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Verification and comparison of SMOS ascending and descending soil moisture observations at a catchment scale: implications to hydrology

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Soil moisture has been widely recognized as a key element in hydrological processes and plays a significant role in hydrological modelling, which is now possible to be measured by satellite techniques. However most previous papers only discussed on their evaluations against point-based ground measurements and analyzed only one orbit (i.e. ascending overpass). It is known that the global Level-3 soil moisture dataset generated from the Soil Moisture and Ocean Salinity (SMOS) observations has been released lately by the Barcelona Expert Center. In order to solve the aforementioned problems, this study particularly focused on catchment scale assessment, where the Soil Moisture Deficit (SMD) derived from the three-layer Xinanjiang (XAJ) model was employed as a hydrological benchmark for all the evaluations and comparisons. Moreover both ascending and descending overpasses were analyzed for a more comprehensive comparison. It was interesting to find that the SMOS soil moisture accuracy was not improving with time as we would have expected. Moreover none of the overpasses provided reliable soil moisture estimates in the frozen season, especially for the ascending orbit. When frozen periods were removed, both overpasses presented significant improvement (i.e. the correlations increased from r = -0.53 to r = -0.65 and from r = -0.62 to r = -0.70, for ascending and descending overpasses respectively). Furthermore it was noted that SMOS retrievals from descending overpass were consistently about 11.7% by volume wetter than ascending retrievals. The overall evaluation demonstrated that descending orbit surpassed the ascending orbit, which contradicted the results found in many studies. Finally, the potential reasons were discussed.