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# Inter-annual variations of wet deposition in Beijing from 2014–2017: implications of below-cloud scavenging of inorganic aerosols

**Baozhu Ge et al.**

*Correspondence to:* Baozhu Ge (gebz@mail.iap.ac.cn) and Zifa Wang (zifawang@mail.iap.ac.cn)

Table S1. Yearly average VWA concentration of major ions in precipitation from 1995 to 2017 in Beijing. Unit: ions (μeq/L) and rainfall (mm)

| Year | $NO_3^-$ | $NH_4^+$ | $SO_4^{2-}$ | $Ca^{2+}$ | Rainfall | References |
|---|---|---|---|---|---|---|
| 1995-1998 | 54.5 | 135.1 | 359.0 | 464.0 | 609 | Yang et al. (2012) |
| 2001-2005 | 105.9 | 236.0 | 314.1 | 209.0 | 441 | Yang et al. (2012) |
| 2007-2010 | 111.1 | 237.3 | 234.9 | | 572 | Pan et al. (2012; 2013) |
| 2010 | 142.5 | 339.9 | 246.3 | | 438 | Pan et al. (2012; 2013) |
| 2014 | 102.2 | 262.9 | 173.7 | 72.3 | 460 | This study |
| 2015 | 84.4 | 220.4 | 132.2 | 74.8 | 452 | This study |
| 2016 | 90.0 | 215.4 | 127.4 | 82.6 | 670 | This study |
| 2017 | 89.9 | 198.3 | 105.9 | 47.2 | 569 | This study |

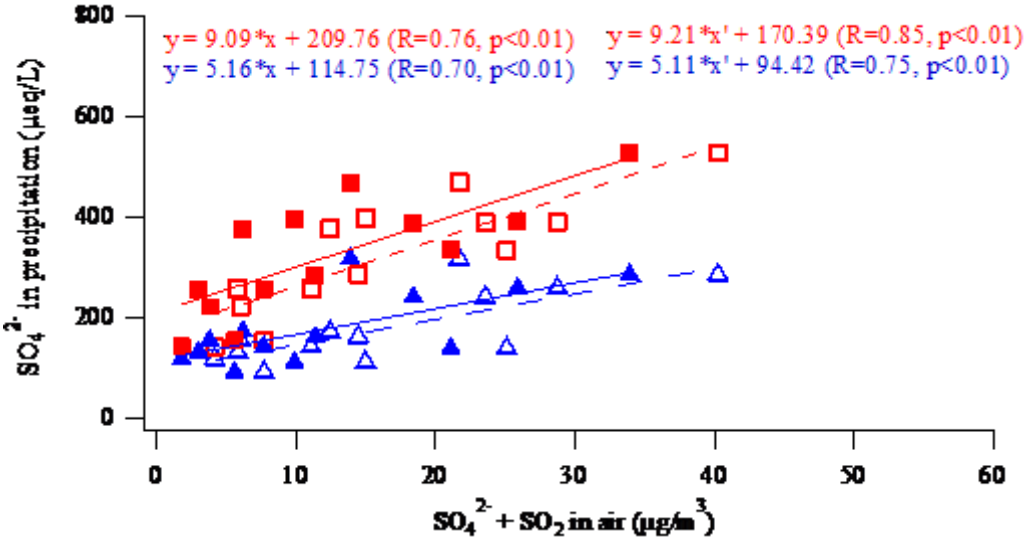


Figure S1. Relationships between the concentration of $SO_4^{2-}$ in precipitation and in air in the 6 h before each precipitation event. The solid (hollow) red square and blue triangle represented the relationships between the $SO_4^{2-}$ concentration ($SO_4^{2-}$+$SO_2$) in air with that in F1# and in VWA, respectively. The solid and hollow lines represented linear regression line of $SO_4^{2-}$ in precipitation and in air as well as that of $SO_4^{2-}$ in precipitation and $SO_4^{2-}$+$SO_2$ in air.

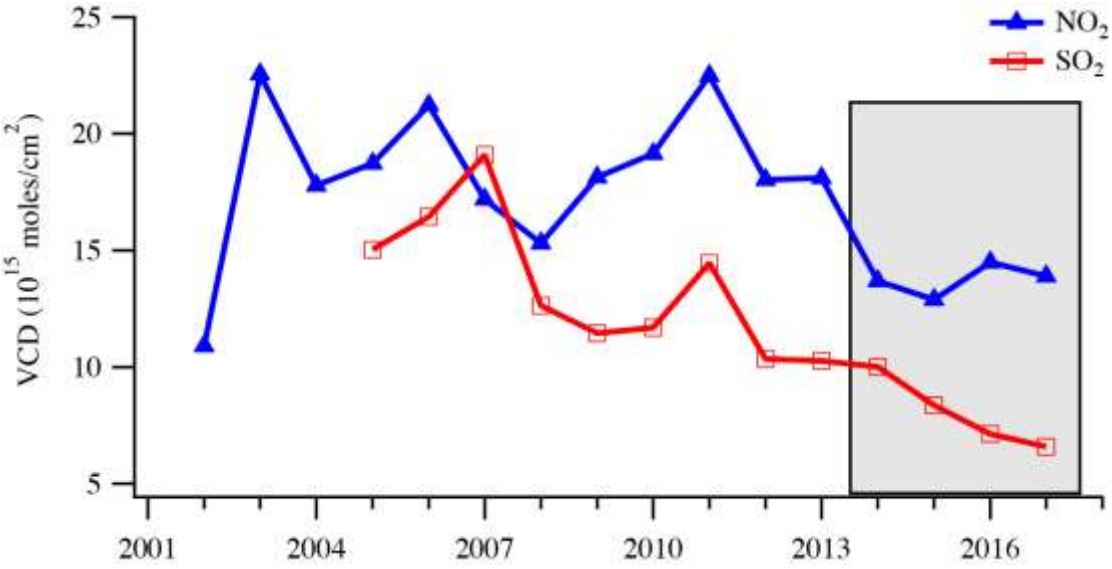


Figure S2. Long-term trend of the $SO_2$ and $NO_2$ VCD in Beijing from satellite observation, the shaded box area is the measurement period of fractional sampling in this study.

Detailed description on OMI $SO_2$ and $NO_2$ VCD data: The level 3 product of the ozone monitoring instrument (OMI) satellite data were used in this study. The OMI instrument, which is board on the Aura satellite, can measures the solar radiation backscattered by the atmosphere and surface in the Earth (Torres et al., 2002). The data is stored in the HDF-EOS format with a resolution of 0.25×0.25, which covers the total vertical

column density for $SO_2$ and $NO_2$, the standard errors, cloud information, data quality flags, and the latitude/longitude information. The OMI VCD $SO_2$ and $NO_2$ data were derived by the algorithm of a principal component analysis (Li et al., 2013), and were widely used in local regions such as Henan province (Zhang et al. 2017) and the major cities (including Beijing) in China (Tang et al. 2019). There are almost 25 pixels covering the whole domain of Beijing. To compare with the yearly trends of sulfur and nitrogen in precipitation, the vertical column density data observed from the space is better than that only observed at the surface layer.

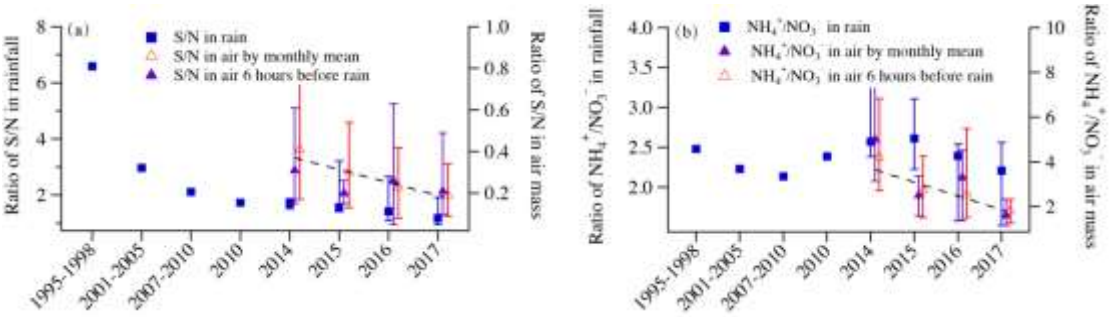


Figure S3. Annual variations in the ratio of sulfate to nitrate (a) and ammonium to nitrate (b) in aerosols and in precipitation. The ratios for aerosols are annual averaged concentration ± σ/3 in the 6 hours before rainfall events.

Reference:


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