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Estimation of pasture net primary production using remote sensing in a holm oak savanna rangeland

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Dehesas are Mediterranean oak savanna woodlands, which provide important ecosystem services as the prevention of forest fires, the protection of soils or the conservation of key habitats for biodiversity. The management of these large areas (more than 3 million ha in South Europe) needs effective instruments that provide accurate data to assist decision-making at different levels. This work focuses on the monitoring of grassland production using remote-sensing data. An adaptation of Monteith crop production model has been applied on the dehesa area in Andalusia, a South Spain region where this ecosystem covers 1.2 million ha.
Monteith model is based on the relation between plant growth and incident solar radiation. In this case, the model has been applied using MODIS satellite images with 250 meters of spatial resolution, combined with spatially interpolated meteorological data, such as solar radiation, temperature and relative humidity, provided at daily scale by regional weather station networks. The model is applied during the hydrological years 2013-2104 and 2014-2015. The adaptation of the Monteith model proposed in this work pays special attention to:
- The use of a physically-based distributed hydrological model (WiMMed) (specifically developed for semiarid regions) for the spatial and temporal interpolation of meteorological variables. This model considers the main factors conditioning the spatial and temporal behavior of each variable (e.g. height in temperature, topography in solar radiation, etc.).
- The presence of a tree layer with variable density as part of the ecosystem. The influence of this layer on the spectral data collected by the remote sensor needs to be accounted for and subtracted accordingly. The assigned value to tree contribution is taken from the data measured during the dry season, when annual pasture is dry and the only photosynthetically active canopy corresponded to holm oak trees.
- The estimation of the fraction of photosynthetically active radiation absorbed by the pasture (fPAR) from NDVI values, using a procedure previously calibrated with field data of an ASD radiometer and leaf area index (LAI).
- The empirical estimation of the light use efficiency for natural grass using pasture biomass field measurements.
Pastures biomass samples were taken at the plot level to serve as validation dataset. These biomass samples were collected during the growing season in farms distributed all over the area. The production was calculated using the Comparative Yield Method.
The estimations presented a mean absolute error (MAE) equal to 202 kg/ha, equivalent to the 10,3% of measured average production for hydrological year 2013-2014 and MAE equal to 183 kg/ha, equivalent to the 8,3% for hydrological year 2014-2015.