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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Numerical modeling of rogue waves in coastal waters" *by* A. Sergeeva et al.

Anonymous Referee #1

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The paper "Numerical modelling of rogue waves in coastal waters" by Anna Sergeeva et al. continues and expands research into the formation, properties, propagation and fate of rogue (freak) waves in the oceans and thus definitely falls into the scope of NHESS. Differently from the large pool of papers in which freak waves are addressed using the nonlinear Schrödinger equation (NLS) and synthetic freak wave shapes or records at a single location, this manuscript addresses records at several locations representing different wave approach conditions and bathymetric features. The core idea is that some properties of wave fields at a certain distance from the measurement site can be reconstructed using an appropriate equation for weakly nonlinear dynamics of waves.

The key tool, the NLS equation, is used in an advanced manner as a version with

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depth-dependent coefficients. The method for its solution, verified in several previous studies, makes it possible to certain extent realistically reconstruct spatio-temporal dynamics (incl. propagation and properties of freak waves) at a certain distance from the measurement site. The resulting simulated dynamics, albeit formally synthetic, still presents an interesting source of information about freak waves. The adequacy of this information crucially depends on how exactly the conditions for the validity of the underlying equation are satisfied, and this is extensively discussed in the paper.

The analysis in the manuscript is performed professionally and properly illustrated. The reader is provided with most of details necessary for evaluation of the credibility of the results. The key results are formulated clearly. The most interesting from my viewpoint are: (i) the possibility of occurrence of (occasionally re-appearing) freak waves with long life-time and (ii) concentration of these freak waves that have not been captured by the wave buoy exclusive offshore from the measurement site. Although the latter result not exactly matches some of the earlier studies, it clearly signals that freak events are much richer in content than commonly expected and further research is necessary for adequate understanding of their nature.

The authors re-use the term "abnormality index" to select rogue wave events from the existing wave system. Although used in the literature addressing rogue waves for almost a quarter of century (probably starting from Dean, R. 1990. Freak waves: a possible explanation, in: Water Wave Kinematics, Tørum, A. and Gudmestad, O. T. (Eds), Kluwer, 609–612), this notion is, to my understanding, infelicitous (as it includes also completely “normal” but infrequent waves) and should be replaced by a more appropriate one. I would seriously consider, for example, naming it as Dysthe index, or Dysthe number, to recognise the contribution of Kristian Dysthe into the rogue wave theory.

There are few aspects that need clarification and/or more detailed explanation.

On page 5782, line 15 it is mentioned that 512 s long sections of wave records are used

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for further analysis. Their duration (about 8.5 minutes) is a small fraction of the one usually recommended for adequate estimates of ocean wave properties (20 min). The use of short segments that contain a group of high waves may overestimate the significant wave height and in this way may lead to ignoring of some of rogue events. Also, it remains unclear how time series of surface elevations are extracted using wavelet transform; probably it is meant that properties of rogue waves are extracted *from* the time series of surface elevation using this technique.

The description of the location of the measurement buoy on page 5784, line 19 is not consistent with, e.g., a similar description on page 5783, line 7.

The description of how different classes of rogue waves are shown in Fig. 5 (page 5787, line 23) is not consistent with the relevant figure caption.

It is not clear what is meant by "fleeting events" on page 5788, line 7.

The paper contains an adequate overview of earlier research within the direct scope of the paper. However, the reader might benefit from a certain extension of the reference list. For example, a preliminary version of the classification of rogue waves (finalised in Sergeeva and Slunyaev, 2013) has been provided in (Didenkulova, I. 2011. Shapes of freak waves in the coastal zone of the Baltic Sea (Tallinn Bay), *Boreal Environment Research*, 16 (Suppl. A), 138–148). It is explained that the equation used in this study fails in very shallow water and that for this reason the calculations are only performed until a certain reasonable depth. Although the limits of the NLS-equation-based theory of freak waves are nicely described, the reader might benefit from mentioning that in even shallower water other equations (such as Korteweg–de Vries or Kadomtsev–Petviashvili equation) and other basically weakly nonlinear mechanisms (such as interaction of Kadomtsev–Petviashvili solitons; e.g., Peterson, P. et al. 2003. Soliton interaction as a possible model for extreme waves in shallow water, *Nonlinear Processes in Geophysics*, 10, 6, 503–510) may produce similar long-living rogue waves and thus the threats associated with freak waves may easily extend to the immediate

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nearshore as highlighted in (Nikolkina, I. and Didenkulova, I. 2012. Catalogue of rogue waves reported in media in 2006-2010, *Natural Hazards*, 61, 3, 989–1006).

The weakest element of the manuscript is the use of English. Although the points made by the authors are understandable for expert readers and definitely interesting, the entire text needs radical improvement (not only in terms of grammar and choice of words but in some places also in terms of clarity) and partially also reshaping (to avoid field-specific jargon and repetition in the body text of information already provided in figure captions) before the manuscript can be accepted for publication.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 5779, 2013.