The Influence of Topography on Hydrology in the Hotel Gulch Watershed

Samantha Motz 1, Sara Warix 2, Dr. Alexis Navarre-Sitchler 3, Dr. Kamini Singh 2

1 Earth and Atmospheric Sciences, Georgia Institute of Technology, 2 Hydrologic Science and Engineering, Colorado School of Mines

1. Objective

Comprehending our water systems is critical. Hydrology is influenced by topography, but the full extent of topography’s influence remains unclear.

Question:
Does topographic wetness index correlate to a lower variability in discharge and a higher variability in specific conductivity in surface water?

2. Site Description

- Hotel Gulch resides in the Manitou Experimental Forest, which is a semi-arid climate between 2,601 m and 2,835 m in elevation (Fig. 1).
- Hotel Gulch has limited anthropogenic activity and is prone to impacts of climate change; its ease access makes it ideal for determining how climate change will impact similar watersheds.

3. Methods

- Topographic analysis in comparison to discharge and specific conductivity data from stilling wells in the Hotel Gulch Watershed.
  - Coordinate collection
  - Watershed delineation in ArcGIS Pro
  - Topographic calculations
  - Data analysis in MatLab and Excel

4. Results

Topographic Wetness Index: $\ln(\frac{a}{\tan \beta})$

- Sites 1, 4, 6, 7, and 8: lower standard deviation in discharge and higher standard deviation in specific conductivity. Additionally, these same sites have lower topographic wetness index values at the wells (Fig. 4 & 5).
- Sites 2, 3, and 5: higher standard deviation in discharge and lower standard deviation in specific conductivity. These sites also have higher topographic wetness index values at their wells (Fig. 4 & 5).

Outliers:
We note that Site 2 has a positive relationship between discharge and specific conductivity (Fig. 2 & 3). Additionally, discharge is very dynamic at site 2 (standard deviation = 1.64 L/s) relative to site 1 (standard deviation = 0.59 L/s), even though the two sites are only 570 meters apart.

Fig. 2: Graphs representing the moving mean of discharge over time for each site fitted with a slope intercept equation to display the differences in trends between sites.

Acknowledgments
This material is based upon work supported by the National Science Foundation under Grant No. 1724794. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

5. Conclusion

- Topographic wetness index as an indication of hydrologic parameters—discharge and specific conductivity—in a mountainous, semi-arid watershed
- High topographic wetness index correlates to a high standard deviation in discharge and a lower standard deviation in specific conductivity.
- Low topographic wetness index correlates to a low standard deviation in discharge and a higher standard deviation in specific conductivity.

- A foundation of how the topography plays a role in this area; this work will be continued to be built upon in future studies.

References


Future research:
The influence of the Mount Deception Fault System (Fig. 6) on groundwater interactions, and additional water and soil chemistry.

Fig. 6: En-echelon faults associated with the Mount Deception Fault System. (Fig. 6, Modified from Temple et al. (2007).)