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Active-Layer Soil Moisture Content Regional Variations in Alaska and Russia by Ground-Based and Satellite-Based Methods, 2002 Through 2014

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Soil moisture is a vital physical parameter of the active-layer in permafrost environments, and associated biological and geophysical processes operative at the microscopic to hemispheric spatial scales and at hourly to multidecadal time scales. While in-situ measurements can give the highest quality of information on a site-specific basis, the vast permafrost terrains of North America and Eurasia require space-based techniques for assessments of cause and effect and long-term changes and impacts from the changes of permafrost and the active-layer. Satellite-based 6.925 and 10.65 GHz sensor algorithmic retrievals of soil moisture by Advanced Microwave Scanning Radiometer – Earth Observation System (AMSR-E) onboard NASA-Aqua and follow-on AMSR2 onboard JAXA-Global Change Observation Mission – Water-1 are ongoing since July 2002. Accurate land-surface temperature and vegetation parameters are critical to the success of passive microwave algorithmic retrieval schemes. Strategically located soil moisture measurements are needed for spatial and temporal co-location evaluation and validation of the space-based algorithmic estimates. We compare on a daily basis ground-based (subsurface-probe) 50- and 70-MHz radio-frequency soil moisture measurements with NASA- and JAXA-algorithmic retrieval passive microwave retrievals. We find improvements in performance of the JAXA-algorithm (AMSR-E reprocessed and AMSR2 ongoing) relative to the earlier NASA-algorithm version. In the boreal forest regions accurate land-surface temperatures and vegetation parameters are still needed for algorithmic retrieval success. Over the period of AMSR-E retrievals we find evidence of at the high northern latitudes of growing terrestrial radio-frequency interference in the 10.65 GHz channel soil moisture content. This is an important error source for satellite-based active and passive microwave remote sensing soil moisture retrievals in Arctic regions that must be addressed.
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