Atmos. Chem. Phys. Discuss., 15, C11678–C11680, 2016
www.atmos-chem-phys-discuss.net/15/C11678/2016/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characteristics of gravity waves generated in a baroclinic instability simulation" *by* Y.-H. Kim et al.

Anonymous Referee #3

Received and published: 18 January 2016

The paper analyzes the gravity waves generated spontaneously in dry idealized numerical simulations of baroclinic instability. The simulations are carried out with the WRF model, on a sphere. The resolution is somewhat better than dx $\sim$ 10 km (latitude - longitude grid such that dx=10 km at the Equator, and 7.3 km at 45 degrees). The baroclinic life cycle differs from the ones previously investigated because it emphasizes disturbances in the troposphere, near the surface. Disturbances are less intense in the upper troposphere than in previous simulations. The manuscript describes in detail the waves that appear, analyzes their chronology and their characteristics, both in real space and in spectral space.

The manuscript has several noteworthy qualities: 1- the analysis of the emitted wave packets is thorough and well illustrated: identification of wave packets in physical space

is complemented by isolating their spectral components and convincingly reconstructing them from those spectral components (figures 2 to 4);

2- the spectral analysis is interpreted in a very interesting way, and the combination of the descriptions of the wave packets in physical space and in spectral space reveals noteworthy features. In particular, it is compelling to note that a simple explanation (p32650) can be obtained for the spectral signature of the three northerly wave packets (1, 2 and 3, having a signature in an arc, top right panel of figure 6), and at the same time to see from physical space that these spectral components are due to several independent wave packets.

3- previous studies on the subject are well referenced and well discussed. This is all the more important as there have been a number of such studies over the past two decades.

4- the simulations are also used to test one common hypothesis that is used in parameterizations of non-orographic gravity waves.

5- well written, hardly any typos.

There is nonetheless some room for improvement, and a few suggestions are made below, which the authors may choose to follow. In any case, I recommend publication after minor revision is made.

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main points

1. The text may be a bit long. Sometimes, the figures are discussed in perhaps too much detail. On the other hand, the precise and careful description of all the figures and of the approach contributes to avoid confusions and to make sure that the different points that have been analyzed are well understood. The authors may try to reduce the text a little.

2. It is very good to test the relevance of the frontogenesis function (FF). The tests are not encouraging, which is not so surprising as the FF was proposed as an indicator of gravity wave generation on heuristic arguments, not from theorectical arguments. This part of the study is not included in the summary (section 5). A firmer conclusion on this topic could be included, such as 'Investigation of the relation between gravity waves and the frontogenesis function did not reveal any systematic relation between the two. Using the FF in parameterizations certainly provides a rough indication of regions where fronts are developing, thereby introducing intermittency in the sources, but the present simulations do not provide any evidence for a quantitative or even a precise spatial relation between the two.'

Minor points:

p32648: line 6: is -> are ?

p32652: line 16-19: an important reason may be that the present baroclinic life cycle emphasizes tropospheric processes near the ground (as recalled on p32655, lines 28-29 and onwards), rather than upper-level jet processes. This is closer to the anticyclonic run of PS07, which also had longer vertical wavelengths (especially as resolution increased).

p326661: It would be good to recall, here in the summary, the point above, ie that the present life cycle differs from previous ones in that it emphasizes surface processes.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 32639, 2015.