Remote Sensing Soil Moisture

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Background

US Cow-calf production generates over $100 billion annually, ranking first in agricultural cash receipts. Western rangelands are a crucial part of this system, providing over half of the forage needs to domestic cattle. In semi-arid environments, like the rangelands of the Greater Yellowstone Ecosystem (GYE), the production of forage is dependent on access to enough water during the growing season, however, landscape scale estimates of soil moisture cannot reasonable be accomplished with physical measurements alone. Understanding and predicting how soil moisture varies in the GYE is vital to conserve and protect the local economy and ecosystems; a need that will only increase as climate change continues to limit the amount of precipitation this region receives. Innovations in remote sensing technology offer the potential to capture landscape scale measurements of moisture, but this comes with a number of challenges. Hyperspectral imagery can only capture surface level measurements, thus soil moisture has to be inferred by surface conditions and vegetation responses. Remote sensing of moisture in agriculture fields using a combination of hyperspectral data and machine learning has shown promise in producing high spatial resolution soil moisture modeling. However, rangeland systems are heterogeneous in their community composition and topographic variation, and such models have yet to explore these complex systems. Exploring how soil moisture varies across these landscapes are a vital step towards comprehensive and robust soil moisture models in active ecosystems.

Research Question and Plan

Using a series of 100m^2 transects, that will be created across Red Bluff Research Ranch, we will explore how soil moisture varies across rangeland ecosystems of the GYE and what features of the landscape and/or differences in vegetation community correlate with this variation. Additionally, we will see if and how this ecological variation can be captured via hyperspectral remote sensing and modeled at a fine special scale.

Unmanned aerial Vehicles will be equipped with lidar and hyperspectral imagery of the study landscape will be used to capture reflectance data as well at topographic data. Vegetation and soil moisture will be sampled at each transect to capture how differences in the major landscape variables and community composition affect soil moisture across our study site.