SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2013

Project Title: Validation and improvement of a stratospheric microphysical aerosol scheme in the IFS

Computer Project Account: spfrbekk

Principal Investigator(s): Slimane Bekki

Affiliation: LATMOS, CNRS

Name of ECMWF scientist(s) collaborating to the project (if applicable) Jean-Jacques Morcrette

Start date of the project: June 2013

Expected end date: June 2014

Computer resources allocated/used for the current year and the previous one (if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	600000	791	700000	432221
Data storage capacity	(Gbytes)	1200		1800	189

Summary of project objectives

(10 lines max)

This special project is intended to support the participation of University of Pierre et Marie Curie in the MACC II programme. The aim of this participation is twofold: 1) it finalises the extension of the GLOMAP aerosol scheme implemented in the IFS to the stratosphere and validate the scheme, and 2) it will develop a data assimilation system around the IFS-GLOMAP for the stratospheric aerosol layer. This work is being conducted with partners at ECMWF and University of Leeds, and will make the stratospheric configuration in the IFS-GLOMAP system operational. The operational IFS-GLOMAP system will ultimately form part of the GMES Atmosphere Service, providing detailed aerosol forecasts for predicting air quality and radiation, and boundary conditions for regional models.

Summary of problems encountered (if any)

(20 lines max)

The updating of the MACC-II IFS version (with new cycles) has been a problem. Some of the changes led to bugs appearing with the stratospheric aerosol model. It took often a long time to work out that the origin of problems was not the aerosol codes themselves. Once a version was frozen, the development and evaluation were much easier.

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

Explosive volcanic eruptions inject gas and ash particle loads into the atmosphere at high altitudes. These particles can impact both climate and air traffic because of their long range transport by horizontal wind motion. This is particularly true when volcanic plumes reach the tropopause region (i.e., the atmospheric layer ranging from approximately 8–12km (14–18km in the tropics) that separates the troposphere and stratosphere. Like other natural events, plumes resulting from volcanic eruptions often highlight weaknesses in our ability to accurately predict their evolution. Thus, it is imperative to develop modelling capabilities that are reactive and accurate to forecast plume effects and minimize disruption.

After several tests, it has been decided to model stratospheric aerosols (including high altitude volcanic aerosols) within the preexisting tropospheric aerosol module, the GLOMAP code. For the sake of continuity and consistency between the treatment of aerosols in the troposphere and the stratosphere, the GLOMAP code has been modified to be applicable in the stratosphere as well as the troposphere, rather than implementing the UMPC stratospheric aerosol mass code alongside GLOMAP in the troposphere. Although the tropospheric aerosol code already describes the microphysical processes relevant for stratospheric sulphuric acid aerosols (nucleation, condensation/evaporation, coagulation, sedimentation), several modifications were needed to cover stratospheric conditions. The main modifications to GLOMAP were: a) to amend the calculation of particle density and water content when in the stratosphere and to be consistent with the expected chemical composition of stratospheric aerosols (sulphuric acid weight fraction), and b) to amend the condensation routine to account for the vapour pressure of sulphuric acid, which becomes significant in the stratosphere. With these changes particles can evaporate releasing sulphuric acid back to the gas phase, rather than keeping it permanently in the aerosol phase as initially coded in GLOMAP. Note that this simplification is perfectly valid in the troposphere because the sulphuric acid saturation pressure is negligible there. However, in the stratosphere, above 30-35 km, aerosols release H_2SO_4 into the gas-phase which can then be photolysed to SO_3, and subsequently to SO_2. The treatment of evaporation is

important because during downward transport in the lower stratosphere, a reservoir of SO_2 can build up during polar night with photochemically-induced new particle formation occurring in spring.
The sedimentation routine has also been modified to include the non-linear terms. Instead of discretizing the particle size distribution for the sedimentation calculations, we have used a Taylor development to work out an analytical expression that allows to calculate within a percent the mass-weighed sedimentation velocity for a log-normal aerosol size distribution. A volcanic sulphur injection routine has also been developed. All the routines specific to the stratospheric aerosols have all been thoroughly tested.

Several long cycling of the IFS has been tested successfully after resolving some issues of numerical stability in the model. The tests have focused on simulating important volcanic eruptions when satellite and balloon-born measurements are available.

Most the comparisons against observations show that the model performs reasonably well. Nonetheless, there are two minor features that are not fully consistent with observations and other model simulations. First, the model-simulated size distributions are slightly bimodal during background conditions. Indeed, there is a significant nucleation mode almost everywhere in the model domain whereas this nucleation mode is very limited in non-volcanic observations and is mostly found in the tropical lower stratosphere or after specific conditions (e.g. stratospheric warming). Although this nucleation mode is relatively small, there is a need for further testing. Second, the volcanic aerosol decay is possibly too fast in the model. It is worth pointing out that this bias in stratospheric removal rate, possibly originating from UKCA-mode, is not at all critical for MACC applications. The bias develops on timescale of at least 6 months whereas MACC is about an assimilation system that provides daily aerosol forecasts with a very high assimilation frequency.

The latest MACC report dating from Jan 2013 is also provided.

List of publications/reports from the project with complete references

Summary of plans for the continuation of the project
(10 lines max)

The next phase will be focused on assimilating the CALIOP backscatter data (satellite lidar data) in the IFS that includezs the tropospheric-stratospheric aerosol codes.

2.6 AER: Global aerosols

Work in the AER - global aerosol subproject has proceeded along four different strands: maintenance and further development and testing of a new modal aerosol scheme that includes a stratospheric capability, maintenance and further development of the data assimilation system, further development and provision of satellite aerosol products for stand-alone aerosol monitoring and/or for assimilation in the operational aerosol models, further development and provision of global aerosol services (aerosol forcing, dust forecast, aerosol alert system, aerosol source inversion).

Maintenance of the aerosol scheme in the IFS has proceeded smoothly but has somewhat delayed progress in developing the aerosol scheme further, so that the delay that was inherited from the MACC project has not yet been caught up. However the latest version of the UKCA-mode is now available in the latest cycle of the IFS, and the RADAER module for calculating aerosol optical properties is now ready for use. The UPMC partner now has the capability to run the IFS remotely and preliminary tests with stratospheric SO_2 injection and aerosols are being implemented. A prototype model of improved bias correction for MODIS aerosol optical depth has been developed and implemented. New bias predictors have been introduced and are being tested for AOD over ocean, based on surface wind speed and cloud cover.

Satellite algorithms for aerosol retrieval have continued to be improved and developed. Provision of aerosol products has continued nominally, except for the ENVISAT failure which has stopped NRT delivery of the SYNAER and AATSR products. Operations will resume with SYNAER/METOP and Sentinel 3. MSG SEVIRI aerosol data are now processed in BUFR code, opening the possibility for data assimilation in the IFS. Monthly IASI products are available over the ocean and are being validated over land. Work is ongoing for daily products as planned.

Development and production of global aerosol services have proceeded nominally The dust forecast from the Met Office is available on the WMO SDS node for Europe and North Africa. The aerosol forcings product is also available and updated on a regular basis. There has been significant progress in upgrading the aerosol source inversion system in the LMDZ model with a new set of regions and a priori emission data so that global inversions can now take place. Finally work on defining a global aerosol alert system is also on track although slightly delayed.

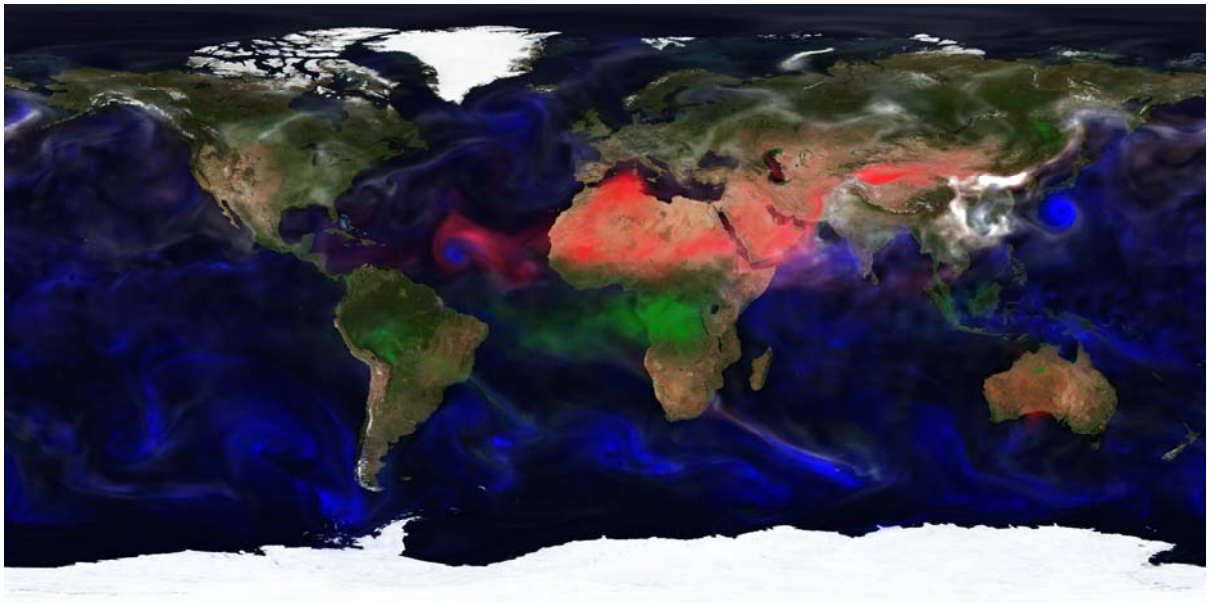

Fig. AER.1: Contribution of different aerosol types to the total AOD in the MACC II analysis (red=dust, green=biomass burning, blue=sea spray, white=industrial aerosols). Courtesy of Simone Mantavoni, MEEO.

2.6.1 Workpackage WP61: AER Coordination (COORD)

The objectives of this WP are to ensure the work of the AER sub-project is coordinated appropriately, to liaise with other MACC-II sub-projects, liaise with other stakeholders including data providers such as ESA and EUMETSAT (e.g. for future delivery of NRT satellite data).

2.6.1.1 Task AER.1.1 (CNRS contribution): Coordination
Coordination of the AER subproject has taken place, with special emphasis on WPs and tasks that have experienced some delays. The coordinator, Olivier Boucher, has visited a number of AER collaborators during the first year. AER has liaised with the GDA workpackage for the MACC web activities and VAL for the validation of the aerosol analysis and forecast products. Dialogue with ESA and EUMETSAT has continued, especially regarding future delivery of data from the EarthCare (ESA) and Sentinel-3 (EUMETSAT) missions.

Deviations from the project work plan and corrective actions

The AER model development activity, which has been delayed in MACC, has not quite caught up its delay (see WP62). Olivier Boucher has therefore paid special attention to the coordination of this activity in this WP.

2.6.2 Workpackage WP62: AER Maintenance and upgrade to the aerosol schemes (RTD)

The objectives of WP62 are to simplify the UKCA-MODE aerosol scheme to make less computationally expensive, perform RTD to support GDA during the switch from the old aerosol scheme to UKCA-MODE aerosol scheme, add new aerosol chemical components of air quality and climate relevance, maintain the tropospheric and stratospheric aerosol schemes in the IFS. Given some delays at the end of the MACC project, attention in the first year of MACC II has focused on finalising the implementation of UKCA-mode within the IFS, including the RADAER module to calculate aerosol optical properties and a capability to simulate stratospheric aerosols. An extension of the UKCA-mode scheme to nitrate has been tested in the GLOMAP setup of UKCA-mode.

2.6.2.1 Task AER.2.1 General maintenance of the aerosol scheme (ECMWF, ULEEDS, UPMC, UKMET)
ECMWF: The GEMS/MACC version of the aerosol model used for near-real time analyses and forecasts at ECMWF has been moved from one operational cycle (f93i on 36R1) to another (fnyp on 37R3). For this new cycle, the sources of dust were rebalanced and following the correction of a bug, the new system has been providing the near-real time analysis and forecast since 8 June 2012, with improved distribution of dust within the three bins.

2.6.2.2 Task AER.2.2 Implementation of UKCA-MODE for operations (ECMWF, ULEEDS, UPMC)
ECMWF: The UKCA-MODE version of the aerosol model was made available on cycles 37R3 and 38R1 (in preparation for moving it to the new IBM-P7 system at the end of October). The latest cycle with IFS-GLOMAP has been successfully tested on the new architecture.

ULEEDS: The latest version of UKCA-mode aerosol scheme, which has been incorporated within the IFS includes modifications for calculation of stratospheric aerosol properties. Development is ongoing for stratospheric aerosol by UPMC.

UPMC: For the cycle 38R1, the testing of the GLOMAP aerosol scheme to the stratosphere has started and is currently on going. The routines specific to the stratospheric aerosols are still being tested. A longer cycling (3 days) of the IFS has been tested successfully after resolving some issues of numerical stability in the UKCA-MODE model. This strand of work is significantly delayed; however the target remains the simulation of the Pinatubo eruption.

2.6.2.3 Task AER.2.3 Upgrade of the MODE tropospheric aerosol scheme (ULEEDS)
The latest version of the UKCA-mode aerosol scheme (matching that in the HadGEM3 and TOMCAT models) is now incorporated within the IFS. Preliminary work on coupling C-IFS and UKCA-mode has been completed, including the writing of an interface routine. UKCA-mode now calculates and stores AOD via the RADAER module. A year-long simulation is underway to provide data for model evaluation and deliverable D62.3. Further evaluation and testing of the nitrate-extended version of GLOMAP-mode has proceeded within the TOMCAT and HadGEM3-UKCA models in preparation for porting to the IFS (milestone MS251). The IFS-GLOMAP system now includes the RADAER AOD module, and calculates monochromatic AOD at six wavelengths. Initial comparisons are promising, though the current model lacks dust and secondary organics leading to an underestimate in AOD. A new simulation including secondary organics and dust will form the basis of the evaluation for D62.3

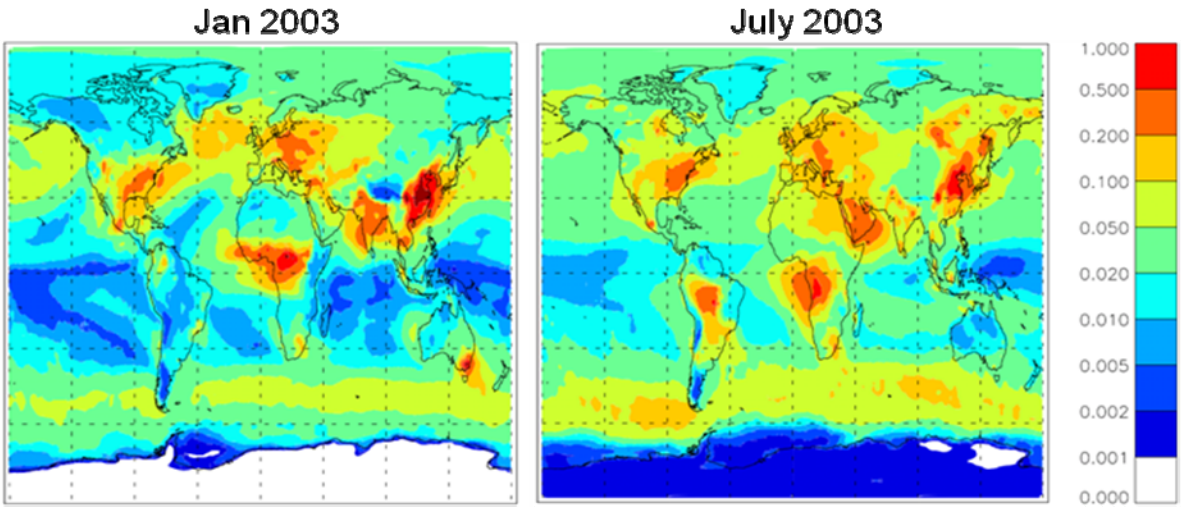

Fig. AER.2: Total AOD (550 nm) from the IFS-GLOMAP system, incorporating the RADAER AOD module.

2.6.2.4 Task AER.2.4 Simplification and optimisation of aerosol scheme (ULEEDS)

The full complexity IFS-GLOMAP scheme will be used for global aerosol forecasts and to provide boundary conditions for regional models. However, several reduced complexity GLOMAP-mode configurations have already been tested in the CTM environment include full composition in 4 modes and two-moment dust in 2 modes. A plan has been formulated to extend these to produce a suite of GLOMAP-mode configurations including where similar components are lumped in the 7 modes. Testing this suite of configurations will take place in the next 6 months in the CTM and with code updates will automatically track through to the IFS-GLOMAP system in the 2nd half of 2013.

2.6.2.5 Task AER.2.5 Maintenance and development of the Unified Model dust scheme (UKMET)

A set of dust simulations for a significant dust event in April 2011 have been submitted to a large model inter-comparison study, including MACC and other WMO-SDS dust models, results of which will feed back into development of the dust model in the coming year. Inclusion of seasonally varying vegetation, allowing dust emission in seasonally vegetated regions such as the Sahel, and large parts of Asia, improving dust simulations, will be operational in the global NWP model by November 2012, Development and testing of data assimilation of MODIS and SEVIRI dust observations is on-going and will be reported on in Interim report due in Month 18 (April 2013).

Deviations from the project work plan and corrective actions

The AER model development activity, which has been delayed in MACC, has not quite caught up its delay. The RADAER module has just been included in the IFS version of UKCA-mode so this deliverable can now be delivered swiftly. Work is proceeding to test and adapt the stratospheric aerosol version of UKCA-mode.

List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title
Month 1	**D62.1**: Maintained tropospheric aerosol code
Month 1	**D62.2**: Maintained stratospheric aerosol code (started but work delayed)
Month 12	**MS251**: Decision point on which nitrate scheme will be used for IFS-MODE

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure
Month 2	**D62.3**: Final assessment of aerosol forecasts against AERONET and NDACC measurements for MODE scheme	Delayed. RADAER module has just been included in the IFS version of UKCA-mode so this deliverable is expected to be delivered early 2013.
Month 4	**D62.4**: Conversion of MODE code to the DOCTOR standard	Not required anymore.

2.6.3 Workpackage WP63: Provision of NRT aerosol satellite data and dust forecast (SUPP)

The objective of this work package is to process and deliver satellite aerosol products that are currently available or become available from further developments made in work-package WP64. These include AOD products from MSG SEVIRI over the ocean and over land, AATSR, IASI and SYNAER, as well as CALIOP aerosol data and an independent dust forecast over the European/North African region.

2.6.3.1 Task AER.3.1 Provision of MSG SEVIRI aerosol data over the ocean (CNRS-ICARE)
CNRS-ICARE keeps acquiring and processing Level-1 MSG SEVIRI data in NRT and provides aerosol products over the ocean to MACC II partners as a continuity of MACC. The products are made available from ICARE FTP site and web site.

2.6.3.2 Task AER.3.2 Provision of MSG SEVIRI aerosol data over land (CNRS-ICARE)
The SEVIRI land product was turned into operational mode. A document describing the SEVIRI aerosol product over land was delivered (D64.1). CNRS-ICARE routinely acquires and processes Level-1 MSG SEVIRI data and provides aerosol products over land to MACC-II partners since Month 6 (April 2012). The current version is provisional and made available 8 days after acquisition. The NRT production mode has been successfully tested and can be activated upon request from partners.

2.6.3.3 Task AER.3.3 Provision of CALIOP aerosol data (CNRS-ICARE)
CNRS-ICARE keeps retrieving CALIOP aerosol products from NASA/ASDC and provide them to MACC II partners since Month 1. The data are made available from ICARE FTP site and web site.

2.6.3.4 Task AER.3.4 Provision of AATSR aerosol optical depth (AOD) data global in NRT (FMI)
The FMI NRT provision of AATSR global AOD continued from MACC to MACCII until April 8, 2012, when contact with ENVISAT was lost. The NRT provision will be continued when SLSTR on Sentinel 3 is operational. However there are some differences between SLSTR and AATSR (swath width, different swath for nadir and rear view, rear view instead of forward, sampling etc. which require algorithm development and testing. There is no clear plan yet to fill the gap between AATSR and SLSTR, with new data provided by FMI from another instrument, but several other instruments are continuing to provide AOD data of good quality (PARASOL, MODIS, MISR). The current FMI focus is on algorithm improvement, building on efforts in the ESA Aerosol-cci project, and use the improved algorithm for reprocessing of existing AATSR data. Work with ECMWF to use AATSR AOD fro assimilation in the models is under discussion.

2.6.3.5 Task AER.3.5 Provision of SYNAER/METOP (DLR)
The SYNAER NRT provision continued from MACC from M1 to M6 until ENVISAT failure. Since April there is a gap until SYNAER/METOP is ready for NRT operations. Released efforts have been used to continue work on qualification of SYNAER METOP (see WP64). In preparation of the reprocessing of full SYNAER data records, improvements made and validated in the ESA Aerosol_cci project with datasets from 2008 (negative bias corrected, better agreement of major global/seasonal features with other satellite products) for SYNAER/ENV are under implementation for the routine production.

Deviations from the project work plan and corrective actions
Due to ENVISAT failure on 8 April 2012, SYNAER/ENV NRT delivery has been stopped – SYNAER/METOP is planned to go into operations in early 2013. There is also a short delay in providing AOD and dust altitude over land from IASI data as the product is still under validation. AOD and dust altitude over the ocean is delivered.

List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title
Month 1	**D63.1**: Provision of NRT MSG/SEVIRI aerosol product over ocean
Month 1	**D63.2**: Provision of NRT and reprocessed CALIOP aerosol products
Month 1	**D63.3**: Provision of NRT AATSR AOD
Month 3	**D63.4**: Provision of NRT SYNAER product (until M6 / ENVISAT failure)
Month 3	**D63.5**: Provision of NRT five day high-resolution dust forecast from the UM
Month 6	**D63.6**: Provision of NRT MSG/SEVIRI aerosol product over land (upon request)
Month 12	**D63.7**: Provision of AOD and altitude from AIRS/IASI, monthly, 1°x1° Completed for "over ocean" products

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure
Month 1	**D63.3**: Provision of NRT AATSR AOD (stopped in M7)	ENVISAT failure
Month 3	**D63.4**: Provision of NRT SYNAER product (stopped in M7)	ENVISAT failure
Month 12	**D63.7:** Provision of AOD and altitude from AIRS/IASI, monthly, 1°x1°	Validation is not completed over land. Provision of the data over land is delayed until validation is completed and data quality is adequate.

2.6.4 Workpackage WP64: AER Development of aerosol satellite data (RTD)

The objective of WP64 is to further develop, improve, assess and document aerosol satellite retrievals used in WP63. This includes the SEVIRI ocean and land products, CALIOP lidar data, AATSR retrievals, SYNAER synergetic product and AIRS/IASI thermal AOD. A major aspect is to test the readiness of the various satellite products for data-assimilations in comparisons to trusted reference data by sun-photometry, in intercomparison among different remote sensing products including those currently used in data-assimilations and in comparisons to MACC-II model simulations for reference years.

2.6.4.1 Task AER.4.1 Improvement to MSG SEVIRI aerosol data (CNRS-ICARE)
The format of the SEVIRI ocean product was adapted to meet MACC II requirements: the standard HDF product is converted into BUFR format for ingest by the MACC global assimilation system. The conversion code is under implementation to give ECMWF access to the BUFR files. The web page describing the SEVIRI ocean product was revised; access to data and browse imagery was added..

2.6.4.2 Task AER.4.2 Improvement to CALIOP aerosol data (CNRS-ICARE)
Activity for this task has not started yet.

2.6.4.3 Task AER.4.3 Improvement to AATSR aerosol optical depth data (FMI)
The AATSR aerosol retrieval algorithms ADV (over land) and ASV (over ocean) have been further improved and error characterization, a must for application of the data for data assimilation, has been added on a per pixel basis. This work is done in conjunction with ESA's Aerosol-cci project and the results will be applied in the MACCII algorithm which will be used for re-processing. A one-year data set has been produced and is currently under evaluation (results expected end of October 2012). This data set will be offered for testing assimilation of AATSR data in MACCII. Furthermore, FMI is looking into the use of SLSTR data, which requires algorithm development due to differences between AATSR and SLSTR, to continue the NRT data delivery when Sentinel 3 has been launched (currently planned for April 2014).

2.6.4.4 Task AER.4.4 Development and assessment of SYNAER/METOP (DLR)
At the end of MACC a major bug was detected and corrected for SYNAER/METOP. In MACC-II a correction of the surface parameterization for the significantly broader channels of AVHRR (METOP) versus AATSR (ENVISAT) was developed, tested and implemented. A one year dataset with this new algorithm version was produced and is currently under evaluation. One further cycle of algorithm improvement is foreseen until its operational implementation. In preparation of the operational implementation, also several technical improvements of the processing chain (AVHRR/METOP APOLLO cloud masks and calibration) have been implemented.

2.6.4.5 Task AER.4.5 Development of dust retrievals (10 µm AOD and altitude) from AIRS/IASI (CNRS-LMD)
IASI-retrieved monthly mean aerosol characteristics (10µm-AOD and altitude) have been extensively compared with other products from MODIS, MISR, PARASOL and AERONET for the AOD, from CALIOP for the altitude. Results from these comparisons at regional scale (20° x 20°) or at more local scale, around AERONET sites, are pretty good. The mean dust particle size has been retrieved for the IASI period (July 2007 to now) at monthly resolution. Results compare well with AERONET product, except an almost systematic bias of 0.3 µm still under investigation. Daily retrieved products are currently under validation. The 10µm-AOD and altitude are consistent with the monthly products. Comparison with MODIS daily product is still under investigation but present results are consistent. The first step of the extension in latitude of the aerosol properties retrieval, i.e., the extension of the cloud/aerosol mask flag has been completed. The next steps include: (i) check if an improvement of the channel selection is required; (ii), generate new LUTs with mid-lat atmospheric situations.

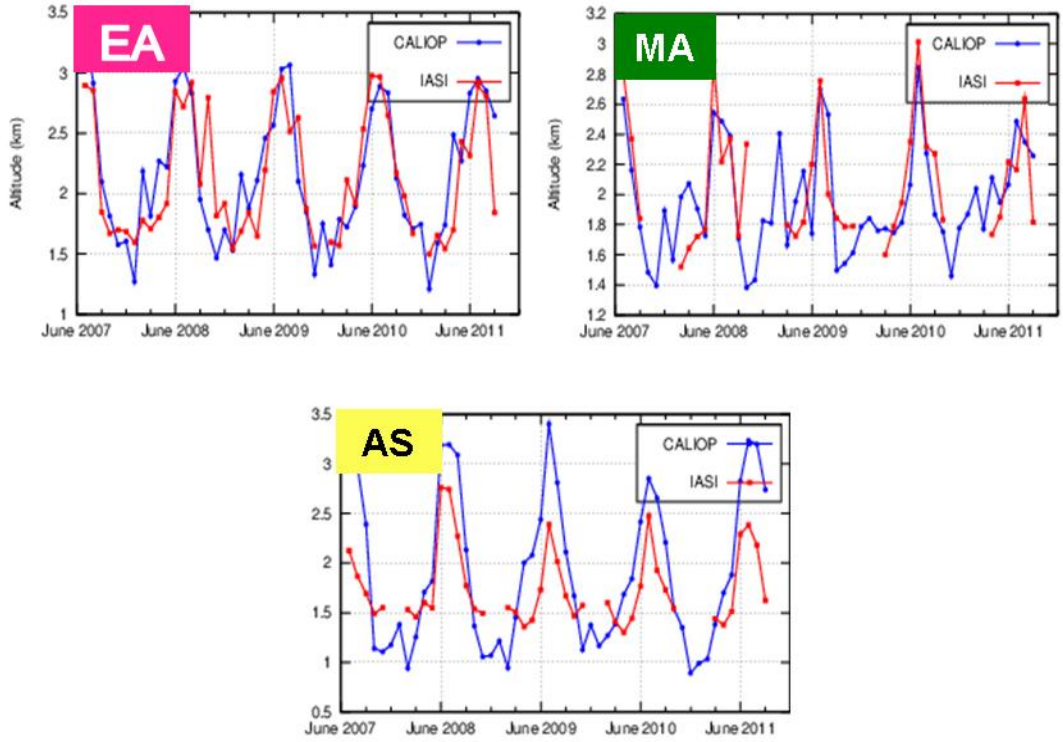

Figure AER.3: Altitude (km) time series of IASI (red) and CALIOP (blue) for the period July 2011 to December 2011 and for the regions EA (top left), MA (top right) and AS (bottom).

2.6.4.6 Task AER.4.6 Assessing suitability of satellite datasets for data assimilation (MPG)
No activity for this period.

Deviations from the project work plan and corrective actions
None.
List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title
Month 6	**D64.1**: Description document for the SEVIRI aerosol product over land
Month 12	**D64.2:** Interim validation report for AATSR aerosol product (preliminary version)
Month 12	**D64.3**: Interim assessment of AIRS/IASI latitude extended daily retrievals over land

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure
Month 12	**D64.2:** Interim validation report for AATSR aerosol product	A revised improved version will be delivered in January 2013.

2.6.5 Workpackage WP65: AER Data assimilation of satellite aerosol information (RTD)

The objectives of WP65 are to continue the development of the aerosol data assimilation system, develop an interactive bias correction system based on AERONET data, develop the data assimilation system for stratospheric aerosols and manage the transition to new satellite datasets.

2.6.5.1 Task AER.5.1 Continuing development of the aerosol data assimilation system (ECMWF)
Improvements are being made to the lidar operator for assimilation of CALIPSO data. These are aimed at making the first guess departures as unbiased as possible, for the analysis to be effective. Improvements to the dust model reported in task 2.6.2.1 are also expected to improve the performance of the lidar assimilation.

2.6.5.2 Task AER.5.2 Development of an interactive bias correction system (ECMWF)
A prototype model of improved bias correction for MODIS Aerosol Optical Depth has been developed and implemented. New bias predictors have been introduced for AOD over ocean, including surface wind speed and cloud cover. This development is currently under testing in CY38R2.

2.6.5.3 Task AER.5.3 Development and testing of a data assimilation system for stratospheric aerosols (UPMC)
Activity for this task has not started yet.

Deviations from the project work plan and corrective actions

The stratospheric aerosol model development activity, which has been delayed in MACC, has not yet caught up its delay. As a result the work on a data assimilation system for stratospheric aerosols has not started.

List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure
Month 12	**D65.1**: Prototype of more complex bias model	The new bias model has been coded up but does not behave as expected. Work will continue in January to iron this out.
Month 12	**D65.2**: Interim version of stratospheric aerosol data assimilation system	Delayed because of delay in WP62 on stratospheric aerosols

2.6.6 Workpackage WP66: AER Further development of aerosol services (RTD)

The purpose of WP66 is to develop and improve the aerosol services which are provisioned in WP67 or will be provisioned post MACC-II. This includes the development of a worldwide aerosol alert system, further development of the prototype operational aerosol monitoring system, and the aerosol source inversion system.

2.6.6.1 Task AER.6.1 Designing a prototype aerosol alert system (MET.NO, CNRS-LMD, ECMWF)
The o-suite and e-suite 3-hourly aerosol fields since 2011 from the IFS model have been extracted from the mars archive to prepare a simulation of an aerosol alert system. An aerosol alert can be triggered by absolute and relative exceedance of thresholds. To cope with variable regional levels of aerosol, a climatology of aerosol fields was constructed using the MACC reanalysis from 2003-2010. The climatology will be used to highlight exceedances of aerosol. The thresholds and visualization method are currently being tested.

2.6.6.2 Task AER.6.2 Monitoring aerosol direct radiative forcing (UKMET, MPG)
Monthly gridded datasets of fine-mode aerosol absorption have been delivered in April 2012. The datasets are derived from global distributions obtained by numerical aerosol models and corrected using ground-based measurements. The aerosol direct radiative forcing estimates now make use of the new datasets, thus improving over the continental-wide and annual prescriptions of aerosol absorption previously used. The direct radiative forcing estimates are evaluated in deliverable D66.2, to be published in the coming weeks (October 2012, Month 12).

2.6.6.3 Task AER.6.3 Monitoring aerosol indirect radiative forcing (ULEI, UKMET)

Developments are currently focusing on task AER.6.2 (direct radiative forcing) and there has been no activity in this task, as planned.

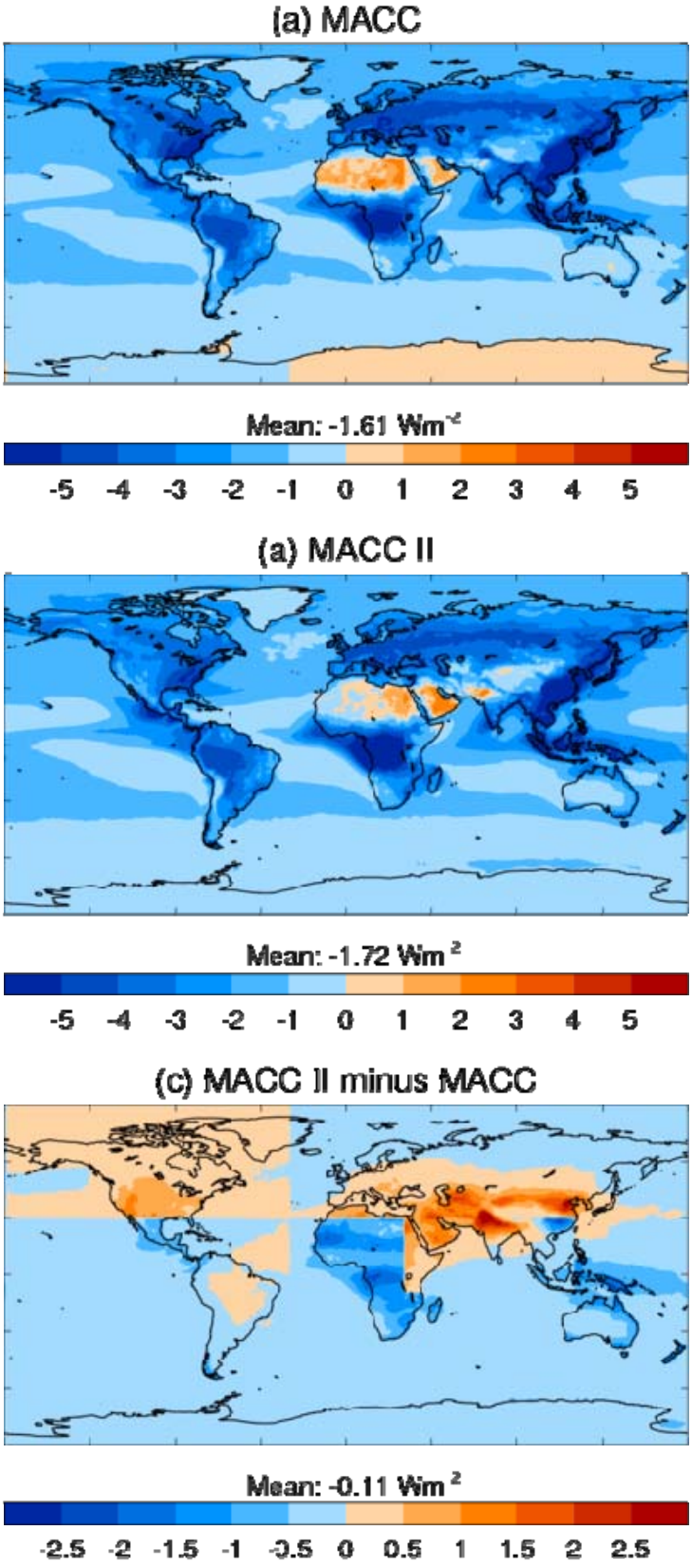

Figure AER.4: Shortwave direct radiative forcing at the top of the atmosphere in cloud-free conditions over the period 2003-2010 in (a) MACC and (b) MACC II, and (c) their difference.

2.6.6.4 Task AER.6.4 Aerosol source and sink inversion (CEA, CNRS-LMD)

The aerosol source inversion has been upgraded with a new optimised set of regions for biomass burning and fossil-fuel/industrial emissions. The timescale for the chemical conversion of SO_2 to sulphate aerosols has been modified. Error covariance matrices for the background and observations have been modified to better represent regional and global uncertainties. The new simulation shows promising results, both in terms of improving the skill scores of the model against observations, and correcting some biases in the emissions.

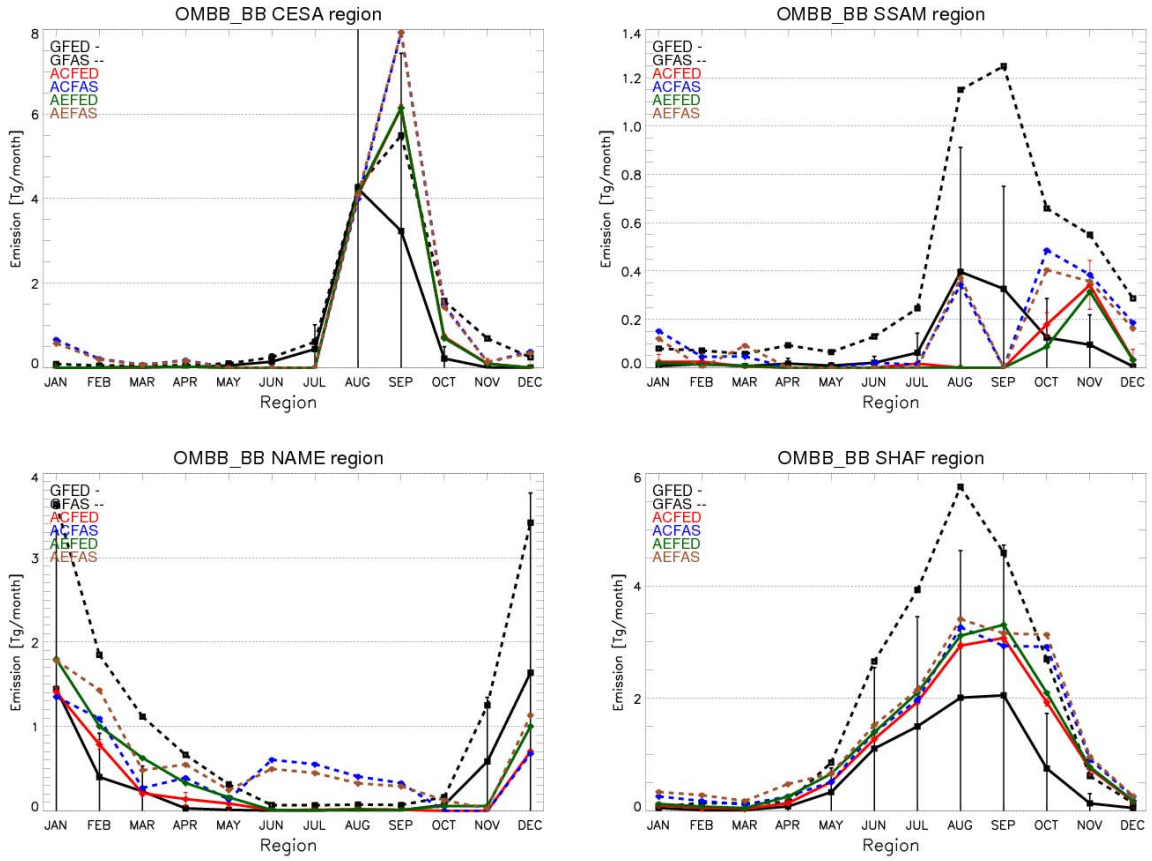

Figure AER.5: Seasonal cycle of POM emissions (Tg month^{-1}) from BB in the main four regions illustrated in Fig. 1c. A black solid line illustrates the GFED emissions whereas a black dashed line illustrates the GFAS emissions. The four possible combinations of anthropogenic and biomass burning emission inventories used in this work are included, namely ACFED (red), ACFAS (blue), AEFED (green) and AEFAS (brown). Vertical bars correspond to the uncertainties in the emissions and represent one standard deviation.

Deviations from the project work plan and corrective actions

None

List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title
Month 6	**D66.1**: Improved data-sets for the aerosol absorption for the use in direct radiative forcing simulations
Month 12	**D66.2**: Initial evaluation for the direct radiative forcing product

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure
Month 12	**D66.3:** First report on the aerosol alert system based on this IFS aerosol fields	There is some delay in the work but task is ongoing. Delivery is scheduled for March 2013.

2.6.7 Workpackage WP67: AER Provision of aerosol services (SUPP)

WP67 builds on aerosol forecast and analysis to deliver a pre-operational aerosol forcing monitoring system.

2.6.7.1 Task AER.7.1 Provision of aerosol direct radiative forcing (UKMET)
The MACC II server currently provides direct radiative forcing products for the re-analysis period (2003-2010). Products for the analysis period (2011-ongoing) will be provided by month 12 (October 2012). Processing of the MACC re-analysis period (2003-2010) using the revised aerosol absorption dataset has been completed, but publication of an improved product will not happen until the end of the project, as planned.

2.6.7.2 Task AER.7.2 Provision of aerosol indirect radiative forcing (ULEI, UKMET)
The MACC II server currently provides indirect radiative forcing products for the re-analysis period (2003-2010). Products for the analysis period (2011-ongoing) will be provided by month 12 (October 2012).

Deviations from the project work plan and corrective actions
None

List of accomplished deliverables and milestones

Due Date	Deliverable or Milestone title
Month 4	**D67.1**: 3-monthly aerosol direct forcing product (period Jan 2011-Sep 2012 published in bulk on month 12)
Month 4	**D67.2**: 3-monthly aerosol indirect forcing product (period Jan 2011-Sep 2012 published in bulk on month 12)

List of deliverables and milestones not accomplished

Due Date	Deliverable or Milestone title	Reason for delay or failure

References

Bellouin, N., Quaas, J., Morcrette, J.-J., and Boucher, O.: Estimates of aerosol radiative forcing from the MACC re-analysis, *Atmos. Chem. Phys. Discuss*., 12, 20073-20111, doi:10.5194/acpd-12-20073-2012, 2012.

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