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Seasonal trends of spectral indexes for monitoring GPP in a Mediterranean cork oak savanna

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It is nowadays clear that the inclusion of spectral indexes into biogeochemical models can greatly improve actual estimates of gross primary productivity (GPP) at local and global scale. Several vegetation indexes can be obtained by the reflectance of light at specific wavelengths. Among them, the Normalized Vegetation Index (NDVI), the Enhanced Vegetation Index (EVI) and the Photochemical Reflectance Index (PRI) were found suitable to represent different characteristics of ecosystems strictly related with GPP, such as biomass and photosynthetic capacity (NDVI, EVI) or radiation use efficiency (PRI). In Mediterranean cork oak savannas, characterized by high heterogeneity, the application of spectral indexes derived from coarse spatial resolution remotely sensed data (e.g. MODIS imagery) to represent the performance of the whole ecosystem is complex. A better knowledge of the variability of vegetation indexes for specific vegetation types, assessed in fieldwork, is fundamental to the interpretation of the same indexes obtained with satellite data and a key step through the integration of such indexes into biogeochemical models.

We consider three different vegetation types: trees, grasses and shrubs, concurring to the overall ecosystem carbon budget in Mediterranean cork oak savannas. Since April 2011, reflectance measurements were performed in the range of 300-2500nm by the use of a handheld hyperspectral spectroradiometer (FieldSpec3, ASD Inc. CO, USA) in several species of the three vegetation types in a cork oak savanna eddy covariance site located in central Portugal. Measurements were always performed around solar noon and repeated approximately every two weeks. Several vegetation indexes were calculated. All indexes showed clear differences among vegetation types and among species. Marked seasonal trends were identified for grasses and shrubs, clearly related with the onset of dry summer conditions. Both NDVI and EVI decreased in grasses from April to the second half to July when they reached the same value of litter and bare soil. The recovery was only observed after the first rains in October. The occurrence of rain in October also reestablished the values of NDVI and EVI for evergreen shrubs that showed a marked decrease in September. On the contrary, both indexes remained stable in cork oak along the whole measurement period (April–December). In the perspective of the use of spectral indexes derived from satellite imagery, we compared the PRI values calculated with the wavelengths of 531 and 570nm proposed originally for this index (PRI570) and the wavelengths available on MODIS data: 531 and 550nm (PRI550). Both the indexes revealed different trends for the three vegetation types. Anyway, measurements of cork oak leaf reflectance performed with a leaf clip and compared with leaf chlorophyll concentration, showed that PRI570 is better correlated with leaf chlorophyll concentration than PRI550.

Our results suggest that established vegetation indexes are well suited to represent the seasonal variability of the three vegetation types. In further studies, we intent to use the temporal variability of vegetation indexes to estimate the contribution of each vegetation type to the total GPP and its seasonal variability.