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A Sub Basin Comparison of Soil Moisture to Inform Meteorological Station Location

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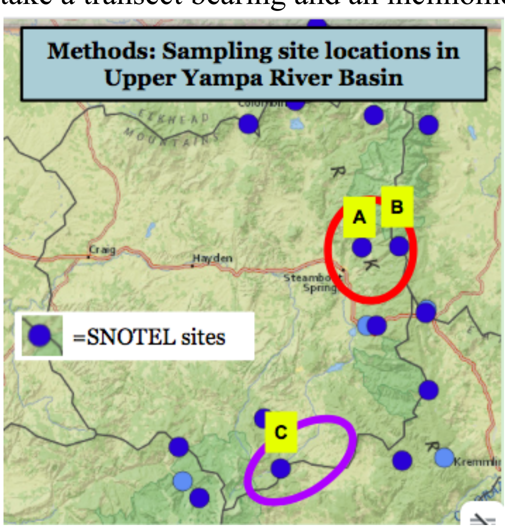
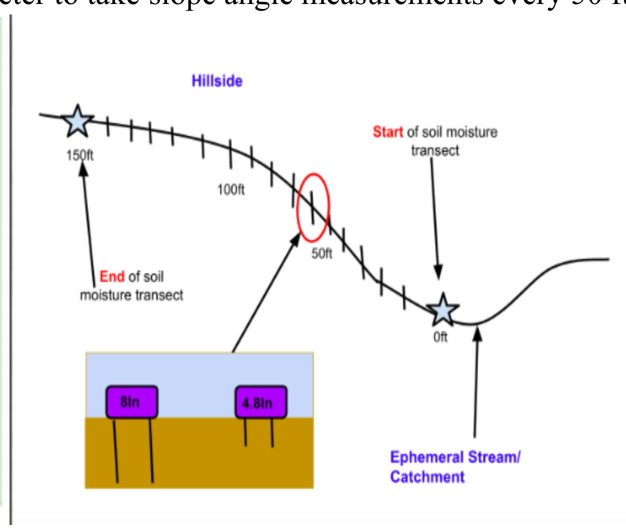
The Center for Western Weather and Water Extremes (CW3E) is partnering with Yampa Valley Sustainability Council and Colorado Mountain College to implement a soil moisture network in the Upper Yampa River Basin (UYRB) aiming to better conserve and manage water. Soil Moisture has become increasingly important to study, “in the context of understanding water availability and improving water forecasts for utility managers" (Osenga et. al, 2019). As an intern this summer, I examined how vegetation cover and topography influence soil moisture variability and how these observations interpret water availability in the soils. “When the soil in a watershed is dry, water absorption by the soil can significantly reduce the amount of precipitation making its way into streams and rivers” (Zamora et al., 2010). The motivation of my research was, “to explore how sub basin variability in soil moisture could potentially influence where soil moisture monitoring stations are sited in catchments to best support water management decision making”. Which leads up to my research question, “How do insitu soil moisture measurements vary at the sub basin scale and what landscape-level parameters potentially influence that variability?”.

To answer this question, I used Google Earth and USGS to identify water producing zones and locate existing instrumentation. To manually measure Soil Moisture, I used a TDR 150 Soil Moisture Meter that measures Volumetric Water Content (VWC) and Time Domain Reflectometry. For my transect sampling I used a tape measure for linear site intervals of 10ft until 150ft, I took soil samples from each site to compare soil types, I used a digital compass to take a transect bearing and an inclinometer to take slope angle measurements every 50 ft.



A.

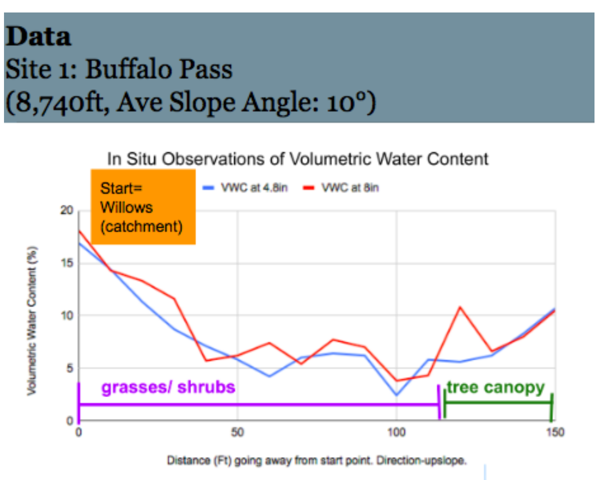


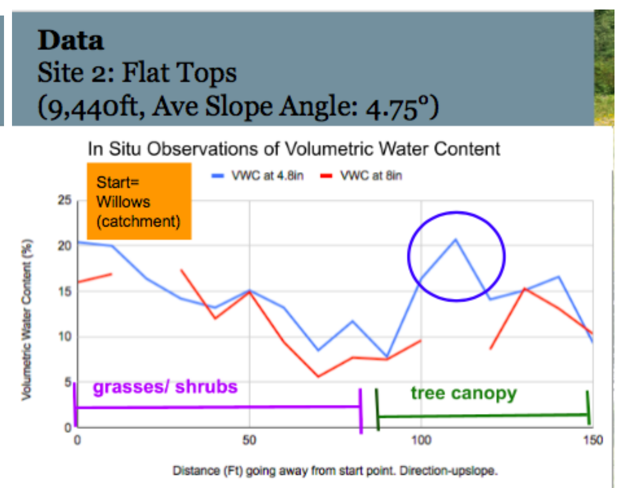
B.

In image A, is the UYRB boundary and the blue dot represents existing SNOTEL sites. Circled is my first site selection, Buffalo Pass Wilderness where I took three soil moisture transects in between SNOTEL sites labeled A(Dry Lake) and B(Tower). Circled in Purple is the

Flat Tops Wilderness area which consists of three soil moisture transects near the SNOTEL site labeled C(Bear River). I chose to locate transects near SNOTEL sites because each site measures precipitation, temperature, snow depth and sometimes wind speed data. And both locations supply an immense amount of snowpack each year contributing to streams and rivers that influence our water supply. I also determined my site selection by field observations of important indicators. Plant community indicators; Willows, Ferns, Corn Lily and Aspen trees and physical catchment indicators ephemeral streams, streams and rivers a topography- hillsides surrounding the area, creating a bowl in the area.

Shown in image B is a drawing of each transect sample. Start of soil moisture transect at catchment area, going upslope, away from the catchment at 4.8in and 8in at each transect. In both graphs (image D and E), the results showed a high %VWC at the start of the catchment as it decreased going away into shrub and grassland, and again spiked under the tree canopy. Showing there is a notable relationship between vegetation and water availability that would have a great influence on the decision making process of water managers. Another observation I noted was average VWC at 4.8 and 8in compared to precipitation data (image F). At buffalo pass in 2021 there was a higher precipitation accumulation than at the Flat Tops. And soil moisture data I captured showed the exact opposite. Higher %VWC at the Flat Tops than at Buffalo Pass. My final conclusion is that *In situ* soil moisture measurement variability is influenced by landscape level parameters such as vegetation cover, soil type, slope, aspect and elevation.





D. E.

Average VWC at 3 samples at site 2:

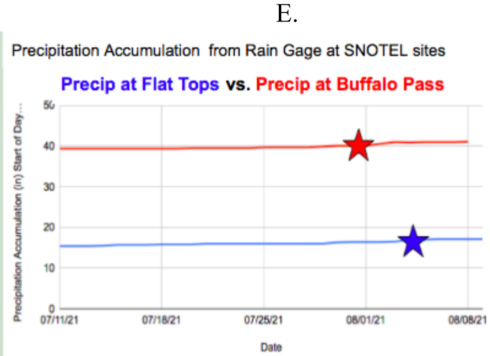
Flat Tops

- At 4.8 in - **23.6% VWC**
- At 8 in - **19.6% VWC**

Average VWC at 3 samples at site 1:

Buffalo Pass:

- At 4.8in- **11.5% VWC**
- At 8 in- **13.5% VWC**



F.

References

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Zamora, R. J., Ralph, F. M., Clark, E., & Schneider, T. (2011). The NOAA Hydrometeorology Testbed Soil Moisture Observing Networks: Design, Instrumentation, and Preliminary Results. *Journal of Atmospheric & Oceanic Technology*, *28*(9), 1129–1140. https://doi.org/10.1175/2010JTECHA1465.1