

SENSECO – WG3 datasets

Dataset 1

Country: Hungary

Location:

Datasets:

- thermal (and RGB), imaging - UAV
- SIF (Piccolo Doppio) (non imaging) - handheld
- reflectance (non imaging) - handheld

Purpose:

To study drought/vegetation state/spatial heterogeneity of ecosystem functioning in a species rich grassland and in a cropland.

Publication:

Data owner:

ESA

Availability to others, e.g. for STSM?

Yes

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Plant ecology research group
Szent István University
Hungary

Dataset 2

Country: Italy

Location: Latisana, northeast Italy (45°46'46.1"N, 13°00'50.5"E)

Datasets:

- Telops HyperCam-LW (TIR, 7.7 – 11.5 μm) – airborne (Cessna T303)
- Specim HyPlant (VNIR/SWIR, 0.4 - 2.5 μm ; SIF, 0.67 -0.78) – airborne (Cessna 208B Grand Caravan)

In situ data:

- weather station
- Chamber Flux Measurements

Purpose: artificial drought stress symptoms by chemical agents (VaporGard and Kaolin)

Publications:

Gerhards et al. (2018): Analysis of Airborne Optical and Thermal Imagery for Detection of Water Stress Symptoms. Remote Sensing, <http://www.mdpi.com/2072-4292/10/7/1139>

Abstract:

High-resolution airborne thermal infrared (TIR) together with sun-induced fluorescence (SIF) and hyperspectral optical images (visible, near- and shortwave infrared; VNIR/SWIR) were jointly acquired over an experimental site. The objective of this study was to evaluate the potential of these state-of-the-art remote sensing techniques for detecting symptoms similar to those occurring during water stress (hereinafter referred to as 'water stress symptoms') at airborne level. Flights with two camera systems (Telops *Hyper-Cam LW*, Specim *HyPlant*) took place during 11th and 12th June 2014 in Latisana, Italy over a commercial grass (*Festuca arundinacea* and *Poa pratense*) farm with plots that were treated with an anti-transpirant agent (Vapor Gard®; VG) and a highly reflective powder (kaolin; KA). Both agents affect energy balance of the vegetation by reducing transpiration and thus reducing latent heat dissipation (VG) and by increasing albedo, i.e., decreasing energy absorption (KA). Concurrent in situ meteorological data from an on-site weather station, surface temperature and chamber flux measurements were obtained. Image data were processed to orthorectified maps of TIR indices (surface temperature (T_s), Crop Water Stress Index (CWSI)), SIF indices (F_{687} , F_{780}) and VNIR/SWIR indices (photochemical reflectance index (PRI), normalised difference vegetation index (NDVI), moisture stress index (MSI), etc.). A linear mixed effects model that respects the nested structure of the experimental setup was employed to analyse treatment effects on the remote sensing parameters. Airborne T_s were in good agreement ($\Delta T < 0.35$ K) compared to in situ T_s measurements. Maps and boxplots of TIR-based indices show diurnal changes: T_s was lowest in the early morning, increased by 6 K up to late morning as a consequence of increasing net radiation and air temperature (T_{air}) and remained stable towards noon due to the compensatory cooling effect of increased plant transpiration; this was also confirmed by the chamber measurements. In the early morning, VG treated plots revealed significantly higher T_s compared to control (CR) plots ($p = 0.01$), while SIF indices showed no significant difference ($p = 1.00$) at any of the overpasses. A comparative assessment of the spectral domains regarding their capabilities for water stress detection was limited due to: (i) synchronously overpasses of the two airborne sensors were not feasible, and (ii) instead of a real water stress occurrence only water stress symptoms were simulated by the chemical agents. Nevertheless, the results of the study show that the polymer di-1-*p*-menthene had an anti-transpiring effect on the plant while photosynthetic efficiency of light reactions remained unaffected. VNIR/SWIR indices as well as SIF indices were highly sensitive to KA, because of an overall increase in spectral reflectance and thus a reduced absorbed energy. On the contrary, the TIR domain was highly sensitive to subtle changes in the

temperature regime as induced by VG and KA, whereas VNIR/SWIR and SIF domain were less affected by VG treatment. The benefit of a multi-sensor approach is not only to provide useful information about actual plant status but also on the causes of biophysical, physiological and photochemical changes.

Data owner:

LIST, Uni Trier, FZ Jülich, Uni Udine, Poznan University of Life Sciences; contact person:

Availability to others, e.g. for STSM?

Clarify with authors and co-authors

Contact:

Max Gerhards (gerhardsm@uni-trier.de)

Dataset 3

Country: Czech Republic

Location: e.g. Moravian-Silesian Beskydy Mts., Czech Republic (spruce forest biochemical parameters)

Datasets: Multi-sensor airborne

- VNIR covered by CASI-1500 sensor (Itres), spatial resolution 0.5-1m
- SWIR by SASI-600 sensor (Itres), spatial resolution 1.25-2.5m
- LWIR by TASI-600 sensor (Itres), spatial resolution 1.25-2.5m
- Lidar (Riegl Q780)

In situ data:

- Leaf properties (for spruce forest):
 - leaf chlorophyll a+b and carotenoids content
 - leaf water content
 - leaf mass per area
 - leaf optical properties (reflectance and transmittance) (ASD Fieldspec 350-2500nm)
 - Leaf area index of the spruce forest stand was measured using three optical instruments:
 - Plant Canopy Analyser LAI-2200 (Li-cor Biosciences Inc., US)
 - LaiPen (Photon Systems Instrument, CZ)
 - digital hemispherical photographs (Canon 450D digital camera with Sigma 4.5 mm fisheye lens).

Purpose:

- retrieval of biochemical parameters in forests (Norwegian spruce)
- urban greenery in city of Brno
- agrosystems

Publication:

Homolová L., Janoutová R., Lukeš P., Hanuš J., Novotný J., Brovkina O., Loayza Fernandez R. R. 2017: In situ data collection supporting remote sensing estimation of spruce forest parameters at the ecosystem station Bílý Kříž – Beskydy, 10 (1, 2): 75–86.

https://beskydy.mendelu.cz/media/pdf/beskyd_2017010010075.pdf

Abstract:

Remote sensing offers an effective way of mapping vegetation parameters in a spatially continuous manner, at larger spatial scales and repeatedly in time compared to traditional in situ mapping approaches that are typically accurate, but limited to a few distributed location and few repetitions. In case of forest ecosystems, remote sensing allow to assess quantitative parameters or indicators related to forest health status such as leaf area index, leaf pigment content, chlorophyll fluorescence, etc. Development, calibration and validation of remote sensing-based methods, however, still rely on supportive in situ data. The aim of this contribution is to introduce the individual in situ components in the framework for the retrieval of forest quantitative parameters from airborne imaging spectroscopy data. All measurements were acquired during an extensive in situ/flight campaign that took place at the Norway spruce dominated study site Bílý Kříž (Moravian-Silesian Beskydy Mts., Czech Republic) during August 2016. In addition to airborne remote sensing data acquisition, the in situ activities included terrestrial laser scanning

for tree 3D modelling, measurements of needle biochemical and optical properties, leaf area index measurements and spectral measurements of various natural and artificial surfaces. Leaf pigments varied between 25.2 and 49.1 $\mu\text{g cm}^{-2}$ for chlorophyll a+b content, 4.9 – 10.6 $\mu\text{g cm}^{-2}$ for carotenoid content depending on needle age and its adaptation to sun illumination, whereas ratio between the two pigments was stable around 4.6 – 5.3. Specific leaf area of spruce needles varied between 49.3 and 105.8 $\text{cm}^2 \text{g}^{-1}$, being the highest for the shade adapted needles of the current year. Leaf area index of spruce stands of various age and densities varied between 5.3 and 9.3.

Data owner:

CzechGlobe

Availability to others, e.g. for STSM?

Some of the datasets are available, depending on the project

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Dataset 4

Country: Switzerland

Location: LAEGEREN forest, Switzerland

Datasets:

- APEX (hyperspectral imager) 400nm - 2500nm (airborne)
- Full waveform LIDAR (airborne and drone based)
- RGB+NIR photogrammetry (structure from motion) (drone based)
- ground based LIDAR

In situ data:

- FLoX on tower
- FLUX data
- Unispec spectral sensor on tower
- ground spectral data (ground control points for airborne data quality checks and leaf optical properties)

Purpose: digital forest reconstruction, long-term monitoring, fundamental research

Publication:

Schneider, F. D., Leiterer, R., Morsdorf, F., Gastellu-Etchegorry, J.-P., Lauret, N., Pfeifer, N. and Schaepman, M. E. (2014). "Simulating imaging spectrometer data: 3D forest modeling based on LiDAR and in situ data." Remote Sensing of Environment **152**(0): 235-250.

Schneider, F. D., Morsdorf, F., Schmid, B., Petchey, O. L., Hueni, A., Schimel, D. S. and Schaepman, M. E. (2017). "Mapping functional diversity from remotely sensed morphological and physiological forest traits." Nature Communications **8**(1): 1441.

Paul-Limoges, E., Damm, A., Hueni, A., Liebisch, F., Eugster, W., Schaepman, M. E. and Buchmann, N. (2018). "Effect of environmental conditions on sun-induced fluorescence in a mixed forest and a cropland." Remote Sensing of Environment **219**: 310-323.

Data owner:

Michael Schaepman, Felix Morsdorf, Alex Damm, A. Hueni

Availability to others, e.g. for STSM?

Yes

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Dataset 5

Country: England/Scotland

Location:

Datasets: drone-based and in situ

- Workswell WIRIS Thermal camera (drone and in situ)
- Resonon Pika-L hyperspectral sensor (drone and in situ)
- Lidar time series
- Radar satellite data

Purpose: forest health, drought and pathogen infection, wind damage

Publication:

Data owner:

Availability to others, e.g. for STSM?

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I have a Workswell WIRIS Thermal camera and a Resonon Pika-L hyperspectral sensor. Both sensors operate on drones and from ground stations. I am located in Edinburgh, have a professional pilot's license and main interest is on forest health. I am looking at drought and pathogen infections using a combination of proximal and satellite sensors. I am starting my research but so far I have a data capture in a forest area in England infected by *Chalara fraxinea* and Acute Oak Decline. This is part of a PhD project of one of my students at Swansea University. I am also using different radar configurations to monitor clearfellings and wind damage in Scotland. This is also part of another PhD project. I have time-series of LiDAR data in the same area we are monitoring in Scotland and in England.

Dataset 6

Country: Denmark and Costa Rica

Location: Costa Rica sugarcane and rice crops, Denmark willow forest plantation

Datasets: drone based dataset (DJI hexacopter)

- CUBERT hyperspectral camera (VNIR)
- MCA (multispectral camera six channels VNIR)
- FLIR tau 2 thermal camera
- RGB camera (Structure from Motion, SfM)

In situ data:

- Eddy Covariance data
- Soil moisture
- fPAR
- ASD radiometer data
- Chlorophyll (SPAD)
- LAI

Purpose: Modeling evapotranspiration, drought, gross primary productivity, crop growth models. Scaling stomatal conductance. Synergies using thermal, optical and SfM (crop height)

Publication:

1. Wang, S., Garcia, M., Ibrom, A., Jakobsen, J., Köppl, C.J., Mallick, K., Looms, M.C., Bauer-Gottwein, P., 2018. "Mapping root-zone soil moisture using a temperature-vegetation triangle approach with an unmanned aerial system: Incorporating surface roughness from structure from motion". Remote sensing. doi:10.3390/rs10121978
2. Wang, S., Garcia, M., Bauer-Gottwein, P., Jakobsen, J., Zarco-Tejada, P.J., Bandini, F., Paz, V.S., Ibrom, A., 2019. High spatial resolution monitoring land surface energy, water and CO2 fluxes from an Unmanned Aerial System. Remote Sensing of Environment doi:10.1016/j.rse.2019.03.040
3. Wang, S., Baum, A., Zarco-Tejada, P.J., Dam-Hansen, C., Thorseth, A., Bauer-Gottwein, P., Bandini, F., Garcia, M., 2019. "Unmanned Aerial System multispectral mapping for low and variable solar irradiance conditions: Potential of tensor decomposition". ISPRS Journal of Photogrammetry and Remote Sensing. doi:10.1016/j.isprsjprs.2019.06.017

Data owner:

Monica Garcia

Availability to others, e.g. for STSM?

Yes

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Dataset 7

Country: Romania

Location:

Datasets:

Multispectral satellite data (Landsat 8, Sentinel-2/3, MODIS, SPOT5/6/7, Formosat, Pleiades 1B)

In situ data:

- Romanian soil moisture and temperature network
- Romanian weather station network
- Romanian National Agrometeorological Network

Purpose:

- Early drought detection using multi-sensor satellite information and in-situ data;
- Validation of satellite-based products with in situ data for crops drought stress monitoring;
- Synergistic use of passive multi-sensor for the assessment of the intensity, areal extent, rate of expansion, and time of drought occurrence.

Publication:

1. Stancalie, G., A. Nertan, P. Struzik, L. Toullos, M. Spiliotopoulos, G. Papadavid, A. Tarquis, M. Kepinska-Kasprzak, E. Calleja, J. R. Nunes. "Assessment of the most appropriate set of vegetation indices and biophysical variables in the context of a cost-effective solution to monitor water stress , using satellite data", in book : "How the study of the Water Footprint of agricultural crops can benefit from the use of satellite remotely sensed data", COST Action ES1106 EURO-AGRIWAT, Edited by: Leonidas Toullos and Piotr Struzik, ISBN 978-80-85754-38-4, 39 - 74p., 2016.
2. Stancalie, G., Nertan A. T., Toullos, L., Spiliotopoulos, M. „Potential of using satellite based vegetation indices and biophysical variables for the assessment of the water footprint of crops". Proc. SPIE 9229, Second International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2014), 92290K (August 12, 2014); doi:10.1117/12.2066392. (<http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1897226&resultClick=1>), 2014.
3. SEE Project-OrientGate: A structured network for integration of climate knowledge into policy and territorial planning, National Meteorological Administration, Bucharest, ISBN 978-973-0-17760-2, 2014.
4. Mireia Romaguera M., Toullos, L., Stancalie, G., Nertan, A., Spiliotopoulos, M., Struzik P., Calleja, E. J., Papadavid, G. „Identification of the key variables that can be estimated using remote sensing data and needed for Water

- Footprint (WF) assessment". Proc. SPIE 9229, Second International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2014), 922912 (August 12, 2014); doi:10.1117/12.2066120, 2013.
5. A.T. Nertan, A. T., Panaitescu, M., Stancalie, G., Irimescu, A., Flueraru, C.. "Analysis of drought phenomenon using remote sensing data in Romania". In Recent Advances in Energy, Environment, Economics and Technological Innovation - 4th Intern. Conf. on DEVELOPMENT, ENERGY, ENVIRONMENT, ECONOMICS (DEEE '13)"ISSN 227-4588, ISBN: 978-960-474-343-8, 2013.
 6. "Guide to Good Practices for Preventing Drought and Water Scarcity in the Mures River Basin", EC DGENv. "Halting desertification in Europe", Project "Mitigation Drought in Vulnerable of the Mures Basin – MIDMURES". Published by the National Meteorological Administration, Bucharest, 2012.
 7. Stancalie, G. and Nertan, A., „Possibilities of Deriving Crop Evapotranspiration from Satellite Data with the Integration with Other Sources of Information", chp. 20, p. 437 – 466, in Evapotranspiration – Remote Sensing and Modeling, edited by Ayse Irmak, InTech, Croatia, ISBN 978-953-307-808-3, 2011.
 8. Roumenina, E., V. Kazandjiev, G. Stancalie. "Methodological Requirements for Testing PROBA-V and VEGETATION data for agricultural applications in Bulgaria and Romania". 01/2011; Publisher: Academic Publishing House, Sofia, Bulgaria, 2011.
 9. Stancalie, G., Marica, A. and Toullos, L. „Using Earth Observation Data and Cropwat Model to Estimate the Actual Crop Evapotranspiration". Physics and Chemistry of the Earth. 35(1-2), p. 25-30. 2010.

Data owner:

National Meteorological Administration (NMA), Bucharest, Romania

Availability to others, e.g. for STSM?

Yes

Contact:

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Dataset 8

Country: Germany, Poland, Czech Republic, Switzerland, Italy, Spain, France, USA

Location:

Datasets:

- Airborne imaging spectrometer HyPlant (**hyperspectral sensor 400 – 2500 nm** & high performance **FLUORESCENCE** modul to quantify solar-induced fluorescence
- **TASI** and airborne **LiDAR** measurements (in 2018)

In situ data:

- Various ground based measurements of biophysical properties of vegetation (with emphasis on photosynthesis
- Permanently installed FloxBoxes and eddy towers to continuously record fluorescence and photosynthesis
- Synergies with various other campaign activities such as thermal campaigns, dedicated stress experiments or biodiversity studies

Purpose:

Acquire high resolution data to support the upcoming FLEX satellite mission

Support new product development (focus of photosynthesis related data products)

Better understand the link between solar-induced fluorescence and vegetation photosynthesis and stress

Data owner:

ESA, FZ Jülich

Availability to others, e.g. for STSM?

data are available on request from dedicated data portals and via ESA

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Dataset 9

Country: Luxembourg

Location: Luxembourg Remich, Insitute Viti-Vinicole

Datasets:

- UAV equipped with a thermal (TEAX ThermalCapture Fusion Zoom) in coming summer seasons 2019-2021
- UAV equipped with a hyperspectral VNIR (Headwall NANO+lidar) sensor in vineyards in coming summer seasons 2019-2021
- Thermal and VNIR (Gamaya) available for 2018

In situ data:

- Diseases severity assessment
- ASD leaf clip
- Meteo data

Purpose:

Aim is the detection of diseases (peronospora, ESCA) in vineyard

Publication:

Data owner:

LIST, Luxembourg

Availability to others, e.g. for STSM?

Yes

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