

SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

Project Title:	”Investigation of aerosol feedbacks on decadal timescales”
Computer Project Account:	spnlwill
Start Year - End Year :	2010 - 2014
Principal Investigator(s)	Dr J. E. Williams
Affiliation/Address:	KNMI
Other Researchers (Name/Affiliation):	N/A

The following should cover the entire project duration.

Summary of project objectives

(10 lines max)

To investigate the effects of heterogeneous uptake and changes in photolytic activity over the period 2000-2009. This will be performed using the recently developed modified CB05 chemical mechanism and the CTM driven by the ERA-interim re-analysis. TM5 has the ability to include variations in the Aerosol Optical Depth due to variability in the aerosol distributions into the calculation of the photolysis rates for trace species such as tropospheric ozone. Therefore another project aim is to investigate the impact of such physical processes on the composition of the troposphere.

Summary of problems encountered

Migration of the code to C2a during the course of this three year special project caused delays due to issues with the netCDF libraries and issue related to memory paging when allocated a shared node which resulted in the model behaving abnormally and been stopped by the operators. The netCDF issue was fixed with the help of user support.

Experience with the Special Project framework

In general the reporting was not too heavy, although requirements of details within the report should be related to the size of the project. There is a stipulation that projects > 500 KSBUs have to have a more rigorous discussion for being accepted and this should also be reflected in the reporting procedure.

Summary of main results

During this study a number of significant modelling steps were performed, which has fed directly into the MACCII and MACCIII projects via the development of the C-IFS. A new chemical mechanism developed for inclusion in aerosol studies (Williams et al, 2013) and tested in TM5 using specially developed emission inventories based on the MACC emissions included the nesting of an alternative emission inventory for Asia (REASv2.0; Kurokawa et al, 2013), available from 2000-2011. This was then adopted in the C-IFS and is used for the production of atmospheric composition datasets at ECMWF. Two sets of decadal runs were performed with an emphasis on biogenic pre-cursor emissions and their impact on dominant trace gas species, notably the governing factors controlling the distribution of CO and HCHO in the Southern Hemisphere. The results were also utilised by interns for studies related to CH₄ and deposition. These results were also involved in a multi-model intercomparison study with 3 other major atmospheric composition models across different international institutions. Modifications were made to the optical properties of the cloud droplets and aerosols in TM5 in order to improve on tropospheric J values. The instantaneous profiles output for CO were also used as a-priori distributions in the re-processing of the SCIAMACHY CO record between 2003-2012.

List of publications/reports from the project with complete references

- (i) Quantifying the uncertainty in simulating global tropospheric composition due to the variability in global emission estimates of Biogenic Volatile Organic Compound, **J. E. Williams**, P. F. J. van Velthoven, and C. A. M. Brenninkmeijer, *Atmos. Chem. Phys.*, 13, 2857-2891, 2013.
- (ii) The impact of the chemical production of methyl nitrate from the $\text{NO} + \text{CH}_3\text{O}_2$ reaction on the global distributions of alkyl nitrates, nitrogen oxides and tropospheric ozone: a global modelling study, **J. E. Williams**, G. Le Bras, A. Kukai, H. Ziereis and C. A. M. Brenninkmeijer, *Atmos. Chem. Phys.*, 14, 2363-2382, 2014.
- (iii) Seasonal changes in the tropospheric carbon monoxide profile over the remote Southern Hemisphere evaluated using multi-model simulations and aircraft observations, J. A. Fisher, S. R. Wilson, G. Zeng, **J. E. Williams**, L K Emmons, R. L. Langenfelds, P B. Krummel and L P Steele, *Atmos. Chem. Phys.*, 15, 3217-3239, 2015.
- (iv) Multi-model simulation of CO and HCHO in the Southern Hemisphere: biogenic emissions and model uncertainties, G. Zeng, **J. E. Williams**, J. A. Fisher, L. K. Emmons, N. B. Jones, O. Morgenstern, J. Robinson, D. Smale, C. Paton-Walsh, and D. W. T. Griffith, *Atmos. Chem. Phys. Discuss.*, 15, 2615-2678, 2015.

Future plans

The work performed in this special project will be used in future EC Earth runs concerning the impact of projected anthropogenic emission changes on air quality and climate.