EGU General Assembly 2021

EGU21-10740
https://doi.org/10.5194/egusphere-egu21-10740
EGU General Assembly 2021

The development and relevance of a consistent flagging strategy for multi-sensor satellite soil moisture climate records

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The quality of soil moisture retrievals from passive microwave satellite sensors is limited during certain conditions, e.g. snow coverage, radio-frequency interference and dense vegetation. Therefore, masking the retrievals in these conditions by data flagging algorithms is vital for the production of reliable satellite-based products. However, these products utilise different flagging methods. A clear overview and comparison of these methods and their impact on the data are lacking. For long-term soil moisture records such as the ESA CCI soil moisture products, the impact of any flagging inconsistency from combining multiple sensor datasets was not assessed.

Recently, Van der Vliet et al. (2020) provided a review of the data flagging system that is used within multi-sensor ESA CCI soil moisture products as well as the flagging systems of two other soil moisture datasets from sensors that are also used for the ESA CCI soil moisture products: The level 3 Soil Moisture and Ocean Salinity (SMOS) and the Soil Moisture Active/Passive (SMAP). Substantial differences were detected between the SMOS and SMAP soil moisture flagging systems in terms of the number and type of conditions considered, critical flags, and data source dependencies. The impact on the data availability of the different flagging systems was shown to differ globally and especially for northern high latitudes, mountainous regions, and equatorial latitudes (up to 37%, 33%, and 32% respectively) with large seasonal variability. These results highlighted the relevance of a consistent and well-performing flagging approach that is applicable to all individual products used in long-term soil moisture data records.

Consequently, Van der Vliet et al. (2020) designed a consistent and model-independent flagging strategy to improve soil moisture climate records. For the snow cover, ice, and frozen conditions, which were found to have the highest impact on data availability, a uniform satellite driven flagging strategy was designed and evaluated against two ground observation networks. Compared to the individual flagging approaches adopted by the SMOS and SMAP soil moisture datasets, the new flagging approach was demonstrated to be a robust flagging alternative, with a similar performance, but with the applicability to the full ESA CCI historical record without the use

of modelled approximations.

A part of the designed flagging decision tree demonstrated to form a good base for the filtering of bare grounds and heavy precipitation events as well. A future extension of the flagging strategy is expected to mask these conditions, as well as other conditions such as radio frequency interference and dense vegetation.