

Validation Activities

At Forschungszentrum Jülich

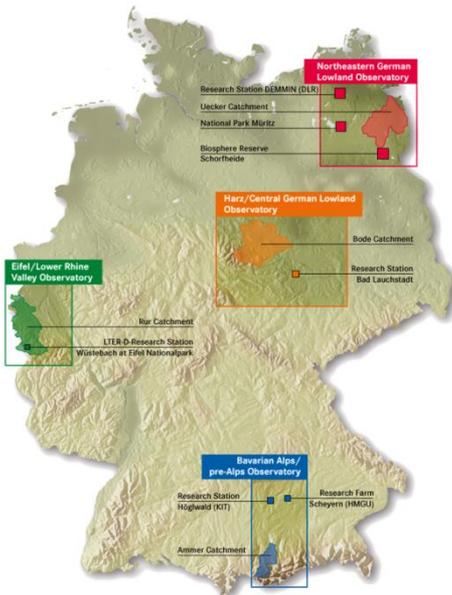
TERENO network and FLUXNET

March 2016 | Jörn Ungermann

TERENO

In situ observations

TERENO Terrestrial Environmental Observatories
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

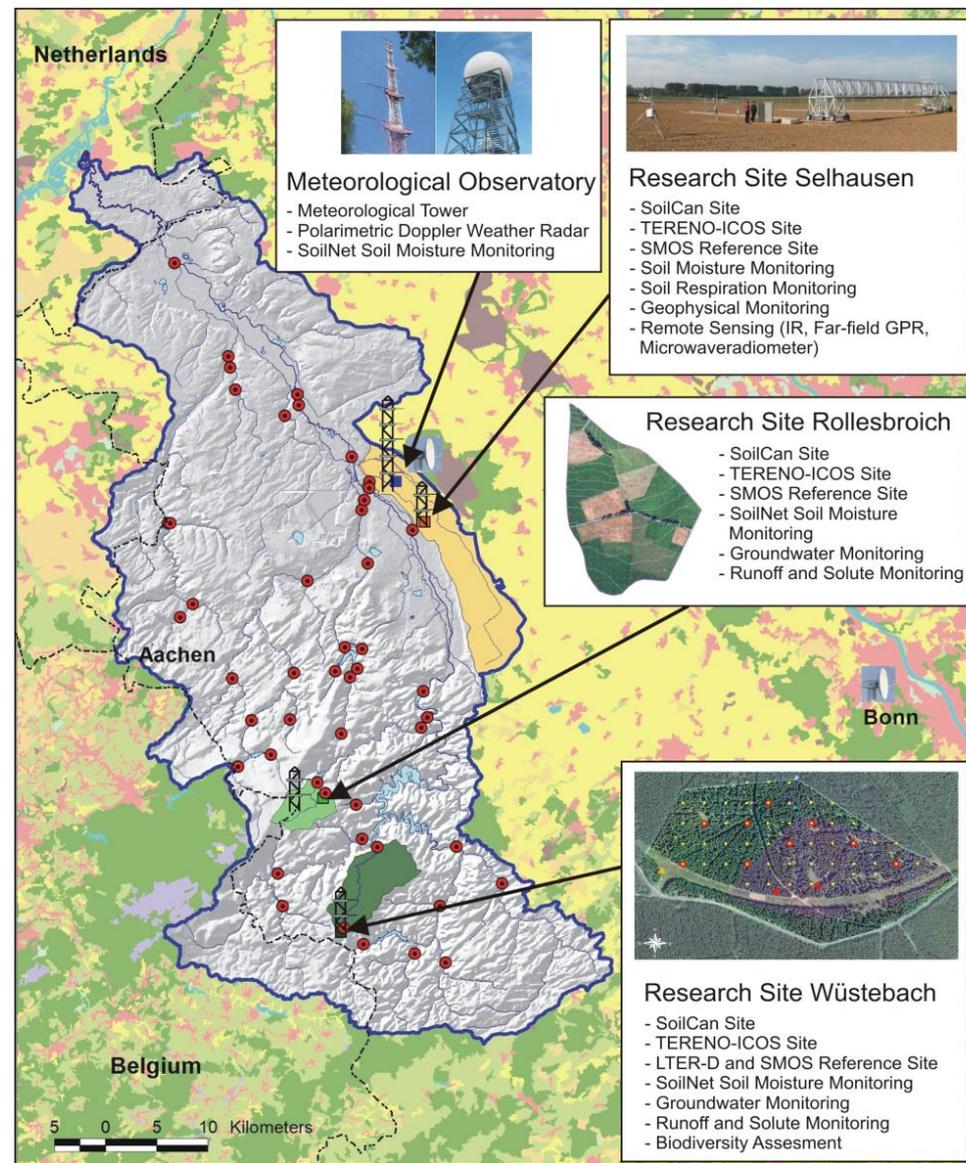


Observatorium Nordostdeutsches Tiefland
 Koordination: GFZ

Observatorium Harz / Mitteldeutsches Tiefland
 Koordination: UFZ

Observatorium Eifel / Niederrheinische Bucht
 Koordination: FZJ

Observatorium Bayerische Alpen / Voralpenland
 Koordination: KIT / HMGU

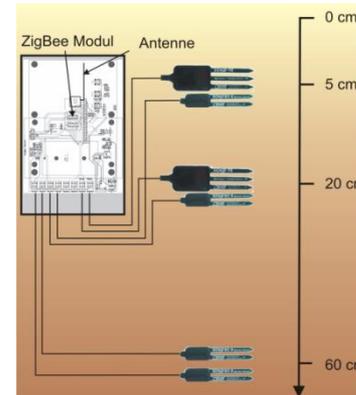
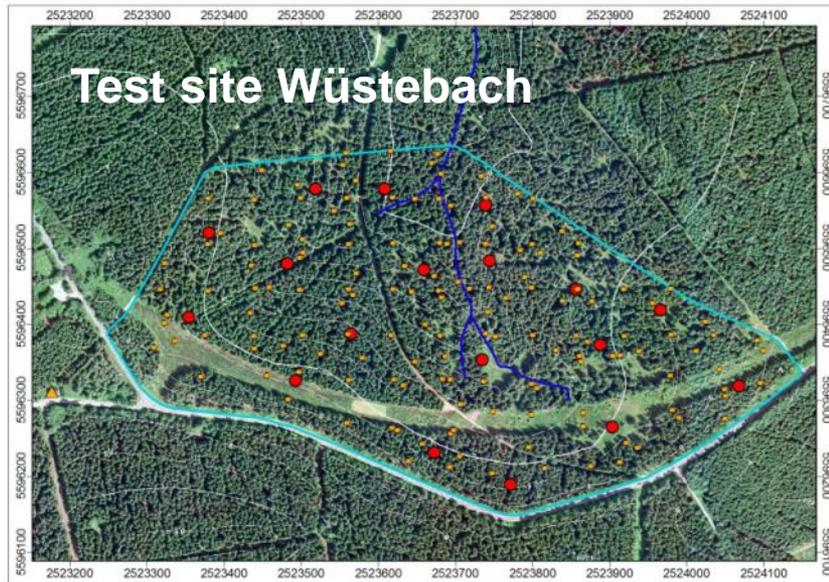


TERENO
TERRESTRIAL ENVIRONMENTAL OBSERVATORIES

Eifel/Lower Rhine Valley Terrestrial Observatory

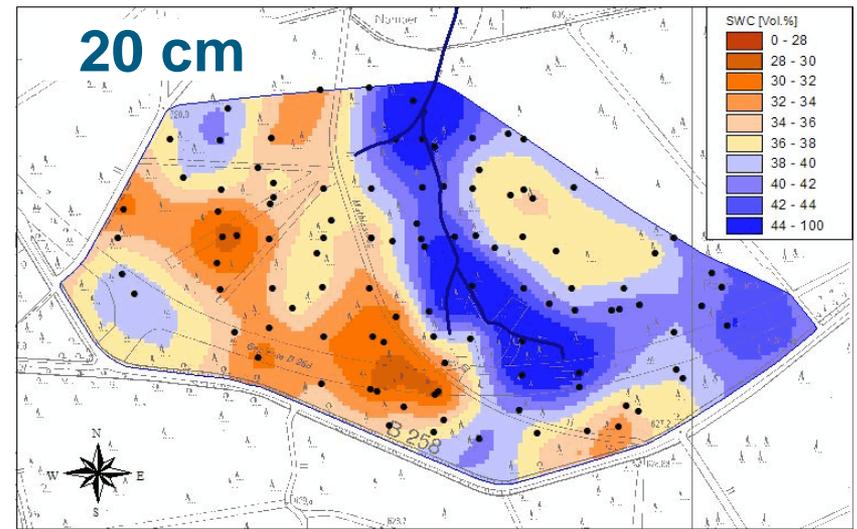
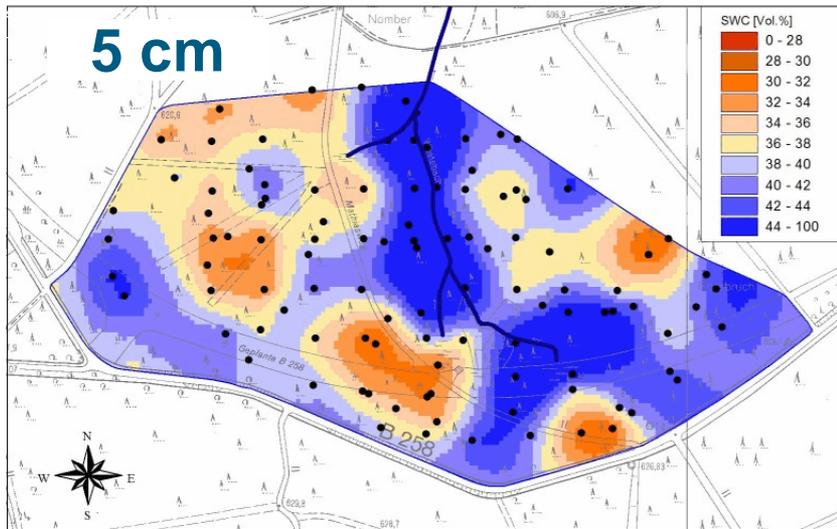
- Rur Hydrological Observatory
- Ellebach Subbasin
- Kall Subbasin
- Erkensruhr Subbasin
- Waterbodies
- Streams
- National border
- Runoff gauging station
- Eddy flux tower
- Weather Radar

Wireless soil moisture sensor network SoilNet



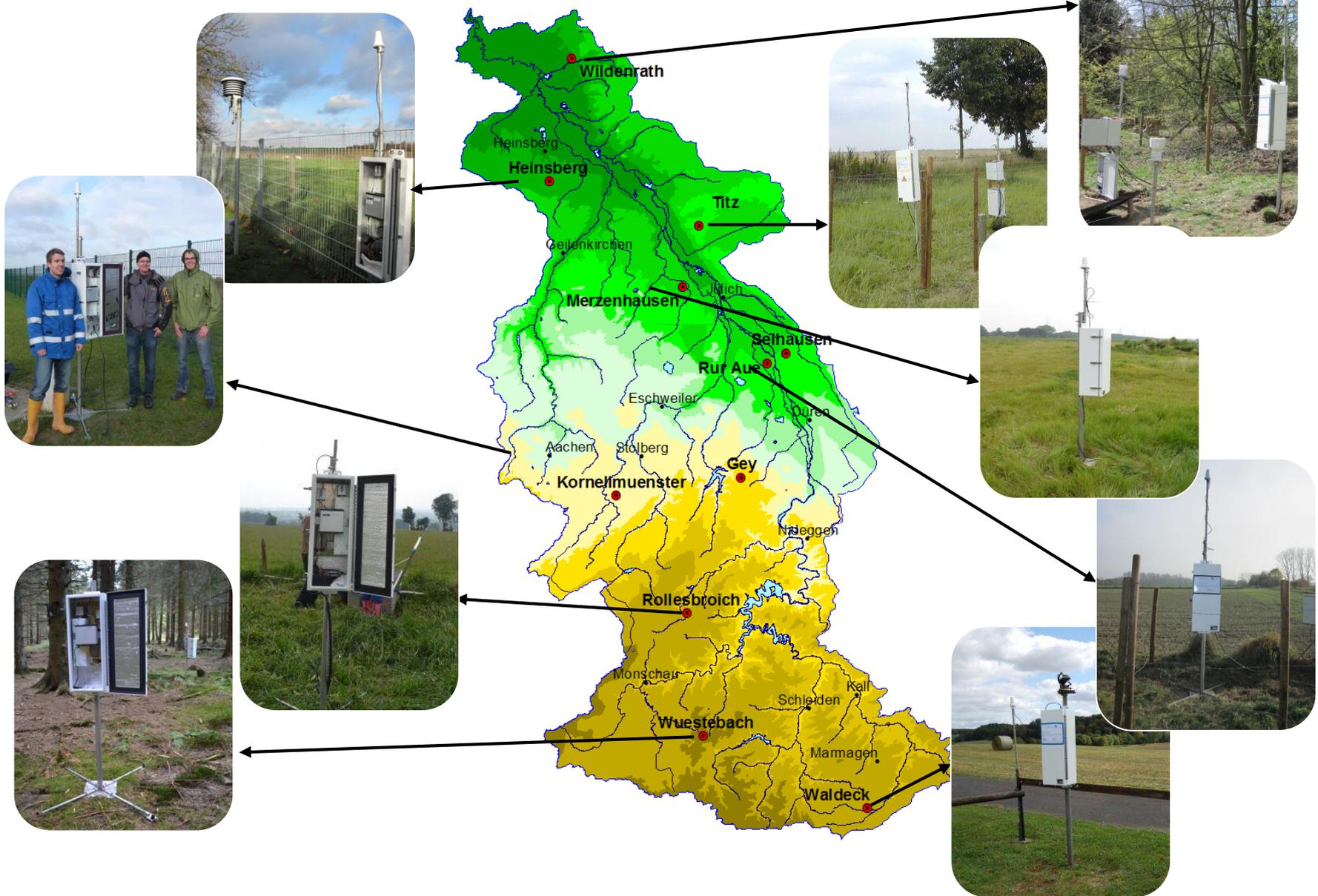
- 150 Sensor units
- 18 Router units
- 900 Soil moisture sensors
- 300 Temperature sensors

455 days: ~10 Mio. hourly measurements!

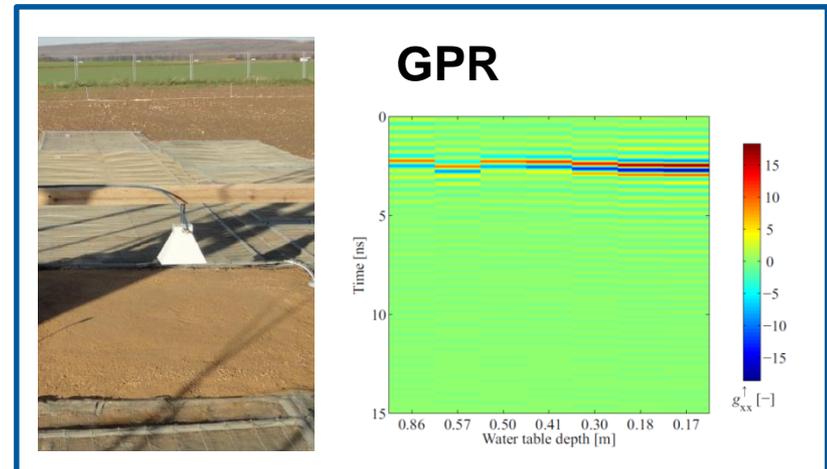
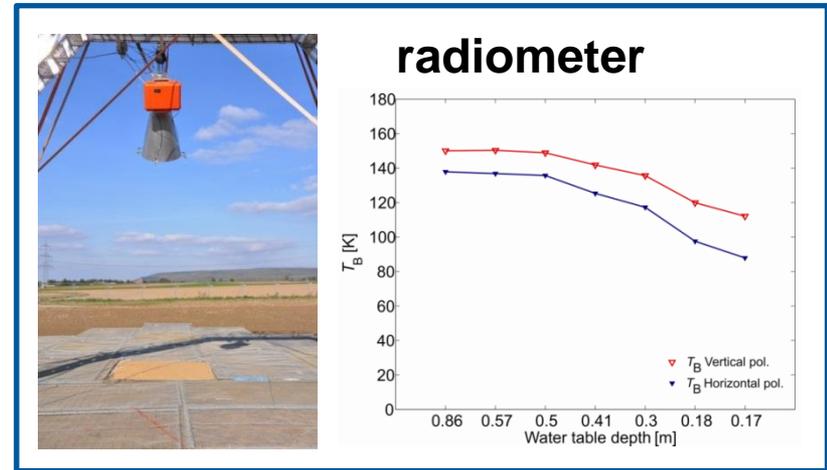


Bogena et al. (2010)

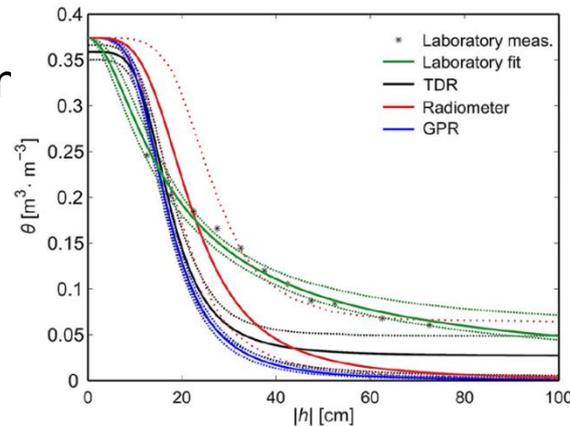
Cosmic Ray Probe Network in the Rur catchment



Passive and active microwave monitoring at L-band



Inverse estimation of hydraulic parameters





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LOGIN

TERENO

TERRESTRIAL ENVIRONMENTAL OBSERVATORIES



Search

What ?

Where ?

When ?

Search Clear

Map Viewer

Search Results

Sensor Search Results

Cosmic Ray/Climate/Soil station Ruraue

Select Data

Query	Stations	Style	Basket
Offering	Public		SoilTemperature_0.2mSensor1
Valid	2011-11-08 2015-08-18		SoilTemperature_0.2mSensor2
Begin	2015-05-01 12:00:00		SoilTemperature_0.5mSensor1
End	2015-05-31 12:00:00		SoilTemperature_0.5mSensor2
			SoilWaterContent_0.05mSensor1
			SoilWaterContent_0.05mSensor2
			SoilWaterContent_0.2mSensor1
			SoilWaterContent_0.2mSensor2

Information

Result

SoilWaterContent [%_Sat]

Date [yy-MM-dd HH:mm]

TERENO

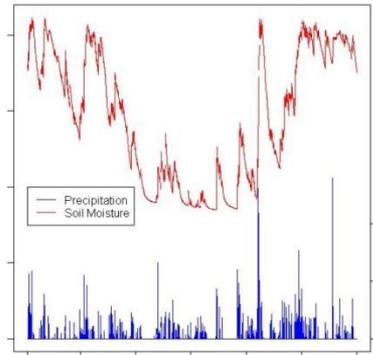
- Long-term monitoring of the terrestrial environment (>15 years)
- Focus on water and energy fluxes
- Monitoring data available to the public
- TERENO part of Integrated Carbon Observation System (ICOS) European Research Infrastructure Consortium (ERIC)

SMOS VALIDATION CAMPAIGN 2010

Soil moisture reference (area-wide time series)

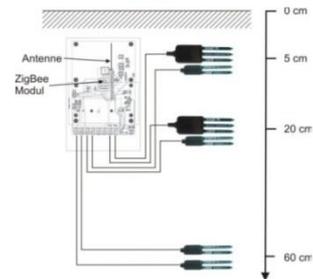
**Soil moisture
measurements**

WaSiM-ETH
modelling →

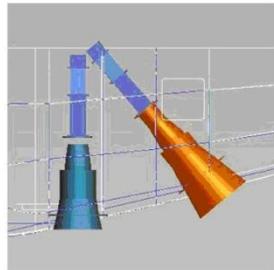


← Product-
validation

**SMOS
soil moisture**



**Radiometric
measurements**



Radiative Transfer
Model L-MEB

→ Parameter
estimation

**Tb (area-wide
time series)**

→ Aggregation/
Validation

SMOS Tb

↑ SMOS Level 2
Processor

local

regional

global



Airborne measurements with the Short Skyvan of Aalto University



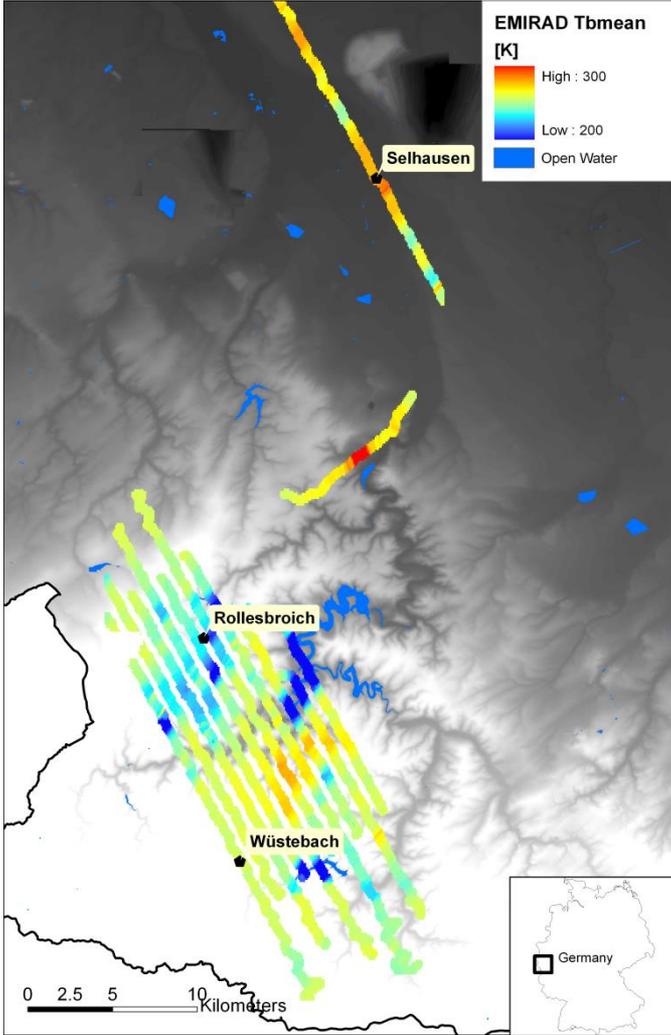
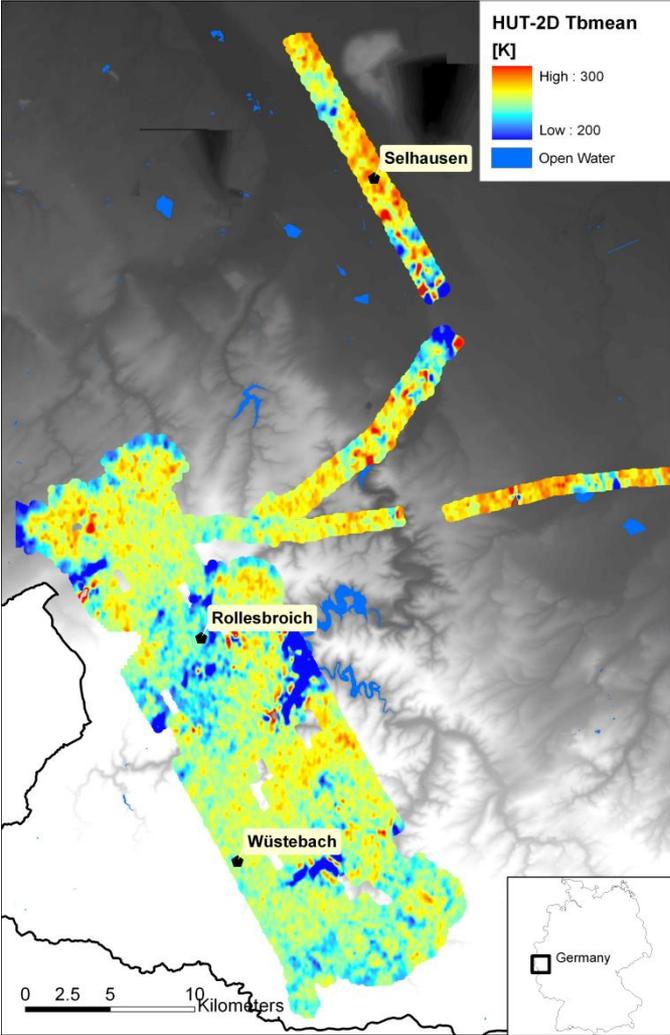
HUT-2D Radiometer Aalto University



EMIRAD Radiometer DTU Denmark



Airborne Radiometer data



SMOS Validation at TERENO Sites

- Validation on both brightness temperature level and on soil moisture level
- Airborne campaign to cover scale between in situ point measurements and spaceborne measurements

SMAP VALIDATION AT NASA

Global SMAP Validation

Soil Moisture Active Passive (SMAP) Mission



In situ data transfer status: SM



- Automated pull running
 - SMOSMANIA (#01)
 - TEREÑO (#02)
 - REMEDHUS (#03)
 - Reynolds Creek (#04)
 - Kuwait (#05)
 - HOAL (#06)
 - Monash (#07)
 - AAFC (#09)
 - SCAN (#11)
 - Twente (#12)
 - ARS (#16)
 - FMI (#17)
 - SAOCOM (#19)
 - CRN (#21)
 - Kenya (#24)
 - SoilSCAPE (#25)
 - Kenaston (#27)
 - Tabasco (#32)
 - Valencia (#41)
 - EURAC (#44)
 - GPS (#49)
- Automated pull ready to start
 - Merguillil (#08)
 - Oklahoma Mesonet (#46)
- Initials setup but some further details need to be worked out
 - Millbrook (#26)
 - Berambadi (#42)
- Work needed
 - NEON (#47)
- No automation planned at the moment
 - Tibet (#12)
 - AMMA (#45)
 - Mongolia (#53)

Source: Andreas Colliander, NASA

SMAP Validation at TERENO Rur

Climate class: Temperate (Cfb)
Landcover: Croplands

TERENO (Candidate Pixel)



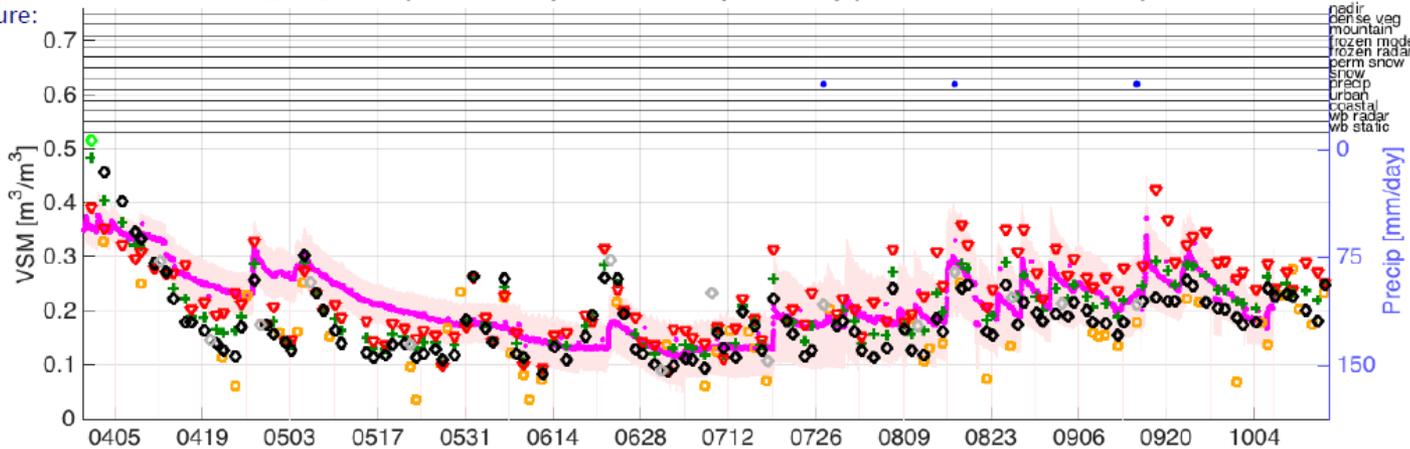
L2_SM_P-BL (T11880-999): 0201-36-01 (TERENO) (51.00, 6.35; -5988, -540)

Soil texture:

S-%: 41

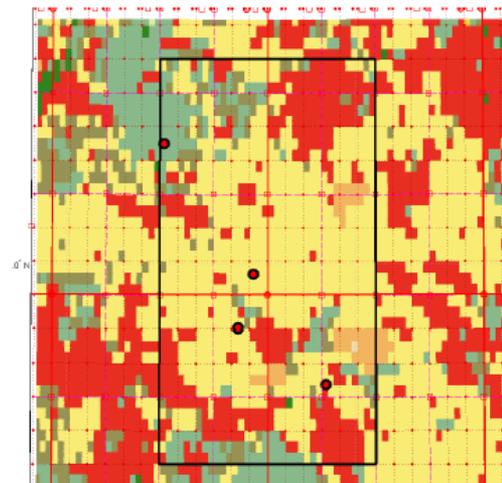
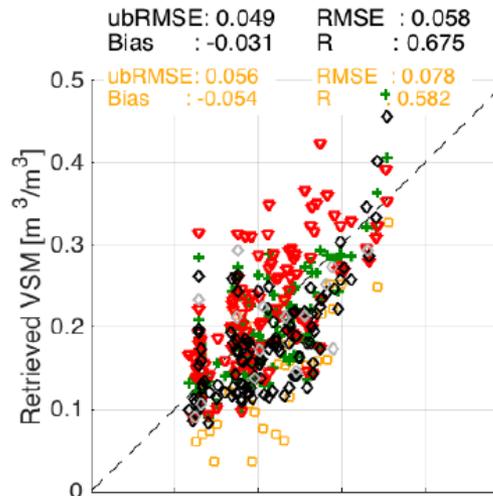
C-%: 22

BD: 1.40



- In Situ
- ◆ SCA-H
- + SCA-V
- ▲ DCA
- ◻ SMOS SM

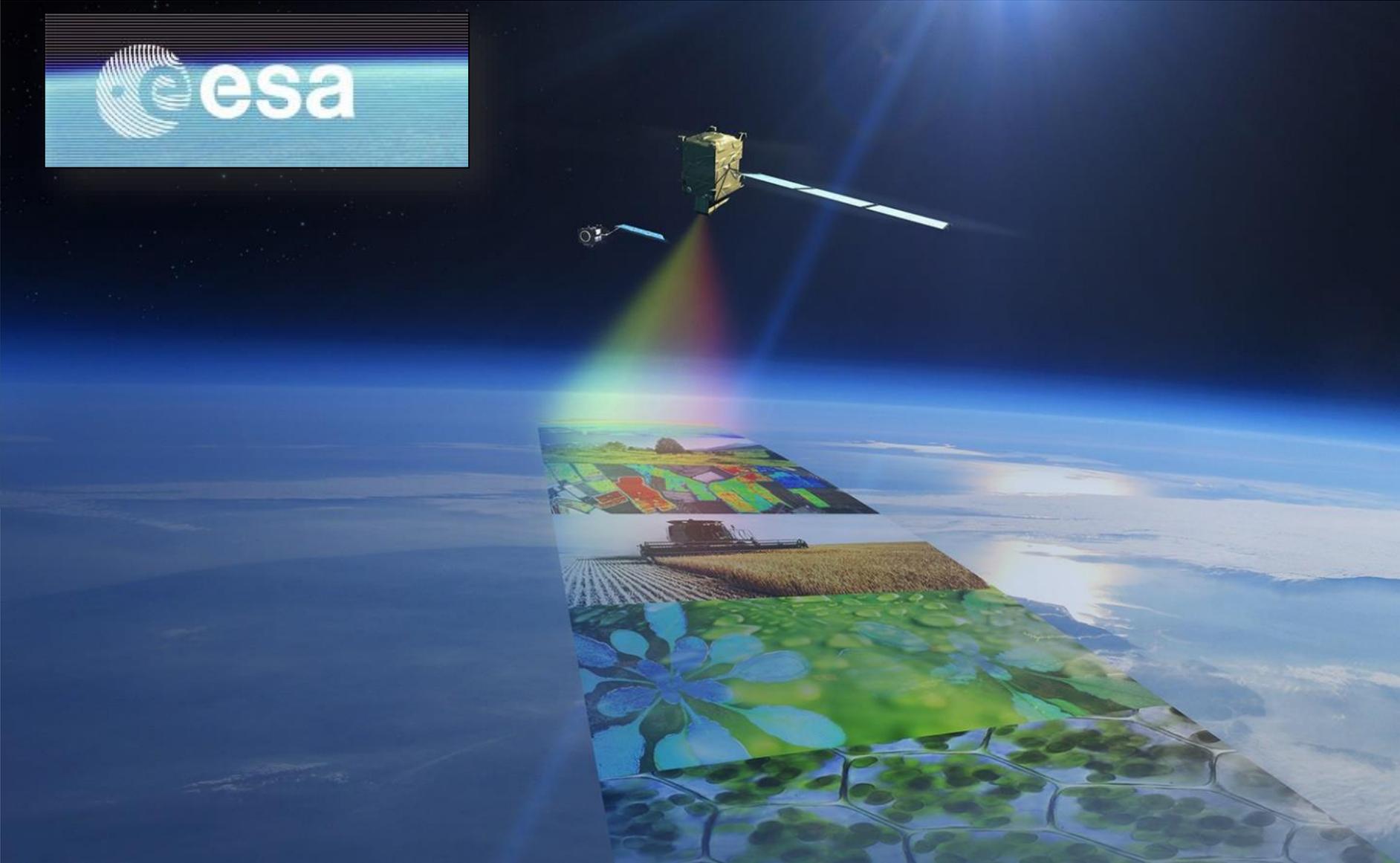
Alg	ubRMSE	Bias	RMSE	R
SCA-H	0.049	-0.031	0.058	0.675
SCA-V	0.048	-0.009	0.049	0.713
DCA	0.056	0.016	0.058	0.646



Source: Andreas Colliander, NASA

FLEX

FLEX – a satellite mission to directly measure actual photosynthesis from space



FLEX products validation

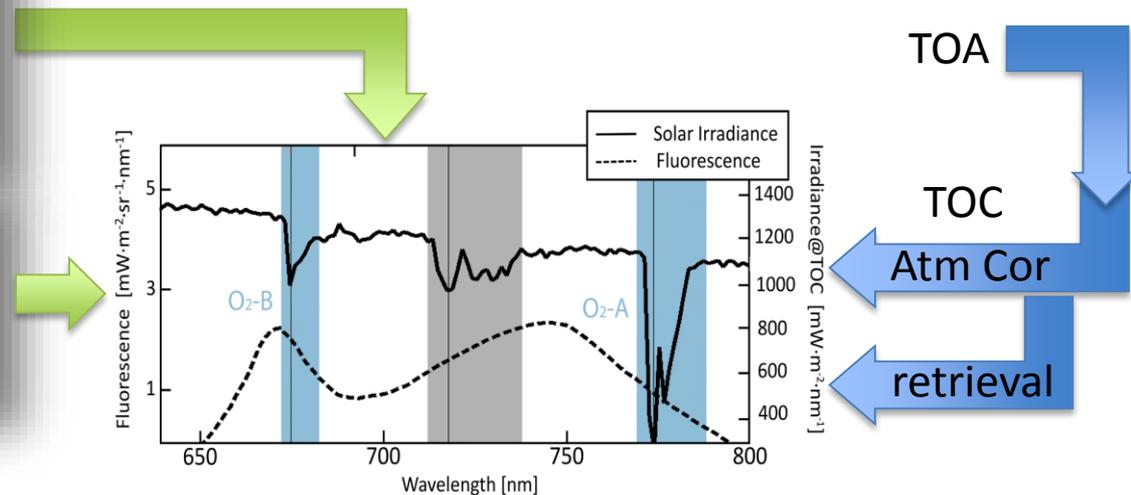
- Fluorescence products validated using in-situ measurements
 - selection of sites, field instruments and protocols
 - scaling methods
- Validation of atmospheric corrections and surface reflectance
 - surface solar irradiance measurements
 - surface spectral reflectance characterization
- Validation of derived vegetation products (LAI, f_{Cover} , Chlorophyll)



Top-of-Canopy

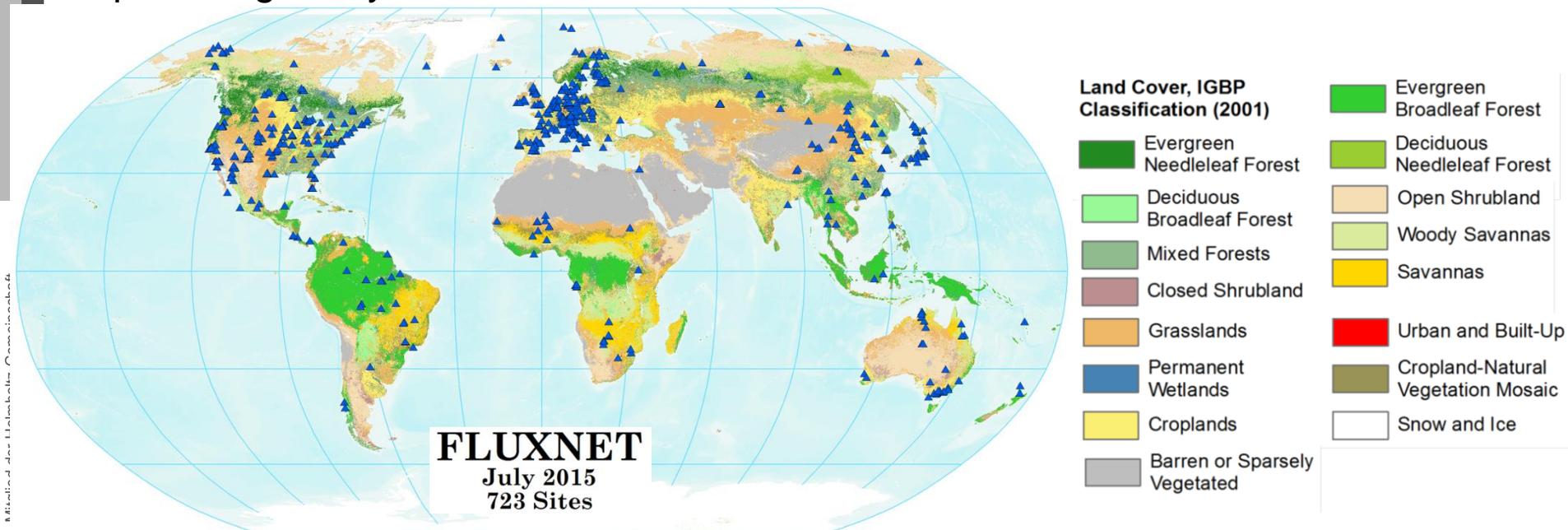


Leaf level



Selection of Cal/Val sites

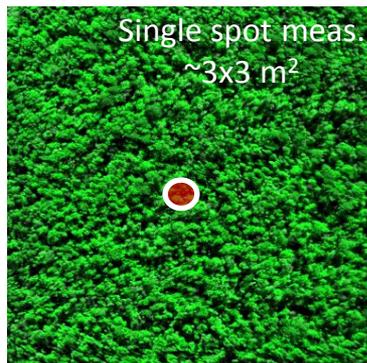
- Cal-Val sites (CVS) distributed around the globe:
 - Existing optical spectral measurements at flux towers, ecological sites, ...
 - Dedicated supersites
- Spatial domain: analyse correlation significance over all CVS points in a single global coverage
- Temporal domain: analyse correlation significance for each CVS over a full phenological cycle



Available technologies for field fluorescence measurements



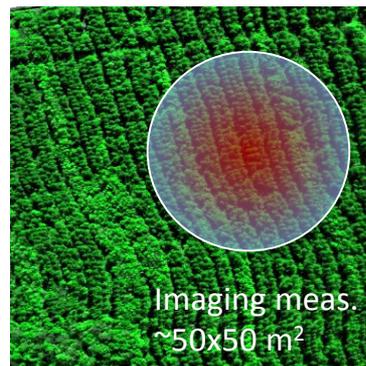
Spot spectroradiometer



Fluorescence at O₂-A and O₂-B
Fully autonomous
Single spot, localized
High temporal sampling (seconds)



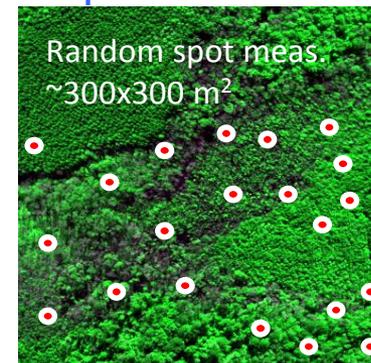
Robotized imaging spectroradiometer



Fluorescence at O₂-A
Fully autonomous
Imaging, localized
Mid temporal sampling (hours)



UAV mounted spot spectroradiometer



Fluorescence from RT modelling
Partially autonomous
Multiple spots, delocalized
Low temporal sampling (days)

Dedicated ground spectrometers



ESSEM COST Action ES1309

Innovative optical Tools for proximal sensing of ecophysiological processes (OPTIMISE)

Descriptions are provided by the Actions directly via e-COST.

Important European and international initiatives (SPECNET, BIOSPEC and COST Action ES0903) explored the use of proximal optical sensing of



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Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

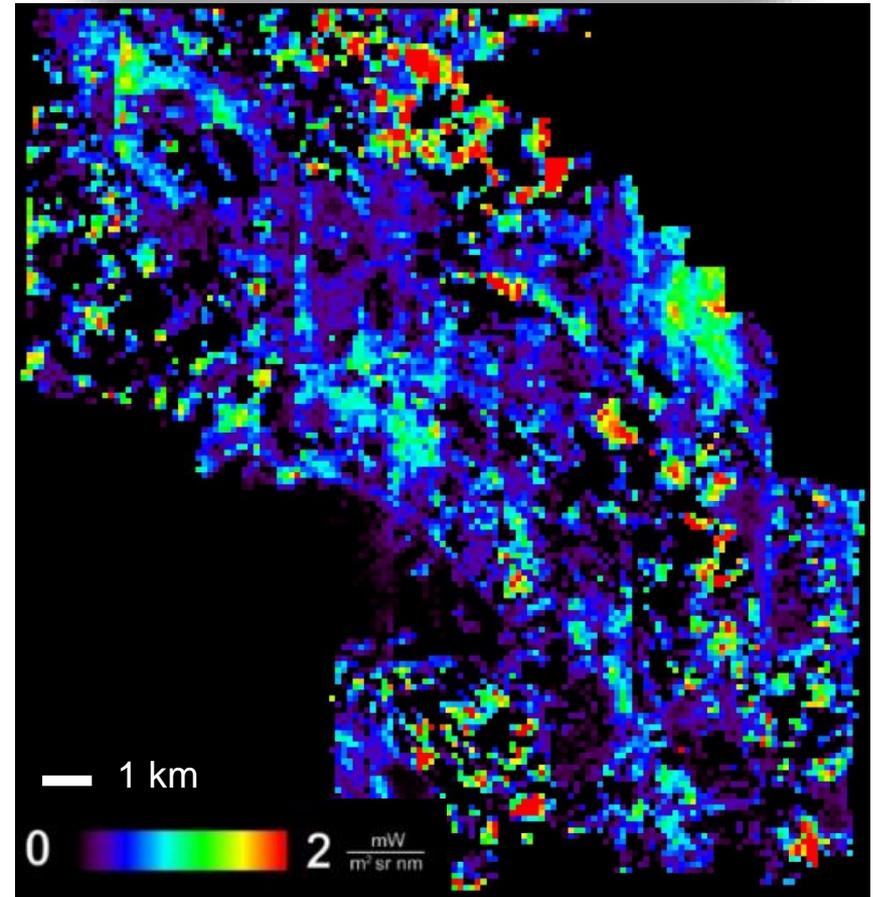
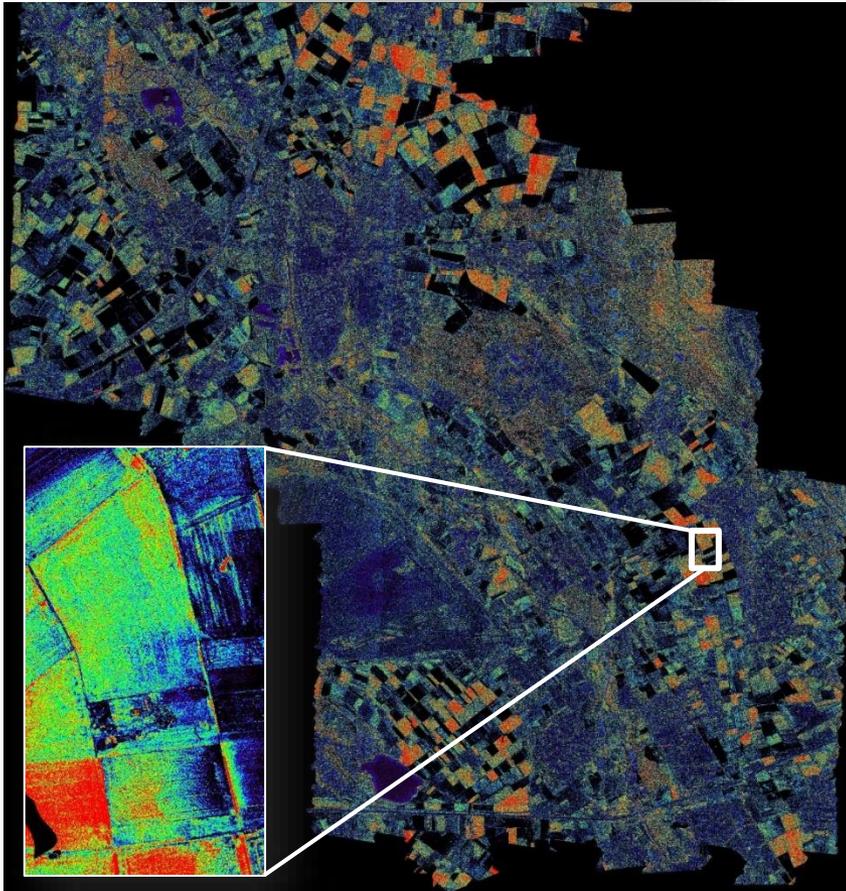


Continuous and long-term measurements of reflectance and sun-induced chlorophyll fluorescence by using novel automated field spectroscopy systems



S. Cogliati ^{a,*}, M. Rossini ^a, T. Julitta ^a, M. Meroni ^{a,b}, A. Schickling ^c, A. Burkart ^c, F. Pinto ^c, U. Rascher ^c, R. Colombo ^a

Airborne tool for validation (upscaling)





University of Zurich ^{UZH}



Centre de Recherche Public Gabriel Lippmann

Freie Universität



Berlin



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P & M Technologies
Innovations in Plant Science & Technology

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