

# Available datasets for the LIAISE WG3 experiment: atmospheric forcing and physiography.

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LIAISE WG3 Meeting 31/03/2022

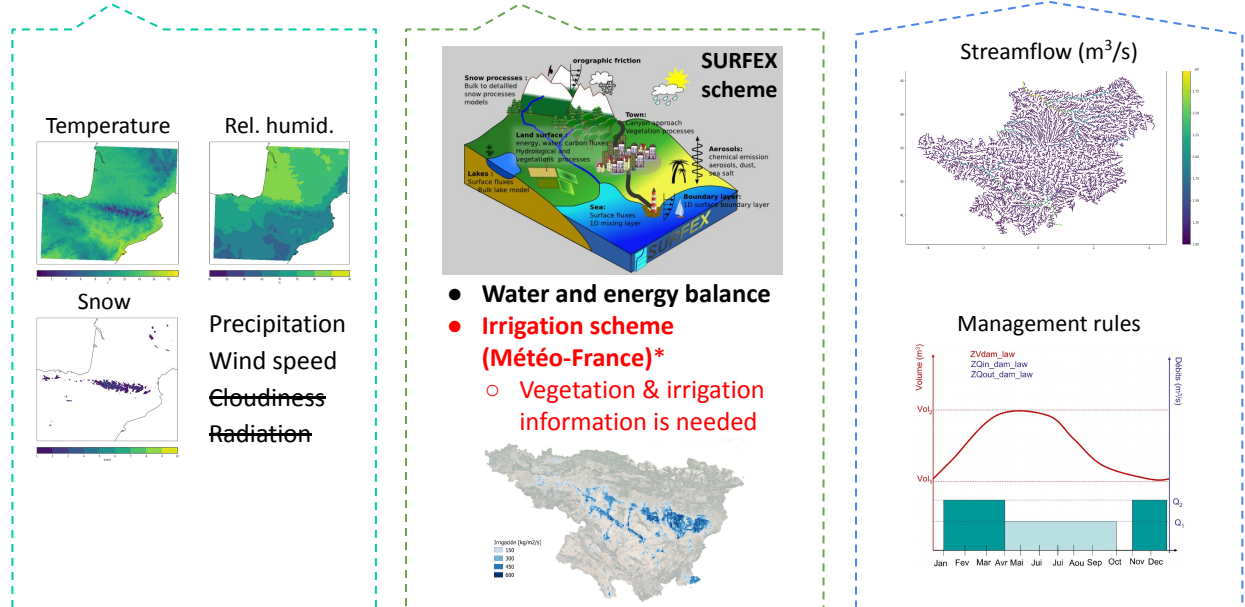


# SASER hydrometeorological chain

## SASER: LSM based hydrological modeling chain.

Implemented in three domains:

- Iberian Peninsula
  - 1979-2016.
  - 5 km.
- Enlarged Pyrenees.
  - 1979-2014.
  - 5 km.
  - Including climate scenarios.
    - 6 models.
    - 2 RCPs
- Ebro River Basin.
  - 2008-2019-2021
  - 1 km.



- Water and energy balance
- Irrigation scheme (Météo-France)\*
  - Vegetation & irrigation information is needed

\* No link between irrigation and dam management

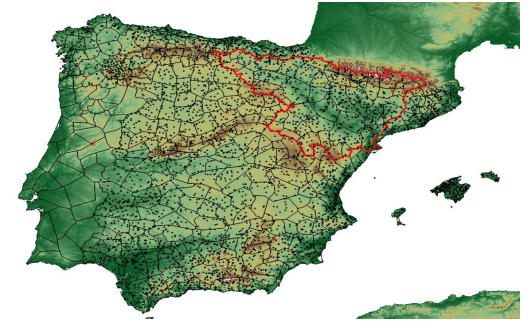
# SAFRAN meteorological forcing dataset

**SAFRAN** meteorological analysis system (Météo-France)

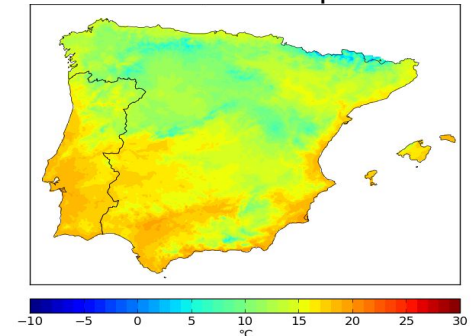
- There are different versions of SAFRAN
  - SAFRAN “Avalanches” (Grenoble)
  - SAFRAN “Simplified” (Toulouse)
- Variables: P, T, W, RH,  $\ominus$ .
- Optimal interpolation method.
- Modelled downward VIS and IR radiation.
  - Bad results in Spain, we use ERA5 instead.
- Input:
  - 6h observed data, 24h for P.
  - First guess (ERA5).
- Output:
  - 1h time step (not real time resolution),
  - User defined grid (5, 2.5 km or 1 km).

**Challenge:** Some areas of the Pyrenees have a low density of rain gauges.

SAFRAN/ES zones and meteorological stations.

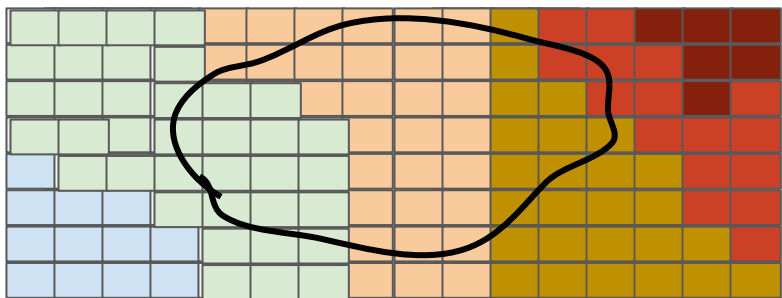
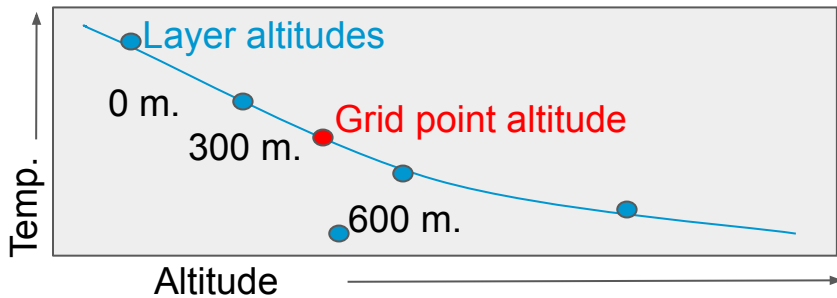
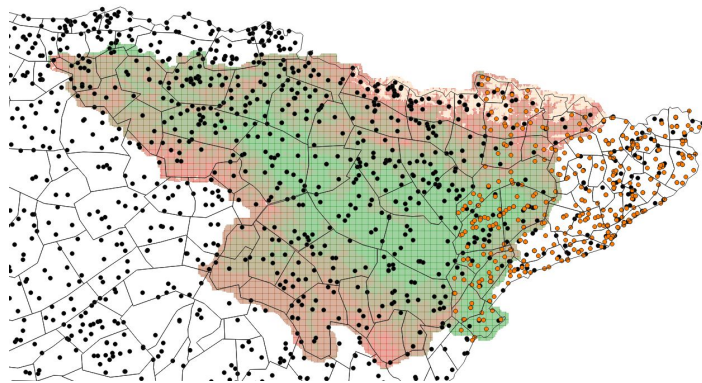


Mean annual temperature

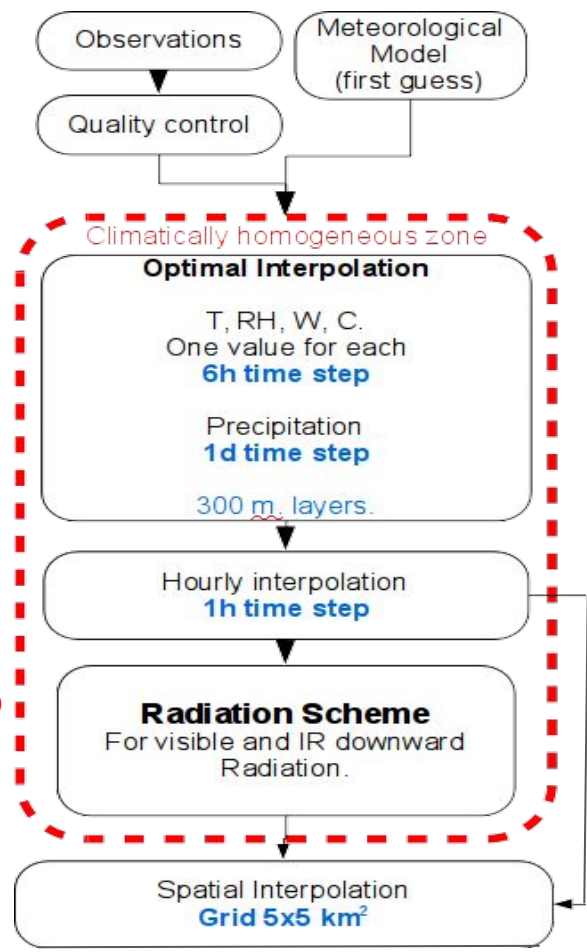


# Interpolation to the grid

- For each zone, we have one value of each variable at different altitude levels.
- Each grid point in the zone has an altitude.
- We can vertically interpolate.



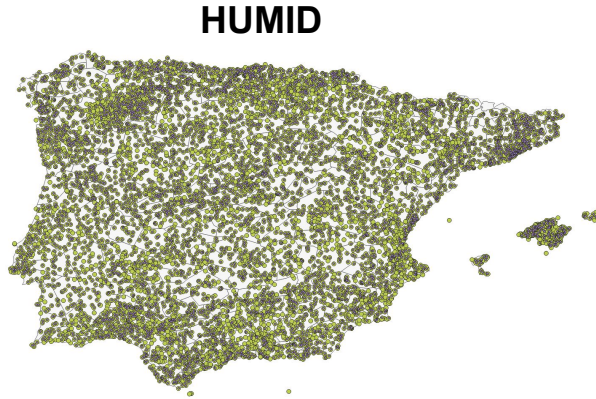
Homogeneous zones



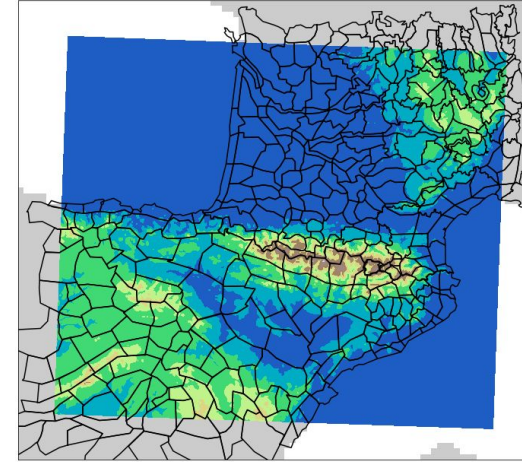
# Current implementations

## HUMID

- Iberian Peninsula and Balearic Islands.
- AEMET + Portuguese observations.
- 5 km of spatial resolution.
- 1979/80-2016/2017.



## PIRAGUA

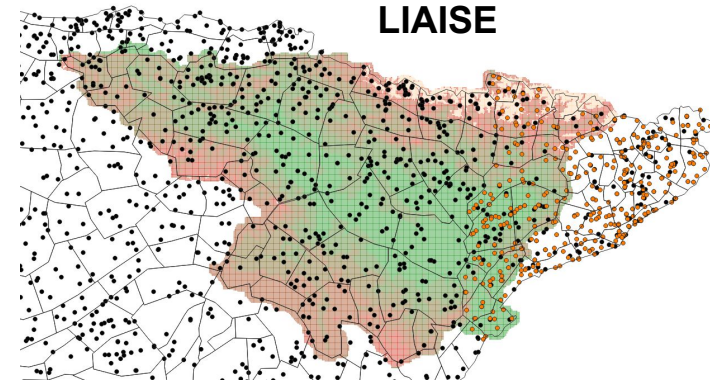


## PIRAGUA

- Enlarged Pyrenees (Adour-Garonne, Ebro, ...).
- AEMET + Météo-France observations.
- 2.5 km of spatial resolution.
- 1979/80-2014/15.

## LIAISE

- Ebro River Basin.
- AEMET + SMC observations.
- 1 km of spatial resolution.
- 2008/09-2019/2020
  - we plan to add one year every year.



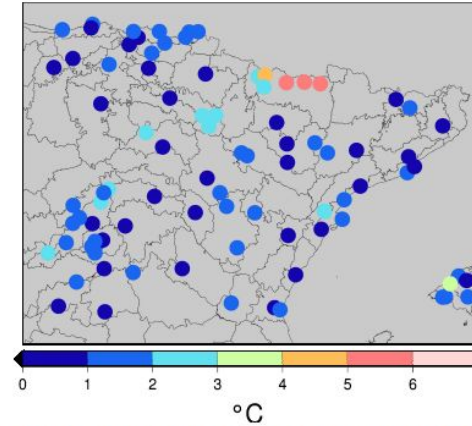
# Validation

## Quintana-Seguí et al. (2016) Validation of an implementation on the North-East of the Iberian Peninsula at a resolution of 5 km.

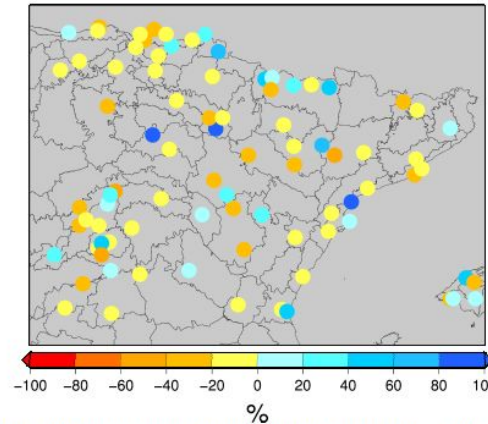
**Table 3.** Mean Bias (analysis - observations) and RMSD Calculated for Dependent Stations

	SF <sub>m</sub> <sup>o</sup>	SF <sub>b</sub> <sup>o</sup>	SF <sub>m</sub> <sup>g</sup>	SF <sub>b</sub> <sup>g</sup>	SP	HIR
Bias						
T (°C)	0.0	0.0	-0.2	-0.2	-	-0.8
W (m·s <sup>-1</sup> )	-0.2	-0.3	-0.2	-0.3	-	0.5
HR (pp)	0.3	0.4	0.1	0.2	-	-0.4
N (oktas)	-1.5	-1.2	-1.4	-1.2	-	-1.0
P (mm·d <sup>-1</sup> )	-0.1	-0.1	0.0	0.0	0.1	0.2
RMSD						
T (°C)	1.0	1.5	1.4	1.6	-	2.2
W (m·s <sup>-1</sup> )	1.2	1.6	1.3	1.5	-	2.0
HR (p.p.)	7.8	9.3	8.6	8.7	-	12.6
N (oktas)	3.0	3.0	3.0	3.0	-	3.2
P (mm·d <sup>-1</sup> )	3.2	3.4	3.2	3.5	2.9	6.8

\*The differences in Relative Humidity are expressed in percentage points (pp).



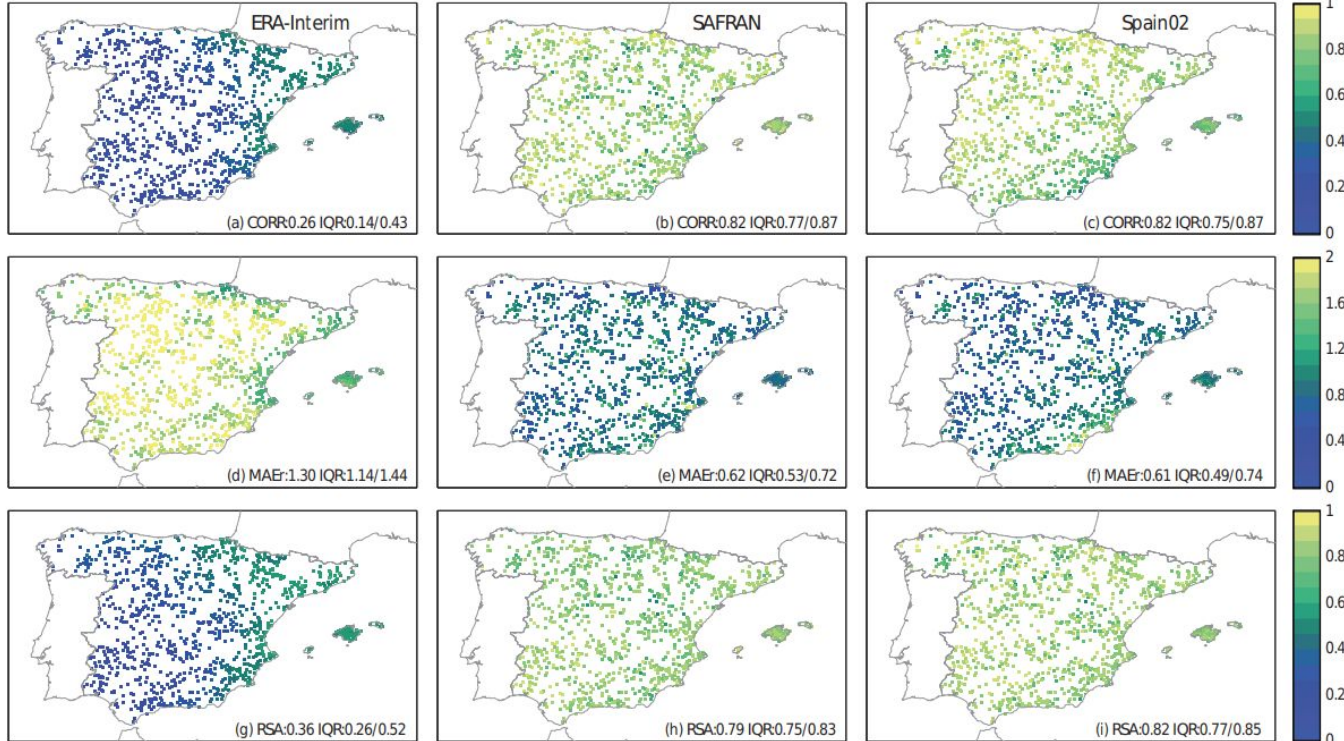
**Figure 2.** RMSD of mean annual temperature (°C) between SAFRAN ( $SF_m^g$ ) and the dependent stations.



**Figure 3.** Relative bias of mean annual wind speed (%) between SAFRAN ( $SF_m^g$ ) and the dependent stations.

- Scores comparable to those obtained in France.
- Scores always better than those of HIRLAM.
- The interpolation to the grid doesn't degrade the results much.
- More uncertainty over the relief.

# Validation



- Quintana-Seguí et al. (2017)
- SAFRAN and Spain02 have very similar scores.
- SPAIN02 a little bit better.
- Both better than ERA-Interim.
- SAFRAN is robust.
- Furthermore, both SAFRAN and Spain02 are also robust with altitude and across seasons.
- Era-Interim reproduces spells remarkably well in contrast to the low skill shown by the high-resolution products.

# Improving hourly precipitation

SAFRAN Precipitation is Un-Mediterranean at hourly time scales.

- ingests daily precipitation observations, which are distributed to an hourly scale using relative humidity.
- Low intensities and unrealistic hourly distribution.

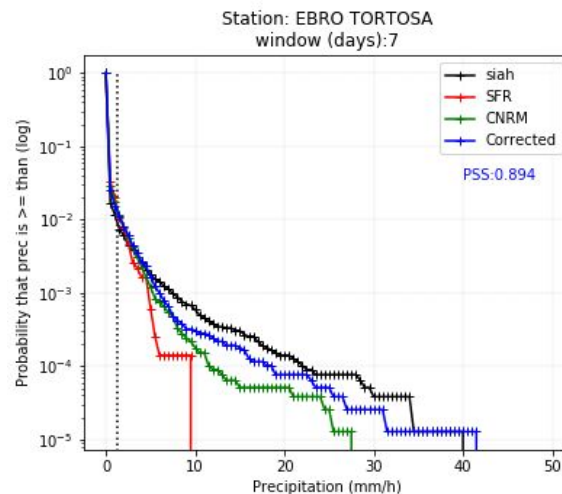
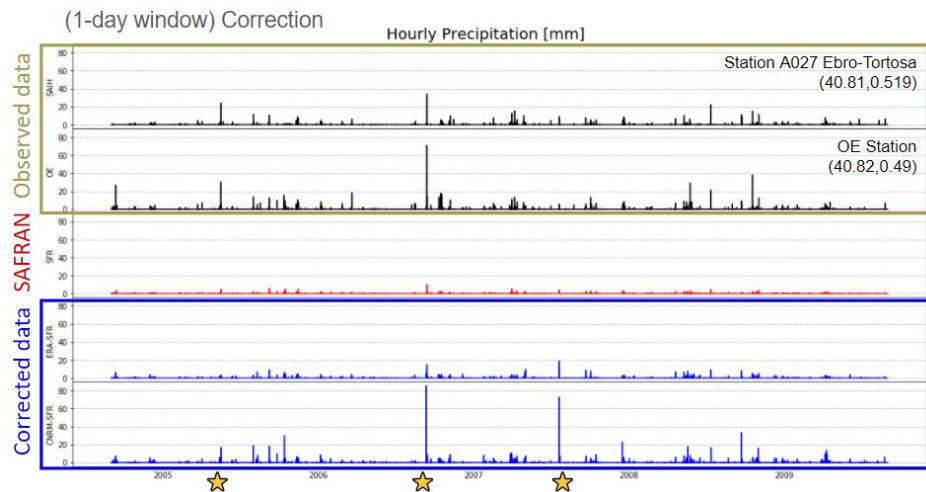
We use CNRM-ALADIN63 (EURO-CORDEX) simulation (0.11 deg).

**The CNRM simulation is bias corrected using SAFRAN.**

- We preserve the precipitation volume of SAFRAN.
- Tested over temporal windows that span from 1 to 14 days (the larger the window, the more we trust the model).

Validation through the Perkins skill score (PSS), which provides a measure of similarity between observed and modeled frequencies (Perkins et al., 2007), we evaluated the hourly precipitation distribution of a set of 11 precipitation stations (SAIH).

Station Name	PSS (SAFRAN)	PSS (ALADIN)	PSS (Corrected 7 days)
EBRO TORTOSA	0.73	0.85	0.89

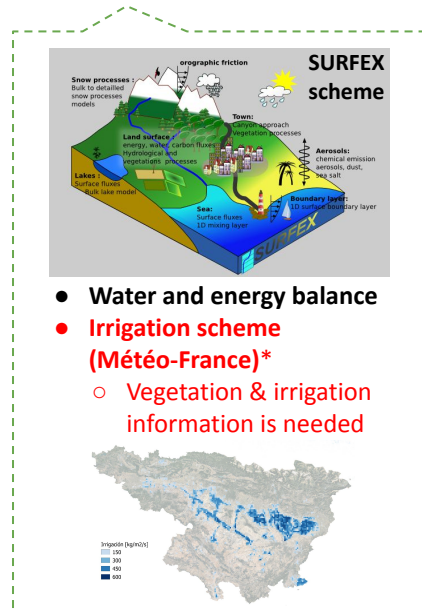




# Maps needed to simulate irrigated lands



We are using the new SURFEX Irrigation Scheme by Arsène Druel and Clément Albergel.



- A **Land Cover Map (LCM)** to identify the different land cover classes.
- An **Irrigated Areas Map (IAM)** to let the model know which grid points have to be irrigated.
- An **Irrigation Methods Map (IMM)** to assign the correct method (flood, sprinkler or drip) to each grid point.

# Plot information dataset

The Geographic Information System for Agricultural Parcels, **SIGPAC**, allows the geographical identification of parcels declared by farmers and ranchers, receiving any public subsidy related to the area cultivated or used by livestock.

## Spanish dataset:

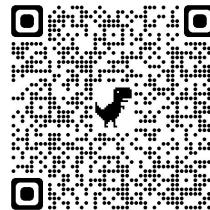
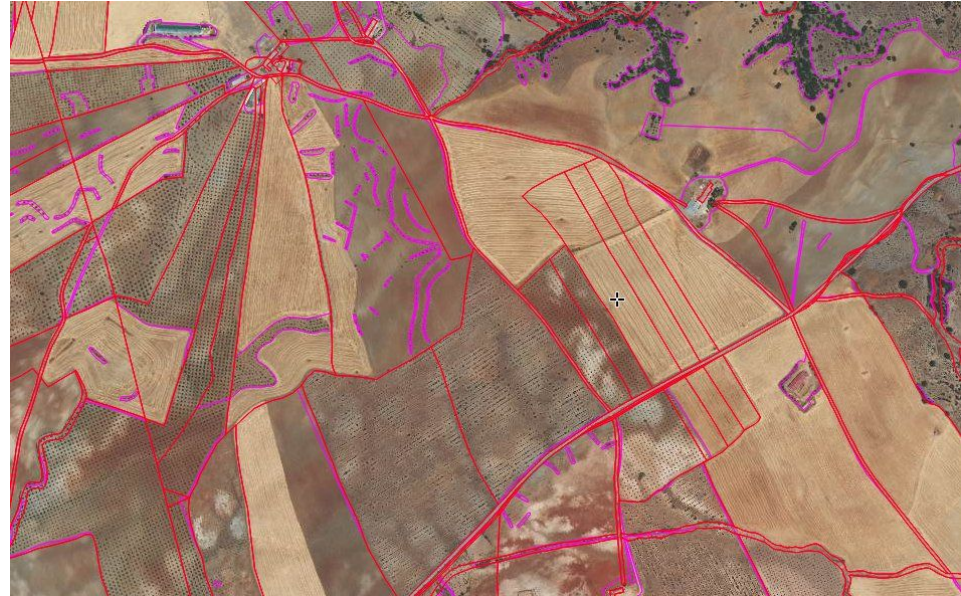
- We downloaded data for 2019.
- Does not include Catalan data..

## Catalan dataset:

- We downloaded data for 2020.
  - We are currently working on 2021 data.
- The categories are not exactly the same as in the Spanish dataset.

## This is the best information available on crops at the plot scale.

- It is not perfect.
- It does describe double cropping.
- It contains information of installed irrigation, not actual irrigation.



[Official  
SIGPAC  
website  
\(Spain\)](#)



[Official  
SIPAC  
website  
\(Catalonia\)](#)

# How good is ECOCLIMAP SG Land-Cover map?

- ECOCLIMAP SG: Physiographic Database used by latest versions of SURFEX (required by the new irrigation scheme).
  - i) ecosystem classification and ii) set of land surface parameters necessary in land-surface modelling.
- We only validated the product on **cultivated areas**.



		SIGPAC							Validation results (F1-score)		
		Cereals	Summer cereals	Citrus	Forage crops	Pome fruits	Olive grove	Vineyard	Nuts	1 <sup>st</sup> correspondence	2 <sup>nd</sup> correspondence
ECOCLIMAP-SG	Temp. broad. deciduos					1		1	1	0.33	-
	Temp. broad. evergreen			1			1			0.05	-
	Win. C3 crops	1,2								0.67	0.63
	Sum. C3 crops				1,2					0.13	0.12
	C4 crops		1,2							0.06	0.06
	Shrubs			2		2	2	2	2	-	0.06

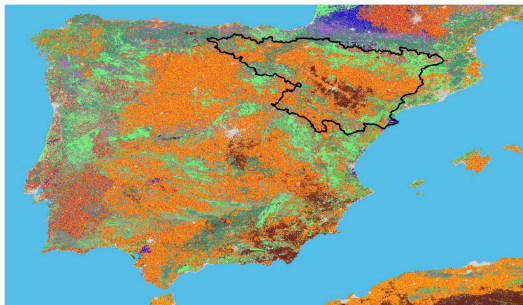
**Bad scores!**

We need to develop a new LCM to simulate irrigation over the Ebro basin

**The model is very sensitive to the land-cover.**

# Creation of an improved Land Cover Map

ECOCLIMAP-SG: SURFEX's Land Cover Map



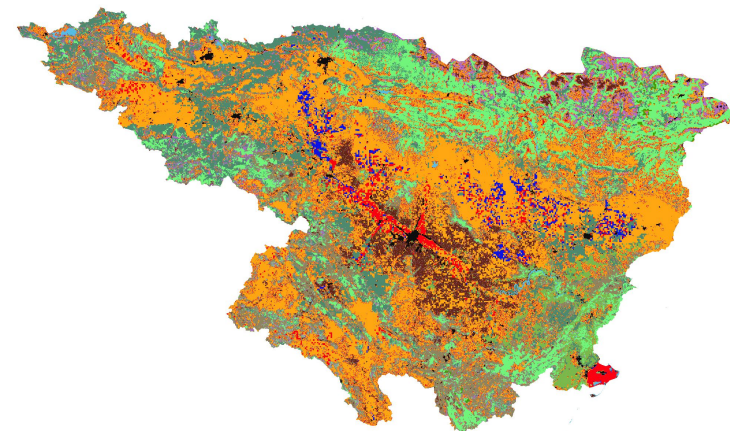
SIGPAC plots  
(Eastern Aragón)



SIGPAC products have been classified into the different ECOCLIMAP-SG classes and replaced in the original ECOCLIMAP-SG LCM.

ECOCLIMAP-SG classes	Temp. broad. deciduos	Trop. broad. deciduos	Temp. broad. evergreen	Trop. broad. evergreen	Winter C3 crops	Summer C3 crops	C4 crops
Nº prods.	47	1	24	14	66	82	11

Improved ECOCLIMAP-SG LCM



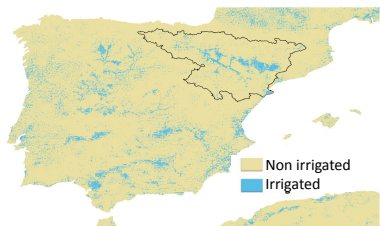
- Increase of Summer C3 and C4 crops
- Spatial distribution of herbaceous and tree crops is closer to reality

Land cover classes are now better represented over the Ebro basin.

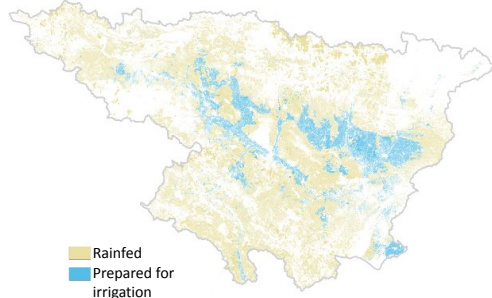
# Creation of an Irrigated Areas Map

1. ECOCLIMAP SG similar to SIGPAC.
2. We know that SIGPAC overestimates the irrigated area:
  - SIGPAC informs which plots are prepared for irrigation, but does not identify irrigated ones.
3. Météo-France provided 2 maps of LAI assimilation increments at 1 km:
  - Assimilation of LAI from Copernicus Global Land Service into CNRM's LDAS, provided by J.C.-Calvet, CNRM.
  - Two dates: 20/08/2017 & 10/08/2019
  - Irrigated area threshold = 0.2

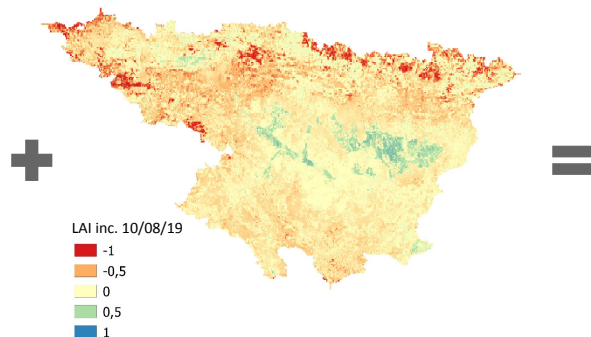
ECOCLIMAP-SG Irrigated Areas Original Map



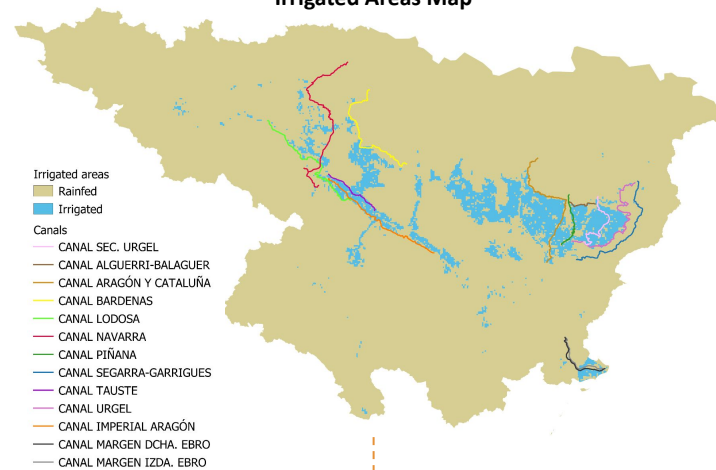
1. SIGPAC plots prepared for irrigation



2. LAI Increments



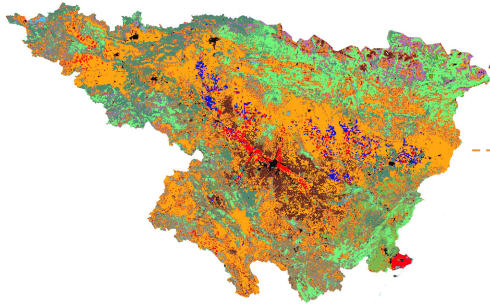
Irrigated Areas Map



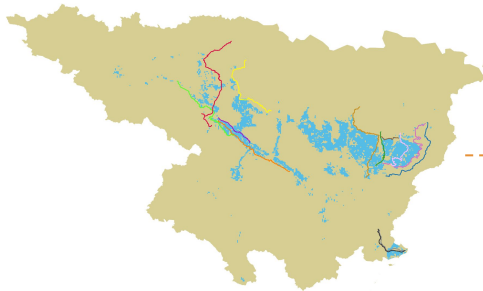
Irrigated areas receive water from the main canals that belong to the main irrigation systems identified in the Hydrological Plan from 2015 - 2021 (Spanish Ministry of Agriculture, Fisheries and Food).

# Creation of an Irrigation Methods Map

Improved ECOCLIMAP-SG LCM



Irrigated Areas Map

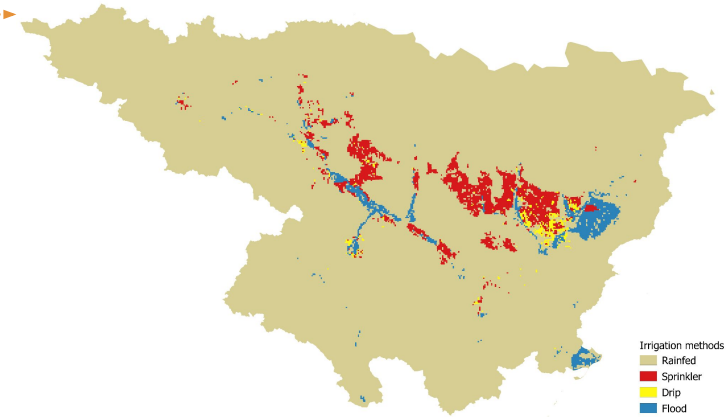


Both maps are combined to develop a map of irrigation methods.

- traditional → flood
- modern-herbaceous → sprinkler
- modern-trees → drip



Irrigation Methods per Area Map

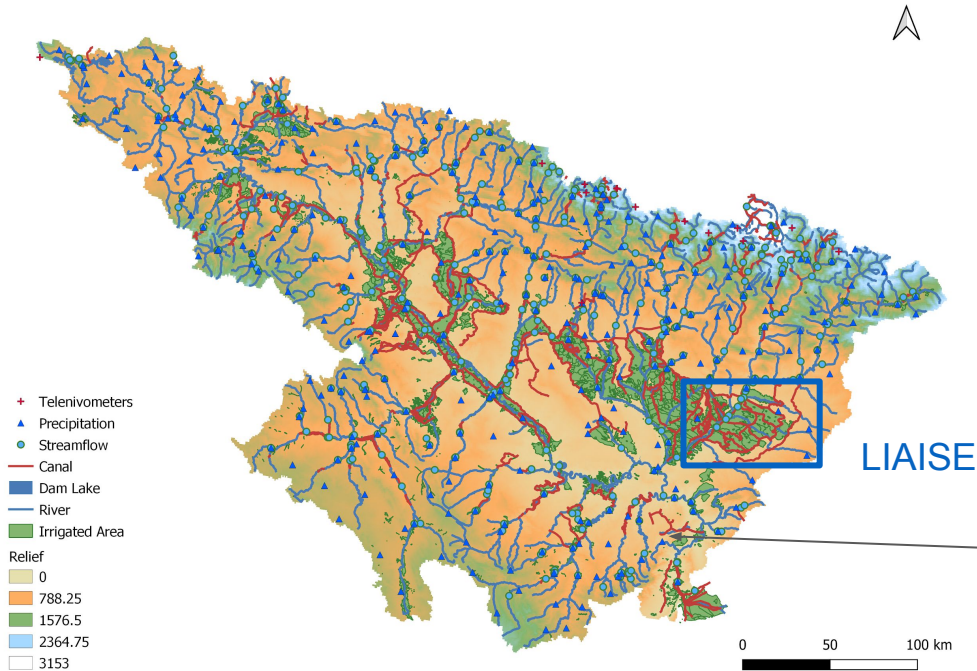


Other sources of information:

- The Catalan government published an irrigation type map for Catalonia, but it is not accurate.
- Giovanni Paolini (isardSAT) is working on a AI based irrigation type map which works quite well!

The model is not very sensitive to the irrigation method (communication by Simon Munier).

# Validation dataset



A SAIH dataset (2015-2021) is currently being prepared and will be uploaded to the LIAISE database.

- Easy to read in JSON format (same format for all variables).

It will also be easy to access historical data, which I have in CSV and JSON format on my drive.

## Meteorological data.

- Observations: SAIH, AEMET\* and SMC.
- High resolution analysis: SAFRAN.

## Evapotranspiration.

- LIAISE Campaign data.

## Hydrology.

- SAIH Ebro: Streamflow, dam levels and outflows, telenivometers.
- MITECO Dataset: Same variables, historical time series.

## Irrigation

- SAIH Ebro: Main canal flows (areal average of water consumption for each irrigation district).

## Underground water

- SAIH Ebro: Piezometers.

## Soil Moisture

- Terra Alta Network (8 vineyards).
- LIAISE Campaign.

# Conclusions and next steps

- De Ebro River basin is a data rich basin, ideal for simulation exercises.
  - The Basin Authority (CHE), MITECO, Catalan Meteorological Service and the Catalan Government publish a lot of open data. AEMET's data is also accessible, but not as open.
- The Ebro Observatory has created datasets which are necessary to simulate the real water cycle in the Ebro River basin.
  - SAFRAN Meteorological Forcing Dataset at 1 km of spatial resolution (nominal resolution).
  - Land Cover Map (Improved ECOCLIMAP SG based on SIGPAC data).
  - Irrigated Areas Map (SIGPAC + LAI Assimilation Increments).
  - Irrigation Methods Map (Simple approach based on information about modernization and crop type).
  - SAIH based validation dataset.
- We are currently working on a data paper describing all these data.
- The data will be shared with the Scientific Community through the LIAISE Database.



# Thank You!



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