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Using Ethanol to Investigate Dynamic Soil Water Repellency

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Large gaps remain in our fundamental understanding of the behaviour of water in dynamically repellent soils. By investigating these systems using other miscible fluids that minimize or eliminate repellency, e.g. ethanol, we seek to better understand and quantify soil water repellency. The advantages of the enhanced wettability of water repellent soils to other miscible fluids, however, come with complications including shifts in effective pore water pressures induced through variable interfacial tensions as well as differences in fluid mobility due to variable fluid viscosities and densities. With these considerations in mind, we compare and contrast the observed behaviours of fluid infiltration and retention in dynamically hydrophobic soils and hydrophilic soils. We conducted field and laboratory studies using tension disc infiltrometers along with water and ethanol solutions to investigate dynamic repellency in post-wildfire soils from Northern Ontario, Canada. Tension infiltrometers maintain a constant negative liquid pressure at the surface which proved to be useful for isolating wettable behaviours sensitive to dynamic changes in wettability. We present the data and system conceptualised and explained through contact angle dynamics and variable fractional wettability of the soil. The limitations of extending hydrophilic concepts and hydraulic functions to hydrophobic soils are discussed along with persistent challenges to advance our ability to simulate and predict system behaviours in naturally occurring water repellent soils.