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Validation of long term satellite soil moisture records using tree ring data

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Recently, a multi-decadal dataset of satellite observed soil moisture products has been developed as part of the European Space Agency (ESA) project Earth observation Water Cycle Multi-Mission Observation Strategy (WACMOS). This dataset will be further improved within the Climate Change Initiative (CCI) programme of ESA. This dataset is based on both passive and active microwave observations and has been validated extensively with in situ observations and models. However, these validation studies have always been applied on short periods but were hardly evaluated for long term variations (> 10 years). This study aims on the use of tree ring data for annual variation validation. Tree rings chronologies are sensitive to climate variations and have successfully been used in the past to reconstruct evaporation, precipitation and drought fluctuations. The preservation of climate records in tree ring data makes it therefore potentially suitable for independent satellite validation. Tree ring data from different climate regimes were obtained from the international tree ring databank and compared to the 32 year (1979-2010) satellite soil moisture record. The dominant tree ring signal was retrieved by applying an empirical orthogonal Function (EOF) analysis on the normalized tree ring widths for the selected areas. This signal was then compared to soil moisture and the analysis revealed a strong relationship between annual tree ring width and soil moisture observation. Especially the soil moisture conditions during spring time have strong impact on the tree ring width. These first results give us confidence in the reliability of the annual variations of the multi-decadal products. The productive years corresponded with high soil moisture values and the opposite was found for less productive years. Although this is still based on a few selected tree ring sites we believe that data from the tree ring data bank can have a strong potential as a validation tool for long record satellite datasets. However, further research on more sites is still necessary to confirm the consistency of such an approach.