

Semantic Image Segmentation in Open Set Scenarios

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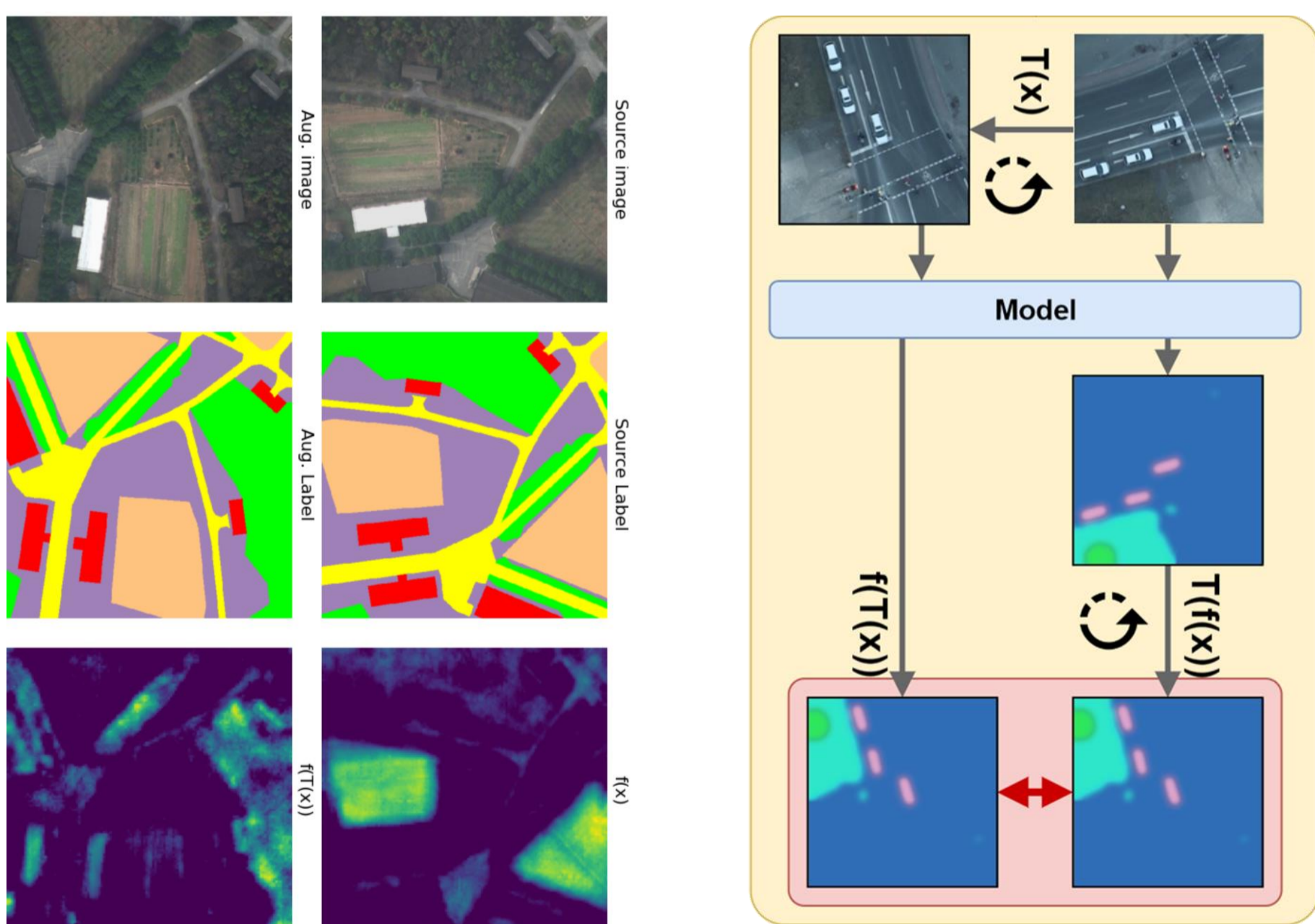
1. Introduction

Semantic Segmentation is a computer vision task where every pixel is assigned to a specific category. State-of-the-art approaches are tailored to *natural images* and using a *closed set* of classes. The objective of this work is to **adapt segmentation methods to aerial settings**, with an eye towards **robustness** and **open set** contexts.

2. Top-down Viewpoint

Aerial imagery differs from its natural counterpart in many ways, including **geographical location**, **multispectral** and **multimodal inputs**, and the **top-down view**.

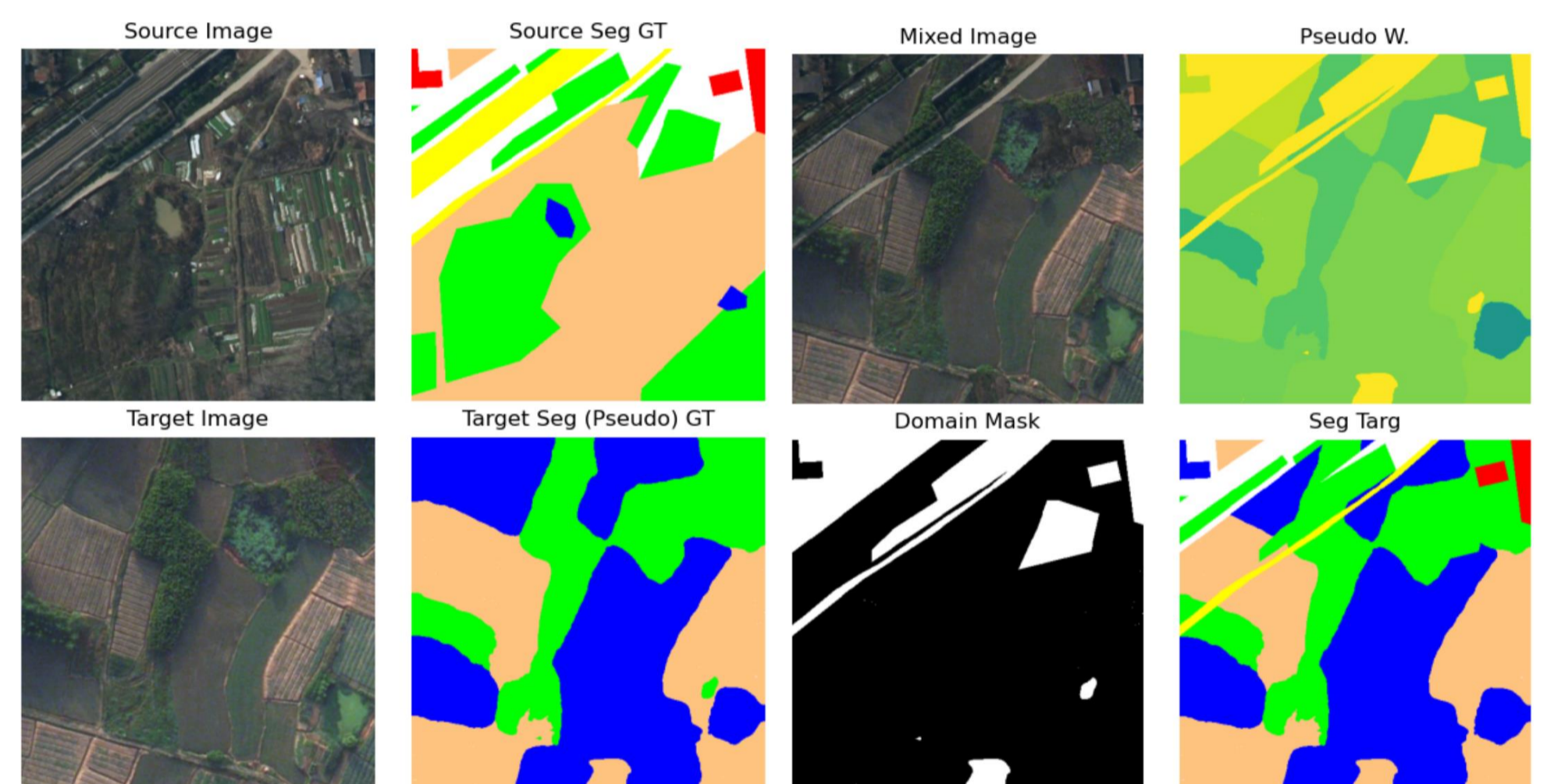
Rotation invariance: when images are taken from above, the rotation becomes arbitrary. This can be exploited to force a consistency among features of the image and its rotated versions.



An image and its transformed version are fed to the model. The obtained feature maps are first realigned, then compared for consistency [1, 2].

3. Different Domains

Different geographical locations exhibit **different distributions** (categories, pixels). Moreover, pixel unbalance between categories greatly hinders the ability of models to generalize. Exploiting **instance labels** (connected components) and the **elevation hierarchy** can improve semantic **Unsupervised Domain Adaptation (UDA)** methods.



Hierarchical Instance Mixing (HIMix): (i) extracts instances from the source label and the pseudo-label, (ii) uniformly selects half of them to be mixed on the target, (iii) merges source and target instances hierarchically based on their size (*smaller ones on top*), and (iv) produces a binary mask M to construct the final blended sample.

4. Conclusions

Aerial images provide several challenges when compared to natural images, also in tasks such as semantic segmentation. Future works will focus on Open Set and Out of Distribution Detection in aerial images.

5. References

1. A Contrastive Distillation Approach for Incremental Semantic Segmentation in Aerial Images, Arnaudo et al., ICIAP 2022
2. Augmentation Invariance and Adaptive Sampling in Semantic Segmentation of Agricultural Aerial Images, Tavera, Arnaudo et al., CVPRW 2022
3. Hierarchical Instance Mixing Across Domains, Arnaudo, Tavera et al., IEEE Access 2022 (under review)