Geophysical Research Abstracts
Vol. 21, EGU2019-7365, 2019
EGU General Assembly 2019

Reactive nitrogen chemistry remains the most possible sulfate production pathway during extreme winter hazes in Beijing

Guangjie Zheng (1,2), Hang Su (1), Ulrich Pöschl (1), and Yafang Cheng (1)

(1) Multiphase Chemistry Department, Max Planck Institute for Chemistry, Mainz 55128, Germany, (2) Center for Aerosol Science & Engineering, Department of Energy, Environmental & Chemical Engineering, Washington University in St. Louis, St. Louis, Missouri 63130, USA

With fine-particle concentration reaching up to 1 mg m^{-3}, the extreme winter haze events threaten the health of more than 400 million people in the North China Plain. Sulfate is a major component of fine haze particles, while current air quality models cannot reproduce its high levels, mainly due to the missing atmospheric oxidants with weakened photochemistry (Zheng et al., 2015). Our previous studies show that reactive nitrogen chemistry in aerosol water, whose oxidation capacity comes from direct emissions rather than photochemistry, can explain sulfate production during the extreme haze formation in China (Cheng et al., 2016). Recently, this explanation has been under debate with the emergence of both supporting and opposing new evidences. Major opposing arguments include: (1) aerosol acidity should be higher than that required for reactive nitrogen chemistry to play a significant role; and (2) importance of some other mechanisms, like the H_2O_2 oxidation and HCHO related pathways, can be underestimated during the severe hazes. In this study, we clarify that the reactive nitrogen chemistry is aimed to explain the extreme winter haze events with fine particulate ($PM_{2.5}$) mass concentration larger than ~200-300 μg m^{-3}. The opposing arguments are mostly based on measurement of haze episodes which are less severe and thus lacking one or more key features of the extreme cases. With supporting evidences from isotopes and H_2O_2 measurement, we show that reactive nitrogen chemistry remains the most possible sulfate production pathway during the extreme haze conditions.

References

Cheng, Y., Zheng, G., Wei, C., Mu, Q., Zheng, B., Wang, Z., Gao, M., Zhang, Q., He, K., Carmichael, G., Pöschl, U., and Su, H.: Reactive nitrogen chemistry in aerosol water as a source of sulfate during haze events in China, Science Advances, 2, 10.1126/sciadv.1601530, 2016.

Zheng, G. J., Duan, F. K., Su, H., Ma, Y. L., Cheng, Y., Zheng, B., Zhang, Q., Huang, T., Kimoto, T., Chang, D., Pöschl, U., Cheng, Y. F., and He, K. B.: Exploring the severe winter haze in Beijing: the impact of synoptic weather, regional transport and heterogeneous reactions, Atmos. Chem. Phys., 15, 2969-2983, 10.5194/acp-15-2969-2015, 2015.