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Developing, cross-validating and applying regression models to predict the concentrations of faecal indicator organisms in coastal waters under different environmental scenarios

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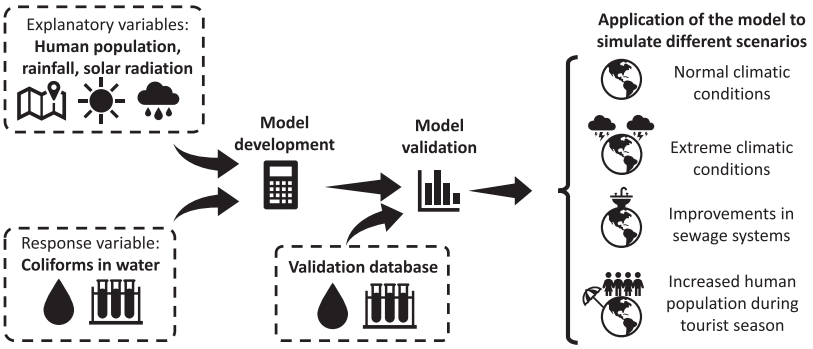
HIGHLIGHTS

- Enhanced models predicted coliforms in coastal waters based on environmental data.
- Cross-validation indicates adequate characterization of coliform variability.
- High rainfall and low solar radiation increased coliforms by 5 $\log_{10}$ MPN.100 mL^{-1}.
- In the summer, coliform die-off offsets higher contamination due to tourism.

GRAPHICAL ABSTRACT



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ABSTRACT

This study developed, cross-validated and applied a regression-based model to predict concentrations of faecal indicator organisms (FIOs) under different environmental conditions in the North and South bays of Santa Catarina, South of Brazil. The model was developed using a database of FIO concentrations in seawater sampled at 50 sites and the validation was performed using a different database by comparing 288 pairs of measured and modelled results for 15 sites. The index of agreement between the model outputs and the FIO concentrations measured during the validation period was 66%; the mean average error was 0.43 $\log_{10}$ and the root mean square error was 0.58 $\log_{10}$ MPN.100 mL^{-1}. These validation results indicate that the model provides a fair representation of the FIO contamination in the bays for the meteorological conditions under which the model was trained. The simulation of different scenarios showed that under typical levels of resident human population in the catchments and median rainfall and solar radiation conditions, the median FIO concentration in the bays is 0.4 MPN.100 mL^{-1}. Under extreme meteorological conditions, the combined effect of high rainfall and low solar radiation increased FIO concentrations up to 5 $\log_{10}$ MPN.100 mL^{-1}. The simulated scenarios also show that increases in resident population during the summer tourist season and average rainfall concentrations do not increase median FIO concentrations in the bays relative to periods of time with average population, possibly because of higher bacterial die-off in the waters. The models can be an effective tool for management of human health risks in bathing and shellfish waters impacted by sewage pollution.

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