Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-47-AC2, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivities of the MJO Forecasts on Configurations of Physics in the ECMWF Global Model" *by* Jun-Ichi Yano and Nils P. Wedi

Jun-Ichi Yano and Nils P. Wedi

jiy.gfder@gmail.com

Received and published: 24 August 2020

We much appreciate the comments posted on 17 March 2020 by the present Reviewer. Our apologies for a delay of a response from our side, mostly due to a *confinement* of the first author during the epidemic.

Indeed, the present Reviewer provides us with a very good summary of the present study. We also much appreciate a positive evaluation, stating that "there may be many interesting results, especially that can help the world-best MJO forecast model to be even better. Therefore, I agree with the authors that (from the reply to the reviewer's comment) this is a significant study." However, as the case with the first reviewer, the

Printer-friendly version

Discussion paper

present Reviewer remarks that “it is very hard to follow” mostly due to “too complicated results”.

Yes, the results are “very complicated” with very different behaviour sensitively depending on the choice of physics to be turned off. These are results that we even did not expect when we started this project. However, we are afraid that we must best present these complicated results as they are, because these are what we get. By reading through the original manuscript carefully, we realise that the main problem was in presenting our original motivation of the study as if the purpose of the paper itself. The real purpose here is to report these complicated results, which do not give any clear-cut interpretations in terms of the nonlinear free–Rossby wave dynamics as we originally envisioned. The original manuscript was hard to read, because we presented the results without warning the readers properly. In the revised manuscript, we will make this point as clear. Furthermore, more interpretational remarks will be inserted into the analysis section so that readers may not be get lost in details.

We agree that, as a reviewer may react, it is very usual just to report all those details of model sensitivities as a scientific report. However, the first author, especially, points out that the very fact of never reporting those modelling sensitivities is a core reason for slow progress of global models, without much useful inputs from theoretical studies. A commentary to Nature by Metha (2019) makes the merit on this type of publications clear.

For example, as already suggested in the original introduction, there are extensive studies in theoretical literature about whether the friction contributes to the MJO dynamics positively or negatively. However, all these studies are based on a rather simple Rayleigh–friction formulation with a dichotomy of with or without friction. A very important message from the present study is that the effects of friction is hardly such a simple dichotomy. Rather the performance of MJO prediction sensitively depends on the choice of the exact friction term. This very fact is something to be reported to the theoretical community so that theoreticians can more positively contribute to un-

derstand these “complex” behaviours of MJO within global models.

Another important message to convey from the present study is a difficulty of emulating the free dynamics within an operational global model: if we totally turn off the dissipation terms as well as diabatic heating, as attempted in this study, the basic climatology, that is required to support a free nonlinear–wave dynamics, is also destroyed as a result, thus an expected free dynamics is no longer simulated. The significance of these lessons from the present study will be more clearly highlighted in revision.

As for more specific issues:

1) Presentation of Figures: We decided to focus on the Hovmuller plot, because we find it the most succinct manner of presenting the MJO behaviour both in terms of convection and vorticity (rotational flows). Under this configuration, “anticyclonic vortex pair symmetric to the equator” appears as a positive anomaly in a Hovmuller plot, as already remarked in Sec. 2.1. To make a point clearer, we will add a phrase “over the Indian Ocean” in revision. We will also change the phrase itself as “anticyclonic activity”, because it is true that by Hovmuller plot only, it is not possible to tell, whether this is a vortex pair or not. A reader would be able to identify a development of a positive stream–function anomaly along a MJO propagation easily in this manner. On the other hand, the role of the vortex pair in the theory will be explicitly remarked in revision for better clarity.

2) Improvement of Hovmuller plots:

i) Though it would be possible to remove some redundant color bars from figures, presentation of figures would become less coherent as a result. For this reason, we opt not to perform this change.

ii) In Revision, “Hovmoeller of” will be removed from all the figure headings as suggested. Similar simplifications of the figure headings will also be applied to Figure 2.

iii) There was a problem with sub-labels in the original Figure 3. This will be corrected

in final version.

iv) The values beyond a range of colour code is not shaded. This fact will be remarked in the revised caption of Figure 1 in such manner that the remark also applies to all the subsequent figures.

3) Results: For reducing the amount of results to be presented, Sec. 3.5.2 will be removed in revision, because it does not offer much. Nevertheless, the main message to be conveyed by the present paper is the very fact that none of the existing theories appears to explain the identified complex sensitivities. In this very respect, a number of cases is important to explicitly indicate a complex response of the model by selectively turning off the physics.

4) MJO event selection: A 'low–skill event' is selected in the present study, because by definition, it is more challenging to forecast. As shown in Fig. 3, the performance of controls runs is rather poor. Thus, the question is: how can we improve it? As reported herein, we have certain successes. However, the change of the model performance is not quite consistent in terms of change of contribution of friction. We believe that the latter is more important to emphasise rather than reporting some limited successes, which are only superficially good news.

By following a suggestion of the present Reviewer, some diagnostics based on RMM indices will be added in revision (new Fig. 3).

references:

Mehta, D., 2019; Highlight negative results to improve science. *Nature*.

https://www.nature.com/articles/d41586-019-02960-3

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-47, 2020.