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Modelling and Remote Sensing to estimate evaporation and water use in the Ebro Basin

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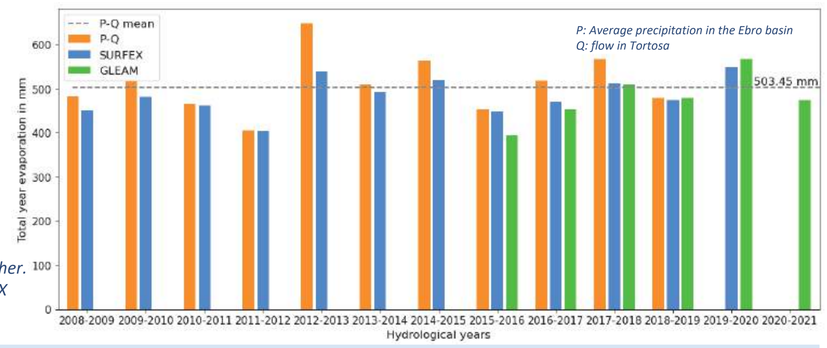
1. Introduction

- The Ebro Basin exhibits an uneven distribution of precipitation. Although runoff is mostly generated over the Pyrenees, the water resources are mainly used in the valley for agricultural purposes.
- The expansion of forests in non-agricultural areas, resulting from the abandonment of unmechanized agricultural lands, has further increased water consumption. Thus, the forest is competing with agriculture for water availability.
- Quantifying total evaporation helps to manage the water resources and make better decisions.
- Land-Surface Models (LSM) and Remote Sensing (RS) data can be used to analyse the total evaporation in the Ebro Basin.

2. Objectives

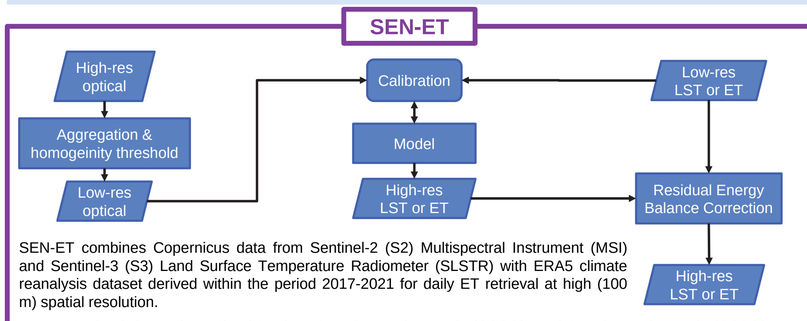
- **Identify** diferences in **space** and **time** among the three products: SASER, GLEAM and SEN-ET.
- Identify potential sources of uncertainty, particularly related to irrigation and forests water use.



- *Good fit between the P-Q values and the SURFEX model specially during years with low evaporation values.*
- *Years with great evaporation values the differences are higher.*
- *The values of the GLEAM product are so close to the SURFEX model.*

3. Datasets

SEN-ET

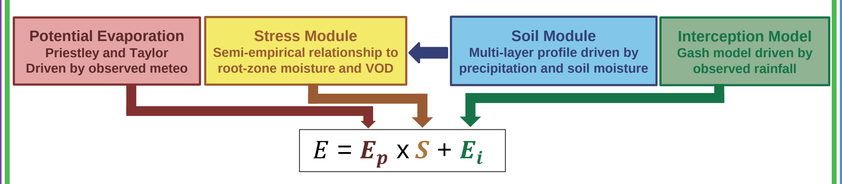


SEN-ET combines Copernicus data from Sentinel-2 (S2) Multispectral Instrument (MSI) and Sentinel-3 (S3) Land Surface Temperature Radiometer (SLSTR) with ERA5 climate reanalysis dataset derived within the period 2017-2021 for daily ET retrieval at high (100 m) spatial resolution.

Methodology described in detail in Guzinski et al. (2020) and Bartkowiak et al. (2023).

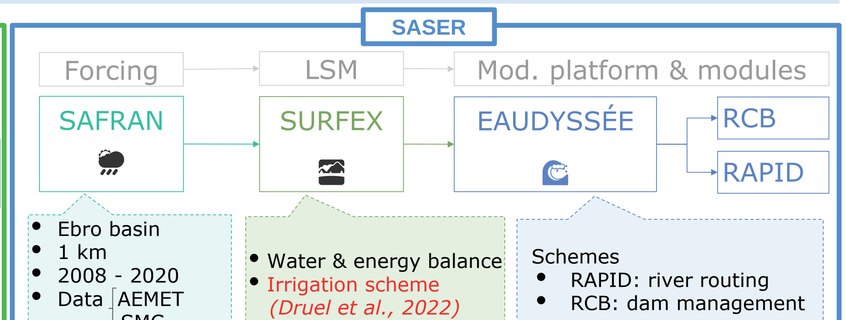
GLEAM

The Global Land Evaporation Amsterdam Model (GLEAM) is a set of algorithms that separately estimate the different components of land evaporation. In this work Actual Evaporation (E) is used.

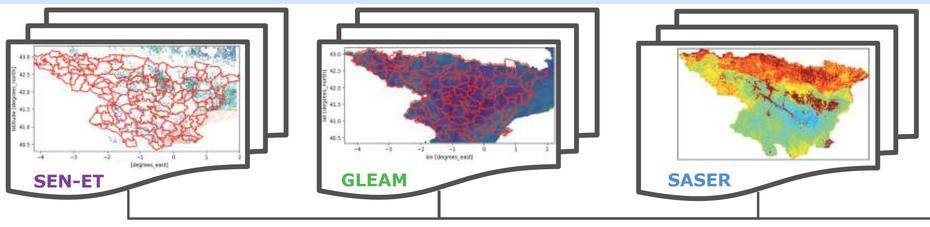


The dataset is described in detail by Martens et al. (2017).

SASER



4. Methodology



Available years per product

Product	Period
SEN-ET	2017 to 2021
GLEAM	2015 to 2021
SASER	2008 to 2019

Bring the data to a **common grid and period**.
- The satellite and modelled data will be interpolated to the spatial grid defined in the project
- The period of analysis will be from 2017 to 2019.
- Masking to common data

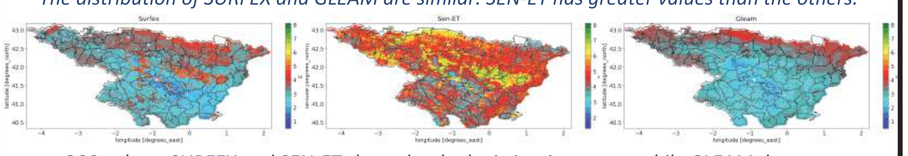
Statistical analysis:
- Descriptive statistics
- Spearman correlation coefficient
- Temporal series: Time aggregation due to gaps in data
- Analysis by land cover: an improved physiographic map based on ECOCLIMAP-SG is used to mask the different land covers.

5. Results

Descriptive statistics

Product	Mean	Max	Min	Q10	Q50	Q90	Std.Dev.
SURFEX	4.32 / 0.37	23.90 / 0.90	4.3 / -0.96	4.32 / -0.04	4.32 / 0.22	5.67 / 0.50	2.2 / 0.0
SEN-ET	6.45 / 0.94	93.30 / 1.47	6.45 / 0.0	6.45 / 0.02	6.45 / 0.70	8.14 / 1.3	4.02 / 0.0
GLEAM	4.18 / 0.34	7.93 / 0.56	3.08 / -0.19	3.16 / 0.02	4.33 / 0.31	5.91 / 0.51	1.88 / 0.0

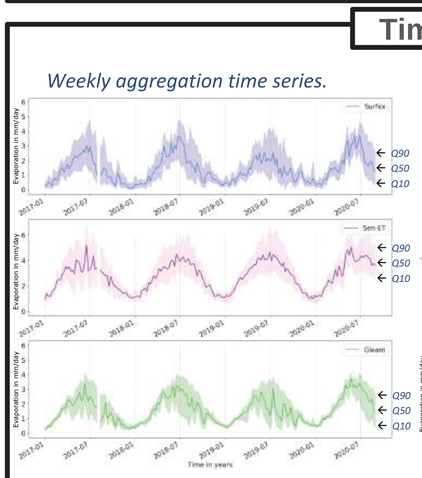
The distribution of SURFEX and GLEAM are similar. SEN-ET has greater values than the others.



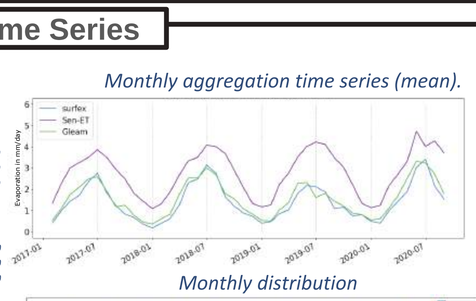
Q90 values: SURFEX and SEN-ET show clearly the irrigation areas, while GLEAM does not.

Time Series

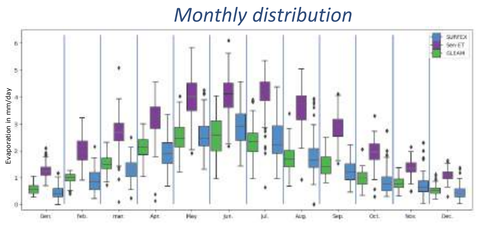
Weekly aggregation time series.



Monthly aggregation time series (mean).

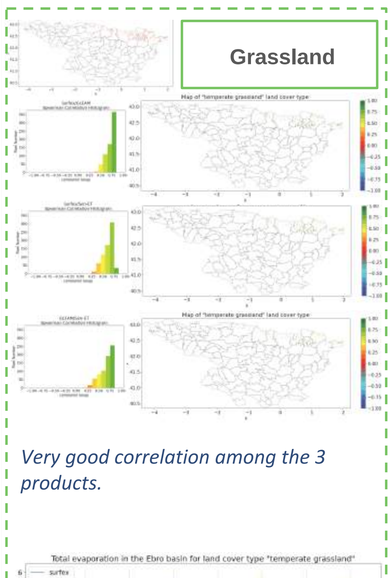


Monthly distribution

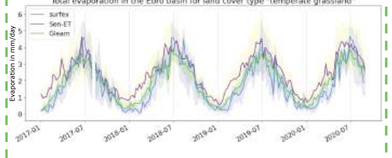


Analysis by land cover

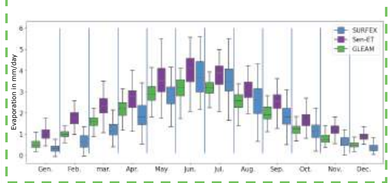
Grassland



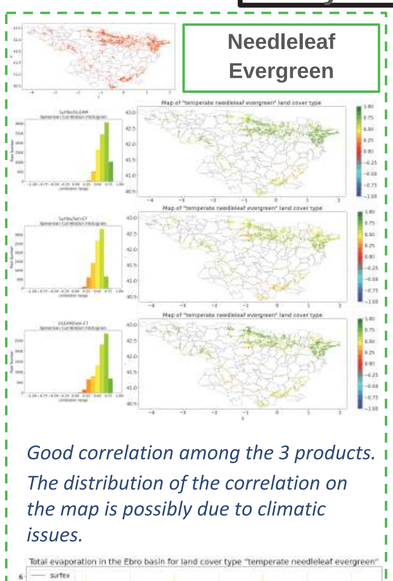
Very good correlation among the 3 products.



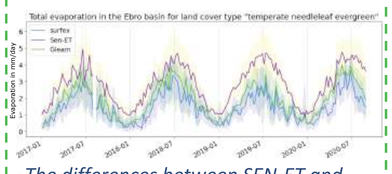
- *These exhibit a strong resemblance.*
- *The biggest differences when curve rises and similarities when curve decreases*



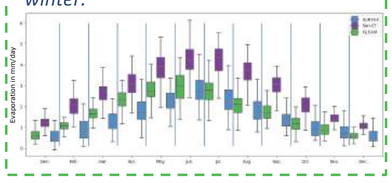
Needleleaf Evergreen



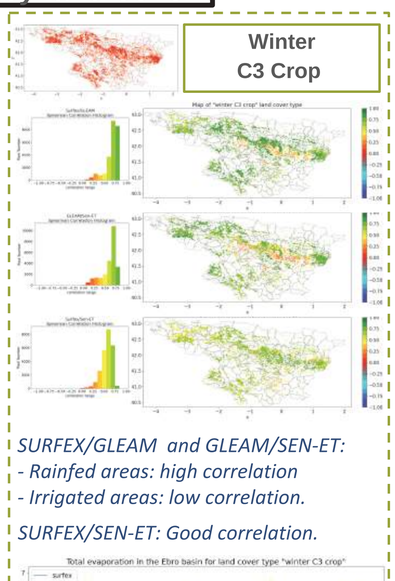
Good correlation among the 3 products.
The distribution of the correlation on the map is possibly due to climatic issues.



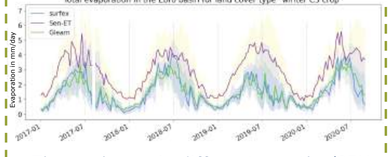
- *The differences between SEN-ET and SURFEX/GLEAM are max. in summer.*
- *The differences between SURFEX and GLEAM are max. in sping and min. in winter.*



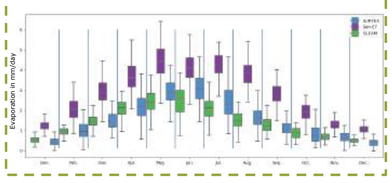
Winter C3 Crop



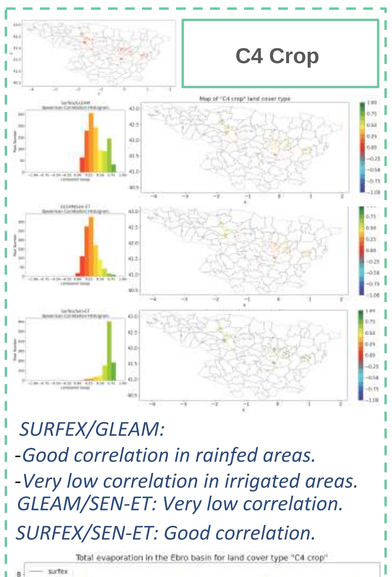
SURFEX/GLEAM and GLEAM/SEN-ET:
- Rainfed areas: high correlation
- Irrigated areas: low correlation.
SURFEX/SEN-ET: Good correlation.



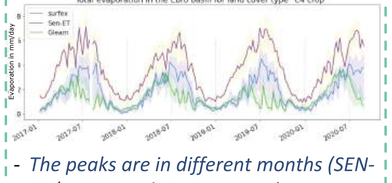
- *The peaks are in different months (SEN-ET:May, SURFEX/GLEAM:Jun)*
- *The differences with SEN-ET are max. in Aug and min. in Dec.*



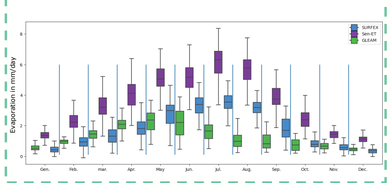
C4 Crop



SURFEX/GLEAM:
-Good correlation in rainfed areas.
-Very low correlation in irrigated areas.
GLEAM/SEN-ET: Very low correlation.
SURFEX/SEN-ET: Good correlation.



- *The peaks are in different months (SEN-ET/SURFEX:Jul, GLEAM:May)*
- *The differences with SEN-ET are max. in Aug and min. in Dec.*



6. Conclusions

- A comparison of land cover 'grassland' shows good correlations, providing a good benchmark for product intercomparison.
- Irrigation and climate are the two factors that most condition the correlation between products.
- Both satellite products differ significantly from each other, especially noteworthy:
  - SEN-ET significantly overestimates evaporation, especially high values.
  - GLEAM does not detect irrigated areas.

… and perspectives

- Analyze more land covers
- Analyze rainfed and irrigated areas.
- Analyze climatically

References

Bartkowiak, P., Castelli, M., Ventura, B., and Jacob, A. (2023). Large scale two-source energy balance modelling of evapotranspiration over Mediterranean region, EGU General Assembly 2023, Vienna, Austria, EGU23-8428, https://doi.org/10.5194/egusphere-egu23-8428

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