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Soil Moisture from Satellite Radar Altimetry (SMALT)

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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. These models are made by cross-calibrating and reconciling multi-mission altimeter sigma0 measurements from ERS1, ERS2, EnviSat and Jason2. This approach is made possible because altimeters are nadir-pointing, and most of the available radar altimeter datasets are from instruments operating in Ku band. These DREAMS are complicated to build and require multiple stages of processing and manual intervention. However this approach obviates the requirement for detailed ground truth to populate theoretical models, facilitating derivation of surface soil moisture estimates over arid regions, where detailed survey data are generally not available.

This paper presents results from the creation of the DREAMS over desert surfaces, and showcases the model development over the Simpson desert, the Sahara, and the Kalahari desert. A global assessment is given of areas where DREAMS may successfully be generated, and an outline of the required processing to obtain soil surface moisture estimates is given. Results for altimeter derived soil moisture validation are presented for the Simpson desert, assessed against the Queensland Climate Change Centre AussieGRASS model outputs. First soil moisture products from ERS2 and EnviSat radar altimetry in arid regions are presented, and the temporal and spatial resolution of these data are analysed.

The results generated by this ESA sponsored initiative will be made freely available to the global scientific community. First products are planned for release within the next twelve months. Further information can be found at http://tethys.eaprs.cse.dmu.ac.uk/SMALT.