Supplemental Information for "Neutrons on Rails – trans-regional monitoring of root-zone soil moisture and snow water equivalent"

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Additional Supporting Information (Files uploaded separately)

S4 Data (raw and processed) for the train journey from Garmisch-Partenkirchen to Munich to Leipzig (Manuscript section 3.3). Also attached is the Copernicus SWE geotiff data downloaded from the Copernicus database.

1. S1. The barometric factor for neutron radiation

Cosmic radiation originates in space, producing high-energy neutrons and protons in the upper atmosphere which propagate down to the Earth's surface. The attenuation of these particles by air mass can be expressed by the barometric factor:

$$b = e^{\beta\,(P(z)-P(0))}, \tag{1}$$

which equals the standard pressure correction approach for neutrons (Zreda et al., 2012). Here, $\beta = (135\,\mathrm{hPa})^{-1}$ is the atmospheric attenuation coefficient of neutrons (Hendrick & Edge, 1966; Desilets et al., 2006) and air pressure P is particularly sensitive to changes in altitude z following the barometric formula:

$$P(z) \approx P(0) \cdot (1 - (0.0065\,z)/(T + 0.0065\,z + 273.15))^{5.257}. \tag{2}$$

Parameter $P(0) = 1013.15\,\mathrm{hPa}$ is the standard air pressure at sea level and $T = 20°\mathrm{C}$ is the atmospheric temperature.

References

Desilets, D., Zreda, M., & Prabu, T. (2006). Extended scaling factors for in situ cosmogenic nuclides: new measurements at low latitude. *Earth and Planetary Science Letters*, *246*(3-4), 265–276.

Hendrick, L., & Edge, R. (1966). Cosmic-ray neutrons near the earth. *Physical Review*, *145*(4), 1023.

Zreda, M., Shuttleworth, W. J., Zeng, X., Zweck, C., Desilets, D., Franz, T. E., & Rosolem, R. (2012). COSMOS: the COsmic-ray Soil Moisture Observing System. *Hydrology and Earth System Sciences*, *16*(11), 4079-4099. doi: 10.5194/hess-16-4079-2012