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Using the potential energy anomaly equations as a new diagnostic tool for coastal ocean modelling

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A new diagnostic tool is presented that is suitable for studying the processes contributing to stratification and de-stratification in coastal ocean models. First we present the potential energy anomaly equations suitable for the analysis of three-dimensional numerical models. Then we apply this equation to an idealised numerical model simulation of the Rhine Region of Freshwater Influence (ROFI) to examine the roles of wind driven upwelling versus upwelling induced by tidal straining. The principal terms discussed here are cross-shore and alongshore straining, cross-shore and along shore advection of density gradients, horizontal mixing terms in the cross-shore and alongshore directions, a term describing the effect of vertical mixing on the density profile and a term related to up and downwelling. The example presented here is an extension of work recently published in Ocean Modelling and further demonstrates how we can use the potential energy anomaly equation to analyse the physical processes affecting stratification, in this region of freshwater influence (ROFI). The potential energy anomaly equation allows us to present a detailed overview of the spatial distribution of the terms affecting the evolution of stratification in the Rhine ROFI. This provides a powerful tool with which to analyse the mechanisms contributing to mixing and stratification in coastal seas and estuaries.