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Enhancing the modelling of Gross Primary Productivity with Sentinel-2 data for the monitoring of wetlands health.

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Wetlands, being essential habitat for several plants, animals and ecosystem services providers, are highly valuable ecosystems for biodiversity and human beings. Wetlands not only support all water-related ecosystems and are vital in maintaining the water cycle, but also regulate the impact of natural hazard providing flood alleviation, and coastal protection during extreme weather events, playing a key role in mitigating climate changes effects. Regardless of the importance of wetlands for biodiversity and the benefits to human beings, the natural wetland extension has drastically declined in the past decades.

Given the status and trend in the wetland ecosystems degradations, several international agreements have emphasized the importance of monitoring and conserving these areas. Satellite imageries, providing information in a systematic and timely way can serve as a monitoring tool to describe the dynamics of the ecosystem in time and space, and better understand processes and drivers of ecosystem changes leading to better conservation and restoration practices.

This study investigates the potential of the Sentinel-2 MSI to improve the accuracy of gross primary productivity (GPP) estimation across marshland ecosystems. An empirical model based on remote sensing (RS) vegetation indexes (VIs), in-situ measurements and environmental driver is developed to estimate temporal and spatial variation of GPP. The methodology evaluates multiple remotely sensed indices and additional environmental variables aiming at improving the model formulation and its versatility facilitating its uptake to different ecosystems.

The workflow is implemented in a study case in a wetland ecosystem located in Doñana National Park. The Doñana National Park, with an extension of 537 km2 is a UNESCO Biosphere Reserve and a Natural Heritage and a Ramsar. It shelters the largest wetland in Western Europe, composed of a complex environment of marshlands, phreatic lagoons, and a dune ecosystem.

For this case study, the red-edge chlorophyll index (CLr) which is more sensitive to photosynthesis activity, and the rainfall with a rolling average of three months and a delay of 5 months, are selected for the model formulation since they are variables with the higher correlation to Primary Productivity (PP). The coefficient of determination of this model is R2 = 0.93 yielding MAE equal to 0.52 gC m-2 day-1, RMSE equal to 0.63 gC m-2 day-1 and significance level $p < 0.05$. Model outcomes is compared with MODIS GPP, and an enhancement of the estimation of GPP is found.

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