

VALIDATING THE FRENCH HYDROMETEOROLOGICAL REANALYSIS (FYRE) WITH DOCUMENTARY EVIDENCE

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Validating FYRE Hydro with documentary evidence

Lack of historical streamflow observations

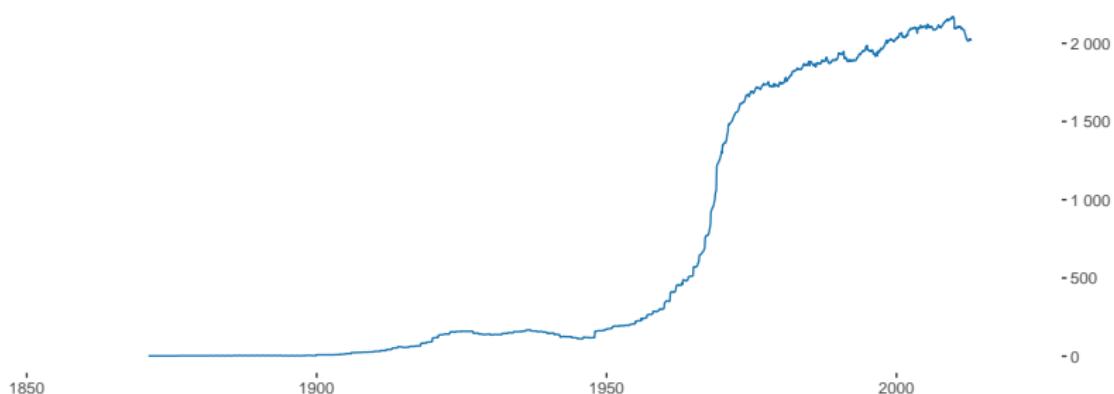
FYRE Hydro

Validation with documentary evidence

Conclusions

Lack of historical observations

Number of streamflow stations in France



Lack of historical data in current databases for assessing local to country-wide hydrological variations

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FYRE Hydro

French Hydrometeorological REanalysis – Hydrology

→ Global atmospheric circulation 20CRv2 (1871-2012)



FYRE Hydro

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1. Statistical climate downscaling

→ Meteorological reconstruction *SCOPE Climate*



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Daily streamflow

661 near-natural catchments

25-members ensemble time series

1871-2012



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Target features

Low flows

Various spatial scales: small catchment to country-wide

Various temporal scales: daily to multi-decadal

Documentary evidence

Rather unconventional documents

Letter (1877)

Poem (1906)

Photograph (1942)



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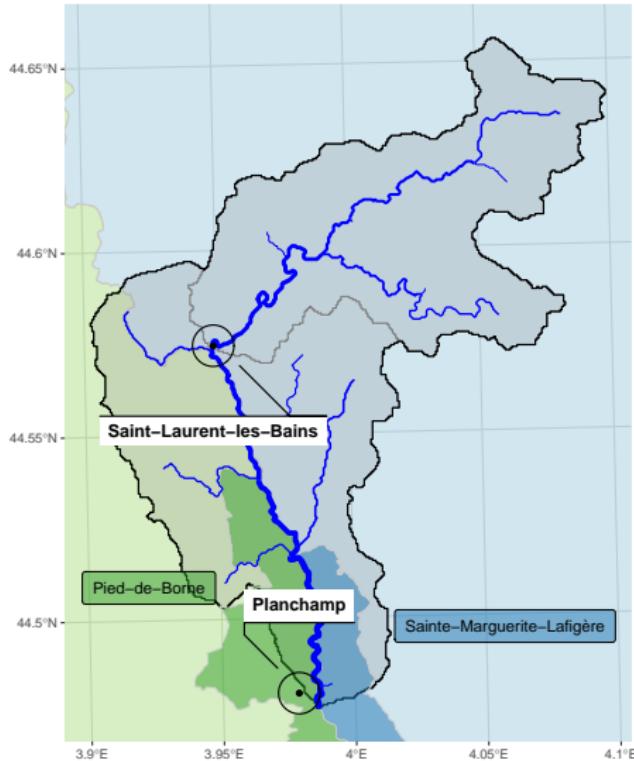
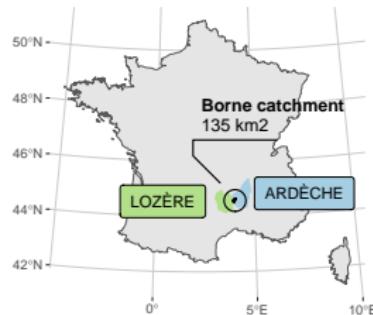
Photograph

Conclusions



Letter: The intake of discord – 1877

The Borne catchment (Borne may be translated as “boundary”)

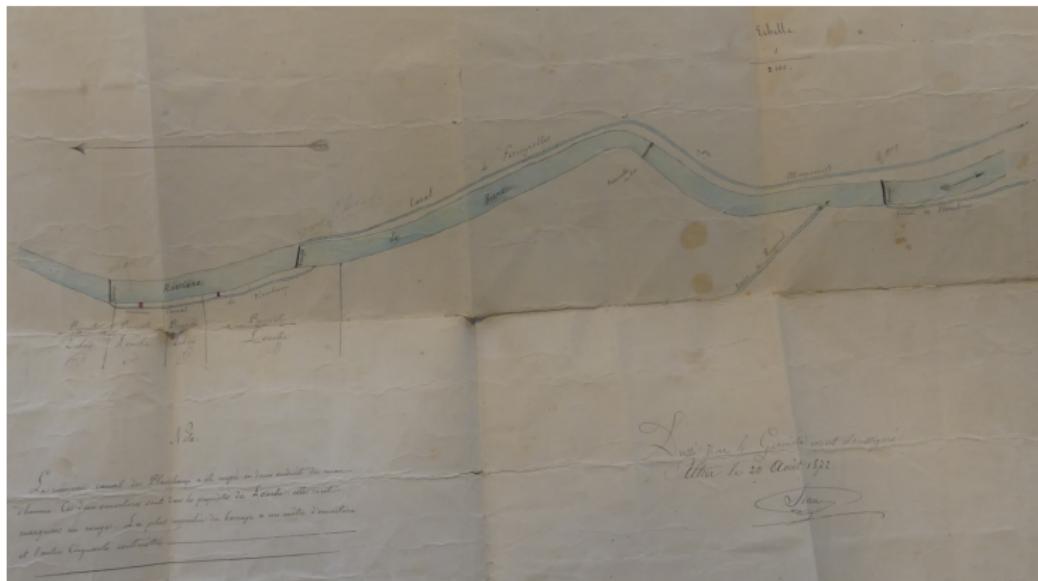


The Borne river acts as a boundary between

- administrative départements:
Lozère/Ardèche
- communes:
Pied-de-Borne/Sainte-Marguerite-Lafigière

Letter: The intake of discord – 1877

Numerous water intakes on both sides for irrigation



Map of water intakes on Ardèche (up) and Lozère (down) sides, dressed in 1872.
Photograph Maël CRÉPY.

Letter: The intake of discord – 1877

The dwellers' letter

Original manuscript version transcribed by
Maël CRÉPY

« Planchamp 5 août 1877 :

Monsieur le Préfet,

A lé réception de vorte [sic] arretté [sic] du 5 juillet consernan [sic] le partage des eau [sic] de la Borne, les interesés [sic] de la commune de Saint Jean Chazorne et ceux de Planchamp se son [sic] empréssé [sic] de [illisible] vos ordres. Mas [sic] le cotted de l'ardèche ils non [sic] rien fait pour sela [sic] au contraire ils dises [sic] qu'il [sic] ne veule [sic] pas le faire.

Depuis un mois nous sommes privés des eaux, et toutes nos récoltes perisses [sic] par la privations de ses eau [sic].

Nous vous prion [sic] Monsieur le Préfet de faire exequeter [sic] vos ordres par l'ardèche, et nous faire connaitre seque [sic] nous aurons à faire en cas ou [sic] ils ne les exequete [sic] pas prontemen [sic].

Dans l'espoir que vous voudrre [sic] bien faire droit à notre juste réclamation nous avons l'honneur de nous dire de Monsieur le Préfet les très humbles et très dévoue sujet [sic].

[4 signatures] »

Corrected and translated version

“Planchamp 5 August 1877 :

Mr. Prefect,

Upon receipt of your decree of July 5 concerning the sharing of the waters of the Borne, the interested parties of the commune of Saint Jean Chazorne and those of Planchamp hastened to [unreadable] your orders. But on the Ardèche side they did nothing for that, on the contrary they say they don't want to do it.

For a month now, we have been deprived of its waters, and all our crops are perishing because of the deprivation of its waters.

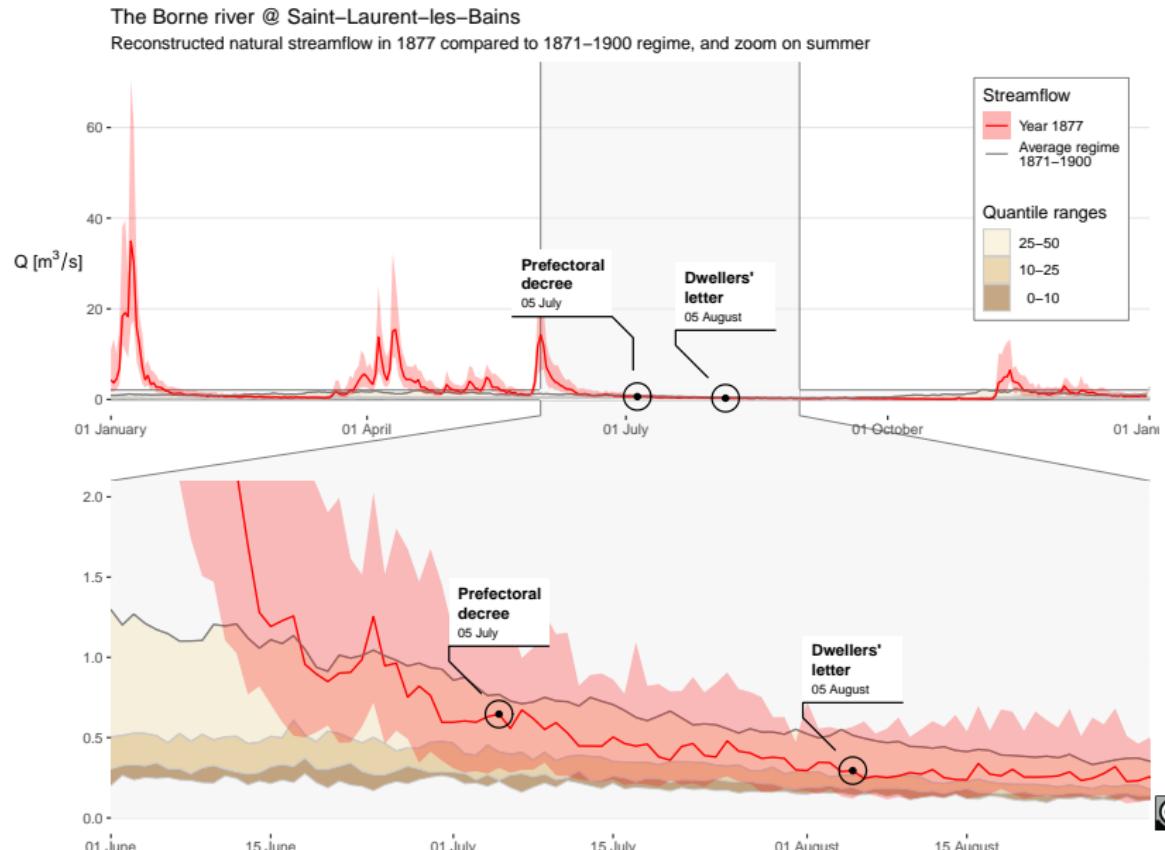
We ask you, Mr. Prefect, to have your orders executed by the Ardèche, and to let us know what we will have to do if they do not execute them promptly.

In the hope that you will be willing to accept our just complaint, we have the honour to say of the Prefect the very humble and devoted subjects.

[4 signatures]”

Letter: The intake of discord – 1877

FYRE Hydro reconstructed natural streamflow on the upper catchment



Letter: The intake of discord – 1877

Validation summary

Fact checking

“For a month now, we have been deprived of its waters”: upstream natural water resources under long-term average 1 month before the letter is sent

Water resources amount down to quantile 0.25 at the time of letter writing: low but not exceptional

Anthropogenic water shortage as suggested by dwellers

Conclusion

FYRE Hydro is able to reconstruct the timing of low flows on very small catchments where and when no streamflow data were available



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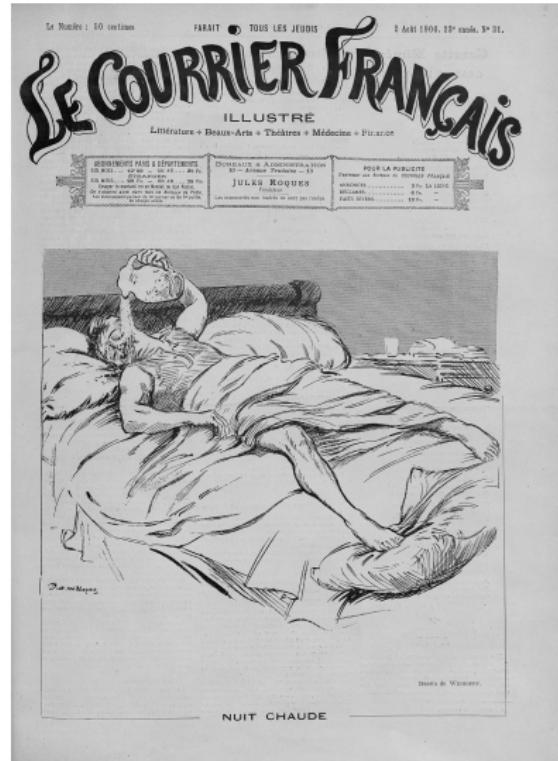
Photograph

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Poem: “Obsession for water” – 1906

Le Courier Français, weekly newspaper



Newspaper's cover for 2 August 1906



Poem: “Obsession for water” – 1906

Le Courrier Français, section “Gazette rimée”: « Obsession de l'eau »

Original text

« Chaque année, à la même époque,
Quand sous la chaleur on suffoque,
C'est le même cri dans Paris :
Ah ! mon Dieu, si l'eau continue
À ne pas tomber de la nue,
Nous allons tous être cuits, frits.

Que sur quelque fleuve baroque,
Le Mançanarès, l'Orénoque...
Ne vient pas nous ravitailler,
Comment pousserons nos fleurs, voire
Qu'est-ce donc qu'il nous faudra boire ?
Avec quoi nous débarbouiller ?

Nos puits sont morts et nos cisternes
Ne furent jamais aussi ternes.
Nous avons épuisé la Dhuis,
Le lac Pigalle **ainsi que l'Avre :**
Et la sécheresse vous navre
De la Fontaine Médicis... »

Tentative translation

“Every year, at the same time of year,
when under the heat we are suffocating,
it is the same cry in Paris:
Oh my God, if the water keeps on
not falling from the sky,
we are all going to be cooked, fried.

That if some baroque river,
the Mançanarès, the Orinoco...
doesn't come to supply us,
how will our flowers grow, or even
what will we have to drink?
What will we wash ourselves with?

Our wells are dead and our cisterns
have never been so dull.
We've exhausted the Dhuis,
the Pigalle Lake **and the Avre:**
And the drought is bothering you from the
Médicis Fountain...”

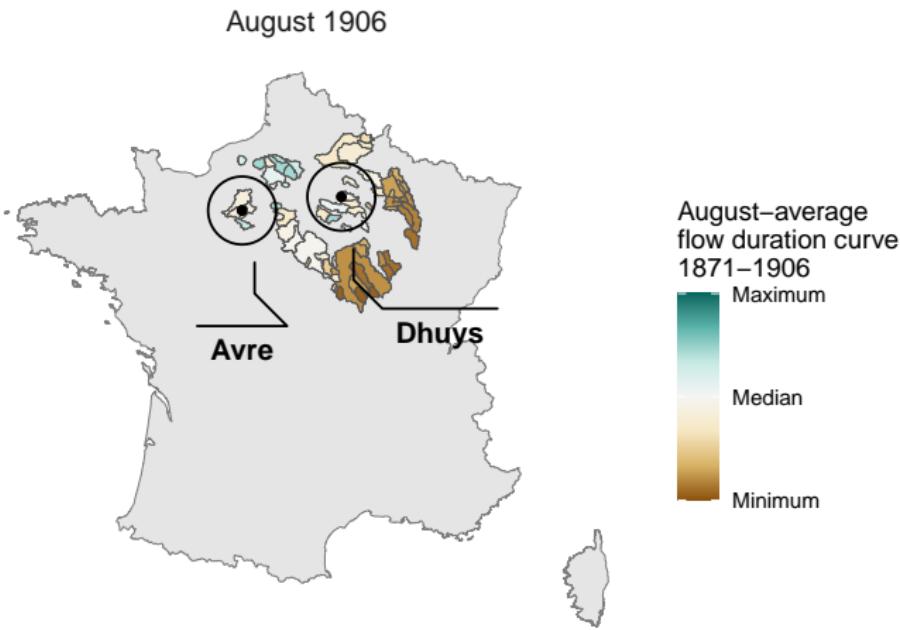
Raoul PONCHON
23 août 1906

Raoul PONCHON
23 August 1906



Poem: “Obsession for water” – 1906

Streamflow conditions in the Seine basin in August 1906 according to FYRE Hydro



The Dhuis and Avre rivers serve as water intakes for aqueducts supplying Paris with water. They were at the time in a relatively dry state.

Poem: “Obsession for water” – 1906

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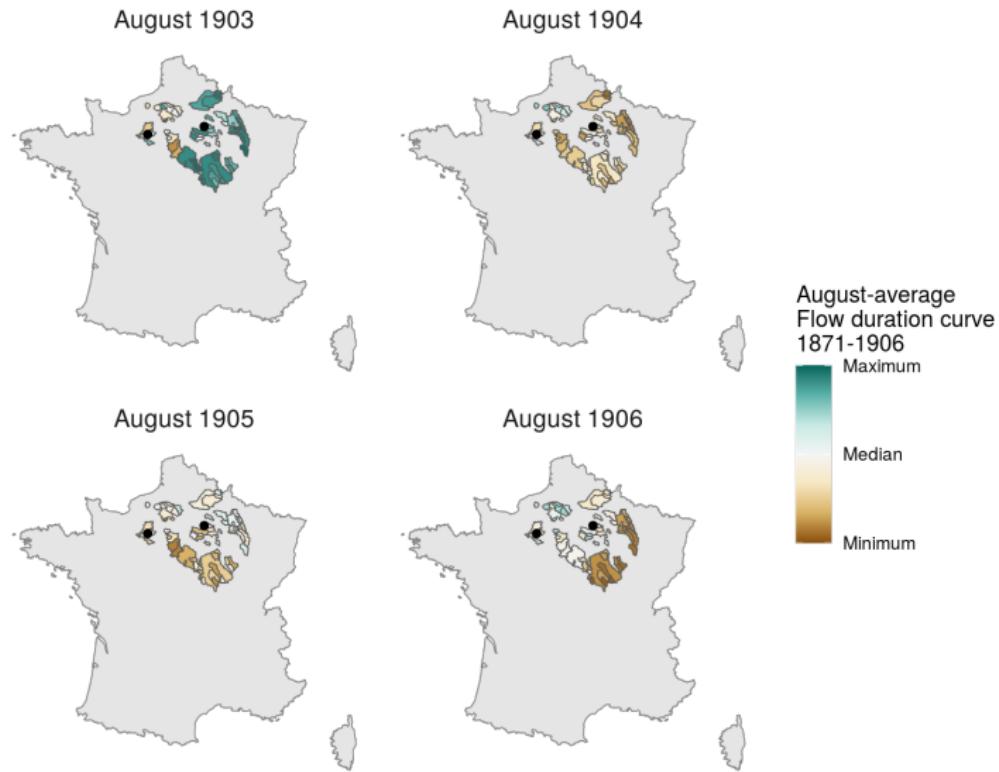
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Poem: “Obsession for water” – 1906

Streamflow conditions in the Seine basin in August 1903–1906 according to FYRE Hydro

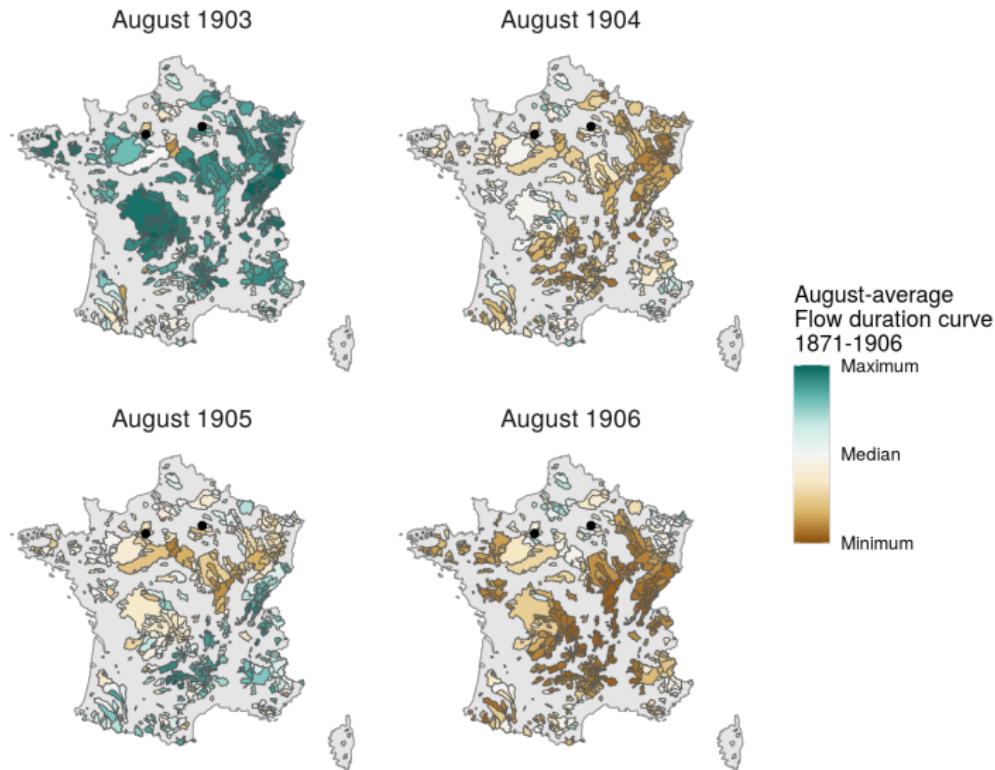


3-4 years in a row with lower-than-normal August streamflow for the Seine basin.



Poem: “Obsession for water” – 1906

Streamflow conditions in France in August 1903-1906 according to FYRE Hydro



One of the few basins in France with such recurring dry conditions.



Poem: “Obsession for water” – 1906

Validation summary

Fact checking

“Every year, at the same time of year [...] We've exhausted the Dhuis [...] and the Avre”. – 23 August 1906

Lower-than-normal 1906 August streamflow conditions over the Seine basin

3-4 years in a row width dry conditions

The Seine basin is one of the few ones in France with such August dry conditions over the past few years

Conclusion

FYRE Hydro is able to reconstruct multi-year recurring dry conditions and contrasts between large basins.



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Photograph: The Seine closure – 1942

The Seine at Paris during low flows



The Seine river at Marie bridge (Paris), 16 or 19 August 1942. (unknown photographer)

Photograph: The Seine closure – 1942

The Seine at Paris during low flows

Summer low-flows in Paris

The photograph shows very low water levels in Paris

Possible **closure** of the Seine in Paris by closing upstream ship locks and opening downstream ones

Used by Nazis during WWII (and French officials after the war) to inspect bridge piers:

August 1942

July 1943

October 1944

September 1946

Natural conditions during closures

Operation only possible during very low-flow periods

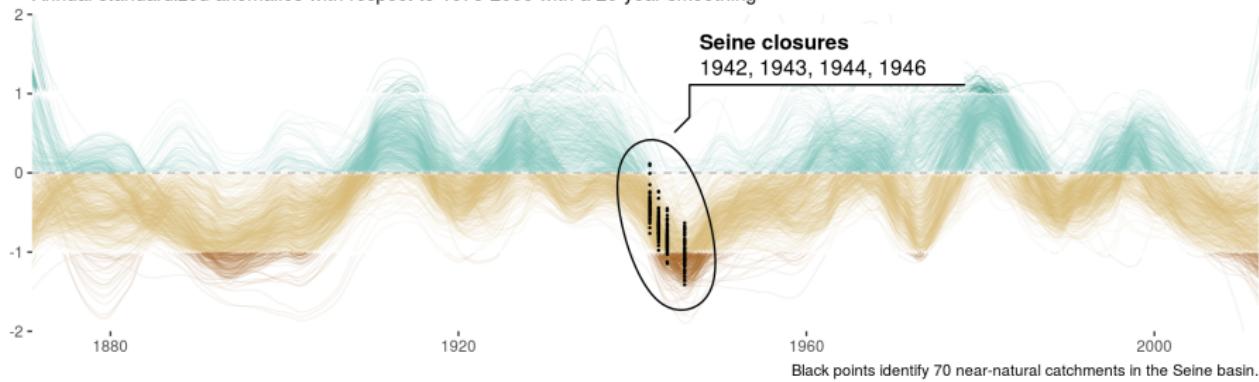
Very dry 1940s in France

Photograph: The Seine closure – 1942

Multidecal streamflow variability in France according to FYRE Hydro

Multidecadal streamflow variability over 661 near-natural catchments

Annual standardized anomalies with respect to 1973-2006 with a 20-year smoothing



Photograph: The Seine closure – 1942

Validation summary

Fact checking

[Low water levels in August 1906 in Paris](#)

Photograph testifies from natural streamflow low enough to perform Seine closures

Several examples of such dry conditions during the 1940s

Dry decade well identified in FYRE Hydro

Conclusion

FYRE Hydro is able to show multi-decadal variability and multi-year droughts over France.



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Conclusions

Validating FYRE Hydro with documentary evidence

Developing an ensemble daily streamflow reanalysis covering 142 years for 661 near-natural catchments in France: FYRE Hydro

Validating the reanalysis on low-flow events at various temporal and spatial scales

Using unconventional historical evidence that show the high potential of hydrological information in documentary archives

Highlighting anthropogenic characteristics of low-flows during the Anthropocene



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United Nations
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EURO-FRIEND *Low flow and Drought* group



Working Group *Drought in the Anthropocene*

Thank you for your attention!

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