Geophysical Research Abstracts
Vol. 19, EGU2017-9553-4, 2017
EGU General Assembly 2017


# Global Scale Simultaneous Retrieval of Smoothened Vegetation Optical Depth and Surface Roughness Parameter using AMSR-E X-band Observations

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Traditionally, passive microwave retrieval algorithms such as Land Parameter Retrieval Model (LPRM) estimate simultaneously soil moisture and Vegetation Optical Depth (VOD) using brightness temperature (Tb) data. The algorithm requires a surface roughness parameter which – despite implications – is generally assumed to be constant at global scale. Due to inherent noise in the satellite data and retrieval algorithm, the VOD retrievals are usually observed to be highly fluctuating at daily scale which may not occur in reality. Such noisy VOD retrievals along with spatially invariable roughness parameter may affect the quality of soil moisture retrievals. The current work aims to smoothen the VOD retrievals (with an assumption that VOD remains constant over a period of time) and simultaneously generate, for the first time, global surface roughness map using multiple descending X-band Tb observations of AMSR-E. The methodology utilizes Tb values under a moving-time-window-setup to estimate concurrently the soil moisture of each day and a constant VOD in the window. Prior to this step, surface roughness parameter is estimated using the complete time series of Tb record. Upon carrying out the necessary sensitivity analysis, the smoothened VOD along with soil moisture retrievals is generated for the 10-year duration of AMSR-E (2002-2011) with a 7-day moving window using the LPRM framework. The spatial patterns of resulted global VOD maps are in coherence with vegetation biomass and climate conditions. The VOD results also exhibit a smoothening effect in terms of lower values of standard deviation. This is also evident from time series comparison of VOD and LPRM VOD retrievals without optimization over moving windows at several grid locations across the globe. The global surface roughness map also exhibited spatial patterns that are strongly influenced by topography and land use conditions. Some of the noticeable features include high roughness over mountainous regions and heavily vegetated tropical rainforests, low roughness in desert areas and moderate roughness value over higher latitudes. The new datasets of VOD and surface roughness can help improving the quality of soil moisture retrievals. Also, the methodology proposed is generic by nature and can be implemented over currently operating AMSR2, SMOS, and SMAP soil moisture missions.