

Interactive comment on “The tropopause inversion layer in baroclinic life cycles experiments: the role of diabatic and mixing processes” by D. Kunkel et al.

Anonymous Referee #3

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General comments

This paper examined formation mechanisms of the tropopause inversion layer (TIL) in idealized baroclinic life cycle simulations using mesoscale model (with fine vertical resolution). Particularly, it focuses on the contributions from non-conservative processes (e.g., radiation and moist physics) in order to answer the question "how much do the non-conservative process affect the TIL?". The research question is clear and meaningful addition to previous knowledge based on dry-dynamics and radiation. The experiments and diagnostics are reasonably made and the paper is well written. This paper is recommended for publication in ACP. I have only a few minor comments and

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possible suggestions for the authors:

Specific comments (minor)

1. In Fig. 6, comparison between RAD and BMP is very interesting. As authors mentioned, both RAD and BMP show large ΔN_2 values near the tropopause, while only RAD shows significant PV change near the tropopause. BMP show minimal change in PV, and this strongly supports authors idea that BMP's contribution on ΔN_2 is largely due to upward motion (which is likely forced well below the tropopause). Further contrasting the two experiments in the text (around beginning paragraph in P21510) may be beneficial.

2. Related to Fig. 9, the early increase of N_2 in BMP RAD TRUB CONV SURF experiment is interesting, but is it only attributable to radiation process? This could also be due to direct effect of enhanced upward motion (mass flux could be interpreted this way too). Could you clarify which one contribute more? If this is not straightforward, mentioning the both possibilities of radiation and updraft (direct effect) may lead the discussion to be a more balanced.

3. First paragraph in P21514 (and Fig. 11): The initial importance of updraft and time behaviour of TIL seems interesting. However, this paragraph and figures are complex and difficult to understand unless read it several times. For example, Fig 11 has 12 panels, but not all the figures are necessary for the discussion. Further simplification will be helpful for readers (maybe comparison of two contrasting experiments, BMP vs RAD?).

Technical comments

P21505 L7: The abbreviation QADI sounds somewhat misleading. Although the saturation adjustment process is the most simple one, it gives enough latent heating as authors shows in Fig. 5b. In that sense, it is far from adiabatic process.

P21506 L11: BMP, RAD) => '(BMP, RAD) or may rephrase as "we compare results

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from the first four life cycle experiments (BMP, RAD, TURB, and REF)"

P21509 L7: "which increases the convergence of isentropic surfaces" => which enhances the vertical gradient of isentropic surfaces"?

P21509 L12: "Fig.6a and Fig.6b" do not match with Fig. 6; maybe Fig.6 (left panels) and Fig.6 (right panels)?

P21514 L25: feedback feedback => feedback

P21517 L14: "sharpening" is sometimes used for stronger TIL; this may be misleading. Could you rephrase this?

P21517 L27: relative => relatively

Table 1: Experiment names are confusing if you break it into two lines. Putting indent for the second line could be helpful.

Figure 13: This figures are somewhat redundant. Showing just one good example may be clearer.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 21495, 2015.