

Introduction

- Biomass estimation supports numerous critical activities such as biodiversity monitoring and forest management.
- Grünblick is a scalable forest biomass estimation service.
- We benchmark competitive baselines with features such as:
 - Multi-modal estimation, advanced feature extraction selection.
- We propose and evaluate a metric for estimating the benefits of finetuning AGB multi-modal models.

Gain of Finetuning over Training from Scratch

$$G_{a,i}(t) = \frac{\sum_{s_j \in M_{s_i}} F_a(s_i, s_j, t) - F_a(\text{none}, s_j, t)}{\text{Card}(M_{s_i})}$$

Where:

- $G_{\{a,i\}}(t)$: the relative gain in performance for a model a , pre-trained using sensor s_i , evaluated after t epochs of fine-tuning.
- $F_{\{a\}}()$: the performance of a model a , pre-trained on sensor $s_{\{pre\}}$ and evaluated after t epochs of fine-tuning using sensor $s_{\{finetuning\}}$.
- $M_{\{s_i\}}$: the set of finetuning sensors that are compatible with pretraining on sensor s_i .

Influence of Sensor Fusion on the Estimations

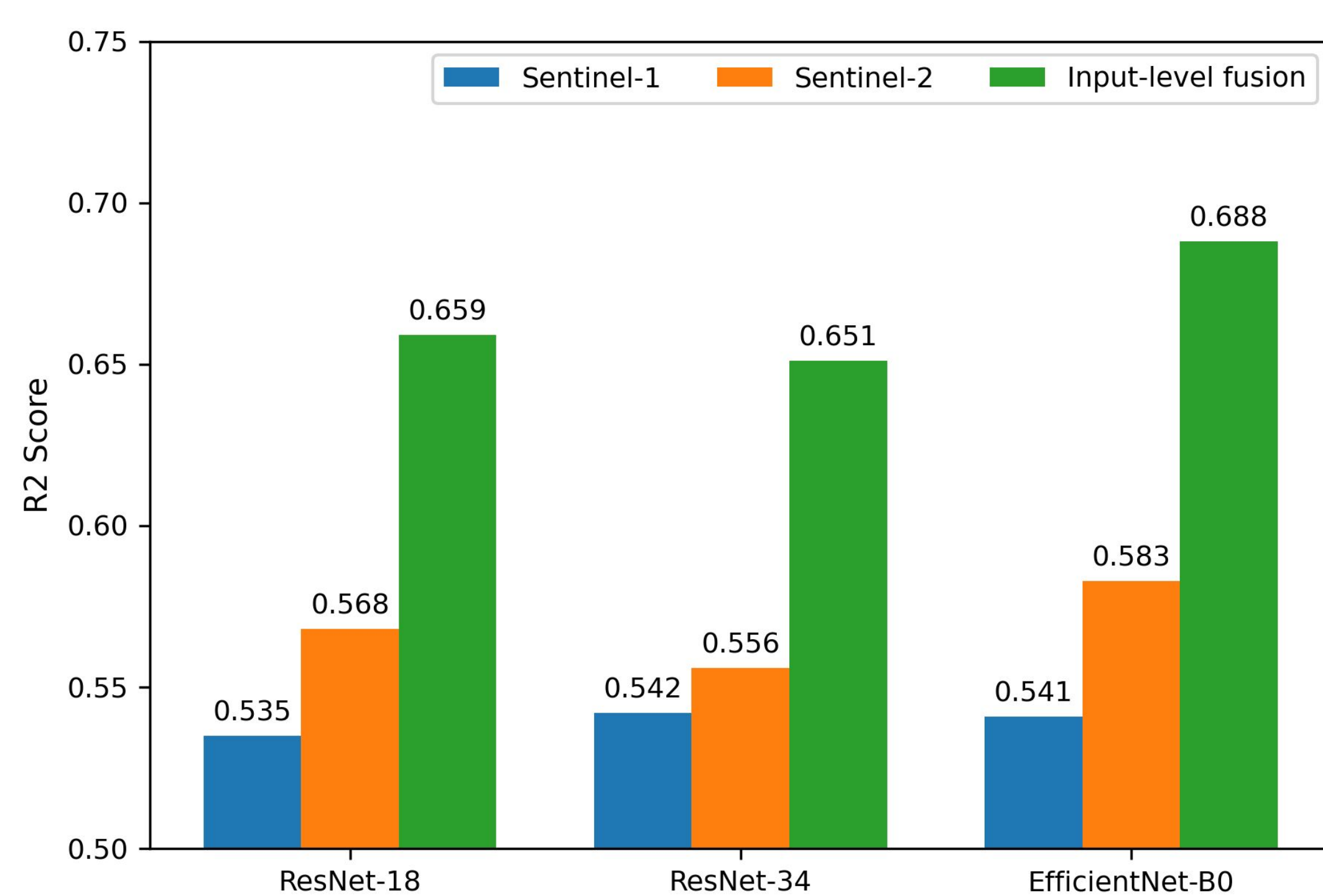


Figure 2. AGB estimation of a U-Net under variable sensor modalities.

- **Enhanced** AGB estimation accuracy using **sensor fusion**.
- Modalities best taken advantage of by **more efficient backbones**.

Gain of Finetuning using various Sensors

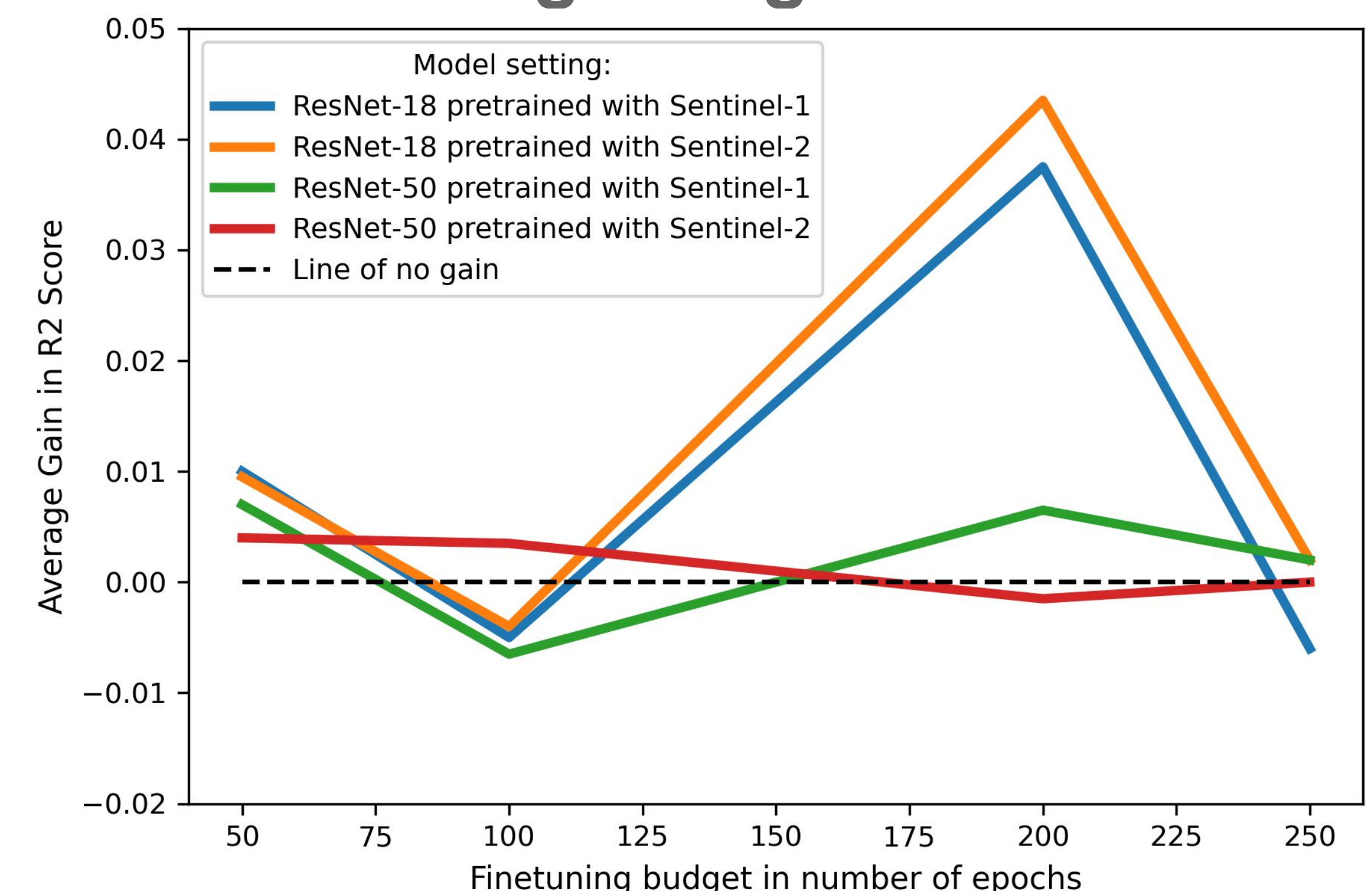


Figure 3. Gain in Finetuning of a U-Net under variable sensor modalities.

- Pre-training can benefit when using **enough training** budget
- Some **architectures** benefit more then others.

Datasets

- **Sensors:** Sentinel-1 and 2.
- **Coverage:** Finland, from 2017 to 2021.
- **Volume:** 13k images x 12 months.
- **Task:** AGB Pixel-wise regression.
- **More:** Internal dataset collection - covering Canada (British Columbia).

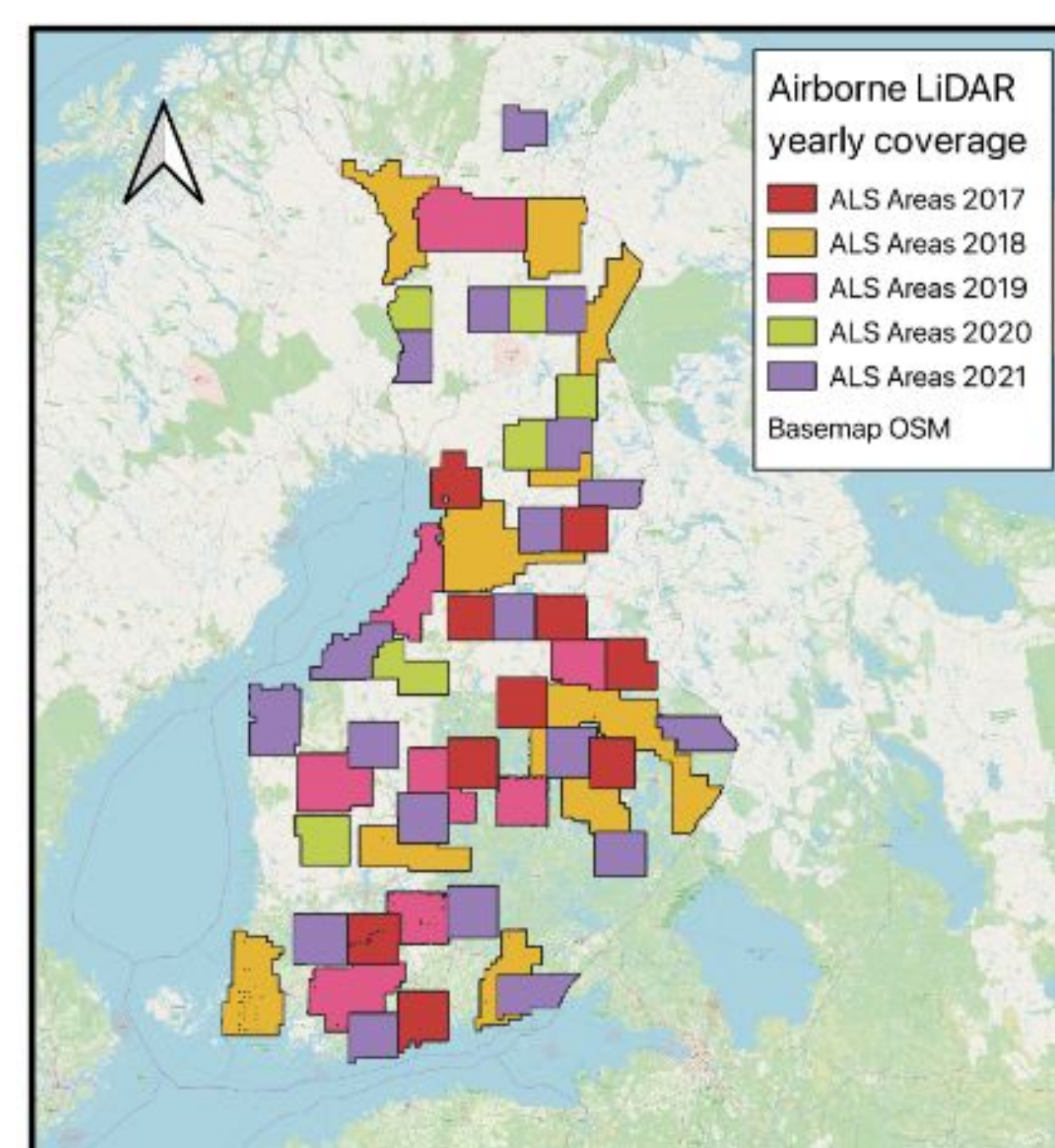


Figure 4. Lidar coverage by Biomasssters.

Conclusion

- We use Grünblick - a scalable AGB estimation service, for studying model selection for forestry use-cases.
- We propose and evaluate a metric for estimating the relative gain in performances of finetuning over training from scratch multi-modal models.
- Our systematic model-agnostic benchmark provides insights for a reliable model selection for AGB estimation.

References

- Ma et al., [Development of forest aboveground biomass estimation, its problems and future solutions: A review](#), Ecological Indicators, 2024.
- Nascetti et al., [Biomasssters: A benchmark dataset for forest biomass estimation using multi-modal satellite time-series](#), NeuRIPS 2023.

Acknowledgment