# GBNet v0.2

ML4EO
2026

## Ordnance Survey's Next Iteration of a Geo-Foundation Model for Great Britain



→ Harry Baker

→ Acting Senior Research & Innovation Scientist

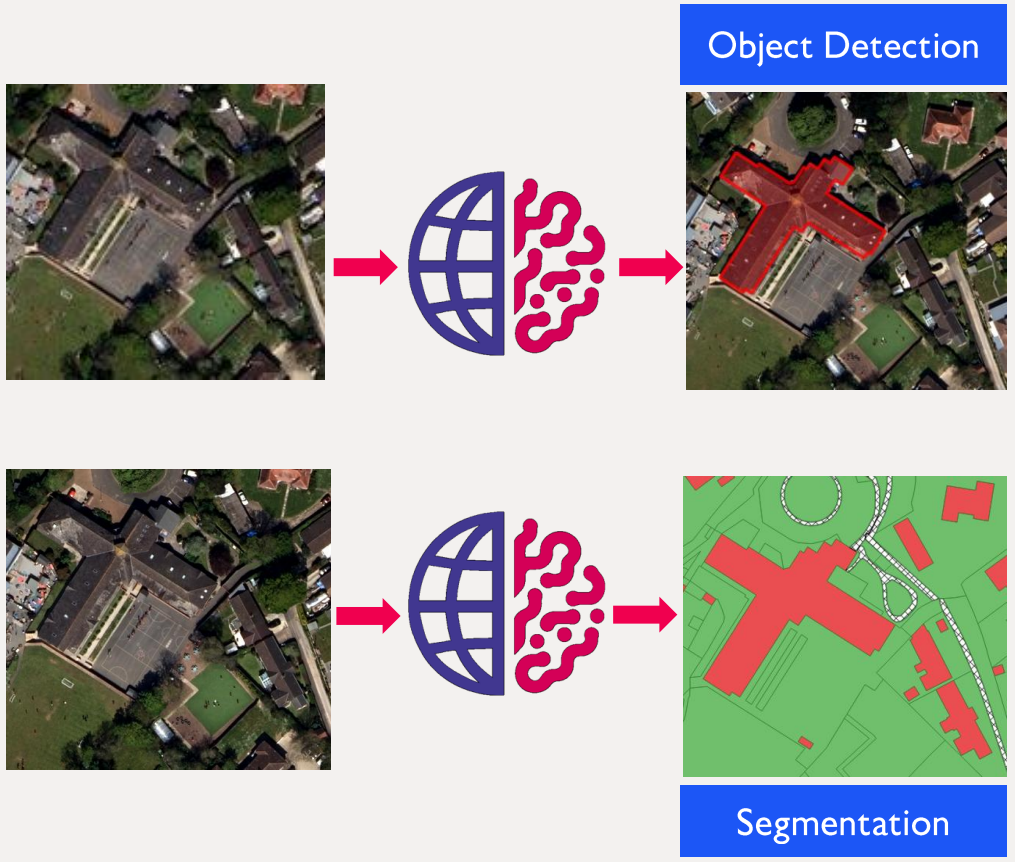
01

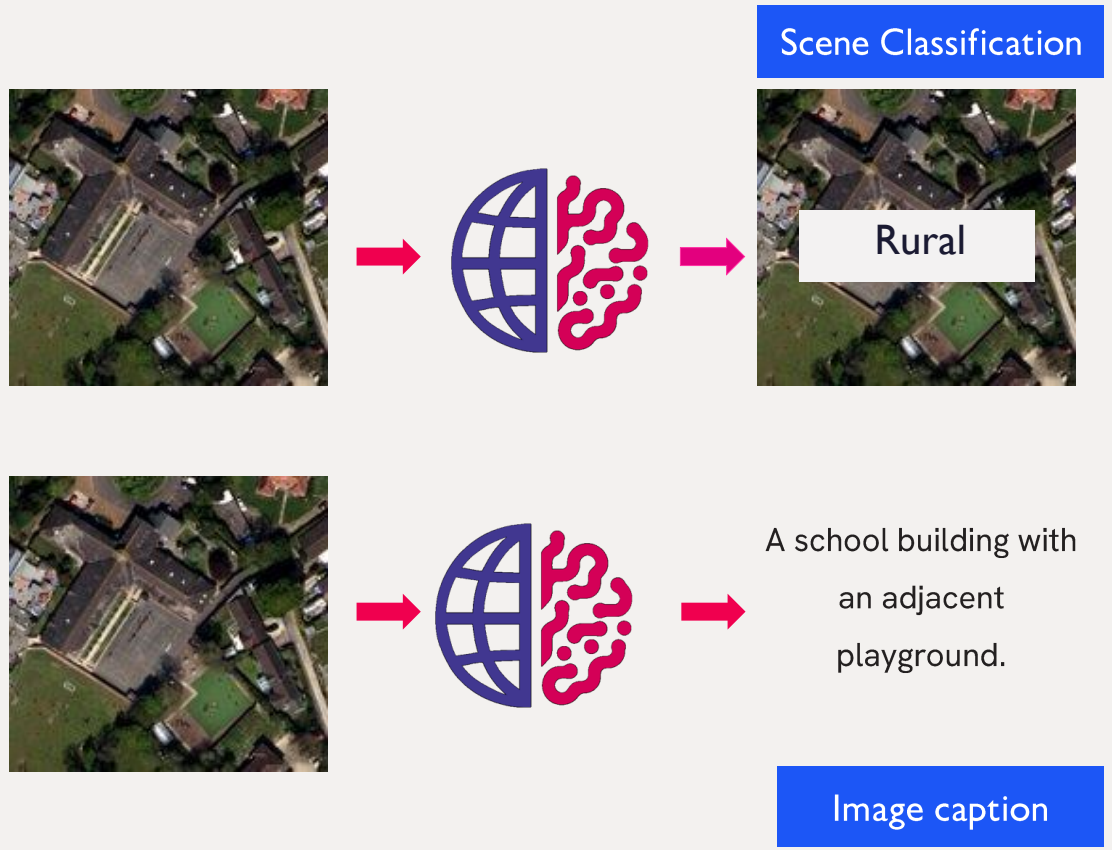
# Geo Foundation Models

GBNet

OS GeoAI

# Many Tasks, Many Models



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# Many Tasks, One Model

*A foundation model is an AI that can adapt to perform lots of different tasks*

Foundation Model

Object Detection

Segmentation


Scene Classification



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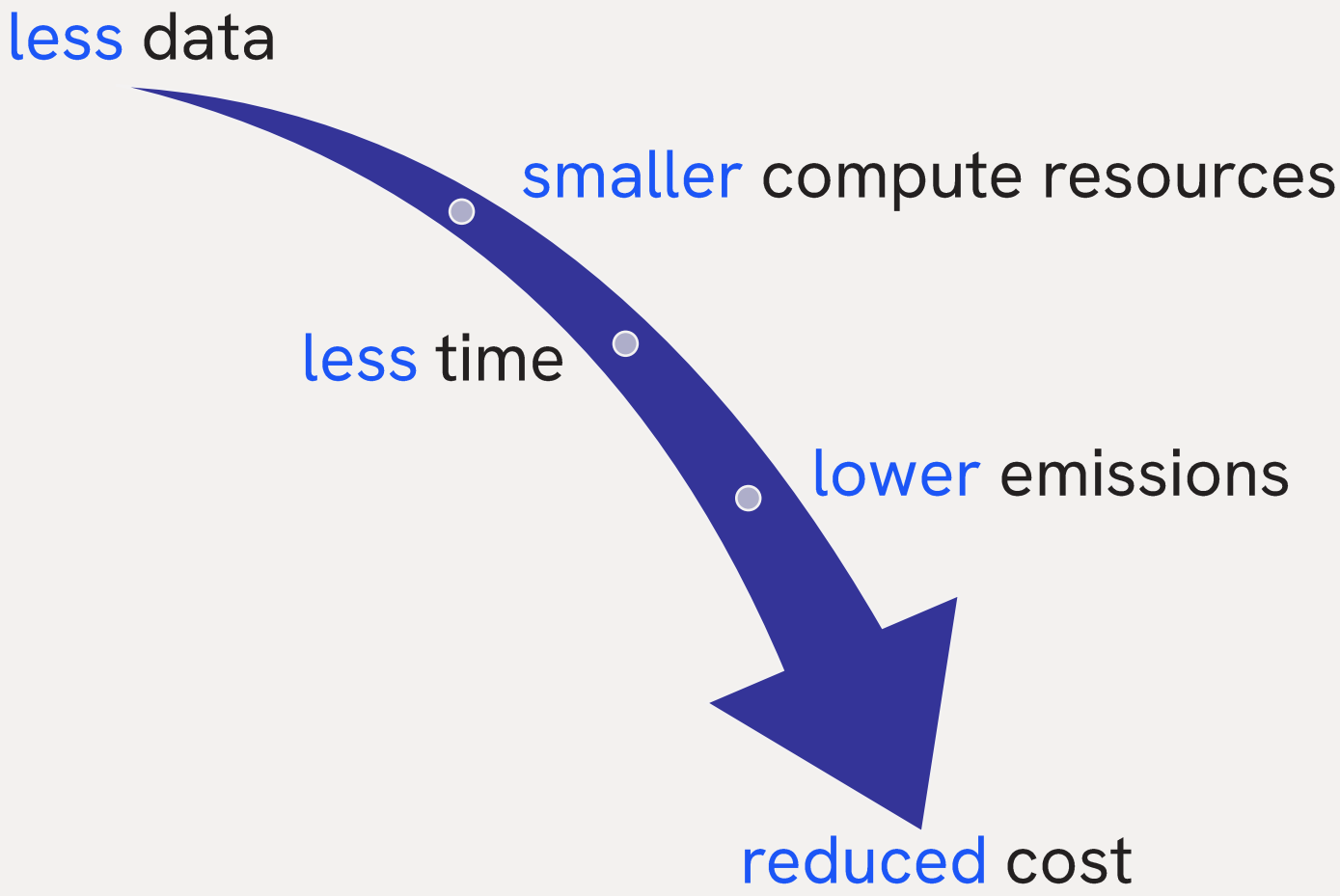
# Geo Foundation Model Benefits



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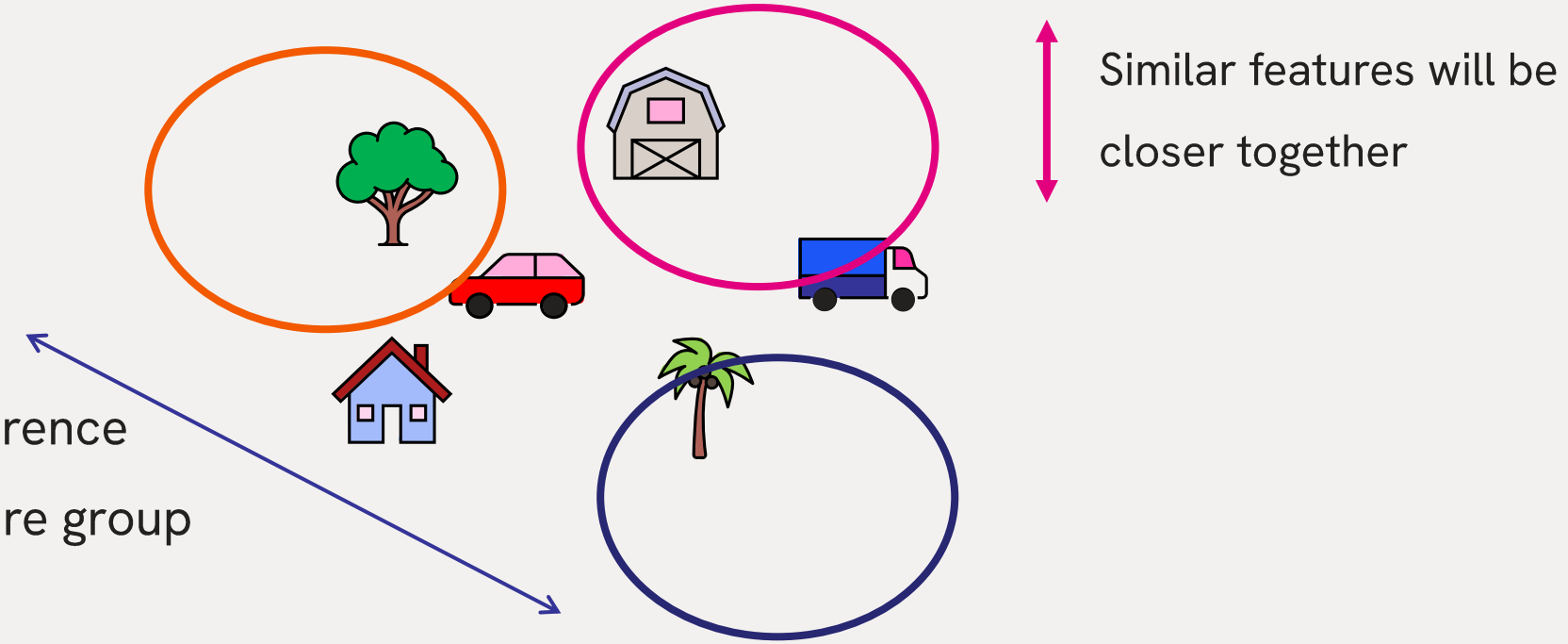
02

# What is GBNet?

GBNet
OS GeoAI

# Contrastive Learning

GBNet is a self-supervised model trained on pairs of OS imagery patches using contrastive learning to group similar spatial features.



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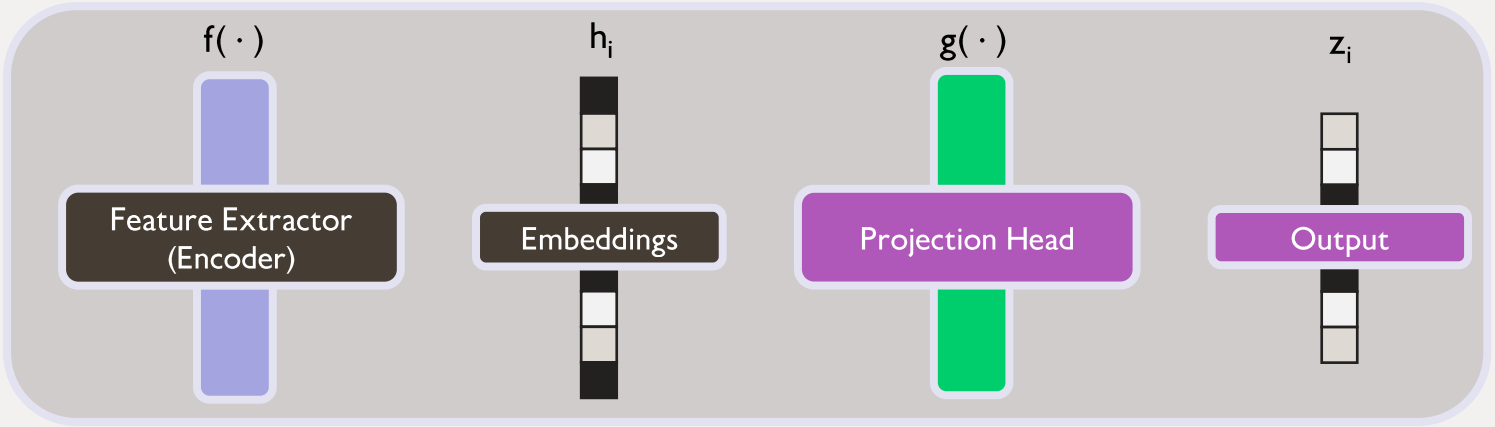
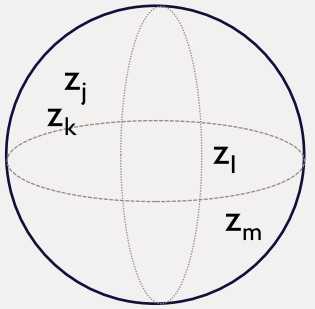
# GBNet Architecture: Siamese Learning

$\tilde{x}_j$

$\tilde{x}_{kn}$




NT-Xent Loss




Yamada *et al.*, 2022



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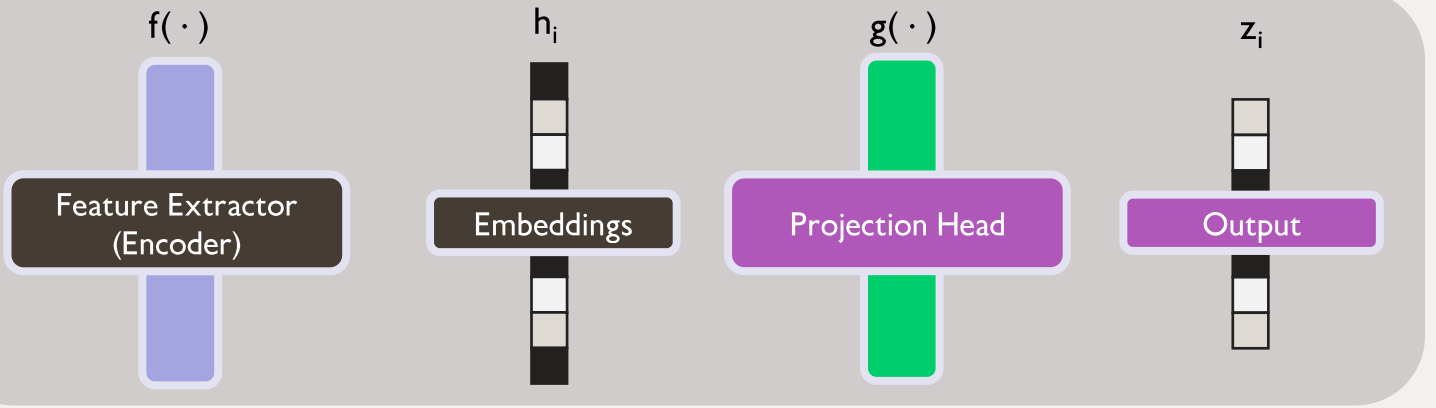
# Foundation Model – GBNet Transfer Learning

## Self-Supervised Contrastive Learning

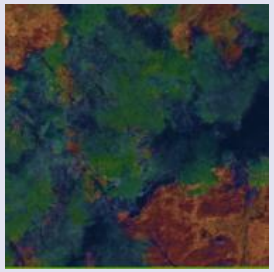
Current

Inputs

Archive



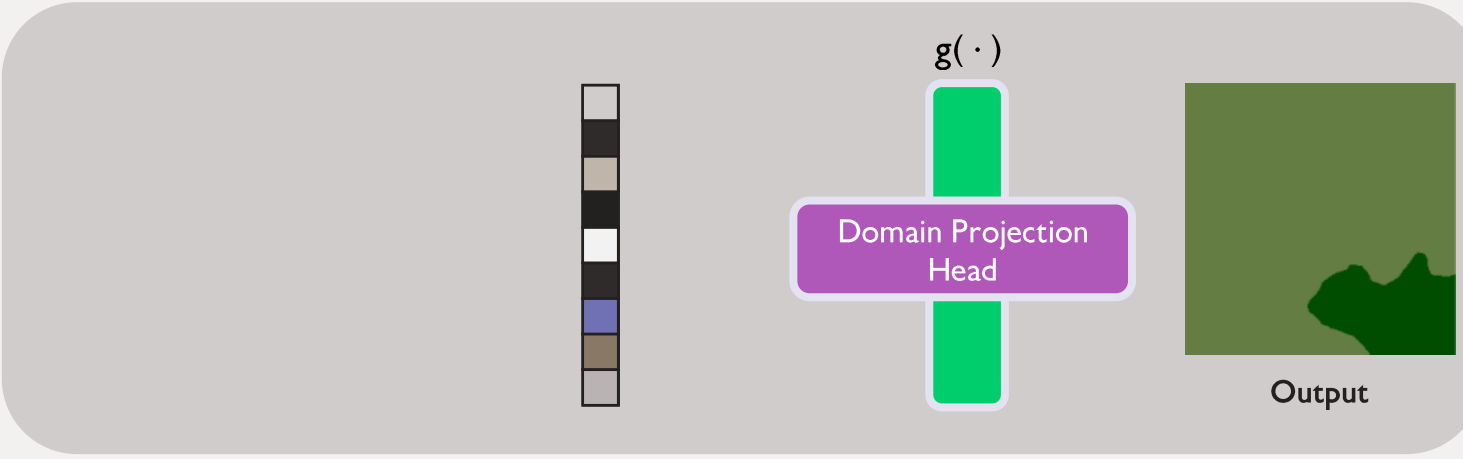

## Domain Specific Task



Image

Inputs

Label



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03

# GBNet v0.2

GBNet

OS GeoAI

# GBNet Pre-Training Data

Themes derived from NGD

Data sampled across Great Britain

Even representations of Urban, Suburban and Rural locations

8 topographic feature themes

→ Version 0.1

- First GBNet Dataset
- 50,000 Image pairs

→ Version 0.2

- 100,000 Image pairs
- Improved data sampling criteria
- Balanced across the 8 English regions, Scotland and Wales nations
- Reworked feature selection



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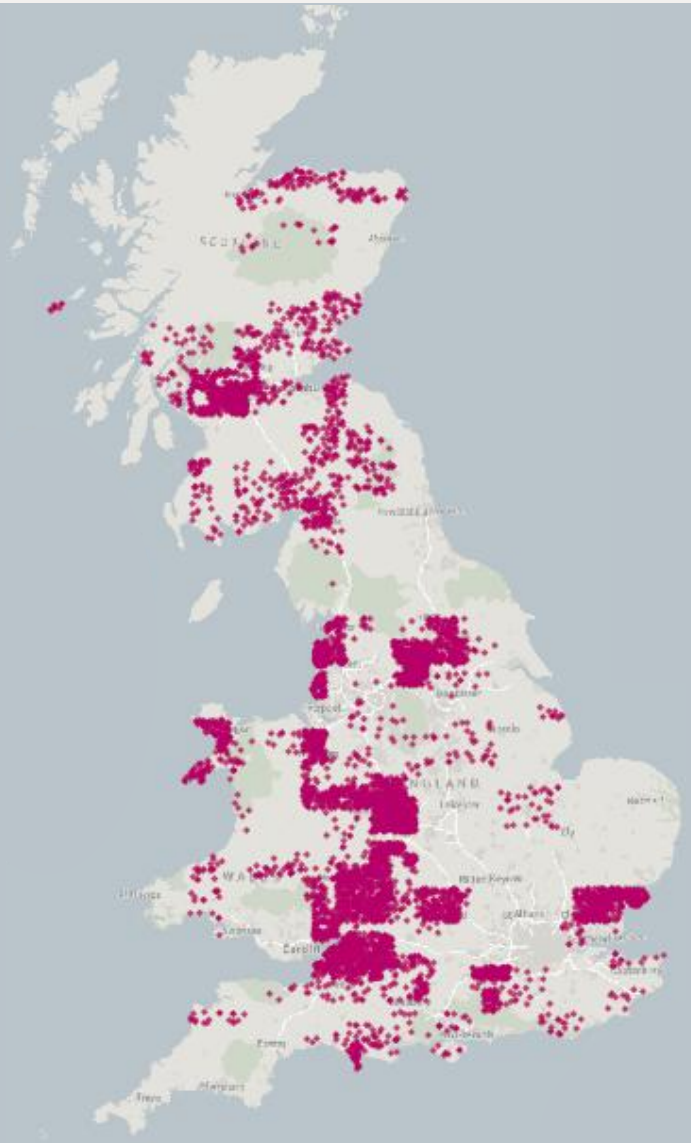
04

# *"Ullswater"* OS NGD Benchmark

# *Ullswater* Sampling Scheme

- Sampling approach distinct from GBNet v0.2 – avoids potential bias
- Grid GB into 100m x 100m population counts (from WorldPop)
- Remove patches that overlap GBNet v0.2
- Use a quasi-logarithmic binned approach to maintain urban-rural balance
- Results in ~12,000 56m x 56m patches





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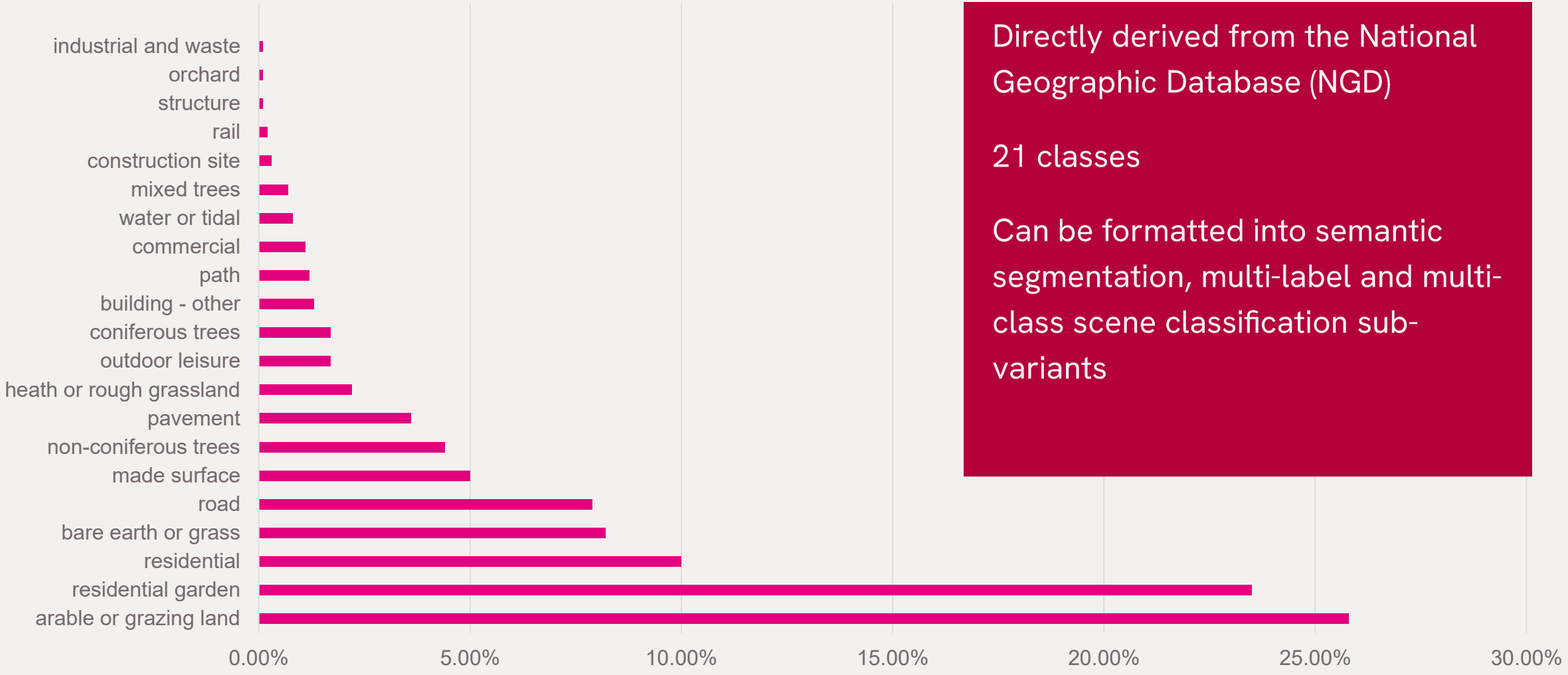
# Classes




Directly derived from the National Geographic Database (NGD)

21 classes

Can be formatted into semantic segmentation, multi-label and multi-class scene classification sub-variants



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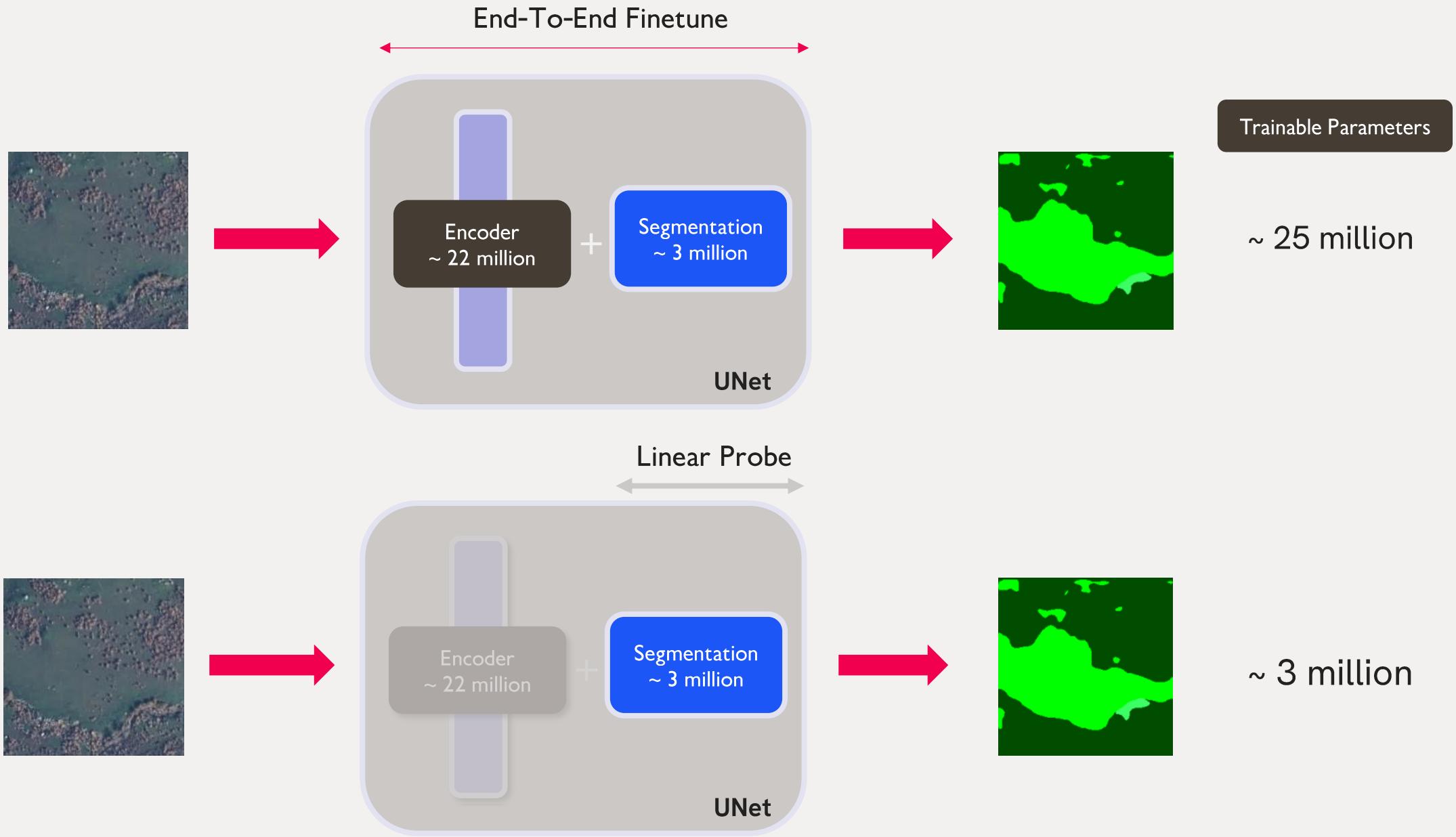
# Downstream Results

GBNet

OS GeoAI



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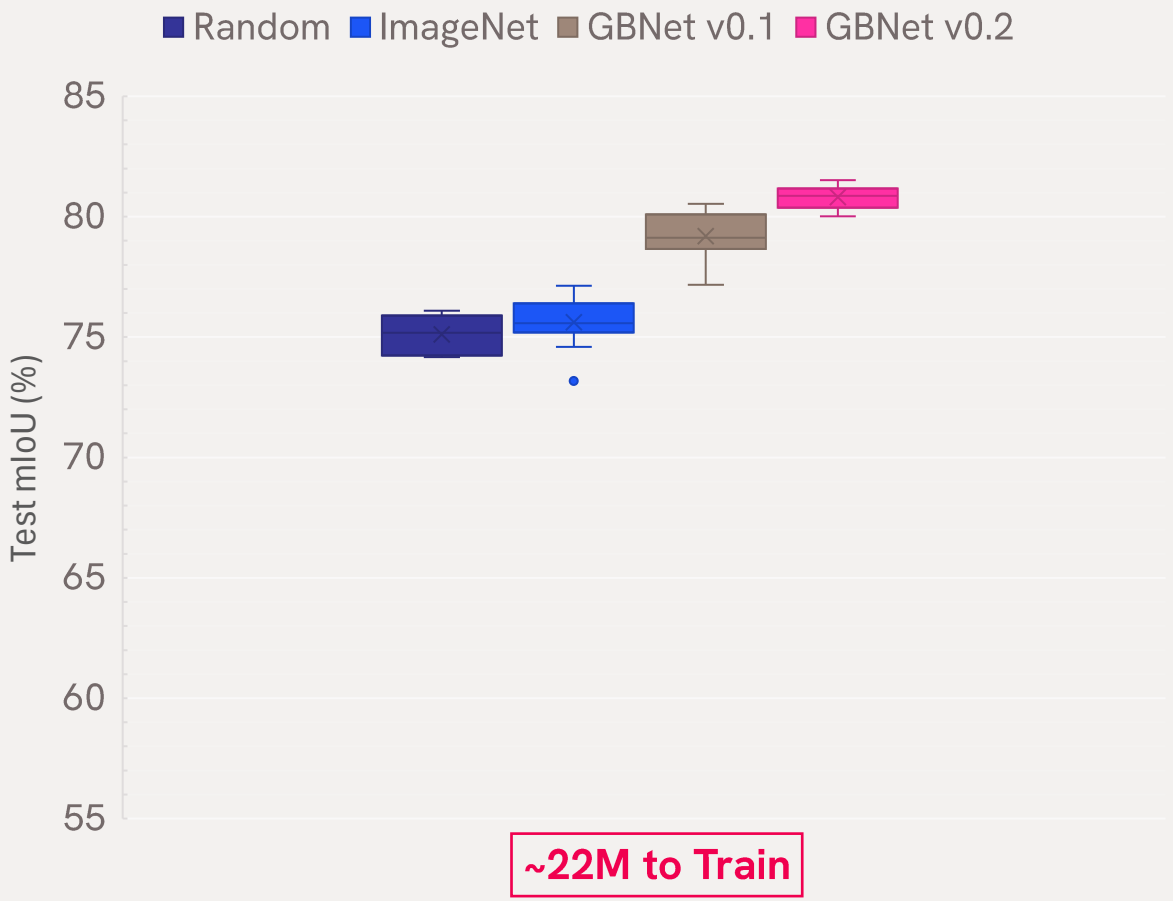
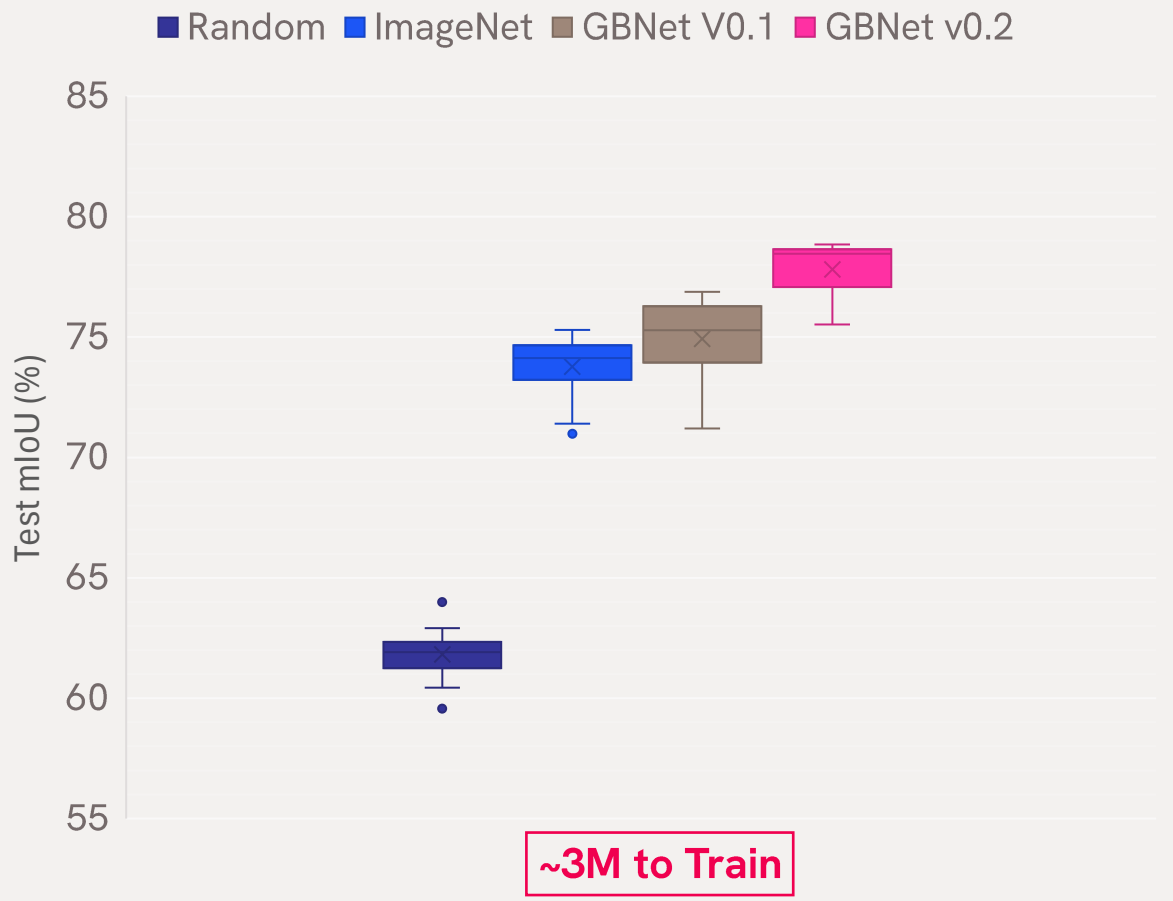
# Ullswater Segmentation Results

## ResNet-34 Fine-Tuning




~22M to Train

## ResNet-34 Linear-Probing




~3M to Train



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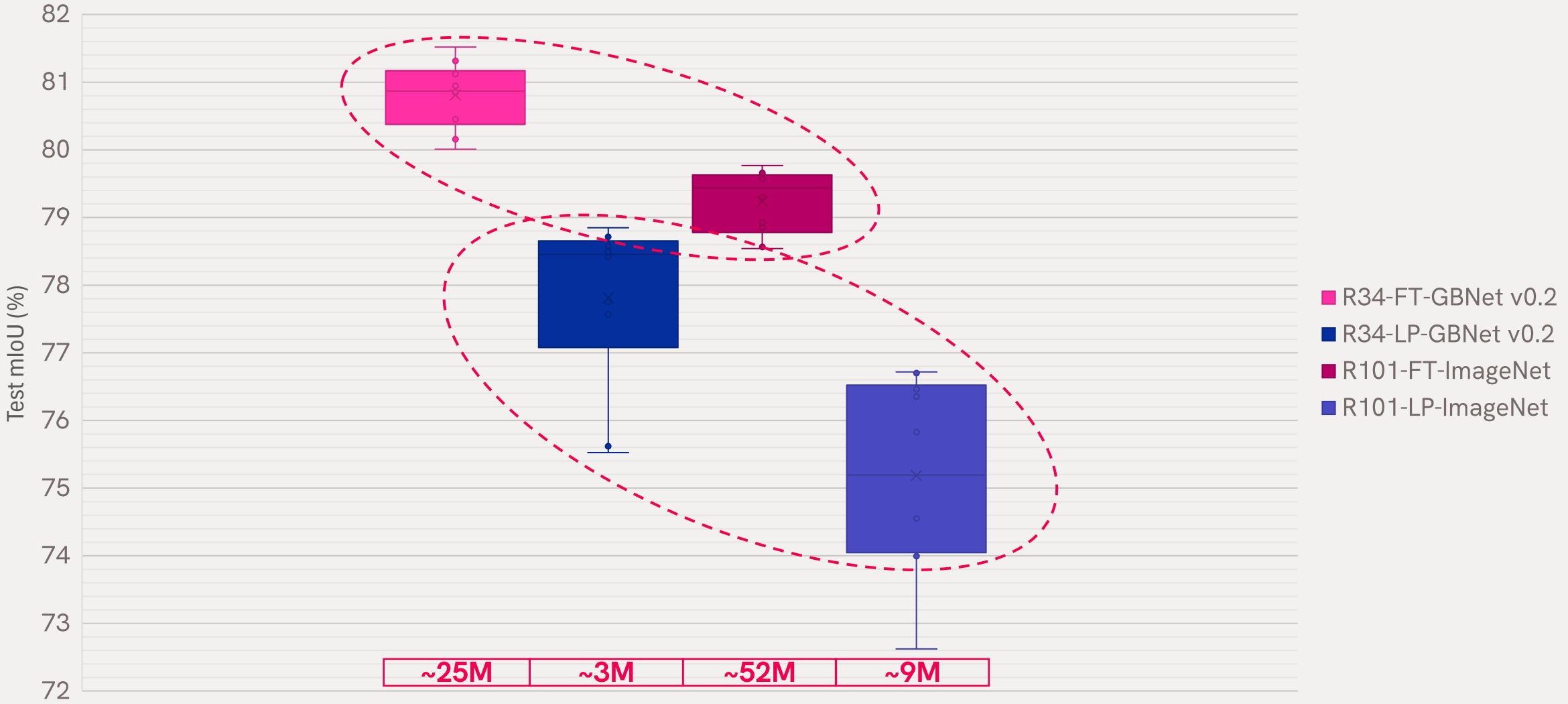
# Ullswater Segmentation Results



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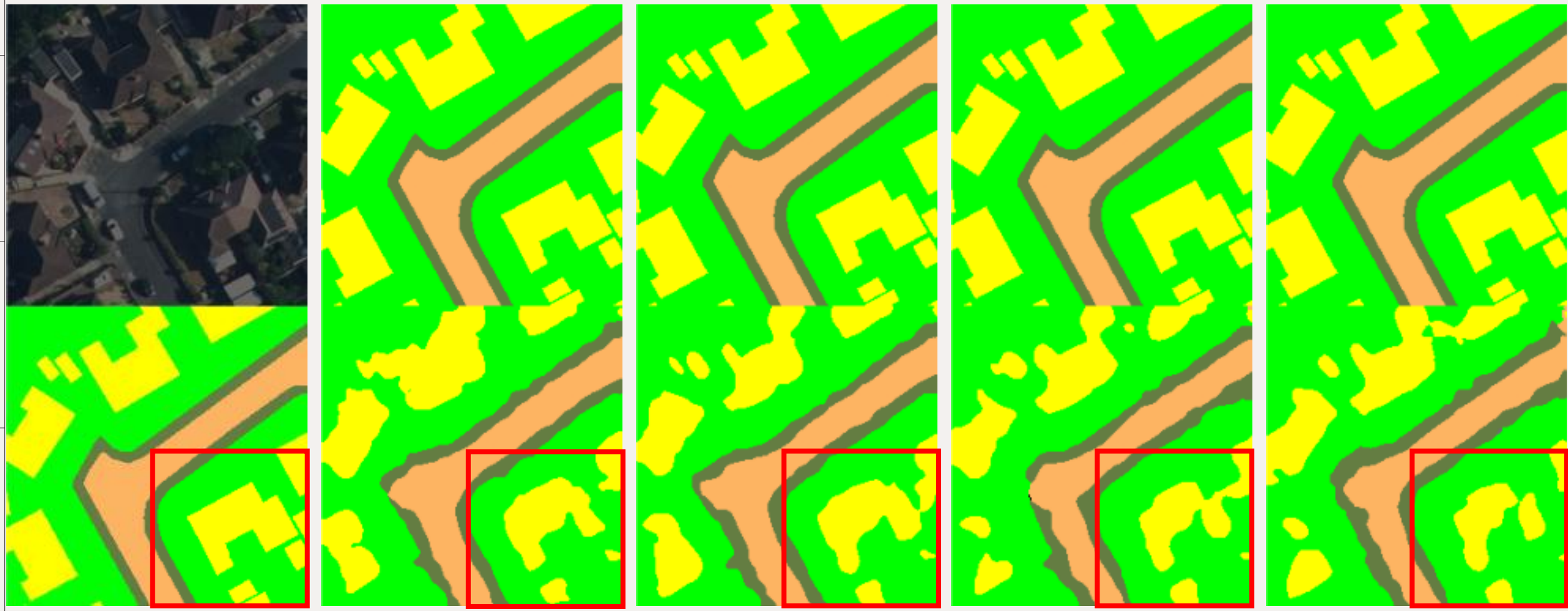
Ground Truth | GBNet v0.2 | GBNet v0.1 | ImageNet | Random





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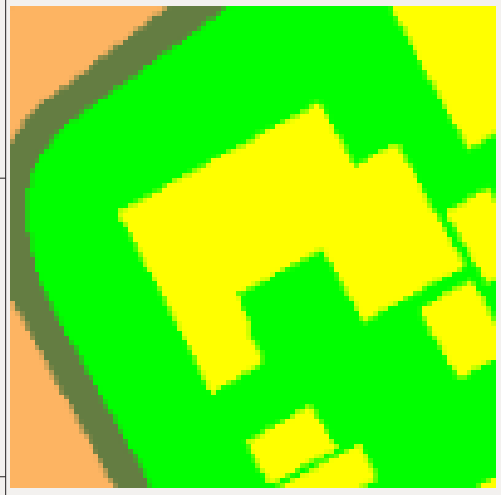
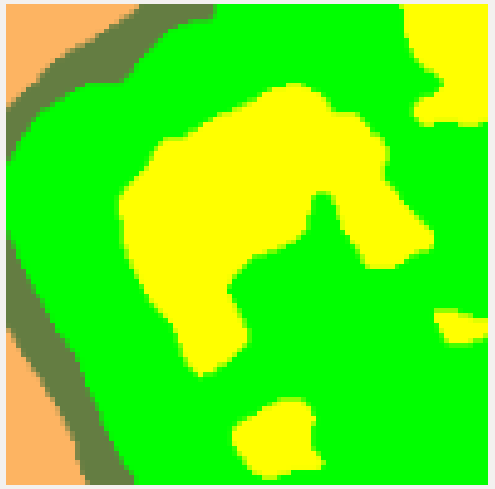
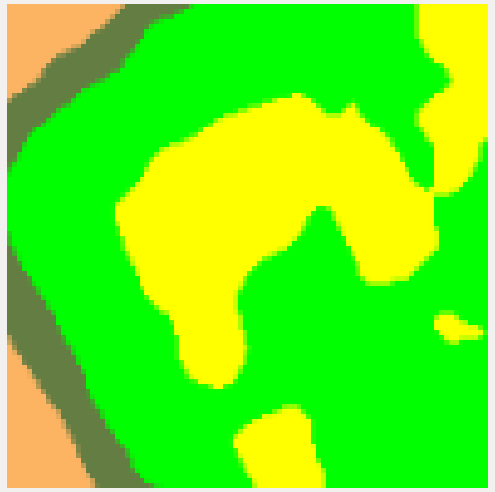
Ground Truth



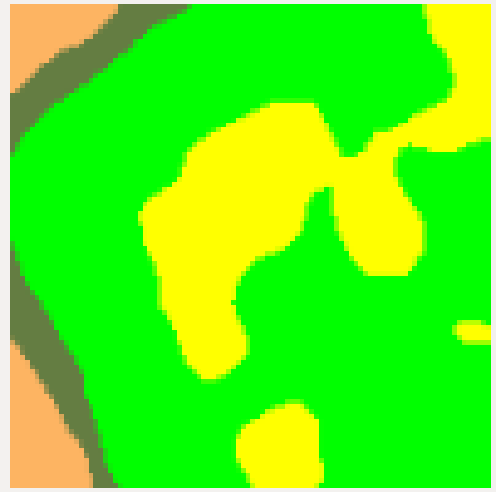
GBNet v0.2



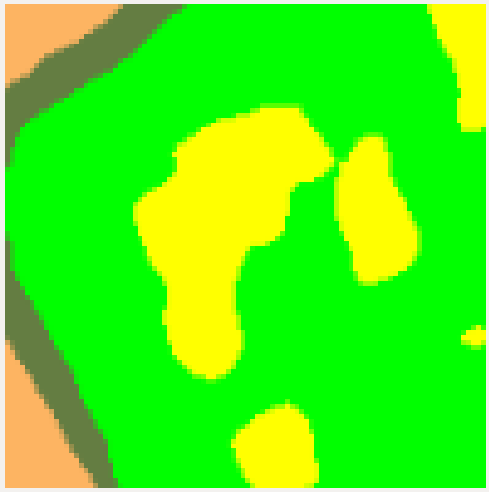
GBNet v0.1



ImageNet



Random





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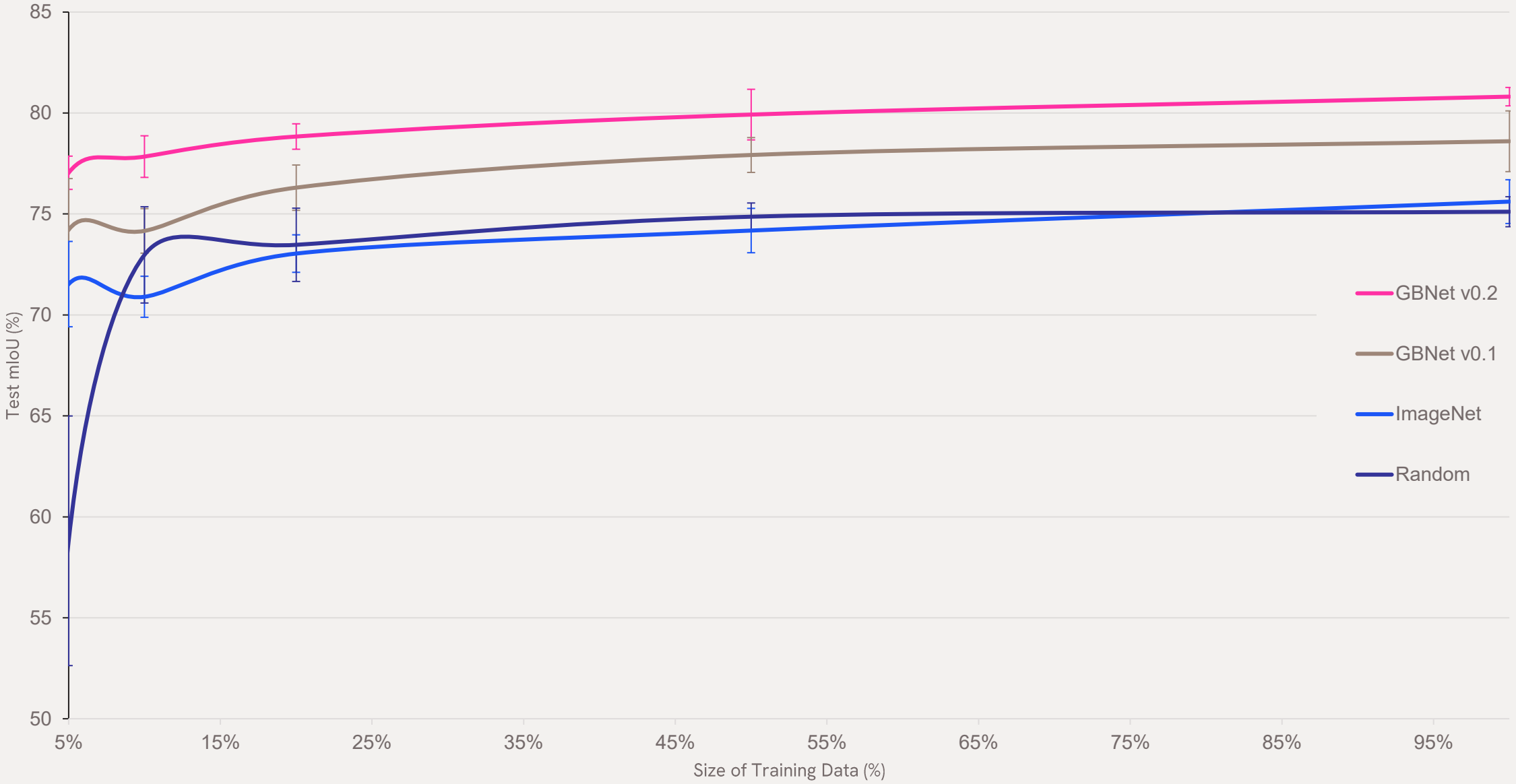
# ResNet-34 Training Size Ablation Study



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# Conclusion & What Next?

# Key Results

GBNet v0.2 outperform GBNet v0.1 with **~10%** of the data and ImageNet with **<5%** of the data

GBNet v0.2 outperforms ImageNet by **5pp** in fine-tuning and **4pp** in linear-probing

GBNet ResNet 34s outperform ImageNet ResNet101 models

GBNet v0.2 builds on v0.1's success – a 1pp improvement in fine-tuning, 2pp improvement in linear-probing

# Next Steps

GBNet v0.3 in development. Trained on 500k sample-pairs

Get GBNet into production. Use across OS and public sector

Investigate embeddings

Incorporate height (nDSM)

Vision + Language




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# Any Questions?

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Ordnance Survey

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