Heterogeneous Chemistry of Sulfur Dioxide in the Atmosphere

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Sulfur dioxide (SO_2) is a major pollutant from human activities and the oxidation of sulfur dioxide leads to acid rain and particulate sulfate. While acid rain formation has been well studied for decades, the mechanisms of particulate sulfate formation are poorly understood, leading to errors in predicting particulate matter formation. In this work, we investigate the rates and mechanisms of SO_2 oxidation in the gas phase and in submicron particles. Experiments were conducted in bulk solution and in environmental simulation reactors. We show that the main sinks of SO_2 are reactions with organic peroxides and dissolved ozone in aqueous particles, accounting for over 90% of the SO_2 sinks at atmospherically relevant humidities. Organosulfates were detected and identified using electrospray ionization-ion mobility time of flight mass spectrometer (ESI-IMS-TOF) and we propose mechanisms for their formation. Our results demonstrate the synergistic effects between organic aerosol formation and SO_2 oxidation through and illustrate the importance of considering the chemistry of organic and sulfur-containing compounds holistically to properly account for their reactive sinks.

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EARTH SYSTEM SCIENCE PROGRAMME

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