Remote Sensing Vegetation Indices: Evaluation on a Mandarin Orchard - Abstract

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Summary

Precision agriculture involves modern crop surveillance methods, such as spectral vegetation indices via satellite remote sensing. This study examines the performance of Normalized Difference Vegetation Index (NDVI) and Normal Difference Moisture Index (NDMI) spectral indices as irrigation management tools. The IRMA_SYS (https://arta.irmasys.com) intelligent irrigation decision support system for the plain of Arta, which has an area of 45000 hectares, provides means for downloading the above-mentioned indices for each field. These indices are obtained from the available Sentinel-2 satellite images i.e., every 2 or 3 days. These images have pixel dimension of 20 m that attains the spatial accuracy of each spectral index.

The study was carried out for two mandarin orchards. The fields were coded in IRMA_SYS as: a) field 728, with an area of 5000 m^2 and b) field 729, with an area of 30000 m^2. Also, a complete meteorological dataset is available for each field through IRMA_SYS, by spatial interpolation of data from seven agro-meteorological stations in the area. Daily values of temperature (°C), solar energy (W m^{-2}) and rainfall (mm) were obtained from 15/3/2021 to 28/10/2021. Also, NDVI and NDMI values were obtained for a characteristic point for each of the two fields. The total effective rainfall for field 728 was 232 mm while for field 729 was 252 mm, correspondingly. The two farmers followed different irrigation strategies: The owner of field 728 applied 2 irrigations totaling 59 mm with an average of 29.5 mm, while the owner of field 729 applied 7 irrigations totaling 78 mm with an average of 11.2 mm.

Based on the analysis performed, the aforementioned indices are strongly related to rainfall or irrigation, since in both fields' irrigation was followed by a clear upward trend in the values of the two vegetation indices. In particular, the NDVI index seems to be more responsive than the NDMI index in cultivation practices such as weed removal. It should be noted that after rainfall or irrigation, the variation of both indices is not immediately noticeable, but a period of 2 or 3 days is required since the trees do not correspond instantly to the applied water. Therefore, the changes of the vegetation indices should be evaluated not as individual values but as continuous time series. This evaluation should consider information concerning cultivation practices carried out during this period.

Conclusively, irrigation is reflected through the NDVI and NDMI vegetation indices, to a satisfactory degree so that they can be used under specific conditions as a tool for monitoring crops within the context of precision agriculture practices.

Keywords

Precision agriculture, remote sensing, IRMA_SYS, NDVI, NDMI, irrigation

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