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Particle based superhydrophobicity - Lab model to field behaviour

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Soil water repellency can be caused by such factors as volatile organic compounds released during wildfires, microbial action within the soil or organic contaminants. The chemical hydrophobicity imparted by such factors can be amplified by the topography of the soil causing water repellency which, in turn, can lead to enhanced erosion. We present a mathematical model to predict the water repellency of soil systems in relation to the particle size and configuration of such particles. Our model relates the size of the particles in the top layer (radius = r) to the size of the particles in the next layer down (radius = R) and relates them to a critical contact angle (θ_c) of the impinging liquid which results in spontaneous imbibition into the particle bed. The model is tested by performing molarity of ethanol (MED) drop testing on simplified model representing a sandy surface soil layer to allow the critical contact angle to be measured. Such models consist of three layers of hydrophobic bead packs with the base layer fixed, the second layer being the same size as the fixed base layer. Beads in the top layer are smaller than those in the underlying layers to give packs with r/R values ≤ 1. The critical contact angle can then be extrapolated by measuring advancing contact angles of microscope slides modified in the same way as the beads. Results show good correlation between the measured critical contact angle and those predicted by the model.