Spring-neap variations in sediment trapping in tide-dominated estuaries

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In many estuaries, subtidal variations in the suspended particulate matter (SPM) concentration and the estuarine turbidity maximum (ETM) are observed on the spring-neap timescale (Allen et al., 1980). The formation of these ETM is typically understood as convergence of tidally-averaged sediment transport. However, this is only true for constant subtidal conditions. On the spring-neap timescale ETM follow from a more complex and dynamic interplay between sediment transport processes on the short tidal timescale, the timescale associated with the spring neap cycle and temporal variations of the bottom pool (Burchard et al., 2018).

To model the influence of the spring neap cycle on the water motion, sediment transport and trapping, the width-averaged process-based idealised model described in Brouwer et al. (2018) is extended to include the spring-neap variations in the tidal forcing by using a two timescale approach. The fast timescale is related to the tidal period of a typical semi-diurnal tidal constituent and the slow timescale to the beat frequency that results from the interactions of the M_2 and S_2 tidal components. As a result, the one-fraction SPM dynamics also depends on the two timescales. For the dynamics of the bottom pool we only allow for temporal variations on the long timescale by averaging the bottom pool dynamics over the short timescale.

In this study, we systematically analyse the differences between ETM formation including/excluding the spring neap timescale. We illustrate that the ETM location does not have to correlate with the location of convergence of the tidally averaged sediment transport during part of the complete spring-neap cycle. The results will be explained in terms of the relative importance of and variations in the various sediment transport contributions during the spring neap cycle, and the associated sediment pool dynamics. Furthermore, the sensitivity of these results to various parameters, and specifically the erosion parameter will be discussed in detail.

Reference

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