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Atmospheric Chemistry and Physics Discussions

Interactive comment on "WRF-chem model predictions of the regional impacts of N_2O_5 heterogeneous processes on nighttime chemistry over north-western Europe" *by* D. Lowe et al.

Anonymous Referee #1

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General comments

The authors applied a new version of the WRF-Chem model over the North-Western Europe, simulated air quality for July 10-30, 2010, and compared model predictions to observed data obtained from the Role Of Nighttime chemistry in controlling the Oxidising Capacity Of the atmosphere project. They evaluated the current understanding of atmospheric processes affecting NO3 and its impact on nighttime chemistry. They also examined the importance of N2O5 heterogeneous chemistry on model predictions by analyzing model sensitivity results.

Specific comments

Page 20894, lines 24-26 A reference is helpful to support the use of a constant oceanic DMS concentration of 2 nM/L.

Page 20903, lines 24-26 Most air quality models employ 90% of NOx as NO and 10% of NOx as NO2 or something similar. NO2 fraction in new vehicle emissions is even greater. Is there any specific reason for using the entire NOx as NO?

Page 20905, the last paragraph It is not clear how the low sulphate content of the PM1 aerosol in the model leads to higher PM1 chloride content. Please elaborate briefly.

Section 3.4 A figure presenting reaction probability will be helpful to readers.

Section 3.5 The authors suggest that the daytime nitrate production is the main reason for over-predicting PM1 nitrate and HNO3 compared measurements. It will be helpful to readers to specify the rate constant used for the NO2+OH reaction.

Section 3.5 How is the partitioning of nitrate between gas and aerosol phases accounted for in the model?

Page 20909 (lines 22-25) Table 3 suggests that the full inorganic N2O5 heterogeneous chemistry following Bertram and Thornton is employed for “het on” case while the “no cl pathway” case employs the inorganic N2O5 heterogeneous chemistry without the ClNO2 production. If the “het on” case includes ClNO2 production, then it should produce lower HNO3/NO3- prediction compared to that of “no cl case (since a fraction of the reaction produces ClNO2). However, the authors state that “het on” produces more HNO3 than the “no cl pathway” case which is contrary to the findings reported by Sarwar et al. (2012, ACP). Some discussions are needed.

Page 20910, lines 7-9 The following sentence is not clear: In all model scenarios, however, the potential PM10 nitrate (HNO3 plus PM10 nitrate) is lower than the summed CIMS+AMS potential PM1 nitrate (not shown).

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Figure 12 Panels A and B show the incremental change in the domain mean total nitrate. However, it is not clear how the incremental change was calculated. Which height is shown in the figure?

Technical corrections:

Page 20890, lines 11-12 The sentence starting with “Under this formulation . . .” appears to be incomplete.

Page 20893, equation (7) CN2O5 in equation (7) is not defined.

Page 20901, line 25 The sentence appears to contain an extra parenthesis following [NO2].

Page 20902, line 13 Please check the subscript of N2O5.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 20883, 2014.