Continuous monitoring of crop water use and productivity by fusing ECOSTRESS, PRISMA and Sentinels as part of the EOAfrica's Explorers initiative

Héctor Nieto, M. Pilar Martín, Vicente Burchard-Levine, Radoslaw Gusinski, Michael Munk, Darren Ghent, Mike Perry, Nobuhle Majozi, Abel Ramoelo, Alidou Sawadogo, Kobamelo Dikgola
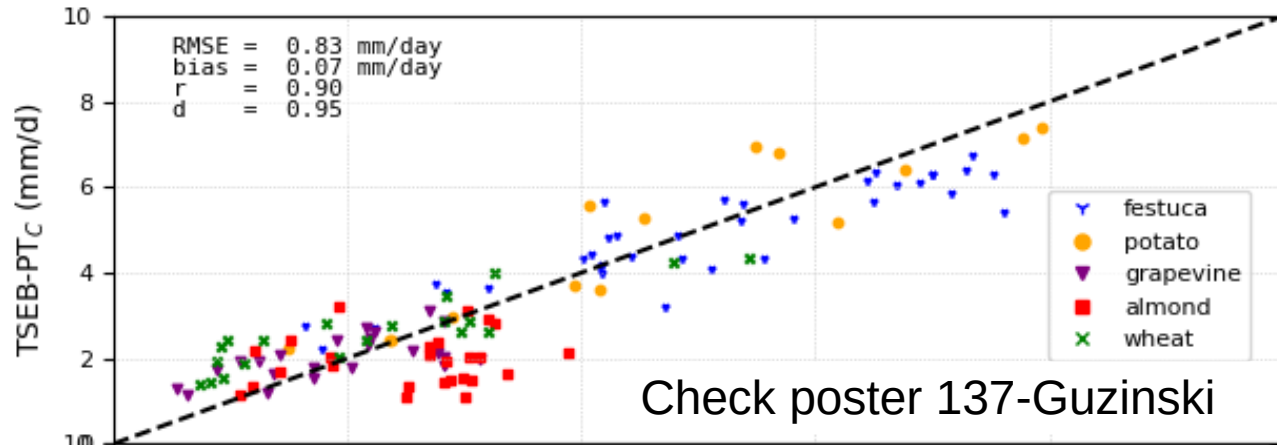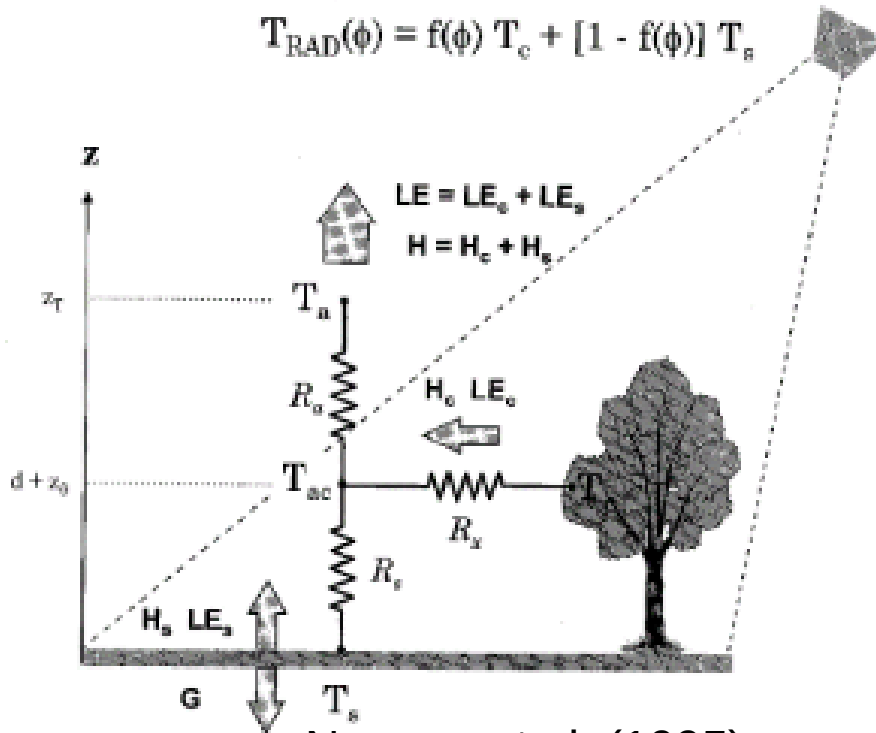
Overview

- Starting point on water use / ET

- Thermal EO & …

  - Gross Primary Productivity

  - Crop Yield

- EO AFRICA EXPLORERS EO MAJI project

Starting Background

- Copernicus dekadal ET maps at NRT
  - SenET: https://www.esa-sen4et.org
  - ET4FAO: https://et4fao.dhigroup.com
- LST sharpening, data fusion and gap filling

Check poster 137-Guzinski

TSEB model

$$T_{RAD}(\phi) = f(\phi) \, T_c + [1 - f(\phi)] \, T_s$$

Norman et al. (1995)

- Physically-based
- Partitions soil Evaporation from plant Transpiration
- Simulates flux interactions between sources
- Requires detailed and accurate biophysical traits
  - Also canopy architecture
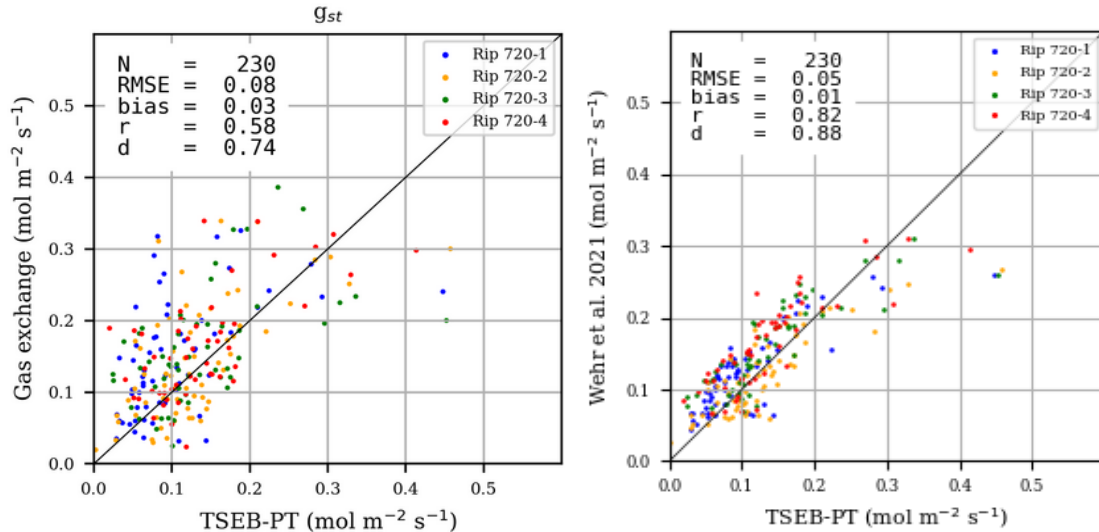- Continuously in development

https://github.com/hectornieto/pytseb

Thermal IR and GPP

- Water and productivity
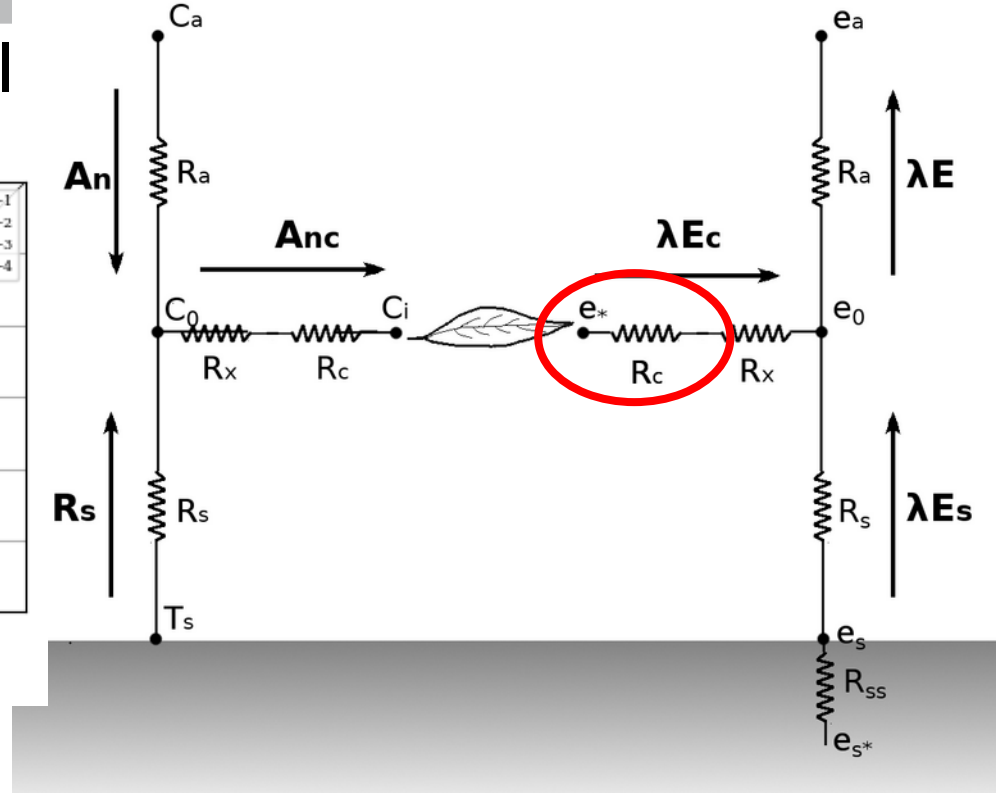 - Link between H_2O and CO_2 fluxes
  - Crop yield prediction
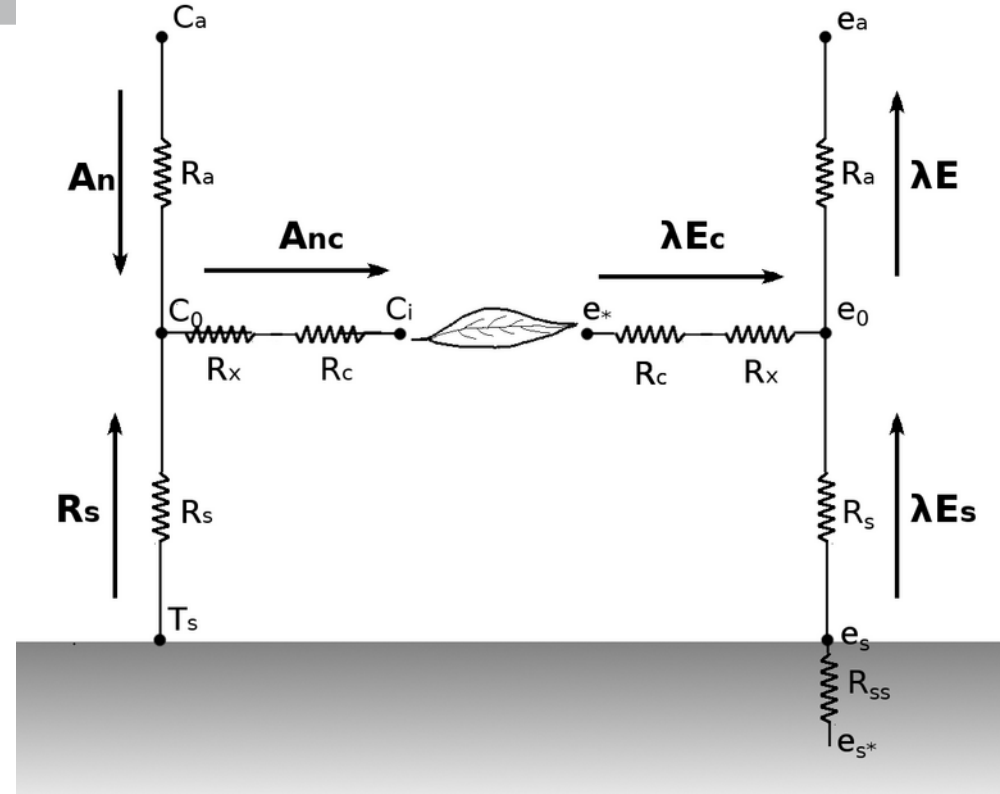
Thermal IR and GPP
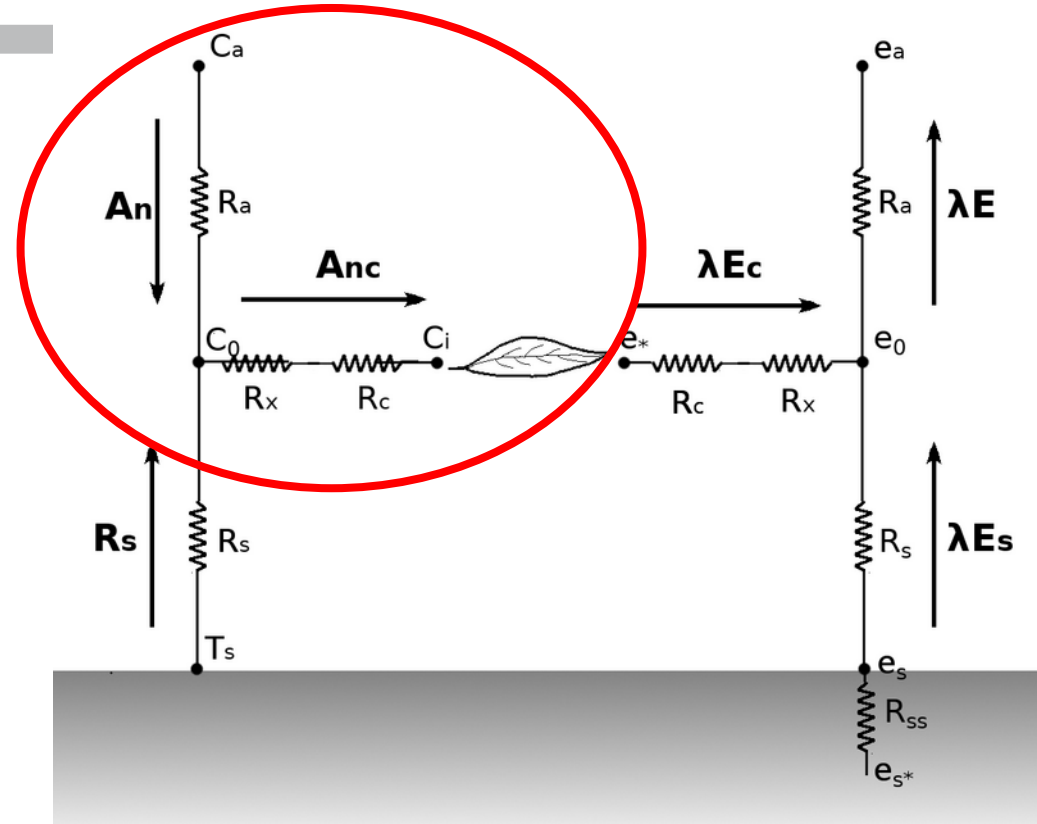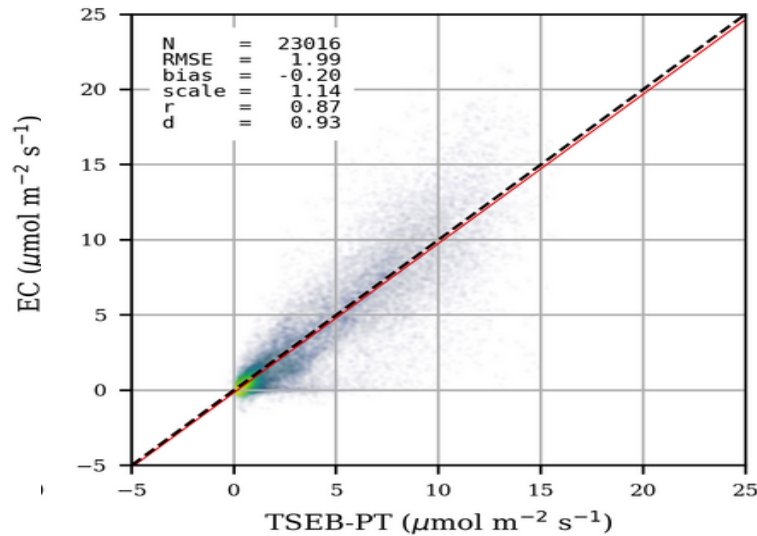
- Stomata conductance retrieval

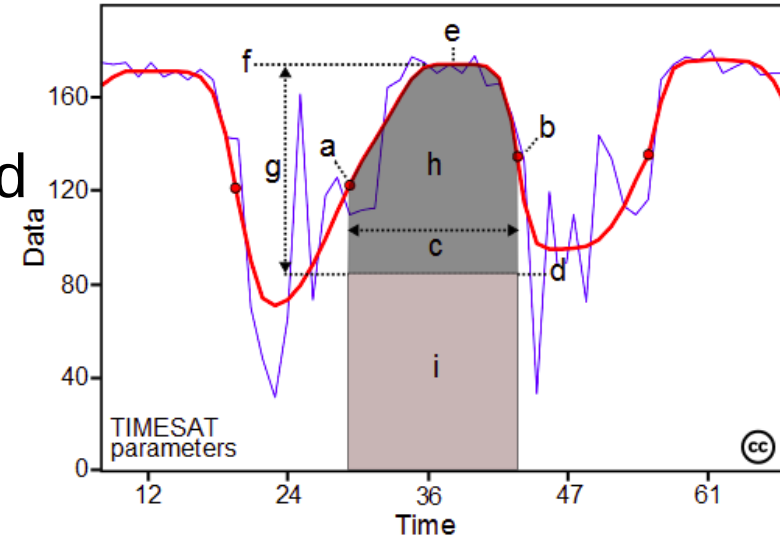

Nieto et al. Irr. Science (2022)

Thermal IR and GPP

- Gs into Farquhar-based model

Thermal IR and Crop Yield

- Simulation-based Hybrid approach
  - Crop model simulations
    - Full range of meteo, soils, management…
  - Extract simulated timeseries metrics and crop yield
    - E.g. LAI/biomass, N/Cab, ET, ...
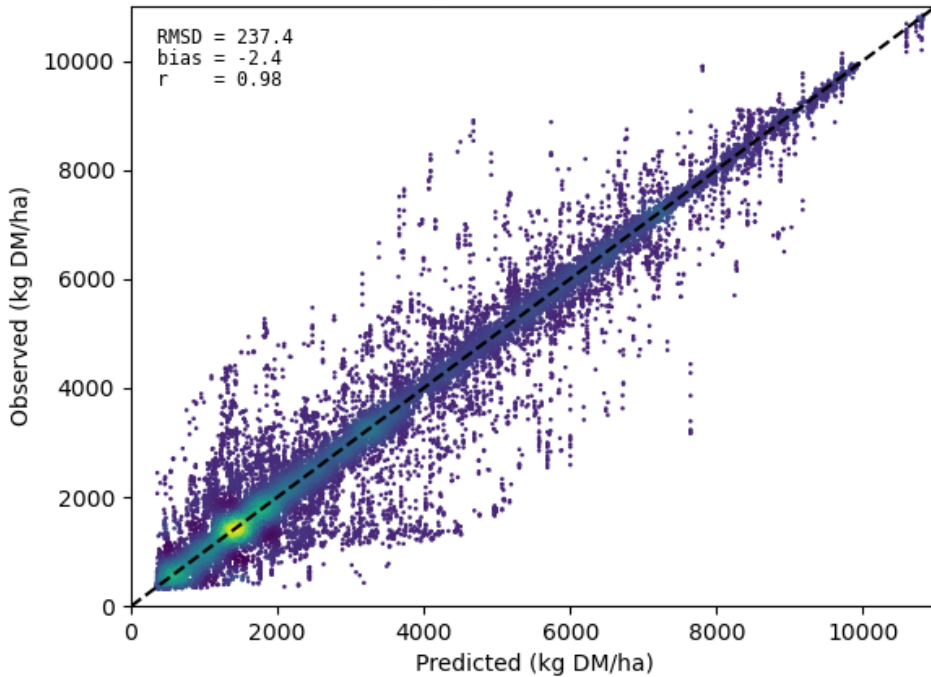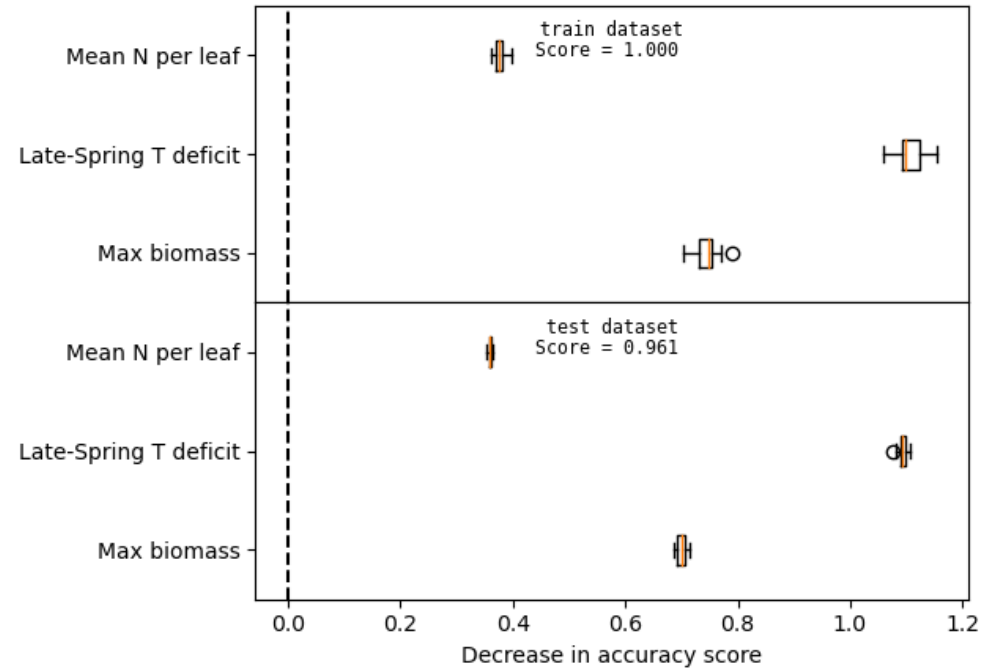 - yield~f(timeseries metrics)
  - Apply the model to EO data

Thermal IR and Cereal Yield

Random Forest Regression

Thermal IR & Cereal Yield

Gaussian Process Regression
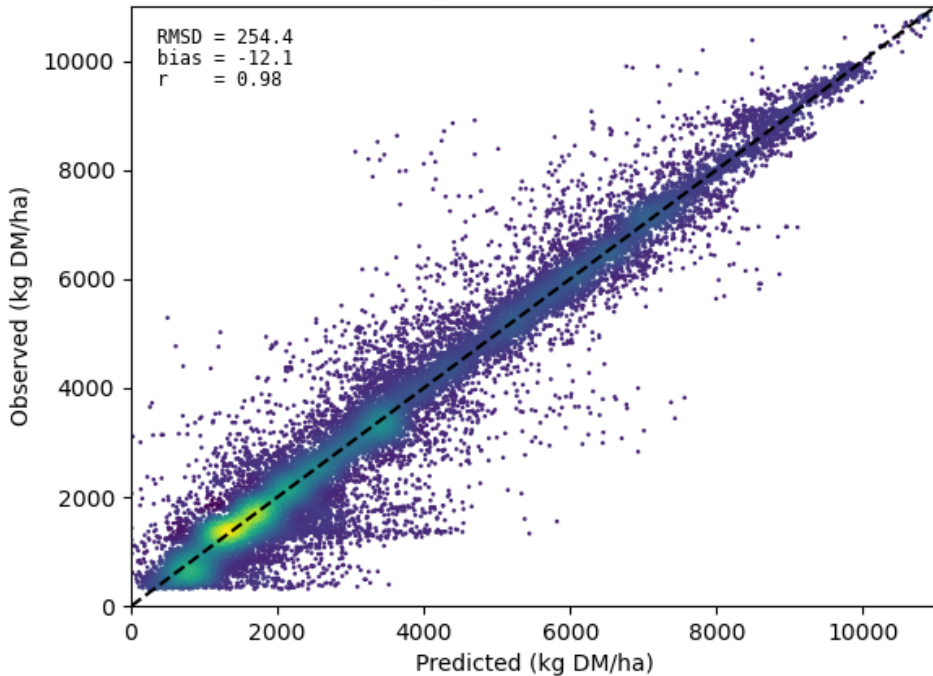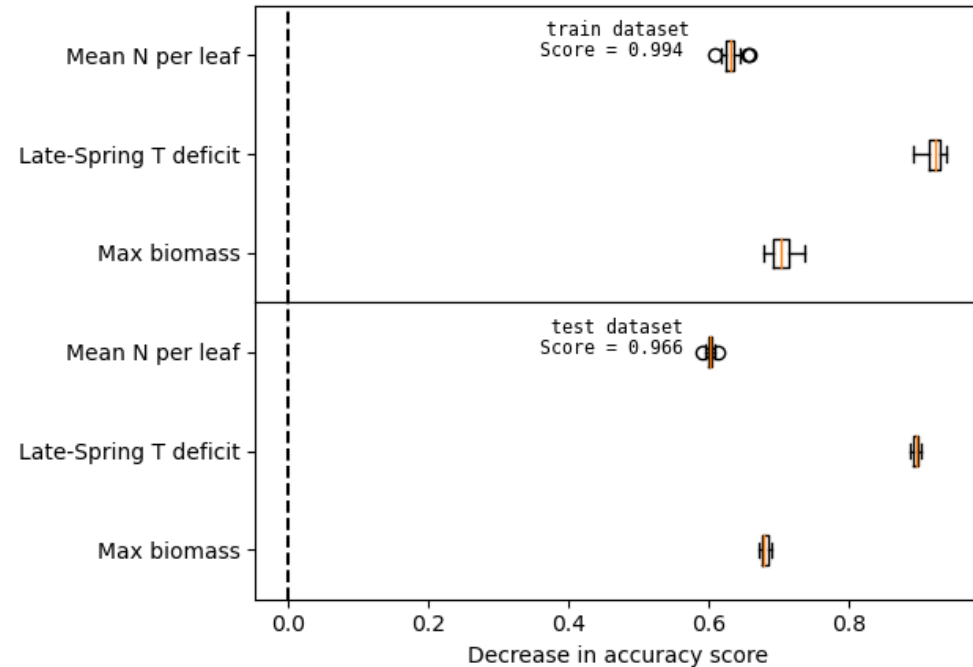
Thermal IR & Cereal Yield

Support Vector Machine Regression
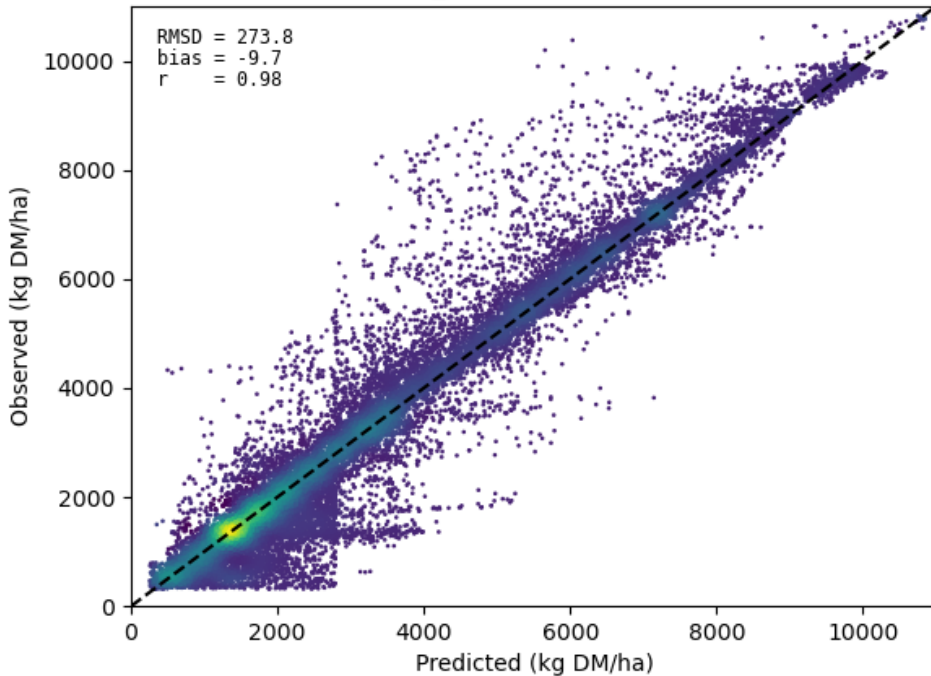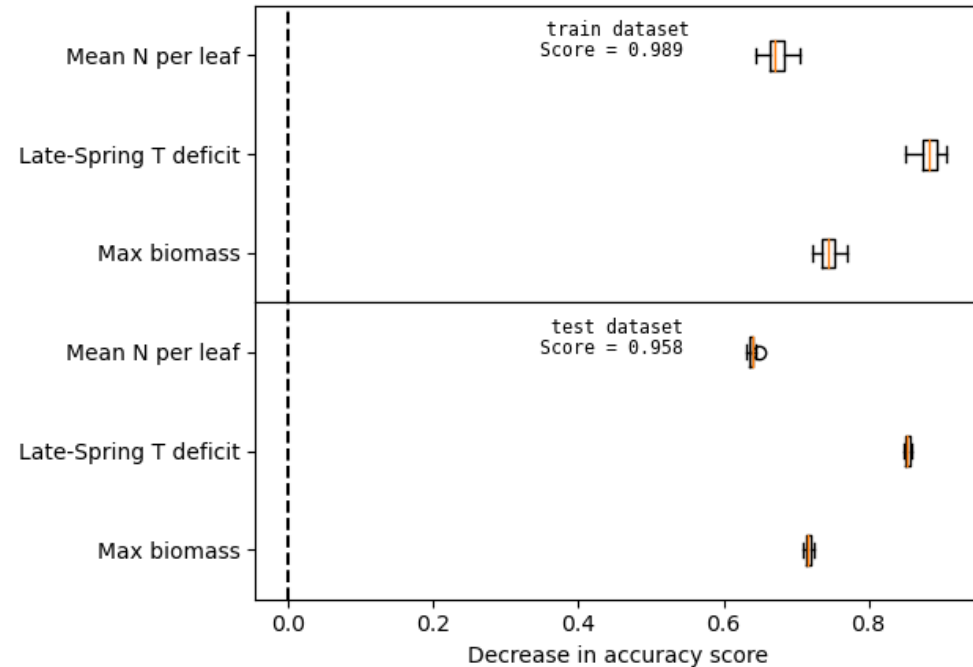
EO MAJI

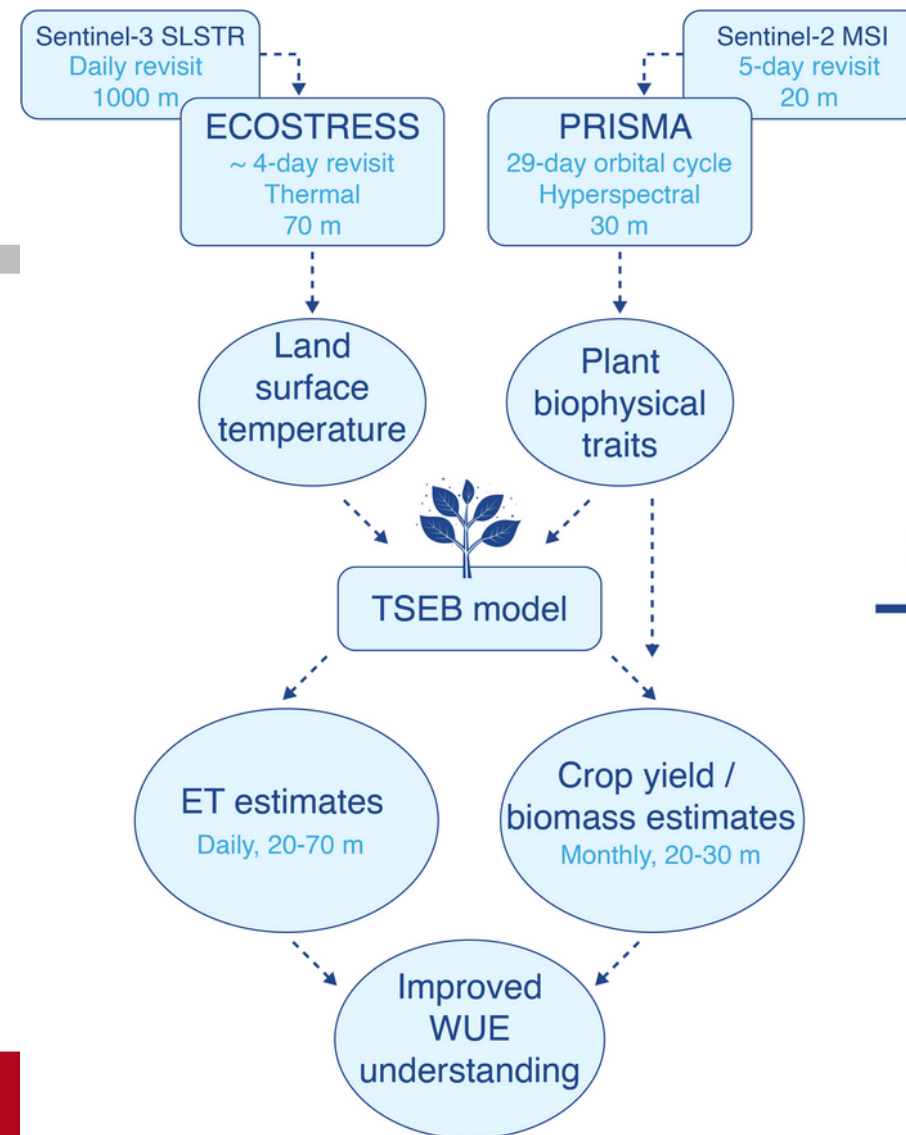- Earth Observation system to Manage Africa's food systems by Joint-knowledge of crop production and Irrigation digitization

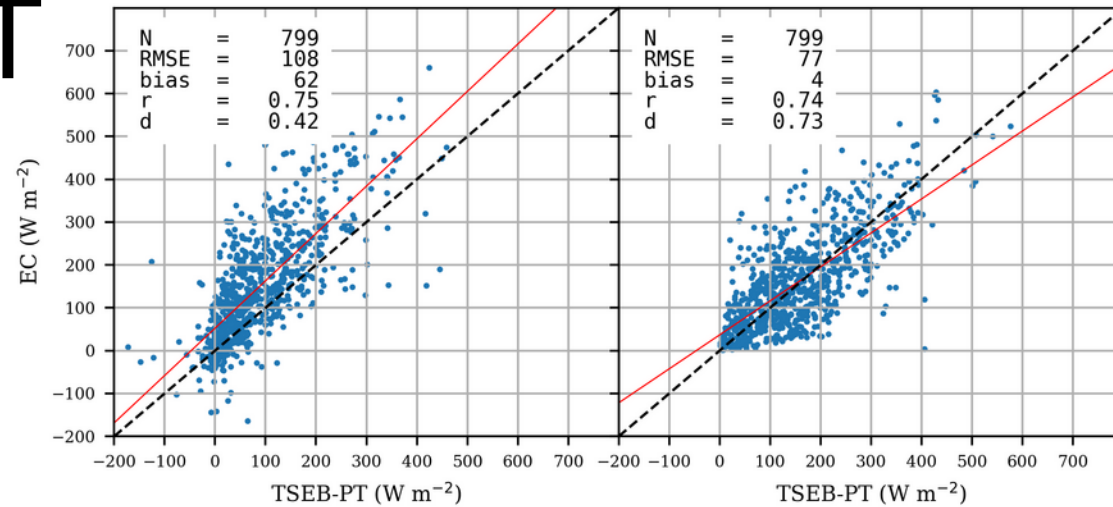 - Irrigation mapping

  - Irrigation accounting

  - Crop yield

THANK YOU!

ECOSTRESS ET

- ECOSTRESS LST
- VIIRS LAI
- ERA5 meteo
- ICOS Dry Winter DB

All ICOS Warm Winter 2020

H: N = 799, RMSE = 108, bias = 62, r = 0.75, d = 0.42

λE: N = 799, RMSE = 77, bias = 4, r = 0.74, d = 0.73

Cropland ICOS Warm Winter 2020

H: Croplands (N = 229), RMSE = 115, bias = 63, r = 0.65, KGE = 0.25

λE: Croplands (N = 229), RMSE = 79, bias = -7, r = 0.75, KGE = 0.74