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Resonant Trapped Internal Waves in a Partially Mixed Estuary

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Small scale topography is a common feature of estuaries and coastal seas. The flow of a stratified fluid over such small scale topographic features may generate significant internal wave activity. While much attention has been paid to internal lee waves, trapped internal waves generated by the flow of stratified fluid over a series of bed waves have in comparison received far less attention. Field surveys of a partially mixed estuary, the Rotterdam Waterway, revealed a spectacular series of resonant trapped internal waves with amplitudes of 3-4 m in an estuary with a mean depth of 16 m. The waves were analysed analytically with stationary linear and finite amplitude theories. While such an approach can be used to explain the presence of these waves both the time dependence and the non-linear behaviour of these waves needs further investigation. With the development of advanced non-hydrostatic models it now becomes possible to further investigate these waves through numerical experimentation. This is the focus of the work presented here. The non-hydrostatic finite element numerical model FINEL was used in the experiments presented here. The model has recently been validated against linear internal wave theory and laboratory experiments of internal lee waves. We present some of these results and then use the model to investigate the effects of non-linearity and time dependence. Finally we consider the importance of resonant internal waves for turbulence production in stratified coastal environments.