

Improvement of high and low flow simulation in the hydrological model chain SASER

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The SASER model (Performance Evaluation)

🔗 **SASER = SAFRAN + SURFEX + Eaudyssée + RAPID**

Meteorological forcing (**SAFRAN**)

- It analyses daily observed precipitation and interpolated to the hourly scale.

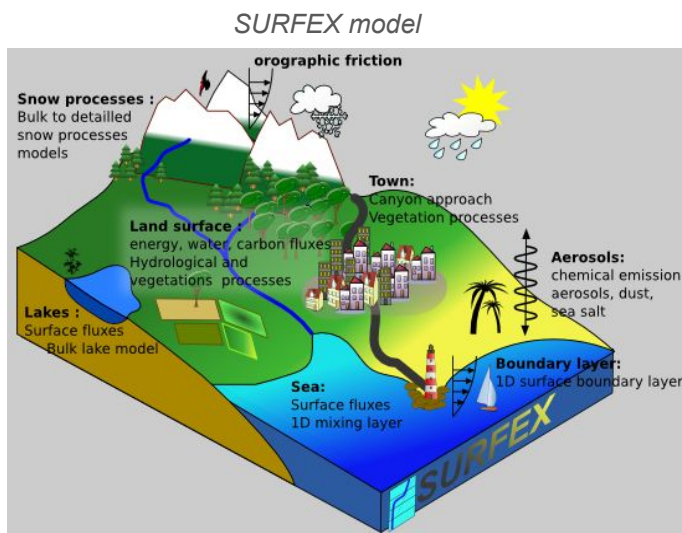
Land Surface Model (**SURFEX**) uses ISBA-DIF.

- It describes the vertical processes in the soil column and the vegetation.
- not simulate river flow.

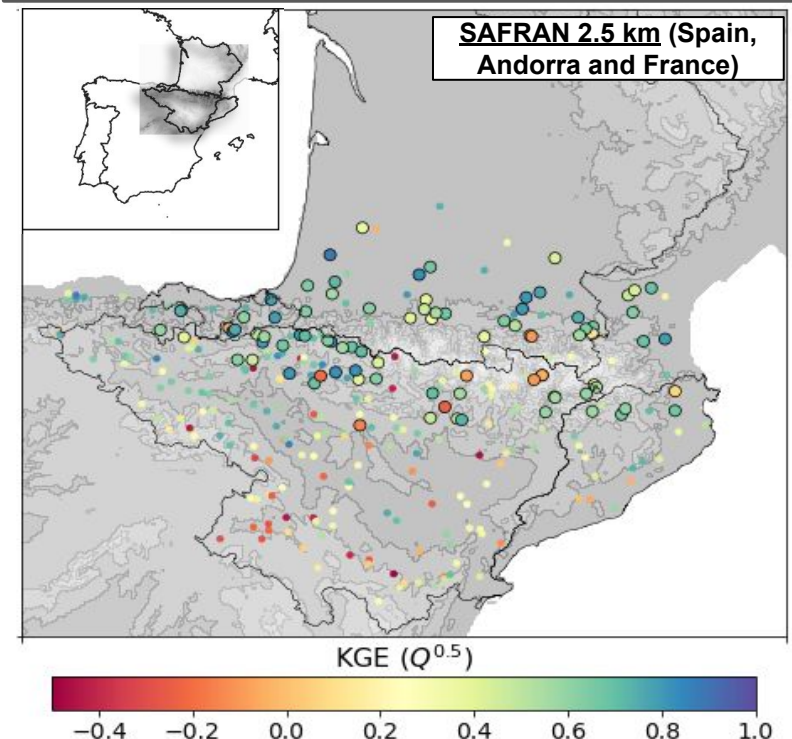
Routing Scheme (**Eaudysse + RAPID**).

- Transport SURFEX's runoff and drainage to the river

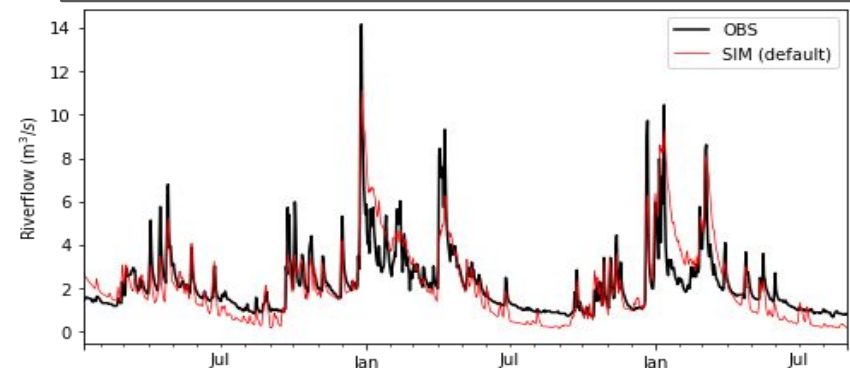
SASER does not simulate underground interactions.



Good KGE in natural basins



low flows are poorly reproduced

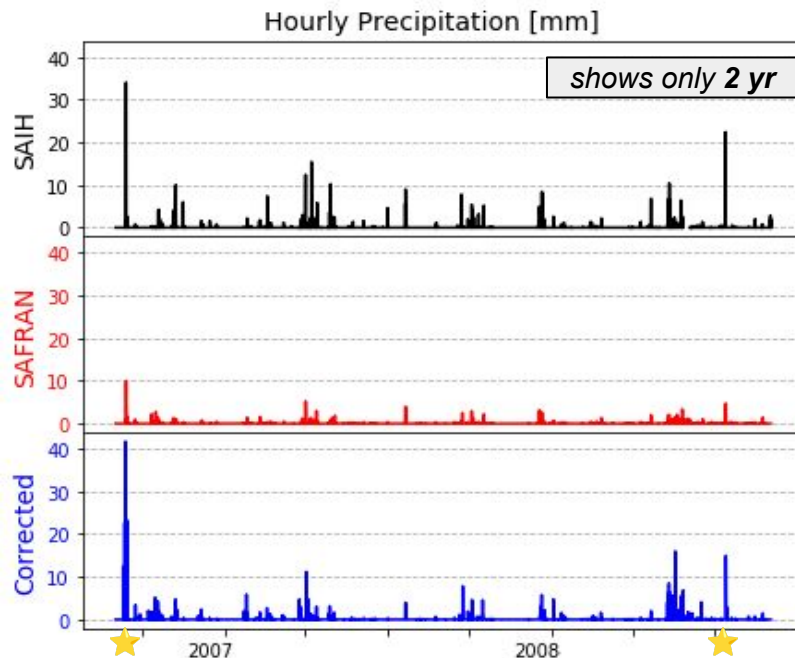


Improvement of forcing data (precipitation)

Our idea: Improving high flows by correcting the distribution of hourly precipitation

- Low intensities and unrealistic hourly distribution.
- We use CNRM-ALADIN63 (EURO-CORDEX dataset)

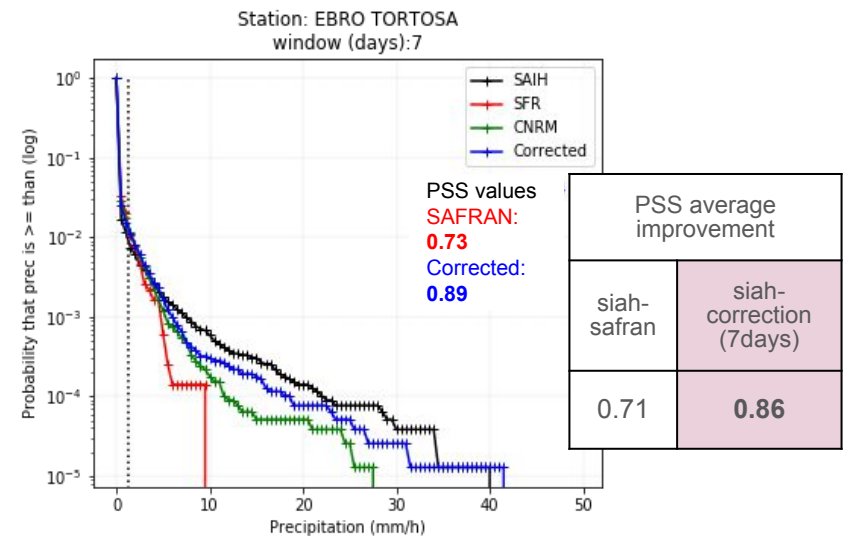
$$P(t)_{corrected} = P(t)_{product} * \frac{\sum^w P(t)_{SAFRAN}}{\sum^w P(t)_{product}}$$



- Set of 11 precipitation stations (SAIH) from 2005 to 2014

- Preserve the precipitation volume of SAFRAN.
- The correction is applied over temporal windows that span from 1 to 14 days (the larger the window, the more we trust the model).

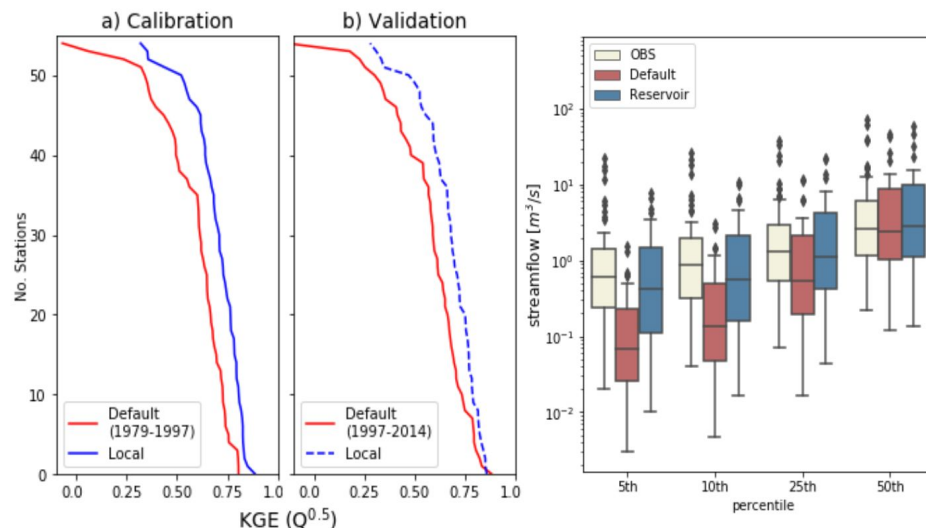
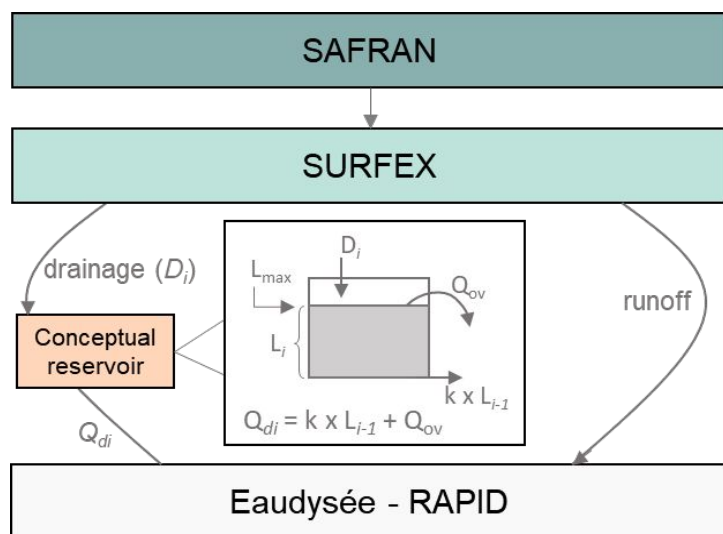
Perkins skill score (PSS): measure of similarity between observed and modeled frequencies (Perkins et al., 2007).



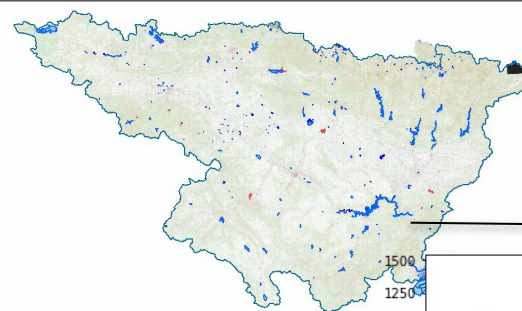
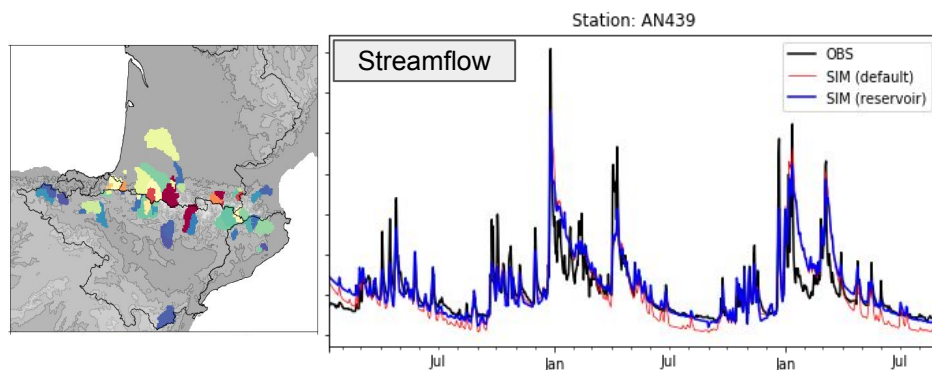
We are working on evaluating the impact over the hydrological response (runoff, drainage, evaporation)

Improvement of low flow simulation (additional conceptual reservoir)

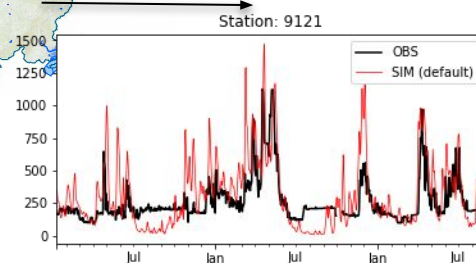
- Additional reservoir at **grid-scale**
- **Implemented in 55 near-natural sub-basins** (headwaters)
- k and L parameters
 - Calibrated with observed streamflow



How to extend it to human-influenced basins?



Dams in the Ebro basin
(source: CHE)



Improvement of low flow simulation (regionalization approach with genetic algorithm)

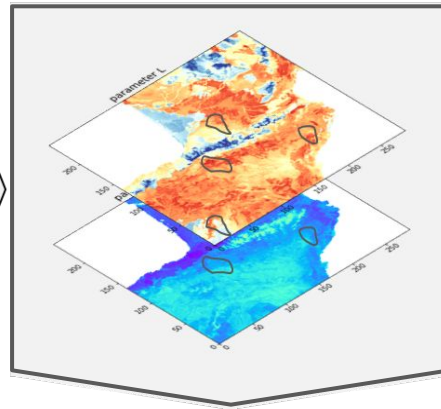
$$MP_i = w_{i1} ARI + w_{i2} MAP + w_{i3} PET + w_{i4} NDVI + w_{i5} SNW + w_{i6} SL + w_{i7} SND + w_{i8} CLY + w_{i9}$$

Predictor Maps

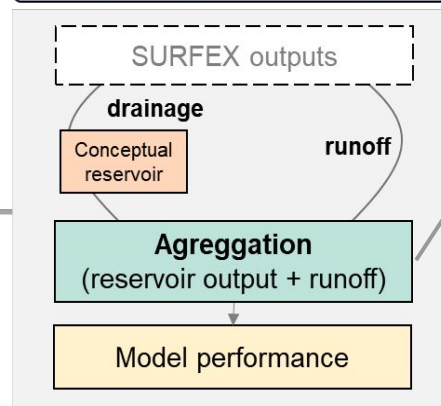
- Humidity index (P/PET)
- Mean annual precipitation (P)
- Mean annual potential evaporation (PET)
- Fraction of snow
- NDVI
- Slope
- Sand
- Clay

transfer equations

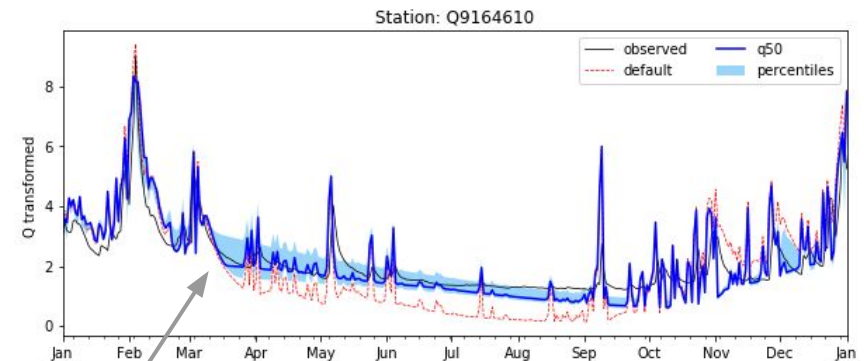
Parameter Maps



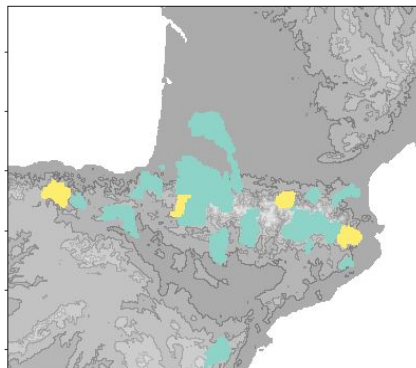
Hydrological modeling



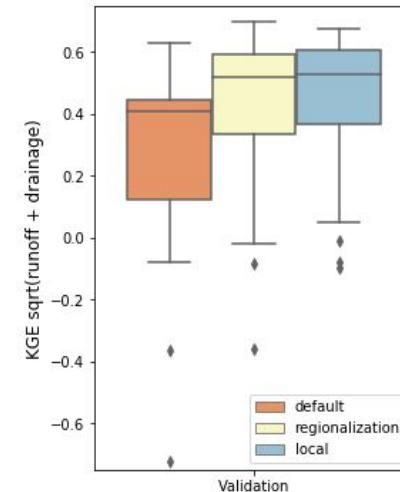
- Linking physical characteristics with reservoir parameters (Beck et al., 2020)
- We used a **genetic algorithm (GA)**
- **8 experiments were carried out**



Cross-validation



(training and validation subsets)



median KGE improvement
($\Delta KGE = 0.14$)

Thank you!
Question and comments

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