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➤ CAMELS-FR

A large sample hydroclimatic dataset for France to support model testing and evaluation

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Context

Large sample hydrology

- Over the last decades, development of large sample hydrology (Andréassian et al., 2006; Gupta et al. 2014)
- Generalization of sound model evaluation and testing practices based on various types of split-sample tests
- CAMELS international initiative (Addor et al., 2017): facilitate reproducible hydrological research by the use of large sample catchment datasets

Several CAMELS datasets already published:

- USA
- Chili
- Great-Britain

Other datasets are being finalized:

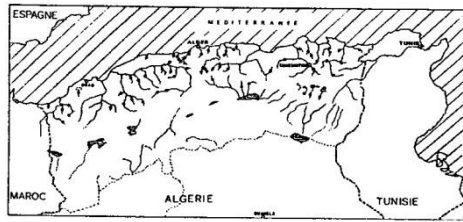
- Australia
- France

Andréassian, V., Hall, A., Chahinian, N., Schaake, J. (2006). Introduction and Synthesis: Why should hydrologists work on a large number of basin data sets? IAHS Publication, 307, 1-5, <https://hal.inrae.fr/hal-02588687>.
Gupta, H.V., Perrin, C., Blöschl, G., Montanari, A., Kumar, R., Clark, M., Andréassian, V. (2014). Large-sample hydrology: A need to balance depth with breadth. *Hydrology and Earth System Sciences*, 18(2), 463–477, doi: <https://doi.org/10.5194/hess-18-463-2>
Addor, N., A. J. Newman, N. Mizukami and M. P. Clark (2017). "The CAMELS data set: catchment attributes and meteorology for large-sample studies." *Hydrol. Earth Syst. Sci.* 21(10): 5293-5313.

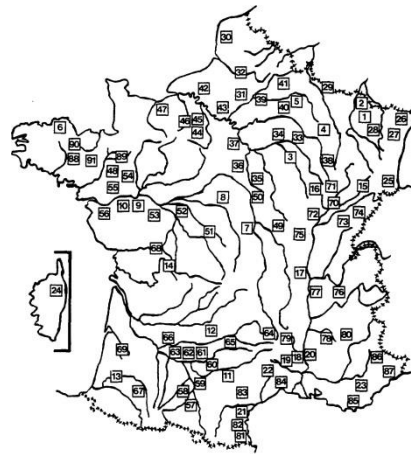
Context

Large sample hydrology expertise at INRAE (France)

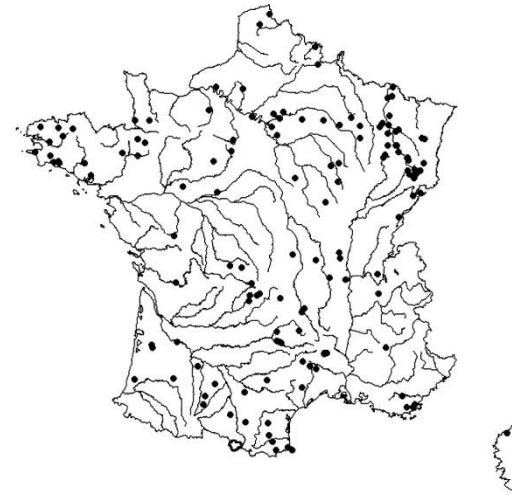
Increasing number of studies conducted on large datasets over the last three decades



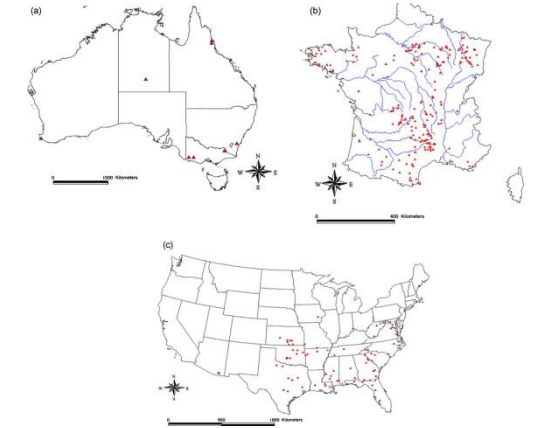
63 catchments in Algeria
(Kabouya et al., 1991)



91 catchments in France
(Makhlouf et al., 1994)



140 catchments in France
(Edijatno et al., 1999)



308 catchments in Australia, France & USA
(Oudin et al., 2005)

Kabouya, M. and C. Michel (1991). Monthly water resources assessment, application to a semi-arid country." *Revue des Sciences de l'Eau* 4(4): 569-587.

Makhlouf, Z. and C. Michel (1994). "A two-parameter monthly water balance model for French watersheds." *Journal of Hydrology* 162(3-4): 299-318.

Edijatno, N. O. Nascimento, X. Yang, Z. Makhlouf and C. Michel (1999). "GR3: a daily watershed model with three free parameters." *Hydrological Sciences Journal* 44(2): 263-277, DOI: 210.1080/02626669909492221.

Andréassian, V., C. Perrin and C. Michel (2004). "Impact of imperfect potential evapotranspiration knowledge on the efficiency and parameters of watershed models." *Journal of Hydrology* 286(1-4): 19-35.

Oudin, L., C. Michel and F. Anctil (2005). "Which potential evapotranspiration input for a rainfall-runoff model? Part 1 - Can rainfall-runoff models effectively handle detailed potential evapotranspiration inputs?" *Journal of Hydrology* 303(1-4): 275-289, DOI: 210.1016/j.jhydrol.2003.1009.1030.

Context

Hydrological tourism?

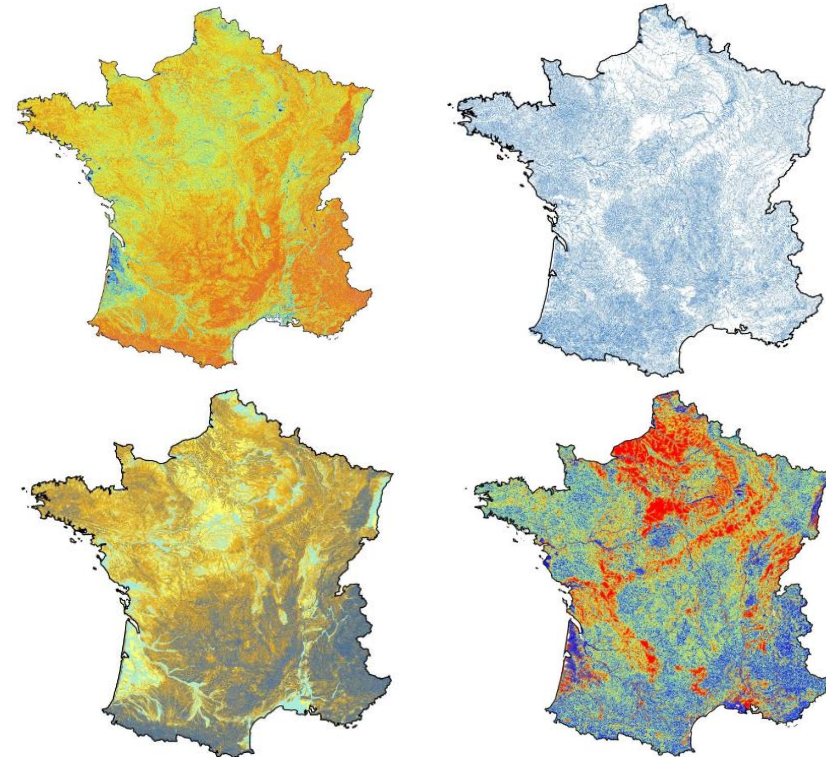
According to the United Nations (UNWTO agency):

France is on the top of the world tourism rankings not only because of the beauty of Paris or the Mont-Saint-Michel or because of the quality of wines but also because of the diversity of the landscapes

Indeed, France is a very diverse territory:

- climates
- soils
- relief
- etc.

An ideal playground for hydrologists!



MEDDE, GIS Sol. 2014. Enveloppes des milieux potentiellement humides de la France métropolitaine. Notice d'accompagnement. Programme de modélisation des milieux potentiellement humides de France, Ministère de l'Ecologie, du Développement Durable et de l'Energie, Groupement d'Intérêt Scientifique Sol, 50 pages

The CAMELS-FR dataset

Data sources

Dataset assembled by an automated chain fed by national data products (Delaigue et al., 2020)

CAMELS-FR dataset on several hundreds of watersheds over the 1958-2021 period:

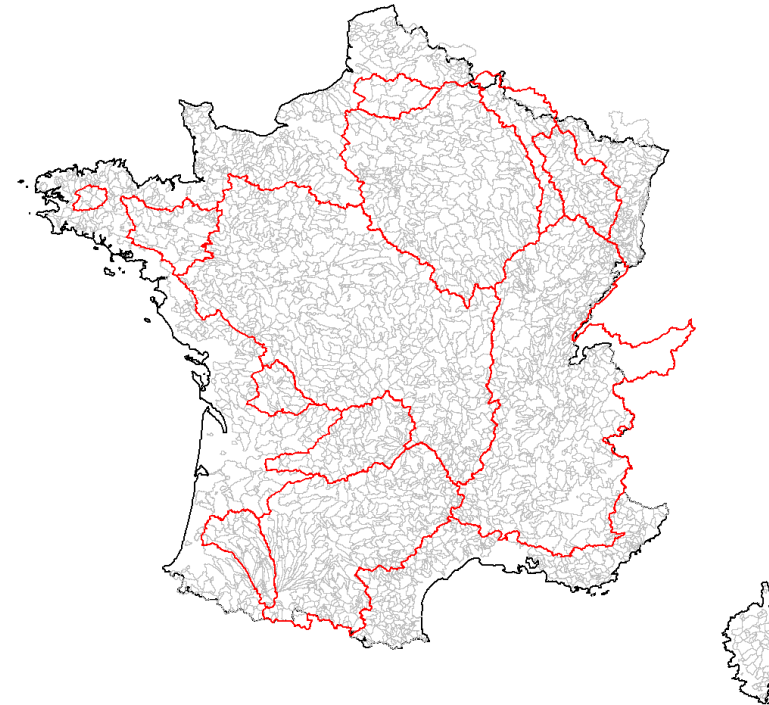
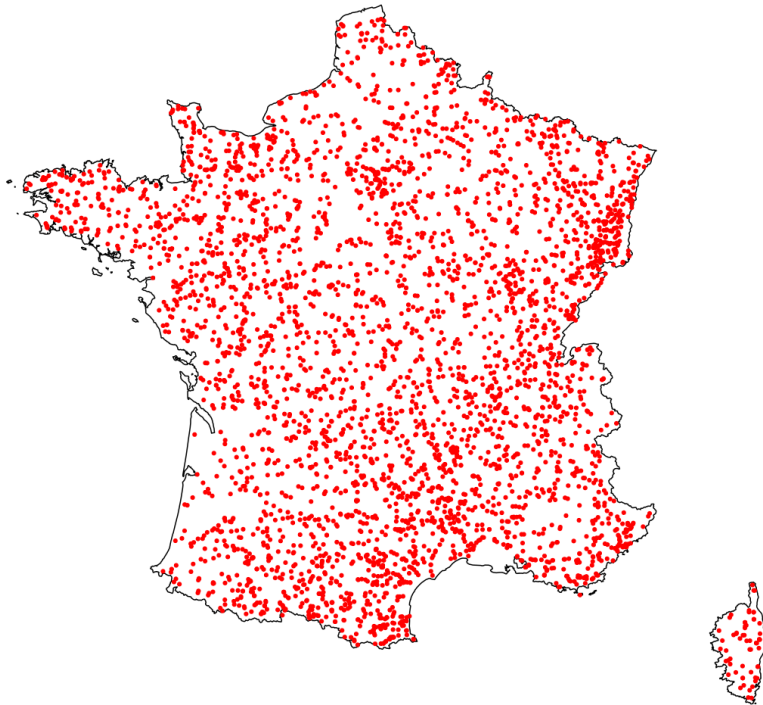
- Hydrological data (from French national Banque hydro)
 - Streamflow time series
 - Qualitative indices time series
 - Information about possible regulations upstream
- Climatic data (from Météo-France SAFRAN product)
 - Solid and liquid precipitation time series
 - Potential evapotranspiration time series
 - Temperature time series
 - Other time series
- Land cover (from Corinne Land Cover)
- Topography indices (from the SRTM DEM)
 - Elevation and slope distributions
 - Drainage density
 - Topographic index
 - etc.

Delaigue, O., Génot, B., Lebecherel, L., Brigode, P., Bourgin, P.Y. (2020). Database of watershed-scale hydroclimatic observations in France. Université Paris-Saclay, INRAE, HYCAR Research Unit, Hydrology group, Antony. URL: <https://webgr.inrae.fr/base-de-donnees>.

The CAMELS-FR dataset

Hydrological data

- More than 4000 hydrological stations in [Banque Hydro](#)
- Station snapped on INRAE theoretical hydrographic network
- Catchments automatically computed by INRAE and checked visually



The CAMELS-FR dataset

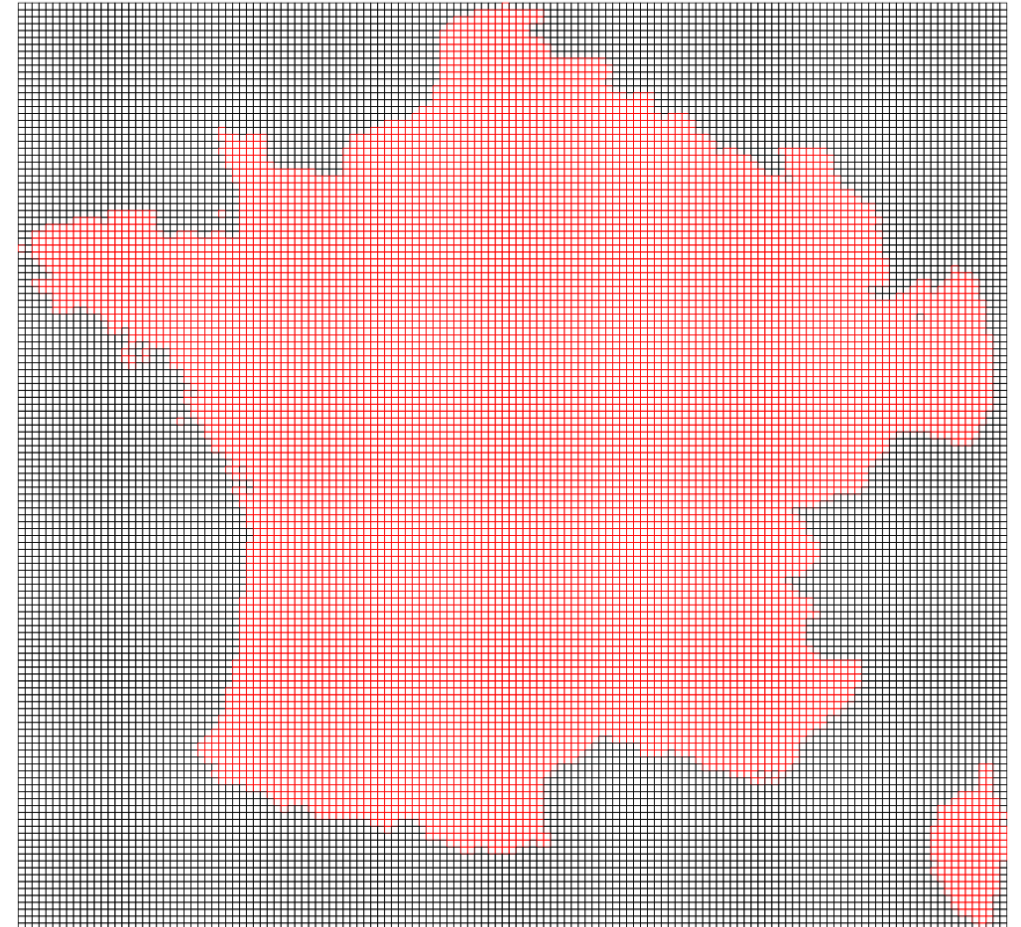
Climatic data

SAFRAN atmospheric reanalysis produced provided by [Météo-France](#) at daily time step (Vidal et al., 2010)

- Mesoscale analysis system of near-surface atmospheric variables
- Use of ground observations, combined with data from meteorological models

Parameters interpolated on a regular grid ($8 \times 8 \text{ km}^2$):

- solid and liquid precipitation
- temperature
- potential evaporation
- humidity
- wind
- water equivalent of snow
- solar radiation
- infrared radiation

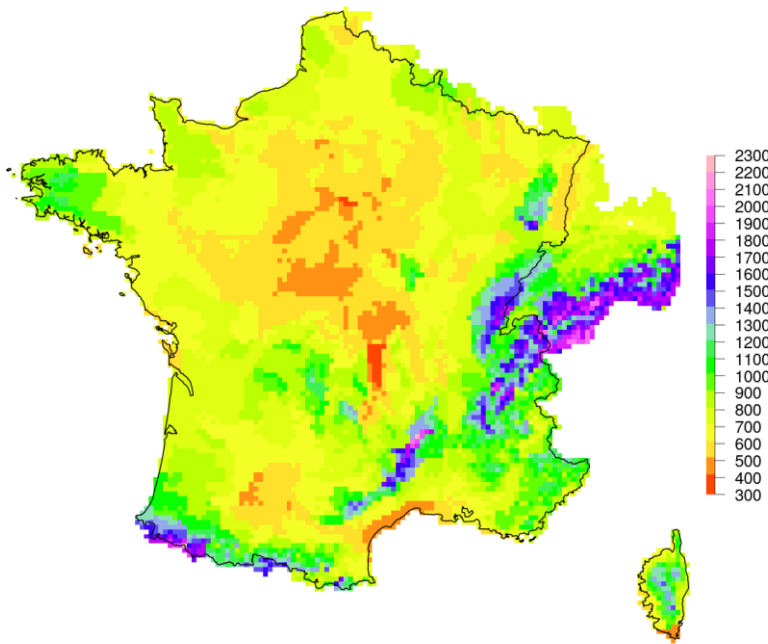


Vidal, J. P., E. Martin, L. Franchisteguy, F. Habets, J. M. Soubeyrou, M. Blanchard and M. Baillon (2010). "Multilevel and multiscale drought reanalysis over France with the Safran-Isba-Modcou hydrometeorological suite." *Hydrology and Earth System Sciences* 14(3): 459-478.

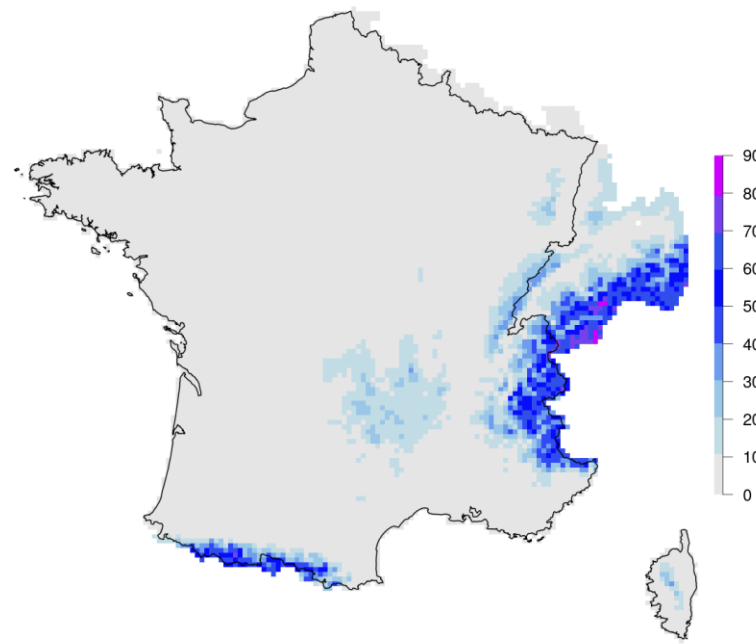
The CAMELS-FR dataset

Examples of variables

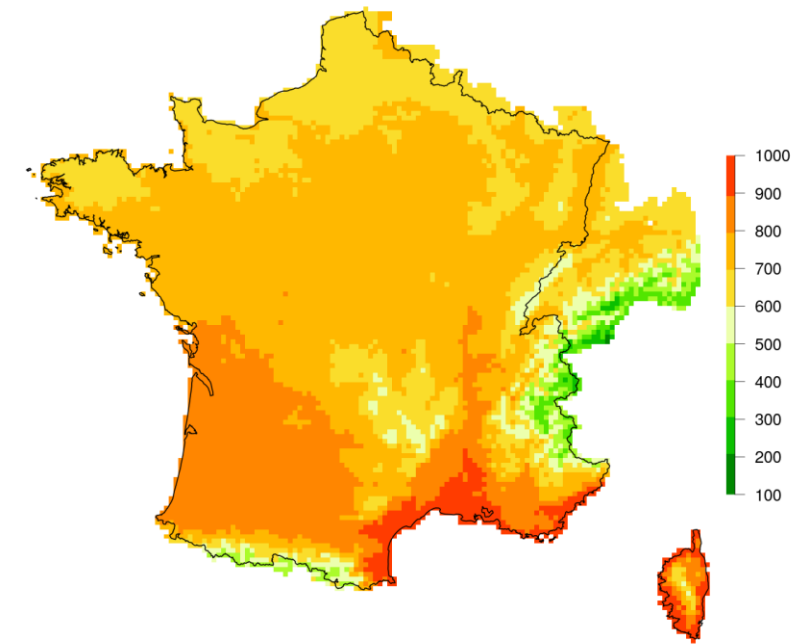
Precipitation (mm)



Solid precip. fraction (%)



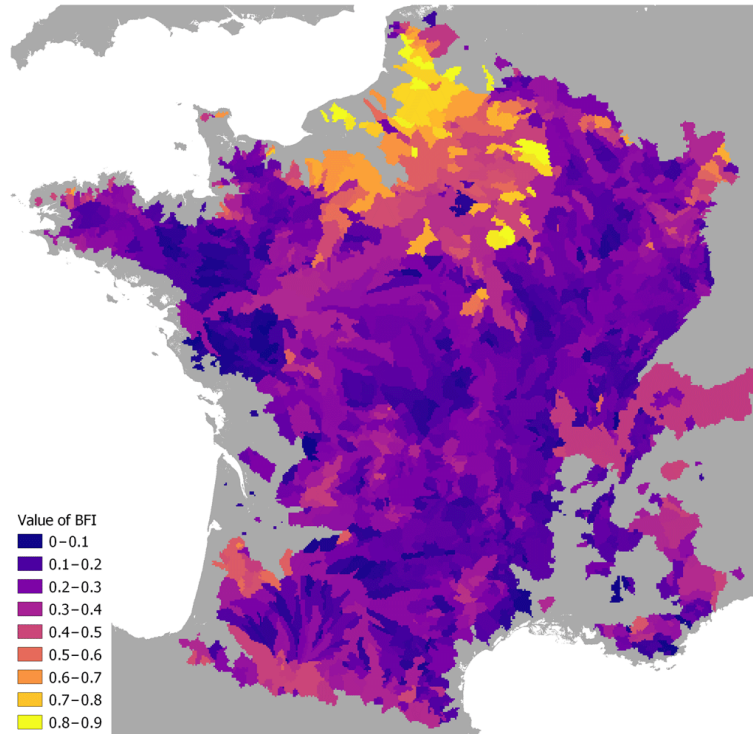
Evapotranspiration (mm)



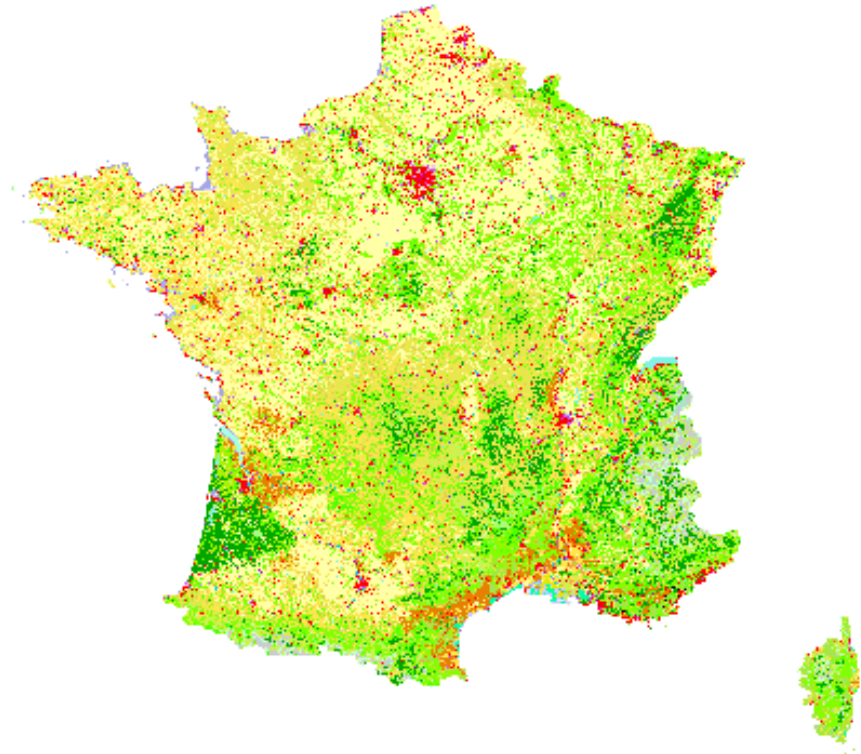
The CAMELS-FR dataset

Examples of variables

Base flow index



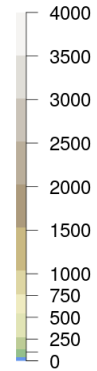
Land cover



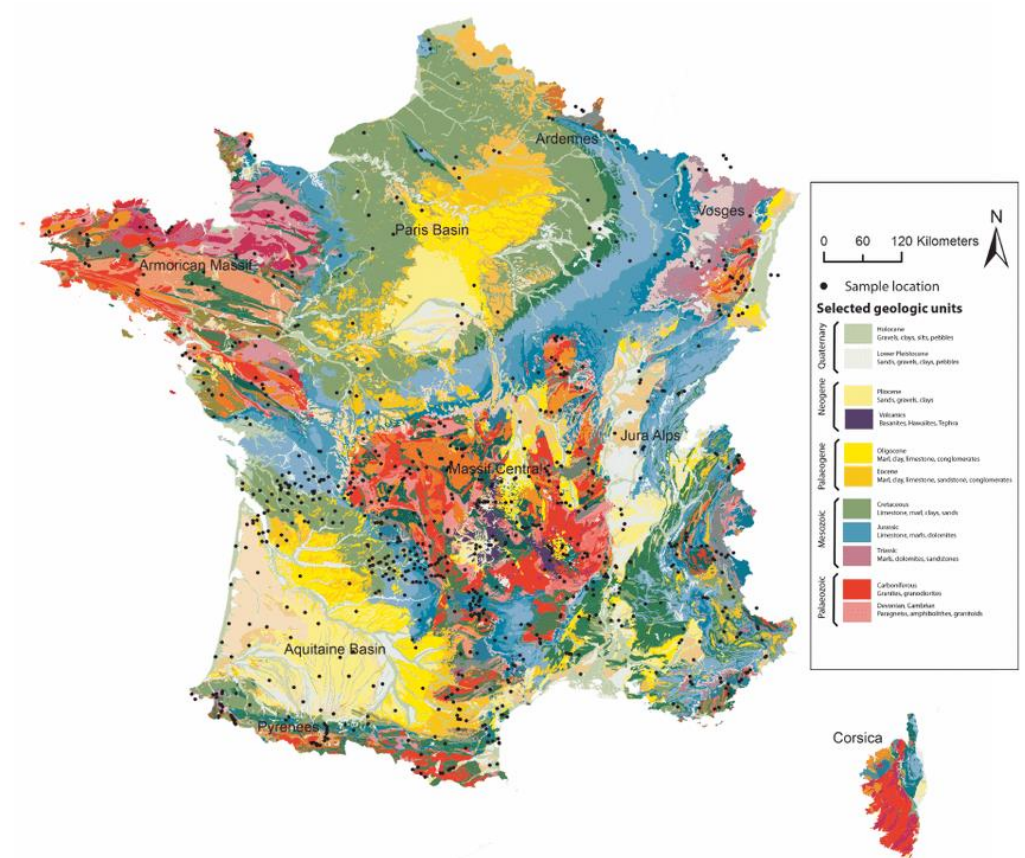
The CAMELS-FR dataset

Examples of variables

Elevation (m)



Geology



The CAMELS-FR dataset

Example of time series

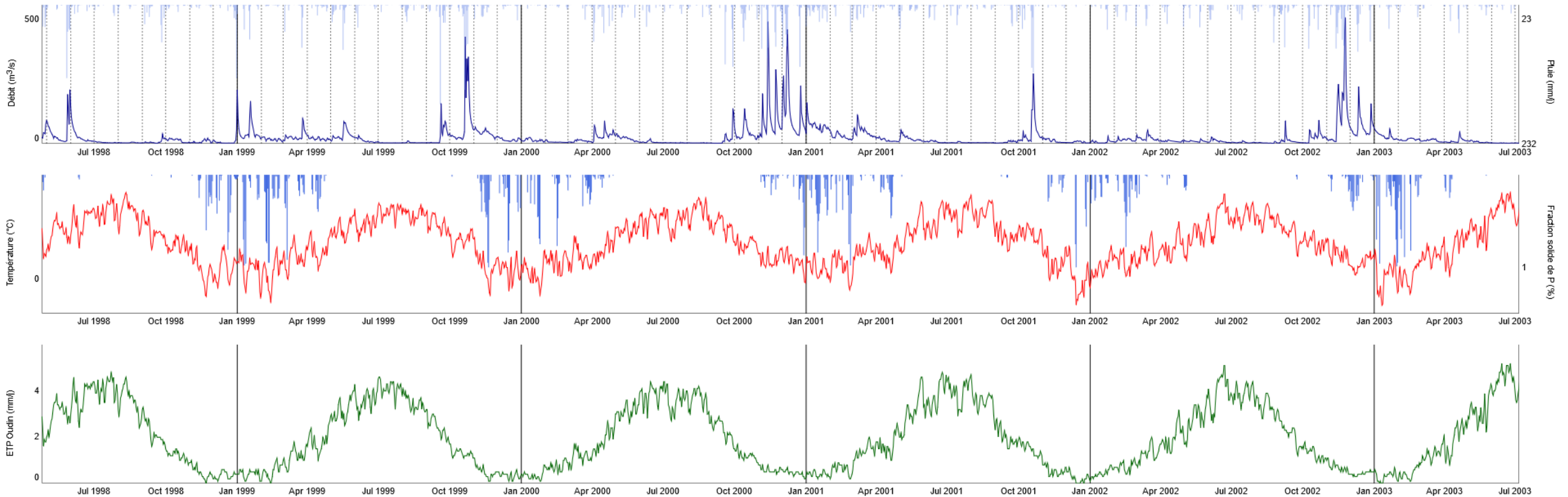


L'Ard che   Vogu 

Station : V5014010 Superficie : 619.87 [km²]
X = 765013 [m] ; Y = 765013 [m] (Lambert 2  tendu) ; Z = 181 [m]
Gestionnaire : SPC Grand Delta

BH: Indice de validit  Banque HYDRO
BI: Indice de validit  INRAE

- 5: estim 
- 1: inconnu faible
- 3: inconnu fort
- 8: reconstitu  bon
- 0 : anomalie pr sum e : valeur interpol e
- 2 : d bits n gatifs



The CAMELS-FR dataset

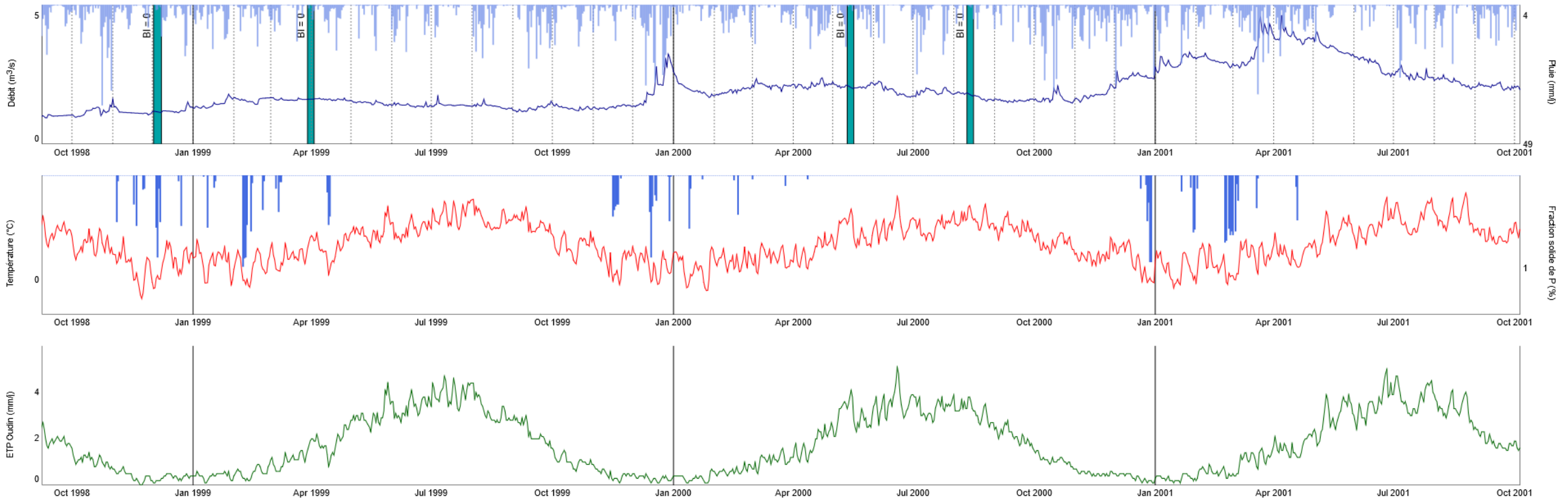
Example of time series



Le Petit Thérain à Saint-Omer-en-Chaussée

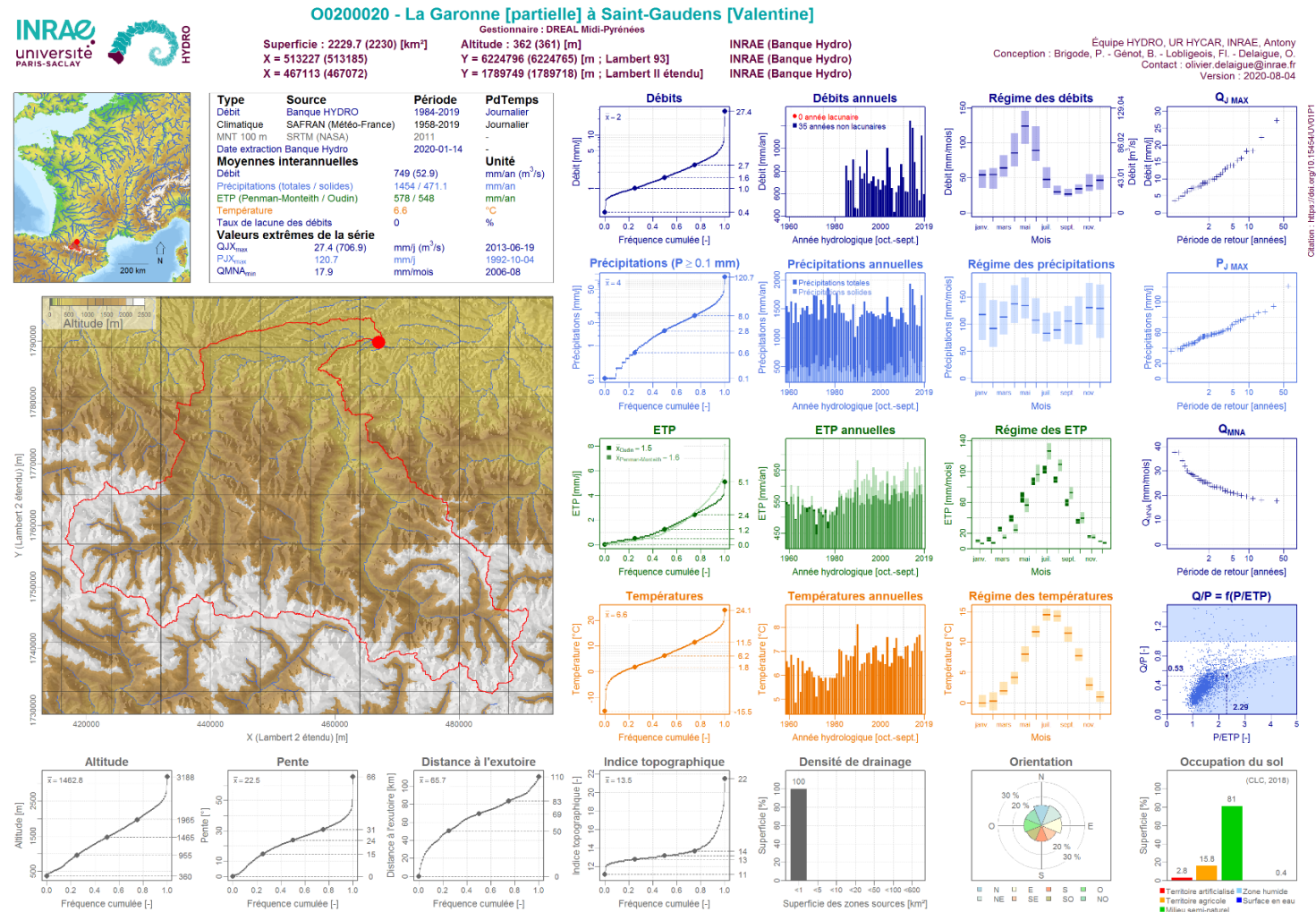
Station : H7713010 Superficie : 214.11 [km²]
X = 575513 [m] ; Y = 575513 [m] (Lambert 2 étendu) ; Z = 89 [m]
Gestionnaire : DREAL Picardie

BH: Indice de validité [Banguie HYDRO](#) BI: Indice de validité [INRAE](#)
5: estimé 0: anomalie présumée : valeur interpolée
1: inconnu faible 2: débits négatifs
S: inconnu fort
8: reconstitué bon



The CAMELS-FR dataset

Example graphical summary sheet on CAMELS-FR catchments



Source: Brigode et al., 2020

Brigode, Pierre; Génot, Benoît; Lobligois, Florent; Delaigue, Olivier, 2020, "Summary sheets of watershed-scale hydroclimatic observed data for France", <https://doi.org/10.15454/UV01P1>, Portail Data INRAE, V1

The CAMELS-FR dataset

A graphical user interface to help users to select catchments

The screenshot displays the basinSample web application interface. On the left, there are several vertical sliders for filtering catchments based on various parameters:

- Superficie [km²]:** Range from 0 to 95458.8, currently set at 658.4.
- Altitude [m]:** Range from 0 to 1924, currently set at 0.
- Pente [°]:** Range from 0 to 31.4, currently set at 8.8.
- Précip. moy. annuelles [mm/an]:** Range from 0 to 2228, currently set at 0.
- Fraction solide des précip. [%]:** Range from 0 to 75, currently set at 0.
- Débit moyen [mm/j]:** Range from 0 to 83.2, currently set at 0.
- Taux de lacune des débits [%]:** Range from 0 to 100, currently set at 0.
- Nb d'années de débits disp. [-]:** Range from 0 to 61, currently set at 0.
- Stockage amont [m³]:** Range from 0 to 95098, currently set at 0.
- Types d'influences:** A checkbox for 'Inconnue' is checked.

The main content area is divided into several sections:

- Summary:** Shows 255 / 3632 (7.0 %) Bassins versants and 16 / 20 (80.0 %) Références bibliographiques.
- Carte:** A map of France and surrounding regions with catchment areas highlighted in orange and blue.
- Superficie [km²]:** A histogram showing the distribution of catchment areas on a logarithmic scale.
- Altitude [m]:** A histogram showing the distribution of catchment altitudes on a logarithmic scale.
- Pente [°]:** A histogram showing the distribution of catchment slopes on a logarithmic scale.
- Liste des bassins versants:** A table listing catchments with columns for Code and Nom.

Code	Nom
A2230310	L'Ill à Kogenheim
A2240310	L'Ill à Osthouse
A2250310	L'Ill à Fegersheim [Ohnheim]
A2860110	La Bruche à Holtzheim [2]
A2860111	La Bruche à Holtzheim [1]
A2860112	La Bruche à Oberschaeffolsheim
A3311010	La Moder à Kaltenhouse
A4250640	La Moselle à Épinal
- Liste des références bibliographiques:** A table listing bibliographic references with columns for Auteur, Année, and Pas de temps.

Auteur	Année	Pas de temps
BERTHET	2010	H
BOURGIN	2014	JH
BOURQUI	2008	J
GUINTOLI	2012	J
KOCHANNEK	2014	J
LEBECHEREL	2015	J
LEMOINE	2008	H
LERAT	2009	H
- Précip. moy. annuelles [mm/an]:** A histogram showing the distribution of annual average precipitation.
- Fraction solide des précip. [%]:** A histogram showing the distribution of the fraction of solid precipitation.

Available on sunshine.irstea.fr

The CAMELS-FR dataset

How to retrieve the data?

The CAMELS-FR dataset will be available in the second half of 2021 on the following websites:

- The HYMEX web portal
 - <https://www.hymex.org/>

- The webGR webiste
 - <https://webgr.inrae.fr/>

