

Interactive comment on “The Climatology of Brewer-Dobson Circulation and the Contribution of Gravity Waves” by Kaoru Sato and Soichiro Hirano

Anonymous Referee #1

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I agree with the authors that the parameterized gravity wave drag are not the true gravity wave drag, and the difference between the parameterized and the true gravity wave drag contributes to the increment error. However, I still do not agree with the authors that their method can serve as an estimation for the true gravity wave drag. Basically, the authors are assuming all the terms except the gravity wave drag in the momentum equation can be perfectly accurately calculated from reanalysis data or small enough to be negligible, and therefore the residual term from the equation would be the gravity wave drag. This may be true in a model simulation where all variables are dynamically consistent with each other, which explains the results from Okamoto et al. (2011) the authors are referring to. But the assumption that all the other terms

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can be accurately calculated does NOT hold in the reanalysis products. Due to the assimilation process in the reanalysis data, nonphysical increments are introduced in all the variables. As also pointed out by Dr. Abalos, the other reviewer, this increment error does not only arise from gravity wave but also from many other processes as well. The residual term of the momentum equation therefore does not only consist of the true gravity wave drag, but also differences between the calculated and the true value in all the other terms. More importantly, the true gravity wave drag may not dominate in this residual term, so the residual term does not even give a bulk approximation for the gravity wave drag. Take the term (2) for example, if it can be accurately calculated from reanalysis, then one would expect that v^* calculated from its definition would be the same among different reanalysis products since they are representing the same real world. But as shown in this paper as well as in Abalos et al. (2015), this directly calculated TEM velocity does vary among reanalysis products, and the difference is NOT small compared to the residual term or the so-called “true gravity wave drag”.

I also agree with Dr. Abalos that it would be helpful to compare the increment error explicitly, since it represents the accumulative errors from not only gravity waves but also resolved waves as well as mean circulation. While the parameterized gravity waves may not represent the true gravity wave effects in the real world, I think a comparison among reanalysis is still meaningful.

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