Spatial exploration for monitoring water stress: towards a new paradigm for the optimal management of irrigation water in the Doukkala region (Western Morocco)

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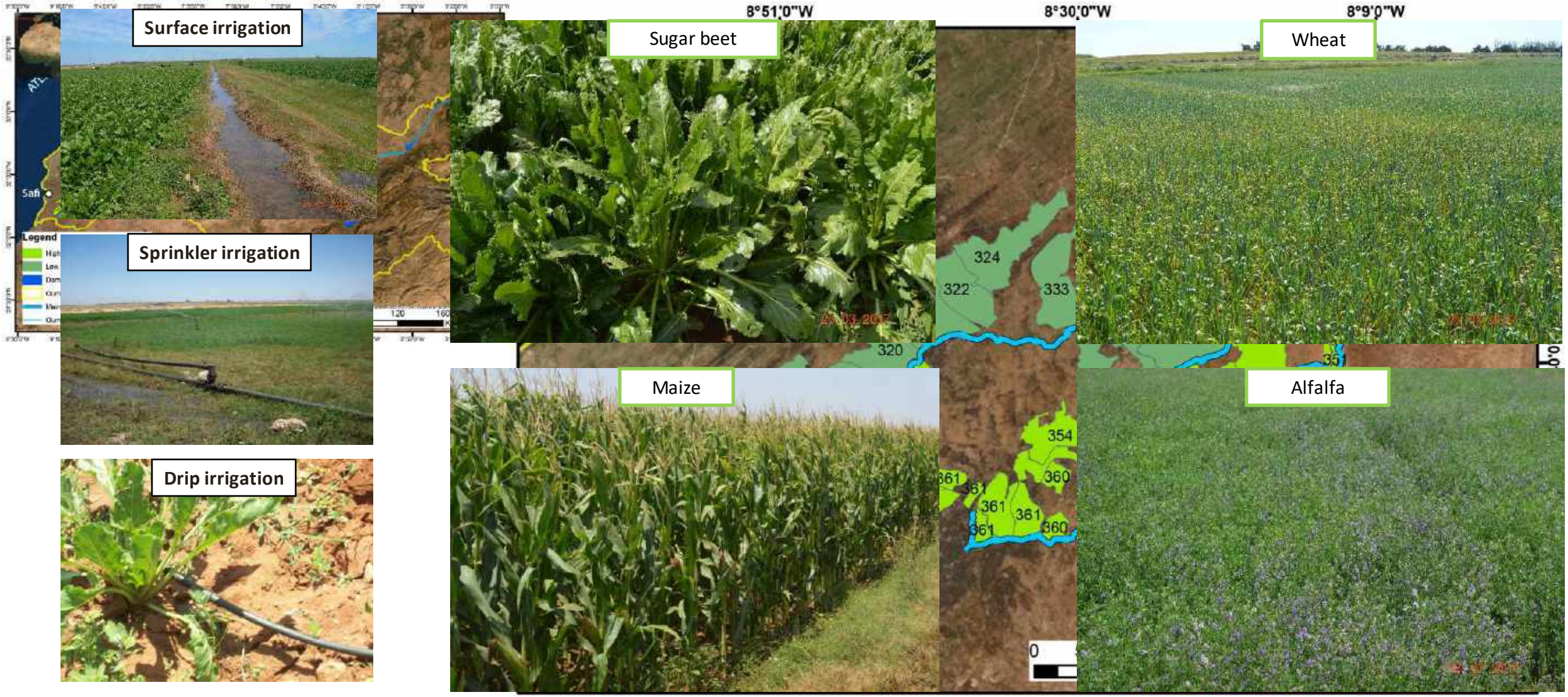
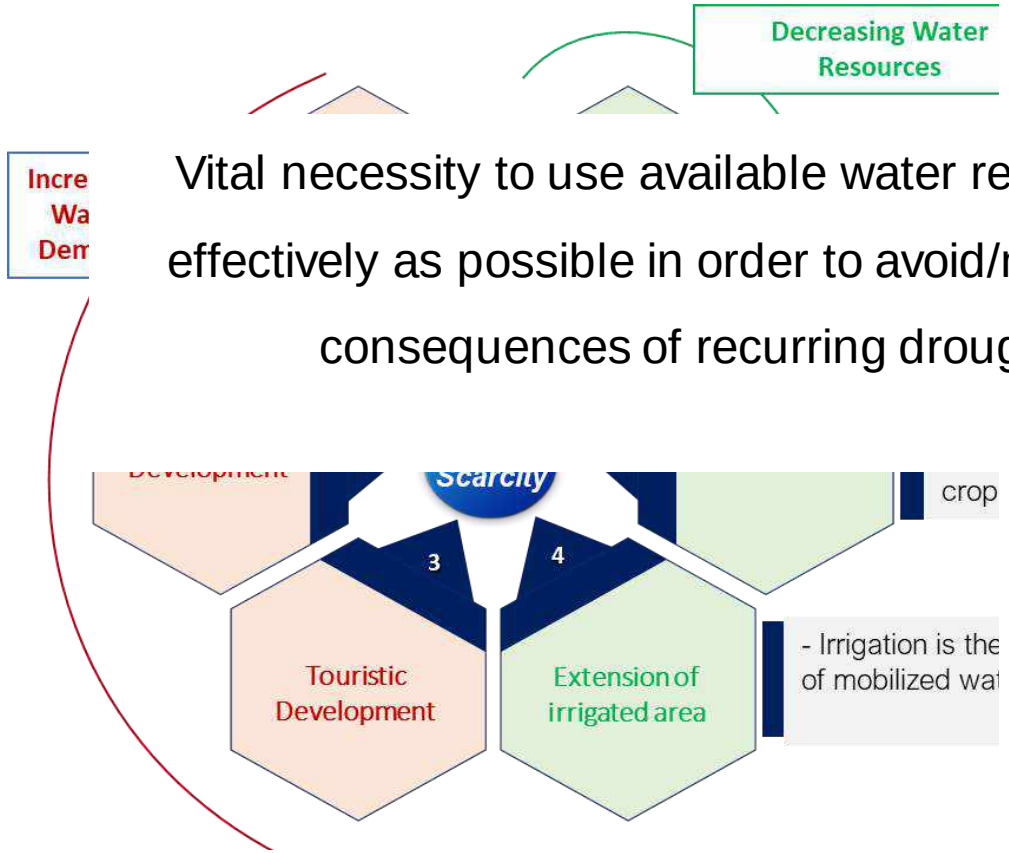
SMARTIES_Prima projects

AfriSmart, CROSMOD_EO AFRICA Projects

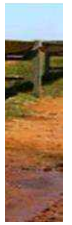

Surface irrigation
Sprinkler irrigation
Drip irrigation
Sugar beet
Wheat
Maize
Alfalfa
8°51'0"W
8°30'0"W
8°9'0"W
324
322
333
320
354
360
361
361
361
361
360
Legend



Vital necessity to use available water resources as effectively as possible in order to avoid/mitigate the consequences of recurring droughts.

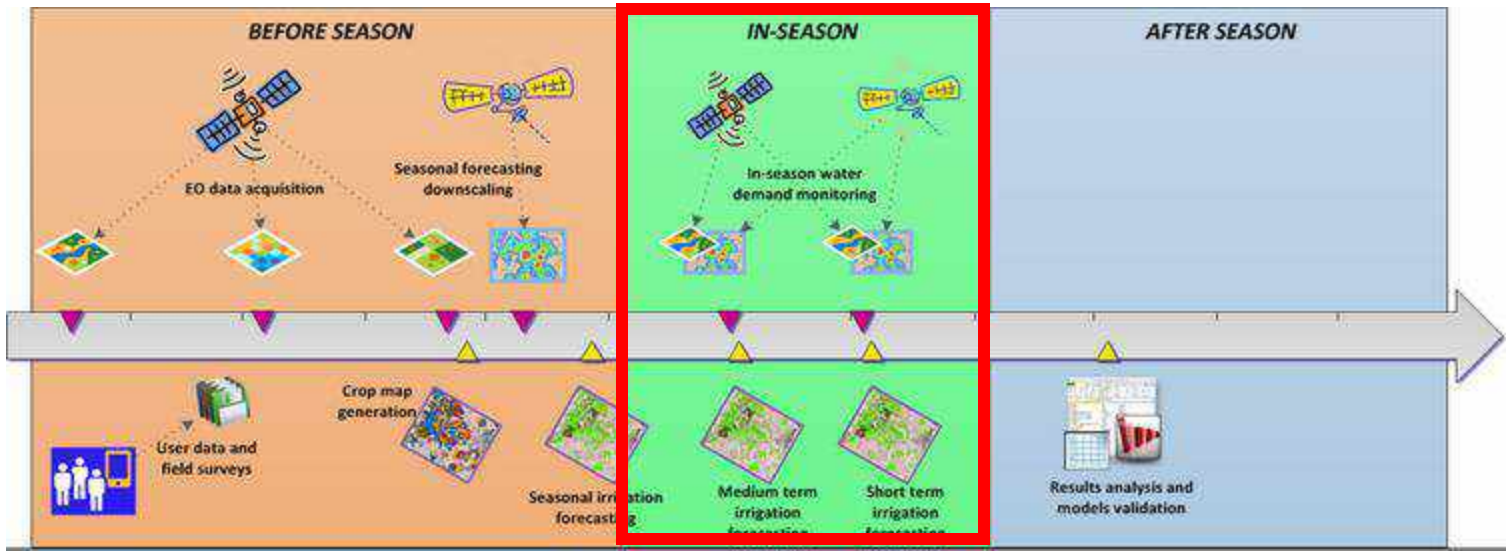
……while awaiting the development of unconventional water resources //Energy cost

Rational use of the existing



The main objective of the study is to generate products to water procurement and management agencies to facilitate the planning of irrigation, with the aim of:

- Saving water;
- Improving services to farmers;
- Manage and reduce the risk of drought and its impact;



Short term irrigation forecast

- Crop water demand (CWD)
- In season irrigation forecast

METHODOLOGY

The in season crop water demand module

Multispectral Satellite Data

Landsat-8 and Sentinel-2

short-term meteorological forecast

Precipitation, ET0, T, RH ...

Crop phenological variables and crop water demand (CWD)

Fao-56: Kc-NDVI method

NDVI

Kc

*ETc=Kc*ET0*

Analytical approach

Net shortwave radiation Rns ← **Albedo**

Canopy resistance rc,min ← **LAI**

Aerodynamic resistance ra ← **hc**

$$ET_c = \frac{1}{\lambda}\frac{\Delta(R_{ns} - R_{nl} - G) + 1.013\rho D_e / r_a}{\Delta + \gamma\left(1 + r_{c,\min} / r_a\right)}$$

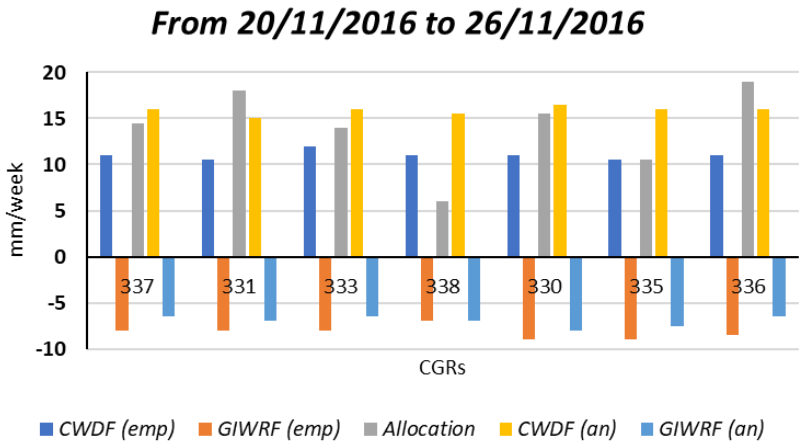
Computation of daily CWDF

Computation of weekly CWDF

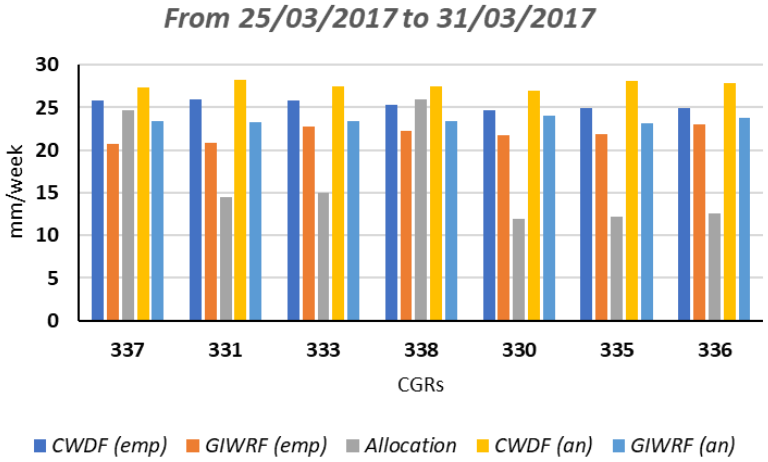
Computation of weekly GIWDF = CWDF-P

CWDF and GIWDF Maps

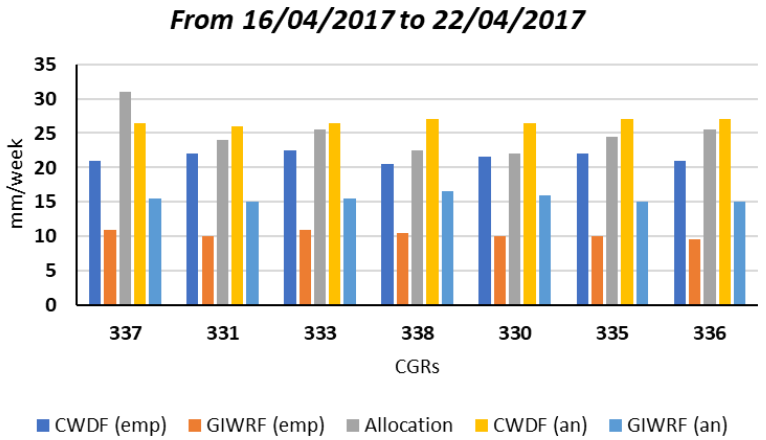
CWDF: Crop Water Demand Forecast
GIWDF: Gross Irrigation Water Demand Forecast



Initial Stage



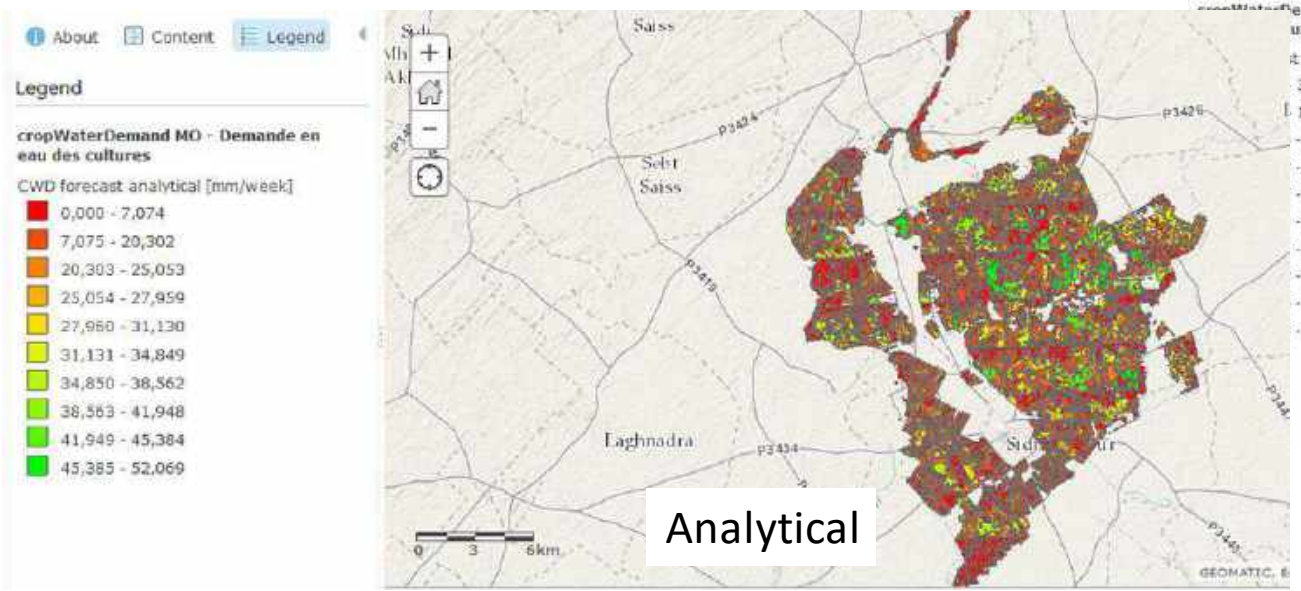
Mid-season (winter)

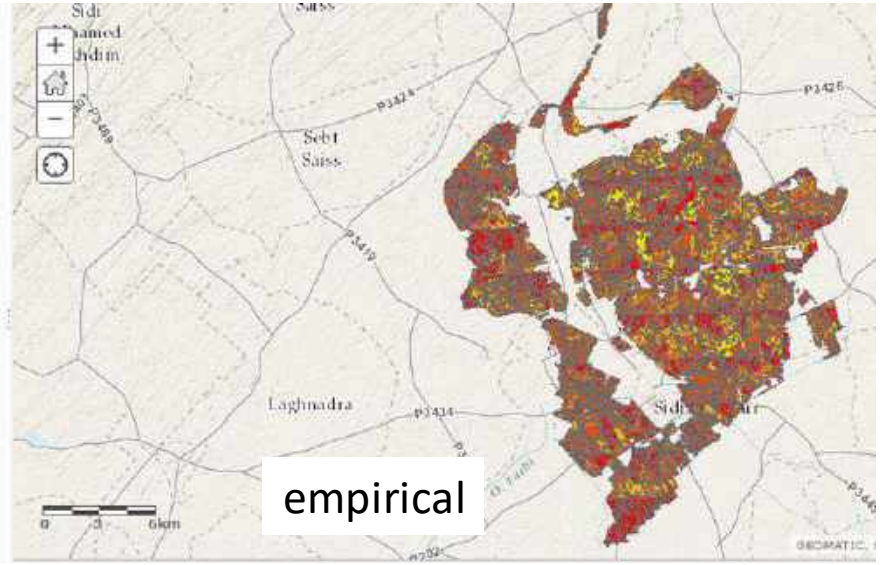


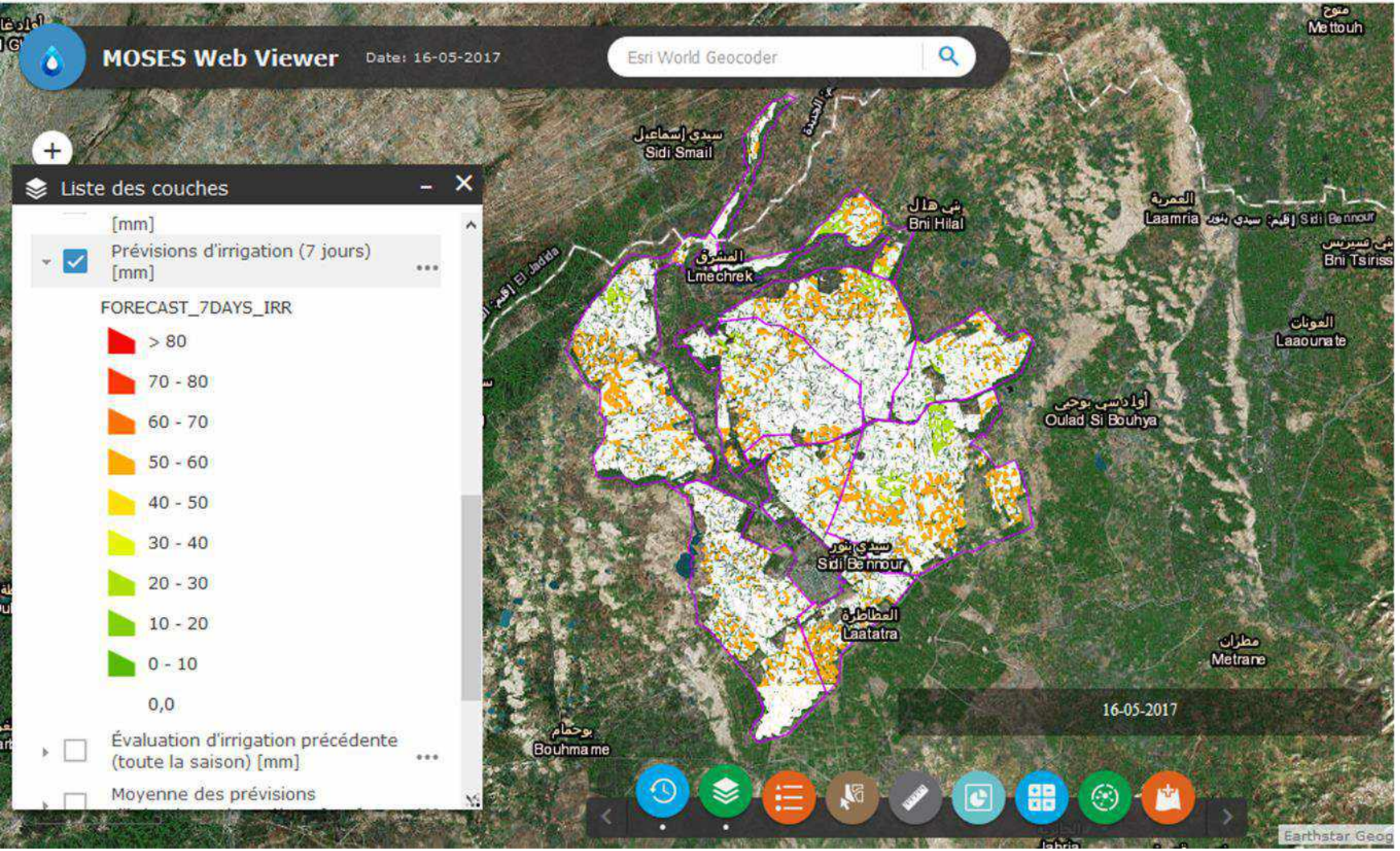
Development stage (Spring)

Crop Water Demand

Anatical vs empirical method (6 -13 septembre 2017)







Mean= 13.39 mm/7jours

Mean=1.91mm/jours

- **WA= 4.254.336 m3** ***(7days)***
- ***Forecast: 4.552. 600 m3 (7days)***

In Season Irrigation Forecast (Short term)

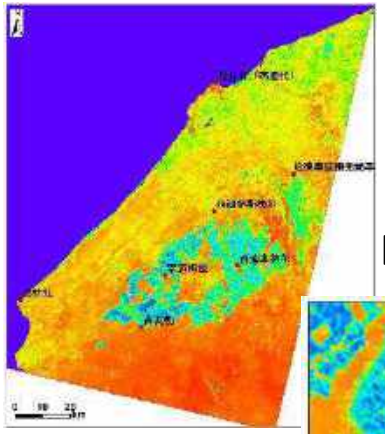
- CWDF calculated by the analytical method is greater than the one calculated by the empirical and the differences are larger in spring than in winter. This is probably due to the development stage of the crop in spring.

- The differences between GIWDF and the allocation suggested that the precipitation is not taken into account by ORMVAD when the water to allocate to the CGRs is defined.

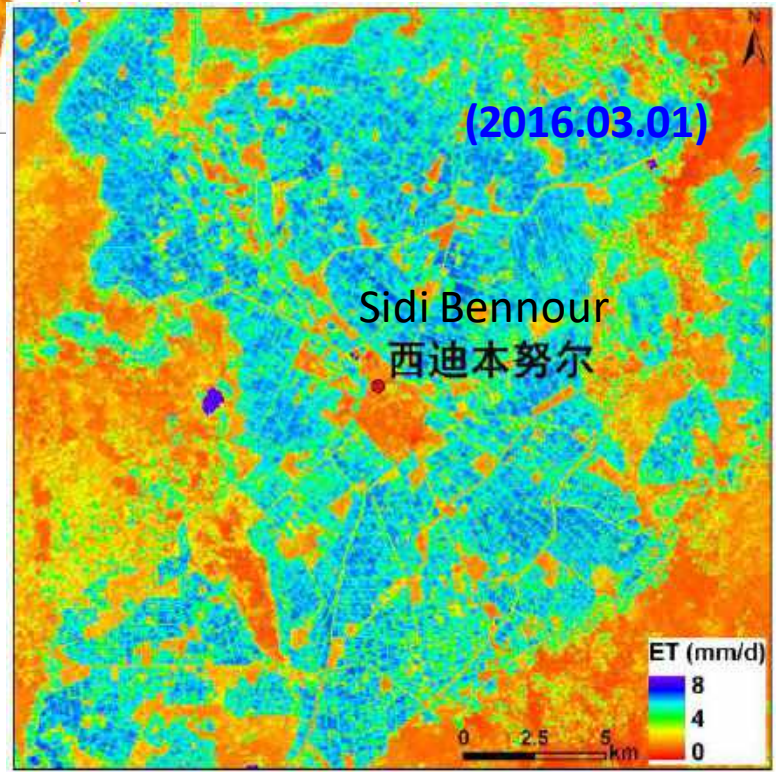
- The use of CWDF and GIWRF products during the irrigation management operations would help the water management, especially during the winter season, leaving additional water available to meet requirements in spring and summer.

- An in-season crop mapping procedure allow fine tuning of water allocation, taking into account spatial variability in the crop growth cycle.

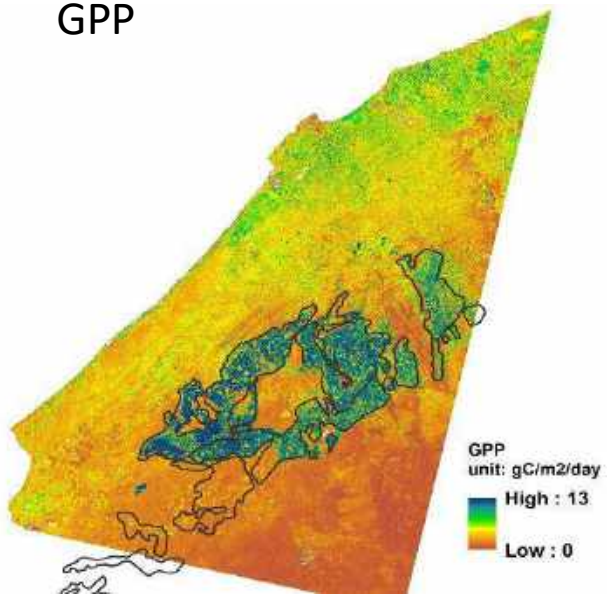
Water use and water productivity



ET from ETMonior @30mMorocco

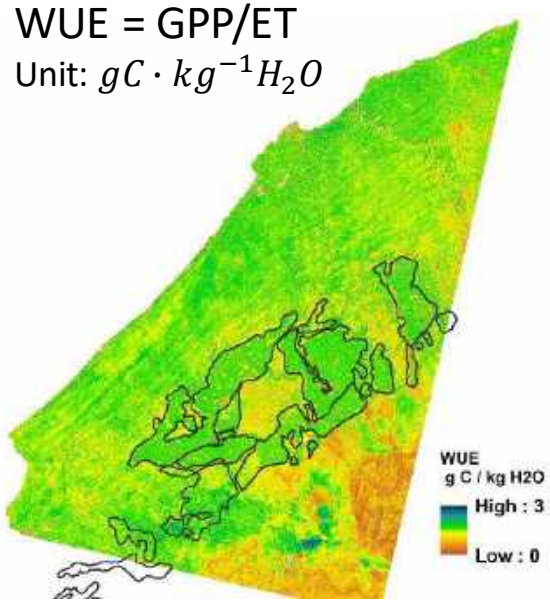


GPP

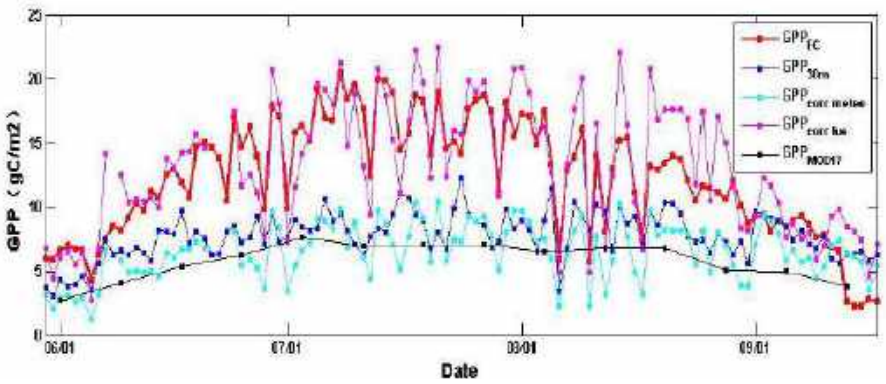


WUE = GPP/ET

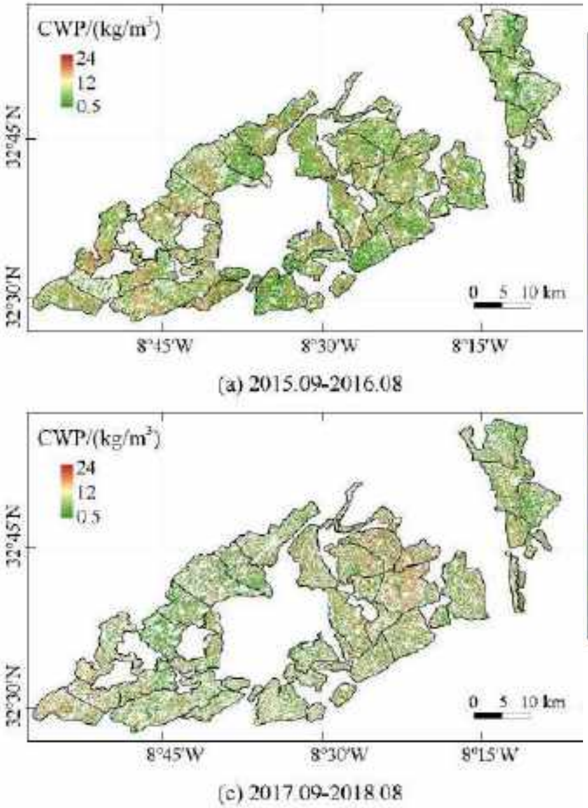
Unit: $gC \cdot kg^{-1}H_2O$



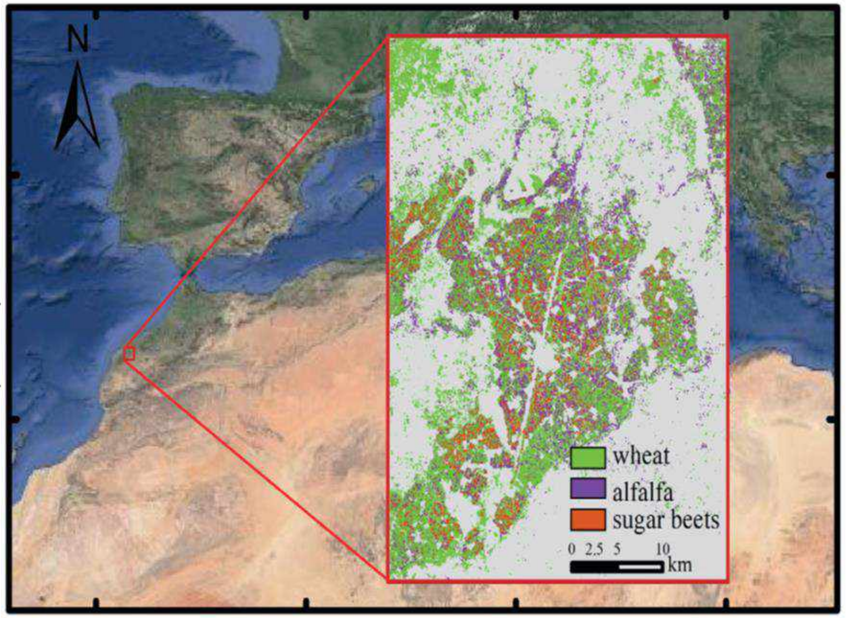
Lessons learnt from study in China

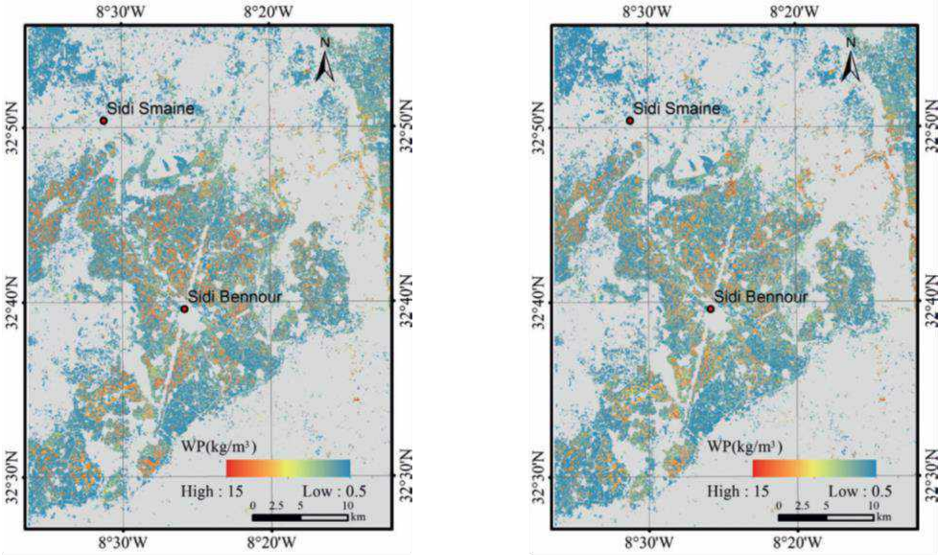


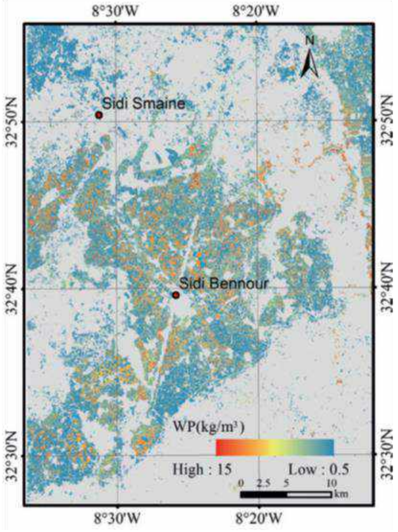
Current MODIS GPP algorithm underestimated in semi-arid crop land

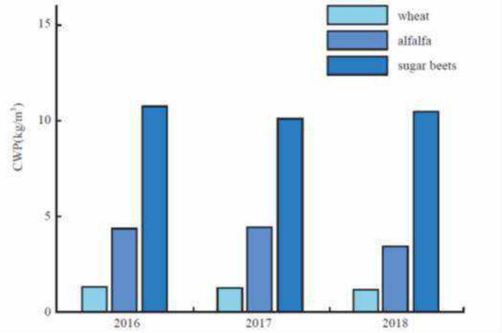


Spatial distribution of crop water productivity in









Water productivity by crop:

- wheat : 1.3 kg/m3,

- alfalfa (4.1 kg/m3)

- sugar beets (10.5 kg/m3).

FEST-EWB_SAFY MODEL

FEST-EWB

FEST-EWB: Flash – flood Event – based Spatially – distributed rainfall – runoff Transformation – including Energy - Water Balance

Soil water balance

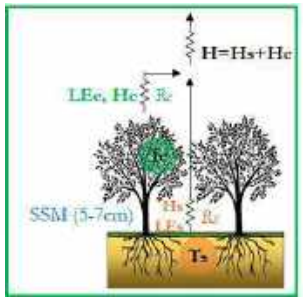
$$P_{tot}=R+ET_{eff}+D+(\theta_{t+1}-\theta_t)*Z$$

Energy balance

$$Rn - G - H - LE = \frac{dS}{dt} \qquad ETeff = \frac{LE}{rCp}$$

Crop growth

$$\Delta DAM = APAR \cdot Pgro\_Lue \cdot F_T(Ta)K_s$$



Inputs

(1) meteorological forcings; (2) maps of soil hydraulic parameters; (3) vegetation parameters; (4) groundwater level; (5) irrigation volume.

Calibration with LST and SM (ET) for soil surface parameters pixel by pixel

LAI for crop parameters Calibration

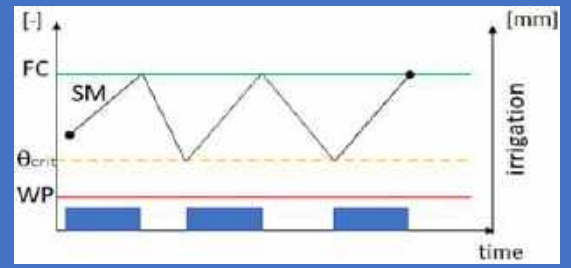
irrigation strategy

time

Outputs

- Time continuous LAI and crop yield
- Time continuous soil moisture, LST and evapotranspiration distribution

EQUATION FAO



$$\theta_{crit} = FC - p(FC - WP)$$

Corbari & Mancini 2022, (IRR); Corbari et al., 2022 (AWM); Corbari et al., 2011, (HSJ); Battude et al., 2018, Duchemin et al .2008

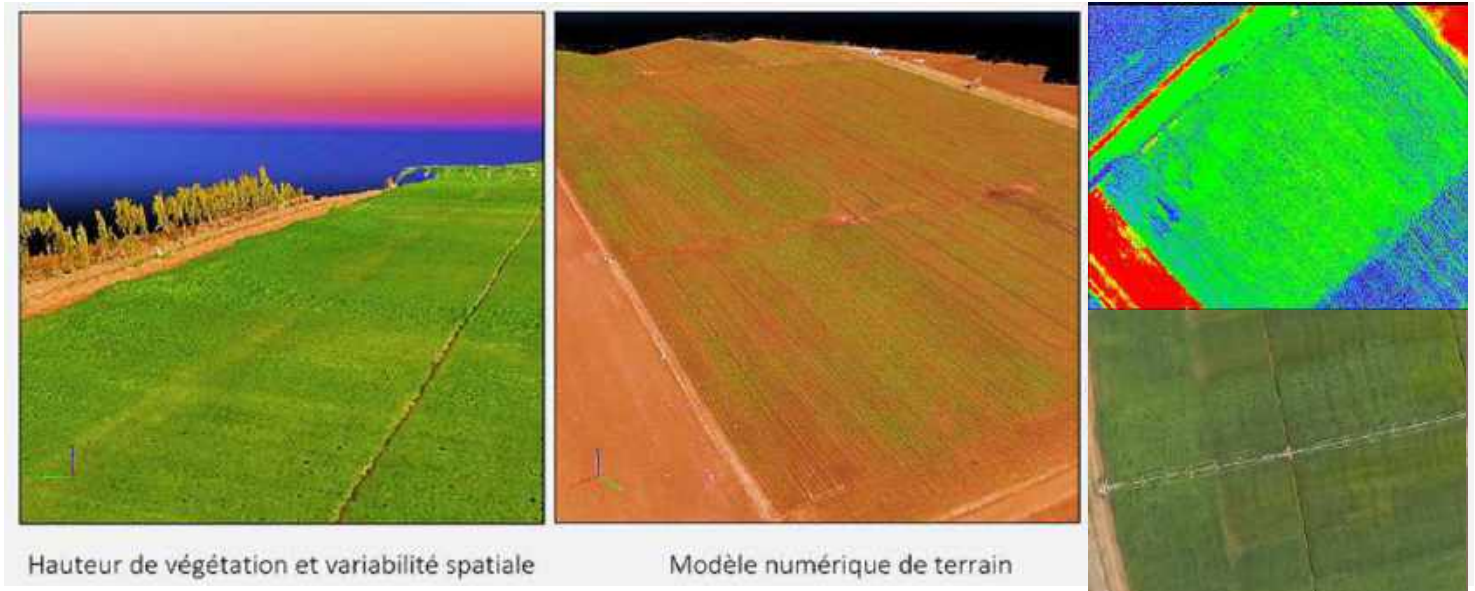
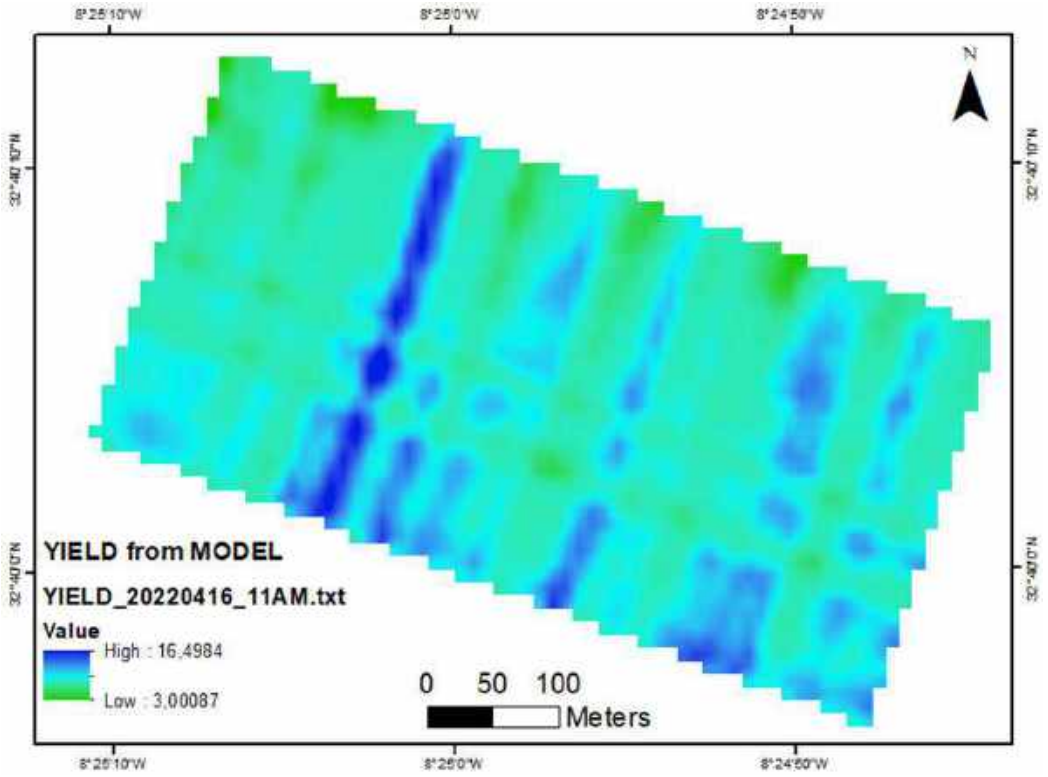
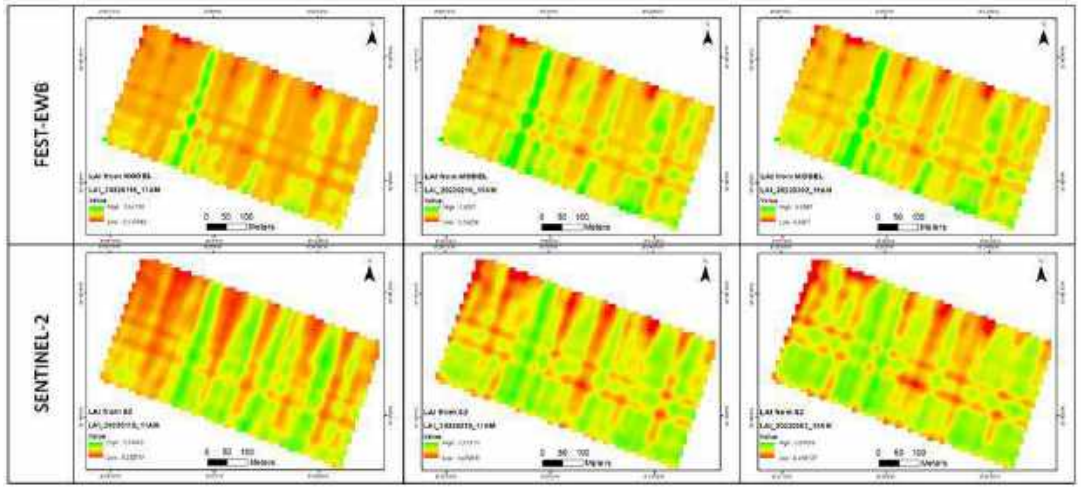


Image Drone: Agriculture de précision

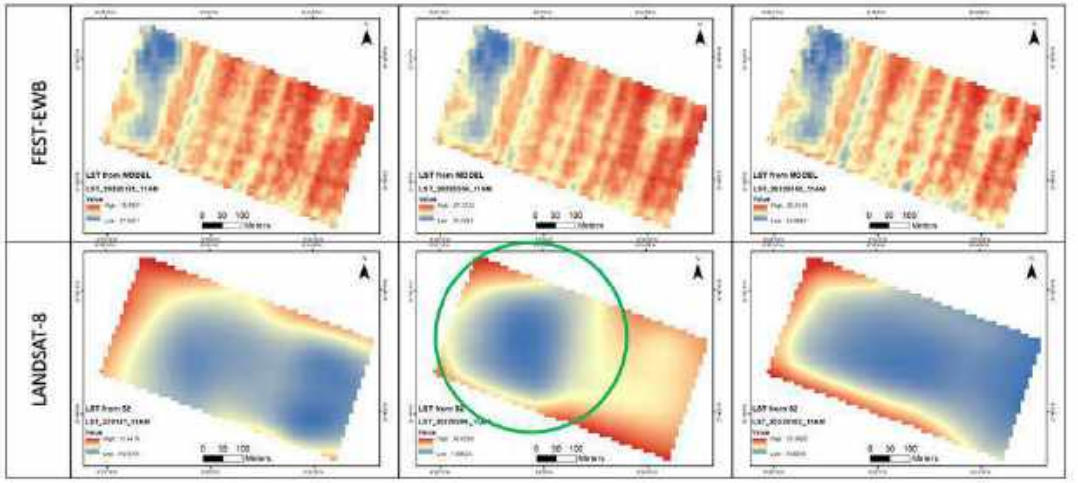


Yield map
by SAFY model

Calibration du modèle FEST-EWB-SAFY
Culture: Blé
Parcelle SB-15-23 (Kandil)



LAI-Sent2



LST-Landst8

Mutualisation / coordination des efforts

Doukkala's irrigation area, image Kompsat, labbassi's credit

- Partners' points of strength and roles identified
- Researchers, Stakeholders and end-user involvement

Thank you.....