

Improving Forecasting System for Bathing Water Quality in Odaiba Seaside Park : Classification of Post-rainfall Fecal Contamination States

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お台場海浜公園における海水浴水質予測システムの改良：降雨後の糞便汚染状態の分類

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1. Introduction

Odaiba Seaside Park is envisioned as a water activity-friendly destination where people can swim safely. However, fecal contamination resulting from combined sewer overflows (CSOs) has significantly degraded water quality in the area, posing a major challenge to achieving this goal. The contamination state is strongly influenced by the amount and distribution of CSOs and tidal conditions. Thus, the objective of this study is to investigate and compare the state of fecal contamination after rainfall under various tidal conditions through model simulations.

2. Methods

Firstly, 1,003 rainfall events that occurred in Tokyo during 2008 - 2020 were categorized using cluster analysis (Ward's method). Rainfall data of 8 drainage areas in Tokyo were used in the calculation. Representative events were selected and applied to model simulation analysis under 8 tidal scenarios combining spring, neap, low and high tide levels. The water quality model used for the calculations takes into account the inactivation process of *E. coli* by salinity and sunlight.

Radar charts were used to characterize the contamination states after rainfall events, considering peak *E. coli* concentrations, recovery time (to standard level of 3-log concentration), and tidal effects.

3. Results and Discussion

Figure 1 shows a dendrogram of 1,003 rainfall events. Rainfall events were categorized into 6 groups. In addition, sub-groups were determined i.e. 1A, 1B, 1C, and 1D. Tidal effect was determined by scoring system considering 2 factors: 1) effect of changes in peak concentrations (> 0.5 log) and 2) significant longer recovery time (> 8 hours) among 8 tidal scenarios. Zero score indicates no significant tidal effect, while score of 2 refers to both tidal effects.

Different rainfall groups have distinct contamination states as shown in **Fig. 2**. The most intense rainfall (6B) shows highest peak concentration (4.84 log CFU/100mL) with longest recovery time (4.75 days) and no significant tidal effect. On the other, smaller rainfall (2A, 3B) shows a large tidal effect as well as impacts on the peak *E. coli* concentration and recovery time.

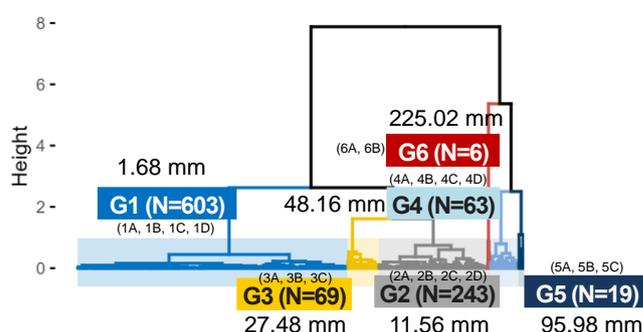


Fig. 1 Cluster dendrogram of rainfall events during 2008 - 2020 in Tokyo with average total precipitation (average values of 8 drainage areas)

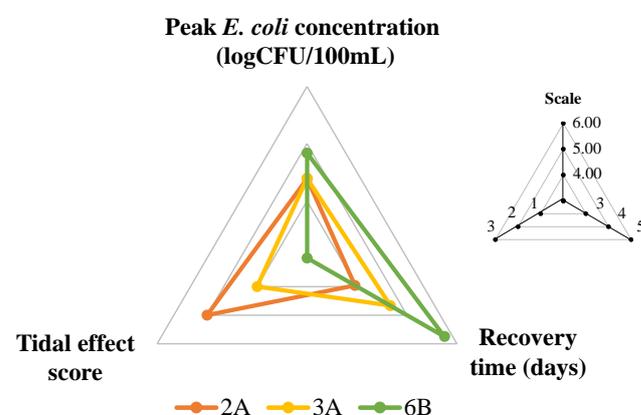


Fig. 2 Radar chart of fecal contamination states following 2A, 3A, and 6B rainfalls

4. Conclusions

The fecal contamination states after rainfalls with different characteristics were characterized, providing insights into the effect of the amount and distribution of CSO and tidal conditions on *E. coli* concentration and recovery periods. The results highlighted the influence of tidal effects, with smaller rainfall events being significantly affected, whereas intense rainfall events showed no notable tidal effect.

References

Poopipattana C. and Furumai H. (2021). Fate Evaluation of CSO-derived PPCPs and *Escherichia coli* in Tokyo Coastal Area after Rainfall Events by a Three-dimensional Water Quality Model. *Journal of Water and Environment Technology*, 19(4), 251–265.