

## OPTIMISE COST ACTION, NEWSLETTER 1

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#### **Editorial**

We are happy to release the first issue of the OPTIMISE COST Action (ES1309) Newsletter. The goal of these Newsletter series is to regularly compile and disseminate the main highlights accomplished during OPTIMISE Cost Action. In this issue we focus on the first two training courses organized during OPTIMISE. Training courses are an important component of COST Actions as they act as tool to transfer knowledge and know-how to future scientists. This is particularly relevant for our project “Innovative optical Tools for proximal sensing of ecophysiological processes OPTIMISE”, because as the name suggest, the tools that we use are innovative and new and very limited formal education can be offered at Universities. With these activities we want to fill part of this gap by introducing young scientists with cutting edge methods and instrumentation relevant in our field.

We also present an overview of general activities and plans for the upcoming months.

**We hope you enjoy it!**

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#### **THE “ABEL” TRAINING COURSE ON UAVs AND BIOGEOCHEMICAL CYCLING**

The ABEL course (uAvs and Biogeochemical cycling) aimed at training young researchers on the acquisition, management and processing of spatially explicit spectral information for the study of biogeochemical cycles.

The course took place in the “Las Majadas del Tiétar” experimental site located in Western Spain (Cáceres province). The site is a typical *dehesa* (oak savanna) ecosystem with two vegetation layers: a low density tree layer with fraction cover of about 20% and mean

tree age about 150-200 years; and a grazed pasture layer. The site is a well-established observational facility for ecosystem process studies equipped, amongst others, with three state-of-the-art flux towers operated by the Mediterranean Center for Environmental Studies (CEAM) and the Institute of Biogeochemistry of the Max Planck Institute (MPI-BGC) (<http://fluxnet.ornl.gov/site/440>). In addition to flux measurements and other micrometeorological variables, the site is equipped with continuous measurements of spectral reflectance. This, together with a high probability of having clear skies to conduct field spectral measurements and good food for the

lunch breaks, made of “Las Majadas” and excellent choice for the ABEL Training Course.

Altogether, a total of twelve students and eight trainers coming from 10 different European countries shared their experiences and knowledge; and enjoyed a mild weather and the beautiful Spanish spring.

Students acquired theoretical knowledge attending different lectures in field spectroscopy, sampling experimental design, spectral databases, radiative transfer modeling, sun induced fluorescence and data integration. Concretely, the radiative transfer model SCOPE (<http://ipl.uv.es/artmo/index.php/radiative-transfer-models/88-rtm-leaf-canopy/17-scope>) and the spectral database SPECCHIO (<http://www.specchio.ch/>) were explained and practical exercises were carried out.



*In the Picture: Students acquiring hand held spectral measurements with different sampling schemes.*

The practical core of the school took part in the field. Students gathered in four teams to design and carry out four different experiments. First they visited the study site in order to perform a risk assessment and to get first-hand information of the site characteristics and conditions. Each group was responsible of the design of one experiment which was presented to the other groups. Subsequently, the teams rotated in order to participate in all of the experiments, acquiring their own measurements. A common data management scheme was settled to share all the data acquired in the field. Each group reported the results of their work

during the OPTIMISE Second Working Group Workshop and MC Meeting organized in Madrid right after the course.



*In the picture: Students taking directional measurements of tree crowns from a crane.*

The first experiment was the acquisition of multi-angular spectral measurements of tree crowns from a crane; as an alternative to a UAV platform (permission to fly the OPTIMISE trainer’s UAVs had not been received from the Spanish authorities). These measurements were also accompanied of infrared imagery. The second experiment analyzed the effect of the illumination conditions on the physiology of Holm oak leaves. To do so, the students used a hand held radiometer and a leaf clip specifically designed to measure both apparent reflectance and the fluorescence emission. The third experiment was an assessment of the uncertainties related with the sampling methodologies in hand-held spectroscopy; where several sampling schemes were tested by measuring with a field spectroradiometer in grass patches of different characteristics. The fourth experiment used an UAV to acquire photogrammetric imagery of the study area later used for the 3D tree canopy reconstruction using Structure from Motion techniques.

*“This has been the best day ever in my life”* said Dr. Andreas Hueni after a day of perfect clear sky conditions in Majadas for field spectroscopy. *“Me vais a volver loco – you’ll drive me crazy”* used to say the Spanish contact point. *“We cannot eat anymore”* said the students at the Hotel los Granados’ restaurant.

One of the students, Helge Aasen (University of Cologne) gave us his opinion about the school:

*"ABEL included a wide variety of field and analysis techniques for proximal and UAV based remote sensing with a dense and well prepared program. We were divided in four groups of three students. Experiments were carried out to quantify uncertainties in field spectroscopy, BRDF measurements, different types of UAV mapping and leaf level fluorescence measurements. Every group designed one of the experiment and all groups rotated through them. Not only gave these activities useful insights into scientific methods, but also fostered team work and helped developing organization and communication skills for larger field campaigns, since each of the single experiments were fit into an overall framework of the entire group. Out of these activates a good team spirit arise which expanded into non-scientific activities such as exploring the environment around Naval Moral de la Mata where we were accommodated. Overall, everything was very well organized by the local organization team and lectures and field experiments were well guided by the OPTIMISE trainers. Also the size of the student group was well suited for a trainings school".*

During the ABEL school, the students acquired a theoretical and practical knowledge on the acquisition and analysis of spectral information, and experienced a real case scenario with difficulties related to the national regulations for UAV platforms, to the field environmental conditions and the use of different instruments, platforms, data management and integration.

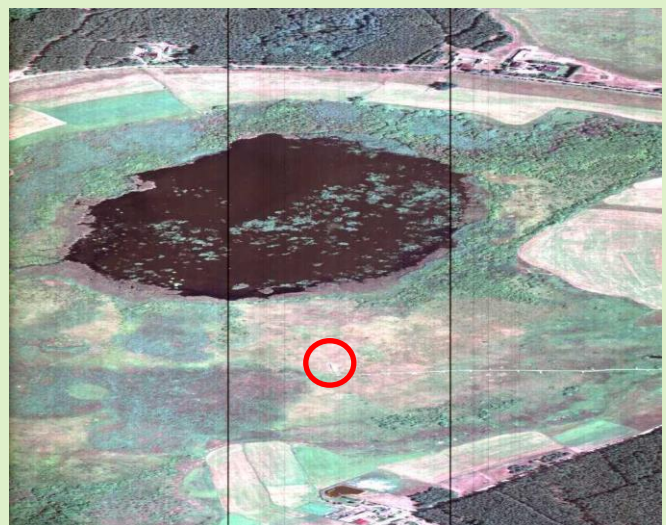
The ABEL school was coordinated by the OPTIMISE Action chair, Alasdair MacArthur (University of Edinburgh) and the Action training leader, Enrico Tomelleri (EURAC) in collaboration with local organizers Pilar Martín and Javier Pacheco (SpecLab-CSIC). Other OPTIMISE members that participated as school trainers were: Karen Anderson (University of Exeter), Luis Alonso (University of Valencia), Andreas Hueni (University of Zurich), Francesco Fava and Micol Rossini (University of Milano Bicocca), Arnaud Carrara (CEAM) and Marcos Jimenez (INTA).

**Dr. Pilar Martín and Mr. Javier Pacheco** (ABEL Organizers), [mpilar.martin@cchs.csic.es](mailto:mpilar.martin@cchs.csic.es), [Javier.pacheco@cchs.csic.es](mailto:Javier.pacheco@cchs.csic.es)

#### **THE "SWAMP" TRAINING SCHOOL: SPECTROMETRY OF A WETLAND AND MODELLING OF PHOTOSYNTHESIS WITH HYPERSPECTRAL AIRBORNE REFLECTANCE AND FLUORESCENCE.**

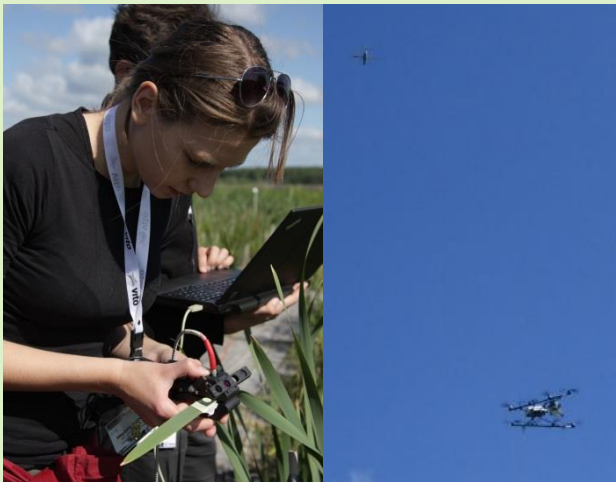
The SWAMP training course was hosted by the Poznan University of Life Sciences (PULS) and held from July 6th to 16th 2015 in Obrzycko-Rzeczyn (POLWET), Poland. The training course was co-funded and co-organized by the FP7 European Facility for Airborne Research (EUFAR), COST Action OPTIMISE (ES1309) and European Space Agency (ESA).

The training course took place in the Obrzycko Palace complex, 25km from the POLWET experimental site where training activities and airborne, UAV and field measurements were conducted. The POLWET site is located in the Rzeczyn wetland, a 87ha mesotrophic peatland located in the middle of the Notecka Primeval Forest in Western Poland. The flux tower is located in the middle of the wetland and has been operated since 2004. The flux tower is also equipped with multiband radiometers for derivation of vegetation indices.



*In The picture: APEX quicklook of the POLWET site. The circle indicates the location of the flux tower.*





*In the Picture: Student measuring in vivo fluorescence spectra of leaves (left). Multiscale airborne measurements with UAVs and aircrafts (right).*

A total of 20 participants including early-stage researchers and trainees, from 12 different European member states were funded by EUFAR and OPTIMISE and participated in the SWAMP training course.

The focus of the SWAMP training course was on multiscale spectral measurements (leaf, UAV, aircraft) and data management. The specific goals were to learn how to:

- develop a measurement strategy and design a flight plan for an airborne campaign,
- recognize what laboratory and field calibration and validation measures are necessary for airborne and near-ground optical remote sensing,
- develop a sampling strategy and carry out ground-based measurements to support an airborne campaign,
- develop a sampling strategy and carry out near-ground measurements from small UAV platforms,
- post process airborne and near-ground optical measurements, and
- analyse these data through statistical methods and through radiative transfer modelling studies.

The course included a series of lectures, demonstrations, tutorials, field and airborne measurements, as well as guided data post-processing and analysis activities. Since the course was jointly organized by OPTIMISE and EUFAR with ESA support,

the students could get hands on practice in the design of a flight plan in addition to acquiring ground/near-ground validation data with UAVs and field spectral measurements. Students also performed preliminary analysis of the data acquired at multiple scales during the campaign.



*Group picture taken in front of the Obrzycko Castle*

Overall, data acquisition during the SWAMP training course included airborne acquisitions with HyPlant and APEX and imaging spectroradiometers, UAV acquisitions with imaging spectroradiometers, atmospheric measurements with Microtops II sun photometers, ground radiometric measurements with field spectrometers, surface energy budget measurements with Eddy Covariance, plot scale CO<sub>2</sub> fluxes measurements with dynamic chambers, and ground biophysical measurements LAI, fAPAR, and fluorescence spectra. Spectral data was stored using the online SPECCHIO spectral information system.

The students gained a better understanding in the complexities and uncertainties in optical Earth observations from near-ground, airborne and satellite platforms.

*“It was a unique opportunity to participate in the SWAMP 2015 course because of many reasons. First of all, the program of the course was well prepared and full of interesting and well presented topics. It included all aspects and steps of research with imaging spectroscopy. Beginning with theoretical introduction, field measurements methodology and data processing and modeling, through real exercises with instruments, mission planning and software tutorials given by highly*

*experienced trainers, to real field measurements and data processing. Secondly the organization was extraordinary. Localization of the course was in Obrzycko Palace where we had excellent conditions to study. The number of topics and classes was impressive and complex, quality of presentations was outstanding. Another important advantage of this course was networking of young and experienced scientists from all over the world (including China, Israel and Brasil). During the course we had a great opportunity to cooperate not only inside the working groups but also between them. Also contact with the trainers was very good. They were very helpful and worked with us to explain everything what we were interested in. All these aspects are the achievements of this course in my opinion.”* wrote Michal Krupiński, a student from the Space Research Centre of the Polish Academy of Sciences.

The training course would not have been possible without the support of its trainers and organizers, thanks to: Alasdair Mac Arthur (University of

Edinburgh), Enrico Tomelleri (EURAC), Christiaan van der Tol (University of Twente), Tommaso Julitta (University of Milano Bicocca), Andreas Burkart (FZJ Jülich), Ils Reusen (VITO), Andreas Hueni (University of Zurich), Alexander Damm (University of Zurich), Jochem Verrelst (University of Valencia), Helge Aasen (University of Cologne), Tomasz Prost (Bird&Bird), Karolina Sakowska (Edmund Mach Foundation), Radosław Juszczak (PULS), Dirk Schuettemeyer (ESA), Pieter Kempeneers (VITO), Marian-Daniel Iordache (VITO), Bart Bomans (VITO), Koen Meuleman (VITO), Bogdan Chojnicki (PULS), Janusz Olejnik (PULS), Marcin Stróżecki (PULS), Klaudia Ziemblińska (PULS), Anke Schickling (Forschungszentrum Jülich GmbH), and Bringfried Pflug (DLR).

**Dr. Radoslaw Juszczak** (SWAMP Coordinator, PULS, Poznan, Poland), [radjusz@up.poznan.pl](mailto:radjusz@up.poznan.pl)

**Dr. Ils Reusen** (EUFAR Education and Training coordinator, VITO, Belgium), [ils.reusen@vito.be](mailto:ils.reusen@vito.be)

**Remember to keep an eye on our website for updates, information and instructions on how to join our Action!**

**Feedback is most welcome : [joan.porcar@helsinki.fi](mailto:joan.porcar@helsinki.fi)**

**UPDADE OF OPTIMISE ACTIVITIES AND FUTURE PLANS**

OPTIMISE has got off to a flying start! We managed to complete most of our first year's work plan in just 8 months, (due to unavoidable delays in COST Association authorizing funding) thanks to the great effort of all who helped plan and participate in the activities.

*Activities 2014/15 period.* Three STSMs were successfully completed during our 1<sup>st</sup> year and we held three well-attended WG workshops, with over 40 participants and our 2<sup>nd</sup> MC meeting at the U. of Milano-Bicocca hosted by Dr. Micol Rossini during October 2014. Then our 1<sup>st</sup> Training school, ABEL (reported above) hosted by Dr. Arnaud Carrara and Dr. Pilar Martin. Dr Martin also hosted our WG workshops and annual MC meeting at CSIC in Madrid at the end of March. At this meeting an outline plan for 2015/16 was discussed and a joint EUFAR/OPTIMISE training school proposed. However, as less than 2/3<sup>rd</sup>s of the Action member countries (we had 26 member countries and 17 were represented) were present at the meeting the proposals were minuted and subsequently approved by the MC by e-Vote. The only planned activity that we were unable to complete, due to time constraints, was to hold the planned UAV Training for Trainers school proposed by Dr Karen Anderson. We have rescheduled this training to be held at U. of Exeter in March/April 2016. Due to not holding this activity we underspent our budget for the first contract period. However, COST accepted our request for a budget increase for the 2<sup>nd</sup> contract due to the increase in the number of OPTIMISE member countries.

*Activities 2015/16 period.* Four STSMs completed or planned. We held our 2<sup>nd</sup> training school (reported above) at the beginning of this period and plan to hold the UAV training for trainers in the 1<sup>st</sup> quarter of 2016. During the 1<sup>st</sup> part of this 2<sup>nd</sup> contract period, COST Committee of Senior Officials approved the applications of: Dr Taras Kazantsev, Scientific Centre for Aerospace Research of the Earth, Institute of Geological Science, NASU, Ukraine (a Near-neighbour country); Prof. Phil. Townsend, U. of Wisconsin-Madison, USA and Prof. J. Gamon, U. of Alberta, Canada; (both International partner Countries) and awarded them MC Observer status. We welcome Taras, Phil and John to OPTIMISE and look forward to meeting them at MC meetings in the future. Preparations are now underway for the next series of WG workshops and our annual MC meeting for the 2015/16 contract period. As agreed following approval of the last MC meeting minutes and proposals, the next MC meeting and WG workshops will be held in Croatia in late February 2016. The format will be to hold a WG1 (spectral information systems) practical training workshop, followed by WG2 and WG3 workshops comprising of, invited talks, science presentations and open-floor discussions, with of course networking opportunities☺, and followed by the 4<sup>th</sup> OPTIMISE MC meeting to discuss, plan and approve activities for 2016/17. The OPTIMISE Core Group are really keen that all countries contribute actively to our Action. We request that if MC members from each country are unable to attend they try to encourage their country's MC substitute member come in their place. We are also looking for countries and institutes to volunteer to host training schools and workshops during 2016/17. Note to host training schools we need a reasonable chance of 'blue sky' in summer (normally July) and be legally able to fly our UAVs. Please contact me directly if this is of interest to you.

Finally I would like to inform you that FLEX-Bridge has announced that FLEX has been recommended by the ESA User Consultation Committee as the sensor for Earth Explorer 8. Many thanks to Profs. Jose Moreno and Uwe Rascher and their groups and all others involved for their efforts over many years and many congratulations to them. Finally, I would like to thank you all for supporting OPTIMISE.

**Dr. Alasdair MacArthur** (OPTIMISE Chair)