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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Revisiting global satellite observations of stratospheric cirrus clouds" *by* Ling Zou et al.

Anonymous Referee #2

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General Comments:

This carefully written manuscript advances our global/seasonal estimates of the occurrence frequency of cirrus clouds that, for CALIPSO satellite measurements, reside 0.5 km or higher above the tropopause; that is, stratospheric cirrus clouds. Polar stratospheric clouds or PSCs, primarily occurring over Antarctica, have been filtered out of this data set, and are not considered. This study builds on other studies by using for the first time the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS; onboard ESA's Envisat) limb measurements to detect stratospheric cirrus clouds 0.75 km above the tropopause (identified using ERA-interim global reanalysis). Due to the larger sample volume of the MIPAS atmospheric limb measurements, MIPAS can detect cirrus clouds down to optical depths of 2 x 10-5 compared to a detection threshold

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for CALIPSO of 1 x 10-3, resulting in 2 to 3 times more stratospheric cirrus cloud occurrence frequencies outside the tropics relative to CALIPSO.

I have only six fairly minor comments listed below. The paper is very well written and organized and makes a significant contribution to our knowledge of stratospheric cirrus clouds. The scientific methods and assumptions are valid and clearly outlined, and the results appear traceable.

Major and Minor Comments:

1. Line 23: Not all cirrus clouds are optically thin; suggest removing “optically thin”.

2. Lines 31-37: Cirrus cloud occurrence frequencies vary considerably partly due to satellite instrument sensitivity (as mentioned here), but this may also depend on how cirrus clouds are defined (e.g. in terms of a temperature or altitude threshold, or in terms of pressure and optical depth as with ISCCP, etc.). Please indicate the cirrus definition when citing estimates of occurrence frequency for cirrus clouds.

3. Lines 123-133: How is ACI calculated? Is it simply the largest of the two values [i.e. ACI=max(CI, AI)]?

4. Lines 192-194: The JJA band of enhanced (4-8%) stratospheric cirrus downwind of the southern tip of South America is a “hotspot” for mountain-induced stratospheric gravity wave formation as described by Jiang et al. (2002, JGR) and Hoffmann et al. (2016, ACP), although the maximum in gravity waves in Jiang et al. is during SON (rather than JJA as shown in Hoffmann et al.). This suggests that the observed stratospheric cirrus enhancement in Fig. 3c resulted from mountain-induced gravity waves. The occurrence frequency for relatively thick ($0.3 < \tau < 3.0$) cirrus clouds downwind of the Southern Andes was found to be greatest during JJA in Mitchell et al. (2016, ACPD; see Mitchell et al. 2018, ACP, for additional details), corroborating the results of this study somewhat.

5. Lines 388-390: Please indicate that this sensitivity refers to cloud optical depth.

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6. Line 410: Suspect typo: "1% at nighttime" => "1% during daytime"?

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2020-304/acp-2020-304-RC1-supplement.pdf

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