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SMALT - Soil Moisture from Altimetry

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Soil surface moisture is a key scientific parameter; however, it is extremely difficult to measure remotely, particularly in arid and semi-arid terrain. This paper outlines the development of a novel methodology to generate soil moisture estimates in these regions from multi-mission satellite radar altimetry. Key to this approach is the development of detailed DRy Earth ModelS (DREAMS), which encapsulate the detailed and intricate surface brightness variations over the Earth's land surface, resulting from changes in surface roughness and composition.
DREAMS have been created over a number of arid and semi-arid deserts worldwide to produce historical SMALT timeseries over soil moisture variation. These products are available in two formats – a high resolution track product which utilises the altimeter's high frequency content alongtrack and a multi-looked 6" gridded product at facilitate easy comparison/integeration with other remote sensing techniques. An overview of the SMALT processing scheme, covering the progression of the data from altimeter sigma0 through to final soil moisture estimate, is included along with example SMALT products.
Validation has been performed over a number of deserts by comparing SMALT products with other remote sensing techniques, results of the comparison between SMALT and Metop Warp 5.5 are presented here. Comparisons with other remote sensing techniques have been limited in scope due to differences in the operational aspects of the instruments, the restricted geographical coverage of the DREAMS and the low repeat temporal sampling rate of the altimeter. The potential to expand the SMALT technique into less arid areas has been investigated. Small-scale comparison with in-situ and GNSS-R data obtained by the LEiMON experimental campaign over Tuscany, where historical trends exist within both SMALT and SMC probe datasets. A qualitative analysis of unexpected backscatter characteristics in dedicated dry environments is performed with comparison between Metop ASCAT and altimeter sigma0 over Saharan Africa. Geographical correlated areas of agreement and disagreement corresponding to underlying terrain are identified.
SMALT products provide a first order estimation of soil moisture in areas of very dry terrain, where other datasets are limited. Potential to improve and expand the technique has been found, although further work is required to produce products with the same accuracy confidence as more established techniques. The data are made freely available to the scientific community through the website http://tethys.eaprs.cse.dmu.ac.uk/SMALT