Consideration on the Movement of Ocean Currents in Semi-Enclosed Sea

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1. Research Motivation

Why is there so much garbage concentrated on Chijiwa Beach? We wanted to find out why so much garbage is concentrated on Chijiwa Beach.

2. Research Objectives

We would like to know the movement of ocean currents in semi- enclosed seas where there is a lot of drifting debris. And we would like to use the results for coastal cleanup.

3. What is a Semi-Enclosed Sea? [Definition.]

Inland seas and bays are surrounded by land, and seawater is not easily exchanged with the open sea.

*The purple line on the right is the semi-enclosed sea called Tachibana Bay.



figure I Tachibana Bay, a closed sea area

4. Research Question I · II

Research Question I

How do ocean currents move in Tachibana Bay, which is a semienclosed sea?

Research Question II

What are the movement routes of marine debris in Tachibana Bay?

5. Hypothesis I · II

Hypothesis I

Tachibana Bay is a semi-enclosed sea that opens to the southwest, and there is a tendency for ocean currents to flow toward the back of the bay.

Hypothesis I

In Tachibana Bay, the fish are unable to leave the bay and continue to circulate within the bay or stay on the coast.

6. Model Experiment

Prerequisites before starting the model experiment: In order to investigate the trend of wind direction in Tachibana Bay, we utilized historical weather data from the Japan Weather Agency to investigate wind direction for approximately one month from September 1st to September 30th 2024.

·Result

The radar chart on the lower left shows that Tachibana Bay Tends to be dominated by southwesterly winds.

OModel experiment

- I)Create a closed sea area model, pour water to a height of 1.5 cm, and float fine styro foam pieces (10 pieces) that resemble marine debris.
- 2) Reproduce sea breeze with a small fan (wind speed 2.0m/s)
- 3) The origin is near the center of the model, and the distance between the origin and the small fan is adjusted 0 cm, 5 cm, 10 cm, and so on, to see how much litter has drifted away. and check the status of litter drift.

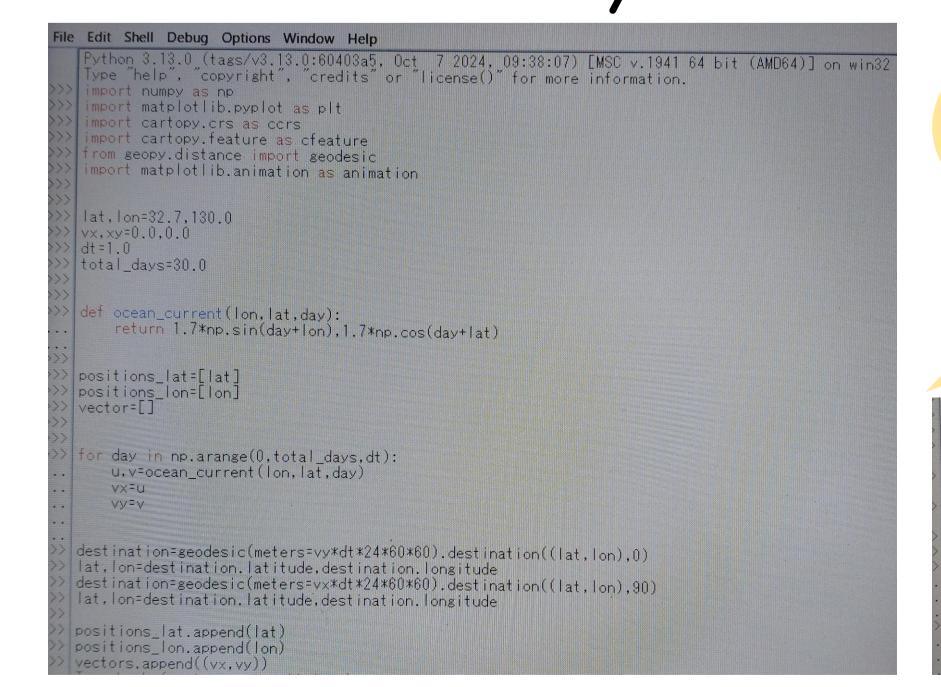
Distance between origin and small fan[cm]	Number of pieces of drifted litter[n piece/I Opieces]	ratio[%]
Ocm(origin)	9 piece/10 pieces	Approx. 90%.
5cm(Move 5cm away from the origin)	8 piece/10 pieces	Approx. 80%.
10cm(Move 10cm away from the origin)	6 piece/I0 pieces	Approx. 60%.

The shorter the distance from the origin, i.e., the stronger the wind strength, the higher the percentage (probability) of drifting ashore on Chijiwa Coast.

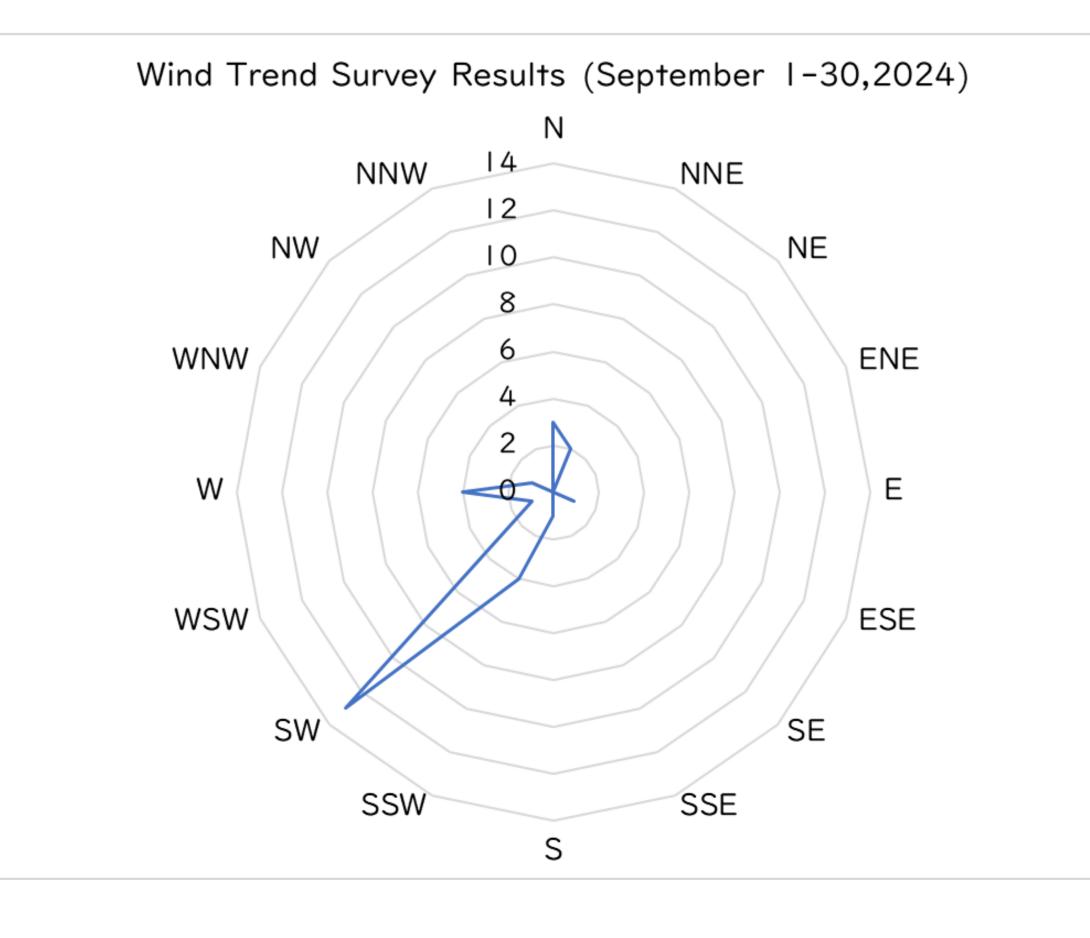
- ①Currents and winds toward the back of the bay tend to be more frequent.
- 2 A lot of marine debris accumulates on the Chijiwa coast and the surrounding coasts.
- (3) The stronger the wind, the more marine debris tends to accumulate on Chijiwa Beach

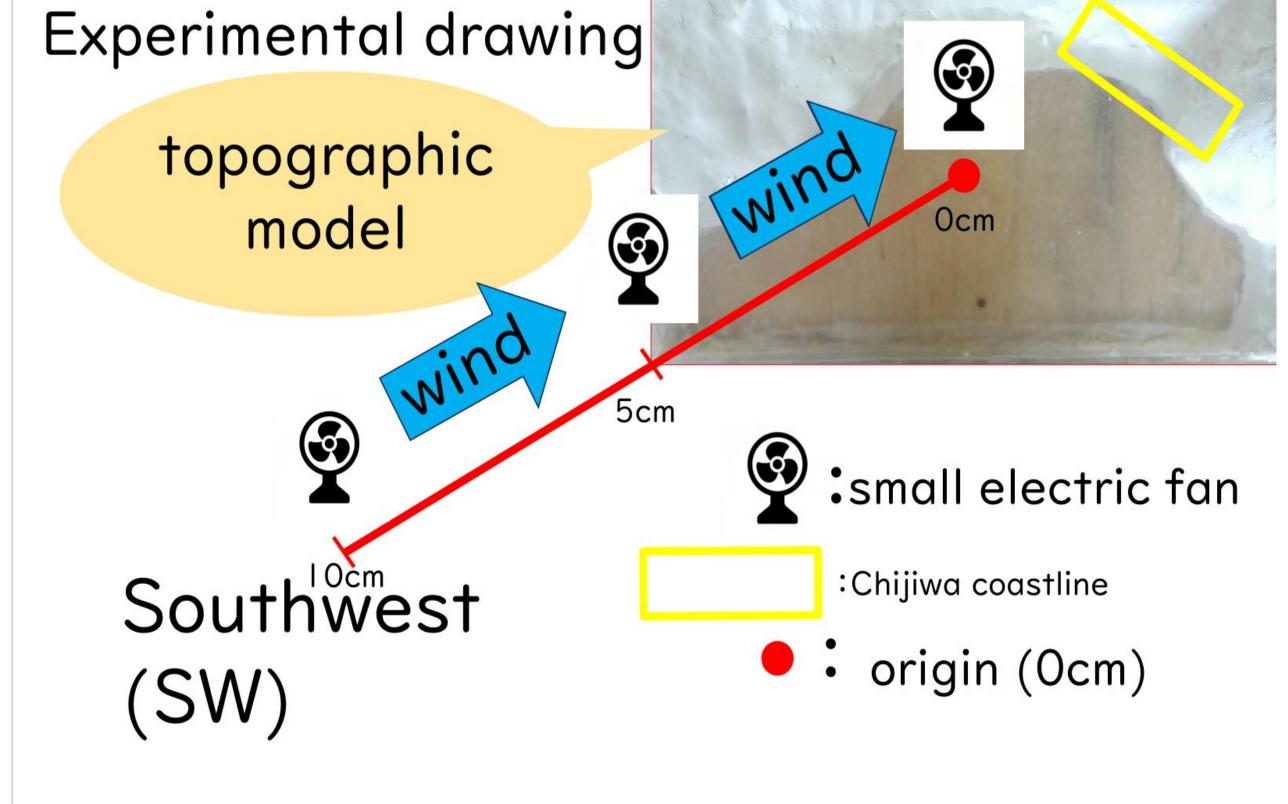
7. Simulation of Marine Litter Drift Prediction Programming languages such as Python and Fortran, and the Eulerian method are used to understand the behavior of ocean currents in

Tachibana Bay.



Program
(under
construction)





8. Future Prospects

The goal of this study was to conduct simulations using Python and Fortran to predict marine debris drifting, but we struggled to build a simulation environment and were unable to obtain the results of Hypothesis II. In order to continue our research, we summarized our future prospects. They are as follows

- · Obtain a lot of experimental data.
- ·Investigation of other semi-enclosed seas such as Omura Bay and Nagasaki Bay, and comparative experiments