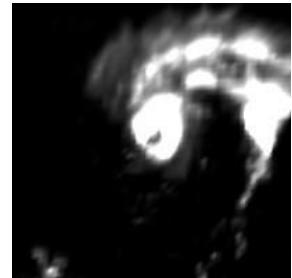
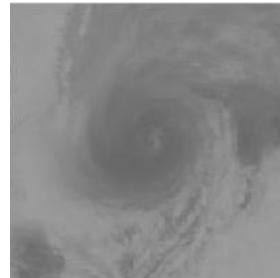


# Tropical Cyclone Rainfall Prediction via Infrared Imagery

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Autoencoder & GANs

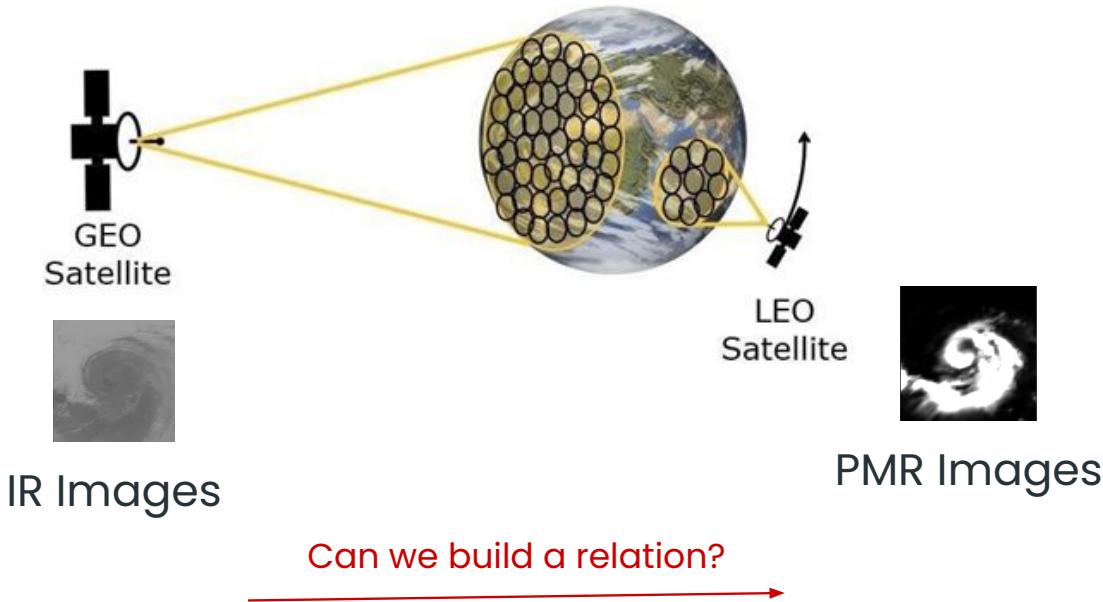
E

## Conclusion

Lessons Learned & Results



# Problem Definition



# **State of the Art: Image-to-Image**



## **Generative Models**

Conditional GANs (cGANs),  
Diffusion Models

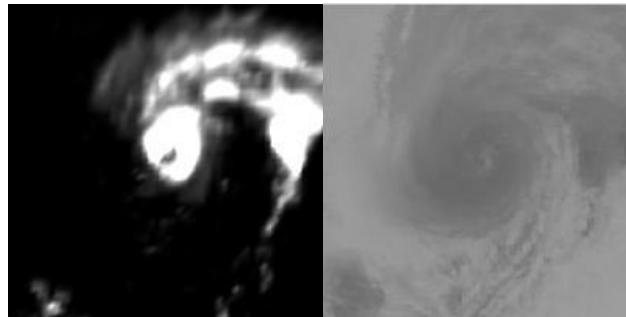


## **Reconstruction Models**

Autoencoders: (baseline)

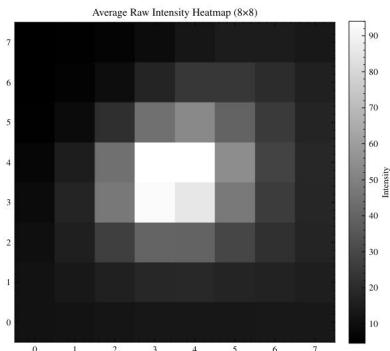
# Data Description

- Over 70000 paired samples of IR->PMR images
- Snapshot of a tropical cyclone
- Capturing cloud-top brightness temperature
- And associated rainfall distribution

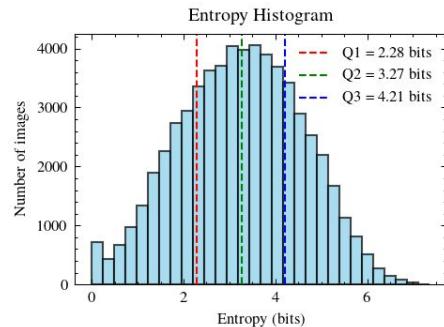


# Data Statistical Analysis

Activity Concentration



PMR Entropy



Non-Black pixels

Least white (left half)  
10020.jpg  
frac=0.0000

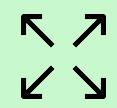
Most white (left half)  
34078.jpg  
frac=0.9673



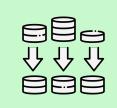
# Data Preprocessing



Input Splitting



Resizing



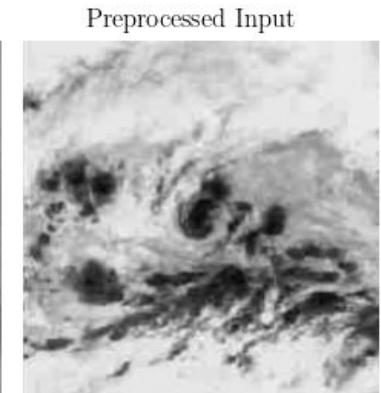
Per-image Normalization



Data Augmentation

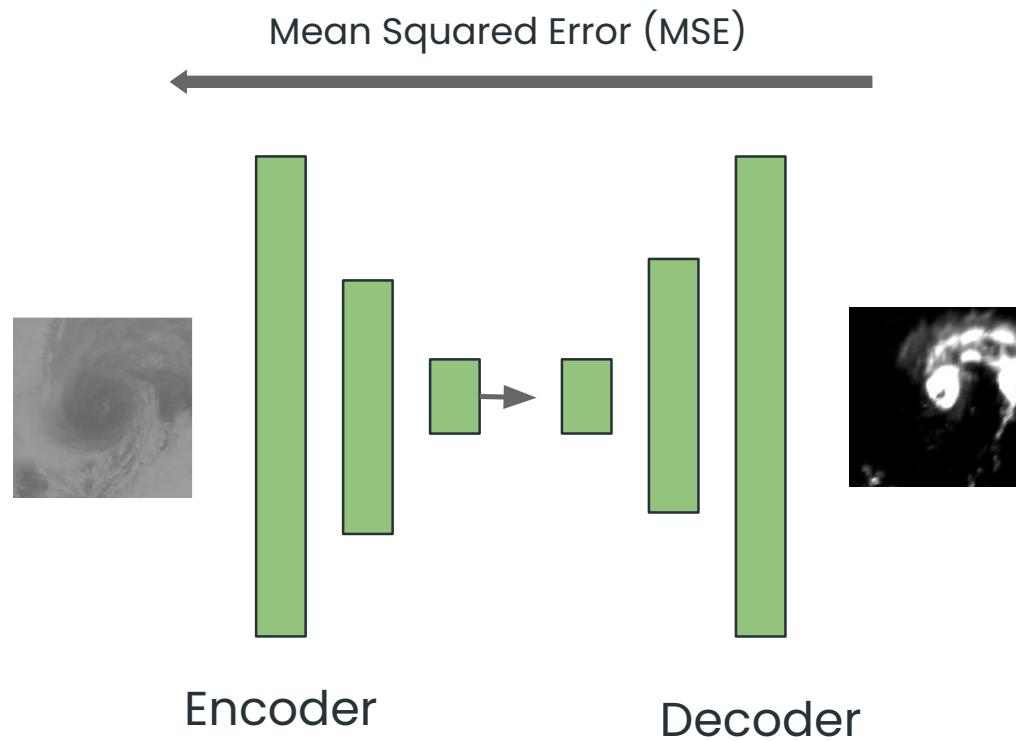


Original Input

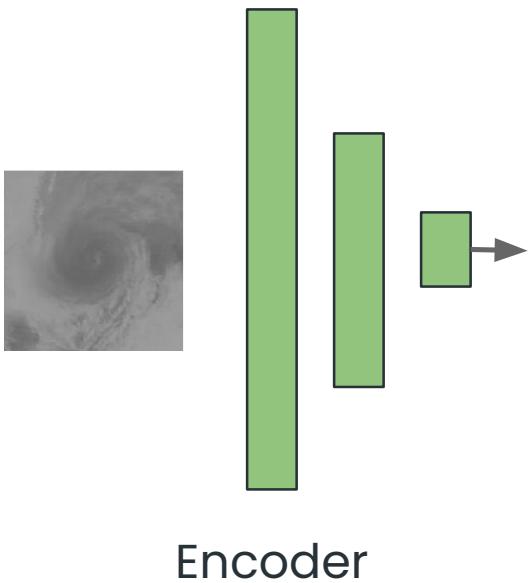


Preprocessed Input

# Autoencoder



# Autoencoder



## Deep Convolutions:

- 3x Conv2D layers
- Kernel: 3, Stride: 2 (Spatial downsampling)

## Filter Progression:

- 32 → 64 → 128 (Increased feature complexity)
- Capturing richer, abstract features

## Training Stability & Non-linearity:

- Batch Normalization
- ReLU Activation

# Autoencoder

## Deconvolutional Upsampling:

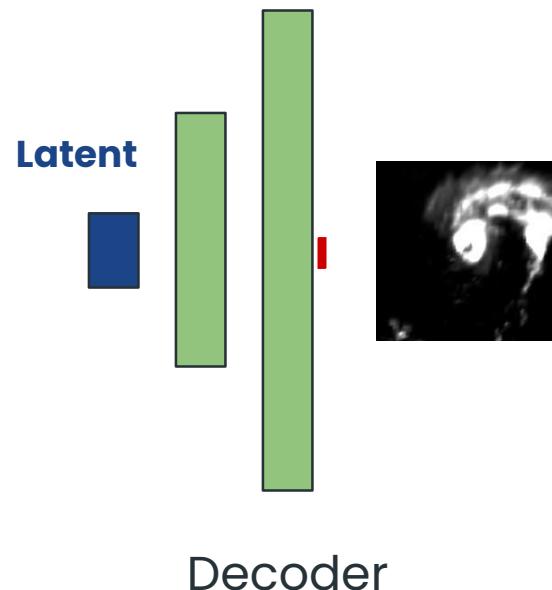
- 3x Conv2DTranspose layers
- Kernel: 3, Stride: 2 (Spatial upsampling)

## Filter Regression:

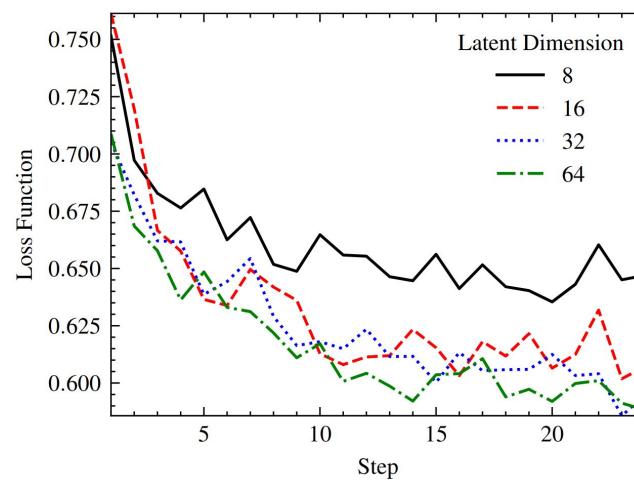
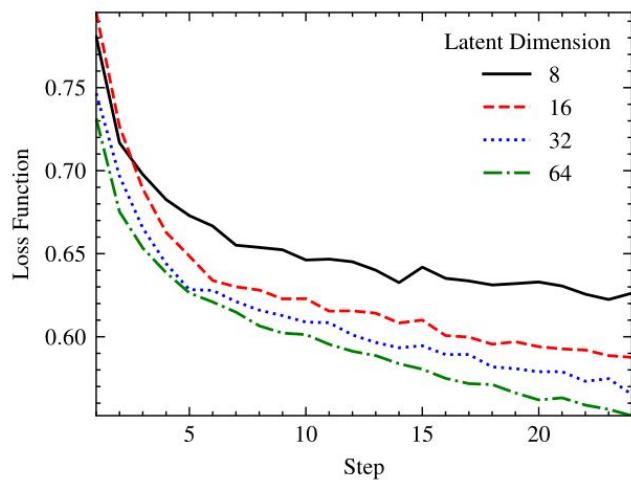
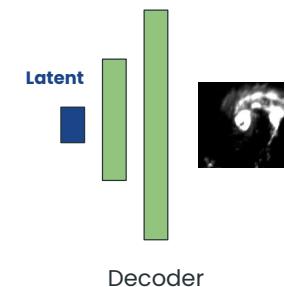
- 128 → 64 → 32 → 1 (Reduced feature complexity)
- Reconstructing spatial details

## Final Layer & Activation:

- Conv2DTranspose(1, ...): Output channel (e.g., grayscale)
- ReLU Activation
- Last Activation Function?

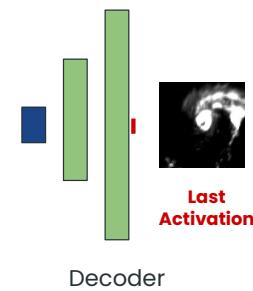
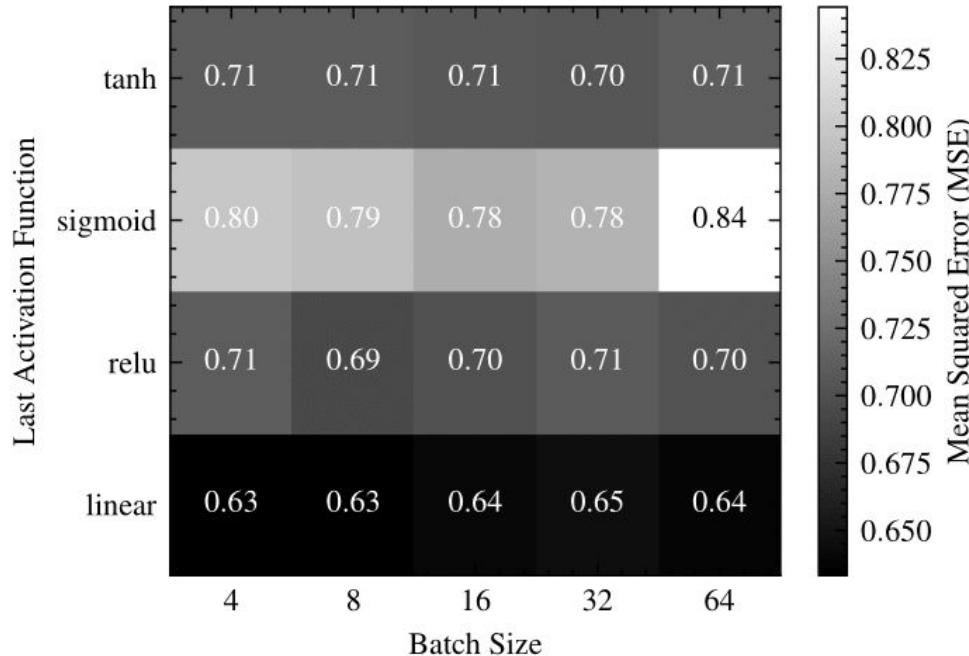


# Latent Dimension



# Parameter Optimization

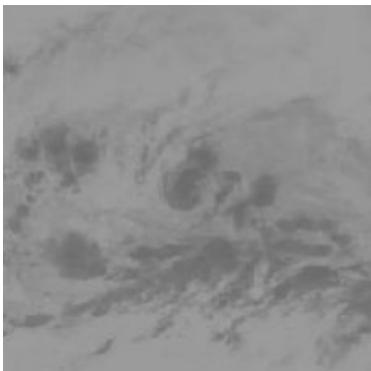
## Grid Search



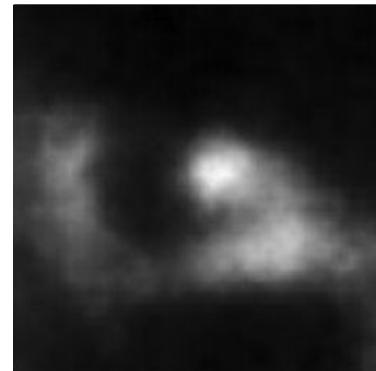
# Reconstruction Quality

Autoencoder

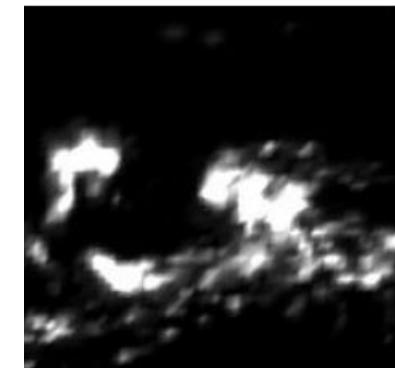
Input



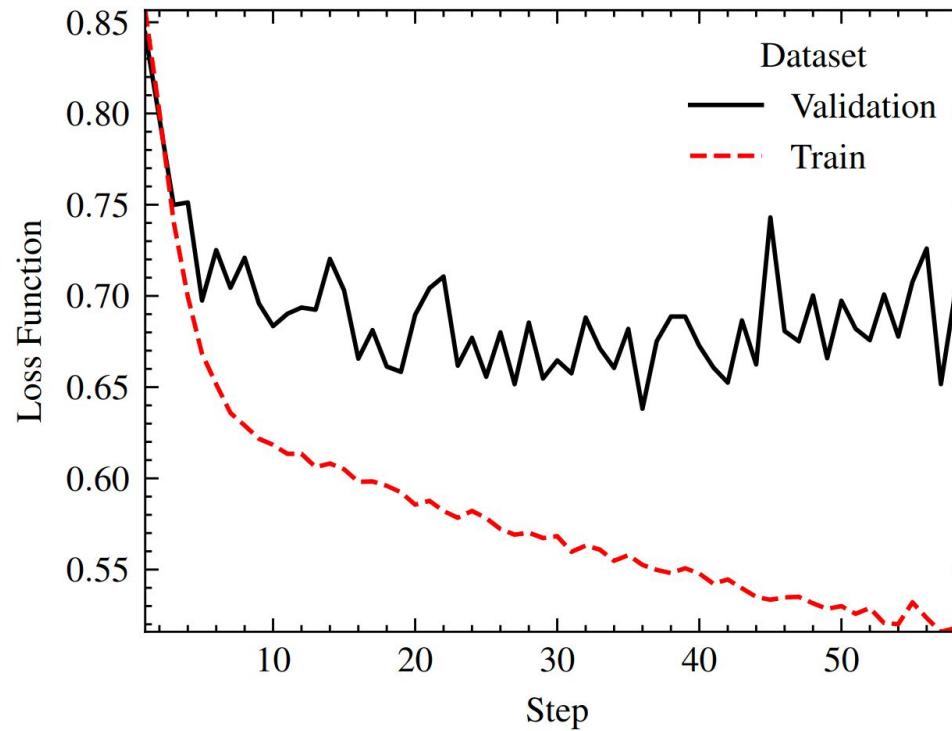
Output



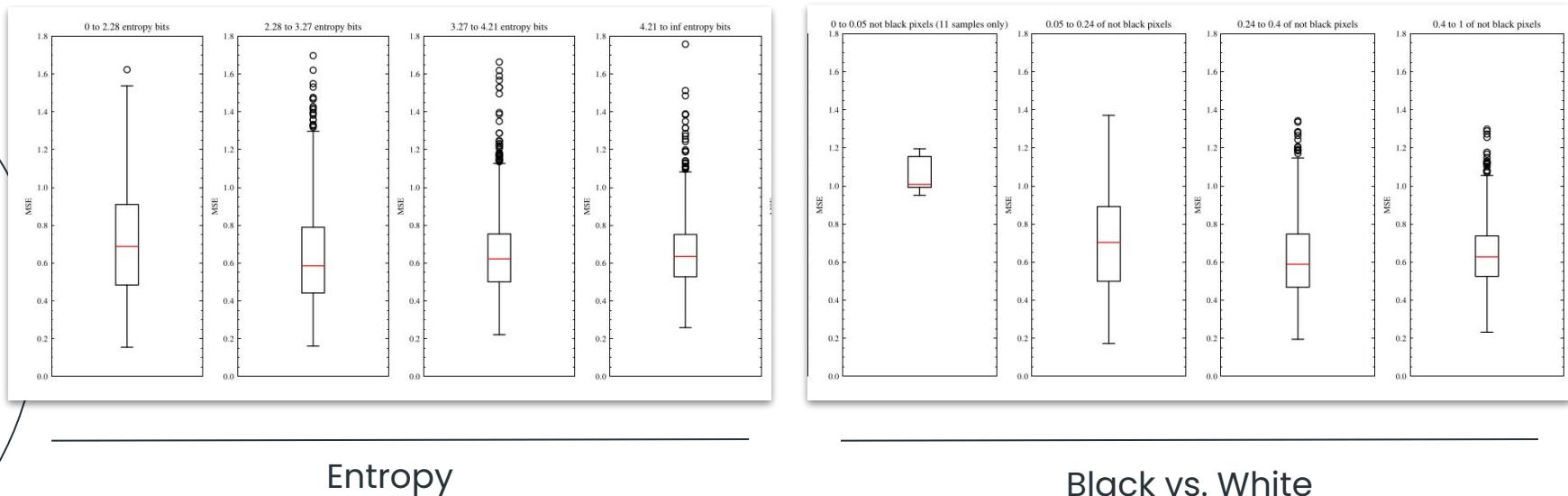
Expected



# Overfitting Everything



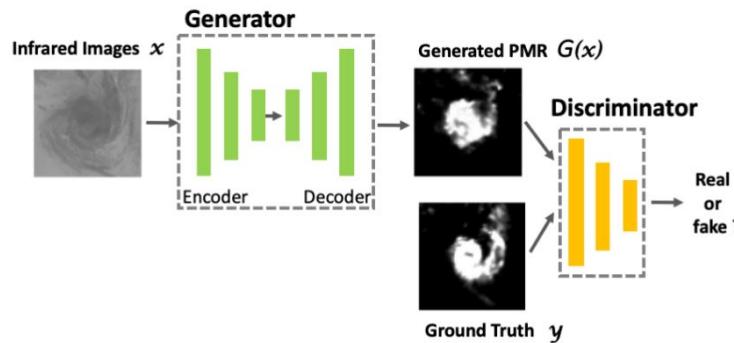
# Subsets Correlation



Entropy

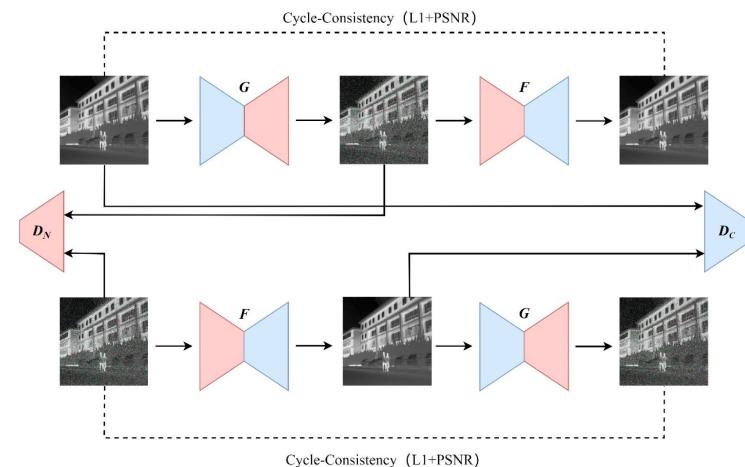
Black vs. White

# Generative Adversarial Network



Pix2pix

VS.



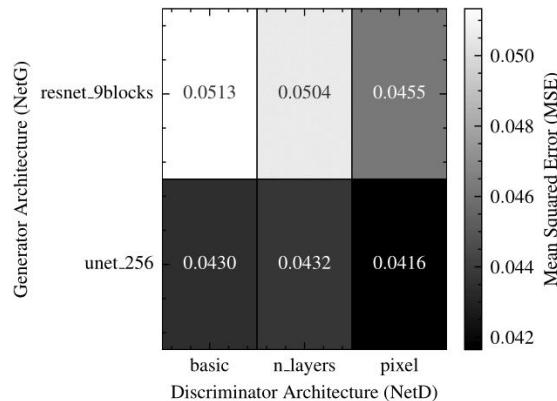
CycleGan

# Parameter Optimization

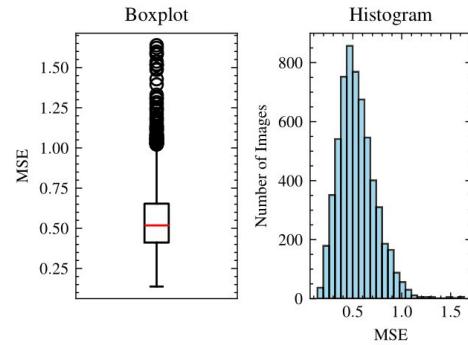
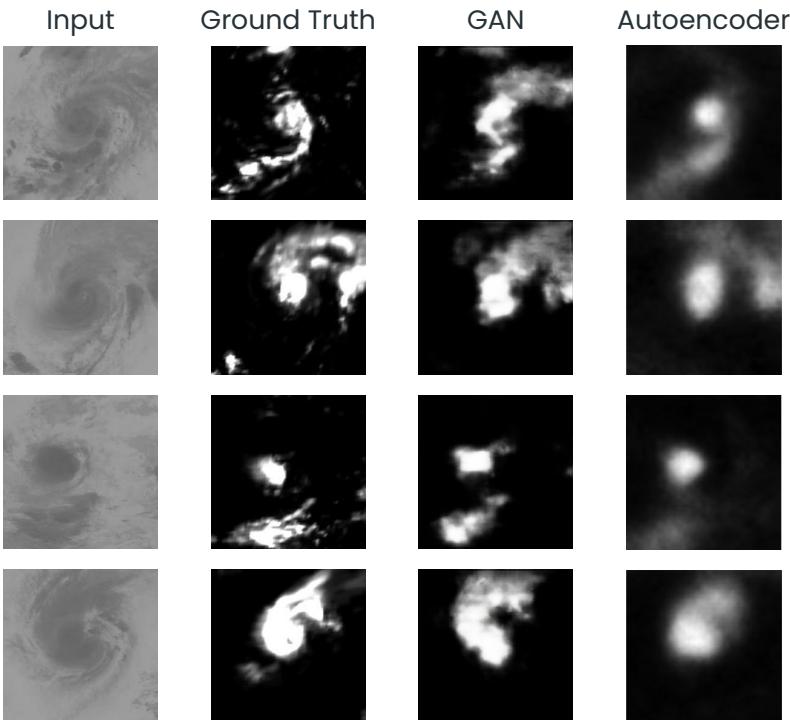
Random Search

Parameter	Range/Sampling	Best
Batch size	{1, 2, 4}	4
Learning rate	[0.0001, 0.0003]	0.00029
Normalization	{batch, none, instance}	batch

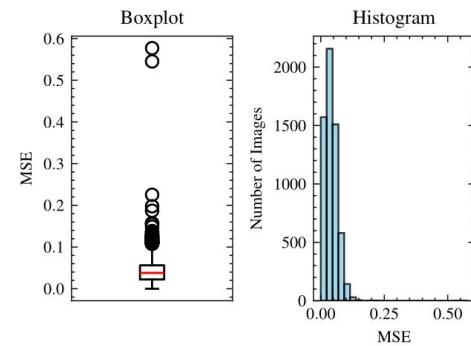
Grid Search



# Results



Autoencoder



GAN

# Conclusion



## cGANs Outperformed

Higher accuracy, Better generalization, Detailed PMR.



## Autoencoder Strengths & Limits

Fast, stable training,  
Generalization challenges.



## Deep Learning for Methodology

Validates image translation.  
Future: Advanced generative models.

Questions?

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