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Gross primary production dynamics assessment of a mediterranean holm oak forest by remote sensing time series analysis

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Agroforestry ecosystems have a significant social, economic and environmental impact on the development of many regions of the world. In the Iberian Peninsula the agroforestry oak forest called “Dehesa” or “Montado” is considered as the extreme case of transformation of a Mediterranean forest by the management of human to provide a wide range of natural resources. The high variability of the Mediterranean climate and the different extensive management practices which human realized on the Dehesa result in a high spatial and temporal dynamics of the ecosystem. This leads to a complex pattern in CO_2 exchange between the atmosphere and the ecosystem, i.e. in ecosystem′s production. Thus, it is essential to assess Dehesa′s carbon cycle to reach maximum economic benefits ensuring environmental sustainability. In this sense, the availability of high frequency Remote Sensing (RS) time series allows the assessment of ecosystem evolution at different temporal and spatial scales. Extensive research has been conducted to estimate production from RS data in different ecosystems. However, there are few studies on the Dehesa type ecosystems, probably due to their complexity in terms of spatial arrangement and temporal dynamics. In this study our overall objective is to assess the Gross Primary Production (GPP) dynamics of a Dehesa ecosystem situated in Central Spain by analyzing time series (2004-2008) of two models: (1) GPP provided by Remote Sensing Images of sensor MODIS (MOD17A2 product) and (2) GPP estimated by the implementation of a Site Specific Light Use Efficiency model based as MODIS model on Monteith equation (1972), but taking into account local ecological and meteorological parameters. Both models have been compared with the Production provided by an Eddy Covariance (EC) flux Tower that is located in our study area. In addition, dynamic relationships between models of GPP with Precipitation and Soil Water Content have been investigated by means of cross-correlations and Granger causality tests. Results have indicated that both models of GPP have shown a typical dynamic of the Dehesa in a Mediterranean climate in which there are primarily two layers, the arboreal and the herbaceous strata. However, MODIS underestimates the production of the Dehesa while our Site specific model has given more similar values and dynamics to those from the EC tower. Additionally, the analysis of the dynamic relationships has corroborated the strong dynamic link between GPP and available water for plant growth. In conclusion, we have managed to avoid the main sources of underestimation that has MODIS model with the implementation of a Site specific model. Thus, it seems that the different ecological and meteorological parameters used in MODIS model are the principally responsible for this underestimation. Finally, the Granger causality tests indicate that the prediction of GPP can improve if Precipitation or Soil Water is included in the models.

References

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