Construction of the Response Support System for Water Quality Accidents in Water Resource Rivers:

Construction of analytical method on risk of occurrence of water quality accident and prediction of river flow of cause substance

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INTRODUCTION

- In Japan, there is a culture of drinking water from tap directly.
- The Tokyo Waterworks conducts water quality control by setting our unique water quality target, which is stricter than the levels of the national water quality standard.
- Various water pollution risks that may threaten the potable delicious tap water still exist in rivers in urban areas such as Tokyo.
- In the case of water pollution accidents, it might be required to restrict water intake and/or strengthen the water treatment in water purification plants (WPPs).
- In order to supply potable delicious tap water, it is extremely important to grasp water pollution risks in advance and predict the impact by water quality accidents.

METHOD

The analysis of water pollution risks in river basins of water resources

- The data of Pollution Release and Transfer Register (PRTR) system was analyzed using a geographic information system (GIS) and the methods to evaluate risks of water quality accidents were examined.
- The number of PRTR facilities located upstream of intake points of WPPs was calculated for every catchment area, and risks of water quality accidents were assessed based on the results.
- The chemical substances were evaluated according to the number of the facilities handling the substances, the discharged and moved quantity of the substances, and the quantity of river discharge. Based on these results, chemical substances with high risk of water quality accidents were extracted.

The improvement of the flow-down simulation system for water pollutants

- This simulation system can predict when pollutants reach WPPs and the concentration of pollutants at the time.
- In order to improve the prediction accuracy of the existing system, the new three models were introduced for calculation:
  - One-dimensional unsteady flow model for calculating flow rate
  - Land use tank model for calculating the inflow amount of rainwater into rivers
  - Advection diffusion model for calculating pollution concentration

RESULTS and DISCUSSION

The analysis of water pollution risks in river basins of water resources

- The number of PRTR facilities was calculated for every river.
- The Nakagawa River basin has the largest number of PRTR facilities among water resources of Tokyo Waterworks (Figure 1).
- Focusing on the Nakagawa River basin, chemical substances were classified according to risks of water quality accidents.
- In terms of the number of the handling facilities and the discharged and moved quantity of the substances, the risk of organic compounds such as toluene and xylene was turned out to be high.
- In terms of the discharged quantity to river basin, the risk of metals such as manganese was turned out to be high.

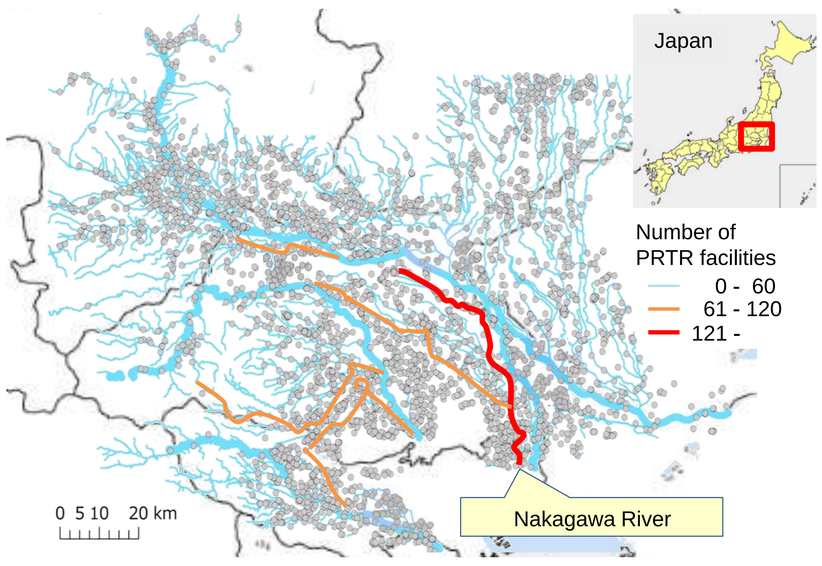

Figure 1- Locations of PRTR facilities

The improvement of the flow-down simulation system for water pollutants

- The effects of the simulation improvement were verified based on the actual date of water quality accidents in the past.
- By the new system, the relative error of arrival time of pollutants from the base point to the B point decreased to 4 %, and that of arrival concentration decreased to 24 % (Figure 2).
- The improvement of the system enhanced the prediction accuracy greatly.

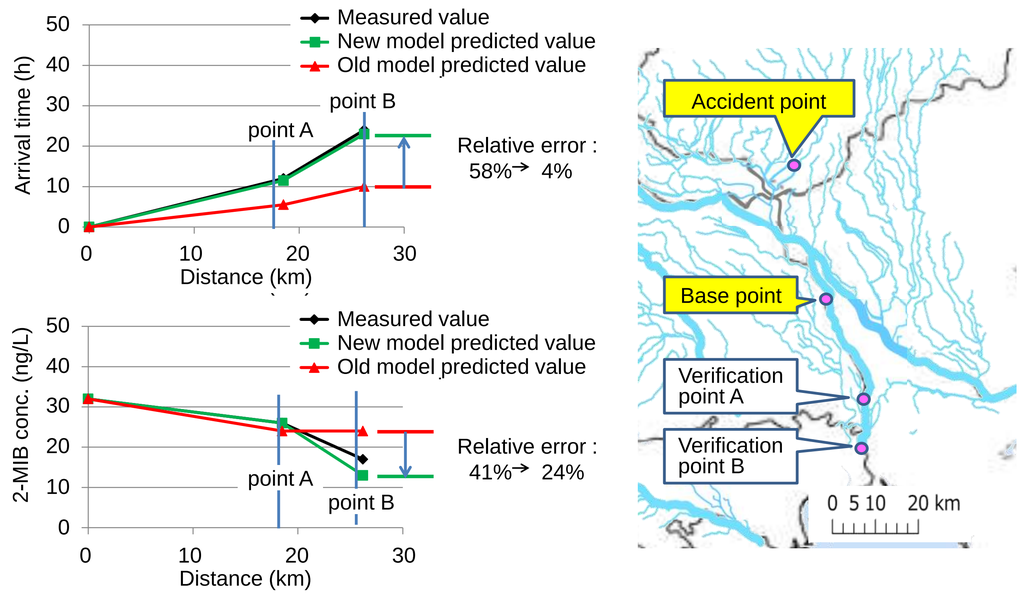

Figure 2- Verification of prediction results of new and old simulation models

To improve the abilities to response to water quality accidents furthermore

- In order to take accurate measures in response to actual water quality accidents, it is indispensable to grasp the actual situation in a timely manner.
- Based on this concept, Tokyo Waterworks equipped the water quality examination vehicle for accurate understanding of on-site circumstance timely.
- The water quality examination vehicle is equipped with analytical instruments capable of rapid test of 31 substances of negatively affect public health.
- In addition, the analytical instruments (LC-TOF-MS etc.) capable of identifying various chemical substances are introduced. The quality of rivers are periodically monitored in order to sense changes in the risk of water quality accidents.

Picture 1- Water quality examination vehicle

Picture 2- LC-TOF-MS

CONCLUSIONS

- The risk of water pollution in river basins of water resources was analyzed using PRTR and GIS. As a result, rivers and chemicals with high-risk of water contamination were identified.
- The improvement of the simulation system resulted in elimination of relative error of arrival time of pollutants and decrease of that of arrival concentration.
- We will continue to maximize the use of this support system described in this report while conducting practical accident response drills repeatedly and improving our comprehensive capacity to handle water quality accidents.

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