FEASIBILITY OF USING SENTINEL-2 AND SENTINEL-3 TO SCHEDULE IRRIGATION AT DIFFERENT WATER REGIMES IN AN ALMOND ORCHARD

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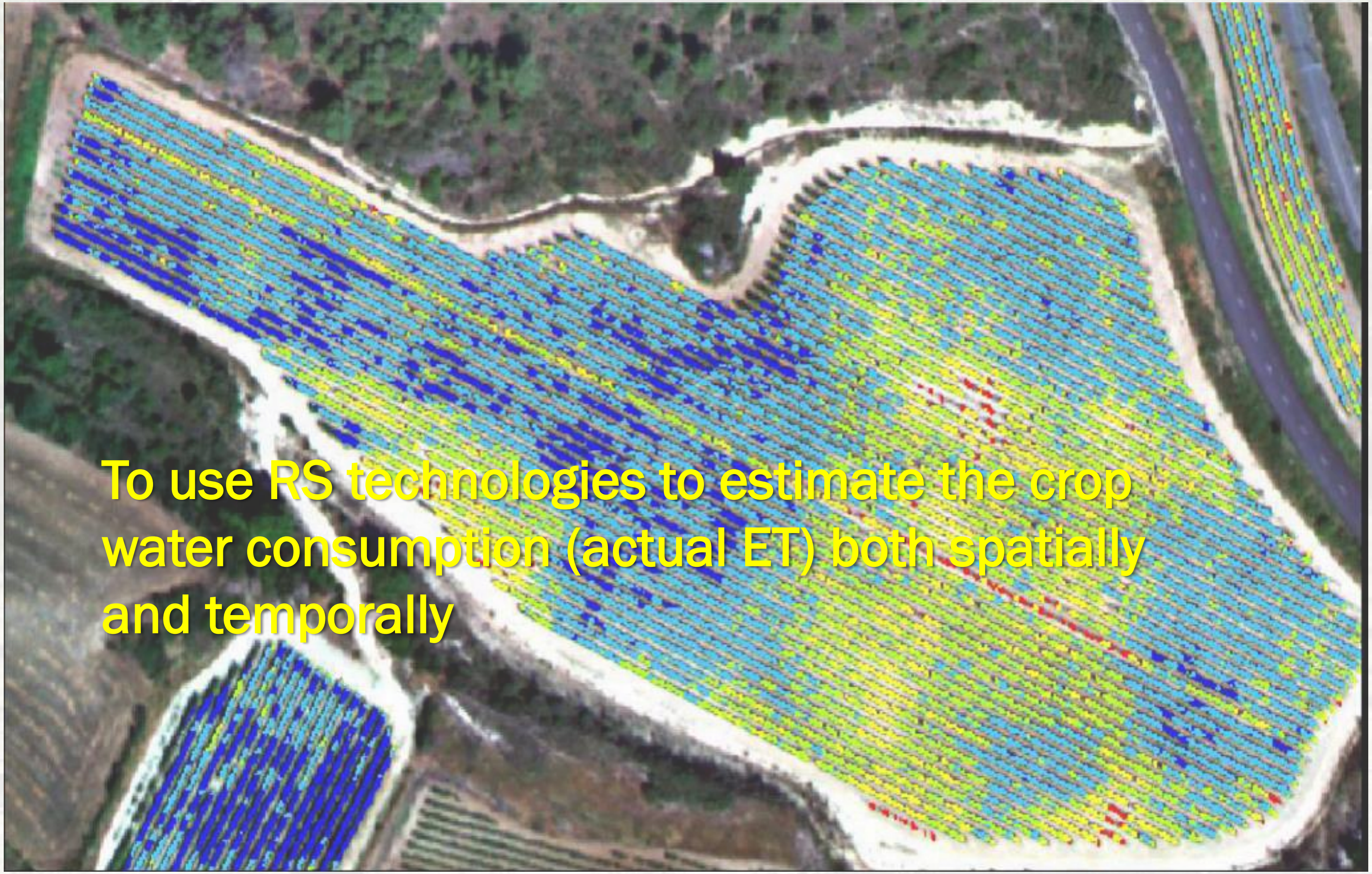
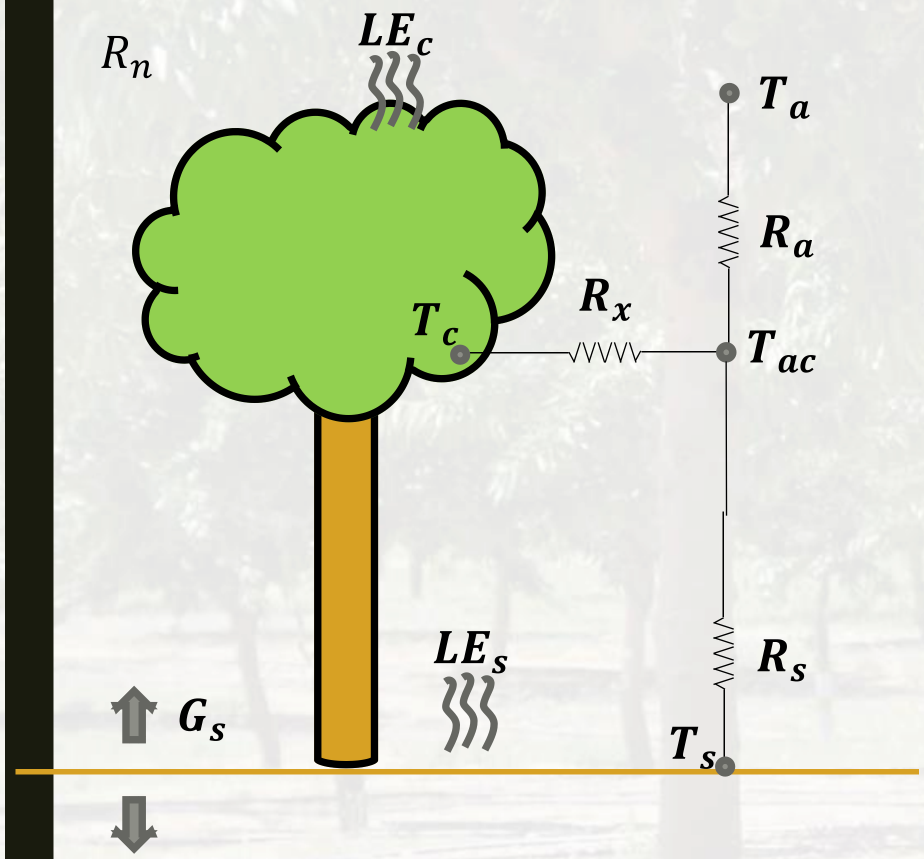
Joaquim Bellvert

Context

To enhance water productivity: ‘more crop per drop’



Two-source energy balance model (TSEB)



- Two source energy balance model (Norman 1995, Nornam & Kustas 1999)

$$Rn = H + LE + G_s + P - R + G_p$$

$$H = H_c + H_s$$

$$H_c = \rho_{air} C_p \frac{(T_c - T_{ac})}{R_x} \qquad H_s = \rho_{air} C_p \frac{(T_s - T_{ac})}{R_s}$$

$$LE_c = Rn_c - H_c$$

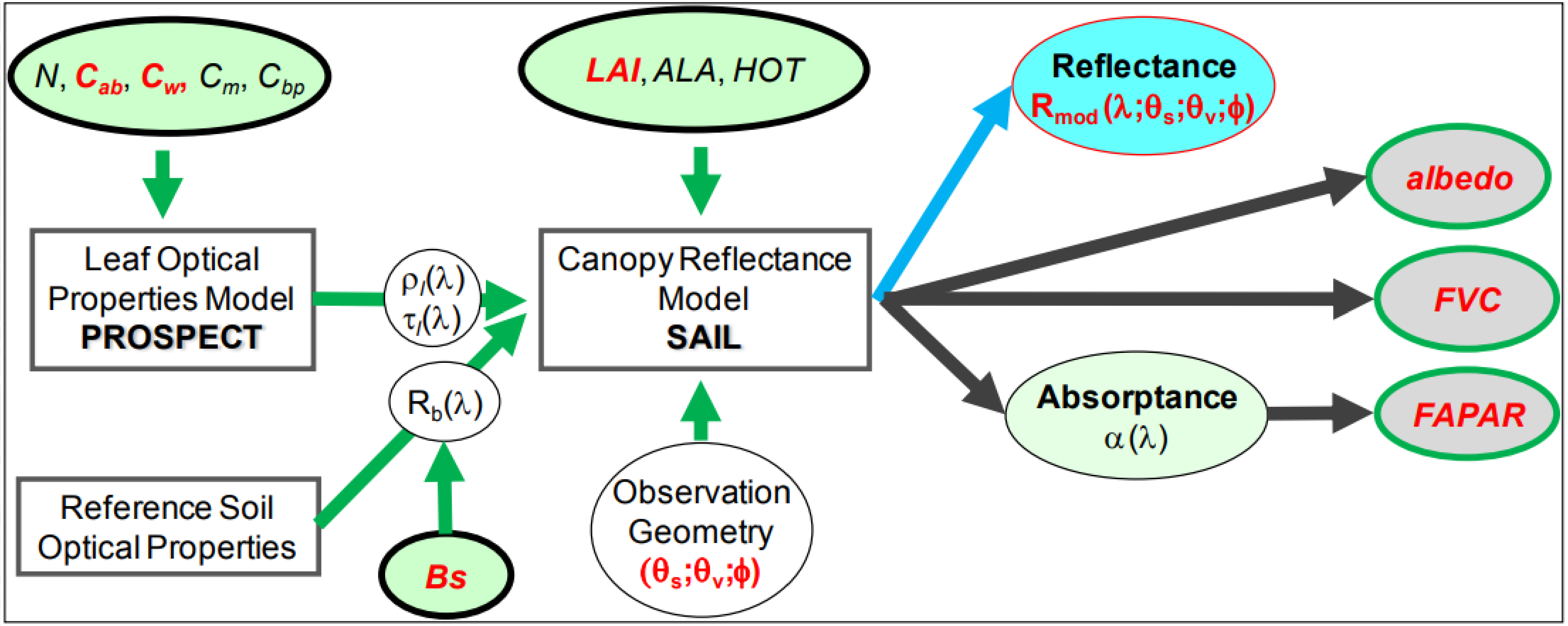
$$LE_s = Rn_s - H_s - G_s$$

Partitions Latent Heat Flux into evaporation and transpiration

https://github.com/hectornieto/pyTSEB

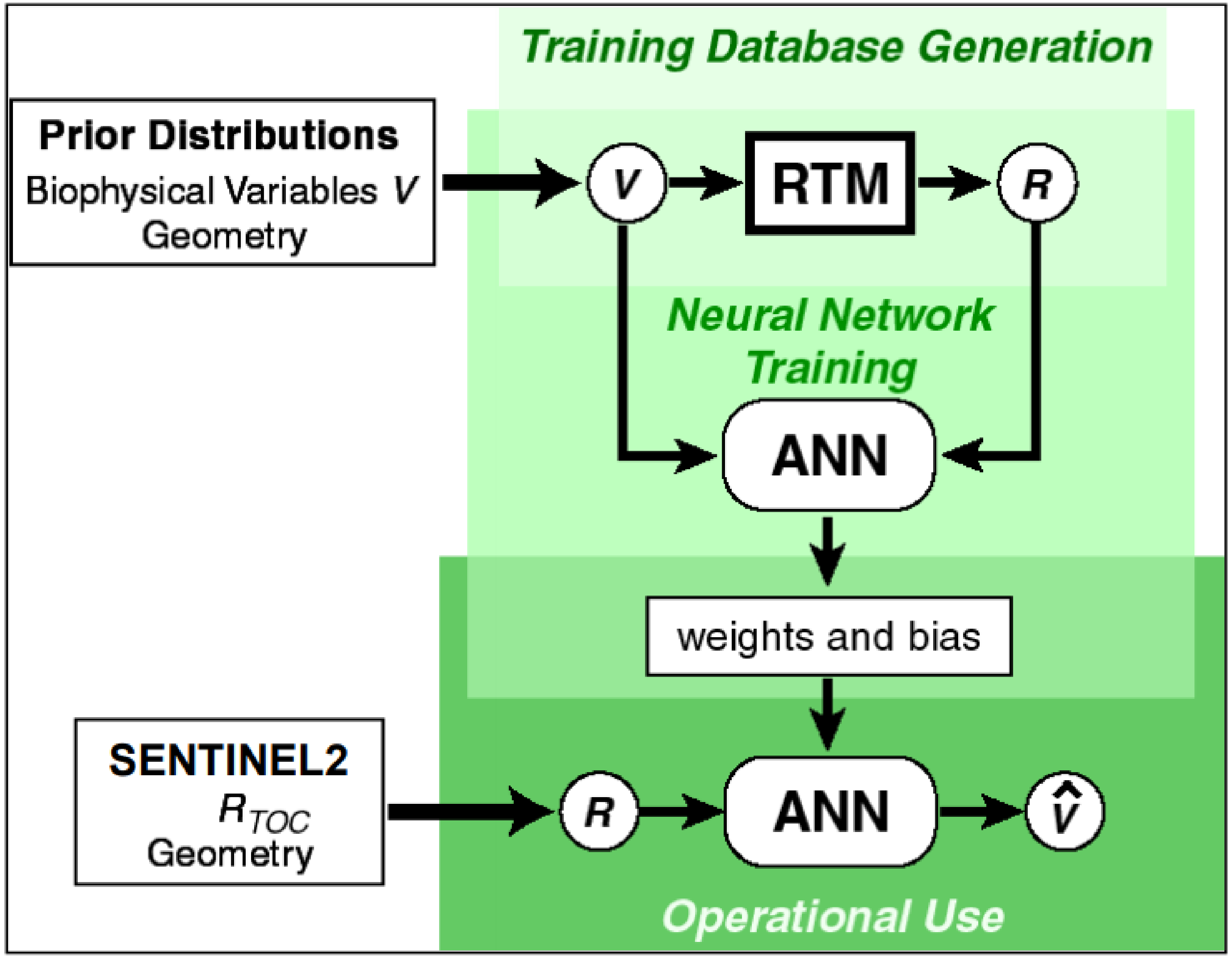
www.esa_sen4et.org

Biophysical parameters from RS



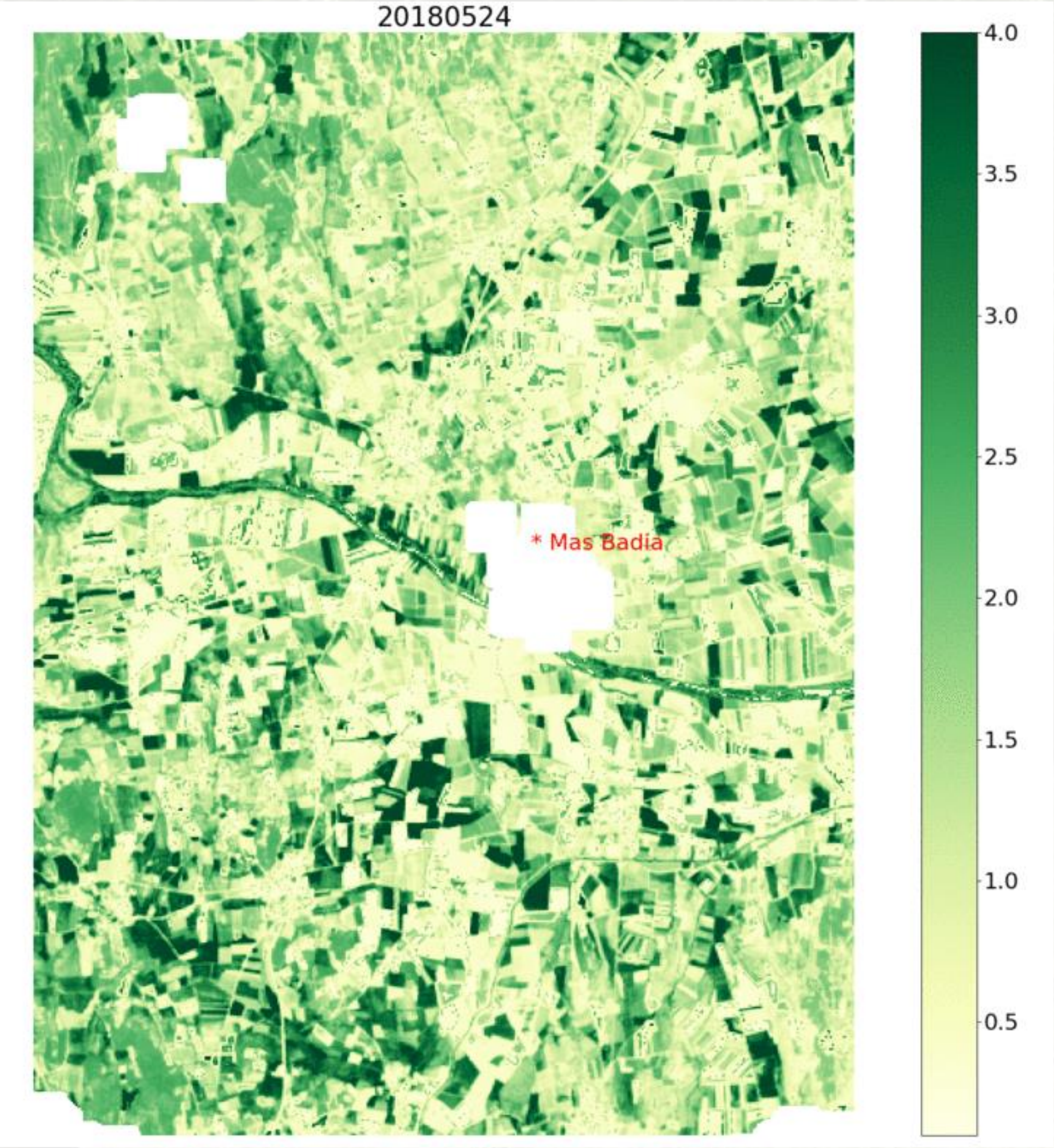
INRA 2016

Biophysical parameters from RS



INRA 2016

Biophysical parameters from RS



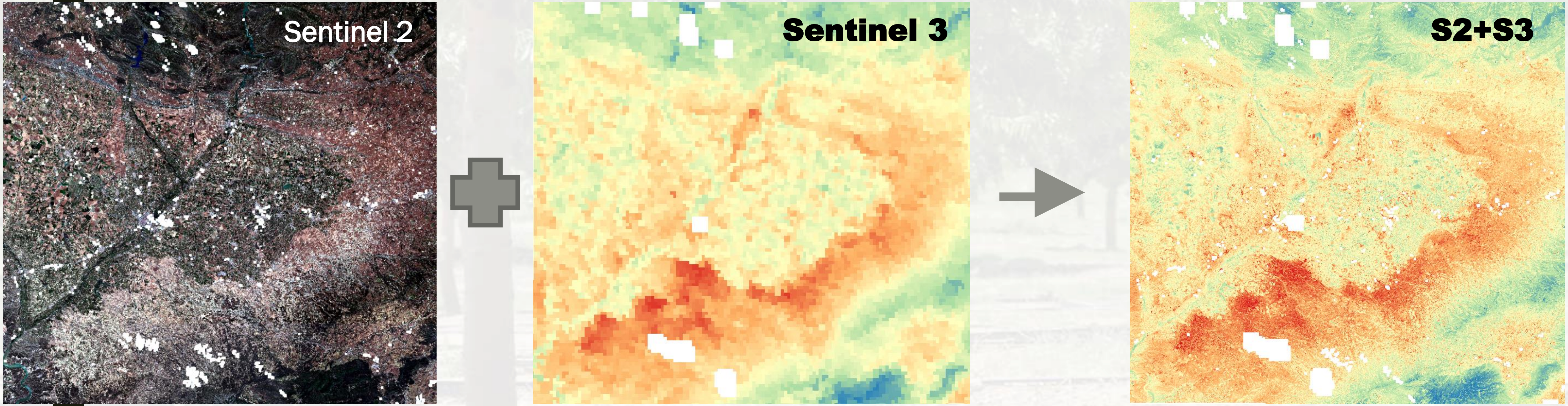
Land Surface temperature (LST)

Gao et al. (2012)

Sentinel-2 Surface Reflectance 20m → Data mining sharpener

LST 1km Sentinel-3 → Data mining sharpener

Data mining sharpener → LST 20 m



Inputs of TSEB

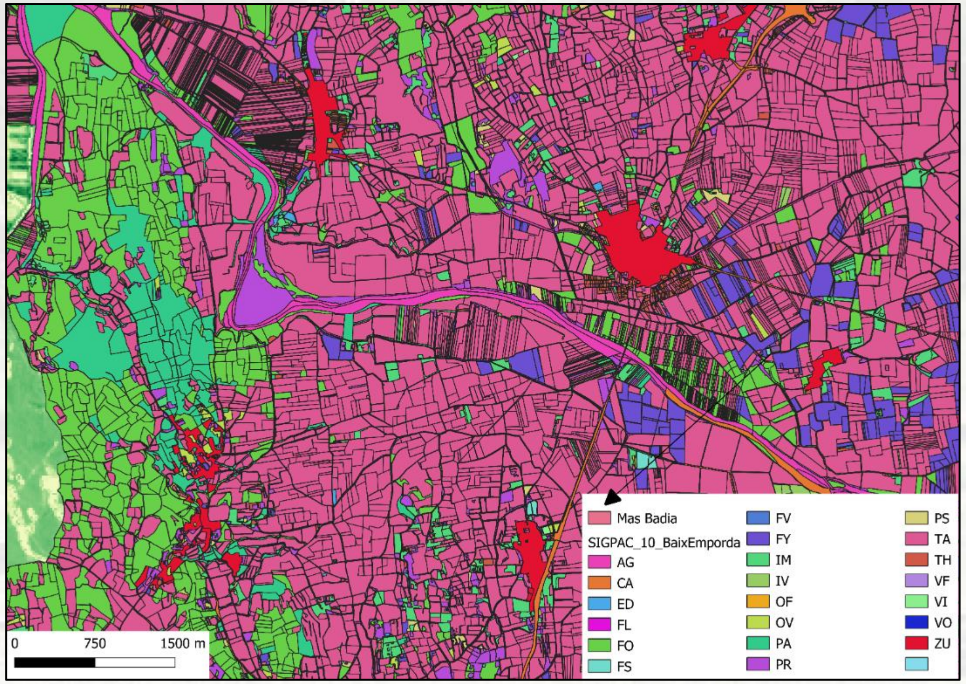
- Meteorological data
  - *Solar Irradiance*
  - *Air temperature*
  - *Wind speed*
  - *Relative humidity*

Climate Change Service

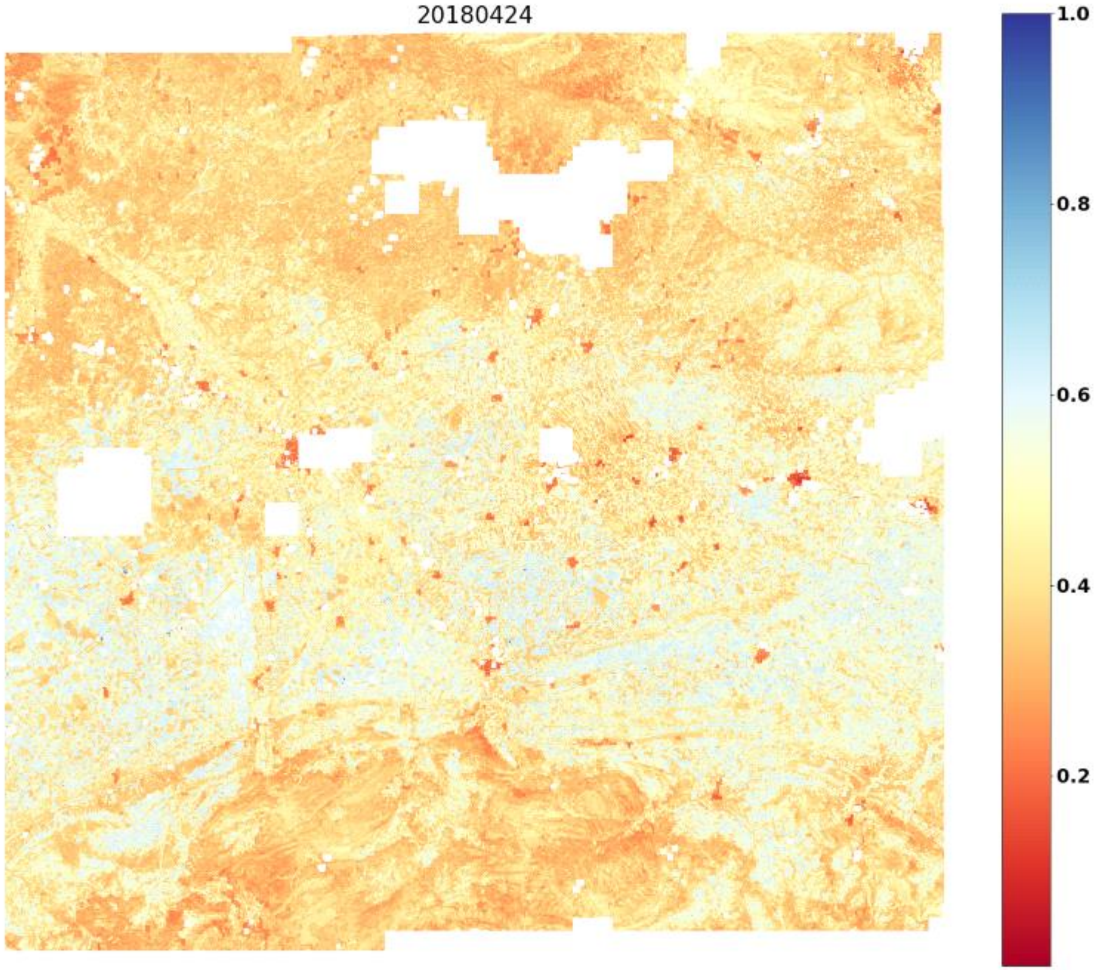
ECMWF

Inputs of TSEB

- Ancillary data
  - Leaf width
  - Leaf type
  - Canopy height
  - Leaf angle distribution



Instant ET mm/hr

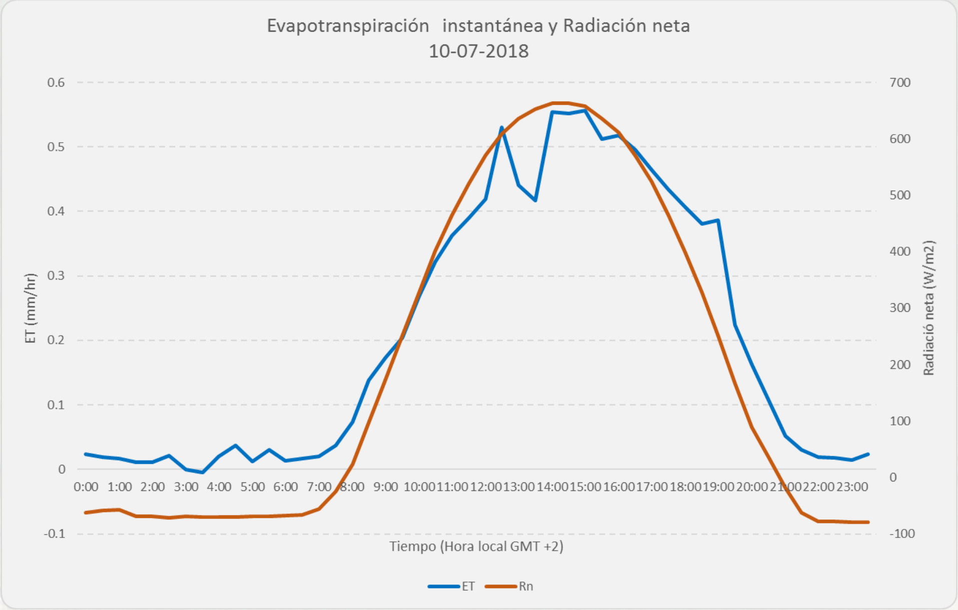


Upscaling to daily ET

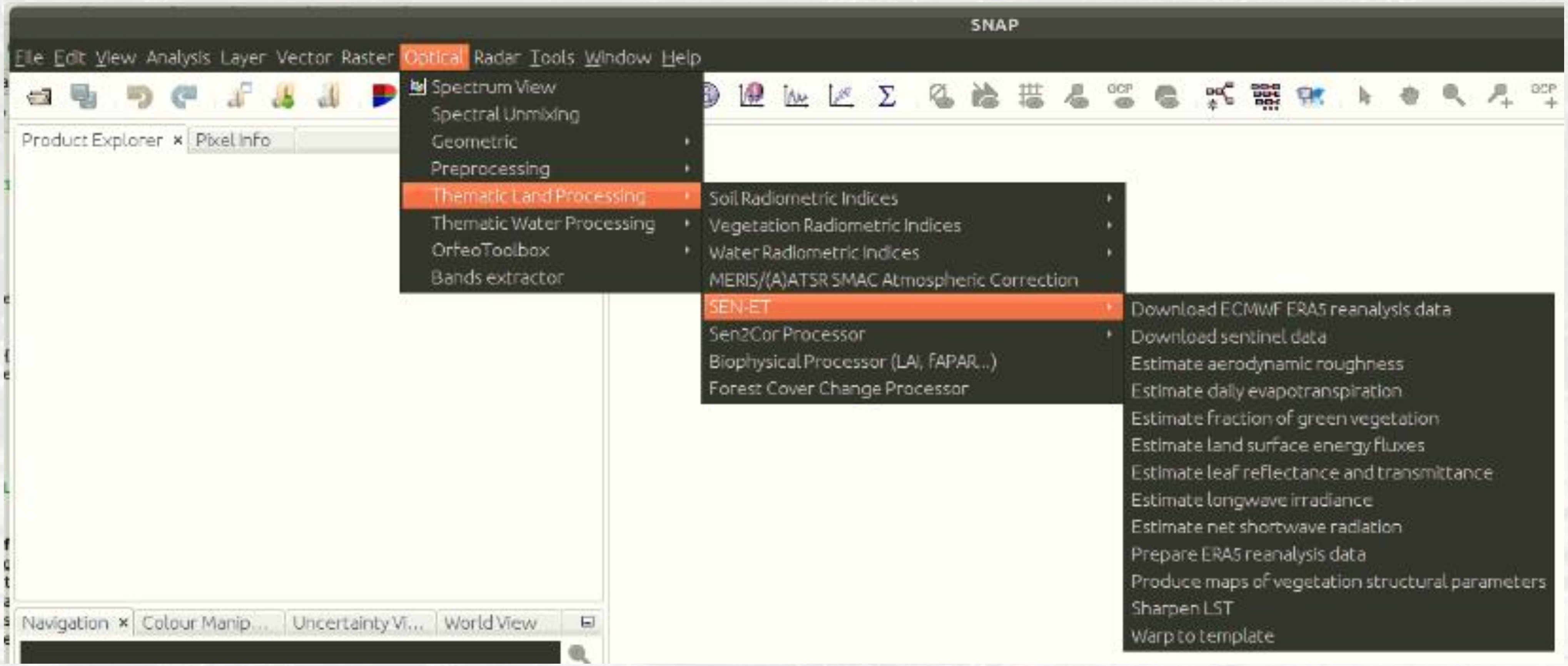
- Assumed a constant ratio between solar irradiance and evapotranspiration.

- $$ET\ daily = ET\ instant \times \frac{Daily\ solar\ Irradiance}{Instant\ solar\ Irradiance}$$

- Problem with partially cloudy days

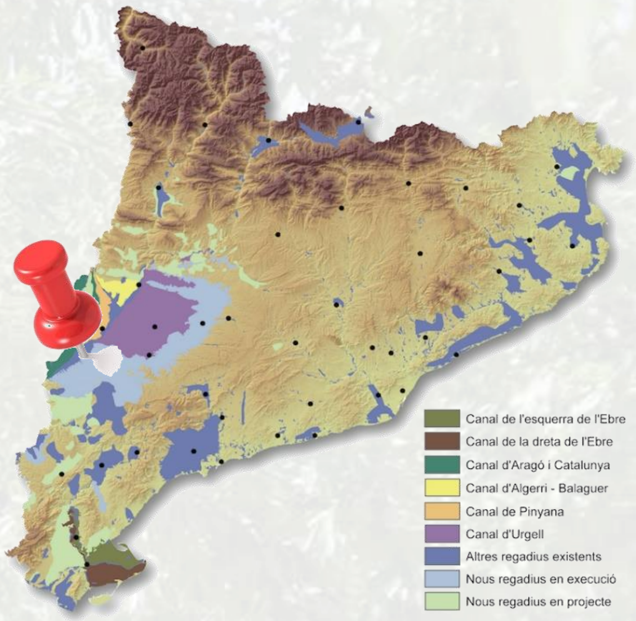


Sen4ET



SNAP
File Edit View Analysis Layer Vector Raster Optical Radar Tools Window Help
Product Explorer
Pixel Info
Spectrum View
Spectral Unmixing
Geometric
Preprocessing
Thematic Land Processing
Thematic Water Processing
OrfeoToolbox
Bands extractor
Soil Radiometric Indices
Vegetation Radiometric Indices
Water Radiometric Indices
MERIS/(A)ATSR SMAC Atmospheric Correction
SEN-ET
Sen2Cor Processor
Biophysical Processor (LAI, fAPAR...)
Forest Cover Change Processor
Download ECMWF ERA5 reanalysis data
Download sentinel data
Estimate aerodynamic roughness
Estimate daily evapotranspiration
Estimate fraction of green vegetation
Estimate land surface energy fluxes
Estimate leaf reflectance and transmittance
Estimate longwave irradiance
Estimate net shortwave radiation
Prepare ERA5 reanalysis data
Produce maps of vegetation structural parameters
Sharpen LST
Warp to template
Navigation
Colour Manip...
Uncertainty Vi...
World View

Study-site



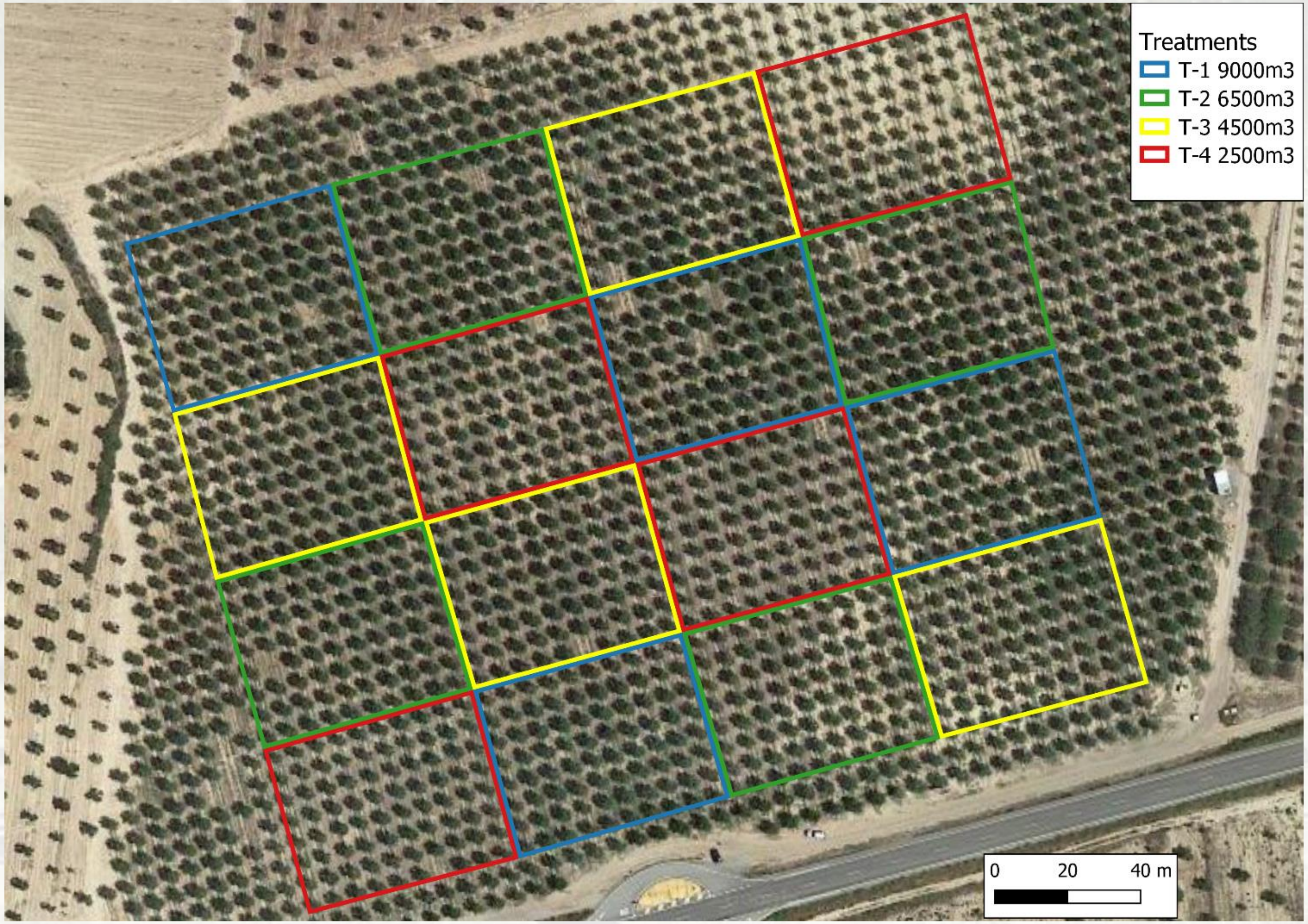
- Maials – Les Garrigues, Lleida (41.36, 0.5) (~300 mm/yr)
- Typical mediterranean climate
- Segarra-Garrigues irrigation district

- Almond orchard of cv.*Vairo* (*4-665* x *Lauranne*) planted in 2015
- Double-line drip irrigation

- Soil - loamy

Almond Plot

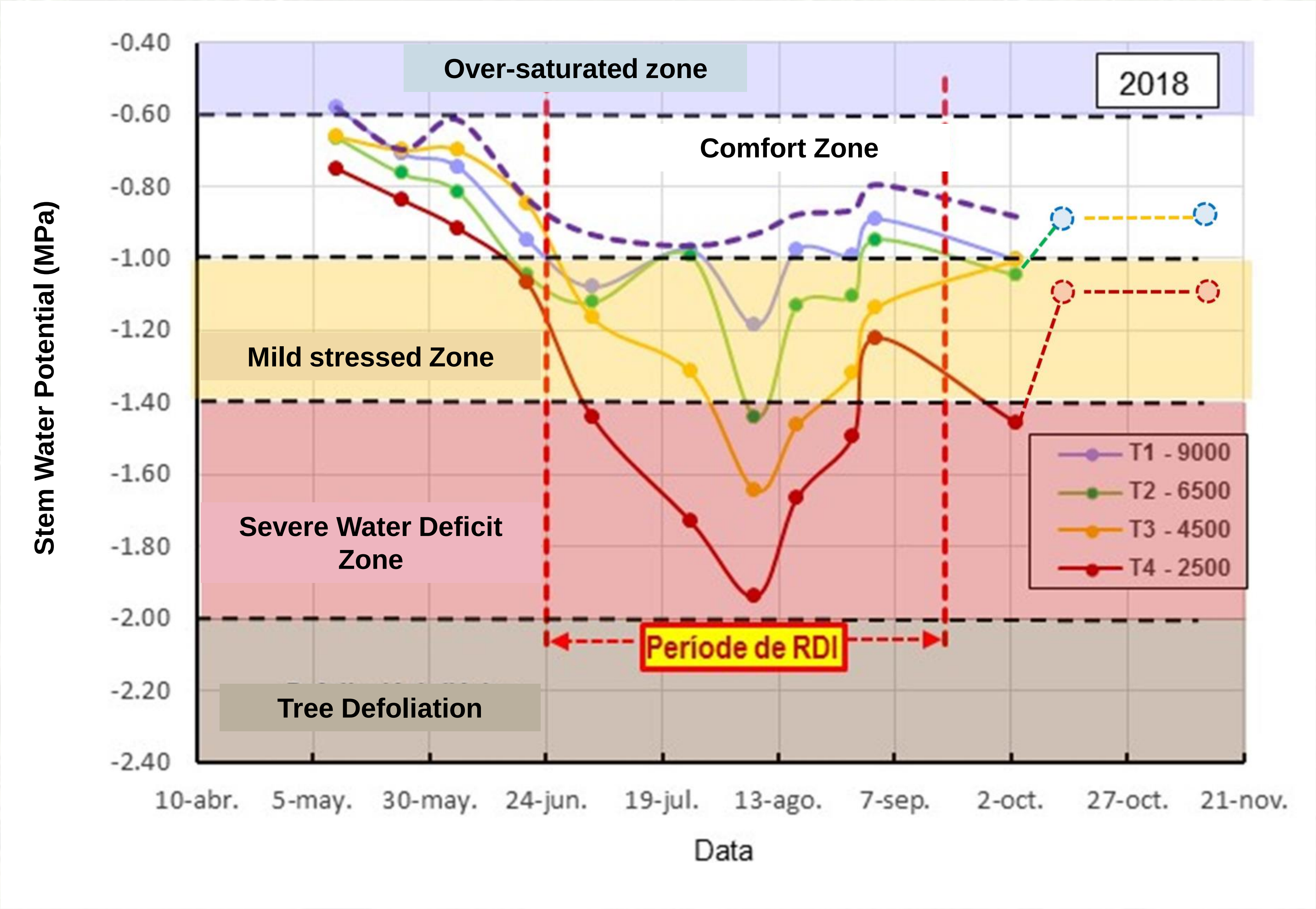
2017 – 2019 (3 years data)



16 plots with 4 irrigation treatments

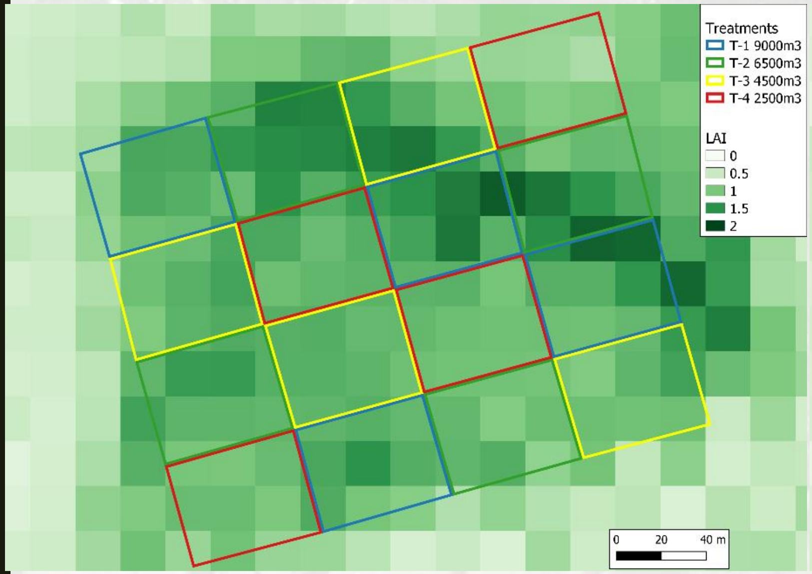
T-1 Over irrigated $(9000m^3/yr)$
T-2 Well Irrigated $(6500m^3/yr)$
T-3 Under irrigated $(4500m^3/yr)$
T-4 Stressed $(2500m^3/yr)$

Evolution Stem Water Potential

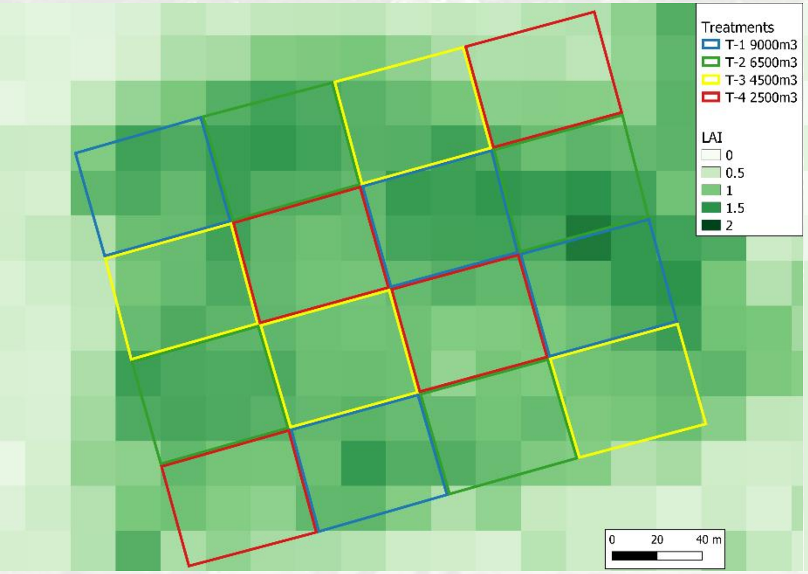


Biophysical parameters

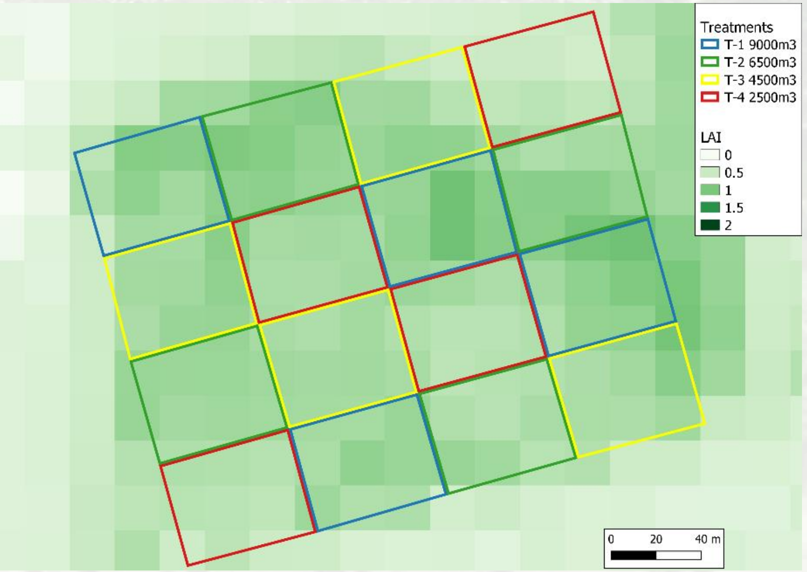
May 2018



August 2018

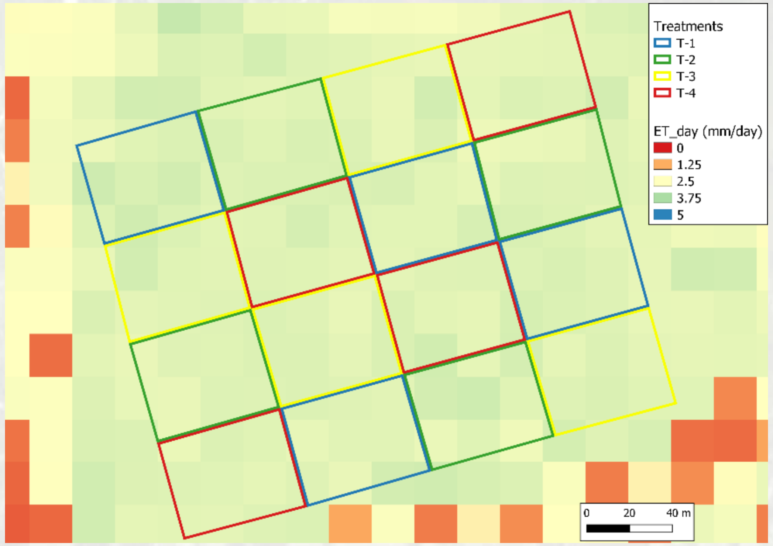


October 2018



Daily ET (mm/day)

May 2018



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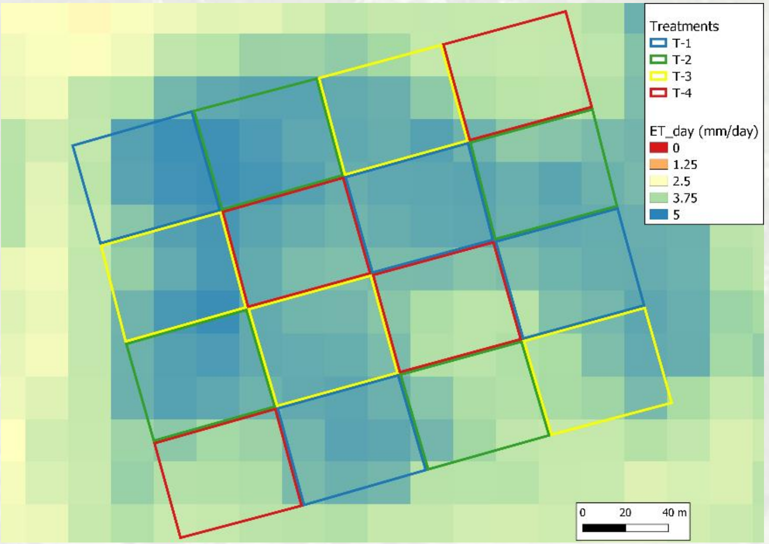
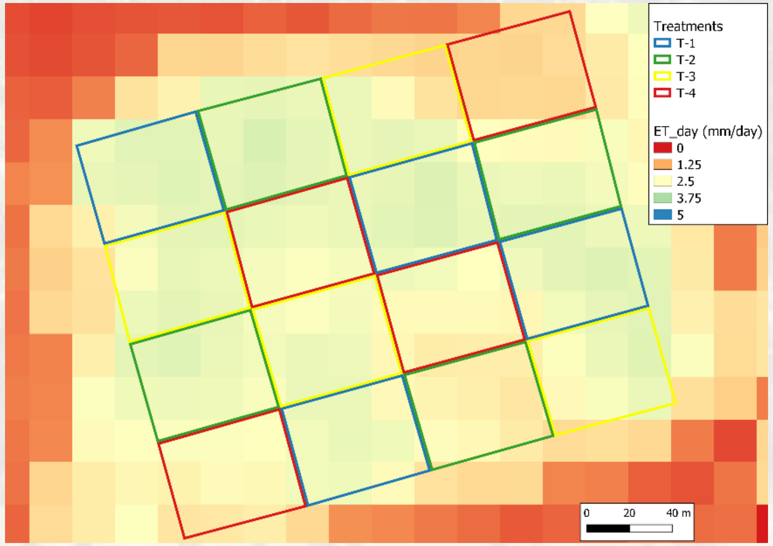
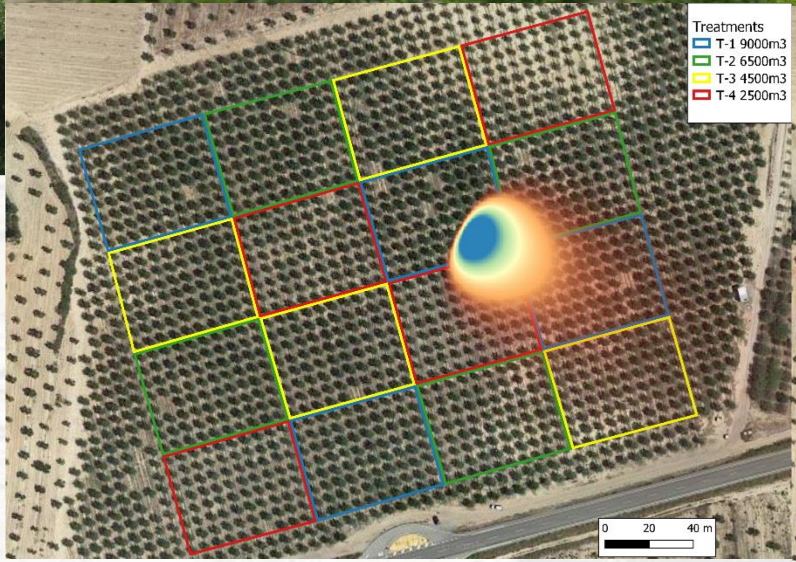


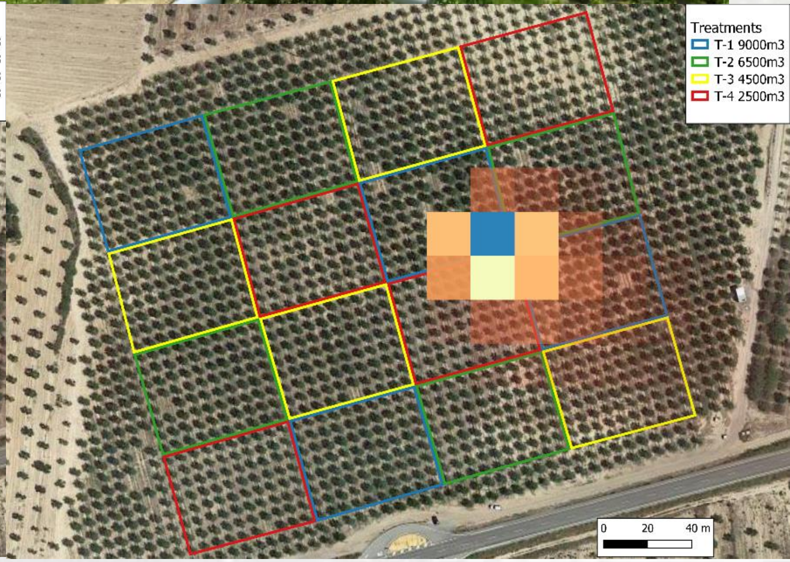
October 2018



Validation with Eddy-covariance

Kljun 2015

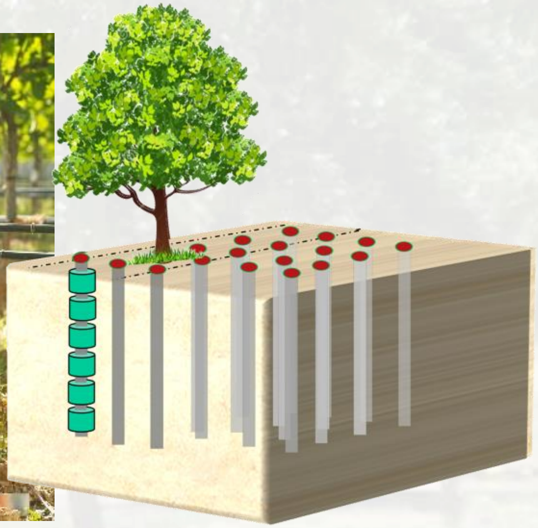




Field Measurements

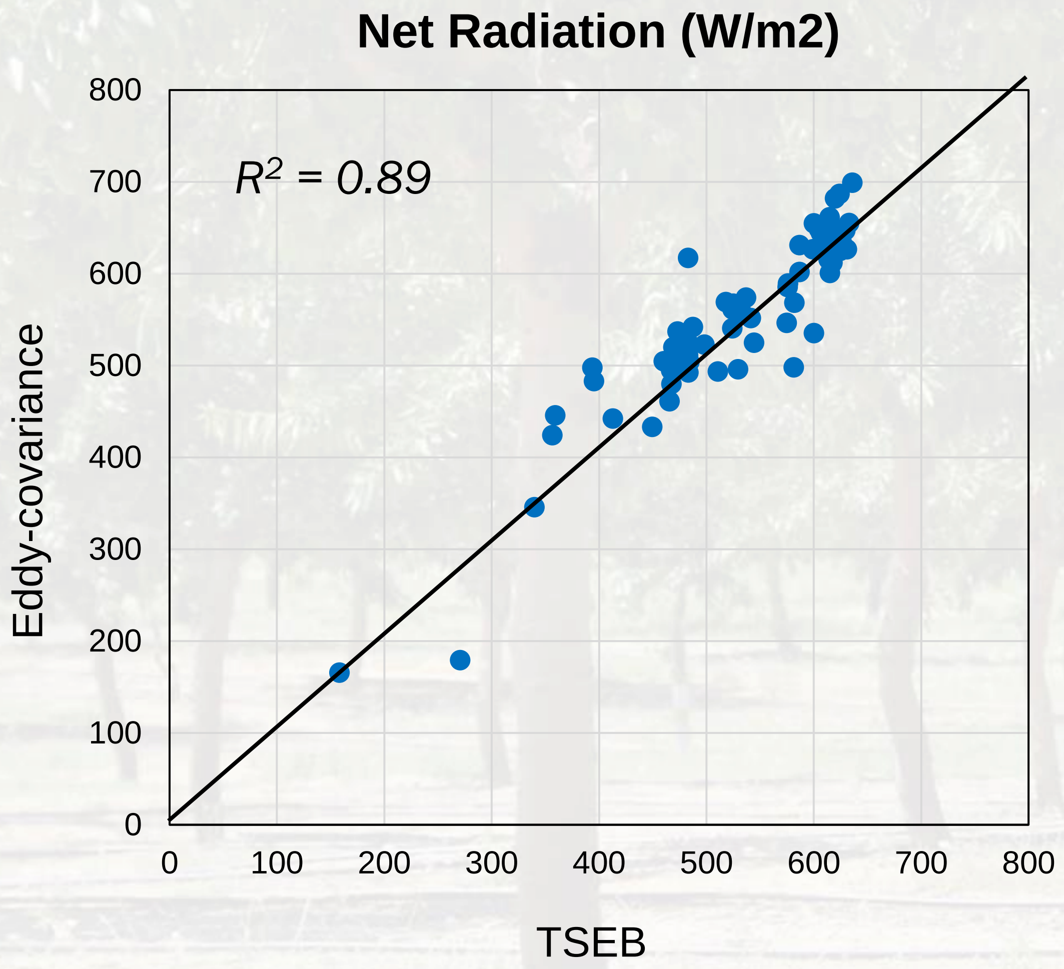
Stem Water Potential

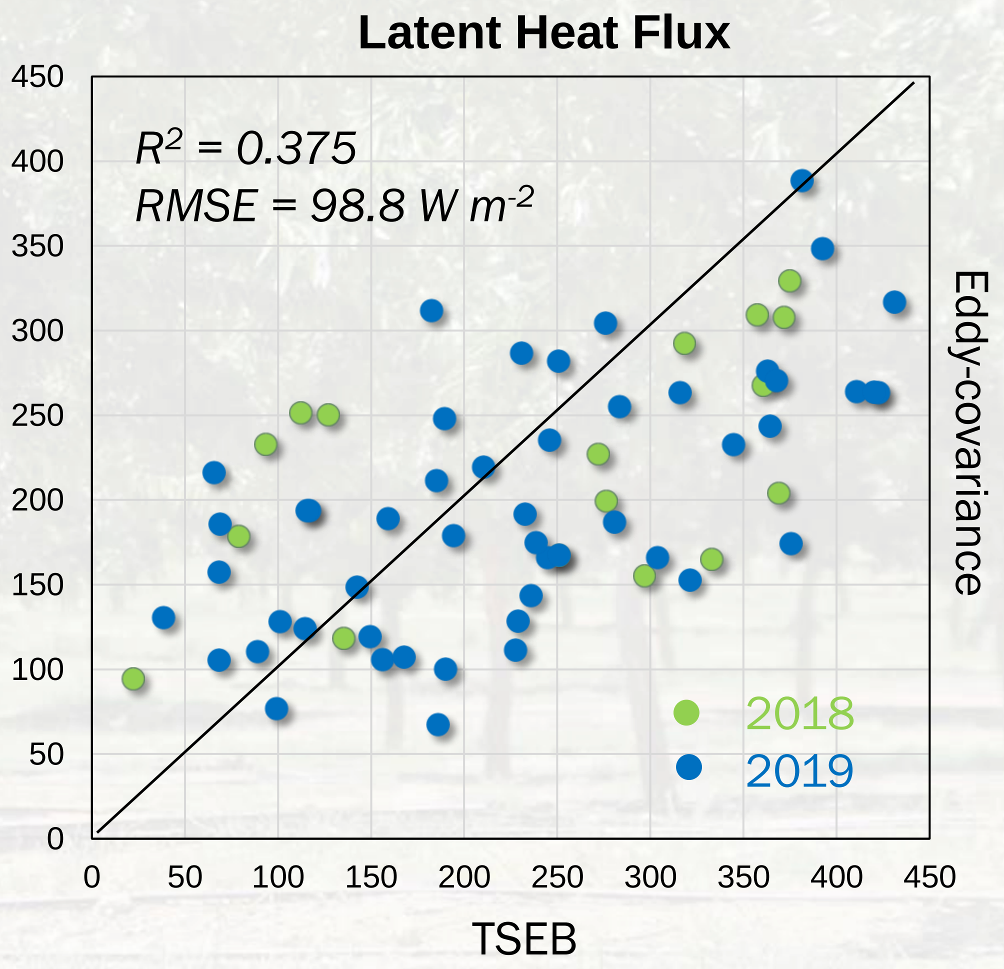
Neutron Probe



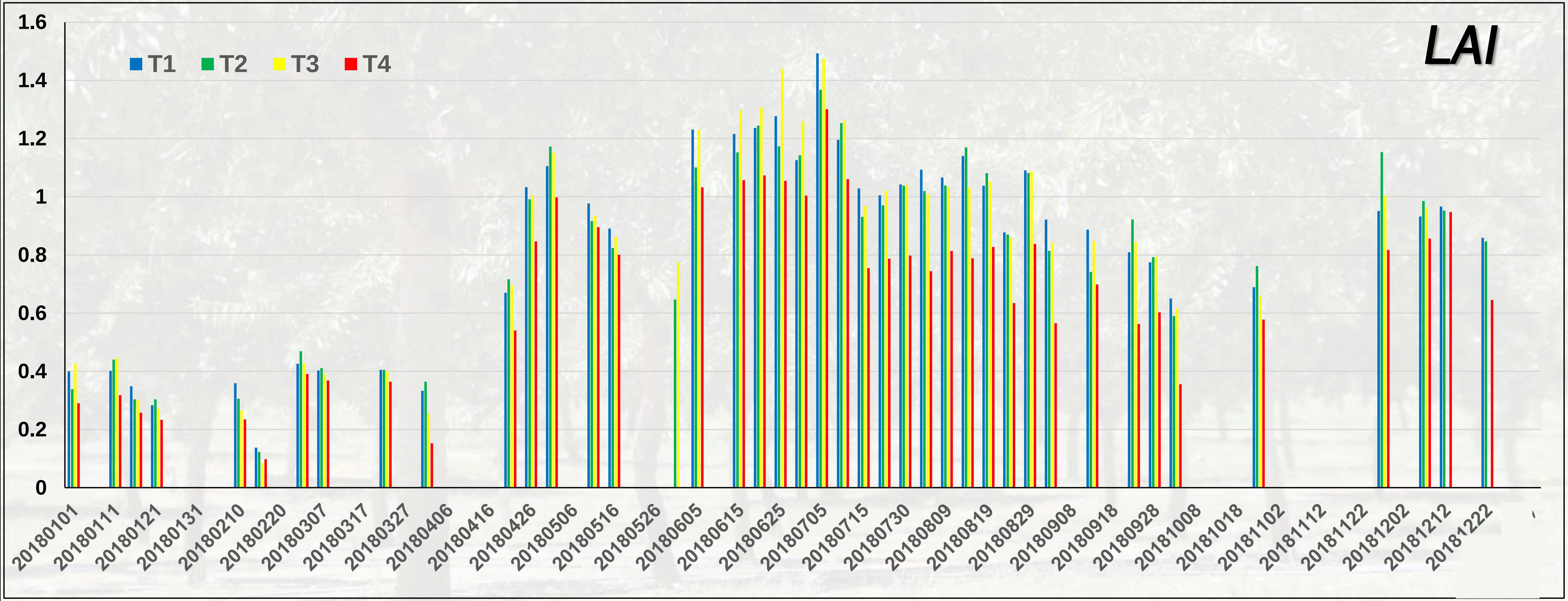
ADC (Portable Photosynthesis device)

Preliminary Results

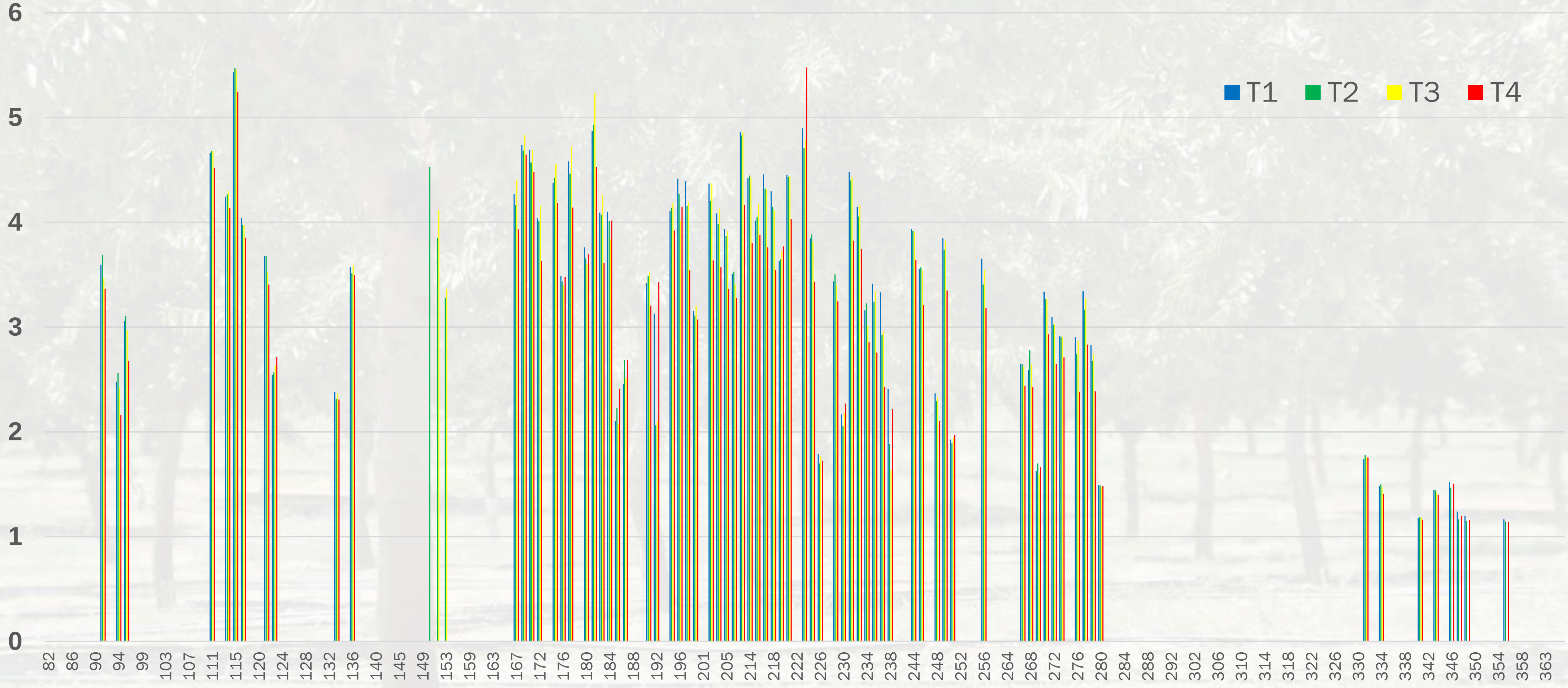




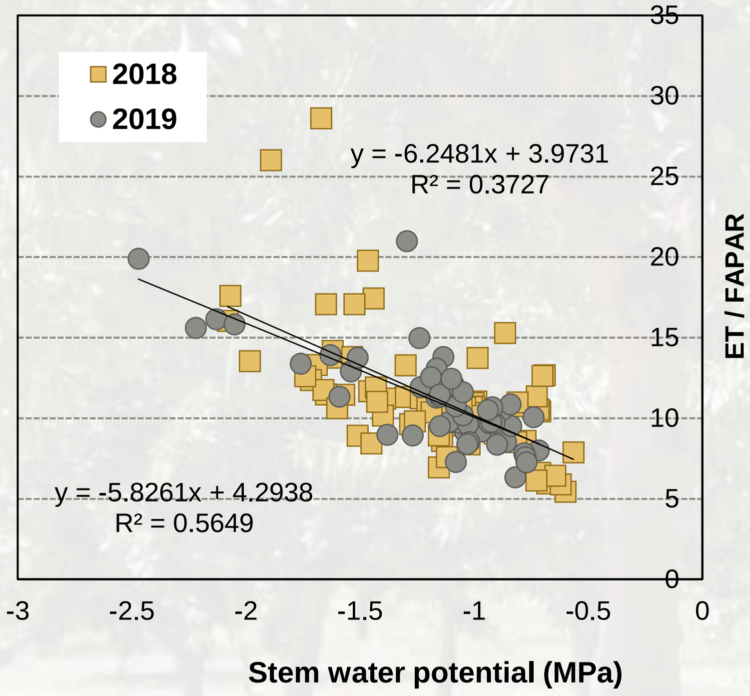
Biophysical series

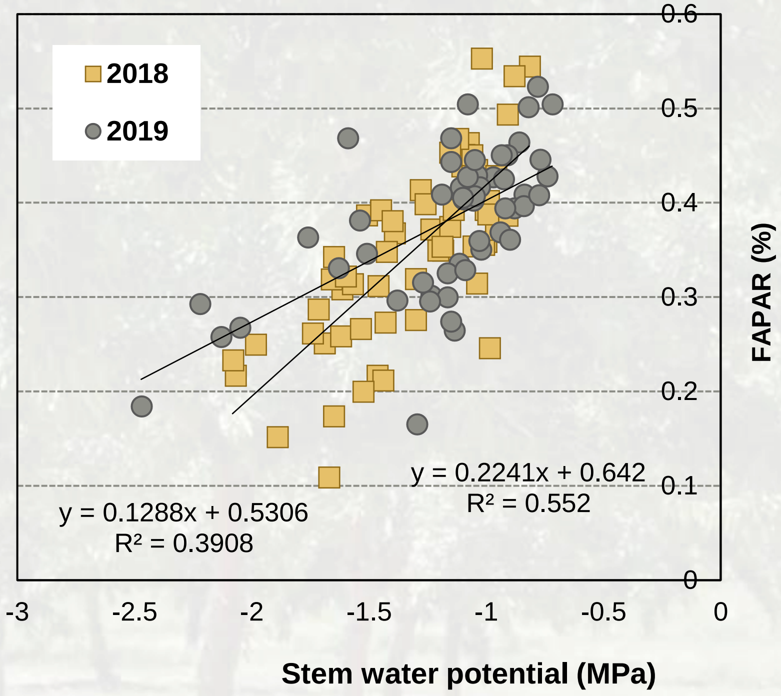


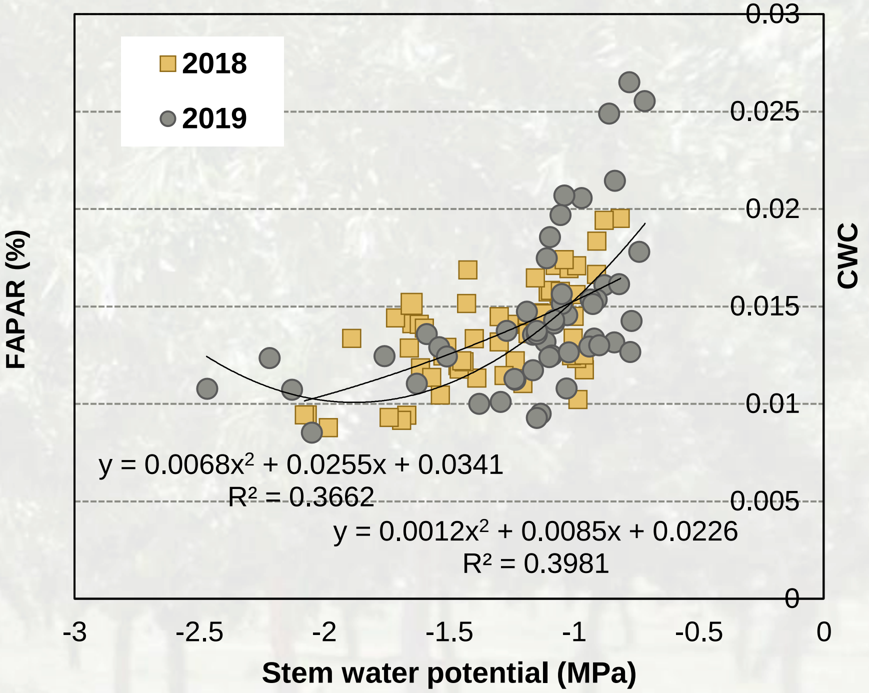
ET daily series (mm/day)



Regressions SWP – ET, FAPAR & CWC







Conclusions

- There is significant advance in remote sensing applie to agriculture due to the frequency of obsevations.

- It is possible to identify stressed vegetation using remote sensing techniques.

- Further study is needed to validate ET estimates throughout S2+S3 sharpenning approach under conditions of water stress