Water management of mediterranean orchards analyzed from Remote Sensing data and surveys.

ROUAULT Pierre [(1)], COURAULT Dominique[(1)(*)], DEBOLINI Marta, LOPEZ Raul, CHANZY André, FERNANDEZ-MENA Hugo, FLAMAIN Fabrice, POUGET Guillaume, DOUSSAN Claude, McCABE Matthew[(2)]

(1) UMR 1114 EMMAH INRAE -Université d'Avignon, route de l'aérodrome, 84914 AVIGNON
(2) King Abdullah University of Science and Technology (KAUST), Saudi Arabia
(*) dominique.courault@inrae.fr

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Around the Mediterranean, water represents the major resource that limits growth and production of plants, and which tends to decrease because of increase of irrigated territories, and competition between various water users on a territorial scale. The water consumption of fruit orchards depends on various factors, among them the soil and climate characteristics which vary a lot spatially, and also the leaf development which vary temporally according to crop variety. The water management at the basin scale must therefore take into account the plant need and also the farmer practices. Remote sensing at high spatial and temporal resolution can provide useful information for monitoring water status of orchards. This study aims two main purposes: 1) assess the development of orchard from biophysical variables derived from Sentinel data and 2) better understand the variability of irrigation management from farm to territory level in order to propose suitable tools for optimizing water use. A typical mediterranean basin was chosen in Southeastern France, where various monitorings are conducted on orchards by the EMMAH and Kaust teams: the Ouvèze basin (centered 44° 13.050' N, 5° 8.579'E). The analysis was based on multiple sources of data: 1) surveys on the agricultural practices of 15 farmers covering more than 495 fields; 2) various ground observations including soil moisture measurements made on 5 cherry trees on both inter and intra row, hemispherical photos taken on 13 cherry trees having different inter-row managements and 3) multi-spectral Sentinel 1 and 2 images acquired between 2016 and 2021. The images were processed using the Snap software for Sentinel 1 data and R functions to extract the mean values for each field of different vegetation indices and biophysical variables obtained from the BVNET model. The temporal profiles of indices and radar signals have been compared to ground observations. The survey analysis has shown a large heterogeneity among the different irrigation practices, for cherry trees for example some farmers brought around 140mm/year and others more than 450mm for similar drip systems. Statistical analysis based on PCA and AHC allowed to propose six different classes of farmers on the area. The surveys revealed that most farmers start irrigation after the crop flowering. Temporal profiles of spectral indices obtained for several orchards with Sentinel 2 allowed to clearly identify the trees' phenology and the impact of the inter-row management. Thresholds can be defined to separate young and old orchards. First correlation analysis between soil moisture measurements of the 5 fields monitored with different water management and the VV polarization extracted from Sentinel 1 data showed that radar data allow to reproduce the main trend of soil moisture variations and a significant correlation is obtained at field scale (r^2=0.57 for the best score), but a lot of noise still remains to be deeper investigated. The different variables derived from Sentinel data are useful for future spatialized modeling approaches. For the next work phases, different models will be compared to quantify water requirements for each field of the basin, in order to identify the most suitable to provide useful indicators to improve irrigation management in mediterranean context.

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