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Energy and Water Fluxes at the Soil Atmosphere Interface of Water Repellent Soils

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Water transport processes in water repellent soils are different from transport processes in non repellent soils. These differences have been and are studied extensively. Little is known about the effects of water repellency on energy exchange between soil and atmosphere. Changes of the energy balance are mainly caused by changes of water content distribution in the topsoil. Our working hypothesis is that water repellency will significantly affect the soil-atmosphere energy balance. These changes can influence local and even global climate. The above mentioned change of water distribution influences many factors of energy transfer, e.g. thermal capacity, thermal conductivity, and albedo.
We further hypothesize that water distribution on the microscopic scale is changed due to water repellency. This means that the thermal conductivity as a function of water content $\lambda(\theta)$ of hydrophilic and water repellent soils may not be unique.
To test our hypotheses we are conducting lysimeter experiments. All components of the water and energy balances are measured in and on top of lysimeters filled with strongly water repellent soil. Reference lysimeters are filled with the same substrate which was treated with surfactant to become hydrophilic. In addition to the lysimeter measurements we are conducting laboratory experiments to study fundamental processes and to determine the hydraulic and thermal properties of the hydrophilic and water repellent materials. We will also undertake field experiments to obtain measurements on a larger scale. Finally the results shall be incorporated in a numerical model for water and energy transport in the soil-atmosphere continuum.