

MASS ACCOMMODATION COEFFICIENT OF WATER VAPOR ON AQUEOUS SULFURIC ACID SURFACES

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The size and number distribution of droplets in forming clouds is affected by the rate of water transfer between the gaseous and condensed phase. For example, slower transport of gaseous water into pre-existing aqueous aerosol particles leads to higher water vapor supersaturation, activating a greater fraction of available aerosol seeds. The interfacial rate for mass transfer of vapor is often quoted as the mass accommodation coefficient, the probability that a water molecule impinging on a liquid surface penetrates that surface and becomes incorporated into the bulk liquid.

We report the first experimental determination of the mass accommodation coefficient of water vapor on aqueous sulfuric acid droplets. The uptake of isotopically labeled gas-phase water was measured as a function of temperature (252 - 295 K) and acid concentration (50 and 70 wt% H₂SO₄) using a droplet train flow apparatus. The mass accommodation coefficient exhibits negative temperature dependence. For 50 wt% sulfuric acid solution it ranges from (0.40 +/- 0.05) at 278 K to (0.55 +/- 0.06) at 250 K and for 70 wt% solution the mass accommodation coefficient ranges from (0.54 +/- 0.03) at 295 K to (0.76 +/- 0.05) at 252 K.

These results imply that the maximum rate of water gas-to-liquid mass transport in the atmosphere is limited by the mass accommodation for particles smaller than ~0.5 micron in diameter.