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Mobile Soil Moisture Sensing in High Elevations: Applications of the Cosmic Ray Neutron Sensor Technique in Heterogeneous Terrain

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The use of the Cosmic Ray Neutron Sensor (CRNS) for the detection of field-scale soil moisture (∼20 ha) has been the subject of a multitude research applications over the past decade. One exciting area within agriculture aims to provide soil moisture and soil property information for irrigation scheduling. The CRNS technology exists in both a stationary and mobile form. The use of a mobile CRNS opens possibilities for application in many diverse environments. This work details the use of a mobile "backpack" CRNS device in high elevation heterogeneous terrain in the alpine mountains of western Austria. This research demonstrates the utilization of established calibration and validation techniques associated with the use of the CRNS within difficult to reach landscapes that are either inaccessible or impractical to both the stationary CRNS and other more traditional soil moisture sensing technology. Field work was conducted during the summer of 2016 in the Rauris valley of the Austrian Alps at three field sites located at different representative elevations within the same Rauris watershed. Calibrations of the "backpack" CRNS were performed at each site along with data validation via in-situ Time Domain Reflectometry (TDR) and gravimetric soil sampling. Validation data show that the relationship between in-situ soil moisture data determined via TDR and soil sampling and soil moisture data determined via the mobile CRNS is strong (RMSE ∼ <2.5 % volumetric). The efficacy of this technique in remote alpine landscapes shows great potential for use in early warning systems for landslides and flooding, watershed hydrology, and high elevation agricultural water management.