EGU2020-7408
https://doi.org/10.5194/egusphere-egu2020-7408
EGU General Assembly 2020

Mapping surface soil moisture over wheat crops in southern Mediterranean regions using the backscattering coefficient and the interferometric coherence derived from Sentinel-1

Nadia Ouaadi[1,2], Lionel Jarlan[2], Jamal Ezzahar[3,4], Saïd Khabba[1,4], Mehrez Zribi[2], Elhoussaine Bouras[2,5], Safa Bousbih[2,6], and Pierre-Louis Frison[7]

[1]Cadi Ayyad University, FSSM, LMME, Marrakech,Morocco (nadia.ouaadi@gmail.com)
[2]University of Toulouse,CESBIO, IRD/CNRS/UPS/CNES, Toulouse, France
[3]Cadi Ayyad University, ENSA, MTI, Safi, Morocco
[4]University Mohammed VI Polytechnic, CRSA, BenGuerir, Morocco
[5]Cadi Ayyad University, FSTG , LP2M2E, Marrakech, Morocco.
[6]National Institute of Agronomy of Tunis, INAT, GREEN-TEAM, Tunis, Tunisia.
[7]University of Paris-Est, IGN, LaSTIG//MATWAS, Champs sur Marne, Paris, France.

High spatial and temporal resolution products of Sentinel-1 are used for surface soil moisture (SSM) mapping over wheat fields in semi-arid areas. Within these regions, monitoring the water-use is a critical aspect for optimizing the management of the limited water resources via irrigation monitoring. SSM is one of the principal quantities affecting microwave remote sensing. This sensitivity has been exploited to estimate SSM from radar data, which has the advantages of providing data independent of illumination and weather conditions. In addition, with the use of Sentinel-1 products, the spatial and temporal resolution is greatly improved. Within this context, the main objective of this work is estimate SSM over wheat fields using an approach based on the use of C-band Sentinel-1 radar data only. Over the study site, field measurement are collected during 2016-2017 and 2017-2018 growing seasons over two fields of winter wheat with drip irrigation located in the Haouz plain in the center of Morocco. Data of other sites in Morocco and Tunisia are taken for validation purposes. The validation database contains a total number of 20 plots divided between irrigated and rainfed wheat plots. Two different information extracted from Sentinel-1 products are used: the backscattering coefficient and the interferometric coherence. A total number of 408 GRD and 419 SLC images were processed for computing the backscattering coefficient and the interferometric coherence, respectively. The analysis of Sentinel-1 time series over the study site show that coherence is sensitive to the development of wheat, while the backscatter coefficient is widely linked to changes in surface soil moisture. Later on, the Water Cloud Model coupled with the Oh et al, 1992 model were used for better understand the backscattering mechanism of wheat canopies. The coupled model is calibrated and validated over the study site and it proved to goodly enough reproduce the Sentinel-1 backscatter with RMSE ranging from 1.5 to 2.52 dB for VV and VH using biomass as a descriptor of wheat. On the other side, the analysis show that coherence is well correlated to biomass. Thus, the calibrated model is

used in an inversion algorithm to retrieve SSM using the Sentinel-1 backscatter and coherence as inputs. The results of inversion show that the proposed new approach is able to retrieve the surface soil moisture at 35.2° for VV, with R=0.82, RMSE=0.05m^3/m^3 and no bias. Using the validation database of Morocco and Tunisia, R is always greater than 0.7 and RMSE and bias are less than 0.008 m^3/m^3 and 0.03 m^3/m^3, respectively even that the incidence angle is higher (40°). In order to assess its quality, the approach is compared to four SSM retrieval methods that use radar and optical data in empirical and semi-empirical approaches. Results indicate that the proposed approach shows an improvement of SSM retrieval between 17% and 42% compared to other methods. Finally, the validated new approach is used for SSM mapping, with a spatial resolution of 10*10 m, over irrigated perimeters of wheat in Morocco.