpose of the proposal preparation in case of acceptance, the Parties will provide each other with all necessary relevant information.

The signatory Party of this letter of understanding agrees upon the following:

Preparation of the Project
The signatory Party undertakes to make its necessary and best efforts to concur to the preparation of the submission proposal and negociations of the Project:

- delivers the needed information,
- contributes to the Project definition,
- attends the meetings,
- respects planning and deadlines.

The signatory Party gives its explicit consent to the coordinator of the Project, CNRS, designated by all the partners (hereinafter the Coordinator) to its participation and for submitting the Project proposal.

The signatory Party assesses that the proposal will comply with ethical principles (including the highest standards of research integrity as set out, for instance, in the European Code of Conduct for Research Integrity and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).

The signatory Party will bear its own costs involved in the preparation of the Project proposal.

The signatory agrees to perform, as a subcontractor of CNRS, the assigned tasks as mentioned in the technical solution proposed by this tenderer for the CAMS-81 proposal "Global and Regional Emissions".

Confidentiality
The signatory Party undertakes to treat all information, whether of financial, commercial, scientific or technical nature, it has received directly or indirectly during the preparation of the proposal and in the context of the negotiations about the Project, as strictly confidential.

The signatory Party undertakes not to disclose the received information in any form to third parties, including other partners of the Project, for any purpose unless and until expressly authorized in writing to do so by the disclosing partner.

The signatory Party agrees that the received information shall be used solely for the purpose for which it was submitted.

In particular, the signatory Party states that no other commitment has been and will not be made with any third party to establish a proposal based on the information received from other partners of the Project.

In case of a non-acceptance by the Commission, or if the negotiations fail to lead to a consortium agreement, the obligations of confidentiality herein stated shall remain into force for a period of two years after the date of the signature of this letter of understanding.

Eligibility and accuracy of the information
The signatory Party confirms it has the financial and operational capacity to carry out the Project.

The signatory Party recognizes that it is responsible for the accuracy of the information relating to its own organisation contained in the proposal and remains responsible for the correctness of the information.

General provisions
This letter of understanding shall come into force on the date of its signature and shall remain in force until the signature of the subcontracts or the rejection of the proposal.

Ir. P.A. van Ruiten
Director Environment and Sustainability
Authorized to sign on behalf of TNO

CNRS - Délégation Midi-Pyrénées
att, Claire Granier
16, Avenue Édouard Belin
BP 24367
31055 Toulouse Cedex 4
France

Norwegian Meteorological Institute

Our ref.	Matter handled by	Our date
2015/466/342	Per Helmer Skaali	14.11.2016

Letter of Understanding (LOU)

Tender for Copernicus Atmosphere Monitoring Service 81

Dear Claire Granier,

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

Whereas for the purpose of the proposal preparation in case of acceptance, the Parties will provide each other with all necessary relevant information.

The signatory Party of this letter of understanding agrees upon the following:

Preparation of the Project

The signatory Party undertakes to make its necessary and best efforts to concur to the preparation of the submission proposal and negotiations of the Project:
- delivers the needed information,
- contributes to the Project definition,
- attends the meetings,
- respects planning and deadlines.

The signatory Party gives its explicit consent to the coordinator of the Project, CNRS, designated by all the partners (hereinafter the « Coordinator ») to its participation and for submitting the Project proposal.

The signatory Party assess that the proposal will comply with ethical principles (including the highest standards of research integrity as set out, for instance, in the European Code of Conduct for Research Integrity and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).

The signatory Party will bear its own costs involved in the preparation of the Project proposal.

The signatory agrees to perform, as a subcontractor of CNRS, the assigned tasks as mentioned in the technical solution proposed by this tenderer for the CAMS-81 proposal "Global and Regional Emissions".

Norwegian Meteorological Institute
Org.no 971274042
post@met.no

Oslo
P.O. Box 43 Blindern
0313 Oslo, Norway
T. +47 22 96 30 00

Bergen
Allégaten 70
5007 Bergen, Norway
T. +47 55 23 66 00

Tromsø
P.O. Box 6314
9293 Tromsø, Norway
T. +47 77 62 13 00

www.met.no
www.yr.no

Confidentiality

The signatory Party undertakes to treat all information, whether of financial, commercial, scientific or technical nature, it has received directly or indirectly during the preparation of the proposal and in the context of the negotiations about the Project, as strictly confidential.

The signatory Party undertake not to disclose the received information in any form to third parties, including other partners of the Project, for any purpose unless and until expressly authorized in writing to do so by the disclosing partner.

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The signatory Party recognizes that it is responsible for the accuracy of the information relating to its own organisation contained in the proposal and remains responsible for the correctness of the information.

General provisions

This letter of understanding shall come into force on the date of its signature and shall remain in force until the signature of the subcontracts or the rejection of the proposal.

Signed on *14.11.2016*

Signature: Harald Schylerg

FOR Name: Øystein Hov
Position: Director of Research,
authorised representative for Meteorologisk institutt

Official Stamp:

UNIVERZITA
KARLOVA

Rektor

Letter of Understanding (LOU)

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

Whereas for the purpose of the proposal preparation in case of acceptance, the Parties will provide each other with all necessary relevant information.

The signatory Party of this letter of understanding agrees upon the following:

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- contributes to the Project definition,
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The signatory Party assess that the proposal will comply with ethical principles (including the highest standards of research integrity as set out, for instance, in the European Code of Conduct for Research Integrity and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct).

The signatory Party will bear its own costs involved in the preparation of the Project proposal.

The signatory agrees to perform, as a subcontractor of CNRS, the assigned tasks as mentioned in the technical solution proposed by this tenderer for the CAMS-81 proposal "Global and Regional Emissions".

Ovocný trh 5/560, 116 36 Praha 1
telefon: (+420) 224 491 313–4, 900
e-mail: rektor@cuni.cz
http://www.cuni.cz

Confidentiality

The signatory Party undertakes to treat all information, whether of financial, commercial, scientific or technical nature, it has received directly or indirectly during the preparation of the proposal and in the context of the negotiations about the Project, as strictly confidential.

The signatory Party undertake not to disclose the received information in any form to third parties, including other partners of the Project, for any purpose unless and until expressly authorized in writing to do so by the disclosing partner.

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The signatory Party recognizes that it is responsible for the accuracy of the information relating to its own organization contained in the proposal and remains responsible for the correctness of the information.

General provisions

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Charles University

Authorized to sign on behalf of Charles University

Name and function of the authorized signatory: prof. MUDr. Tomáš Zima, DrSc., MBA, Rector

Date: 14. 11. 2016

Signature:

UNIVERZITA KARLOVA
REKTORÁT
Ovocný trh 560/5, 116 36 Praha 1
IČO: 00216208, DIČ: CZ00216208

Letter of Understanding (LOU)

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

Whereas for the purpose of the proposal preparation in case of acceptance, the Parties will provide each other with all necessary relevant information.

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The signatory Party recognizes that it is responsible for the accuracy of the information relating to its own organisation contained in the proposal and remains responsible for the correctness of the information.

General provisions

This letter of understanding shall come into force on the date of its signature and shall remain in force until the signature of the subcontracts or the rejection of the proposal.

FINNISH METEOROLOGICAL INSTITUTE

Authorized to sign on behalf of Finnish Meteorological Institute

Name and function of the authorized signatory: Dr. Ari Karppinen, Research Manager

Date: 10/11/2016 Helsinki

Signature:

Letter of Understanding (LOU)

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

Whereas for the purpose of the proposal preparation in case of acceptance, the Parties will provide each other with all necessary relevant information.

The signatory Party of this letter of understanding agrees upon the following:

Preparation of the Project

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General provisions

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BARCELONA SUPERCOMPUTING CENTER-CENTRO NACIONAL DE SUPERCOMPUTACIÓN (BSC)

Authorized to sign on behalf of *BSC*
Name and function of the authorized signatory: Mateo Valero Cortés, Director of BSC

Date:

Signature:

Mateo Valero
Director
Barcelona
Supercomputing
Center
Centro Nacional de Supercomputación

Letter from the MPI-C partner

Letter of Understanding (LOU)

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

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The signatory Party recognizes that it is responsible for the accuracy of the information relating to its own organisation contained in the proposal and remains responsible for the correctness of the information.

General provisions

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[NAME OF THE PARTICIPANT]

Authorized to sign on behalf of *Max Planck Institute for Chemistry*
Name and function of the authorized signatory: Prof. Jos Lelieveld, Director

Date: 10/11/2016

Signature:

Letter of Understanding (LOU)

Preamble

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General provisions

This letter of understanding shall come into force on the date of its signature and shall remain in force until the signature of the subcontracts or the rejection of the proposal.

UMWELTBUNDESAMT GmbH

Authorized to sign on behalf of UMWELTBUNDESAMT GmbH

Karl Kienzl

Deputy Managing Director

Date: 14 November 2016

Signature:

umweltbundesamt
Umweltbundesamt GmbH
1090 Wien, Spittelauer Lände 5
www.umweltbundesamt.at

Letter of Understanding (LOU)

Preamble

Considering all provisions of the ECMWF Framework Agreement Model for Copernicus Services and in particular Section 2.9;

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General provisions

This letter of understanding shall come into force on the date of its signature and shall remain in force until the signature of the subcontracts or the rejection of the proposal.

CHALMERS TEKNISKA HOEGSKOLA AB

Authorized to sign on behalf of *Chalmers tekniska hoegskola AB*

Date: 15 November 2016

Signature:

Gunnar Elgered,
Head of Department of Earth and Space Sciences

Annex 3: Letter from the EDGAR group on the exchange of data

EUROPEAN COMMISSION
JOINT RESEARCH CENTRE

Directorate Energy, Transport & Climate (Ispra)
Air and Climate Unit

Ispra, November 22nd, 2016

To whom it may concern

Collaboration with the Emissions Database for Global Atmospheric Research (EDGAR):

Exchange of data.

The team of the Emissions Database for Global Atmospheric Research at the Joint Research Centre in Ispra is highly interested in collaborating on global emissions gridmap and as such in the progress and results expected from the CAMS81 emissions proposal.

The EDGAR global emissions gridmaps are unique and the JRC is eager to enable maximal use of these. While the EDGAR emission gridmaps are publicly available, the underlying datasets are not and only exchanged on a case by case basis. In this case of CAMS81, EDGAR judges it opportune to exchange also underlying data, such as our spatial distribution profiles (from our dataset of over 300 sector-specific global proxy gridmaps) with any consortium selected for the call. We are willing to collaborate in providing access to our global proxy data in exchange for feedback and improvements to these datasets.

While JRC is not allowed to participate in this call, it is willing to take up an advisory role, without any costs to the consortium.

Greet Janssens-Maenhout

EDGAR group leader, Air and Climate Unit
Directorate Energy, Transport, Climate
European Commission, Joint Research Centre