

Microsite Influence on Soil Temperature and Moisture Dynamics in Sagebrush Ecosystems: Insights from TOMST Sensor Network

Nyamekye Joshua Okyere
University of Nevada, Reno; Desert Research Institute
Joshua.okyere@dri.edu

Mentors: Gabrielle Boisrame, Desert Research Institute
Markus Berli, Desert Research Institute

Abstract

Soil microclimate plays a critical role in regulating hydrological and ecological processes in semi-arid environments, yet fine-scale variability driven by vegetation cover remains insufficiently quantified. This study investigates how vegetation cover influences soil temperature and moisture dynamics using high-resolution data from TOMST sensors deployed in inter-shrub and under-shrub microsites in a semi-arid sagebrush ecosystem. Continuous measurements of soil temperature and moisture were processed and aggregated to daily average values for analysis across a full year (from summer to summer).

Results reveal microclimatic differences between inter-shrub and shrub-covered soils. Under-shrub locations exhibited reduced temperature variability, with dampened diurnal extremes compared to inter-shrub areas. Soil moisture signals indicated greater persistence beneath shrub canopies, particularly following precipitation events. Time-series analysis showed that shrub cover moderates both thermal and hydrologic responses, leading to delayed drying and enhanced moisture retention relative to exposed soils.

These findings highlight the role of vegetation as a key regulator of soil microclimate through shading, reduced evaporative demand, and modified energy balance. The observed buffering effects have important implications for soil water availability, ecosystem resilience, and land-atmosphere interactions in water-limited environments. This work demonstrates the value of high-frequency sensor networks for capturing fine-scale heterogeneity and provides empirical evidence to inform ecohydrological modeling and land management strategies in semi-arid systems.