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Investigating processes of stratification and de-stratification in a high resolution model of the German Bight

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Insight into processes contributing to the onset and breakdown of stratification enhances our understanding of the ecosystem dynamics of shallow seas. In the German Bight, a region of freshwater influence (ROFI), stratification is mainly influenced by tidal mixing, fresh water river inflow and wind forcing. The physical regime of the German Bight in the ROFI region switches between stably stratified to semi-diurnal stratification. In order to investigate the processes contributing to this variability, a three dimensional high resolution numerical model is setup based on the General Estuarine Transport Model (GETM). The model has a horizontal resolution of 300 m in the inner German Bight and incorporates 30 vertically adaptive layers.

The model results are first compared against observations, showing that the model is able to reproduce the observed physical regime. The model results are then used to calculate the terms in a dynamic equation for the potential energy anomaly (ϕ). These terms include the horizontal advection, depth-mean straining, non-mean straining, vertical advection and vertical mixing. The contribution of these processes to stratification is assessed under different conditions in the ROFI region. The results show that in the semi-diurnal stratification condition, the depth-mean straining and horizontal advection terms are the most important processes. Both of these processes are in phase leading to stratified conditions during low water and mixed conditions during high water. On the other hand, in the stably stratified condition, vertical advection is as important as depth-mean straining and horizontal advection. In this condition, the depth-mean straining and horizontal advection are out of phase and therefore oppose each other, while the depth-mean straining and vertical advection are in phase. This results in minimum stratification (minimum ϕ) occurring at maximum ebb and maximum stratification (maximum ϕ) occurring at slack after ebb (low water).