Referee's Report

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Title: On the applicability of linear wave theories to simulations on the mid-latitude β-plane
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Recommendation: I recommend minor revisions.

In this paper, two ways to treat fluid motions on mid-latitude β-plane are described and compared. One is a conventional way to treat mid-latitude β-plane, which is, when considering inertial gravity waves, essentially the same as f-plane where the Coriolis parameter is represented as a certain constant value f_0, and in this paper, it is called "harmonic wave theory". The other is to treat the Coriolis parameter as linearly changing with y or $f = f_0 + \beta y$ also for gravity waves, and it is called "trapped wave theory".

Some numerical calculations or time integrations of a simple β-plane numerical model are performed, and the accuracies of harmonic wave theory and trapped wave theory are investigated. And the results are summarized such as the error of the harmonic wave theory becomes large when the latitudinal width is large, while the error of the trapped wave theory becoms large when the latitudinal width is small.

The comparison of the two theories for simple β-plane calculation is important and the results obtained here are also significant; it is worth publishing, I think. However, when I first read this article, I over-hoped for this trapped wave theory; it must overcome the defects of the harmonic wave theory since the change of Coriolis parameter is exactly treated without approximation in the trapped wave theory. But, actually, the situation where this trapped wave theory can be applied is quite limited; the region should be widely spread in the north direction, the region should be limited by some cost in the south direction, the motion should be relatively large so that the frequecy of the wave is near to the intertial cycle, which assure that the motion is evanescent in the north area but wavy in the south, and so on. On the other hand, in the conventional harmoni theory, although the Coriolis parameter is treated as constant, we are usually able to consider "local dispersion relation" which is often used as WKBJ treatment. In this article some real examples of observations or simulations are described, and most of them are referred to as examples which show the advantage of the trapped wave theory. In some examples, the difference of the phase speed or frequency cannot be explained by harmonic theory where the Coriolis parameter is constant, but if we consider local value of the Coriolis parameter, it may be explained. As another example shown in p.32, the D'Asaro et al's argument is critisized, the presumed form of the wave does not satisfy the wave equation. This becomes a problem when considering exact solution in the entire region, but if we consider approximation as WKBJ treatment and consider local relation, which is possible when considering solutions like harmonic theory, it does not become a problem.

It is true that the harmonic theory has advantage as an exact solution, but harmonic theory has advantage that it can be considered locally like WKBJ treatment. I think that the theoretical and calculation parts in this artilce does not have problems but introduction and discussion parts where the comparison with real observation is desceibed should be reconsidered, since the harmonic theory and earlier theories are unfarily critisized.