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Exact edge waves and stratified flow

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Since their discovery by Stokes some 150 years ago, edge waves have gone from being a mathematical curiosity to the subject of great interest in nearshore wave dynamics. Though initially their experimental detection was difficult, they have since been seen to play a potential role in such coastal processes as the formation of beach cusps, crescentic bars, and the spacing of rip currents; furthermore, tsunami-generated edge waves have been recently detected in real time. Though classical models of edge waves rely on linearisations of the water wave equations, a remarkable extension of the Gerstner wave solution to the full nonlinear governing equations was shown to represent edge waves along a sloping beach, an observation rigorously established by Constantin in recent years. We consider this explicit edge wave solution and compare it with the classical subharmonic edge wave solution. We show that, by virtue of the special structure of the Gerstner flow, these edge waves are possible in water of arbitrary density stratification.