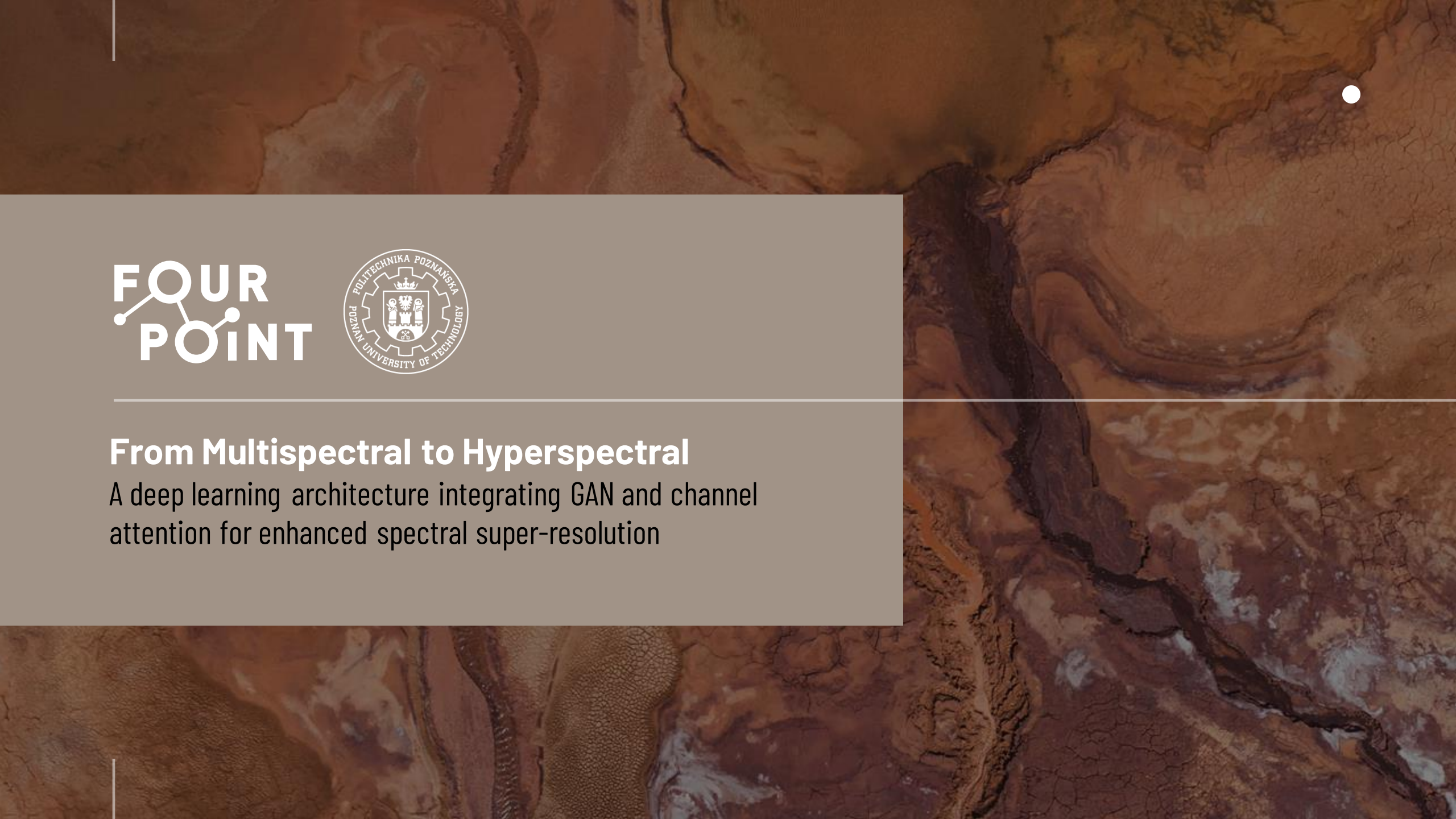


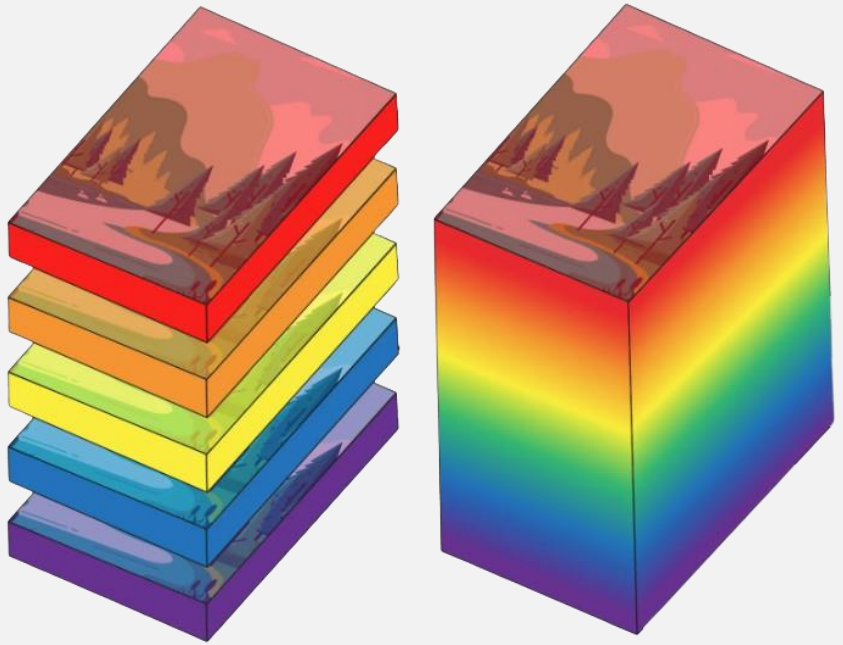
From Multispectral to Hyperspectral

A deep learning architecture integrating GAN and channel attention for enhanced spectral super-resolution

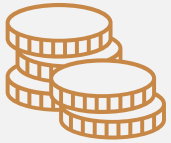
Plan

1. Introduction
2. Proposed solution
3. Results
4. Applications

Traditional SR vs. Spectral SR



Motivation



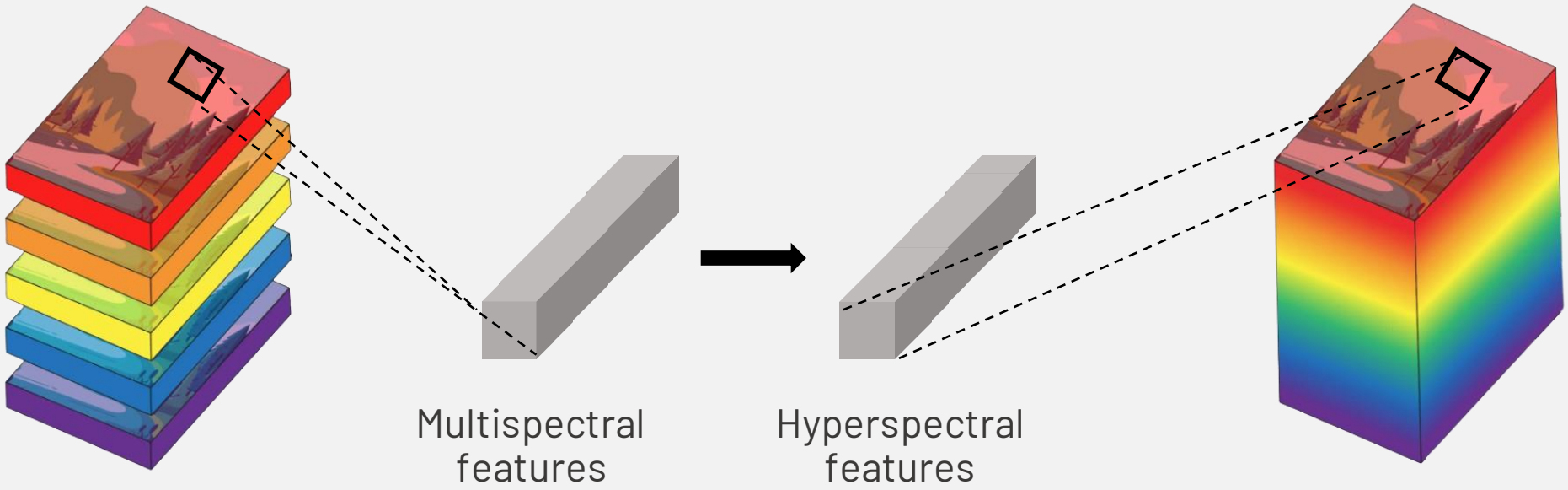
HSI images are difficult to access and exist for specific time interval

Existing solutions were developed on synthetic datasets

The more information the better

Our approach

Augment the spectral resolution of multispectral images, increasing the number of bands from 13 in multispectral images (MSI) to 238 in hyperspectral counterparts (HSI).

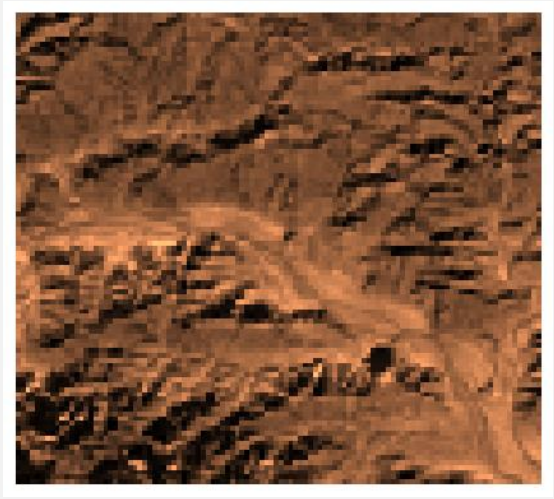


Dataset

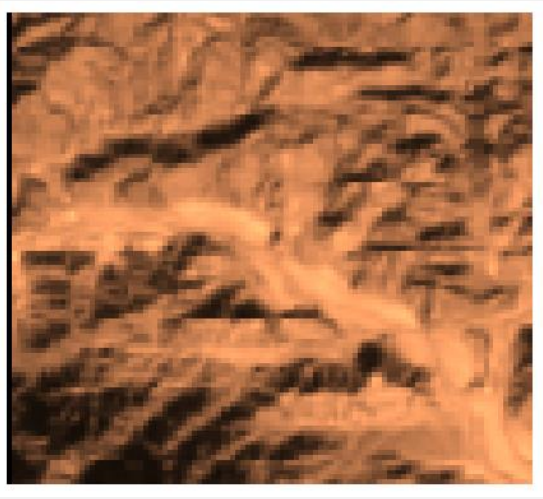
60 pairs of corresponding MSI and HSI images

- MSI: Sentinel-2, 12 channels
- HSI: PRISMA, 239 channels

Location: Atacama, Chile



Multispectral

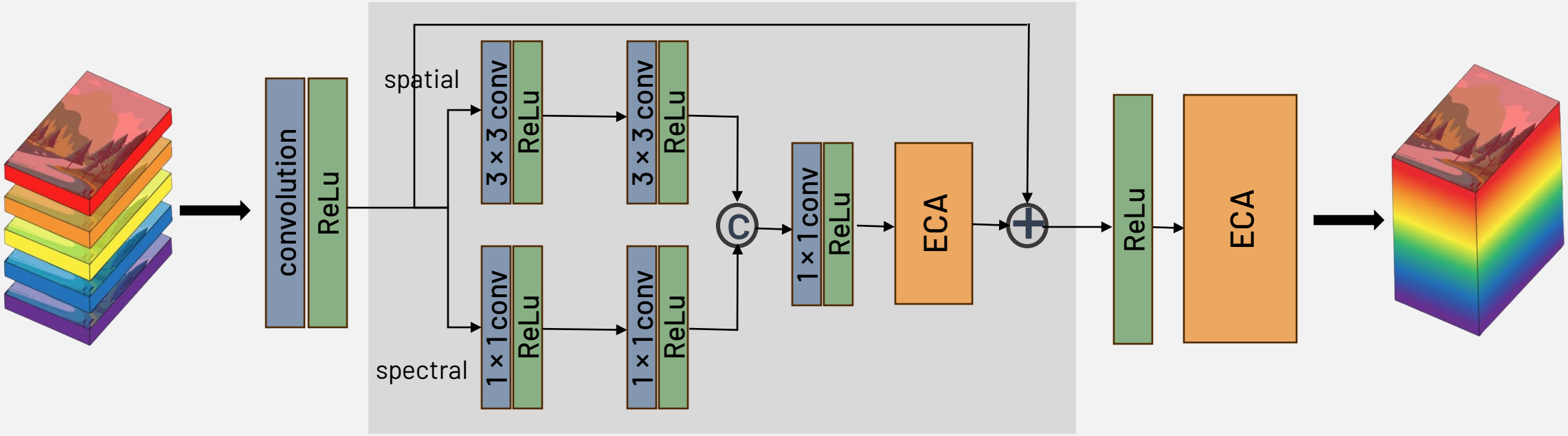


Hyperspectral

Preprocessing:

- Patching to size 20 × 20 with stride 10
- downsampling MSI to the same spatial resolution as HSI
- scaling values to the same range

Architecture: Generator



Spatial-spectral residual block

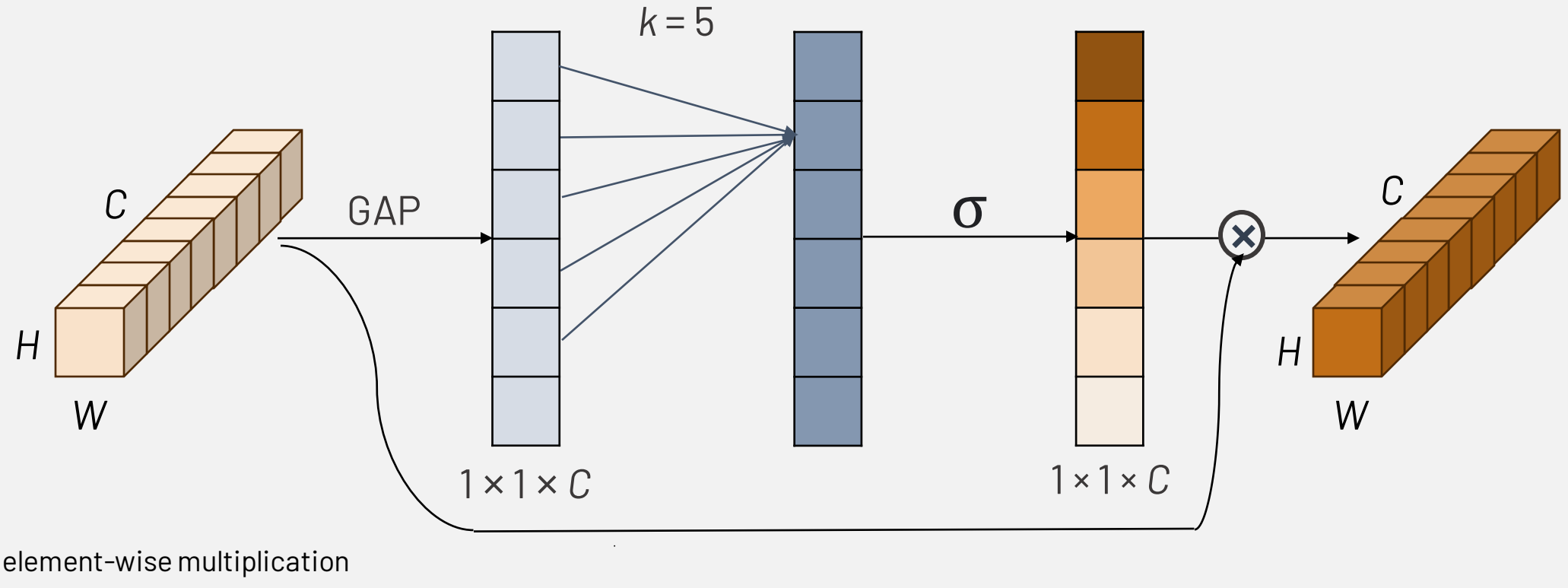
concatenation

element-wise addition

Xiangtao Zheng, Wenjing Chen, Xiaoqiang Lu
Spectral Super-Resolution of Multispectral Images Using Spatial–Spectral Residual Attention Network, IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 60, 2022

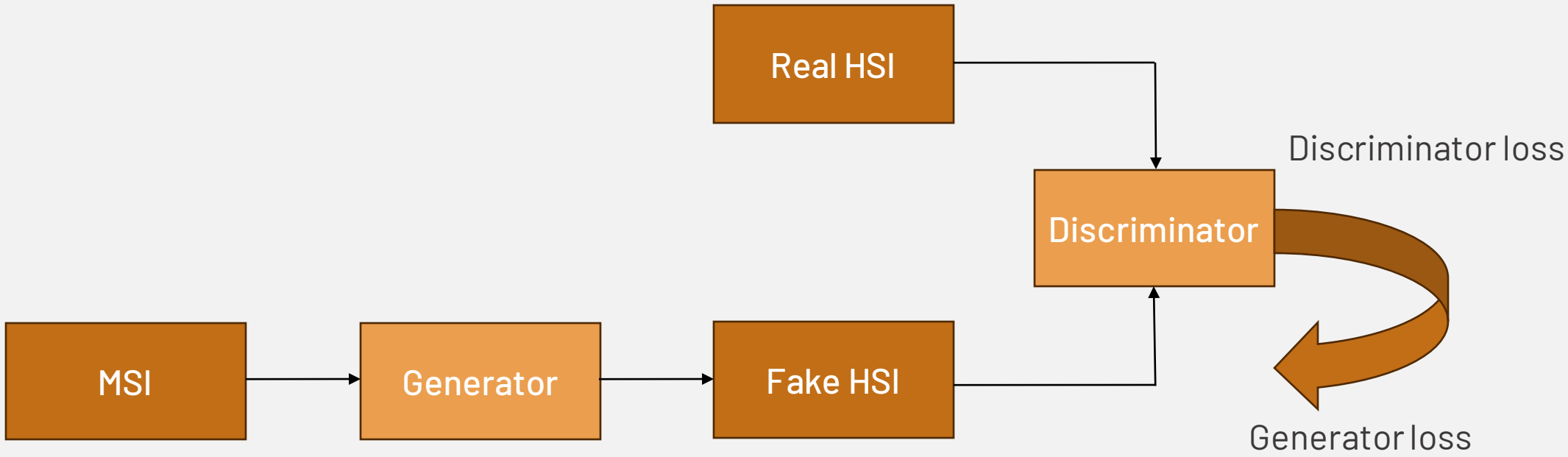
Efficient Channel Attention

Given the aggregated features obtained by global average pooling (GAP), ECA generates channel weights by performing a fast 1D convolution of size k.



Qilong Wang, Banggu Wu, Pengfei Zhu, Peihua Li, WangMeng Zuo, QinGhua Hu
ECA-Net: Efficient Channel Attention for Deep Convolutional Neural Networks, CVPR 2020

Generative Adversarial Network



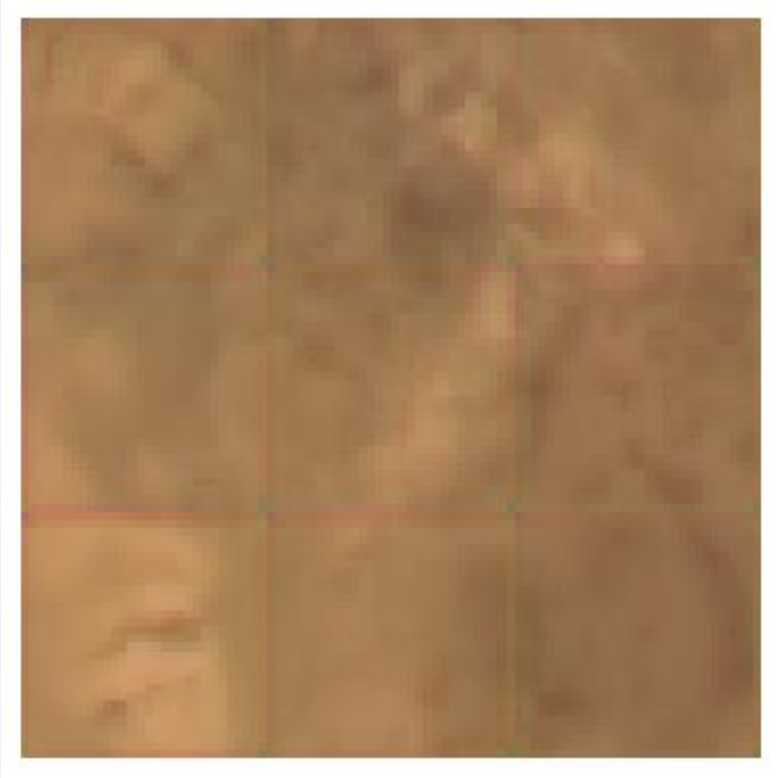
Ian J. Goodfellow, Jean Pouget-Abadie, Mehdi Mirza, Bing Xu, David Warde-Farley, Sherjil Ozair, Aaron Courville, Yoshua Bengio
Generative Adversarial Networks, NeurIPS 2014

Results on test set

Architecture	PSNR	RMSE	Training time
ConvNet	25.9	0.05	5 min
ConvNet with ECA	30.1	0.02	10 min
GAN	27.2	0.04	15 min
GAN with ECA	32.3	0.01	20 min

The training was performed on NVIDIA Quadro T500 Mobile (laptop GPU).
Each model was trained for 50 epochs.

Averaged RGB

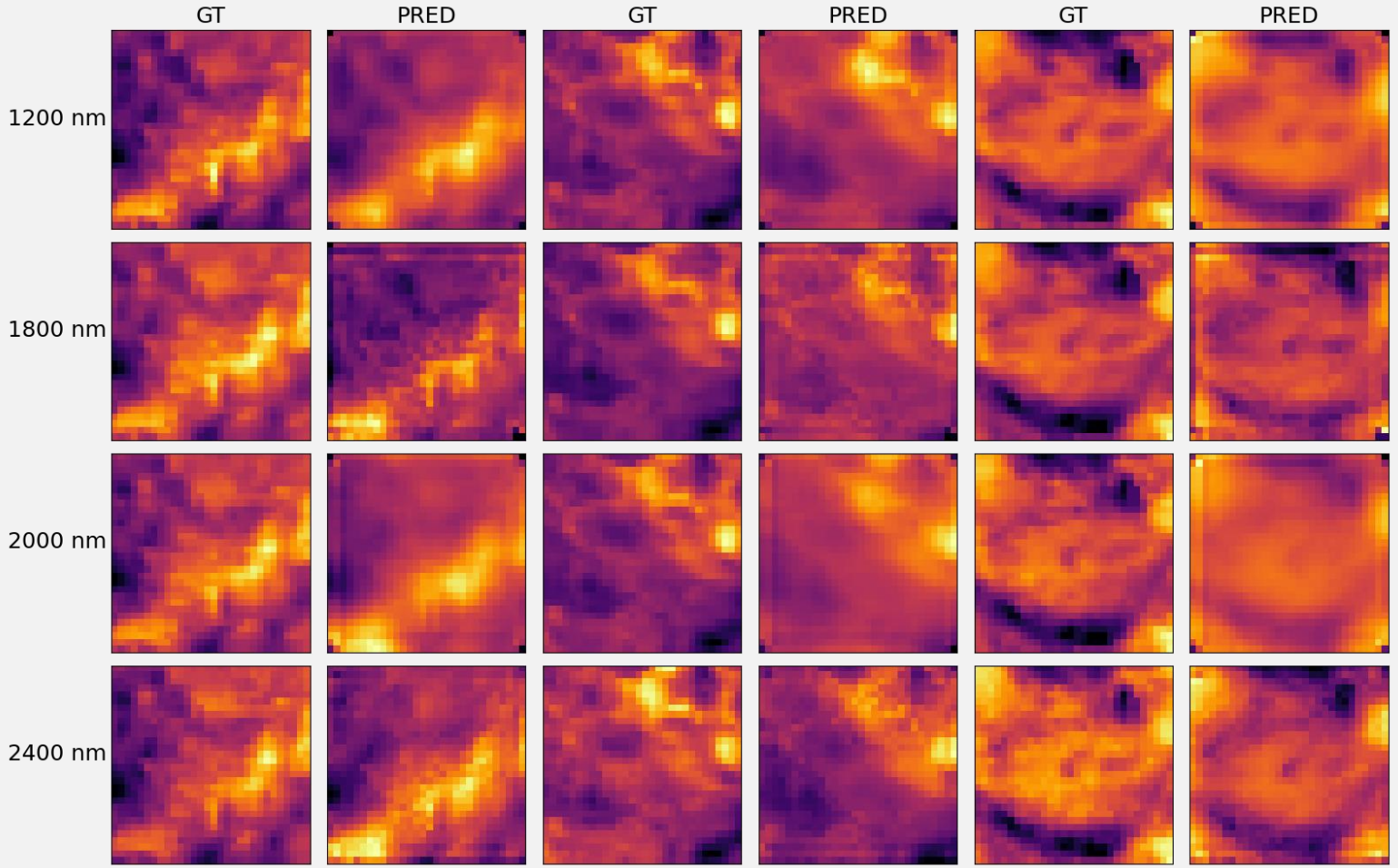


prediction

target

Sentinel 2 bands

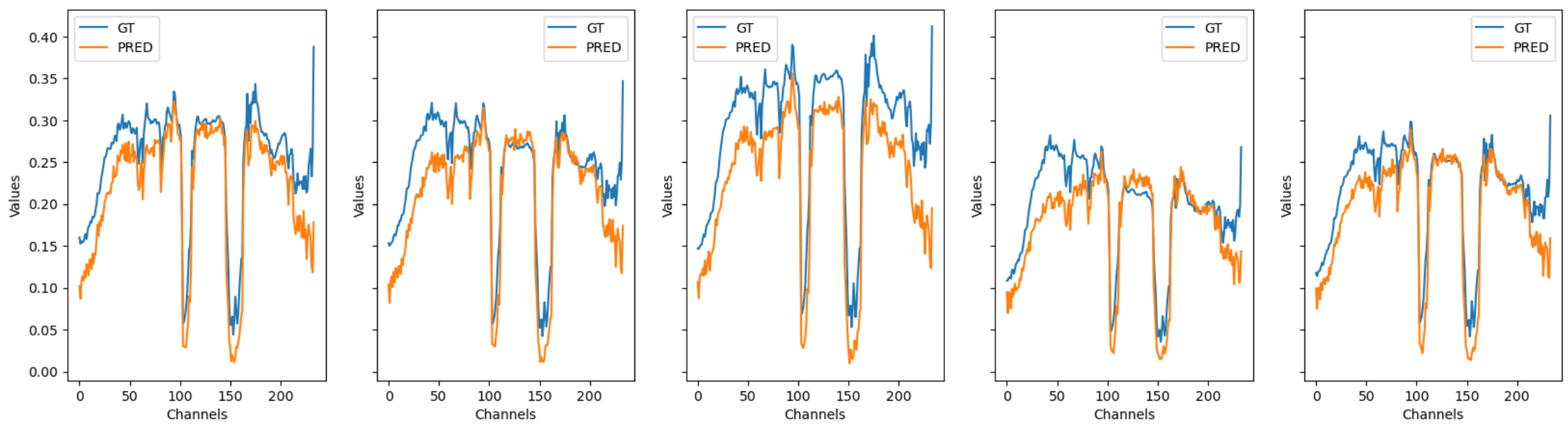
Band number	Wavelength [nm]
1	443
2	490
3	560
4	665
5	705
6	740
7	783
8	842
8a	865
9	945
10	1375
11	1610
12	2190



Reconstructed HSI bands
(not present in Sentinel)

Spectral curves

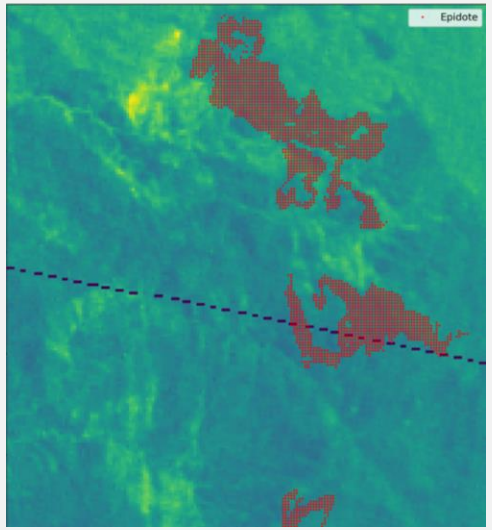
Random pixels from different images.



Looking for minerals

Hyperspectral image

Segmentation
(pixel classification)

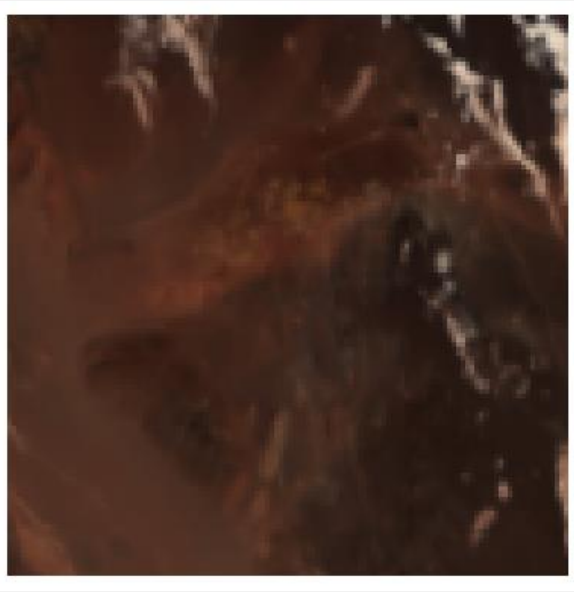


Two classes: background and epidote

Masks

Output for real HSI

Output for reconstructed HSI



HSI

Summary

- The proposed architecture can be effectively used to extend hyperspectral datasets
- It is possible to adjust the solution to other data sources and number of channels
- In the future we plan to improve spatial and spectral resolution simultaneously

FOUR POINT

THANK YOU

Zuzanna Gawrysiak
zuzanna.gawrysiak@fourpoint.space