



HAL
open science

CAMELS-FR: A large sample hydroclimatic dataset for France to explore hydrological diversity and support model benchmarking

Olivier Delaigue, Pierre Brigode, Vazken Andréassian, Charles Perrin, Pierre Etchevers, Jean-Michel Soubeyrou, Bruno Janet, Nans Addor

► To cite this version:

Olivier Delaigue, Pierre Brigode, Vazken Andréassian, Charles Perrin, Pierre Etchevers, et al.. CAMELS-FR: A large sample hydroclimatic dataset for France to explore hydrological diversity and support model benchmarking. IAHS-2022 Scientific Assembly, May 2022, Montpellier, France. hal-03687235

HAL Id: hal-03687235

<https://hal.inrae.fr/hal-03687235v1>

Submitted on 3 Jun 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

➤ CAMELS-FR (*CHAMEAU*)

A large sample hydroclimatic dataset for France to explore hydrological diversity and support model benchmarking

Olivier Delaigue¹, Pierre Brigode^{1,2}, Vazken Andréassian¹, Charles Perrin¹, Pierre Etchevers³, Jean-Michel Soubeyrou³, Bruno Janet⁴, & Nans Addor^{5,6}

¹ Université Paris-Saclay, INRAE, UR HYCAR, Antony, France

² Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, IRD, Géoazur, Sophia-Antipolis, France

³ Météo-France, Toulouse, France

⁴ SCHAPI, Toulouse, France

⁵ Geography, College of Life and Environmental Sciences, University of Exeter, Exeter, UK

⁶ Fathom, Square Works, Bristol, UK

olivier.delaigue@inrae.fr

webgr.inrae.fr

Context

Large sample hydrology

Generalization of sound model evaluation and testing practices based on various types of split-sample tests

CAMELS international initiative

- Facilitate reproducible hydrological research by the use of large datasets

CAMELS datasets already published

- USA
- Chili
- Great-Britain
- Australia
- Brazil

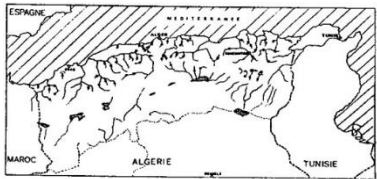
Other datasets are being finalized

- France
- Germany

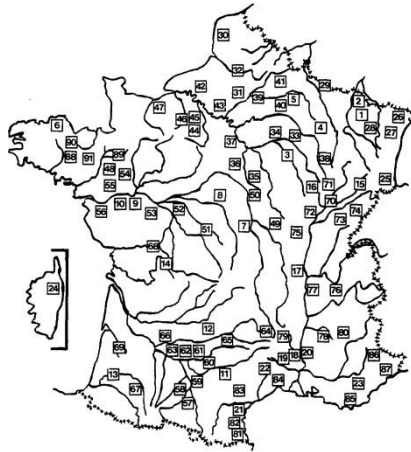
Context

Large sample hydrology expertise at INRAE (France)

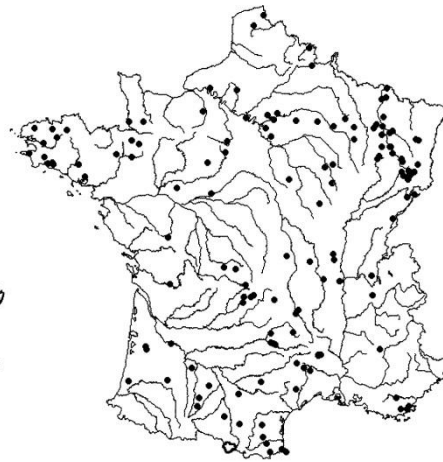
Increasing number of studies conducted on large datasets over the last three decades



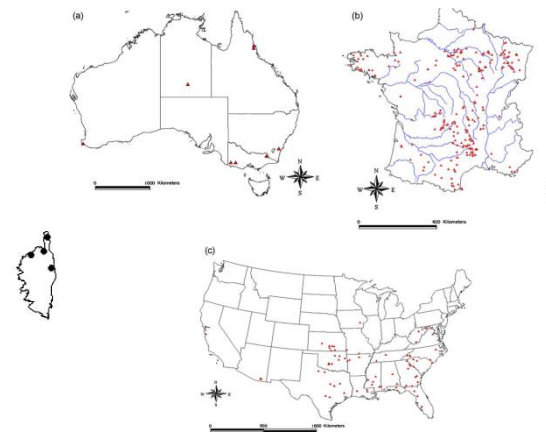
63 catchments in Algeria
(Kabouya *et al.*, 1991)



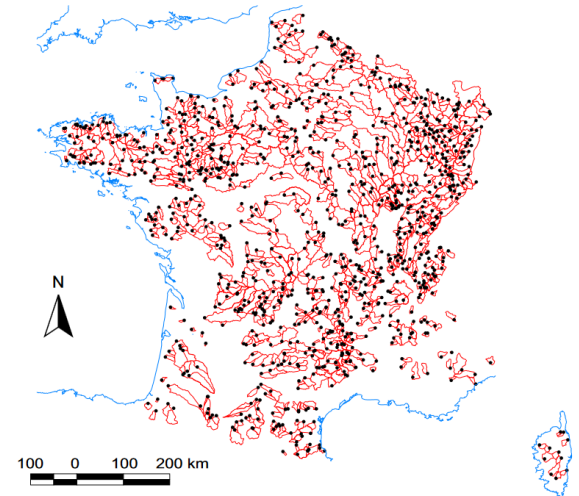
91 catchments in France
(Makhlouf *et al.*, 1994)



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



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



1040 catchments in France
(Le Moine, 2008)

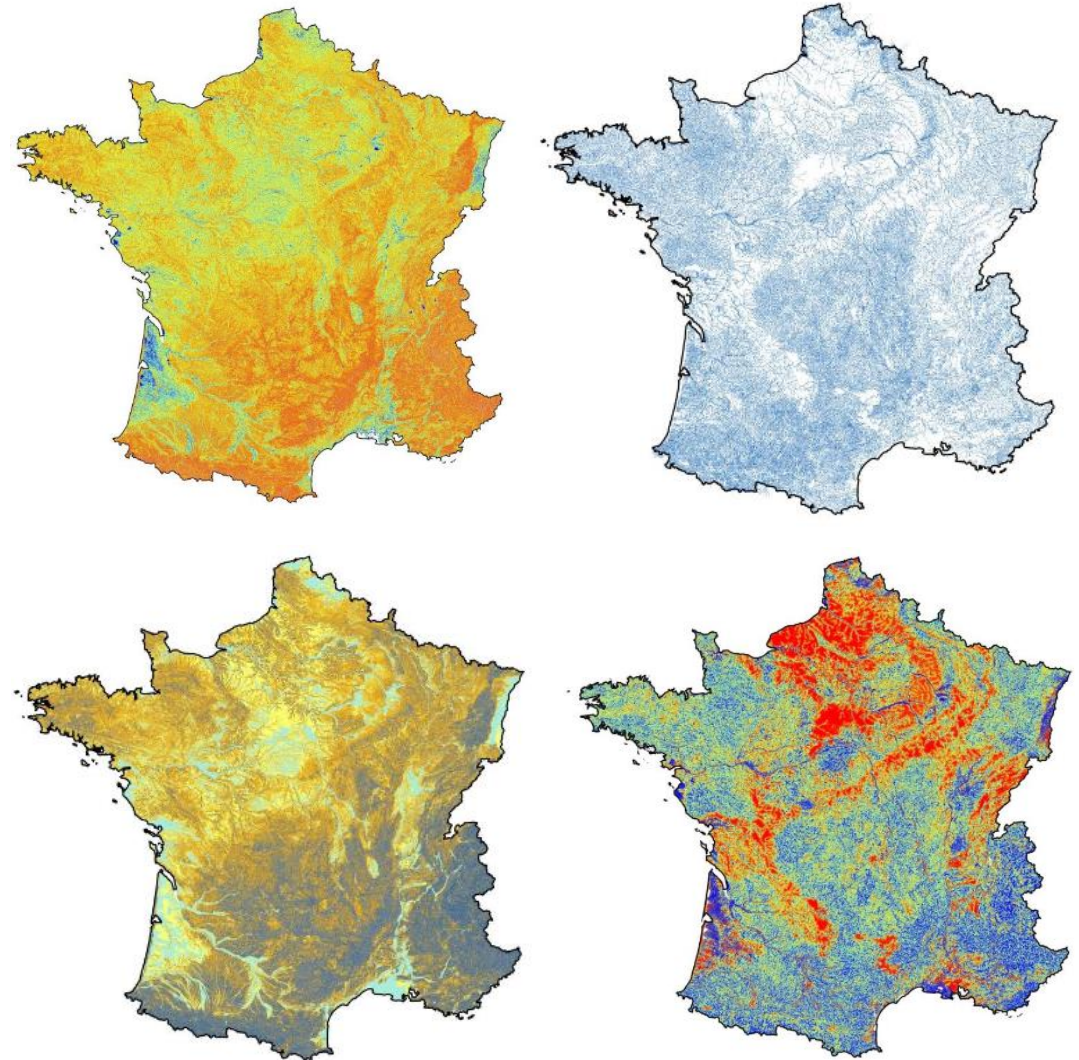
Context

Hydrological tourism?

According to the UNWTO

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

An ideal playground for hydrologists!



MEDDE (2014).

The CAMELS-FR (CHAMEAU) dataset

Data sources

Automated chain fed by national data products (Delaigue *et al.*, 2020)

Time series (1970-2019)

- Topography indices
 - Elevation and slope distributions
 - Drainage density
 - Topographic index
 - etc.
- Land cover
- Daily climatic data
 - Solid and liquid precipitation time series
 - Potential evapotranspiration time series
 - Temperature time series
 - etc.
- Daily hydrological data
 - Streamflow time series
 - Data quality flag

The CAMELS-FR (CHAMEAU) dataset

Climatic data

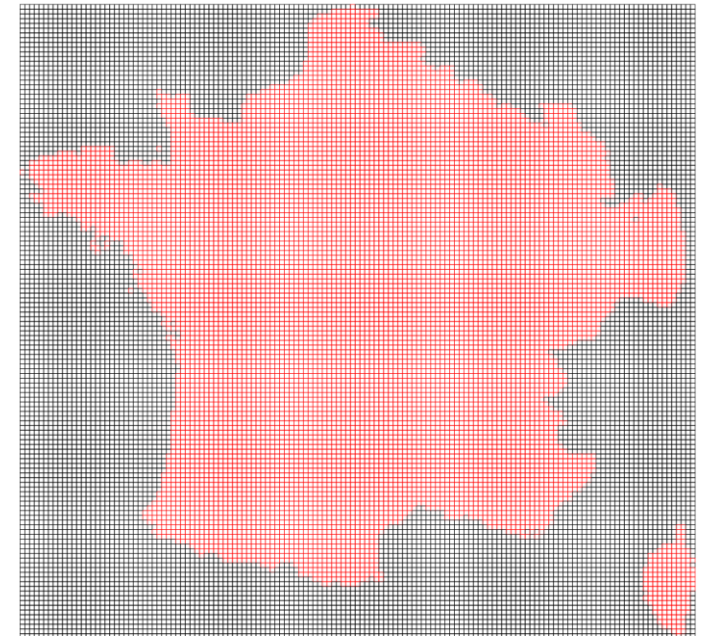
Météo-France's SAFRAN atmospheric reanalysis at daily time step

- 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 × 8 km)

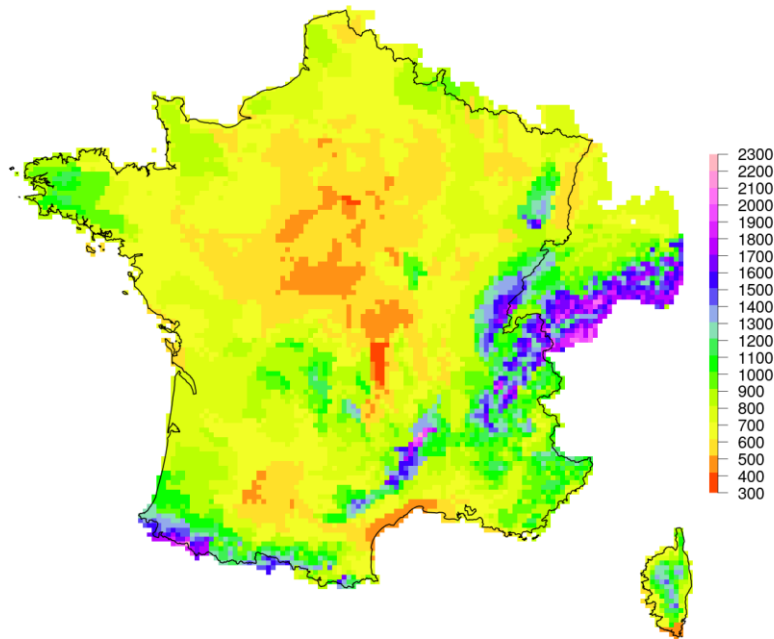
- solid and liquid precipitation
- temperature
- potential evaporation
- humidity
- wind
- water equivalent of snow
- solar & infrared radiation



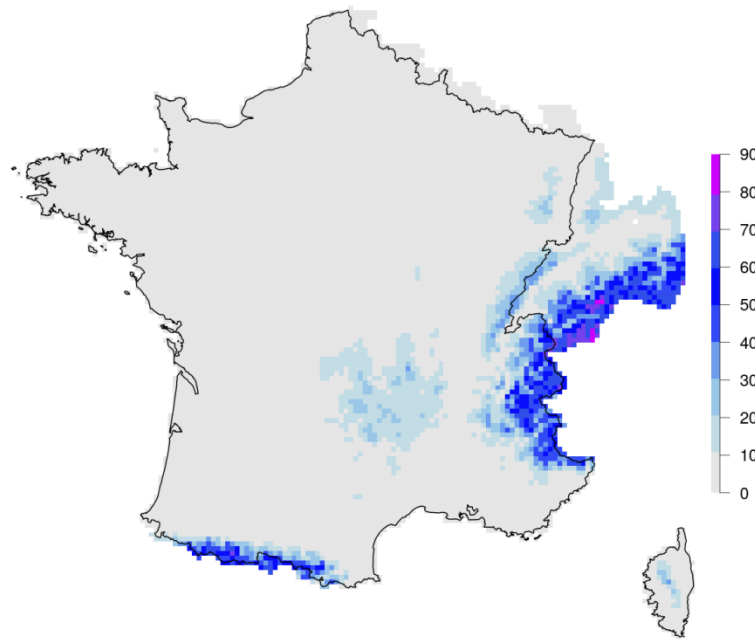
The CAMELS-FR (CHAMEAU) dataset

Examples of climatic variables

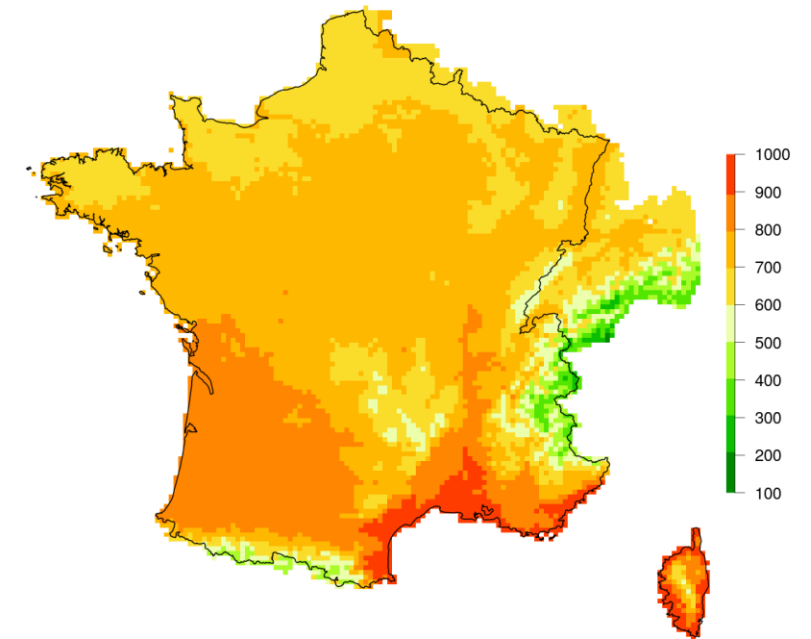
Precipitation (mm/yr)



Solid precip. fraction (%)



Evapotranspiration (mm/yr)

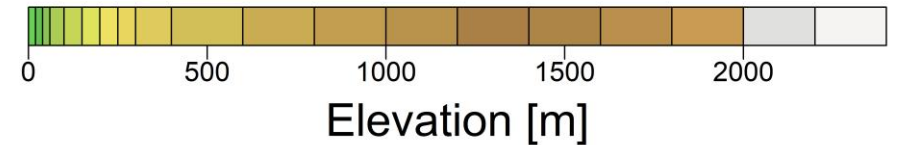
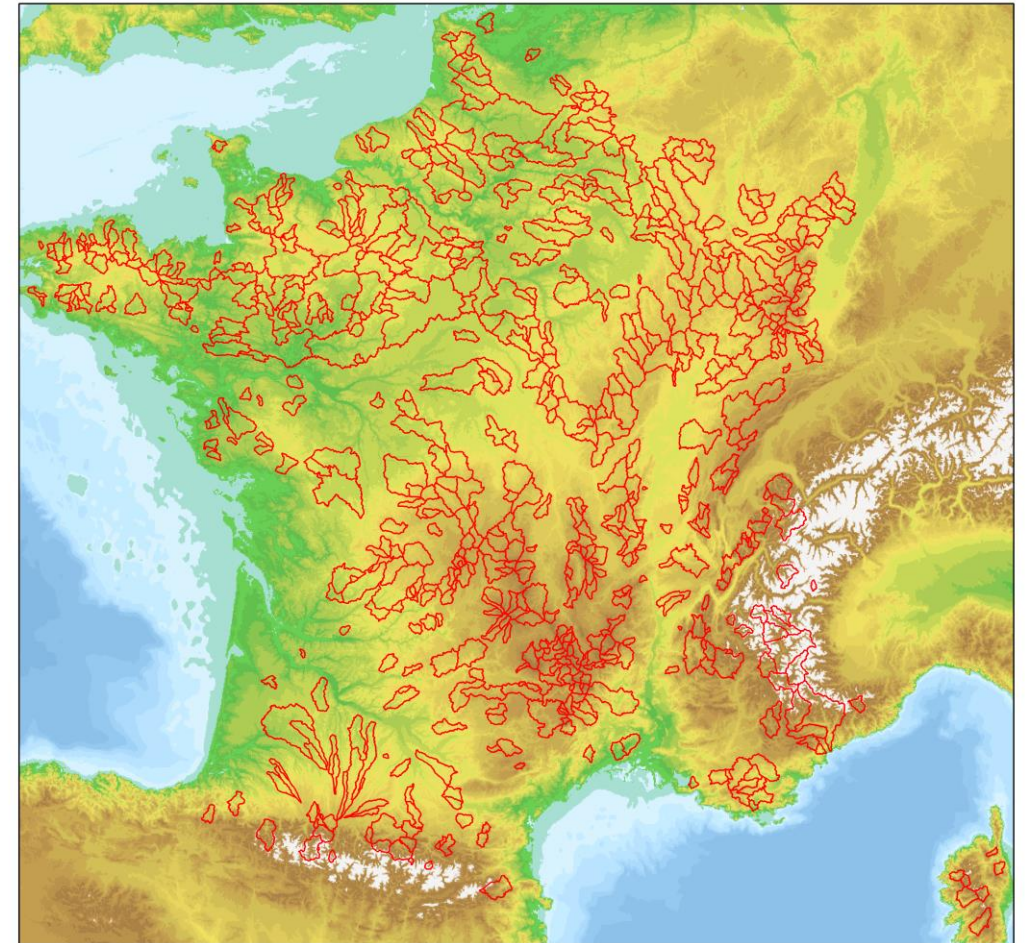


The CAMELS-FR (CHAMEAU) dataset

Catchment selection (v1.0)

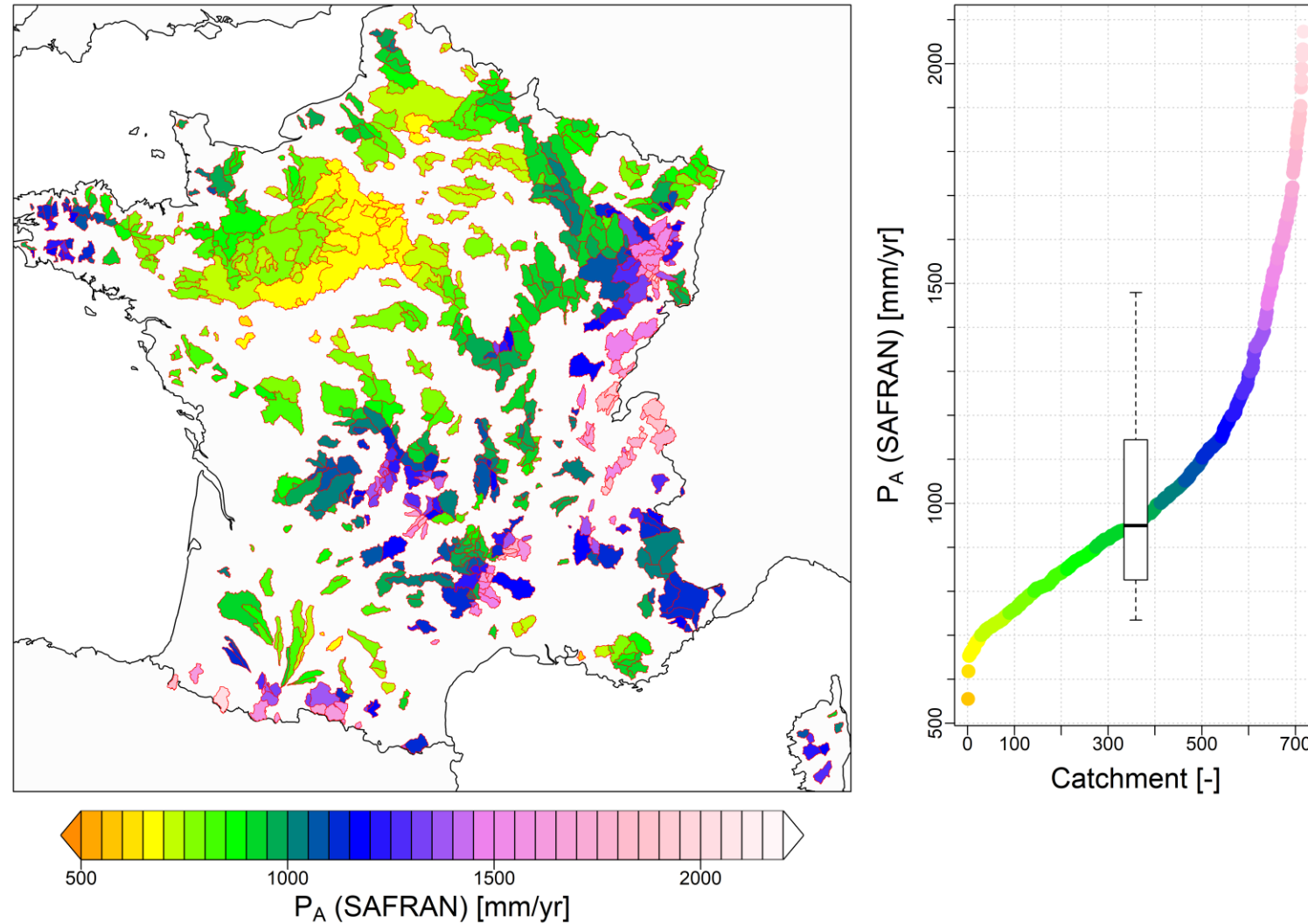
717 catchments

1. At least 30 years with limited missing data (< 20 %) over the 1970-2019 period
2. Limited identified upstream influences (< 10 mm)
3. Manual verification of gaging station location
4. Visual analysis of flow time series



The CAMELS-FR (CHAMEAU) dataset

Catchment selection (v1.0): mean annual precipitation



The CAMELS-FR (CHAMEAU) dataset

ChameauGraphs - dynamic graphs of time series



L'Ardèche à Vogüé

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

BH: Indice de validité [Banque HYDRO](#)

BI: Indice de validité [INRAE](#)

5: estimé

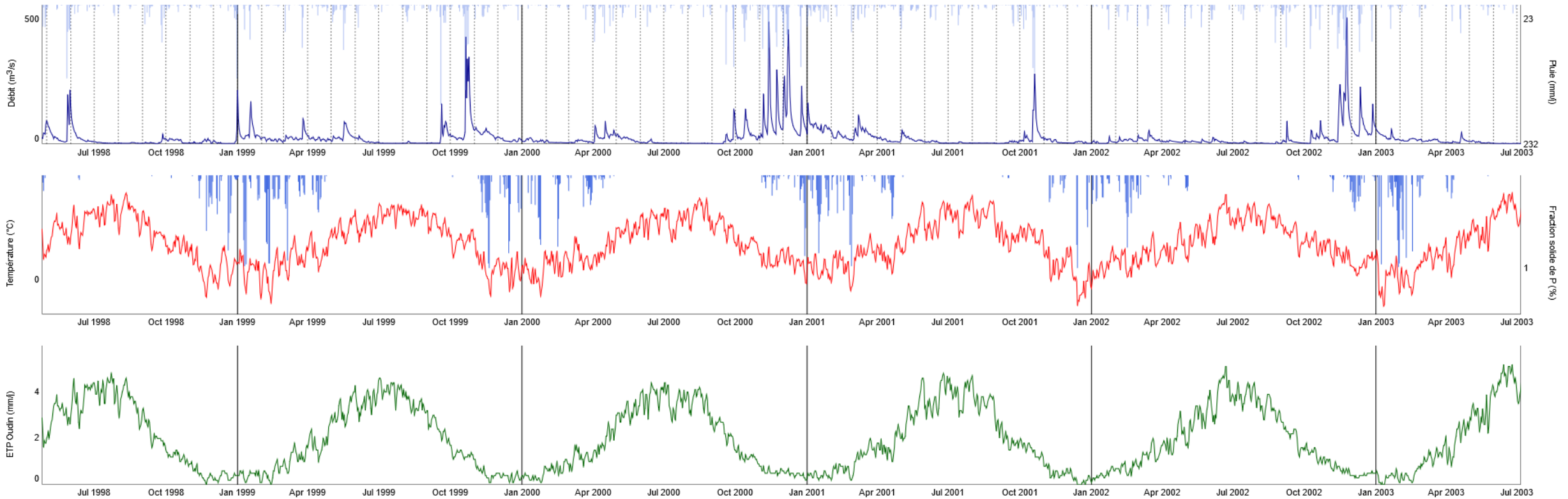
1: inconnu faible

3: inconnu fort

8: reconstitué bon

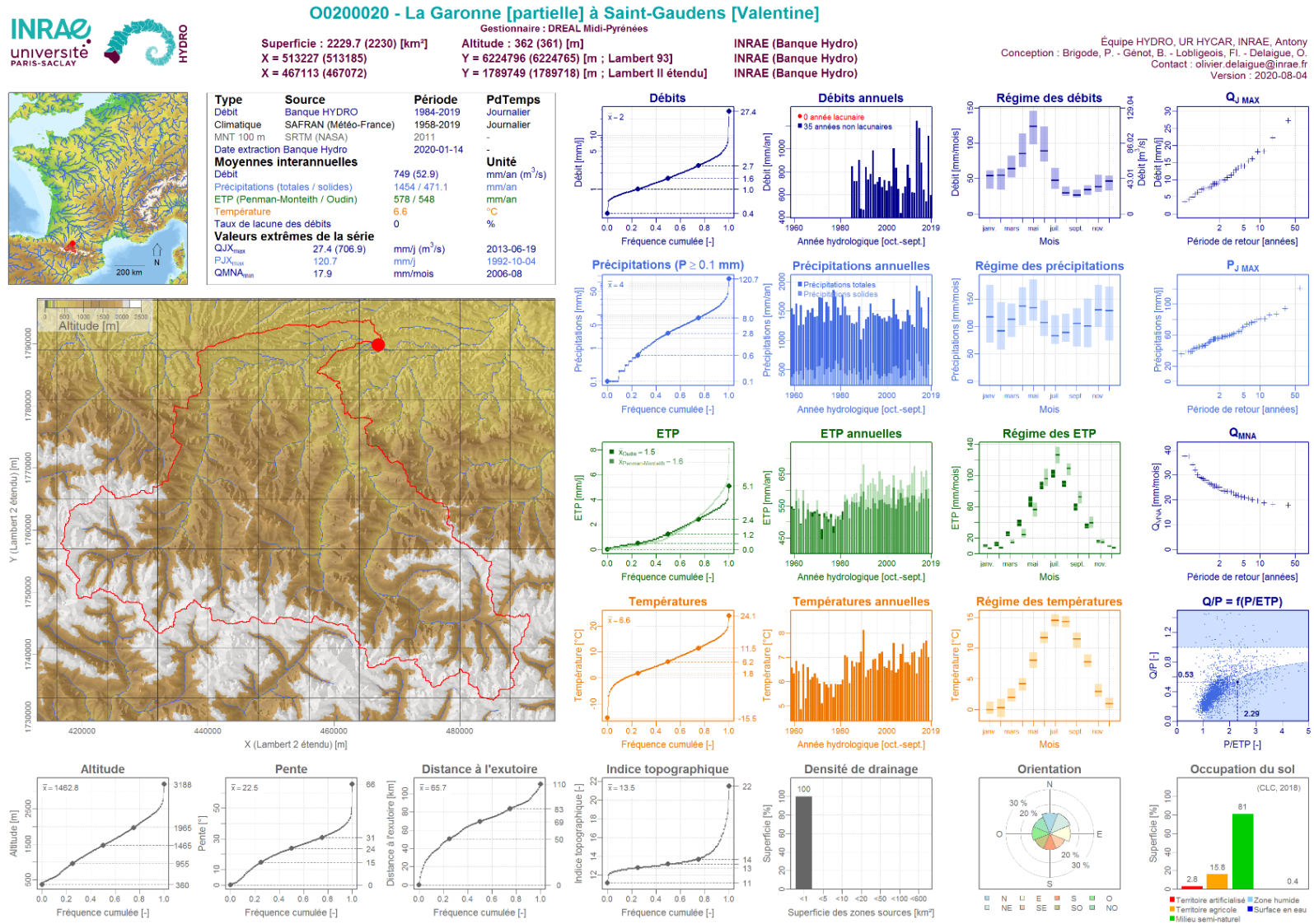
0 : anomalie présumée : valeur interpolée

2 : débits négatifs



The CAMELS-FR (CHAMEAU) dataset

ChameauSums - Graphical summary sheets provided



The CAMELS-FR (CHAMEAU) dataset

ChameauSampler - A web app to help users select catchments

The screenshot displays the ChameauSampler web application interface. The top header shows selection statistics: 255 / 3632 (7.0 %) Bassins versants and 16 / 20 (80.0 %) Références bibliographiques. The left sidebar contains various filters with sliders and checkboxes, including Superficie [km²], Altitude [m], Pente [°], Précip. moy. annuelles [mm/an], Fraction solide des précip. [%], Débit moyen [mm/j], Taux de lacune des débits [%], Nb d'années de débits dispo. [-], and Stockage amont [m³]. The central map shows a geographical view of catchments in France and surrounding regions, with a search bar and map controls. Below the map are two tables: 'Liste des bassins versants' and 'Liste des références bibliographiques'. The right side of the interface features a grid of histograms for various catchment characteristics: Superficie [km²], Altitude [m], Pente [°], Précip. moy. annuelles [mm/an], and Fraction solide des précip. [%].

Liste des bassins versants

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

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

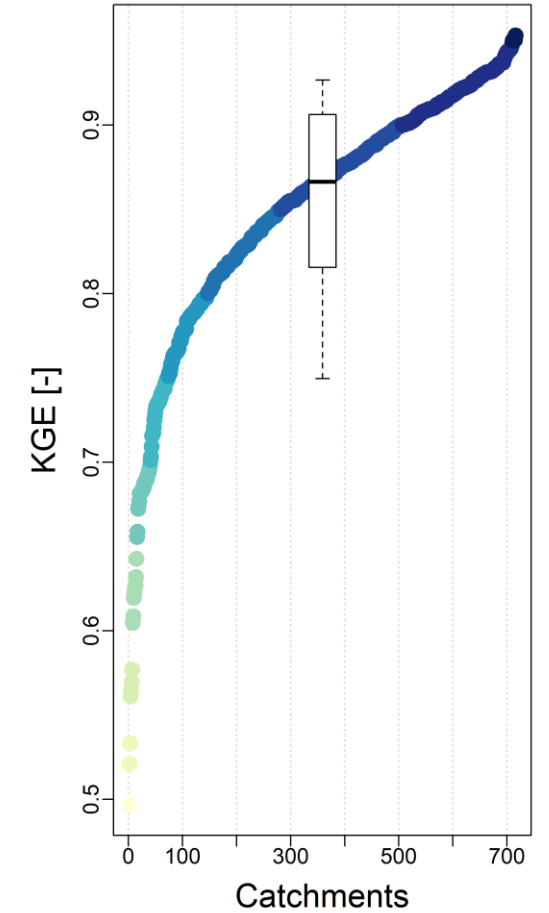
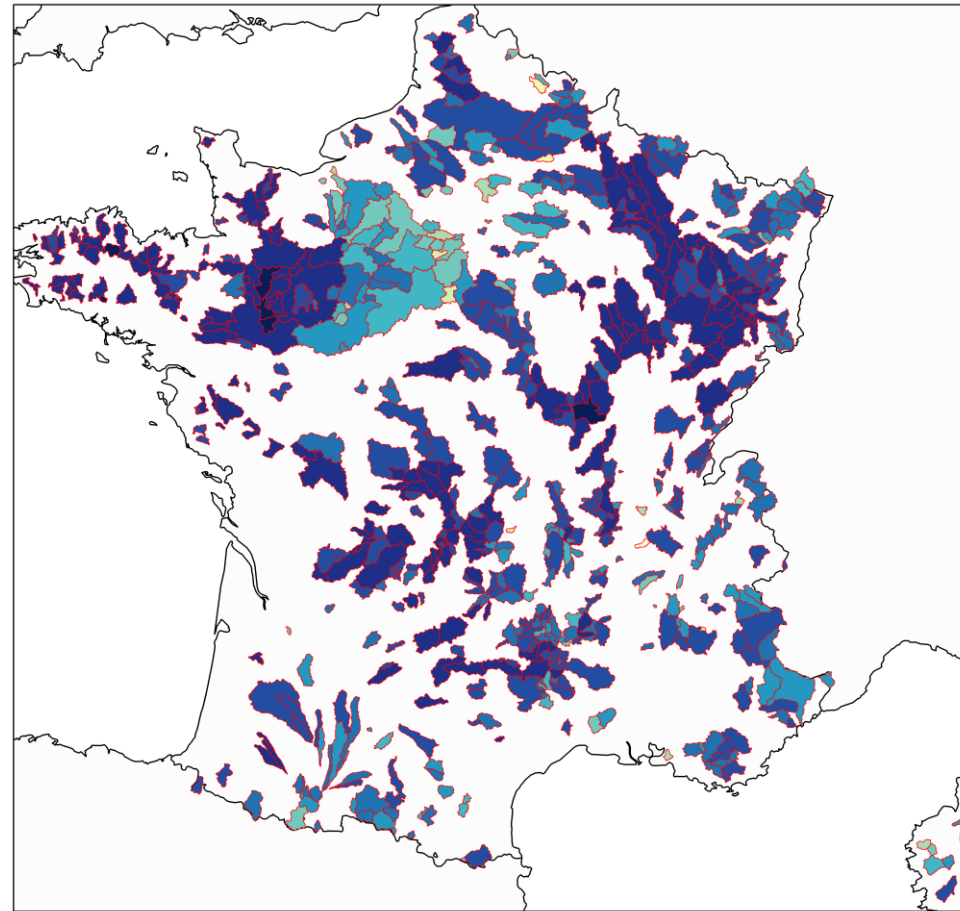
Available on sunshine.inrae.fr

The CAMELS-FR (CHAMEAU) dataset

Model performances

GR4J

Calibration efficiency (KGE)



The CAMELS-FR (CHAMEAU) dataset

CAMELS-FR is a **living** dataset!

- Updating time series
- Enlarge the number of catchments
- Tagging flow measurement characteristics updated by the data producer

CAMELS-FR has an upgradeable DOI (v1.0, v2.0...) to insure reproducible analysis

The CAMELS-FR (CHAMEAU) dataset

How to retrieve the data?

Freely available to the scientific community (partnership Météo-France & SCHAPI) on <https://data.inrae.fr/>

The screenshot shows the INRAE Data Portal interface. At the top, there is a navigation bar with the INRAE logo and links for 'Recherche', 'À propos', 'Guide d'utilisation', 'Support', 'Français', 'S'inscrire', and 'Se connecter'. Below the navigation bar, the breadcrumb trail reads 'Portail Data INRAE > INRAE >'. A search bar is present with the text 'Chercher dans ce dataverse...' and a 'Chercher' button. To the right of the search bar, there are links for 'Recherche avancée', 'Contact', and 'Partager'.

The main content area displays search results for 'R functions to compute potential evaporation'. The results are filtered by 'Dataverses (0)', 'Datasets (11)', and 'Fichiers (4)'. The 'Année de publication' filter shows 3 results for 2021 and 8 for 2020. The 'Data Origin' filter shows 2 observational data, 1 aggregate data, 1 analysis data, and 1 computer code. The 'Kind of Data' filter shows 4 software, 3 datasets, 2 models, 2 others, and 1 image. The 'Author Name' filter shows 7 results for Delaigue, Olivier, 2 for Ansart, Patrick, 2 for Azougui, Abdelkader, 2 for Blanchouin, Arnaud, and 2 for Brigode, Pierre.

The search results list 11 items, with the first three visible:

- R functions to compute potential evaporation** (5 nov. 2021) by LEMAITRE-BASSET, THIBAUT, 2021, "R functions to compute potential evaporation", <https://doi.org/10.15454/NCNCHG>, Portail Data INRAE, V2. Functions in R language to compute potential evaporation with six different formula: Penman-Monteith, Penman, Hamon, Hargreaves, Priestley-Taylor, Morton. Another R function compute the Penman-Monteith potential evaporation including the effect of CO2 on stomatal resistance.
- A joint database of French catchments and piezometers** (6 sept. 2021) by PELLETIER, ANTOINE, 2021, "A joint database of French catchments and piezometers", <https://doi.org/10.15454/GGAESY>, Portail Data INRAE, V1. The database of streamflow and groundwater level data that was used for the following study: Pelletier, Antoine and Andréassian, Vazken, "A surface view on groundwater level information: how are floods and droughts seen by piezometers?", Environmental Research Letters, 2021, unde...
- airGRdatassim: Ensemble-Based Data Assimilation in GR Hydrological Models. R package version 0.1.3.** (22 janv. 2021) by Piazzì, Gaia; Delaigue, Olivier, 2021, "airGRdatassim: Ensemble-Based Data Assimilation in GR Hydrological Models. R package version 0.1.3.", <https://doi.org/10.15454/WEYVYZ>, Portail Data INRAE, V1. Add-on to the 'airGR' package which provides the tools to assimilate observed discharges in daily GR hydrological model. The package consists in two functions allowing to perform the assimilation of observed discharges via Ensemble Kalman filter or Particle filter.

The fourth result is partially visible: 'Hydrology modelling R packages: codes for simulating streamflow using one parameter set' (21 sept. 2020).