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A comprehensive evaluation of water uptake on atmospherically relevant mineral surfaces: DRIFT spectroscopy, thermogravimetric analysis and aerosol growth measurements

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Abstract. The hygroscopicity of mineral aerosol samples has been examined by three independent methods: diffuse reflectance infrared Fourier transform spectroscopy, thermogravimetric analysis and differential mobility analysis. All three methods allow an evaluation of the water coverage of two samples, CaCO₃ and Arizona Test dust, as a function of relative humidity. For the first time, a correlation between absolute gravimetric measurements and the other two (indirect) methods has been established. Water uptake isotherms were reliably determined for both solids which at 298 K and 80% relative humidity exhibited similar coverages of ~4 monolayers. However, the behaviour at low relative humidity was markedly different in the two cases, with Arizona Test Dust showing a substantially higher affinity for water in the contact layer. This is understandable in terms of the chemical composition of these two materials. The mobility analysis results are in good accord with field observations and with our own spectroscopic and gravimetric measurements. These findings are of value for an understanding of atmospheric chemical processes.

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