

Soil Moisture Measurements Based on GNSS-R

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GNSS-R (Global Navigation Satellite System-Reflectometry) is a passive bistatic radar sensing system using reflections of GNSS signals off the Earth's surface. Its applications range from altimetry to measurements of soil moisture and vegetation, and of these applications this research will focus on soil moisture measurements, which are essential for understanding the hydrological cycle, useful for predicting floods and droughts, and applicable to agricultural estimations. The main data products of GNSS-R are called Delay Doppler Maps (DDMs), which are array-like data arranged by the delay and the Doppler frequency of the signal. Previous researches indicate a correlation between DDM and soil moisture, but there are few researches who aim to precisely retrieve soil moisture from spaceborne GNSS-R devices. The proposed method created datasets treating the DDM data from CYclone Global Navigation Satellite System (CYGNSS) project as the feature and the surface soil moisture data retrieved from the Soil Moisture Active Passive (SMAP) project as the training data, and applied Support Vector Machines (SVM) to investigate the correlation between them. The average and the standard deviation of the accuracy of 4-fold cross validation was used to evaluate the correlation. Six different points that have a variation in soil moisture were investigated, and the results displayed a certain correlation between the two data at four of the six points. In particular, a point in Eastern India displayed an average in accuracy of over 80% in all investigations. However, the standard deviation tended to display a value as large as $\pm 20\%$, and this value must be improved to be used in applications. Further investigation is planned using the precipitation data retrieved from Global Satellite Mapping of Precipitation (GSMaP) by JAXA, and an improvement in correlation is expected by this approach.

Keywords: Remote Sensing, Soil Moisture, GNSS-R, Machine Learning