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Evapotranspiration und Gasaustausch an der Grenzfläche zwischen Boden und Atmosphäre - Messung und Modellierung

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Titel
Contact angles mediate equilibrium fractionation between soil water and water vapor

Abstract
Soil water potential is a function of grain size, adhesion and cohesion energy. The mechanical equilibrium between the interfacial free energies between water-gas, water-solid and solid-gas, leads to a particular contact angle at the three phase boundary water-solid-gas. The contact angle of the solid-soil affects the water retention in soils. Contact angles >0 lead to a shift of the water retention curve to simulating a coarser soil texture. Thus, a certain amount of water is stronger bound in a soil with a low contact angle compared to the same soil with a high contact angle. The relationship between the contact angle and the fractionation of water stable isotopes between soil water and water vapor has yet not been studied.
We present a simple laboratory experiment with soil samples ranging from sand to silt to clay. Two subsamples were hydrophobized (or treated with) using dichlorodimethylsilane to produce different contact angles. Subsamples were transferred into Ziploc bags spiked with water of known isotopic composition and the headspace filled with dry air. After equilibration (at least 24h) the headspace was measured for its isotopic signature with a Laserspectrometer. Soil water potential was measured with a soil water potential meter and the contact angle determined with the Wilhelmy-plate-method (WPM).
The working hypothesis is that the equilibrium between water and water vapor depends on the matric potential. Having the same pore and the same water content water repellency affects the soil water potential. Therefore the hydrophobized soil will change the equilibrium fractionation between water and water vapor. Hence, the contact angle between adsorbed water and water vapor is related to isotope effects.