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Interactive comment on "Different approaches to model the nearshore circulation in the south shore of Oahu, Hawaii" *by* Joao Marcos Azevedo Correia de Souza and Brian Powell

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Anonymous Referee #1

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General remarks:

This paper examines output from regional waves and circulation models of the south shore of O'ahu, Hawaii, for two typical scenarios. SWAN and ROMS are used to model the flow and wave fields, respectively, and their outputs are described in isolation, and when the models are coupled in a variety of ways, i.e. one- and two-way coupling. This way the differences due to wave-current interactions are described. The focus is

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on the difference in near shore processes in the region. The paper also discusses the operational suitability and feasibility of the different approaches. I think the paper could be better structured to help the reader understand the content. One way to do this could be to have a model validation section, before the results, detailing the validation of the models, i.e. the separate SWAN and ROMS models. It would also help if Sections 3.1 and 3.2 could be split up further. I was struck by the absence of validation of the ROMS model. I understand that the currents model cannot be validated to the extent that the waves model is in the paper, due to the scarcity of data. But, is there not even any water elevation records within the fine scale domain that could be presented, to show that the phase of the tide etc. is correct? It would be useful to have some presentation of the baseline spatial variability of the wave parameters, such as Hs and Tp and wave direction, i.e. in the format of Fig. 4. This would allow the reader to gain some idea of the typical conditions, before being presented with the differences between the models (Fig. 4). Following on from this the differences in significant wave height (Hs) of around 0.5 m presented for Keehi Lagooon seem quite large for a “stagnant region”. If this is the difference between two models, then what would Hs predictions be for each individual model? I found the use of the phrase “experiment” in relation to modelled scenarios a bit strange. You could consider using “scenario” instead, but I understand this is probably a question of style and personal preference. In Section 2.1 some more details of the tidal boundary forcing should be provided. For example, does the tidal forcing simply compose of waters elevations along the boundary, or are tidal velocities through the water column also used? Do the outer models (which this model is nested in) also provide tidal boundary forcing, i.e. are the models tidal, or has the tide been removed from the output of these models? Given that the forcing from the outer models is provided every 3 hours, I assume that they have no tide in them, but this should be clarified in the text.

Author: First we would like to thank the reviewer for the precise and complete review of our manuscript. We made a few changes to the manuscript structure, adding a subsection on model validation where we bring some information on previous efforts

to evaluate the model system results. Unfortunately, there are no observations to the best of our knowledge on the near shore circulation in O'ahu. The only water level measurement is obtained inside the harbor channel – that is not properly resolved by our model – and can not be used for validation. Since the outer grid assimilate High Frequency Radar surface velocities in the vicinity of the near shore domain, the currents provide as boundary conditions have very small phase shift (∼5min) in relation to the real measured currents. Due to the small domain covered by the inner grid, we believe there will be no significant change in the phase – although we cannot prove it without observations. A more detailed explanation on how the model include the tides is given. A new figure (Figure 2) was included presenting the baseline of wave conditions as measured by the Kilo Nalu observatory. The Keehi Lagoon is not the focus of the present analysis and was removed from the figures. That said, we believe our model didn't resolve the complete geography and bathymetry of the Lagoon and the interaction of the tidal currents in the channels with the wind waves.

Specific comments:

Page 4, line 17: It sounds like you are using a curvilinear grid. If this is the case please indicate this in the text.

Author: The grid is rectangular rotated to fit the shore orientation. Page 4 – Lines 19 to 22

Page 4, line 21: Regarding the percentage of the grid being deeper than 50 m, and it being deepest at the southern boundary. How deep is the model at the southern boundary?

Author: It varies. The deepest part in the southeast is 300m – and it decreases fast towards the cost as shown in Fig. 1. Page 4 – line 25

Page 4, line 23: This text makes it sound like the ROMS model is forced with surface gravity waves. I understand the SWAN model, which is described later, to be the waves

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model for all the simulations. This needs to be explained here, as it is confusing to the reader.

Author: We modified this paragraph to make it clearer. In reality the ROMS does not receive waves boundary conditions - only SWAN. The WAVEFORCE ROMS simulation is forced with surface waves from an independent SWAN simulation. While in WAVECOUPLE the models are coupled. Page 4 - line 29

Page 5, line 1: I don't understand how tidal forcing can be imposed as a "separate spectral forcing". This should be further explained, as I don't think this kind of forcing is that common. Do you mean harmonic forcing, i.e. tidal harmonic constituents are used to force the tide?

Author: A complete explanation is given. The barotropic velocities and water level are given at the boundary, as well as tidal potential in each grid point. Page 5 – lines 8 to 13

Page 6, line 30: please explain why this assumption about the wave field is necessary

Author: This is not a necessary assumption – just the way the model system and in particular SWAN works (SWAN = Simulating Waves NEARSHORE). In reality, there are efforts to couple ROMS to other models without this limitation. The fact is that close to the shore this is a reasonable approximation. But if one goes to deep water the influence from several different swells coming from different directions should be taken into account.

Page 7, line 13: This sentence doesn't really make sense. You mention the difference between the wave parameters, but these differences haven't been presented yet, and you do not explain how these differences don't impact the model solution, or what this means. It is also not clear what the times in brackets are indicating.

Author: Thank you for point this out. There was a problem with the phrase formulation, that was corrected – we were referring to the communication time step between

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models. Page 7 – line 28

Page 7, line 18 – page 8, line 2: This is a description of the validation of the waves model. You could consider having a separate subsection detailing the validation in order to help structure the paper a little more (see earlier comment about paper structure). It appears to me that these model results are from a SWAN only run, is that correct? This should be made clear. One way to do this would be to introduce another 'group of simulations', i.e. (4) WAVEONLY or similar.

Author: Yes, the evaluation of the wave is made on a SWAN run. This correspond to the WAVEFORCE simulations – where SWAN is run separate from ROMS. Page 8 – lines 3 to 23

Page 7, line 31 – page 8, line 2: Regarding the model representing the typical multi-modal wave conditions. I don't understand how this can be deduced from the results presented so far can, i.e. a comparison of wave parameters with measurements (Figs 2 and 3). I understand multi model seas to be hard to represent with parameters such as peak period, and that an analysis of the wave spectrum is necessary. Could this be done? Or could more of an explanation about how you came to your conclusion be provided? It would also be useful for the multi-model nature of experiment 1 to be mentioned earlier, in section 2.4.

Author: We were referring to the comparison with NDBC buoys we described earlier in the same paragraph. We modified the text to make it clearer. Page 8 – lines 5 to 7

Page 8, line 3: You should supply results / evidence to support this statement, i.e. introduce Fig 4 here and say how this shows this. Fig 4 shows how Hs is lager, but there's not presentation of wave periods.

Author: We added this result to the old figure 4 (now fig. 5). Figure 4

Page 8, line 23: You mention that 20% higher Hs if considering the whole domain. Is this because of the contribution at Keeki Lagoon?

Author: This was removed since we do not trust the results in Keehi Lagoon. Our model does not resolve the intricate channels that connect the lagoon to the ocean, with tidal plains. There are strong tidal currents in the model results of the lagoon, that should influence the Hs in the coupled runs.

Page 8, line 29: You mention the return flow area in the middle of the beach. It is hard to discern the beach in the figure. I can see an area of no change in Hs, and this must be this section of the beach. It would be useful to have the extent of the beach indicated somehow; maybe in Fig 1 if that's easier.

Author: We changed the phrase to refer to the small bay formed by the beach – that can be seen in the figures. We though this to be a better approach, since the map in fig. 1 has already a lot of text – what could make it confusing to indicate the beach. Page 9 – line 28

Page 8, lines 31- 34: Can you provide some more details as to how the correlation analysis was performed.

Author: Time series of the differences and current direction and intensity in each grid point in the domain covered in Figure 4 were extracted and the obtained correlations spatially averaged. Page 9 line 32 – page 10 line 1

Page 9, lines 18 – 21. Please explain how the along-shore and cross-shore components were calculated.

Author: We refer to mean along-shore and cross shore. That mean, along and perpendicular to the mean shore orientation. Although it does not correspond to the perfect along and cross shore components at each individual point at the coast, this projection reflects the mean circulation from a regional point of view. Page 10 lines 19 and 20

Page 13, lines 31 -34: The reduction in computation cost of WAVEFORCE, compared to WAVECOUPLE is discussed. Surely the waves model alone has some computational cost and it would be interesting to mention this, as this would also have to be run

in an operational modelling scenario.

Author: The processing time for the SWAN alone for the near shore domain is trifling compared to ROMS. The coupling is what takes time. Page 14 line 34 – page 15 line 1

Page 13, line 27: can you consider specifying the percentage increase in Hs and Tp in brackets.

Author: Added following the reviewer comment. Page 14 line 27

Minor Points and typos:

Author: All typos were corrected and figures modified according to the reviewer comments.

Fig1c should have a label and units for the colour scale (depth).

Page 6, line 28: “thickness” -> “depth”

Page 6, line 30: “what was found” -> “which was found

Page 7, line 4: “These simulations” -> “Each of these simulations

Page 8, line 7: The current, u, should be defined in the text

Page 8, line 18: What the difference is Hs is should be stated, i.e. is it Hs_(WAVEFORCE) – Hs_(WAVECOUPLE) or the other way around?

Page 8, line 25: “/reff4B”

Page 9, line 5: “prevalence of small waves ( ), this emphasizes ” -> “prevalence of small waves () emphasizes”

Page 10, line 13: “associated to the” -> “associated with the

Page 10, line 15: “observed differences in the total currents between the WAVEFORCE AND WAVECOUPLE models”

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Fig 8: The first line of the caption doesn't quite make sense.

Page 11, line 32: Fif. /reff11

Page 12, line 10: “as evident” -> “as is evident”

Page 12, line 14: “seams” -> “seems”

Page 12, line 33: “aim on providing” -> “aim to provide”

Page 13, line 25: “with general stronger” -> “generally with stronger”

Page 14, line 2: "view" -> "viewed"

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