OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

COST
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

Introduction to SWAMP training course and research activities at the Rzecin (POLWET) site

Radosław Juszczak

Janusz Olejnik, Bogdan Chojnicki, Marek Urbaniak, Jacek Lesny, Karolina Sakowska, Daria Polmańska, Klaudia Ziemblińska, Marcin Stróżecki (PULS)

Alasdair Mac Arthur (UEDIN, UK), Micol Rossini (UNIMIB, IT), Enrico Tomelleri (EUR.AC, Bozen, IT), Andreas Hueni (RSL, UZH, CH), Christiaan van der Tol (University of Twente, NL), IlS Reusen (VITO, BE)

University of Zurich UZH

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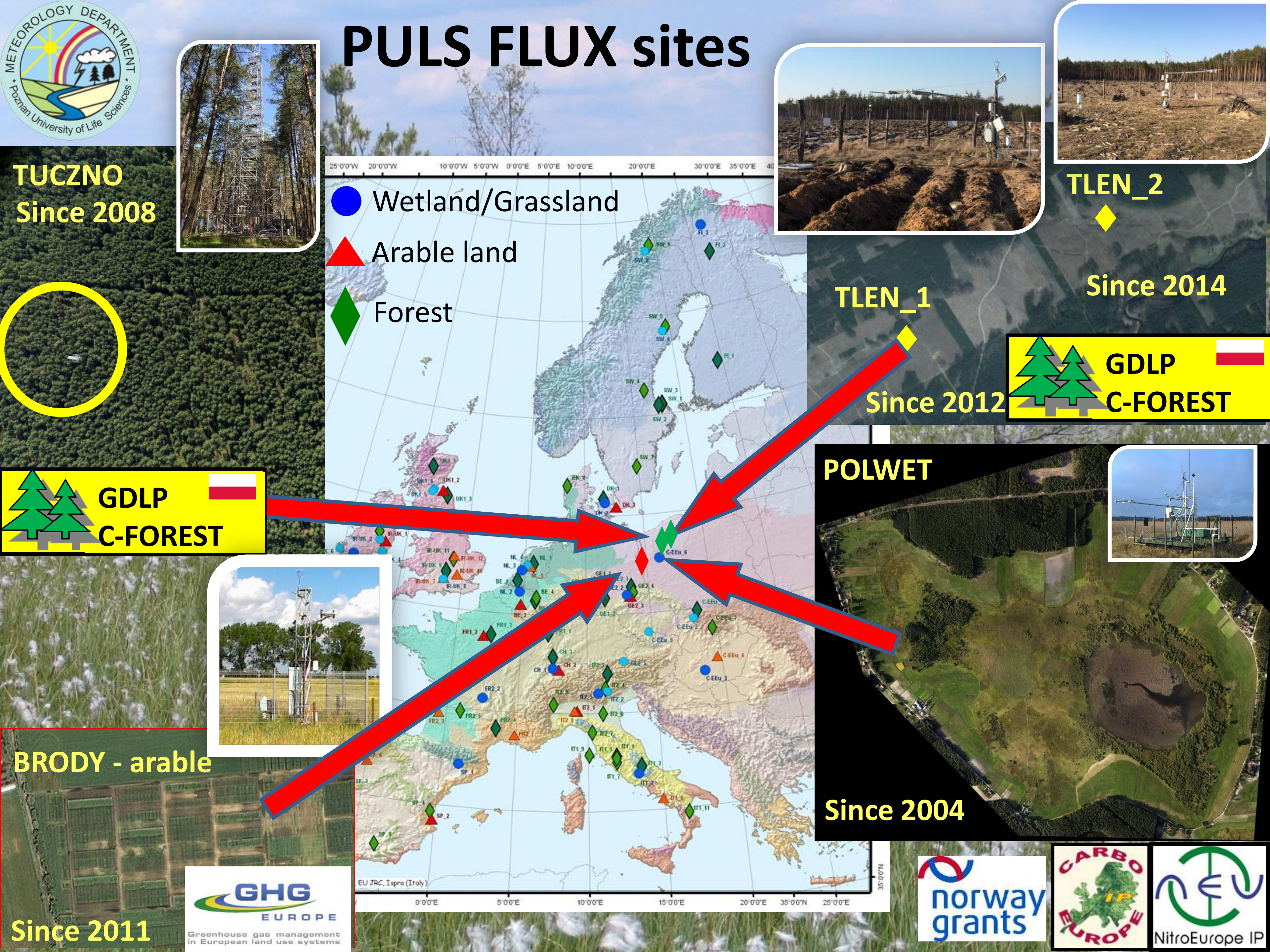
METEO FRANCE

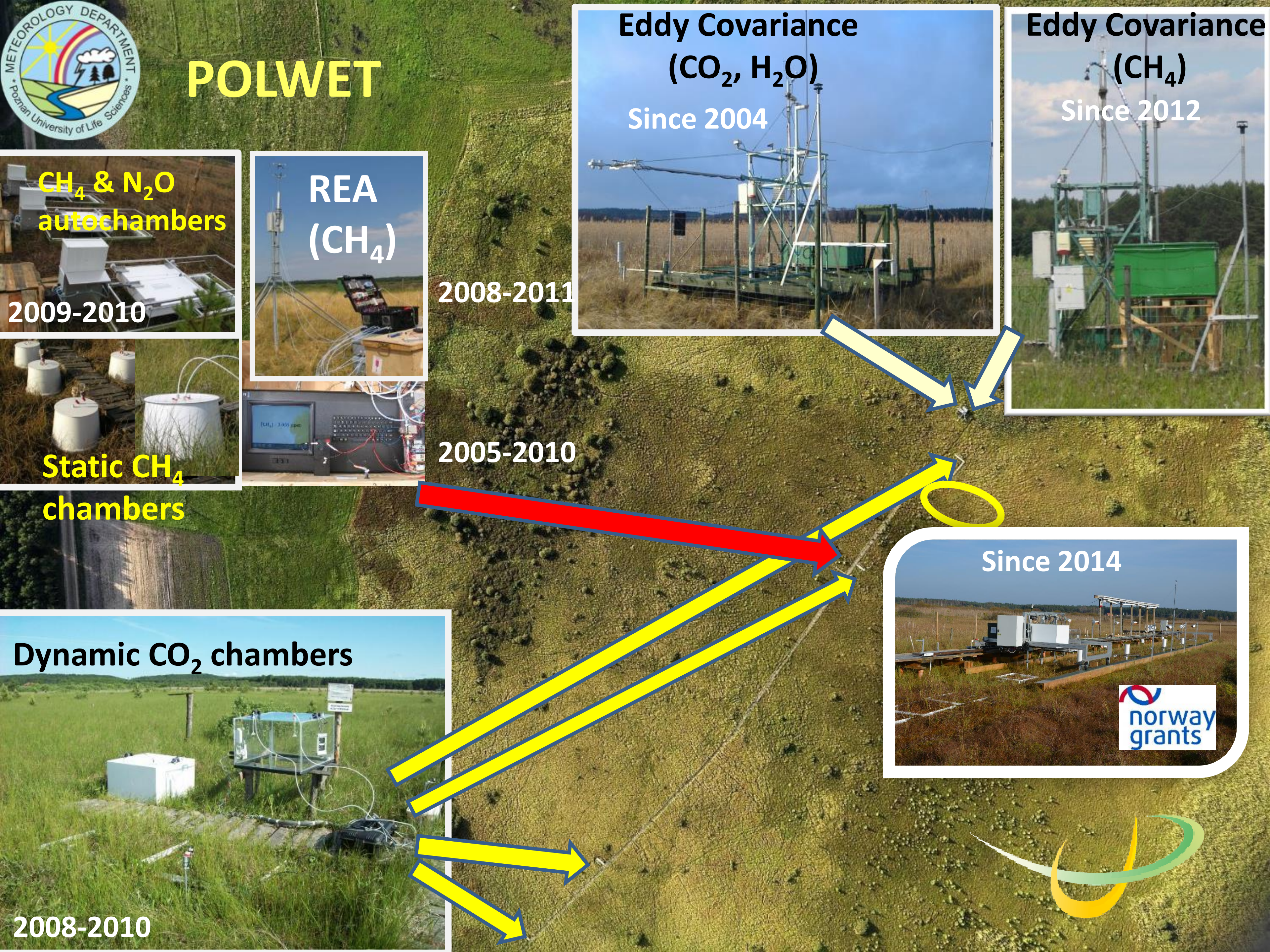
Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNC

University of Twente
The Netherlands

EURAC research

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA


PULS FLUX sites
METEOROLOGY DEPARTMENT
Poznan University of Life Sciences
TUCZNO
Since 2008
Wetland/Grassland
Arable land
Forest
TLEN_2
Since 2014
TLEN_1
Since 2012
GDLP
C-FOREST
GDLP
C-FOREST
POLWET
Since 2004
BRODY - arable
Since 2011
EU JRC, Ispra (Italy)
GHG EUROPE
Greenhouse gas management in European land use systems
norway grants
CARBO EUROPE IP
NitroEurope IP


METEOROLOGY DEPARTMENT
Poznan University of Life Sciences
POLWET
CH_4 & N_2O autochambers
2009-2010
REA (CH_4)
2008-2011
Eddy Covariance (CO_2, H_2O)
Since 2004
Eddy Covariance (CH_4)
Since 2012
Static CH_4 chambers
2005-2010
Since 2014
norway grants
Dynamic CO_2 chambers
2008-2010

Polish-Norwegian Research Programme

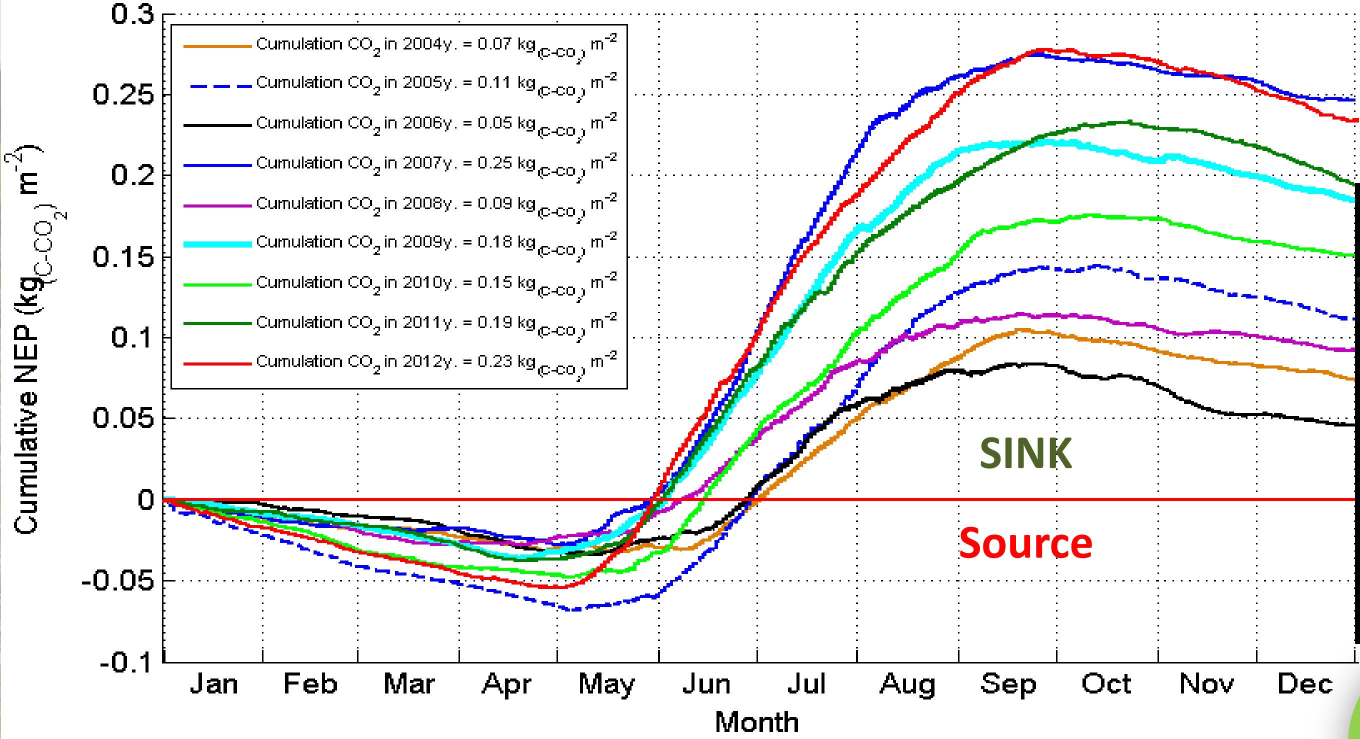
norway grants

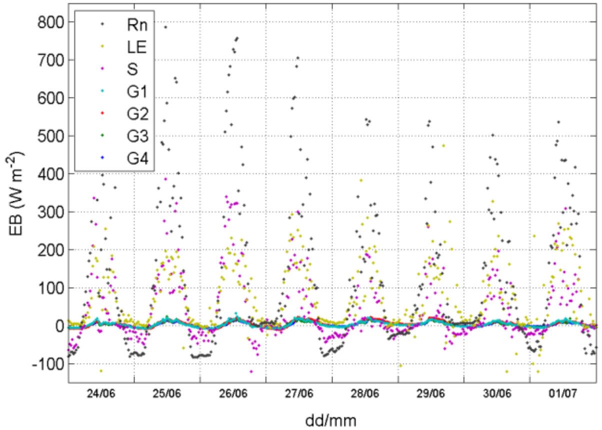
Narodowe Centrum Badań i Rozwoju

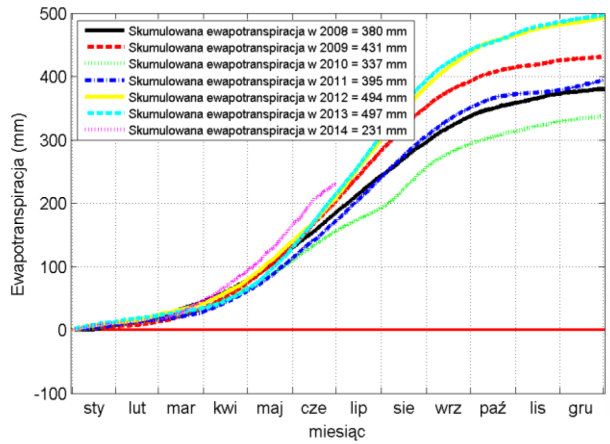
WETMAN
PULS,Bioforsk
Polish-Norwegian Research Programme

METEOROLOGY DEPARTMENT
Poznan University of Life Sciences

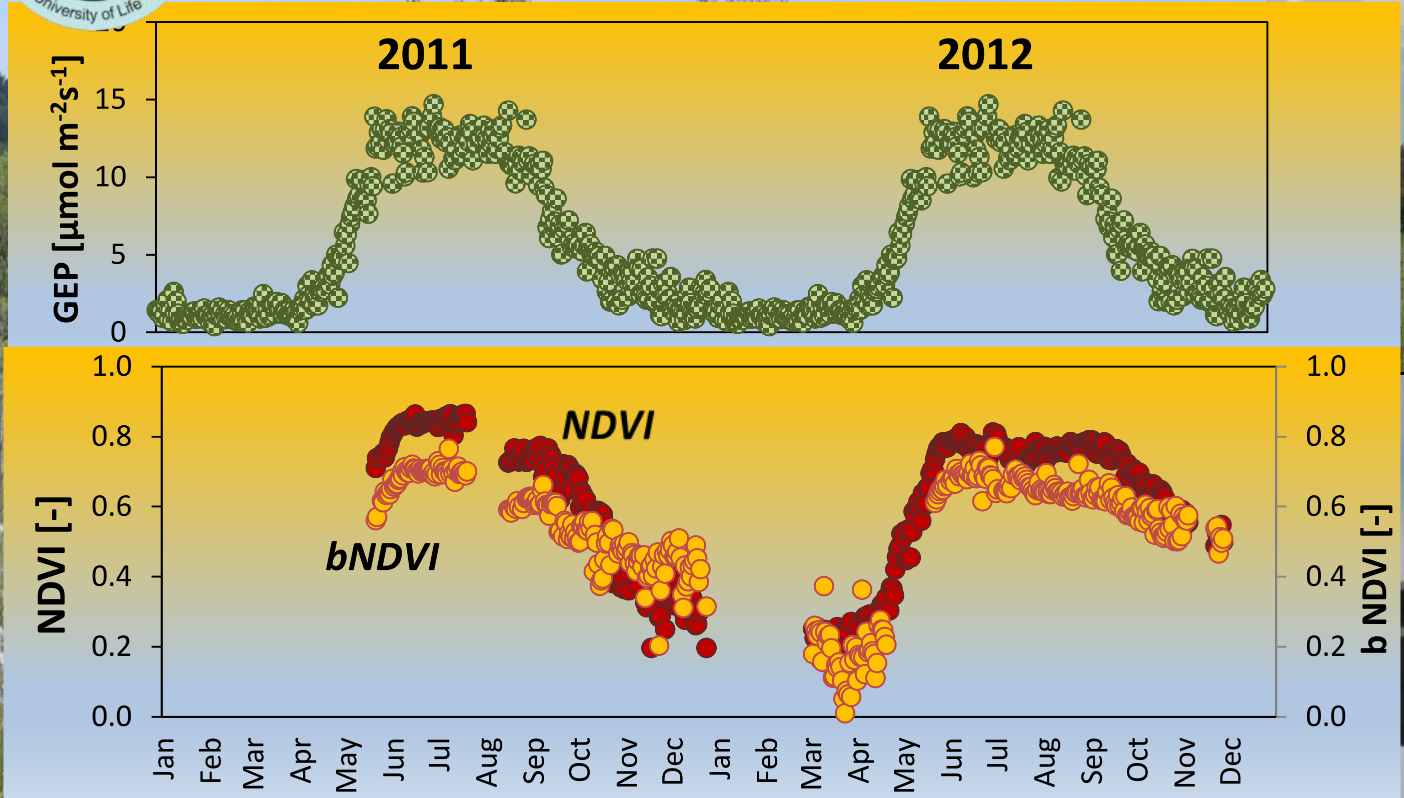
POLWET – CO_2 and H_2O fluxes

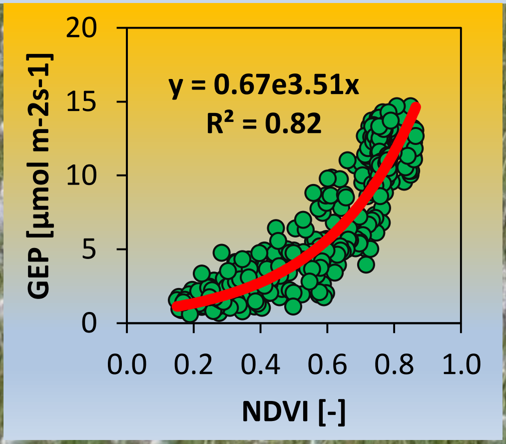


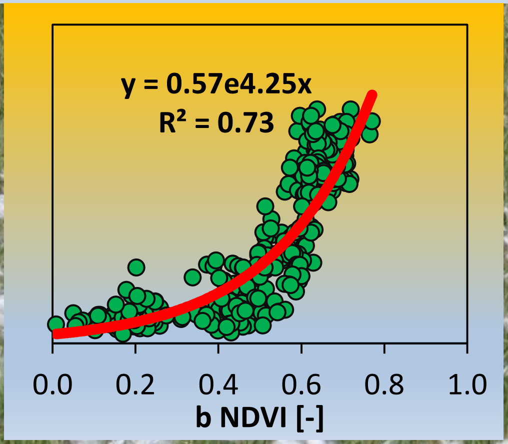




POLWET







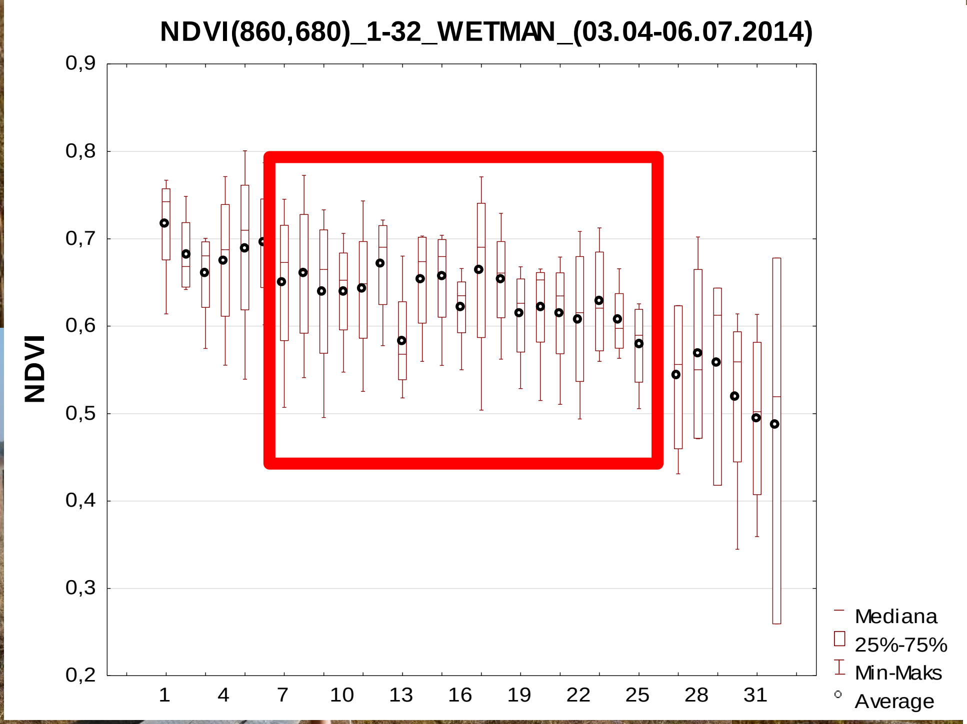
NDVI, PRI

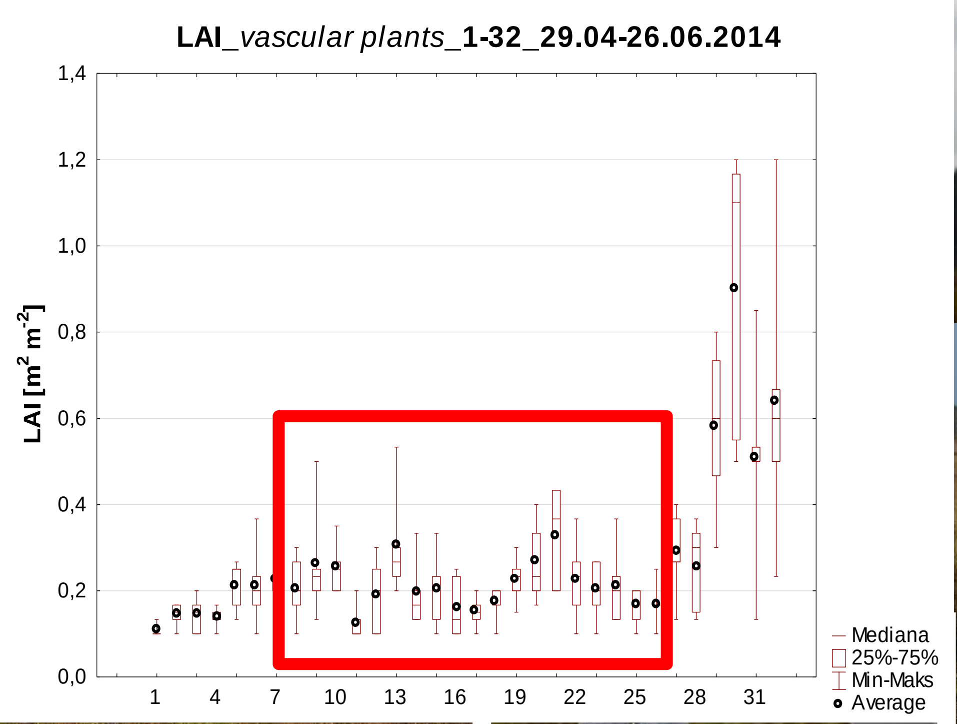
POLISH-NORWEGIAN RESEARCH PROGRAMME

norway grants

WETMAN
PULS, Bioforsk
Polish-Norwegian Research Programme

Climate manipulation experiment since 2014





POLISH-NORWEGIAN RESEARCH PROGRAMME

norway grants

Narodowe Centrum Badań i Rozwoju

WETMAN
PULS, Bioforsk
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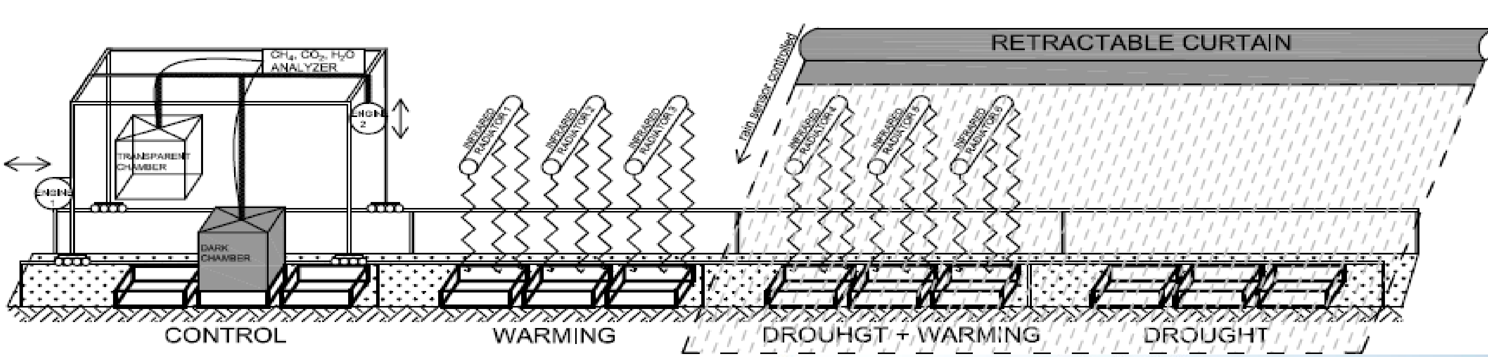
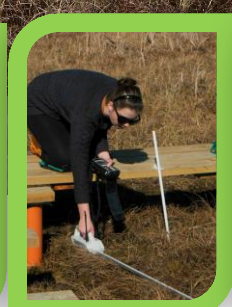
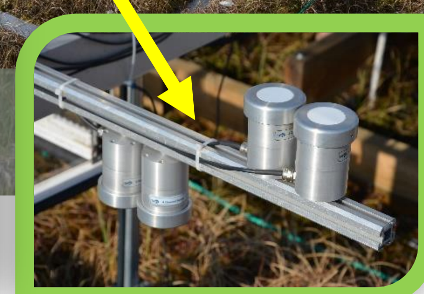
3D SCHEME OF AUTOMATIC CHAMBER MEASUREMENT







METEOROLOGY DEPARTMENT
Poznań University of Life Sciences

Bioforsk

Polish-Norwegian Research Programme

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WETMAN
PULS, Bioforsk
Polish-Norwegian Research Programme

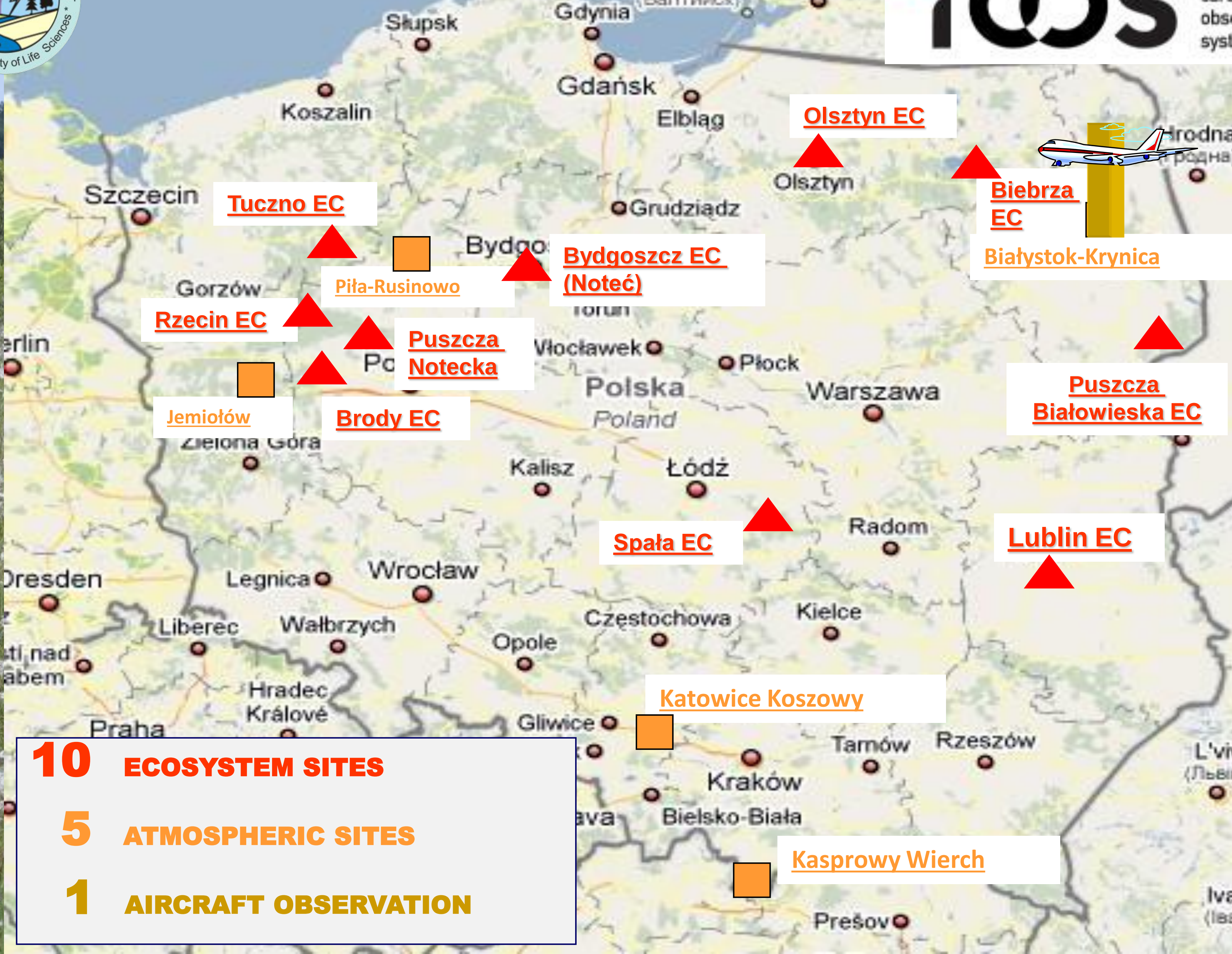
530 nm
550 nm
570 nm
670 nm
850 nm
900 nm
970 nm
1240 nm

Bioforsk

Meteorology Department
Poznan University of Life Sciences

ICOS-Poland

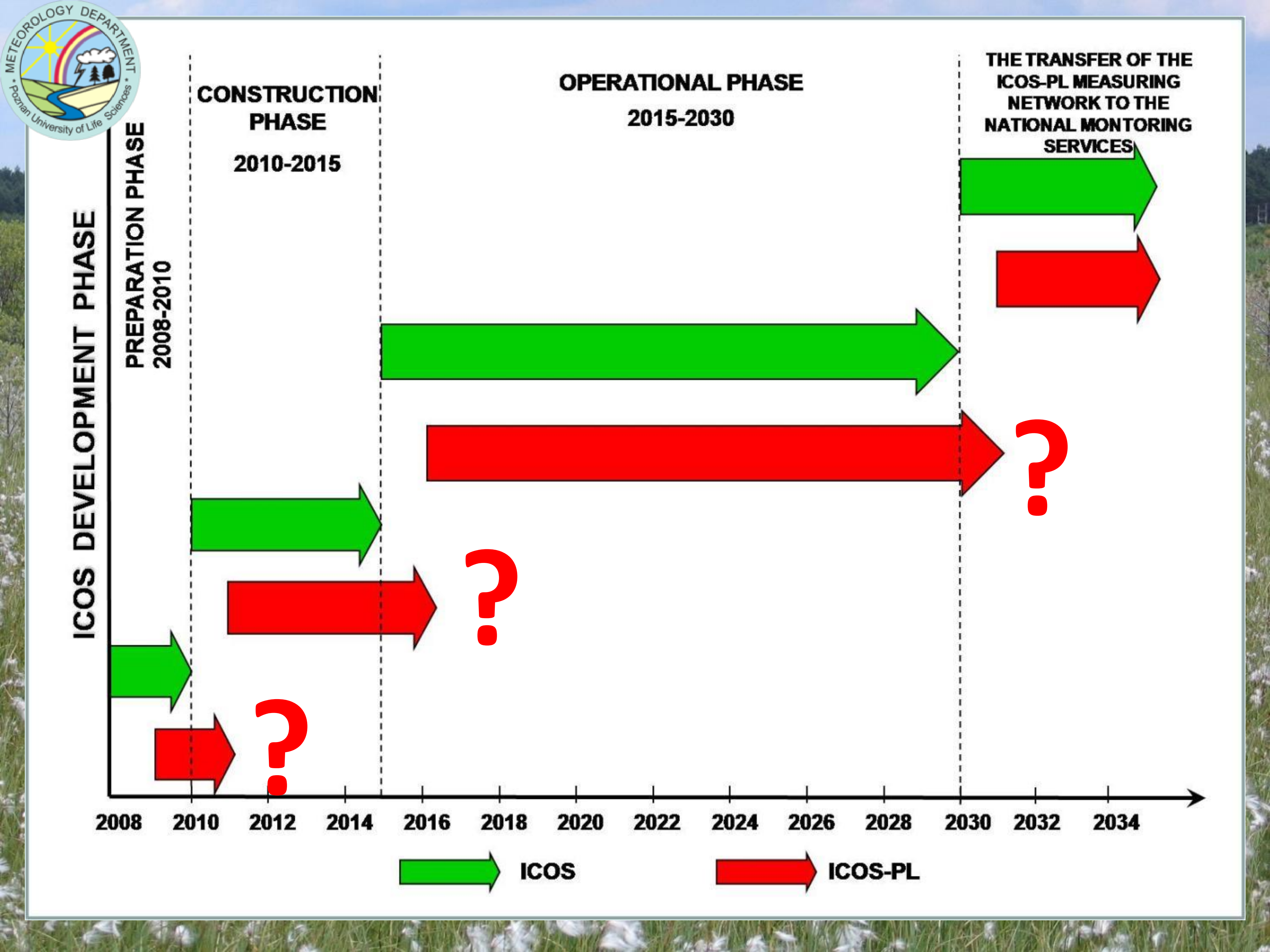
integrated carbon observation system



10 ECOSYSTEM SITES

5 ATMOSPHERIC SITES

1 AIRCRAFT OBSERVATION


ICOS DEVELOPMENT PHASE
PREPARATION PHASE
2008-2010
CONSTRUCTION PHASE
2010-2015
OPERATIONAL PHASE
2015-2030
THE TRANSFER OF THE ICOS-PL MEASURING NETWORK TO THE NATIONAL MONTORING SERVICES
?
?
?
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
ICOS
ICOS-PL

OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

COST
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

EUFAR

SWAMP training course

Spectrometry of a Wetland And Modelling of Photosynthesis with Hyperspectral Airborne Reflectance and Fluorescence

Obrzycko-Rzecin, Poland
6-16 July 2015

METEOROLOGY DEPARTMENT
Poznan University of Life Sciences

Poznan University of Life Sciences, Poland

University of Zurich[UZH]

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vision on technology

METEO FRANCE

Field Spectroscopy Facility
NATURAL ENVIRONMENT RESEARCH COUNCIL

THE UNIVERSITY OF EDINBURGH

University of Twente
The Netherlands

EURAC research

EUFAR/OPTIMISE training course aims:

to teach a 15-20 early stage researchers (PhD students and post docs) and a limited (max. 5) number of university lecturers how to organize and conduct an airborne campaign supported by a near-ground UAVs with hyperspectral imaging sensors and spectrometers.

Through the training course participants will learn how to:

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

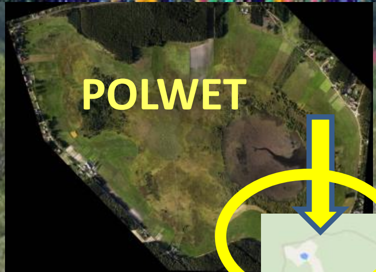
OPTIMISE

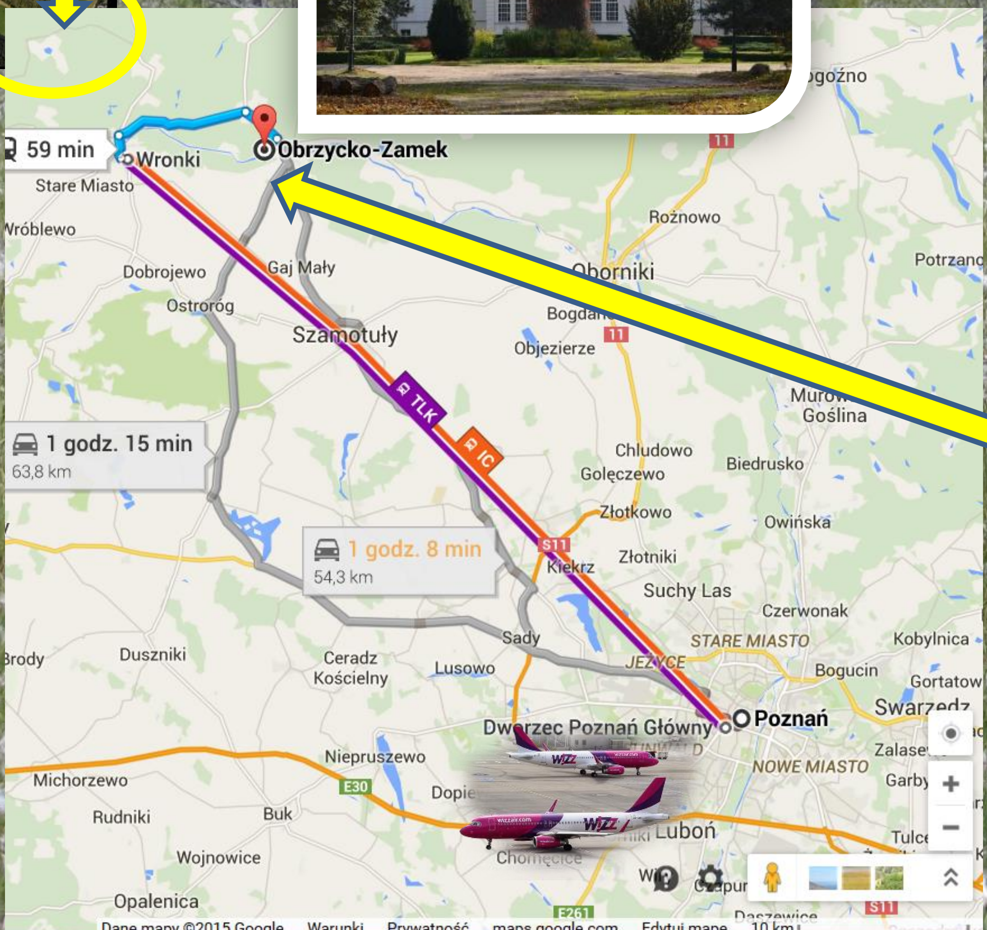
Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

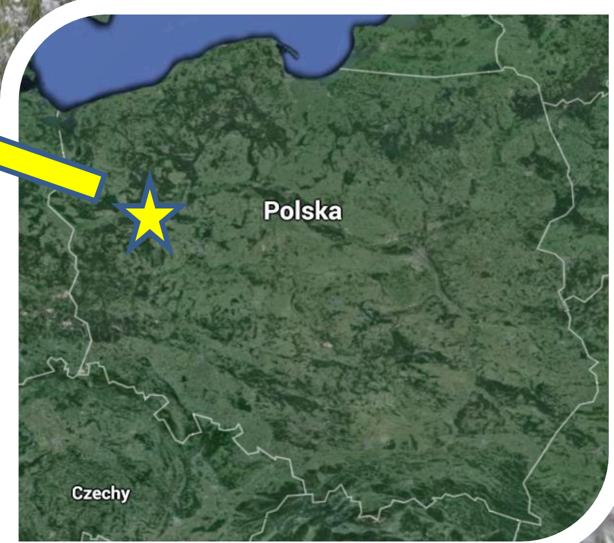
EUFAR

Where?

http://www.palac-obrzycko.pl/





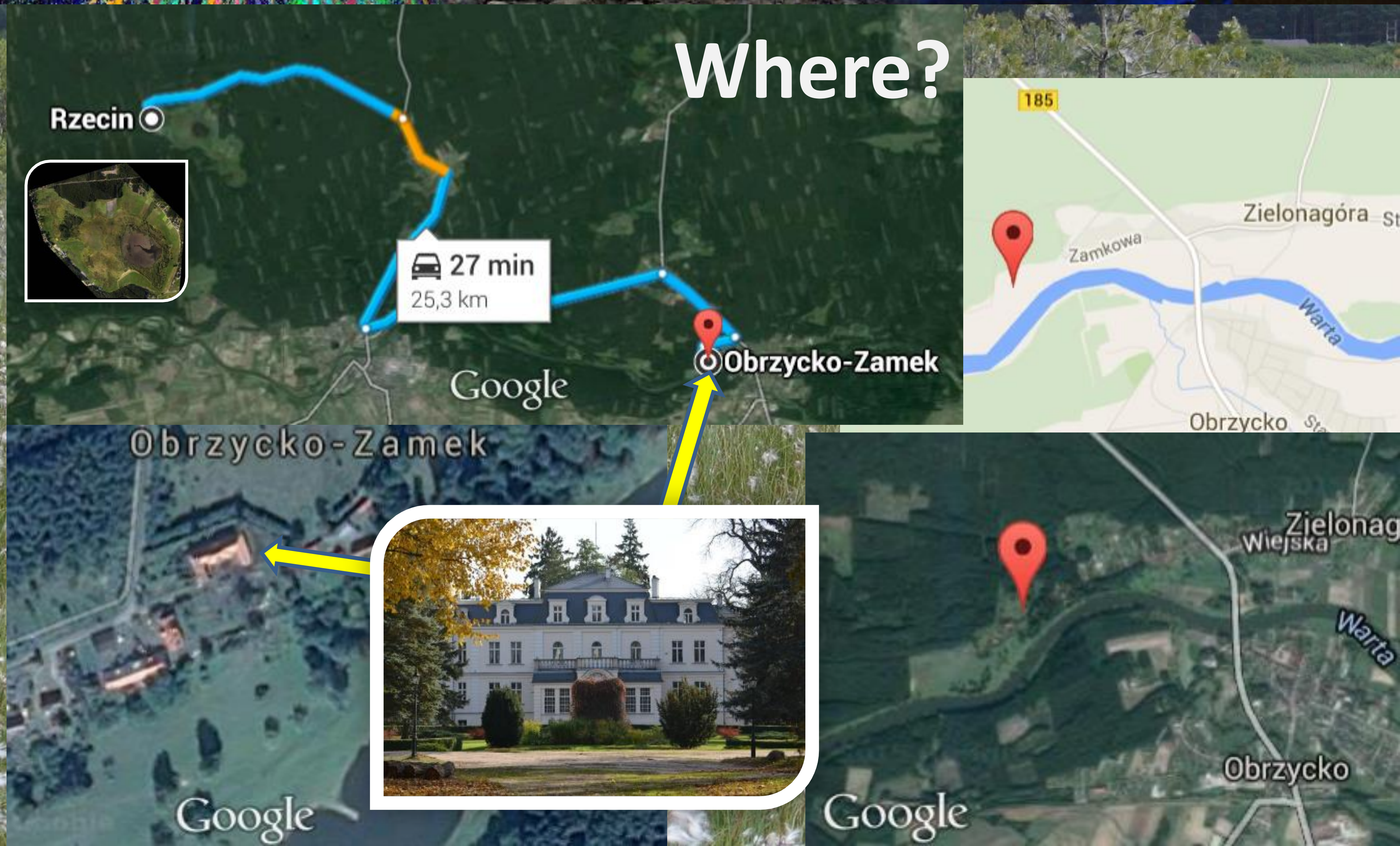


OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

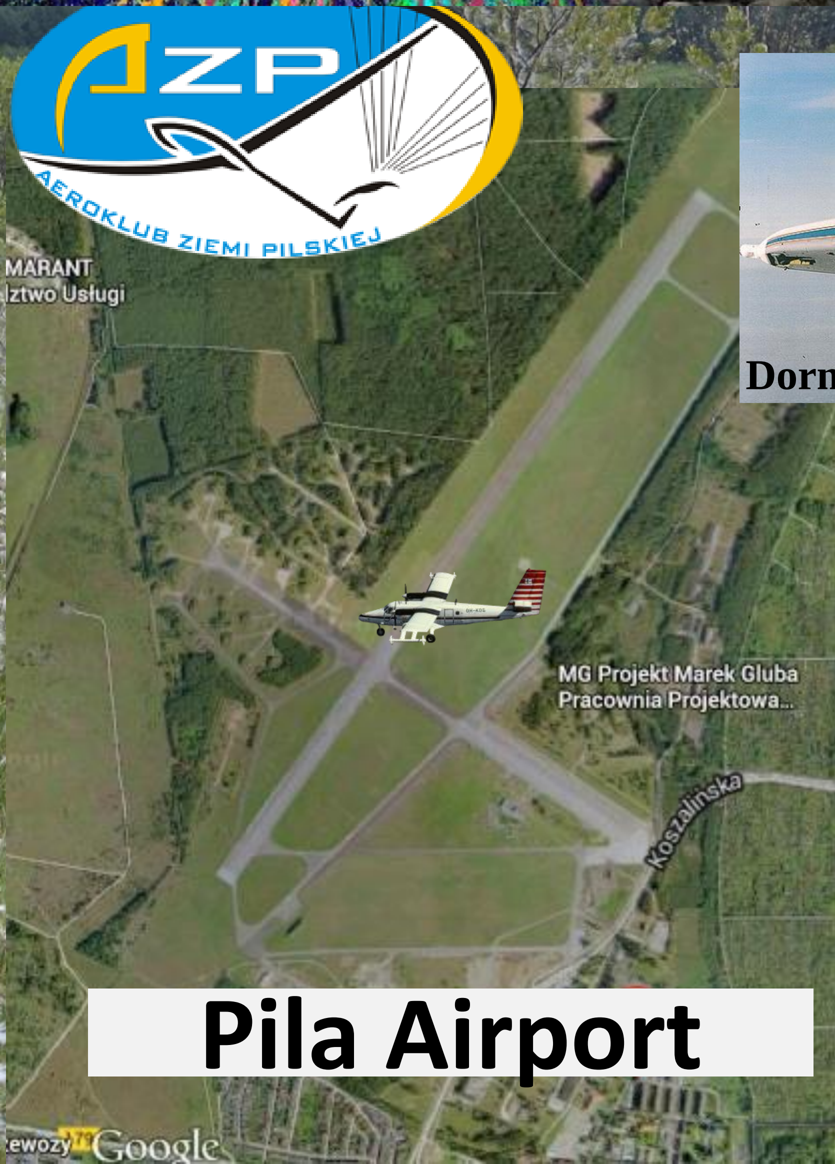
EUFAR

Where?



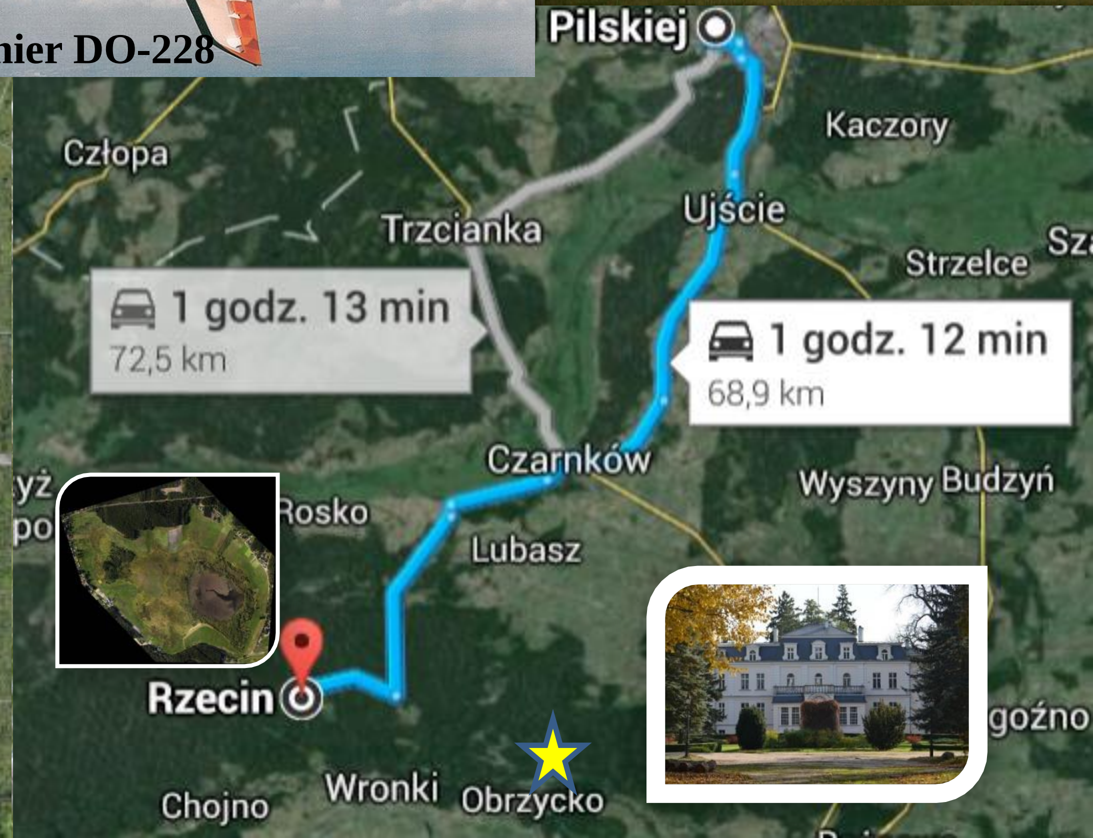
OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes



Pila Airport

Dornier DO-228



OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

EUFAR

flight window between
12th to 14th of July 2015

LL
B=16°17'45.24" L=52°45'15.18"

LR
B=16°19'27.52" L=52°45'14.43"

UR
B=16°19'29.68" L=52°46'14.45"

UL
B=16°17'43.39" L=52°46'14.45"

FLUX TOWER
B=16°18'34.14" L=52°45'44.21"

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University of Zurich UZH

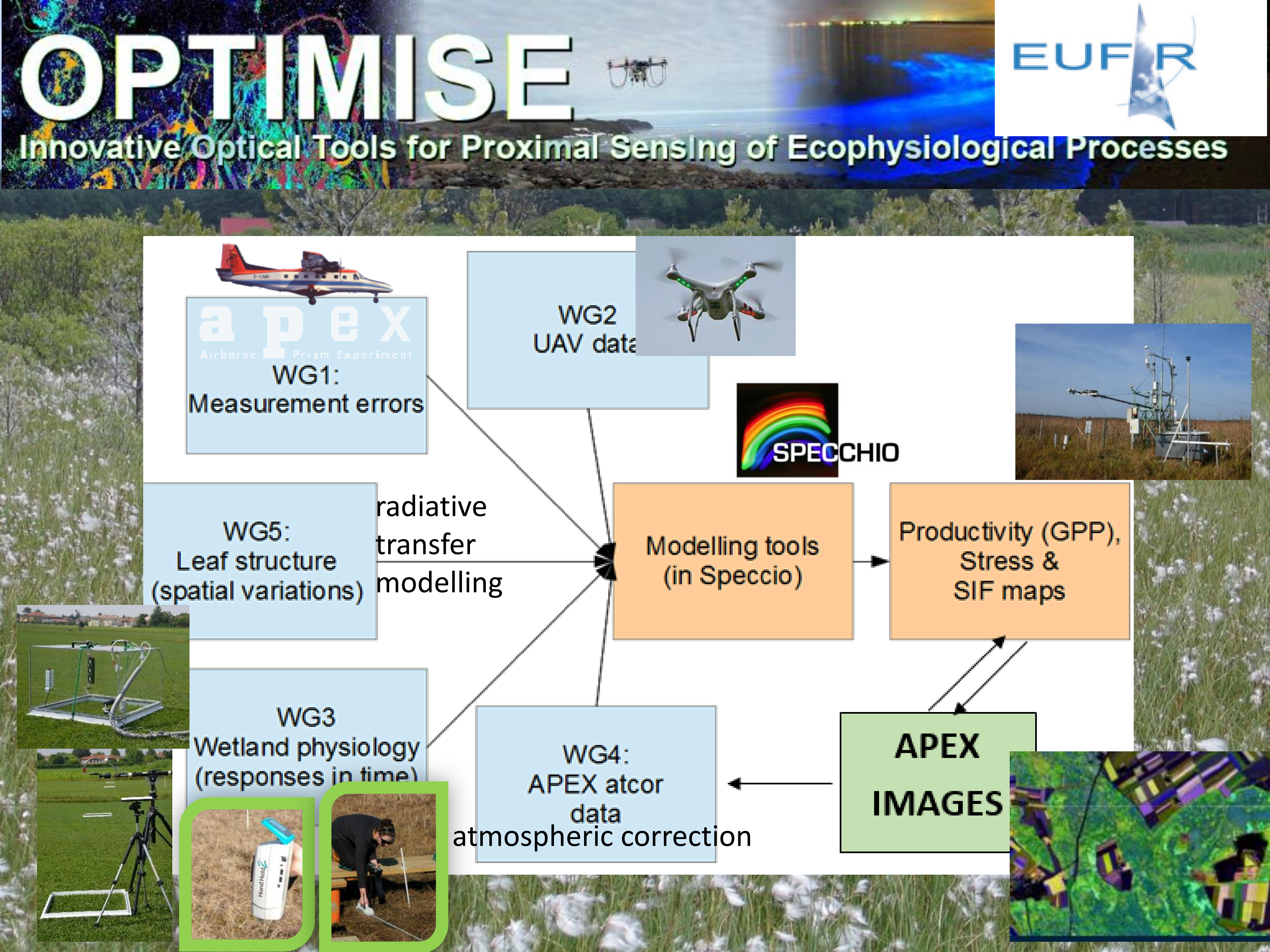
Rzecin, POLWET, 52°45' N, 16°18' E


OPTIMISE
EUFAR
Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes
Pigment Composition of Vegetated Ecosystems
APEX-CIR
Anthocyanin
Chlorophyll
Carotenoid
Pigment composition
RSL Supersite, Oensingen, Switzerland
www.apex-esa.org
apex Airborne PRISM Experiment
apex Airborne Prism Experiment
vito vision on technology
University of Zurich UZH
esa
Chlorophyll Fluorescence
Fluorescence
0.0
0.15
RSL Supersite, Oensingen, Switzerland
www.apex-esa.org
apex Airborne PRISM Experiment
http://www.apex-esa.org/content/apex

PILSKIE MUZEUM WOJSKOWE

W ORGANIZACJI

PILA MILITARY MUSEUM


OPTIMISE
EUFAR
Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes
apex
Airborne Prism Experiment
WG1:
Measurement errors
WG2
UAV data
SPECCHIO
WG5:
Leaf structure
(spatial variations)
radiative
transfer
modelling
Modelling tools
(in Speccio)
Productivity (GPP),
Stress &
SIF maps
WG3
Wetland physiology
(responses in time)
WG4:
APEX atcor
data
atmospheric correction
APEX
IMAGES

- **Exp 1 (WG 1)** - APEX Scope: to map the small scale heterogeneity of the study site with high spectral resolution, quantify spectroscopy uncertainties and retrieve ground hemispherical conical reflectance factors.
- **Exp 2 (WG 2)** - sUAV Scope: to develop statistically robust spatial sampling strategies for sUAV spectroscopic sampling of the heterogeneous wetland research site
- **Exp 3 (WG 3)** - fluorescence and reflectance Scope: to infer and map the spatial patterns of the productivity from reflectance and fluorescence measurements for this specific ecosystem;
- **Exp 4 (WG 4)** - atmospheric correction. Scope: to provide airborne and UAV borne reflectances comparable with proximal sensing including BRDF estimations and airborne imagery atmospheric correction validation;
- **Exp 5 (WG 5)** - radiative transfer modelling. Scope to link vegetation parameters with optical properties of the biosphere.

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Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

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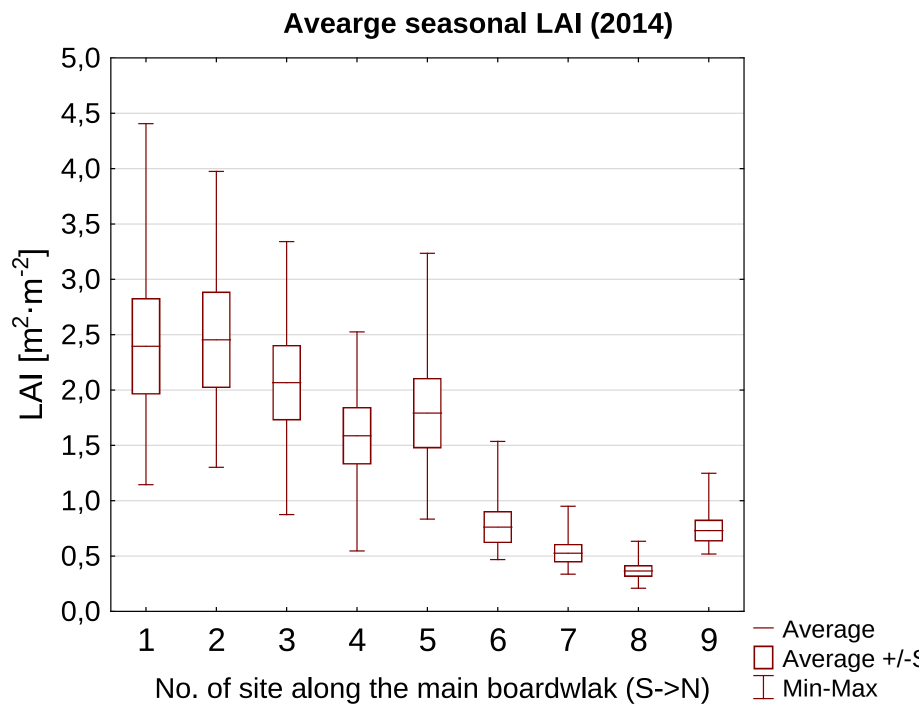
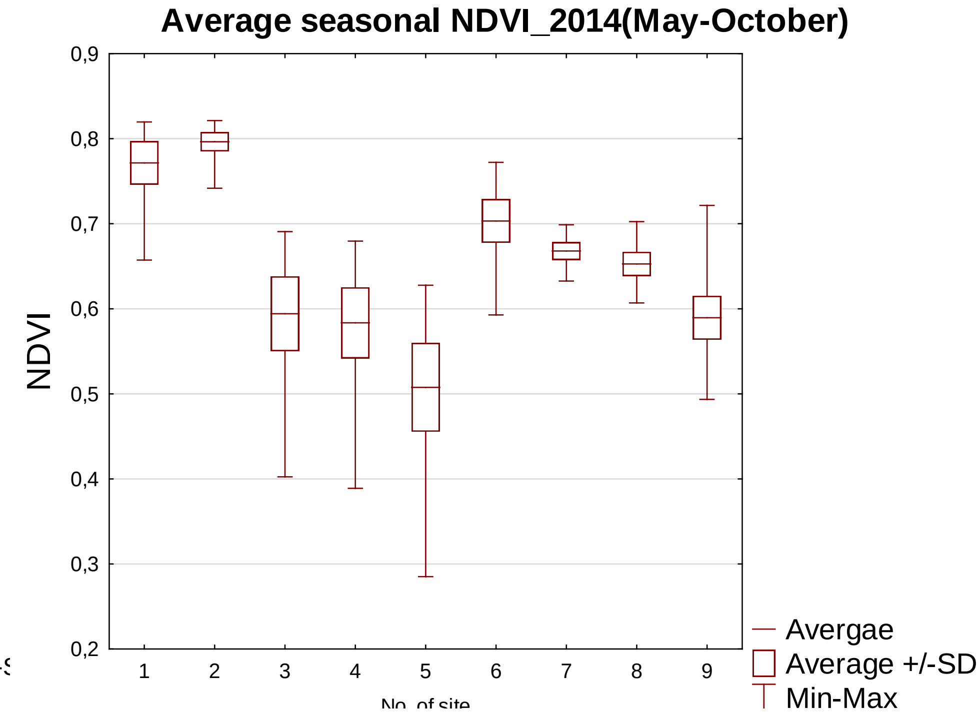
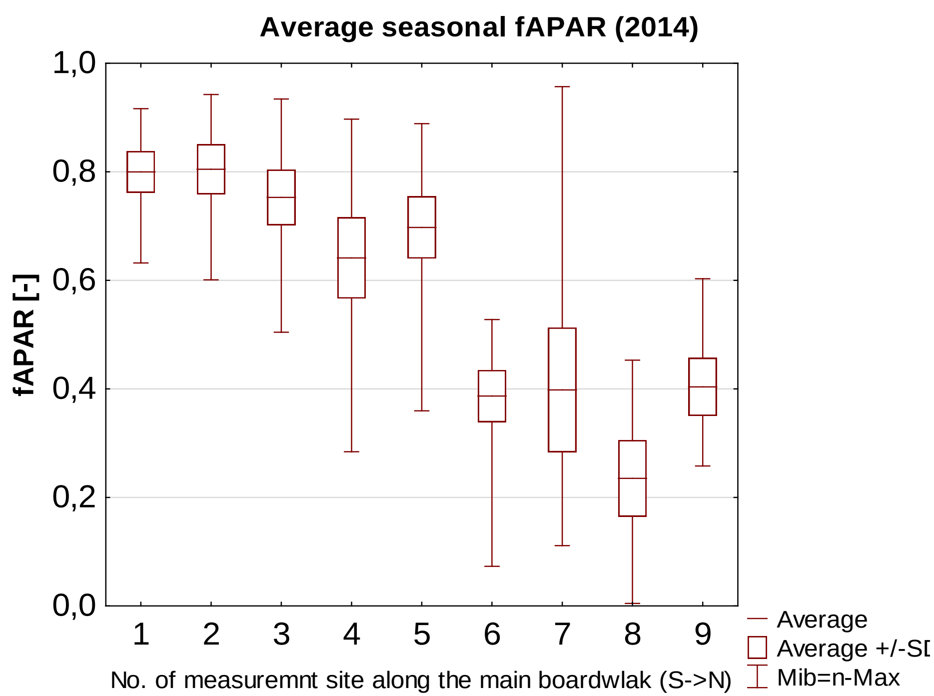
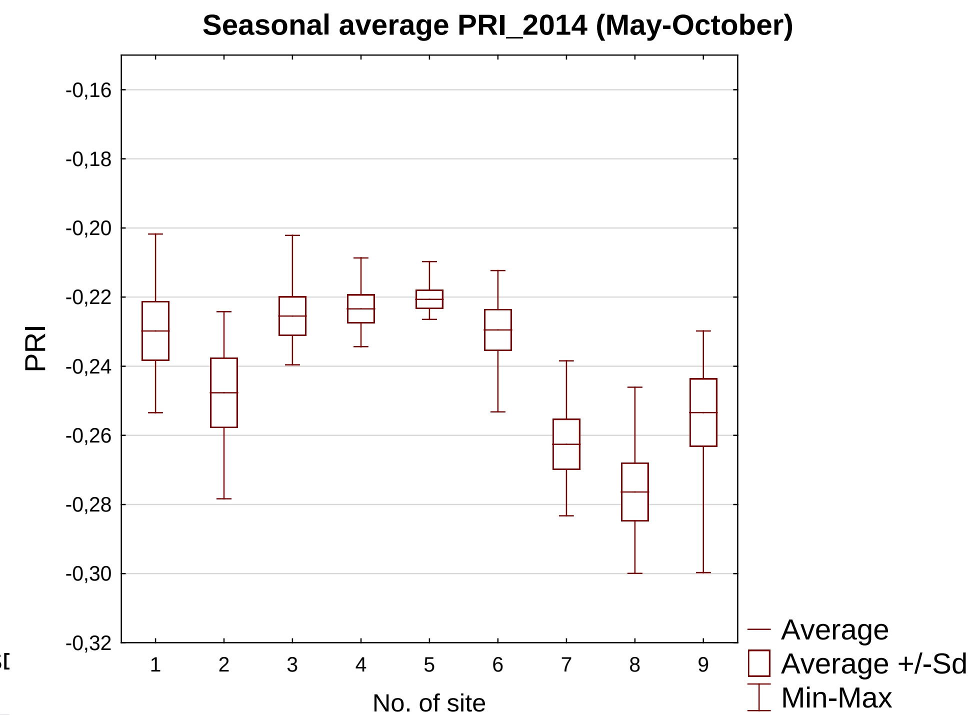
Description of parameters/measurements required for experiment:

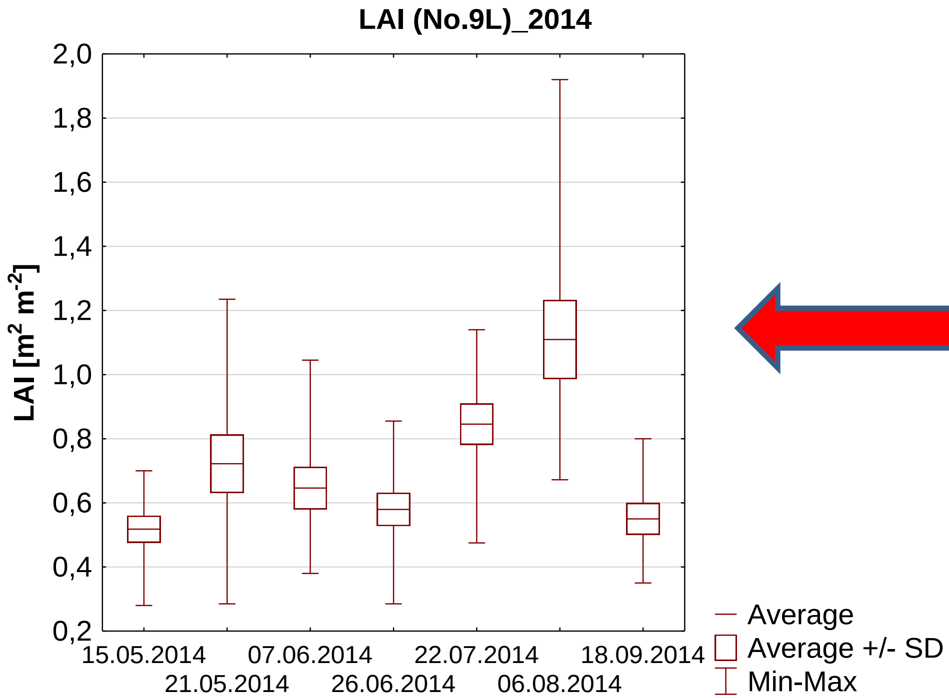
- **Diurnal cycles of fluorescence with an HR4000 in the flux footprint**
- **Leaf area index**
- **Canopy reflectance and fluorescence from near-ground and UAV platforms**
- **Leaf photosynthesis with a gas exchange system,**
- **Ecosystem scale CO_2 fluxes (Chambers +EC)**
- **Canopy surface temperature**
- **Moni-PAM data of active fluorescence (Provisional)**
- **Hemispherical solar irradiance and sky RGB images**
- **Ground target directional reflectance**
- **Aerosol optical thickness and water vapor content**

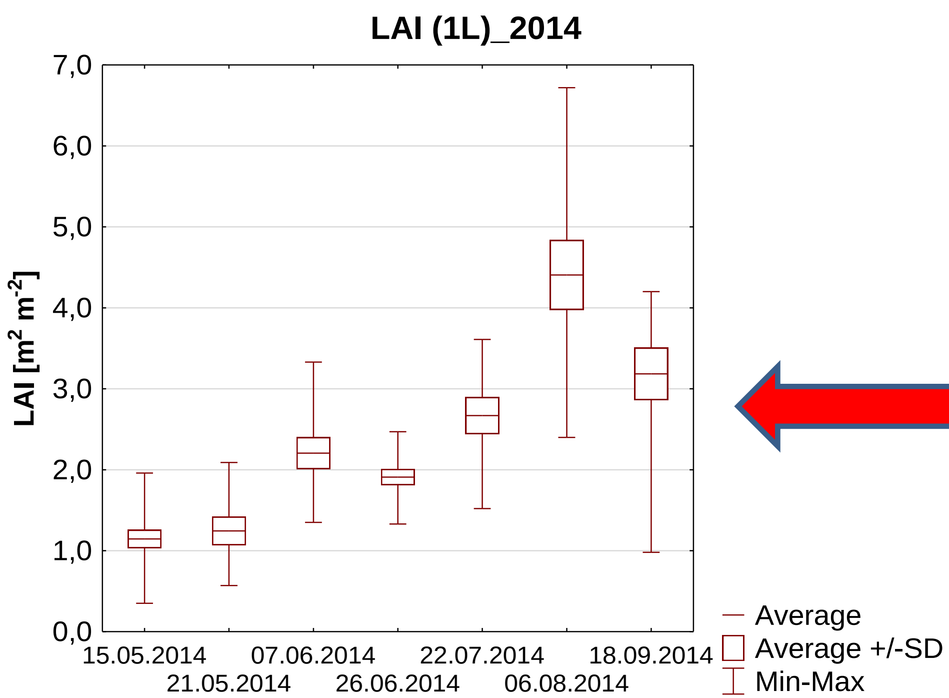

Avearge seasonal LAI (2014)
LAI [m²·m⁻²]
5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
1 2 3 4 5 6 7 8 9
No. of site along the main boardwlak (S->N)
Average
Average +/-S
Min-Max


Average seasonal NDVI_2014(May-October)
NDVI
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
1 2 3 4 5 6 7 8 9
Avergae
Average +/-SD
Min-Max


Average seasonal fAPAR (2014)
fAPAR [-]
1,0
0,8
0,6
0,4
0,2
0,0
1 2 3 4 5 6 7 8 9
No. of measuremnt site along the main boardwlak (S->N)
Average
Average +/-SI
Mib=n-Max

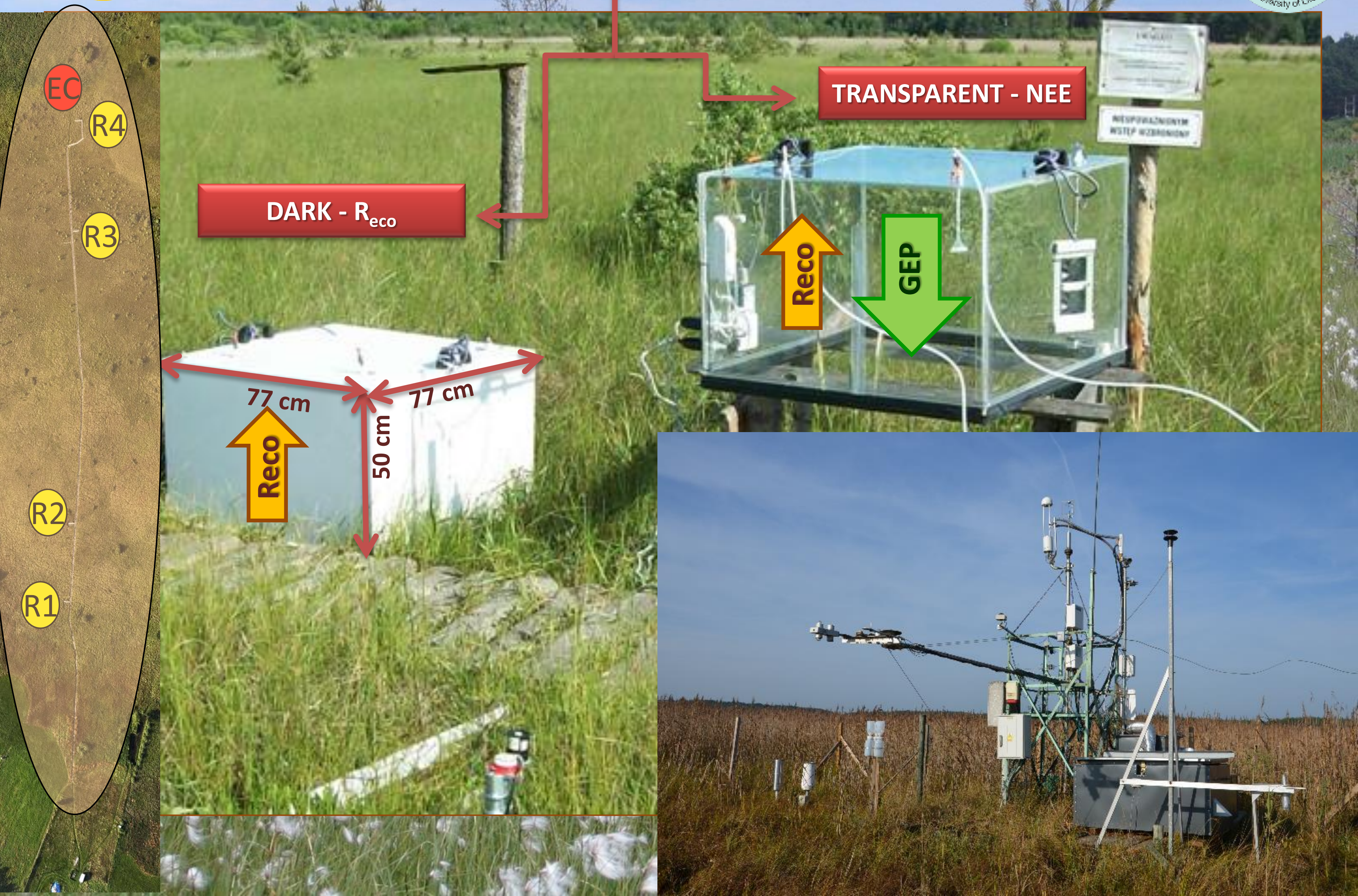

Seasonal average PRI_2014 (May-October)
PRI
-0,16
-0,18
-0,20
-0,22
-0,24
-0,26
-0,28
-0,30
-0,32
1 2 3 4 5 6 7 8 9
No. of site
Average
Average +/-Sd
Min-Max


LAI (No.9L)_2014
LAI [m2 m-2]
2,0
1,8
1,6
1,4
1,2
1,0
0,8
0,6
0,4
0,2
15.05.2014
21.05.2014
07.06.2014
26.06.2014
22.07.2014
06.08.2014
18.09.2014
Average
Average +/- SD
Min-Max


LAI (1L)_2014
LAI [m2 m-2]
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
15.05.2014
21.05.2014
07.06.2014
26.06.2014
22.07.2014
06.08.2014
18.09.2014
Average
Average +/-SD
Min-Max


EC
WETMAN
9L
8L
7L
6L
5L
4L
3L
2L
1L

FLUX measurments in Rzecin (POLWET)



FLEX-EU campain, Italy 2014

Latisana campaign, 3-20 June 2014

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esa

OPTIMISE

Innovative Optical Tools for Proximal Sensing of Ecophysiological Processes

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Important dates

- Announcement: **1st April 2015**
- Deadline on-line application: **15th May 2015**
- Publication of accepted, non-eligible, rejected applications at EUFAR website: **26th May 2015**
- Training course: **6th to 16th July 2015**
- Deadline on-line reports: **15th August 2015**
- Deadline scientific working group reports from participants: **15th December 2015**

TRAINING COURSE

Spectrometry of a Wetland And Modelling of Photosynthesis with Hyperspectral Airborne Reflectance and Fluorescence (SWAMP)

Obrzycko-Rzecin, Poland, 6 – 16 July 2015

Hosted by the Poznan University of Life Sciences, and co-funded by the FP7 European Facility for Airborne Research (EUFAR) & the European Cooperation in Science and Technology (COST) Action OPTIMISE (ES1309)

The main aim of this training course is to teach early stage researchers (PhD students and post-docs) and a limited number of university lecturers how to plan and conduct an airborne research and (near-)ground validation campaign and how to use the collected data. The training course will include an airborne campaign with the APEX imaging spectroradiometer mounted in the DLR Dornier 228 aircraft combined with a concurrent ground campaign and near-ground campaign with small UAV platforms and satellite data acquisitions. All these platforms and sensors will be used to determine Earth surface reflectance and fluorescence to support multi-scale ("leaf to ecosystem") land-atmosphere exchange modelling studies at the instrumented POLWET wetland study site. Through this training the students will gain a better understanding of the complexities and uncertainties in optical Earth observations from near-ground, airborne and satellite platforms. This in turn will grant them insight into the potential and limitations of current and future satellite Earth observations and enable them to generate a greater scientific impact through their future campaigns.

Through the training course, participants will learn how to:
- develop a measurement strategy and design a flight plan for an airborne campaign;
- develop a sampling strategy and carry out (near-)ground measurements to support an airborne campaign and measurements from small UAV platforms;
- recognise what laboratory and field calibration and validation measures are necessary to support airborne and near-ground optical remote sensing;
- post process airborne and near-ground optical measurements;
- analyse these data through statistical methods and how to integrate them into radiative transfer models.

DLR's Dornier DO228 (above), APEX instrument operated by VITO & UZH (left)

Participants will have the opportunity to visit the Dornier DO-228 aircraft operated by DLR Braunschweig and ESA's Airborne Imaging Spectrometer APEX. During and after the training course acquired or archived data will then be processed and analysed with the support of experienced users of airborne facilities and form the basis for the final report.

Applicants: PhD students, post-docs and university lecturers (number of participants is limited to 20)
Fee: free of charge – travel & subsistence funded by EUFAR & OPTIMISE
Information & Registration: register and apply online on the EUFAR website: www.eufar.net/ET

Deadline: 15 May 2015
(Selected participants will be notified by before 26 May 2015)
Contact: EUFAR Office - bureau@eufar.net

Scientific Committee

R. Juszczak (SWAMP PI, PULS, PL)
A. Mac Arthur (OPTIMISE Chair, UEDIN, UK)
E. Tomelleri (EURAC, IT)
Els Reusen (EUFAR ET coordin., VITO, BE)

Organising Committee

R. Juszczak, J. Olejnik & B. Chojnicki (PULS, PL)
A. Mac Arthur (OPTIMISE Chair, UEDIN, UK)
M. Rossini (UNIMIB, IT)
E. Tomelleri (EURAC, IT)
A. Hueni (RSL, UZH, CH)
C. van der Tol (University of Twente, NL)
EUFAR Office (Météo-France, FR)

EUFAR integrates operators of instrumented aircraft and remote-sensing instruments, and experts in airborne measurements in the field of environmental in the atmospheric, marine, terrestrial and Earth Sciences. For more information, visit www.eufar.net

University of Zurich

cost   METEO FRANCE   Field Spectroscopy Facility   vito

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THANK YOU FOR YOUR ATTENTION

Radosław Juszczak

Janusz Olejnik, Bogdan Chojnicki, Marek Urbaniak, Karolina Sakowska, Daria Polmańśka, Klaudia Ziemblińska, Marcin Stróżecki (PULS)

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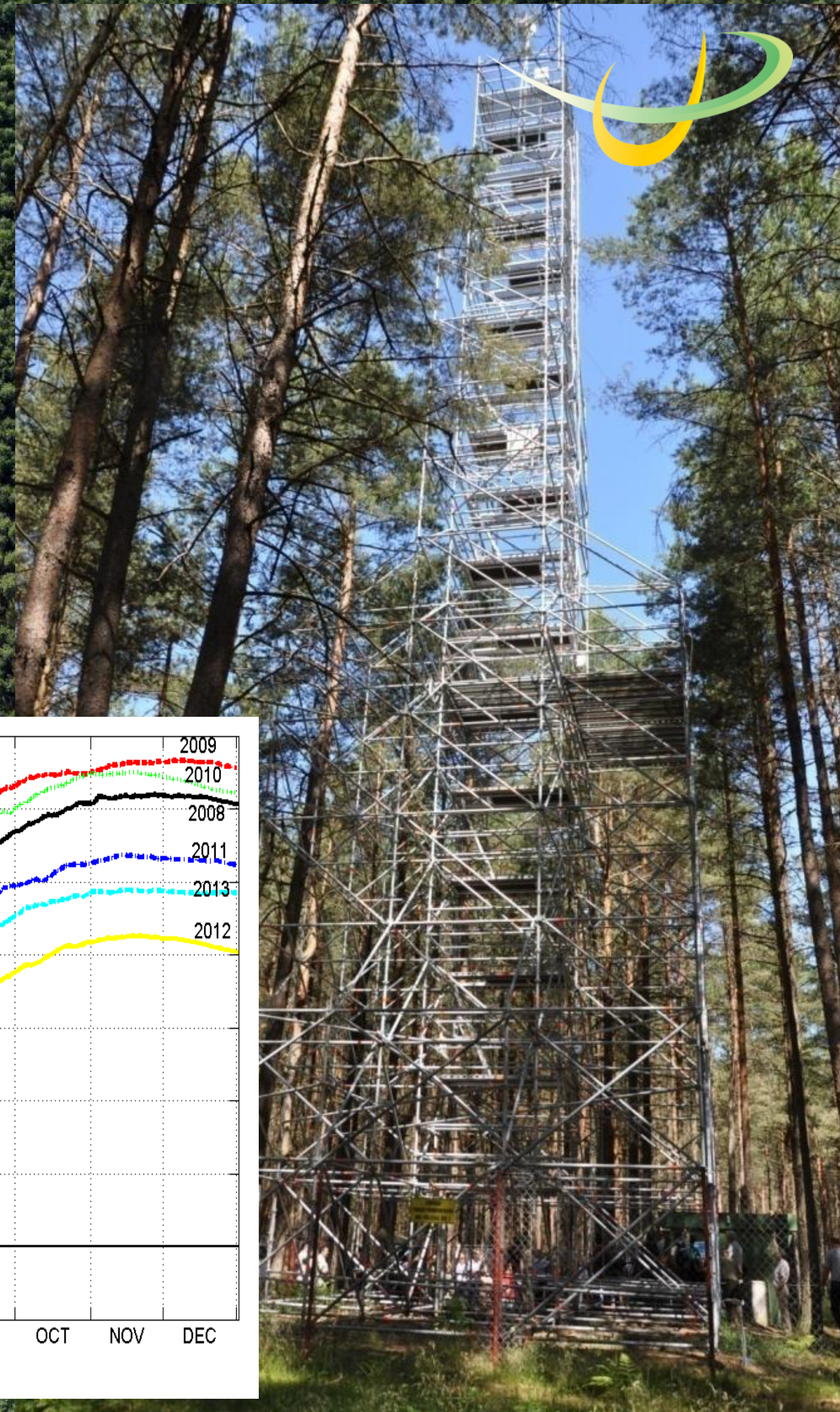
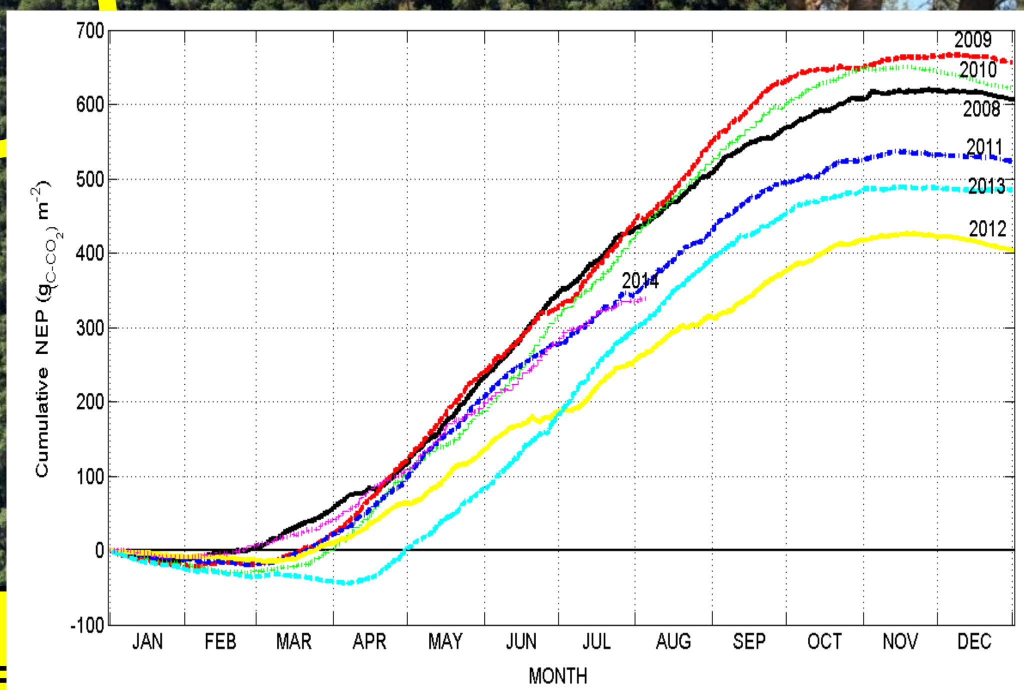
Christiaan van der Tol (University of Twente, NL)

EUFAR Office (Météo-France, FR)

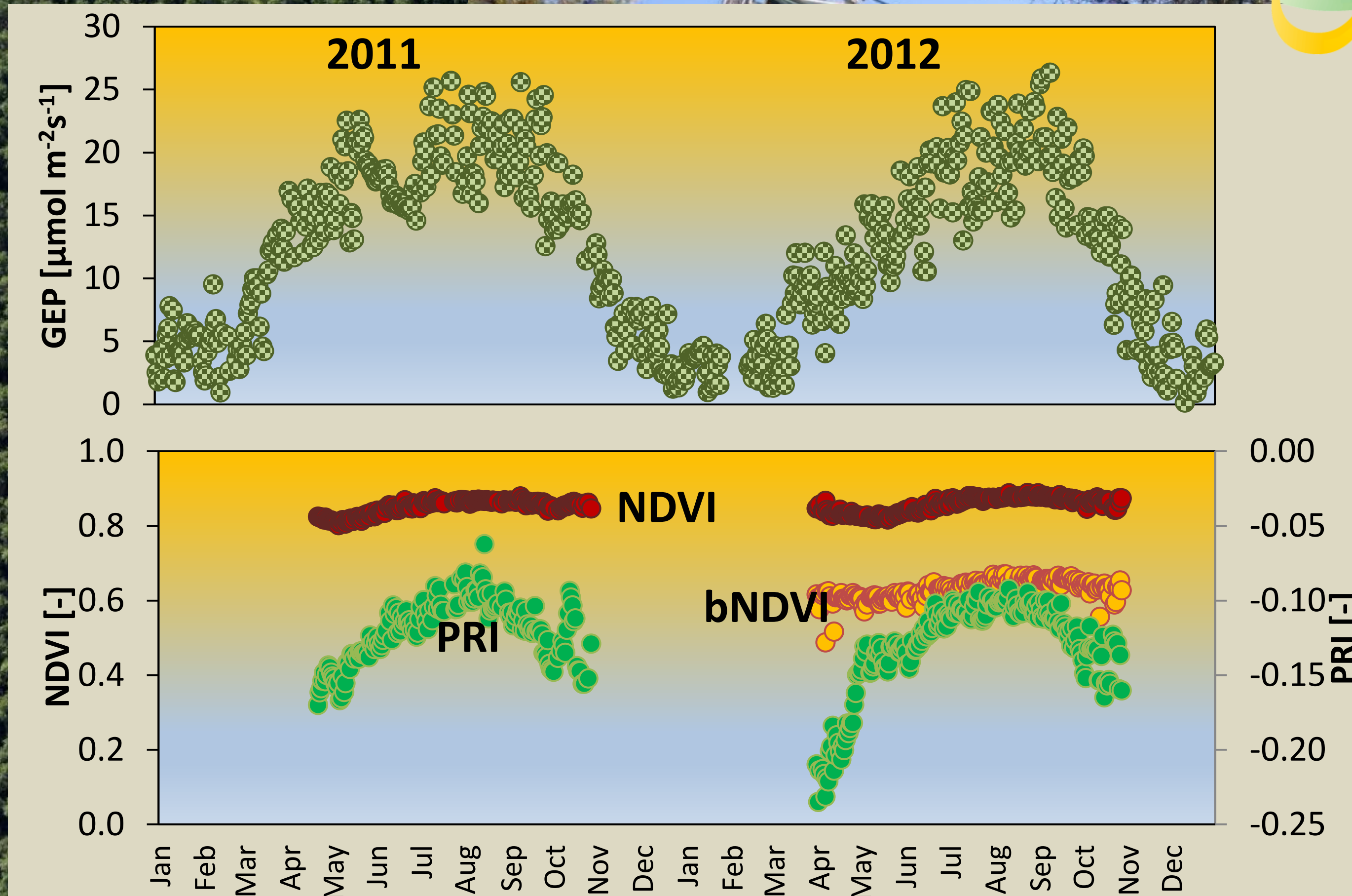
TUCZNO

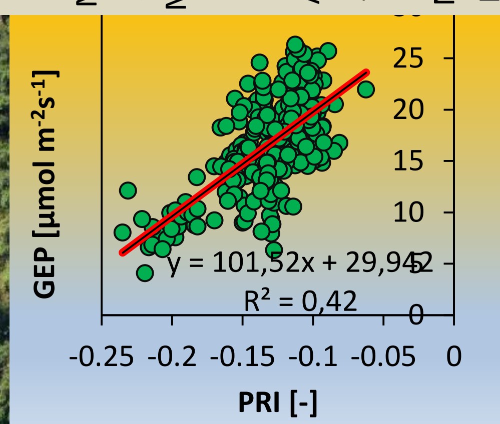


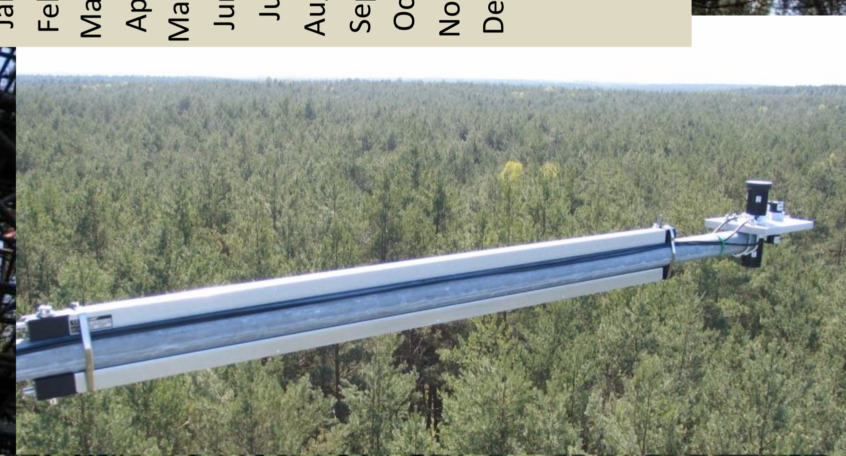


GDLP
C-FORE

TUCZNO

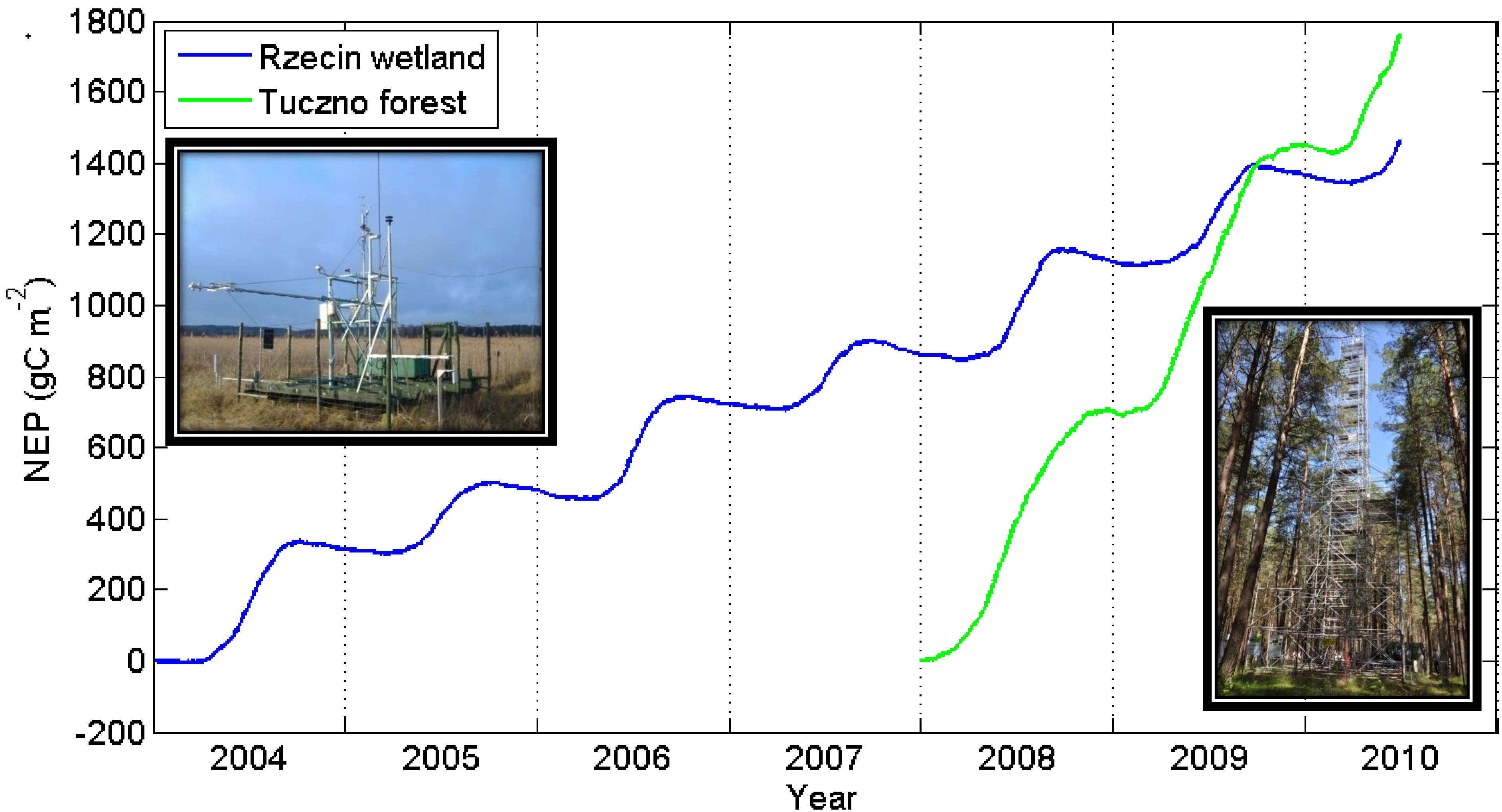




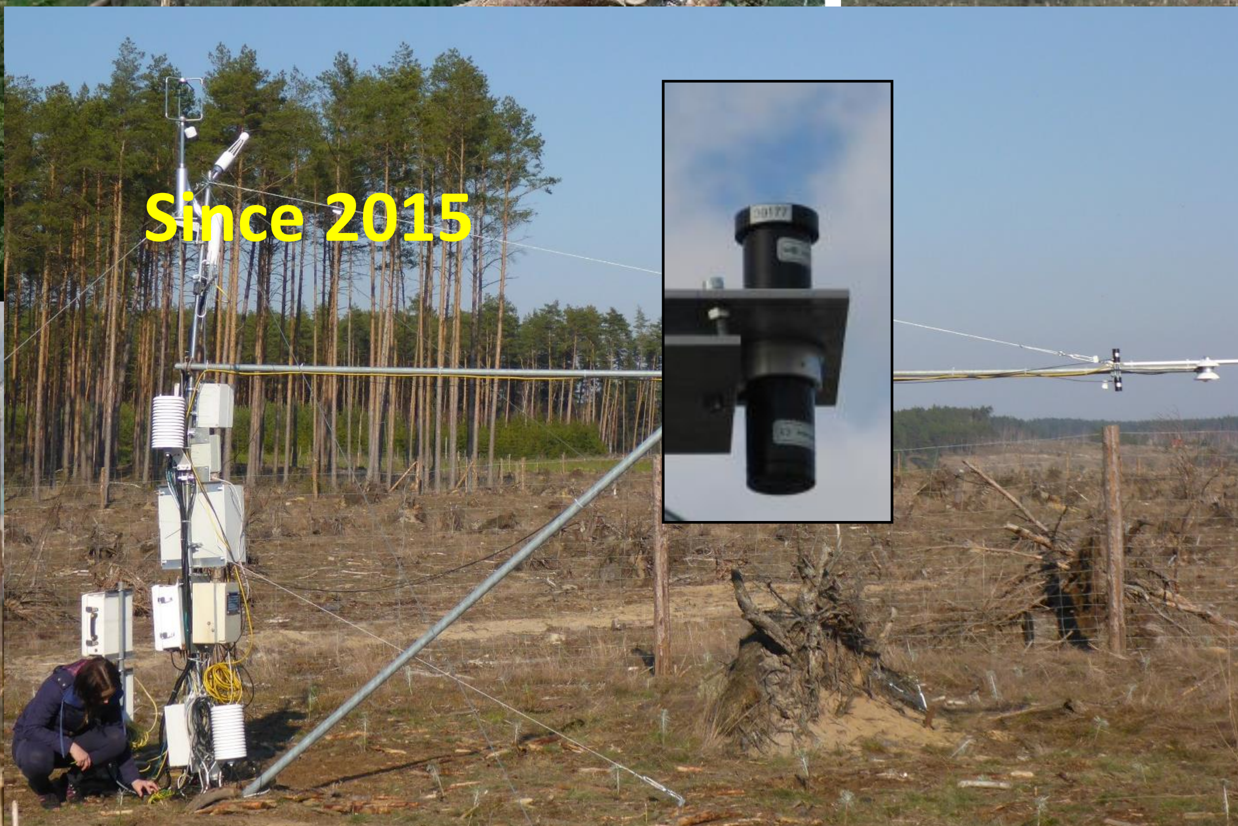


GDLP
C-FOREST

Cumulative NEP of Tuczno forest vs POLWET



Tlen_1



Tuczno vs Tlen_1 2013

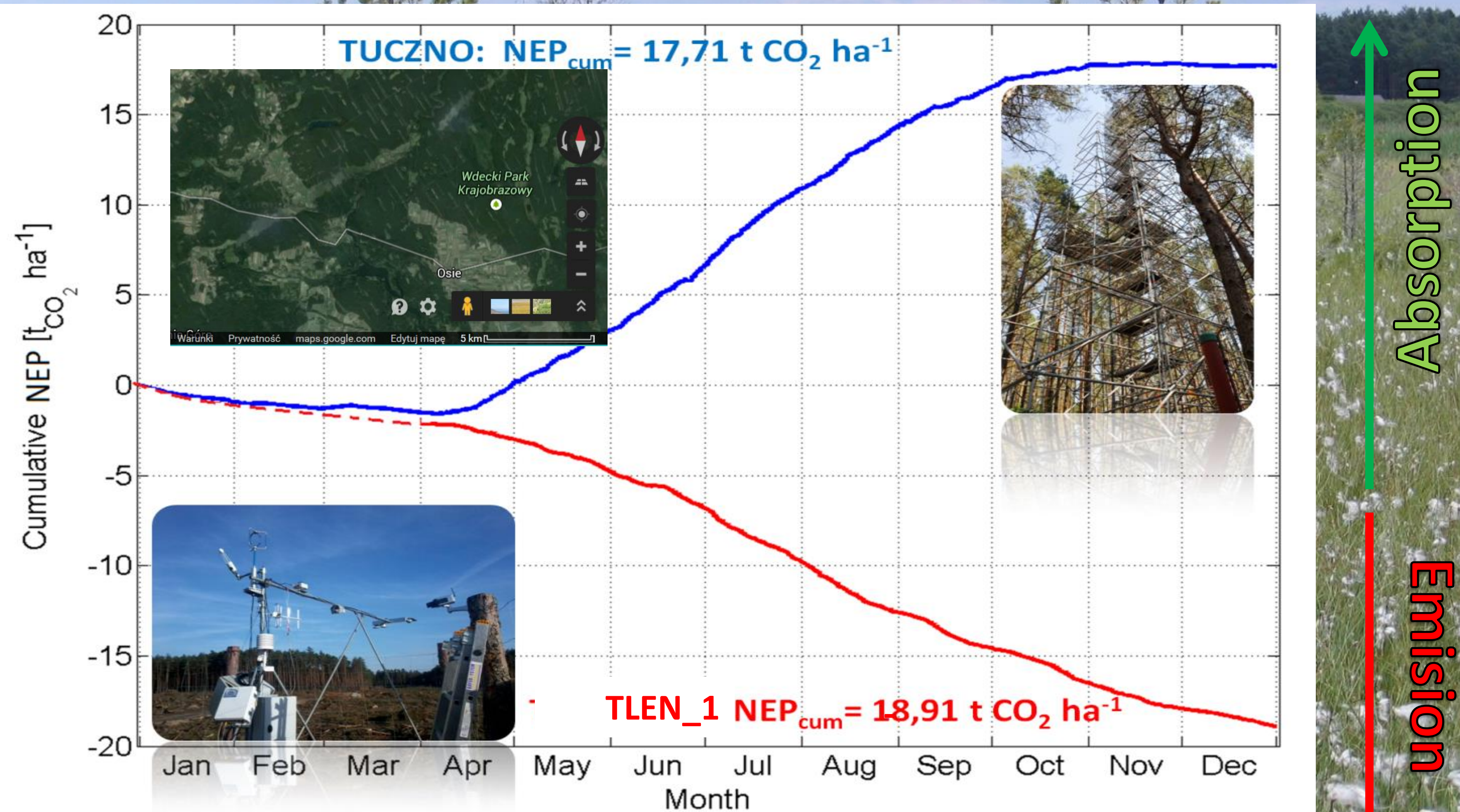


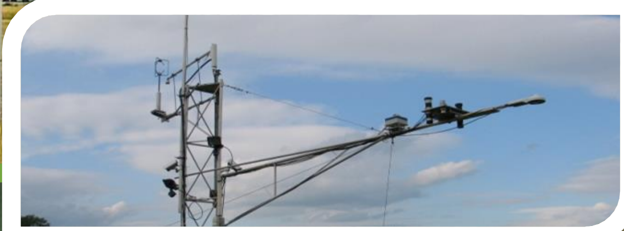
Fig. Cumulative NEP comparison- Tuczno forest (control) and Trzebciny (treatment) site in 2013

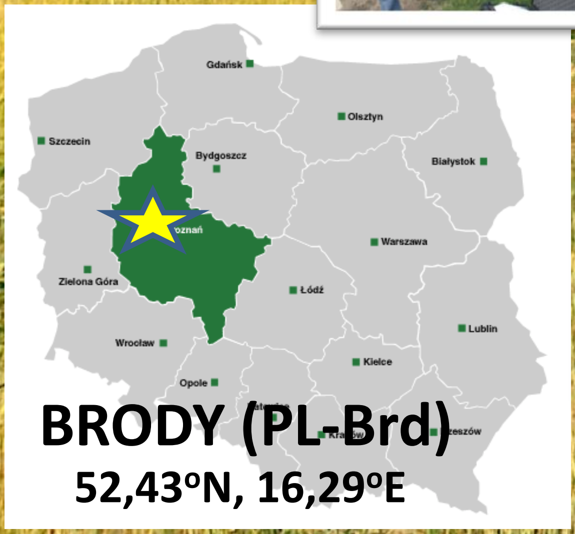
BRODY (PL-Brd)

PLANT ROTATION SCHEME (7-year)

TREATMENT	CULTIVATED PLANTS
1. control	
2.manure	
3. manure+NPK	
4. NPK+Ca	ALFALFA II → WINTER WHEAT → WINTER RYE → POTATOE → SPRING BARLEY → TRITICALE
5. NPK	
6. NP	
7. NK	
8. PK	
9. N	
10. P	
11. K	

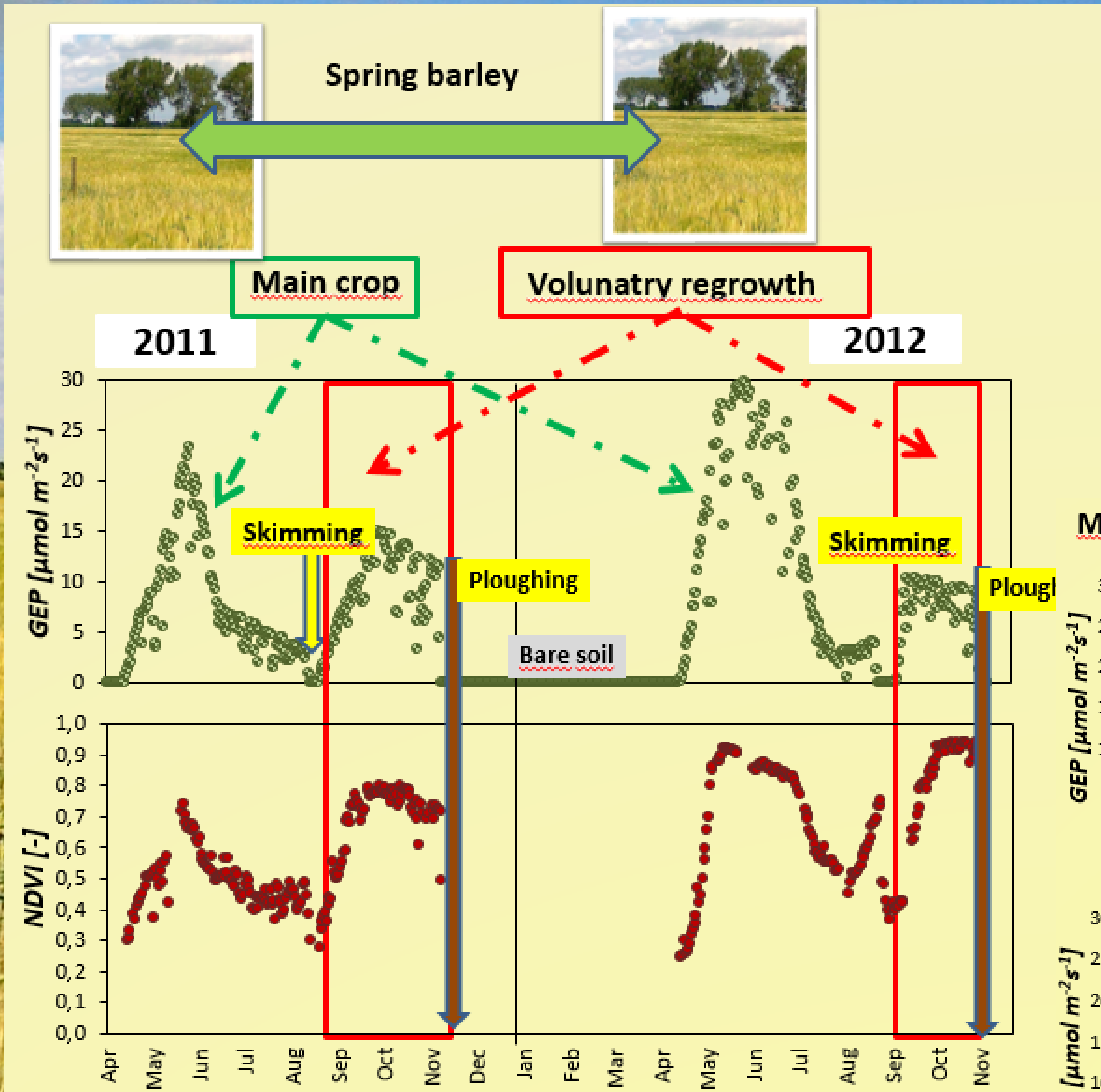
N – 90 kg/ha
K_2O – 120 kg/ha
P_2O_5 - 60 kg/ha



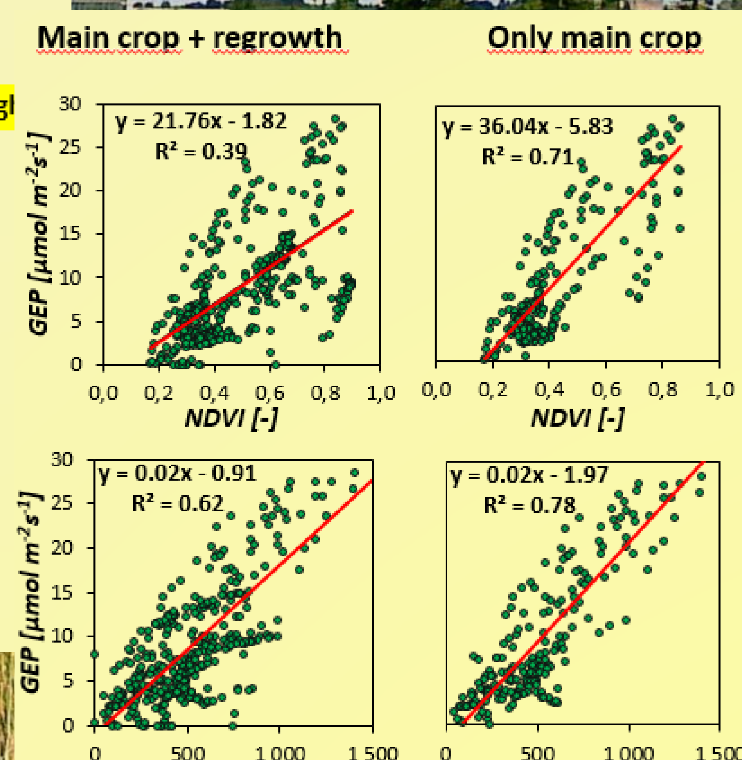


BRODY (PL-Brd)
52,43°N, 16,29°E

BRODY (PL-Brd)



Spring barley
Main crop
Volunatry regrowth
2011
2012
Skimming
Ploughing
Bare soil
Skimming
Ploug
GEP [μmol m-2s-1]
NDVI [-]
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov



Main crop + regrowth
Only main crop
y = 21.76x - 1.82
R² = 0.39
y = 36.04x - 5.83
R² = 0.71
NDVI [-]
NDVI [-]
GEP [μmol m-2s-1]
y = 0.02x - 0.91
R² = 0.62
y = 0.02x - 1.97
R² = 0.78
GEP [μmol m-2s-1]

WP 5.

Simulated climate change impact on spectral properties of plant canopy

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Reflectance assessment of seasonal and annual changes in biomass and CO_2 uptake of a Mediterranean shrubland submitted to experimental warming and drought

Iolanda Filella*, Josep Peñuelas, Laura Llorens, Marc Estiarte

Unitat d'Ecofisiologia CSIC-CEAB-CREAF, CREAF (Center for Ecological Research and Forestry Applications), Universitat Autònoma de Barcelona, Edifici C, 08193 Bellaterra, Barcelona, Spain

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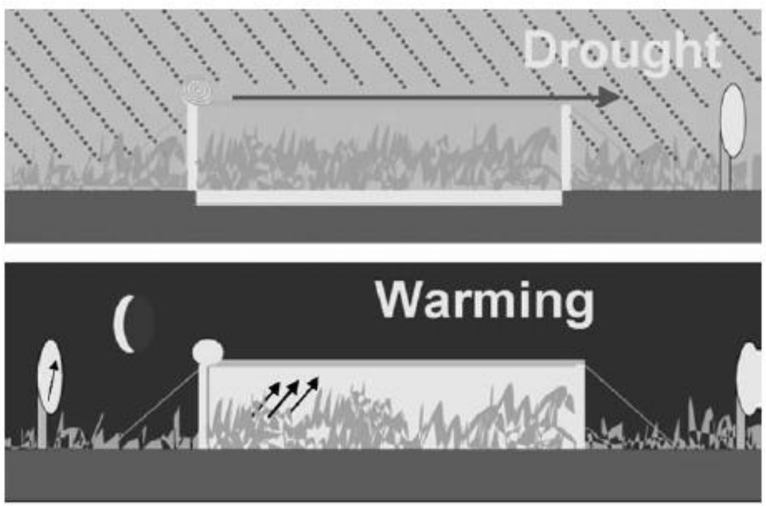

Fig. 1. Scheme of the experimental devices installed in a Mediterranean shrubland to simulate drought and warming expected for the next decades (IPCC, 2001). Drought plots: a transparent curtain automatically covers vegetation during rainfall events in the growing season. Warming plots: an infrared reflective aluminium curtain automatically covers vegetation at night over the whole year (Beier et al., in press).

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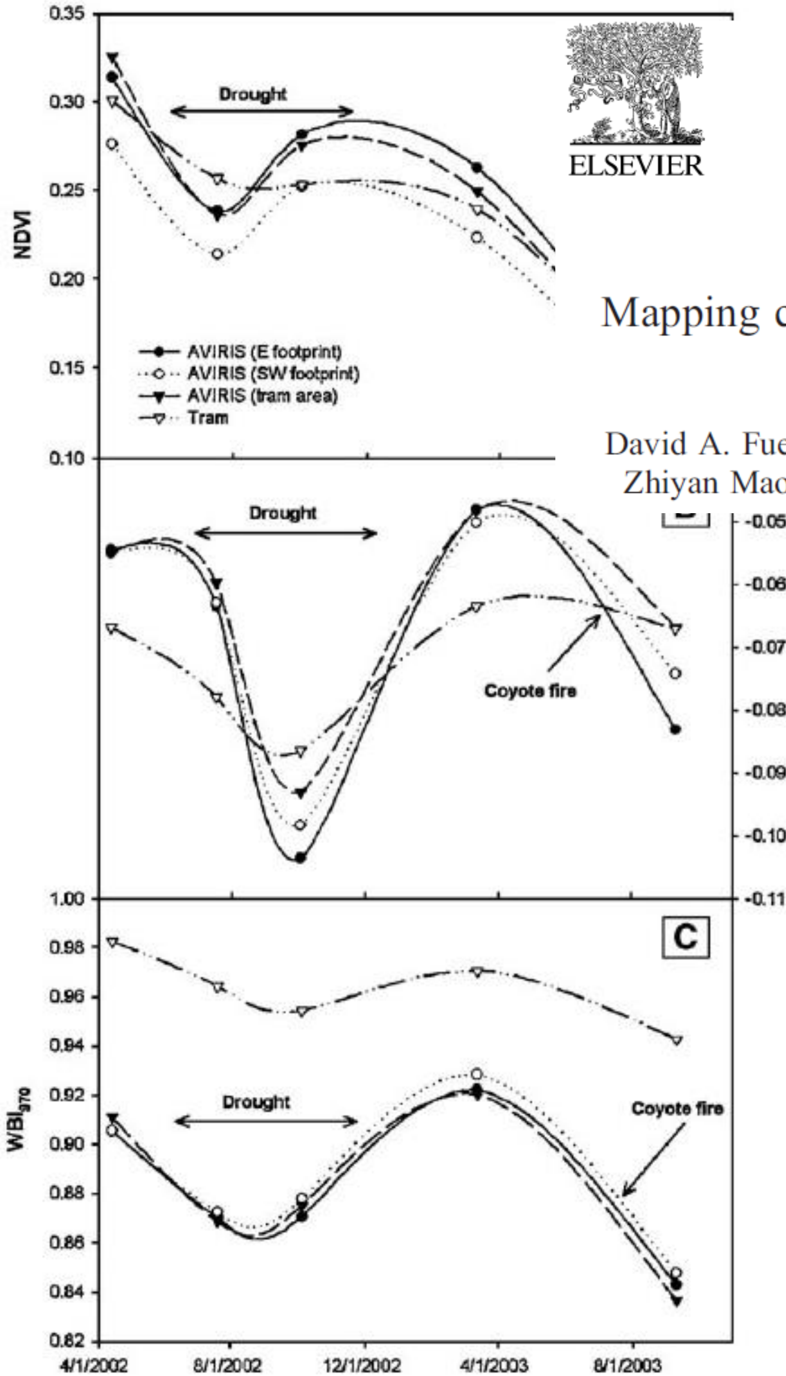
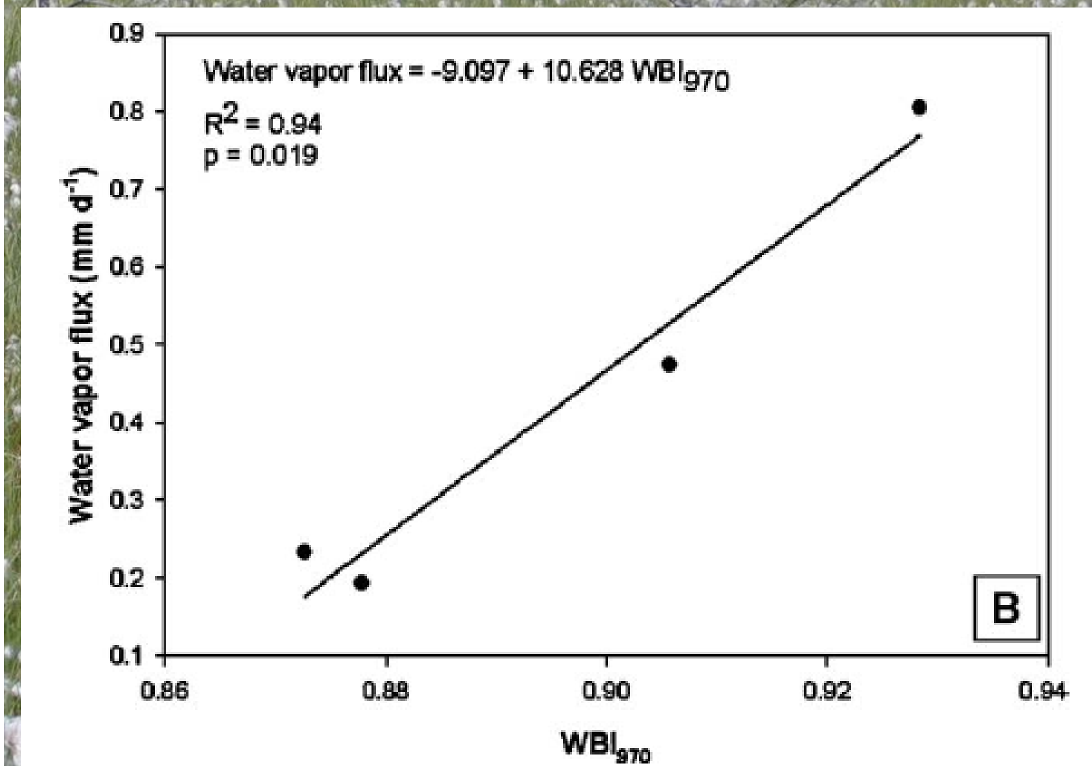
Mapping carbon and water vapor fluxes in a chaparral ecosystem using vegetation indices derived from AVIRIS

David A. Fuentes [a,*], John A. Gamon [a], Yufu Cheng [a], Helen C. Claudio [a], Hong-lie Qiu [b], Zhiyan Mao [a], Daniel A. Sims [c], Abdullah F. Rahman [c], Walter Oechel [d], Hongyan Luo [d]





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Remote Sensing of Environment 103 (2006) 304 – 311

Remote Sensing of Environment

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Monitoring drought effects on vegetation water content and fluxes in chaparral with the 970 nm water band index

Helen C. Claudio *, Yufu Cheng, David A. Fuentes, John A. Gamon, Hongyan Luo, Walter Oechel, Hong-Lie Qiu, Abdullah F. Rahman, Daniel A. Sims

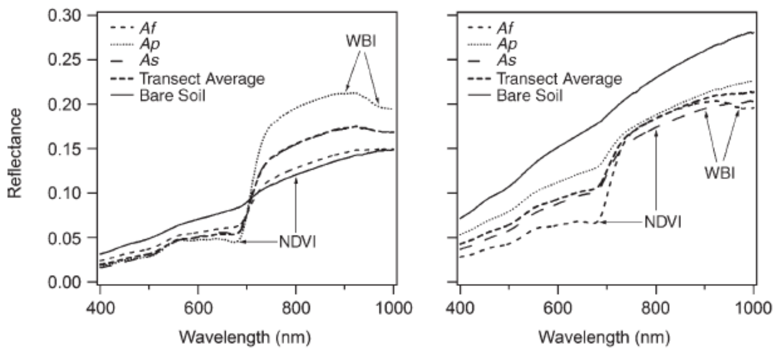

Fig. 1. Typical reflectance spectra for each species (*Af* = *Adenostoma fasciculatum*, *Ap* = *Arctostaphylos pungens*, *As* = *Adenostoma sparsifolium*). To the left are the pre-drought reflectance spectra and to the right are the drought spectra, taken December 2001 and June 2002, respectively. The wavelengths used for the two reflectance indices, NDVI (normalized difference reflectance index) and WBI (water band index), are also shown. The different species and the bare soil are averages of that particular cover type from a single tra

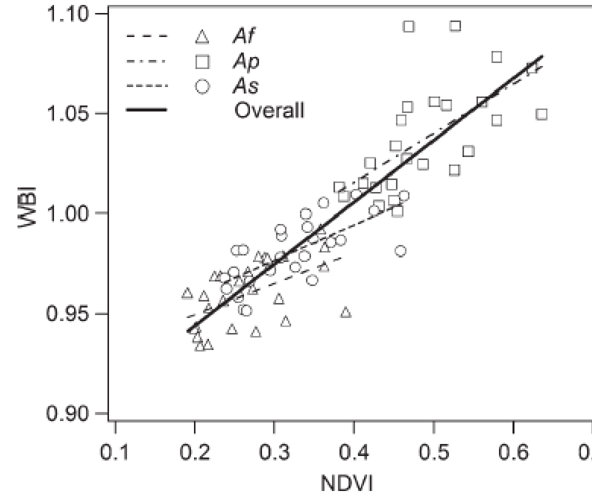

Fig. 6. NDVI vs. WBI for *Adenostoma fasciculatum* (*Af*), *Arctostaphylos pungens* (*Ap*), and *Adenostoma sparsifolium*, as well as the overall correlation for all species together, from reflectance data collected between March 2001 and July 2003. $r^2=0.782$, $p<0.0001$, slope = 0.301 overall, $r^2=0.295$, $p=0.0042$, slope = 0.155 for *Adenostoma fasciculatum*, $r^2=0.389$, $p=0.0007$, slope = 0.246 for *Arctostaphylos pungens*, $r^2=0.502$, $p<0.0001$, slope = 0.177 for *Adenostoma sparsifolium*. There was a significant difference among the slopes (ANCOVA: $F=47.6186$, $p<0.0001$) with significant differences between *Af* and *Ap* ($q=13.690$) and *As* and *Ap* ($q=9.921$) at the 0.05 significance level (Tukey's test: $q_{crit}=3.399$).

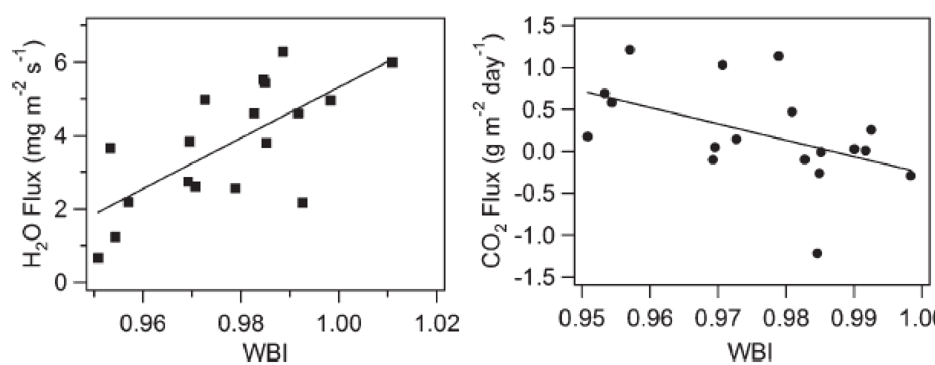

Fig. 8. Correlations between CO_2 and H_2O fluxes with transect average WBI respectively. Note the stronger correlation between WBI and H_2O flux than with CO_2 flux. For the CO_2 flux, negative values indicate uptake into the ecosystem, while positive values indicate loss into atmosphere. H_2O–WBI: $r^2=0.492$, $p=0.0012$. CO_2–WBI: $r^2=0.238$, $p=0.040$.