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Optical and radar satellite synergy for the estimation of the surface water condition

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Soil moisture is a key parameter in agricultural process and an important measure for crop yield prediction. The monitoring of soil moisture allows a quick detection of water stress over agricultural areas. Radar sensors allow Soil moisture mapping regardless of the meteorological and temporal conditions. With the arrival of Sentinel-1 and Sentinel-2 ESA spatial missions, data is acquired with high spatial and temporal resolution over different regions in the world.
In the semi arid regions the absence of rainfall, with the occurrence of long periods of drought, represents one of the main environmental factors having a negative effect on agricultural productivity. The evaluation of vegetation cover and the monitoring of soil moisture are indispensable in these regions.
The aim of this study is to optimize an optical and radar data synergy for a regional mapping of soil water content, through experimental campaigns over agricultural fields in the Kairouan plain, in the central of Tunisia, during two agricultural seasons (2015-2016 and 2016-2017). Firstly, a radiative transfer model, Water Cloud Model is calibrated using NDVI index acquired from Sentinel-2 images to eliminate the vegetation effects on radar signal. Secondly, an inversion approach based on the calibrated Water Cloud Model is applied over bare soils and wheat fields (Irrigated and non irrigated fields). In this context, a mapping of surface moisture is proposed at 20 m spatial resolution with a six day repeat frequency for the entire studied site.
This study reveals the high potential of Sentinel-1 data, when combined in synergy with optical images (Sentinel-2), for the recovery of moisture and vegetation characteristics. In this context, the proposed approach is validated ground truth measurements during the period (2015-2017). The maps produced from radar acquisitions are found to be reasonably correlated with the field measurements.