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Ocean Science
Discussions

Interactive comment on "Three-dimensional modelling of wave-induced current from the surf zone to the inner shelf" *by* H. Michaud et al.

Anonymous Referee #1

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This paper presents an implementation into a 3D numerical ocean model of a new formulation for wave-current interaction. The method is described and several test cases and a realistic application are presented. The manuscript is clearly written and organized in a well-defined manner. The incorporation of wave-current formulations and the need for model coupling is recently being demonstrated as an important aspect of ocean modeling. Several formulations for wave-current interactions have recently been developed in the literature, with several recent works identifying deficiencies in many of these methods. This present manuscript presents an implementation that holds promise for the conservative wave-forcing components, however, many of the non-conservative aspects still require parameterizations that need further investigations. The paper presents test cases that have been established in the literature and then applies the methods to a realistic case.

Some general comments: 1) The presentation of the momentum equations is in two forms. First, a non-conservative form that cleanly separates out the vortex force (VF) terms, and secondly a conservative form that is more consistent for numerical implementation but does not clearly separate the VF terms. For future use, if a momentum balance is performed it needs to be clearly identified if the balance is using the specific forcing terms or the conservative approach.

2) Turbulence closure ? is rather weak approach these days. Suggest developers code in a two equation model or link to GOTM. It has been shown in relatively recent literature that these 1.5 level models are not correctly characterizing the turbulence length scales.

3) The modeling system is characterized as using a new version of WW3. Is WW3 able to be redistributed openly? If not, why was this wave model chosen?

4) Figure 1b- why does the cross shore depth-averaged velocity fall off quicker than the analytical solution?

5) p. 2433 lines 16: should this be ?as shown in section 3.1.2? not 4.1.2?

6) Figure 3: not very obvious what is being shown here. Can we see the important terms of the momentum that actually balance?

7) section 3.1.2 ? maybe you need a better turbulence closure model.

8) p.2437 line 18, rip current test case ? It seems that you really cranked up the bottom friction term here. Are the rips oscillatory, or heavily stationary? They can still oscillate, as that represents correct physics, and then take an average.

9) p. 2438 line 15-18: These test cases were for very shallow flows. May not be adequate for deeper water applications.

10) Figure 14: difficult to really see the comparison. maybe the figure needs to be larger.

11) Figure 13: text says on line 1-2 p. 2447 that the currents are stronger with the wave forcing than without. But the right middle panel has weaker currents with the wave forcing.

12) the discrepancy is suggested to be caused by the (p. 2447 line 14) "underestimation of the wind speed." But text on p. 2443 line 7 says "... the Aladin model is in reasonable agreement with the data ..." Please clarify. Also, the figure 10 for wind speed does not show an underestimation of the wind speed.

13) p. 2448 line 15 " a perspecitve of this study could be to fully couple wave and circulation models..." So was this simulation fully coupled?

14) Figure 13: text could provide some guidance as to what processes are driving these large currents. In the surf zone, is it predominately the Bernoulli head or wave breaking dissipation forces?

Interactive comment on Ocean Sci. Discuss., 8, 2417, 2011.