

Generating Photorealistic Flood Predictions with Generative Adversarial Networks

Natasha Randall

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Cologne
A.I. & Machine
Learning Meetup



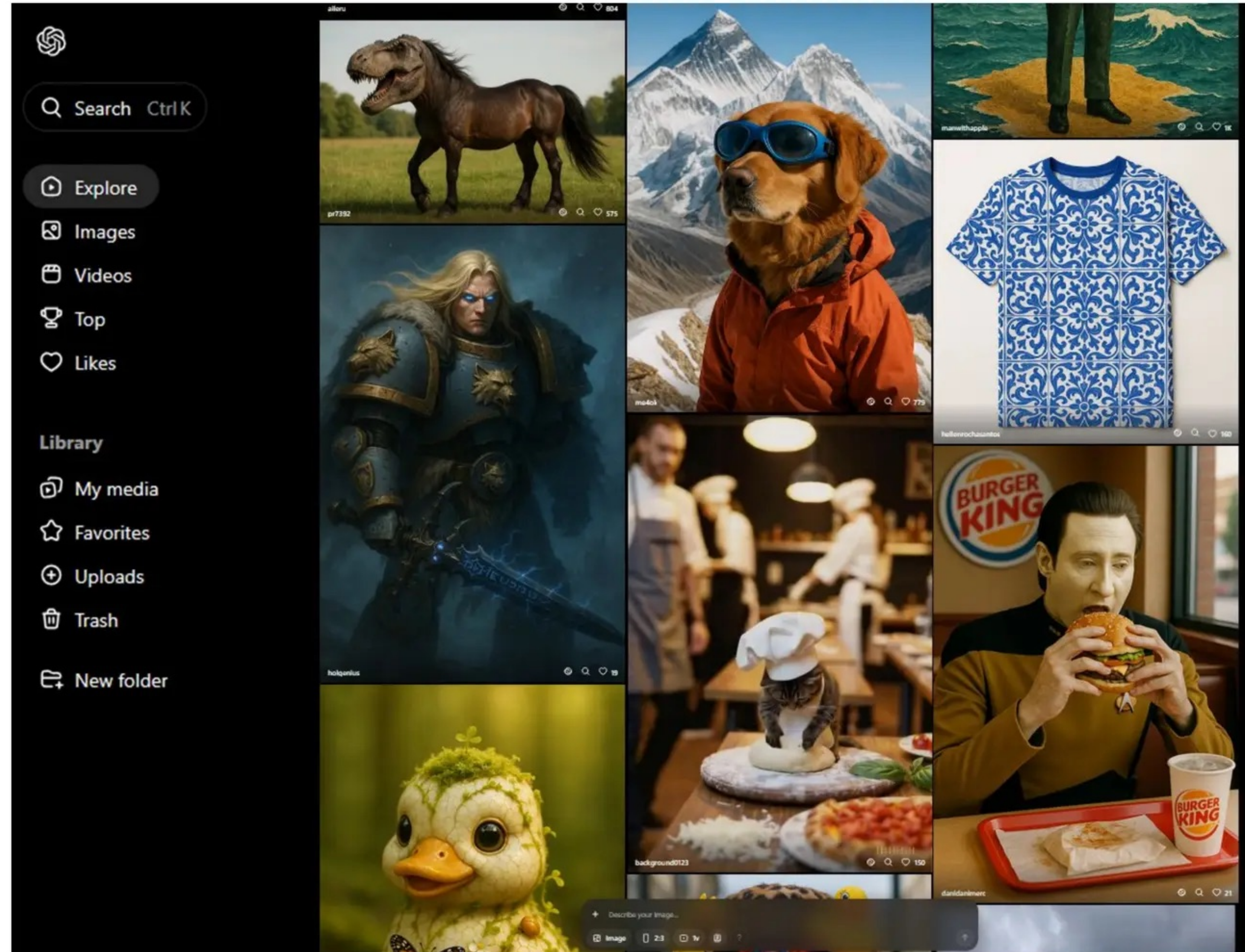
PROMOTIONS-
KOLLEG NRW

Technology
Arts Sciences
TH Köln

COLOGNE
AIMLab

Image Generation

*SORA, OpenAI (2025)
<https://sora.chatgpt.com/>*

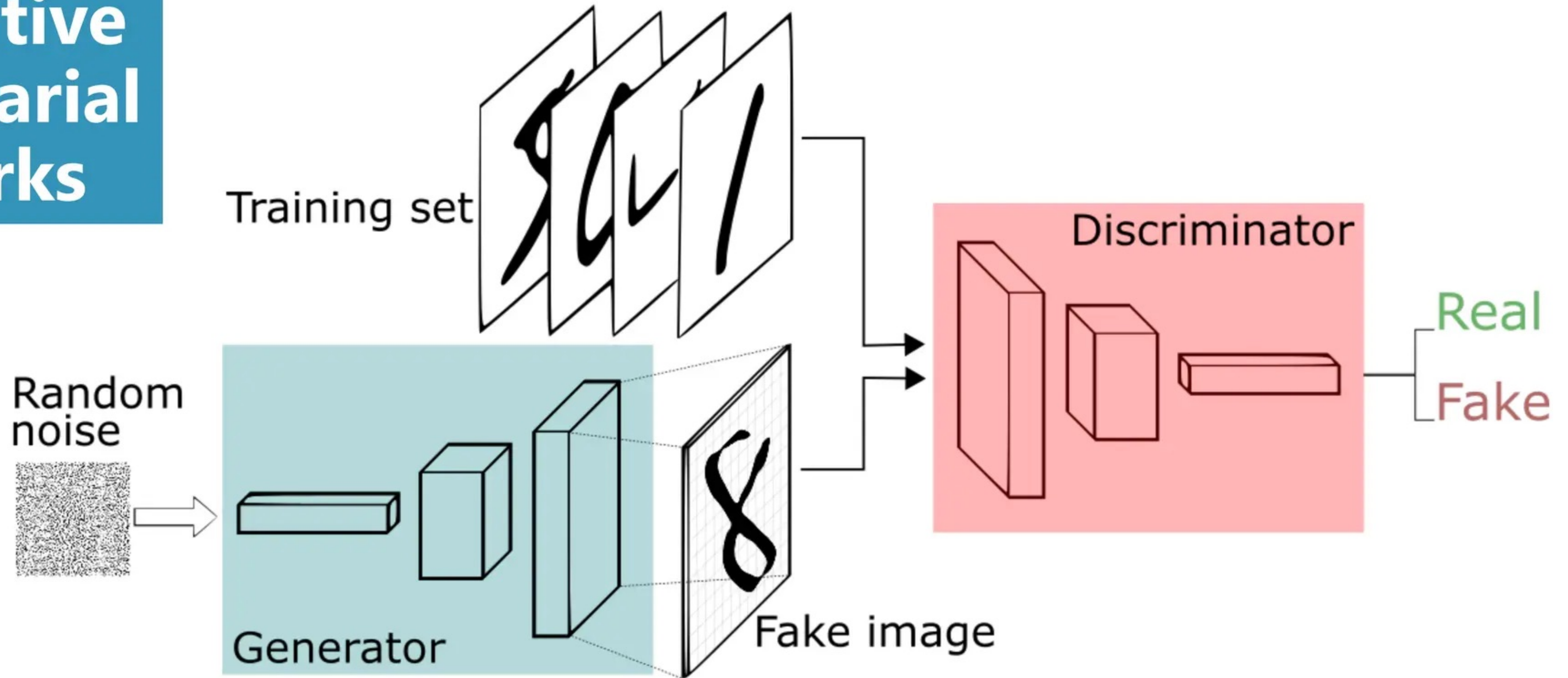


Generative Adversarial Networks



*StyleGAN (2019)
Karras, T., Laine,
S. and Aila, T.*

Generative Adversarial Networks



Thalles Silva (2017)
<https://sthalles.github.io/intro-to-gans/>

Generative Adversarial Networks

- 1. Fast**
- 2. Efficient**
- 3. Effective** (on small datasets)

Objectives

1. Generate **photorealistic imagery** of floods
2. Generate **accurate predictions** of floods

Pre-flood



Post-flood



Dataset

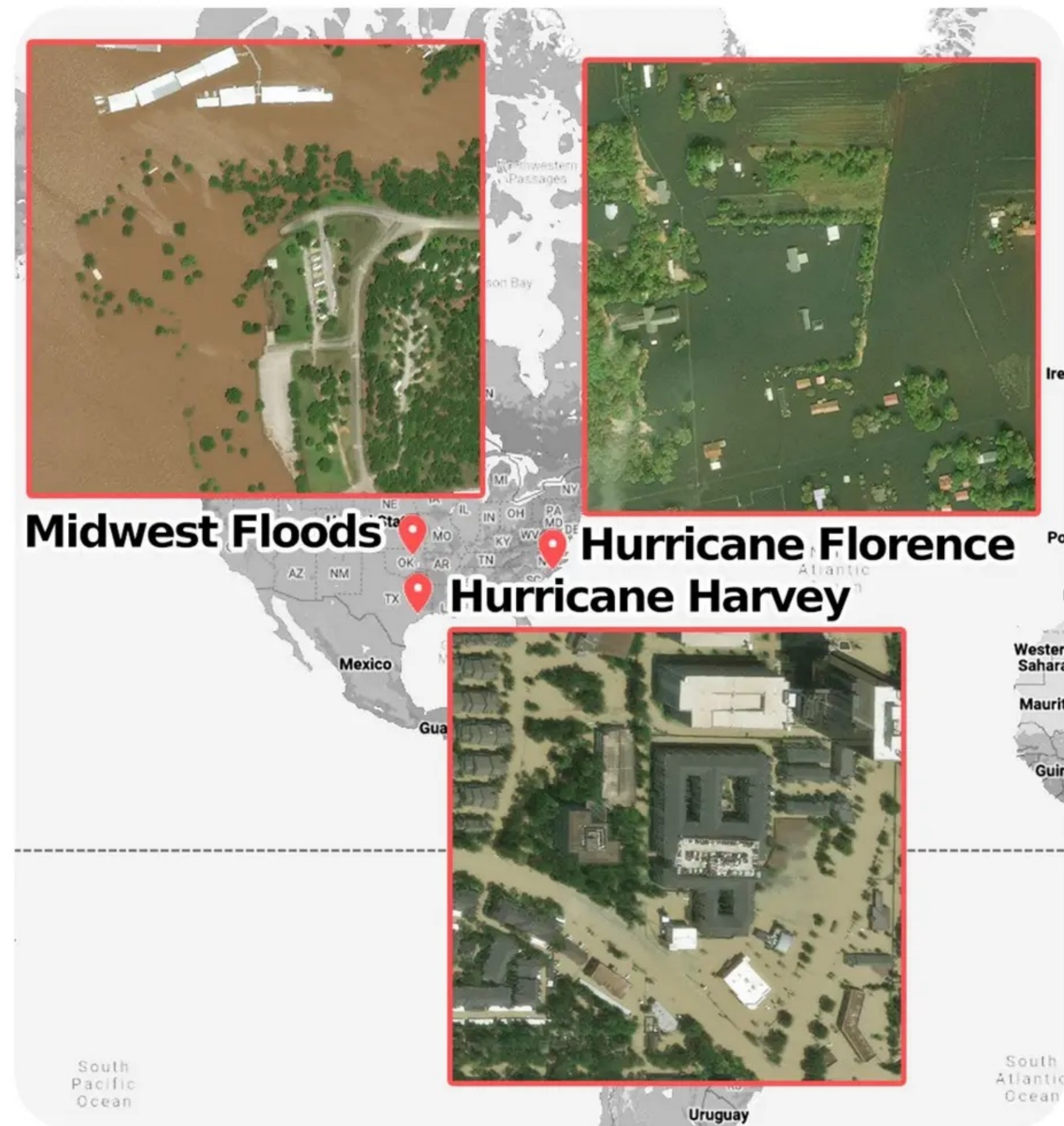
Pre-flood



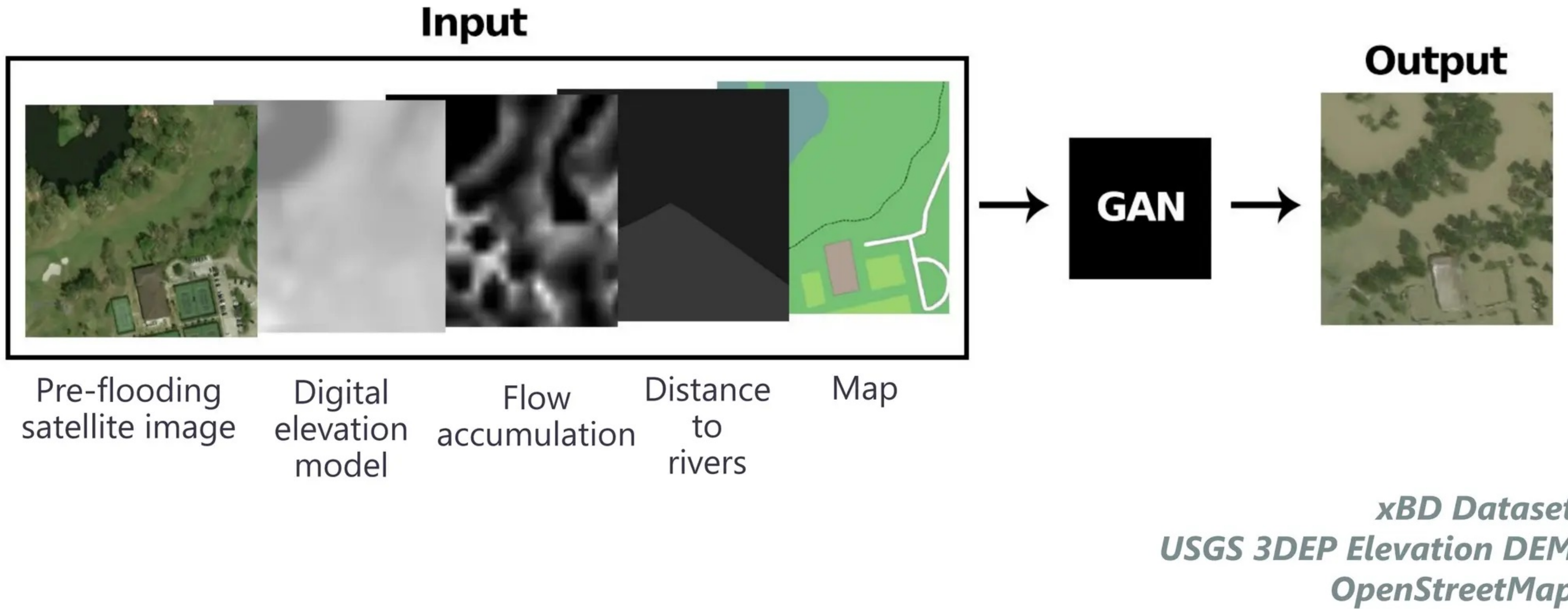
Post-flood



xBD Dataset (2019)
<https://xview2.org/>

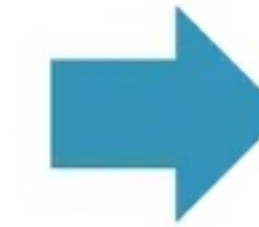
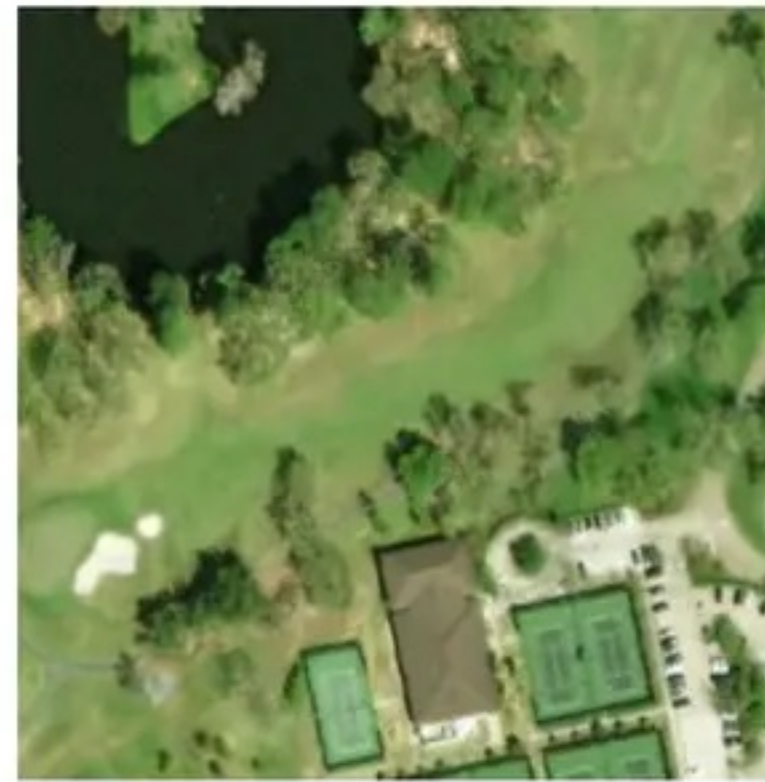


Dataset

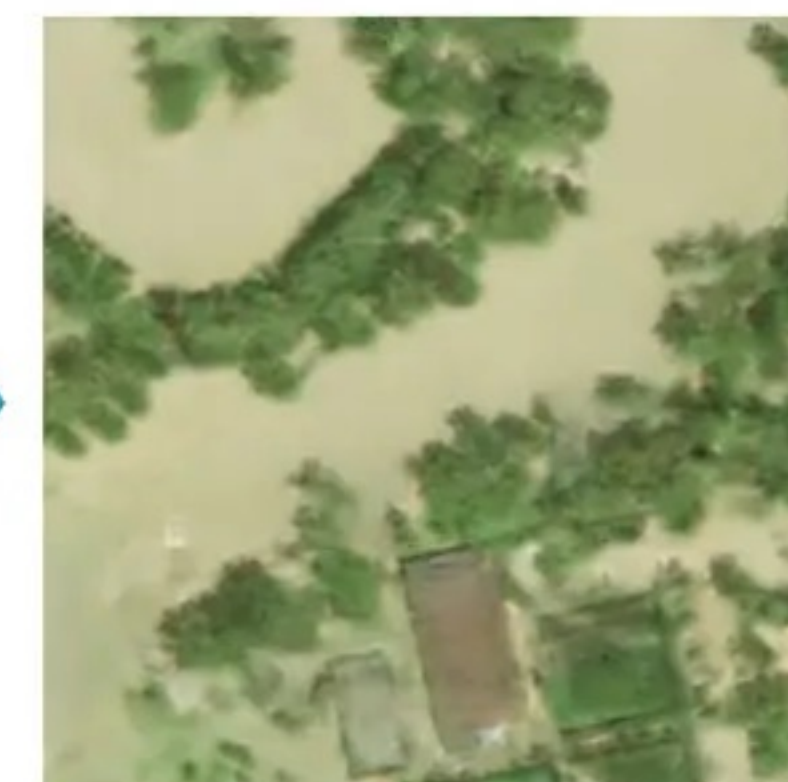
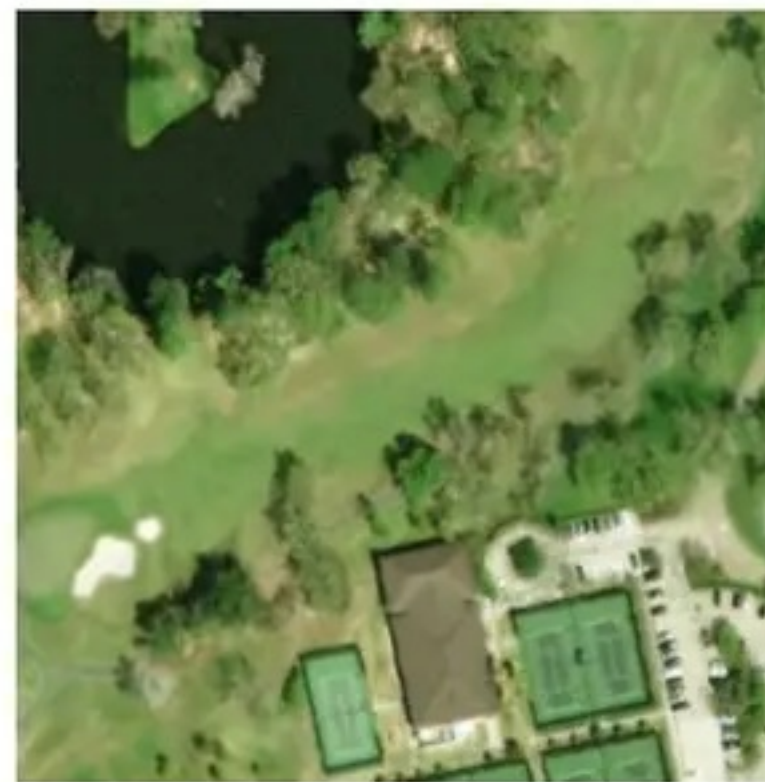


Model Architectures

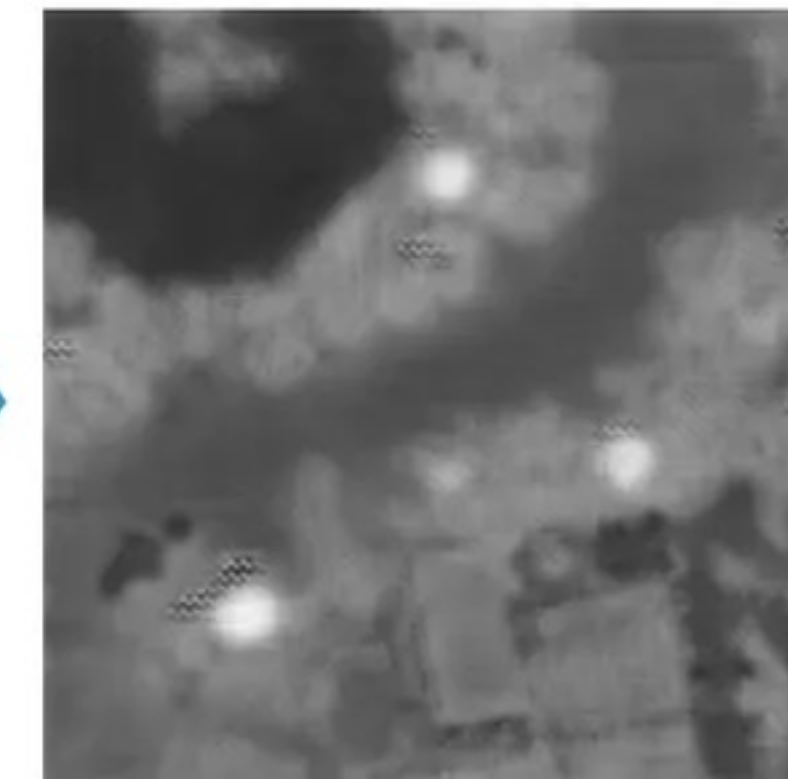
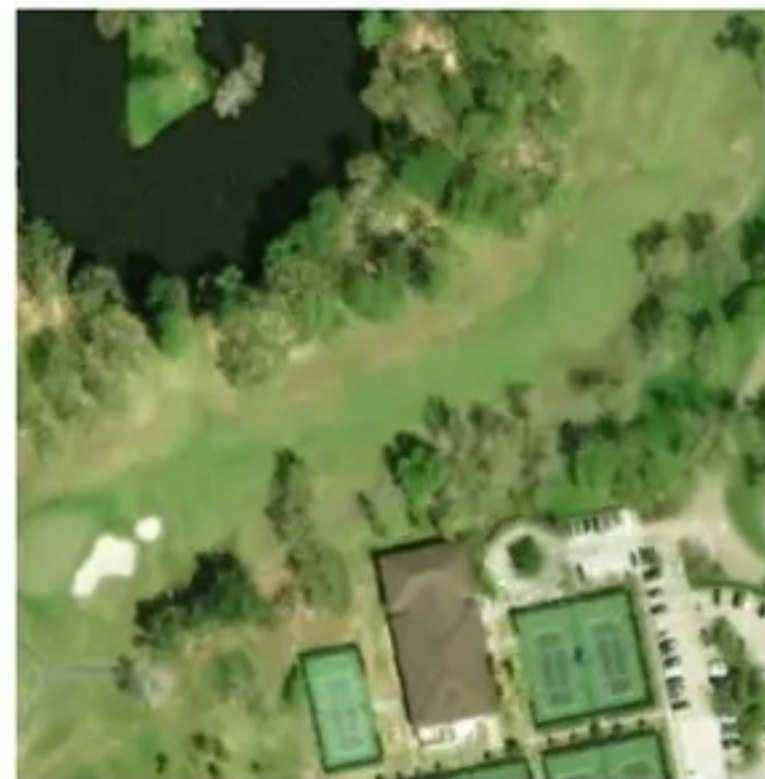
Pix2Pix



CycleGAN



PairedAttention

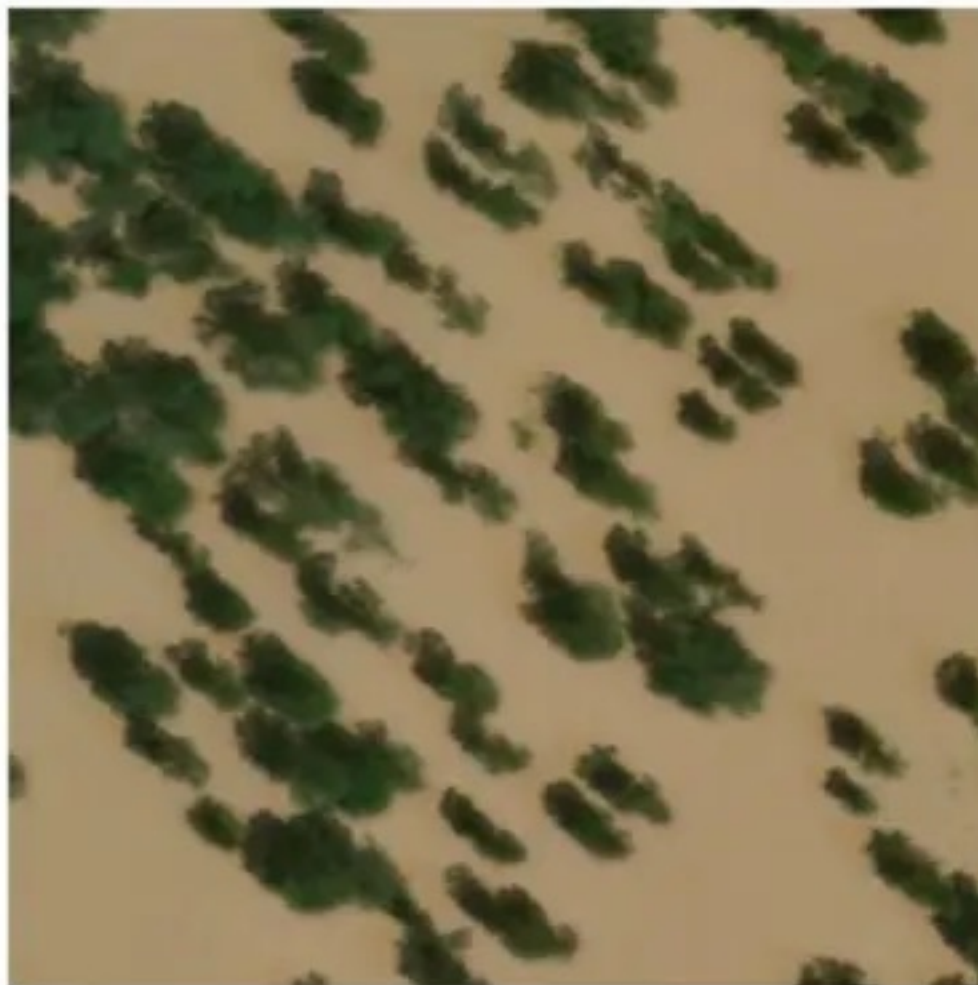


Metrics

GAN



Ground
Truth



Evaluating Photorealism:

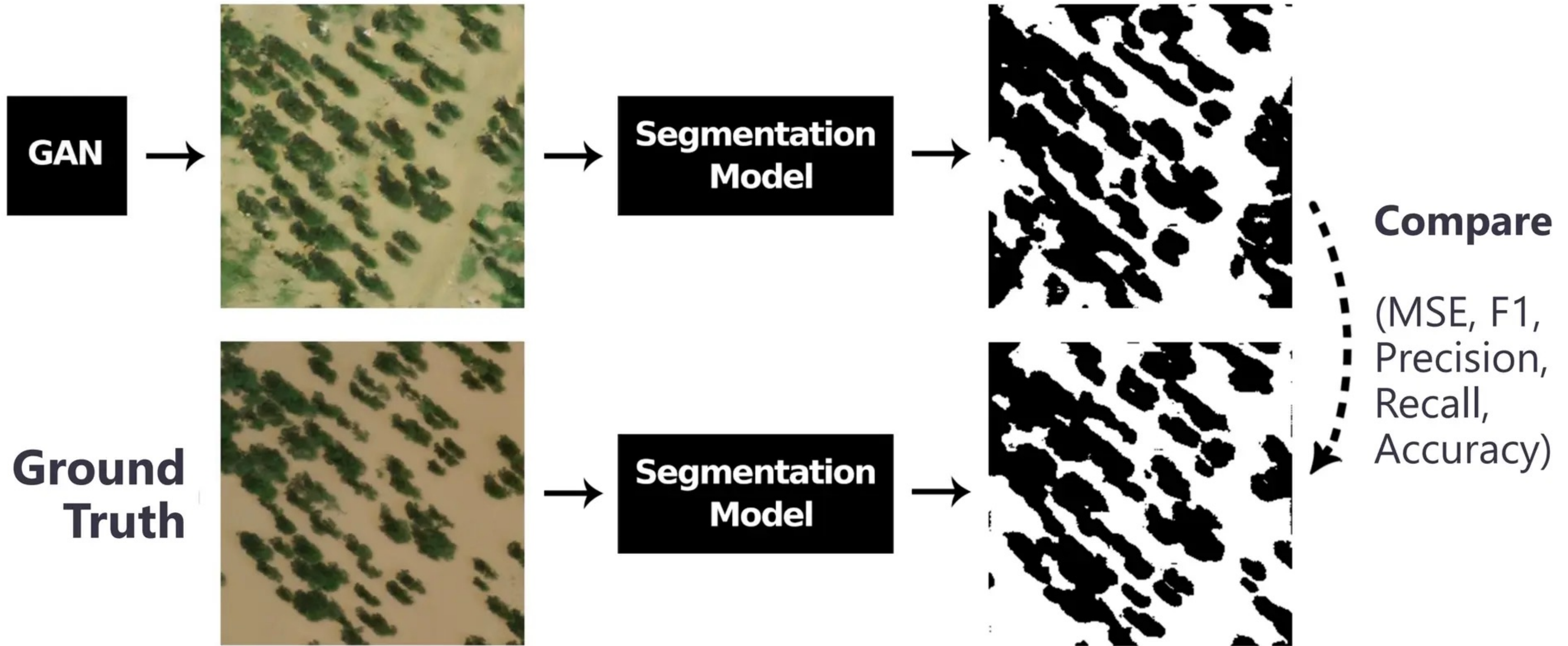
PSNR, SSIM, MS-SSIM, LPIPS

Predictive Performance:

MSE, F1, Precision, Recall, Accuracy

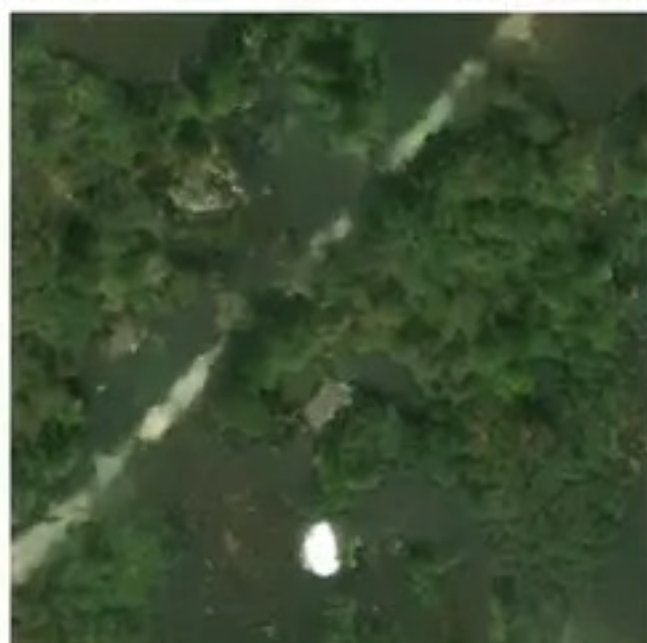
Metrics

Predictive Performance:

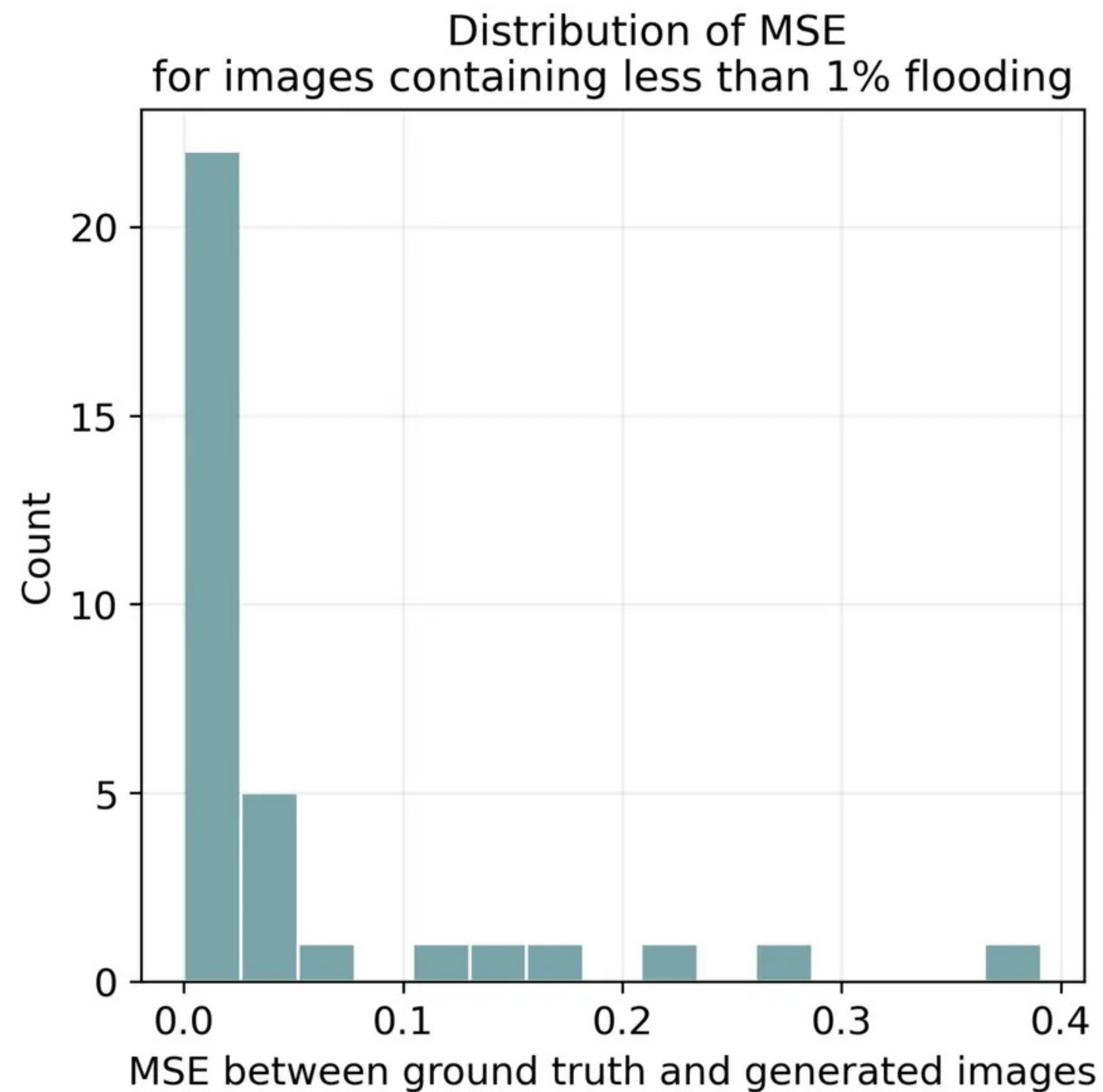
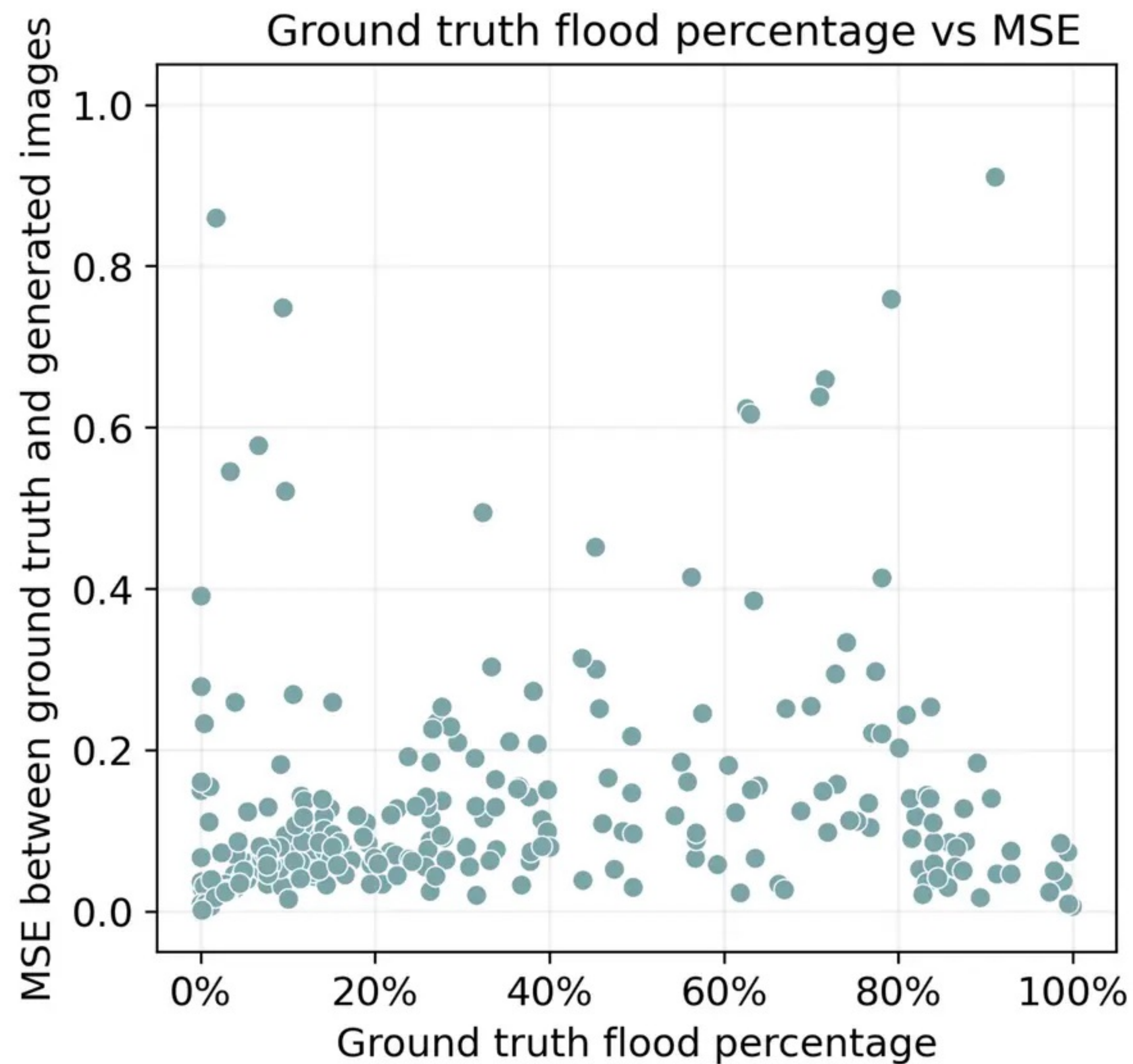


Results

Examples

Input	Ground truth	Paired Attention	Pix2Pix	CycleGAN
				
				
				
				

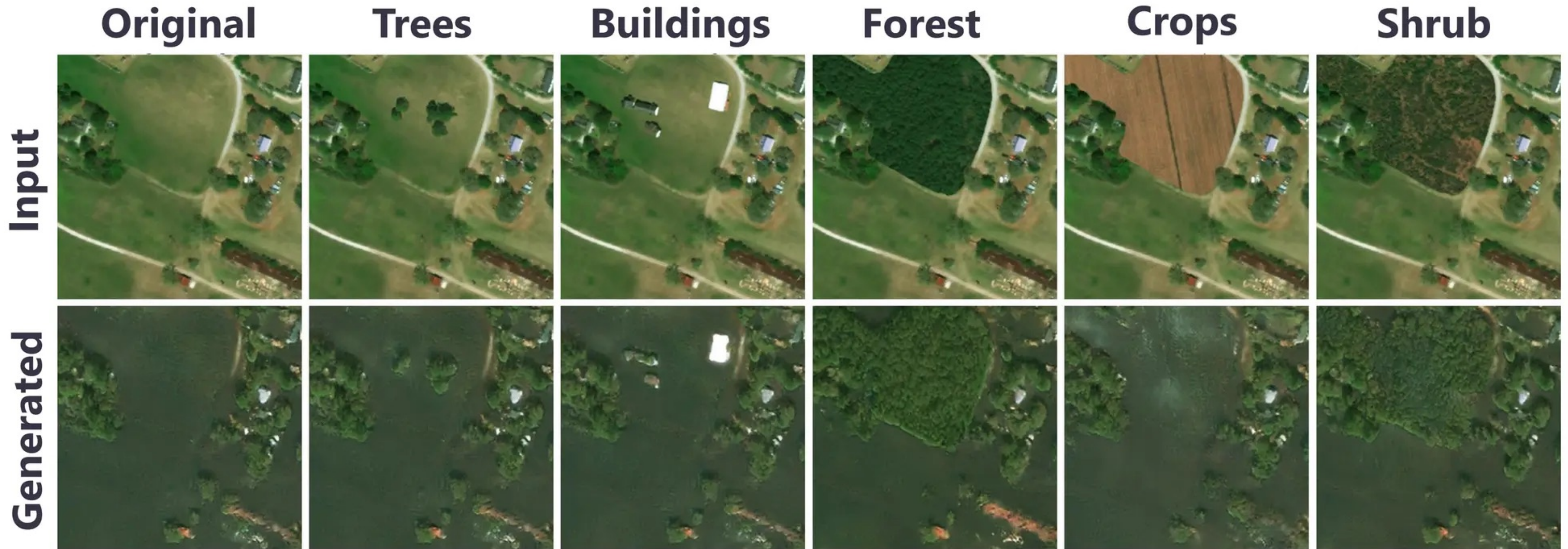
Results



**What has the
model learned?**



Model Behaviour

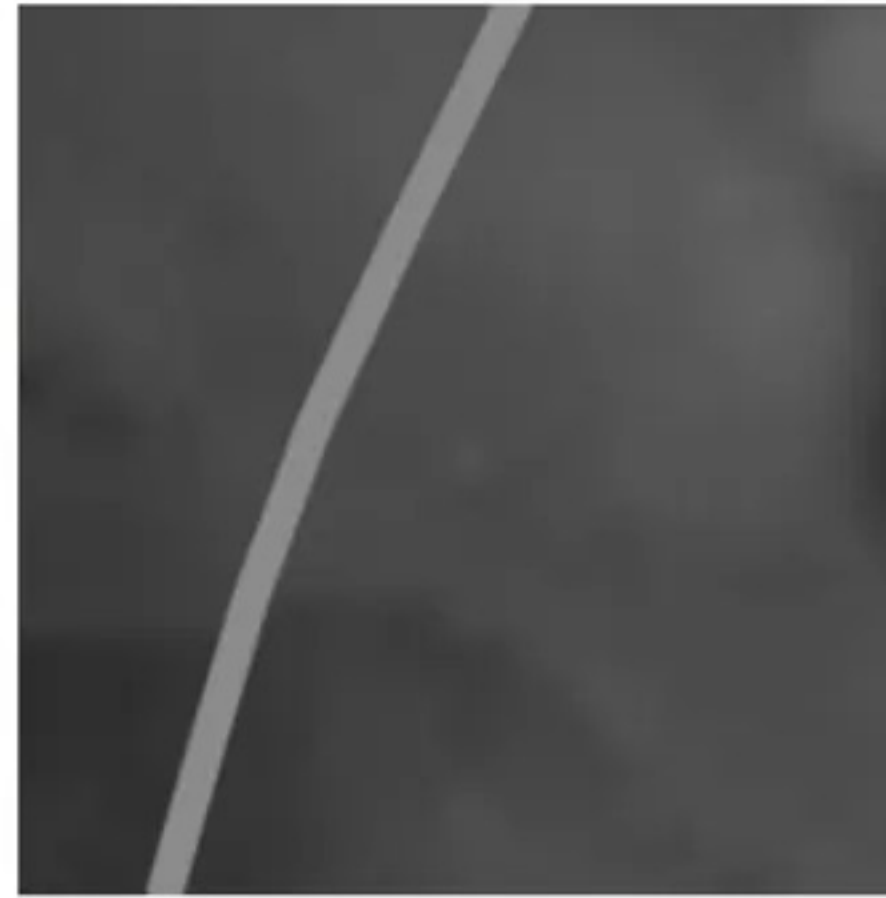


Model Behaviour

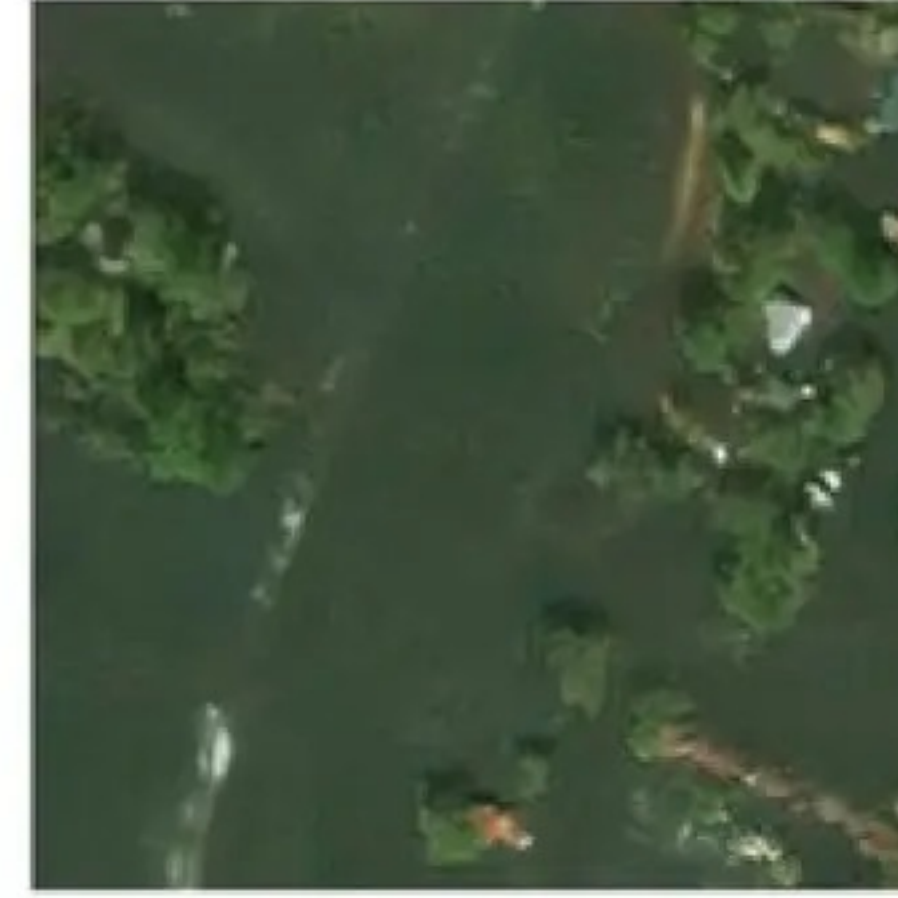
Input



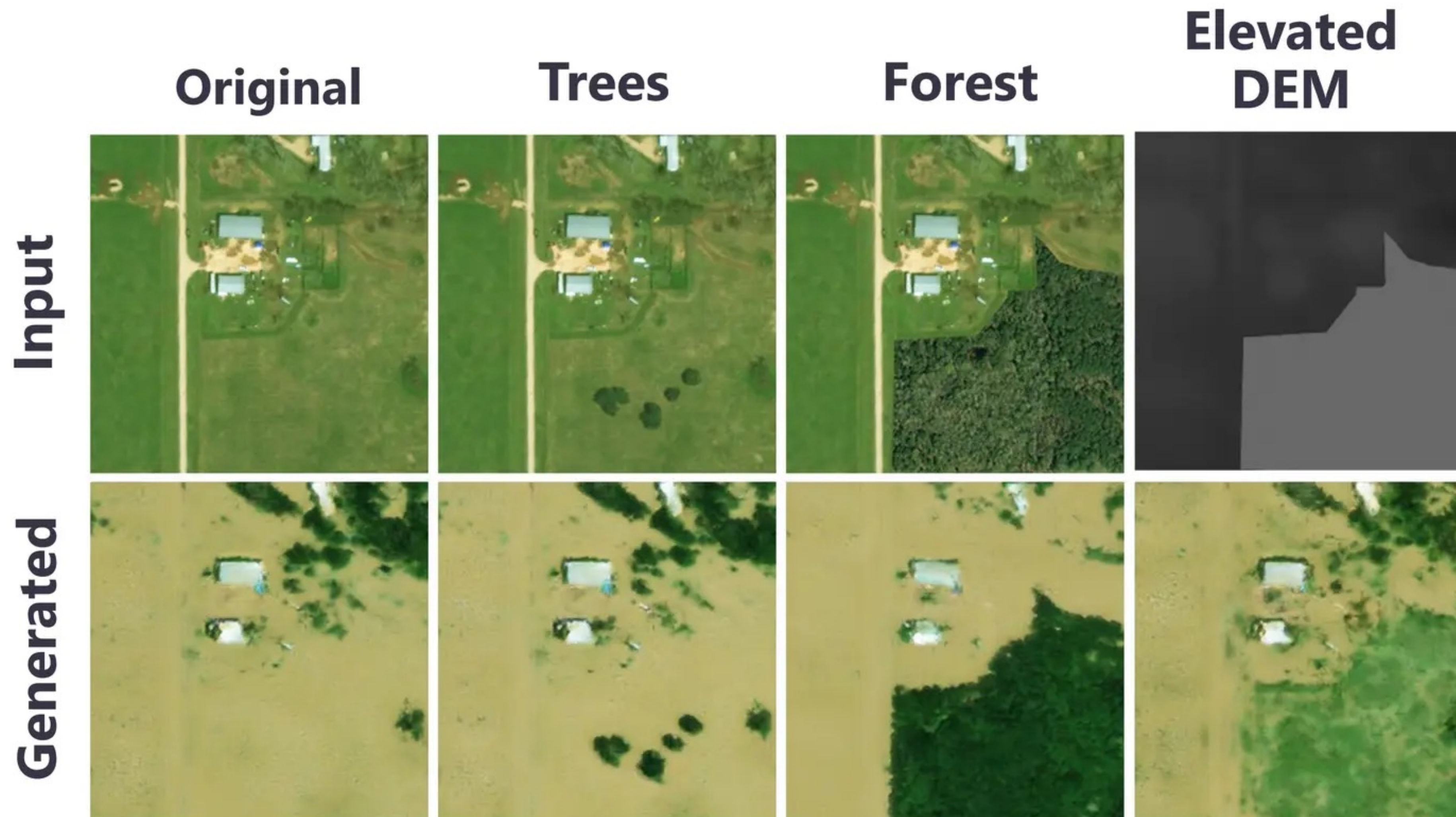
Elevation



Generated



Model Behaviour



(Dis)entangled Data Representations

- Individual factors described by distinct data representations
- Effect of features is independent



Generalisability

Examples



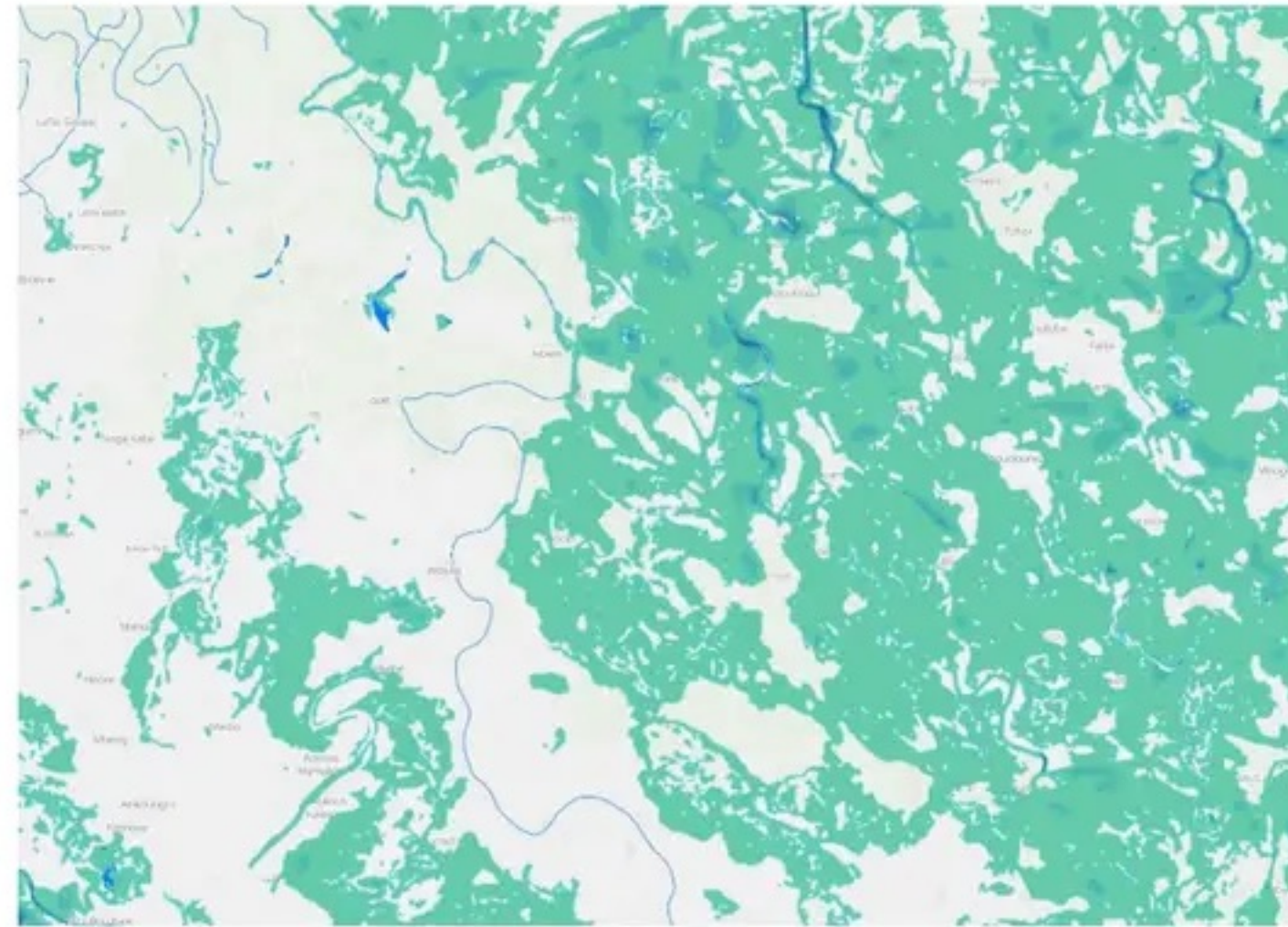
Flood Predictions by GANs



- GANs can generate accurate **flood predictions**
- GANs are great with **small datasets**
- GANs can learn **physical processes**

Generalisable and Robust Flood Prediction Models

Copernicus Data
European Commission Joint Research Centre



- **AI** is viable for flood prediction
- Much **faster** and **easier** than traditional flood forecasting



Thank you! Questions?

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