Heterogeneous reactions of SO_2 and NO_2 with mineral dust affects the formation of nitrate and sulfate, and also impacts physicochemical properties of aerosol particles. Despite a number of studies carried out in the last 20 years, kinetics parameters have not been well constrained yet, especially under illuminated conditions. Yu and Jang carried out systematical laboratory work using an outdoor chamber, and developed a numerical model to describe these processes. The laboratory and modeling work is well done, and the manuscript is well written. I would like to recommend it for final publication after the following comments are adequately addressed.

Scientifical comments:

Page 11, line 1-2: why does DGG show higher photo-activation ability than ATD? Can this be explained by measured mineralogical components for these two types of dust?

Page 11, line 21-22: Why does GDD have higher buffering capacity than ATD? Is it related their carbonate contents? I would suggest the authors measure the carbonate (and iron oxides) contents for these two types of mineral dust.

Technical comments:

Uptake coefficients have been widely used to describe the rates of heterogeneous reactions of mineral dust. Can the author derive uptake coefficients for their experiments under different conditions and then compared these values with those reported in previous studies?

Page 2, line 11: Two important reviews papers on heterogeneous chemistry of mineral dust (Crowley et al., 2010; Tang et al., 2017) should be cited here.

Page 3, line 1 and line 8 (as well as a few other places in the manuscript): please change “tracers” to “trace gases”.

References:

Crowley, J. N., Ammann, M., Cox, R. A., Hynes, R. G., Jenkin, M. E., Mellouki, A., Rossi, M. J., Troe, J., and Wallington, T. J.: Evaluated Kinetic and Photochemical Data for Atmospheric Chemistry: Volume V - Heterogeneous Reactions on Solid Substrates, Atmos. Chem. Phys., 10, 9059-9223, 2010.

Tang, M. J., Huang, X., Lu, K. D., Ge, M. F., Li, Y. J., Cheng, P., Zhu, T., Ding, A. J., Zhang, Y. H., Gligorovski, S., Song, W., Ding, X., Bi, X. H., and Wang, X. M.: Heterogeneous

reactions of mineral dust aerosol: implications for tropospheric oxidation capacity, Atmos. Chem. Phys., 17, 11727-11777, 2017.