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Ocean Science Discussions

Interactive comment on "Imbalance of energy and momentum source terms of the sea wave transfer equation for fully developed seas" *by* G. V. Caudal

G. V. CAUDAL

gerard.caudal@latmos.ipsl.fr

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Dear Dr Webb, In your short comment, you suggest that other approaches could have been followed in order to remove the inconsistency between energy and momentum budgets. In particular you suggest that the standard theory may underestimate the decay rate of short waves. As a matter of fact, since the ratio of momentum over energy carried by sea waves is larger for short waves, increasing the dissipation rate at short waves as compared to long waves would tend to remove more momentum for given energy loss, and this would thus reduce the energy/momentum inconsistency. Since the main dissipation term is the wave breaking term, this would require to modify the functional form of the wave breaking term. I fully agree with you that there is not a unique way to do that, and this point is stressed at the beginning of section 3. Instead

of modifying the functional forms of the source and sink terms, my approach in this paper was to stick to the functional forms of the source and sink terms proposed in the literature, but to supplement them by including a downshifting term related to wave breaking. The reason for this choice is that there are some theoretical and experimental justifications for such a process, as discussed in section 3.1.

In your comment you also recommend that the paper should include the non-linear terms, and should show in wavenumber space where the imbalances are occurring. In the beginning of the paper I refer only to the energy and momentum budgets integrated over the spectrum and thus I do not include at this stage the resonant nonlinear interactions, which conserve overall energy and momentum. Then, in section 4, I perform a local study in wavenumber space, where this time I indeed include the nonlinear resonant term (section 4.2). In the future version of the paper, I will use the exact-nl calculation instead of the discrete interaction approximation that I used so far. Following your recommendation, I have prepared a new figure (see attached figure Z in the supplement file) to be included into the paper, in which I now show in wavenumber space where the imbalances are occurring. Thus in Figure Z, I compare the repartition of momentum variation rate of this paper with the results of the classical approach where only the energy balance is fulfilled (by taking γ=γ1). Function g(k) of figure Z should be ideally zero everywhere. Unfortunately due to model inaccuracies this is not the case. Compared to the classical approach, the model of this paper leads to higher discrepancy in the vicinity of the spectral peak, but to lower discrepancy at higher wavenumbers. In Figure Z, in the case of the classical approach (dashed line), it can be seen that the area over the line g(k)=0 is significantly larger than the area below the line. This indicates that in this case the net integrated momentum variation rate is positive, leading to irrealistic accumulation of momentum within the wave system, as mentioned in the paper. Together with the new figure Z, I propose to add a discussion on that question at the end of section 4.3 (see proposed text in the supplement file)

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Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/9/C1111/2012/osd-9-C1111-2012-supplement.pdf

Interactive comment on Ocean Sci. Discuss., 9, 2581, 2012.