



Silicon chemistry in the mesosphere and lower thermosphere

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Silicon is one of the most abundant elements in cosmic dust, and meteoric ablation injects a significant amount of Si into the atmosphere above 80 km. In this study, a new model for silicon chemistry in the mesosphere/lower thermosphere is described, based on recent laboratory kinetic studies of Si, SiO, SiO₂ and Si⁺. Electronic structure calculations and statistical rate theory are used to show that the likely fate of SiO₂ is a 2-step hydration to silicylic acid (Si(OH)₄), which then polymerizes with metal oxides and hydroxides to form meteoric smoke particles. This chemistry is then incorporated into a whole atmosphere chemistry-climate model. The vertical profiles of Si⁺ and the Si⁺/Fe⁺ ratio are shown to be in good agreement with rocket-borne mass spectrometric measurements between 90 and 110 km. Si⁺ has consistently been observed to be the major meteoric ion around 110 km; this implies that the relative injection rate of Si from meteoric ablation, compared to metals such as Fe and Mg, is significantly larger than expected based on their relative chondritic abundances. Finally, the global abundances of SiO and Si(OH)₄ show clear evidence of the seasonal meteoric input function, which is much less pronounced in the case of other meteoric species.