Third Review of

Properties of ice clouds over Beijing
from surface Ka-band radar observations during 2014–2017

by Juan Huo et al.

General: The paper has again improved, but my assessment remains that the data set is very interesting, the scientific evaluation and the writing style could still be upgraded. Nevertheless, I'll now recommend the paper for publication with 'minor revisions'. However, I would like to recommend the authors to please submit more mature papers in future to avoid such lengthy review processes with several revision cycles.

1) Lines 19-21: ‚*Our analysis indicates that most cirrus clouds are of the in situ-origin type in winter and autumn; the in situ-origin type cirrus clouds are more common than liquid-origin cirrus clouds in spring, while summer features more liquid-origin cirrus clouds.*‘

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‚Our analysis indicates that in spring, in situ-origin cirrus are more common than liquid-origin cirrus, while in summer liquid-origin cirrus are more frequent; in autumn and winter, most cirrus clouds are of in situ-origin.‘

2) Line 27: ‚*Cirrus clouds are dominated by ice crystals. Studies show that the occurrence frequency of the cirrus clouds exhibits latitudinal variability ...*‘

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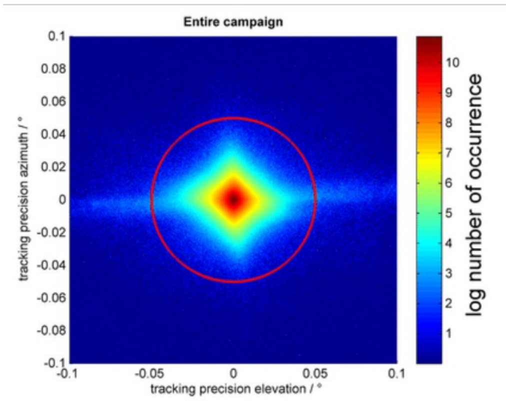
‚Cirrus clouds consist solely of ice crystals. Their occurrence frequency exhibits latitudinal variability ...‘

3) Lines 71-79: ‚*For comparison, the 94 GHz cloud profiling radar (CPR) on CloudSat has a sensitivity of approximately −30 dBZ.~~As shown by in situ measurements, the number density of ice particles often peaks at particle sizes between 100 and 1000 µm in effective diameter (Heymsfield et al., 2013).~~* This sentence is neither needed nor correct.
Calculations or measurements of radar reflectivity in previous studies reveal that the reflectivity of ice clouds over mid-latitude regions are mostly larger than −30 dBZ (Deng et al., 2010; Pokharel and Vali, 2011; Matrosov and Heymsfield, 2017). Therefore, KPDR is capable of detecting most ice clouds over Beijing. However, the Ka- band radar is more sensitive to larger particles in a cloud target since the reflectivity is proportional to the D6 (D is particle size). For the CPR, thin ice clouds with ice water content (IWC) lower than approximately 0.4 mg/m3 are invisible (Wu et al., 2009). It is possible that KPDR ~~may~~ miss some thin ice clouds when they ~~only~~ consist of ~~very~~ small ice crystals (i.e., D less than 20 µm) or the IWC is smaller than 0.4 mg/m3.‘

4) Line 88: ‚*Ice clouds ~~is~~ are composed of various types of ice crystals and ~~is~~ are usually thin.*‘

5) point 12) of the last review:

A logarithmic color code is usually used for a wide range of values to be displayed. Below is an example from the Internet - please redo Figures 5 and 6 in this way:



https://www.researchgate.net/figure/Both-figures-show-occurrence-of-tracking-errors-in-logarithmic-color-code-The-left_fig2_281982255

6) point 15) of the last review, new lines 334-339:

‚In the four seasons, the 'n' at −45°C is the biggest among all temperatures, indicating that cirrus cloud appears more frequently at −45°C than at other temperatures. This is the result of the combination of temperature, water vapor and upward movement. For example, the lower the temperature, the more conducive it is to the formation of ice particles (this is not correct). *On the other hand, limited upward movements determine the maximum height (lowest temperature) where water vapor or cloud particles can reach* (this is not correct). *Spring has the biggest 'n' at each temperature, indicating that cirrus clouds in spring are the most frequent, which has also been shown in Fig. 2.‘*

The finding that cirrus clouds appear most frequent at −45°C is consistent with the findings of Krämer et al. (2020) from 10 years of satellite observations (what is great!). The reason is that at these altitudes both in situ origin and liquid origin cirrus appear, whereas at colder temperatures only in situ origin cirrus exist. Please change the explanation accordingly.

Krämer, M., Rolf, C., Spelten, N., Afchine, A., Fahey, D., Jensen, E., Khaykin, S., Kuhn, T., Lawson, P., Lykov, A., Pan, L. L., Riese, M., Rollins, A., Stroh, F., Thornberry, T., Wolf, V., Woods, S., Spichtinger, P., Quaas, J., and Sourdeval, O.: A Microphysics Guide to Cirrus – Part II: Climatologies of Clouds and Humidity from Observations, Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-40, in review, 2020.