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Data Article

A dataset on physico-chemical hyporheic variables in the Selune River: Towards understanding the impact of dam removal on riverbed clogging processes

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A R T I C L E I N F O

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Dataset link: Dataset of physico-chemical variables for a full-year time series characterization of Hyporheic zone of Selune River, Manche, Normandie, France (Original data)

Keywords:
Hyporheic zone
Surface-subsurface transfers
Biogeochemical processes
Reactive transport
Dissolved oxygen
Dam removal

A B S T R A C T

This article presents field measurements that document the physical and chemical response of riverbeds to critical hydrological and sedimentary forcing in the Selune River (France). The river flows into the bay of Mont Saint-Michel and thus impacts numerous economic activities and the spawning of several key species such as Atlantic salmon and lamprey. To restore the hydro-sedimentary continuity of the river, two dams are currently being removed. Significant changes in the stream flow regime, stream-aquifer exchanges and sediment transport are expected, hence the monitoring campaign. A network autonomous sensor (water level, temperature, conductivity, oxygen and pressure differential) was installed on 18 October 2021 at various depths in the riverbed and the river for a one-year period. This was to continuously record variations in the main physico-chemical variables and relate them to surface processes. To assess the impact of dam removal on these variables, two measurement sites were chosen: one upstream of the dams where flow conditions re-

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mained stable, and another downstream of the dams where a large amount of fine sediment has been released. This original data can be used to determine the biogeochemical functioning of the hyporheic zone and its coupling with dynamical flow and sedimentary processes.

Specifications Table

Subject	Environmental Science
Specific subject area	Hydrology and Water Quality, Ecology
Type of data	Tables: time series and geospatial data Graphs Figures
How the data were acquired	The data was acquired during the removal of two dams (Roche-Qui-Boit (RQB) and Vezins) to restore hydro-sedimentary continuity in the Selune River (France). We used high-frequency autonomous probes to continuously monitor physico-chemical variables in several sectors of the river over a 12-month period. Two measurement sites were chosen. The first site, referred to as the "Virey" site, is located far enough upstream of the dams to not be directly affected by the dam removal. The second site, referred to as the "Signy" site, is located downstream of the dams. During the measurement period, it was thus directly impacted by a large-scale release of fine sediments. At the Virey site, a number of physico-chemical variables were measured in the river and at various depths in the sediment, including dissolved oxygen concentration, conductivity, water level and temperature. We used the following autonomous sensors: HOBO (U26, U24), Rugged TROLL 100 and PT100. At the Signy site, there was a Campbell acquisition unit, meaning that wire probes could be used. Dissolved oxygen, conductivity, water level and temperature were also continuously recorded from the river and the sediment bed at various depths. At both sites, LOMOS-mini (The mini–MOnitoring LOcal NAppe-RIveR) [1] were used to monitor high-frequency hydraulic head difference between the sediment and the river, as well as the vertical temperature profile. The vertical temperature profile is obtained using temperature sensors (PT100 sensors) at increasing depths in the riverbed (10, 20, 30 and 40cm). A pressure differential sensor is installed in the direct vicinity of the temperature system and measures the differential in hydraulic head between the stream and the sediment at 30cm. The LOMOS-mini data can be used to estimate advective and diffusive thermal fluxes, as well as the permeability and thermal conductivity of the riverbed at a sub-daily resolution [2]. In addition to these sensors, two INRAE (the French National Research Institute for Agriculture, Food and the Environment) permanent gauging stations continuously record the water level, river conductivity and turbidity at both the Virey and Signy sites, plus river dissolved oxygen at Virey only.
Data format	Raw: CSV file of time-series of river and hyporheic zone physico-chemical variables.
Description of data collection	At the two sites, the specific probes installed were selected based either on: (i) the presence of fish spawning grounds; or (ii) electrical conductivity measurements in sediments attesting to high local hydraulic conductivity. Such criteria aimed to maximize the intensity of coupling between stream and sediment physico-chemical response. The probes in the sediment were placed in tubes buried 15 and 30cm below the sediment surface, making it possible to estimate vertical concentration gradients in dissolved oxygen, conductivity and temperature. There are strainers located 4cm up from the bottom of each tube that allow the water to pass through. This setup enables the autonomous probes to be easily extracted for data collection and maintenance without disturbing the local sediment bed. Foam plugs (ethylene vinyl acetate) seal the tubes and preclude the infiltration of stream water. All tubes were installed in the riverbed within an area with a 1m radius.

(*continued on next page*)

	The LOMOS-mini data was monitored between 14th April 2022 and 16th September 2022. Other physico-chemical variables were monitored over a full year (October 2021 to September 2022). All data was registered at a high frequency (15 min). This period equates to ten months before and four months after the withdrawal of the Roche-Qui-Boit dam (May 2022). The data from the autonomous probes was retrieved every few months, when stream discharge was sufficiently low to walk in the river. Data from the wired probes was constantly accessible via the Campbell station on the riverbank.
Data source location	- Institution: Geosciences Rennes, CNRS UMR 6118, University of Rennes 1 - City/Town/Region: watershed Selune River, Manche, Normandy - Country: France - Latitude and longitude of collected samples/data: Site Point Virey X: -1.11582907 Y: 48.57164085 Signy X: -1.29367814 Y: 48.59571737
Data accessibility	**- Repository name:** Recherche.data.gouv> **- Data identification Numbers:** doi:10.57745/SBXWUC https://doi.org/10.57745/SBXWUC **- Direct URL to data:** https://entrepot.recherche.data.gouv.fr/dataset.xhtml?persistentId=doi:10.57745/SBXWUC Instructions for accessing this data: • The links above lead directly to the data. • Data can be searched from the Recherche Data Gouv Repository's home page. • Simple searches can be run from the menu and under the carousel. • You should use inverted commas to search for an exact phrase (e.g. "Selune River") or the DOI of a dataset ("10.5072/WBQYR2"). After finding the dataset, simply click "access datasets" to download the data.

Value of the Data

- This data constitutes a new time database of significant physico-chemical parameters for the river water and hyporheic zone. Notably, the data provides the first simultaneous and high-frequency observations of vertical gradients in the sediment in dissolved oxygen, conductivity and temperature. This gradient data can be used to determine the nature of reactive transport processes in other riverbeds.
- This data was obtained in the unique context of dam removal in the Selune river. Data comparison between the Signy site, directly impacted by sediment release, and the Virey site, located upstream of the dams, provides a robust way of assessing the consequences of dam removal for the hyporheic zone.
- The long and high frequency (e.g. every 15 min) measurement period makes it possible to determine the impact of dynamical forcing such as flood waves on the functioning of the hyporheic zone.
- This database is also useful for monitoring spawning ground and clogging processes. The variability of dissolved oxygen is key for the survival of fish eggs in the sediments.
- Vertically resolved data provides new opportunities for predicting oxygen distribution in the hyporheic zone and its dependence on geomorphological processes [3].
- This data can be used to compare reactive transport models (oxygen uptake, denitrification, precipitation, etc.) and to assess biogeochemical function hotspots and key times in the hyporheic zone [4].

1. Data Description

1.1. Study sites

The study sites are located in the catchment of the Selune River, in the region of Normandy, France (Fig. 1). The Selune River is 90km long and drains a catchment area of 1,051km². Two dams have radically altered the functioning of the river and ecological continuity has been broken. The Vezins dam was destroyed between 2019 and 2020. Removal of the Roche-Qui-Boit dam began in May 2022. The estimated volume of sediment at the Vezins dam and Roche-Qui-Boit dam are 1.3 million m3 and 0.3 million m3 respectively [5].The removal of dams in the Selune River should have a significant impact on hydrology and sediment transfer and thus may cause de-clogging and clogging of the riverbed downstream. [6].

One of the main objectives of this study is to assess the impact of dam removal on hydro sedimentary flows and how this affects the functioning of the hyporheic zone.

Two measurement sites were chosen. The first was upstream of the dams where flow conditions remained stable, known as the Virey site, and the second was downstream of the dams where a large quantity of fine sediment was released, known as the Signy site (Fig. 1). At these two sites, a number of probes were installed to monitor physical and chemical gradients in the sediment riverbed layer. The data from these probes will help to fulfil a more fundamental objective, namely that of better understanding hyporheic physico-chemical flows.

The Signy site is characterized by the presence of fish spawning grounds, including lamprey and Atlantic salmon [7].

This site very sensitive to the presence of fine sediments and to riverbed clogging, both of which reduce oxygen penetration inside the riverbed. Before May 2022, the dams prevented

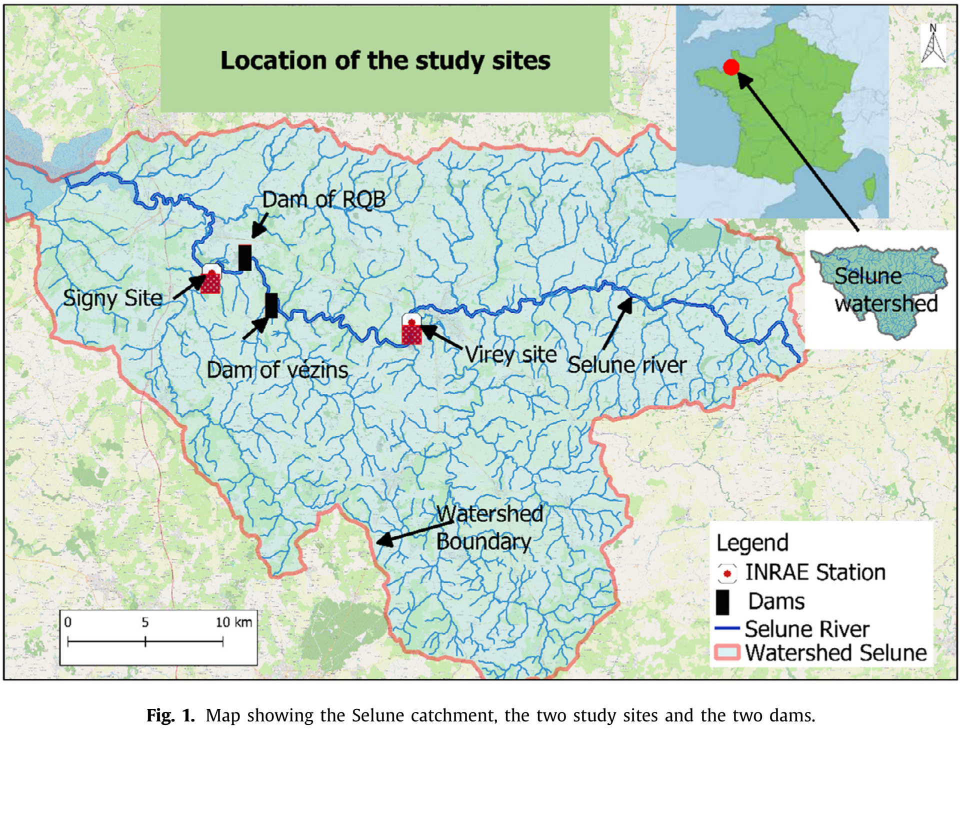

Fig. 1. Map showing the Selune catchment, the two study sites and the two dams.

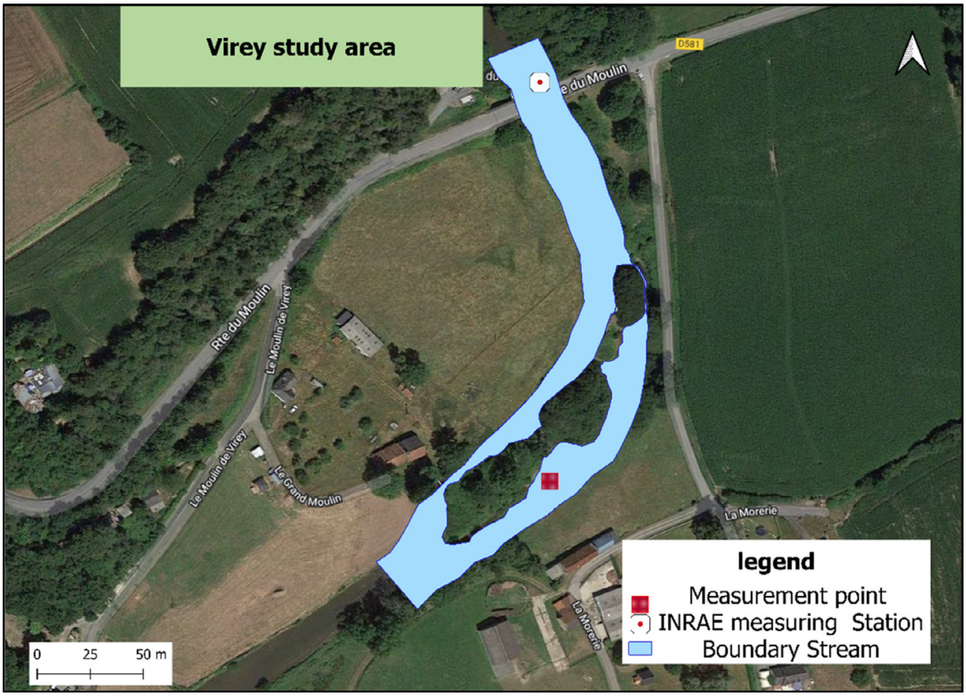

Fig. 2. Map showing the Virey site, the location of the measurement point and the INRAE measurement station (Google Earth).

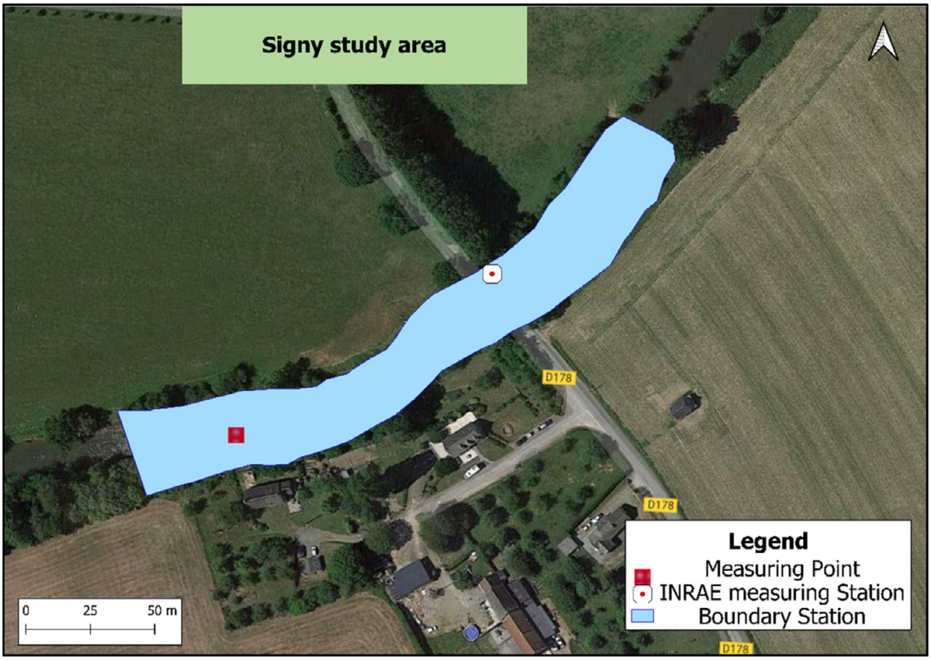

Fig. 3. Map showing the Signy site, the location of the measurement point and the INRAE measurement station (Google Earth).

most of the sediment from reaching the Signy site. Since the removal of the second dam in May 2022, high concentrations of suspended load are being transported to the Signy site. This sediment had been accumulating in the reservoir behind the dams for the last hundred years and is now being stirred up by the higher stream velocities.

It is in this particular context that the LEARN Project (Impact of dam removal on the hyporheic flows and river exchanges of the Selune) is being carried out. This project is part of a global exosystemic program managed by the INRAE (https://programme-selune.com/en/).

In all files, the first column is the date set out in YYYY/MM/DD HH:MM:SS format. Data is registered at a high frequency (15 min).

1.2. Data at the Virey site

At the Virey site, the physico-chemical variables are measured using autonomous probes installed in the hyporheic zone. Data on the water level, conductivity and turbidity of the river is also recorded at an INRAE gauging station located 300m upstream.

All data from the Virey site is registered in the following order in each file:

- √ The csv file “data_oxygen_upstream-virey-zh.csv” contains the times series of oxygen concentration in mg/l at 15cm and 30cm depths below the riverbed;
- √ The csv file “data_conduc_upstream-virey-zh.csv” contains the time series of conductivity in micro-siemens/meter (µs/m) and temperature in degrees Celsius (°C) at 30cm below the riverbed;
- √ The csv file “data_oxygen_upstream-virey-river.csv” contains the time series of oxygen concentration in mg/l and temperature data of the river in °C;
- √ The csv file “data_station_oxygen_upstream-virey-river.csv” contains the time series of oxygen concentration data of the river (*INRAE station*) in mg/l;
- √ The csv file “data_water-level_upstream-virey-river.csv” contains the time series of water levels in millimeters (mm) and temperature data of the river in °C;
- √ The csv file “data_baro_upstream-virey.csv” contains the time series of barometric pressure in millibars (mbar) at the Virey site;
- √ The csv file “data _station_usptream-virey-river.csv” contains the time series of conductivity in µs/m, turbidity in FNU and river water levels (*INRAE station*) in mm;
- √ The csv file “data_mini-lomos_upstream-virey.csv” contains the time series of pressure differentials in meters between the bottom of the hyporheic zone and the river, as well as the water temperatures in °C at depths of 10, 20, 30 and 40cm in the hyporheic zone.

For the Virey site, there is data missing from the file “data_oxygen_downstream-virey-river.csv” for the period between 6th December 2021 and 2th February 2021. There is also data missing from the file “data_oxygen_upstream-virey-zh” for the period between 7th May 2022 and 13th May 2021. These data breaks occur as the oxygen membranes of the HOBO U26 probes expire and have to be changed every six mixes. The small data gaps correspond to the time of the field intervention.

At Virey, apart from the oxygen data files, the NaN values in other files correspond to periods when the probes are stopped to collect data in the laboratory or in the field, if possible. We have stand-alone probes on this site.

1.3. Data at the Signy site

At the Signy site, the physico-chemical variables are measured using wire probes installed in the hyporheic zone. Data on the water level, conductivity and turbidity of the river is also collected at an INRAE station located 200 meters upstream.

Data is saved in the following order in each file:

Table 1
Correlation between column label and variables registered in csv files.

Column Name	Indication	Units
Date_time	*Date of registration*	*YYYY/MM/DD HH:MM:SS*
Id	*Identification*	
batt_voltage	*Battery of the data acquisition system*	*Volt*
batt_temp	*Battery temperature*	*(degree Celsius)*
t_30cm_sensor_ox	*Temperature at 30cm*	*(degree Celsius)*
oxy_sat_30cm	*Dissolved oxygen at saturation at 30cm*	*percent*
oxy_conc_30cm	*Oxygen concentration at 30cm*	*mg/L*
t_15cm_sensor_ox	*Temperature at 15cm*	*degree Celsius*
oxy_sat_15cm	*Dissolved oxygen at saturation at 15cm*	*percent*
oxy_conc_15cm	*Oxygen concentration at 15cm*	*mg/L*
press_30cm	*Pressure at 30cm*	*mm of water*
t_30cm_sensor_cond	*Temperature at 30cm*	*degree Celsius*
cond_30	*Conductivity at 30cm*	*µs/cm*
press_15cm	*Pressure at 15cm*	*mm of water*
t_15cm_sensor_cond	*Temperature at 15cm*	*degree Celsius*
cond_15cm	*Conductivity at 15cm*	*µs/cm*
water_lvl	*Water level*	*mm of water*
oxy_conc_river	*Oxygen concentration of the river*	*mg/L*
oxy_sat_river	*Dissolved oxygen at saturation of the river*	*Percent*
t_river	*River temperature*	*degree Celsius*
Barometric	*Barometric pressure*	*mbar*
dif_press	Differential *pressure*	*meter*
t_10cm; t_20cm;t_30cm;t_40cm	*Temperature at 10cm, 20cm,30cm and 40cm*	*degree Celsius*
conduc-river	*Conductivity of the river*	*µs/cm*
turbi-river	*Turbidity*	*Formazin Turbidity Units*

- √ The csv file “data_downstream-signy-zh.csv” contains data on battery voltage in Volts, battery temperature in °C, temperature in °C, oxygen saturation in %, oxygen concentration in mg/l (firstly at 30cm and secondly at 15cm below the riverbed), conductivity in µs/m, pressure in mm and temperature in °C (all at 15cm below the riverbed), and water level in mm;
- √ The csv file “data_mini-lomos_downstream-signy.csv” contains the time series of pressure differentials in meters between the bottom of the hyporheic zone and the river, and water temperatures at depths of 10, 20, 30 and 40cm in the hyporheic zone;
- √ The csv file “data_oxygen_downstream-signy-river.csv” contains data on temperature in °C, oxygen saturation in %, and oxygen concentration in mg/l;
- √ The csv file “data_station_downstream-signy-river.csv” contains the time series of conductivity in µs/m, turbidity in FNU and river water levels (*INRAE station*) in mm.

For the Signy site, it is to be noted that some of the data is missing from the file “data_station-downtream-signy-river.csv” for a one-month period (12th April to 12th May 2022). The abrupt restoration of the hydro sedimentary continuity induced a massive release of fine sediment downstream that buried the INRAE station conductivity and turbidity probes. Missing values are replaced by NaN characters for these dates. There is also data missing from the file “data_oxygen_downstream-signy-river.csv” for the period between 11th May 2022 and 18th August 2022. All other probes continued to work properly during this period.

Table 1 lists the correspondence between column names and physical or chemical variables in csv files, as well as their units.

Table 2 lists the types, names and the characteristics of the probes (accuracy, resolution and measuring range) deployed on each site.

Table 2
Probes used and their characteristics.

	Sensors	Parameters	Accuracy	Resolution	Range	Sites
Autono-mous probes	Prosensor U20L-01	Water level + Temperature	±0.1% full scale, 1.0cm of water; to ±0.2% full scale, 2.0 cm of water	<0.21cm of water	69 to 207kPa, 0° to 40 °C	Virey
	Prosensor U24-001	Conductivity + Temperature	3% of the measurem ent or 5µS/cm	1µS/cm	Low: 0 to 1,000µS/cm; High: 0 to 10,000µS/cm	Virey
	Prosensor U26-001	Dissolved oxygen + Temperature	0.2mg/L: 0 to 8mg/L; 0.5mg/L: 8 to 20mg/L	0.02mg/L	0 to 30mg/l	Virey
	In-Situ Inc. Rugged TROLL 100	Water level + temperature	±0.05%: from -5° to 50 °C	±0.01% FS	9m to 18m	Virey
	In-Situ Inc. Rugged Baro TROLL	Barometric Pressure + Temperature	±0.05%: from -5° to 50 °C	±0.01% full scale	0.5 to 2 bar	Virey
Wired probes	STS TM/N - Passive level probe (compensated, not amplified)	Water level + Temperature	≤ ± 0.50 / 0.25% full scale		1 to 250mH2O	Signy
	WiSens CTD 50 Autono-mous data logger	Conductivity + Temperature and depth data logger	0.04mS/cm		0 to 70mS/cm	Signy
	Ponsel OPTOD Optical Digital Dissolved Oxygen Sensor	Dissolved oxygen+ Temperature	+/- 0.1mg/L	0.01mg/L	0 to 20mg/L	Signy
LOMO-mini	26PCA pressure sensor	Pressure Differential	+/-0.25%		0 to 0.7m	Signy/ Virey
	PT100	Temperature	±0.3 °C		-50 to +250 °C	Signy/ Virey
INRAE Station	OTT PLS pressure	Pressure	≤ ± 0.05% full scale	0.1mbar	0 to 10 bar	Signy/ Virey
	Aqualabo Ponsel sensor	Conductivity	±0.1% full scale	0.01 to 1µS/cm	0 to 2,000µS/cm	Signy/ Virey
	Hach Solitax sensor	Turbidity	± 0.01 FNU/NTU		0.001–4000 FNU/NTU	Signy/ Virey

1.4. MATLAB script

We provide a MATLAB script (read_data_”site-name”.m) to automatically read and plot data time series from a generic folder named “data_formatted,” in which all files should be saved. The resulting plots are saved in a “Plot” folder.

Fig. 4. is an example of the MATLAB script output plot for physical and chemical parameters measured at the Signy station for 18/10/2021 to 4/02/2022.

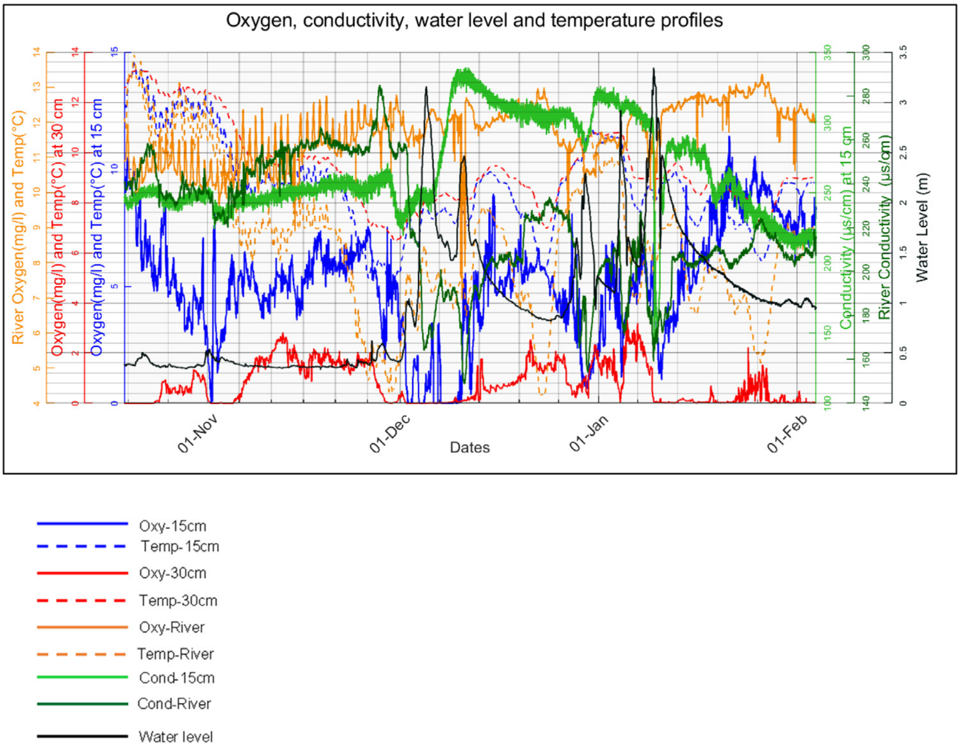

Fig. 4. Physical and chemical parameter curves at Signy: The orange curves in continuous and discontinuous lines correspond to dissolved oxygen (Oxy_River) and temperature (Temp_River) in the river respectively. Their scales are represented on the third orange y-axis on the left. The blue curves in continuous and discontinuous lines correspond to dissolved oxygen (Oxy-15cm) and temperature (Temp-15cm) at 15cm respectively. Their scales are represented on the first blue y-axis on the left. The red curves in continuous and discontinuous lines correspond to dissolved oxygen (Oxy-30cm) and temperature (Temp-30cm) at 30cm respectively. Their scales are represented on the second red y-axis on the left. Conductivity curves for the river and at 15cm (Cond-River and Cond-15cm) are dark green and light green respectively. Their scales are represented on the first dark green y-axis and on the second light green y-axis on the right. Water level (m) is represented by the black curve (Water-level). Its scale is represented on the third black y-axis on the right.

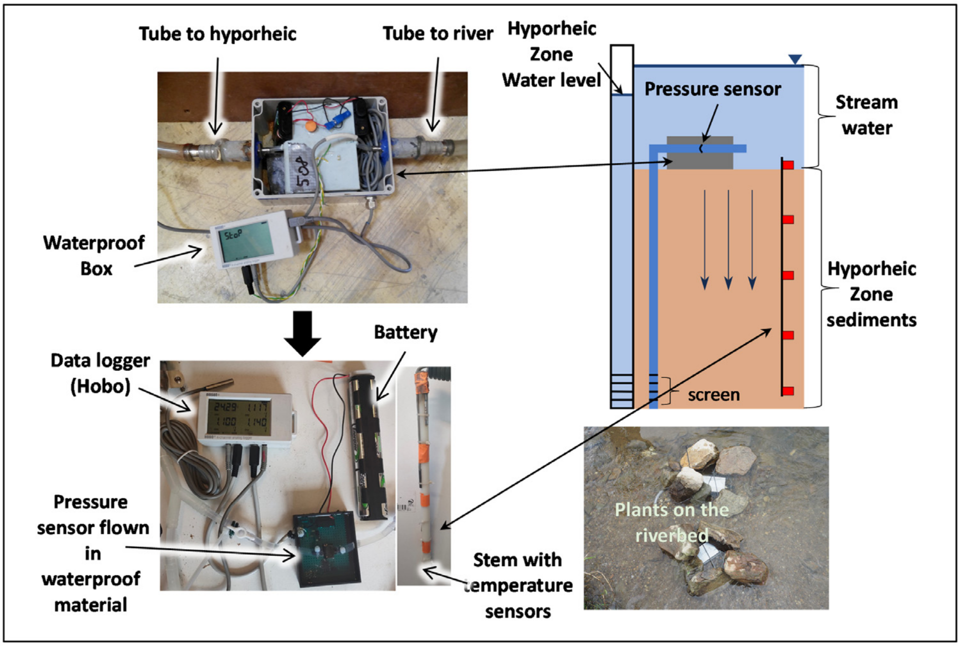

Fig. 5. Photo showing all components of the LOMOS-mini system:
-Top left, the equipment is placed in a waterproof box.
-Bottom left: the differential pressure sensor, battery and data logger and the temperature rod with four PT100s of 10, 20, 30 and 40cm in length to be embedded in the sediment.
-Top right: illustration of the field deployment.
-Bottom right: photo showing the LOMOS-mini in the riverbed.

2. Experimental design, materials and methods

2.1. Autonomous sensors setup (Virey site)

At the Virey site, we opted to install autonomous sensors because of site accessibility difficulties during the high flow season. The following autonomous sensors were installed:

- Prosensor HOBO dissolved oxygen loggers (U26-001) with dissolved oxygen sensor (Prosensor HOBO, U26-RDOB-1) that were assembled and calibrated at the laboratory.
- Prosensor HOBO U24 conductivity data logger.
- Prosensor HOBO U20 pressure sensors, used to measure the water level.
- In-Situ Inc. TROLL 100 probe, also used to measure the water level.
- In-Situ Inc. Rugged BaroTROLL probe, used as a barometric reference probe for barometric compensation data.

2.2. Wire probes setup (Signy site)

At the Signy site, we installed wire probes controlled by a Campbell CR 1000X data logger, which centralizes and applies the same reference times to all measurements at this site.

The Campbell CR 1000X controls:

- The STS sensor TM/N that records water levels.
- The Wisens CTD 50 data logger that records conductivity, temperature and pressure at a depth of 15cm in the hyporheic zone.
- The Ponsel OPTOD optical digital oxygen sensor that records dissolved oxygen in the river at depths of 15 and 30cm in the riverbed.

2.3. LOMOS-mini equipment

The LOMOS-mini system combines monitoring the hydraulic head gradient between the surface and the hyporheic zone at 30cm below the stream (using a 26PCA Honeywell differential pressure sensor) with a temperature profile in the stream and at four different depths within the hyporheic zone (10, 20, 30 and 40cm). Hydraulic head gradients are measured using the pressure sensor technology presented in Greswell et al. (2009) [6].

The pressure transducer used in the LOMOS-mini is the 26PCA series pressure sensor designed by Honeywell, USA. The 26PCA series sensor monitors pressure differentials with a magnitude of up to 1 psi (0.7m water head) in both directions, and it can resist pressure differentials of up to 20 psi (14m). This circuit is placed at the center of a waterproof box. The pressure box is connected to two tubes, one of which goes into the river and the other into the hyporheic zone. Each tube is made of flexible and transparent plastic and has an internal diameter of 16mm and outer diameter of 20mm.

The hyporheic zone tube is positioned in the streambed with its extremity at a depth equal to the depth of the deepest temperature sensor. There is a 2–3cm long perforation along the bottom of the tube to ensure that the hydraulic head in the tube equals the hydraulic head in the hyporheic zone at depth.

The temperature probes are 3-wire 10kX NTC sensors compatible with the Prosensor HOBO data logger (Water/Soil Temperature Sensor TMC6-HD provided by Onset). These probes measure temperature above 0 °C with ±0.3 °C accuracy. Four temperature probes are placed at regular intervals along a plastic stick into which notches the size of the temperature caps are cut. Plastic is chosen because it is a thermal insulator and is resistant to field conditions.

2.4. Calibration of the probes

The dissolved oxygen sensor (Prosensor HOBO, U26-RDOB-1) was calibrated before each deployment at barometric pressure with 100% and 0% saturation solutions. Calibration to 0% was carried out using Prosensor U26-CAL-SOL Sodium Sulfite Solution, after the probe had been cleaned with distilled water. Prosensor HOBO, U26-RDOB-1 was replaced once (after 6 months of deployment) following a Prosensor recommendation.

For the Ponsel OPTOD optical digital oxygen sensor, factory calibration was controlled in the laboratory before deployment with a reference portable probe, Hach HQ300.

To control drift, all of the oxygen sensors were checked during each field data collection campaign (every two months), and the dissolved oxygen concentration in the water of the river was measured with both probes: the in-situ probe sensor and the reference probe Hach HQ300. No drift was observed during the monitoring period.

CTD conductivity sensors were calibrated in the factory. Each field data collection campaign, the conductivity of the water in the river was measured with a reference Hach HQ300 portable probe. This conductivity value is used to recalibrate and correct any drift, either through the HOBOwarePro software for the in-situ Prosensor HOBO U24 or the Campbell PC400 software for the Wisens CTD sensor device configuration.

In-Situ Inc. TROLL 100 and STS TM/N probes were checked in the laboratory before deployment with a device containing a water column. The water level in the river was measured man-

Table 3
Parameters measured at each site with time steps and sediment measurement depths.

Parameters	Locations	Depths	Recording Time Step
Dissolved oxygen	Sediment	15 and 30cm	15 min
	River water	Riverbed Surface	15 min
Conductivity	Sediment	30cm	15 min
	River water	Riverbed Surface	15 min
Pressure	River water	Riverbed Surface	15 min
Temperature	Sediment	15 and 30cm	15 min
	River water	Riverbed Surface	15 min
Vertical profile temperature	Sediment	0, 10, 20, 30, 40cm	15 min
Pressure differential	River water sediment	Between 0 and 30cm	15 min

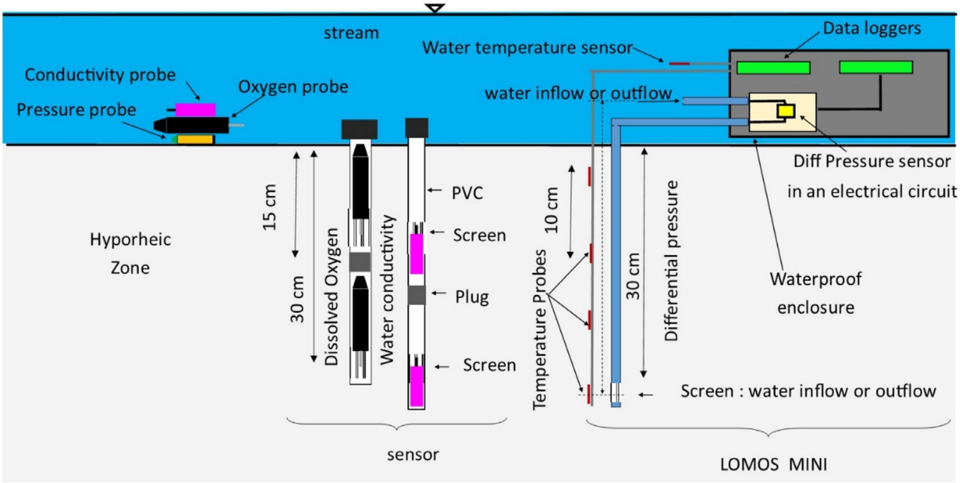

Fig. 6. Deployment of the probes at the study site On the right, the pressure differential sensor (yellow) is placed in an electrical circuit inside the pressure box and is connected to two tubes, one of which goes into the river and the other into the hyporheic zone. The waterproof boxes containing two HOBO data loggers are shown in green: -The first HOBO data logger records water temperatures and at sediments depths of 10, 20, 30 and 40cm. -The second HOBO data logger records the differential pressure between the bottom of the hyporheic zone and the river. This box also contains the equipment required for its operation: six 1.5V AA batteries; the batteries are connected in series to provide a voltage greater than or equal to 7V. In the center of the diagram, there are mini-piezometers containing conductivity sensors (pink), or oxygen sensors (black) set at depths of 15 and 30cm. The mini-piezometers are perforated (screened) at 15cm and 30cm to ensure water flow circulates from the mini-piezometers. On the left of the mini-piezometers, there are pressure (orange), conductivity (pink) and oxygen probes (black) that are used to measure conductivity, oxygen and water levels.

ually at each site and during each field data collection campaign. These values help to control any drifting. None of the water level sensors showed any noticeable drift during the monitoring period.

LOMOS-mini differential pressure measurements are based on a sensor that converts the pressure difference on an electrical voltage.

Measured tension are, primarily, a function of the deformation of the membrane under the applied pressure differential.In addition to the membrane deformation, the electronic circuit is highly sensitive to temperature fluctuations. The relationship between pressure differential, temperature and voltage depends on the gain chosen for the amplifier, as well as on the temperature sensitivity of each individual component in the electronic circuit. Therefore, each pressure system needs to be individually calibrated. Thus, in order to translate the electrical voltage measured in the field into differential pressure, it is necessary to establish the relationship between the measured voltage, differential pressure and temperature. It should further be noted that the measured voltage is also a function of the temperature of the membrane. For the experimental protocol used to obtain the measurements necessary for this calibration, see [1].

2.5. In-situ probe deployment

At each site, all probes are deployed in an area of less than 1m^2 *(Table 3 and Fig. 6).* This was a compromise solution to satisfy both the need to measure similar local physico-chemical conditions and the requirement to keep the sedimentary bed intact between probes.

Ethics statements

This work does not involve human participants, or samples derived from humans or animals, which includes living vertebrates and higher invertebrates.

This work does not involve data collected from social media platforms.

CRediT Author Statement

Moustapha BA: Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation, Resources, Writing - Original Draft, Writing – review & Editing, Visualization, Supervision, Project Administration; **Alain Crave:** Conceptualization, Methodology, Resources, Validation, Formal Analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization, Supervision; Project Administration, Funding Acquisition; **Joris Heyman:** Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation, Writing – original draft, Visualization; **Agnès Rivière:** Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation; **Marc Oliver-Soulayrol:** Hardware Design, Resources, Investigation; **Vincent Stubbe** and **François Meric:** Resources, Investigation, Validation, Formal Analysis of INRAE Data; **Bruno Kergosien, Pascal Rolland, Chistophe Petton** and **Jean-Jacques Kermarrec:** Hardware Design.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Dataset of physico-chemical variables for a full-year time series characterization of Hyporheic zone of Selune River, Manche, Normandie, France (Original data) (Recherche Data Gouv).

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