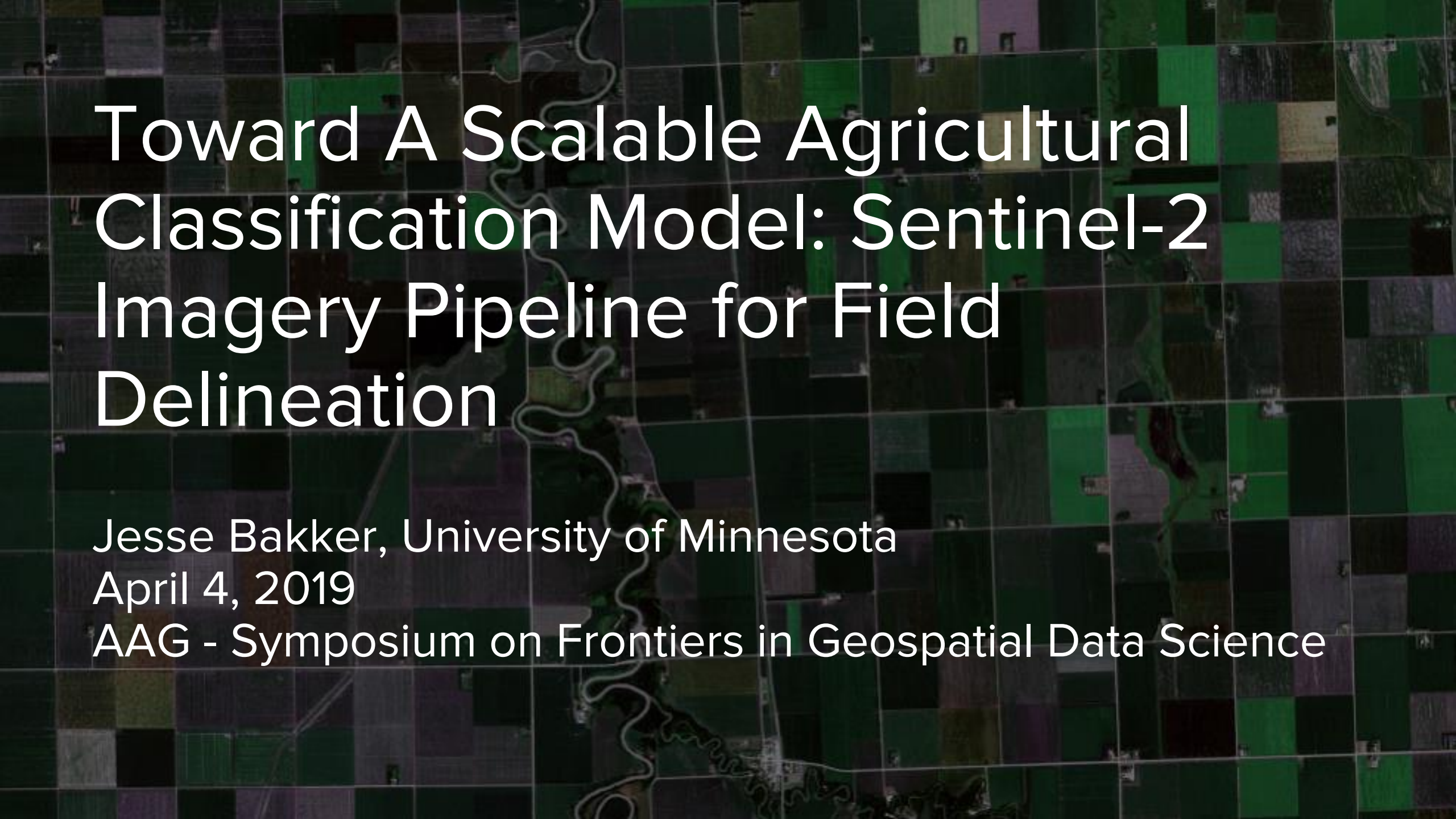


Toward A Scalable Agricultural Classification Model: Sentinel-2 Imagery Pipeline for Field Delineation

Jesse Bakker, University of Minnesota
April 4, 2019
AAG - Symposium on Frontiers in Geospatial Data Science

Project Overview

Goal: Build a Python workflow to extract ag field boundaries from Sentinel-2 imagery for the whole planet

- **Core Questions:**
  - How much *imagery data* (really, how little) is necessary to return accurate field boundary polygons?
  - What *methods* produce accurate field boundary segmentation most efficiently?

- **Balance accuracy and processing:**
  - Global scope: Flexible & Scalable
  - Computationally Efficient Methods & Design

Scalable and **Flexible** to handle different ag types

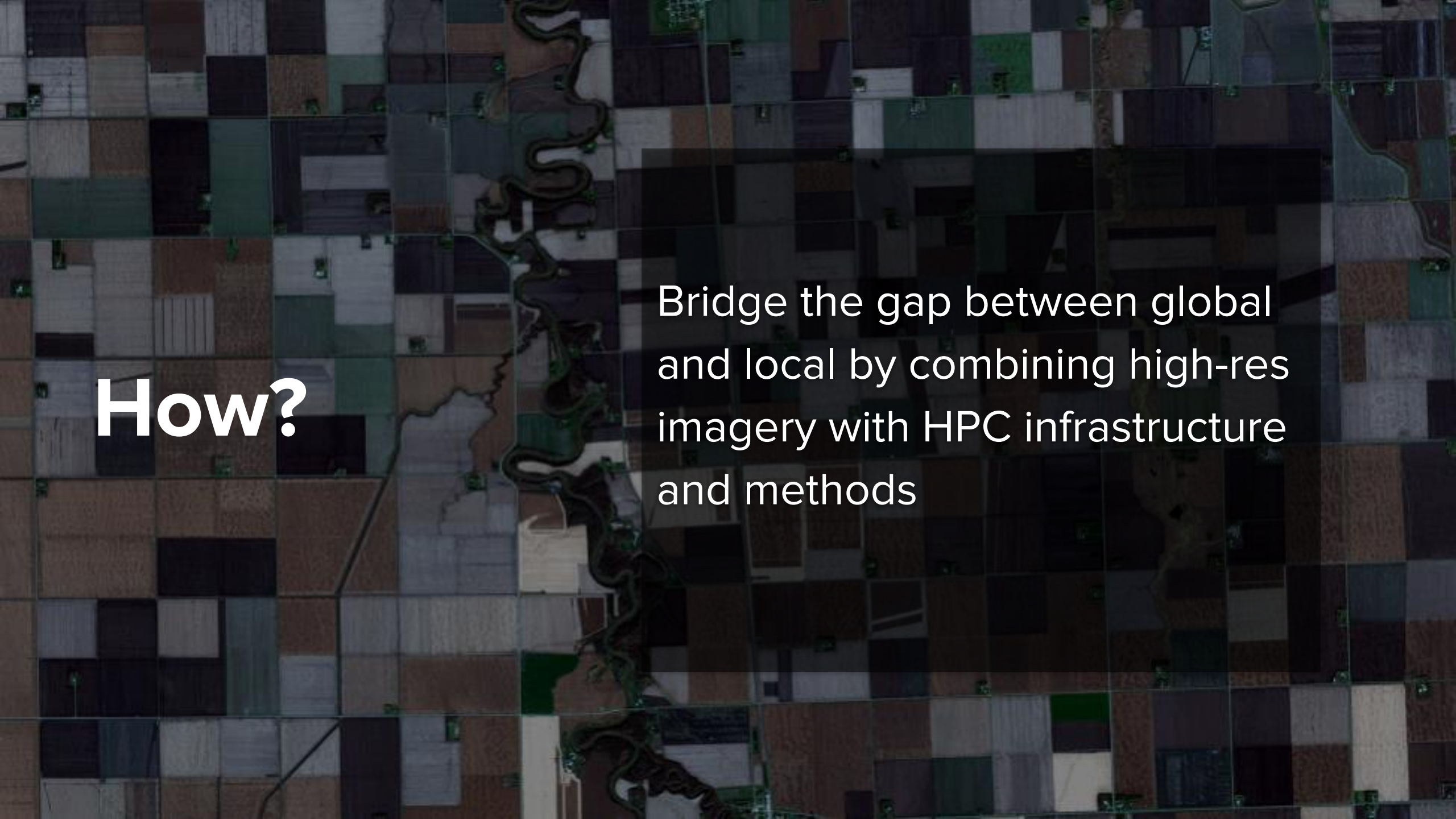
Starting with this.

Red River Valley,

MN

Why?

- **Fields** are the operational unit of agriculture, critical for understanding impacts of climate change on ag
- **Global** agriculture estimates are too coarse or too slow
- **Local** analysis is not scalable



How?

Bridge the gap between global and local by combining high-res imagery with HPC infrastructure and methods

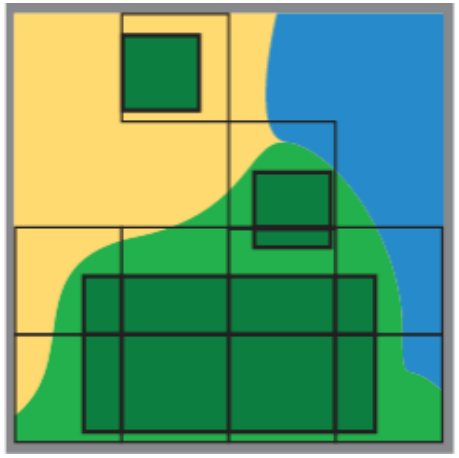
Conceptual Workflow

Download Imagery Data ❯ **Intermediate Data Processing** ❯ **Image Segmentation**

All Tiles

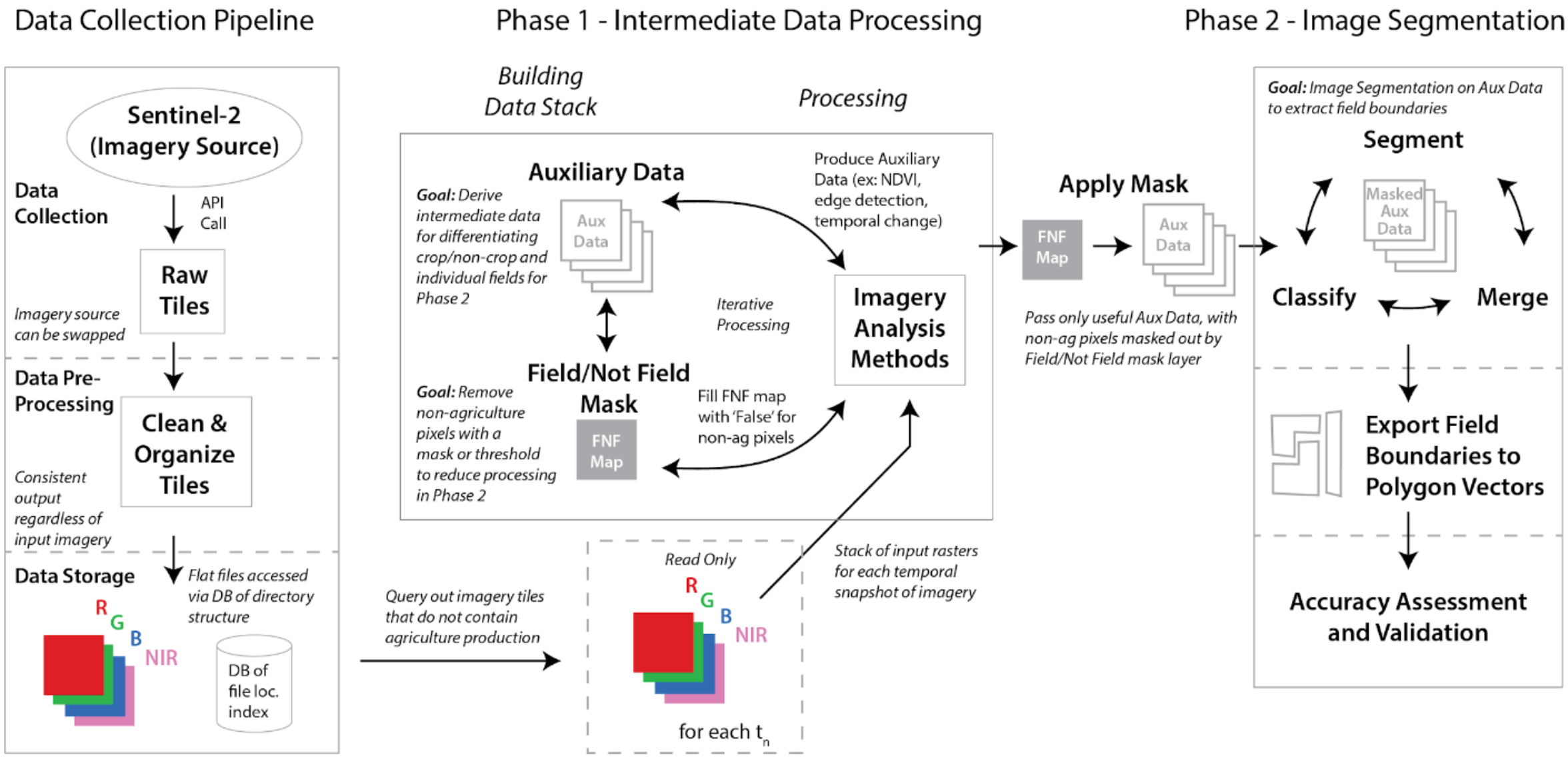
Drop Tiles w/o Crops

Drop Pixels w/o Crops

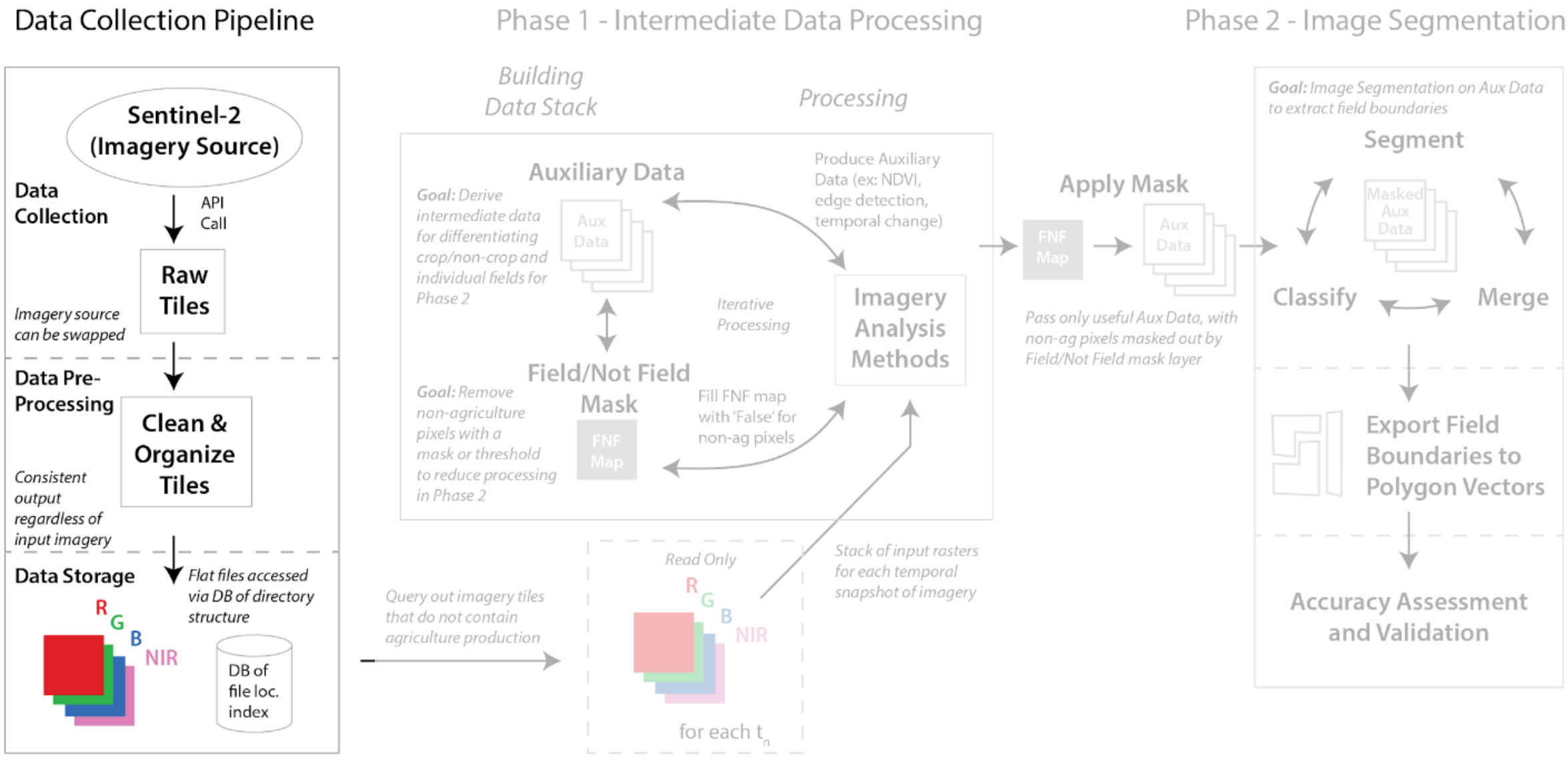


Perform Segmentation

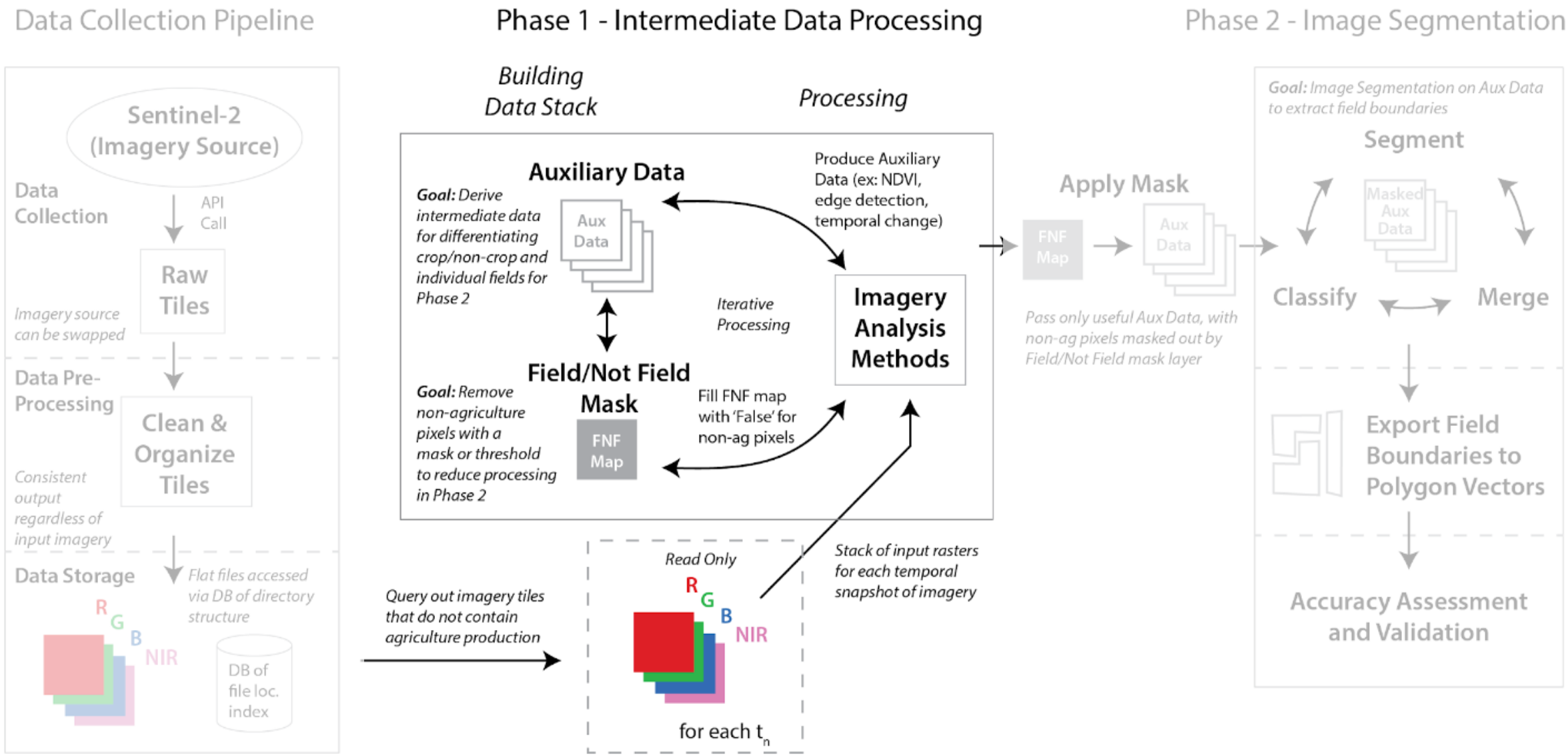
Conceptual Workflow



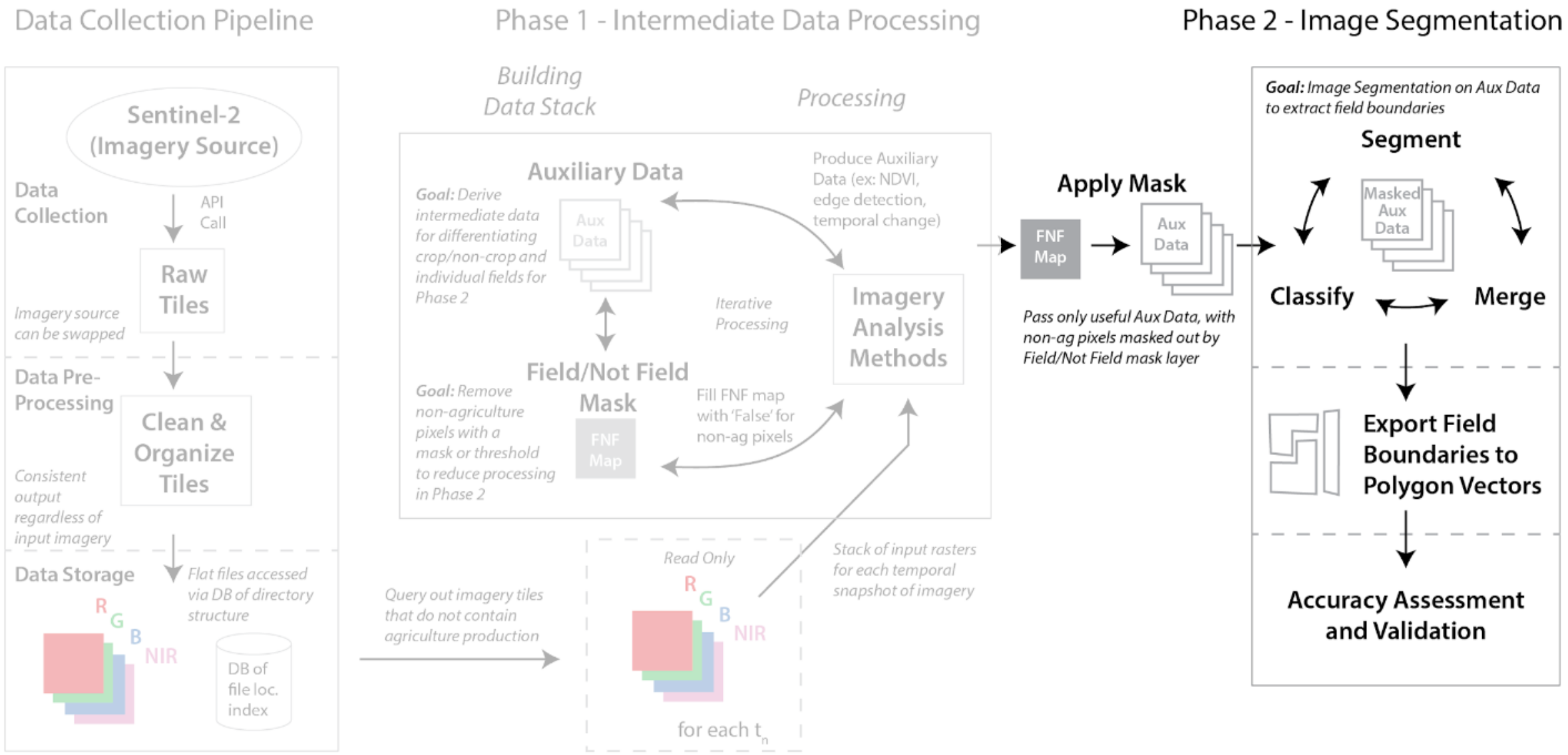
Conceptual Workflow



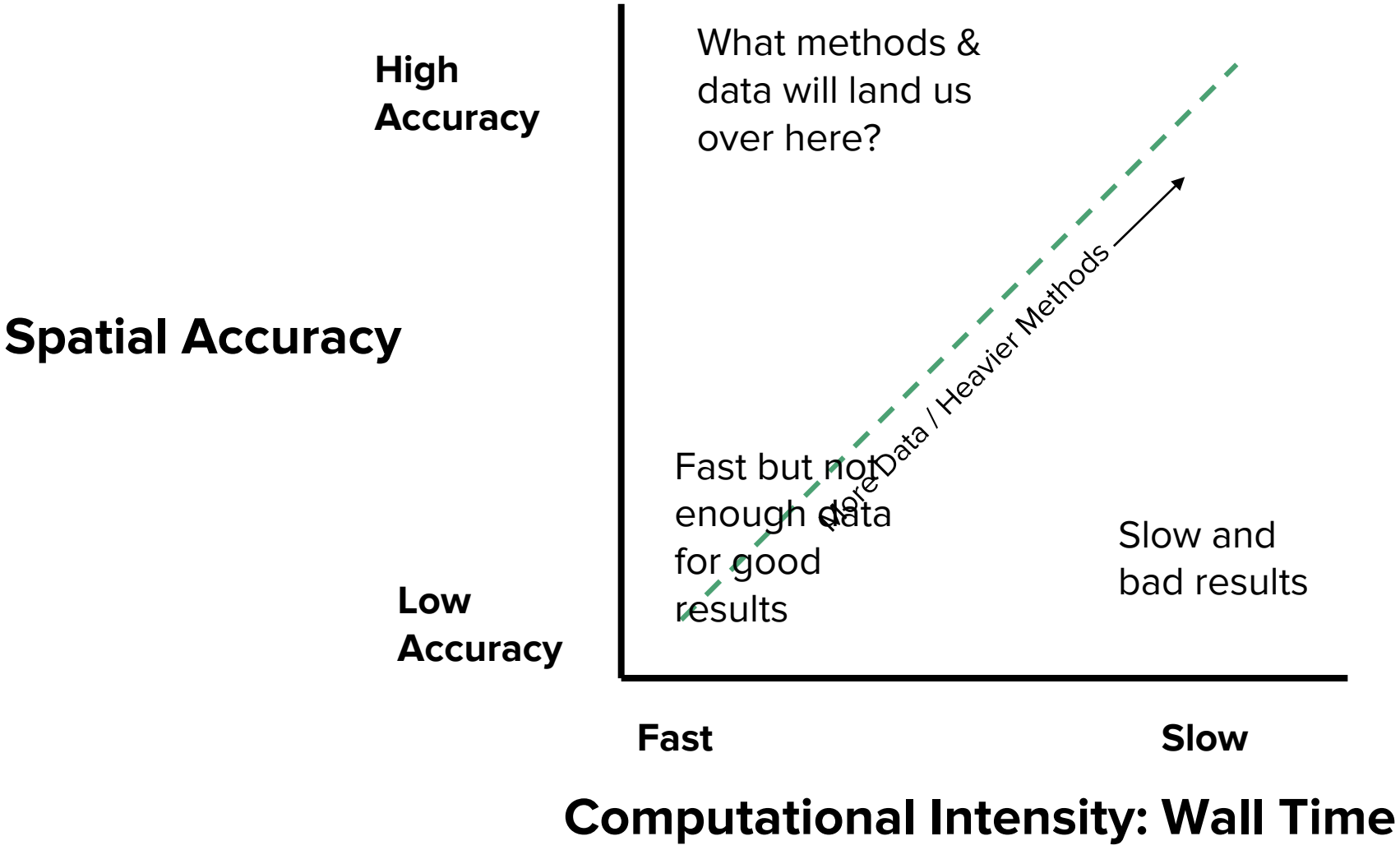
Conceptual Workflow



Conceptual Workflow



Trade-offs: Speed and Accuracy

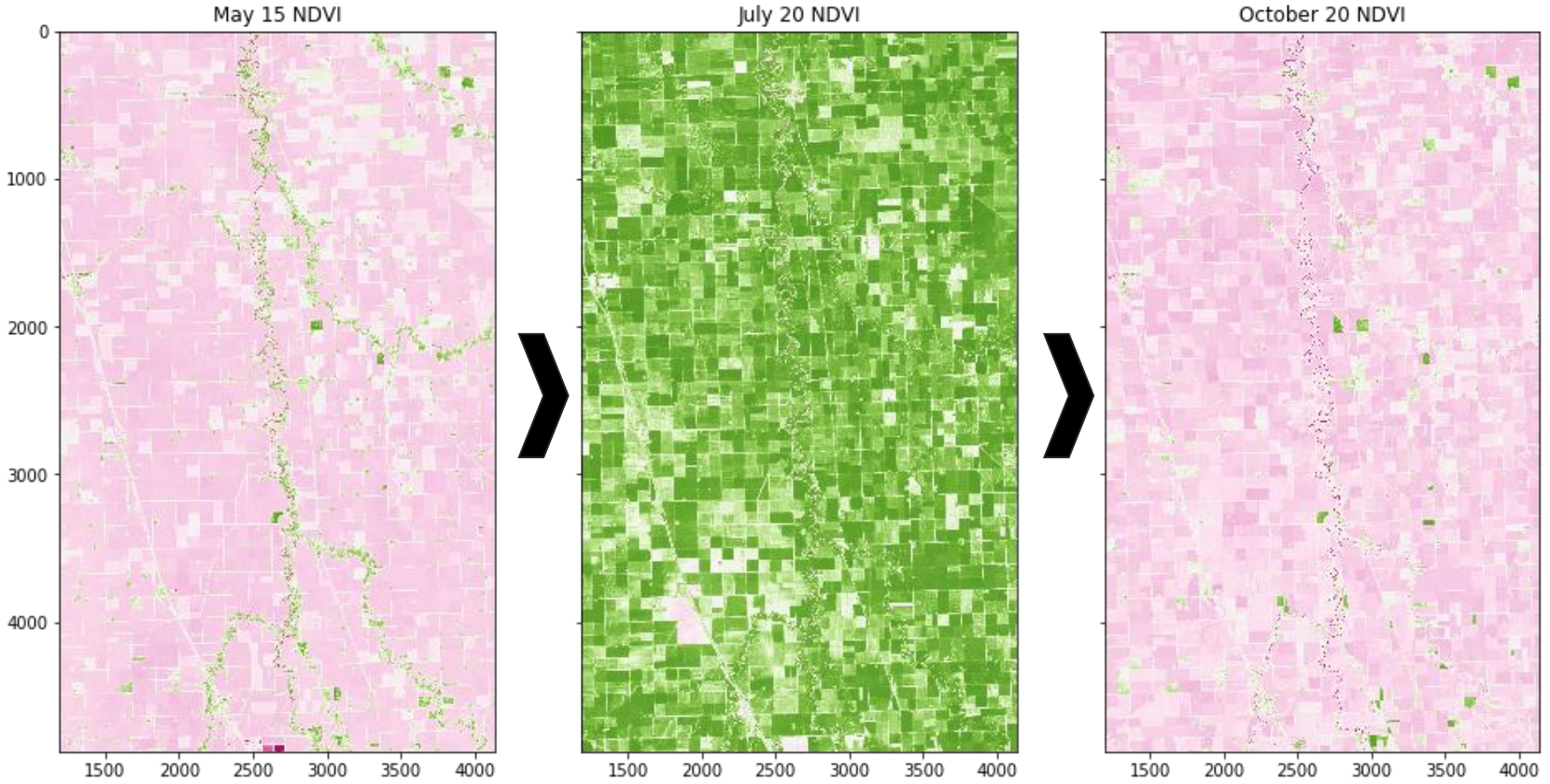


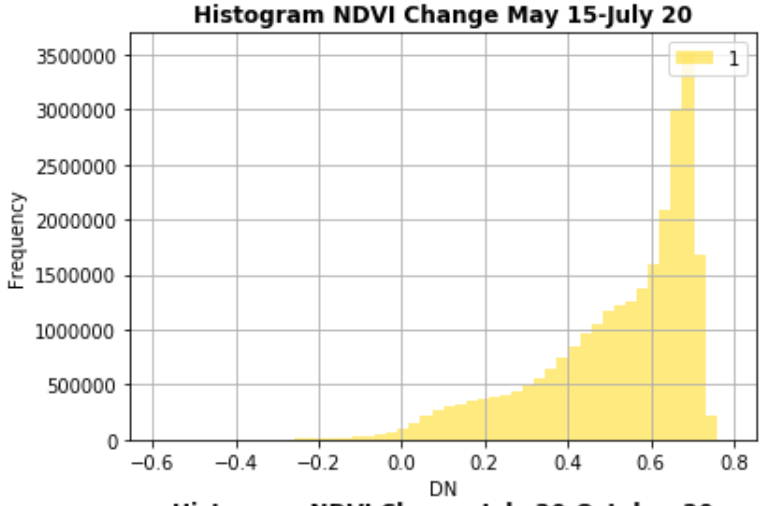
Next Step: Methods Testing

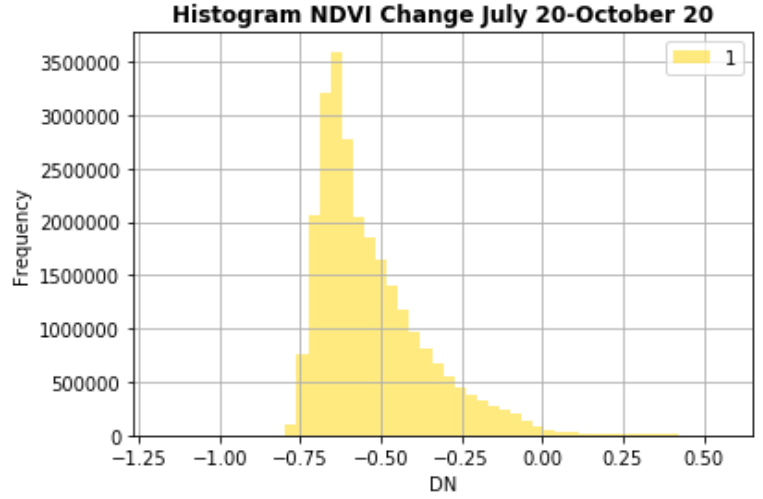
Preliminary Study Area:
Red River Valley, MN

Intermediate Data Processing

Example: NDVI Change





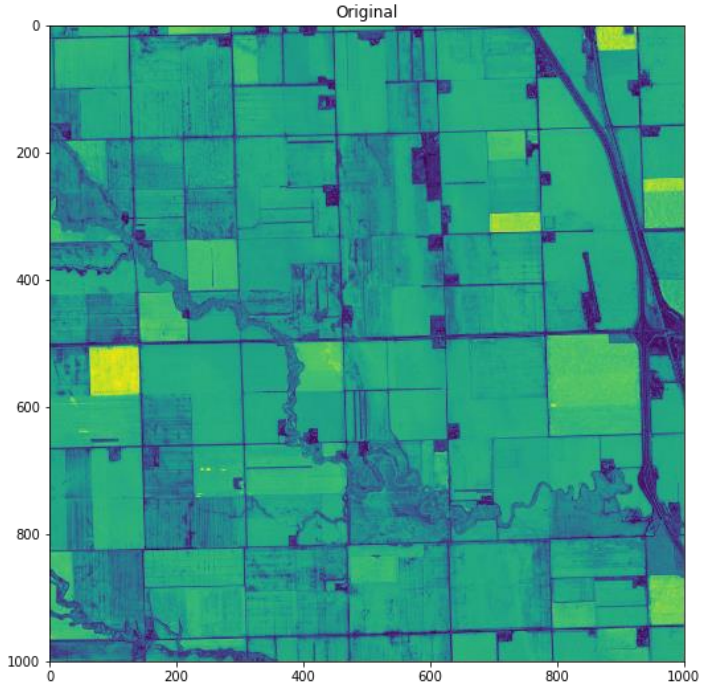


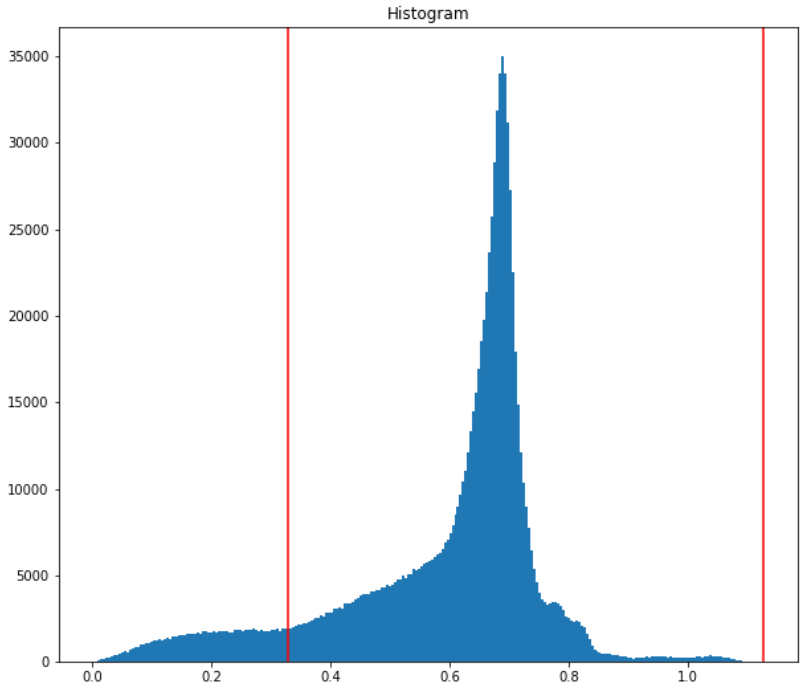
Cumulative NDVI Change to Show Crop vs. Non-Crop

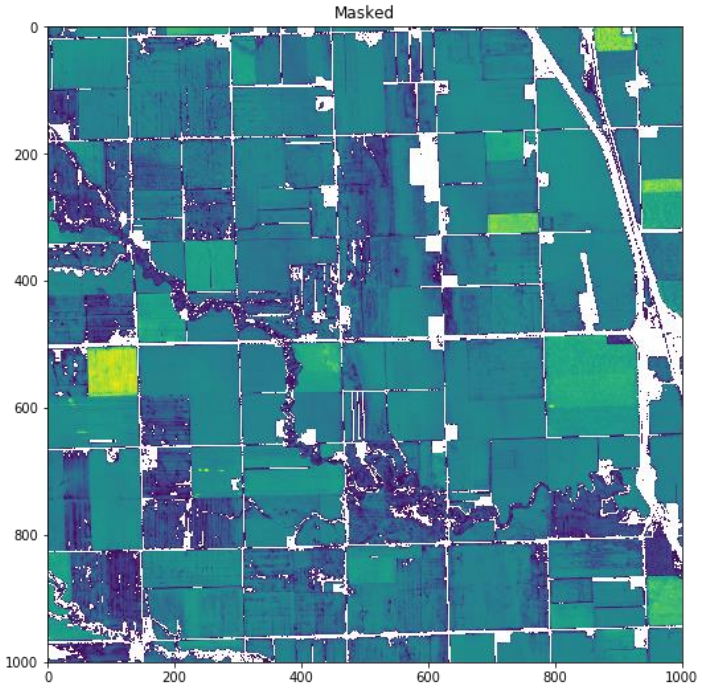
NDVI Change

Mask out pixels
(ex: bottom 10%)

Pass mask to
segmentation

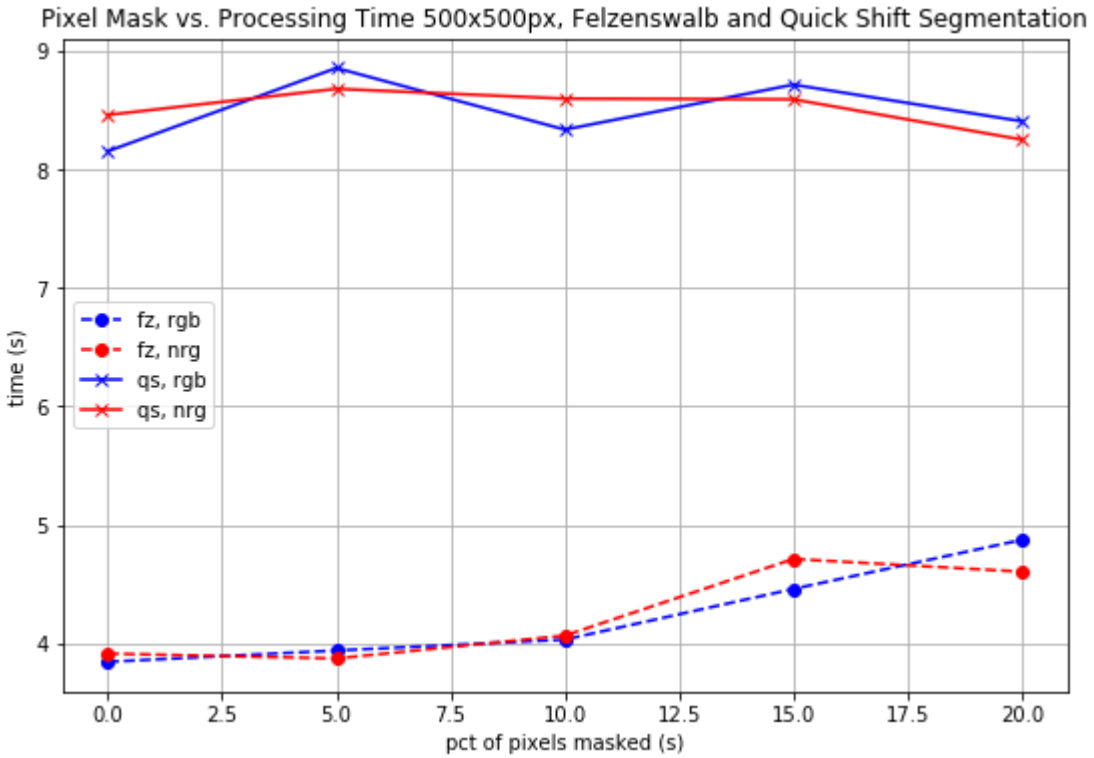




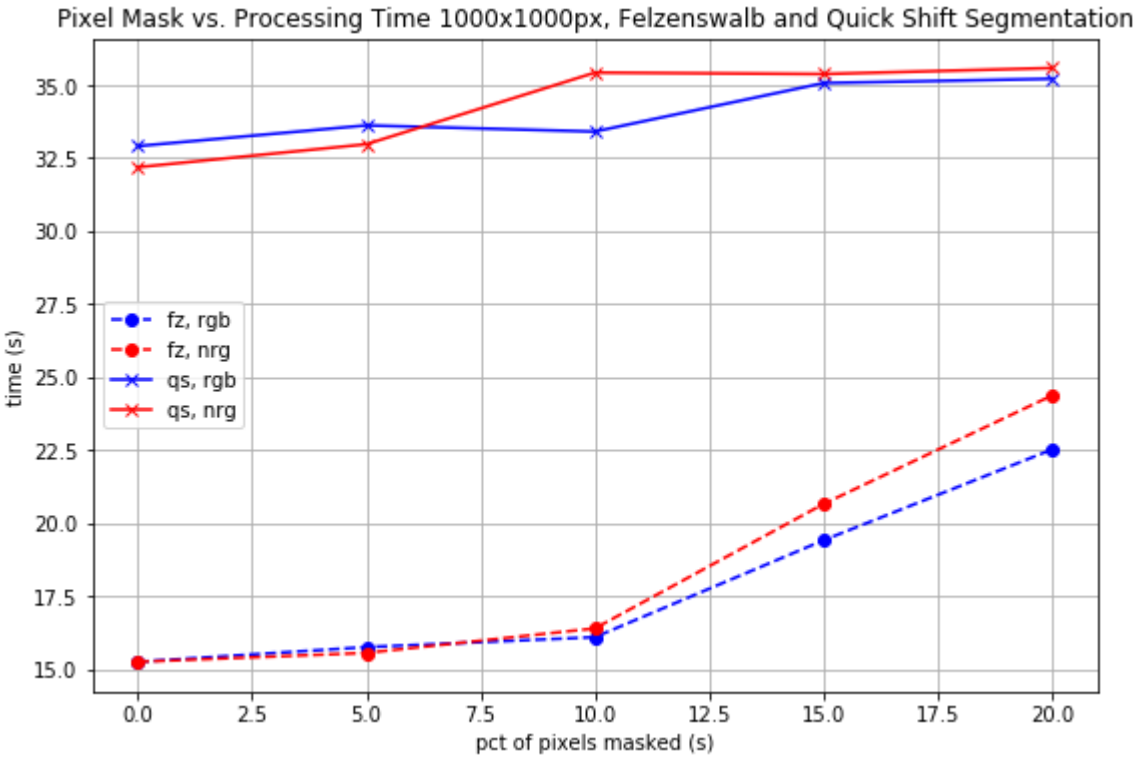


Masking doesn’t necessarily improve processing speed

500x500 pixel image



1000x1000 pixel image

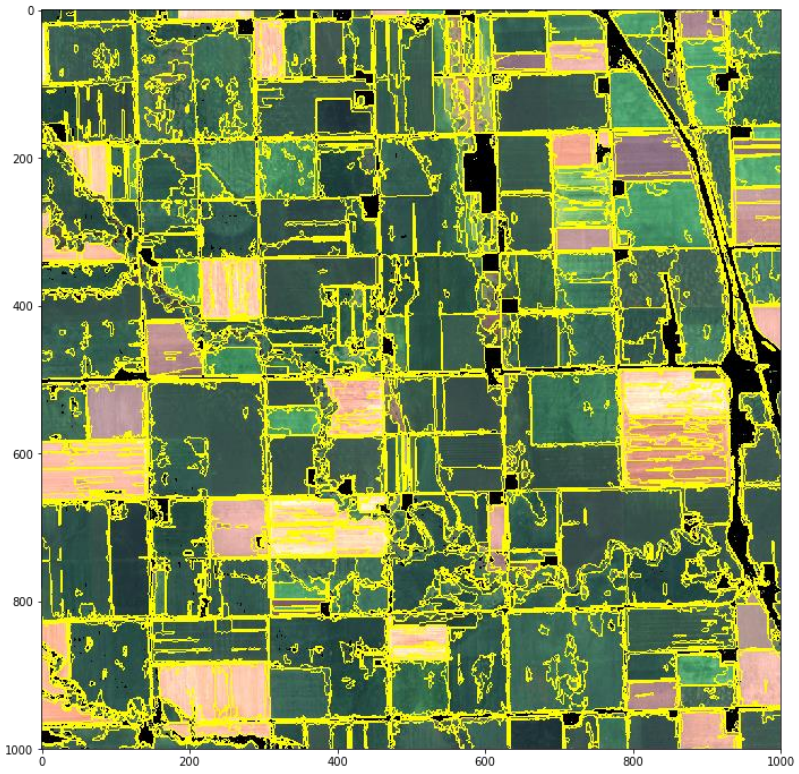


More testing will be needed at scale

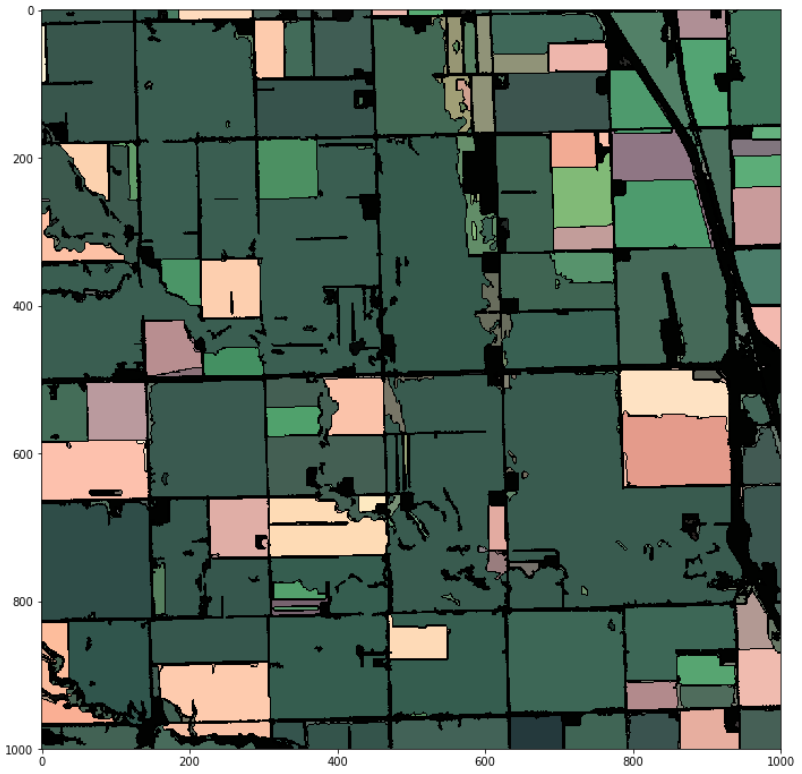
But is does help with edge detection

RGB Image (no mask)

Segmentation (with mask)

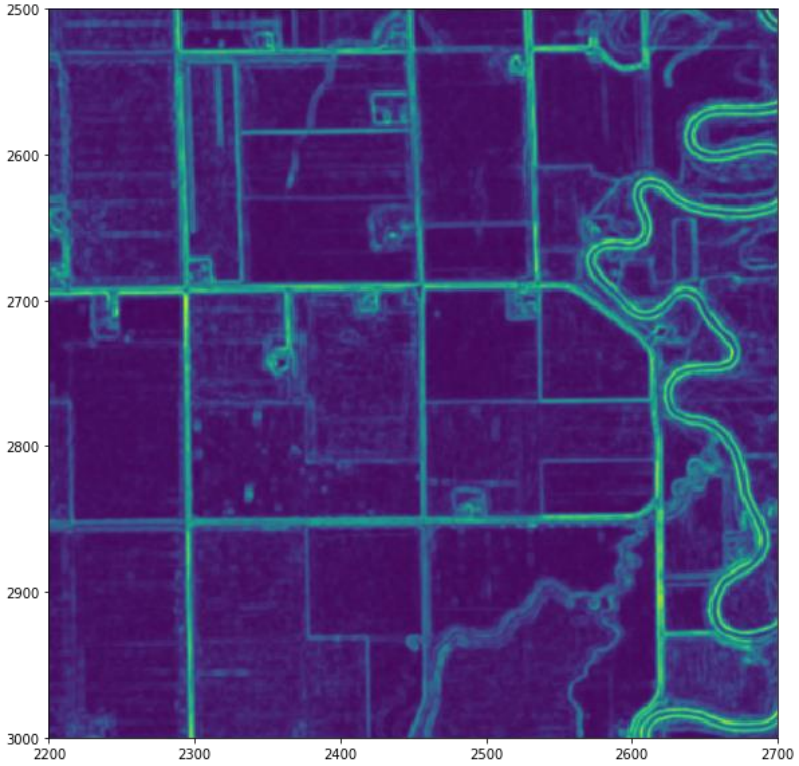


Merge Labels

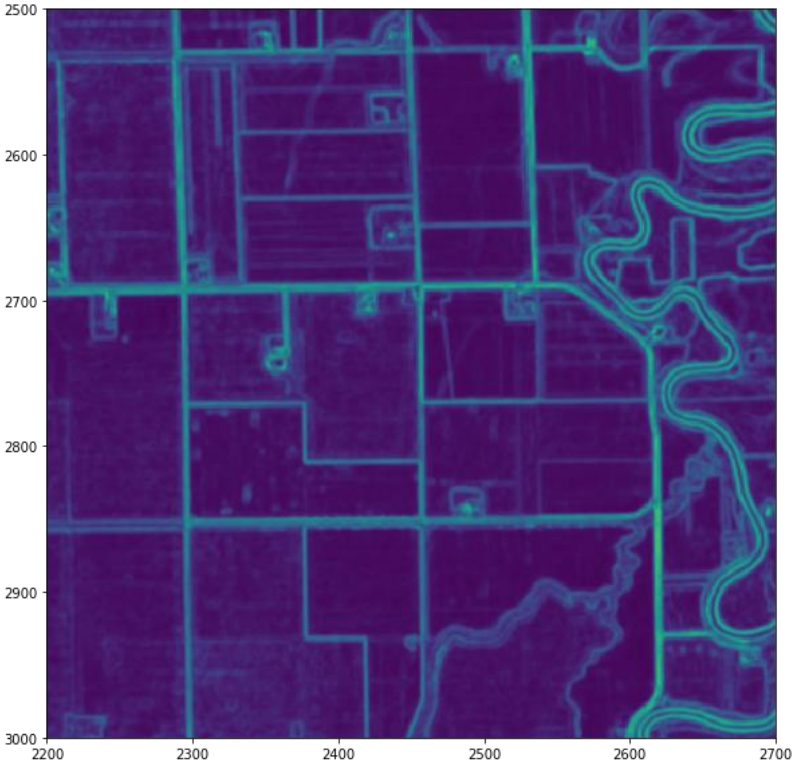


Temporal Imagery for Edge Detection

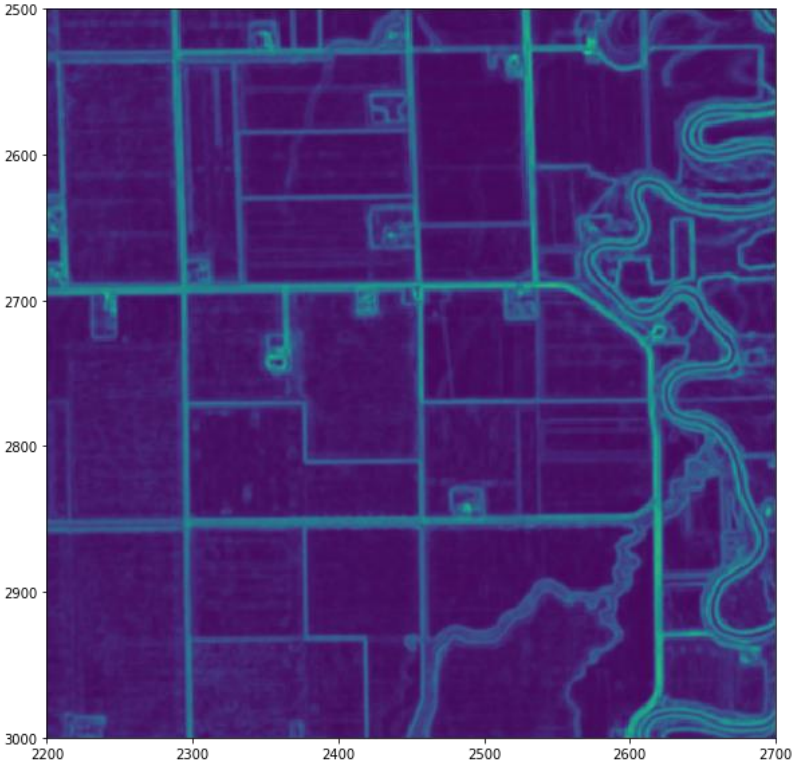
1 Image (24 sec)



3 Images (55 sec)



5 Images (93 sec)



Method: Watkins & van Niekerk, 2019

Next Steps

- Validation and spatial accuracy assessment
- Apply the framework: model experiments for MN
- Sensitivity testing


Questions?
Thanks!