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Soil moisture estimation by airborne active and passive microwave remote sensing: A test-bed for SMAP fusion algorithms

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The objective of the NASA Soil Moisture Active & Passive (SMAP) mission is to provide global measurements of soil moisture and its freeze/thaw state. The SMAP launch is currently planned for 2014-2015. The SMAP measurement approach is to integrate L-band radar and L-band radiometer as a single observation system combining the respective strengths of active and passive remote sensing for enhanced soil moisture mapping. The radar and radiometer measurements can be effectively combined to derive soil moisture maps that approach the accuracy of radiometer-only retrievals, but with a higher resolution (being able to approach the radar resolution under some conditions).
Aircraft and tower-based instruments will be a key part of the SMAP validation program. Here, we present an airborne campaign in the Rur catchment in Germany, in which the passive L-band system Polarimetric L-band Multi-beam Radiometer (PLMR2) and the active L-band system DLR F-SAR were flown on six dates in 2013. The flights covered the full heterogeneity of the area under investigation, i.e. all types of land cover and experimental monitoring sites.

These data are used as a test-bed for the analysis of existing and development of new active-passive fusion techniques. A synergistic use of the two signals can help to decouple soil moisture effects from the effects of vegetation (or roughness) in a better way than in the case of a single instrument. In this study, we present and evaluate three approaches for the fusion of active and passive microwave records for an enhanced representation of the soil moisture status: i) estimation of soil moisture by passive sensor data and subsequent disaggregation by active sensor backscatter data, ii) disaggregation of passive microwave brightness temperature by active microwave backscatter and subsequent inversion to soil moisture, and iii) fusion of two single-source soil moisture products from radar and radiometer.