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Assessing Soil Salinity with the use of WorldView-2 Hyperspectral Images in Timpaki, Crete

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Salinization is one of the major soil degradation threats occurring worldwide, with its effects being observed in numerous vital ecological and non-ecological soil functions. Traditionally, soil salinity is assessed by laboratory determination of the soil electrical conductivity (ECe), rendering large scale studies labor and cost intensive. This study evaluates the feasibility of surface soil salinity estimation, monitoring, and mapping based on images acquired by the WorldView-2 and Landsat 8 multispectral sensors after calibration with a limited number of soil samples. A range of satellite image processing techniques are applied, starting with geometric, radiometric and atmospheric preprocessing corrections. More than 10 spectral salinity indices (algebric equations between visible and infrared band) including three newly introduced salinity indices, as well as vegetation indices (NDVI, SAVI, etc.) are implemented to detect surface salt deposition and vegetation health. Spectral unmixing is used to monitor salinity employing sophisticated classification approaches. Principal Component Analysis (PCA) is applied to a WorldView-2 images in order to determine the initial axes used for the orthogonal transformation, followed by a subsequent 3D rotation of the PCA axes. The linear coefficients of the transformation are retrieved and adjusted to detect salinity in all the range of WorldView-2 image. Furthermore, Landsat 8 images are used to establish and compare the diachronic vegetation regime and plant health in both brackish irrigation and salinity-free olive groves areas. The proposed methods are tested in the RECARE FP7 Project Case Study of Timpaki, a coastal semi-arid region in south-central Crete. Long term agricultural over-exploitation in the area and little irrigation alternatives have led to seawater intrusion and in turn to soil salinization. EO products are calibrated using soil samples collected from bare soil plots at 0–5 cm depth and representing a broad range of ECe ranging from 0.84 dS m-1 in non-cultivated fields to 199.91 dS m-1 at the coastal salt marsh Katalyki. Results show that WorldView-2 and Landsat 8 images have a potential for effective topsoil salinity mapping when adequately calibrated.

Keywords: soil salinity; remote sensing; WorldView-2; Timpaki Crete

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