PERFORMANCES OF THE RIP CURRENT WARNING SYSTEM AT THE HAEUNDAE COAST OF SOUTH KOREA

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INTRODUCTION

Haeundae is one of the most beautiful beaches in Korea, and is also notorious for frequent and strong rip currents. Every recent year in this beach, hundreds of swimmers rescued from rip currents have been reported. The large-scale Haeundae rip current is known to be a kind of transient rip currents which is hardly predicted. The successive ends of wave-crest pattern (i.e., honeycomb wave-crest pattern(Dalrymple et al., 2011)), which generate rip current, are mainly formed by two-directional wave trains due to the refraction of incident swells over submerged shoals and ridges of the Haeundae coast.

Many people are caught by the rip current in the relatively calm sea and weather conditions. The incident waves generating rip currents are nearly monochromatic with the wave period of 7-13 seconds. These swells are supposed to be generated by distant typhoons formed in the Philippine Sea. Some of them might propagate with dispersion and dissipation during the travel toward the south coast of the Korean Peninsula, especially to the Haeundae coast.

In order to protect the swimmers from the rip current accidents, Choi et al. (2014) proposed a method for a rip current warning system, and Korea Hydrographic and Oceanographic Administration (KHOA) has established and operated the rip current warning system to the Haeundae beach. The rip current warning system estimates the rip current risk level based on the real-time incident wave conditions measured near the beach and the database pre-calculated by a numerical model according to various wave and tide conditions and the topography of the Haeundae coast. The Boussinesq wave model, FUNWAVE (Wei et al., 1999; Choi et al., 2015) was utilized for resolving the ends of the wave crests. This study showed the performance of the forecast and warning system of the rip current at the Haeundae coast of South Korea.

METHOD

The real-time rip current warning system (Choi et al., 2014) produces a real time sequence of index to quantify the risk and the likelihood of rip current based on the real time observations such as waves, currents, and tide. The index is estimated by using the rip current likelihoods derived from the numerical simulations with various sea conditions, the topography, the parameters of which correspond to the observation quantities, fore example, wave height, wave period, wave direction, wave spectrum (i.e., frequency directional spreads), and tidal elevation. The real-time observations, video image and the rip current warning index were provided to the coast guards at the beach in the form of the web-service (Figure 1) and the short message service.

RESULT

The rip current warning system has been operated for five years since 2012 at the Haeundae beach. The performance was validated by using the observations based on the video camera records. Even though it is difficult to detect all signs of rip current by using the video camera images, most events of large-scale rip currents might be recorded by involving surfzone white bubbles, floaters and victims captured by rip currents. The comparisons between the event time and the prediction time of the system showed good agreements in most cases presenting the large scale rip currents.

Since its performance was proved to be successful, to suffer from the shortage of warning lead time, the rip current forecast was produced by applying the wave forecast to the database of the real-time rip current warning system.

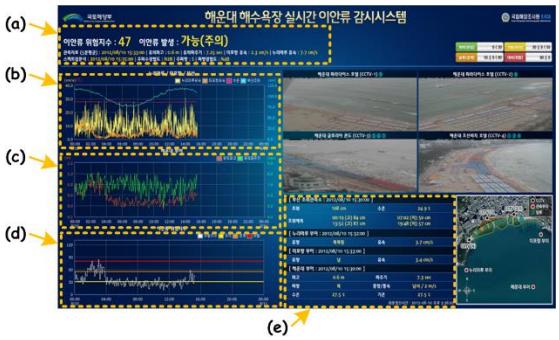

Figure 1 - An example of the web-service of the real-time rip current warning system of KHOA including (a) the summary of observations and rip current index and level, (b) the observed tidal elevation and current velocities, (c) the wave height and period, (d) the rip current warning index, and (e) the other observations (Choi et al., 2014).

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