Preliminary assessment of nitrate sources of pollution in the urbanized catchment of the Kifissos River

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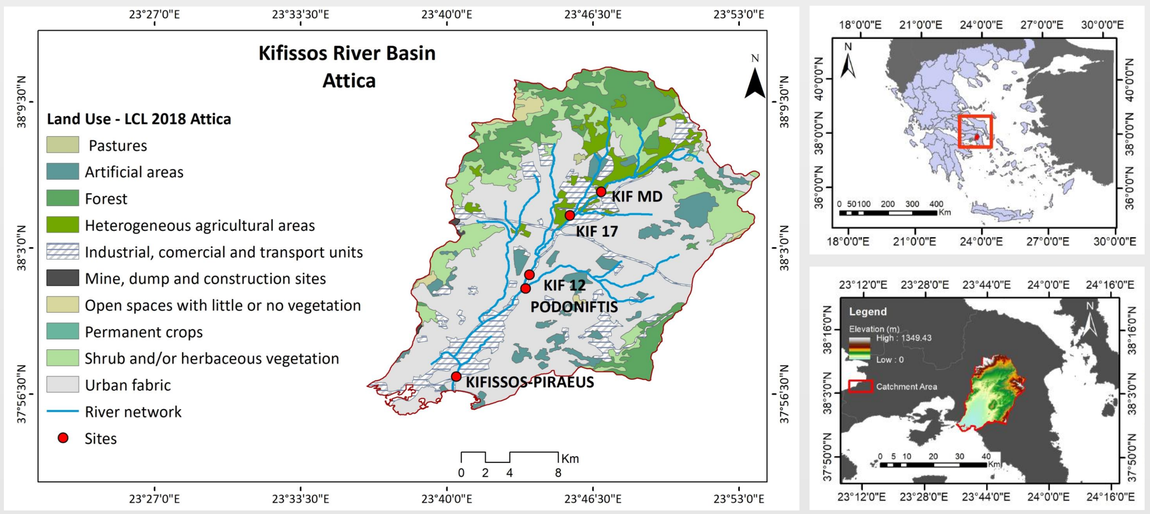
Introduction

The Kifissos River is an urban river that belongs in an urbanized catchment (Kifissos River Basin-KRB) in the western part of Athens metropolitan area (~3.8 million inhabitants). The river is ~25 km long and discharges into the Saronikos Gulf, close to Piraeus port. Most of the year river water discharge is low (~3.2 m^3/s), but during flood events the water fluxes may reach up to 1,400 m^3/s. Kifissos river in Attica Greece, comprises a typical example of an urban river prone to environmental degradation mainly due to its proximity to several pollution sources. We should point out that the Kifissos river is the main urban river of the capital city of Greece (Athens), which nevertheless is not monitored adequately regarding water pollution, and therefore, relevant information is scarce.



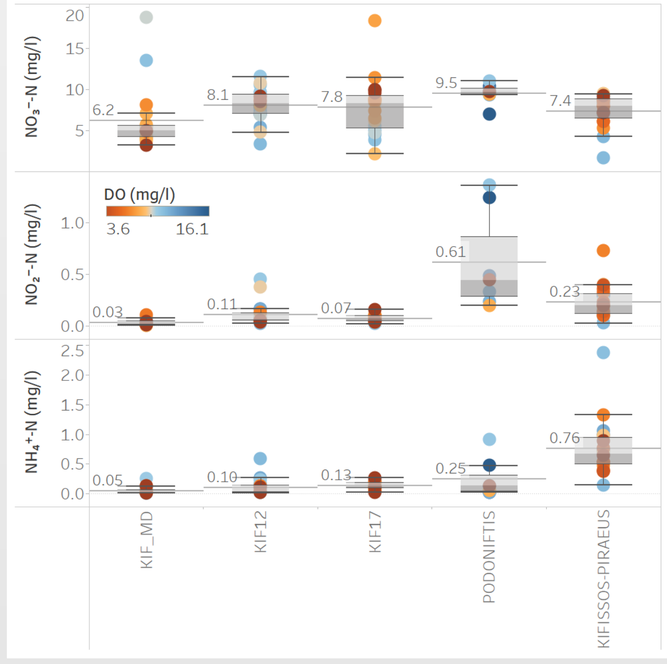
Methods

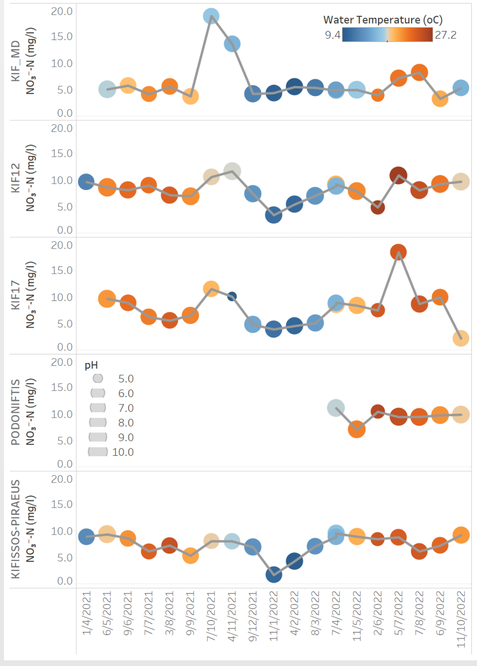
A systematic collection of water samples from 5 monitoring sites in the KRB was done from April 2021 until October 2022 on a monthly basis. We used 125 mL HDPE bottles for the collection of samples to be analyzed for N chemical compounds (e.g., NO_3^-, NO_2^-, NH_4^+). All samples were filtered with 0.45 µm acetate filters prior to collection and HgCl was used for preservation of the samples, prior chemical analysis.

The water samples were analyzed for N-species using an Ion Analyzer (Metrohm) at the HCMR laboratories and were complemented with in-situ measurements (e.g., pH, Electrical Conductivity (EC), Dissolved Oxygen (DO)) using YSI instruments. Box and whisker plots per sampling site were developed to examine the distribution of the measured concentrations. Information about sample sizes was represented by the width of each box, where the widths are proportional to the square roots of the number of observations. Box and whiskers plots present the min-max and median in addition to the first and third quartiles of each variable and site for the entire sampling period. Finally, correlations were used to identify monotonic relationships between two quantitative parameters simultaneously using the 1-tailed Spearman's rank correlation.

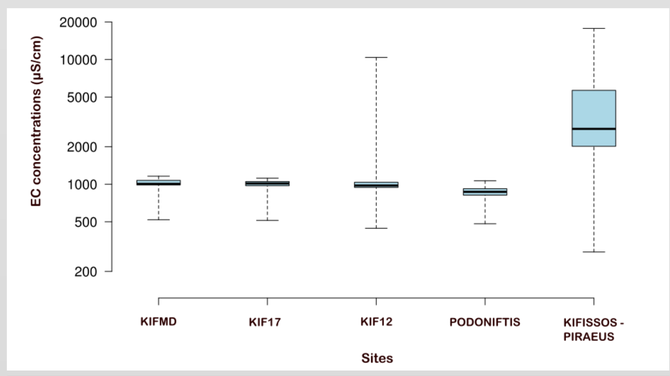
Results & Discussion

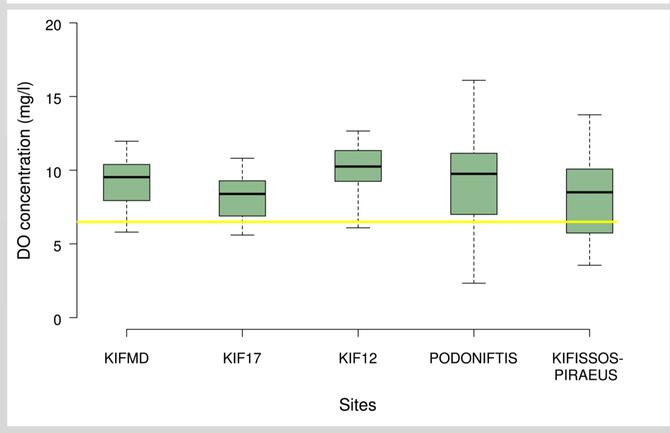
The preliminary results showed that the overall nitrate-nitrogen concentrations ranged between 1.7 and 18.7 mg/l (average: 7.6 mg/l, as NO_3^--N), whereas ammonium-nitrogen concentrations were between 0.01 and 2.38 mg/l (average: 0.26 mg/l, as NH_4^+-N). The nitrate-nitrogen concentration values (as NO_3^--N) increased from upstream (Kif_MD average: 6.2 mg/l) to downstream peaking high at Podoniftis tributary (average: 9.5 mg/l) but decreased at the main river outlet (average: 7.4 mg/l) due to seawater influence. Most river sites exhibited their highest N-concentrations during summer season when discharge was lower.

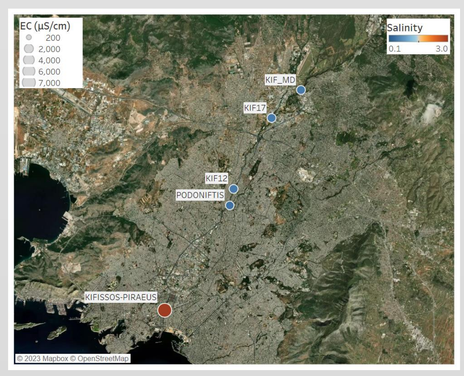




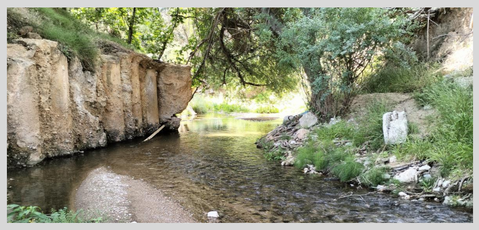
EC concentrations ranged from 286.3 µS/cm to 17,740 µS/cm in water obtained from Kifissos-Piraeus. This wide variation at this sampling site, which is considerably different from the rest, is mainly due to seawater influence. The highest EC values in most all other cases were close to 1000 µS/cm. DO concentrations ranged from 3.6 to 16.1 mg/l. The yellow line indicates the moderate quality threshold according to the EU Directive 2006/7/EC. Spearman's rank correlation showed no correlation among physicochemical parameters. Finally, it is evident that high frequency samplings with the adoption of modern sensors can provide high frequency data and substantially larger datasets to reduce uncertainty related to pollution particularly in urban rivers with multiple stressors, such as the Kifissos River.







	pH	EC (µS/cm)	Temp. (°C)
Temp. (°C)	-0.38	0.039	1.0
EC (µS/cm)	-0.15	1.0	0.039
pH	1.0	-0.38	-0.15



Conclusions

Our survey showed that according to the WFD standards, the quality for nitrates is bad, while for ammonium varies from moderate to bad. Therefore, the KRB suffers from nitrate pollution, which originates mainly from urban runoff, wastewater and industrial effluent discharges and sewer systems. Future research is required to investigate the accuracy and description of pollutant transfer processes during rainfall events and their effect on the pollutant load of urban rivers. Finally, to avoid further degradation of Kifissos river and its related ecosystems, several protection and restoration measures should be undertaken within the framework of the existing EU and national policies.

References

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Acknowledgments

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