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Heterogeneous hydroxymethanesulfonate (HMS) chemistry in northern China winter haze

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Chemical mechanisms responsible for rapid sulfate production, an important driver of winter haze formation in northern China, remain unclear. We propose a potentially important heterogeneous hydroxymethanesulfonate (HMS) chemical mechanism. Through analyzing field measurements with aerosol mass spectrometry, we show evidence for a possible significant existence in haze aerosols of organosulfur primarily as HMS, misidentified as sulfate in previous observations. We estimate that HMS can account for up to about one-third of the sulfate concentrations unexplained by current air quality models. In addition, HMS in the presence of hydroxyl radicals can trigger rapid sulfate production in aerosol water. Heterogeneous production of HMS by SO_2 and formaldehyde is favored under northern China winter haze conditions due to high aerosol water content, moderately acidic pH values, high gaseous precursor levels, and low temperature. These analyses identify an unappreciated importance of formaldehyde in secondary aerosol formation and calls for more research on sources and on the chemistry of formaldehyde in northern China winter.