Interactive comment on "Ocean swell within the kinetic equation for water waves" *by* Sergei Badulin and Vladimir Zakharov

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Answers to referee #2

The authors appreciate efforts of the reviewer and his/her valuable comments. The paper is significantly updated: almost all the figures have been re-drawn, additional numerical runs have been carried out as recommended by one of referee for longer duration and with higher directional resolution. Ten new references appeared in the paper bibliography. A native speaker who checked the text has made very few suggestions in English style and grammar. Our answers follow the reviewer's report.

1. **The simulations are made for a very long time scale; could higher order effect in the kinetic equation take place (e.g. five wave interactions?)**

We do not discuss the effect of five-wave (and higher-order) interactions intentionally by a number of reasons.

First, the solution itself of the four-wave (Hasselmann) kinetic equation for long time is a real computational problem. The five-wave extension of the equation is well-known (see sect.5 and eqs. 5.1, 5.2 Krasitskii, 1994) but the authors are not aware of attempts to solve it numerically.

Secondly, the passage to the five-wave kinetic equation is 'of principal significance' in the words of Krasitskii (1994). The account for five-wave interactions is violating the wave action conservation law (wave energy and momentum remain to be formal integrals of the extension) and, thus, makes the theoretical concept of the Kolmogorov-Zakharov cascading and power-law Kolmogorov's spectra inapplicable. The authors set a high value on the theoretical background in this paper;

Finally, our principal goal was to stay within the today concept of wind wave and swell prediction where the four-wave Hasselmann equation plays a key role. Tentative estimates of the effect of five-wave interactions for low steepness swell ($\mu \simeq 0.03$) offer prospects of their rather small effect. Quite interesting issue of wave field short-crestedness at long times (e.g. Badulin *et al.*, 1996) is, evidently, beyond of the paper goals and the statistical theory of sea waves;

2. **Line 9, page 6: while discussing the two-lobe structure of the higher frequency part of the spectrum, the authors state that the appearance of such structure is generally discussed as an effect of wind. This is only partially true, indeed, the role of nonlinearity in the formation of the lobes has been already discussed in Toffoli, Alessandro, et al. "Development of a bimodal structure in ocean wave spectra." Journal of Geophysical Research: Oceans 115.C3 (2010).**

Thank you. This note is extended by references to Pushkarev *et al.* (2003) and Toffoli *et al.* (2010). Note, that the latter paper presents results of simulations for

rather short durations of very few hundreds peak periods, i.e. about one hour only for our swell parameters. An extensive discussion of the spectra bi-modality is given in sect.3.4 with references to experimental (Ewans, 2001; Ewans *et al.*, 2004) and numerical works (Banner & Young, 1994; Young *et al.*, 1995);

3. **in eq. (16) the letter ν has already been used for the degree of homogeneity of the wave action.**
   Thank you. Symbol ν in (2) is changed to υ now;

4. **Please, comment more on the fact that the 'wave action is the only true integral of the kinetic equation'.**
   Comments are given in the cited papers (Zakharov *et al.*, 1992; Pushkarev *et al.*, 2003);

5. **Please, explain what do the authors mean by 'free boundary condition' (line 15 page 8)**
   A short comment is added (now line 25, p.8): 'Free boundary conditions were applied at the high-frequency end of the domain of calculations: generally, short-term oscillations of the spectrum tail do not lead to instability, i.e. the resulting solutions can be regarded as ones corresponding to condition of decay at infinitely small scales ($N() \to 0$ when $|| \to \infty$).'

6. **How much the reduction of the wave energy (H_s) depend on the high frequency cut off in the simulations?**
   We did not find difference when reduced number of frequency grid points from 128 to 112. This is mentioned in the updated text (line 1, p.9)

7. **English should be improved.**
   Thank you. We did our best to make the paper readable

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