

MAPPING OF GEOLOGICAL FRACTURES: A CNN APPROACH

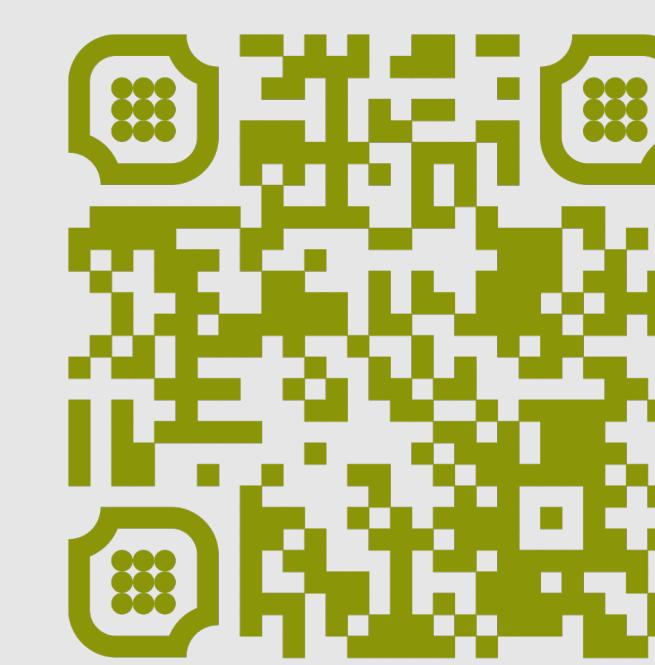
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INTRODUCTION

- Natural fractures can create permeable fluid pathways that are important for geo-energy applications such as CO₂ sequestration and geothermal projects [1].
- Drone and LiDAR-based acquisition methods produce high-resolution 2D data, suitable for detailed fracture mapping [2].
- Manual and semi-automated fracture mapping is time-consuming and susceptible to interpreter bias [3].

Interactive results ▾

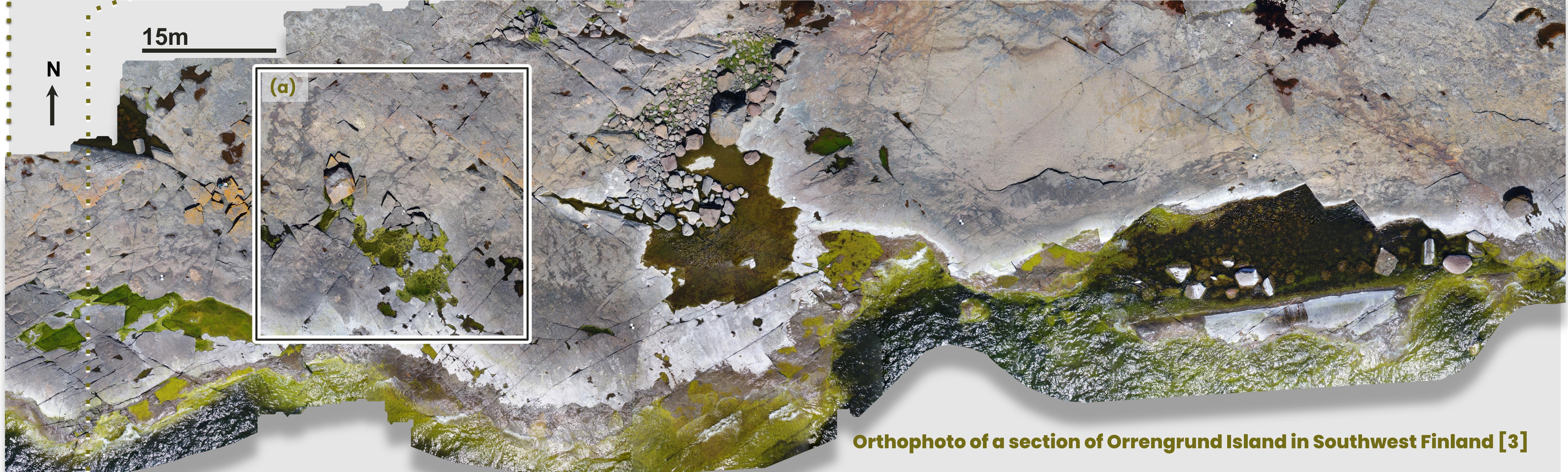


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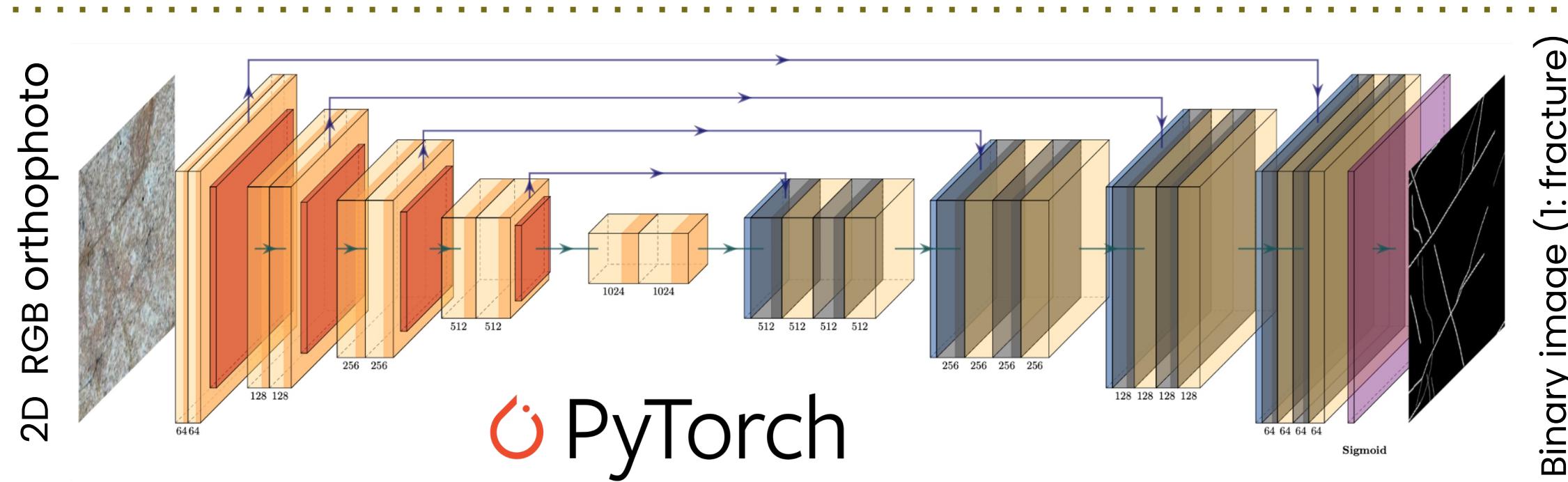
Automatic: No manual intervention required;
Accurate: Results closely match real fractures and unaffected by interpreter bias.

Can we use deep learning (Convolutional Neural Networks) to automate 2D fracture mapping for quick and accurate results?



Orthophoto of a section of Orrengrund Island in Southwest Finland [3]

METHODS



MODELS:

All based on convolutions

- U-Net [4]
- DeepLabV3+ [5]
- PAN [6]

Post-processing

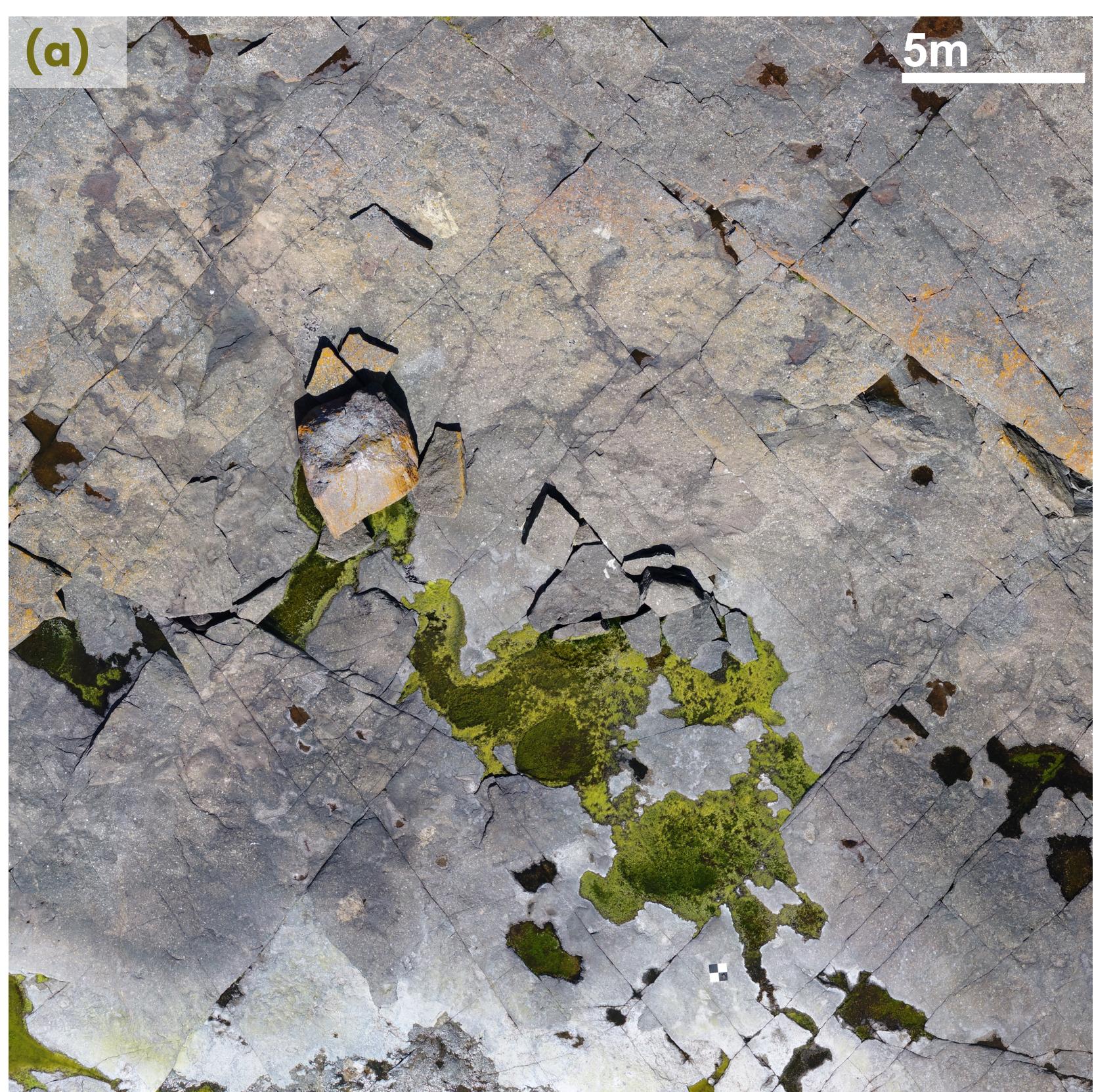
- a.Thin
- b.SMOOTH
- c.Vectorize

RESULTS AND DISCUSSION

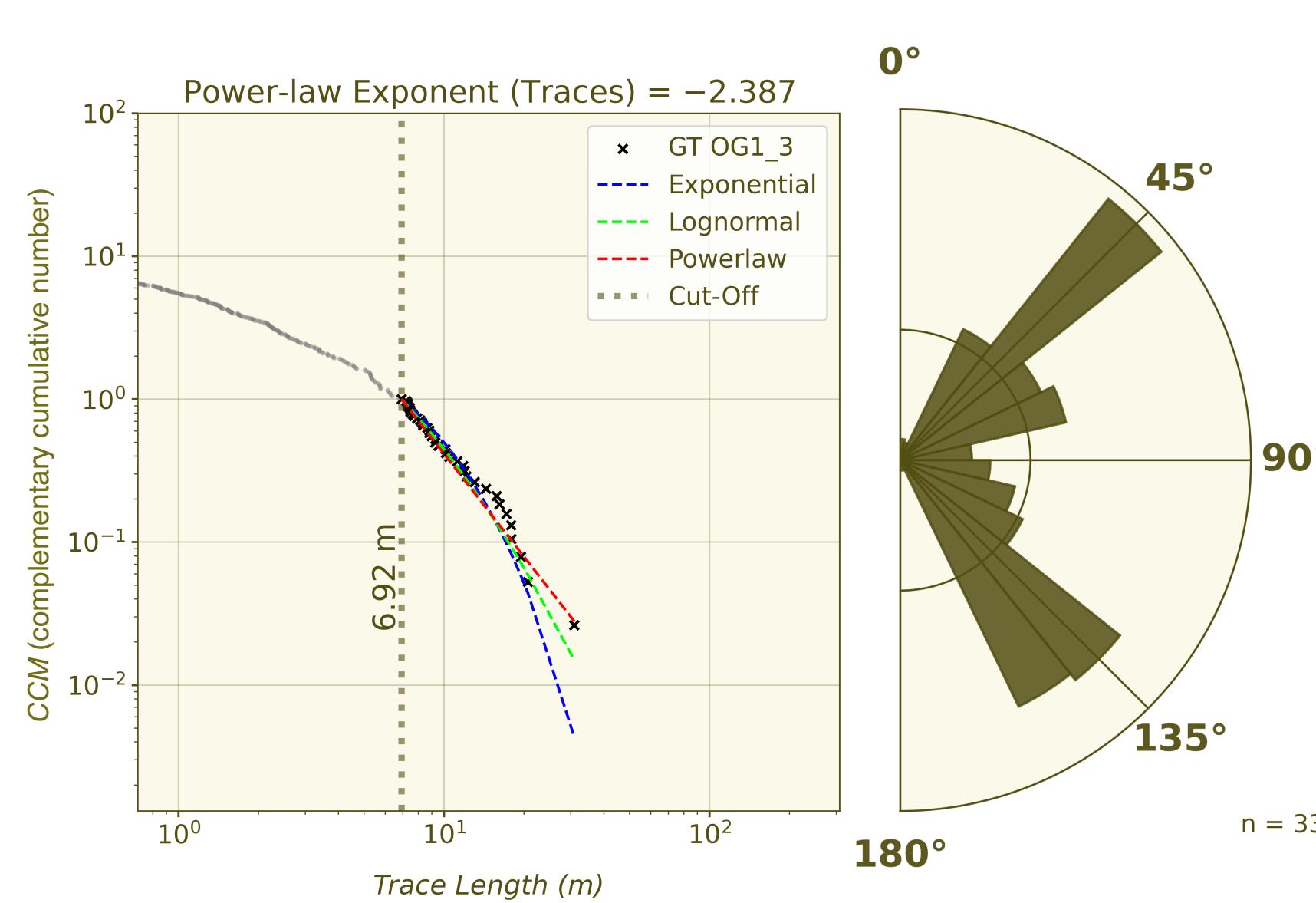
Results

- The model generates more segments, with some being very short (noise)
- The model's trace length distribution has a lower cut-off value
- Rose diagrams have similar directional pattern

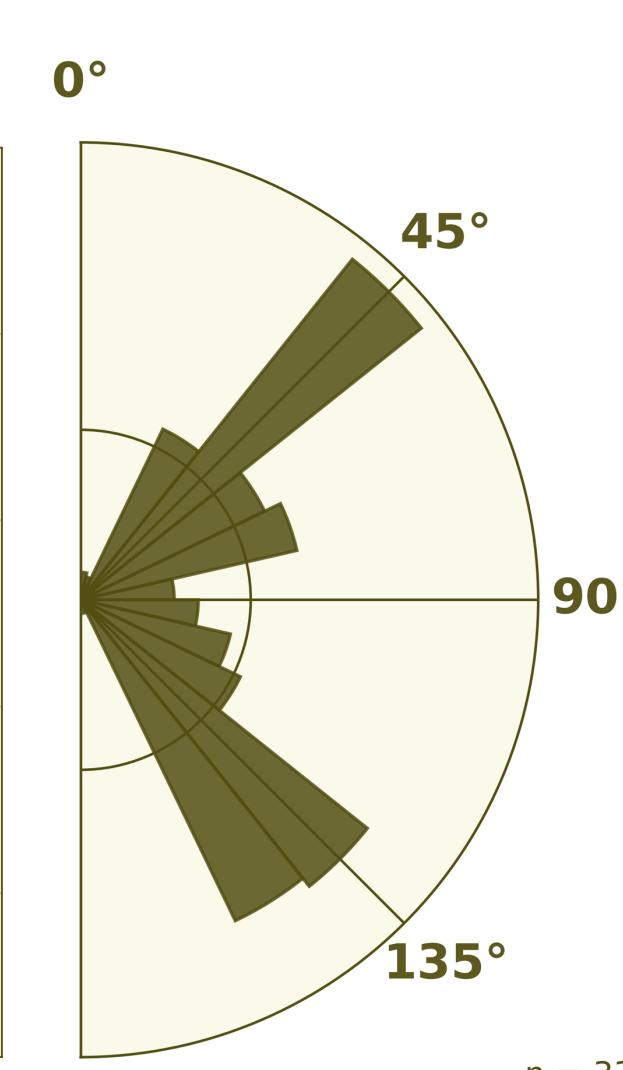
- (a) Portion of the test dataset (OG1) [3]
(b) **Manual mapping** (geologists' interpretations): Ground truth [7] and its respective fracture trace length distribution and rose diagram created using fractopo [8]
(c) **Automated mapping**: Predictions of the PAN model and its respective fracture trace length distribution and rose diagram [8]



✓ Automatic



✓ Quick



⚠ Accurate

