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The uptake of SO_2 on Saharan dust: a flow tube study

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Abstract. The uptake of SO_2 onto Saharan mineral dust from the Cape Verde Islands was investigated using a coated wall flow tube coupled to a mass spectrometer. The rate of loss of SO_2 to the dust coating was measured and uptake coefficients were determined using the measured BET surface area of the sample. The uptake of SO_2, with an initial concentration between (2-40)x10^{10}molecule cm^{-3} (0.62-12 µTorr), was found to be strongly time dependent over the first few hundred seconds of an experiment, with an initial uptake $\gamma_{0,BET}$ of (6.6±0.8)x10^{-5} (298 K), declining at longer times. The amount of SO_2 adsorbed on the dust samples was measured over a range of SO_2 concentrations and mineral dust loadings. The uptake of SO_2 was found to be up to 98% irreversible over the timescale of these investigations. Experiments were also performed at 258 K, at a relative humidity of 27% and at 298 K in the presence of ozone. The initial uptake and the amount of SO_2 taken up per unit area of BET dust surface was the same within error, irrespective of the conditions used; however the presence of ozone reduced the amount of SO_2 released back into the gas-phase per unit area once exposure of the surface ended. Multiple uptakes to the same surface revealed a loss of surface reactivity, which did not return if the samples were exposed to gas-phase water, or left under vacuum overnight. A mechanism which accounts for the observed uptake behaviour is proposed and numerically modelled, allowing quantitative estimates of the rate and amount of SO_2 removal in the atmosphere to be estimated. Removal of SO_2 by mineral dust is predicted to be significant at high dust loadings.

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