Appendix A. Proposal Format

HICO Data User's Proposal

Monitoring pasture quality and production in oak savannah systems within LIFE Biodehesa Project

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Abstract/project summary

This proposal is addressed in the framework LIFE-Biodehesa project, which aims to promote the sustainable and integrated management of oak savannas to improve the state of biodiversity through the outreach of demonstrative actions that address main challenges related to the conservation of these systems.

Dehesas (Oak savannas known as M*ontados* in Portugal) cover about 3 million hectares in the Iberian Peninsula. The monitoring of these large areas requires effective tools that provide timely and accurate data to assist management and decision-making at different levels. This work will explore the monitoring of grassland's production and quality in extensive systems using remotely sensed data with different spatial and temporal scales. Pastures net primary production is estimated using an adaptation of Monteith model (1977), based on the relation between plant growth and incident solar radiation. On the other hand, some studies suggested that functional relations may be obtained between vegetation reflectance provided by remote sensing and biochemical variables, successfully predicting quality.

The final purpose is to promote an advisory service which may help farmers to make appropriate decisions and minimize feed costs of animals in extensive grazing systems, preventing overexploitation, and seeking to ensure the conservation of the system but guaranteeing profitability.

1. Statement of work description

The final goal is to obtain an effective tool to provide information to farmers of the quantity and quality of the pasture at regional level, helping to make better decisions at the time of feeding livestock. The importance lies in reducing supply costs and decreasing overgrazing, which directly influences the maintenance of the system.

Regarding pasture production, biomass estimation models using remote sensors are often used in agriculture in order to obtain inputs for crop models that predict or estimate the harvest. Empirical models are easy to apply but difficult to extrapolate, the approaches with a more physical basis, such as biomass estimate model of Monteith (1977), allow to incorporate remote data as input variables, like the fraction of PAR radiation absorbed by the plant, and combine with meteorological information to provide quite accurate estimates (Padilla et al., 2012). The use of complex growth models such as DSSAT or WOFOST have been combined with information from remote sensing for estimating crop at regional scale. In forestry, there are many studies of biomass production for homogeneous forest or forest plantations mixed with different techniques, such mechanistic models with eddy covariance systems, or forest inventories (Van Tuyl et al., 2005). For pasture production there are several empirical models like Hobbs (1995). However, in the dehesa system this type of studies are rare, focusing on grass production models without remote sensors. Within the LIFE Biodehesa project, a first approach using the Monteith model (1977) with data from PAR radiation fraction (although low spatial resolution) and spatially interpolated meteorological information has been made. Currently, in situ data collection for drying laboratory and obtain the dry weight of pasture to validate the model is been done.

Traditional laboratory analyses of grass nutritive value are time-consuming and costly. Some studies (Pullanagari et al., 2012; Starks et al., 2008) suggested that functional relations may be obtained between vegetation reflectance provided by remote sensing and biochemical variables, successfully predicting quality. Changes in variables, such as nitrogen concentration (N) and in vitro dry matter digestibility (IVDMD), therefore, should affect properties of canopy reflectance in a wide range of spectra from 400 to 1695 nm (Starks et al., 2008). Laboratory analyses have found high correlations (<0.95) for calibrations of crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF) and organic matter digestibility (OMD) with dry and ground pasture samples, offering a rapid and inexpensive approach to assess these properties. Within the LIFE Biodehesa project, it is being taken parallel to the sampling for dry weight, reflectivity measurements performed with ASD radiometer FieldSpec, to be related to the nutritional quality of the sample.

The HICO, temporal, spatial and spectral high resolution would be helpful in our work. On the one hand, help to increase the level of detail in the production estimate, since it could limit the area of influential spectrum in the fraction of PAR radiation absorbed by the plant besides it in an adequate spatial resolution for the extension to be monitored and the volume of data to analyze. On the other hand, the quality of pasture with measures related to ASD could relate with HICO bands and to extrapolate the quality of a point to a regional level. Therefore, with HICO could get a raster map at regional scale quantity and quality of pasture, which would lead to the achievement of the objectives of the work.

The images required are level 1b product located in the north of the province of Córdoba, Spain, between 38° 36 'and 38° 08' North and 5° 10 'and 4° 12' West, referring to time zone 30. The request would be for the 3 seasons of pasture growth comprising the duration of the project, ie from March 1 to May 31 in years 2014, 2015 and 2016.

2. Biographical sketch and available facilities

The principal investigator is Forestry engineer by the University of Cordoba (Spain) and Master degree in Environmental Hydraulics by the University of Cordoba, Granada and Malaga (Spain). The PI has worked in forest management for The Andalusian Environment and Water Agency and as a researcher for Fluvial Dynamics and Hydrology research group (University of Cordoba and Granada). The PI has no experience in oceanic remote sensing, but has worked researching in remote sensing applied to continental water, estimating soil water content and studying the quality of dam water. Currently, the PI is working for IFAPA (Agricultural and Fisheries Research and Training Institute) in Biodehesa project and developing a PhD thesis related to pasture production estimation with remote sensing data evaluating water stress.

In this project, available images of Landsat and MODIS products are being downloaded and unmanned flights for the visible and infrared spectrum in some areas of special interest have been performed. Furthermore, as discussed above, samples of pasture and measured of reflectivity with ASD radiometer are taken in situ. Farm infrastructure associated with the project and the budget thereof, makes it possible to take this information with appropriate frequency.

3. Output and derivables

The final output will be two raster maps (90x90 meters of spatial resolution) in dehesa area of Southern Spain: the first one of seasonal pasture production and the second one in pasture quality. Thanks to HICO, both approaches may be tested, because the quality data may be extrapolated to regional scale and production data will have better spatial resolution than using other available product.

The products offers to HICO are the algorithms produced, exploring the link between the spectral range and the quality of pasture (in terms of N and IVDMD) and the biomass production at regional scale.

4. References

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