Response to the Anonymous Referee #2

We would like to thank the Referee #2 for the valuable comments.

COMMENT BY THE REFEREE

What are the values, in the computational domain, of the components of the wave vectors of the carrier wave (k_0 = 5?) and sidebands (ΔK_x = 1, ΔK_y = 0.7 or 0.77?). The values of these parameters are not given explicitly.

What is the number of modes in the two directions?. As I understand the values of ΔK_x and ΔK_y are unchanged while k_0h and a_0k_0 vary and so it is not always the most unstable or almost unstable modes which are selected.

For instance, the linear stability analysis of McLean for k_0h = 1 and a_0k_0 = 0.10 shows that the most unstable class I instability corresponds to $\Delta K_x / k_0$ = 0.28 and $\Delta K_y / k_0$ = 0.19, i.e. $\Delta K_y / \Delta K_x$ = 0.67 instead of 0.77. For infinite depth, $\Delta K_x / k_0$ = 0.18 which is close to the value used in the paper. To conclude section 3 does present clearly the choice of the parameters discussed above.

ANSWER BY THE AUTHORS

We thank the Referee for this comment. The parameters in the computational domain have been added to the manuscript.

The wave vectors are defined as follow:

Waves	*Kx*	*Ky*	*Normalized Kx/k0*
Carrier	0.0403	0	1.00
Side band 1	0.0322	0.00563	0.80
Side band 2	0.0322	-0.00563	0.80
Side band 3	0.0483	0.00563	1.20
Side band 4	0.0483	-0.00563	1.20

The parameters used in this paper are:

$\Delta K_x / k_0 = 0.20$.

$\Delta K_y / k_0 = 0.14$.

$\Delta K_y / \Delta K_x = 0.70$.

2) COMMENT BY THE REFEREE

How is computed the nonlinear basic wave?

ANSWER BY THE AUTHORS

Our initial condition is purely linear. The Euler equations automatically build up the nonlinear components (Stokes' contribution and higher order nonlinear components) in the wave field.

COMMENT BY THE REFEREE

In 3D (or 2D propagation), I believe that the frequency downshifting phenomenon observed in tanks or in numerical simulations without dissipation, is due to the confined aspect in the transverse direction. If l is the transverse dimension of the tank, there is a forced selection of modes whose transverse wavenumbers are n_/l with n = 1, 2.... The same mechanism may work in numerical tanks. In other words oblique perturbation is selected at the expense of the collinear perturbation. Furthermore, I suspect a numerical artefact when I see in Fig. 3c that for infinite depth the dominant mode becomes an oblique one. From my point of view the frequency observed by Trulsen et al (1999) in confined geometry does not prove that it prevails in open natural conditions.

ANSWER BY THE AUTHORS

We thank the Referee for this comment. The aim of Figure 3c is just to show that maximum amplitudes grow under the effect of oblique perturbations. This result is consistent with our laboratory experiments, which were carried out in a large directional basin, where the confined geometry should not be an issue.

COMMENT BY THE REFEREE

Results presented in Fig. 9 are biased because the instability of higher order are not introduced in the initial conditions or excited at the maximum of modulation. In fact, there is a coupling between class I instability and class II instability that leads to breaking wave in infinite and finite depth as well. A deeper discussion is needed in the paper about this coupling. I do not agree with the last paragraph of section 4 (pages 5246-5247). In deep water, it is shown experimentally (see Su & Green, 1985) and numerically (see Fructus et al, 2005) that there is a coupling between class I and class II instabilities that results in 3D breaking waves of wave trains with initial steepness as low as 0.12. When a_0k_0 is less than 0.12, class I instability stabilizes class II instability. A diagram can be found in Fructus et al showing predominance of class I instabilities versus class II instabilities for $k_0h = 1$ and $k_0h = 1$ as a function of the wave steepness. These results were confirmed and supplemented by Kristiansen et al (2005) in finite depth. In addition, it is shown by Francius & Kharif (2006) that higher-order instabilities become more important in shallower water.

ANSWER BY THE AUTHORS

We thank the referee for this detailed comment on class II instability. Accordingly, a discussion has been added in the amended version of the paper; reference to Su & Green (1985) and see Fructus et al (2005) have also been included.

Further, we also rephrase the last paragraph in Section 4. Comparison between simulations with order M=3 and M=5 shows, in fact, that higher order terms support a higher growth in wave amplitude, suggesting a notable role of class-II instability as suggested by the referee.