**RESPONSE TO REFEREES & REVISION DETAILS**

**Journal:** Natural Hazards and Earth System Sciences

**Ms. Ref. No.**: nhess-2016-63

**Title**: High resolution wave and hydrodynamics modelling in coastal areas: operational applications for coastal planning, decision support and assessment.

**Authors:** Samaras, A.G., Gaeta, M.G., Miquel, A.M. and Archetti, R.

*Note: Page/Line/Figure numbers in the fields "Response" and "Revisions in manuscript" refer to the revised version of the manuscript.*

## Referee #1 / nhess-2016-63-RC1

*The paper is of excellent scientific importance and quality, relevant to the scientific targets of the periodical . It addresses a subject very interesting to the community of coastal oceanographers and coastal engineers, operationally important. The approach is clear and the applications illustrative of the validity and the comparative value of the tested wave models.*

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*1.1 - The paper has a quite excessive length and detailed descriptions that could be reduced a little to offer comfort to the reader.*

***Response:*** When structuring and writing this paper, the authors' intent was to provide the readers with a clear view on the background, the rationale and the findings of this study. This was attempted by following a combined strategy of: (a) explaining in-depth parts that were deemed to be essential for the understanding of this work; and (b) keeping to a minimum the extent of information that was deemed to be common knowledge in relevant studies or that would have been repeated from the cited literature. This is always a challenging task to achieve in technical writing, even in papers with fewer results to present than this one. Accordingly, and regarding the specific aspect, revisions in the manuscript were made trying to balance between the need for a more concise text as noted by this Remark, the need to further elaborate on some points as noted by other Remarks, and the inherent need to maintain the scientific and conceptual integrity of the manuscript.

***Revisions in manuscript:*** Excessive details omitted in **Page 2 / Lines: 5-10** and **Page 6 / Line: 12** in the revised manuscript. Silent minor changes were also made throughout the text.

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*1.2 - From the technical point of view, the terms of the hydrodynamic model (aiming to the description of the wave generated currents), should be clarified more (adding explicitly the radiations stresses terms, and their derivation).*

***Response:*** The inclusion of radiation stresses in the description of the terms representing sources of momentum in the respective equations of the hydrodynamic models (i.e. **Eqs. (7) and (8)** in the revised manuscript), was indeed omitted by an oversight. The issue is properly addressed in the revised manuscript, extending the description of the wave models as well.

***Revisions in manuscript:*** Equations (3), (4) and (5), respective definitions, as well as comments to clarify the specific issue added to the revised manuscript in **Page 4 / Lines: 7-14**, **25-26**, and **Page 5 / Lines: 1-3**. Pre-existing equation numbers and in-text references revised accordingly.

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*1.3 - It would be also interesting to have a qualitative or quantitative aspect of the authors on the importance of the wave generation and nonlinear interactions terms in the two applications, the first on narrow coastal strips and the second on the extend of a medium size coastal basin (bay).*

***Response:*** The rationale behind the model intercomparison presented in this paper derived from the general framework within which this work was carried out, that is the use of high resolution wave and hydrodynamics models for: (a) the development and application of a multiparametric approach for the rapid assessment of wave conditions at inshore locations; and (b) the development of a modelling system coupling atmosphere, ocean and coastal dynamics (presented in Gaeta et al., 2016). Accordingly, the TELEMAC and MIKE21 suites were compared in fundamental wave-hydrodynamics modelling applications, aiming to test models' performance and representation of the various processes governing wave propagation and wave-induced nearshore hydrodynamics.

The focus of the comparative evaluation on the nearshore dictated the selection of the dimensions of the computational domain for which the two suites' results were compared (see **Fig. 1(a)**), and this dictated in its turn the processes on which such a comparison should be focused on. Accordingly, based on previous experience, preliminary test results (not included in the final manuscript) and relevant literature, the processes finally included in the spectral wave models' setup were the ones presented in **Table 2**. Wave generation due to wind was not taken into account, as its effect would have been insignificant at such short distances in the cross-shore direction. The process of non-linear energy transfers due to quadruplet (four-wave) interactions was omitted as well, since these interactions are resonant in deep water and – even then – require hundreds/thousands of wavelengths to have a significant effect on spectral evolution. Regarding the

implementation of the multiparametric approach, this modelling need was satisfied by using WAVEWATCH III as the coarser resolution model, as explained in **Sections 2.2** and **3.2**.

***Revisions in manuscript:*** Comment to clarify the specific issue added to the revised manuscript in **Page 8 / Lines: 11-14**.

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## Referee #2 / nhess-2016-63-RC2

*The paper suggests an interesting approach for very high-resolution operational modelling for coastal systems with a broad range of applications, from shore protection to harbour design and management. The manuscript is properly organized and the work performed is very well described, to the advantage of the paper readability. Nevertheless, in order to fully exploit the paper potential, I suggest a minor revision aiming at consolidating a few points listed in the following.*

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*2.1 - Also, as a non-native English speaker I could find some imprecisions suggesting that, although the paper is overall well written, a thorough check on the language is necessary.*

***Revisions in manuscript:*** After consulting a native English speaker colleague, silent minor changes in the use of English were made throughout the text.

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*2.2 - One of the main points of the work lies in the comparison between MIKE21 and TELEMAC results, but there seems not to be a suitable observational background for evaluating the quality of the results and identifying which model actually provides better performances. I encourage either to discuss this point or to introduce some observational data in the analysis.*

***Response:*** The rationale behind the model intercomparison presented in this paper derived from the general framework within which this work was carried out, that is the use of high resolution wave and hydrodynamics models for: (a) the development and application of a multiparametric approach for the rapid assessment of wave conditions at inshore locations; and (b) the development of a modelling system coupling atmosphere, ocean and coastal dynamics (presented in Gaeta et al., 2016). It also retains a strong user-oriented component, presenting examples of how models perform under typical coastal application scenarios and how basic physical processes affect the computed parameters of interest.

Accordingly, the scope of the comparison was to serve as the groundwork for the aforementioned activities and as a comprehensive "roadmap" for modellers using MIKE21 and TELEMAC, rather than to attempt to provide a conclusive verdict on either of the suites' suitability for relevant studies. That is also why applications were designed to follow a scenario-based approach testing both single wave events and time-series of random waves, thus attempting to cover an array of representative wave conditions in the coastal field rather than individual events on the basis of site-specific data availability.

An example of how this – indeed very interesting – issue is addressed in numerical modelling studies can be found in Gaeta et al. (2016), regarding the case study of the Taranto Sea. And, although beyond the scope of this paper, the inclusion of site-specific comparisons between model results and observations is among the authors' plans for future work on the same path.

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*2.3 - A slightly broader description of the differences between parameterisations in MIKESW and TOMAWAC, although they may be very small, would in my opinion significantly increase the insight on the physical implications of the differences between the model results.*

***Response:*** The processes included in TELEMAC and MIKE21 spectral wave models' setup are presented in **Table 2** and the respective common approaches/models applied in this work are listed in **Page 3 / Lines: 27-29** and **Page 4 / Lines: 1-5**, along with the proper references in literature. However, the fact that for the model intercomparison the same parameterization for each of these common approaches/models was used, was indeed not stressed enough in the original manuscript. And as duly noted by the Referee, it couldn't have been easily implied, possibly leading to misconceptions about the observed discrepancies in model results.
Comparing open-source modelling suites with commercial ones poses some inherent limitations, the most essential being the difference in the number of available options regarding the approaches/models to be used for various processes and the definition of physical/numerical parameters. This issue, noted in the original manuscript, was the reason why for the model intercomparison: (a) only common approaches/models for the processes of interest in the two suites were selected to be tested, and (b) for these common approaches/ models the same parameterizations were used. Regarding point (b), in particular, the aforementioned issue itself implies that some options which are available/user-defined in TELEMAC may not be in MIKE21 (even for the same process/model). Accordingly, observed discrepancies could be attributed to reasons ranging from any eventual effect these added options have (if actually set to be different than suggested in relevant literature), to variations in the solvers and/or numerical schemes used (which may not perform the same and are also non-user-defined in commercial suites).
All in all, based on the available options and the theoretical documentation of the two modelling suites, it can be said that applications in this work were set up using the same parameterizations for the processes of interest, something that is properly clarified in the revised manuscript.

***Revisions in manuscript:*** Comment to clarify the specific issue added to the revised manuscript in **Page 8 / Lines: 9-11**.

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*2.4 - If I properly understood, no atmospheric forcing is prescribed in the simulations performed. This choice should be justified, or at least corroborated by a sensitivity analysis exploring the impact on the results of including some (possibly idealized) atmospheric forcings (basically wind stress) in the simulation.*

***Response:*** The issue raised by this Remark is addressed by part of the Response to **Remark 1.3** in the previous.

***Revisions in manuscript:*** Comment to clarify the specific issue added to the revised manuscript in **Page 8 / Lines: 11-14**.

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*2.5 - P3L8: Here and throughout the whole manuscript the authors refer to the domain sections on which the comparison is performed as "trajectories". This can sound somewhat misleading, as it might suggest that something is moving along those directions (suggesting in a way the idea of wave rays), therefore I would rather refer to "transects" or "lines".*

***Revisions in manuscript:*** The terms "trajectory/trajectories" were replaced by the – indeed more clear – terms "transect/transects" throughout the text in the revised manuscript.

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*2.6 - P4L3: "breaking"*

***Revisions in manuscript:*** Typing error corrected in **Page 3 / Line: 25** in the revised manuscript.

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*2.7 - P5L13-16: I am not sure that showing the structure of the output file is necessary, and it is not clear to me what the files are actually bridging: are they not themselves a part of the dataset that they are supposed to be linking to the coarser-resolution operational models?*

***Response:*** The structure of the files in the dataset of model results was originally added for reasons of completion. The term "bridge" in **Page 5 / Line: 15** refers to the query algorithm, along with which the aforementioned dataset forms the high-resolution wave conditions database. The role of the query algorithm is explained in detail in **Page 5 / Lines: 16-23**. Following the authors suggestion, this part was omitted in the revised manuscript.

***Revisions in manuscript:*** Excessive details omitted in **Page 5 / Line 14** in the revised manuscript.

*2.8 - P6L28: I suggest something like "posed by the inclusion of diffraction"*

***Revisions in manuscript:*** Sentence rephrased accordingly in **Page 6 / Line: 27** and **Page 11 / Line: 10** in the revised manuscript.

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*2.9 - P6L29-31: again, the absence of a comparison against observed data can pose some serious limitations to the assessment of the model performances in this condition. Please discuss.*

***Response:*** Please refer to the respective Response section for **Remark 2.2** in the previous, which address the issue raised by this Remark as well. Regarding the applications for Bari, it should be additionally noted that their objective was solely to test the extent to which spectral models like TOMAWAC could be used to capture diffraction effects near harbour entrances (when the detailed agitation inside the harbour is not of interest), without the need to resort to separate time-demanding applications using phase-resolving models. That, along with the rationale explained in the Response to **Remark 2.2**, was the reason why no model comparison was performed for this case as well.

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*2.10 - P9L4: "MIKE"*

***Revisions in manuscript:*** Typing error corrected in **Page 9 / Line: 9** in the revised manuscript.

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***The authors would like to thank the referees for their constructive comments and suggestions.***

***On behalf of the authors***
***Achilleas G. Samaras***