Task4.3. Comparing irrigated and rainfed agrosystems

Objectives:

- Cross analysis about vulnerabilities and adaptation capabilities.
- On the basis of indicators
  - from observed times series about past / current trends
  - from numerical simulations about future trends
- about
  - water stress occurrences,
  - water use efficiency,
  - blue / green water distribution
- by considering several spatiotemporal scales.

Task4.3. Comparing irrigated and rainfed agrosystems

Question : which kind of indicators ?

- Water use efficiency :
  - plant scale, field scale, watershed scale ?
  - across the whole crop cycle, during key phenological periods ?
- Which scale :
  - Farm / irrigated perimeter / land use class / catchment ?

- Activity starting at month 18
- INRGREF, INAT, UCA, CESBIO, CERTE

Task4.3. Comparing irrigated and rainfed agrosystems

Some contributing works by UCA

Water stress occurrences from observations

- across the whole crop cycle,
- during key phenological periods ?

Task4.3. Comparing irrigated and rainfed agrosystems

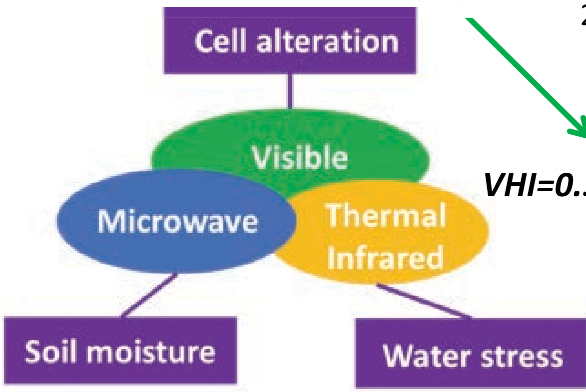
Some contributing works by UCA / CESBIO

Remote sensing variables and index

Vegetation Condition Index

$$VCI = \frac{NDVI_{(i)} - NDVI_{min}}{NDVI_{max} - NDVI_{min}} * 100$$

MODIS MOD13A2 (16-days, 1 km, 2000-2017)



VHI=0.5 TCI + 0.5 VCI

Soil Moister Condition Index

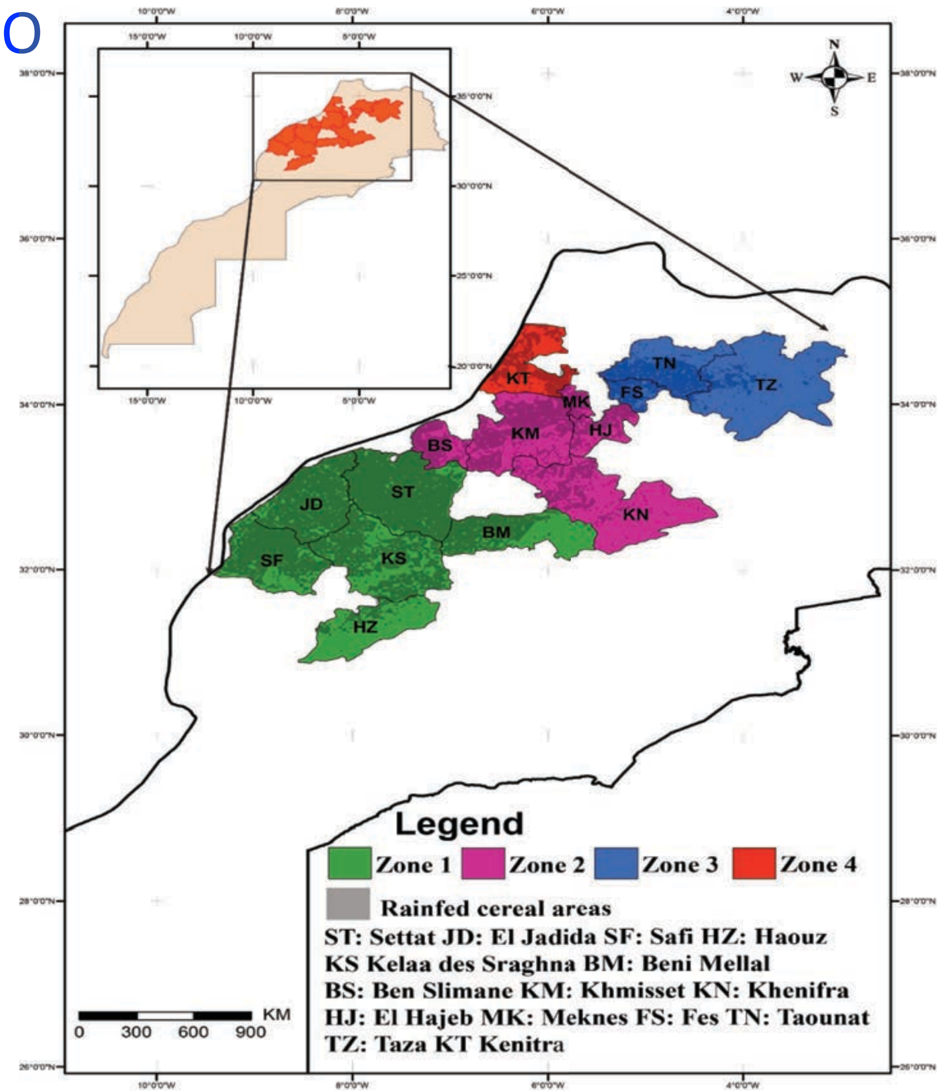
$$SMCI = \frac{SM_i - SM_{min}}{SM_{max} - SM_{min}}$$

ESA CCI SM (daily , 25 km, 2000-2017)

Temperature Condition Index

$$TCI = \frac{LST_{max} - LST_i}{LST_{max} - LST_{min}} * 100$$

MODIS MOD11A1 (daily, 1 km, 2000-2017)

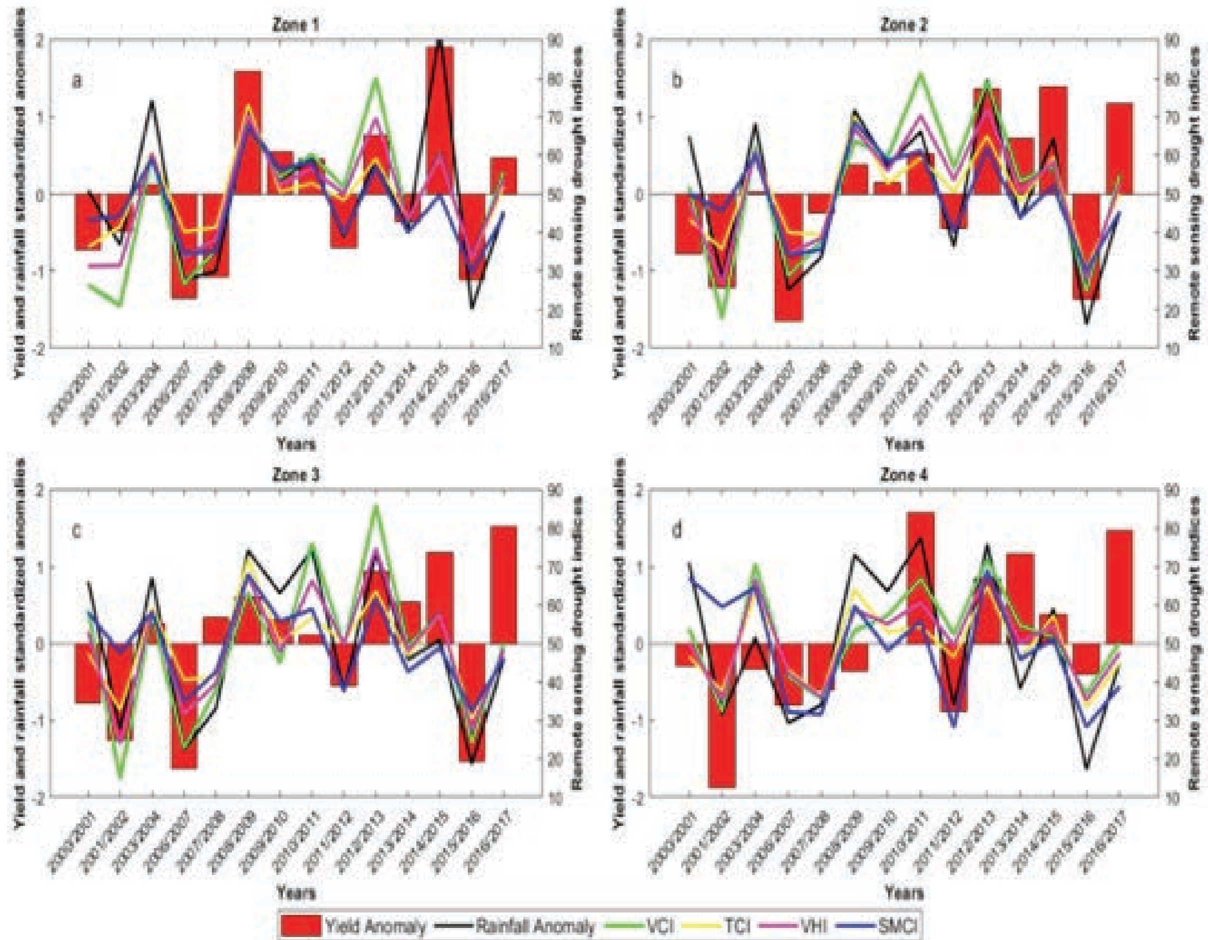


Results

Satellite Drought Indices and Yield Time Series

❖ Seasonal Scale

- The average of the indices over the season (from **October to May**)
- **High correlation** between all indices and yield.
- Extreme events **are well reflected** on the first 3 zones
- The specific behavior of zone 4 is related to **the dominance of irrigated areas** and/or **high coastal humidity.**

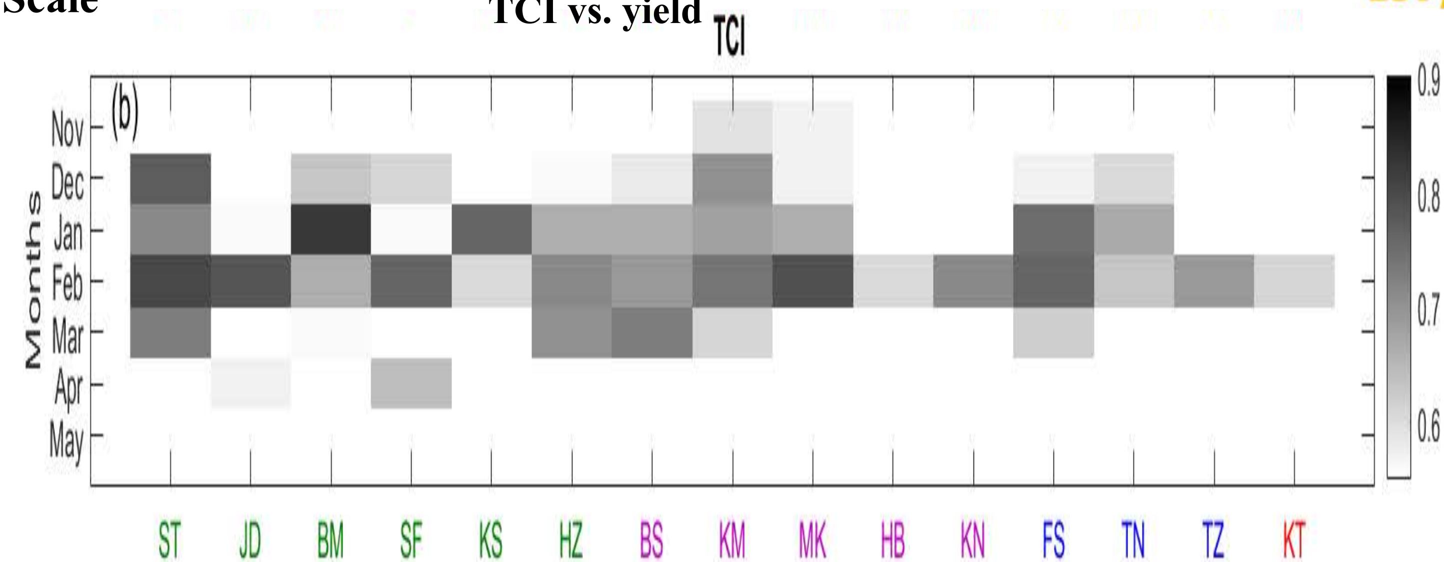


Results

$$TCI = \frac{LST_{max} - LST_i}{LST_{max} - LST_{min}} * 100$$

❖ **Monthly Scale**

TCI vs. yield



- Significant correlation in winter ranging from 0.61 to 0.82 around January or February.
  ➔ Mild temperatures in late autumn and early winter (December, January)

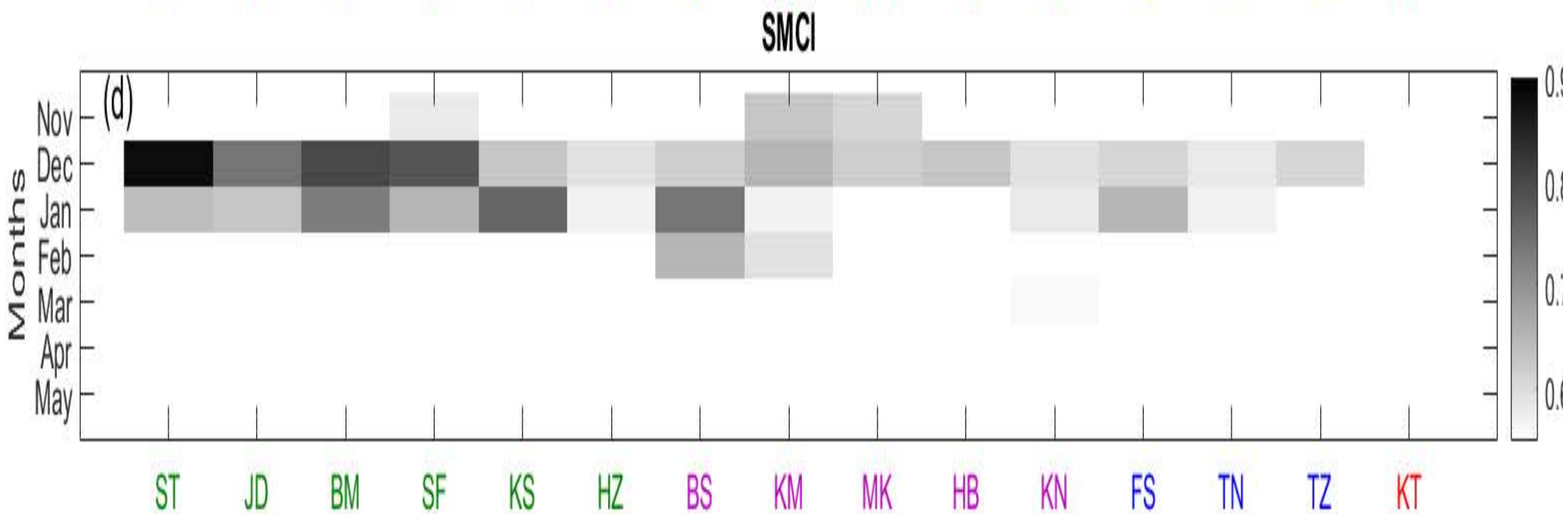
Our results are in line with the literature Salazar et al (2007), Hu et al (2020), Unganai and Kogan (1998)

Results

$$SMCI = \frac{SM_i - SM_{min}}{SM_{max} - SM_{min}} * 100$$

❖ **Monthly Scale**

SMCI vs. yield



- High and positive correlation between **(0.58 and 0.88)** at the beginning of the season **emergence stage** (November to January)

  ➔ High soil moisture are favorable for high yields at this time (Farmer are sowing after first rain).

Our results are in line with the literature Modanesi et al. (2020), Zhang et al. (2017)

Task 4.3: comparing irrigated and rainfed agrosystems

- Cross-analysis for studying vulnerabilities and adaptation capabilities.
- Production and comparison of simulation-based indicators for the above-discussed scenarios.

o Times series of water stress occurrences. o Yield and water use efficiencies.

o Spatial allocations between blue and green water compartments. o Sectorial allocation of water.

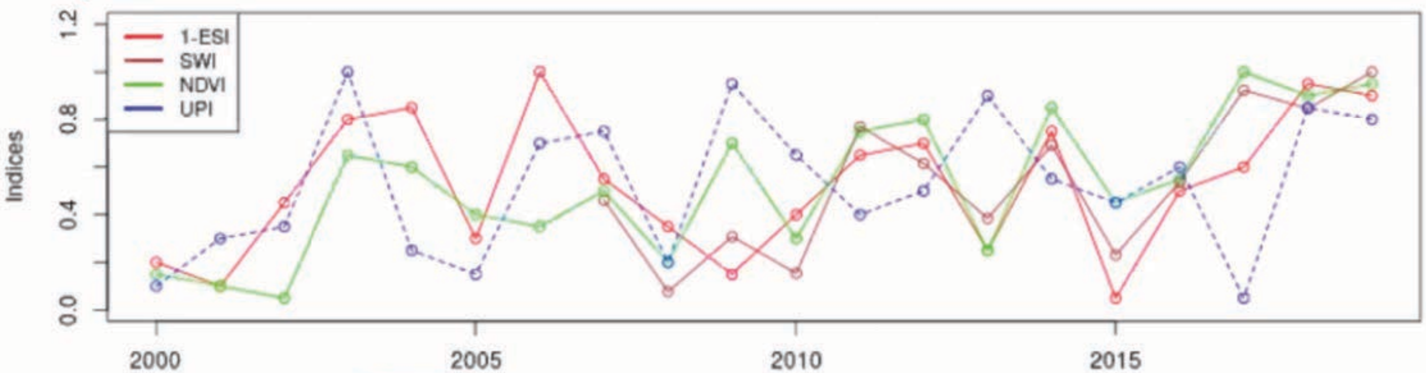
- Spatial scales for indicators are farm / irrigated perimeter / land use class / catchment.

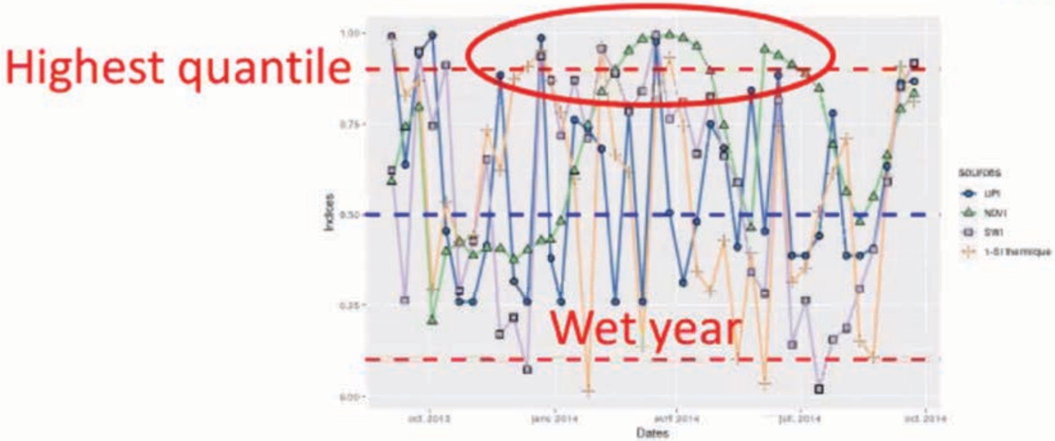
-> historical droughts over Kairouan plain using low resolution RS products: NDVI, SWI (µwave), ESI (TIR) vs UPI (rain)

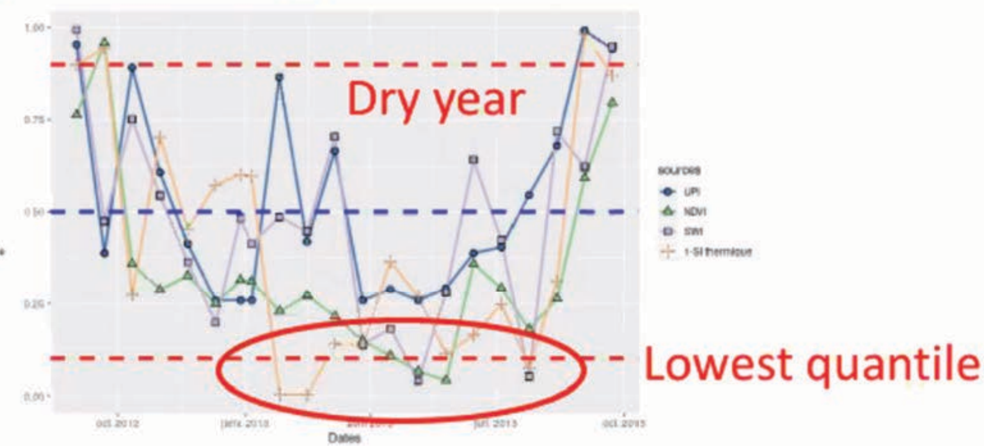
-> agronomical drought indicators in the mediterranean

-> impact of CC on yield

PhD Nesrine Fahrani

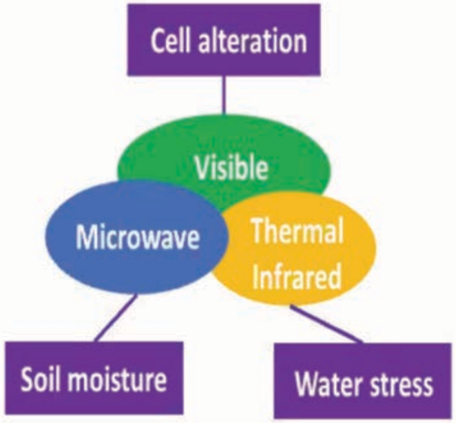




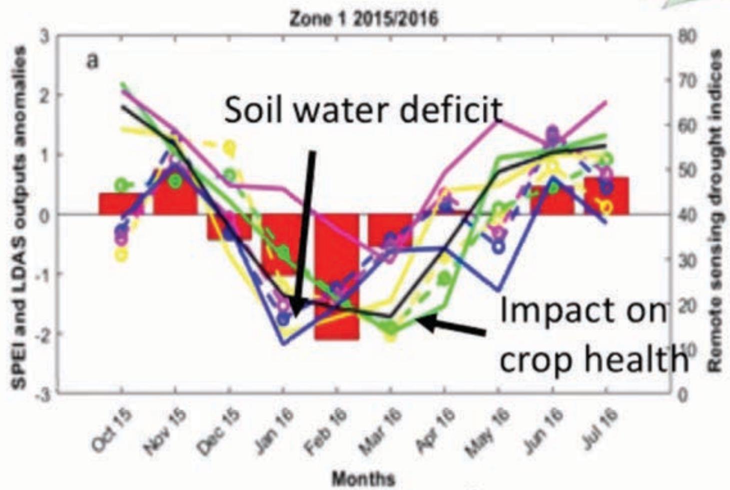


Agronomical drought indicators

Drought indicators

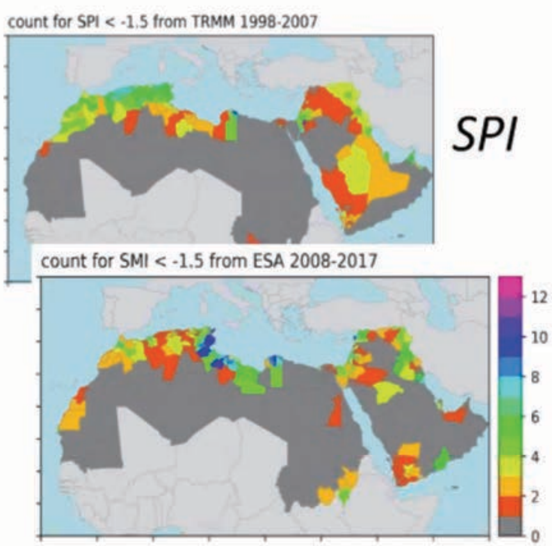


Timing of droughts impact



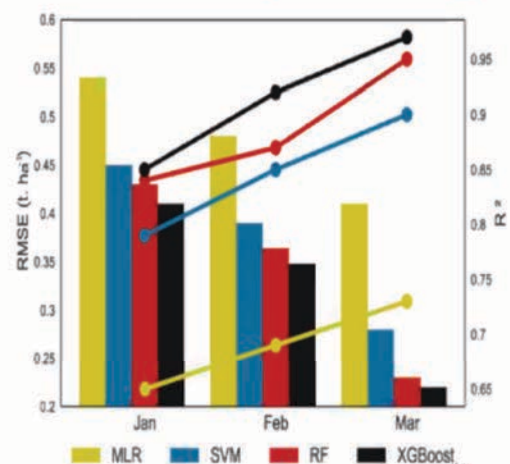
Bouras et al., MDPI/Remote Sensing, 2020

Drought mapping (Comparison of rainfall and SM products)



Najem et al., Nat. Scie. Rep., en révision

Drought indices for early forecasting of yields



Bouras et al., MDPI/Remote Sensing, soumis