Summer School on Field Experimental Design and Data Acquisition (Field data, RS data)

11-18 March, 2018. Navalmoral de la Mata – Cáceres, Spain

Summary:

TruStEE is a 4 years project funded by Horizon 2020 Marie Curie ITN 2016. TRuStEE is a network of Universities, Research Centers and small medium enterprises (SMEs) that will train a new generation of early stage researchers (ESRs) with complementary and interdisciplinary skills in ecosystem modelling, plant physiology, remote sensing technologies and big data analysis, addressing the specific objectives: 1) to identify essential biodiversity variables (EBVs) and the link with plant traits (PTs) and ecosystem functional properties (EFPs), inferable from remote sensing, 2) to investigate a completely new avenue for assessing vegetation photosynthetic efficiency from remote sensing measurements of canopy fluorescence, 3) to assimilate diverse remote sensing data streams with varying spatial and temporal resolution in dynamic ecosystem models and 4) to exploit new satellite missions (e.g. ESA-FLEX, ESA-Sentinels) and Earth Observation products for the upscaling of PTs, EBVs and EFPs.

This Summer school, which is part of the training program for the ESRs, aims to give the students the possibility of experiencing different RS applications (e.g. precision farming and ecosystem modelling). The lectures will provide the background for organizing a field campaign (i.e. field and RS data acquisition) and will provide to ESRs the state of the art of the integration of PTs and EFPs with carbon, water and energy fluxes. Data calibration and processing chain will be also taught. During the practice, ESRs will cooperate in field data acquisition using different instrumentations (e.g. portable high resolution spectro-radiometers and different ecosystem sensors such as gas analyser, active fluorometer -at leaf and canopy level-, terrestrial laser scanner). The field work will be conducted at the experimental site "Majadas de Tietar" a natural agroecosystem composed by Mediterranean Holm Oak (open woodland, Savanna) in the research facility built in the last few years by the cooperation of the CEAM (Valencia), CSIC Madrid, and MPI Jena that is conducting a large scale fertilization experiment (https://www.bgc-jena.mpg.de/bgi/index.php/Research/BAIE). ESRs will collect data from ground with different instruments and sensors (flux measurements, spectral measurements, leaf gas exchange) and they will analyze the data using models or with empirical or data driven approaches. The ESRs will also use data collected with different remote sensing platforms either during the training school or before and made available by the organizers: drone, airborne, satellite. ESRs will be divided into groups and they will report the conducted activity to the summer school participants, thus improving their communication skills. The ESRs participation will be awarded with certificates of participation.

Venue:

- Accommodation and training school headquarters:
  Hotel Los Granados: http://www.hotelosgranados.es/
  Ctra. Nacional V, km 181 - 10300 - Navalmoral de la Mata - Cáceres

- Field campaigns: Majadas del Tietar. Transportation from Navalmoral to Majadas will be provided by the organization (minibus)


Organization:

- **Mirco Migliavacca,** Scientist, Leader of the research group: Biosphere-Atmosphere Interactions and Experimentation. Max Planck Institute for Biogeochemistry, Jena. Germany. For more info see: https://www.bgc-jena.mpg.de/bgi/index.php/People/MircoMigliavacca

- **María Pilar Martín Isabel,** Scientist at the Environmental Remote Sensing and Field Spectroscopy Laboratory (SpecLab) of the Spanish National Research Council (CSIC). Madrid, Spain. For more info see: http://cchs.csic.es/en/personal/mpilar.martin

TRAVEL GUIDE

TRUSTEE TS will be held in Cáceres province (western Spain). Accommodation and training school headquarters will be based in "Navalmoral de la Mata" in the "Hotel Los Granados" where rooms have been booked for all participants. Field campaigns will take place at the experimental site "Las Majadas". Transportation from Navalmoral to Majadas will be provided by the organization.

⊕ Eddy Covariance Tower
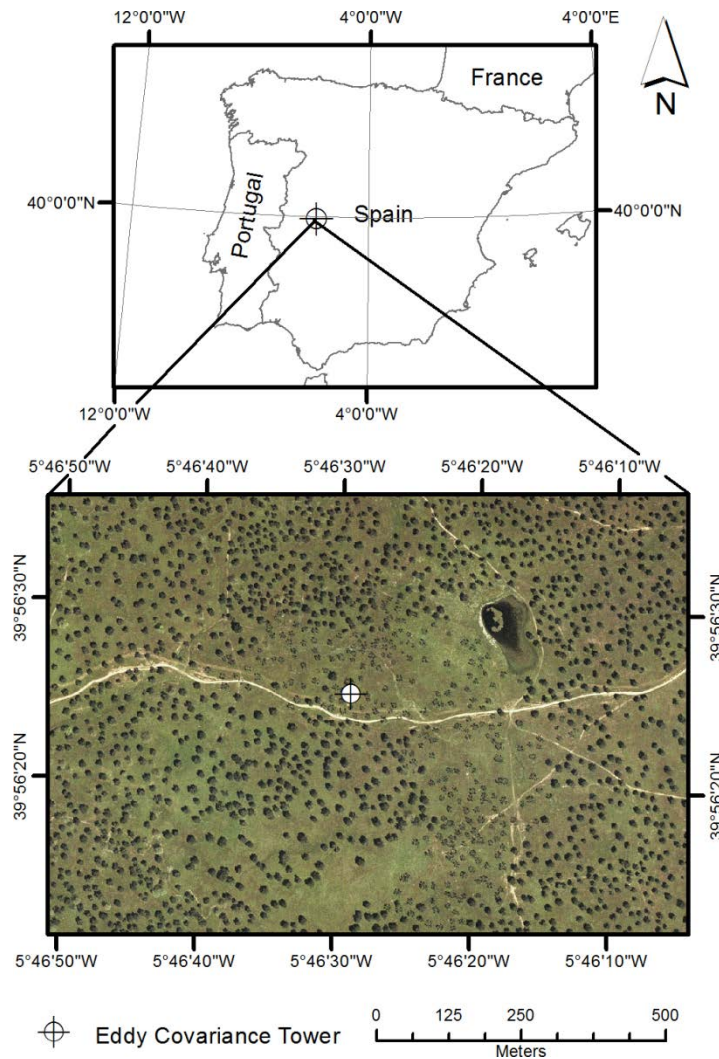
1   How to reach Navalmoral de la Mata

If you are coming from abroad, the quickest way to reach Navalmoral de la Mata is flying to Madrid (Madrid-Barajas Adolfo Suárez airport). From there, you can easily reach the main

train and bus stations from where you could go to "Navalmoral de la Mata" where the hotel and training school headquarters are placed.

Detailed information to getting to and from the airport by public transport can be found in this link. You can also locate al the stations and points of interest in the airport terminals in this link. In the airport there is free internet access via WiFi for unlimited time, basic navigation to limit download speed and supported by advertising.

2 How to reach Navalmoral de la Mata from Madrid Barajas airport

By train
1) From the airport to the railway station:

You can travel from Madrid to Navalmoral de la Mata by train. You must go from the airport to the "Atocha Renfe" train station.

By train: From the airport Terminal 4 a train can be taken to go directly to "Atocha Renfe", see this link. These trains depart with a frequency of 30 minutes, the ticket is less than 3€ and the trip takes about 25 minutes. To reach Terminal 4 from the other terminals, there is a free bus service (see this link).

By bus: From Terminals 1, 2 and 4 there is a bus service that reaches "Atocha Renfe" train station: Línea Exprés (line 203): Atocha railway station, details here. The buses depart every 15 minutes (35 at night), the ticket cost 5€ and the trip takes about 40 minutes.

By metro: "Atocha Renfe" train station can be reached also by metro, we do not recommend using this way unless you want to go first to visit or stay in Madrid. Metro line 8 (pink) departs from Terminal 2 and Terminal 4 and reaches "Nuevos Ministerios" station; from there you can reach any other destination in the city (see the metro map). To go to "Atocha Renfe" from here, you'd take the line 10 (dark blue) to "Tribunal" and change to the line 1 (light blue) to go to "Atocha Renfe". Further information can be found here.

2) From the railway station to Navalmoral de la Mata:

There are trains that depart from the "Atocha Renfe" train station in Madrid and arrive to the train station in "Navalmoral de la Mata train and bus station". They depart from Madrid every two hours approximately between 8:00 and 18:30. The duration of the trip is about 2 hours, and the price about 20€. Timetables can be found in this website.

By bus
1) From the airport to the bus station:

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By metro: Buses from Madrid to Navalmoral de la Mata departs from "Estación Sur-Mendez Álvaro". From the airport you can reach the bus station by metro. Take the Line 8 (pink) that departs from Terminal 2 and Terminal 4, and reaches "Nuevos Ministerios" station (see the map). To go to "Estación Sur-Mendez Álvaro" take the line 6 (grey) to "Mendez Álvaro" stop.

2) From the bus station to Navalmoral de la Mata:

There is a bus service that goes from "Estación Sur de autobuses" (also called "Mendez-Álvaro") bus station approximately every hour (mind a gap around midday) and arrives to "Navalmoral de la Mata train and bus station" in about two hours and a half. Check the time tables in this website (we recommend to use the website in "Castellano" (Spanish), in English it does not seem to work very well). The ticket cost about 20€.

3 From Navalmoral de la Mata station to the"Hotel Los Granados"

From the "Navalmoral de la Mata train and bus station" you can easily walk to the "Hotel Los Granados", just 10 minutes away. See here the route.
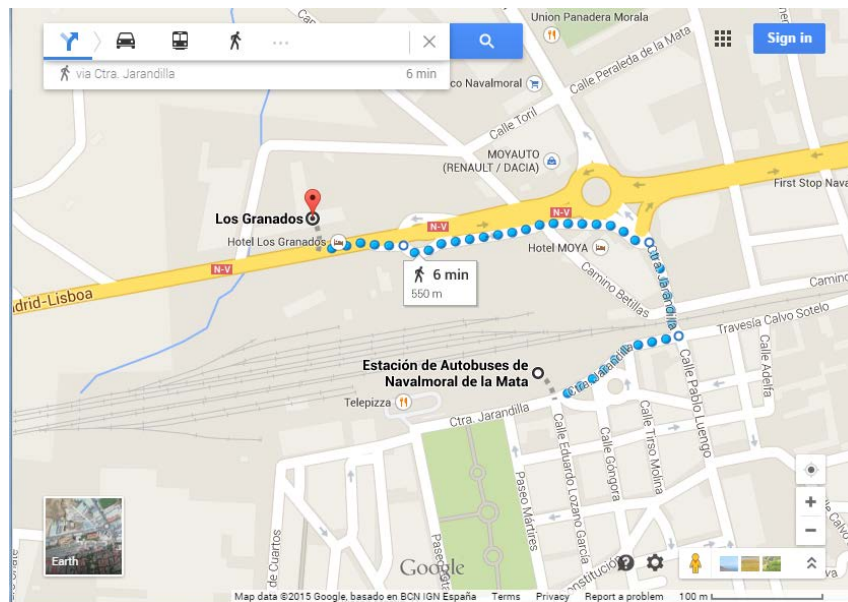
4 From Navalmoral de la Mata hotel to "Las Majadas" research station

Transportation from the Hotel to "Las Majadas" field site will be provided by the organization. Information on arrival and departure hours will be provided during the training school.

Programme:

Sunday March 11	20:30	Ice breaking dinner (hotel)	
Monday March 12	9:00-9:30	Opening session+ Scientific programme of Training School	Mirco Migliavacca (MPI) and Pilar Martin (CSIC)
	9:30-10:30	Ground investigation in support of Environmental Remote sensing: empirical vs physically based models	Pablo Zarco (JRC-Italy)
	10:30-11:00	*Coffee break (hotel)*	
	11:00-12:00	Majadas experimental site: Ecosystem overview	Gerardo Moreno (Univ. Extremadura)
	12:00-13:30	Introduction to science at Las Majadas	Arnaud Carrara (CEAM), Mirco Migliavacca (MPI), Pilar Martin (CSIC)
	13:30-14:30	*Lunch (hotel)*	
	14:30-15:30	Spectral data: proximal to remote sensing at Majadas	Javier Pacheco (MPI)
	15:30-16:30	Meteo and flux data	Arnaud Carrrara (CEAM) and Mirco Migliavacca (MPI)
	16:30-17:00	Field campaigns I: spatial and temporal issues	Pilar Martín (CSIC)
	17:00-17:30	Health and Security and Risk Assessment procedures for field activities	Mirco Migliavacca (MPI), Pilar Martín (CSIC)
	17:30-18:00	TRUSTEE project updates	Marco Celesti (UNIMIB)
	18:00-21:00	Free time	
	21:00	*Dinner (hotel)*	
Tuesday March 13	9:00-10:30	Field campaigns: II. Instrumentation	Javier Pacheco (MPI), Oscar Pérez (MPI)

	10:30-11:00	Field campaigns: III. Metadata and databases organization	Pilar Martín (CSIC), Javier Pacheco (MPI)
	11:00-11:30	*Coffee break (hotel)*	
	11:30-12:30	Presentation of projects activities: Project 1. Estimation of carbon and water fluxes using spectral information: vegetation indices and Sun Induced Fluorescence (SIF). Details in Annex I	Mirco Migliavacca (MPI), Javier Pacheco (MPI), Oscar Pérez (MPI)
	12:30 - 13:30	Presentation of project activities. Project 2. Simulation of spectral characteristics of a tree-grass ecosystem using 3D RTM FLIGHT. Details in Annex I	Jose Ramón Melendo (CSIC) and Pilar Martín (CSIC)
	13:30-14:30	*Lunch (hotel)*	
	14:30-15:30	Presentation of project activities. Project 3. Project 3. BRDF characterization of grass / tree cover using a miniaturized spectrometers onboard drones and a field goniometer. Details in Annex I	Javier Pacheco (MPI), Marco Celesti (UNIMIB), Cinzia Panigada (UNIMIB)
	15:30-16:30	Presentation of project activites. Project 4. Leaf to canopy level estimation of biophysical parameters using field and airborne hyperspectral data. Details in Annex I	Rosario González (INIA), Pilar Martín (CSIC)
	16:30-18:00	Groups organisation and task leader nomination. Preparatory activities for the field campaign	All
	18:00-21:00	Free time	
	21:00	*Dinner (hotel)*	
Wednesday March 14	8:30	Departure from Navalmoral to Majadas experimental site	All
	9:00-9:30	Debrief and revision of Health and Security and Risk Assessment procedure.	Mirco Migliavacca (MPI), Pilar Martín (CSIC)

	9:30-10:00	Prepare and distribute material, instruments and people in the field activities	All
	10:30-13:00	Field activities: ground data collection + Airborne hyperspectral flight	All
	13:00-14:00 or 14:00-15:00	*Picknick Lunch (field)*	
	13:00-18:00	Field activities: ground data collection	All
	18:00-18:30	Check list and organization of samples, equipment, instrumentation	Coordinated by group leaders
	18:30	Departure from Majadas experimental site to Navalmoral	
	19:00-20:00	Free time	
	20:00-21:00	Data download and organization in the school repository	Coordinated by group leaders
	21:00	*Dinner (hotel)*	
Thursday March 15	9:00	Departure from Navalmoral to Majadas experimental site	All
	9:30-10:00	Prepare and distribute material, instruments and people in the field activities	All
	10:00-13:00	Field activities: ground data collection + UAVs flight	All
	13:00-14:00 or 14:00-15:00	*Picknick Lunch (field)*	
	13:00-18:00	Field activities: ground data collection	All
	18:00-18:30	Check list and organization of samples, equipment, instrumentation	Coordinated by group leaders
	18:30	Departure from Majadas experimental site to Navalmoral	
	19:00-20:00	Free time	
	20:00-21:00	Data download and organization in the school repository	Coordinated by group leaders

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	21:00	*Dinner (hotel)*	
Friday March 16	9:00-10:00	Critical review of the field activities, data available, data needs, etc	All. Coordinated by group leaders
	10:00-13:30	Group work: data analysis	All
	13:30-14:30	*Lunch (hotel)*	
	14:30-18:30	Group work: data analysis	All
	18:30	Departure from Navalmoral to Plasencia	
	19:00-23:00	City tour + beers+ dinner	
	23:00	Departure from Plasencia to Navalmoral	
Saturday March 17	9:00-13:30	Group work: data analysis	All
	13:30-14:30	*Lunch (hotel)*	
	14:30-16:30	Group presentations	All
	16:30-17:30	Wrap-up meeting	All
		Participants free to explore Navalmoral	
Sunday March 18	8:00	Departure from Navalmoral to Monfrague National Park	
	9:0 0-12:00	Guided visit to Monfrague National Park	All
	12:00	Departure from Monfrague to Majadas	
	13:00-14:00	Presentation of the Video: Majadas into science. Presentation of scientific activities to local population and the media	Local authorities and TRUSTEE representatives
	13:30-16:00	*Caldereta and tapas for TRUSTEE participants and local population*	
	16:00	Departure from Majadas to Navalmoral (A private bus service will be available for TRUSTEE participants that need to travel from Majadas to Navalmoral before 16:00. Time schedule will be discussed according to participant´s travel plans)	

Project 1: Estimation of carbon and water fluxes using spectral information: vegetation indices and Sun Induced Fluorescence (SIF)

Coordinator/s: Mirco Migliavacca (MPI), Javier Pacheco-Labrador (MPI), Oscar Pérez-Priego (MPI)

Research objectives:

The main scientific objective of this training project are 1) to provide to the student the tools to plan the measurements necessary to interpret the relationship between CO_2 fluxes and remote /proximal sensing observations, 2) to analyse and explore the relationship between hyperspectral data and CO_2 fluxes and 3) to develop the skills to upscale CO_2 fluxes using earth observations and remote sensing information.

Specifically the objectives of the training project are to:

- Establish empirical relationship between spectral information and measurements of photosynthetic CO_2 uptake collected in the field (either during the training school or in previous field campaigns);
- Analyse the relationship between SIF and photosynthetic CO_2 uptake in grassland ecosystems;
- Analyse the response of photosynthetic CO_2 uptake and SIF to variable canopy properties and functional traits using the radiative transfer model SCOPE.

Expected results:

- Establishment of a dataset of CO_2 fluxes, spectral data, SIF, and leaf exchange measurements in at least 2 of the experimental plots in the Majadas del Tietar experimental facility.
- Analysis of the correlation between hyperspectral data and photosynthetic CO2 uptake in plots with variable biomass and nutrient availability.
- Preparation of a database with runs of the radiative transfer model SCOPE.

Project 2: Simulating of spectral characteristic of a tree-grass ecosystem using 3D Radiative Transfer Model (RTM) FLIGHT.

Coordinator/s: Jose Ramón Melendo (CSIC) and Pilar Martín (CSIC)

Research objectives:

The main objective of the project will be to model spectral behavior in the VIS, NIR and SWIR domain of a Tree-grass ecosystem using the 3D Radiative Transfer Model (RTM) FLIGHT. Students will simulate the spectral response of experimental plots using the model and will

emulate the bands of the Compact Airborne Spectrographic Imager (CASI) sensor that will flight the area during the TS. Simulated spectra will be compared with the signal registered by the airborne sensor.

Specifically the objectives of the training project are to:

- Apprehend the basic information needed to properly parametrize a 3D RTM in a heterogeneous ecosystem and how this information should be collected in the field
- Simulate the temporal variability of the underlying background in an open forest to feed a 3D modelling
- To generate simulated FLIGHT spectra and scenes of the study area to compare with the high resolution images provided by the CASI sensor.

Expected results:

Students are expected to learn to properly parametrize and run a 3D radiative transfer modeling to produce a simulated dataset that could be used to characterize an ecosystem with spatial and temporal dynamics. Additionally they will evaluate the model performance by comparing their simulation with "real" data acquired by hyperspectral airborne sensors.

Project 3: BRDF characterization of grass / tree cover using a miniaturized spectrometers onboard drones and a field goniometer

Coordinator/s: Javier Pacheco (MPI) /Marco Celesti and Cinzia Panigada (UNIMIB)

Research objectives:

1.   Characterize Sun Induced Fluorescence (SIF) and Reflectance Factors (RF) directional responses in Mediterranean grassland.

2.   Characterize RF and spectral vegetation indices (SVI) directional responses for tree crowns in a Mediterranean tree-grass ecosystem.

3.   Simulate grass SIF and RF directional responses using SCOPE model and compare results with observed data

Expected results:

- Students will learn the basic theoretical and practical concepts of acquisition of multi-angular spectral data, both from a terrestrial goniometer and from and a drone-borne spectroradiometric system.
- Students will learn to process and represent multi-angular spectral data
- Students will explore and understand the impact of different structural and functional traits on the SIF and RF bidirectional reflectance distribution function (BRDF)

Project 4. Leaf to canopy level estimation of biophysical parameters using field and airborne hyperspectral data

Coordinator/s: Rosario González and Pilar Martín

Research objectives:

To explore the use of high spatial and spectral resolution data acquired with a field spectroradiometer and an hyperspectral airborne sensor for the estimation of biochemical variables (nitrogen, carbon, LMA, water and pigment content) in the Quercus ilex strata of a wooded savanna (dehesa) ecosystem

Expected results:

- Establishment of a tree leaf dataset (TLD) composed of tree biophysical variables (TEBVs), leaf spectra, and selected leaf-SVIs for 4 CASI flights campaigns (previous field campaigns). Generation of a dataset of canopy EBVs and simulated canopy spectra and ASD-canopy-SVIs generated from leaf spectra.
- Establishment of a tree canopy dataset (TCD) composed of canopy EBVs and CASI extracted canopy spectra and CASI-canopy-SVIs.
- Fast development of empirical PLSR models and retrieval errors for the estimation of TEBVs with continuum leaf and canopy spectra using the software Unscrambler® X.
- Regression analysis for the empirical estimation of canopy TEBVs with CASI-SVIs and ASD-SVIs. Comparison of retrieval errors.