Contrail Segmentation With Deep Learning - Part II

FLY AI Forum 2024

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TU Delft

Outline

- Segmentation models from few-shot transfer learning
- Contrail shadow segmentation for altitude calculation
- Open-source library

1. Few-shot transfer learning

Encoder-Decoder like network

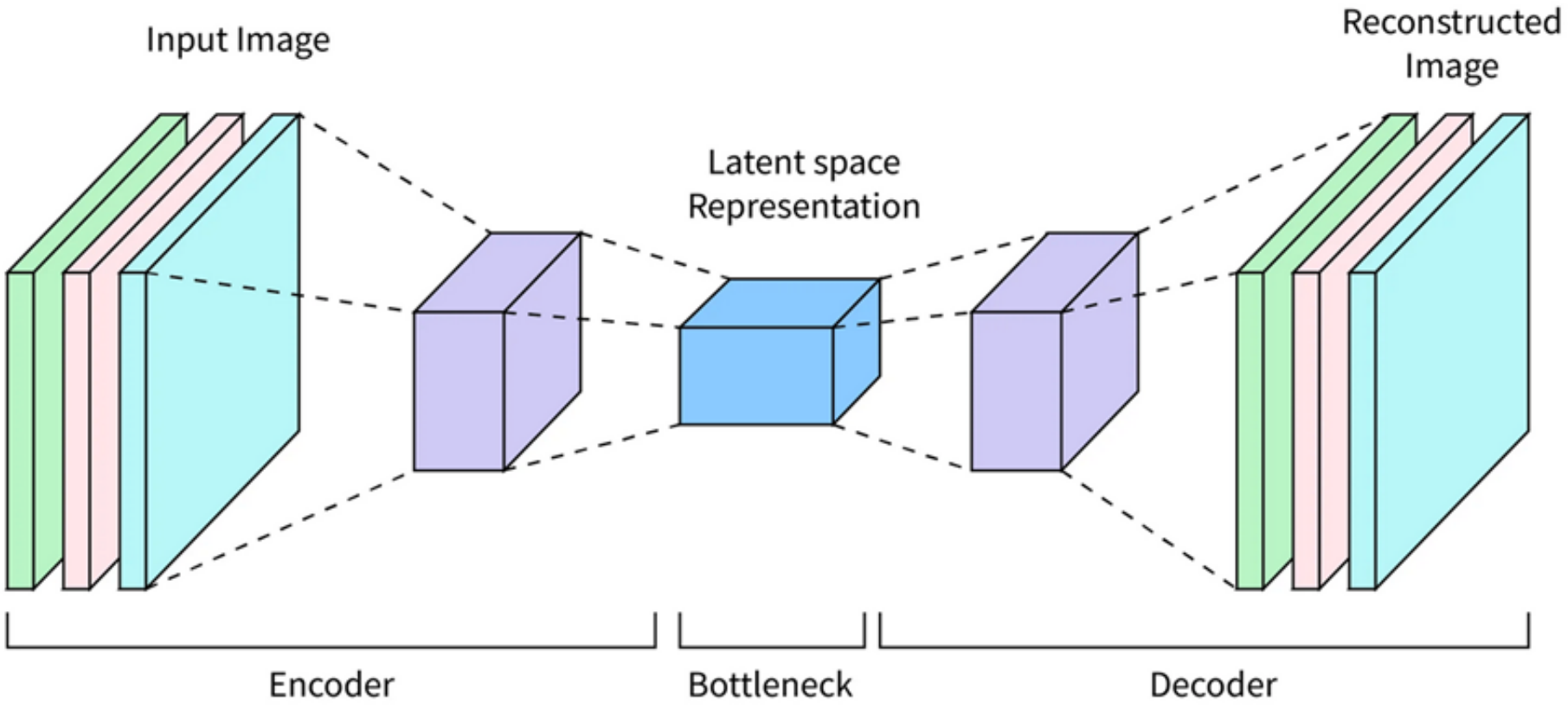
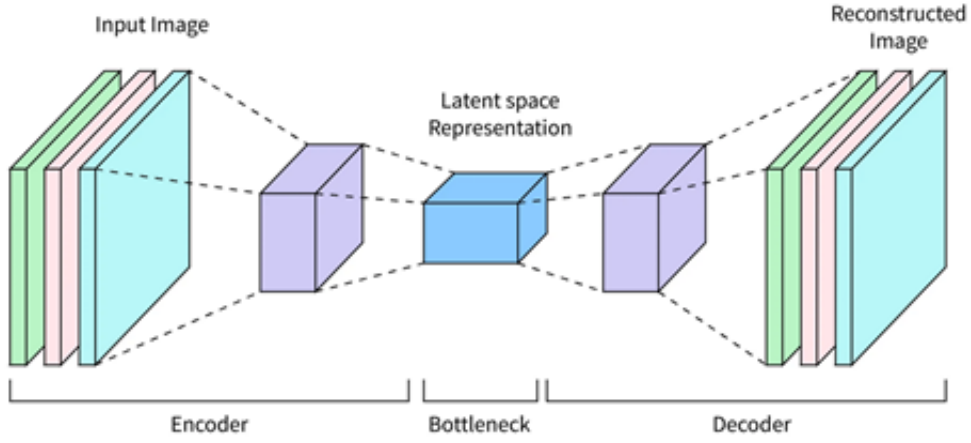
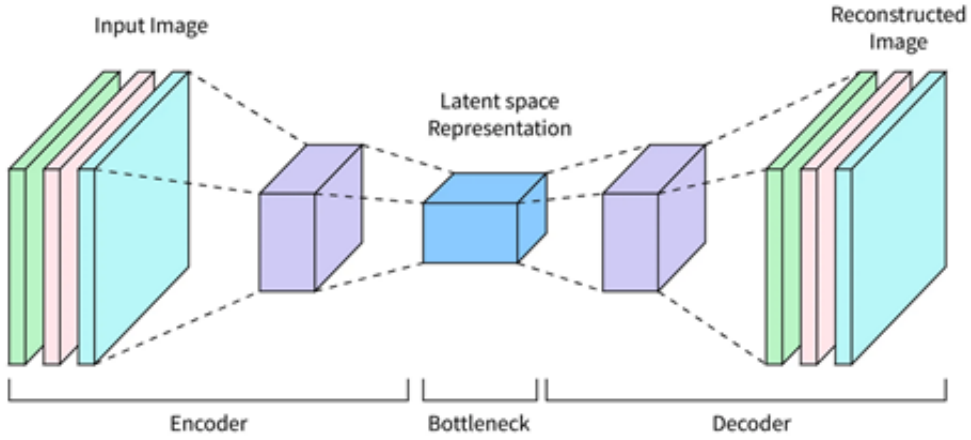


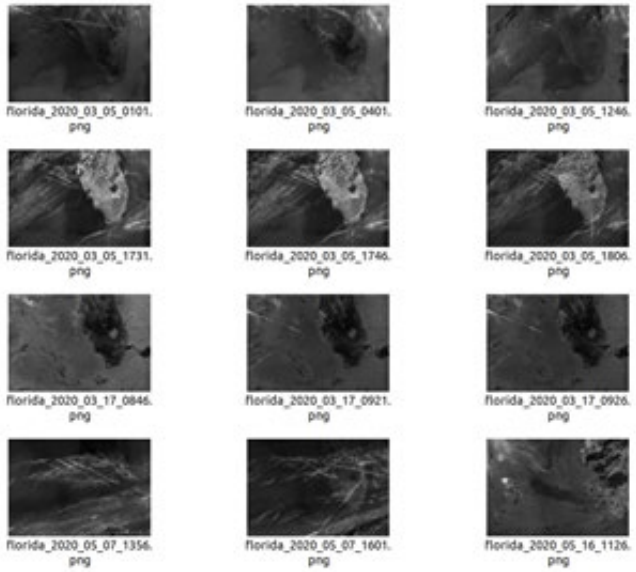
Image source: https://www.scaler.com/topics/deep-learning/autoencoders/

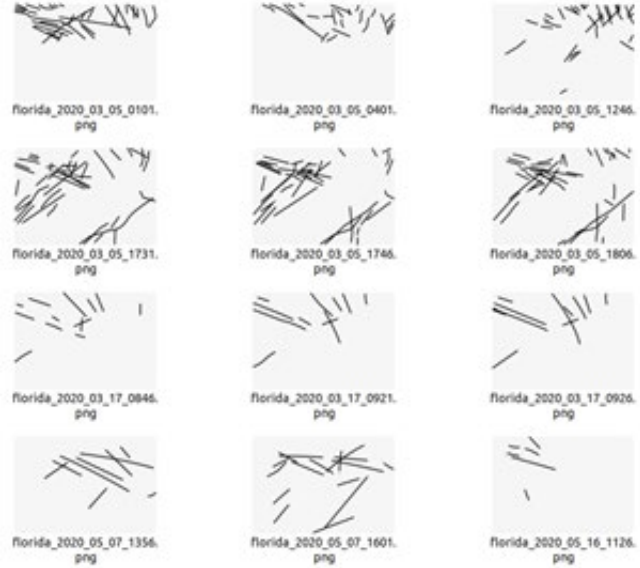
Pre-training with generic dataset



Few-shot transfer learning

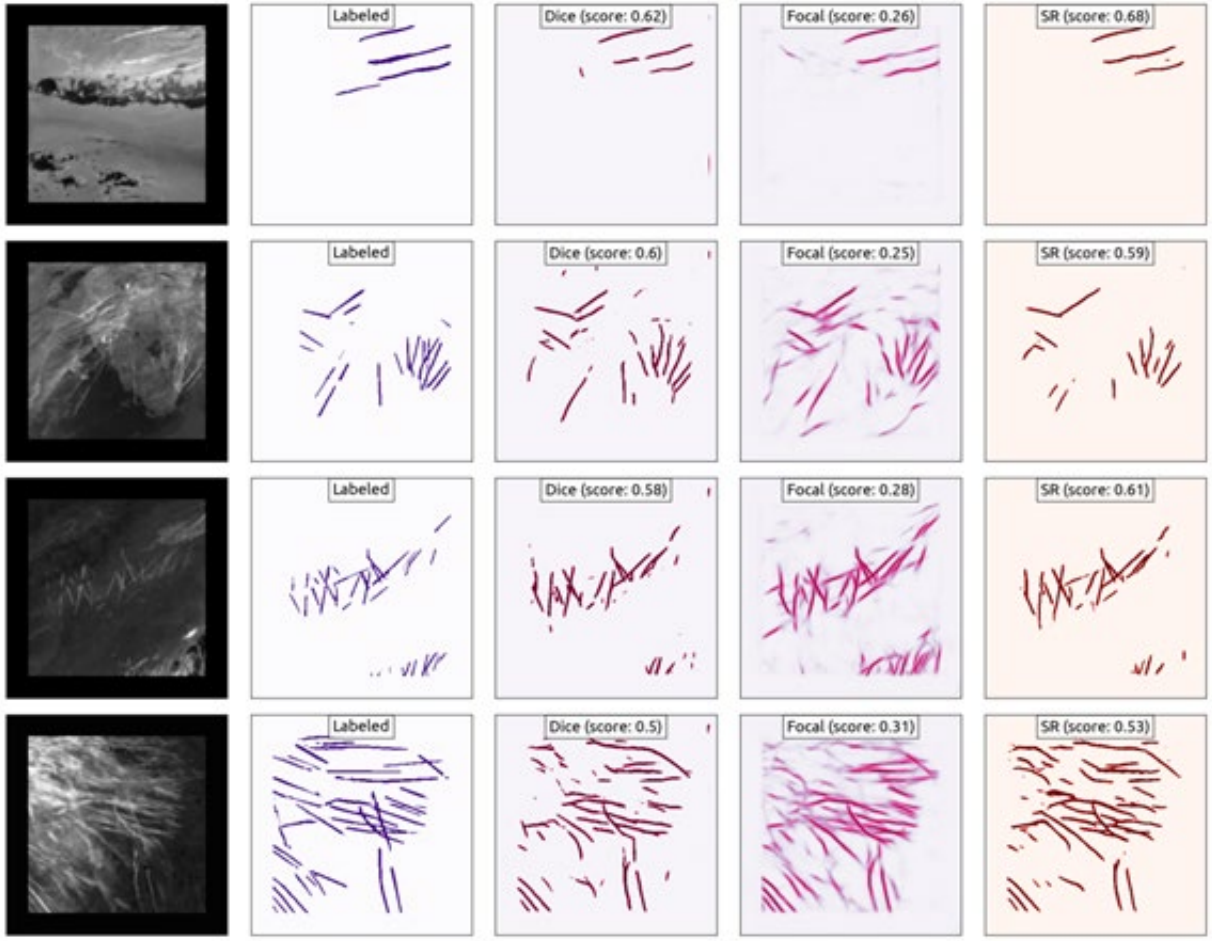






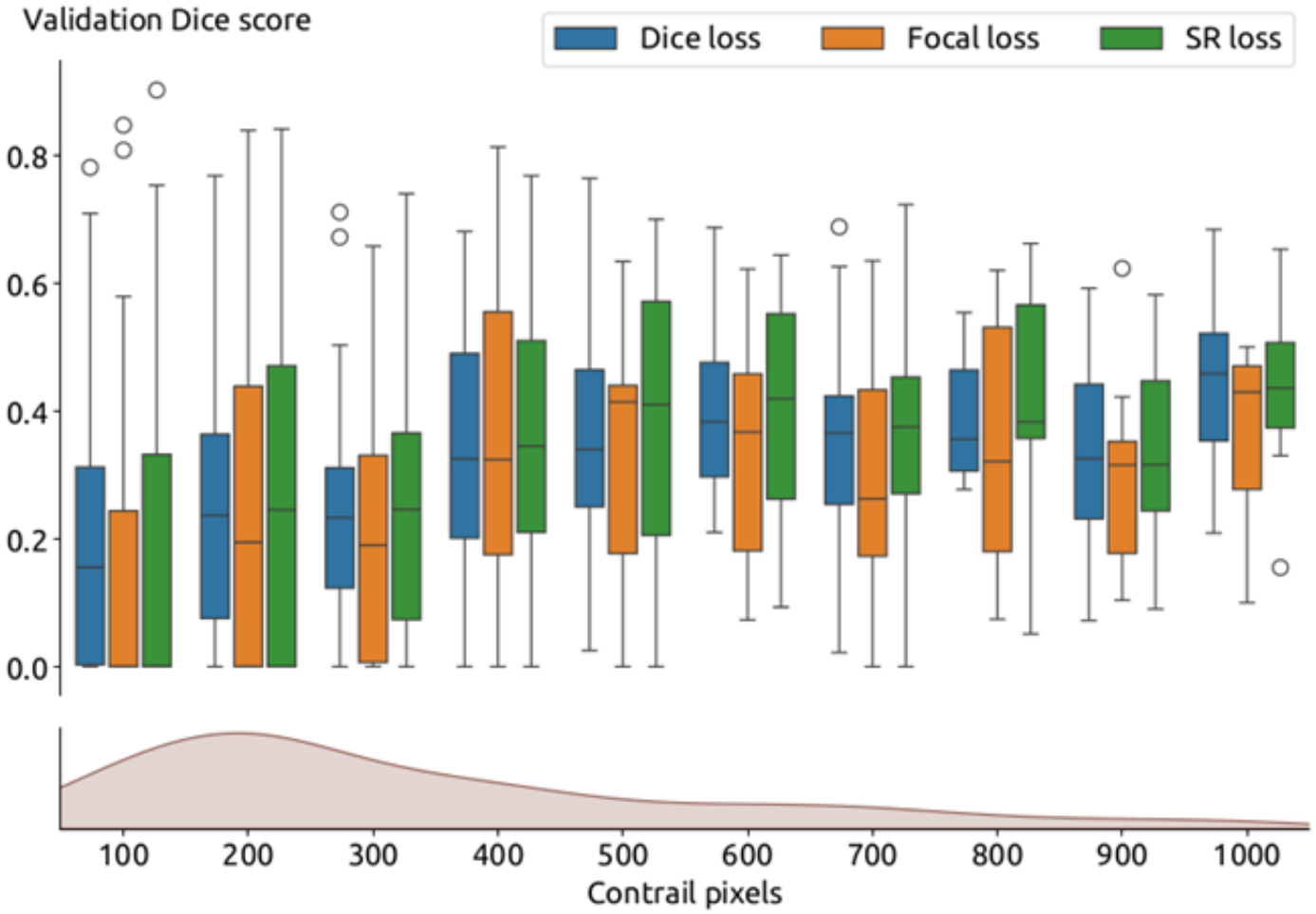
Performance of the few-shot learning

- Trained with ~30 own images
- Applied image augmentation for better generalization
- Evaluated on the Google dataset



Google contrail image

Performance of the few-shot learning



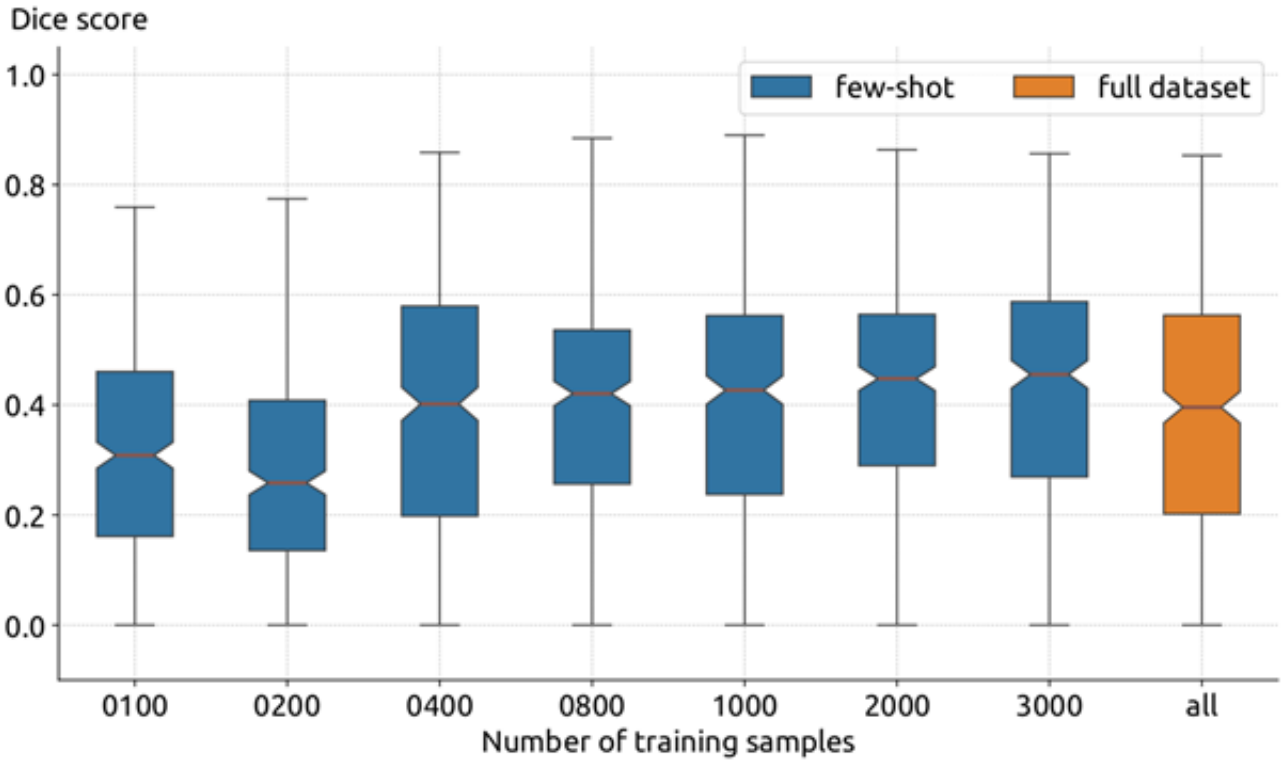
Note:

Trained with ~30 own labeled images.

Evaluated on the Google dataset validation images with contrails masks

~2000 images total
(of which, 30% contains contrails)

How many images do you need?

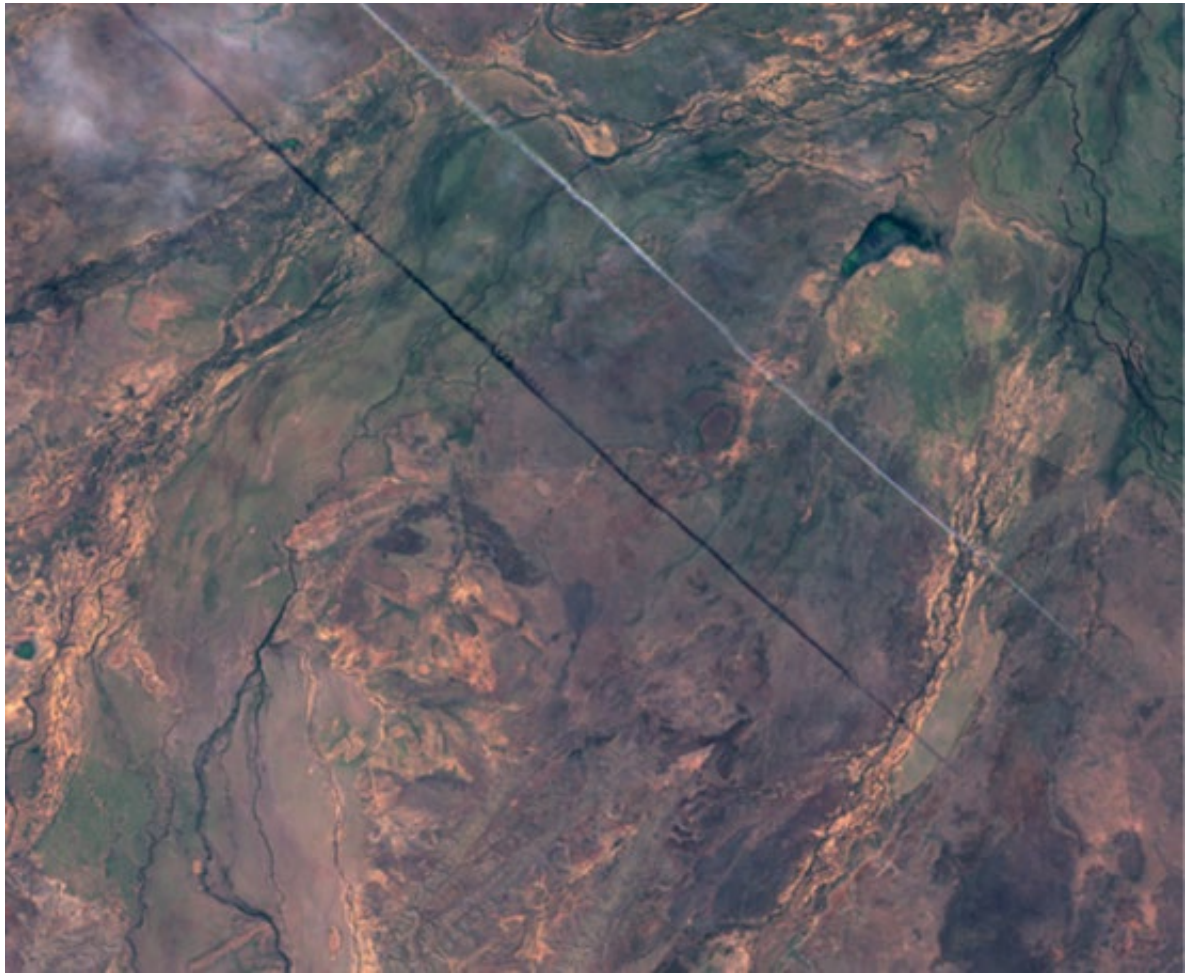


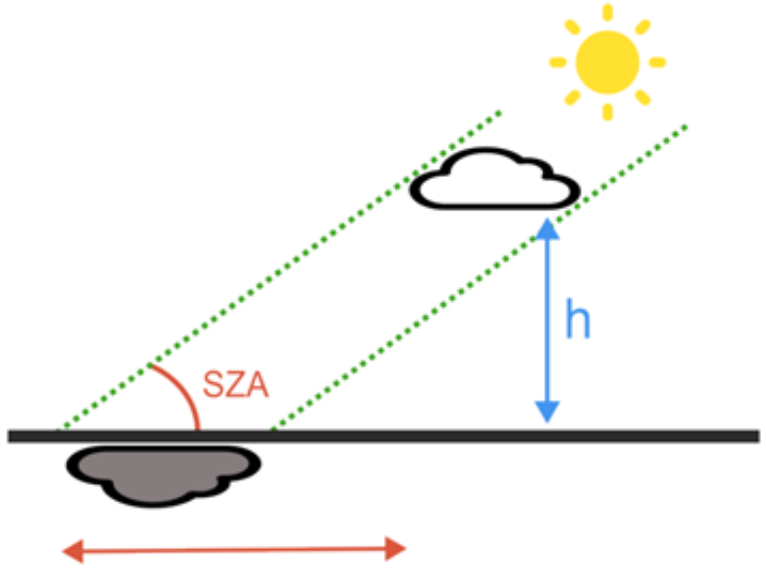
All models are trained with:

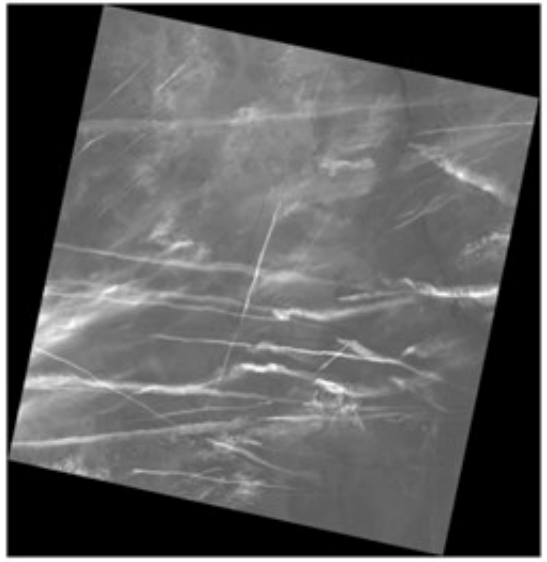
- Dice loss
- 30 minutes GPU time
- NVIDIA A10G GPU
- Trained with sampled Google contrail images
- Evaluated on the Google evaluation dataset

2. Altitude determination through contrail shadows

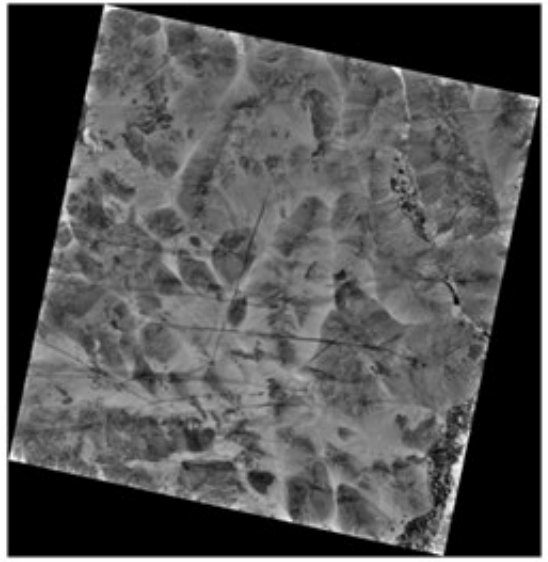
Altitude determination through contrail shadows



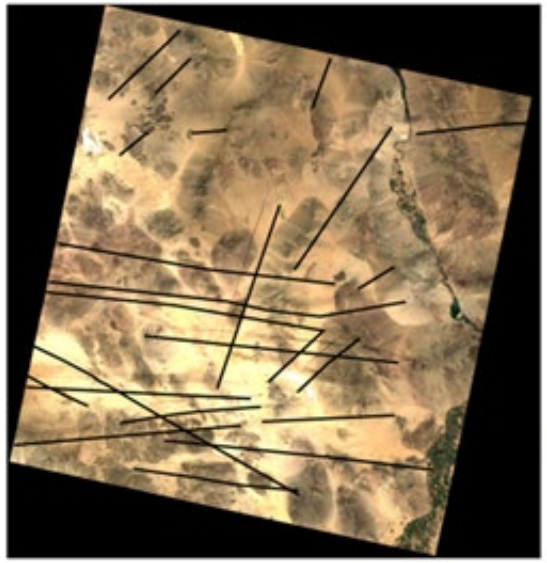




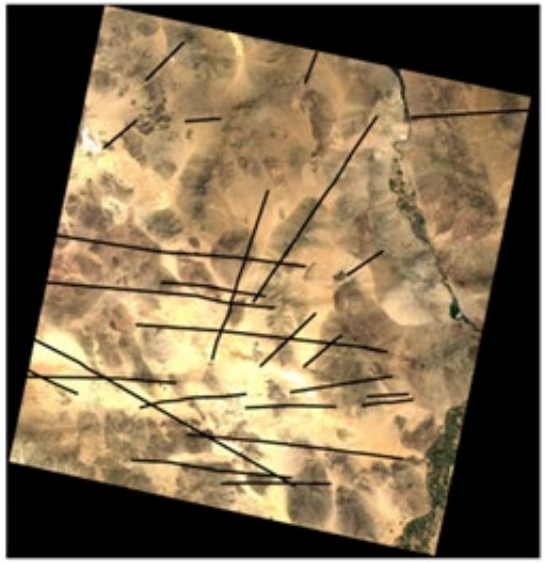
(a) Band 9: Contrails visible



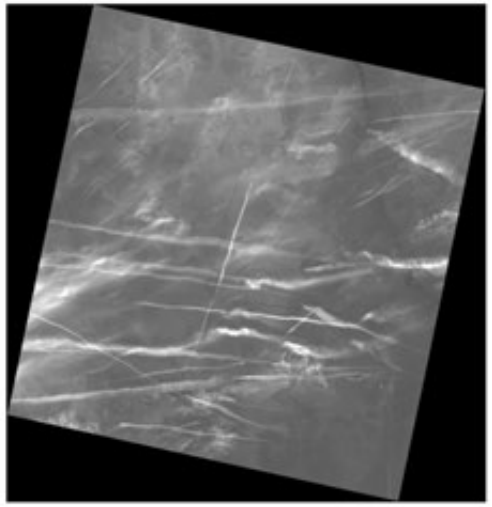
(b) Band 7: Shadows visible



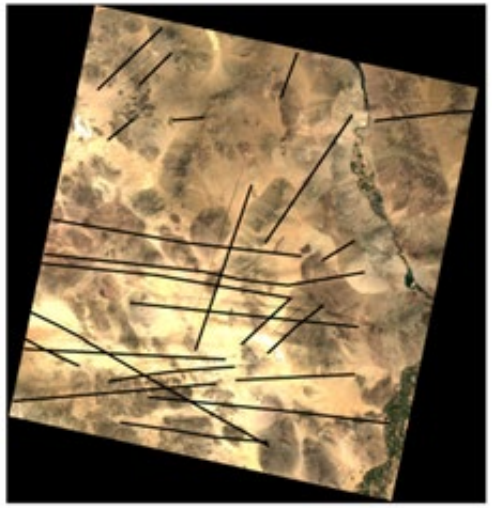
(d) Manually labelled contrails



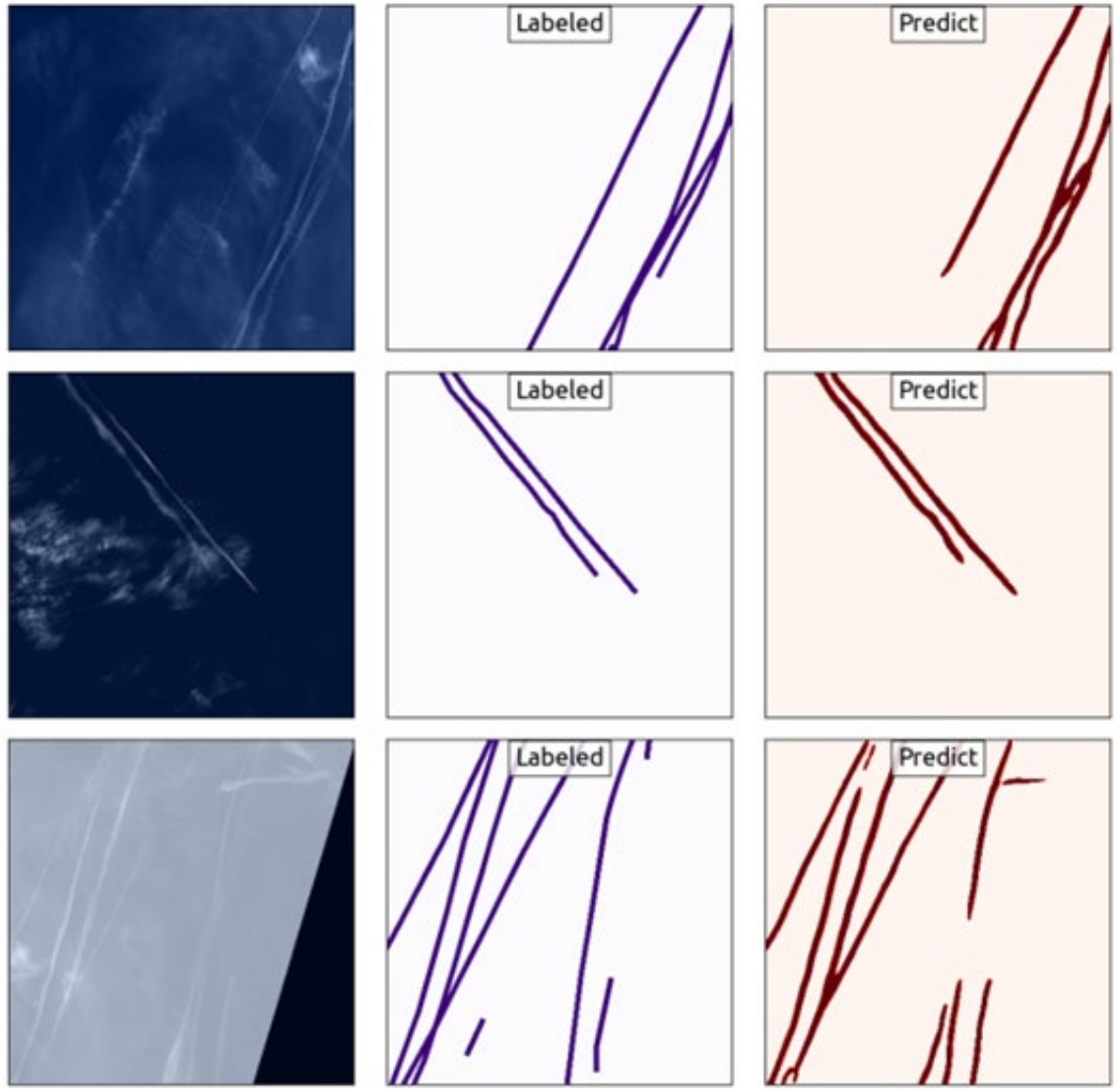
(e) Manually labelled shadows

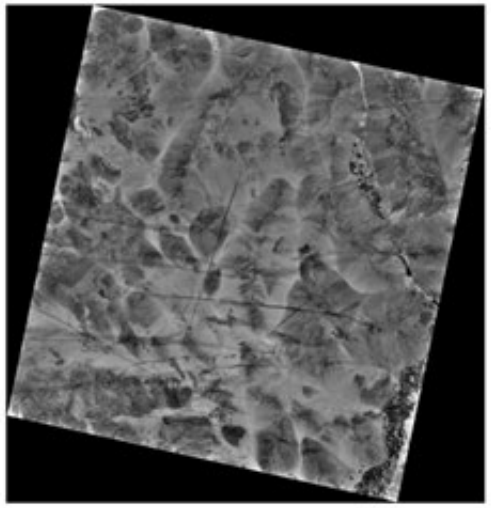


(a) Band 9: Contrails visible

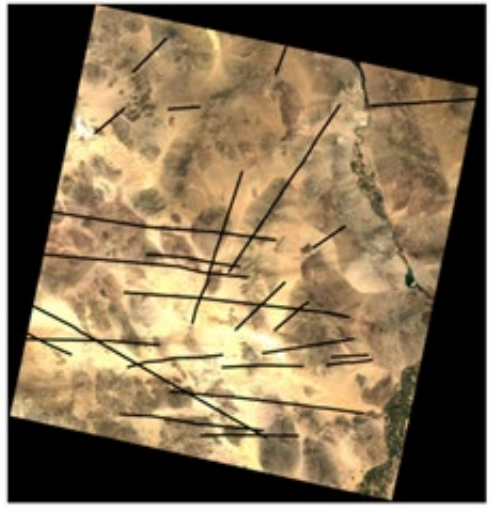


(d) Manually labelled contrails

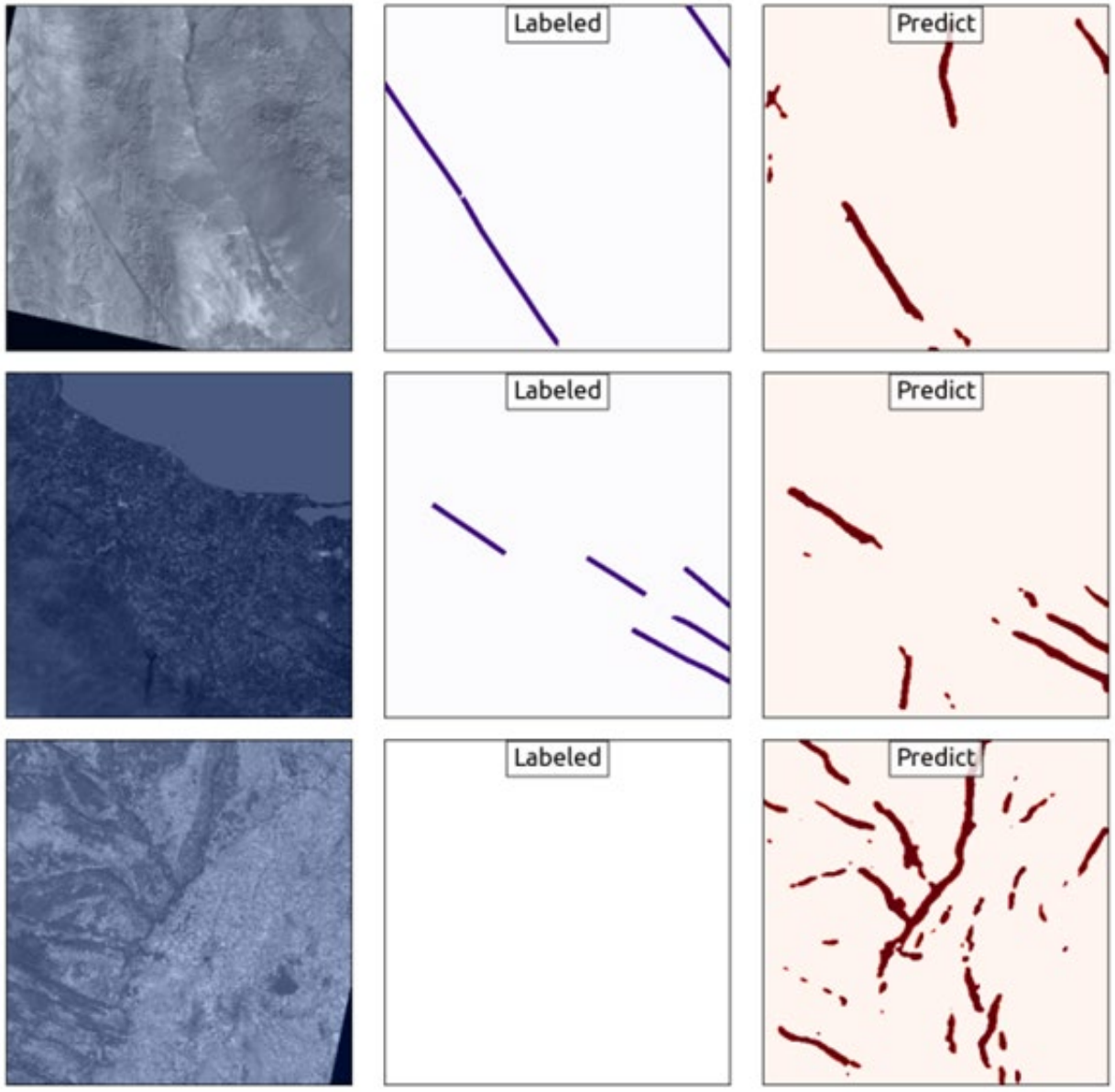


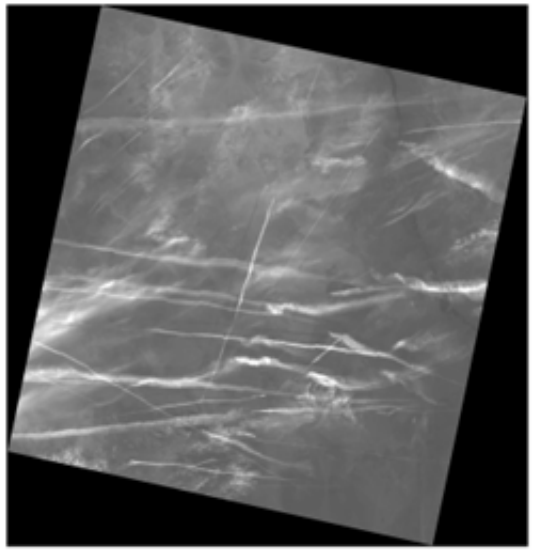


(b) Band 7: Shadows visible



(e) Manually labelled shadows





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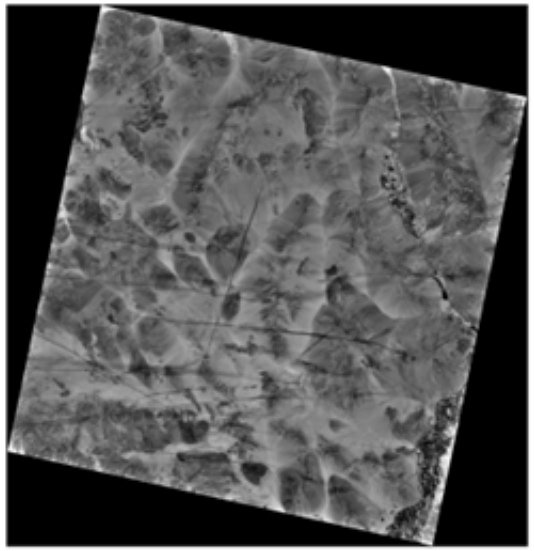
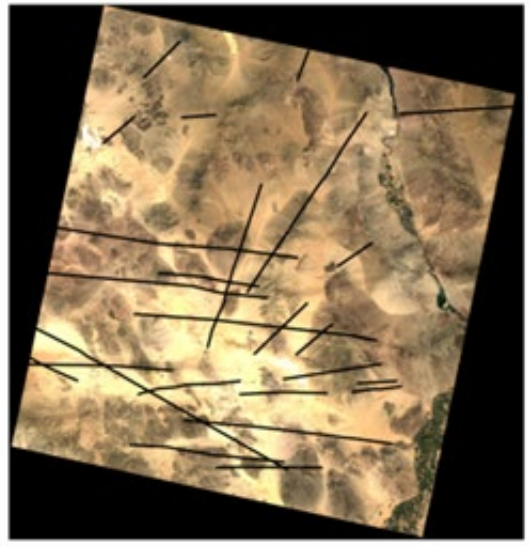
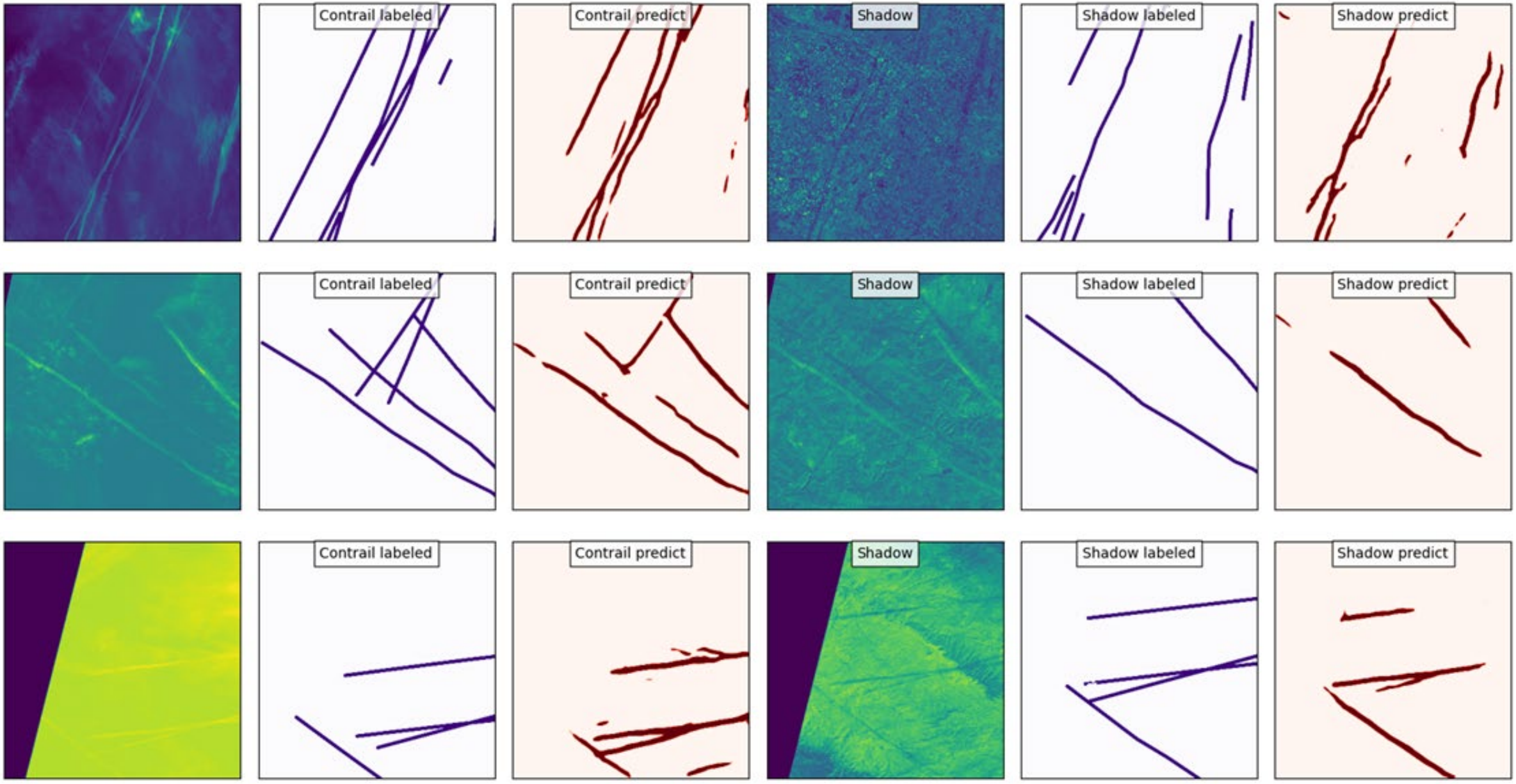


(b) Band 7: Shadows visible



(e) Manually labelled shadows


Contrail labeled
Contrail predict
Shadow
Shadow labeled
Shadow predict
Contrail labeled
Contrail predict
Shadow
Shadow labeled
Shadow predict
Contrail labeled
Contrail predict
Shadow
Shadow labeled
Shadow predict

3. Open code / data available at:

https://github.com/junzis/contrail-seg

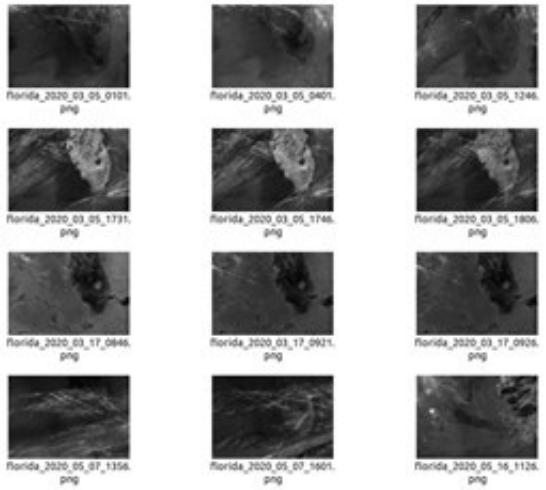
```
# train with own dataset, for 1000 epoch, SR loss function
python train.py --dataset own --epoch 1000 --loss sr

python train.py --dataset own --epoch 1000 --loss dice

# train model for 60 minutes
python train.py --dataset own --time 60 --loss focal
```

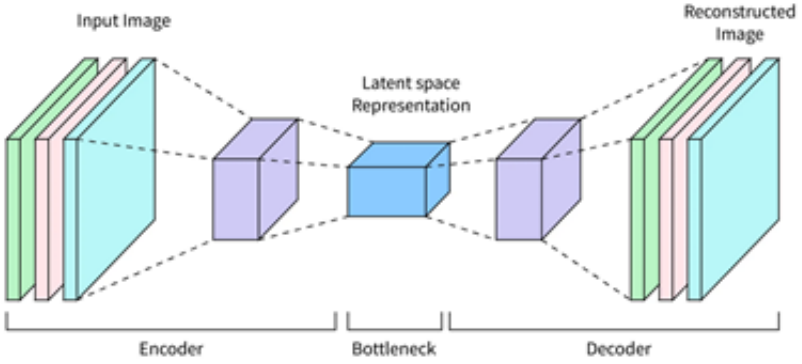
```
# train with google dataset, 30 minutes, SR loss
python train.py --dataset google --time 30 --loss sr

# fewshot training, 400 images, 30 minutes
python train.py --dataset google:fewshot:400 --time 30 --loss dice
```

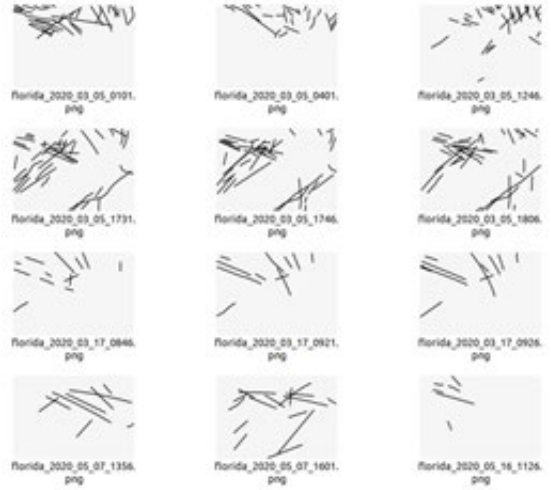
Future work

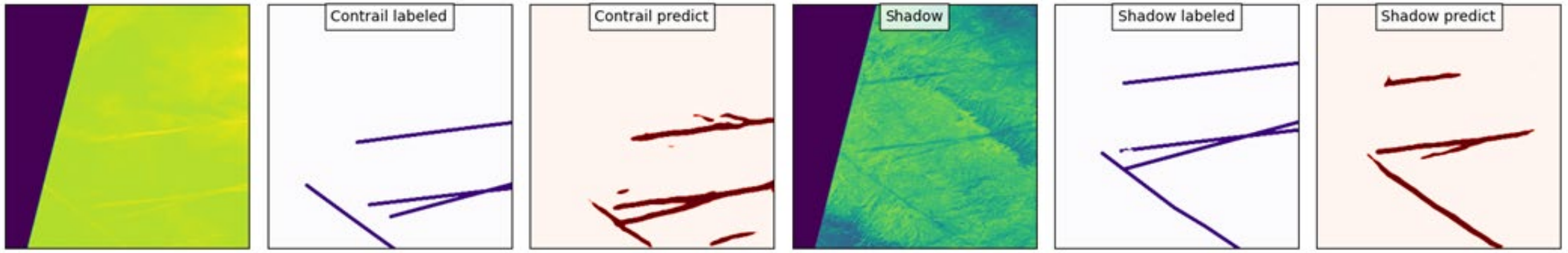
1. For few-shot learning:
    a. Use of data from ContrailNet initiative
    b. A small well curated dataset from different satellite sources
2. For shadow detection:
    a. Improve the detection model with more image channels
    b. Replace the contrail image (channel B9) with output from the contrail prediction model

Thank you!




Input Image
Reconstructed Image
Latent space Representation
Encoder
Bottleneck
Decoder




Contrail labeled
Contrail predict
Shadow
Shadow labeled
Shadow predict