FIELD OBSERVATIONS OF SEDIMENT PARTICLE MOVEMENTS IN THE SWASH ZONE USING FLUORESCENT SAND

Takayuki Suzuki, Yokohama National University, suzuki-t@ynu.ac.jp
Tomoki Hayashi, Yokohama National University, hayashi-tomoki-cb@ynu.jp
Mustarakh Gelfi, Yokohama National University, gelfi-mustarakh-bj@ynu.jp

INTRODUCTION

Many studies have been conducted to investigate sediment transport mechanisms in and out of surf zones. However, detailed studies on sediment transport dynamics that track the movement of each sediment particle in the swash zone are limited. In this study, fluorescent sand tracers were introduced into the surf and swash zones, and sand in the swash zone was sampled every few hours. In addition, the currents and wave heights were observed to investigate the sediment movement dynamics in the swash zone.

DATA DESCRIPTION AND METHOD

Observations were conducted from 12:45 pm on Sep. 7, 2021, to 3:45 pm on Sep. 8, 2021, on the Hasaki coast, Japan facing the Pacific Ocean (Fig. 1). An observation array was installed in the surf zone, x = 45 m, to measure waves, turbidity, and currents during the observation period. Moreover, an outdoor camera was installed on the research pier to determine shoreline positions. The averaged significant wave height and period observed at the off Kashima port were 1.94 m and 8.35 s, respectively.

Red and yellow fluorescent sand tracers were installed at x = 45 and 20 m, respectively, at 12:45 pm on Sep. 7. Sediment sampling was conducted at 10 m intervals in the cross-shore direction (x = -15 to 35 m) and at 40 m intervals in the longshore direction (y = -200 to 200 m) (Fig. 1). Sediment samples were collected six times (1:15pm, 3pm, 5pm, 9pm on 7th and 6am, 3pm on 8th). The collected sediment was thoroughly dried naturally and irradiated with UV light to extract the fluorescent sand. In total, 311 sediment samples were collected.

RESULTS AND DISCUSSION

The number of fluorescent sand tracers per 100 g was determined using the collected sediment samples. The spatial distribution and center of gravity of the red fluorescent sand tracers are shown in Fig. 2. If the tracers exceeded 50 per 100 g, their number was recorded as 50. Immediately after the tracer placement, the movement of particles was primarily observed in the cross-shore direction. However, the movement along the longshore direction was also observed over time.

The time of wave effect on the sediment movement in the swash zone depended on tidal and wave actions. The minimum and maximum run-up positions of the waves were determined using camera images, and the flooding time at each cross-shore location was calculated. Since the center of gravity also moved in the cross-shore direction, the average flooding time was obtained by averaging the flooding times in the range where the center of gravity moved.

Fig. 3 shows the relationship between the center of gravity shift in the longshore direction and the product of the longshore current and mean flooding time. This relationship exhibited a correlation of y = 0.01x. The longshore-ward shift of the center of gravity was approximately 1 % of the value calculated from the current.

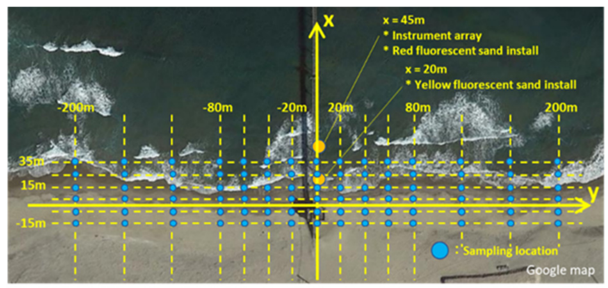

Figure 1. Placement points of fluorescent sand tracers and sediment sampling locations.

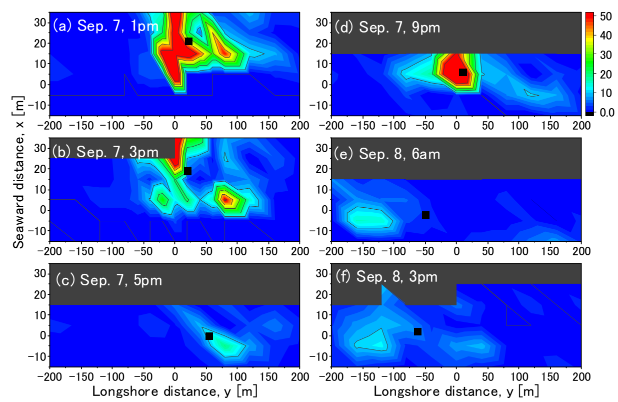

Figure 2. Spatial distribution of red fluorescent sand tracer and the center of gravity position, (a) Sep. 7, 1:15 pm, (b) 3 pm, (c) 5 pm, (d) 9 pm, (e) Sep. 8, 6 am, and (f) 3 pm.

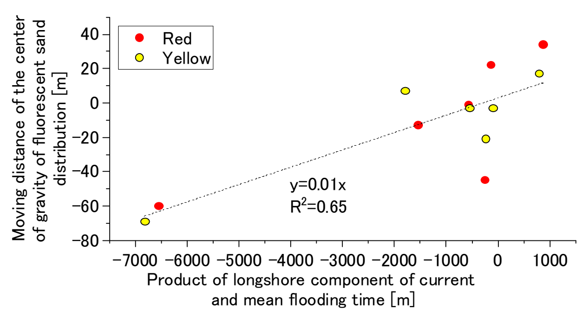

Figure 3. Correlation between the moving distance of the center of gravity of the fluorescent sand distribution and the product of the longshore component of current and mean flooding time.