ACCWA

Monitoring possible discrepancies between crop water needs and consumptions over an irrigation district: a remote sensing-based modeling approach

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MidTerm Review

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PRIMA PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

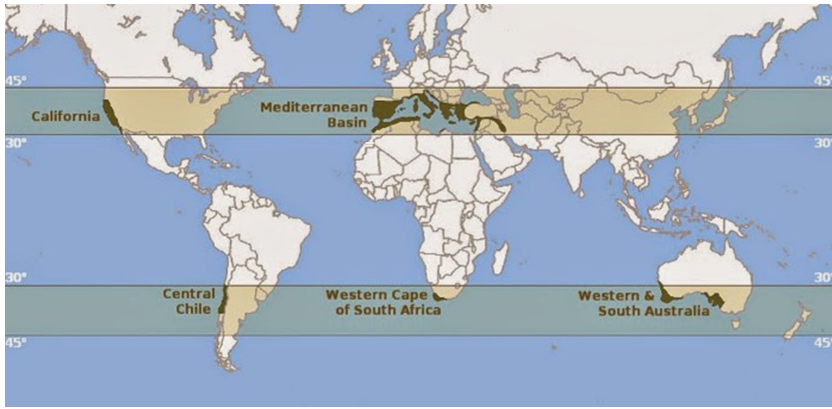
Marie Curie Actions

THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION HORIZON 2020

Context

- Irrigation consumes > 70% of freshwater at global scale (Foley et al., 2011). > 80% in semi-arid regions
- Water is particularly sensitive in Mediterranean regions: one of the most sensitive areas to climate change (Giorgi, 2006; IPCC, 2013)
- **Information irrigation is often unavailable**
- Monitoring water resources over extended areas is critical for an efficient management of water
- Optimizing on-farm irrigation management is becoming a matter of increasing urgency

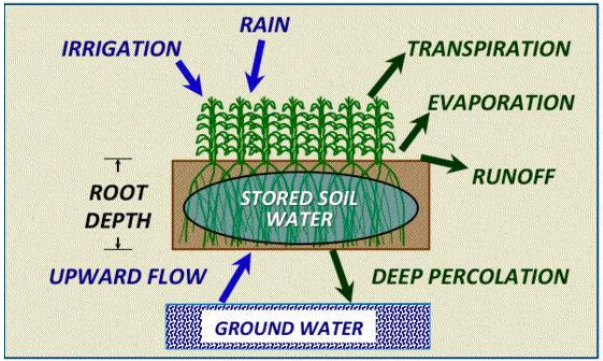
Areas with Mediterranean climate

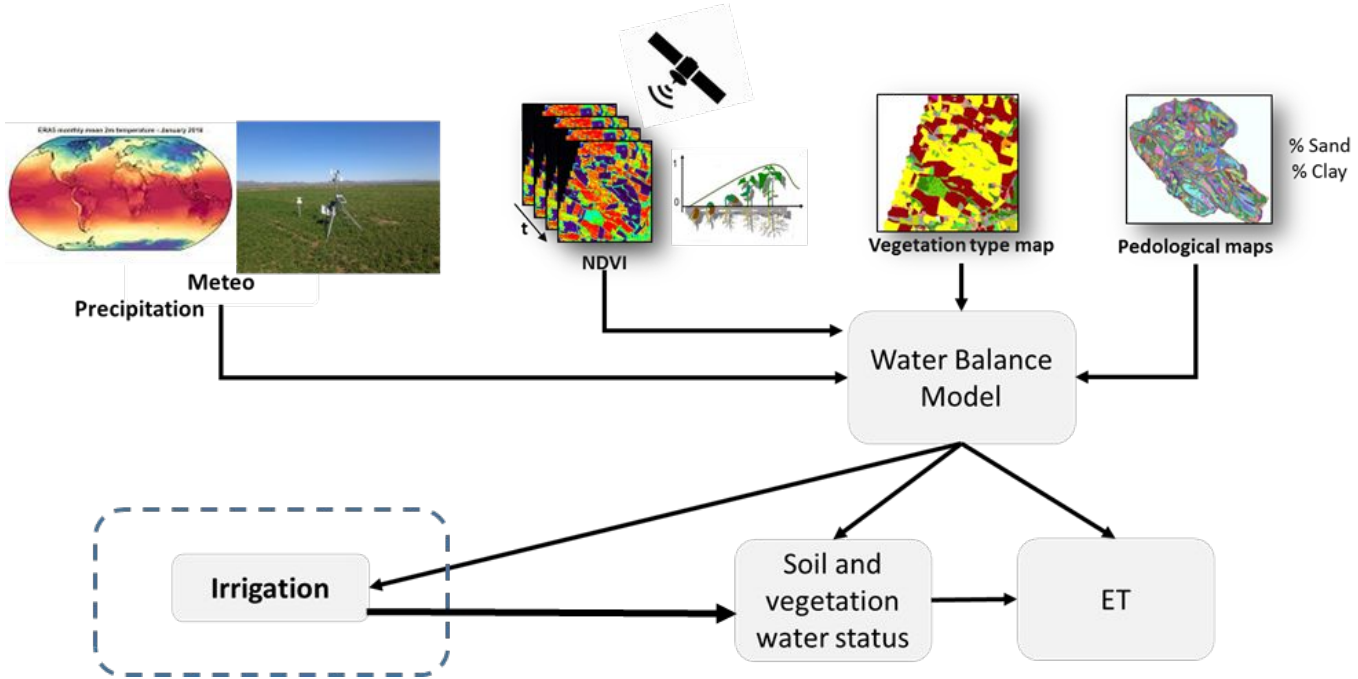


Water Balance model : SAtellite Monitoring of IRrigation (SAMIR)

- FAO-56 based model for crop water requirements
- Daily water balance

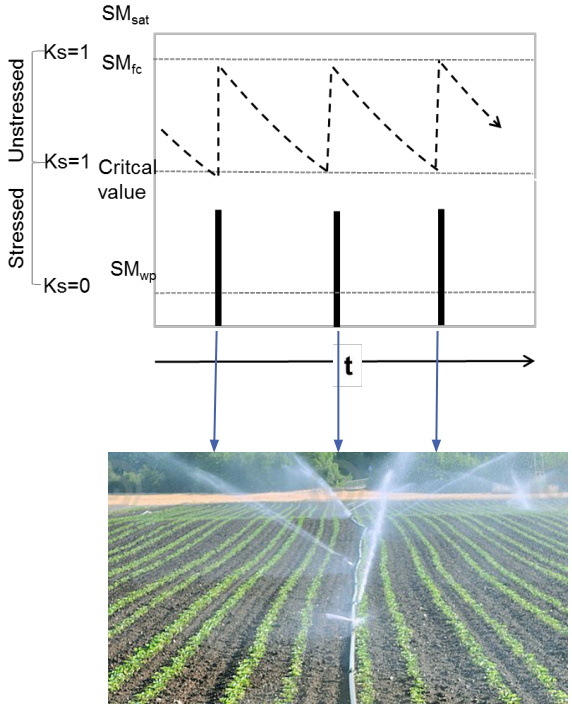
Crop Water Balance model





Irrigation triggering according SAMIR (FAO-56 model)

Automated mode : optimized irrigation scenario



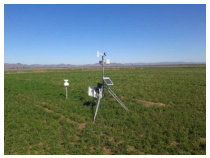
Irrigation triggering value: RZSM above an a priori threshold (No-stress)

- SAMIR applies only the water requirements to reach field capacity SM and limited by a parameter of maximum volume of water by irrigation event
- Drainage will be produced only if rains after water storage capacity is filled by Irrigation or large precipitation

Irrigation parameters

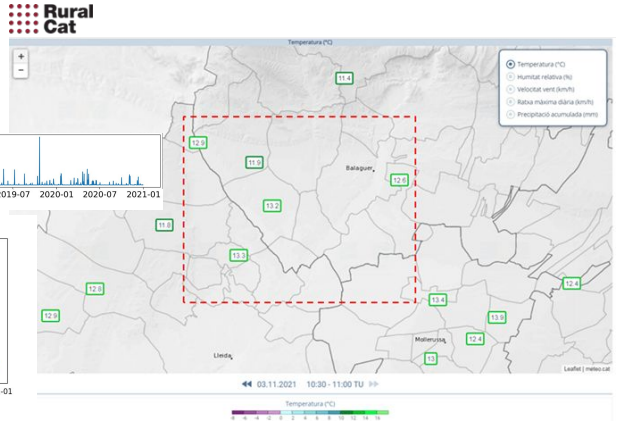
Vol_max	$freq_{min}$	Kcbmin_start	Kcbmax_stop
20 (mm)	1 day	0.1	0.85

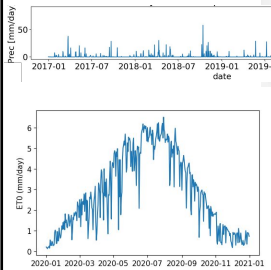
Water Balance model : SAMIR Inputs

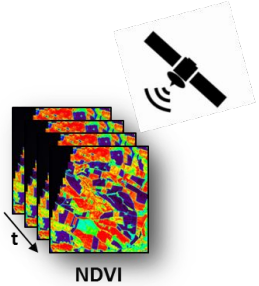


Meteo

2017 – 2020

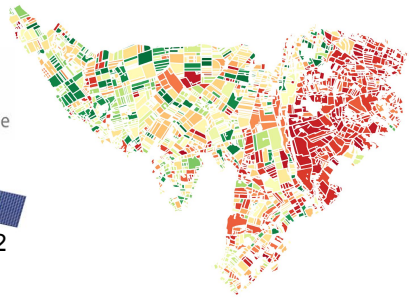


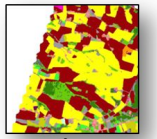




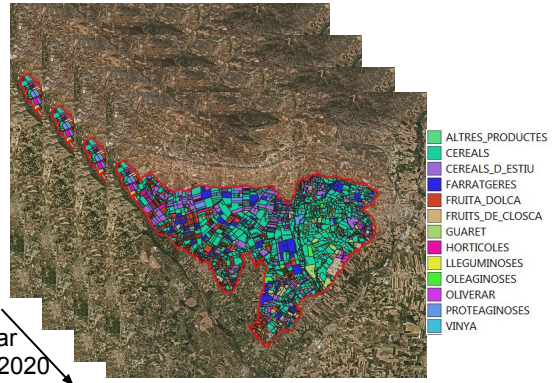
2017-2020

Sentinel-2



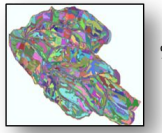


Vegetation type map



Year
2017-2020

DUN-SIGPAC



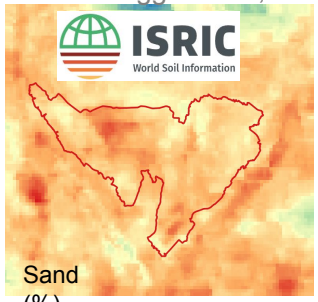
Pedological maps

% Sand
% Clay

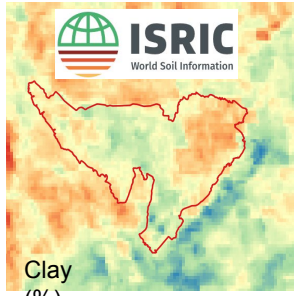
SoilGrids 2.0
Uncertainty < 3% in the district
Poggio et al., 2021

Google Earth Engine

- Different depths
- Uncertainties
- 250 m
- Pedotransfer function to get SM_{fc} and SM_{wp}

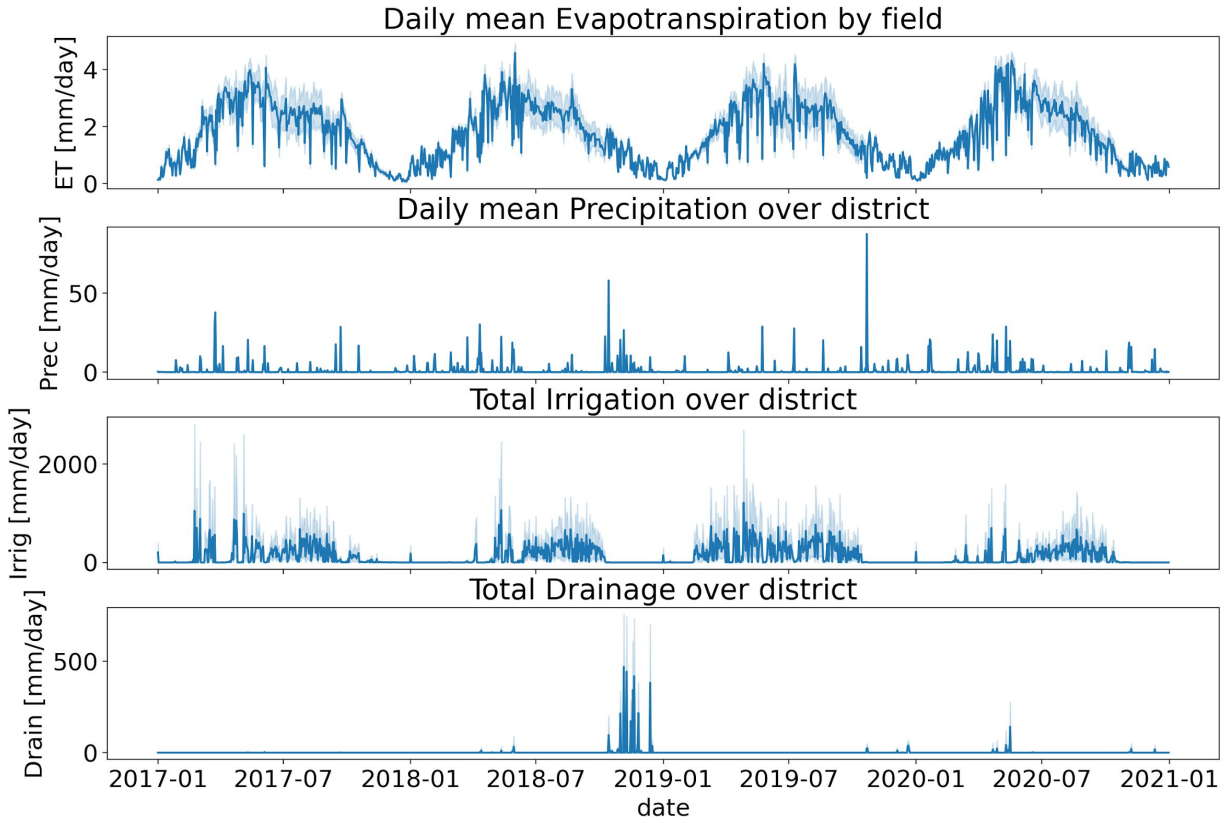


Sand
(%)



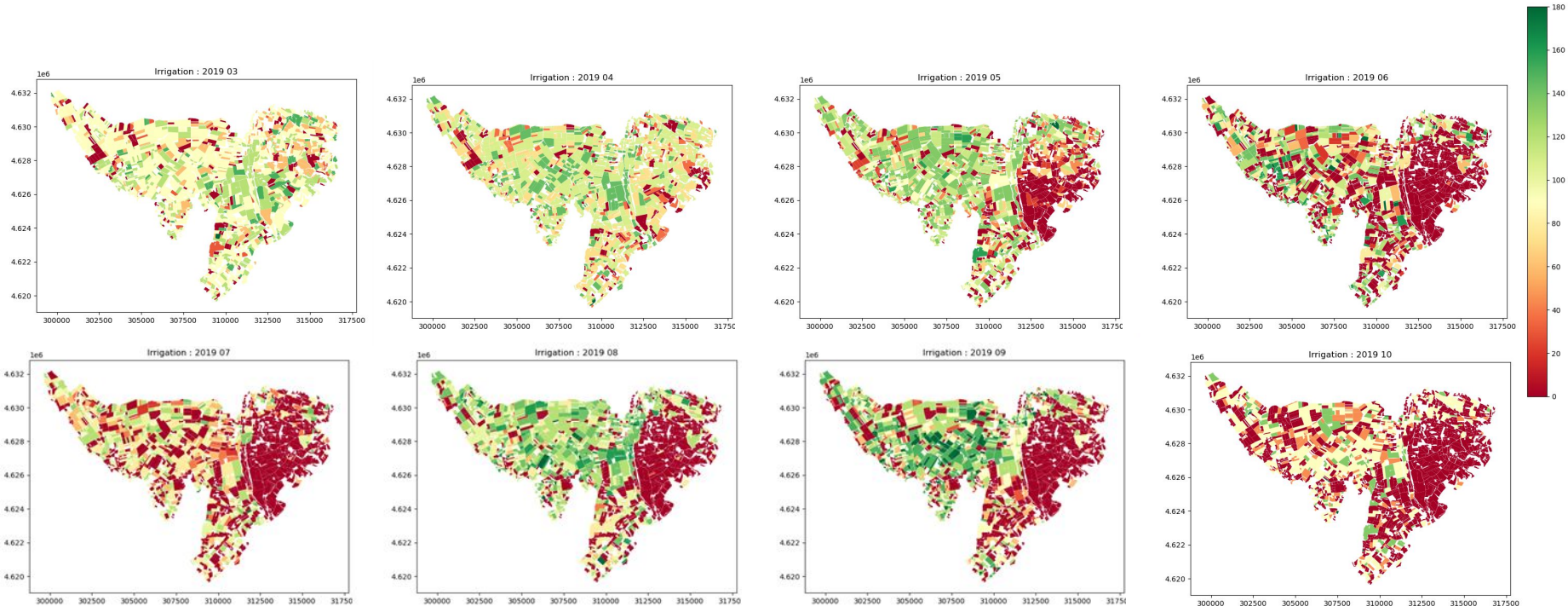
Clay
(%)

Water Balance components time series



- ET highly modulated by ET0 and phenological data (NDVI)
- Inter/intra annual variability
- Clearly identify the irrigation period.
- Not only 1 well defined period (different agricultural season during the year)
- SAMIR is not able to estimate drainage from irrigation

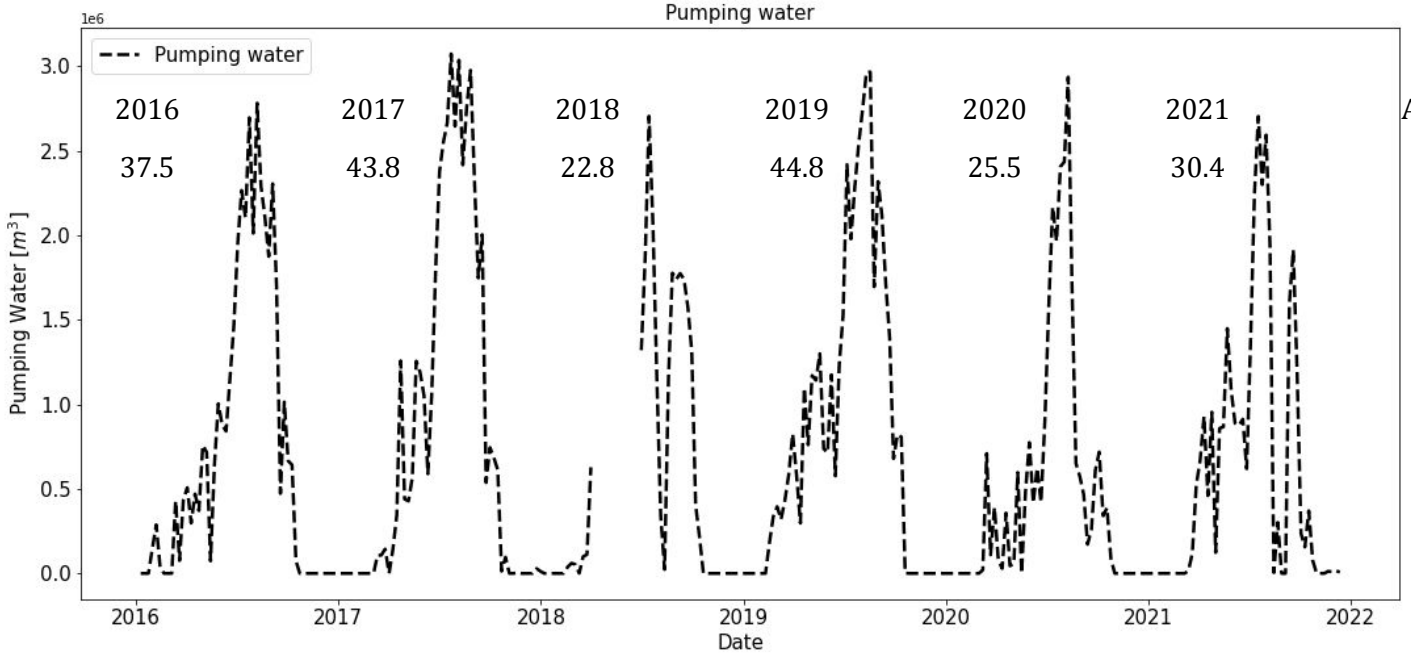
Simulated irrigation over Algerri-Balaguer district



Comparison between observed and simulated Irrigation

Volumes of pumping water for Algerri-Balaguer district from Automatic Hydrologic Information System of the Ebro river basin (SAIH Ebro)

accumulated on a weekly basis



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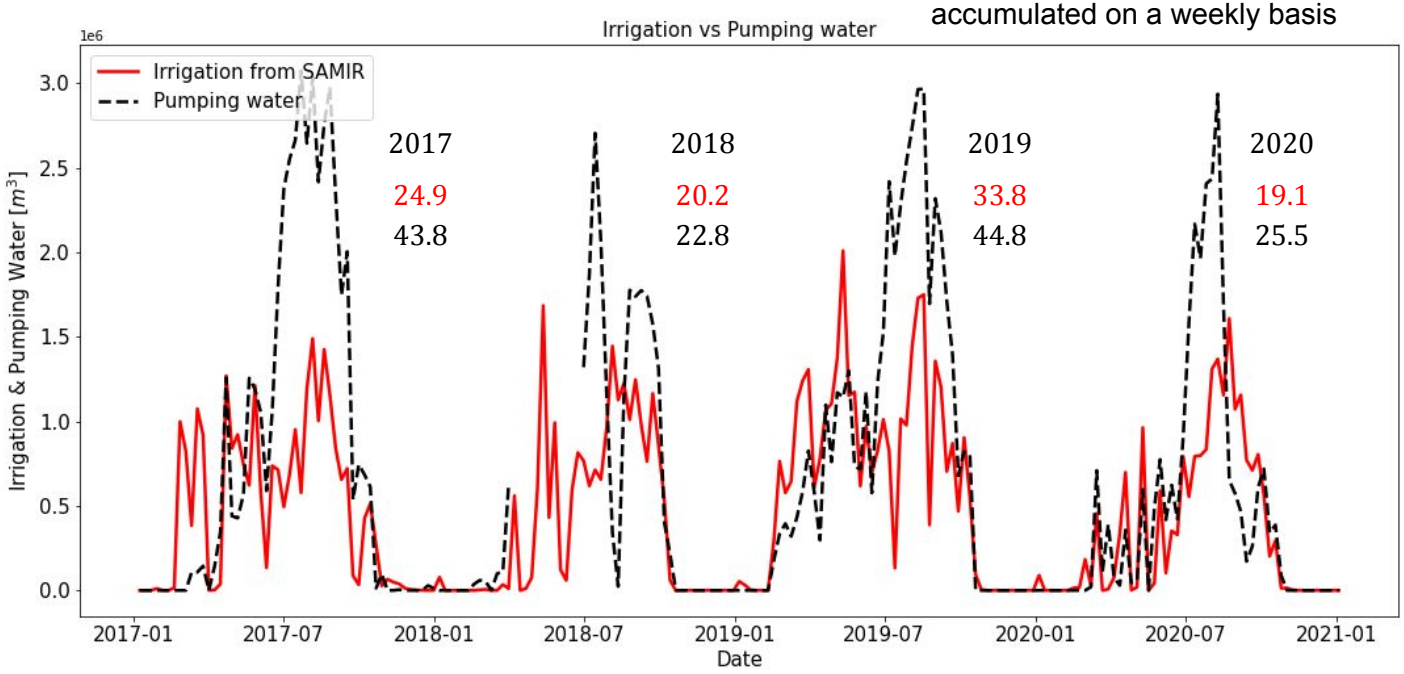


	2017	2018	2019	2020
Annual total (hm^3)				
SAMIR	24.9	20.2	33.8	19.1
Pumping water	43.8	22.8	44.8	25.5

Perspectives

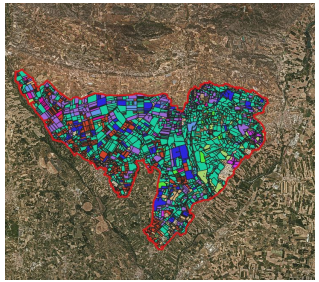
Calibrate irrigation parameters

Optimal Irrigation parameters (I_{event}, $freq_{min}$, $p_{trigger}$)

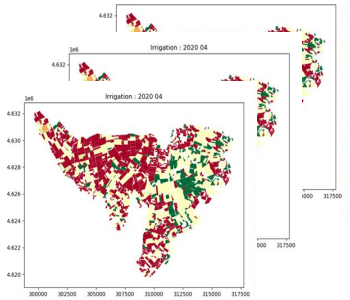
Assimilation (Particle Filter)

SAMIR Water balance model

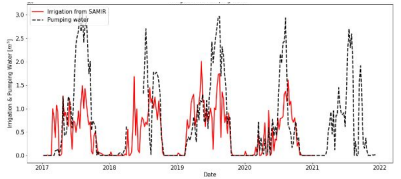
by Land Cover



Retrieved Irrigation at ***Land Cover scale***



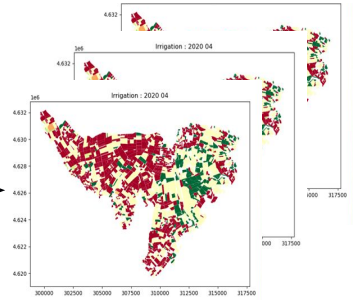
Observed vs Retrieved Irrigation



Comparison at ***Irrigation district scale***

by crop field

Retrieved Irrigation at ***crop field scale***

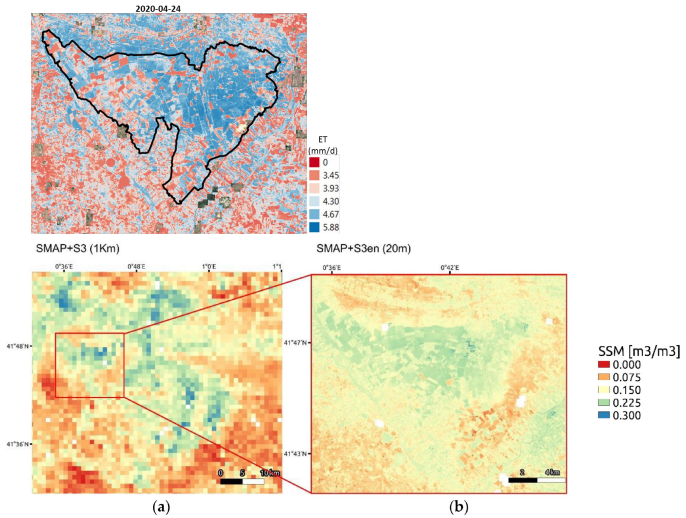


Validation *Irrigation at district scale*

Perspectives

Assimilating remote sensing data :

- ET (SEN4ET produced by IRTA)
- Disaggregated Surface Soil Moisture (as product of Paolini et al. 2022; isardSAT)

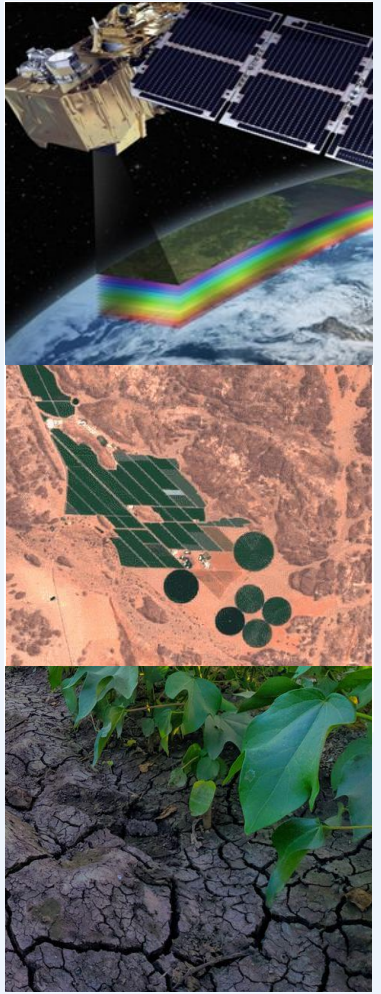


- Retrieve actual irrigation without a priori knowledge (taking into account assimilation of Remote Sensing data)
- Improvement in irrigation and drainage module.
- Avoiding some parameters and providing more flexibility to parameters

Conclusions

SAMIR allows to :

- estimate spatially the water requirements at field crops
- detect differences between adjacent fields at high spatial resolution (linked to 10-m spatial resolution Sentinel-2)
- monitoring discrepancies between those water needs and consumptions: overestimation (stress periods) and underestimation (excess of actual irrigation)
- Assimilate Remote Sensing data could correct the under/overestimation and adjust simulated irrigation to a more real situation



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Thank you!