Topographic observation of the tidal flat at the mouth of the Shirakawa River during the passage of Typhoon No.9 and No.10 using optical fibers

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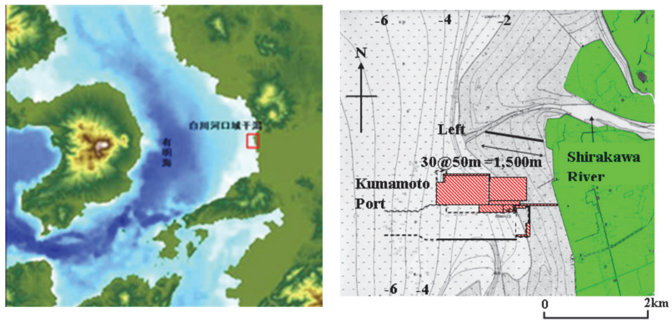
INTORODUCTION

The authors developed a new method for long-term and high frequency measurement of tidal flat using optical fibers and conducted continuous observation from October 2019 and March 2020, confirming the validity of the optical fiber observations. In September 2020, typhoons No.9 and No.10 approached the observation site. Typhoon No.10 was said to be one of the largest and strongest typhoons on record, and an emergency warning was launched. In this study we focused on the periods before and after these typhoons to clarity the validity of this observation method and the tidal flat topographic response during typhoon.



METHOD

The observation site is located on the center of the eastern coast of Ariake Bay in Japan, which is a closed inner bay (Fig.1). As shown in Fig.2, the observation instruments used were a pressure gage for water level, optical fibers for ground elevation and water color and a turbidimeter for turbidity.

Twenty optical fibers are attached to the central instrument to measure the time history of the LED light intensity from the emitting part of the optical fibers. The absence of light intensity values indicates that the LED light has not reached the receiver, and therefore the height of the LED light can be determined to be in the ground. Since the value of light intensity in seawater is assumed to be affected by the turbidity of seawater, the turbidity can be estimated from the value of light intensity. Sea water color was converted from RGB values to L*a*b* values

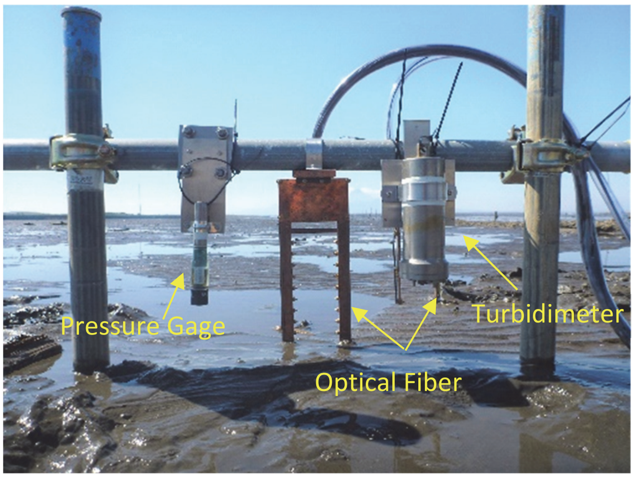


Figure 2 - Observation Instruments

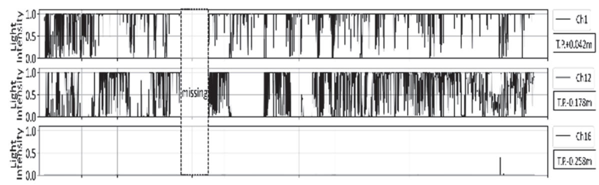


Figure 3 - Time- series of light intensity by optical fibers

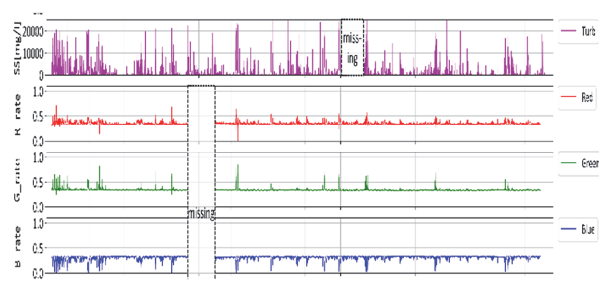


Figure 4 - Time- series of turbidity and sea water color

RESULTS

Figure 3 shows an example of time-series variation of light intensity by optical fiber and Figure 4 turbidity and water color by RGB. The grand elevation decreased by about 4cm after the passage of Typhoon No.9 and by about 6cm Typhoon10, and these values are comparable to the annual changes. The optical fibers capture not only long-term but also short-term topographic changes. The present method is capable of continuous observation for about one year and six months. L* value decrease significantly in the phases when the ground elevation changes remarkably, and turbidity can be estimated using L* values.

The observation method used in this study requires battery replacement only once a month, making maintenance extremely easy. However, the tidal range caused deformation of the optical fibers due to the attachment and penetration of shellfish, so countermeasures are needed for further long-term measurements.