Towards a network of field spectrometers for continuous proximal sensing monitoring: multiple cases of application for FloX and RoX

LPS 2022, May 23rd

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PROJECT, CAMPAIGNS AND PROTOTYPES

2005

2006

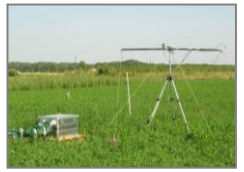
2007

ESA-CEFLES2

2008

2009

ESA-SEN3EXP



2010

ESA-fluorecence

2011

2012

ESA-HyFLEX

2013

ESA-SEN2EXP

2014

2016

F-Bus

HYPERSPECTRAL DEVICES

Funding of
JB Hyperspectral Devices
2016

UNIVERSITA' DEGLI STUDI DI MILANO BICOCCA

JÜLICH FORSCHUNGSZENTRUM

MPI-BGC Jena

OPTIC	Spec1	Spec2
Wavelength range	~ 650–800 nm;	~ 400–950 mn
Spectral Sampling Interval (SSI)	~ 0.17 nm	~ 0.65 nm
Spectral resolution (FWHM)	~ 0.3 nm	~ 1.5 nm
Signal to Noise Ratio (SNR)	~ 1000	~ 250
Field Of View (FOV)	Dual FOV. Upwelling radiance ~25°. Downwelling radiance 180°	

OPERATIONAL	
Signal Optimization	Automatic adaption to varying light conditions
Dark current	Accurate dark current determination at each measurement cycle
Manual acquisition	Interface software for manual measurement and calibration
Automatic acquisition	Fully autonomous measurement mode for unattended data acquisition
Quick measurements	20 seconds under bright sunshine 60 seconds in overcast condition
Stability	Reference system stability check and uncertainty estimates
Simultaneous metadata	Spectrometer temperature, Outside temperature, GPS position, GPS time
Data Display	Live assessment of the systems status
Data storage	SD card up to 32 GB (12 months of measurements)
Case	Robust and Waterproof housing based on the 1510 Pelicase
Dimension	Small form factor (50 × 30 × 20 cm)
Power supply	12 Volt. From battery or solar panels
Power consumption	Average consumption of 60 Watt. (20/100 Watt, cooling on/off)
Energy saver	Day/night switch for energy saving
Interfaces	RS232 via cable and wireless

https://www.jb-hyperspectral.com/products/flox/

OPTIC

Wavelength range	VIS-NIR: ~ 400–950 mn (other options also available on demand)
Spectral Sampling Interval (SSI)	~ 0.65 nm
Spectral resolution (FWHM)	~ 1.5 nm
Signal to Noise Ratio (SNR)	~ 250
Field Of View (FOV)	Upwelling radiance ~ 25°. Downwelling radiance 180°

OPERATIONAL

Signal Optimization	Automatic adaption to varying light conditions
Dark current	Accurate dark current determination at each measurement cycle
Manual acquisition	Interface software for manual measurement and calibration
Automatic acquisition	Fully autonomous measurement mode for unattended data acquisition
Quick measurements	10 seconds under bright sunshine 30 seconds in overcast conditions
Stability	Reference system stability check and uncertainty estimates
Simultaneous metadata	Temperature, GPS position, GPS time
Data storage	SD card up to 32 GB (12 months of measurements)
Case	Robust and Waterproof housing based on the 1200 Pelicase
Dimension	300 × 250 × 130 mm
Power supply	12 Volt. From battery and solar panels
Power consumption	800 mAh
Energy saver	Day/night switch for energy saving
Interface	RS232 via cable and wireless

https://www.jb-hyperspectral.com/products/rox/

In 2022
55 FloXes
28 RoXes

MY FILES

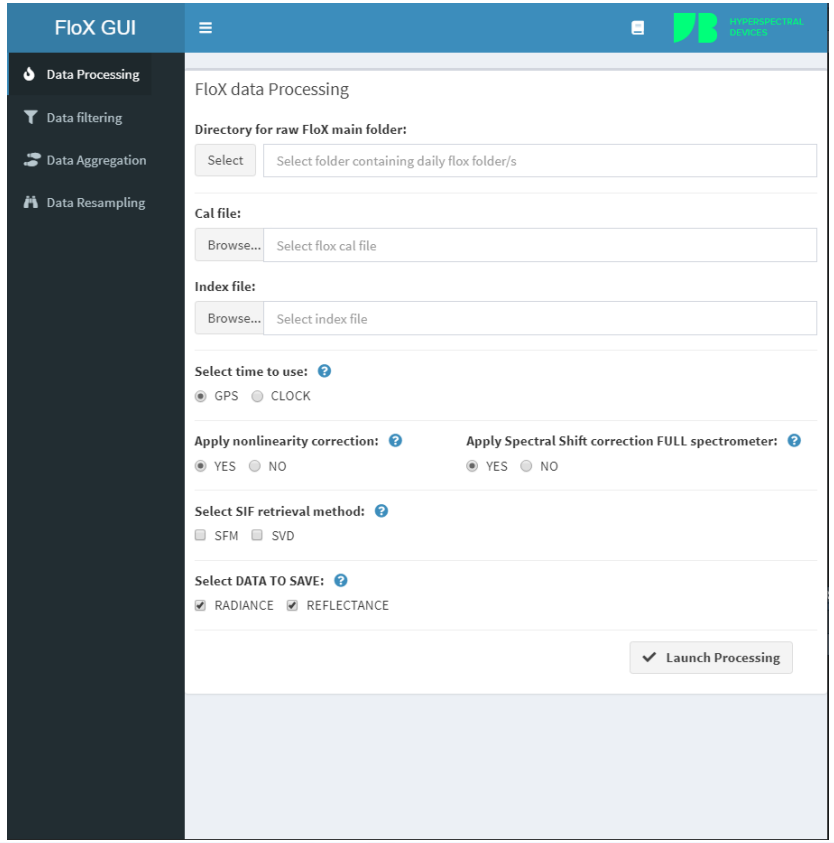
Welcome to your personal area, Iremtech

Below you can find a list of your reserved contnents. Click here to logout.

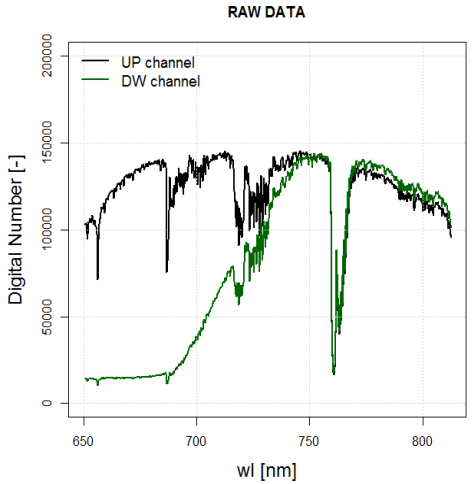
FLOX DATA PROCESSING GUI – JB-031-SK – IREMTECH

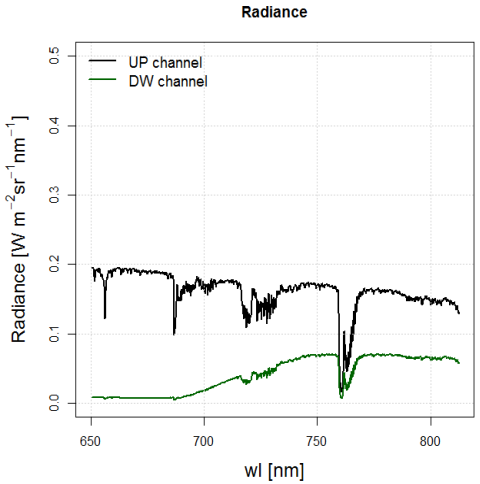
DISCOVER

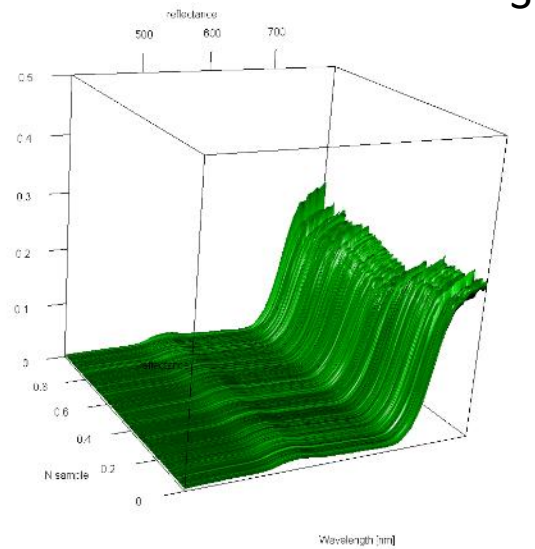
- ✓ Easy
- ✓ Plug and play
- ✓ Open Source



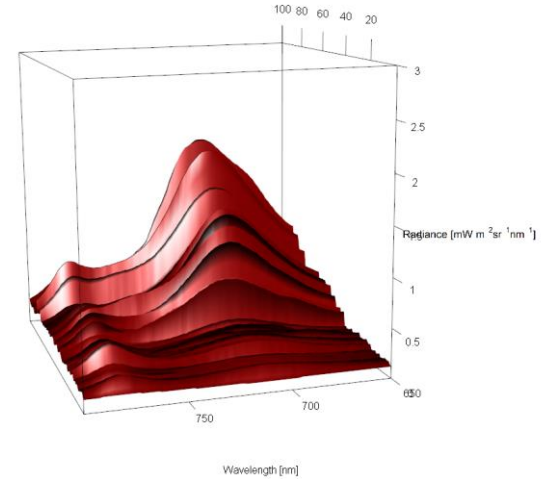
Calibration coefficients

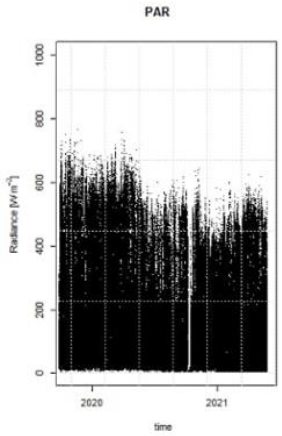


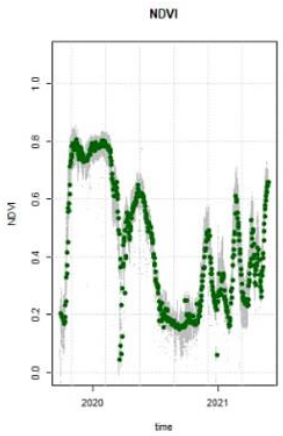


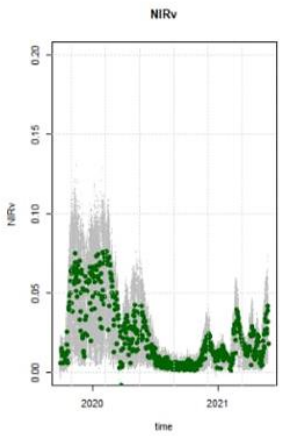


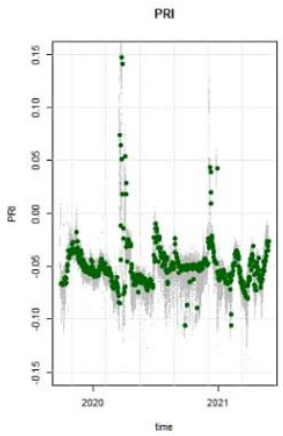
SIF retrieval and Index formulation

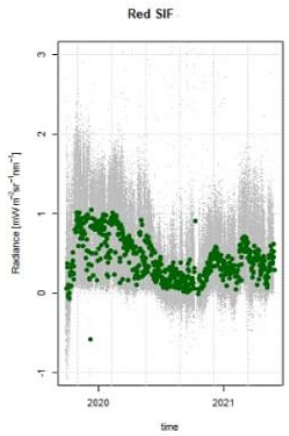


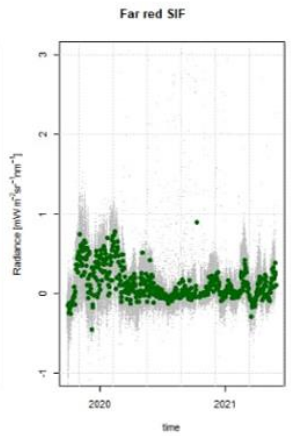








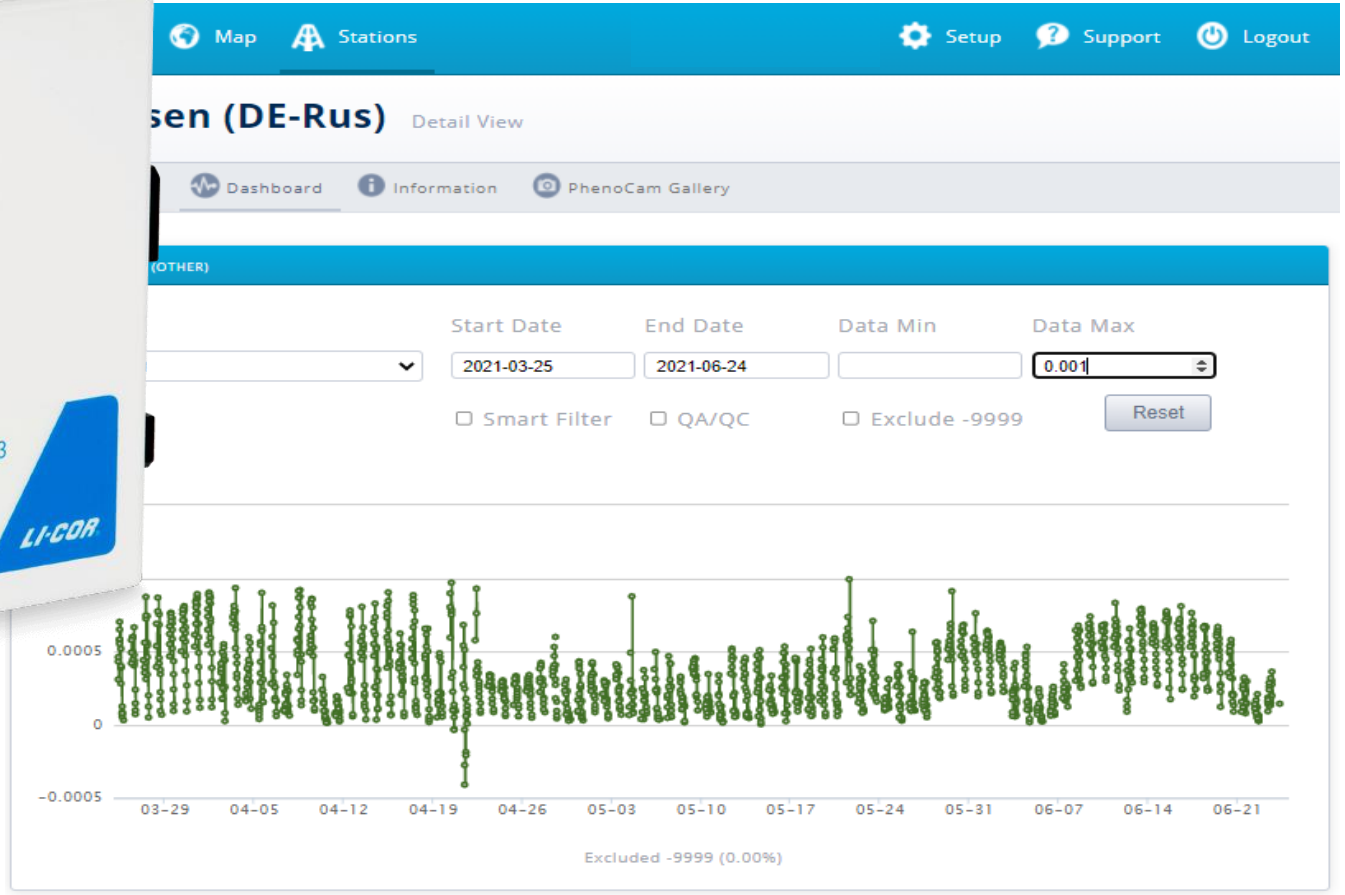




Quality Flag Criteria

Since 2019 JB is collaborating with Licor in order to make JB devices compatible with SmartFluX for a real time visualization of the data.

Communication is based on SDI-12 protocol and allow to a minute based data transfer. A subset of 12 parameters (user defined) calculated by FloX ARM processor can be streamed out after every cycle of measurements.



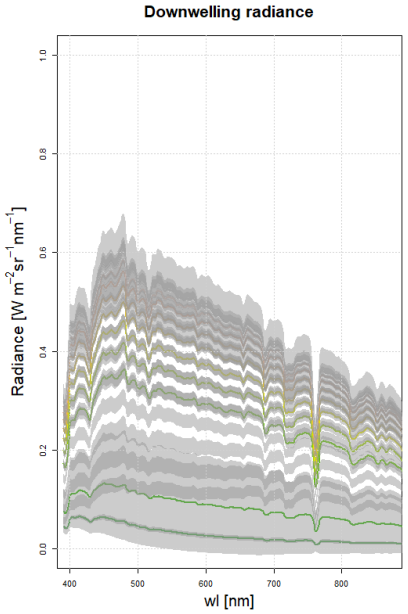
Ongoing collaboration with existing flux networks to release dataset of variable derived by JB instruments:

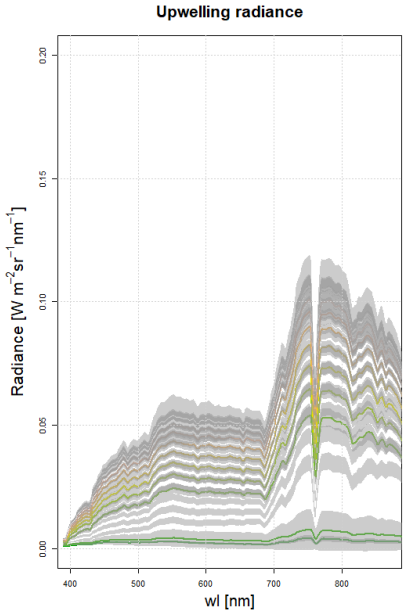
- Upwelling and Down-welling radiance
- Reflectance
- Vegetation Indices

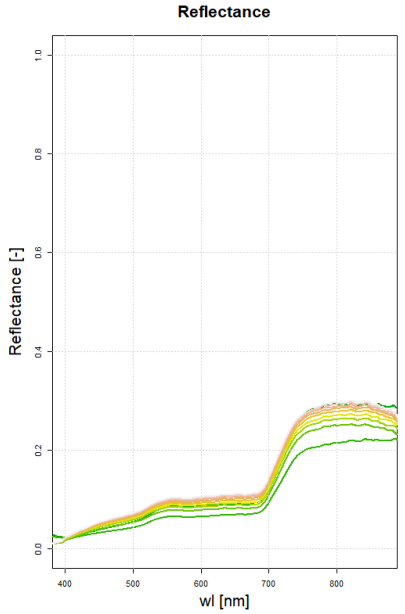
ICOS INTEGRATED CARBON OBSERVATION SYSTEM

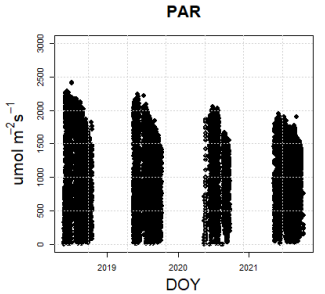
FLUXNET A Global Network

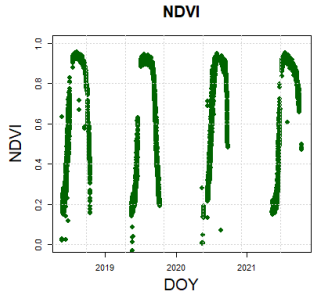
AMERIFLUX

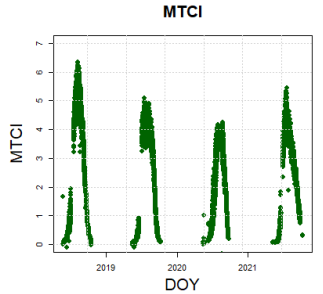


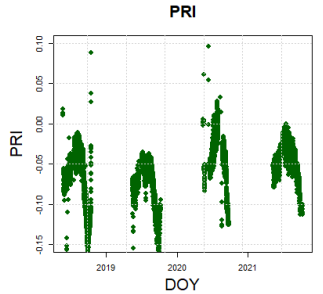


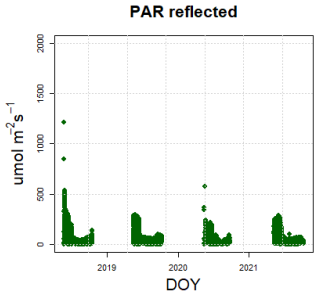


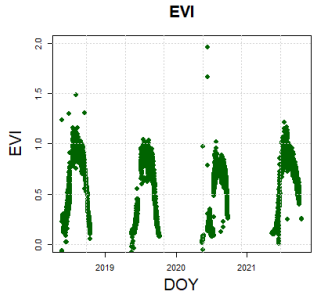


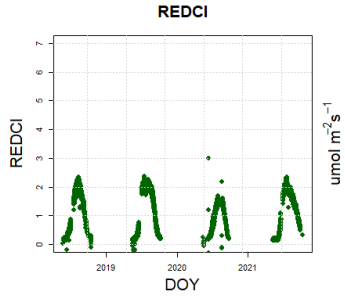


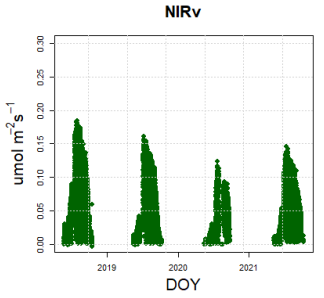










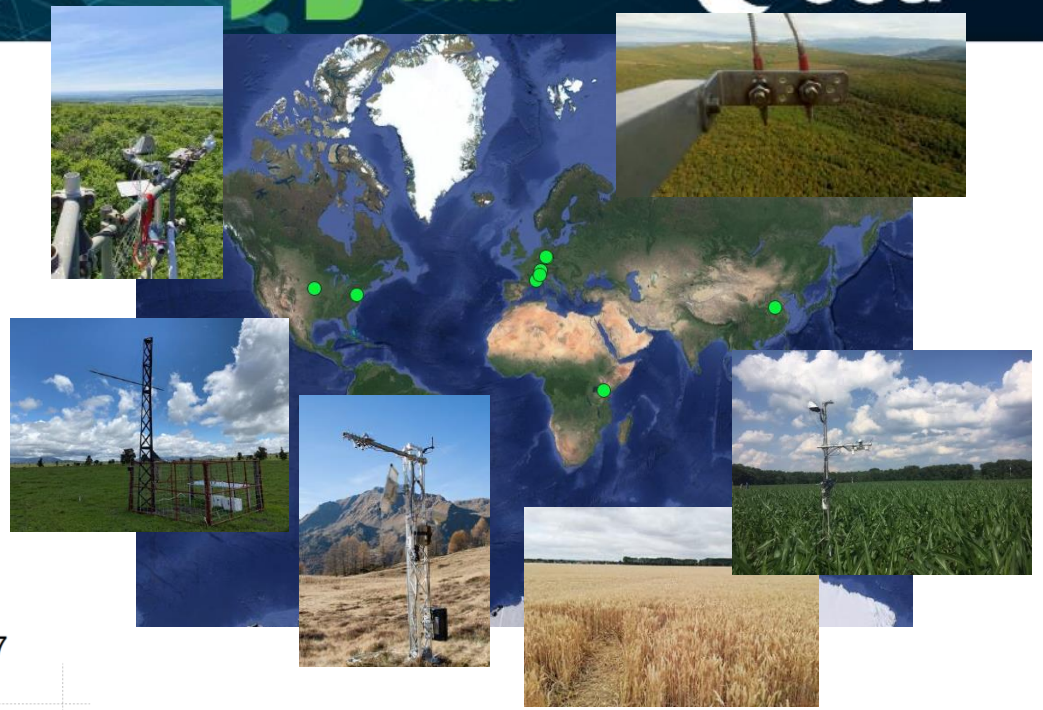


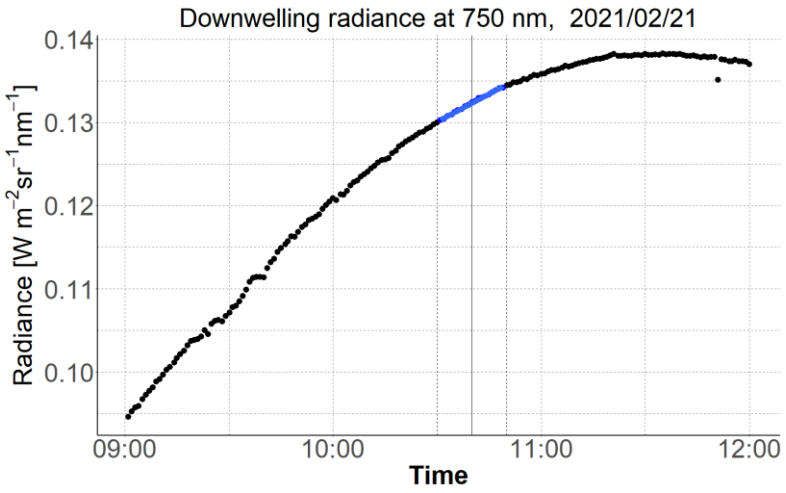
HYPERSPECTRAL DEVICES

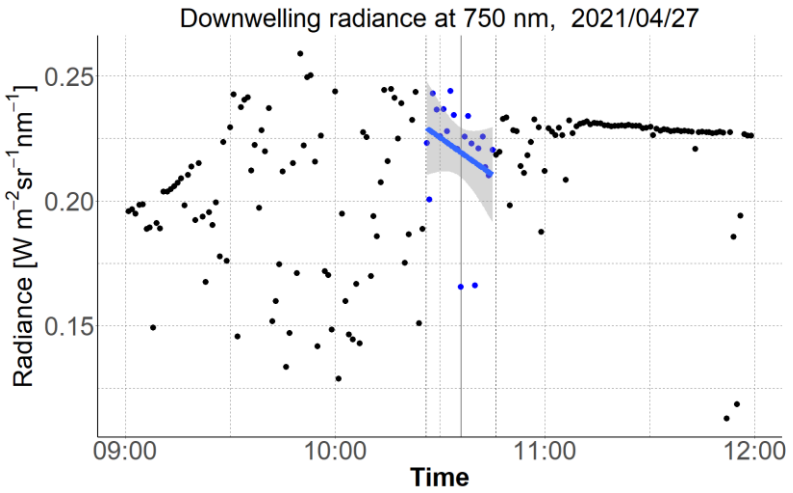
esa

Comparison between FloX and RoX versus Sentinel2.

- 10 sites selected around the globe, covering different targets in time.
- Comparison is made on BOA reflectance and related VIs
- Data filtered based on Sentinel cloud mask and field data







Naethe et al. (in prep)

esa European Space Agency

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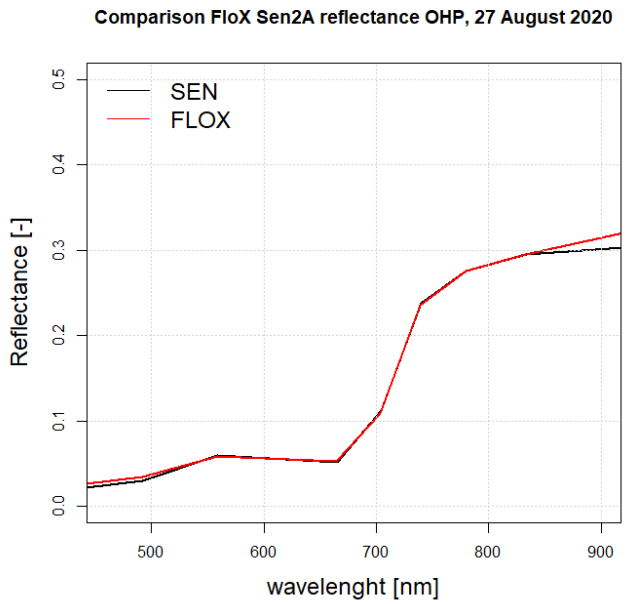
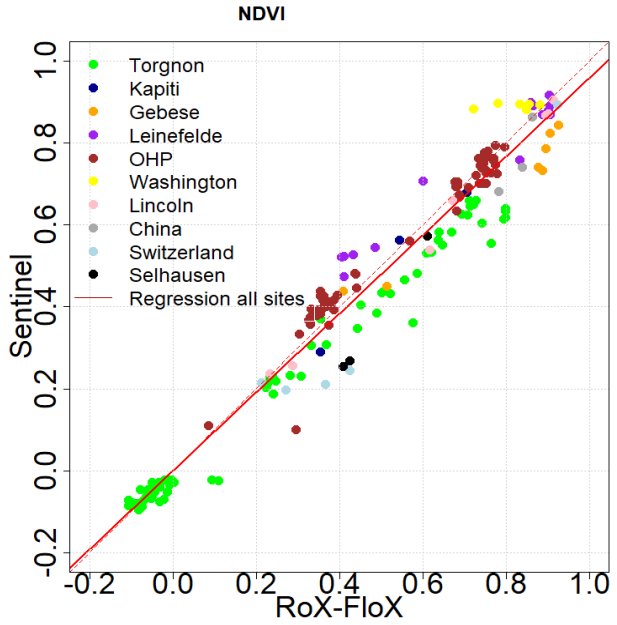
NASA

Universität Zürich[UZH]

Naethe et al. (in prep)

- The sites selection was not made for cal/val activity (**spatial representativeness** was not a criteria of selection).
- Preliminary results show a **good correlation** between ground based and satellite based measurements both on **reflectance and VIs**.
- It was found that the regression between ground and satellite was improving significantly when satellites images were filtered according to ground measured irradiance stability, indicating the **cloud mask** for sentinel was less suitable for such analysis.





Bands wl	R Squared
442	0.47
492	0.59
559	0.59
665	0.72
704	0.59
740	0.45
780	0.55
833	0.45

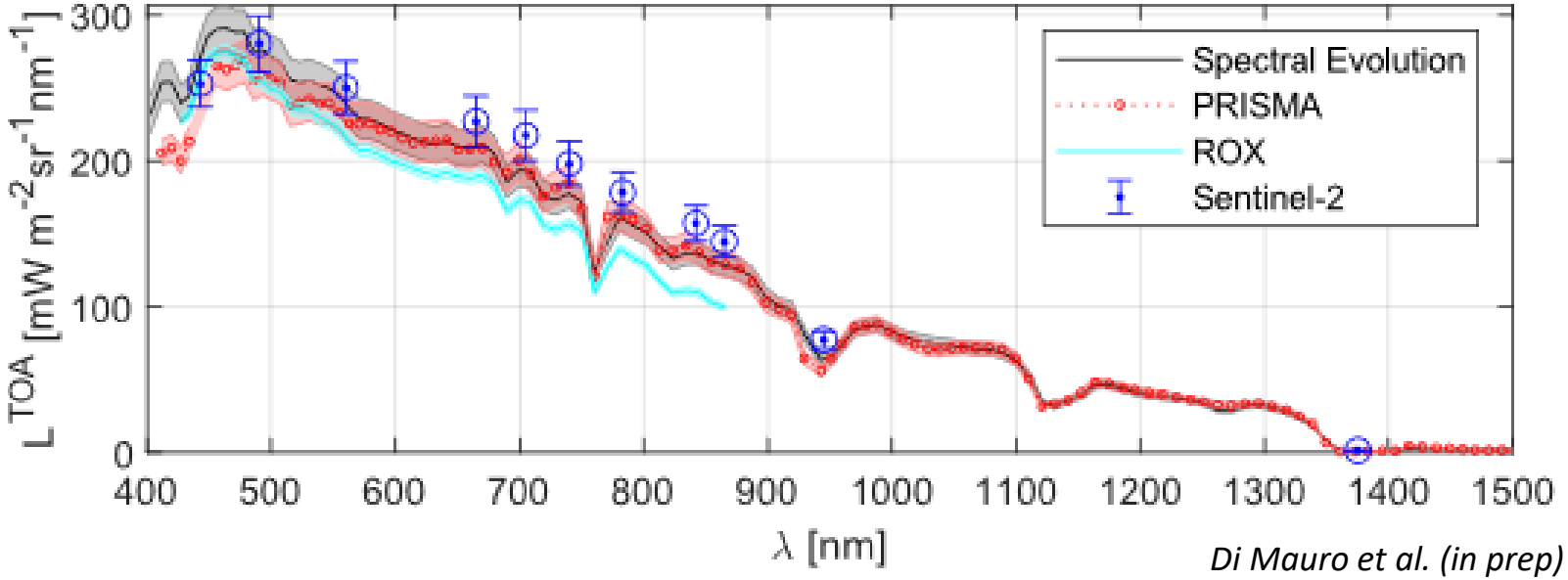
Indices	R Squared
CRred	0.72
EVI	0.86
NDVI	0.9

Naethe et al. (in prep)

Naethe et al. (in prep)

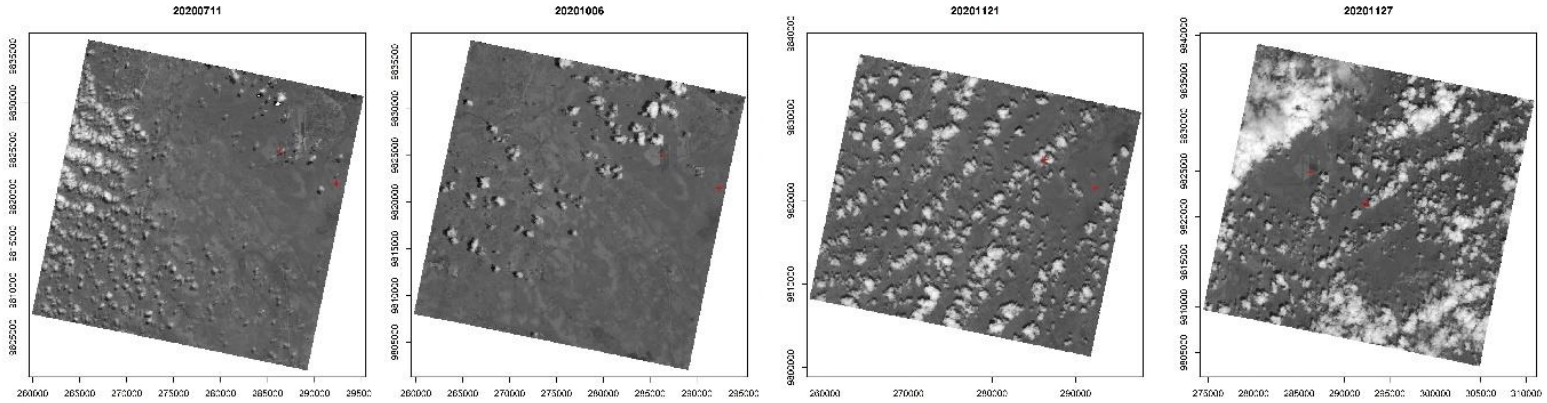
At the Torgnon experimental site (Western Alps), PRISMA L1 spectra show a good agreement with field measurements (Spectral Evolution) and Sentinel 2 data, within the MRD requirements (lower than 5%)

Data from automatic spectrometer ROX represent a novel source of information for systematic and continuous measurements for Cal/Val and temporal monitoring of snow melting dynamics

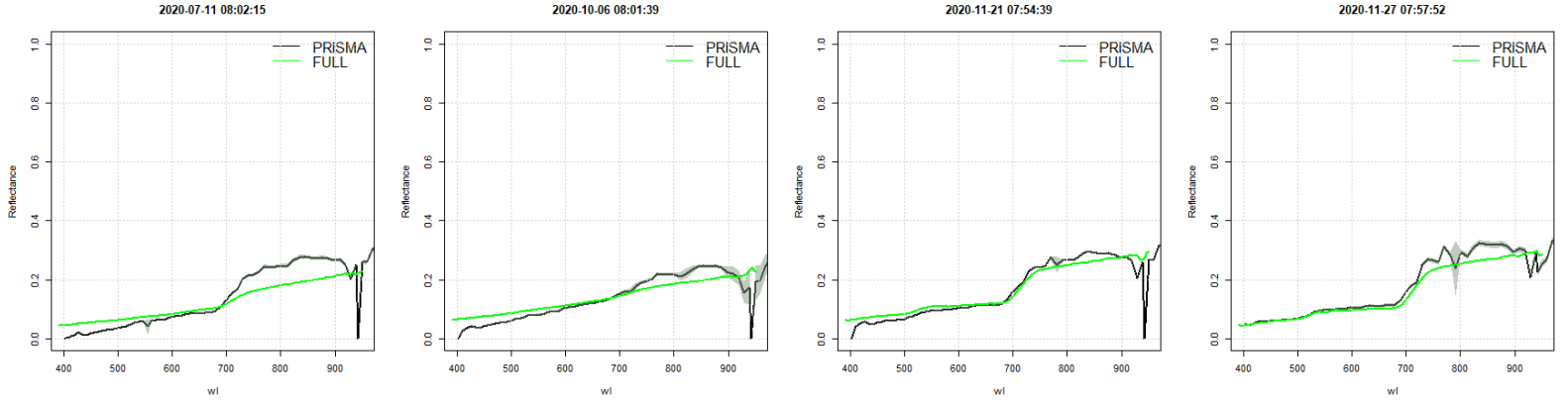


Di Mauro et al. (in prep)

At the Kapiti experimental site (Kenya) a FloX was installed in 2019 and continuously running since then. Acquisition of PRISMA BOA L2D reflectance images were requested. On 9 images acquired 5 had to be rejected due to cloud cover.



Courtesy of Tagliabue, Rossini and Panigada



CONCLUSIONS

- FloX and RoX are consolidated instruments which are collecting data since years, and already used for several scientific studies
- Data processing was tuned in the last 5 years and is now at a robust stage, including data quality flags for filtering criteria
- Remote Data access is one actual key aspect and increasing in stability. Smartflux Li-Cor integration is onrgoing and will make the FloX/RoX data easily accessible to community not directly linked to spectroscopy
- JB data integration with existing FluX network is progressing (ICOS, Fluxnet, Ameriflux etc.)
- Field spectrometer netowk can be used for satellite validation activities, where the number of sites, even if not all matching the spatial requirements can be considered as a plus

THANK YOU FOR LISTENING

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