Study of Marine Traffic Analysis for the Ship
Evacuation Measures Against Tsunami

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1. Introduction

According to the Ministry of Land, Infrastructure and Transport (MLIT) Maritime Bureau(1) in Japan, keeping in mind that the captain cannot contact with operation control office of the headquarters, it is necessary to prepare to select the best measures according to the situation at the time, assuming the tsunami correspondence behavior pattern in advance. The Kamaishi Japan coast guard advises that evacuation to the offshore is safe if it can reach the sea area of more than 200m in depth before encountering the tsunami, and in case it cannot be reached, they instruct the evacuation to land to be an option. Rapid evacuation to the safety area leads to protection of the means of transportation and delivering goods to isolated areas at trough earthquake, because these small vessels are assumed as a fishing ground in Fig.2. The one shown as shown in Fig.3 and high values spread out to outside of the areas. The maximum rate 11.75 is found near the port entrance areas. The maximum rate 11.75 is found near the port entrance which can be found on the Google Earth with latitude 34°59'16.31"N and longitude 138°31'0.08"E. The radar raster image has been saved to the personal computer via DVI to USB converter. The radar raster image has been used from July 2016 until May 2017. Sometimes the radar turned off for several reasons such as when leaving the university for a long time, heavy sea clutter or rain clutter are occurred and few fishery boat found because of strong wind or high waves. Total 179 days of radar image was analyzed for this research.

2. Extracting the Non-AIS ship tracks

Because the speed of the ship is slow, the echo from the ship appears relatively close to each other in continuous data in a short period. There is also feature that the sea clutters and false images do not appear in the same place. In view of these and the rotational rate of radar is 24 rpm, images are extracted every 2.5 seconds, and the barycentric position of the echo which is obtained twice or more within 10 seconds is saved. While comparing this saved data, original radar video image and AIS tracks at hourly intervals, the Non-AIS tracks are extracted manually and filled on Google Earth.

3. Comparing Non-AIS ship tracks and the marine traffic analysis with OZT

Originally, the Non-AIS ship is planned to be included in the calculation for marine traffic analysis, but since fishing vessels have good maneuverability and can avoid large vessels in dangerous situation, there is an opinion that it is better not to include in the calculation and only show Non-AIS ship tracks to compare the marine traffic analysis data such as OZT. In addition, as mentioned in chapter 2, because the radar images have not saved every day, there is a possibility that correct recognition could not be obtained if Non-AIS ship is put into the OZT calculation. For this reason, the estimated result of the collision course area due to OZT’s existence and Non-AIS tracks are shown separately and analyzed.

3.1 The OZT and the marine traffic observation with OZT

It was estimated the collision course area using OZT in offshore refugee outside the Port(4). In this research, in order to compared with the movement of Non-AIS vessels in Suruga Bay, the larger area is analyzed by using 1 year AIS data from June 2016 until May 2017.

3.2 The analysis result

The Non-AIS ship tracks with transmittance set at 20% and estimated ship flow are shown in Fig.1. The part painted white is a place considered a fishing ground in Fig.2. The one shown by the dotted line is considered to be Non-AIS ship which navigating between Shimizu Port and off Shimoda, and this track is not found in Fig.1. The average OZT existence per day for one year around Shimizu Port is shown Fig.3. As shown the figure, around Shimizu Port is high values compared with other areas. The maximum rate 11.75 is found near the port entrance as shown in Fig.3 and high values spread out to outside of the port like a fan. In the port, the OZT rate is high along the container ship route from the container terminal. This is also true that the center of the route is higher than side of the navigation route. By comparing the Non-AIS ship movement data in Fig.1 and Fig.2, the Shimizu port area might be dangerous.

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In Suruga Bay, the following characteristics can be cited as compared with the tsunami in the Great East Japan Earthquake.

- The time to reach the tsunami is very short
- The depth is relatively deep and the distance from the port to the safe depth of 200 meters is short
- Since Nankai Trough and Tokai earthquake has been expected, consciousness to measures is high.

4.1 The Tsunami countermeasure for ship at Tokai University

Tokai University own 3 ships that are Bosei Maru (2174 ton), Hokuto (18 ton) and Minamijuuji (19ton). The author and relative navigator and Tokai university staff discussed about the tsunami measure for these ships and summarized below.

4.1.1 Countermeasure for Bosei Maru

During the berthing of the quay where is shown in Fig.3, basically one person from the deck section or the engine section carry out a watch. In an emergency situation, even one engineer can start the main engine within about 15minutes, but it is difficult for the personnel required for ship operation to gather until the arrival of the tsunami. For this reason, if the earthquake occurred, personnel on the Bosei Maru evacuate to the bridge with transceiver which is prepared for the tsunami measure. When she is already departing, it is necessary to evacuate to the sea area where the depth of 200 meters or more considering same thing with AIS ships.

4.1.2 The Tsunami countermeasure for Hokuto

Hokuto mooring place is near the innermost part of Shimizu Port as shown in Fig.3. Except the case which she is able to evacuate 200 meters depth or more, crews need to evacuate on land. As general rule, if the wave height is 2 meters or more, she cannot leave the port. If it is 1.5 meters, it is decided after careful discussion. In the Shimizu Port, maximum tsunami height is expected to 3 meters, it requires to select an appropriate land evacuation site beforehand.

5. Conclusion

It has been studied the tsunami countermeasure in Suruga Bay. In Shizuoka prefecture, there are plans that vessels including small fishery boat can be used for reconstruction after the occurrence of the tsunami. Although tsunami countermeasures have been developed, it is appeared that still many points are inadequate. It needs to cooperate with Shizuoka Prefecture and promote the tsunami countermeasure for saving life and ships from the tsunami.

References

1. Ministry of Land, Infrastructure and Transport Maritime Bureau, Handbook of tsunami evacuation manual at ship operators, A study meeting for improving ship evacuation posture at the time of the occurrence of the tsunami, 63, 2014