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Natural Hazards and Earth System Sciences
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Discussions



# *Interactive comment on* "Safe-economical route and its assessment model of a ship to avoid tropical cyclones using dynamic forecast environment" *by* L. C. Wu et al.

**L. C. Wu et al.**

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Dear Referee #1,

We really appreciate of your detailed suggestions and comments which highlighted some shortcomings in the paper which have now served as a valuable aid to improve the manuscript. The reply to the comment and suggestion is listed as following: Specific comments:

(1) It is not clear for a non-expert reader which concepts, equations and fairway design methods are commonly in use, which ones taken from earlier specialized studies and

which aspects are new in this manuscript. Even if the presentation (or its part) follows some classical sources, external sources should be indicated (unless the material is generic).

We have added some explanation of some concepts and references in the section 4.1.1. It will be easy understood for the non-expert reader, and they can read the reference to learn the basic concepts. Please see the revised manuscript.

(2) The readers would appreciate if the authors could view their methods and results in a somewhat wider context. Although the text contains a number of references to various fairway design methods, the authors do not mention many generic and widely used approaches. Doing so is fine for experts in the field but may create a biased perception for those who are not familiar with the ship routing problems. In particular, the pool of European and US-based research is almost not reflected. There exist many methods which do not rely on a set of predefined waypoints. In essence, most of such methods rely on a particular quantification of the offshore (either in terms of the risk to the ship, or the risk to the environment stemming from the ship) similarly to the present manuscript, after which a variety of approaches (Monte-Carlo-type optimization, Dijkstra's algorithm, or even simply following the local maxima or minima of the resulting 'cost function' can be used to specify the optimum route. The presented method is, in essence, a discrete version of finding an optimum fairway along the minima corresponding to the areas that can be crossed with minimum fuel consumption in the presence of an additional restriction of staying in safe enough areas in terms of the risk of capsizing.

Thanks for your suggestion. We have added some references about the shipping route. Because the weather routing is a complex problem, which related with the changing wave condition over time, and also the ship's position forecasted is related with the wave condition. It not reasonable to design the ship's route to avoid a TC without predefined waypoints. It will caused much more computation cost. It other hands, some research using the grid of wave data to design the weather routing, but it will not



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suitable for the route to avoid TC because RATC need the higher resolution weather data. And the frequency changing ship's course is also not reasonable when ship try avoid TC.

(3) The description of the results (Section 5.3) and the Conclusions section are perhaps too compact and also partially fail to fully open the importance of the results. Also, the description is to some extent deceptive. For example, it is claimed that the new method is superior to a simple typhoon avoidance method. The results in Table 3, however, show that the simple method actually is the second best (in terms of fuel consumption) among the sequence of optimized fairways. The same claim is repeated in Conclusions - a large part of which actually is dedicated to forthcoming research. The Conclusions are the weakest part of the manuscript and should be clearly improved. I suggest to considerably expand the sections in question towards more unambiguous explanation of the results of the study and towards discussion of the shortcomings (e.g. quantifying the associated increase in computational costs), benefits and applicability of the new method.

Thanks for Referee's comments and suggestion. We have revised the description of the results (Section 5.3) and the conclusions section. In the revision of manuscript, we have added more description and analysis about results and conclusion according to your suggestion. There were some unclear expression in Table 3 about the result of the experiments. In the Table 3, the last row is logarithm of Benefit-cost ratio, we have changed it.

(4) Some claims are not exact. For example, Abstract tells that both the impact of wind and waves are taken into account. In the body of the paper, however, it is explained that the wind impact is accounted for implicitly, through its role in wave generation

Yes, in the model, the wind impact is accounted for implicitly. We have corrected the abstract. Also, we have corrected some other problems of expression and claims.

(5) The text contains however, many obviously wrong expressions, typos and formatting



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issues. For example, all equations should be punctuated as parts of the text.

We have reread the manuscript carefully and corrected the wrong expression and formatting.

Technical issues:

(1) The two sentences of the Abstract are not exactly correct; the claim on lines 10–11 is unclear as the risk level is evaluated in terms of risk of capsizing of the ship under the impact of wind and waves; moreover “wave resistance” is normally used in a completely different context.

We have corrected the wrong expression. In the manuscript, the risk level is evaluated in terms of risk of capsizing of the ship under the impact of wind and waves. Under the same wave condition, the ship’s capsizing depend on the ship’s ship’s characteristic and the loading condition.

(2) Page 1866, line 1: "ITTC” is not defined and no reference is given to the source. Equation (12) presents, in essence, a classical Pearson-Moskowitz spectrum but the sea state near a tropical cyclone generally does not match well this spectrum

We have added the reference about the ITTC. The sea state bear a TC may not match well this spectrum. The spectrum is given from the aspect that the wave effect on the ship’s maneuverability. We used it because it is only one parameter, it is easy and operable when calculated the ship capsizing probability.

(3) line 16: to my knowledge, this is the first time when "wave feature period” has been used; please reformulate in conventional terms

It should be significant wave period. We have corrected it in the revision version.

(4) Page 1871, lines 8-10: "risk probability” (used here for the first and last time) sounds strange; either is is a probability (nondimensional) or risk (a product of probability and consequences, usually dimensional). I guess that still "capsizing probability” is meant



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It is capsizing probability. We have corrected it in the revision version.

(5)line 12: "broken point" is used here for the first and last time; although heuristically understandable what has been meant, still please rephrase in more common terms

We have used 'unnavigable point' to replace the 'broken point' and used the 'unnavigable waypoint' to replace the "break waypoint".

(6) Page 1872: optimization procedure of the set of waypoints is a classical routine for similar problems and needs not to be described in detail; just a description of the principles on a couple of lines and a reference to Fig. 5 would do. BTW, how do you avoid touching a cyclone when sailing along the optimized route (cf. the red short way in the upper part of the cyclone in Fig. 4); is this a part of step 2?

Yes, the step 2 is used to avoid touching a TC when sailing along the optimized route. Before optimized route, the algorithm (fig. 3) can avoid TC based on the calculation of the risk according the forecast environment and ship's position. Although the route before optimized can avoid TC dangerous area, it also to recalculate the risk in every position and time because the position and wave conditions is always changing with time. So I think the optimization procedure will be much clearer with detail described. If the optimization procedure only be described by the Fig. 5, it will make some confused. So we didn't change this part.

(7) Figure 2 is extracted from (Chu et al. 2004) and can be omitted without any loss to the content of the paper.

We have deleted Figure 2 in the revision manuscript.

(8) The title should be adjusted; in particular "model" stands in a wrong location

We have adjusted the title to "Safe-Economical Route Model of a Ship to Avoid Tropical Cyclones Using Dynamic Forecast Environment"

The rest of minor comments have been already corrected in the revision manuscript.



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Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/1/C938/2013/nhessd-1-C938-2013-supplement.pdf

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