

ANALYSIS OF TOPOGRAPHIC AND CURRENT INFORMATION BY ADCP AND WATERCRAFT

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INTRODUCTION

In August 2017, when some high school students swam at Zenibako beach in Hokkaido, three students carried away and drowned. The several other accidents occurred at this beach in recently years. Firstly, we check the weather condition and the wave condition. Secondary, we conducted the field survey in August 2018. In the field survey, we used ADCP, and we got the water depth information and the current information. When we used the ADCP, this device and GPS device attached to a watercraft. During conducting the field survey, we got the aerial photographs by the UAV. The photographs were used to make a grid topographic data. Thirdly, we simulated the wind driven current in Ishikari Bay, and the wave current around Zenibako Beach. Finally, we considered the reason why the accident occurred.

Our final purpose of this research is to obtain the knowledge for preventing the occurrence of water accidents. To obtain the knowledge, we grasped the mechanism of drowning by grasping the topography of the field and dynamics of the seawater when the water accident occurred.

WEATHER AND WAVE CONDITIONS

Firstly, we acquired some weather chart of the accident occurred day (9 a.m. 27th August, 2017) and we grasped the time change of the weather. Furthermore, we acquired the wave observed data. According the results, when the accident occurred, a high pressure moved to the east and approach to Zenibako beach. Therefore, the maritime wind velocity and the wave height increased. When the accident occurred (11 am), the significant wave height was 1.08 m.

FIELD SURVEY

We conducted a field survey with the Society of Water Rescue and Survival Research and Hokkaido Water Safety Association in 24th August, 2018. In the survey, attached a ADCP (ADCP: Acoustic Doppler Current Profiler) and a GPS to a water motorcycle. When the water motorcycle moved to measure, the motorcycle moved as 1 m/s, and measured as 20m grid spacing. During the measurement, the sensor of ADCP was submerged in water, therefore, we defined the real water depth as the value obtained by adding 0.4 m from the measured value.

Furthermore, to correct the tidal level, we subtracted 0.1 m from the obtained water depth to the real depth at the accident.

After obtain the data, we averaged the mean current velocity and the current direction in the significant wave period.

During conducting the survey, the significant wave height at NOWPHAS Ishikari Shinko Port was 0.25 m.

There was not rip current. Under these conditions, we visualized the current by using the water colorant, and we took aerial photograph by using the UAV. As the result, the average current velocity was about 0.1 m/s.

Furthermore, we obtained the situation at the accident occurred by the witness, 1st Regional Coast Guard Headquarters, Otaru Coast Guard Office, Hokkaido Prefectural Police and Otaru City Fire Department.

NUMERICAL SIMULATION

Firstly, we made the topographic information by using the field survey data, and we made the 1m spacing grid data. Secondary, we grasped the nearshore current condition of the survey time by the numerical wave model. In this case, we used modified Boussinesq equations and continuous equations to calculate the wave condition and the nearshore current. Thirdly, we tried to grasp the wind driven current in Ishikari Bay. Here, we used the numerical model of the explicitly differentiates hydrostatic pressure approximation equations and continuous equations.

CONCLUTIONS

Many accidents occurred near Zenibako beach. When the field survey was conducted at Zenibako beach, the wave condition was calm. Therefore, we did not confirm the occurrence of the rip current. However, as the simulation results, when the accident occurred, the wave height at offshore area was over 1m. However, the wave height decreased at onshore of break water, and the weak rip current occurred there. The velocity of the current was about 0.2 m/s. According the field survey, the depth at the drowned point was about 1.5 m, and the seafloor gradient increase at offshore area from there. The average height of Japanese high school boy is about 1.7 m. If the depth increases over about 1.5 m, the foot of the average height boy cannot reach the bottom. In this case, the drowning person keep the upright posture. Because, he keeps trying his foot reach the bottom. In the case, he swims using only his hands, and the moving speed is lower than 0.2 m/s. Therefore, we concerned that the drowning victims were carried away by the weak rip current, and finally they were drowned.

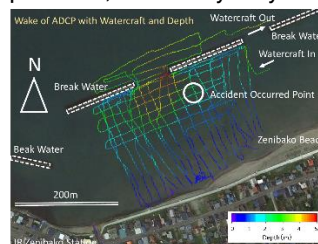


Figure 1 - Wake of Watercraft with ADCP Color Shows Depth.

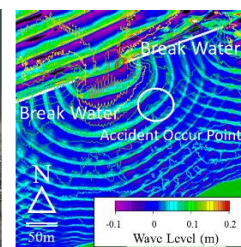


Figure 2 - Profile of incident wave when the accident occurred.