

# GeoAI Model Transformation

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## Team 6 (Team Awesome)

Claire Simpson, Salar Jarhan,  
Yalin Yang, Jiyoung Lee,  
Yanhong Huang

## Team leaders

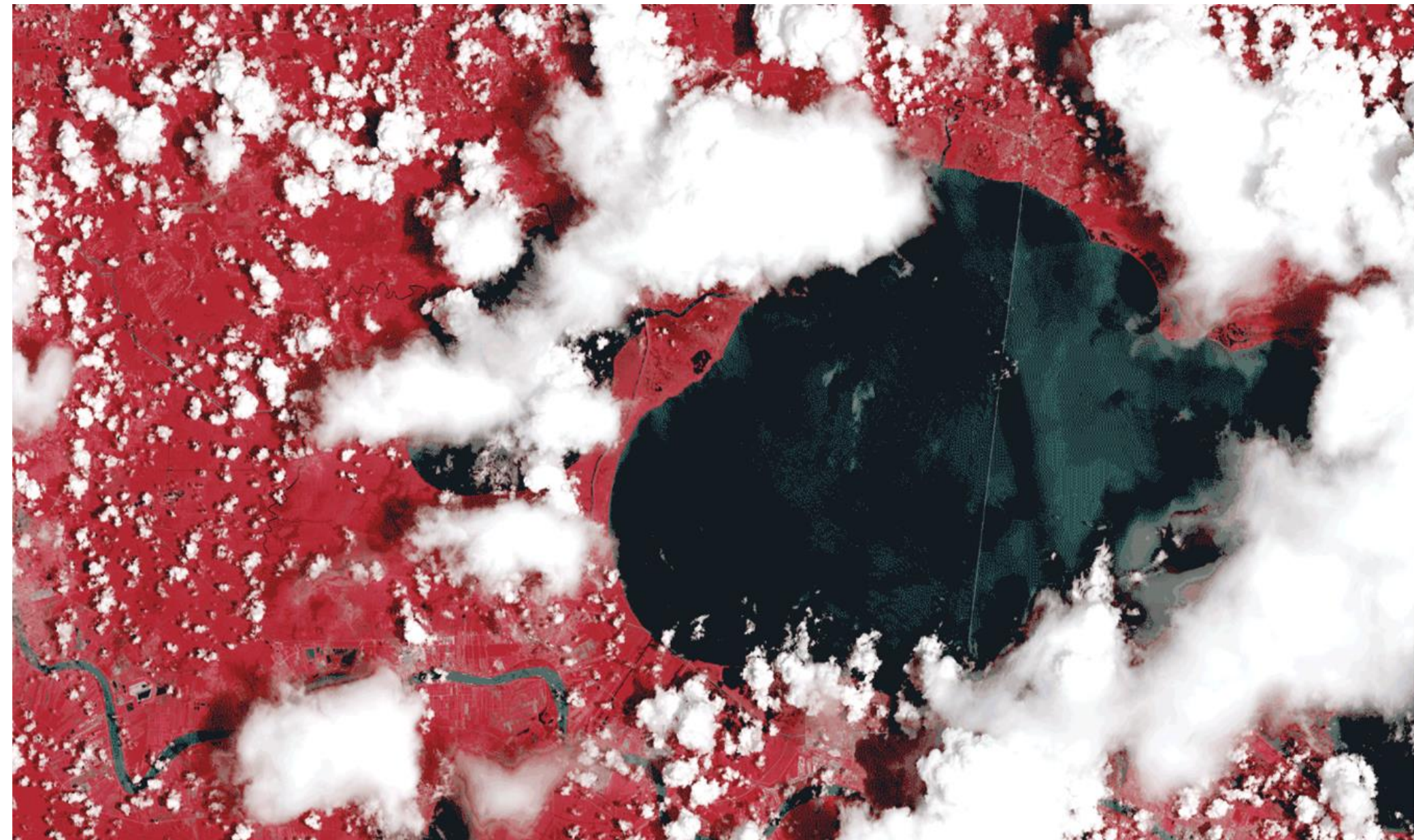
Dr. Eric Shook & Dr. Diana Sinton



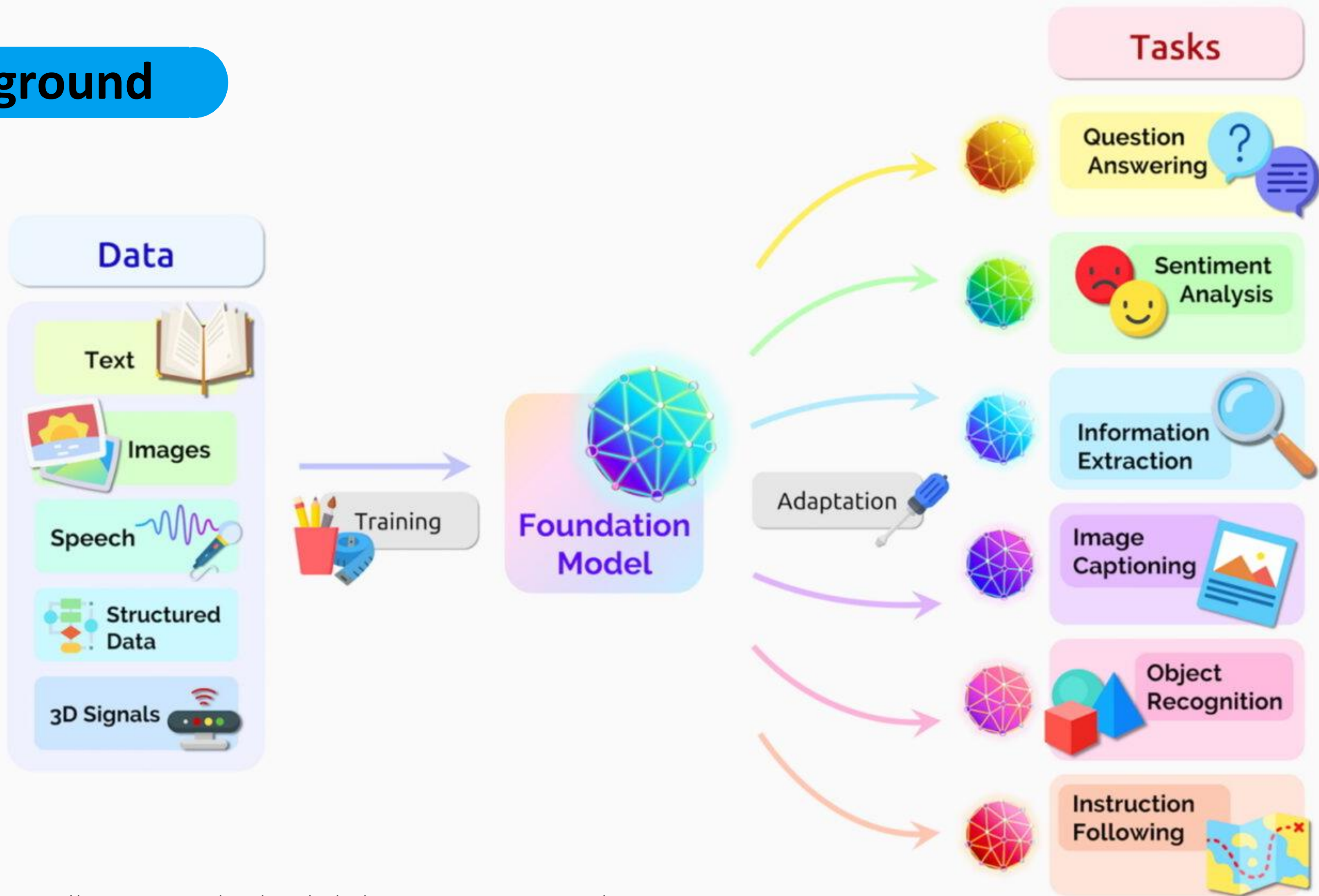
## Background

Gain **practical experience** in applying **deep learning techniques** to real-world spatial problems, at the **cutting edge of GeoAI**

- *“NASA's first open-source geospatial artificial intelligence (AI) foundation model for Earth observation data...is a **milestone in the application of AI for Earth science.**”*

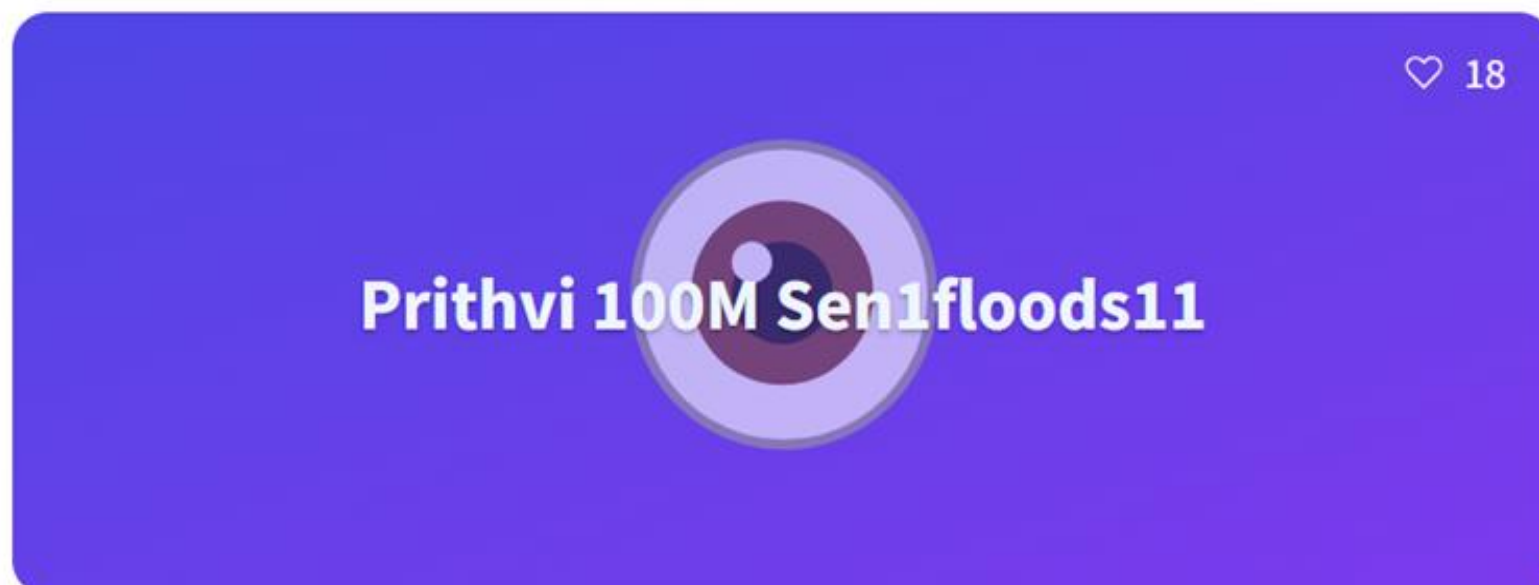


# Background



## Research Objectives

1. Deploy foundation model to the I-GUIDE Platform
2. Replicate model fine-tuning for flood, burn, and crop classification
3. Create our own fine-tuned model to detect built areas

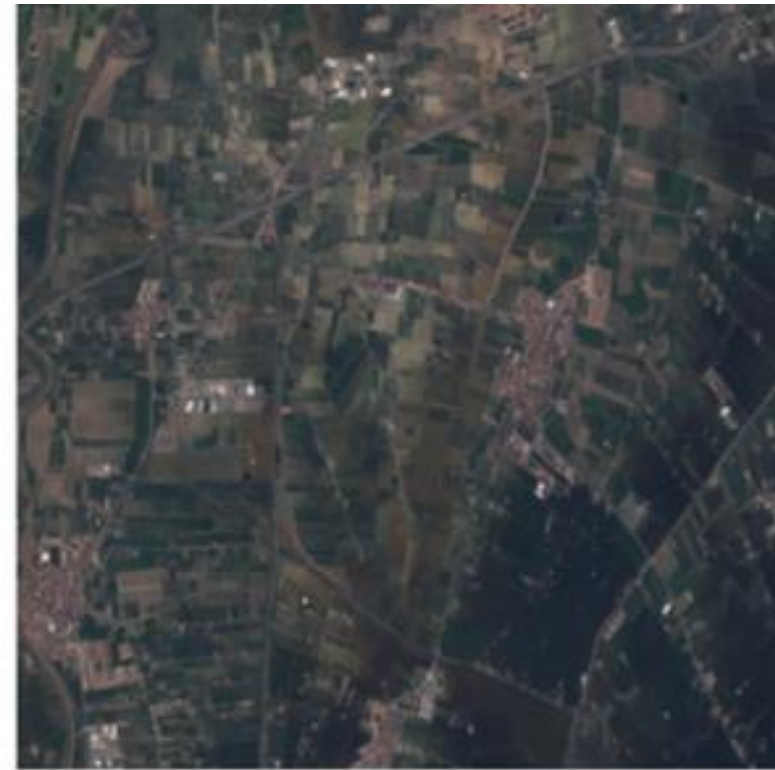


(<https://huggingface.co/ibm-nasa-geospatial>)

## Fine-tuning: Flooding

■ No water  
□ Water / Flood

Inputs  
(Raw Imagery)



Outputs  
(Binary Classification)



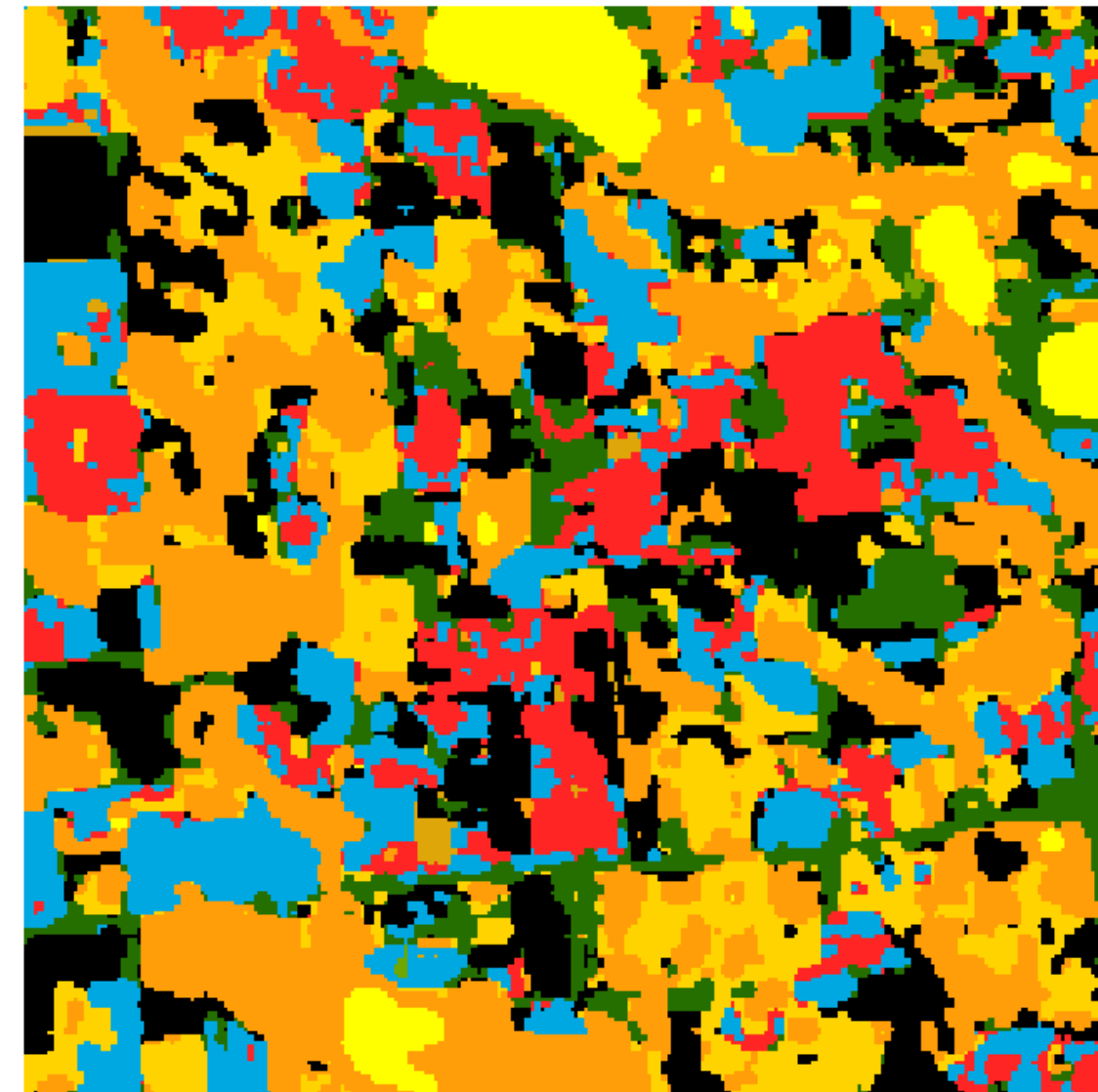
## Fine-tuning: Crop Classification



Input (Multi-Temporal Imagery)



Multi-classification

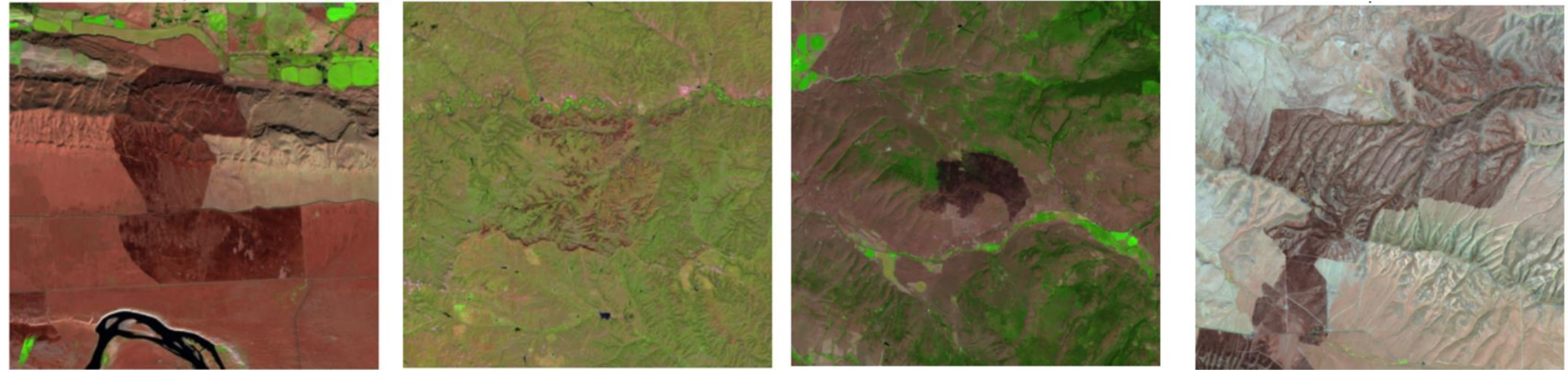


Model Prediction

## Fine-tuning: Burn scar

■ Unburnt land  
□ Burn scar

Inputs  
(Raw Imagery)



Outputs  
(Binary  
Classification)



## Fine-tuning Model for Our Novel Application

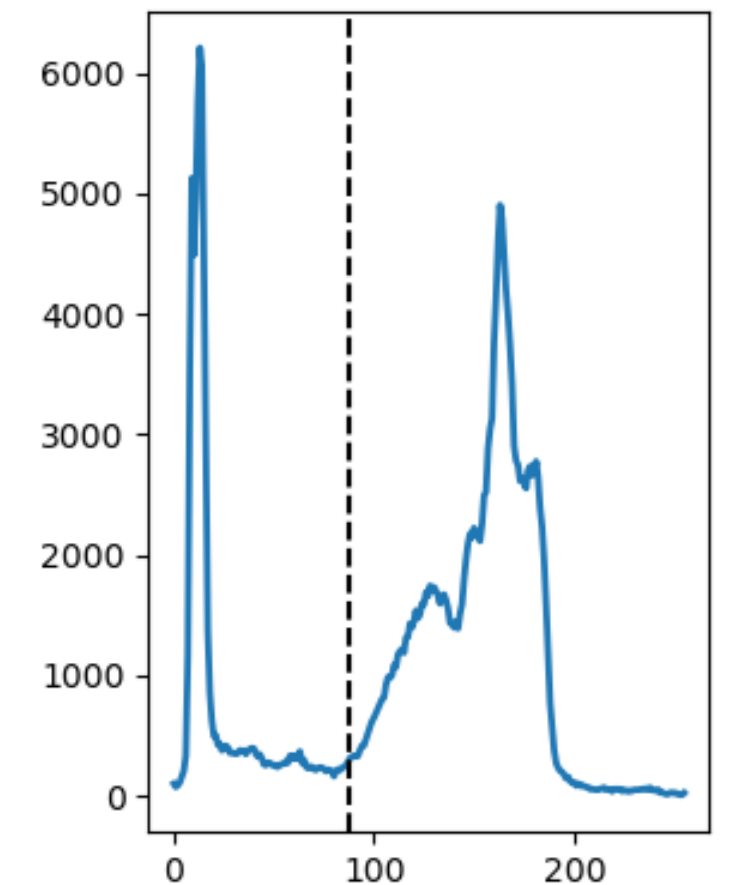
### Normalized Difference Built-Up Index (NDBI) for Urban

Mapping (Zha et al., 2003)

$$NDBI = \frac{SWIR - NIR}{SWIR + NIR}$$

where SWIR is the mid-infrared and NIR is the near-infrared band

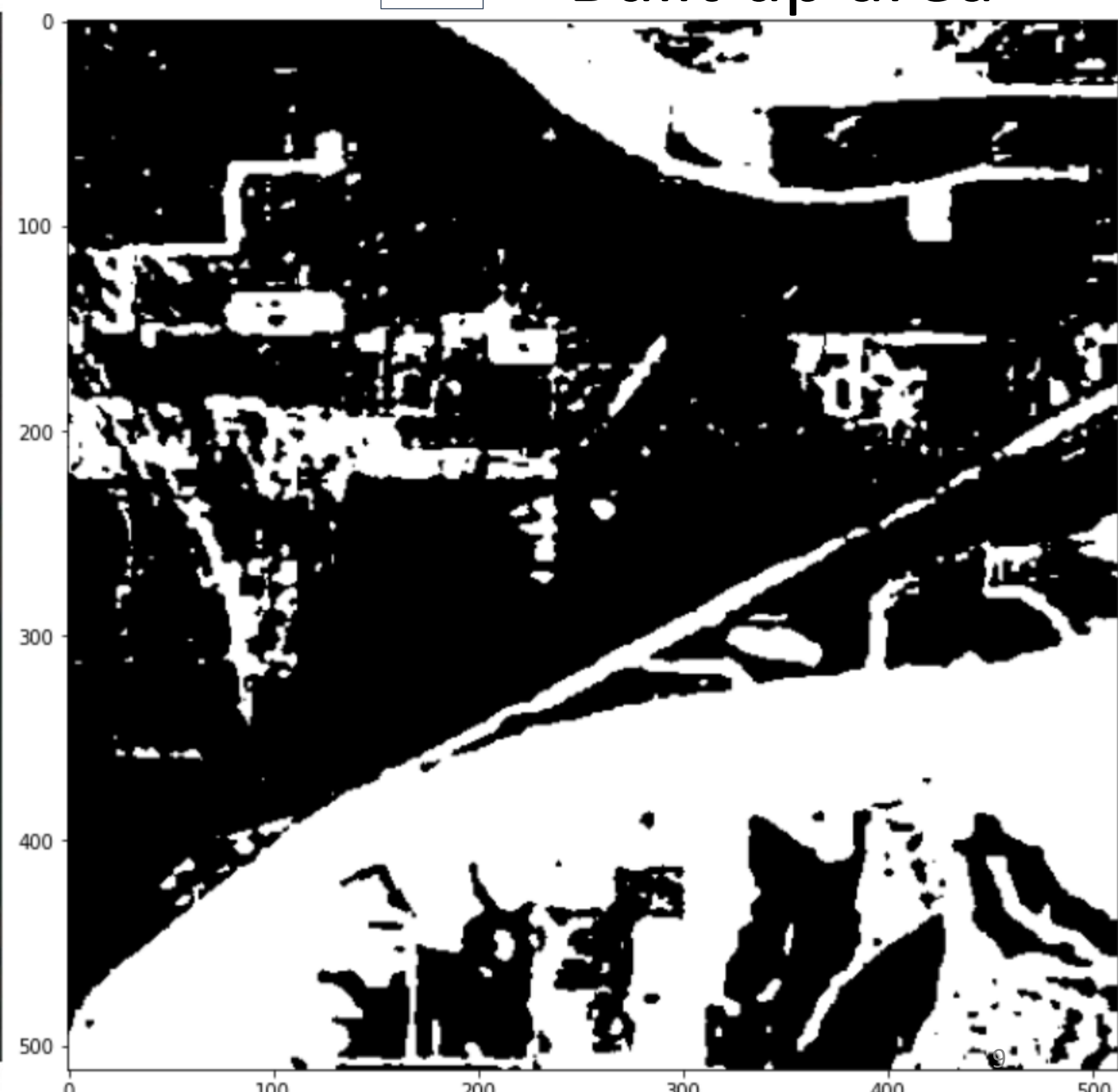
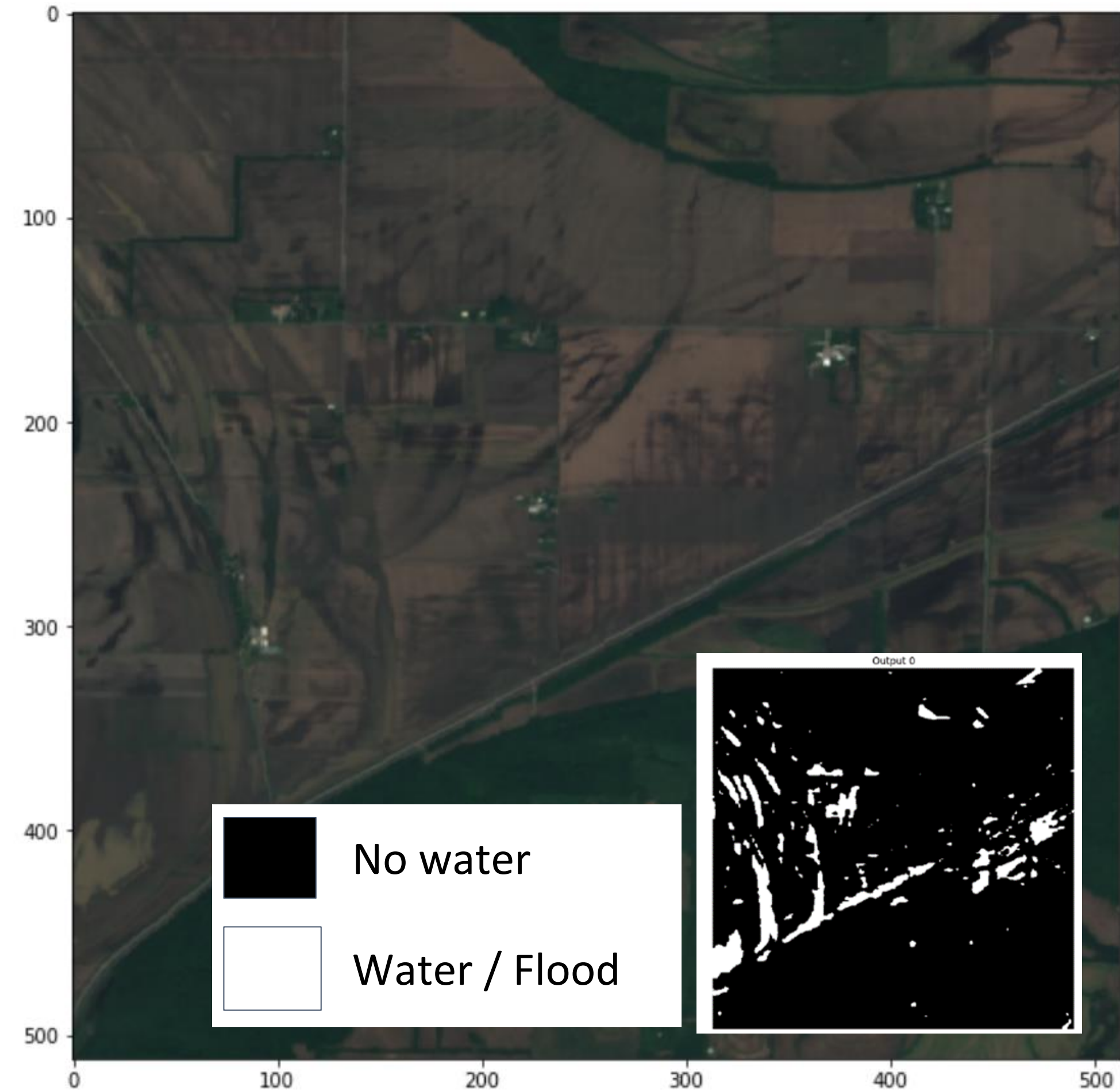
Otsu's thresholding method





# Fine-tuning results of our model

■ Non built up area  
□ Built up area



# Contributions



## Data Card



ABRIDGED VERSION PRODUCED FOR I-GUIDE SUMMER SCHOOL, August 2023



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### Team 6 dataset

Write a short summary describing your dataset (limit 200 words). Include information about the content and topic of the data, sources and motivations for the dataset, benefits, and the problems or use cases it is suitable for.

The dataset utilized in this project contains temporal Harmonized Landsat-Sentinel imagery of diverse land cover and crop type classes across the Contiguous United States for the year 2022. The data card is right here <https://huggingface.co/datasets/ibm-nasa-geospatial/multi-temporal-crop-classification>. The primary motivation behind this dataset was to use a model capable of generating masked datasets for specific classification, leveraging training datasets for model training and validation. The resultant dataset showcases prediction results that could be vital for urban planning, environmental studies, disaster management, and other relevant fields. The process's benefits include the ability to monitor land use changes, understand urban expansion, and contribute to sustainable development practices. This dataset is particularly suitable for applications that require a detailed understanding of land use patterns, where quality spatial information about built-up areas is essential. Its utilization promises to enhance the understanding and management of urban landscapes, catering to both scientific research and practical applications in various domains.

DATASET LINK

DATA CARD AUTHOR(S)

Provide a link to the dataset:

Select one role per Data Card Author:

(Usage Note: Select the most appropriate choice to describe the author's role in creating the Data Card.)

Dataset Link  
<https://huggingface.co/datasets/ibm-nasa-geospatial/multi-temporal-crop-classification/tree/main>

Claire Simpson, Team 6: (Contributor)  
 Salar Jarhan, Team 6: (Contributor)  
 Yalin Yang, Team 6: (Contributor)

# Contributions

- Advance Geo AI research based on **reproducibility** and **collaboration**
- Guide for you to execute your own tasks

The image shows a Jupyter Notebook interface with several tabs. The main tab is titled "Image segmentation by foundation model finetuning". It contains a code cell with the following Python code:

```
[20]: import r
from mat
import n
from ras
import n
matplotlib

[21]: def img
# Re
red
gree
blue

# No
red
gree
blue

# St
rgb
retu

[58]: flood_or
flood_re
input_ls
```

Below the code, there is a section titled "Running the inference" with the text: "We can run inference on the new data in GeoTIFF format. The data can be of any shape (e.g. height and width) as long as it follows the bands/channels of the original".

Another tab is titled "Data preparation for GeoAI Models" and contains the following text:

Team 6: Claire Simpson, Salar Jarhan, Yalin Yang, Jiyoung Lee, Yanhong Huang

1. Introduction

As of August 03, 2023, NASA and IBM announced a largest GeoAI Foundation Model, using Harmonized Landsat and Sentinel-2 data. We migrated the foundation model over I-GUIDE and fine tuned the model for detecting 'Build-up' and 'Non-build-up area'.

2. Download the

Run the following ce

```
[5]: # Install git Large
pip install git-lfs
# Clone Prithvi-100M
git clone https://
# Clone Prithvi-100M
git clone https://

Defaulting to user
Requirement already
WARNING: You are not
You should consider
fatal: destination
fatal: destination

Open Prithvi_run_inf
Add from Prithvi:

1 import argparse
2 import functools
3 import os
4 from typing import
5
6 import numpy as
7 import rasterio
8 import torch
9 import yaml
10 from einops import
11
12 #from mae.model
13 from Prithvi import
Then, in the terminal
cd Prithvi-100M
python Prithvi_run
demo/HLS_L30_T13RE
Prithvi_100M_conf
```

Below the code, there is a diagram titled "Multi-Temporal Crop Classification Model". The diagram shows a flow from "Multi-Temporal HLS Data" and "CDL Labels" to an "Encoder", which then feeds into a "Conv Head". The "Conv Head" outputs a "Prediction" map, which is compared against "Ground Truth" using "CrossEntropyLoss". The "CrossEntropyLoss" block has an "Update" arrow pointing back to the "Conv Head".

image source: <https://huggingface.co/ibm-nasa-geospatial/Prithvi-100M-multi-temporal-crop-classification>

**Dataset**

Data for this task is stored on Hugging Face [here](#). The dataset contains satellite imagery (Harmonized Landsat Sentinel-2 - HLS) GeoTIFFs, where each tif file is 224 x 224 pixels at 30m spatial resolution. Each input GeoTIFF contains 18 bands including 6 spectral bands for three time steps stacked together. That is, each GeoTIFF file effectively represents three images acquired over the same spatial location at three different times. Each GeoTIFF file for the mask contains one band, where each pixel represents the target categorical class.

**Input Bands:**

In each input GeoTIFF the following bands are repeated three times for three observations throughout the growing season: Channel Name, HLS S30 Band number

1. Blue, B02 (Image 1)
2. Green, B03 (Image 1)
3. Red, B04 (Image 1)
4. NIR, B04A (Image 1)
5. SWIR 1, B11 (Image 1)
6. SWIR 2, B12 (Image 1)
7. Blue, B02 (Image 2)
8. Green, B03 (Image 2)



**Thank you!**  
**Awesome Geo AI**  
**Awesome I-GUIDE**  
**Awesome Summer School**