



Controls of channel morphodynamics on the intertidal dune morphodynamics and associated bedload transport in the open-coast macrotidal flats

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Intertidal dune morphodynamics is closely tied to bedload transport that is variable in time and space due to the interplay between tide, wave and runoff discharge. Surprisingly the control of intertidal channel morphology on the dune morphodynamics and related bedload transport is scarcely documented. Actively migrating dunes are widely developed in the lower intertidal zone of Yeochari tidal flat in the northern Gyeonggi Bay, west coast of Korea. High-resolution aerial images, high-precision transect profiles, and hydrodynamic dataset were repeatedly obtained and analyzed to quantify the intertidal dune morphodynamics and associated bedload transport, and to address the role of channel morphodynamics. During the research period, the intertidal channel became more sinuous and an ebb barb arose concurrently at the upstream of the channel point bar. The ebb barb exerted a key role in the downstream delivery of fine-grained sediments onto the areas covered by dunes and the intertidal channel by reinforcing ebb currents with a pronounced time-velocity asymmetry. The presence of the ebb barb resulted in a rapid decrease of the width/depth ratio of the channel that had migrated laterally 130 m in six years. After the ebb-barb development, the heights and steepness (height/wavelength) of dunes on the point bar and near the ebb barb decreased notably. Simultaneously dune migration rate had increased from 0.5 m/day to 2.5 m/day, which decreases away from the channel. Bedload transport estimated by using Meyer-Peter and Muller (MPM) equation and Dune-Tracking Method (DTM) also decreases away from the channel. Bedload transport calculated by DTM (qb_{DTM} , 0.03-0.38 m²/day) is much smaller than that estimated by MPM (qb_{MPM} , 0.10-4.17 m²/day) by a factor of 1.5 to 62. The discrepancy ratio between the two bedload estimates (qb_{MPM}/qb_{DTM}) increases toward the channel and the ebb barb. Downslope flow toward the channel during the late stage of ebb tide may account for the underestimation of qb_{DTM} by facilitating downslope sediment transport that reduced the dune steepness with the infilling of dune trough. The present study showcased a dynamic response of the dune morphodynamics and associated bedload transport in the open-coast tidal flats to the changes in the channel morphodynamics that is controlled by seasonal runoff discharge as well as tidal currents.