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A change detection algorithm for retrieving high resolution soil moisture from SMAP radar and radiometer observations

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Soil moisture is a critical hydrological variable that links the terrestrial water, energy and carbon cycles. Global and regional observations of soil moisture are needed to estimate the water and energy [U+FB02]uxes at the land surface, to quantify the net carbon [U+FB02]ux in boreal landscapes, to enhance weather and climate forecast skill and to develop improved [U+FB02]ood prediction and drought monitoring capability. Active and Passive L-band microwave remote sensing provide a unique ability to monitor global soil moisture over land surfaces with an acceptable spatial resolution and temporal frequency [1].

Radars are capable of a very high spatial resolution ($\sim$ 3km) but, since radar backscatter is hightly in[U+FB02]uenced by surface roughness, vegetation canopy structure and water content, they have a low sensitivity to soil moisture, and the algorithms developed for retrieval of soil moisture from radar backscattering are only valid in low-vegetation water content conditions [3]. In contrast, the spatial resolution of radiometers is typically low ($\sim$ 40km), they have a high sensitivity to soil moisture, and the retrieval of soil moisture from radiometers is well established [4]. To overcome the individual limitations of active and passive approaches, the Soil Moisture Active and Passive (SMAP) mission of the NASA, scheduled for launch in the 2010-2013 time frame, is combining these two technologies [2]. The SMAP mission payload consists on an approximately 40-km L-band microwave radiometer measuring hh and vv brightness temperatures and a 3-km L-band synthetic aperture radar sensing backscatter cross-sections at hh, vv and hv polarizations. It will provide global scale land surface soil moisture observations with a three day revisit time and its key derived products are: soil moisture at 40-km for hydroclimatology, obtained from the radiometer measurements; soil moisture at 10-km resolution for hydrometeorology obtained by combining the radar and radiometer measurements in a joint retrieval algorithm; and freeze/thaw state at 3-km resolution from the radar measurements. A downscaling algorithm has been developed for combining the high radar resolution and the high radiometer accuracy into an optimal blend for the SMAP 10-km soil moisture product.