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Applicability of TVDI (Temperature Vegetation Dryness Index) to the Assessment of Soil Moisture Spatial Resolution Variability in the Valencia Anchor Station in the Framework of F SMOS Validation Activities

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Longitude: 39,783º - 38,672º N
Latitude: 2,572º - 1,105º W

Soil moisture content is highly variable in time and space and therefore quite difficult to be characterized in large areas. The *Temperature Vegetation Dryness Index* (TVDI) can readily be obtained from surface temperature (Ts) and normalized difference vegetation index (NDVI) remote sensing measurements and contains valuable information on the spatial pattern of soil moisture

Validation of SMOS soil moisture products requires an independent knowledge of this parameter in large extended areas, at least of the order of about 50 x 50 km². The Valencia Anchor Station, a reasonably homogeneous site in Eastern Spain, of about that size, has been chosen as a core validation area for SMOS land products. The site has been heavily equipped with soil moisture related instruments and been object of a significant number of field and aircraft campaigns.

The large dataset of soil moisture measurements both from the network installed and from the field and aircraft campaigns (ESA SVRC 2008, CNES CAROLS 2009 and ESA-CNES CAROLS 2010) has been confronted to MODIS TDVI derived estimations and the relationship between both parameters is giving us sufficient insight to allow for the spatialization of the soil moisture measurements to larger areas.

Methodology

The method for obtaining the TVDI is a simplification of the approach described by Moran et al. (1994). The main advantage of this method is that it can be obtained both for vegetation and bare surfaces and that is entirely based on remote sensing information.

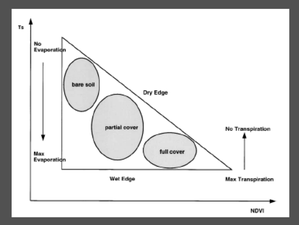


Fig 1. Distrubution of soil types in the Triangle Method (Sandholt et al., 2002)

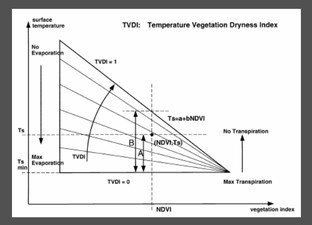


Fig 2. Definition of TVDI (Sandholt et al., 2002)

The upper limit (dry edge) represents soils with no moisture available, the lower limit (wet edge) represents moistured soil.

$$TSS_{max} = a + b*NDVI$$

$$TVDI = \frac{TSS - TSS_{min}}{a + b \cdot NDVI - TSS_{min}}$$

We use here data from 3 soil moisture stations from the Climatology from Satellites Group:

-V1 (39,548º, -1,277º)
-M4 (39,573˚, -1,251º)
-MELBEX-2 (39,522º, -1,292º)

Results

Example of TVDI (25/09/2009)

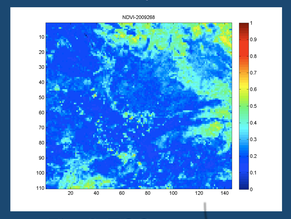


Fig 3.TSS

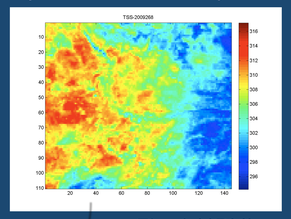


Fig 4.NDVI

Fig 5.Scatterplot NDVI vs TSS

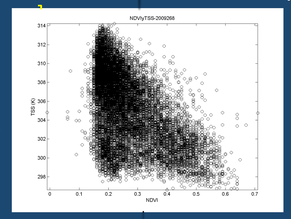
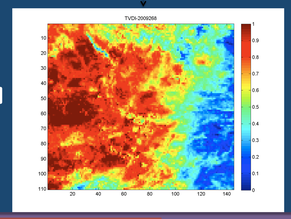
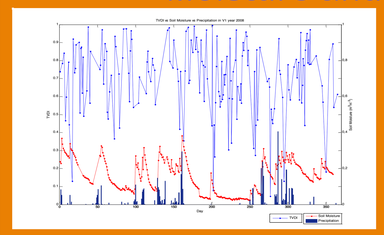
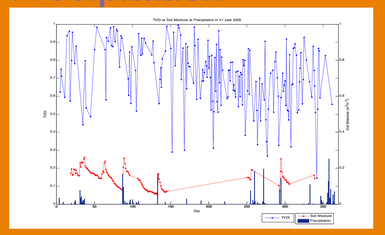


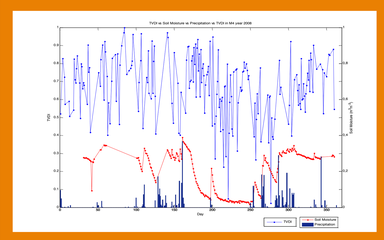
Fig 6.TVDI

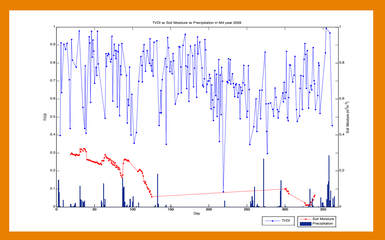


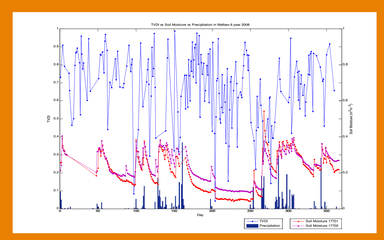
Temporal evolution of TVDI along with Soil Moisture and Precipitation

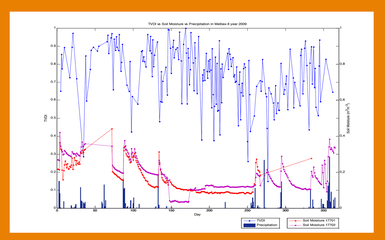




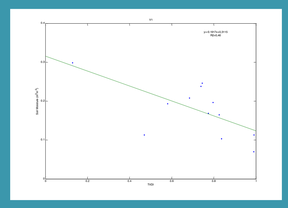


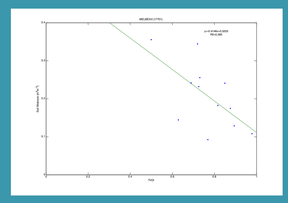


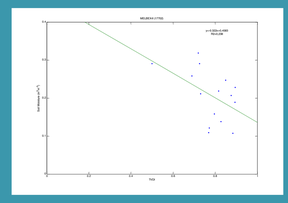




Relationship TVDI & Soil Moisture







Conclusions

TVDI is sensible to rainfall amounts. In particular, the highest values of TVDII appear during periods with little or no precipitation, while they tend to be lower on days with higher amounts of precipitation. High values of TVDI mean dry conditions and low values of TVDI mean wet conditions. It can be assumed that the temporal evolution of TVDI can potentially be used to capture the temporal variation of soil moisture. A complicating factor is that the estimate of TVDI satellite data is very sensitive to cloud cover. The estimate of TVDI is problematic in locations near urban areas that distort the signal (eg. M4). The main advantage of this method is that it can be obtained both for vegetation and bare surfaces and that it is entirely based on remote sensing information

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