Geophysical Research Abstracts
Vol. 16, EGU2014-5250, 2014
EGU General Assembly 2014
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Detection of changes in soil moisture content using GNSS SNR signals

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As multipaths still represent a major problem for reaching precise GNSS positioning, the mitigation of their influence has been widely investigated. However, previous studies have lately proposed to use these interferences of GNSS electromagnetic waves to estimate parameters related to the reflecting surface (e.g., antenna heights, rugosity,...). Variations of the nature of the surface is likely to modify the properties of the reflected waves, and consequently lead to variations of amplitude / phase of the signal-to-noise ratio (SNR), e.g. recorded at 1 Hz by a GNSS L1 and L2 receiver. By analyzing the time variations of SNR measurements linked to the dielectric constant of the surrounding soil, we use a method to recover the local fluctuations of the soil moisture content. It is simply based on the obvious linear correlation between SNR amplitude / phase time series and measurements of humidity probe at 5 and 10 cm depths. This method of combination is applied to determine soil moisture in a corn and soya field at Lamasquère, France, for ten successive days. Possible improvements are currently investigated, in particular the possibility of cumulating SNR data from several GNSS satellites of different constellations (GPS, GLONASS, Galileo) to obtain denser and more accurate estimates of soil moisture.