

Relative effect of wind waves and tidal currents on sediment resuspension in the Saemangeum region, west coast of Korea

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The eastern Yellow Sea is a macro-tidal environment, and tidal currents are known to play a major role in sediment transport in the coastal regions (Hwang *et al.*, 2014). In addition to tide, strong wind waves and wind-driven currents may also influence sediment resuspension and erosion, especially during wintertime when north-westerly winds get stronger. This study presents observation data from the Saemangeum area on the southwest coast of Korea, which demonstrates the temporal and spatial variability in the relative importance of wind waves and tidal currents on sediment resuspension/transport processes. Monitoring programme consists of a month-long continuous measurement on 3 locations using ADCP, pressure sensor, and optical backscatter sensor (AAT TM256-S) on November 2013 (Fig. 1a). Concentration of suspended sediments were measured by both acoustic and optical sensors every 10 minutes, and then calibrated with filtered *in-situ* water samples.

Mooring data show that there exist three distinctive high SSC (suspended sediment concentration) events during the study period (e.g., 10-13, 17-21, and 25-28 Nov.; Fig. 1b). During November, winds were blown mostly from north or northwest, which drives wave propagation toward southwest. Particularly during the events of elevated SSC, wind speeds were higher than 10m/s and significant wave height was larger than 2m. Tidal current speeds were variable during each period, including both flood and ebb as well as neap-spring cycles. The bottommost currents range 0.2-0.6m/s depending on tidal stage and locations. The envelop of tidal currents show a clear trend of fortnight cycle overlaid with several high speed events which are related to high wind periods.

SSC in the bottom boundary layer (~1 m above the bed) showed several episodic events, which were clearly correlated with high wind and wave periods (Fig. 1b), that is consistent with other studies in the eastern coastal zone of Yellow Sea (Lee *et al.*, 2004; Lee and Ryu, 2008). The high SSC events occurred only during the wind speed >10m/s and the significant wave height >2m, which could be considered as critical threshold condition for initiation of resuspension. The highest SSC peak on the PC1 station was observed during the condition of strongest wind period (>15m/s during 11/25 event). It is not surprising to conclude that the resuspension is mainly controlled by wind waves, especially offshore regions of the study area. In such area of >10m water depth, resuspension might be dominated by waves even without the aid of tidal currents. Otherwise, the combined effect of wave and currents is necessary to initiate resuspension.

On the shallower station, PC3, however, the SSC was highest during 11/17 event when the wave height was medium but tidal currents were larger than other events, due probably to spring tidal condition. It indicates that tidal currents could be equally or more important to make sediments resuspended, particularly in the shallower region. Under the similar wave condition of ~2m wave height, SSC during spring tide (11/17) was higher than neap (11/10) on all three stations. Another supporting evidence for the importance of tidal currents on resuspension is that while elevated SSC occurred immediately after increase in wave height during neap, during spring tide SSC was increased after currents velocity was higher than 0.2m/s even under high wave condition (>2m). In addition, the tidal cyclicity of SSC, which is more prominent during spring condition, was almost neglectful during neap.

Even during a single event, the relative importance of waves and currents effect on resuspension occurs in different patterns for different regions. During 11/10 event (neap tide, medium-high wave condition), for instance, the resuspension event was related more to wave activity on PC3 (southern shallow station) while elevated SSC event seemed to be correlated to increased current speed rather than wave offshore station (PC1). Under the wave condition of larger than 2m height, the period of elevated SSC corresponded to approximated 0.2m/s of current speed on PC1.

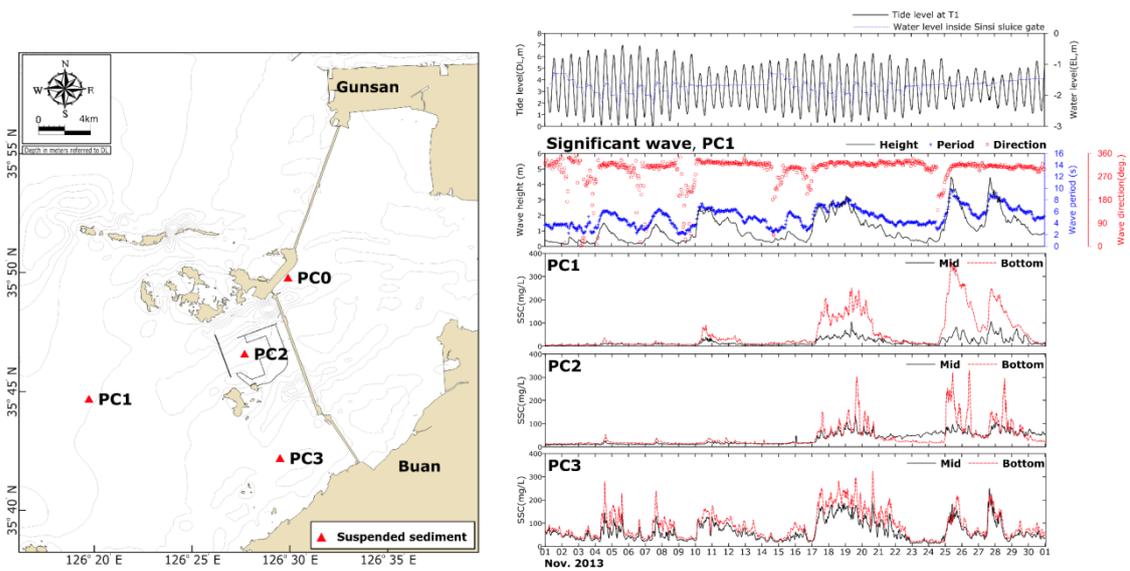


Fig. 1. (a) Study area and 3 mooring locations. (b) Time series of tide level, wave height, direction, and period, and suspended sediment concentration.

References

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