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Interactive comment on "Brief communication: Rapid machine learning-based extraction and measurement of ice wedge polygons in airborne lidar data" *by* Charles J. Abolt et al.

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Summary: The manuscript presents a machine learning-based workflow to perform extraction and measurement of ice wedge polygons (IWP) from digital elevation model (DEM). The major contribution of this study is the use of a state-of-the-art convolutional neural network (CNN) and other computer vision algorithms to map troughs and polygonal boundaries. A couple of major concerns must be addressed before considering for publication. Therefore, I suggest a major revision before further consideration.

1. Page 1-Line 22: troughs are not always polygonal boundaries. Polygonal boundaries can be rims.

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2. Page 1-Line 23: "The same techniques could be applied to any form of remotely sensed data with sufficient spatial resolution". Please try not to make this kind of statement without any supportive evidence. For example, it's widely known that extracting actual boundaries of buildings in LiDAR data is much easier than even in very high resolution optical imagery.

3. Page 2-Line 11-19: As a technical paper with a focus on applications of machine learning/computer vision in Arctic IWP mapping, some related articles are not mentioned. Some methods have been previously proposed for mapping polygonal terrains, such as: (1) Pina P; Saraiva J.; Bandeira L.; Antunes J. (2008) "Polygonal terrains on Mars: A contribution to their geometric and topological characterization", Planetary and Space Science, 56, 1919-1924. (2) Bandeira L.; Pina P.; Saraiva J. (2010) "A multi-layer approach for the analysis of neighbourhood relations of polygons in remotely acquired images", Pattern Recognition Letters, 31, 1175-1183. (3) Zhang, W.; Witharana, C.; Liljedahl, A.; Kanevskiy, M. (2018). "Deep Convolutional Neural Networks for Automated Characterization of Arctic Ice-Wedge Polygons in Very High Spatial Resolution Aerial Imagery". Remote Sensing, 10(9), 1487.

4. Page 2-Line 11-19: The method (Mask R-CNN) used in the paper "Deep Convolutional Neural Networks for Automated Characterization of Arctic Ice-Wedge Polygons in Very High Spatial Resolution Aerial Imagery" is an end-to-end object instance segmentation mapping solution for optical RS imagery with much less required training data and steps than the proposed "Polygon delineation algorithm". Besides delineating IWPs precisely, the paper reports relatively accurate classification of IWP type. Please carefully justify the benefit of using the proposed workflow in the introduction section.

5. Page 2-Line 30: Please provide the size of two study areas in Study areas and data acquisition section instead of Page 6-Line 9.

6. Page 3-Line 20: It is difficult for readers to understand the workflow without a schematic. Please add a schematic of the proposed workflow in the Method section

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because Figure 1 only shows some intermediate results.

7. Page 4-Line 1-5: Please explain each threshold setting here. For example, why did you set a radius as 20m in 2D filter; why did you set a minimum intensity to depression of 0.7 m or greater; . . .

8. Page 4-Line 9. “a CNN is a classification tool which accepts images of a fixed size (in our case, 27×27 grayscale arrays) as input and generates categorical 10 labels as output.” From I see in Figure 1A, it does not look like a 27 rows by 27 columns input image.

9. Page 4-Section 3.1.2 Convolutional neural network. I suppose the authors conducted this study not earlier than 2017. (1) I wonder why the authors did not use an advanced CNN instead of a 7-layer CNN. A lot of advanced CNN architecture had been developed and shown amazing capacity in pattern recognition. Please provide reasons. (2) How many test data did you use to achieve 99% accuracy?

10. Figure 2. Edge misalignment is a common issue using any CNN to process a large picture. I do not see any edge misalignment issue in Figure 2. How did you stitch all partitioned (27*27 pixels) patches together?

11. Quantitative validation is necessary to assess the performance of the proposed workflow. Please provide an assessment of the delineation.

12. Figure 2: two study sites are two small extreme cases (1 km2) filled with IWPs. A case study with a diverse landscape and large area is expected to support the effectiveness of the proposed workflow. Please take your time and carefully address this concern.

13. Please make sure all maps have some essential components, such as scale bar and north arrow.

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