iJiNUS
GROUPE CLAIRE

Connected instrumentation
Sensors - Web services

Installation Guide

Battery powered ultrasonic level sensors

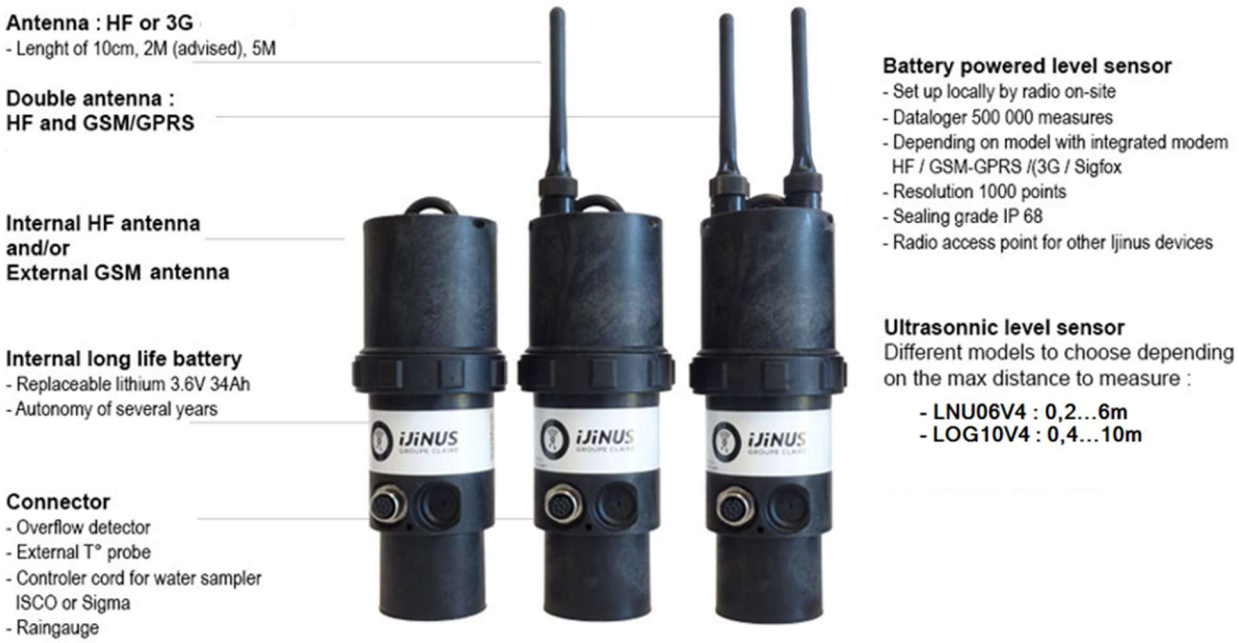
Measurement of water heights

Table of contents

1. Introduction

This Ijinus product unites ultrasonic water height measurement, with automatic measurement cycle changes depending on threshold values and flow rate transformation through conversion tables. Some sensors are equipped with connectors for coupling with an overflow detector or to control water sampler.

In addition to measuring, these sensors can also be paired with others or serve as data concentrators by 2G/3G or 2G/4G (LTE-M/NB-IoT).

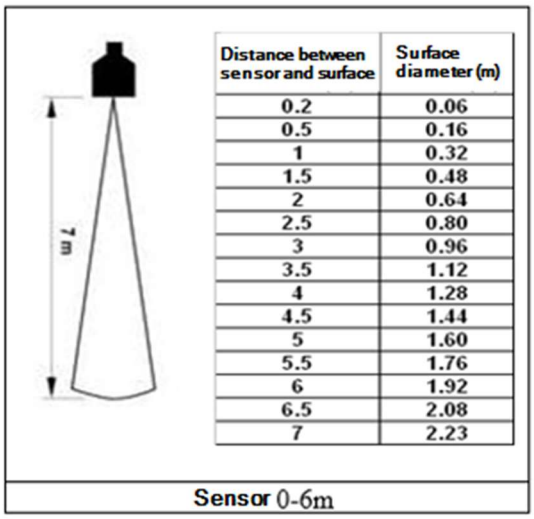


2. Three main ranges of measurements (depending on max distance to measure)

LNU06V4
Measure up to 6m

LOG10V4
Measure up to 10m
External ultrasonic probe

For example, the figure below shows the diameter of the area that will be studied by two probes models (6 and 10m) as a function of the distance:



Distance between sensor and surface	Surface diameter (m)
0.2	0.06
0.5	0.16
1	0.32
1.5	0.48
2	0.64
2.5	0.80
3	0.96
3.5	1.12
4	1.28
4.5	1.44
5	1.60
5.5	1.76
6	1.92
6.5	2.08
7	2.23

3. Equipment (4 configuration examples)

a. Temporary Installation

The sensor is autonomous, and battery powered (lithium battery), it measures water level by air ultrasonic waves. It has internal logger and data can be retrieved on-site (with radio using the programming kit: Wiji).

Ultrasonic sensor

Lithium battery

Programming kit

Water sampler cable

Overflow detector

Fixations: Bracket, fixations either with single or double metal plate with bracket

b. Permanent installation of a unique level sensor (continuous monitoring or self-monitoring of water networks)

For battery powered level measurement (replaceable lithium) and cellular communication (2G, 3G or 4G depending on the sensor).

Sensor integrating a logger, cellular communication modem and its external antenna

c. Permanent installation of several level sensors and a logger (continuous monitoring or self-monitoring of water networks):

For battery powered level measurement (replaceable lithium) and short-range radio communication used with a second logger to retrieve the data and send them out with cellular communication.

Data logger as a radio/3G access point

d. Other configurations.

Currently, the available communication protocols for the Ijinus devices are the following:

- Radio for a HF configuration and data retrieval: Wiji protocol
- Wireless communication for remote data monitoring: 2G, 3G, LTE-M and NB-IoT
- Wired communication with a PLC: Modbus RS 485

4. Quick configuration with the software Avelour

We will show here the most common way to program the system for level measurement and data sending by cellular communication.

a. Necessary equipment

- The software Avelour in 7.0 version minimum

- Programing Wiji kit or Wiji key

Avelour Wiji kit Wiji key

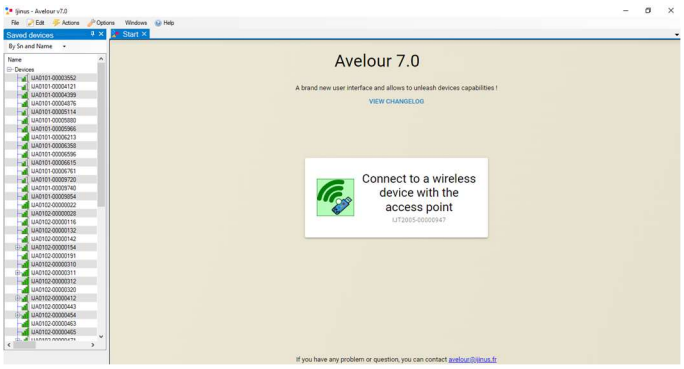
a. Prerequisite

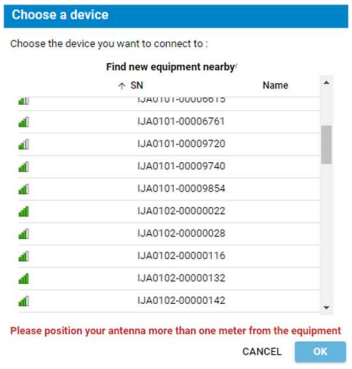
- The equipment should be functional, with a working battery.

- All indications contained in this document refers to programming using Avelour 7.0 minimum

b. First step: Run Avelour and connect to the sensor to configure

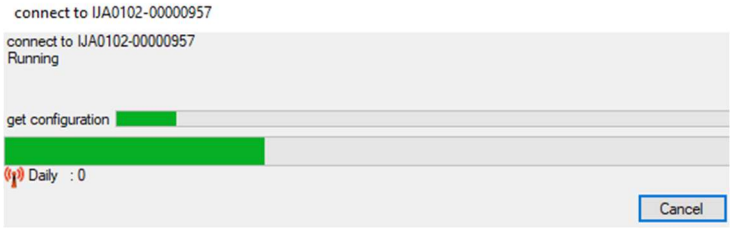
After connecting the Wiji kit equipped with its antenna (or the Wiji key) on your laptop or PC USB port, run Avelour software. Click the button “Connect to a wireless device”. The sensor or logger will be directly visible by its part number (SN) without the need to activate anything else (ex: IJA0101-0000 3559). Locate the sensor's serial number (SN) on the sensor label and click "OK".
On the first connection with the sensor only the serial number will appear. During the next connections you will also see the name of the installation site or another name that you have previously defined.



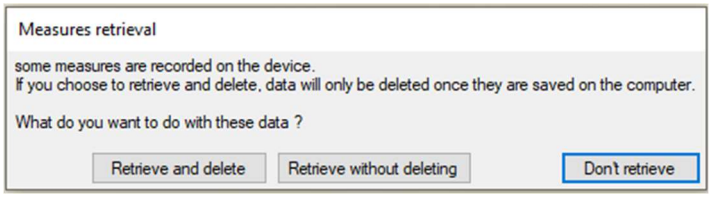


c. Second step: Selection of the sensor to configure, a firmware update could potentially be suggested

During its connection with the sensor, the following pop up appears:



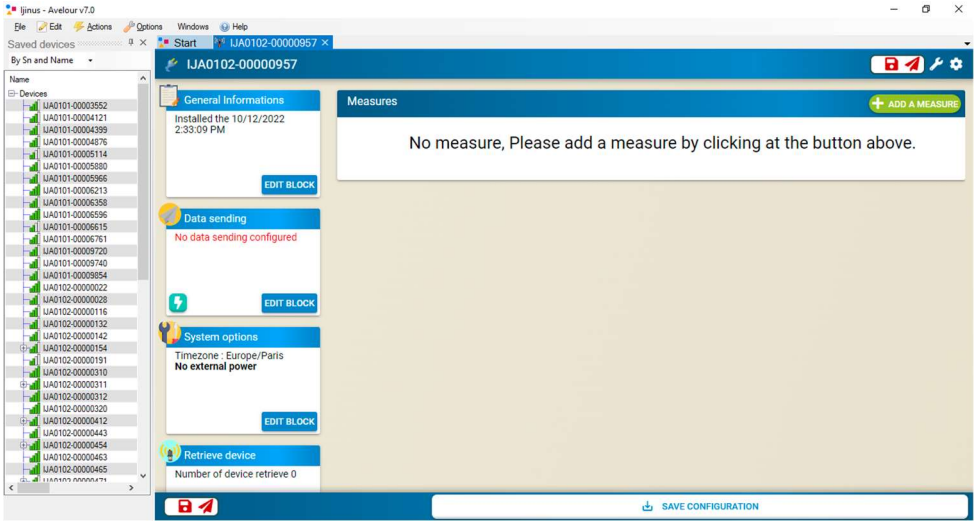
When connected, and only if the sensor already has measures in its memory, the following options will suggest you retrieve the data:



After this, if the sensor is not up to date (case of new firmware developed since your last connection or you are now connected with a new version of the software Avelour). It is strongly recommended to read carefully the different messages in the options windows.

The firmware update can take 7 to 12 minutes. It is advised to do it while in your office. On-site, prefer the best radio connection (avoid the closed metal cover of a manhole).

When the sensors are ready, Avelour will look like bellow:

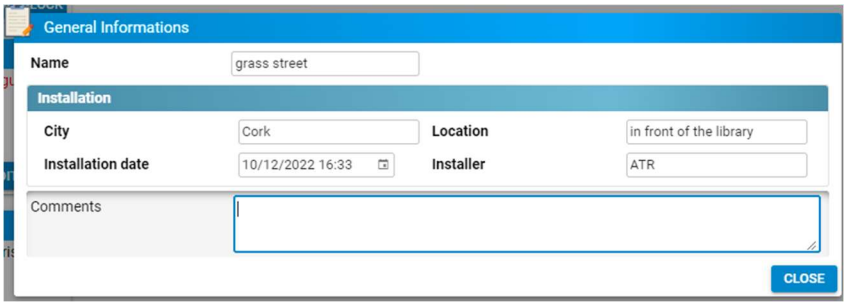


d. Third step: Level Measurement Configuration

This part is divided in several paragraphs. Each step will be detailed.

General information

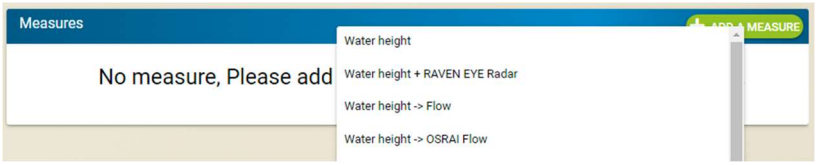
This part is useful to describe the measurement point. The most important information would be the name that will help you to find your sensor for future connections.



Measures

Choice of the application to be configured

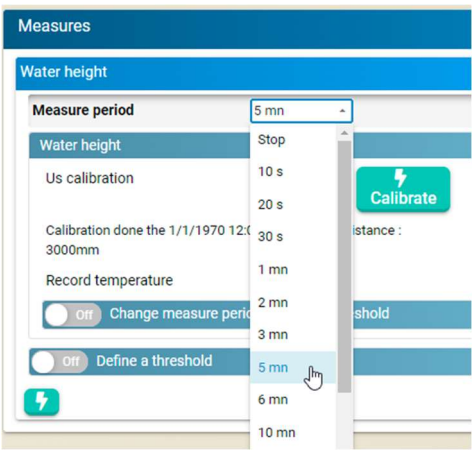
This part is the most important, it allows you to configure your sensor.
The simplest way is to click on the button “Add”, then choose “Water height”.



Choice of the measure period

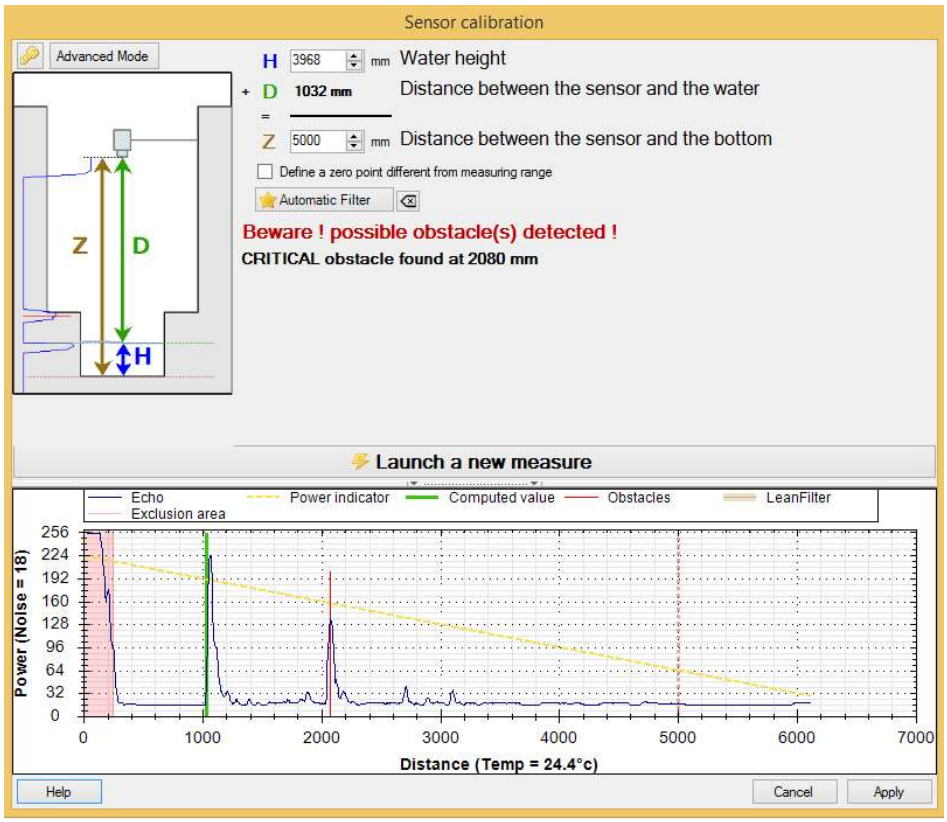
In this new menu, select the measure period (in this example every 5min).

To the right of the measure period selector, 2 little icons allowing a deferred programming according to the period and day of the week you can choose from. The sensor is not yet calibrated.



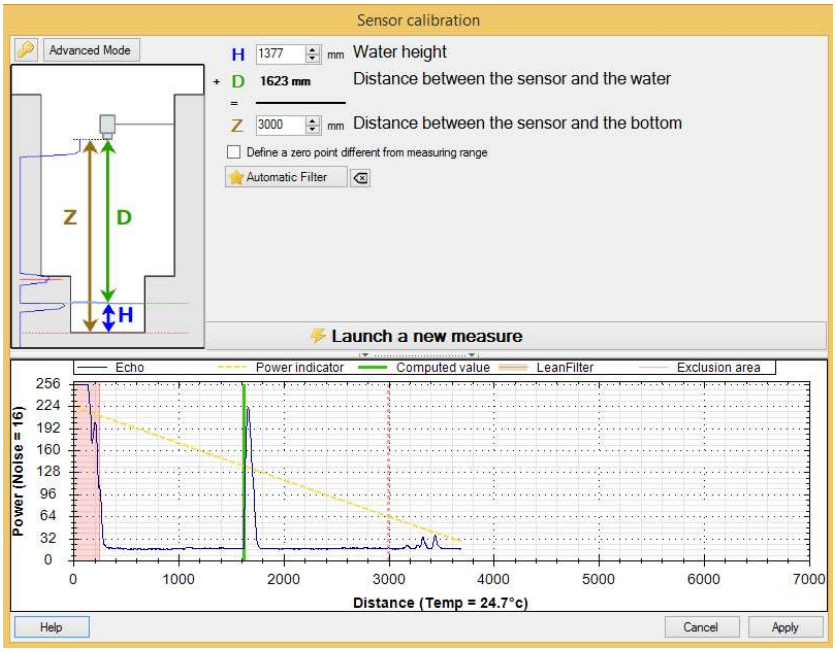
Calibration of the water height

After clicking on the “Calibrate” button the following window appears

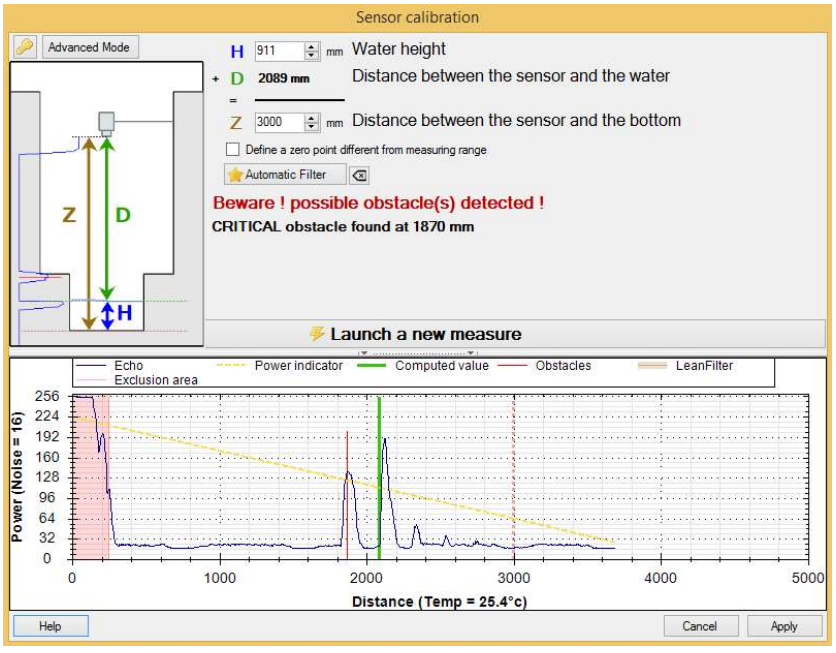


It is difficult to establish rules but globally 3 cases may arise:

<u>CASE 1</u>: Ideal case: unique echo (test in lab or if the sensor faces flat water surface for example)
A simple calibration will be possible.

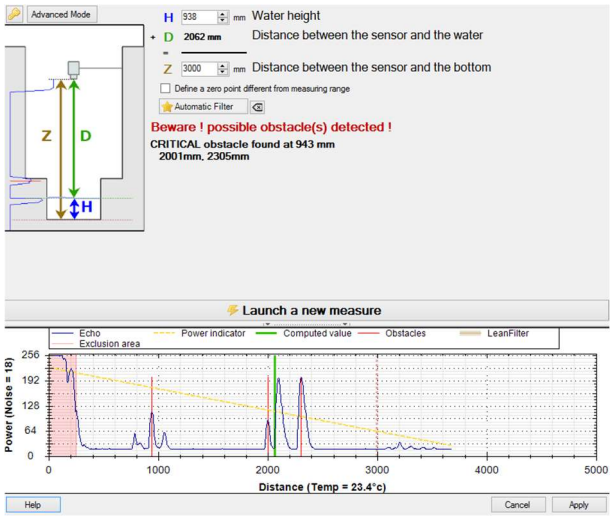


<u>CASE 2</u>: Case of a classic manhole with an invert channel at the bottom. The figure bellow shows two echoes (the invert channel and the water). An advanced mode calibration will be possible. First check that the sensor is well positioned, facing and perpendicular to the water.



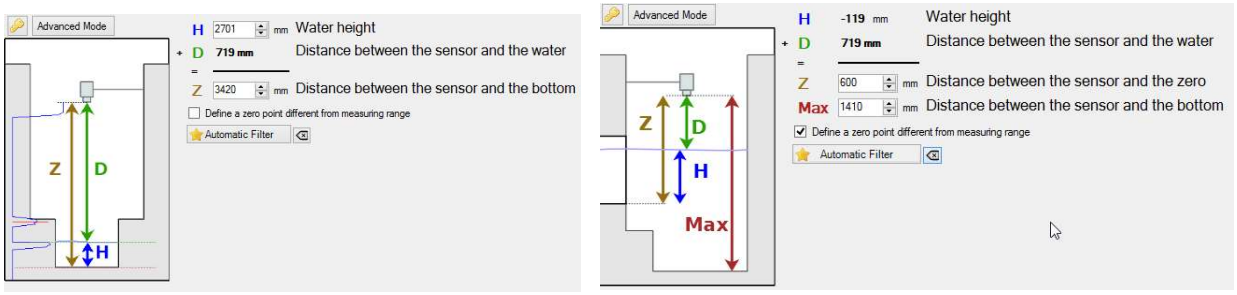
CASE 3: Complex case

The presence of many echoes makes the simple calibration inappropriate. **The best option is to move the sensor if possible. Otherwise go to the expert mode. (Only for experienced users).**



Calibration of the sensor Case N°1 (Ideal)

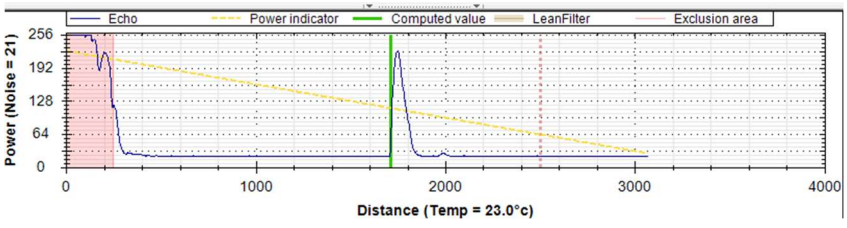
The first case presenting only one echo, you only need to adjust the water height **H** or the maximal distance between the sensor and the bottom **Z** and relaunch a measure. Note that it is possible to define a different zero point (zero at the level of an overflow threshold for example), very useful for stormwater overflows.



Sensor zero-point (example of ideal case) – On the right a different zero-point

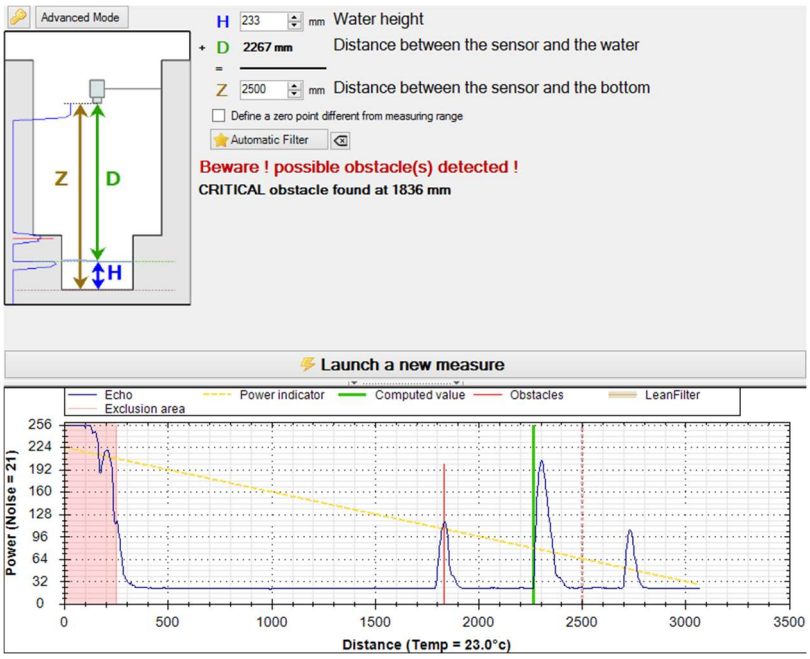
Once done, **the calibration must be confirmed by clicking on "Apply" button**. The configuration is then automatically saved in a file called "configuration". This file can be found within the software even when disconnected from the sensor.

To be noted: the echo figure includes a power indicator, showed as a yellow dot line (oblique from left to right). This one is very useful to fine tune the sensor. The echo should ideally be above that line. A weak echo means the measurement is not precise. An echo that is too high provides accurate measures but uses more energy. A temperature check during the measure also must be done (here 23°C at the bottom of the graph). Although the measure is temperature compensated, you should not calibrate a sensor when the temperature is too high and then ask it to measure on a different environment (typical case of 15°C under a sewer manhole).



Calibration of the sensor Case N°2 (Classic example of a manhole with an invert channel)

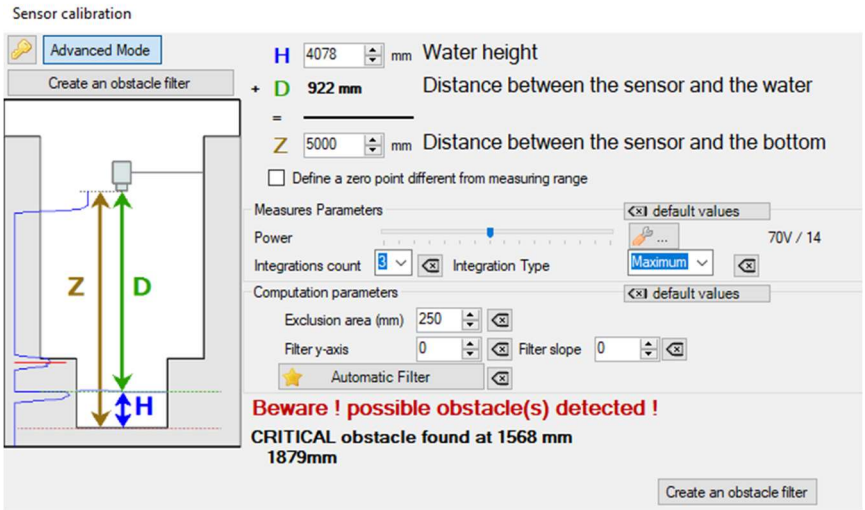
In case no. 2, with an echo having several peaks, the software indicates the presence of "critical" obstacles that can disturb the measurement if the sensor remains in simple calibration. These critical obstacles appear in red on the graph, while the echo reported by the sensor as the measurement is shown in green. The power indicator is still present.



In this case, follow the following procedure:

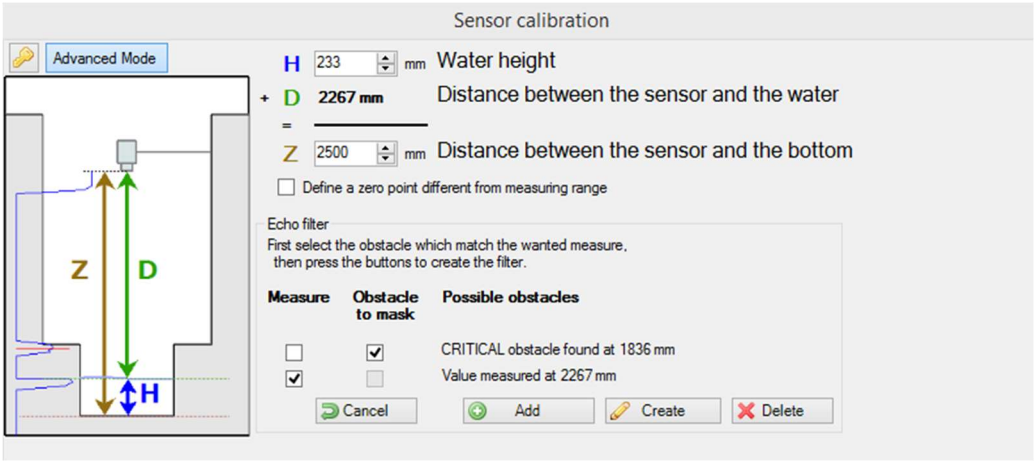
- Activate the **advance mode** by clicking on the button at the top,

The software displays a more precise first stage of calibration named “Measures parameters”: This parameter allows to extend the exclusion area corresponding roughly to the dead band of the sensor. This parameter is to be modified, mainly in the case of 0-6m probes if there are interfering echoes in this zone, or in the case of a probe mounted on an angular return bracket. The manipulation consists in increasing the area of the pink zone, so it covers the different peaks for distances close to the probe.



- This advanced mode also allows to create “obstacle filter” that consist in masking obstacles echoes that disrupt the measure like in the case of invert channel or ladder rungs present in the field of view of the sensor.

After clicking on “Create an obstacle filter”, you need to choose with the tick box the obstacle matching the wanted measure (water height), press “Create”.



- Once the filter has been made and checked, you need to confirm it by clicking the button “Launch a new measure”, then adjust either the H or the H2 to ensure the quality of water height measurements.

Finally, this advanced mode allows two other particularly efficient optimization and filtering operations.

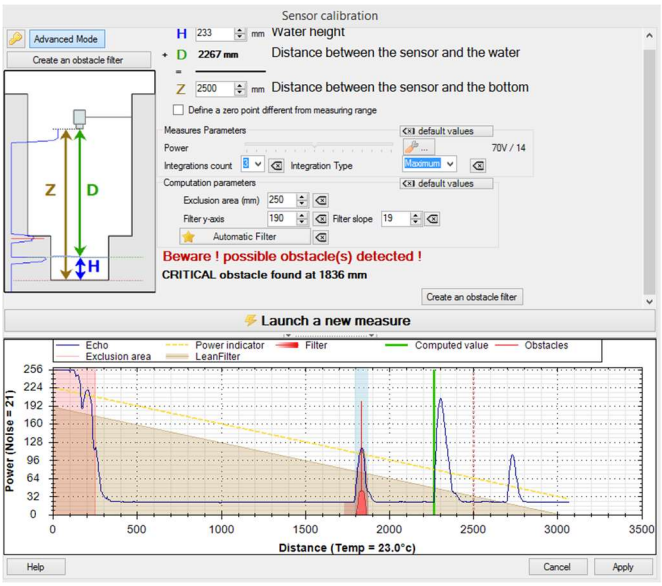
One computation parameter often named “oblique filter” works as follow:

- Choose a Filter y-axis of 160

- Adjust the filter slope until it becomes parallel to the power indicator (yellow line) and ends to the zero of the sensors.

- If you can’t see that oblique filter, adjust the y-axis.

The integrations count option, available for minimum, average and maximum, is the successive ultrasonic shoots treatment (3 by default). The average option calculates the average of those shoots. Most of the time the maximum option is to be chosen to get reliable measurements (and especially in presence of condensation) but also depends of the power setting of the sensor.



Finally, you need to launch a new measure to check the relevance of the result so:

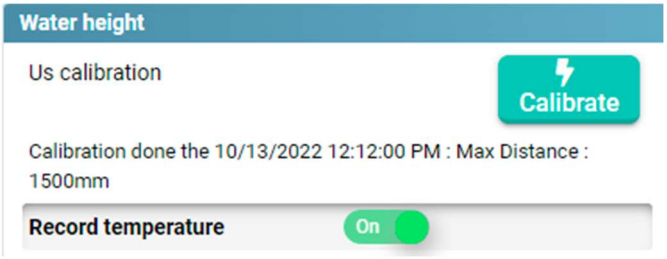
- The green line position used for the measure,
- Values of the echo slightly higher than the power indicator,
- and validate by pressing the Apply button

Calibration of the sensor Case N°3 (complex) – Expert mode

The expert mode is to be used only in complex cases and needs user experience and knowledge of ultrasonic measure data processing. Various parameters and options are then available but won't be detailed in this document. You need a password to go on expert mode. Please contact your sales representative or the customer service. The password as well as some information will be given.

Temperature recording

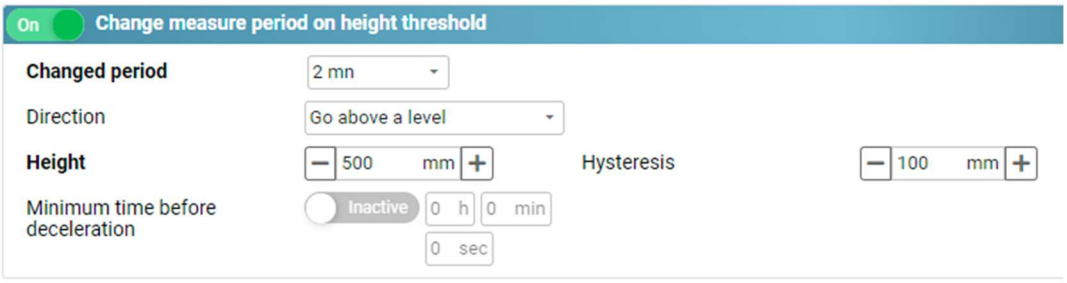
You can log the temperature thanks to the internal temperature probe used to compensate the level measurement with ultrasonic.
For information, the sound speed in the air at 10°C is 337,6m/s.



Change measure period on height threshold

For some sensors, you can have two different time of data acquisition depending on water height measures. For example, you can measure every hour when the level is low and accelerate to every 2 minutes when level goes above a threshold value. This measurement period acceleration can be set to some time slots, following an exceedance of level (with or without hysteresis) and with the choice of a minimum time before deceleration.

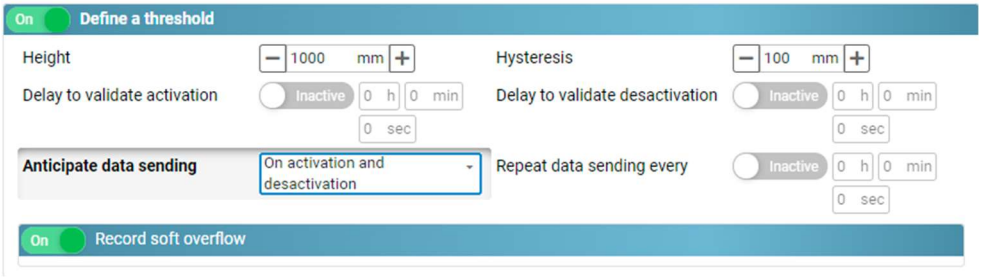
The limit of this acceleration is it can only be done with a water height measurement. If you wish to accelerate the measures as soon as the water go over one level between two measurements, you have to connect one of our overflow detectors to the ultrasonic level sensor.



Define a threshold / software overflow detection (Two can be set)

After the programing of the first threshold, you can then define a second one. This second threshold makes it possible to record a software overflow. This option creates a new file with a start time for change of state (measured height higher than the indicated threshold) and a time to return to a "non-overflow" state. (Height measured lower than the indicated threshold).

This threshold also makes it possible to anticipate the data sending (if the logger is equipped with a communication card) on activation and/or deactivation of the threshold.



To go further and use the advanced parameters: Zoom on the debugging echoes (acoustic signature) and the replacement values in case of loss of echoes.

All advanced parameters won't be explained here, but two zooms on very useful functionalities are proposed here:

Debugging echoes

The record of debugging echoes is very useful to log when there is a difference between two successive measures (on rise and or on lowering: here 75 for both), the acoustic signature of the measures, or the famous ultrasonic echo. A post review allows you to evaluate the quality of level measurements and to correct them if needed.

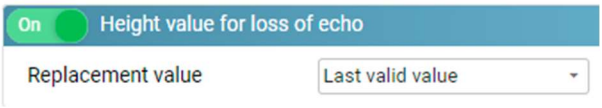
For your first or complex installations, we strongly advice to activate this functionality.

Height value for loss of echo

In the field of ultrasonic, a loss of echoes is reflected by the absence of peaks (or a very weak peaks not detected as an obstacle) on echoes that materialize by a maximal height, the Z you define during the calibration. This function is used when the sensor encounters this situation, to replace this value “a priori” false by another one defined by the user:

The last valid value, a value you define, no value, …

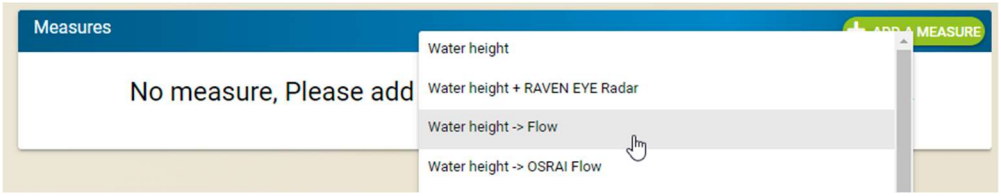
This option must be appropriately used, it never should compensate a not completed or not adapted calibration.



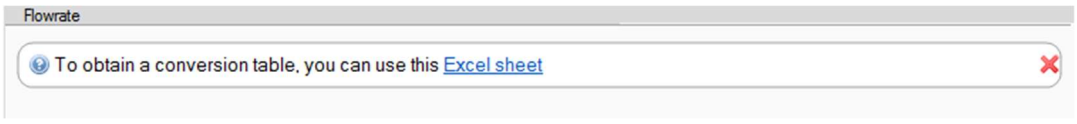
Programing for flow rate calculation from height measures and control a water sampler

Before completing this chapter, it is important to keep in mind that a flow rate measure is obtained by two factors 1) the wet area and 2) the average velocity. The sensors described in this document only measure water height (that allows wet area calculation via the collector shape) but never a velocity measure.

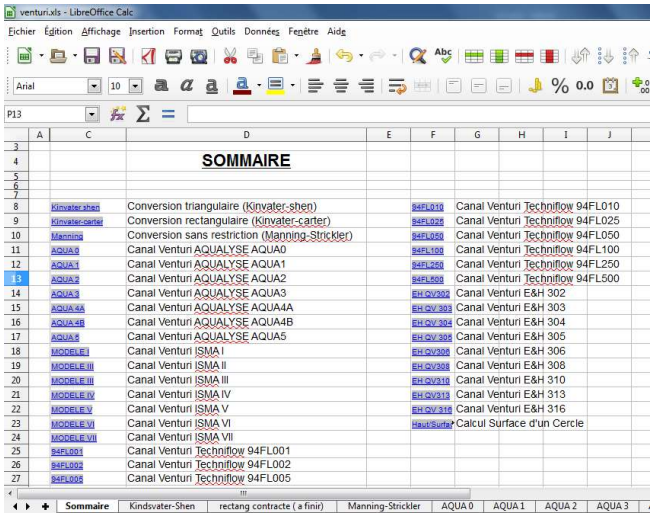
Nerveless some tools to transform water height measured in flow rate (then in volume) by conversion table or measuring system on threshold are available. It is the user’s responsibility to choose the transforming tool. In this case, it must be chosen at the beginning of the programing (or to modified) height/flow rate like shown below.

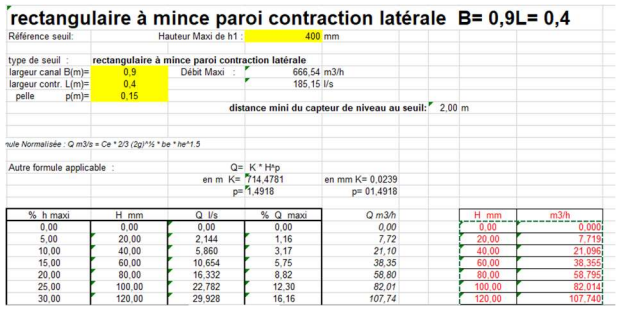


Once the programing choice has been done, an example sheet of conversion is available:

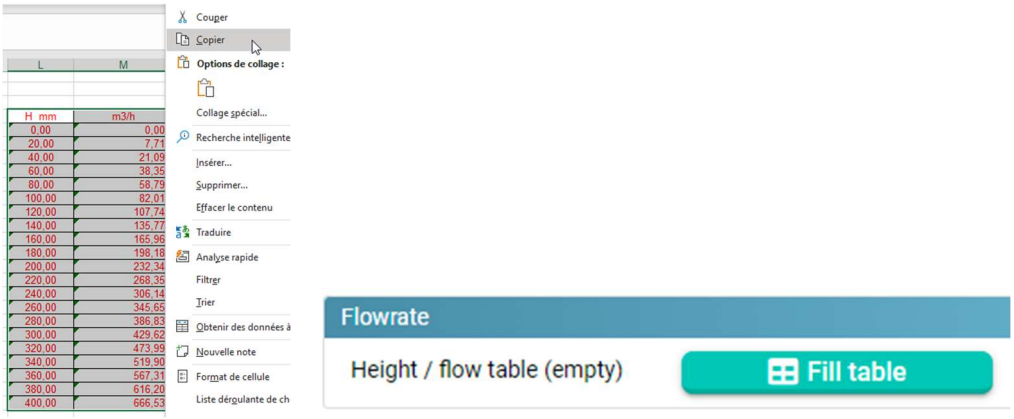


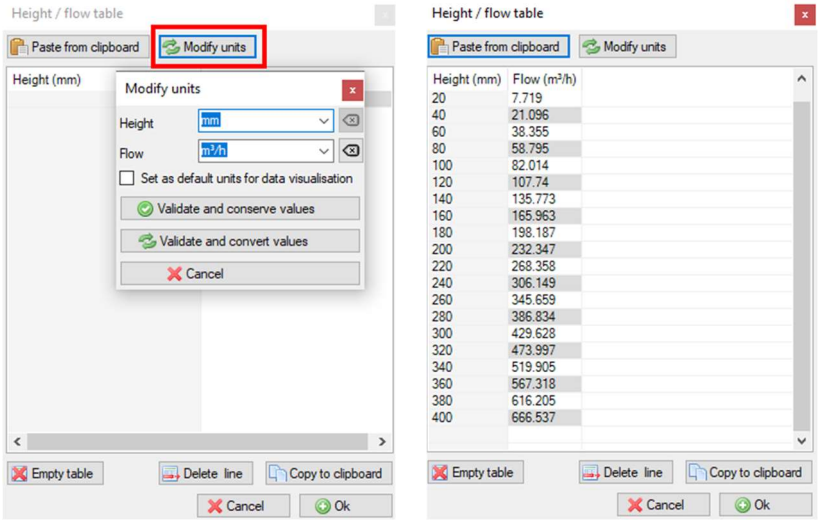
By clicking on the “Excel form” link, an Excel file opens and in the Summary sheet you will find the available laws indicated below. For example, in the case of a measurement of the level in a rectangular weir, the sheet entitled "rectang contracté" makes it possible to generate a table of Height (mm) / Flow rate (m3/h) values according to the characteristics of the threshold encountered. Only the boxes in yellow are to be filled in, the conversion will be done automatically.



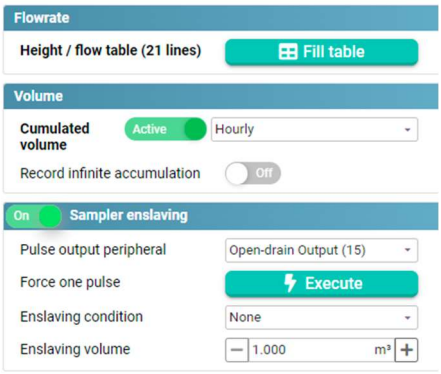


You need to select and copy the bloc Height/Flow in Excel (bellow example) then click on "Fill table" in Avelour and modify the units if necessary, click on "Paste from clipboard". The final validation is done by clicking on “OK”.

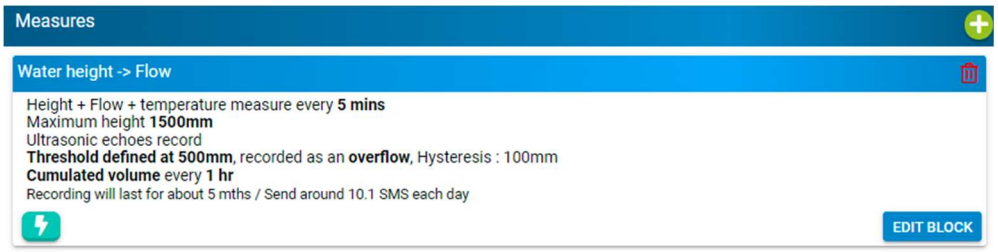




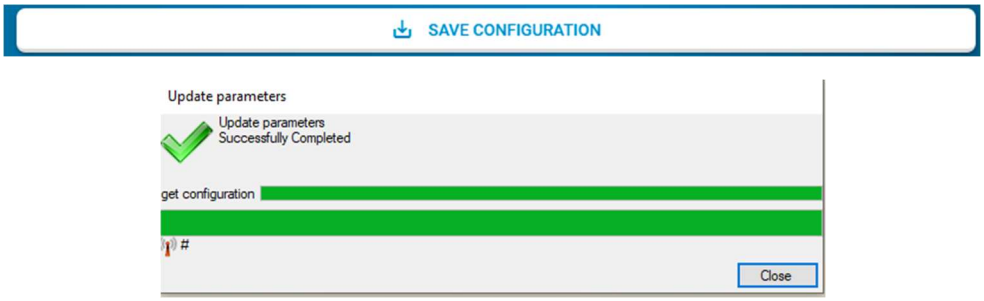
This operation validates the input of these data in the table by displaying the number of lines, then can activate, depending on calculation needs, flow calculation and log and eventually to control a water sampler.



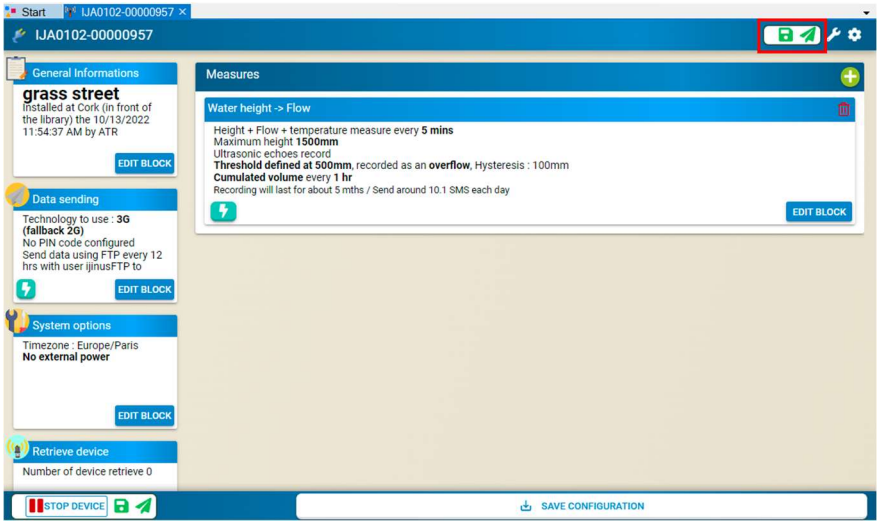
Once the programming is done, a resume summarized your different choices



Finishing of the programming: you must validate with the "Program the device" button to send the configuration in the sensor memory:



After the saving operation is done, please check that you have at the top right corner the two green signs showing that the sensor is working, recording and also sending data. You can stop them both by pressing the red Stop icon, if needed.

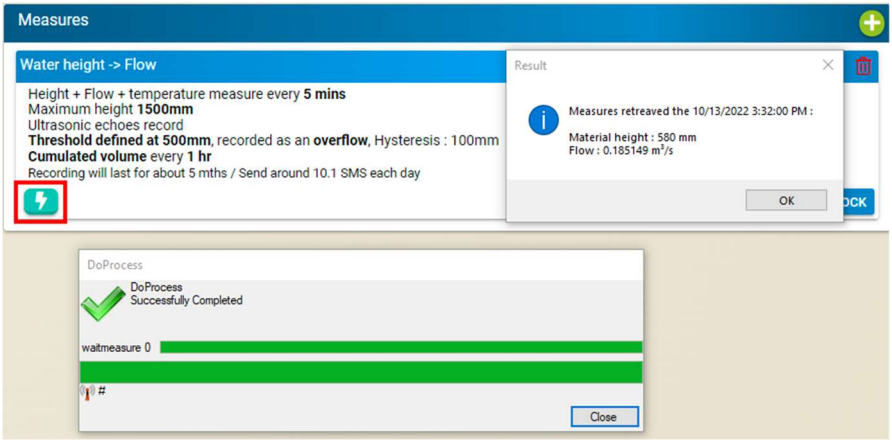


e. Fourth step: Data reading in real time

You have two possibilities to read the data in real time: By pressing the "**Test measure**" button, or by selecting on the main menu the window "**View broadcast measures**" (Main menu > Windows > View broadcast measures).

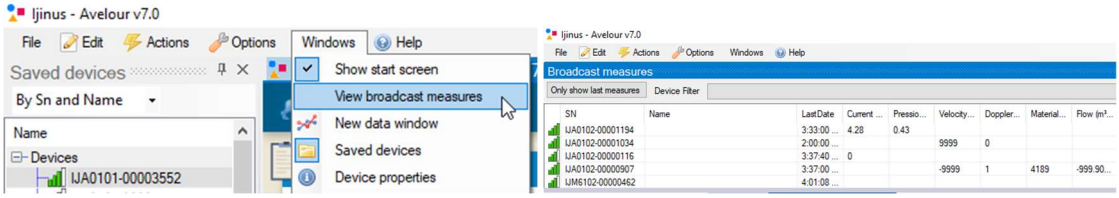
Force a measurement:

Click on the button with the lightning, after a few seconds the result appears in a new window.



View broadcast measures:

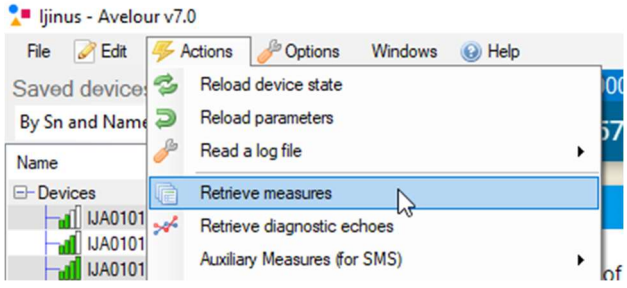
In the "Windows" menu, select the option "View broadcast measures": this option uses the measurements of your sensor with its radio communication and presents the main measurements in progress.

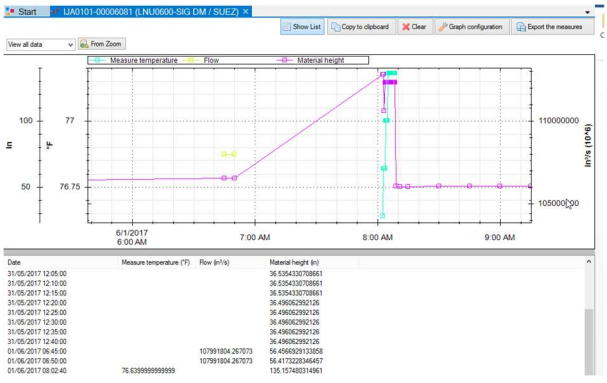


f. Fifth Step: Retrieve and see locally your data by radio

When connected to a sensor, the software directly asks you if you want to retrieve data. You can find this command from the main menu: Menu > Actions > Retrieve measures.

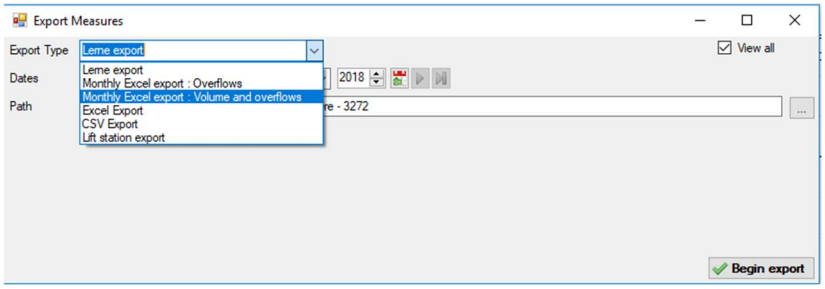
You can view the data, even offline, on graphic and list. A graph configuration module allows you to change colors, thickness of lines, …, but also to apply statistical filters and formula to your data.





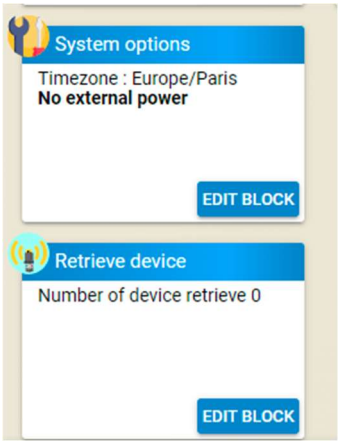
g. Sixth step: Data export

From the graph and/or list of data you find the tab “Export the measures” with the choice of different files format and style of reports, from date to date, by month, or simply all data.



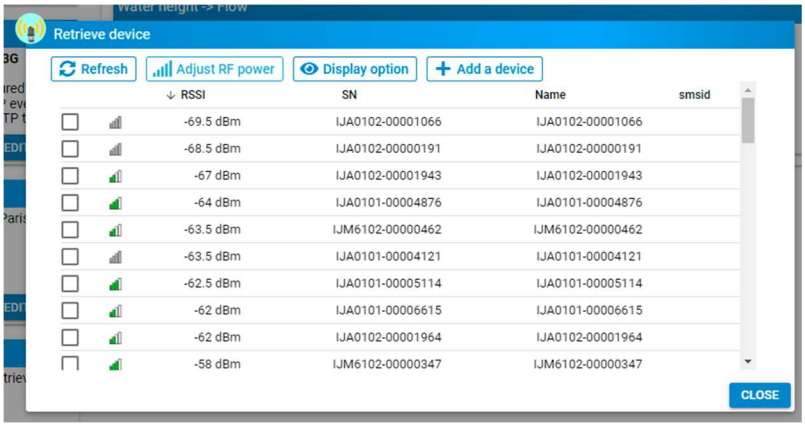
h. Seventh step: Pair devices

Our level sensor can locally retrieve the data from other nearby sensors and logger by radio and send them with its modem. To do this you need to check in Avelour what devices this sensor can see around it. In the “retrieve device” part, click the Edit button.



Then you need to click the Refresh button to run the test. Simply tick the boxes corresponding to the devices you want to associate.

Then the different loggers "visible" by the logger being programmed are offered in the "Retrieve device" window. Reception quality is indicated by green bars (the more there are, the better the quality) and by a numerical value. Be careful the quality of radio signal is nothing to compare with cellular communication: -70 dB is a bad quality for radio but excellent for cellular communication.



i. Eighth step: Data sending

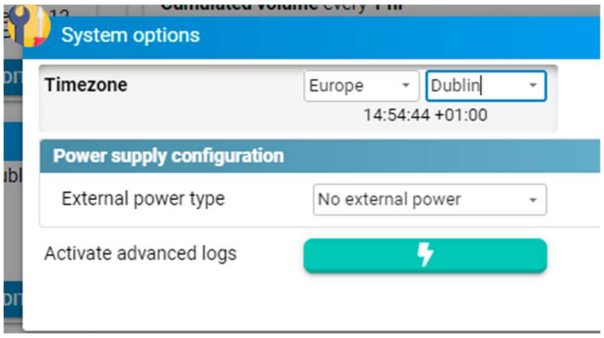
As we said at the beginning of the document different ways to send data are possible like SMS and FTP. In this part I will show you the way to do it by FTP. First keep in mind that on the installation location if you already can't find operator signal in surface, it will be even more difficult while under a metal cover in the manhole.

Sending by FTP:

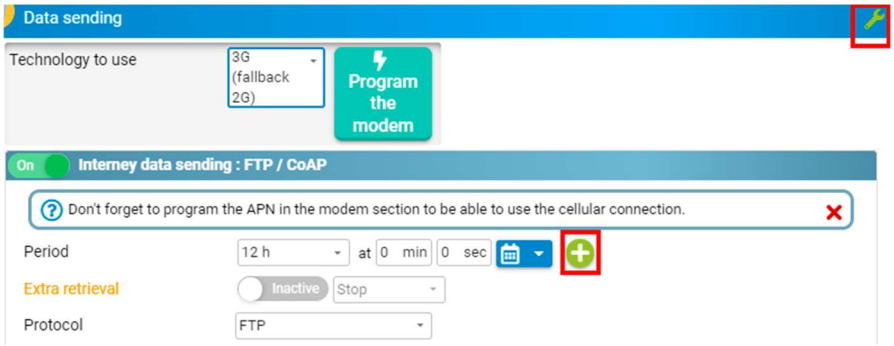
First, you need to:

- Insert in the sensor SIM holder a regular size data sim card with at least 5 Mo/month on your plan. While buying the card please ask the APN of the operator, as well as the Pin code if any. We will need these information. The cellular antenna has also to be connected to the connector on top of the sensor.

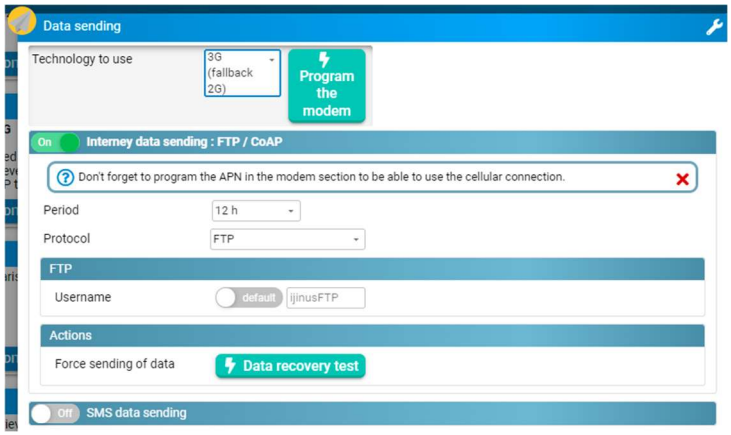
- Set now your time zone in the **System options** menu:



- After clicking on the "Edit block" button of the Data sending part, choose the sending type (FTP for example) and define the data sending frequency. You can define several periods by clicking on the key button "show advanced parameters" and then clicking and the green + icon.



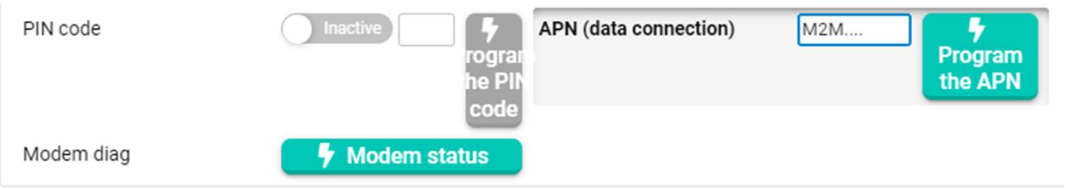
Depending on your configuration you may need to choose a minimum delay between 2 anticipated data sending.



- If the sim card id locked, please enter your code (if any) and press the **Inactive** button (that will turn green and become **Active**) and **Program the pin code** button.

- Enter **your** APN code and press the **Program APN** button.

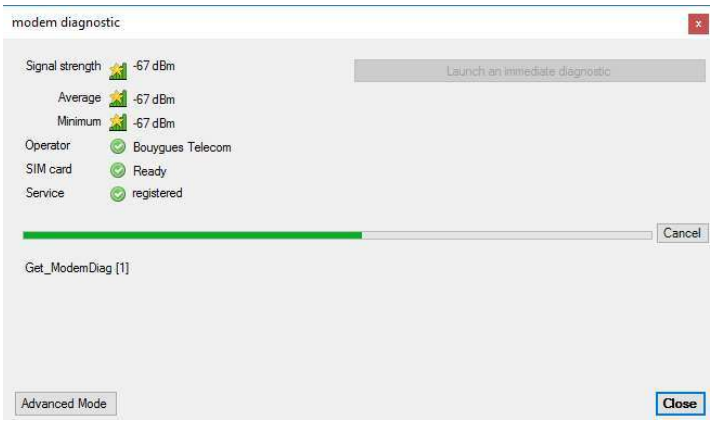
A message will confirm the success for each operation.



By default, the parameters are set to send the data to our server as we propose a **web platform V2.ijitrack.com** with different services to manage them. So **if you choose this option, you don't have to change the FTP Username**.

At this stage you can run a sending test by pressing the **Force data retrieval** button and check on ijitrack.com, in your account, if the sensors data appears. Off course if your account is already created. Please ask otherwise our customer service to do so for you. You should also write the **serial number of the logger** on the label of the sensor, the **address of the installation**, you will need them later to set up the sensor on our web platform.

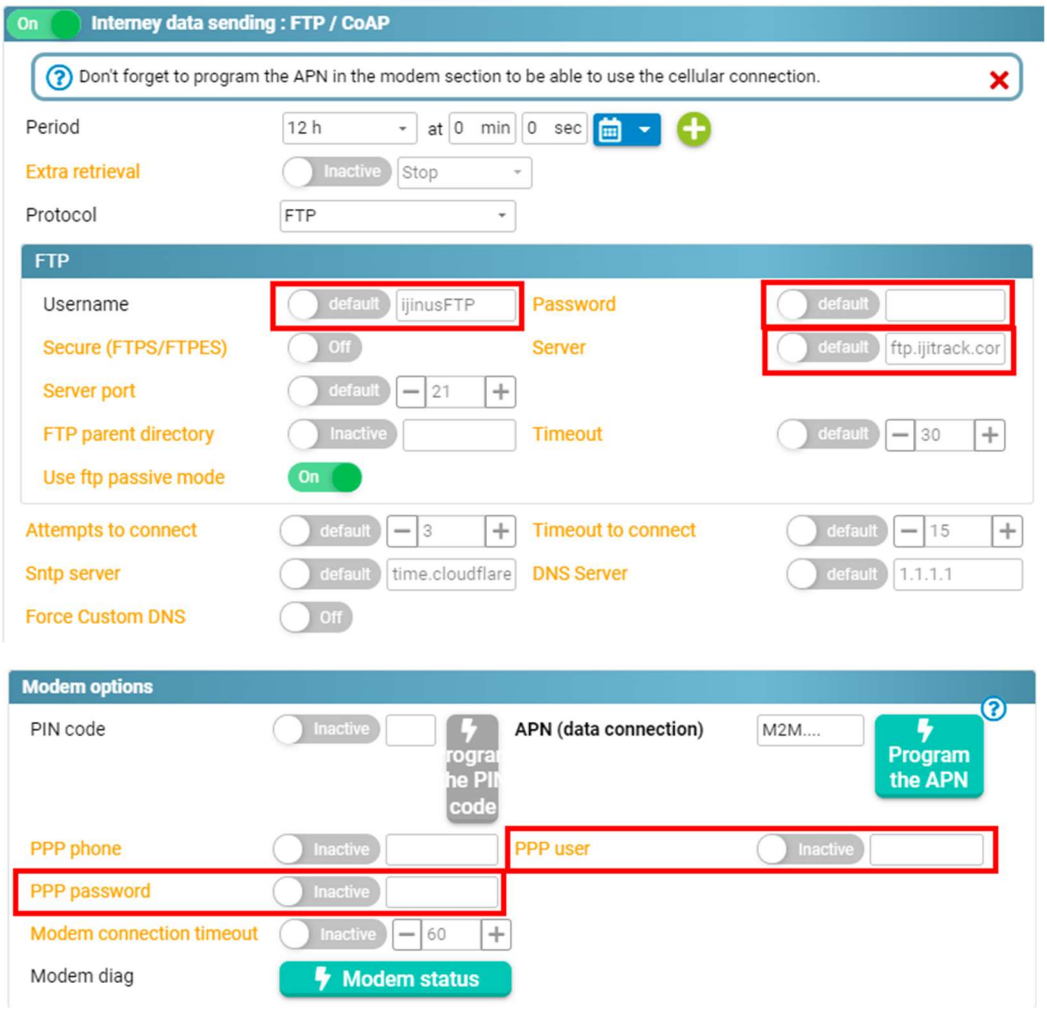
The **modem diagnostic** button available on the modem configuration allows a better diagnostic of the cellular reception quality by doing multiple measurements.



If you use the advanced mode, you also do continuous modem measurements on a longer period. These options are practical to know on what side of the manhole to place the antenna before drilling everywhere in the concrete under the cover plate and inserting it.

Advanced parameters

If you need to send the data to **your server**, first click the “Show advanced parameters”, then more options will appear in the modem options. You need to fill in **your own information details** regarding your server access. Your server administrator can provide that information to you.



After completing this chapter, please press the “Save configuration” button, the configuration will be sent by radio to the sensor.

5. Elements for good practice and installation examples

We propose here, some non-exhaustive elements of good practice such as:

- The sensor must front and be perpendicular to the surface water to be measured. This surface has to be stable and without ripples for more accuracy, without foam). If possible, there shouldn't be any obstacle between the sensor and the water surface (if you can't avoid it, please refer to the calibration chapter to mask it with a filter).

- The calibration is compulsory and the verification of the max distance (Z) very important.

- Calibration must be checked at least once a year.

- Sensors with ultrasonic technology don't need much maintenance, but at least once every six months you should clean it, check on-site the presence of debris, floating debris, anything hang to the sensor

Finally, below are some photos of sensors installed in different environments:

Venturi type channels:



Measurement in collectors:


CSO, SSO applications:



Angle adaptor fixation:

Install in river:


6. Procedure for inserting the SIM card

The sensors and loggers with 2G/3G or 2G/4G modem need a SIM card to send data.

The card holder is located on the board.

Following steps need to be respected to ensure proper operation of the device:

- The sensor must be in standby mode (no connection with our software Avelour or USB) for the modem to recognize the sim card.

- Unscrew the ring then take off the cover.

- It is imperative not to leave the sensor open too long (max 2 min) the desiccant bags may absorb too much moisture and do not fulfill their role thereafter (condensation)

- Insert the SIM card.

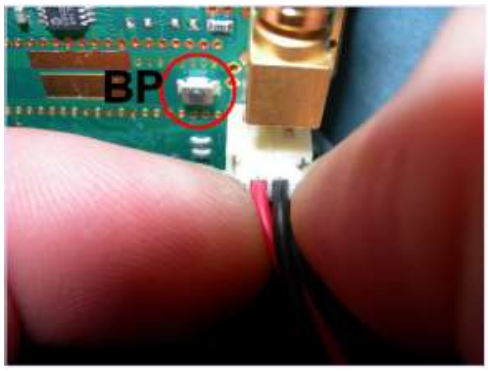
- Place the lid back (mind the notch) on the threads and screw back the ring to the end.

7. Procedure for changing the internal battery

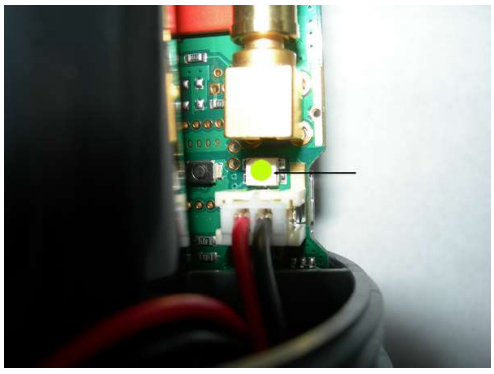
- Unscrew the cover.
- Remove the battery from its housing and disconnect it.
- Throw away the desiccant bags present in the sensor if they are green
- Connect the new battery (the connector is keyed)

At restart, the indicator light must flash Red/Green, and then the light has to flash green every 10 seconds

- **Insert the new desiccant bags** on the side of the battery, then screw the cover back into place.



- Tell the software you have done a battery change by connecting with the software Avelour to your sensor.
To do so, launch the software Avelour, connect to the sensor or logger.
Then go to the general menu,
> Action
> Notify battery changed



8. Document History

Date	Revision	Writer(s)	Changes
2018-11-09	A01	ALG	Creation with document identification from existing user manual
2019-07-12	A02	DM	Adding procedure and image modifications
13/10/2022	A03	ATR	Update for V4 range and Avelour 7