

Interactive comment on “A numerical study of mountain waves in the upper troposphere and lower stratosphere” by A. Mahalov et al.

Anonymous Referee #1

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This paper is a solid case study of the impact of vertically propagating mountain waves on the dynamics and the distribution of trace gases in the upper troposphere/lower stratosphere (UTLS) region. It combines in-situ airborne observations and numerical modelling. A successful application of a novel, recently published numerical approach (nesting of a LES-type model into a mesoscale weather prediction and research model) demonstrates the huge potential for future analyses of aircraft data.

In the study, the appearance of small-scale instabilities due to Kelvin-Helmholtz instabilities is deduced convincingly. Furthermore, the fluctuations of trace gases as O₃ and CO are discussed and their variability is explained.

Altogether, the paper is well written and logically structured. There are only minor comments, otherwise, the paper can be accepted.

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MINOR COMMENTS

The discussion in section 6 never mentioned the term "tropopause" (surprisingly for a paper on the UTLS, it appears only 5 times in the text). I believe, it is a known fact that the observed vertical gradients of O₃ and CO are a signature of the tropopause. Can a PV-diagnostic as computed from the model results help to classify the observed air masses as being located in the above/below the actual tropopause??

GENERAL

page 8: what is the meaning of ARW in WRF-ARW?

page 12 lines 7/8: try to avoid qualitative statements as "The observed and simulated profiles are in good agreement." This says nothing; specify the min/max or the mean standard deviations! See also page 18, line 12, page 21, line 11,

page 12, last paragraph: could you estimate if the vertical profiles of the Scorer parameter would allow for trapped waves and support your findings in such a way by predictions from linear theory?!

page 16, 1st paragraph: "The short-wavelength co-spectrum peak is not present at lower levels; this confirms that these short-wavelike fluctuations do not originate at mid- and upper-tropospheric levels." I don't understand the logic of this sentence. Isn't it just the opposite you want to conclude??

page 19: here, I expect a more physical discussion about the sampling in different air masses related to the tropopause.

page 19, line 10: "In an other hand" = "On the other hand" ?? Also on page 20, line 27.

page 19, line 22: delete one of both "negative"

page 20, line 20. Capital letter in Looking

Use SI units and their abbreviations ("h" instead of "hrs" and so on)

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FIGURES

There are 21 figures, some of them could be omitted (e.g. Fig. 1 or Fig 10), some could be combined (Figs 2 and 6,7). Generally, the quality is good. However, the readability of Fig. 18 could be enhanced by using different colors for the aircraft observations instead of dashed lines.

REFERENCES

- typing errors in Moustouli et al. 2010 (Grubisic), Plougonven et al. 2008 (Plougonven)

not cited in the text:

Dornbrack, A.: Turbulent mixing by breaking gravity waves, *J. Fluid Mech.*, 375, 113-141, 1998.

Wicker, L. J. and Skamarock, W. C.: Time splitting methods for elastic models using forward time schemes, *Mon. Wea. Rev.*, 130, 2088-2097, 2002.

not resolved in the reference list:

Fritts and Alexander, 2003 Dornbrack et al., 1999

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 11, 4487, 2011.