

The Sub-Daily Temporal Distribution of Snowmelt

Ryan W. Webb¹, Steven R. Fassnacht², and Michael N. Gooseff³

¹Department of Civil and Environmental Engineering, Colorado State University

²Department of Ecosystem Science and Sustainability, Colorado State University

³Department of Civil, Environmental, and Architectural Engineering, University of Colorado

Abstract. The hydrologic cycle in many mountainous headwaters around the world is dominated by snowmelt. High rates of snowmelt, in addition to water resources for communities and ecosystems, can cause flooding that can damage infrastructure. The standard in the United States flood forecasting primarily utilizes rainfall estimates but lacks estimates for high rates of snowmelt in regions, such as the Southern Rocky Mountains. Recent studies have shown that events such as a 10 year 24 hour snowmelt event is as much as 45% greater than the same recurrence interval rain event. Additionally, this 24 hour snowmelt likely occurs over a much shorter time. This study presents and tests a sub-daily temporal distribution of snowmelt. The snowmelt distribution presented herein is tested against hourly data snow telemetry (SNOTEL) stations using both snow pillow and 5 cm soil moisture observations. The intent of this study is to provide a snowmelt intensity curve that may be used as a design event for modelling purposes rather than the computationally intensive method than the mass energy approach or the simple degree-day method. This can be used for streamflow, groundwater recharge, soil moisture distribution, and other hydrological modeling efforts. Results display reasonable agreement with hourly SNOTEL data from Colorado Front Range stations for an assumed 8-hour melt period with a shifting of peak runoff timing earlier in the day with elevation, likely the result of the time of year melt occurs. The presented sub-daily temporal distribution of snowmelt may be beneficial for designs of infrastructure such as bridges and open channels in previously unmonitored stream networks where snowmelt is important.