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Effective and layered Soil moisture study using cosmic-ray neutron sensor in Yellow River source region of Tibetan Plateau

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Soil moisture of Tibetan Plateau plays a key role in the water cycle and the global climate change. Cosmic-ray neutron sensing (CRNS) can provide reliable hectometer scale effective soil moisture measurement in this special and harsh climate conditions. In this study, a distributed continuous soil monitor network were used to evaluate the application of CRNS measurements for soil moisture content determination in a semi-humid region covered by alpine meadow in Tibetan Plateau. The results firstly indicated the high frequency noise or uncertainty from different sampling interval of CRNS measurement can be removed by 6 hours average in a high-count environment, and based on four times above ground vegetation sampling from the early growth stage to the withering period, we investigated the effect of equivalent biomass hydrogen on CRNS and used a simple strategy to eliminate vegetation impact on CRNS. The N0-mothed and N0-method and the COsmic-ray Soil Moisture Interaction Code (COSMIC) then were be used for effective soil moisture retrieve during the whole non-freezing season in 2017, which indicated both methods were capable of retrieving effective or integral soil moisture based on monitor network measurement lateral weighted moisture, while the COSMIC had higher dynamic extent for recurring soil dry status during the extreme drought event in August. However it is not possible to conclude with a solvable or easy straight-forward analytical formulation to retrieve layered soil moisture within effect detecting depth by individually using CRNS measurement. Thus the Ensemble Kalman filter (EnKf) was employed to assimilate CRNS measurement by an isolate point profile measurement in order to obtain layered soil moisture analysis values. The assimilation results indicated even the point profile measurement with obvious biases, but the analysis increment always made the analysis value tending to the network lateral weighted moisture, and it was demonstrated that by means of the 2 cm depth assimilated the RMSE of 5 cm moisture and 10 cm depth analysis value with COSMIC operator was decreased by 0.347 and 0.008 respectively.