Compiled by Kate Cline

Of Snow & Soil

Winter is nigh, and that means one thing in many regions: snow. While many dread the thought of winter snow due to the havoc it can cause in day-to-day life, snow is an important source of water in many areas—not least of which is drought-stricken California. In an effort to better understand snowmelt and its effects on soil and groundwater, Ryan Webb of Colorado State University led a study to measure soil wetting and drying dynamics. WQP Managing Editor Kate Cline recently caught up with Webb to learn more about the study and its implications for drought-affected regions.

KATE CLINE: ***What were the goals of the study?***
RYAN WEBB: The goal of this study was to gain further understanding of the soil moisture wetting and drying dynamics that occur beneath a seasonally persistent snowpack in non-frozen soil. This was accomplished by determining the number of wetting events that occurred at depth profiles of soil moisture sensors throughout the winter and spring seasons, and analyzing these sensor profiles under different tree canopy conditions to identify the wetting and drying variability between locations in a mixed conifer forest.

CLINE: ***How did you conduct the measurements for the study?***
WEBB: The measurements were primarily from time domain refloctometer sensors that measure the dielectric permittivity of the soil, which then is used to calculate the amount of water in the soil. The fluctuations of soil moisture beneath a snowpack, as shown from sensor data, were analyzed to observe how many pulses of snowmelt were reaching depths in the soil. Additionally, we observed locations and depths that tend to remain wetter or drier, which would promote or inhibit moisture movement through the soil.

CLINE: ***What challenges did you face in completing the study?***
WEBB: The biggest challenge in completing this study was the amount of data that was available. More data are always better in order to try and capture the processes that are occurring; however, it can be a challenge to find which approach should be taken. We knew that there was a story to tell from the beginning; we just needed to determine how to approach finding it.

CLINE: ***What were the key findings of the study?***
WEBB: Results from our study indicated that the wetting and drying dynamics beneath a snowpack in a mixed conifer forest are highly variable. Locations differed in number of wetting pulses from one event up to 18 events with no general pattern observed for canopy conditions. The findings of our study indicate that further investigation is necessary in order to better understand mountainous systems and the potential impact of climate change on groundwater recharge, plant production and stream flow response.


Ryan Webb

CLINE: ***What implications do these results have for the California drought?***
WEBB: Our study displays how much the infiltration and wetting process varies from snowmelt. Oftentimes, modeling efforts aimed at estimating groundwater recharge and streamflow assume less variability. The snowpack is an important resource for water, and estimating the partitioning of this resource to groundwater recharge, stream flow or plant production requires an understanding of the processes occurring during melt. As more data become available, the scientific community will be able to better understand the dynamic processes and improve upon estimates for water resources. Our study shows how important these data-gathering operations are to estimating the long-term effects of low snowfall years.

CLINE: ***In general, how does snowfall level affect groundwater levels?***
WEBB: In general, the snowfall effects on groundwater levels depend on a number of different factors. In particular, groundwater connection to snowfall can vary from location to location. Some places have observed large contributions of snowmelt to groundwater levels, while others have not. In snow-dominated regions, the annual snowfall can have an impact on all water resources. **WQP**

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