



Reply

Response to Comments on the reduction in emerging contaminants in water samples from the Esmeraldas Coast (Ecuador)



Thank you for your interest in our recent article on the impacts of COVID-19 on the occurrence of emerging contaminants in surface water bodies of a coastal province in Ecuador. We appreciate your thoughtful feedback and would like to respond to your comments.

This study is the result of a long-term effort that the authors have been carrying out in the Esmeraldas region and in the topic of emerging pollutants in Ecuador. This is not the first study executed, as over a period of 5 years several unpublished undergraduate dissertation works have been done; in them, caffeine and other substances have been observed frequently in surface and even in drinking waters in Esmeraldas before COVID. We wanted to analyze relevant substances so, the criterion for prioritizing the pharmaceuticals was the local consumption, measured by national sales volume. We also considered that diclofenac and sulfamethoxazole are included in the Watch List under the Water Framework Directive (EU 2020/1161), which highlights the importance of their monitoring. Additionally, 3 of the five compounds studied are designated by Zhang et al. (2021) as indicator compounds representative of emerging concern contaminants, due to their usage, occurrence, resistance to treatment, persistence, and physicochemical properties.

Regarding the sampling campaigns, indeed two trips were carried out in 2019 and 2020, similar to other articles published in the context of the COVID pandemic. For instance, Galani et al. (2021) compares the concentrations of several pharmaceuticals in wastewater samples in March 2019 and March 2020, that is before and during the lockdown in Greece. Other researchers in different countries take a similar approach with water quality analysis: Hagnazar et al. (2022) takes samples in February and May 2020, Chakraborty et al. (2021) in February and April 2020, Tokatli and Varol (2021) January and June 2020, and Selvam et al. (2020) in February and April 2020. We do agree that an increased number of sampling trips would have benefited the research. However, the article was revised clarifying the link of COVID with the reduction of tourism and provided additional supplementary information that supports the conclusions. The 2020 sampling campaign occurred during a time of ongoing restrictions in Ecuador, as detailed in the National Emergency Operations Committee (COE) reports from October 30th and November 19th (COE, 2020). Most beaches were still closed to the public, remote work and schooling were the norm, and differentiated mobility limitations were in place for each canton. Besides, the earlier date suggested (April/May 2020) was logistically impossible due to a National State of Emergency that restricted interprovincial travel, thus making sample transportation not feasible.

Regarding the temperature difference and its influence in the reduction of ECS, we want to point out that due to tropical climate and low influence of cold marine currents, sea surface temperature in the coast of Esmeraldas is fairly uniform year long. Monthly mean sea surface temperature between 2005 and 2017 oscillated between 24.5 and 28.5 °C, but most of the data were in the range between 25.0 and 27.5 °C (Parrales, 2019). So, the variability of sea surface temperature in Esmeraldas is much lower than that observed in temperate regions. Differences in microbial activity along time may exist, but temperature is likely to be less important in controlling microbial activity than in temperate areas.

Regarding the influence of microorganisms as a possible source of ECS degradation, we agree that it could be an interesting research path for the future. However, Gomes et al. (2020), after an extensive literature review, concluded that although some research show that ECS have an impact on the microbiota of water systems, an accurate assessment of its effects is hampered by the absence of a standardized methodology. Also, in marine environments the microorganisms are distributed in water, biofilm, and sediment, so a complete overview of the microbiological role in ECS concentration variation should consider a comprehensive methodology that was beyond the scope of our study.

Finally, conditions that facilitate the detection of ECS in coastal waters are well represented in Solaun et al. (2021). ECS are more easily detected in urban areas with sewer systems that collect the wastewater of a large population which finally drains at a single location into a confined estuary. Although wastewater is released without treatment in Esmeraldas, more than 50 % of households are not connected to sewer systems and discharge wastewater into underground septic tanks. Also, there are no large sewer systems that collect wastewater from large areas and drain at a single discharge point. Although the lack of wastewater treatment may suggest a high probability of ECS detection, the absence of sewer systems makes detection of ECS in estuaries difficult. In coastal sites, detection of ECS should be more difficult than in estuaries because more dilution than in estuaries is expected. So, the consistent detection of ECS at Same beach (C8) suggests the presence of a large pollution source: a holiday resort with luxury houses that has a sewer system that discharges wastewater near the sampling point.

We agree that further research is needed to fully comprehend the complex relationships between environmental factors, microbiological activity, and the occurrence of emerging contaminants in surface water bodies. However, we believe that our study provides a valuable contribution to this field, and we hope that our findings will encourage further research on this topic.

Thank you again for your feedback.

CRedit authorship contribution statement

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Data availability

No data was used for the research described in the article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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