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Thermal imaging of water repellence breakdown and build up following surfactant application

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Surfactants are used in dry land cropping systems to improve water infiltration in water repellent soils, yet the dynamic nature of water repellence during various seasons and the associated hydrologic changes are still poorly understood. Here we evaluate surface temperature changes of a water repellent sand in response to irrigation and surfactant applications, reflecting infiltration, evaporation, and energy balance changes across multiple wetting-drying cycles. Using a near-infrared thermal camera soil surface temperatures of 15 1m^2 plots were recorded at 10 minute intervals for three weeks. Plots differed by the width of surfactant application bands (16 cm, 25 cm, 50 cm, and 100 cm wide surfactant bands as well as a control with no surfactant), individual treatments were replicated three times. Temporal changes in the spatial variability was examined using semivariograms and wavelets. The semivariogram analysis indicates that in contrast to the thinnest surfactant bands, wide bands lead to a gradual increase in soil-temperature heterogeneity towards that seen in a control. Wavelets and time-distance plots reveal a non-linear switch in soil temperature dynamics for surfactant treated plots which were absent in 100 cm band and control plots. This switch, evident in the relative temperature differences across the plot during diurnal cycling, was associated with a gradual drop in ambient temperatures. These results image water repellence breakdown in the field. The study demonstrates the general suitability of using thermal surface properties of water repellent soils to investigate the dynamics of water repellence breakdown. This knowledge can be used to test the efficiency of available and new surfactant products to overcome water repellency.