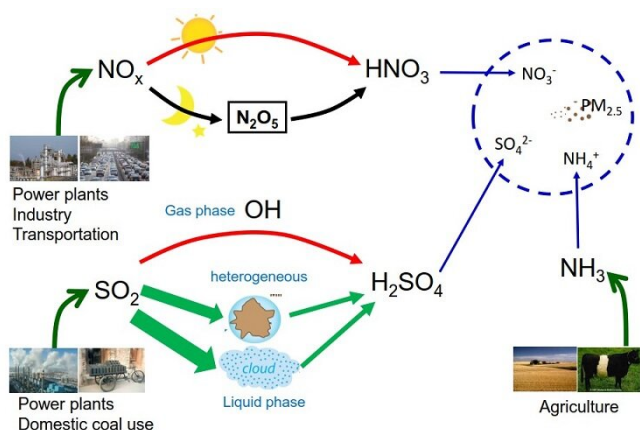


Reducing sulfur dioxide emissions alone cannot substantially decrease air pollution

13 April 2020



Chemical cycle of SO₂, NO_x, and NH₃ in the atmosphere.

High loadings of fine particulate matter (PM_{2.5}) during haze are mostly produced from the chemical reactions of reactive gas precursors, including sulfur dioxide (SO₂), nitrogen oxides (NO_x), ammonia (NH₃), and volatile organic compounds. In an ideal world, air pollution would be cured by wiping clean any one of these four PM_{2.5} precursors. However, in the real world, we have to go step by step, considering the technological conditions and the economic costs in the emission control strategies.

These gases are subject to a certain thermodynamic equilibrium in the atmosphere. Theoretically, NH₃ prefers to combine with SO₂ ([sulfuric acid](#)) to form [ammonium sulfate](#), which is stable in the atmosphere. Excessive NH₃ will react with [nitrogen dioxide](#) (nitric acid) to form ammonium nitrate, which is unstable, and the formation of which is influenced by the relative abundance of NH₃ and nitrogen dioxide. Consequently, a decrease in SO₂ emissions leaves more NH₃ to form ammonium nitrate, and it may also perturb the balance between NH₃ and

nitrogen dioxide.

Due to the delivery of the Air Pollution Control Action Plan, SO₂ emissions have declined dramatically since 2013. It also offers us an opportunity to examine whether a reduction in SO₂ will perturb the balance between NH₃ and nitrogen dioxide in forming [ammonium nitrate](#), and to decide how to make emission control strategies in the future.

Professor Xingying Zhang from the National Satellite Meteorological Center and his coauthors have addressed this issue. They evaluated and compared the behavior of PM_{2.5} with respect to NO_x and NH₃ emission changes in high (2013) and low (2018) SO₂ emission cases.

Prof. Zhang's group has found that, from 2013 to 2018, due to the changes in precursor emissions, the simulated annual mean PM_{2.5} concentration decreased by nearly 20%, more than half of which was driven by reduced SO₂ emissions. "To evaluate the influence of a reduction in SO₂ emissions on the sensitivity of PM_{2.5} to NO_x and NH₃ emissions, we conducted model sensitivity studies by separately perturbing NO_x and NH₃ emissions by 25%. Then, we calculated the relative reduction of PM_{2.5} concentration caused by a 1% decrease in NO_x and NH₃ emissions," explains Professor Zhang.

According to the study of Prof. Zhang, it can be concluded that, due to the reduced emissions of SO₂, and considering the high level of NH₃ emissions in China, nitrogen dioxide emissions control is more effective in reducing the surface PM_{2.5} concentration in China. This paper has been published in *Atmospheric and Oceanic Science Letters*.

More information: Guangyi XU et al, Changes in PM_{2.5} sensitivity to NO_x and NH₃ emissions due to a large decrease in SO₂ emissions from 2013 to

2018, *Atmospheric and Oceanic Science Letters*
(2020). DOI: [10.1080/16742834.2020.1738009](https://doi.org/10.1080/16742834.2020.1738009)

Provided by Chinese Academy of Sciences

APA citation: Reducing sulfur dioxide emissions alone cannot substantially decrease air pollution (2020, April 13) retrieved 23 September 2021 from <https://phys.org/news/2020-04-sulfur-dioxide-emissions-substantially-decrease.html>

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