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Towards the best L-band soil moisture representation – Comparing SMOS satellite pixel with ELBARA footprints

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Continuous and long-lasting measurements of soil moisture provide relevant data about changes in water content and contribute to better understanding of local and global water cycle. In this study we use the ESA L-band Radiometer (ELBARA), mounted on a tower situated between fallow, meadow, cultivated field and Bubnow wetland, enabling continuous observations of different land-covers, in natural seasonal cycle over the year. Bubnow is a swamp in Poland, unique due to its nearly undisturbed hydrological conditions. Owing to the azimuth tracking capabilities, the ELBARA maps the brightness temperatures around the tower within the observation angles varying from 35° to 85° and full circle of azimuths (from 0° to 350°, with 10° step). To evaluate the brightness temperature changes measured over the year we have analysed the Hovmöller diagrams. They were compared with time-courses of surface soil moisture and precipitation measured by the nearby agrometeorological station to assess how the specific footprints reacted to wetting/drying cycle. We have noticed that only a few footprints decreased brightness temperatures after rain events. Most of them increased it, what is characteristic for strong rain interception effects. However, this was expected for rather dense vegetation and needs further investigation. Looking at the diagrams, we have chosen several spatio-temporal structures that are planned for future experiments including biochar and other soil amendments. In order to check if any ELBARA footprint on Bubnow may be treated as “representative” for the entire area, we compared the brightness temperatures measured by two L-band detecting devices: ELBARA radiometer and Soil Moisture and Ocean Salinity (SMOS) satellite. Despite the huge scale difference (single ELBARA footprint covers about 25 m2, whereas SMOS DGG pixel is approx. 200 km2), the comparison of the time-series shown some important relations. Coefficient of determination revealed that the lowest ELBARA-SMOS agreement was for cultivated field, which may be caused by modification (thus diversification) of this area through plant cultivation, mowing and soil ploughing. Wetland, due to the high level of organic matter and lush vegetation cover, showed only a partial agreement. The meadow appears the best match with SMOS result, which is probably a consequence of meadow-agricultural land cover domination in the examined pixel. Also high sand content, low vegetation and thus reduced number of factors influencing thermal radiation may be the reasons for such fair agreement. It should be noted that this comparison refers to measurements for 18 months, which allows observing signal stability in various weather conditions.
The overall conclusion is that the in most of the observed footprints the measured brightness temperatures were strongly influenced by vegetation, litter and interception effects and only partially by soil moisture. Despite that fact, it was possible to determine the footprint representative for the entire pixel area seen by SMOS satellite.
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