Assessing Forest Risk to Infrastructure Using Remotely Sensed Imagery

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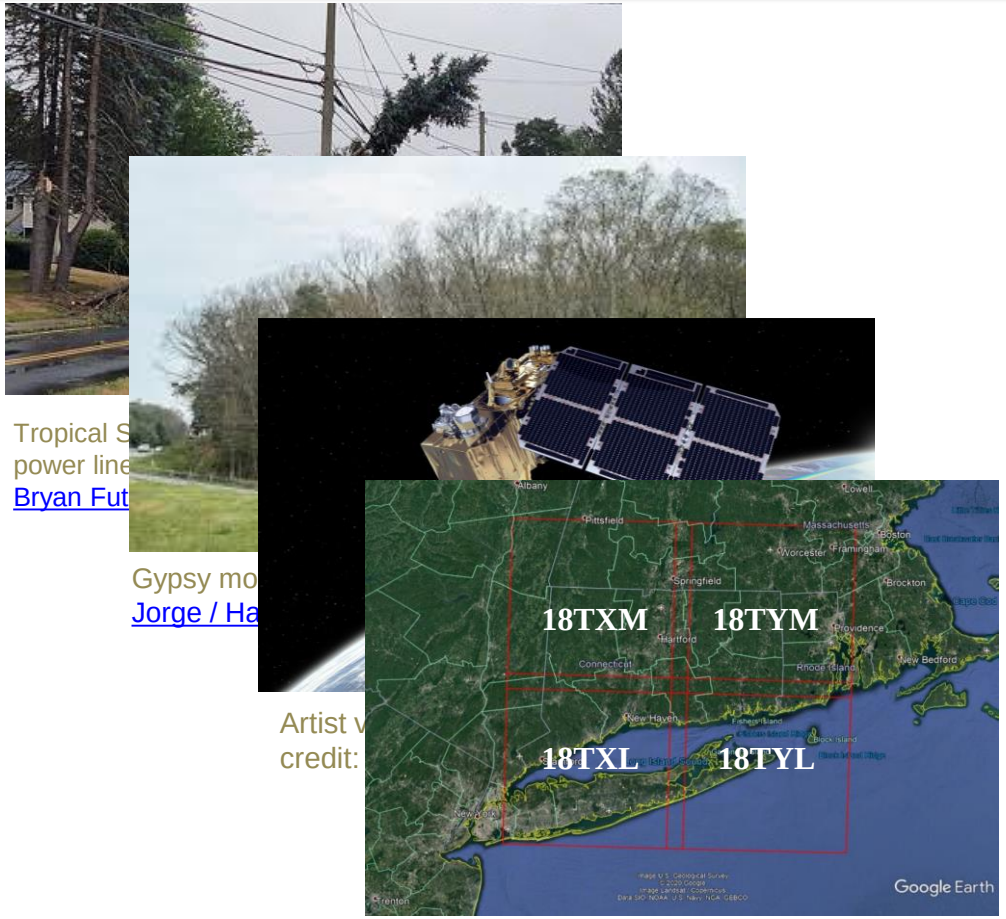
Background

- CT is a highly forested area and many places have experienced **outages during or after storms** due to fallen trees.
- Stressors, such as **insects and diseases** will affect health and vitality of the forest significantly, and unhealthy trees are more likely to break or fall during storms.
- Remote sensing technology provides new opportunities to monitor forest disturbance and disturbance types **in near real-time, large-scale, and detailed information**.



Tropical S
power line
Bryan Fut

Gypsy mo
Jorge / Ha

Artist v
credit:

Figure 1. Four Sentinel-2 MGRS tiles covering the area of CT.

Objectives

1. **Near real-time monitoring** of roadside and right-of-way (ROW) forest disturbances in CT at 10-meter resolution using Sentinel-2 time series. (Year 1)

2. **Near real-time characterization** of roadside and ROW forest disturbance type (e.g., wind, flood, harvest, mechanical, and stress-related such as insects and drought). (Year 2)

3. **Near real-time assessment** of roadside and ROW forest disturbance risk to Eversource infrastructure in CT. (Year 3)

Impacts

1. Monitoring forest disturbance and disturbance type in near real-time (within a few weeks) at roadside and ROW is of great importance for **maintaining a well-updated database of vegetation risk**.

2. Rapidly updated maps of vegetation risk could be an **important input to models** that seek to predict the location and rate of electrical outages during storms, such as the UConn Storm Outage Prediction Model.

3. Such maps could also be highly valuable to decisionmakers in **allocating limited resources for tree management and removal** to be most effective at reducing risks to infrastructure.

Flowchart of Sentinel-2 ARD Preparation

Step 1. unzip L1C data

Step 2. atmospheric correction

Step 3. mask cloud and cloud shadow

Step 4. image resample (20-m to 10-m)

Step 5. BRDF correction

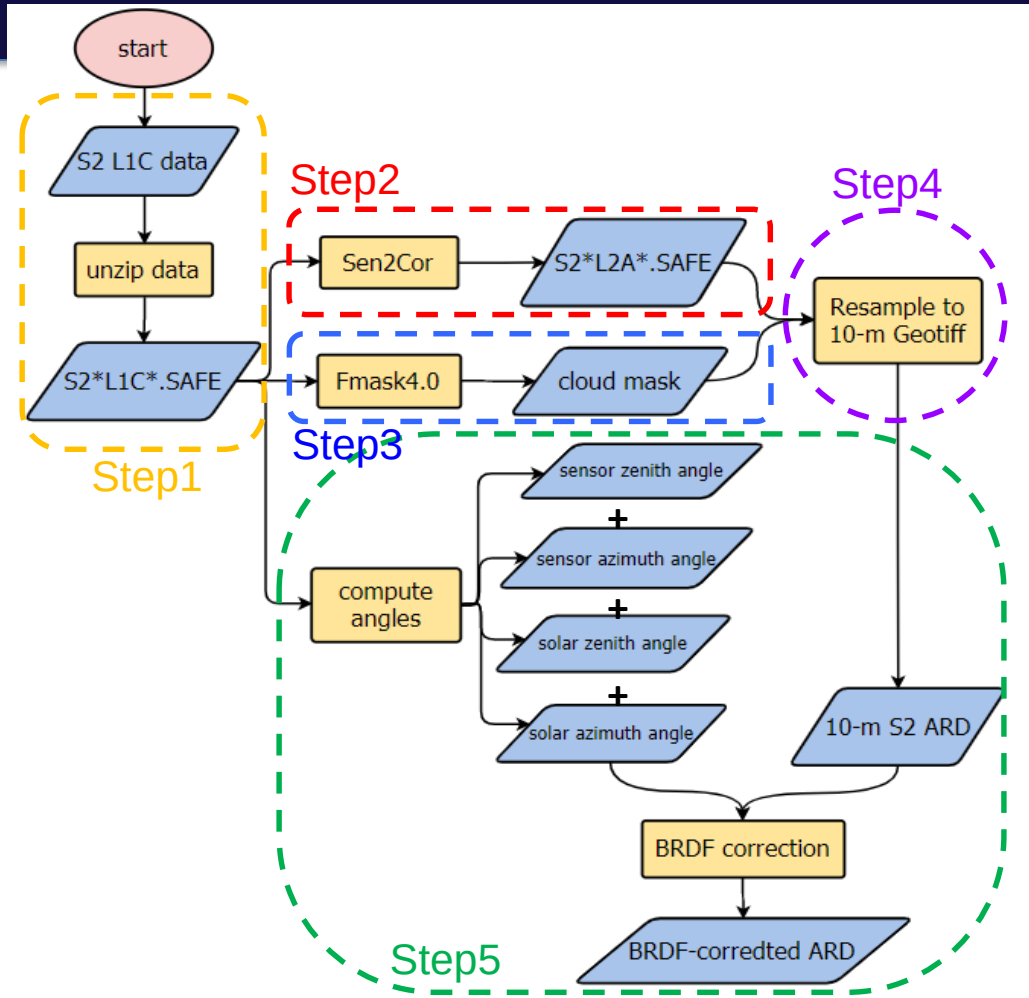


Figure 3. Flowchart of Sentinel-2 (S2) ARD preparation.

Create 10 m Mask from Proximity Pixels

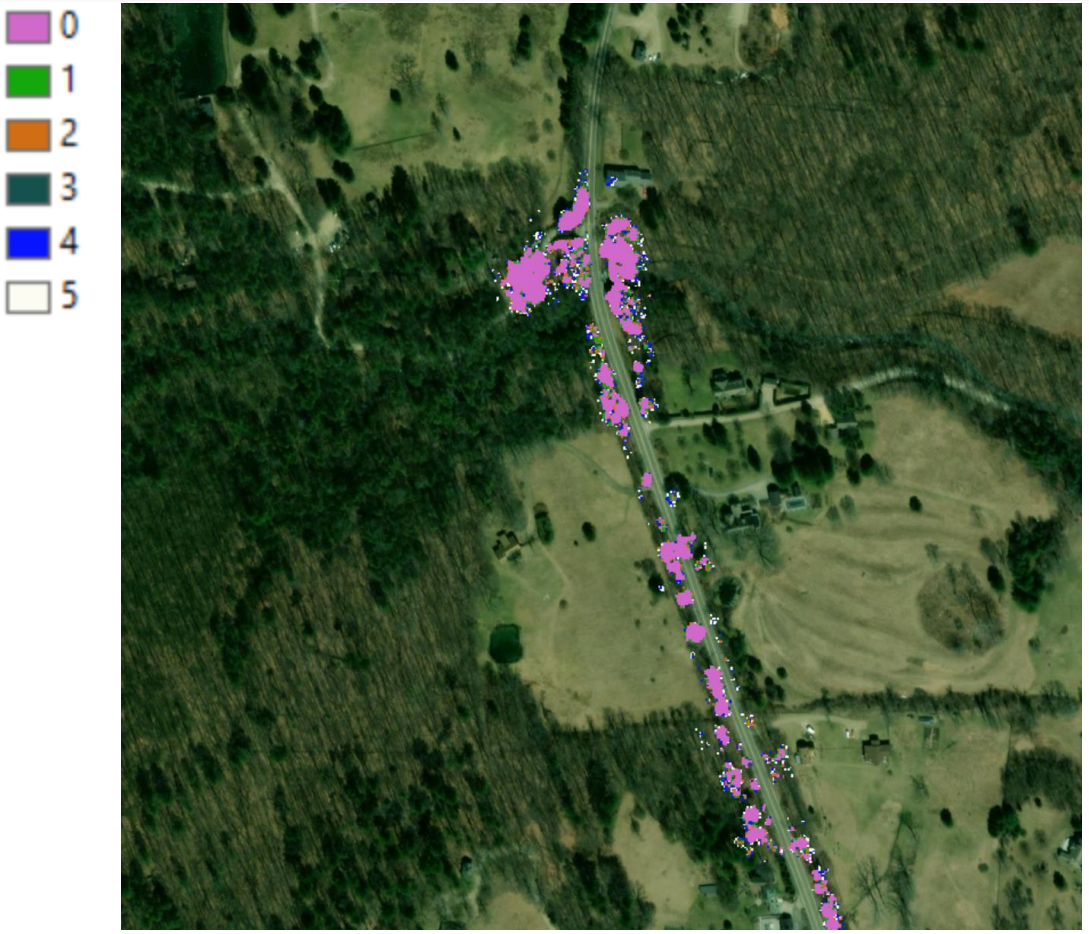


Figure 5-a. Proximity pixel raster #465. Cell size: 4 ft. Coordinate reference system (CRS): NAD_1983_StatePlane_Connecticut_FIPS_0600_Feet.

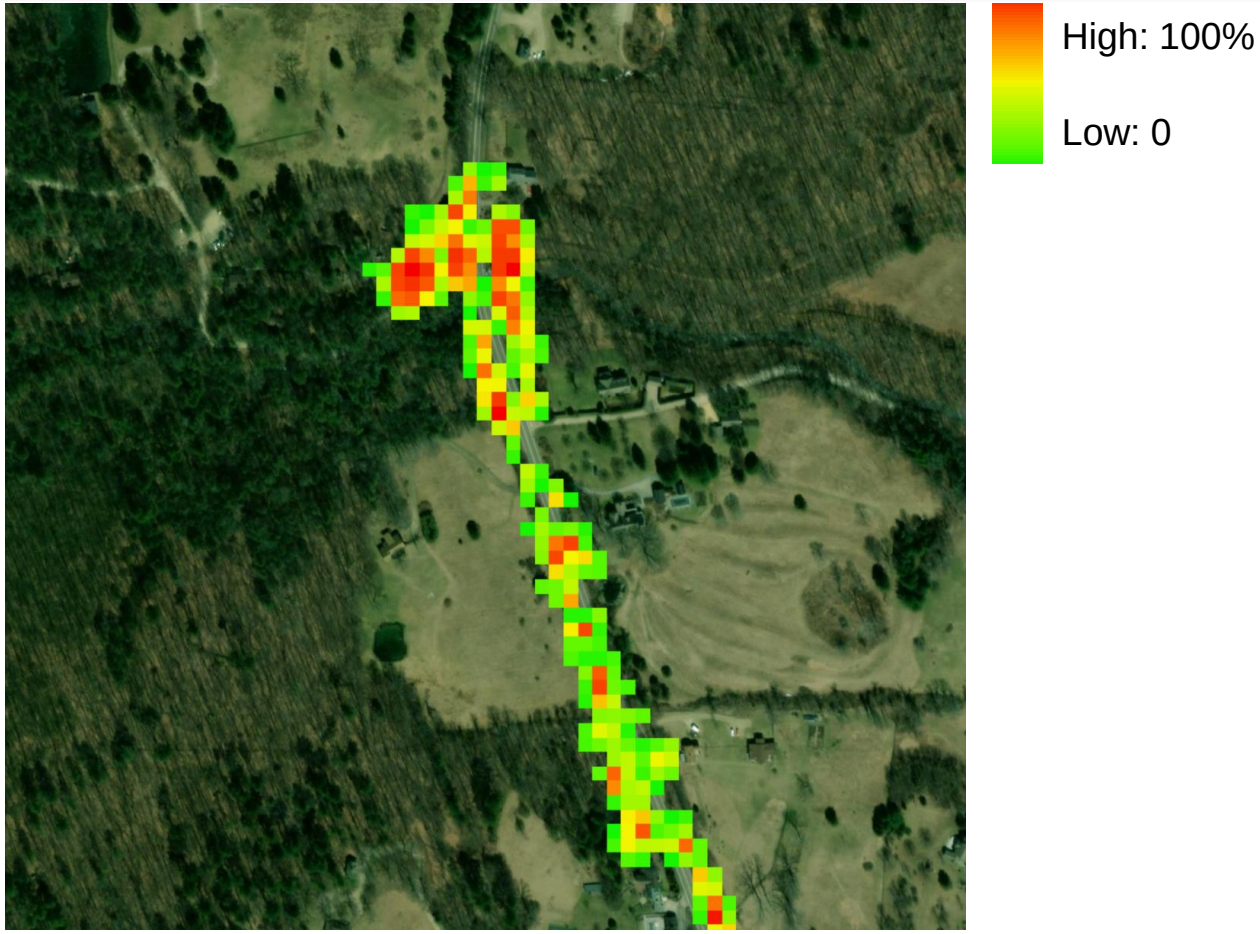
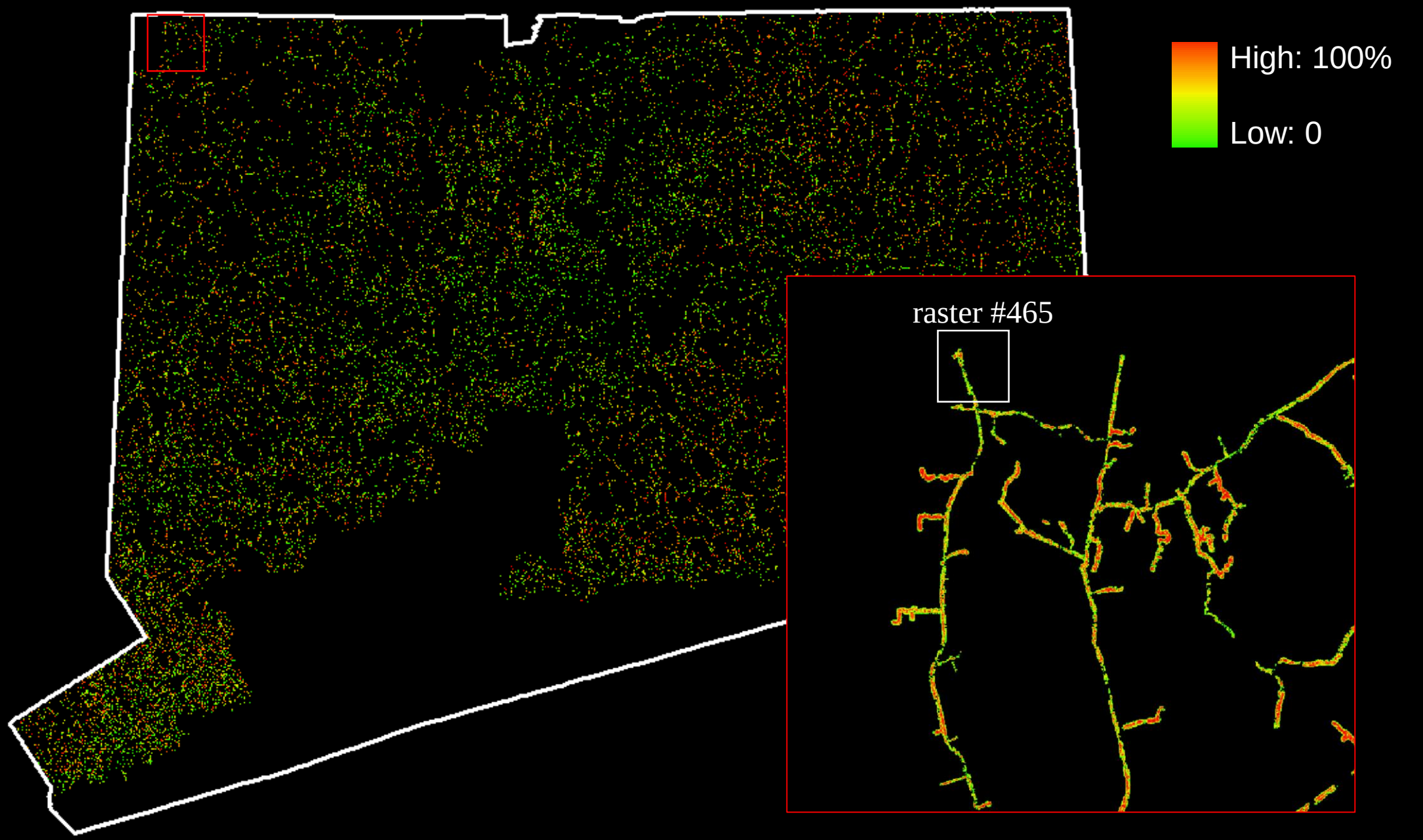
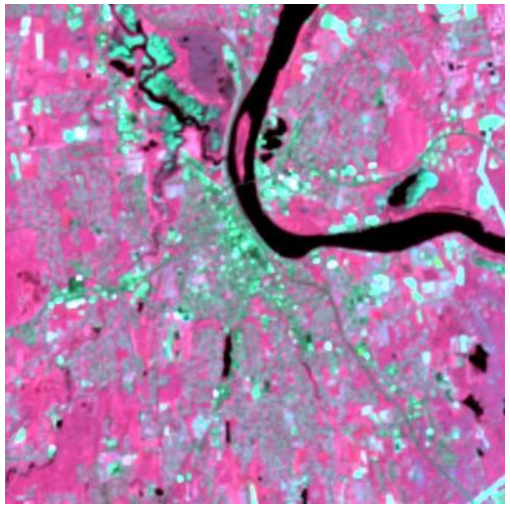


Figure 5-b. Sub-pixel map (a density map). Cell size: 10 m. Coordinate reference system (CRS): WGS 84 / UTM zone 18N.

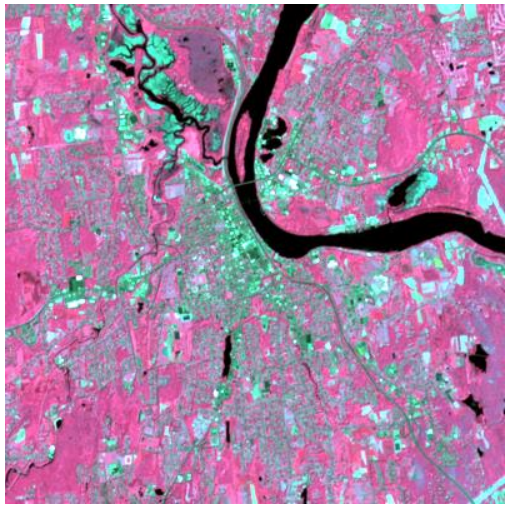

High: 100%
Low: 0
raster #465


2016
2017
2018
2019
2020

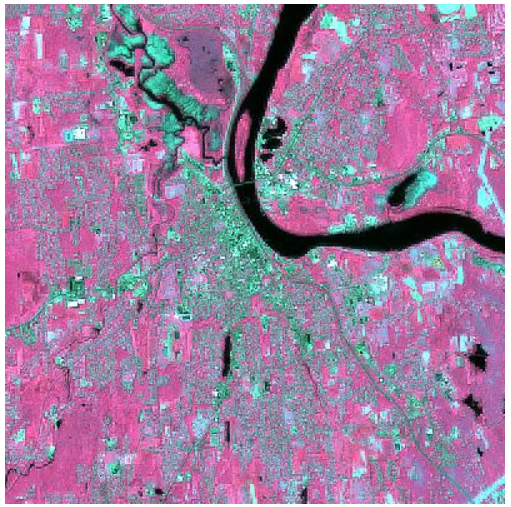
Super-resolution Methods



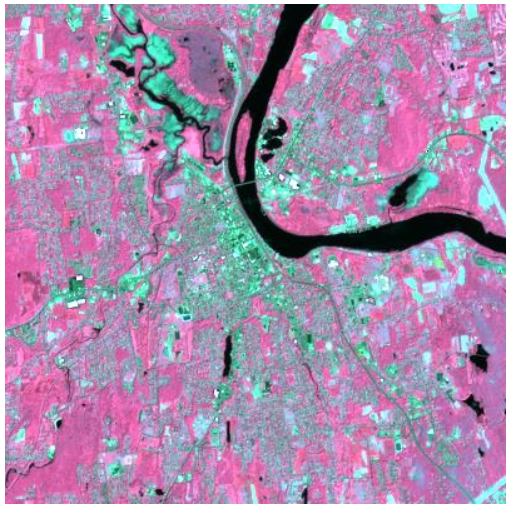
Baseline: Bicubic



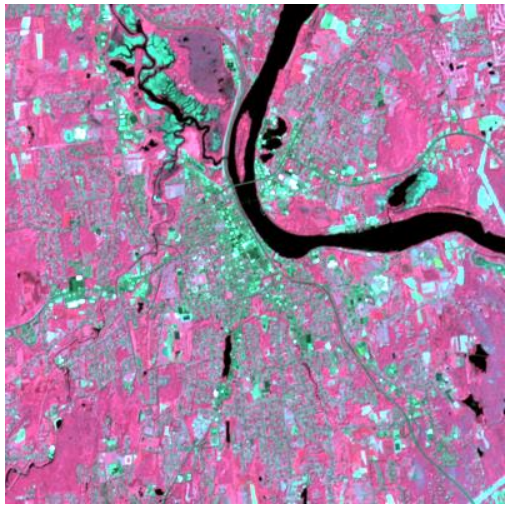
reference



Method 1: Luo



Method 2:
SpecTrans



Method 3:
DSen2

Summary of Effort

1. We have finished the **pre-process of Sentinel-2 images** (2015 – 2020) including atmospheric correction, cloud/cloud shadow masking, and BRDF correction.

2. The **10 m subpixel map** is generated by aggerating high-resolution tree proximity pixels.

3. A **preliminary 10 m ROW forest disturbance map** was produced from 10 m Visible-NIR bands and two resampled SWIR bands (cubic).

4. Three different **image super-resolution methods** was explored for red-edges, narrow NIR, and two SWIR bands. The best RMSEs for the test image are under 0.01.

On-going Work

1. Apply image super-resolution methods to Sentinel-2 time series.

2. Conduct accuracy assessment and write report on forest disturbance product

Project Timeline and Deliverables

Timeline	Deliverables
November 2020	- Sentinel-2 analysis ready data for CT
May 2021	- Maps of roadside and ROW forest disturbance in CT that are updated in near real-time - Reports on near real-time monitoring of roadside and ROW forest disturbance
November 2021	- Roadside and ROW forest disturbance location, time, and type reference data
May 2022	- Maps of roadside and ROW forest disturbance type that are updated in near real-time - Reports on near real-time characterization of roadside and ROW forest disturbance type
November 2022	- Risk prediction model based on forest disturbance magnitude and type.
May 2023	- Maps of quantified risks of roadside and ROW forest disturbance (of different types) to Eversource infrastructure in CT that are updated in near real-time - Reports on near real-time quantification of roadside and ROW forest disturbance (of different types) to Eversource infrastructure in CT

Thanks!
Questions?

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