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Determination of the evaporation coefficient of D₂O

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Abstract. The evaporation rate of D₂O has been determined by Raman thermometry of a droplet train (12–15 μm diameter) injected into vacuum (~10⁻⁵ torr). The cooling rate measured as a function of time in vacuum was fit to a model that accounts for temperature gradients between the surface and the core of the droplets, yielding an evaporation coefficient (Y_e) of 0.57±0.06. This is nearly identical to that found for H₂O (0.62±0.09) using the same experimental method and model, and indicates the existence of a kinetic barrier to evaporation. The application of a recently developed transition-state theory (TST) model suggests that the kinetic barrier is due to librational and hindered translational motions at the liquid surface, and that the lack of an isotope effect is due to competing energetic and entropic factors. The implications of these results for cloud and aerosol particles in the atmosphere are discussed.

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