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A two-dimensional analytical model for tidal wave propagation in convergent estuaries

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A knowledge of tidal dynamics in large-scale semi-closed estuaries, such as the Bay of Fundy, the Gulf of California, the Adriatic Sea, is very important since it affects the estuarine environment and its potential use of water resource in many ways (e.g., navigation, coastal safety, ecology). To obtain insight into physical mechanisms on tidal wave propagation in such systems, analytical models are invaluable tools. It is well known that the analytical solutions for tidal dynamics in semi-closed estuaries can be obtained by Taylor's method, where a cooscillating tide can be described as a superposition of an incident Kelvin wave, a reflected Kelvin wave, and Poincare waves. However, the method is usually limited to special conditions, e.g., prismatic channel with uniform depth, negligible friction etc. In this study, we extend the one-dimensional linear solution for tidal wave propagation in convergent estuaries to the two-dimensional case, explicitly accounting for both the channel convergence (width and depth convergence) and friction.