The physical effect of biological and chemical treatments on water repellent soils.

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Water repellence in soils is a naturally occurring phenomenon, caused by long-chain hydrophobic organic molecules, which affects millions of hectares of agricultural land in Australia and around the world. Breakdown of the hydrophobicity in soils has been attributed to both biological and chemical interactions, it being unclear which is the primary contributor. We employed a novel approach investigating the ability of bio-chemical treatments to breakdown the physical effects of water repellence using 3D electrical resistivity tomography (ERT). The experiment consisted of sterile soil with a hydrophilic, heat treated outer section that framed a 4 cm3 severely hydrophobic, gamma irradiated inclusion. Treatments included wax-degrading microbes, a surfactant, the combination of the two, as well as two additional controls, one sterile and one non-sterile. The experiment used 3D borehole ERT to measure the electric resistivity in the soil after wetting. Resistivities were converted to volumetric water contents allowing determination of in-situ time-lapse water contents. Based on modelling, we expect that physical resistivity changes, from extended wetting, will decrease resistivity as water content increases, and ERT inversion will show the positions at which the wetting occurs. We anticipate that surfactants will increase the wetting rate of the hydrophobic inclusion. We also expect surfactants will change the wetting patterns, from wetting laterally where there is high contact between wet hydrophilic and the hydrophobic soil, to a more stable wetting front. It is also expected that the addition of wax-degrading microbes will increase wetting times, and will result in lower repellence in the long-term, especially after a drying period. This will lead to a better understanding of which mechanisms are responsible for the breakdown of water repellence in soils and how they affect the pattern and longevity of the breakdown.