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# Tide-driven dynamics of ephemeral fluid mud deposits in troughs of large, subaqueous dunes in an estuarine turbidity zone

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Near-bed density stratification due to suspended, fine-grained cohesive sediments and the formation of fluid mud layers are frequently observed in tide-dominated estuaries. Significant progress was made during the past years in terms of the description and parameterization of fluid mud related sediment transport processes. However, only few studies present in-situ measurements of the spatiotemporal distribution of estuarine fluid mud deposits. Due to the tidal excursion, settling of cohesive sediments during slack water and the formation of fluid mud is also expected to occur in tidal channels, located upstream and downstream of the tidally averaged location of the estuarine turbidity zone and characterized by coarser bed sediments and mobile bedforms. In the Weser estuary (Southern North Sea, Germany), high resolution sediment echo sounder and acoustic Doppler current profiler measurements revealed ephemeral fluid mud deposits in troughs of large, ebb-directed, subaqueous dunes during flood slack water. The spatial distribution of fluid mud deposits correlated with the location of the turbidity zone, shifted upstream during the flood phase. Density stratification, induced by the accumulation of suspended sediments in dune troughs, was initially observed 1.2h before flood slack water. Sediment concentrations in the fluid mud layer ranged from 25g/l below the lutocline to a maximum concentration of 70g/l at the river bed, validated by Rumohr-type gravity coring. During the early ebb phase internal waves were observed as current velocities exceeded 0.2m/s, measured 1m above the lutocline. Fluid mud remained in dune troughs for approximately 2h after slack water and was not entrained until current velocities exceeded 0.45m/s. According to the local gradient Richardson number, calculated on the basis of average current velocities, the corresponding density gradient was stable with respect to shear instabilities during entrainment. Entrainment of fluid mud is explained to be induced by the development of the dune specific turbulent flow field downstream of the dune crest and advection of strong turbulent stresses in direction of the lutocline. Indicating high suspended sediment concentrations near the bed, lutoclines were observed for 3.5h during the tidal cycle around slack water. The associated fluid mud deposits are considered to affect the grain size distribution in dune troughs in terms of matrix infilling and the formation of mud drapes, embedded in cross-strata as found to be preserved in the sedimentary record.