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

2015 (01 January 2015 - 30 June 2015)

Project Title:

Improve estimates of global and regional CH_4 and N_2O emissions based on inverse modelling using in-situ and satellite measurements

Computer Project Account:

spjrc4dv

Principal Investigator(s):

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Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Dr. Anna Agusti-Panareda (in the framework of the MACC-III project)

Start date of the project:

01 January 2015

Expected end date:

31 December 2017

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)			400000	200325 (25 June 2015)
Data storage capacity	(Gbytes)			400	

Summary of project objectives
(10 lines max)

(1) Improve estimates of global CH_4 emissions using new satellite retrievals

(2) Improve estimates of European CH_4 and N_2O emissions using in-situ observations

(3) Improve TM5-4DVAR inverse modelling system

Summary of problems encountered (if any)
(20 lines max)

no major problems

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

Improve estimates of global CH_4 emissions using new satellite retrievals

Global CH_4 flux inversions (until 06/2014) have been provided for MACC-III ("Monitoring Atmospheric Composition and Climate (Phase 3) ") (http://www.gmes-atmosphere.eu/), the pre-operational Copernicus Atmosphere service:
http://www.gmes-atmosphere.eu/d/services/gac/delayed/ch4_flux_inversions/

The satellite observation interface of the TM5-4DVAR inverse modelling system has been further extended to allow the use of improved XCH_4 products developed within the ESA-GHG cci - second phase project (http://www.esa-ghg-cci.org/). First global CH_4 flux inversions have been started using three different XCH_4 GOSAT products of the ESA-GHG cci Climate Research Data Package 2 (CRDP2) [Chevalier et al., 2015].

Furthermore, the development of a Monte-Carlo technique has been started to allow uncertainty estimates also for non-linear optimization.

Improve estimates of European CH_4 and N_2O emissions using in-situ observations

European CH_4 and N_2O inversions for the period 2006-2012 have been performed within the InGOS ("Integrated non-CO_2 greenhouse gas Observing Systems") project, using the improved, harmonized InGOS dataset of European CH_4 and N_2O in-situ measurements ('2014 INGOS data release'). The JRC CH_4 and N_2O inversions, based on the TM5-4DVAR inverse modelling system, are currently further analyzed and compared with the inversions from 4 other groups / models (in the framework of the InGOS inverse modelling work package, coordinated by JRC).

Furthermore, a comprehensive validation of the TM5 model has been performed (1) comparing the boundary layer height in TM5 with observations from the NOAA Integrated Global Radiosonde Archive (IGRA) radiosondes, and (2) using ^{222}Rn simulations using a novel detailed ^{222}Rn emission inventory over Europe (developed within InGOS). A scientific paper on the model validation is currently in preparation.

Improve TM5-4DVAR inverse modelling system

Significant progress has been made with the further development of the new modular TM5-pyshell version. It has been verified that the new TM5-pyshell version is reproducing the results of the previous JRC TM5-4DVAR version ('T38') within the statistical uncertainties inherent to the different implementations of the optimizer. An important new development implemented in the TM5-pyshell is the option to use 3-hourly interpolated meteorological fields from the ECMWF (re-)analyses (instead of 6-hourly fields used so far).

List of publications/reports from the project with complete references

Alexe, M., P. Bergamaschi, A. Segers, R. Detmers, A. Butz, O. Hasekamp, S. Guerlet, R. Parker, H. Boesch, C. Frankenberg, R. A. Scheepmaker, E. Dlugokencky, C. Sweeney, S. C. Wofsy and E. A. Kort, Inverse modeling of CH_4 emissions for 2010–2011 using different satellite retrieval products from GOSAT and SCIAMACHY, Atmos. Chem. Phys., 15, 113-133, 2015.

Bergamaschi, P., M. Corazza, U. Karstens, M. Athanassiadou, R. L. Thompson, I. Pison, A. J. Manning, P. Bousquet, A. Segers, A. T. Vermeulen, G. Janssens-Maenhout, M. Schmidt, M. Ramonet, F. Meinhardt, T. Aalto, L. Haszpra, J. Moncrieff, M. E. Popa, D. Lowry, M. Steinbacher, A. Jordan, S. O'Doherty, S. Piacentino and E. Dlugokencky, Top-down estimates of European CH_4 and N_2O emissions based on four different inverse models, Atmos. Chem. Phys., 15, 715-736, 2015.

Chevallier, F., P. Bergamaschi, D.Brunner, S.Gonzi, S.Houweling, T.Kaminski, G.Kuhlmann, T.T. van Leeuwen, J.Marshall, P.I. Palmer, and M.Scholze, Climate Assessment Report for the GHG-CCI project of ESA's Climate Change Initiative, pp. 87, version 2, 22 April 2015, 2015. http://www.esa-ghg-cci.org/?q=node/95

Summary of plans for the continuation of the project

(10 lines max)

Further update global CH_4 flux inversions for ongoing model comparisons within the ESA-GHG cci project. Comprehensive validation of model results, including the stratosphere (using e.g. stratospheric air core data).

Further analyse impact of (1) time resolution of meteorological fields, (2) choice of daily assimilation time window, and (3) parameterisation of convection on European and global flux inversion. Evaluate performance of various TM5-4DVAR sensitivity inversions against regular European aircraft profiles.

Continue development of Monte-Carlo technique for uncertainty estimates. Explore feasibility of alternative method for uncertainty estimates based on approximation of Hessian matrix.