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Effects of prescribed fires on soil properties and associated hydrological processes in southeastern forests of the United States: X-ray computed tomography visualization and quantification of soil structure and infiltration

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Post-fire, the soil physicochemical properties and the hydrological phenomena of a forested watershed are typically changed, impacting infiltration processes and increasing overland flow. Knowledge of the alteration of the infiltration and derived post-fire hydrologic responses is largely unknown. Our study aims at exploring the soil physicochemical properties and the associated spatio-temporal changes in the post-fire infiltration process under the long-term effects of controlled burns for the management of forests in the southeastern United Sates. Soil cores and bulk soil samples were collected from the reference watershed (unburned) and the treatment watershed (controlled burns) at the Santee Experimental Forest, located in the Francis Marion National Forest in South Carolina. Analyses of soil physicochemical and hydraulic properties, as well as soil wettability tests were performed using bulk soils. Infiltration experiments were conducted on intact soil cores and used a non-reactive tracer sodium iodide (NaI) to measure water movement/infiltration and determined soil water content. The visualization and quantification of soil structure (i.e. macroporosity) and infiltration phenomena (i.e. water movement and soil water content) were obtained by X-ray computed tomography. Our study allowed to characterize and link X-ray computed tomography visualization and quantification of soil structure and infiltration phenomena to soil physicochemical measurements, and further elucidate the spatio-temporal changes occurring in post-fire soils as compared to unburned soils.