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Interactive comment on "Modelling of sediment transport and morphological evolution under the combined action of waves and currents" *by* Guilherme Franz et al.

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We are grateful to Dr. Fortunato for his comments and contributes to the manuscript improvement. The manuscript was thoroughly revised to address the referee comments. Our answers to the main questions raised may be found below. Other smaller corrections were performed directly on the manuscript (new manuscript attached as supplement file).

In this manuscript, we introduced an overview of some publications that were important to this work and could guide the reader to a better understanding of the main topics discussed. A complete literature review was out of the scope of this manuscript. A recent publication that gives more details about the model development and differences to other models was cited in the manuscript (see Franz et al., 2017).

Roelvink et al. (2009) used a slope delimiter to consider the erosion of dunes on beaches (avalanching mechanism). In our work, we implemented a similar approach to account for the neglected forces in 2DH models (e.g., undertow), allowing sediment transport seaward and avoiding excessive bed slopes (this is explained in section 3.3). The method was implemented in the MOHID code in terms of mass evolution, in order to be applied in the future considering multiple sediment fractions. This approach also permits to consider the shoreline evolution. The fact that other authors have used the same approach for simulating tidal inlet migration was unknown by the authors. The references of Nahon et al. (2012) and Fortunato et al. (2014) were added to the manuscript. In order to demonstrate the importance of the bed slope correction, bathymetry results of a simulation without considering this mechanism was added to the manuscript (Fig. 1), as suggested by the referee.

The approach adopted in this work, by defining a maximum slope that when surpassed generates sediment transport in the downslope direction, affects only individual cells instead of the entire beach profile. Other models consider the extrapolation of the erosion and deposition fluxes over the entire beach profile. In this case, the bathymetry and shoreline position are updated by defining an invariant equilibrium profile. Thus, the approach adopted in this work is more appropriate to consider the effect of grain-size sorting along the beach profile.

The coupling between the MOHID modelling system and the SWAN wave model was performed through tools developed in the Fortran language in order to convert the results to the appropriate format (section 3.4). This means that the coupling between models was performed by files transferring. An external tool was developed in Python language to automatically manage the runs of the tools and models. At this time, we have focused on model results instead of numerical efficiency, which is a suggestion for future work. However, considering the domain decomposition parallelization approach implemented using MPI directives and the morphological acceleration factor, the computational time required to simulate the presented test cases was feasible through the use of a regular computer with 6 cores.

Explicitly resolving the advection-diffusion equation for suspended sediment leads to more realistic transport results and smoother bed evolution, as the suspended load is not in equilibrium with the instantaneous bed shear stresses in unsteady flows. The net upward flux of suspended sand depends on the equilibrium concentration near the bottom, estimated by empirical equations available in the literature, extrapolated to the middle of the near-bed layer following the Rouse profile, which in 2DH mode means the middle of the water column. The adopted methodology was described previously in Franz et al. (2017), converging for different numbers of vertical layers. The differences obtained in 2DH or 3D mode should be stressed in simpler test cases to avoid the influence of other mechanisms of sediment transport (e.g., undertow), which would not allow a clear conclusion. Thus, this aspect should be investigated in future studies.

The MOHID modelling system is coupled to the General Ocean Turbulence Model (GOTM) for the vertical turbulent closure (e.g., K-ε model). Effects of wave breaking on vertical turbulence can be taken into account through surface boundary conditions (Delpey et al., 2014). This mechanism was disregarded in this work, as the idea here was only to provide an approximate representation of the vertical distribution of wave momentum, in order to generate a general undertow pattern. Thus, the corresponding results should be considered as a first qualitative evaluation of the effect of such an undertow in our morphological model, the latter being our focus here. It is left for further work to use a more advanced formulation of 3D wave-current interactions for more quantitative investigations.

The lateral friction can be computed in MOHID considering a null tangential velocity when the cell face is not covered (Leitão, 2003). The slope effects are included in the bedload formulation (see Franz et al., 2017). Alternatively, the bed slope correction was used to represent the seaward sediment transport due to undertow currents, which cannot be simulated by 2DH models.

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Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/os-2017-8/os-2017-8-AC1-supplement.pdf

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