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

Chuo University ○Chomphunut Poopipattana*, Manish Kumar, Hiroaki Furumai
*chomphunut.ps@gmail.com

Introduction

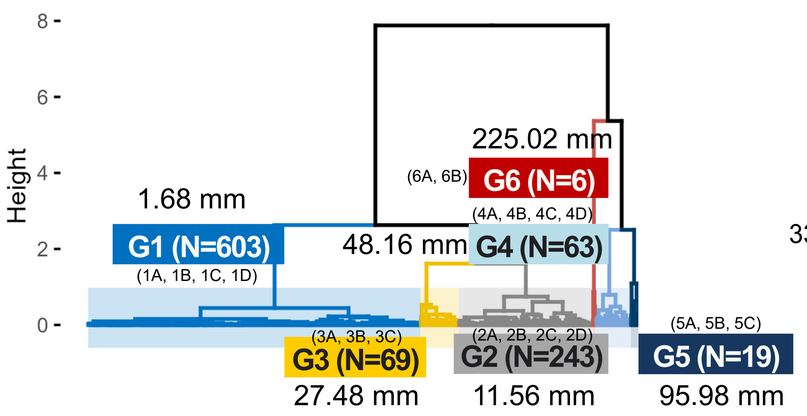
- **Odaiba Seaside Park** is envisioned as a water activity-friendly destination where people can swim safely. However, the area is consistently contaminated by combined sewer overflows (CSOs)
- ***E. coli*** concentration has been used worldwide as an indicator of fecal contamination state of surface water.
- **The contamination state** is strongly influenced by the amount and distribution of CSOs and tidal conditions.

Objectives

- To classify rainfall events that occurred in Tokyo during 2008 – 2020 considering the spatial distribution of CSOs and select representative ones for model simulations.
- To investigate and compare the state of fecal contamination after rainfall under various tidal conditions through model simulations.

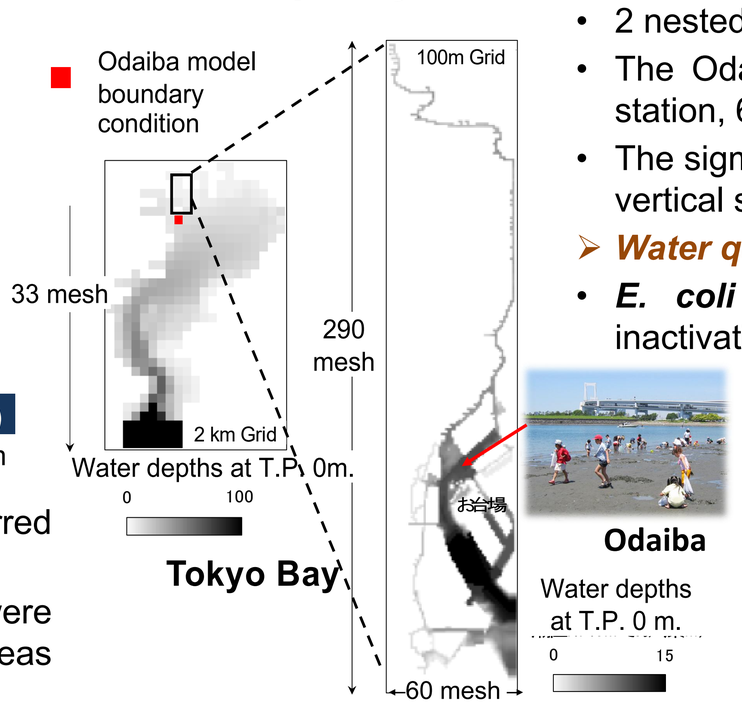
Materials and Methods

➢ Rainfall classification using cluster analysis (2008 – 2020)



- Precipitation data of **1,003 rainfalls** that occurred in Tokyo during 2008 – 2020 was classified.
- Initially, data from 13 rain guage stations were calculated into data of 8 drainage areas considering the spatial distribution of CSOs.
- Rainfall events were categorized using cluster analysis (Ward's method).

➢ 3D water quality model



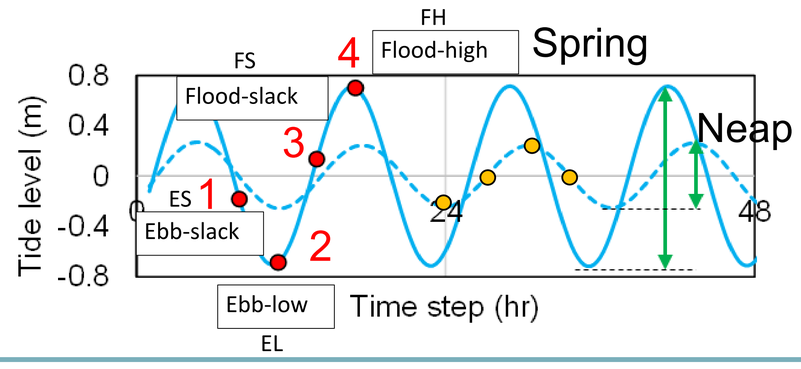
➢ *Hydrodynamic model*

- 2 nested computational domain: Tokyo bay and Odaiba area
- The Odaiba model includes CSO sources of: 29 pumping station, 6 sewage treatment plants (STPs), 6 urban rivers
- The sigma-coordinate vertical grid system were used. The 10 vertical sigma levels were selected for all of domains.

➢ *Water quality model*

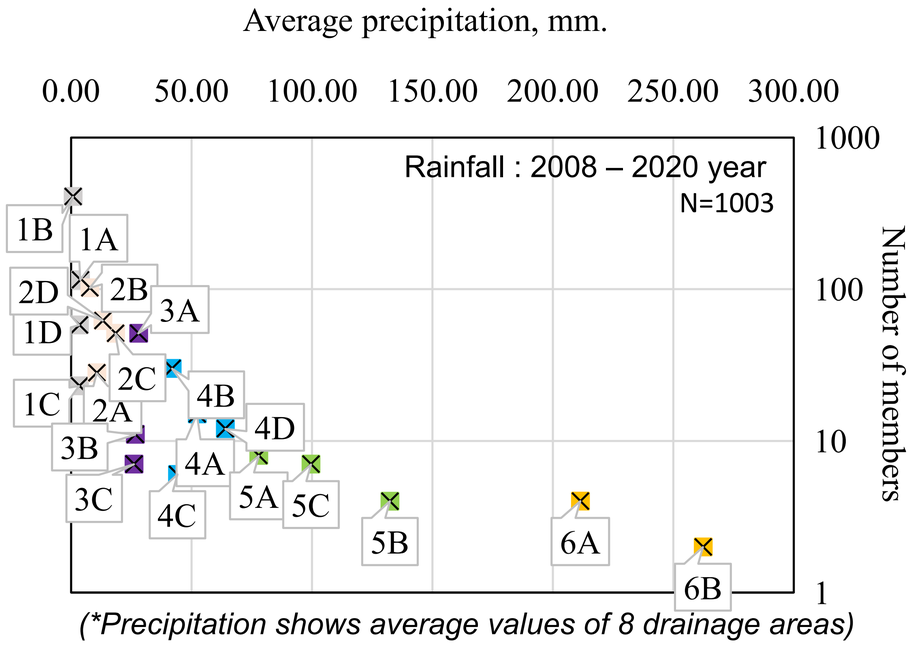
- ***E. coli* fate model** (calibrated) considers settling and inactivation by sunlight and salinity.

➢ Eight tidal conditions



Results and Discussions

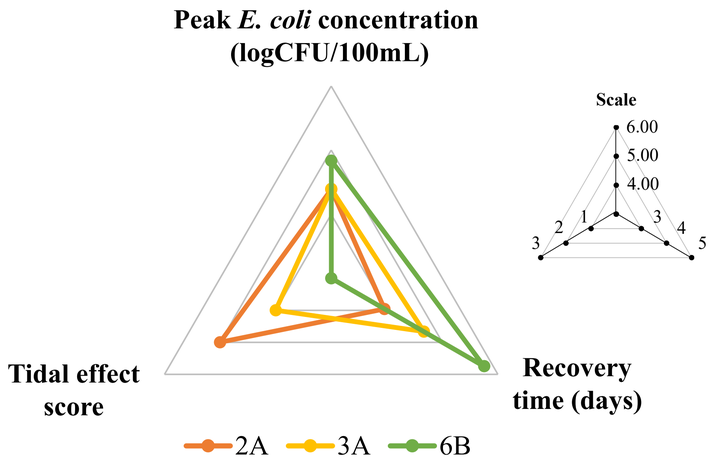
1. Rainfall events classification and representative event selections



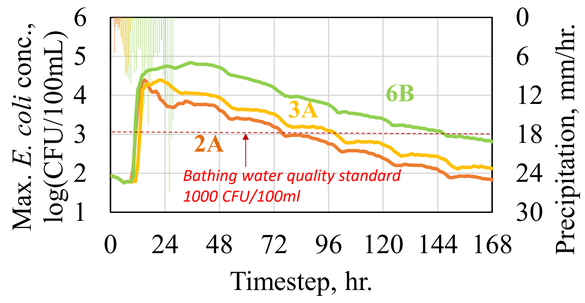
*(*Precipitation shows average values of 8 drainage areas)*

- An overview of rainfall events that occurred in 13 years is illustrated. Rainfall events range from very small events to very intense ones with average precipitation over 200mm.
- Most rainfalls are classified into G1 whereas only 6 events are classified into G6. G1 and G2 are most frequently occurred events with small precipitations. Gradually, the number of rainfall decreases with higher precipitation.

2. Varied fecal contamination states after different rainfall classifications



➢ *Peak concentration and recovery time*

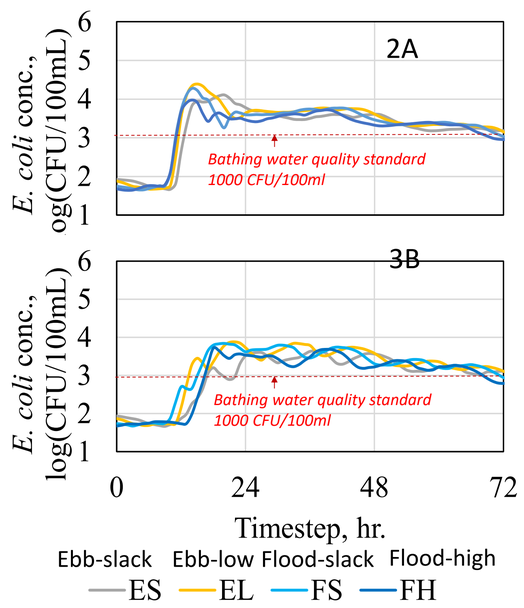


- Different rainfall groups have distinct contamination states. The most intense rainfall (6B) shows highest peak concentration (4.84 log CFU/100mL) with longest recovery time (4.75 days) and no significant tidal effect.

※ Tidal effect score considers 2 factors:

1) Difference in peak *E. coli* concentrations (> 0.5 log)
2) Significant longer recovery time for bathing water quality standard (> 8 hours) among 8 tidal scenarios. (Zero score indicates no significant tidal effect, while score of 2 refers to both tidal effects.)

➢ *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.

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 tidal effects, with smaller rainfall events being significantly affected, whereas intense rainfall events showed no notable tidal effect.**