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Estimation of the surface soil moisture from polarimetric Radarsat imagery in the Braila agricultural area

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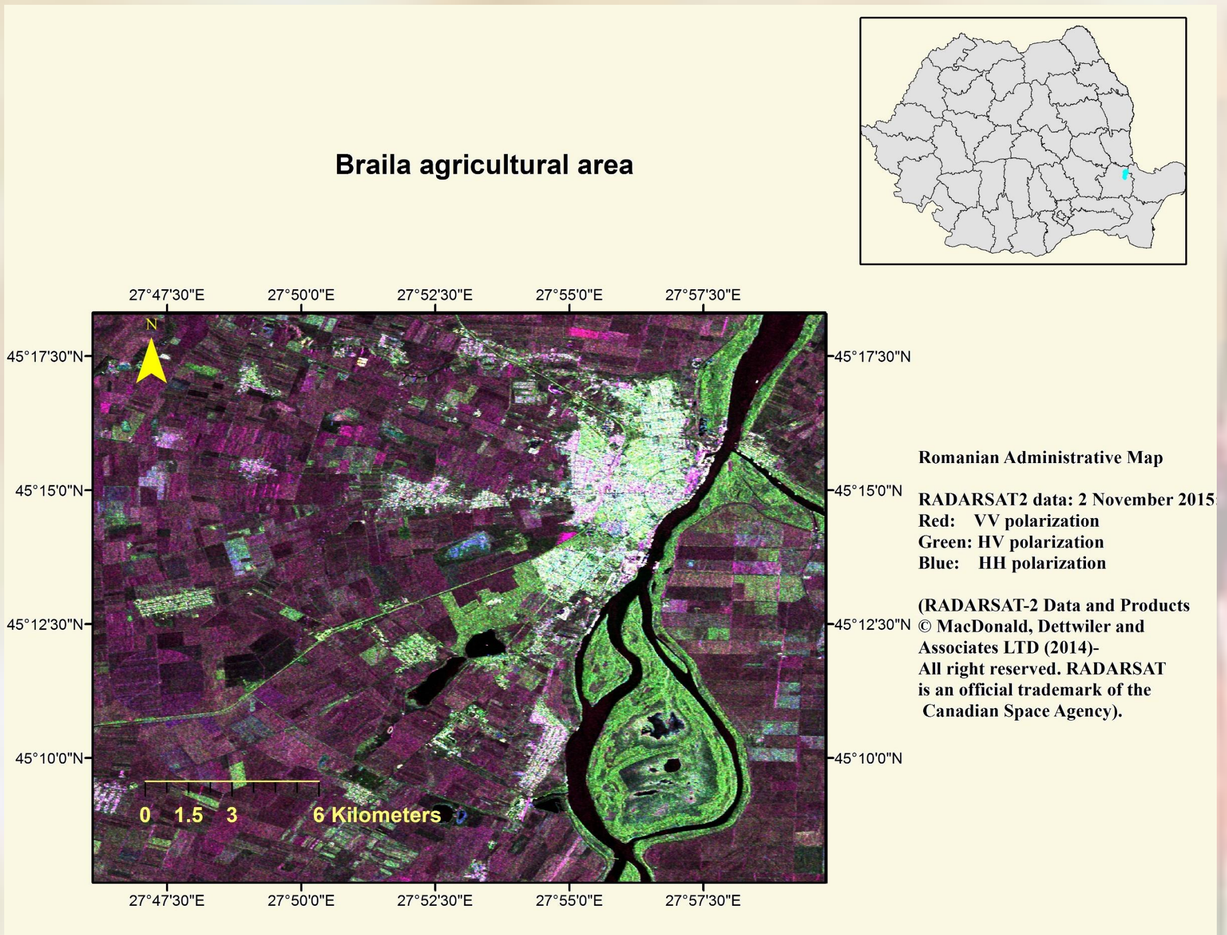


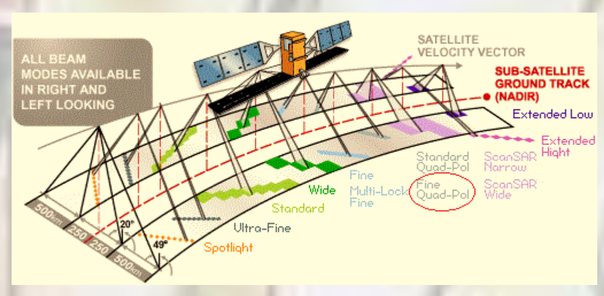
Introduction

Soil moisture is a key parameter that plays a critical role in the surface energy balance at the soil atmosphere interface with direct influence on the evaporation, the runoff generation and the percolation of the water into the soil. The main goal of this paper is to estimate the surface soil moisture of an agricultural area affected by soil salinization and erosion. The second goal is to relate soil moisture with spatio-temporal dynamics of land degradation using Synthetic Aperture Radar (SAR) interferometry. The experimental analysis is carried out on data acquired in the joint ESA-CSA SOAR Europe 16605 scientific proposal over the North Braila Terrace agricultural area during 2014-2015 from the RADARSAT2 in Quad Fine mode. The chosen test area - Braila Plain has the special particularities such as: dry climate, high annual average temperatures (9-11^{0}C), very dry and hot summers which cause a large potential evapotranspiration and conduct to a moisture deficit in soil, alkaline soils, winter winds with an average speed of 2.7 - 3.4 m/s. The soil type and climate conditions favor the culture of maize (50%), wheat and successive crops (16%), alpha-alpha (18%), sugar beet (6%), sunflower (7%), vegetables and other crops (3%).

Dataset

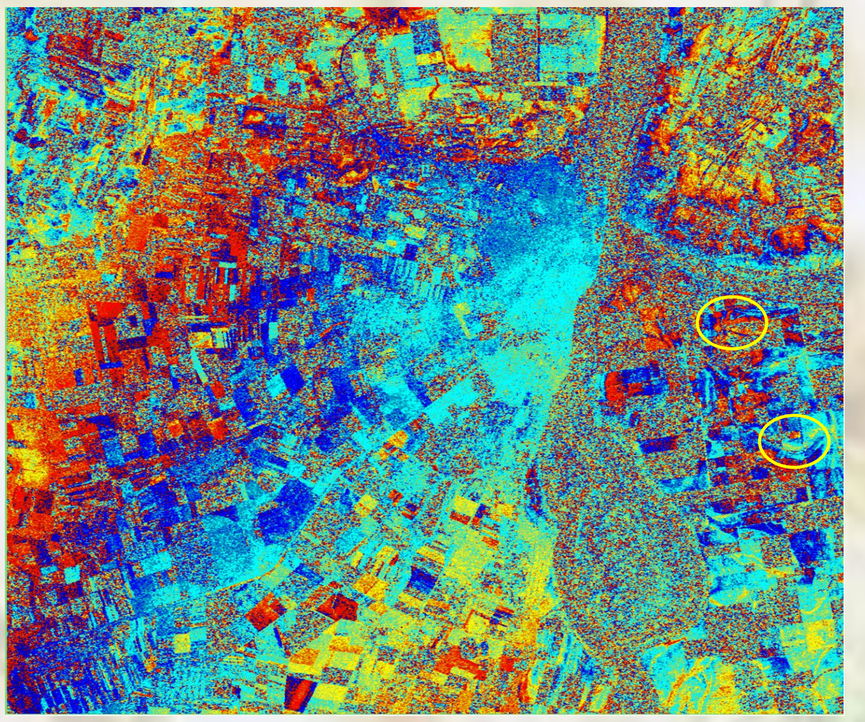
RADARSAT2 data have a resolution of 5x7 m, an incidence angle of 30^0 and descending mode configuration. The SAR data were calibrated, filtered and geocoded using a VHR DEM and orbit descriptors. In order to estimate surface soil moisture, salt tolerant wheat and rape genotypes have been chosen for comparison with each other. Therefore, backscattering coefficients were extracted on 4 winter wheat and 4 winter colza sampling units of 1 ha each.

Date index	Acquisition date
1	03.08.2014
2	27.08.2014
3	20.09.2014
4	07.11.2014
5	31.03.2015
6	24.04.2015
7	18.05.2015
8	11.06.2015
9	29.07.2015
10	22.08.2015
11	15.09.2015
12	10.09.2015
13	02.11.2015
14	26.11.2015

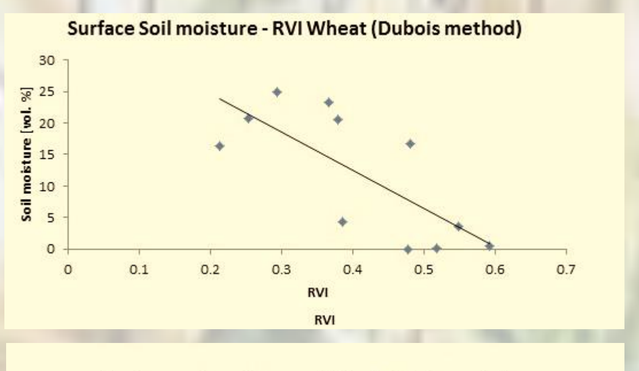


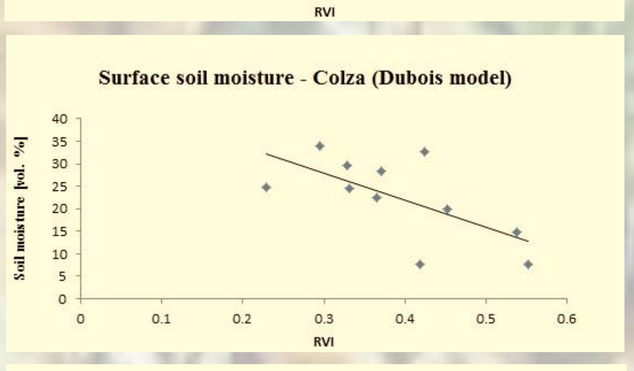
Methodology and results

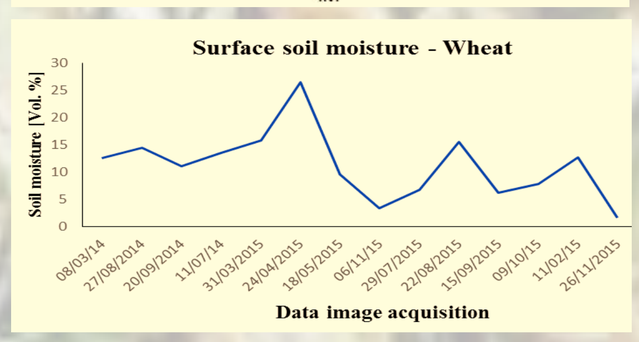
PolSAR technique was applied to invert the soil moisture over bare fields and to decompose the signal on the scattering mechanism components. Also, the InSAR, PolInSAR and multi-temporal SAR analysis were performed for polarimetric SAR signal interaction monitoring. Taking into account the soil type, climate conditions and geomorphological characteristics of the studied area, Oh and Dubois semi-empirical scattering models were applied for the volumetric soil moisture and surface roughness estimation.

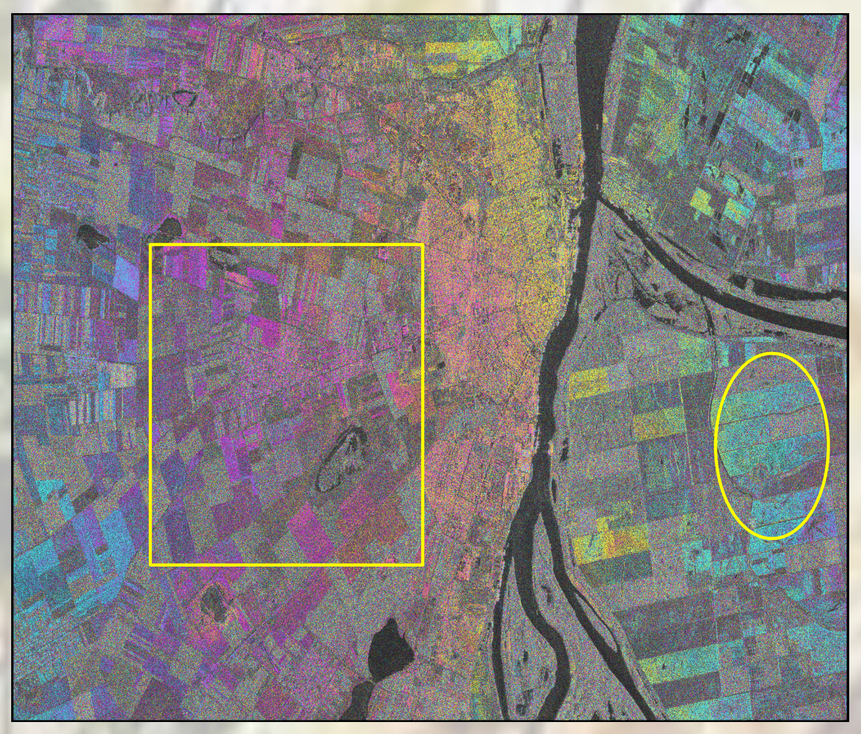


Coherence optimization for 09.10-02.11.2015 image pair: high values correspond to areas with salty soils while decorrelation is observed in the fields with high moisture content. *RADARSAT-2 Data and Products© MacDonald, Dettwiler and Associates LTD (2014)- All right reserved. RADARSAT is an official trademark of the Canadian Space Agency).*









Differential interferogram retrieved from 31.03-24.04.2016: high values correspond to degraded areas while decorrelation is observed in the fields with high moisture content. *RADARSAT-2 Data and Products© MacDonald, Dettwiler and Associates LTD (2014)- All right reserved. RADARSAT is an official trademark of the Canadian Space Agency).*

Conclusion

Soil moisture estimated from full polarimetric RADARSAT 2 data shows a deficit in the moisture content during autumn-spring season with an improvement in harvest stage due to the irrigation measures. Soil moisture – radar vegetation index dependency: a good correlation is observed for rape while wheat is less sensitive.

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