

This manuscript presents a valuable and comprehensive investigation of horizontally oriented ice crystals (HOICs) using a near-year-long dataset covering 354 observation days with dual-angle polarization lidars and a cloud Doppler radar. Given the scarcity of long-term, range-resolved observations of HOIC occurrence at high spatial and temporal resolutions, the dataset presented in this study is particularly valuable. The authors combine statistical analyses with representative case studies, providing useful insights into the macrophysical and microphysical characteristics of HOICs.

The methodology is generally appropriate, the observational dataset is substantial, and the manuscript is well structured and clearly written. The topic falls within the scope of Atmospheric Chemistry and Physics. I recommend publication after the authors address the following minor comments and technical corrections.

Reply: We sincerely thank Referee #3 for reviewing our paper and providing constructive comments for improvement. Responses to these comments are provided below. In this author's comment, we reply (in blue font) to Referee #3's comments (in black font). The relevant part in the revised version is in green font.

Specific Comments:

1. Please moderate definitive expressions such as "fully demonstrates." For example, Section 3.2, line 234 states, "This case fully demonstrates that...". Because evidence from a single case can illustrate or support an interpretation but cannot fully demonstrate a general mechanism, I suggest replacing "fully demonstrates" with "illustrates," "suggests," or "provides evidence that."

Reply: Thank you for your comment! We agree that the original wording was overly definitive for evidence derived from a single case. We have replaced "fully demonstrates" with a more cautious expression "illustrates" as you suggested. The revised sentence (Sect. 3.2, Line 259–260) reads:

"This case illustrates that the presence of SWCs is a favorable condition for the occurrence of HOICs."

2. The caption of Figure 11 states, "To ensure a causal relationship...". This wording is too strong. Requiring the selected SWCs to occur earlier in time and above the ice-crystal observations makes the analysis physically consistent with the sedimentation process, but it does not establish a causal relationship. I suggest revising this sentence to: "To make the analysis physically consistent with ice-crystal sedimentation, the selected SWCs must temporally precede and be located above the observed ice crystals." Related causal statements in the main text should also be moderated where appropriate.

Reply: Thank you for the suggestion. We have revised the sentence in the caption of Fig. 11 to:

"To make the analysis physically consistent with ice-crystal sedimentation, the selected SWCs must temporally precede and be located spatially above the observed ice crystals."

In the main text, we have also reviewed the related discussion and moderated causal wording

to emphasize the observed spatial and temporal association between SWCs and HOICs rather than a demonstrated causal relationship.

“This phenomenon is underpinned by a distinct cloud microphysical mechanism” is changed as (Line 629 in revised version):

“This phenomenon is physically consistent with a potential cloud microphysical mechanism.”

“we propose that the formation of HOICs is closely linked to microphysical processes dominated by supercooled liquid water layers” is changed as (Line 630 in revised version):

“we propose that the formation of HOICs may be closely linked to microphysical processes involving supercooled liquid water layers”

3. The manuscript identifies an EDR of approximately ($10^{-2} \text{ m}^2 \text{ s}^{-3}$) as a dynamical threshold for maintaining the horizontal orientation of ice crystals. Because this value is derived from observations at a single site during one year and may depend on the retrieval and classification methods, “threshold” could imply a universal and sharply defined physical limit. Please consider describing it as an “approximate empirical threshold,” “characteristic transition value,” or “observed transition range,” and clarify that its broader applicability requires further evaluation.

Reply: Thank you for pointing this out. This EDR value of approximately $10^{-2} \text{ m}^2 \text{ s}^{-3}$ is based on our observation in the Beijing dataset in 2022, which may not be a universal physical threshold. We agree with your suggestions; we should be careful about the wording. We have changed the “dynamical threshold” to “approximate empirical dynamical threshold” in the main text (Line 678–Line 679):

“An EDR of approximately $10^{-2} \text{ m}^2 \text{ s}^{-3}$ can be considered one of the approximate empirical dynamical thresholds for maintaining large-scale horizontal alignment of ice crystals.”

4. Figures 1, 8, and 9 use local time. Please specify the corresponding time zone and UTC offset in the figure captions and, where appropriate, for example, “China Standard Time (UTC+8)” if this is the time standard used throughout the study.

Reply: Thank you for the comment. Throughout this study, we use local time (China Standard Time, UTC+8). We have added “China Standard Time (UTC+8)” to the corresponding description in the last sentence of Sect. 2.1 to describe the time zone used:

“The time used in the paper is local time (China Standard Time, UTC+8).”

We have also revised the captions of Figs. 1, 8, and 9 to specify “Local time (UTC+8).”