

## Comment on wcd-2021-13

Anonymous Referee #1

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Referee comment on "Relative importance of tropopause structure and diabatic heating for baroclinic instability" by Kristine Flacké Haualand and Thomas Spengler, Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2021-13-RC1>, 2021

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This is an interesting paper containing usefully insights into the relative role of shear and sharpness at the tropopause. It uses an idealised framework for the investigation, which as the authors acknowledge would require further investigation. This should not be seen as a criticism however as the idealised setting provides the ideal setting for testing ideas and forming hypotheses to be tested in a more comprehensive setting as long as limitations are clearly articulated.  
I feel the following points need to be addressed.

Comments:

Ln 10:

Last line of the abstract. This is slightly too strongly worded. Suggest including the word "may":

"These findings may indicate that tropopause sharpness is less important for baroclinic development than previously anticipated and that latent heating and the structure in the lower stratosphere may play a more crucial role, with latent heating being the dominant factor."

Ln 185: Is it true that that temperature cannot be defined, or is it just the definition is arbitrary (e.g. like zero point of heaviside function). Can it not be defined as the limit as a smooth tropopause tends to a discontinuity or a matching condition for equations above and below the discontinuity. This is a minor point.

Ln 190: "However, that we obtained qualitatively similar solutions for all smoothing ranges, including the sharp experiment, indicates the suitability of QG framework to explore the sensitivity to the sharpness of the tropopause." The rationale here is not clear to me. How does consistency

within the QG framework imply consistency in a more comprehensive setting? This needs to be explained more clearly or perhaps an acknowledgement that this is a limitation of the work included.

Ln 210: How is the non-zero vertical velocity and consequent advection across a discontinuous tropopause justified? Surely this would lead to raising, sinking of the tropopause level. In the Eady model this is avoided by enforcing zero  $\omega$  at the rigid lid. In the idealised setting discontinuous heating profiles are usually assumed to represent a change in state of the moisture - e.g. the lifting condensation level. What is the rationale for maintenance of the sharp tropopause in the present work? Simply small amplitude perturbations?