



On the effects of curvature on mixing and secondary circulation in a partially stratified estuary

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In this modelling study we examine the effects of curvature on the estuarine dynamics and in particular on secondary flows and mixing. The general effects of curvature are demonstrated by a comparison between experiments with two idealised trumpet-shaped estuaries, one straight and another one with a small meandering section. The meanders increase the mixing locally within the water column. Even outside the meandering section flow and flow structure are significantly altered. It is demonstrated that the curvature transforms some portion of the along-channel momentum to the secondary circulation. With the help of the lateral momentum equations in a curvilinear coordinate system we examine the generation of the secondary circulation due to the interaction of the driving terms in the lateral momentum equations. An EOF analysis of the forcing terms demonstrates that the combination of forcing terms tends to form a few modes that drive the secondary circulation. This framework has finally been applied to three profiles of the lateral forcing terms sampled from realistic model results of the Ems Estuary. Although the complex bathymetry increases the complexity of the secondary flow, similar patterns as in the case of the idealised estuary are dominant.