



Dinitrogen pentoxide (N₂O₅): A nighttime artefact in denuder measurements of nitric acid

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A MARGA (Monitor for Reactive Gases and Aerosols, Metrohm Applikon BV, Netherlands) wet-rotation denuder/steam-jet aerosol collector-ion chromatography system for reactive gases and particles was deployed alongside a cavity ring-down spectroscopy (CRDS) system for the measurement of dinitrogen pentoxide (N₂O₅) at the Taunus Observatory, Kleiner Feldberg in SW Germany during August 2012.

The measurements show a strong indication that the well-known heterogeneous reaction, $\text{N}_2\text{O}_5(\text{g}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{HNO}_3$ results in the detection of a significant proportion of N₂O₅ as NO₃⁻ in the MARGA system. This process, which is likely to affect analytical systems using similar denuder technologies, results in the over estimation of HNO₃ and will bias assessments of chemistry in regions where N₂O₅ is a large proportion of $\Sigma[\text{HNO}_3 + 2\text{N}_2\text{O}_5]$. The chemistry of N₂O₅ differs markedly from that of HNO₃ not least as a significant chemical loss of N₂O₅ in regions affected by particulate chloride is the formation of ClNO₂, a relatively unreactive photolabile species which regenerates NO_x on photolysis in addition to the production of Cl radical. The differing loss pathways of N₂O₅ and HNO₃ may result in the misdiagnoses of model output using denuder-based estimates of HNO₃ to assess N-deposition. Denuder and filter-based methods should be assessed for the size of the N₂O₅ bias and the likely result of using these techniques should be estimated.