

Linking spectral information at different spatial scales with biophysical parameters of Mediterranean vegetation in the context of global change (BIOSPEC)



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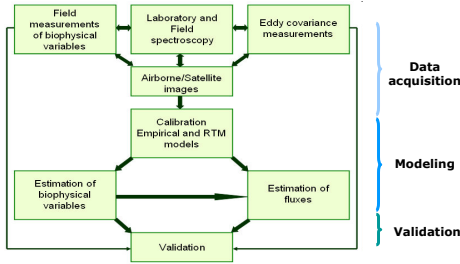


ABSTRACT

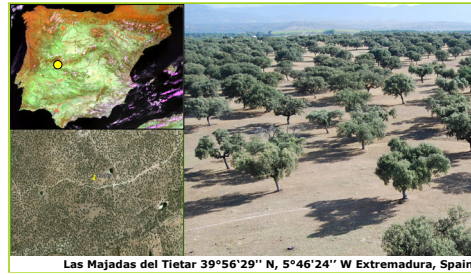
<http://www.lineas.cchs.csic.es/biospec>

BIOSPEC propose a multi-source approach to combine remote sensing products of various spectral and spatial scales (field spectroscopy, airborne and satellite images) in order to analyze and quantify the potential uncertainties in the estimation of relevant vegetation parameters such as water and nitrogen content, LAI, etc in a complex Mediterranean ecosystem. The dataset underlying the study include various spaceborne (Landsat and MODIS) as well as airborne (AHS and CASI) reflectance datasets with different spatial and spectral resolutions. Ground information have been obtained including spectral measurements using field spectroradiometers, measurements of biophysical vegetation parameters, meteorological variables and CO₂, H₂O and energy fluxes from April 2009 to May 2011 in a grazed pasture in northeastern province of Cáceres (Spain) where an eddy-covariance flux tower (included in the Fluxnet network) has been operating since 2003 by Fundación Centro de Estudios Ambientales del Mediterráneo (CEAM).

BIOSPEC Activities



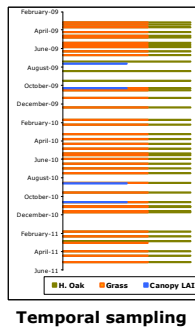
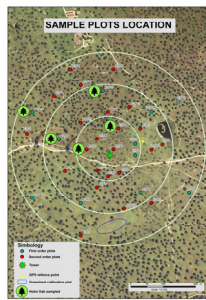
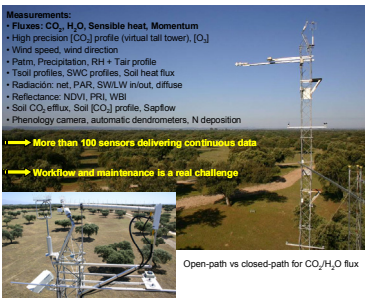
BIOSPEC study site



Ecosystem: "dehesa" Mediterranean Holm Oak open woodland (Savanna)
Mediterranean Climate: annual T = 16.7 °C, annual Prec = 550 mm
Soil: Stagnic Alisols, depth > 2m. Texture: sandy loam. soil C is 8.5 g/kg and soil N is 0.82 g/kg (0-20cm layer).
Tree canopy: 98% *Quercus Ilex*; 25 trees/ha; mean DBH = 45cm; canopy height = 7-10 m; canopy fraction = 20%
Management: tree pruning every 25 years to optimize acorn production
Herbaceous layer: high biodiversity (easy to find > 20 species within 4 m²); ≠ composition below tree / open;
Management: continuous grazing (~ 0.3 cow / hectare)

Data acquisition: Field measurements

Eddy covariance



Field spectroscopy

Every 16 days

- Instrument: ASD FieldSpec F3 (400-2500nm)
- Temporal sampling: in 1st order plots (12) every 16 days (Landsat 5 overpass)
- Protocols
 - Grasslands
 - Two transect x plot ~ 20 spectra per plot x measurement day
 - NW - SE and NE - SW
 - Trees
 - 10 trees in 2009 and 5 in 2010
 - Leaf level: Leaf clip + plant probe
 - New and old leaves: 12 + 12 x tree
 - Canopy level: crow transect using crane

Continuous

- Multispectral
 - Skye SKR1850 (NDVI + PRI)
 - Band centers: 530, 569, 679, 798 nm
 - Bandwidth: 12 nm
- Hiperspectral
 - Unispec DC (to be installed in June 2011)
 - VIS-NIR: 310 - 1100 nm
 - Raleigh Resolution < 10 nm
 - Bin Size (diode array) 3.3 nm
 - Absolute Accuracy < 0.3 nm

Grassland

- Collect all plants in 25x25 cm quadrants to calculate LAI, biomass, FMC, EWT and CWC
- 3 quadrants x plot. Throw the quadrant within the plot and clip all plants in the quadrant using clippers. Then, put all the plants in a big zip-lock plastic bag.
- Every sample bag is weighed in the field to measure fresh weight.
- In the lab: weigh, scan and dry. PCI tool to calculate area

Biophysical variables

Parameter	Measurement scale	Sampling interval	Field Measurement tool/method	
Block 1: vegetation spatial vegetation and phenology	LAI	Canopy/Ancestron	16 days	Destructive sampling + Aerial photograph + TRAC + terrestrial Lidar
Block 2: Vegetation condition/features	FMC	Canopy/Ancestron	once	Aerial Photography
	canopy structure vegetation height	Canopy/Ancestron	once	Forest Inventory sampling
Chlorophyll	Leaf	16 days	SPAD + spectrophotometer (laboratory)	
water content	Leaf	16 days	Destructive sampling, gravimetric methods	
Carbon and Nitrogen	Leaf	16 days	Destructive sampling + Laboratory	

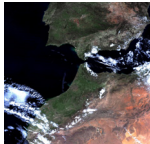
Trees

- Collect 12 leaves from the upper and lower part of the trees (North and South)
- Put the sample in a zip-lock bag to measure FMC, EWT, nitrogen and carbon
 - chlorophyll content measured with SPAD
- Every sample bag is weighed in the field to measure fresh weight.
- In the lab: weigh, scan and dry. PCI tool to calculate area
- LAI is measured with Fish-Eye photos + TRAC + terrestrial Lidar

Data acquisition: Airborne/satellite images

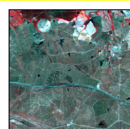
MODIS

- Daily TERRA MODIS MOD09GA + temporal composites + derived products downloaded from NASA server
- Only those images free of clouds and zenithal observation angle lower than 20° were selected
- From the remaining ones, those with failure in channel 5 have been removed



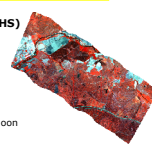
LANDSAT 5 TM

- Images acquired every 16 days
- USGS & Spanish Remote Sensing Program
- Radiometric and Geometric corrections
- 28 cloud free images available from April 2009 to May 2011



Airborne Hyperspectral System (AHS)

- 80 channels:
 - LVNIR(20), SWIR(43)
 - MWIR(7), LWIR(10)
- Image 18/05/2010. Pixel size: 6.5 m
- Image 05/05/2011. Pixel size: 4.6 m
- 2 acquisitions: ±2 hours from solar noon

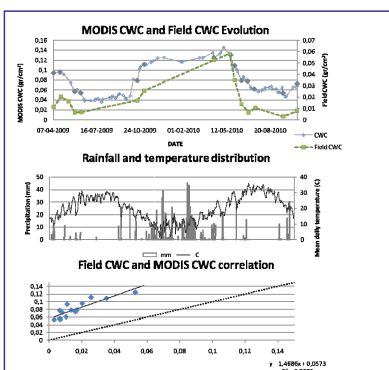


Compact Airborne Spectrographic Imager (CASI)

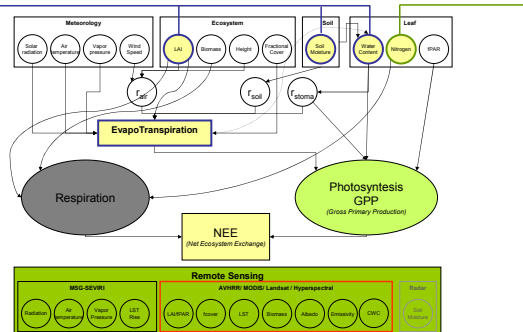
- 288 channels:
 - 366-1050 nm
 - FWHM: 2.4 nm
- Image 18/05/2010. Pixel size 1.35 m
- Image 05/05/2011. Pixel size 0.9 m
- 2 acquisitions: ±2 hours from solar noon



Water content



Modeling: preliminary results



Nitrogen content

