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## **Innovative low-cost and open source turbidity sensor for monitoring urban water management**

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► **To cite this version:**

Anquez Benoit, Perret Franck, Oldrich Navratil, Frederic Cherqui, Philippe Namour. Innovative low-cost and open source turbidity sensor for monitoring urban water management. 10th franco-spanish Workshop IBERNAM-CMC2, Nov 2021, Arcachon, France. hal-03499564

**HAL Id: hal-03499564**

**<https://hal.science/hal-03499564>**

Submitted on 21 Dec 2021

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INRAE

# Cheap'Eau

## Innovative low-cost and open source turbidity sensor for monitoring urban water systems

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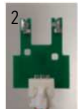
### Material & Methods

Require sensor upgrade & lock-in amplifier

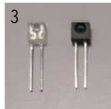
Request a ruggedized and cheap encapsulation



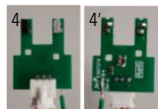
1  
Turbidity sensor SKU SENO189 functional, but :  
• not waterproof cover  
• LEDs sunlight sensitive



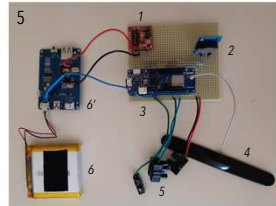
2  
Original sensor PCB (top view)



3  
Transmitter QEE113 & receiver TEKT5400S LEDs



4  
Modified PCB : Emitting LED powered by a square wave signal (0-3.3 V) to subtract the solar IR (front & back)



5  
Electrical setup of the data logger:

1. NanoTimer SparkFun TPL5110,
2. Real Time Clock DS3231,
3. Arduino MKR Wan 1310 PCB
4. LoRa antenna & 5. Sensor connections
6. LiPo Battery & 6'. LiPo rider card



6  
Probe housing



7  
Sensor cap



8  
Data logger housing



9  
Top lid

- Encapsulation made of PVC pipe parts:
- Easy to find, cheap and robust material,
  - Electronic components remain accessible,
  - Do not attract attention in the field.

### Lab Tests (in sunlight)



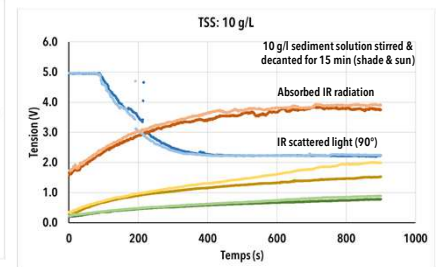
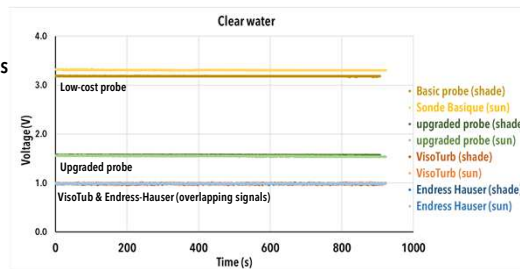
Mobile lab sun-testing unit

Several hours of lab testing on:

- ✓ Electronic operation
- ✓ Encapsulation water-tightness
- ✓ Sunlight impact on probes (basic & upgraded)

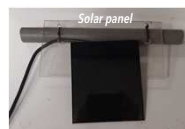
Satisfactory test results,  
Narrower sensing range than market probes (lower sensitivity)

Sunlight Impact (Voltage change over time)



### Field tests in Chassieu town (69) Lyon East

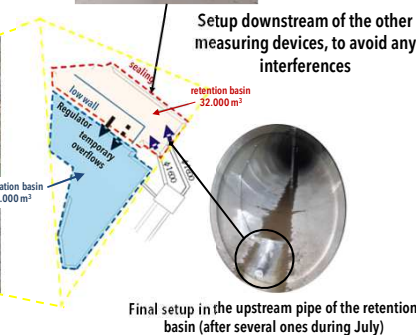
- Solar panel power supply for stand-alone probe
- Control of the turbidity sensor power supply (lock-in detection)



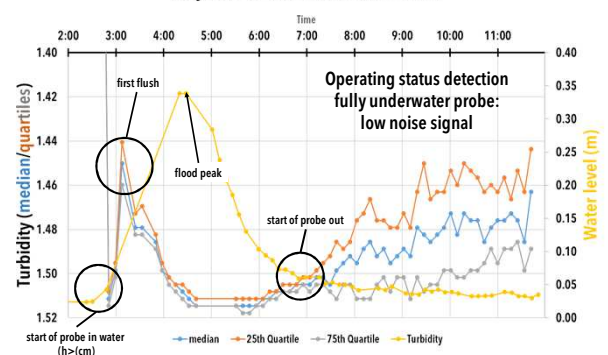
- 5 min standby scheduled between two measurements
- Data transfer via LoRaWAN protocol
- OpenDataEau platform for sharing data



Storm-water runoffs from the Chassieu's industrial zone



July 28, 2021 thunderstorm event



### Conclusions

Remote monitoring system built for a total cost ≈ 200 € HT  
Data transfer via LoRaWAN protocol to  
OpenDataEau platform for sharing data  
Suitable for any low-power sensor

