Quality assessment of a storm overflow, by using different frequency monitoring (Northern France)

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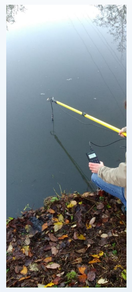
Context

The **Heron lake** (HL) was built in the 70's to receive **rainwater** and **urban runoff** to avoid flooding in the city of Villeneuve d'Ascq. Water level is controlled by automatic pumps at the eastern part of the lake (each one has a discharge of 0.75 m^3 s^{-1}), which release periodically water into the Marque river. Inputs can also be **wastewaters** because of the existence of combined sewers (1/3 of the total network). Furthermore, this **nutrient rich** lake is colonized since 2011 by an **invasive** macrophyte (*Elodea nutalii*) which can lead to pumps clogging and an increase of flood risks.

The global **objectives** are to:

1) Assess the **functioning** of this urban lake;
2) Understand the development of this invasive **macrophyte;**
3) Determine the impact of this storm overflow on the river.

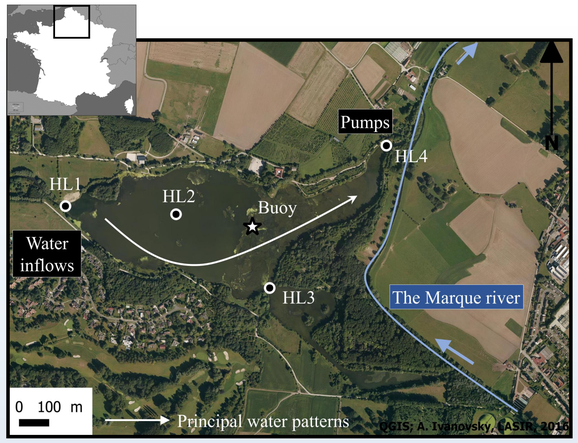
Material & Methods



1) Low frequency monitoring (LF)

4 stations : **HL1, HL2, HL3 and HL4**
Monthly surface water grab sampling from **Feb. 2014 to Feb. 2015**
1 **screening** in **Jan. 2015 (14 stations)**

- Physicochemical parameters: oxygen saturation (**O_2**), water temperature (**Tw**), **pH**, conductivity (**σ**), solid particle matter (**SPM**), dissolved organic carbon (**DOC**)
- Major elements: **Na, Ca, Mg, K, Cl, SO_4**
- Trace metal elements: **As, Cd, Cr, Cu, Ni, Pb, Zn**
- Organic micropollutants: caffeine (**CAF**), carbamazepine (**CBZ**)

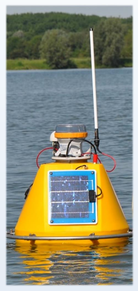


Localisation of the stations in LF and HF monitoring

2) High frequency monitoring (HF)

Buoy equipped with **optical and electrochemical sensors**
Measurements every **10 min. from Mar. 2015 to Dec. 2015**

- Physicochemical parameters: oxygen saturation (**O_2**), water temperature (**Tw**), **pH**, conductivity (**σ**), turbidity
- Photosynthetic pigments: phycocyanin (**PC),** phycoerythrin (**PE**), chlorophyll a (**Chl *a***)



Results

Excess of nutrients compared to eutrophic status assessment in lakes: mean **Ptot**: **370 µgP L^{-1}** and mean **NH_4^+ + NO_3^-: 980 µgN L^{-1}**

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eutrophic to **hypertrophic** system (Dodds, 2002): TP > 100 µg L^{-1} and TN/ 650-1200 µg L^{-1}

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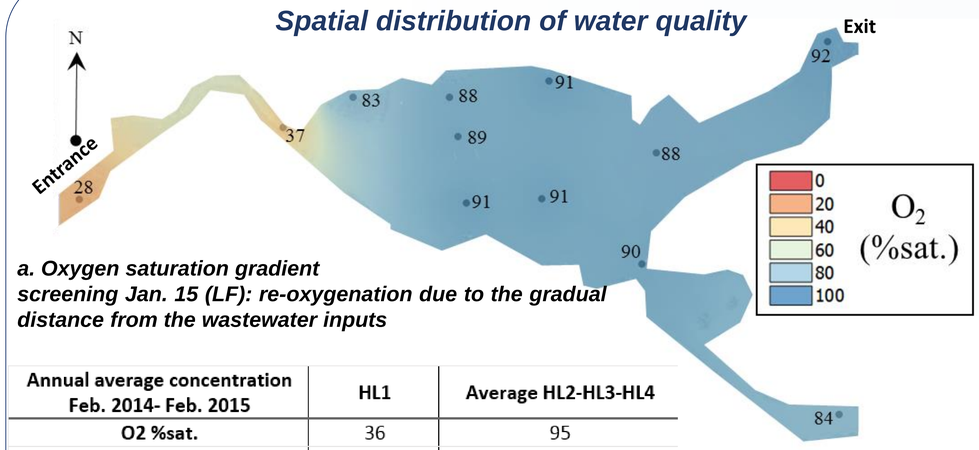
Degradation of the water quality according to standards guidelines for surface water body: **poor** for **NH_4^+** and **bad** for **PO_4^{3-}**

Spatial distribution of water quality



a. Oxygen saturation gradient screening Jan. 15 (LF): re-oxygenation due to the gradual distance from the wastewater inputs

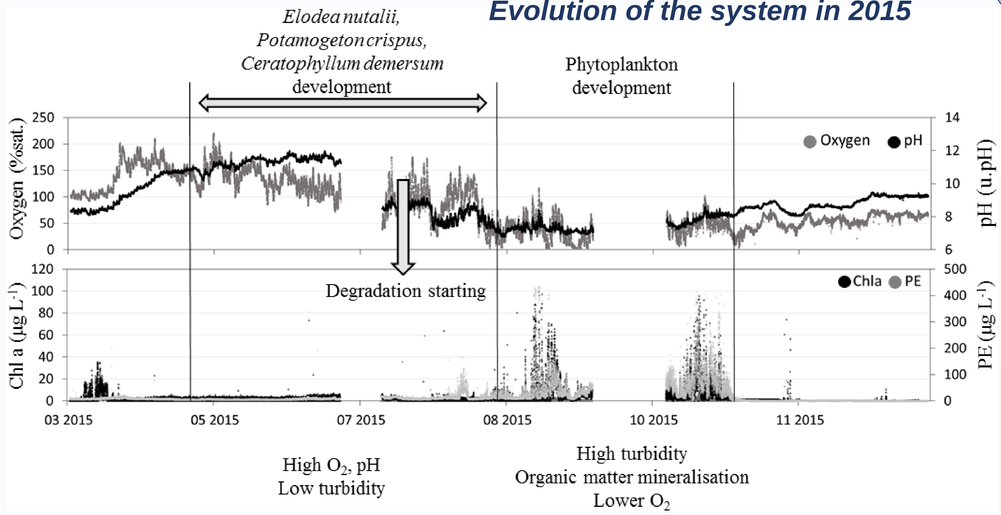
Annual average concentration Feb. 2014- Feb. 2015	HL1	Average HL2-HL3-HL4
O2 %sat.	36	95
pH u.pH.	7.3	8.0
NH_4^+ mgN L^{-1}	1.7	0.16
PO_4^{3-} mgP L^{-1}	0.42	0.33
Cu µg L^{-1}	1.1	0.76
Pb µg L^{-1}	0.38	0.14
Zn µg L^{-1}	16	3.0
CAF ng L^{-1}	2218	239
CBZ ng L^{-1}	176	130

b. Dissolved concentrations at the entrance compared to the east of the lake (LF): decrease of nutrients and micropollutants

Enrichment Factor in surface sediments* Jan. 2015	HL1	Average HL2-HL3-HL4
Cu	12	1.1
Pb	5.7	0.8
Zn	22	1.8

c. Metal concentrations in surface sediments screening Jan.15 (LF): metals accumulation into the channel of metals from urban runoff and leaching

Evolution of the system in 2015



d. Vegetal biomass development (HF) and eutrophication

Conclusions & Perspectives

- Gradient of **re-oxygenation** from west to east due to the gradual distance from the wastewater inputs rich in biodegradable organic matter and physical factors (*e.g.* wind, rain),
- **Decrease of nutrients** from the entrance to the exit owing to their consumption by vegetal biomass and /or transformation (*e.g.* denitrification, sedimentation of phosphorus),
- **Micropollutants** enrichment in the dissolved and particulate phases into the **channel** entrance
- Competition between **macrophytes** and **phytoplankton** development, anoxic events resulting of the biomass degradation,
- To go further: comparison of water quality between the lake and the river according to the season and extreme events; fluxes assessment of micropollutants and nutrients; and solution proposals to limit the impact of eutrophication

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