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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Analysis of cirrus cloud over the Tibetan Plateau from CALIPSO data: an altitude perspective" *by* Feng Zhang et al.

**Feng Zhang et al.**

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1. Indeed, the gravity waves (GWs) frequently occur around the Tibetan Plateau and the GWs possibly contribute to the cirrus formation. However, I am afraid you have not proved that the cirrus is caused, or partly caused by GWs. In Fig. 2 and Fig.3a, the "gravity wave acceleration less than 0" from JRA-55 products(if it could be considered as an index of GWs occurrence) appears at the location with and without a large number of cirrus, which indicates that the GWs may have no relevance with the occurrence of the cirrus. So I do not think it is a very convincing explanation for the cirrus formation and maybe the causality between the GWs and the cirrus should be further justified. The effects of the GWs could not be verified without talking about the amplitudes. Would you please include the figures of the GWs derived from the data and method



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of your choice? And would you please show the amplitude of the GWs? And from my own experience, limited by the horizontal and vertical resolution, the re- analyses, even the ERA5, could not give a nice picture of GWs in the upper troposphere and stratosphere. I think high-resolution model simulations might be necessary for this study. P.S. in Section 3, the statements about GWs from previous studies are mixed with your results. Even though the previous studies are nicely cited, it is difficult for readers to separate your results with others'.

Response: By using Lorenz-type decomposition, the perturbation is decomposed into stationary part and transient part. The stable part is mainly caused by geographical factors, while the transient part is mainly caused by the fluctuations in the atmosphere such as gravity waves. Here is the Lorenz decomposition formula:

where overbar () and prime (âĂš) represent the temporal mean and anomaly. Similarly, bracket (< >) and star (*) represent the spatial mean and anomaly. Thus, and are the stationary part and the transient part, respectively. When Lorenz-type decomposition is applied to the temperature field, the transient part is regarded as the temperature fluctuation which contributes to the formation of cirrus cloud. Figure 1 shows the distribution of temperature fluctuation and specific humidity, respectively. The fluctuation in temperature field is induced by gravity waves and some other convective activities. Although the temperature fluctuation in the northwest is also significant, the water vapor there is not enough to form cirrus clouds. 2. All of the key elements, e.g., the subtropical jets and the OLR in the Northern Hemisphere, the convections at the Tibetan Plateau, the occurrence of the cirrus are substantially subject to seasonal variations. I would suggest you at least separate the situations between winters and summers. Response: Thanks for your suggestion. Our study focus on the formation of cirrus in summer. It would also be interesting to explore the cirrus in winter over the TP in the future.

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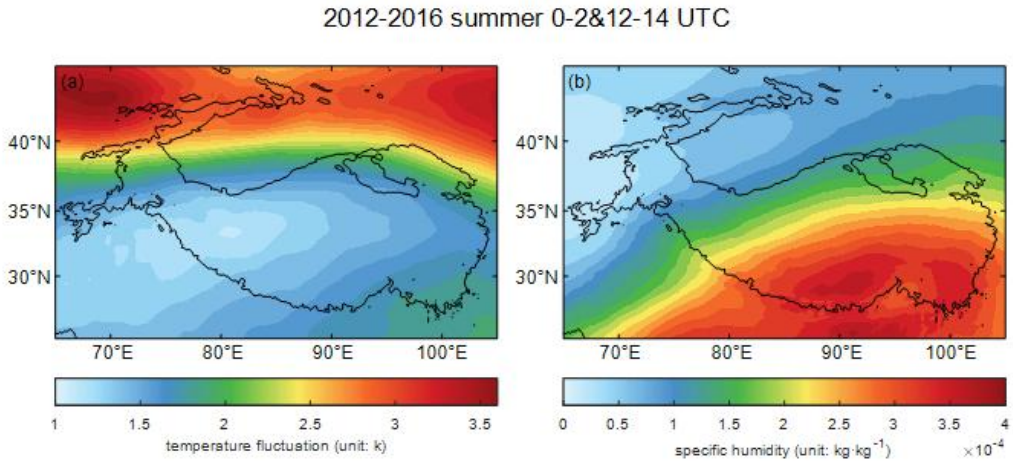


**Fig. 1.** distribution of temperature fluctuation and specific humidity



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