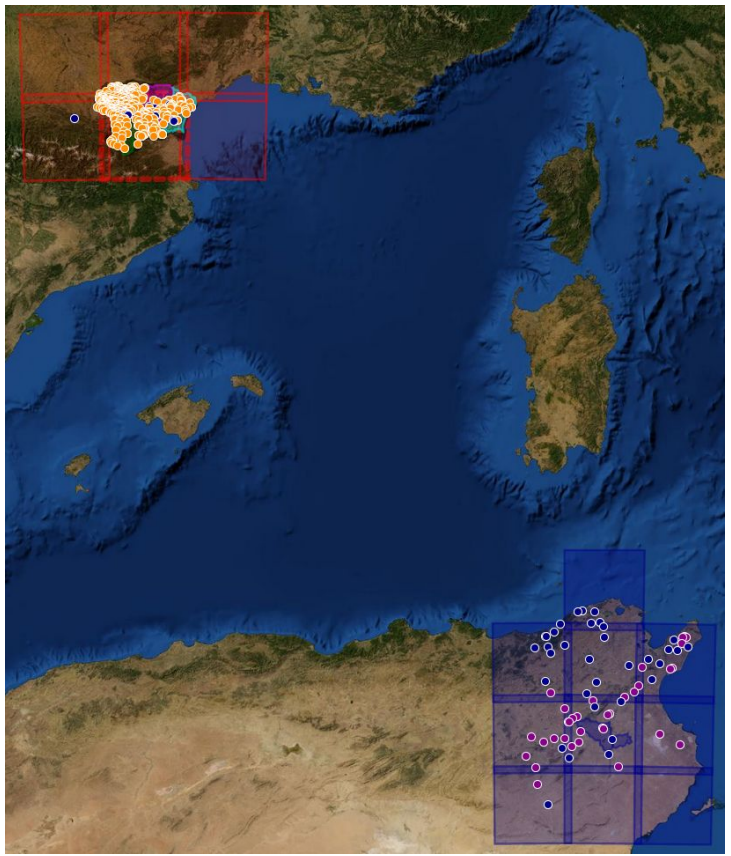
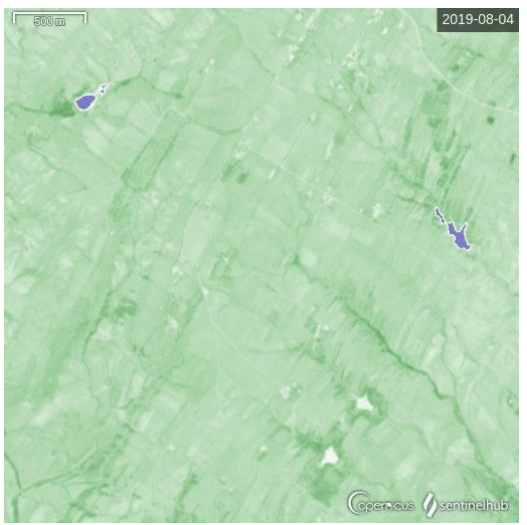
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.1 Reservoirs : *Lebna Watershed*



- Methods for estimating reservoir geometry depends on reservoirs characteristics
- => Need to establish reservoirs typology relative to filling/emptying dynamics
- Sentinel-1 and Sentinel-2 time series
- Collaboration with CNES (water detection)
- Master Thesis 2021 at LISAH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# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.2 Land Use : *Merguellil Watershed*

**supervised classification** ← Confusion between clusters → **unsupervised classification (K-means method)**

**Satellite data**

Sentinel 2
**(01/09/2020 -28/04/2021)**

Cloud cover

Select images where the clouds are less than 30% of the study area

Calculate the indexes (NDVI, NDWI, IB)

gapfilling

Image stack

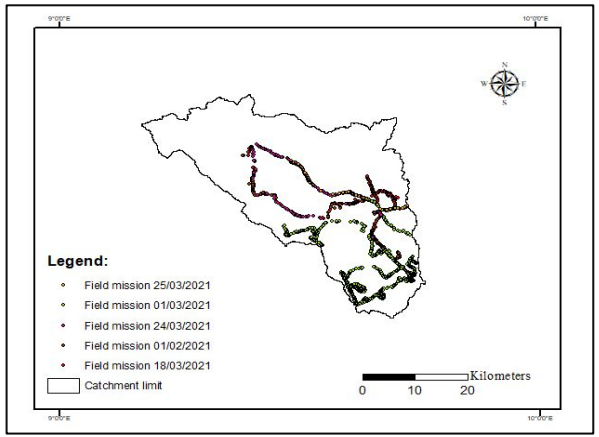



**Figure 2: Field observation (1500 samples)**

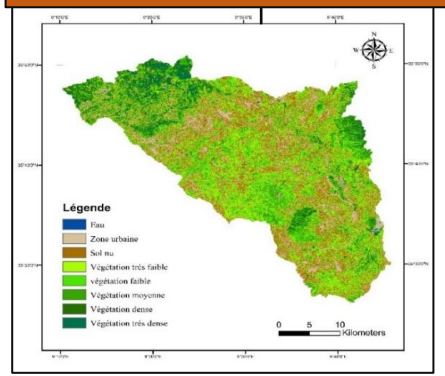



**Figure 1: land use map (23/02/2020)**

Normalized Difference Vegetation Index (**NDVI**)= (NIR-R)/(NIR+R)

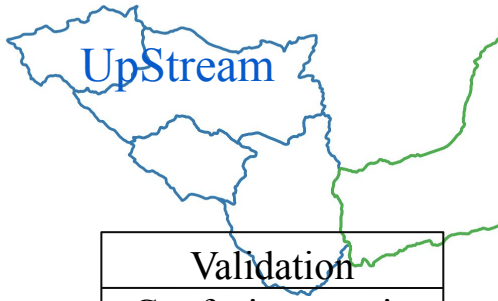
Normalized Difference Water Index (**NDWI**)=(G-NIR)/(NIR+R)

Brightness index (**BI**) $= \sqrt{(G^2 + R^2 + NIR^2)}$

**Train** **Test**

Classification
Statistical computing : mean, STD
Algorithm : Random Forest

Land use Map




Validation
Confusion matrix
Kappa Coefficient

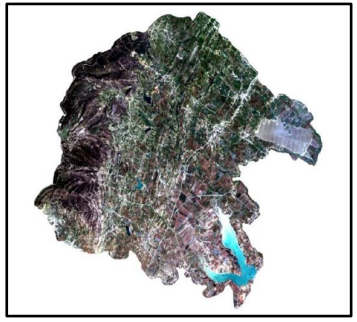
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.2 Land Use : *Lebna Watershed*

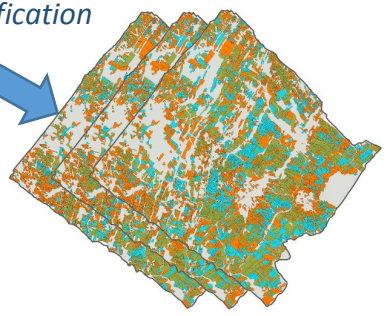
Analysis of the spatio-temporal distribution of crops in the landscape

- Need to understand the current logic of crop distribution in the landscape to help define acceptable land use scenarios for farmers.
- In some parts of North Africa, the spatio-temporal distribution of crop in the landscape results from individual farmers' rules or from collective farmers' rules.

Question : To what extent does the spatio-temporal distribution of crops at the landscape level originate from collective rotations in north-eastern Tunisia ?

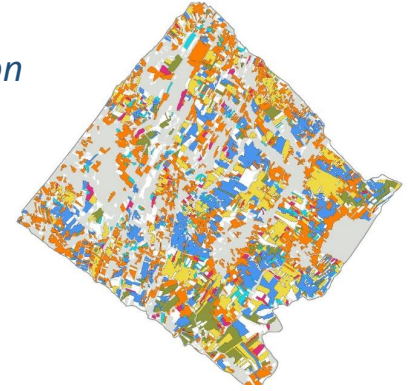


*1 - Spot® image classification*



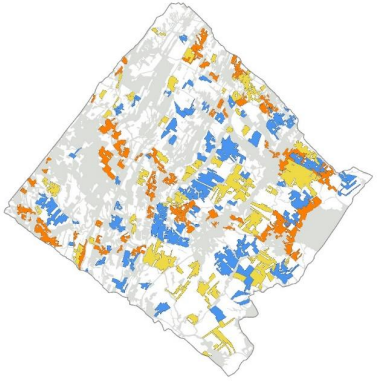
Annual crop distributions at field resolution over successive years

*2 - Identification of clusters*



Clusters of adjacent fields having the same type of crops sequence (e.g. 'Wheat/Other crop/Wheat')

*3 - Spatial statistical test*



Clusters resulting from collective rotations

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# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.2 Land Use : *Tensift*

**Context and objectives**

**Generic issues of classification methods**

Need for groun truth each year for learning (often missing)

Typically 2/3 crops / year => annual map inadequate => maps by season

**+ High complexity of land use in the Mediterranean area**

Associated crops

Heterogeneous development of the same species depending on practices / environment

**=> Objectives**

Methods with minimal requirement for annual ground truth

Classification methods fitted to complexity of the Mediterranean area (=> robustness)

Increase updates frequency (by season instead of yearly)

# Task 1.2: landscaping features, agricultural practices and connectivities

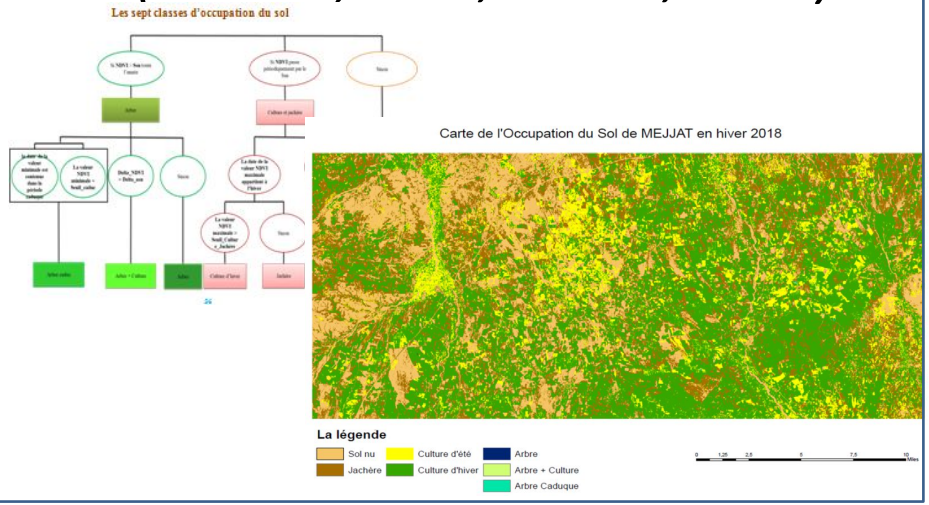
## 1.2.2 Land Use : *Tensift - Planned activities (CESBIO, UCA, UM6P, INAT)*

- **Testing methods based on decision trees** and phenological criteria (e.g. vegetation max. period, vegetation duration, etc.)

Use of Sentinel-2 time series (Master thesis M1 *2018, M2 2019 Morocco*)

**=> Objectives**

- Finalise in Morocco (seasonal maps for several years)
- Apply in Tunisia (Merguellil)

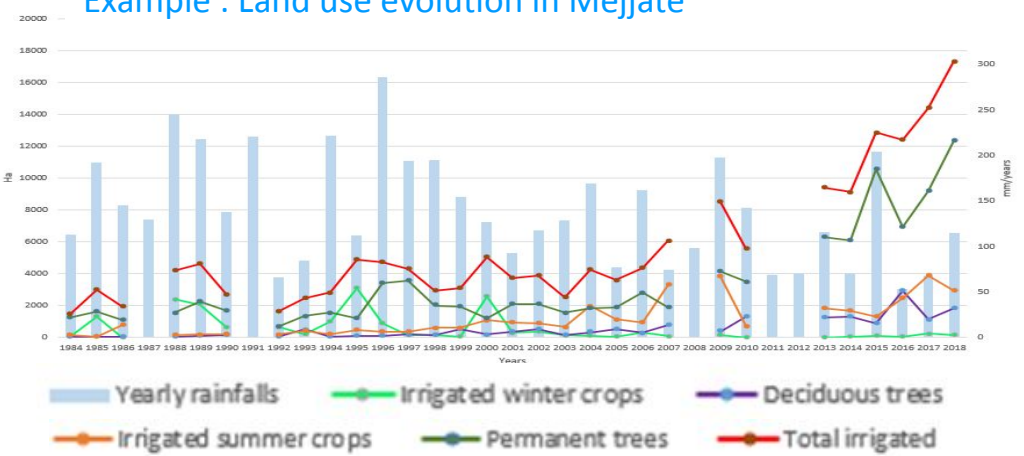



**Reconstitution of LU 1984-2020 history** with Landsat archive (Master thesis *M2 2019 Morroco*)

**=> Objective**

- Finalise Morroco work
- Implement in Tunisia

Example : Land use evolution in Mejjate

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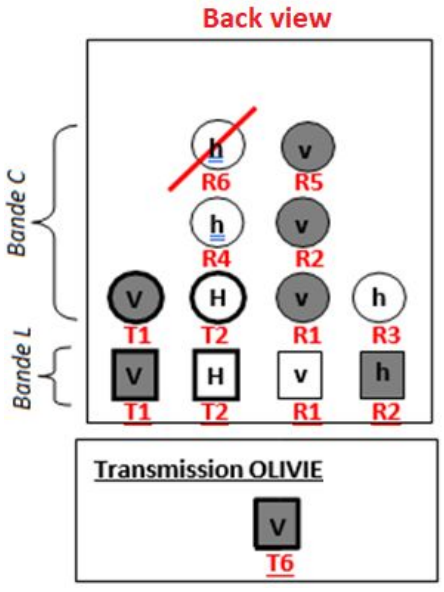
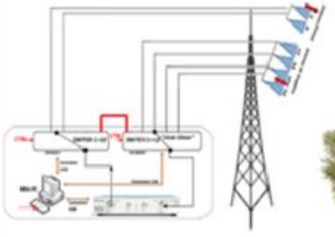
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.2 Land Use : *Tensift (CESBIO, UCAM, UGA)*

Detection of tree crops water stress by C-band radar remote sensing

**In-situ radar measurements:**



**The experience is funded by :**

- CNES/TOSCA MOCTAR

- High Time Frequency Quarter Hour Measurements
- 6 C-band horn antennas (8 Trans/Recep pairs)
- 4 L-band horn antennas (4 Trans/Recep couples)
- 1 L-band horn transmission antenna in the field

- Frequency C & L Band: 5.2-5.8 GHz / 1–1.4GHz
- High frequency time sampling: 3 measurement sequences for each measurement

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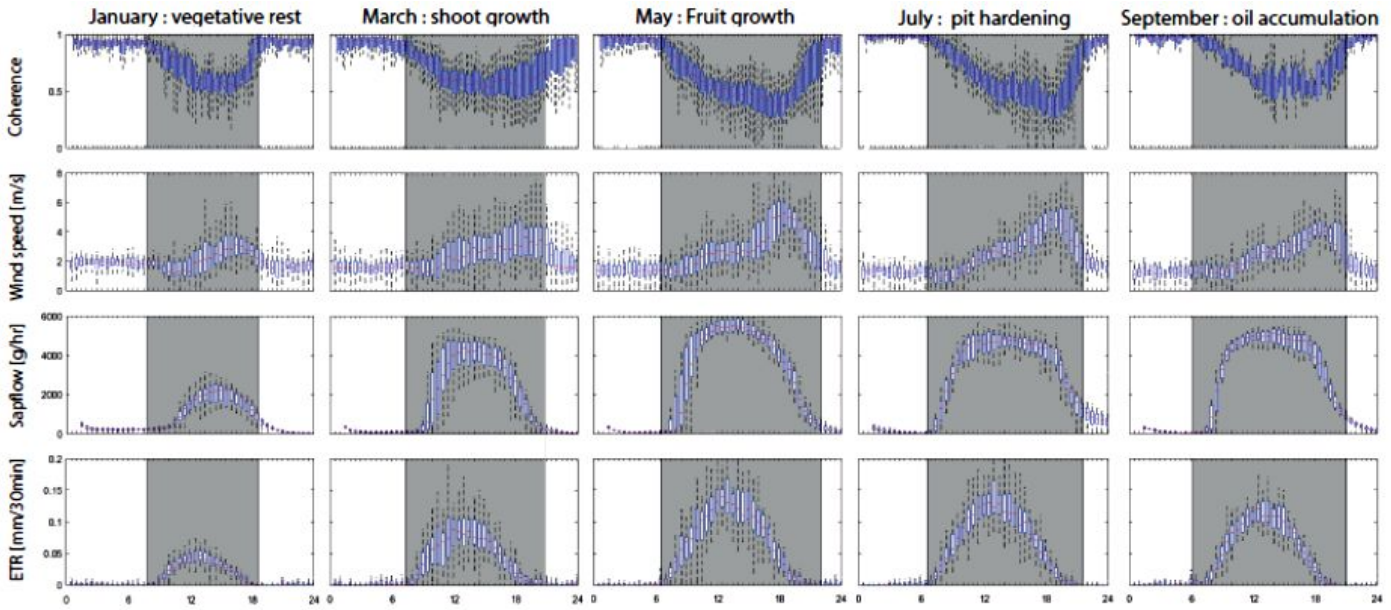
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.2 Land Use : *Tensift (CESBIO, UCAM, UGA)*

## Results - In-situ & sentinel-1 radar data overview :

**Daily average monthly cycles for four key olive physiological stages :**




- High drop in coherence during the summer which corresponds to an increase in vegetation activity (vegetation growth, high demand for water that translates to ETR & Sapflow, etc.)
- A slight decrease in coherence in January which corresponds to a decrease in vegetation activity due to its resting period (low physiological activity in winter)

# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.3 Crop Biomass : *Lebna Watershed (INRGREF/SupCOM)*

- **Objective :** spatiotemporal monitoring of biophysical parameters of rainfed crops ( cereals, legumes, cereal-legume mixtures) for a better water management in rainfed agriculture.
- **Agricultural seasons 2019/2020 and 2020/2021**

| | 2019/2020 | 2020/2021 |
|---|---|---|
| Experimental sites | **5 sites** (2 wheat, 1 faba bean, 1 oat, and 1 mixed crop of vetch and triticale) | **4 sites** (2 mixed crops of vetch-faba bean and triticale, 2 wheat)<br><br>+ **21 sites** of a biomass sampling campaign on 25 and 30 March 2021 |
| Sentinel images | 7 | 12 |
| Field campaigns : biomass sampling, biophysical parameters and phenological stages | 6 | 10 + 2 biomass campaigns during full growth of crops (25 and 30 March 2021) |

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# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.4 Chemical treatements : *Pesticides Treatments in Lebna Watershed*

Objective: To get knowledge about what /how/where/when/at-what-dosis are the active ingredients applied now-days in a south bank Mediterranean watershed (from pluvial up stream to irrigated zones down stream).

*Comment : This task is shared pro-parte with the Eranet Med Project CHAAMS which focuses more specifically on herbicides in pluvial context.*

- Three types of pesticides treatments surveys were & are performed in Lebna watershed :
  1- In OMERE site, 2016 -2021 : Annual survey, in continuous area. Work with IRD Staff (Zakia Jenahoui) -> to be included in observatory data base.
  2- In Lebna pluvial zone (9 sub-watershed of lakes) 2 years of survey, random sampling (2019/2020, 2020/2021). Work with Doctorate student (Ghada Dahmeni) involved in CHAAMS project. -> to be included in PRIMA and CHAAMS data base.
  3- In Coastal irrigated zone: Two years in of annual surveys 2015-2016, in continuous irrigated area dataset will be consolidated and re-analysed). To be included in PRIMA database.

# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.4 Chemical treatements : *Pesticides Treatments in Lebna Watershed*

- To discuss Tunisian water contamination potentiality in front of bibliographic sources about other Mediterranean countries and situations
- To discuss differences between surveys methodologies : continuous and/or random sampling methods.
- To evaluate yearly variability of treatments
- To link treatments applications with cultivations.
- To assess key periods for water contamination by particular active ingredients

A result exemple
on wheat in Lebna

| | Products | Active ingredients |
|---|---|---|
| Wheat | Lancelot 450 | Aminopyralydes + Florasulam |
| | Camaro430 | tébuconazole |
| | Chardol 720 | 2,4-D |
| | Puma Komplete | Fénoxaprop-p- Ethyl + Iodosulfuron-méthyl Sodium +Méfenpyr diéthyl |
| | Amilcar | Mésosulfuron-Méthyl (Mesomax) + Iodosulfuron + Méfenpyr diéthyl |
| | Amistar extra | Azoxystrobine |
| | Topol | 2,4-D sel d'amine |
| | Banko 720 | chlorothalonil |
| | Dialen Super | Dicamba+2,4-D |
| | Horizon 250 | tébuconazole |
| | Granstar | tribenuron-méthyl |
| | kalach | glyphosate |

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# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.4 Chemical treatements : *Pesticides Treatments in Lebna Watershed*

### Calendar & difficulties

- 80 % of field survey work is done (rest is to be processed before end of August 2021).
  - First recommendations about Herbicide contamination in pluvial to be delivered in the mark of CHAAMS in July 2021.
- Deliverables :
  - Data set => 15 month and Milestone: MS1 => 18 Months
    - First Intent for OMERE data => end of 2021
    - Data Pluvial Lebna => end of 2021
    - Data Coastal Lebna => Beginning of 2022
  - Methodological paper => 21 month
    - Survey paper => Mid 2022 :
  - Main drivers of water contamination by pesticides in pluvial and Irrigated part to be delivered mid-2022.
- Difficulties
  - to adopt an appropriate database format (compatible with Hydrological data basis)
  - Extrapolations of the treatment surveys at Lebna scale 200 $km^2$ in absence of precise knowledge of the different crops areas of the year.

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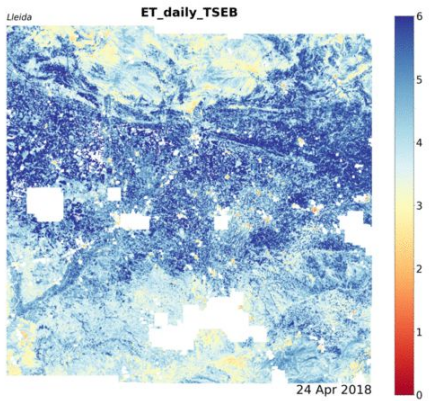
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.5 Hydrological connectivities : *Segre test site*

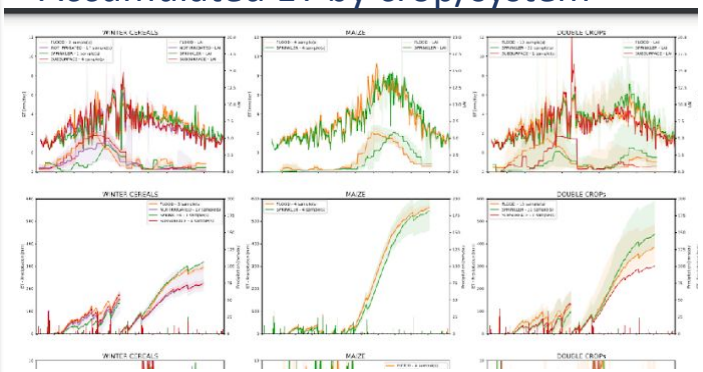
### Inputs for hydrological models

#### 1.Time-series of ET




#### 2. Classification of types of irrigation systems

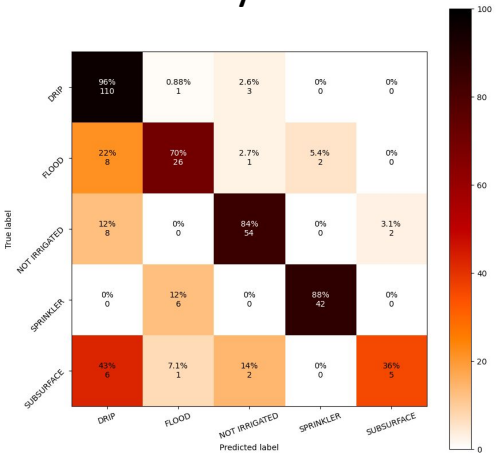
Accumulated ET by crop/system

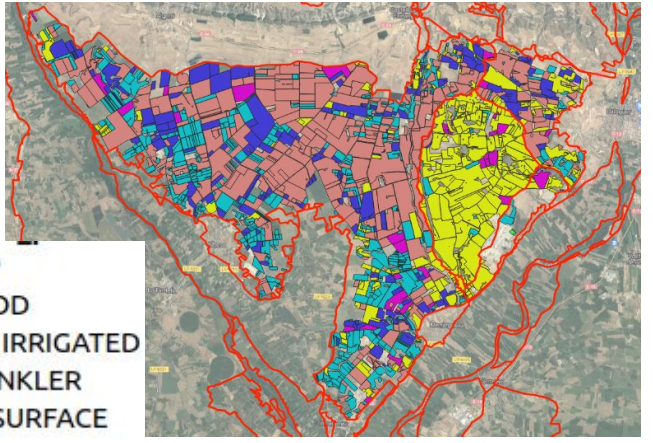



TimeSeries Forest

ROCKET (random convultional kernel transformation)

Accuracy 85.56%



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## 1.2.5 Hydrological connectivities : *Orroli test site*

**Activities:**

**-multisource and multiscale information for representations of surface / subsurface connectivities**


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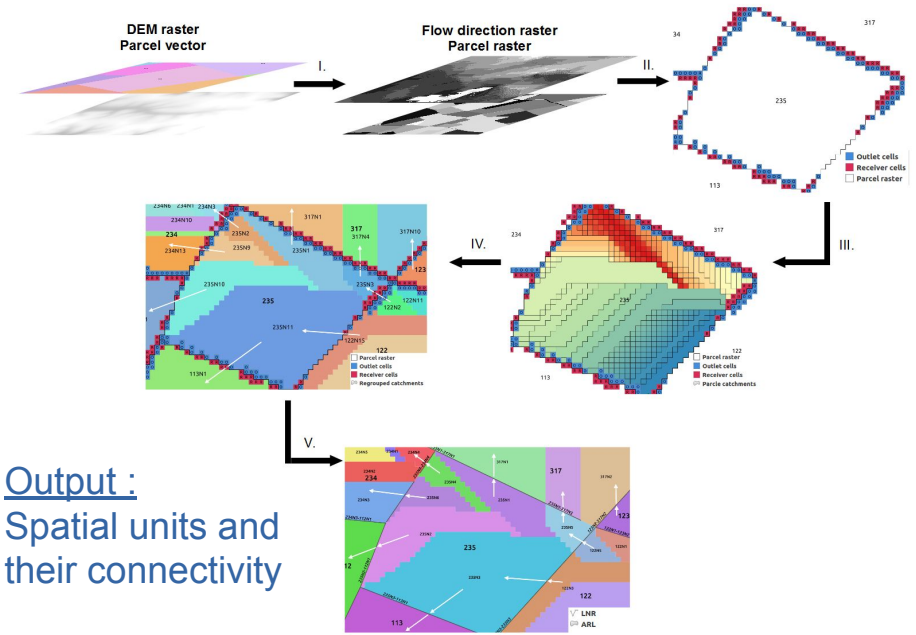
# Task 1.2: landscaping features, agricultural practices and connectivities

## 1.2.5 Hydrological connectivities : *Lebna watershed*

## Groovscape : a landscape discretization tool

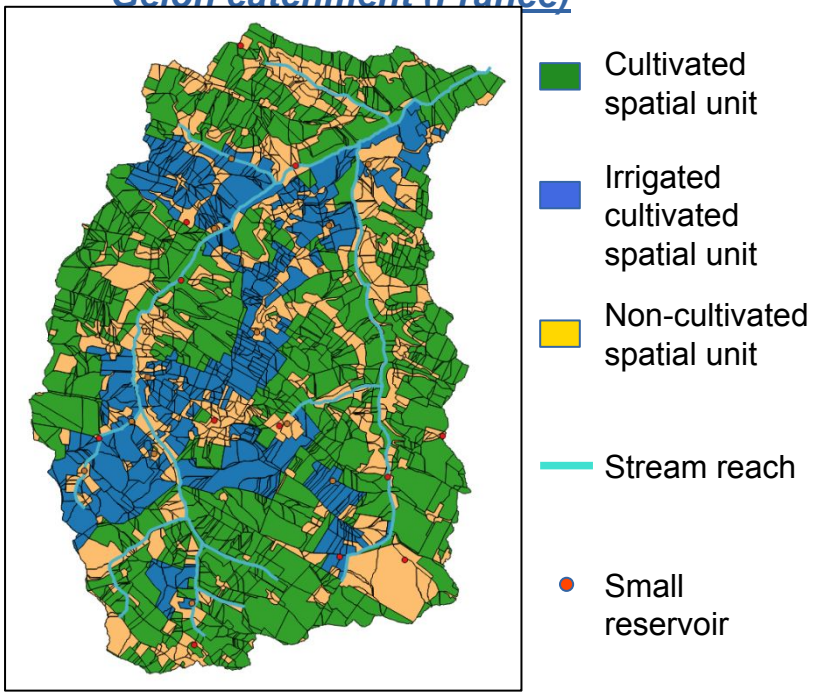
*Lagacherie et al.*

***Steps from data (DEM, parcel, soil) to topology***




Output :
Spatial units and their connectivity

***An example of discretization : Gelon catchment (France)***

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# Task 1.2: landscaping features, agricultural practices and connectivities
# Milestones and deliverables

- MS1: update of clustered database with collected data from monitoring systems. @ Month 18
- D1.2.1 [Task 1.2]: dataset @ Month 15 to be included into project clustered database (WP5).
- D1.2.2 [Task 1.2]: 2 submitted publications for methodological innovations @ Month 21. **=> Done**

Thank you for your attention

# Task 1.2: landscaping features, agricultural practices and connectivities
# Milestones and deliverables

- MS1: update of clustered database with collected data from monitoring systems. @ Month 18
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Thank you for your attention