Beach profile changes around a wave-dominated tidal inlet entrance

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EXTENDED ABSTRACT

INTRODUCTION
Tidal inlet is an opening in a beach face which is mostly controlled by tidal forces and exhibits periodic exchange of water between an inland water body and the ocean water. The second important features of a typical tidal inlet system are offshore and/or inland deltas. The excess sediment accumulation at these deltas, which sometimes fully blocks the natural passage of water, is one of the common issues of a tidal inlet entrance. The so called excess sediments can be provided by different sources; for instance littoral drift, beach washover materials, unsuccessful beach nourishment and so on (Castelle, 2007).
In this study, parts of the results of an extensive filed measurement to explore the dynamics of the Currumbin Creek (Figure 1) are presented and the changes in the beach profile around the creek are considered for detail investigation. Currumbin Creek entrance is one of the highly popular tourist attractions in the south-eastern Queensland, Australia which also had a very old history of maintenance operations. In the past 30 years, there has always been annual dredging campaigns to keep the creek entrance open. Nevertheless, the entrance became shoaled, soon after each dredging.
The inlet entrance is mostly located in the east-west direction. At the immediate inland side of the entrance channel, a lagoon is situated which also hosts the inland (flood) shoal (delta). This shoal is the main focus of the annual dredging work and it is believed to be the main reason for making navigation difficulties (Strauss, 2011). The effect of littoral drift, sediment bypass and erosion of the adjacent beaches were proved to be significant in making spatial changes of the ebb and flood shoals (D’Agata, 2002). However, this is also hypothesized in this research that the shore faces of the lagoon and the creek can, likewise, have a share in providing the sediment supply.

Figure 1. Currumbin Creek aerial photo (Copyright: GCCC 2011/03/25)

METHOD

From the entire 5km of the surrounding beach, the measurements were just limited to some 141 particular lines which were surveyed from Dec. 2012 to Mar. 2013 in a weekly manner. Each line was perpendicular to its local shoreline, extending from the dry part of the beach to a depth (normally) 0.5m lower than the lowest low water mark. Every single line also divided to couple of subsections (based on any abrupt changes in elevation or just a maximum section length of 7m), at each end of that, the coordinates and elevation were measured. In terms of environmental forces, during this period there were a number of sever stormy wave incidents and also a very long and heavy rainy period. Based on recorded data available from Australian Government, Bureau of Meteorology (2013), the total amount of rainfall during the measuring period were about 55% of the total 2012 rainfalls. Also the highest significant wave height ($H_{s,max}$) and the longest storm period (incoming significant waves exceeding 3m) are derived to be about 7.5m and 48hrs.

RESULTS AND DISCUTION

In total, about 54100 points have been collected during 16 weeks of data collection with the total length of all surveys as about 134 km. Figure 2 shows profile nos. 33 and 43 as samples. For better distinction, only data of week 1 and other even weeks are presented. Although some profiles show build-up of beach material by time (like no. 33), there are others which show massive erosion (like no. 43). Comparing profiles in group of 3-4, also suggested that whether lost materials of a profile were added to the consequent lines or even just transferred offshore to the main littoral process. It is also concluded that all lines around the entrance channel exhibited erosion. In contrast, most lines around the lagoon, showed a slight build-up (except for those which were subjected to nourishment). The lines, more upstream the creek (which also contains cohesive materials), were about the same during the measuring period.

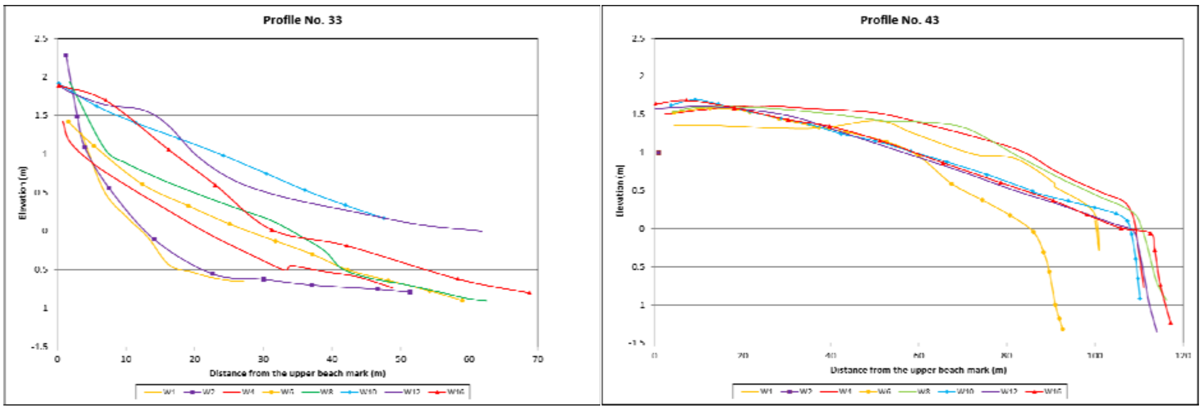

Figure 2. Elevation changes along profile nos. 33 & 43

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