Study on Sedimentation of the Marina Channel in Miyazaki Port

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1. Introduction

Annual dredging efforts to maintain navigation channels, in some cases, may exceed tens of millions m^3 of sediment per year, which results in higher recurrent costs for port operators (Berends, 2019; van Maren *et al.*, 2015, and others). A similar sedimentation problem has been occurring at the marina channel in Miyazaki Port (Fig. 1) and the port authority sometimes closes the channel for several months. Many authors have dealt with this problem of navigation channel sedimentation through theoretical and numerical approaches, as well as field surveys (Ghosh, 2001; Berends, 2019, and others). Among those efforts, an empirical eigenvalue method is commonly utilized to analyze the characteristics of long-term depth change (Kuriyama, 2002, and others), but there are difficulties in interpreting the meaning of higher-order principal components. This study investigates the sedimentation problem along the marina channel in Miyazaki Port through a linear regression model with usage of both long-term and short-term bottom sounding data.

2. Data Analysis

Morphological changes were investigated with two sets of data. One of them is long-term depth data consisting of yearly data from 1999 to 2019. Several survey lines were set from onshore to offshore along the Miyazaki Coast, including Miyazaki Port, and the depth was measured along each line greater than the closure depth (Fig. 2). The other is short-term depth data consisting of daily data from 2013 to 2020. The depth data were measured at several points from P1 to P21 in Fig. 1 each morning to monitor the safe navigation of users. The annual long-term depth data were interpolated at 100 m intervals in longshore and cross-shore directions, and the characteristics of depth change on each grid point were analyzed by the linear regression model. The short-term depth data were also utilized to analyze the characteristics of depth change in the marina channel.

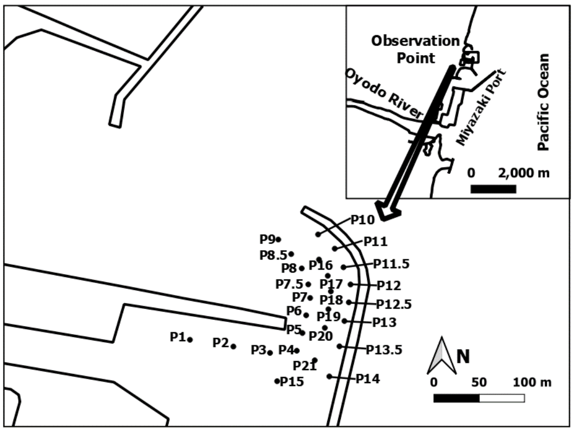

Fig. 1 Depth data points inside the marina channel in Miyazaki Port

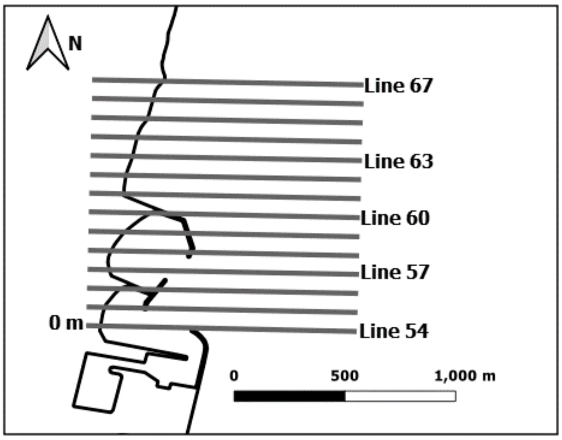

Fig. 2 Interpolated depth data lines on the northern side of the marina channel

3. Discussion

(1) Depth changes in marina channel

The locations of depth measuring points from P1 to P9 are along the left-hand side of the marina channel, from P10 to P15 are on the right-hand side, and from P16 to P21 are in the middle of the channel. Fig. 3 shows the daily depth change at P9 in 2019. This study applied the linear regression analysis to the depth change. The analysis provided the slope of the regression line X in terms of sedimentation speed, correlation coefficient R in terms of the variation of depth change, and significance level based on P-value, which for this study is

5%. A set of the largest values, each of R and X, were selected for each year to investigate the characteristics of sedimentation in the area of the marina channel. For example, (R, X) = (0.675, 0.00212) at P8.5 and (0.824, 0.00526) at P9 in 2019, and (0.596, 0.00187) at P7.5 in 2020. By the analysis from 2013 to 2020, the set of (R, X) largest values can be observed from P9 to P6, and this area tends to have linear sedimentation. On the other hand, the area from P10 to P13 does not have significant sedimentation due to the effect of dredging works.

(2) Depth changes near the marina entrance

The yearly depth data on the northern side of the marina channel (see Fig. 2) was analyzed in the same way as short-term data analysis in order to find the source area of sedimentation materials flowing into the channel. Fig. 4 shows the cross-section profile along line number 54. A sedimentary tendency can be seen between 200 m and 1200 m. Fig. 5 shows the set of R and X on each line. It is clear that the depth becomes shallower between the above range along all lines, and the depth variation also becomes smaller near the marina channel. This means that the sand deposit areas that cause the sedimentation of the channel are widely distributed on the northern side of the marina entrance.

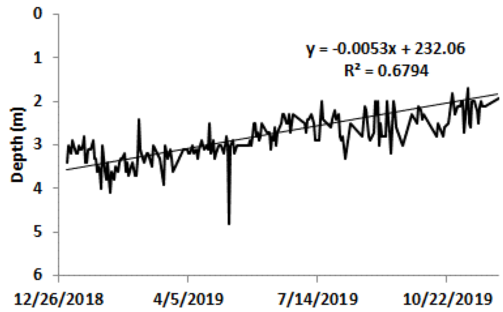

Fig. 3 Example of short-term depth change in the marina channel at point P9 in 2019

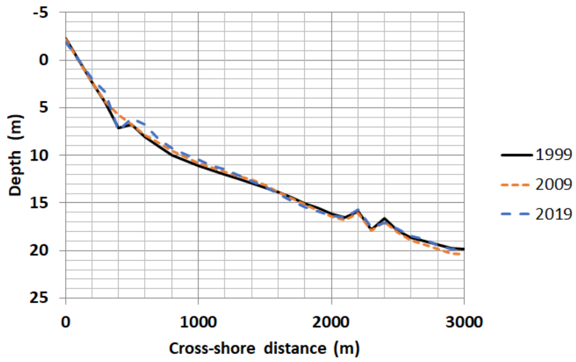

Fig. 4 Example of long-term depth change at line 54

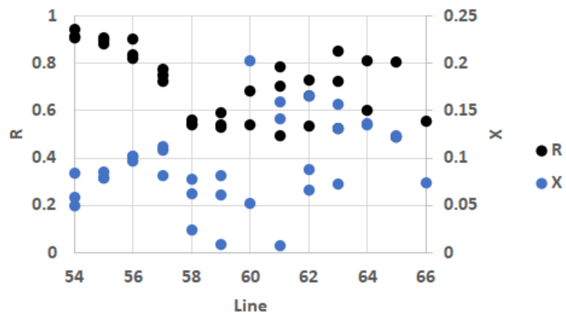

Fig. 5 Distributions of R and X along each line

4. Conclusion

Linear regression analysis was utilized in this study to reveal the characteristics of sedimentation along the marina channel in Miyazaki Port. Higher sedimentation tends to occur at the inside of the marina entrance area. This study also shows the source area of sediments that cause marina sedimentation. Based on the discussion, the authors will conduct a research that proposes an appropriate measure to check for further sedimentation.

References

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