Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-465-RC1, 2020


Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Stratospheric gravity-waves over the mountainous island of South Georgia: testing a high-resolution dynamical model with 3-D satellite observations and radiosondes" *by* Neil P. Hindley et al.

**Anonymous Referee #1**

Received and published: 6 July 2020

General comments

In this manuscript the authors address an important issue for the adequate representation of gravity waves (GWs) in the numerical modelling of the atmosphere. They study the possible impact of the use of a high horizontal resolution grid in the stratospheric simulations around a mountainous island. The overall presentation is well structured and clear with nice figures. However, some of them have been placed uncomfortably far from their first citation. Some arguments in the text (as explained below) remain too hypothetical without further deepening and need to be more profoundly substanti-



ated to support some interpretations and conclusions, e.g. the absence in AIRS data of short horizontal wavelength GWs shown by the numerical model or vice versa with non-orographic waves. There are also some uncertain definitions or descriptions that need a clarification. Finally, I believe that the authors acknowledged only a fraction of the relevant work related to the study of GWs through satellite data and numerical modelling over the last decade in the nearby well-known Southern hotspot.

Specific comments

Introduction: As stated above, I believe that some significant work in relation to GWs studied with satellite data and numerical modelling in the Southern GWs hotspot should be included in the context of this section.

l.134-135 and l.147 There is a need for clarification about some definitions. If vertical resolution is at best 7 km (uncorrelated or independent successive data), then the 3 km sampling is just some kind of interpolation and no wavelengths shorter than 14 km may be detected, which would have a disastrous effect on the following results. Also l.353-355.

l.138 If temperature uncertainty may be up to 1.5 K you need to justify how you rely on results of 1 K amplitude or even less.

l.143 Please mention the artefacts that may remain.

Section 2.2: More details of the simulation characteristics are needed. You should mention the type of sponge and its intensity and the timestep that was used. Did numerical instabilities arise during the initial steps? If so, how did you handle them? Did you assess the model spin up? Did simulations exhibit alterations with slightly earlier or later initial time? In addition, your operational analyses have a 46 km resolution, whereas your simulation domain has a 1.5 km grid. Have you evaluated the possible effect of this factor of 30? Wouldn't it be advisable to use a smaller ratio? May this fact be responsible for the model not being able to adequately represent the non-orographic

GWs (l.403-406, l.972-974)? How reliable are simulations if such a large structure is not "transmitted" from the forecast to the local area model?

L.236-237 You should also compare the numerical model with radiosonde temperature (not only wind validation) as you have it at disposal, but you should not use it for GWs as you clearly stated in l.254-256.

l.298 There may be significant positional errors? How large can they be?

l.449-453 The redundancy of the method should be shortly discussed or cited as it is strongly related to the reliability of the calculated GWs amplitudes. This is especially important in the context of some notable amplitude discrepancies below among AIRS and the model.

l.490-491 You should check your hourly output for stationary phases and increasing wind speed with height.

l.643-645 You should use your model simulations to test this argument.

l.650-651 The model simulations should give you a clue for upward or downward phase propagation.

l.678 Does this imply that AIRS amplitudes are typically the double of the model? If so, explain.

l.701-702 The presence of the jet, the polar vortex, storms and fronts can all be probably checked from your operational analyses in order to verify the support to your argument.

l.706-714 Please use your hourly simulations to verify at least partially in the mentioned geographical domain your detachment or moving secondary waves argument.

Table 1: To check if differences are significant it is necessary to include uncertainties with the averages.



Figure 14d, h: Please discuss the parts where the difference is larger than the absolute fluxes.

Figure 16: How can you define a unique amplitude if it can change by a factor over 4 from 25 to 55 km?

l.896-897, 913-916 and 919-920 This could indicate that AIRS may be omitting an essential contribution to GWs momentum flux and its later parametrization in global models. This fact merits a quantification of the above effect due to the possible discrepancies of simulations or observations in this work with the real atmosphere.

l.936-940 Can you give a reference where this effect has been quantified? How likely is it that this high frequency wind variability exists in that zone? Can you draw conclusions from the individual radiosonde profiles?

l.951-957 Again, another possibility is that AIRS is missing these GWs.

l.993-1000 What was the expectation for GWs amplitudes in your simulations according to the timestep you have chosen? Was it in agreement with your results?

l.1024-1027 Please check if further analysis in the previous sections produces any modifications.

Minor technical corrections or comments

l.28 waves play a

l.42 applied to

l.92 we use

l.251-254: The problem of inferring certain GWs parameters from slanted radiosonde profiles has already been addressed more than 20 years ago (see e.g. doi: 10.1175/1520-0450(1995)034<2747:TIOWAP>2.0.CO;2).

l.281 in -> is

l.284 "."

l.289 "is" or "could be"

l.309 set

l.403 in either

l.435 of our

l.474 are have

l.476 than

l.499 westward in the intrinsic system

l.500 in a wave

l.547-548 Rephrase

l.648-650 Rephrase

l.681 selected

l.700 clear clear

l.718 of

l.826 occurs

l.862-863 Please include reference.

l.921 is is

l.968 results result

l.975-976 over South Georgia. . . over South Georgia

l.976 was found

l.977 match



l.1012 compared to

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