

Salinity-induced stratification impacts tides in estuaries

Authors: R.W.A. Siemes ^{a b}, S.J.M.H. Hulscher ^a

Abstract

Salinity-induced stratification is common in estuaries, yet its effect on tidal propagation is not systematically quantified and depth-averaged models generally neglect it. Using idealised numerical simulations across well mixed, partially mixed, and salt-wedge regimes, we show that stratification suppresses turbulence and reduces effective bed friction, weakening tidal damping and allowing tides to penetrate farther upstream. Stratification induced partial reflection at the landward salt-intrusion limit further amplifies tides, locally increasing tidal ranges by ~30% in salt-wedge estuaries. Depth-averaged models can reproduce these effects through reduced roughness. Results highlight the critical link between salt dynamics and tidal water levels with implications for flood-risk management.

Keywords

Tidal propagation, salinity stratification, salt-intrusion, tidal amplification, numerical modelling, flood-risk

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