A merging framework for improving field scale root-zone soil moisture measurement with Cosmic-ray neutron probe over Korean Peninsula

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Abstract

Characterization of reliable field-scale root-zone soil moisture (RZSM) variability contribute to effective hydro-meterological monitoring. Although a promising cosmic-ray neutron probe (CRNP) holds the pontential for field-scale RZSM measurement, it is often restricted at deeper depths due to the non-unique sensitivity of CRNP-measured fast neutron signal to other hydrogen pools. In this study, a merging framework relied on coupling cosmic-ray soil moisture with a representative additional RZSM, was introduced to scale shallower CRNP effective depth to represent root-zone layer. We tested our proposed framework over a densely vegetated region in South Korea covering a network of one CRNP and nine in-situ point measurements. In particular, cosmic-ray soil moisture and ancillary RZSM retrieved from the most time stable location were considered as input datasets; whereas the remaining point locations were used to generate a reference RZSM product. The errors between these two input datasets and the reference were forecasted by a linear autoregressive model. A linear combination of forecasts was then employed to compute a suitable weight for merging two input products from the predicted errors. The performance of merging framework was evaluated against reference RZSM in comparison to the two original products and a commonly used exponential filter technique. The results of this study showed that merging framework outperformed other products, demonstrating its robustness in improving field-scale RZSM. Moreover, a strong relationship between the quality of input data and the performance merging framework in light of CRNP effective depth variation has been also underlined via the merging framework.

Keywords : Cosmic-ray neutron probe, Root-zone soil moisture, Temporal stability analysis, Merging technique

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