EGU25-8736, updated on 08 Oct 2025
https://doi.org/10.5194/egusphere-egu25-8736
EGU General Assembly 2025

Evaluation of ASCAT-DIREX soil moisture product using in situ measurements in a small mountain catchment

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Recent improvements in satellite-based soil moisture mapping (higher spatial and temporal resolution) add value to using remotely sensed soil moisture estimates in many hydrological applications (e.g. flood forecasting, drought monitoring, understanding climate change impacts, etc.). However, further analyses are required to validate these data sets reasonably in an alpine environment. This study aims (1) to compare satellite-derived ASCAT-DIREX soil moisture data with in situ surface soil moisture measurements in the well-documented experimental catchment (the Jalovecký Creek catchment), located in the Western Tatra Mountains in Slovakia, (2) to assess the factors controlling the mapping accuracy. As a reference, we used in situ surface soil moisture measurements between 2012 and 2019 at depths of 5 cm (open area, 1500 m a.s.l.) and 10 cm (forest, 1420 m a.s.l.), respectively. Satellite soil moisture estimates are obtained by combining ASCAT and Sentinel-1 data (the ASCAT-DIREX dataset), offering relative daily soil moisture measurements at a 500 m spatial resolution. These estimates represent four characteristic timescales (T = 1, 2, 5, and 10 days) and are compared with in situ surface soil moisture observations. The Pearson correlation coefficient (r) is used to describe the consistency between the two soil moisture estimates. The results reveal that satellite-derived soil moisture correlates more strongly with in situ measurements at the open site and with a T-value of 10 days. The correlations exhibit a pronounced seasonal pattern, with low (negative) values in winter/spring and higher correlations in summer/autumn. The primary cause of low correlations during winter/spring is the insufficient masking of the snowpack. After masking days with snowpack, the correlation in April increases to 0.68 (open site) and 0.92 (forest site), respectively. The reliability of soil moisture estimates during summer is influenced by factors such as small-scale variations in precipitation and vegetation dynamics.

Acknowledgments

This work was supported by the Slovak Research and Development Agency under Contract No. APVV-23-0332 and the VEGA Grant Agency No. 2/0019/23. The support by the Danube Region Programme: DRP0200156 Danube Water Balance is also gratefully acknowledged.