2025 International Virtual Science Symposium (IVSS)

30 Years of GLOBE: Understanding the Past, Present, and Future

Submission Category: Earth Sciences

Title:

Investigation of the Spectra and Analytical Parameters of the Tamsui River

Students:

Huei-Jhen Ni, Anle Senior High School,11th Grade

Pin-Hsin Yeh, Anle Senior High School, 11th Grade

Advising Teacher:
Teacher Alice Liu

I. Introduction

Reserch motivation

The Tamsui River is one of the most important rivers in northern Taiwan, which not only has a rich ecosystem, but also has a significant impact on the lives and economies of the local population. With the development of cities, people have also begun to pay attention to the water quality of rivers, and it has gradually become an important issue to monitor the changes in water quality through scientific means and evaluate the impact of these on river ecosystems.

To this end, we learned about GLOBE's hydrospheric protocol through the school, and actually participated in it, and carried out field collection according to the nine water quality variable in GLOBE, and finally we also wanted to compare the satellite image with the field collection, how the measured different satellite's light band will be related to the field collected data, and explore more ways to monitor water bodies.

Reserch purposes

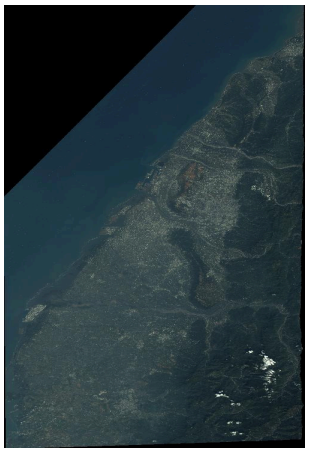
1.Identify the types and concentrations of water ions through on-site water collection.

2.To explore whether the types of water ions in the surface water surface band. reflected by sunlight are related to on-site water extraction

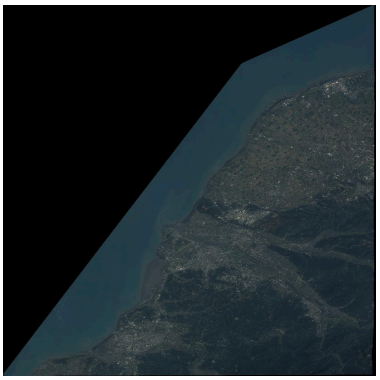
II. Literature Review

1.Introduction, time, location, main water bodies

Figure(1) The location of the river

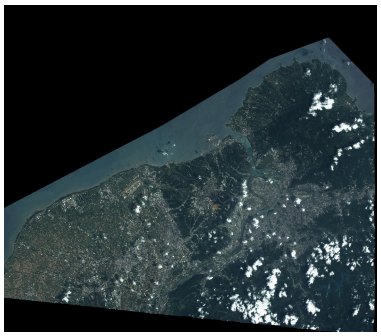


Figure(2)
Date：2020.02.23
River：Jhuoshuei River

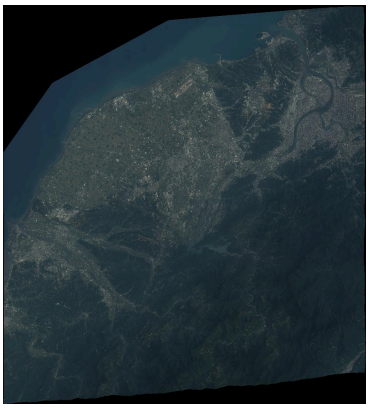


Figure(3)
Date：2016.03.03
River：Jhuoshuei River

Figure(4)
Date：2016.07.26
River：Jhuoshuei River

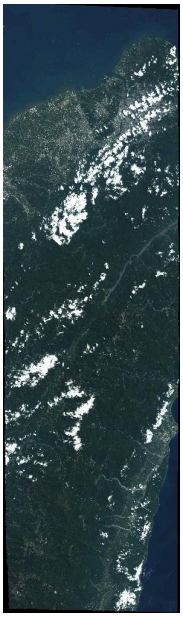


Figure(5)
Date：2016.07.17
River：Tamsui River



Figure(6)
Date：2017.04.04
River：Tamsui River

Figure(7)
Date：2016.09.20
River：Jhuoshuei River

		
Figure(8) Date：2017.07.12 River：Jhuoshuei River	Figure(9) Date：2016.06.04 River：Tamsui River	Figure(10) Date：2016.05.19 River：Jhuoshuei River

2. The application of telemetry technology in water monitoring

(1) Water quality monitoring: monitor the concentration of ions, algae growth or water quality parameters in the water body

(2) Water resources management: monitor the water level changes of water bodies and their scope and area

(3) Disaster early warning: monitor the occurrence of floods and droughts

(4) Ecological and environmental protection: monitoring natural crises such as wetland area degradation, estuarine erosion, and biodiversity

3.Introduction to the SPOT satellite

The SPOT satellite family is an optical telemetry satellite developed by the French Space Agency and the French space company. These satellites are mainly used for Earth observation and environmental monitoring, helping to monitor water resources, urban sprawl and ecological change. The data we are referring to are the SPOT-6 and SPOT-7 satellites, which can have a resolution of up to 1.5 meters, and can observe the same area again in a short period of time compared to other satellites.

III. Research Methods

1.Field collection

After our own planning and discussion, we selected two water extraction sites, and tested each value according to the nine water extraction projects of GLOBE, and finally recorded it.

Figure(11) Sampling location

2.QGIS was used to process the features of water images in satellite imagery

(1) Traditionally, water features are represented by NDWI：

a. Indicators to detect subtle changes in water content.

b.The subtraction process of green and infrared light bands can improve the interference generated by the atmosphere.

$$NDWI = \frac{R_G - R_{NIR}}{R_G + R_{NIR}}$$

https://patents.google.com/patent/CN111932567A/zh

(2) Process：

a. Step 1: Merge the images of different light bands. Select four files with ers extensions, then tick the boxes "Put each input file in a different band" and "Open the output file after the algorithm is executed", then set the Output data type to UInt16,

and finally select the location where the file will be stored (the type is img or tif), and press Run.

b. Step 2: Click on the fence calculator, enter the formula of NDWI, and press OK to generate a new chart, which is the image of NDWI.

3. Spectra captured with a simple spectrometer were analyzed using Image J.

(1) Step 1: Upload the spectral image to Image J, select a desired range, click Duplicate in Image to crop, press ctrl+A to select the image, click Plot Profile in Analyze, and the wavelength image will appear.

(2) Step 2: Compare the wavelengths of water and sunlight, select two points on the wavelength of water and sunlight and write down the X coordinates, Curve Fitting in the Analyze Tools will mark the X coordinates of the four points, and then press Fit, and then a formula will appear, bring this formula into other points to confirm that the formula is correct.

(3) Step 3: Click on the List in the lower left corner of the wavelength picture, download the data and open it in Excel, calculate the correct values in Excel, and make them into a scatter chart, then adjust the data range of the water and sunlight scatter charts, and finally merge them and mark the legend and chart name.

IV. Analysis and Results

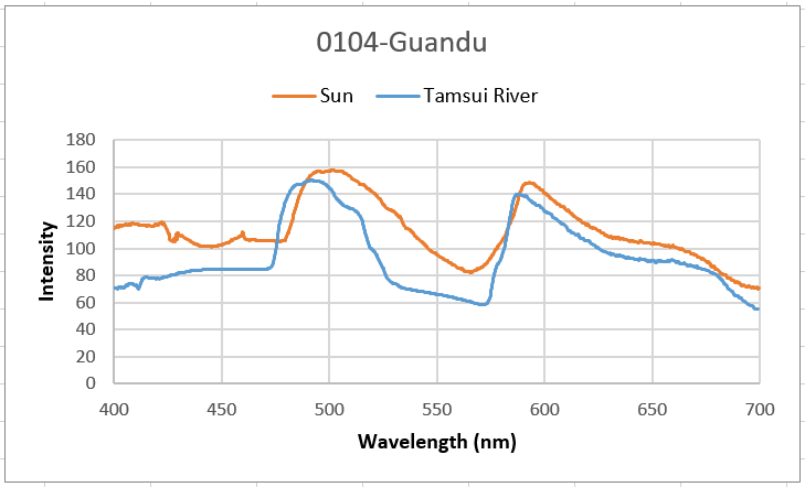
1.Water collection data

Sampling location	Sampling time	Analyze the project	pH	Water Temperature	Water Transparency	Nitrates
		unit	-	℃	Jackson	ppm
Fort San Domingo	2025.01.04 Start:12:04 End:14:00	numerical value	8.5	20.7	0	0
Guandu Nature Park	2025.01.04 Start:16:40 End:17:35	numerical value	21.5	21.5	70	0

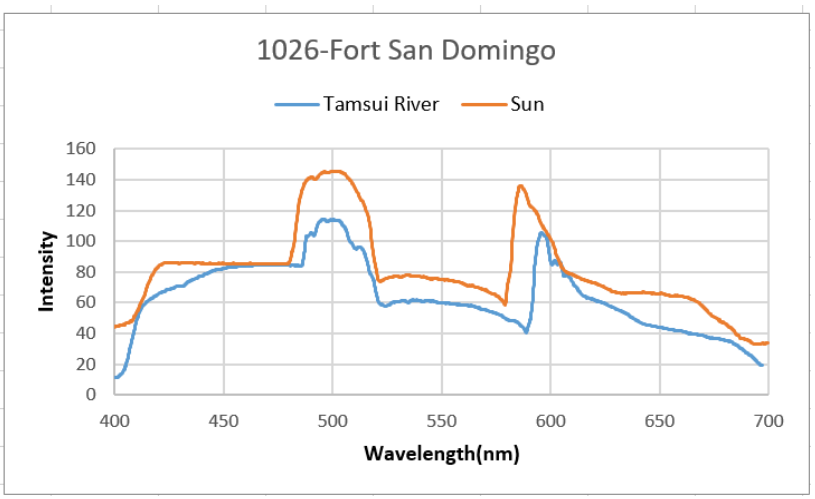
Fort San Domingo	2024.12.21 Start:16:35 End:17:52	numerical value	8.5	-	0	0

Sampling location	Sampling time	Analyze the project	Dissolved Oxygen	Alkalinity	Low phosphate	Conductivity
		unit	ppm	dkh	-	μS/cm
Fort San Domingo	2025.01.04 Start:12:04 End:14:00	numerical value	5.8	88× 0.056	0.2	8~9
Guandu Nature Park	2025.01.04 Start:16:40 End:17:35	numerical value	5.6	80× 0.056	0	12~69
Fort San Domingo	2024.12.21 Start:16:35 End:17:52	numerical value	6	128× 0.056	0.4	0.03187

2.Analysis of data taken by a simple spectrometer



Figure(12)
Date：2025.01.04



Figure(13)
Date：2024.10.26

V. Conclusion and Suggestions

1. When we use a simple spectrometer to photograph sunlight, the distribution of the sunlight spectrum is significantly different from the theoretical value. It may be more obvious when shooting sunlight reflected by water.

2. We tested the pH value of the river water to be alkaline, which showed that although the water body we collected was located in the river area, it was affected by the composition of seawater.

3. In the future, if we can find a specific band for ion absorption on the surface of the river, we can also allow satellites to monitor specific ions through the improved operation technology of NDWI.

4. A simple spectrometer comparing the spectral spectrum of the sun and the surface of the river showed that the intensity between 500-570nm was significantly reduced. In the future, it will be possible to continue to compare the substances that will be absorbed in this band.

Ⅵ. References

1.THE GLOBE PROGRAM(1995) https://www.globe.gov/
2.113暑期衛星遙測基礎應用實務教育推廣工作坊
(2024)https://ocw.ncu.edu.tw/media/4550