Dynamics and Patterns of water quality in a low-land Mediterranean urban stream

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Introduction

Numerous studies have delved into the temporal fluctuations in water quality within stream ecosystems, encompassing both short-term and long-term variations. Most of these studies were conducted in temperate climatic zones and primarily focused on agricultural and forested land uses.

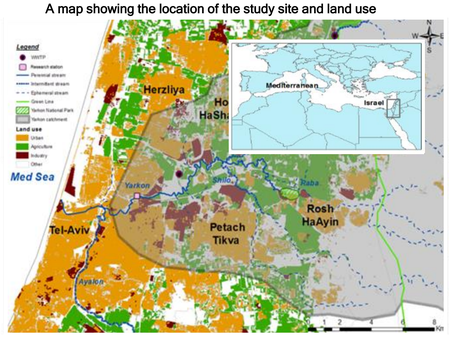
Objective

In this study, we used high-frequency measurement to investigate the daily, seasonal, and yearly dynamics of water quality in a lowland urban stream in the southeastern Mediterranean.

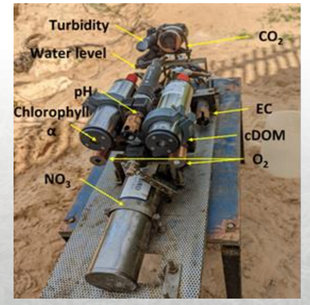
Methods

The Yarkon catchment drains 947 km^2 of mixed rural, agricultural, industrial, and urban land. The riparian zone in the study reach is encompassed by Phragmites Australis, with the occasional presence of Eucalyptus trees, resulting in minor canopy cover. The research station is about 3 km upstream from the Yarkon catchment outlet and includes sensors that measure the level, light, water temperature, turbidity, pH, EC, dissolved oxygen, CO_2, nitrate, cDOM, and chlorophyll *a*. The measurements were collected at intervals of 15 minutes since July 2019.

A map showing the location of the study site and land use



A picture showing the stream at the location of the monitoring station



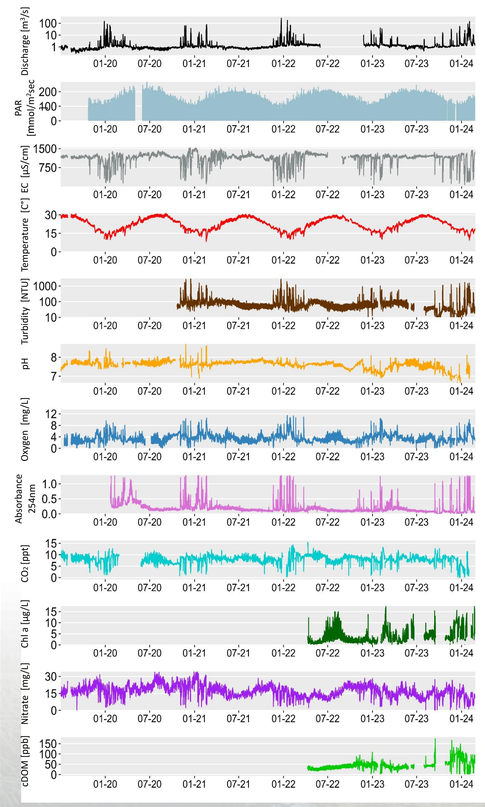
The sensor array

Summary

- This study suggests that low-land Mediterranean urban streams exhibit in-stream biological activity throughout the year as indicated by the oxygen and nitrate measurements.
- In contrast to streams located in temperate climates, the relatively high winter temperatures in Mediterranean regions sustain a highly active ecosystem, as evidenced by diel variations in chlorophyll, CO_2, and nitrate concentrations.
- Oxygen levels remain relatively low year-round, which kept the stream close to hypoxic conditions for a significant amount of time during the year.
- The greatest diel amplitude in oxygen occurs during summer

Results

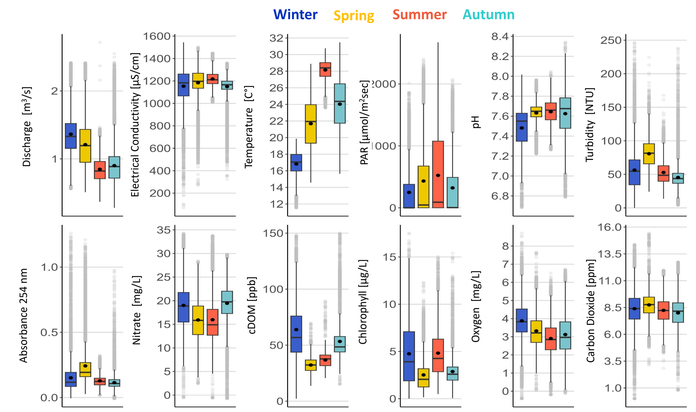
Time series of the measured parameters in the stream



The four-year dataset illustrates the strong influence of seasons on the stream water quality.

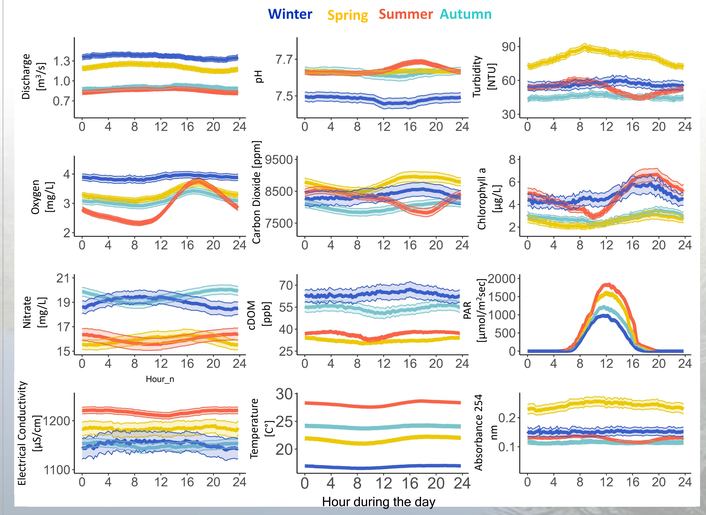
- Temperature, PAR, and discharge shows seasonal pattern typical to Mediterranean climate.
- Flood events are discernible by prominent peaks in discharge, simultaneously with solute dilution as indicated by fluctuations in EC, nitrate, and CO2 levels, alongside an increase in turbidity and absorbance at 254nm.
- In most cases, oxygen levels increased during flood events, except during the beginning of the wet season due to the “first flush” syndrome.

Box plot graph that summarizes the seasonal data distributions during baseflow conditions



- None of the water quality parameters during baseflow clearly followed the seasonal discharge pattern.
- The seasonal trends observed in cDOM and nitrate concentrations compared to EC imply the influence of biogeochemical processes on their variations.
- Oxygen levels were higher in the winter compared to the other seasons
- Turbidity peaked during spring compared to the other seasons, suggesting a higher contribution from algal sources than suspended clay particles to the turbidity levels.

Diel patterns of the measurements during baseflow conditions



- **Diel dynamics** were clearly observed in most of the measured parameters
- Peak values in oxygen, chlorophyll *a*, and temperature occurred simultaneously during the day. However, the magnitude varied across seasons.
- The different patterns of EC and nitrate indicate that nitrate concentrations are not solely influenced by treated wastewater discharge but are strongly linked to in-stream biogeochemical processes.
- Turbidity exhibited different patterns in the different seasons. Turbidity peaked in the early morning during summer and spring, and in the afternoon during winter.
- The peak of chlorophyll *a* in summer did not coincide with the peak in turbidity suggesting that other processes led to the increase in turbidity.

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