

# Simulation Models for Ambient Water Quality Criteria for Dissolved Oxygen

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## Abstract

In the *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries* (U.S. EPA 2007), the cumulative frequency diagram (CFD) approach was introduced. The CFD-based water quality criteria assessment methodology offers the potential for significant benefit in assessing the target bay water quality criteria attainment.

A three-dimensional water quality model is developed for simulating temporal and spatial variations of dissolved oxygen in the ambient water. This developed model predicts the spatial distribution of tidal current and dissolved oxygen to evaluate for the water quality criteria in Japan. The optimal sampling time problem is also presented in this paper.

**Key Words:** misclassification, spatial.

## 1. Introduction

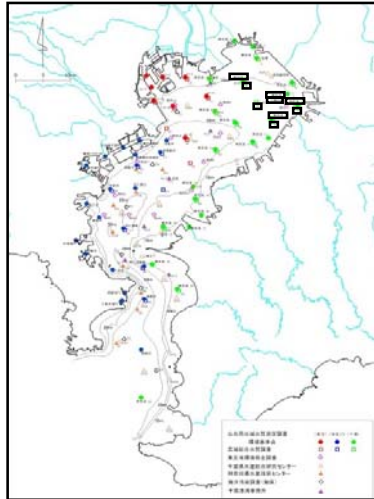
In order to achieve and maintain the water quality conditions necessary to protect the aquatic living resources of the Chesapeake Bay and its tidal tributaries, the U.S. Environmental Protection Agency (EPA) Region III has developed the guidance document, entitled *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries* (Regional Criteria Guidance). Oxygen is one of the most essential environmental constituents supporting life. In the Bay's deeper waters, there is a natural tendency toward reduced dissolved oxygen conditions because of the Bay's physical morphology and estuarine circulation. Criteria for the migratory fish spawning and nursery, shallow-water bay grass and open-water fish and shellfish designated uses were set at levels to prevent impairment of growth, and to protect the reproduction and survival of all organisms.

Recently, in Japan we also must institute the water quality regulations for dissolved Oxygen in the enclosed coastal seas (the Tokyo Bay, the Seto Inland Sea). In a parallel manner we cannot adapt the EPA guidelines and the CFD-method to the data set of the Japanese enclosed coastal seas. In this paper, we present the modified methods for the CFD-based water quality criteria assessment methods.

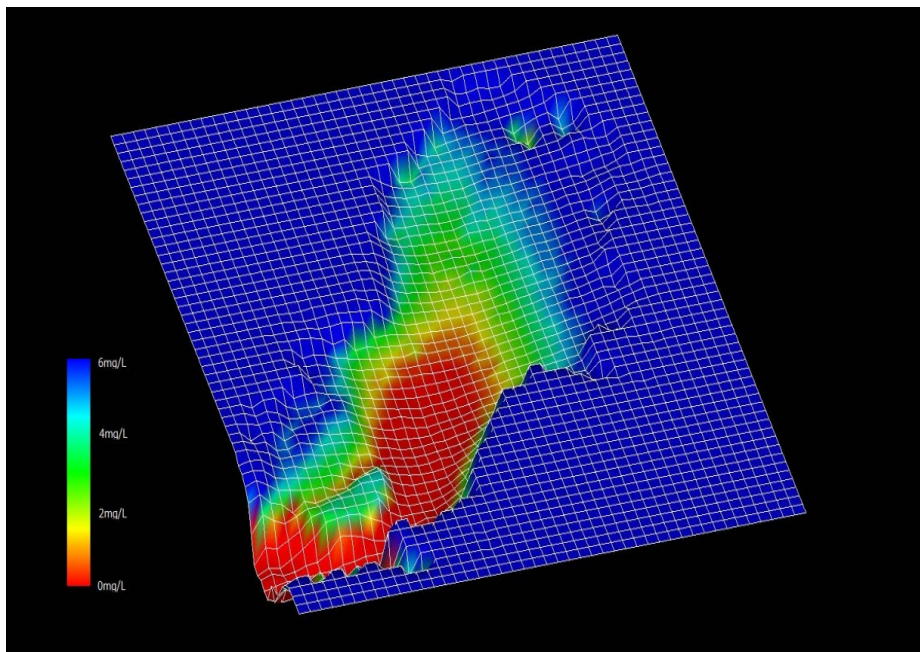
A three-dimensional water quality model is developed to predict the concentrations of Dissolved Oxygen (DO).

## 2. Data

We use the Public Water Body Water Quality data in Japan. Figure 1 shows the sampling points in the Tokyo Bay. Figure 2 is the 3D estimated distribution for Dissolved Oxygen in the Tokyo bay.



**Figure 1:** Tokyo Bay sampling points



**Figure 2:** 3D distribution for DO in the Tokyo Bay

### 3. The optimal sampling times in the evaluation for DO

We estimate the ratio of the misclassification of sampling in the Tokyo Bay based on the simulation data. Figure 3 shows that the ratio of meeting the standard is related with misclassification of sampling. Figure 4 presents the distribution of the misclassification of sampling in the Tokyo Bay. We use this map to evaluate the number of times in sampling at each point.

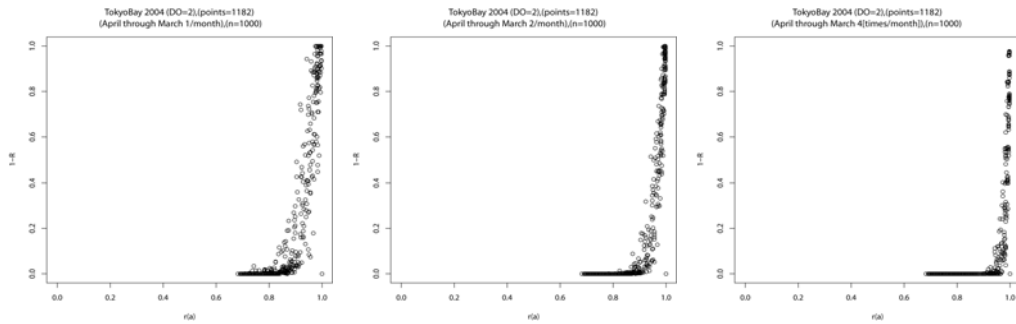


Figure 3: The ration of the misclassification

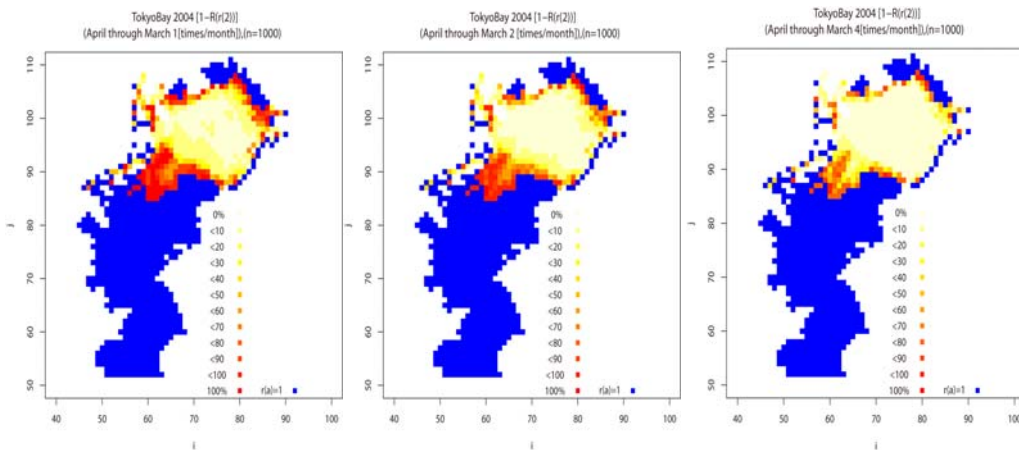


Figure 4: The ration of the misclassification

### 4. Conclusion

We apply this methods to data of the enclosed coastal seas(the Tokyo Bay) in Japan. We validate the evidence of this method. We can get the optimal sampling times at each point.

### Acknowledgements

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### References

*Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries* (U.S. EPA 2007).