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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

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Hi Aurelien,

I'll briefly respond to your clarification relating to my comment regarding lines 44-46 of the original MS. As I've indicated to the authors in my response to their list of corrections, I was confused about the numbering of the four wave phases. I meant to refer to phase 4 instead of phase 3. Also, as I didn't really intend to put aside the effect of ice saturation, let me explain how I understand relative humidity variations to affect the process of air moving through the wave.

Phase 3 should be in fact, the least likely quadrant to encounter ice crystals. As I explained to the authors, air initially rising & cooling during phase 1 will (given sufficient supersaturation) nucleate ice crystals. During phase 2, the air is starting to sink and warm, but is still cold with RHi near or above 100%, allowing crystals that have already formed to grow larger by vapor deposition. What would be observed next in phase 4, where the warming, sinking air becomes sub-saturated, would really depend on how large the ice crystals grew, the particular wave motions, and the background state conditions. It seems that if available moisture is lacking, the crystals would be pretty much disappear while in phase 2, leaving phase 4 cloudless. However, if there's a lot of available vapor, some crystals could survive for a short time as the wave processes an air parcel through phase 4 ($w' < 0$ with $dT'/dZ > 0$).

I think your "P18" figure 3, while "pedagogic" is still valid in principle. The authors of the current manuscript will be changing their figure 4 to compare cloud distributions observed above the tropopause with those found within the TTL in general. Granted, the number of samples confined to the upper TTL is somewhat sparse compared to the larger dataset. Still, it would appear that filtering out the convective influence from the upper troposphere seems to shift the cloud distribution to increase the proportion of clouds in phase 2, and also has a slightly greater impact on reducing cloud encounters within phase 3 than in phase 4. Granted, the signal in the warm phases may be rather faint in these CALIPSO cloud observations.

I appreciate your comment and hope this clarifies my position.

Reviewer #1

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