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Revisiting the barometric effect on cosmic-ray neutron soil moisture sensing

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Accurate soil moisture estimation from Cosmic-ray neutron sensor (CRNS) entails necessary steps in pre-processing observed neutrons at the Earth's surface. One of the most important corrections to the measured neutron data is compensation for the influence of the atmosphere, also called the barometric effect (β). However, the correction for this effect is not universal, as values can vary depending on geographical location (i.e. cut-off rigidity), altitude, atmospheric conditions, and sensor type (i.e. energy range); hence, site-specific β values are required to reduce these offsets. In this study, 25 CRNS stations from around the world are used to estimate site-specific and to explore the sensitivity of β on soil moisture measurement with CRNS. The results obtained showed that β varied both spatially and temporally. Within the cut-off rigidity range of 1 to 4.5 GV where these sites are found, the average monthly for the investigated sites ranged between -0.53 to -0.96 %mbar. Although the cut-off rigidity range was small, we found an increasing relationship of β with increasing cut-off rigidity. In addition, we show how β affects soil moisture estimates through its effect on the atmospheric pressure correction during the CRNS calibration. The results of our study highlight the importance of site and sensor-specific for CRNS calibration and the correction of atmospheric effects on CRNS-derived soil moisture.