



Intra-tidal variability of the vertical current structure in the western Dutch Wadden Sea

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Long-term velocity measurements are presented which were collected during three different seasons at one single location in an estuarine basin of the western Dutch Wadden Sea. These data are used to investigate the processes that determine the variability of the vertical current structure in the western Dutch Wadden Sea, in combination with simplified model runs using the one-dimensional water column model GETM (<http://www.getm.eu/>).

Jay and Musiak [1996] were the first to suggest that intra-tidal variations in the vertical current might be important in determining the residual circulation patterns. More research [e.g. Stacey et al., 2001; Burchard and Hetland, 2010] has supported this hypothesis. Recently, lateral processes have been shown to influence the vertical current structure of alongstream velocity and hence the residual circulation [e.g. Lerczak and Geyer, 2004; Burchard and Schuttelaars, 2012]. Therefore to better understand the tidal dynamics in the western Dutch Wadden Sea, it is crucial to understand the processes that determine the vertical current structure.

The two main findings of this study are that the complex bathymetry at the study site seems to produce an intra-tidal asymmetry in near-bed velocities and secondly that cross-stream processes strongly modify the current structure during late flood. Near-bed velocity and the bed roughness are greater during ebb than during flood. The GETM simulations suggest that vertical mixing during ebb is sufficient to destroy vertical stratification generated by classical tidal straining. The cross-stream current during late flood generate vertical stratification and drive an early reversal of the flood current near the surface. Therefore, it is hypothesized that this processes might increase the residual estuarine circulation at the study site.

References

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