Land Surface Carbon Constellation Study
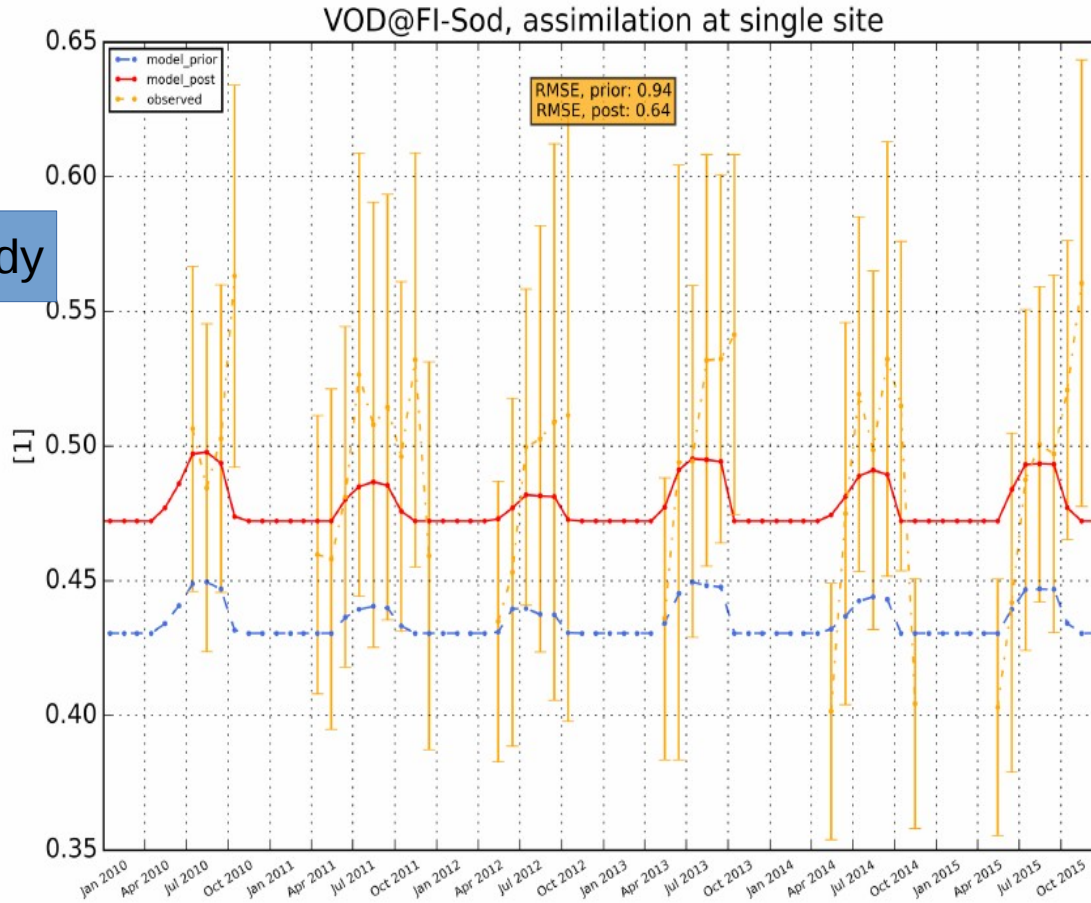
Thomas Kaminski and study team

VOD Discussion Meeting, 22 January 2020

Seasonality in VOD

VOD@FI-Sod, assimilation at single site

SMOS+VEG study

Kaminski et al., IEEE IGARSS 2018

35

Objectives of the project

Overarching scientific objective:

- Investigate the terrestrial biosphere's net ecosystem exchange – photosynthetic CO_2 uptake minus respiratory CO_2 release – response to climatic drivers by means of combining a process-based model with a wide range of observations (in-situ and remotely sensed) on local and regional scale

This breaks down into these specific objectives:

- Demonstrate the synergistic exploitation of satellite observations from active and passive microwave sensors together with optical data for better characterisation of carbon and water cycling on land

- Generate a numerical land surface model for its application in a data assimilation framework both for single sites (local) and spatially distributed (regional scale)

- Acquire and analyse campaign data sets to support the development of the model and the data assimilation scheme on the local scale

Structure of the project

Project work is organised into four blocks, which are broken down into workpackages:

1. EO data (CESBIO)

2. Field activities (FMI)

3. Model and observation operators (UoE)

4. Data assimilation (LU)

plus an additional workpackage for the overall project management (LU)

Block 1: EO data status

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Purpose
SMOS L-VOD	■	■	■	■	■	■	■	■	■	■	■	Assimilation
ASCAT C-VOD	■	■	■	■	■	■	■	■	■	■	■	Assimilation
OCO-2 SIF				■	■	■	■	■	■	■	■	Assimilation
Sentinel 5P SIF								■	■	■	■	Assimilation
S3 FAPAR/LAI						■	■	■	■	■	■	Assimilation
ASCAT backscattering	■	■	■	■	■	■	■	■	■	■	■	Validation
SMOS soil moisture	■	■	■	■	■	■	■	■	■	■	■	Assimilation
SMOS TB	■	■	■	■	■	■	■	■	■	■	■	Validation
AMSR-2 C-VOD		■	■	■	■	■	■	■	■	■	■	Validation
AMSR-2 X-VOD		■	■	■	■	■	■	■	■	■	■	Validation
MODIS LST	■	■	■	■	■	■	■	■	■	■	■	Auxiliary
MODIS PRI	■	■	■	■	■	■	■	■	■	■	■	Auxiliary
S3 LCC						■	■	■	■	■	■	Auxiliary
S3 FVC						■	■	■	■	■	■	Auxiliary

Block 1: EO data status

SMOS L-band Vegetation Optical Depth (L-VOD) : two datasets obtained with two slightly different approaches

- ESA SMOS Level 2 (Kerr et al. 2012, IEEE TGARS). V650 available to start WP1.3. We will update the data base to v700 if available in the first quarter of 2021.

- SMOS-INRA-CESBIO (IC) research product (Fernandez-Moran et al. 2017)

SMOS Vegetation optical depth at L band (L-VOD) is very sensitive to biomass
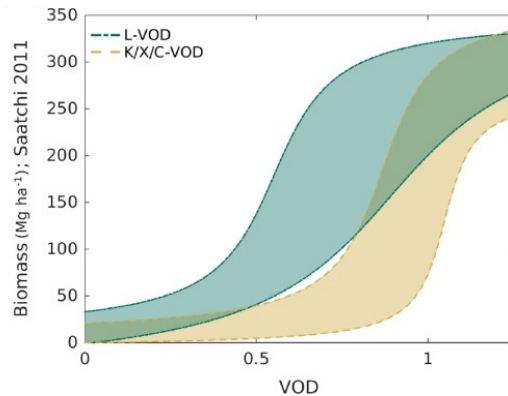
Rodriguez-Fernandez et al. (2018, Biogeosciences)

Average Annual Mean NPP 2010-2015
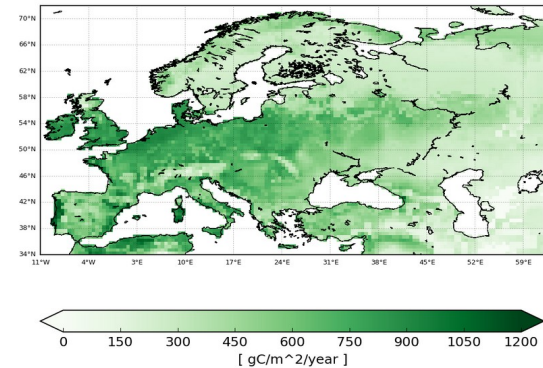
Scholze et al., GRL, 2019

Block 2: Field campaigns

Selected sites:

- Sodankylä, FI
  - Boreal forest site operated by FMI
- Majadas, ES
  - Tree-grass savanna site operated by MPI-BGC

Additional site to include in data base:

Reusel, NL

- Agricultural site operated by TU Delft

Block 2: Field campaign sites, Sodankylä

ICOS tower

Station name	Sodankylä forest
Coordinates	67.36° N, 26.64° E
Altitude (masl)	179
Ecosystem type	Boreal evergreen needleleaved forest
Vegetation type	Pinus sylvestris (scots pine); forest floor: e.g. lichens, mosses and small shrubs
Mean vegetation height (m)	12
Max projected LAI	-1.2
Soil type	Sandy Podzol
Tree density (ha^{-1})	2100
Tree age (years)	60-160
Average temperature (°C)	-0.4
Annual precipitation (mm)	527
Average snow depth at mid-March (cm)	75
Median snow cover start date	Sep 26
Median snow cover end date	May 14

Block 2: Field campaign sites, Sodankylä

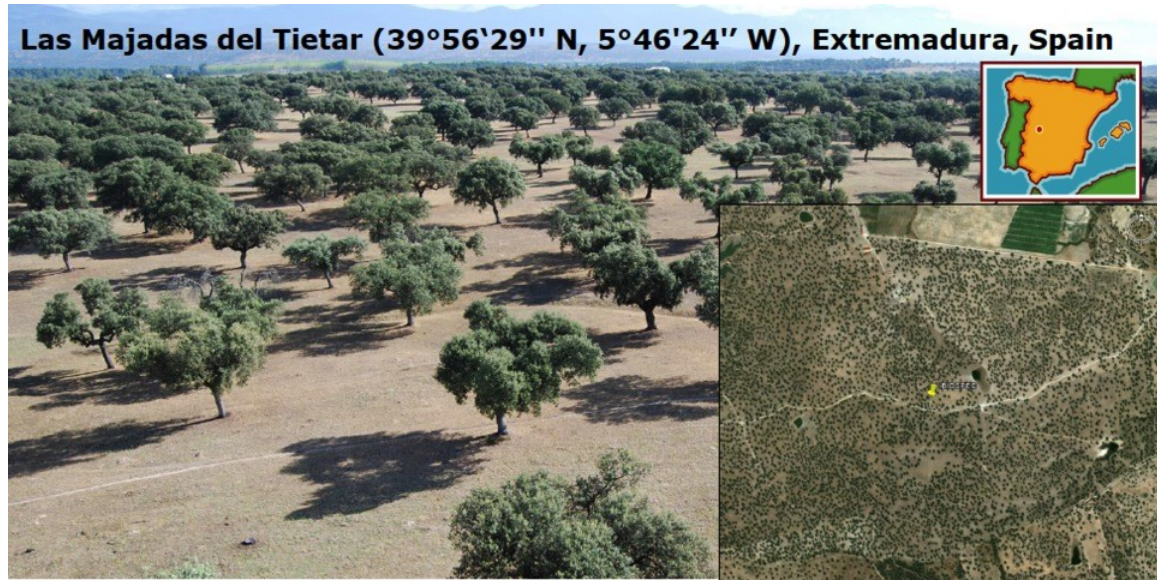Regional model domain (0.25° resolution)

Campaign planning

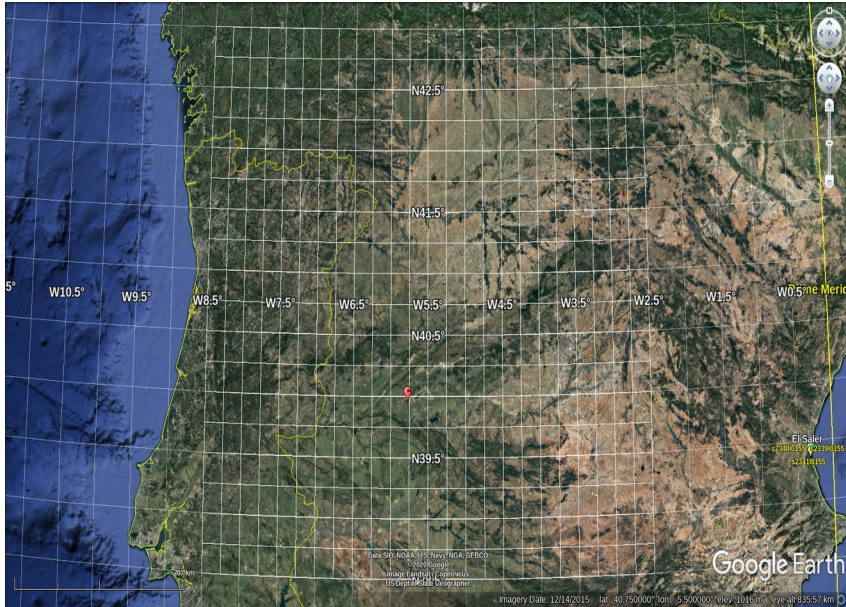Setup status: Sodankylä
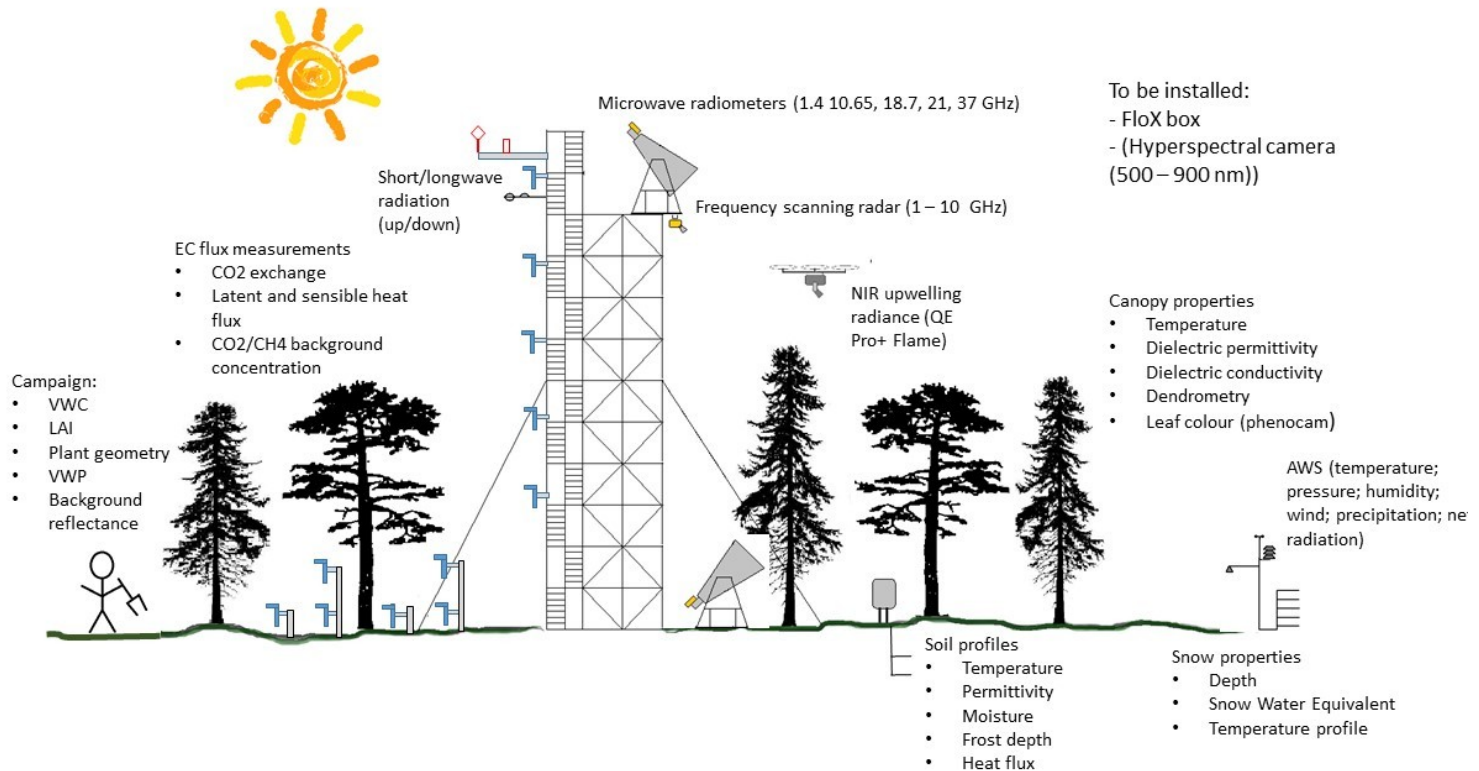
Block 2: Field campaign sites, Majadas

Station name	Majadas de Tietar
Coordinates	39.94° N, 5.77° W
Altitude (masl)	260
Ecosystem type	Savanna
Vegetation type	Open holm oak woodland (Quercus ilex, annual herbaceous stratum)
Mean vegetation height (m)	8 m
Max projected LAI	2.5 m2/m^2
Soil type	Cambisol
Tree density (ha^{-1})	25
Tree age (years)	> 100 years
Average temperature (°C)	16.7 °C
Annual precipitation (mm)	650
Average snow depth at mid-March (cm)	0
Median snow cover start date	-
Median snow cover end date	-

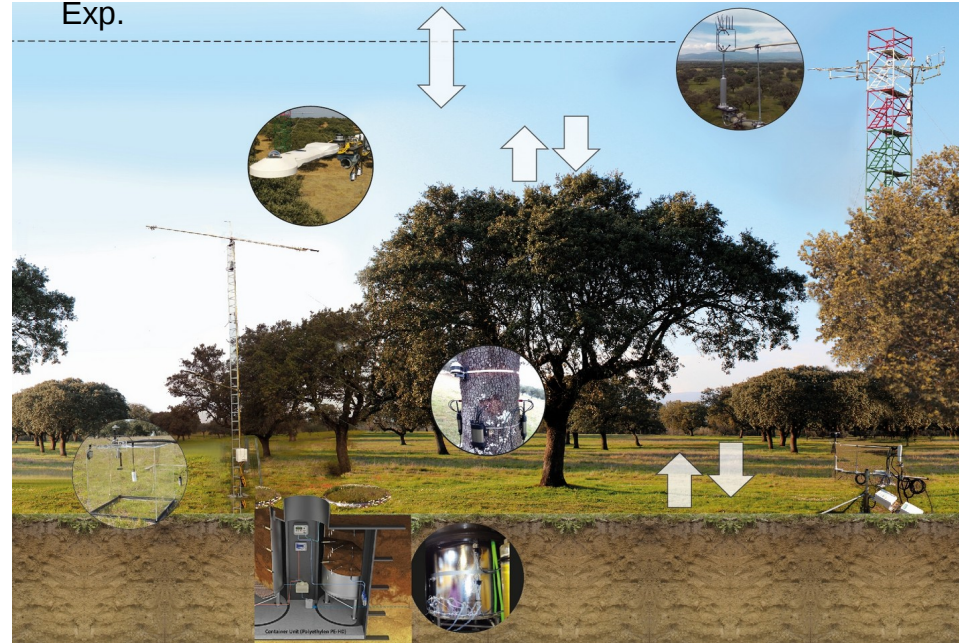Las Majadas del Tietar (39°56'29'' N, 5°46'24'' W), Extremadura, Spain

Ecosystem: *dehesa* Mediterranean Holm Oak open woodland (Savanna)

Block 2: Field campaign sites, Majadas
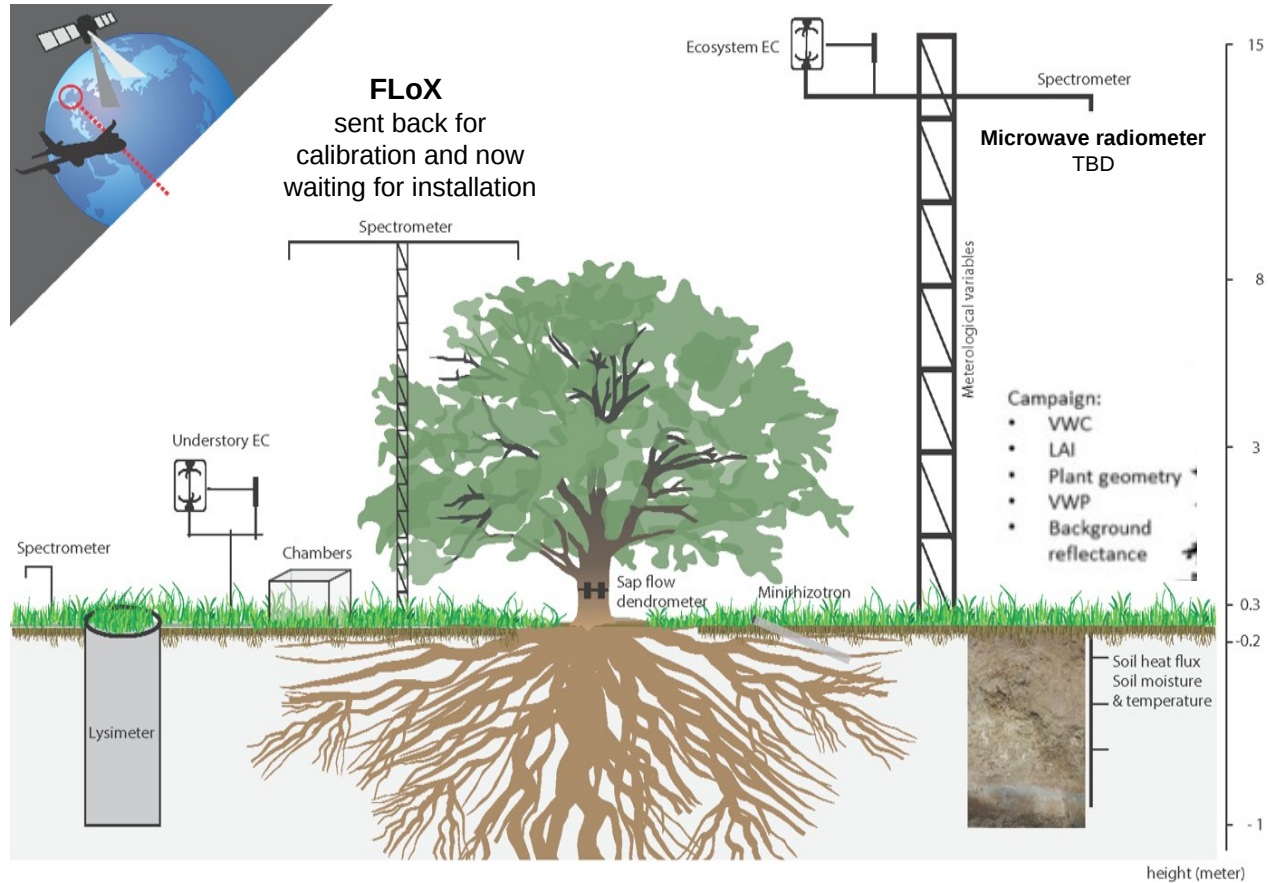
Regional model domain (0.25º resolution)

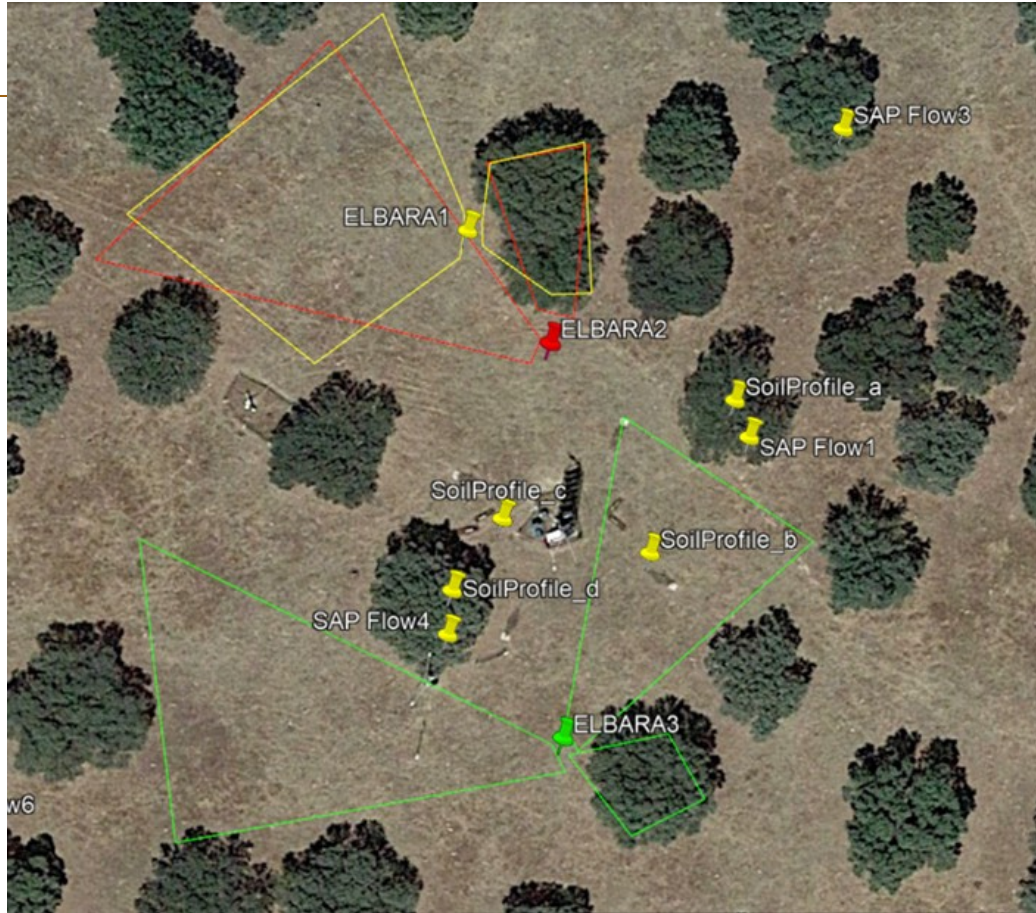Experimental set-up and instrumentations in the MaNiP Exp.

Campaign Planning

FLoX
sent back for
calibration and now
waiting for installation

Ecosystem EC

Spectrometer

Microwave radiometer
TBD

Meterological variables

Campaign:
- VWC
- LAI
- Plant geometry
- VWP
- Background reflectance

Spectrometer

Understory EC

Chambers

Sap flow dendrometer

Minirhizotron

Spectrometer

Lysimeter

Soil heat flux
Soil moisture
& temperature

15

8

3

0.3
-0.2

- 1

height (meter)

STATE OF ELBARA INSTALLATION IN MAJADAS DE TIETAR

- **Preferred position ELBARA 3**

- **Azimuth tracker to sample the two plant types**
- **POLRA potentially pointing the tree-only**

- **Scaffold 4-5 m**
- *Collecting offers for material and stability documents*

- *Discussing with partners + FZJ and WSL about installation details*

Block 3: Model and observation operators

Structure of the D&B model (coupled DALEC and BETHY models)
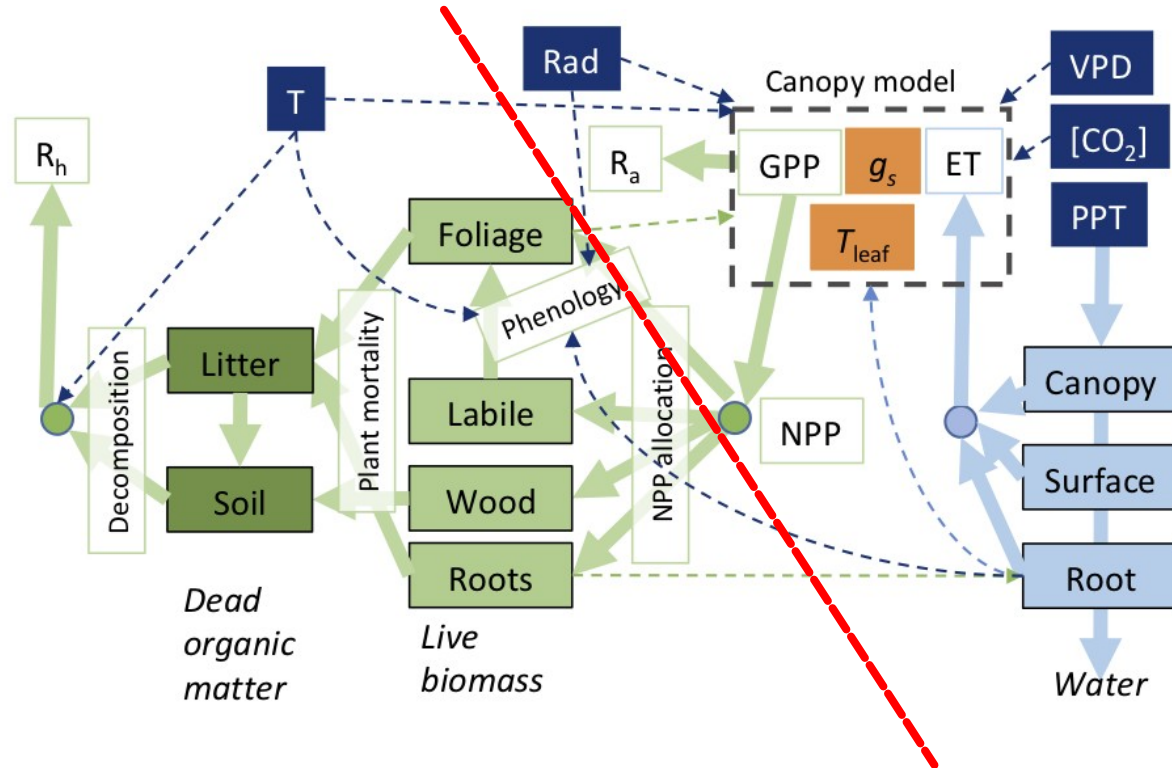
Block 3/4: Observation Operators and data assimilation