Title of Paper

Introduction
Fatal coastal damages due to severe storm are often concentrated locally along the shore. The typhoon T0709, for instance, hit the Pacific Coast of Japan and collapsed a part of Seisho highway and seawall within a short span along the long straight stretch of the Seisho coast (Tajima and Sato, 2009). While Seisho coast has long straight shoreline, it has abruptly changing bathymetry along the shore around the Oiso-Spur and measured inundation heights during the storm showed somewhat periodic variations along the shore. The goal of this research is to investigate interactive features of slowly varying wave and current fields and abruptly-changing bathymetry, which may be one of key factors of local concentrations of coastal damages, through unique sets of laboratory and numerical experiments.

Methodology
Two bottom plane panels with different cross-shore slopes were attached with each other and a straight vertical seawall was placed along the shore (Figure1). On this bathymetry, either single periodic or group waves were obliquely introduced. Heights of these waves were determined so that the rms-surface-water-fluctuations of both cases become identical to each other. To capture the locally concentrated hydrodynamic forces, this study newly developed the following image acquisition system that gives high-resolution data of surface water fluctuations and nearshore currents. Water and the seawall were colored in blue and yellow respectively and the surface water fluctuations along the seawall was recorded. Obtained succeeding still images were rectified based on the x-y coordinate system on the seawall and the surface water boundary was automatically detected. A part of the seawall was replaced by a transparent panel through which green thin laser layer was horizontally introduced to capture the horizontal current velocity. A plane rectangular light source was also imbedded on the bottom plate of the milder slope and the time-varying top-view images of the light source were recorded. Obtained images yielded the time-varying local water depth as a function of instantaneous brightness at each pixel.

Numerical experiment was performed to investigate the physical mechanisms of the observed characteristics of the nearshore wave concentrations. In order to explicitly extract the influence of interactive features among short waves, long waves and nearshore currents on local concentration of waves, this study separately computed the short waves and longwaves with nearshore currents respectively by linear mild-slope equations and by non-linear shallow water equations with wave radiation stress and dispersion terms. The wave radiation stress was numerically estimated from the computed results of the short wave computations in which slowly-fluctuating wave heights and corresponding radiation stress was taken into account.

Results and Discussion
Excellent measuring skills of the present image acquisition system was observed through comparisons with the data obtained by conventional measuring devices. Figure 2 shows the alongshore distributions of the measured and wave heights. Primary findings based on all the data sets are: (i) local concentration of the short wave components on the milder slope was observed only in the case of group waves; (ii) the longshore current velocity induced by the periodic waves was about two times larger than the one by group waves; (iii) dominant long wave components were observed only in the case of group waves.

Figure 2 also compares computed results, (B) to (F), in which the mild slope equations accounted for different sets of the influences such as mean or slowly fluctuating surface water level and current velocities. Primary findings through the numerical experiments are: (i) excellent predictive skills of the wave concentration were achieved after several iterations of wave and current computations; (ii) nearshore current has significant influence on determining local peaks of $H_{rms}$; (iii) comparisons of cases D, E and F indicated that slowly fluctuating current velocity also had certain influence on the local concentrations of wave fields while the slowly fluctuating surface water level had little.

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Figure 1 Experimental setups

Figure 2 Alongshore distributions of measured $H_{1/10}$ and measured and predicted $H_{rms}$. Different predictions are when the wave model accounted for influence of: (B) nothing; (C) setup, (D) (C)+mean current; (E) (D)+low-frequency depth change; and (F) (E)+low-frequency current fluctuations.