

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-491

Anonymous Referee #1

Referee comment on "Aircraft observations of gravity wave activity and turbulence in the tropical tropopause layer: prevalence, influence on cirrus clouds, and comparison with global storm-resolving models" by Rachel Atlas and Christopher S. Bretherton, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-491-RC1>, 2022

Review of the manuscript "Aircraft observations of gravity wave activity and turbulence in the tropical tropopause layer: prevalence, influence on cirrus and comparison with global-storm resolving models"

General comments

The manuscript analyses aircraft observations as obtained from five different measurement campaigns to study the presence of gravity waves and turbulence in the tropical tropopause layer. The study explores relations between the occurrence of gravity waves and turbulence and the distance from deep convective clouds, as diagnosed from satellite images, and the presence of cirrus clouds. The work confirms some existing results, but also highlights some important new ones such as the correlation between gravity waves and turbulence with the microphysical properties of cirrus. The observations are also used to demonstrate that the spectral power of the vertical wind is lower in results from high resolution storm resolving models.

The analyses are clearly explained, the paper reads well and the topic is of interest to the readers of ACP. I only have a few minor suggestions. I recommend to accept the manuscript for publication in ACP.

Suggestions

line 13 "Consistent with a previous study". Mention the kind of study (observations/modeling)?

line 41 "vertical motions strongly influence TTL cirrus microphysics, by initiating new instances of homogeneous freezing". Could you give a short physical explanation how/why this could work?

line 99: "Flight legs that are less than 100 km long and for which the assumption of small mean wind may be less applicable are removed". What could be reason for the presence of high mean vertical wind velocities, is this possibly due to measurement errors or could there be a physical mechanism involved?

line 111: It is stated that the constant of proportionality (α) in the spectral power relation ($P_w = \alpha \epsilon^{2/3} k^{-5/3}$) is dependent on the aircraft speed and the sampling frequency. Is there a reference for the reader who is interested in these details?

l294: wave momentum flux. is it possible to determine momentum fluxes from the observations similar to obtaining the vertical velocity variances? Likewise for the heat flux? Are the turbulent patches also characterized by enhanced variances for the horizontal velocity and temperature?

Fig. C1, line 425: it appears that bottom right and bottom left plots have been swapped (bottom left = short wavelength gravity and not turbulence)?