

Introduction

I need to model wave driven nearshore currents. I'm interested in the undertow generated by shore-normal wave approach. For this purpose I used a real beach profile configuration and applied a shore-normal wave at offshore boundary of the domain. I focus on stationary analysis ($instat = 0$).

For this situation the computations yield a nil Lagrangian current $u = 0$. A current that possesses some undertow characteristics is an Eulerian current ue , which is a mirror reflection of Stokes drift uwf . In my view though, it is not a genuine undertow, because it has no component resulting from wave breaking (that is a current resulting from radiation stress gradient).

The same conclusion can be drawn by theoretical analysis of the governing equations. Let us consider the continuity equation (GLM):

$$\frac{\partial \eta}{\partial t} + \frac{\partial hu^L}{\partial x} + \frac{\partial hv^L}{\partial y} = 0.$$

The first left hand term is nil, because the studied case is stationary. Also, the third left hand term is nil, because there is no alongshore variability. Thus, the following term remains:

$$\frac{\partial hu^L}{\partial x} = 0,$$

which is true for variable bathymetry only in case when u^L is nil. This confirms results of computations, where the Lagrangian current u was equal to zero.

Questions

Does this mean I make a mistake in my settings (params file)?

Does it mean XBeach is unable to model the undertow containing the effects of Stokes drift and wave breaking driven flows?

How should the undertow be modeled?