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Modeling the effect of initial soil moisture on sorptivity and infiltration

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Soil capillarity, often associated with the parameter sorptivity, is a primary control on infiltration during short-duration rainfall and irrigation events. However, most mathematical models used to quantify capillarity are only valid for dry antecedent conditions. In this study, we examine how the capillary component of sorptivity (i.e. wetting front potential) varies with initial soil water content, and use this finding to provide a simple modification to the classic Green-Ampt sorptivity model. The modified model has many practical applications, including 1) describing the relative sorptivity of a soil at various water contents; 2) quantifying saturated hydraulic conductivity from sorptivity measurements; and 3) interpreting transient time behavior of single ring infiltration (i.e. beerkan) measurements. The model is especially useful in low permeability soils, where steady-state conditions may not be attained for hours or even days, and in shrink-swell soils, where rapid infiltration measurements are often desired so as not to induce substantial material swelling.