The Effects of Elevation on Evapotranspiration

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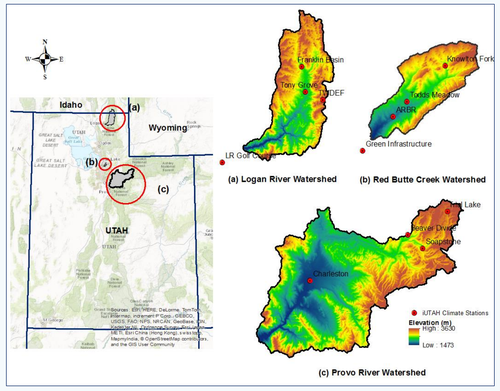
Introduction

- Evapotranspiration is an essential component to the hydrologic cycle, but it can be difficult to measure.
- ET is affected by climate, plant community structure, and elevation.
- In this study we use data collected from the iUTAH climate stations in order to execute a water balance approach to estimate ET.
- At each iUTAH climate station in the GAMUT network there are a series of TDT sensors and data loggers documenting the change in water content over time.
- We've compared ET rates along an elevation gradient.
- We predicted and confirmed that ET and elevation are inversely related.



Site	Elevation (m)
TWDEF	2629.20
Franklin Basin	2109.52
Tony Grove	1927.86
Golf Course	1364.89
Trial Lake	3040.00
Beaver Divide	2508.00
Soapstone	2388.41
Charleston	1659.00
Knowlton Fork	2178.10
Todd's Meadow	1763.00
ARBR	1666.04
Green Infra	1487.12

Fig. The Logan, Provo, and Red Butte Watershed sites included in the iUTAH GAMUT network and their elevations.

Theoretical Considerations

Using data from the TDT sensors, our aim was to calculate ET in the three watersheds in the iUTAH network. We used the water budget equation:

$$P = ET + DR + RO + \Delta W$$

and simplified it in order to solve for ET.

$$ET = P - \Delta W.$$

P = Precipitation
RO = Runoff
DR = Drainage
ΔW=Change in soil water storage
D_i *= Depth increment*

The change in soil water content can be calculated using this equation:

$$\Delta W_i = \Delta \theta_i * D_i$$

The change in volumetric water content is gathered from the array of TDT sensors and the depth increment is calculated based on the depths along the soil profile.

Results

- After identifying when snowmelt occurs and when ET begins using the data from the TDT sensors, we accounted for the inputs in the water balance such as precipitation and calculated ET.
- The graph below shows that elevation influences the timing of soil water usage through ET. Sites at lower elevations tend to exhibit an early change in soil water content due to ET.
- Sites at higher elevations such as TWDEF, Franklin Basin, and Knowlton Fork show a lower ET rate.

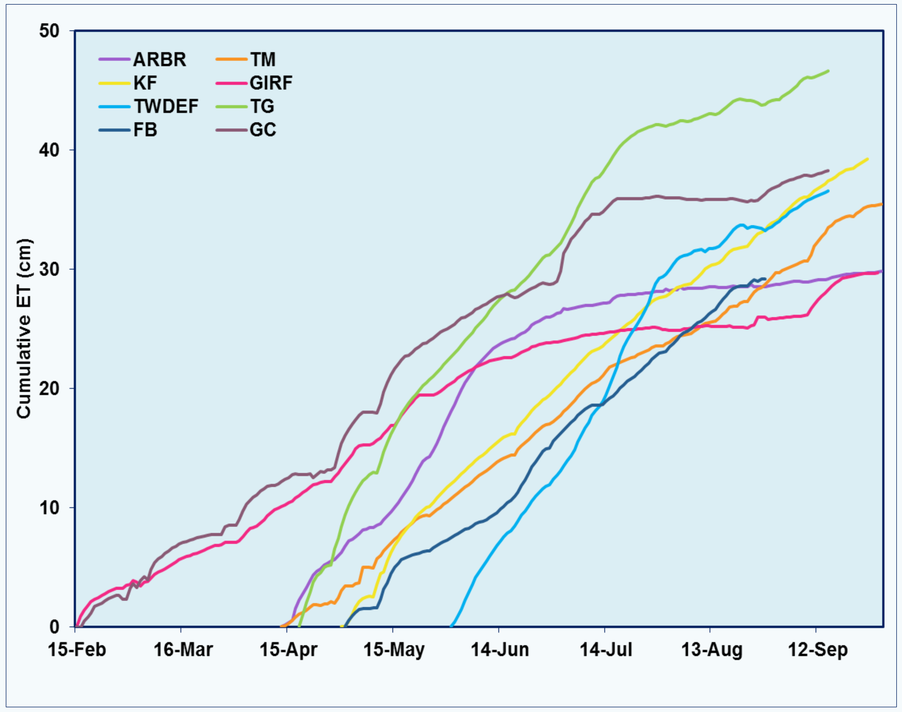


Fig. Cumulative ET (cm) of sites in the Logan and Red Butte Watersheds from the time of snowmelt through September.

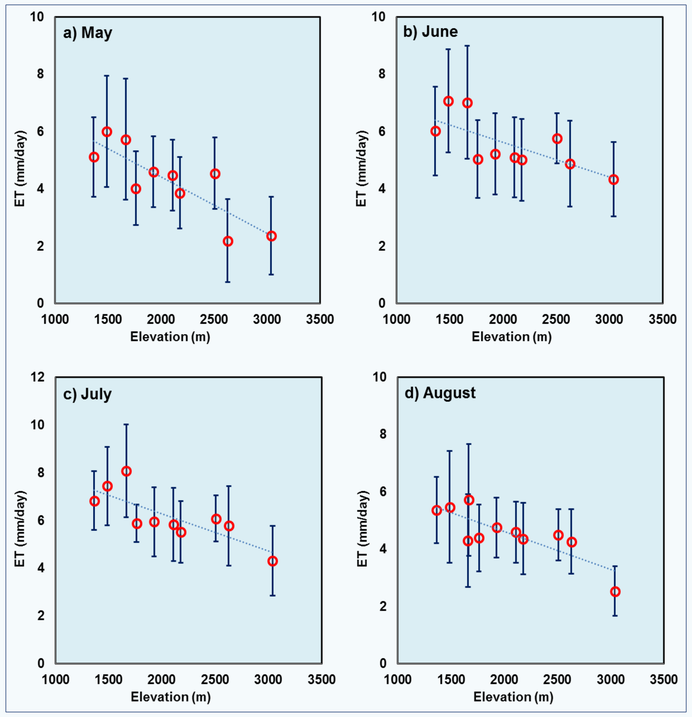


Fig. Change in reference ET with elevation during the 2014 growing period.

Discussion

- The change in soil water content is greater at lower elevations and therefore ET is greater in lower elevations.
- The water balance must equate to zero while using this approach in calculating ET. Further studies should account for groundwater contribution as an input in the water balance for sites like the Logan Golf Course.
- Each site has unique characteristics that are important to consider in order to understand its hydrology. These factors include water table height, plant community type, and soil texture.
- We would expect to see the GIRF site to have a high ET rate based on its elevation, however the high gravel content at the site influenced where the sensors could be placed. thus, the sensors are in a shaded location closer to the creek rather than an open meadow, affecting the ET output of the system.

Fig. Acclima TDT sensor installation

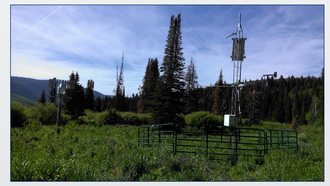


Fig. Climate Station at Franklin Basin

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