Developing soil water potential time series using the Montana Mesonet’s in-situ sensor data and lab-measured soil characteristics

Carly R. Andlauer
ca101073@umconnect.umt.edu

Follow this and additional works at: https://scholarworks.umt.edu/umcur

Let us know how access to this document benefits you.

https://scholarworks.umt.edu/umcur/2020/physicalsciences_poster/1

This Poster is brought to you for free and open access by ScholarWorks at University of Montana. It has been accepted for inclusion in University of Montana Conference on Undergraduate Research (UMCUR) by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.
Developing Soil Water Potential Time Series
Using the Montana Mesonet’s In-situ Sensor Data and Lab Measured Soil Characteristics

Carly Andlauer, Kelsey Jencso, Kevin Hyde, and Zachary Hoylman
Montana Climate Office, W.A. Franke College of Forestry and Conservation, University of Montana, Missoula, MT 59812

INTRODUCTION
The Montana Mesonet is a collaborative effort of federal, state, tribal, and private partnerships. Each of the 79 stations is instrumented with atmospheric and soil sensors. Sensor data is recorded at 15 minute intervals. These data provide the basis for a time-series analysis of a multitude of parameters, including: soil moisture, soil water conductivity, precipitation, relative humidity, vegetation greenness, temperature, solar radiation, and groundwater levels. When this sensor data is combined with lab-derived soil characteristics such as soil porosity, conductivity, and soil-water potential, it is possible to assess management-relevant factors such as plant-available water and the theoretical wilting point to assist with making irrigation management decisions and identify areas susceptible to changes in water availability.

FIELD SAMPLING METHODS & IN-SITU DATA
During station installation, soil cores were collected using a bulk-density soil corer at 4 depths in the soil horizon: 2”, 8”, 20”, 36”. 3 cores were collected from each depth. Soil temperature and moisture sensors were also installed at each depth. These data are accessible online and available to the public via Mesowest.

LAB METHODS
To develop water retention curves, soil cores are analyzed using METER’s HYPROP and WP4C. Both pieces of equipment measure water potential. Water potential along the moist end of the moisture gradient is measured by HYPROP and along the dry end of the moisture gradient by the WP4C. The soil core is saturated (A), mounted onto a sensor with two paired pressure transducers and tensiometers which measure soil tensions while drying (B) and placed on a precision balance (C) which measures mass and calculate volumetric water content. Tension and mass measurements are recorded at 10 minute intervals while the sample dries. The partially-dried sample is then split into 4 subsamples, representative of the moisture gradient in the soil core (D). The WP4C is a dewpoint potentiometer which measures water potential at low volumetric water contents. Each subsample is weighed, analyzed by the WP4C, oven-dried (105°C), and weighed again to determine VWC and water potential for the subsamples as well as the total soil mass (E). Software combines the HYPROP and WP4C generated points and fits the curve using a Van Genuchten model.

FUTURE WORK
Continued work will focus on developing water retention curves for all depths at remaining sites using the HYPROP and WP4C. Another priority is to characterize soil texture at each depth for all sites which can be combined with sensor data to determine field capacity at each site. These site and depth-specific data will be incorporated into landscape models to continually assess the state of water resources across Montana and help land managers make decisions.

ACKNOWLEDGMENTS
Thank you to Kelsey Jencso, Kevin Hyde, and Zachary Hoylman, our Montana Mesonet station partners, and Mesowest.

KEY CONCEPTS

Volumetric water content (VWC)
The volume of water held in a soil per bulk volume.

\[ \text{VWC} = \frac{\text{volume}}{\text{total water}} \]

Soil water potential
The amount of energy required to remove water from the soil. Sum of osmotic potential, gravitational potential, pressure potential, and matric potential.

Theoretical wilting point
The soil water content and tension at which plants can no longer withdraw water from the soil (1500 kPa).

Plant available water (PAW)
Range of water quantities and tensions between field capacity and the theoretical wilting point at which plants can withdraw water from the soil.

Field Capacity
The water content of a previously saturated soil following initial drainage due to gravity. Influenced by differences in soil porosity due to soil texture and structure.