

Semantic Segmentation of Aerial Lidar Data within GRiD

Brad Chambers

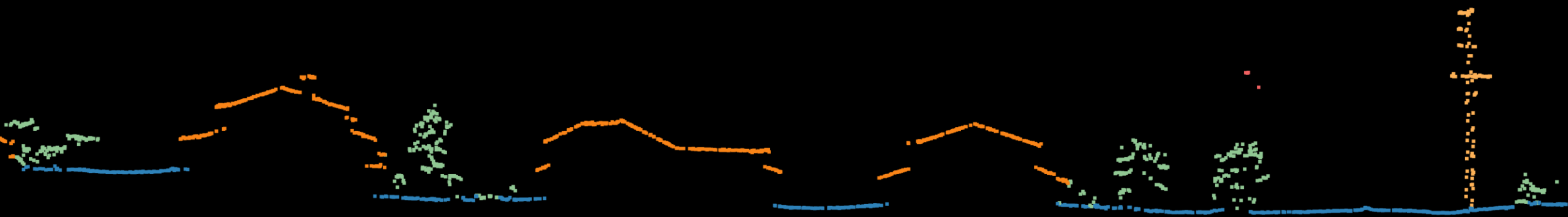


Overview



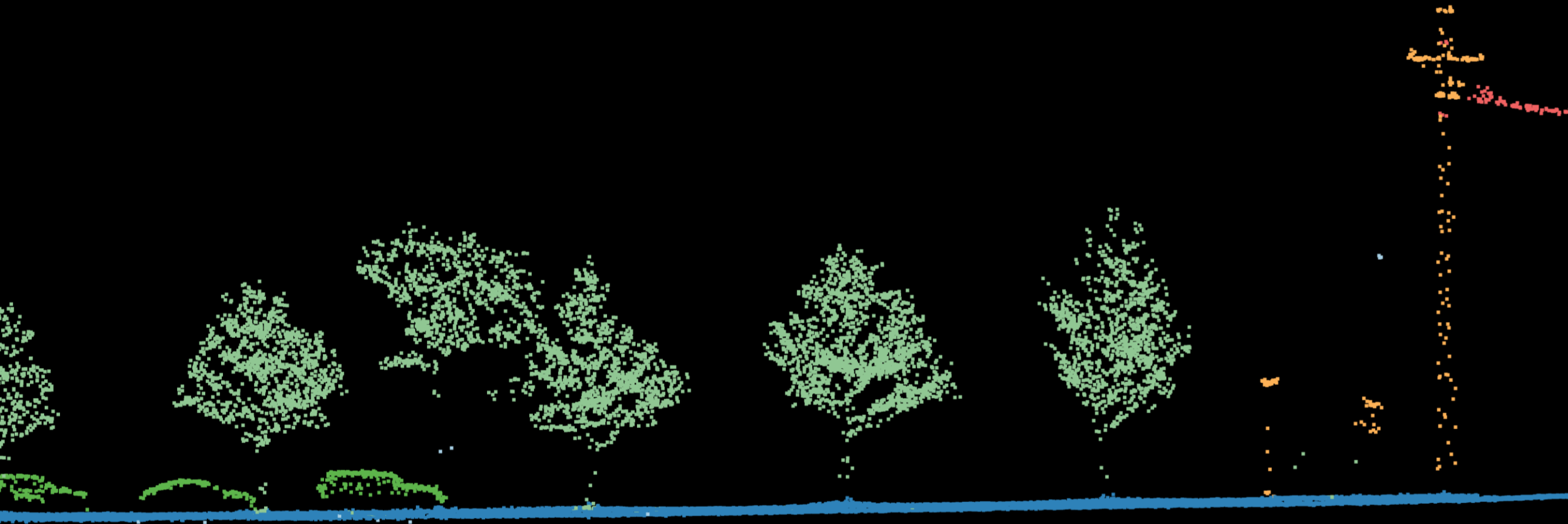
- Data & metrics
- Illustrated history of semantic segmentation within GRiD
- Performance trends
- Impacts to downstream processes
- Next steps

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Data Overview

US3D

- US Cities
- Jacksonville, FL & Omaha, NE
- 110 training tiles (84Mpts)
- Median 2.35 pts/m²
- Class Distribution
 - Ground 65%
 - Vegetation 14%
 - Building 13%
 - Water 2%
 - Bridge %1
 - Unlabeled 2%



Le Saux, B., Yokoya, N., Haensch, R., & Brown, M. (2019). 2019 IEEE GRSS Data Fusion Contest: Large-Scale Semantic 3D Reconstruction [Technical Committees]. *IEEE Geoscience and Remote Sensing Magazine*, 7(4), 33–36.
<https://doi.org/10.1109/MGRS.2019.2949679>

DALES

- Riegl Q1560, Piper PA31 Panther Navajo
- City of Surrey in British Columbia, Canada
- 29 training tiles (369Mpts)
- Median 25.46 pts/m²
- Class Distribution
 - Ground 48%
 - Vegetation 33%
 - Buildings 15%
 - Cars, trucks, power lines, poles, fences 2%
 - Unlabeled 2%

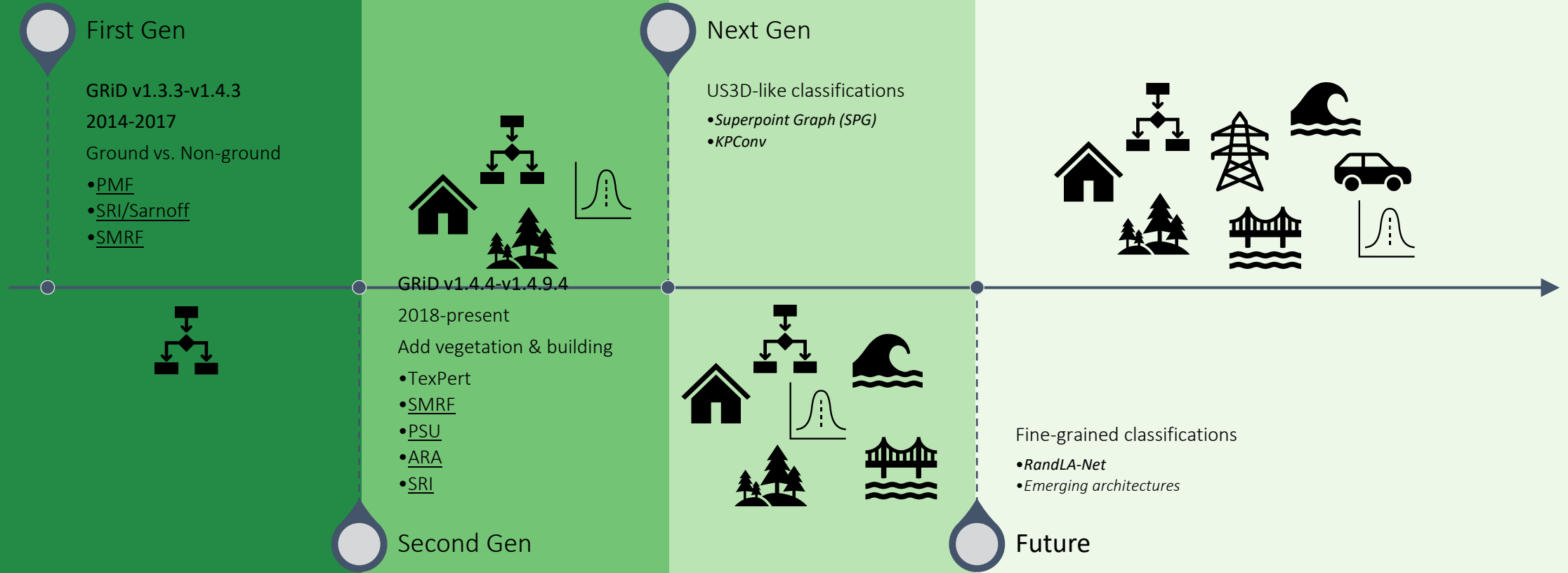
Varney, N., Asari, V. K., & Graehling, Q. (2020). *DALES: A Large-scale Aerial LiDAR Data Set for Semantic Segmentation*. <http://arxiv.org/abs/2004.11985>

Metrics

$$IOU = \frac{TP}{TP + FP + FN}$$

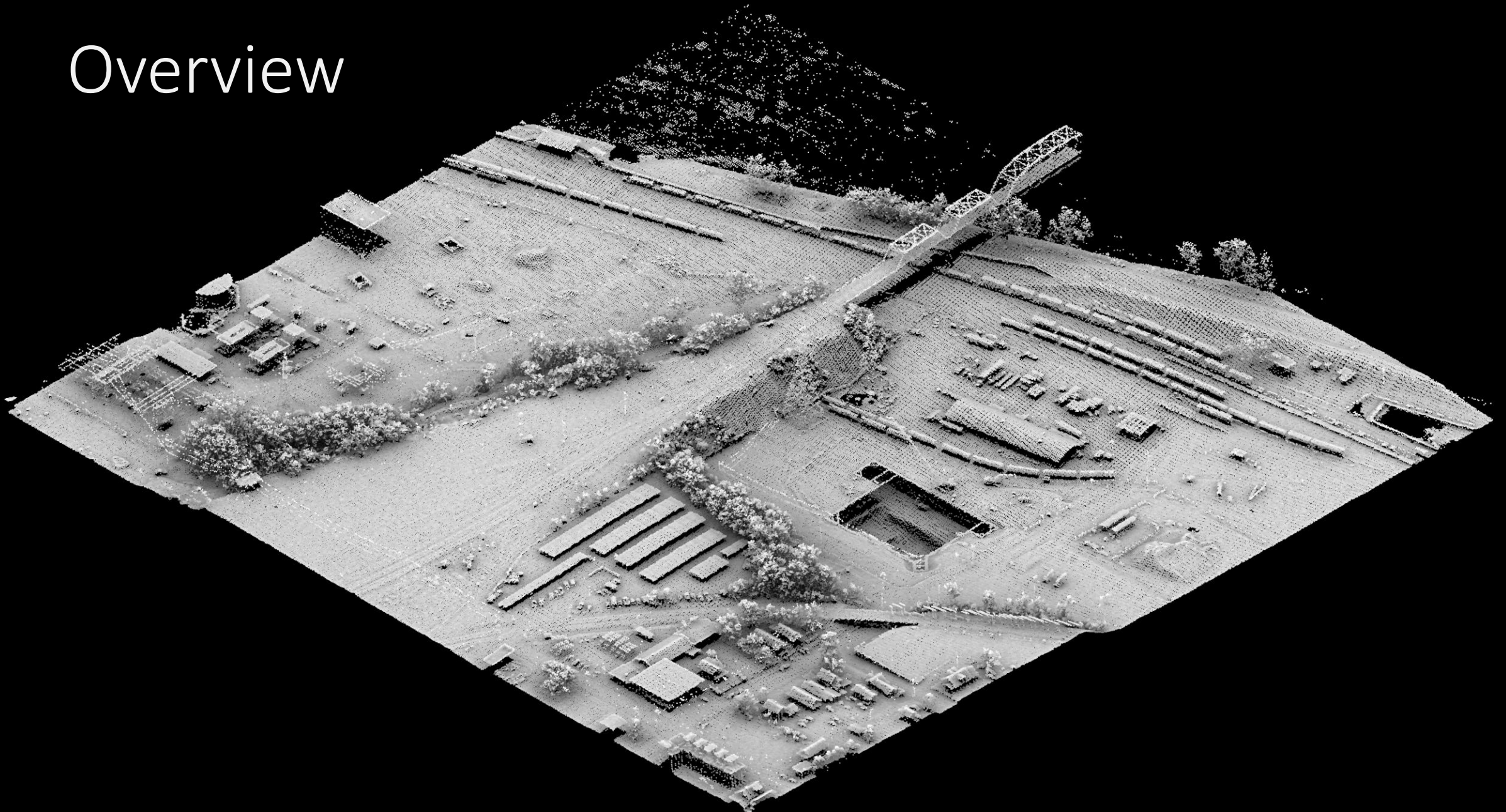
$$OA = \frac{TP + TN}{TP + FP + TN + FN}$$

Generations of AFE Capabilities in GRiD



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Overview

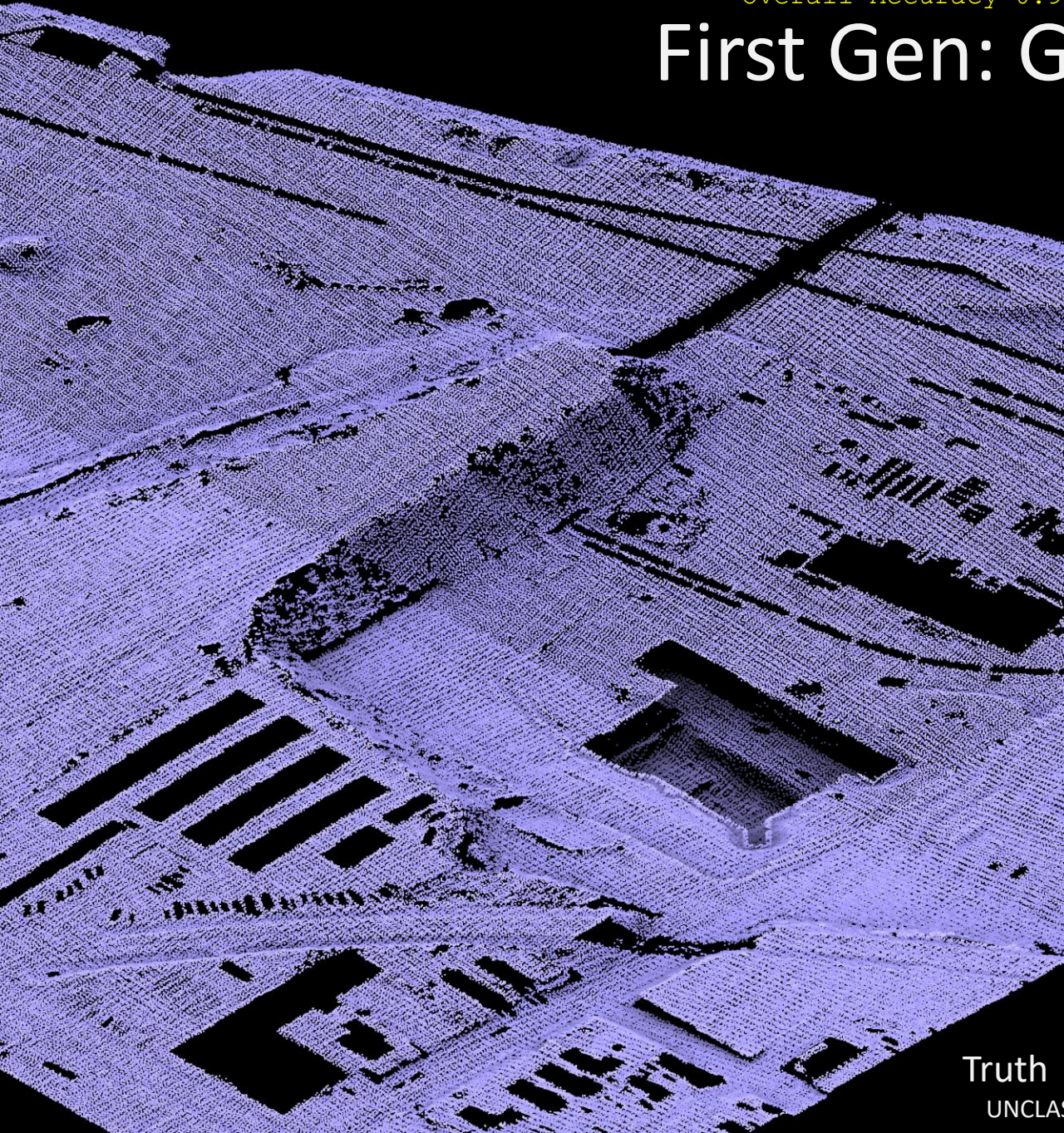


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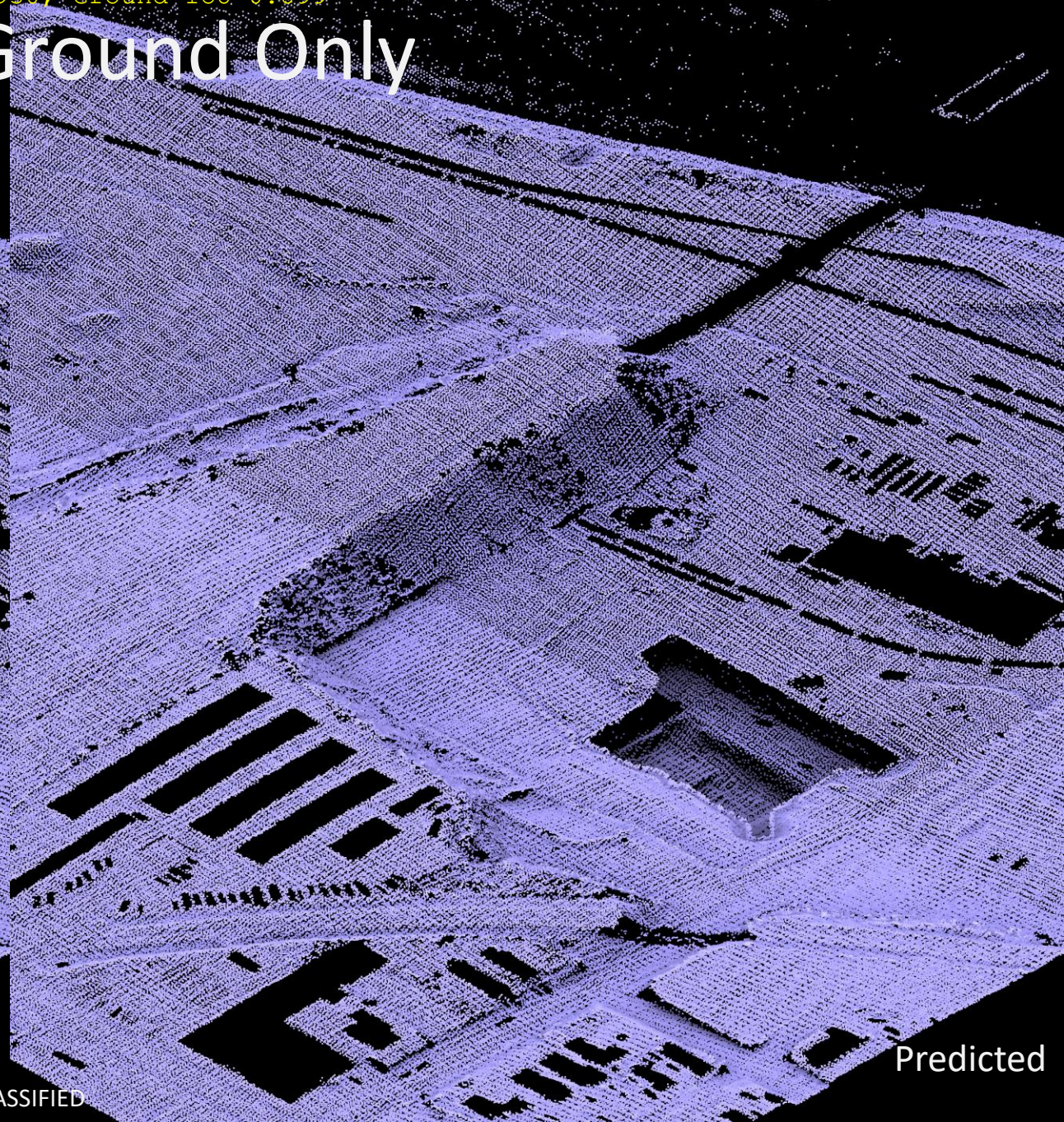
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Overall Accuracy 0.930, Ground IoU 0.899

First Gen: Ground Only



Truth
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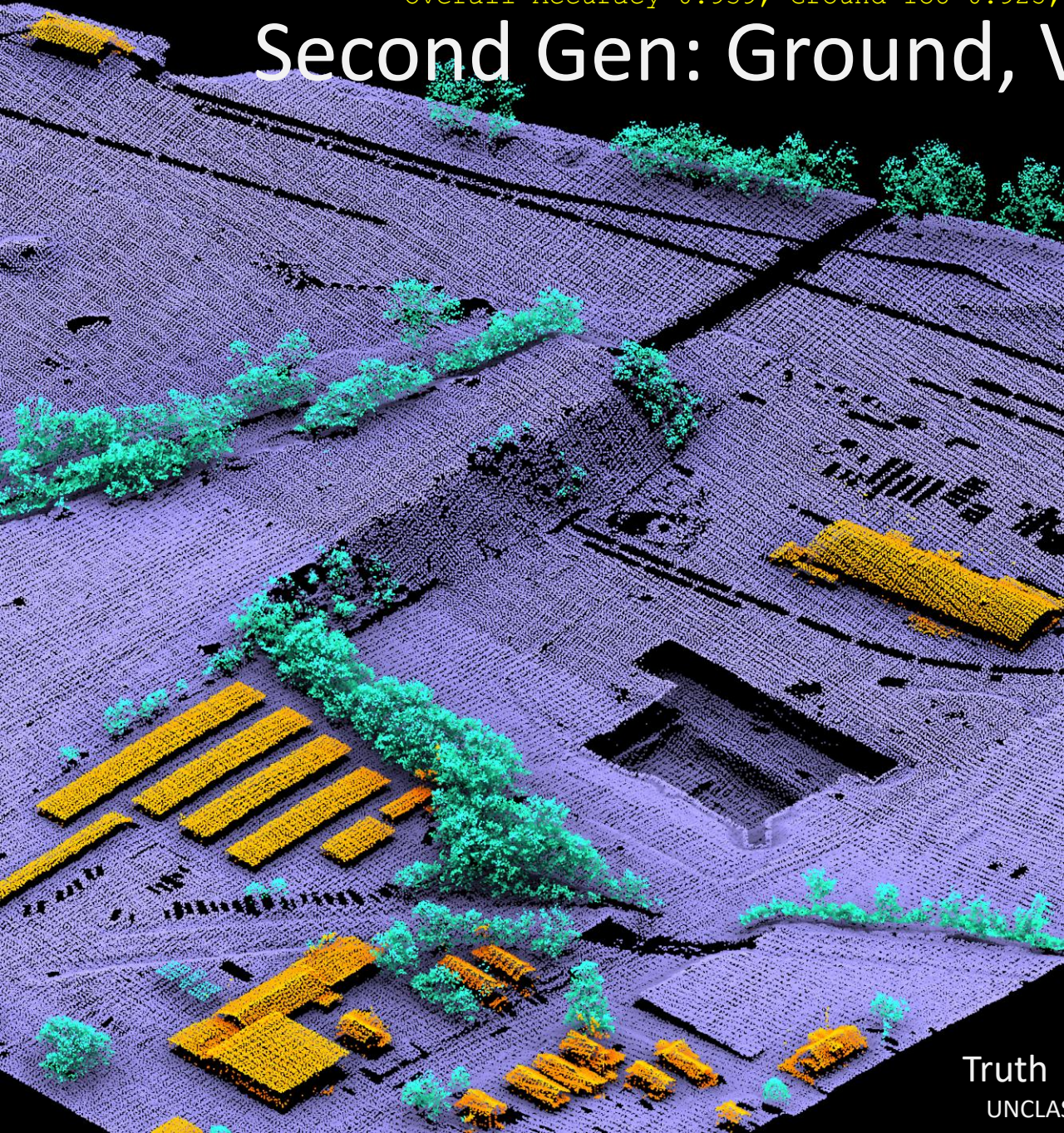


Predicted

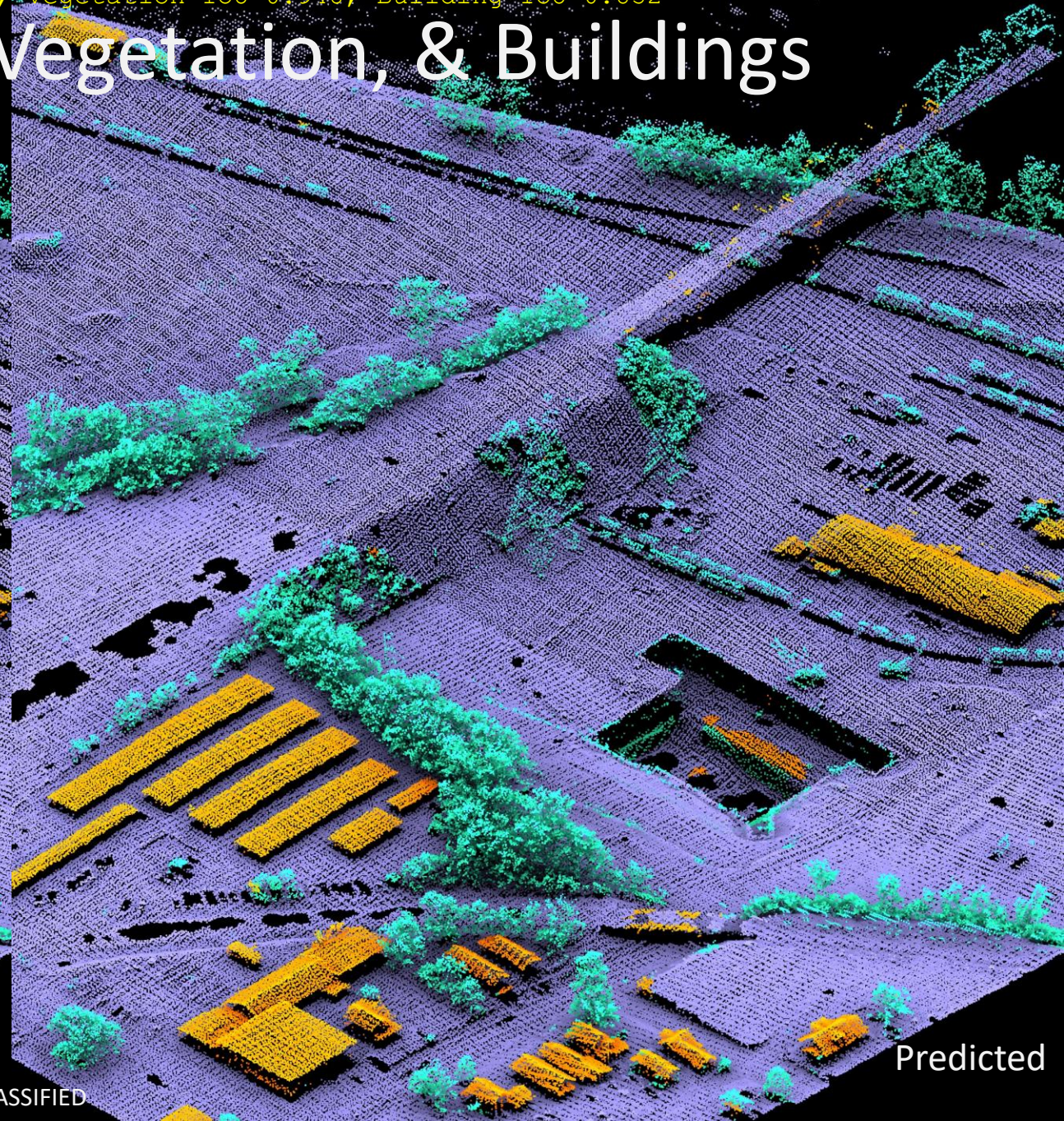
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Overall Accuracy 0.939, Ground IoU 0.925, Vegetation IoU 0.948, Building IoU 0.852

Second Gen: Ground, Vegetation, & Buildings



Truth
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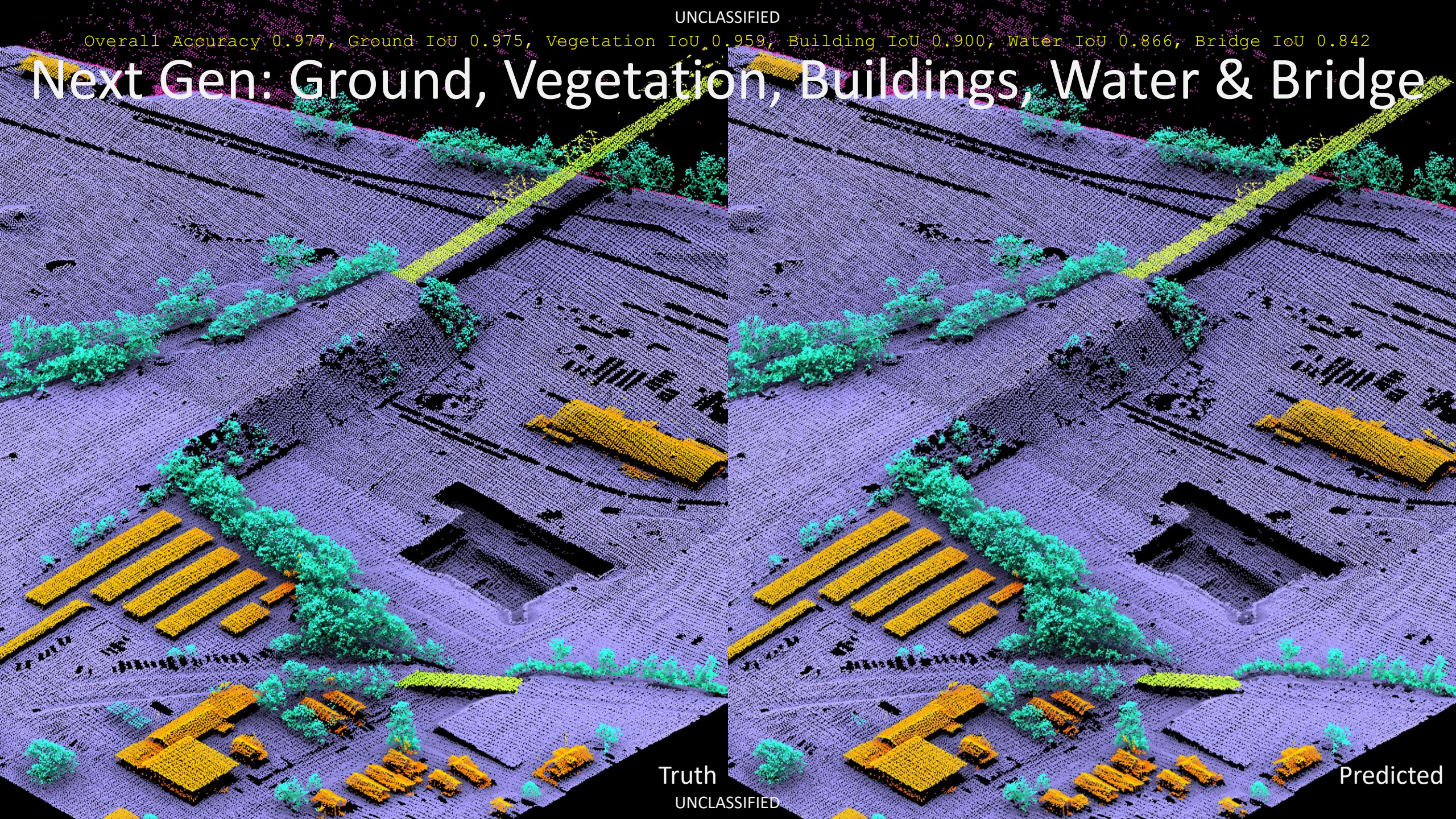


Predicted

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Overall Accuracy 0.977, Ground IoU 0.975, Vegetation IoU 0.959, Building IoU 0.900, Water IoU 0.866, Bridge IoU 0.842

Next Gen: Ground, Vegetation, Buildings, Water & Bridge

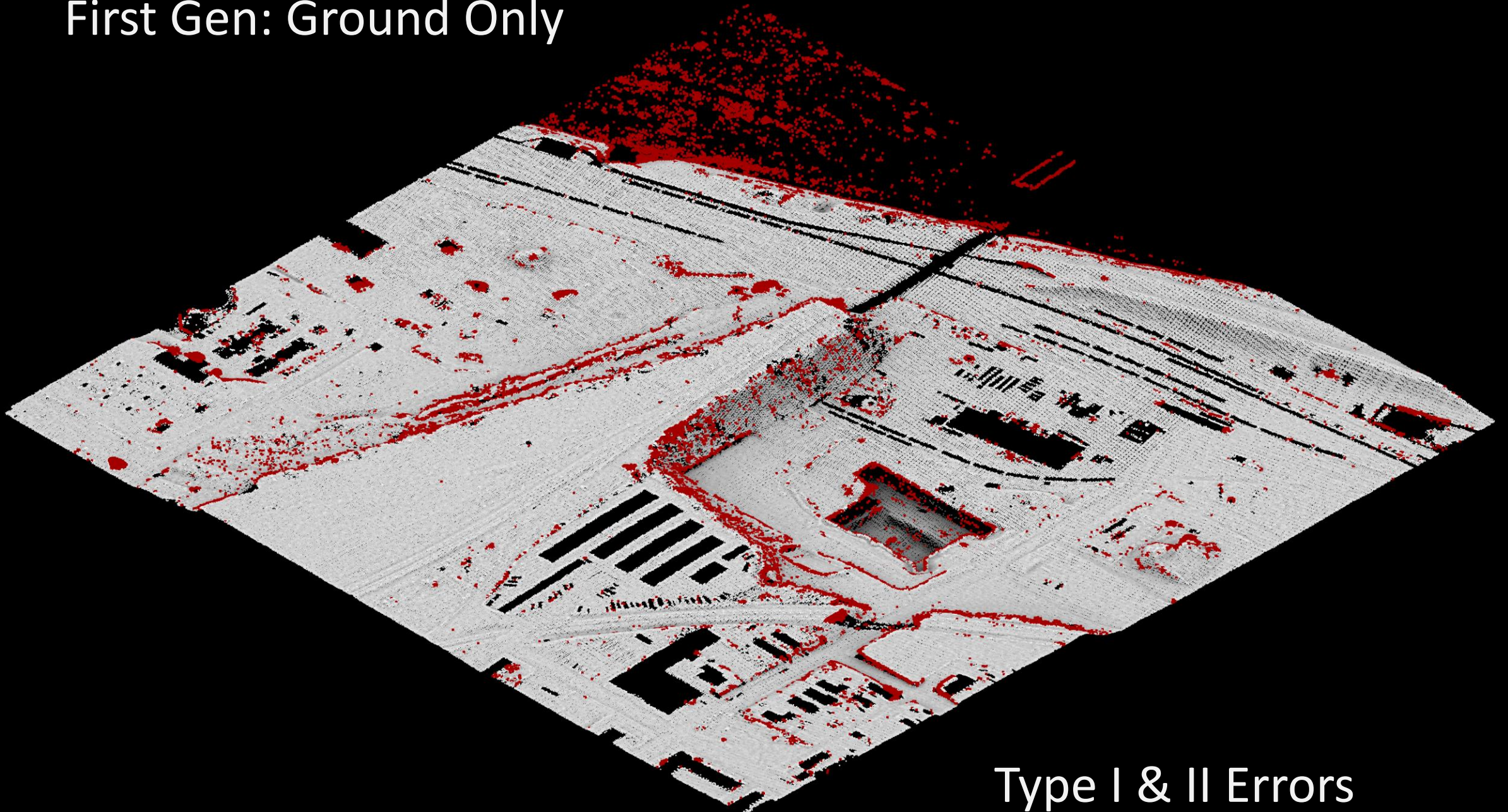


Truth

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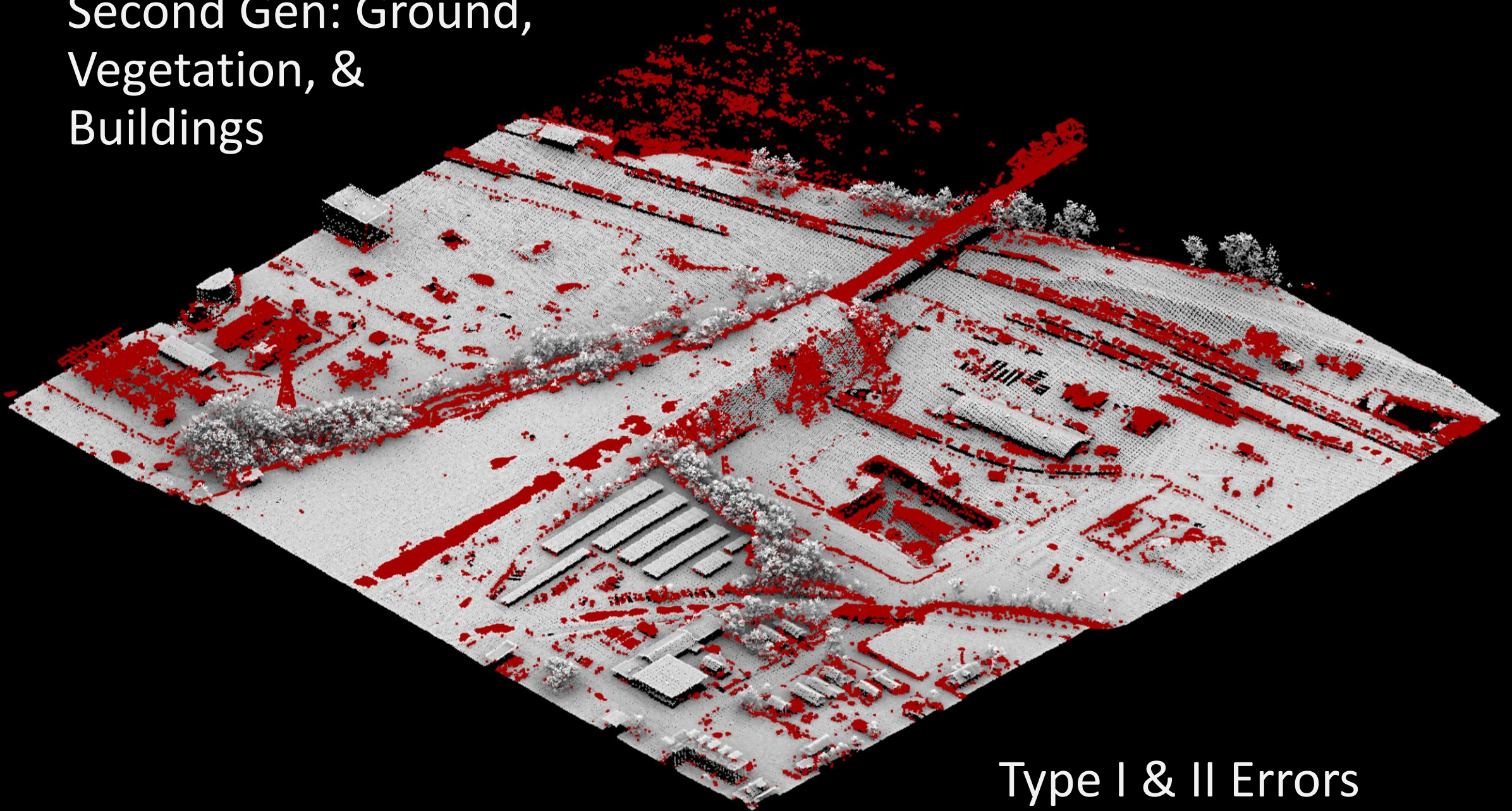
Predicted

First Gen: Ground Only



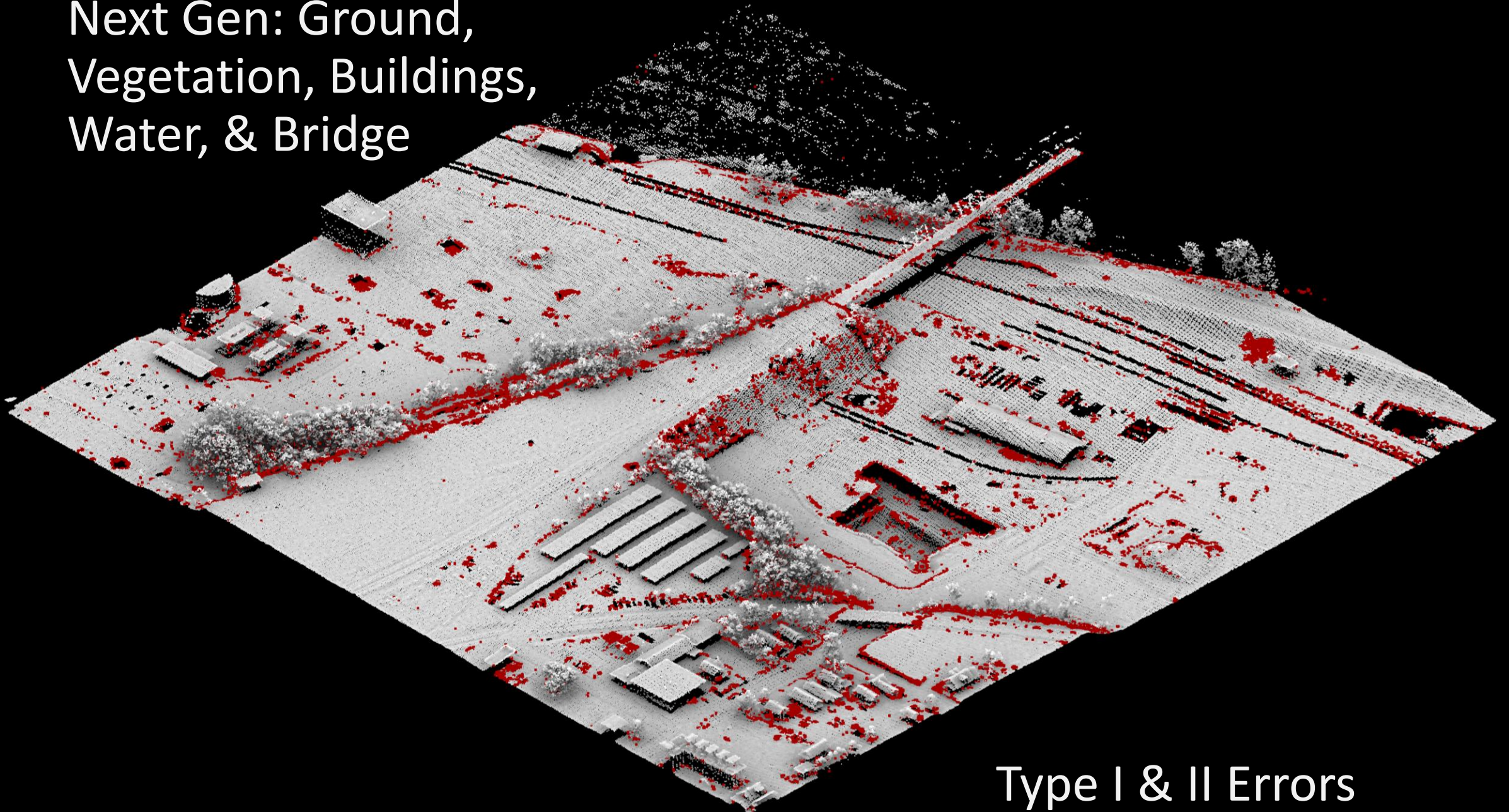
Type I & II Errors

Second Gen: Ground, Vegetation, & Buildings



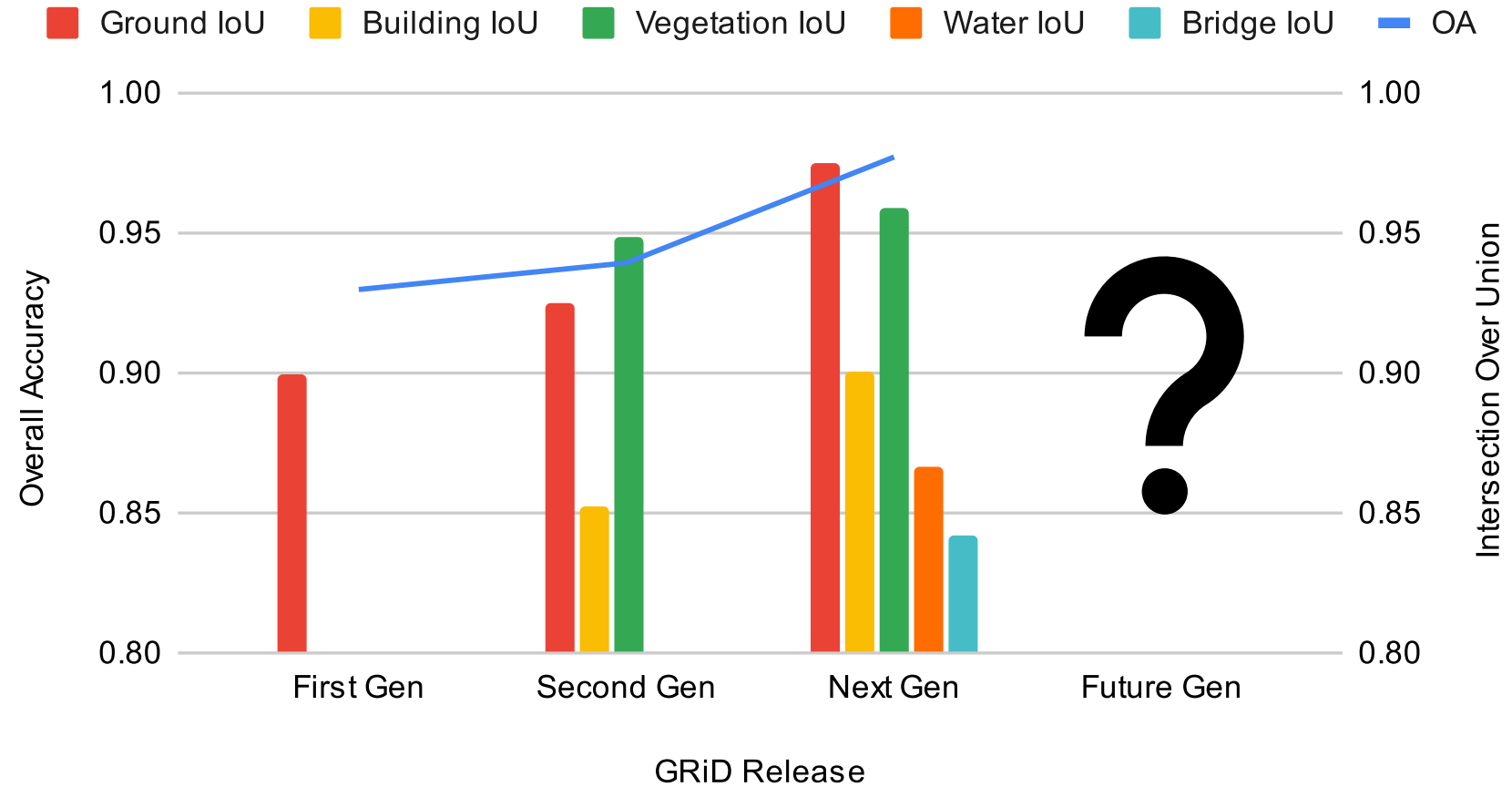
Type I & II Errors

Next Gen: Ground, Vegetation, Buildings, Water, & Bridge



Type I & II Errors

Performance Trends



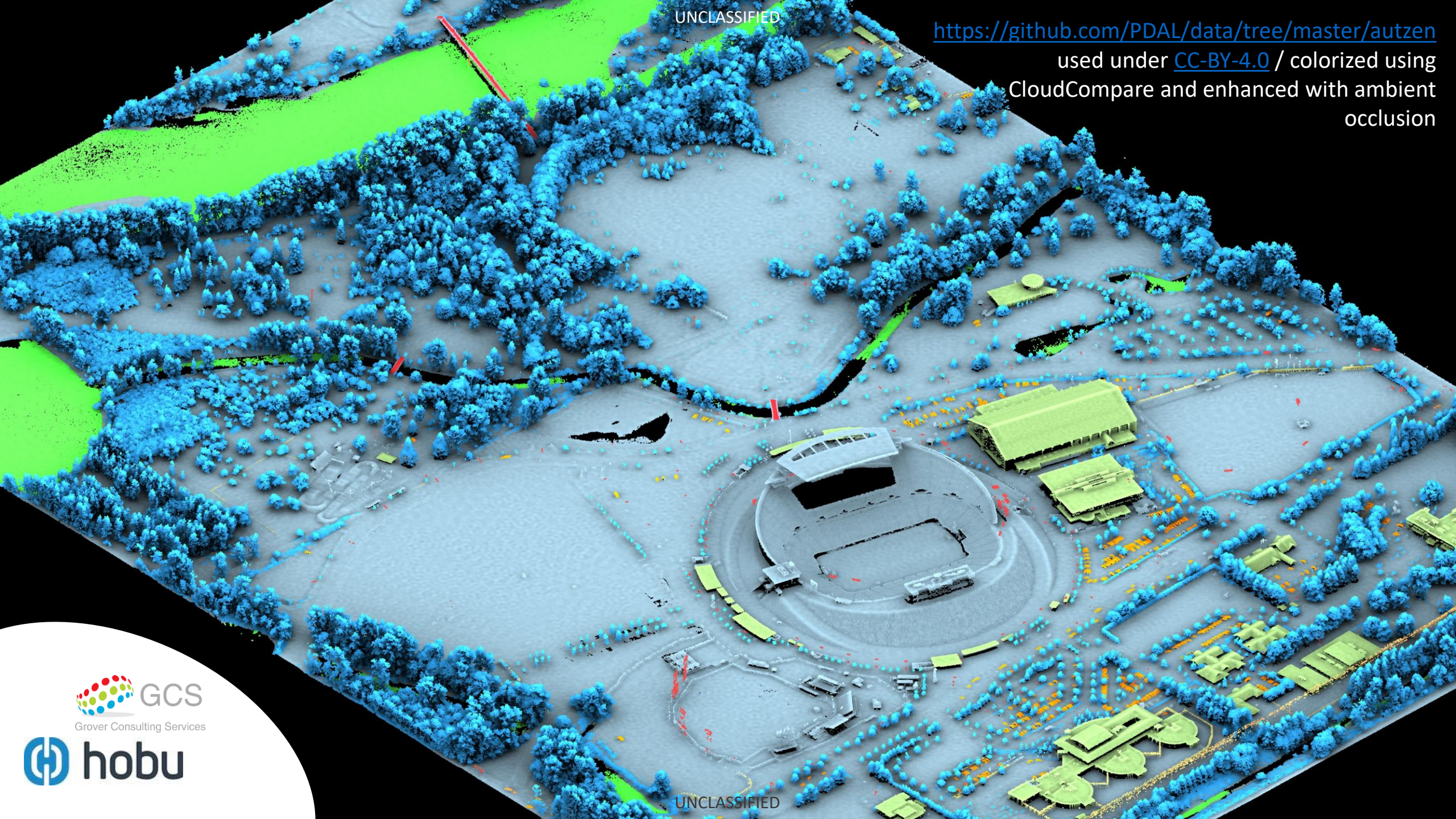
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- | | |
|--------------------------------|------------------------|
| 0: 'never_classified' | 64: 'wire' |
| 1: 'unassigned' | 65: 'car' |
| 2: 'ground' | 66: 'truck' |
| 3: 'low_vegetation' | 67: 'boat' |
| 4: 'medium_vegetation' | 68: 'barrier' |
| 5: 'high_vegetation' | 69: 'railroad_car' |
| 6: 'building' | 70: 'elevated_walkway' |
| 7: 'low_point' | 71: 'covered_walkway' |
| 8: 'model_keypoint' | 72: 'dock_pier' |
| 9: 'water' | 73: 'fence' |
| 10: 'rail' | 74: 'tower' |
| 11: 'road_surface' | 75: 'crane' |
| 12: 'overlap' | 76: 'silo_storage' |
| 13: 'wire_guard' | 77: 'bridge_structure' |
| 14: 'wire_conductor' | |
| 15: 'transmission_tower' | |
| 16: 'wire_structure_connector' | |
| 17: 'bridge_deck' | |
| 18: 'high_noise' | |
| 19: 'overhead_structure' | |

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<https://github.com/PDAL/data/tree/master/autzen>
used under [CC-BY-4.0](#) / colored using
CloudCompare and enhanced with ambient
occlusion



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