Comments on “IceDetectNet: A rotated object detection algorithm for classifying components of aggregated ice crystals with a multi-label classification scheme” by Huiying Zhang et al. (https://doi.org/10.5194/egusphere-2023-2770)

The manuscript proposes a novel ice crystal classification method that employs a two-step process. Initially, a rotated object detection algorithm (IceDetectNet) is applied to categorize the individual component of aggregated ice crystals. Secondly, a multi-label classification scheme is applied, whereby the ice crystals are categorized according to their basic habits, as well as the physical processes that modified them. The IceDetectNet algorithm was trained and tested on data sets obtained from a holographic imager.
The proposed classification method represents a step forward and an improvement compared to traditional machine learning approaches. However, in its current form it is subject to a number of limitations.

It is acknowledged that the authors have addressed the majority of the comments that were raised during the previous reviews. Particular attention is paid to the first and second reviews from Reviewer 1 in which concerns about the accurate labeling of the ice crystal shapes were raised. Within the first and second revision the authors provided a slightly improved version of the main text and added Appendix B. However, the figures given in Fig. 2B still raise questions. In case that the individual crystal images are truly randomly selected, the figure provides evidence of potential false classification: Needles might be falsely classified as columns. In this regard I do agree with Reviewer 1 (1st and 2nd round) that several crystals in the “column-aged”, “CPC”, and the “column-aged-aggregate” category appear to be needles. This raises the question of weather the appearance of the needles is deliberate (e.g., selected as columns) or a miss-classification during the training or the application.

A further critical aspect are the chosen shape categories. Although the selection of ice crystal shapes and physical processes was justified based on the training data set, the selection is however unconventional. For example the distinction between “small” vs “irregular”, as small refers to size and irregular refers to shape. Strictly speaking, it is a comparison of size and shape. Also the choice to differentiate between “pristine” and “aged” is an unlucky selection, in my opinion. Here, pristine refers to shape, while aged refers to a temporal development. While this distinction and the categorization of ice crystals in the manuscript may be applicable to this specific data-set from Ny-Ålesund, it limits the applicability to other data sets and makes it challenging to compare results obtained from IceDetectNet with those from the existing literature.

In this regard, I acknowledge the discussion of the limitations of the current version of IceDetectNet in Section 5. However, it would be fair to the reader of the manuscript / paper to explicitly mention these limitations in the Introduction and the Conclusion. By "limitations” I refer to the restricted shapes in the training data set as well as the unconventional selection of ice crystal shapes and microphysical classes.

The manuscript can be considered for publication, when the limitations from above are explicitly mentioned in the introduction and the conclusion part.

Minor comments:

Line 505 / 507: FigB2 is called before FigB1, so I suggested to change the labeling to keep the order.