



Fiducial Reference Measurements for Soil Moisture (FRM4SM): recent progress in error source identification and traceable uncertainty budget calculation

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In situ soil moisture data is used as the main reference for the validation of satellite soil moisture products. Although in situ measurements are often referred to as the “ground truth” and we have an understanding of the error sources, the magnitudes of the uncertainties associated with in situ measurements and methods to eliminate these uncertainties are hardly known. However, in order to achieve the best possible Return Of Investment (ROI) for a satellite mission, reliable and fully characterized in situ reference datasets are crucial.

ESA’s Fiducial Reference Measurement for Soil Moisture project (FRM4SM) was launched in 2021 to tackle the establishment of comprehensive and fully characterized, traceable uncertainty budgets for in situ soil moisture observations at the satellite footprint scale. The project aims to address the following scientific questions to facilitate the creation and exploitation of such Fiducial Reference Measurements (FRMs), using the International Soil Moisture Network (ISMN) as the in situ source and ESA’s Soil Moisture and Ocean Salinity (SMOS) mission as an example satellite product:

- (1) understand the status quo and means to establish an (SI-)traceable uncertainty budget for in situ soil moisture measurements
- (2) identify error sources that impact the in situ measurement
- (3) create quality indicators that allow to identify the most reliable “soil moisture FRMs” from the ISMN
- (4) verify and demonstrate the merit of these select soil moisture FRMs within validation case studies,
- (5) create protocols and procedures for the creation and use of such an FRM subset, which are

built upon community=agreed standards and practices

(6) integrate the established FRM dataset and all developed validation methods into the freely-accessible Quality Assurance for Soil Moisture (QA4SM) online validation service

In this presentation, we will introduce the FRM4SM project and highlight our latest achievements and ongoing developments. Furthermore, we will discuss future directions, and give insights into challenges that need to be overcome in order to achieve a traceable uncertainty budget calculation for in situ soil moisture data at the satellite footprint scale.