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Interactive comment on "Nitrate formation from heterogeneous uptake of dinitrogen pentoxide during a severe winter haze in southern China" *by* Hui Yun et al.

Anonymous Referee #1

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The manuscript of Yun et al., reported half month measurement of N2O5, ClNO2 and other relative parameters during heavy haze episodes in Pearl River Delta (PRD) of southern China. The N2O5 uptake coefficient and ClNO2 yield were determined from the observations. The study showed the observation evidence of the enhancement of particulate nitrate in the first several hours can be fully explained by the N2O5 heterogeneous hydrolysis and even comparable with the nitric acid formed by OH+NO2 during daytime. Overall, the paper contributes to the knowledge of N2O5 heterogeneous chemistry and highlight the heterogeneous reactions in the formation of particulate nitrate in southern China. The following comments should be addressed before publishing on ACP.

Major comments: The steady state assumption to derive the N2O5 uptake coefficient needs to be verified by model simulations under the observed conditions (with input from NO, NO2, O3, VOCs). It is useful to try other method (e.g. Brown et al., 2006) to derive N2O5 uptake coefficient. Brown, S. S., Ryerson, T. B., Wollny, A. G., Brock, C. A., Peltier, R., Sullivan, A. P., Weber, R. J., Dube, W. P., Trainer, M., Meagher, J. F., Fehsenfeld, F. C., and Ravishankara, A. R.: Variability in nocturnal nitrogen oxide processing and its role in regional air quality, Science, 311, 67-70, DOI 10.1126/science.1120120, 2006.

The uncertainty of the measured N2O5, NMHC and Sa and the overall uncertainty propagated to N2O5 uptake coefficient and ClNO2 yield should be carefully evaluated and discussed. As the hygroscopic growth factor is hard to quantify for RH over 90%, the derived N2O5 uptake coefficient for those conditions may subject with larger uncertainties compared with other RH cases. This is an interesting point to be discussed.

The relationship between N2O5 uptake coefficient, ClNO2 yield and the chemical properties of particles or the meteorological data (such as RH) should be investigated, especially in the part of text around Line 572 (table 1), the reason of the high gamma value in the Jan.3 17:40-20:50 should be addressed as which was much higher than other derived value.

Minor comments: The description of the experimental setup of the key relevant parameters needs to be strengthened, e.g. the limit of detection, the measurement uncertainties and measurement principle should be described.

Line 161. The reference of Yue et al., 2015 may not appropriate and suggests replacing by Dong et al., 2012 Dong, H. B., Zeng, L. M., Hu, M., Wu, Y. S., Zhang, Y. H., Slanina, J., Zheng, M., Wang, Z. F., and Jansen, R.: Technical Note: The application of an improved gas and aerosol collector for ambient air pollutants in China, Atmos Chem Phys, 12, 10519-10533, 10.5194/acp-12-10519-2012, 2012.

Line 586 (figure 2) please check the data of wind speed, as the WS keep below 3 m

s-1 during the whole half month. And the plot style of NOy made the concentration of NO2 hard to follow. The left y-axis of fourth panel should change to PM2.5 or other more appropriate name.

The legend of the early night and later night in figure 6 and 7 should be explained. By the way, how about the NO3- formation potential intercomparison in the day and night of Jan 9 to 10.

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