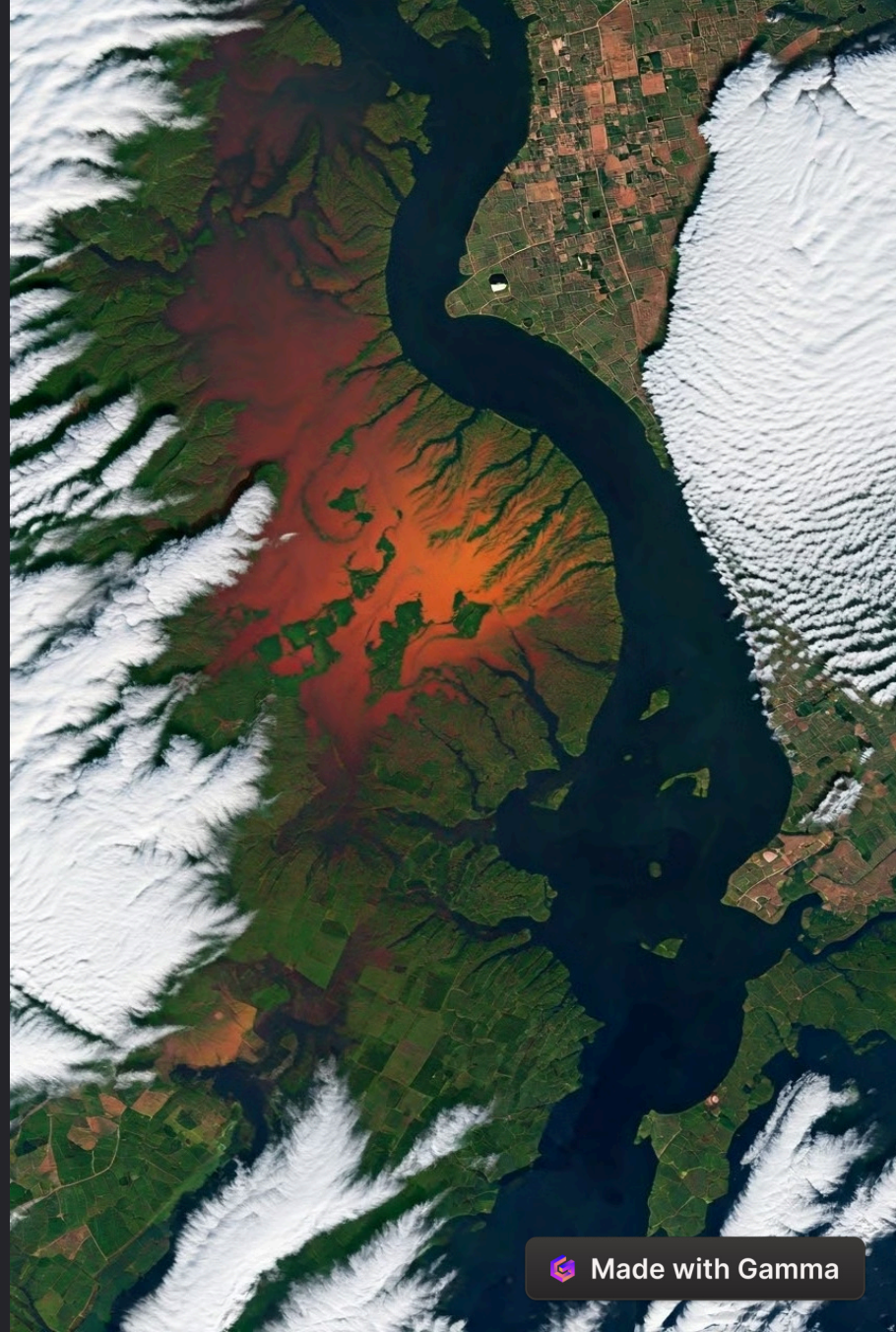
Flood Segmentation Project: Robust Model Development

UNet architecture for precise flood area segmentation in satellite imagery.



UNet Architecture Overview

1. **Encoder**

   Captures low-level features from input image.

2. **Bottleneck**

   Compresses information for efficient processing.

3. **Decoder**

   Reconstructs high-resolution segmentation mask.

4. **Skip Connections**

   Preserve spatial information across network.

Loss Function and Metrics

Binary Cross-Entropy

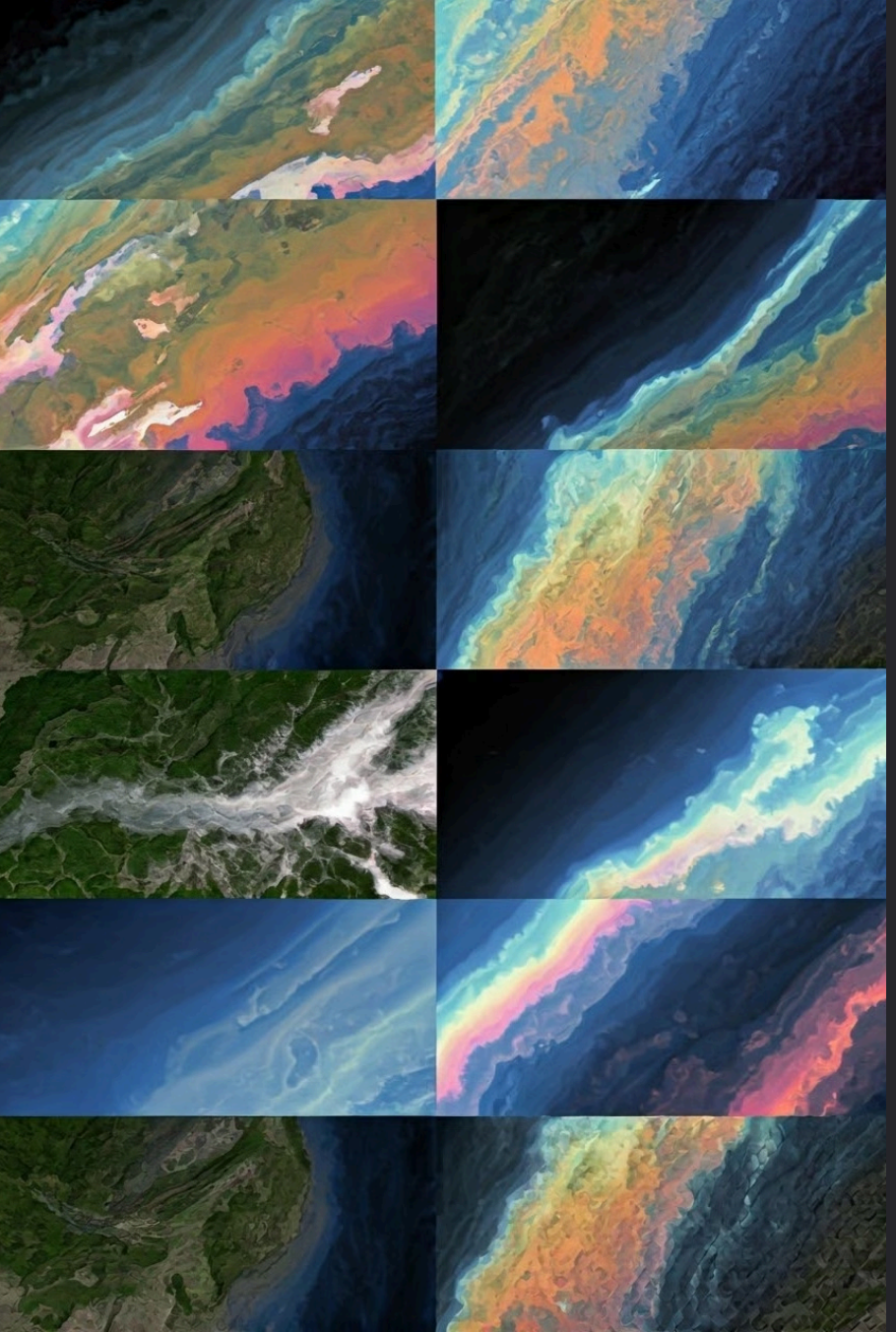
Pixel-wise classification for binary segmentation task.

Intersection over Union

Measures overlap between predicted and ground-truth masks.

Dice Coefficient

Sensitive to class imbalances in segmentation.



Data Challenges

Limited Dataset

Only 290 images available for training.

Hand-labeled Masks

Inaccuracies due to manual labeling process.

Class Imbalance

Flood regions potentially underrepresented in images.

Generalization

Model must perform well on unseen data.

Data Augmentation Techniques

Rotation

Random rotations to simulate different perspectives.

Flipping

Horizontal and vertical flips for orientation invariance.

Scaling

Random zooming to simulate different altitudes.

Contrast

Adjustments for varying lighting conditions.

Training Process

1

Data Preparation

Split dataset: 80% training, 20% validation.

2

Model Initialization

UNet with pre-trained encoder weights.

3

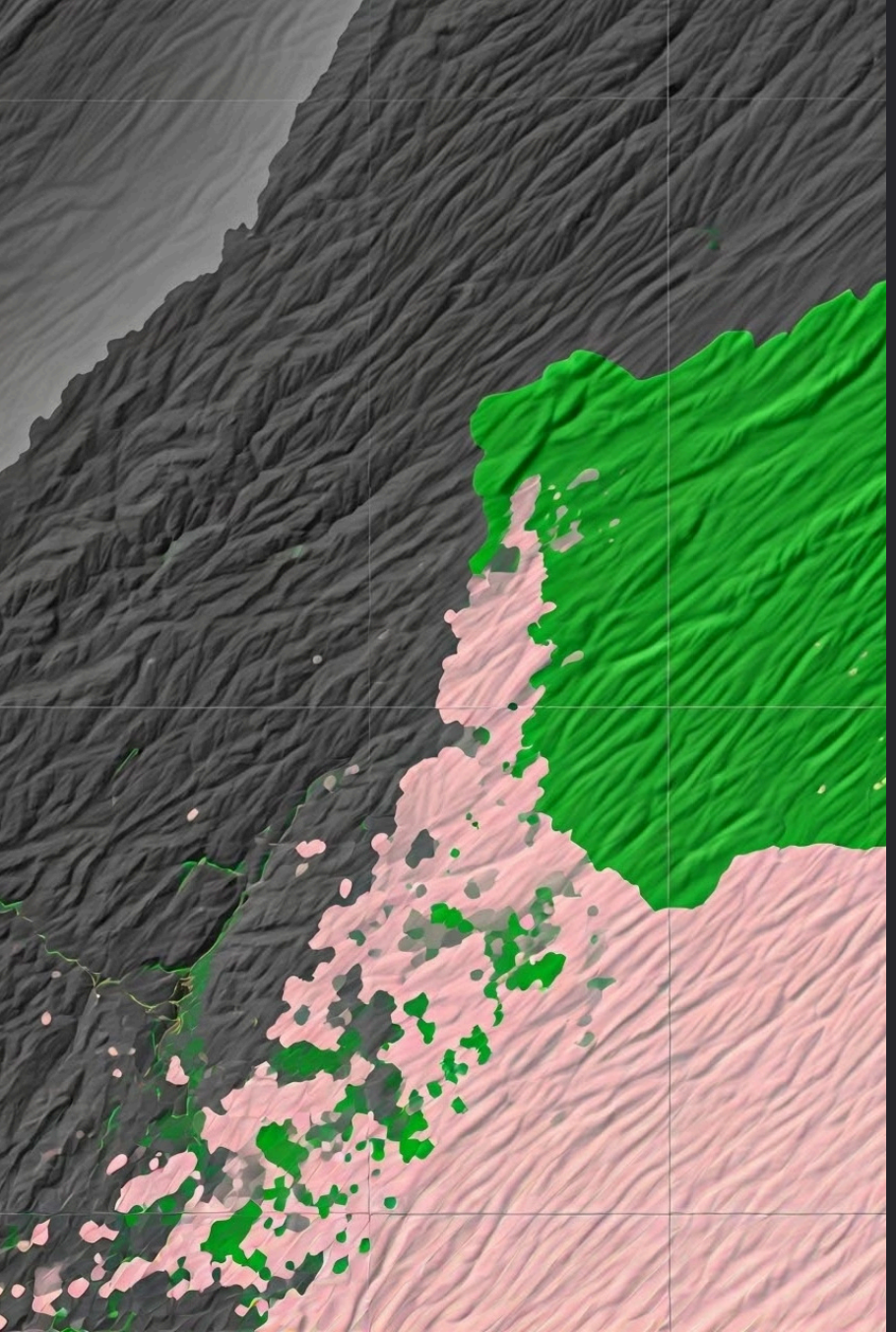
Training Loop

85 epochs with dynamic learning rate.

4

Validation

Regular evaluation on held-out data.



Model Performance

Metric	Score
Validation IoU	0.7851
Validation Dice Coefficient	0.8729
Epochs	85

Future Improvements

1 **Label Refinement**

Implement automated techniques to improve mask accuracy.

2 **Transfer Learning**

Utilize pre-trained models from similar domains.

3 **Semi-Supervised Approach**

Leverage unlabeled data to enhance model performance.

4 **Ensemble Methods**

Combine multiple models for robust predictions.