Combining Remote Sensing and On-site Observations to Explore Salinization Dynamics in the Po River Delta

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Seawater intrusion (SWI) is an escalating concern in coastal regions globally, with alterations in weather patterns and sea-level rise emerging as pivotal factors contributing to the occurrence of SWI in both surface waters and groundwater. This phenomenon poses a significant risk to low-lying agricultural areas, leading to soil salinization with substantial adverse effects on soil quality and crop yields. In the Po River Delta, Italy’s broadest agricultural region impacted by SWI, summer droughts play a pivotal role in driving SWI dynamics. Within this extensive lowland area, the deficiency in rainfall during the summer months reduces river flow, facilitating the inland movement of seawater. The escalating frequency of drought events and exceptionally high temperatures in recent summers, has highlighted the necessity for a thorough understanding of the impact of SWI on cropland, both on vegetation and soil, to detect any possible correlations between SWI, accumulation of salts and plant stress. The objective of this study is to combine multi-temporal remote sensing from satellite imagery, to monitor plant greening, with on-site observations of soil electrical conductivity (EC). Normalized Difference Vegetation Index (NDVI) maps for the summer period 2023 were elaborated from satellite data, classifying cropland with a machine-learning algorithm to filter bare soil and surface water from green vegetation. In the same time period, two experimental sites located in the delta region were periodically sampled with a Time Domain Reflectometry (TDR) probe to monitor soil temperature, moisture and EC. Soil samples were also collected and analyzed to measure EC of the water extracts. Although summer 2023 was not characterized by extreme drought, the combined results offered a quick method for identifying salinization trends within the delta cropland area, pinpointing the most susceptible areas both on a regional scale and on a local scale.