

Interactive comment on “WRF-chem model predictions of the regional impacts of N₂O₅ 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.

C7196

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 NO_x as NO and 10% of NO_x as NO₂ or something similar. NO₂ fraction in new vehicle emissions is even greater. Is there any specific reason for using the entire NO_x 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) CN_2O_5 in equation (7) is not defined.

Page 20901, line 25 The sentence appears to contain an extra parenthesis following $[\text{NO}_2]$.

Page 20902, line 13 Please check the subscript of N_2O_5 .

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