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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Influence of gravity wave temperature anomaly and its vertical gradient on cirrus clouds in the tropical tropopause layer – a satellite-based view" *by* Kai-Wei Chang and Tristan L'Ecuyer

**Anonymous Referee #1**

Received and published: 30 June 2020

Overall: I appreciate you incorporating my suggestions. They have improved the original manuscript in a significant way, and I fully expect your paper will be published after you complete the changes you've indicated are in process. Below I offer just a few additional thoughts on specific matters.

Specific Comments (by Line Number):

45: I need to clarify my previous comment to conform to the definition of the four gravity wave phases that you provided at the top of section 4 (lines 128-130 in the original MS).



If I understand correctly, P18's figure 3 appears to show the possibility of ice crystals present in three of the four phases. These would be phase 1 (air is cooling due to upward vertical motion, leading to ice nucleation), phase 2 (air begins to warm due to downward vertical motion, but in the presence of ice supersaturation, ice crystals may grow larger by vapor deposition), and possibly, phase 4, where sublimation occurs along with downward motion, shrinking any remaining crystals and returning their water content to the vapor state.

In my review, my mistake was to confuse phase 3 with phase 4. As the other reviewer, Aurelian has weighed in to say that his figure 3 is purely "pedagogic," i.e., that he didn't mean to imply that clouds could exist where RHi < 100% (phase 3 or 4), but I slightly disagree, since once ice crystals have grown to reach a maximum size, they can still exist for a finite time in downward moving, sub-saturated air. Granted, whether they would do so would highly depend on individual wave morphology as well as the localized temperature and moisture profiles.

Figure 4 update: It does really seem as if clouds formed by waves (i.e., above the tropopause) are less likely to be observed in both warm phases (regardless of season), but especially so in phase 3. Clouds seem to be a bit more likely to be detected in phase 2 during DJF.

Figure 11 update: I like the new line plot showing the dependence of cloud presence on RHib within phases 1 and 2, especially in sub-saturated conditions, as well as the distribution of RHib in clouds.

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