

Modelling study on the sediment dynamics and the formation of the flood-tide delta near Cullendulla Beach in the Batemans Bay, Australia

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The first 3-D current-wave-sediment coupled model of the semi-exposed estuary Batemans Bay, New South Wales, Australia, was developed in our study based on the Finite Volume Coastal Ocean Model (FVCOM). Our study explored the hydrodynamics, sediment dynamics and morphology change inside the Batemans Bay under large wave events. The modelled monthly-averaged residual flow, sediment flux and suspended sediment concentration with a combined tidal and wave forcing in the inner bay were significantly different to those only with tidal forcing. Storm wave events can generate wave-induced currents and large bottom stresses, influencing the sediment transport. The morphology change of the flood-tide delta (FTD) inside the Batemans Bay under wave effects was also investigated in this study. A FTD is a sediment deposit located on the landward side of tidal inlets, formed by the incoming tidal currents and ocean waves, which is an important morphology coastal feature influencing the sediment exchange with adjacent beach systems. Yet, the dynamic processes of FTDs have not been fully understood and explored quantitatively in sheltered estuaries. Based on the model results, the FTD near Cullendulla Beach is controlled by wave effects and was in an equilibrium status: when the FTD was eroded deeper to a critical value (about 2 meters) by waves, sedimentation occurred. The rocky headland adjacent to the FTD contributed to the formation of the FTD due to sheltering effects. An important result of the study is: the FTD actually developed at the 'wave shadow areas' behind the headland in Batemans Bay, which were dominantly controlled by sheltering effects. Despite being termed a 'Flood-Tide Delta', 'Tide' here is misleading, and a new name of 'Wave Shadow Shoal' should be given to describe such wave-dominated coastal features. In conclusion, this study demonstrated that waves played the dominant role in the hydrodynamic processes, sediment transport and morphology change in Batemans Bay.