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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long-lived contrails and convective cirrus above the tropical tropopause" *by* Ulrich Schumann et al.

Anonymous Referee #3

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General comments:

This manuscript presented analysis of measurements made during the SCOUT-O3 field experiment concerning long-lived contrails and convection-induced cirrus above the tropical tropopause. While contrails in the upper troposphere occur quite frequently and have been studied extensively in the past, those occurring in the lower stratosphere at very cold temperatures and low turbulence environment are considered rare cases. The very long lifetime ($\sim$1h) of the stratospheric contrail in a sub-saturated environment is especially remarkable. An effective procedure was used by the authors to separate encounters of contrails from other naturally-occurring stratospheric cirrus, which I find very interesting.

The paper also studies stratospheric cirrus that was likely produced by overshooting

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Discussion paper

deep convection (Hector) near Darwin Australia. A suite of synergistic measurements were utilized to bear on the stratospheric cirrus case, including in situ data (from Geophysica), downward-looking lidar (from Geophysica), upward-looking lidar (from DLR Falcon), ground-based CPOL radar, and satellite IR images. The authors compared the in situ measurements of stratospheric cirrus microphysics with that inferred from lidar and radar data.

The most rewarding part for me to read the manuscript as a reviewer is the detailed discussion written by the authors. The discussions placed the observations in a broader context. I started to better understand the significance and mechanism of the long lifetime of the stratospheric contrail. The authors also weighed evidences in an effort to explain the origin of the stratospheric clouds observed, i.e., whether they are produced by the exhaust of Geophysica or by the Hector cloud. I can clearly see that the senior author's many years of experience in this field gives him a unique vintage point to deliver these nice discussions.

There is one improvement I'd like to suggest: the body part of the paper, namely, Section 3 (Results), is not very well organized. After reading it, I felt as if I've been walking in the woods, seeing many trees, but not sure where I was led to. Each observation and discussion in Section 3 seem interesting by themselves, but it's just how they are connected to the punch line or key points of the paper that is easily lost to me. I had to read the section several times to piece together the whole story. It would be easier if the authors can present a clear road map in the introduction, and perhaps give us a preview of the key results and main findings of each subsection.

Overall, I find this paper interesting and believe it should contribute to the literature. I'd suggest minor but mandatory revision.

Specific comments:

(Page 5, Lines 25-26) Some more discussion is needed to elaborate how the two extreme temperature readings are related to overshooting convection. Which extreme?

Warm or cold extreme?

(Page 12, Line 9) Shouldn't Figure 6b be Figure 6d? I don't see any "black circles" on Fig. 6b.

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