

Analyzing global trends of water quality using GLOBE hydrosphere data

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Introduction

- Ikuta High School is in Kawasaki City, Kanagawa Prefecture, Japan, near Ikuta Ryokuchi park and Hirase River, which is about 3 meters wide. Since 2016, we have conducted weekly water quality surveys (temperature, pH, COD, phosphoric acid, ammonium, and nitrates) using pack tests.
- We have been conducting experiments since 2018 to investigate the effects of iron ions on photosynthesis.
- This project aims to identify global trends in the effects of global warming on rivers using hydrosphere data from the GLOBE Advanced Data Access Tool. We also compare the characteristics of the Hirase River trends to information future research on water purification and global warming.



Figure 1. Location of Hirase River and our school



Figure 2. Observation activities

Research Question and Hypothesis

- What kinds of global trends can be identified from the hydrosphere data extracted by GLOBE?
- As a global trend, what environmental factors are associated with river water quality?
- What kinds of insights can be obtained from the global analysis of GLOBE hydrosphere data to our future research aimed at mitigating global warming?

Results A)

A) Global and local trends of hydrosphere data

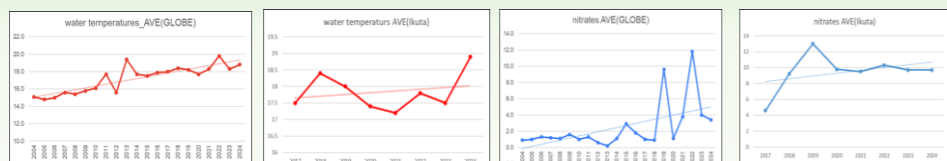


Figure 5. Global trend of water temperature over time

Figure 6. Local trend of water temperature over time (Ikuta High School)

Figure 7. Global trend of nitrates over time

Figure 8. Local trend of nitrates over time (Ikuta High School)

Materials and Methods

A) Local hydrosphere data observed at Hirase river

The GLOBE Hydrosphere protocols were used for water quality surveys at Ikuta High School. (Figure 1 and 2).

B) GLOBE hydrosphere data

GLOBE hydrosphere data was downloaded through the Advanced Data Access Tool on the GLOBE site. The downloaded data includes water temperature, pH, nitrates, conductivity, and dissolved oxygen.

C) Data analyses

The data downloaded from the GLOBE site was supplemented with information on urban regions and river width measurements obtained from the map. Data analysis was conducted using Python. (Figure 3 and 4).



Figure 3. Assessing the degree of urbanization in the surrounding area of the observation points of GLOBE sites and the river widths

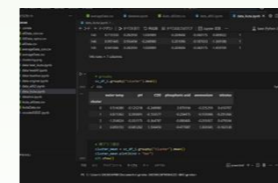


Figure 4. Python Screen

Results B)

B) Factors related to water quality

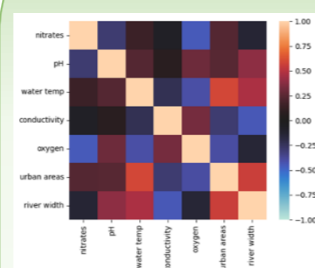


Figure 9. Correlations among all data from GLOBE observation sites

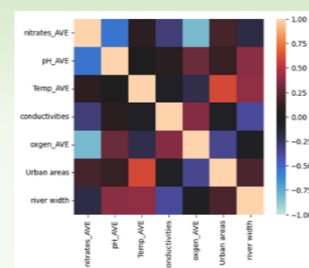


Figure 10. Correlations among the average values for each observation site of GLOBE

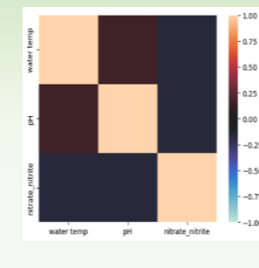


Figure 11. Correlations among the extracted data from the GLOBE database at Ikuta High School

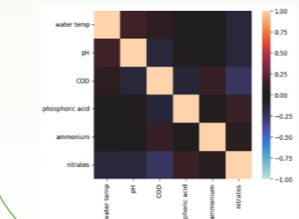


Figure 12. Correlations among all data measured at Ikuta High School

Results C)

We presented a heatmap showing the results of simple regressi

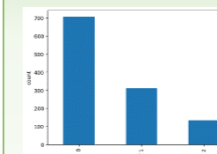


Figure 13. GLOBE Number of data points in each cluster

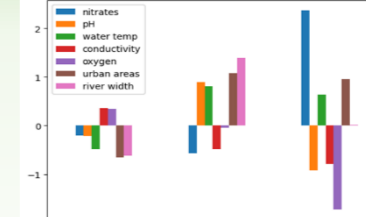


Figure 14. Characteristics of each cluster by variables of water qualities and the other environmental variables

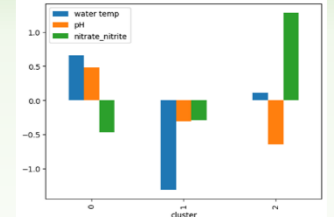


Figure 15. Characteristics of clustered data of Ikuta High School extracted GLOBE database

Discussion

- We were able to learn from the graph that the Earth is warming. (Figure 5 and 6).
- In urban areas, water temperatures tend to be higher which may be attributed to the effects of industrial and domestic wastewater. (Figure 14).
- Wider rivers tend to have slower flows and are often shallower, which allows sunlight to reach the riverbed more easily. This facilitates the proliferation of algae and aquatic plants, which absorb nitrogen through photosynthesis and supply oxygen. The reason is that urban rivers with wider widths also show higher values in terms of pH. This may be because CO₂ in the water is absorbed through photosynthesis, reducing acidic components and resulting in a relatively alkaline water quality.
- According to data from Ikuta High School, the presence of fields around the observation points suggest that fertilizers application during this period may be a contributing factor. (Figure 15).

Conclusion and Future Issues

- Our analysis results are not perfect, and there is a possibility of obtaining entirely different findings. This study revealed that increasing the variety of GLOBE measurement items enables data analysis from various perspectives. We would like to also conduct measurements of dissolved

Bibliography/Citations

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