Figure 1. View of the Marshall Fire. (Pelle, 2022) Reproduced here for educational purposes only.

Evaluating and Comparing Landsat8 OLI/TIRS and Landsat9 OLI/TIRS Satellites to Map Wildfire Burn Areas

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Raelyn Caldwell

GEOG 596A

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Advisor: Dr. Alan Taylor

Agenda

- → Introduction
- → Study Area
- → Problem Statement
- → Goals & Objectives
- → Expected Results
- → Proposed Methodology
- → Projected Timeline
- → Possible Presentation Venues

Introduction

Figure 2. Illustration of Landsat satellite. (NASA, n.d.) Reproduced here for educational purposes only.

- → Wildfires increasing in severity and occurrences.
- → Advances in remote sensing technology

Introduction

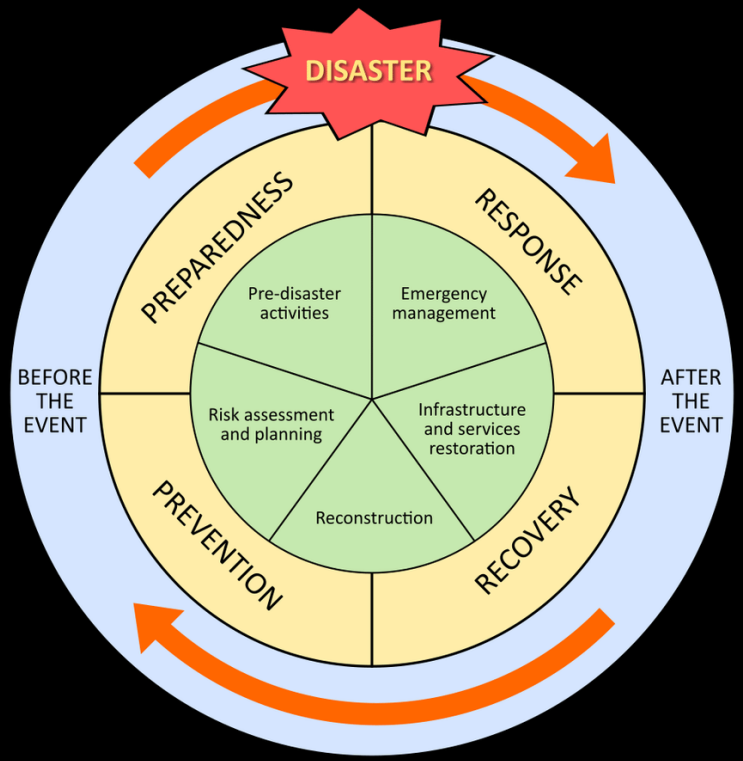


Figure 3. Disaster management cycle. (Natalizio, n.d.) Reproduced here for educational purposes only.

Introduction

Landsat8 OLI-2/TIRS-2

Landsat9 OLI-2/TIRS-2

Figure 4. Landsat program timeline. (NASA, 2020) Reproduced here for educational purposes only.

Introduction

→ Operational Land Imager 2 (OLI-2)

→ Thermal Infrared Sensor 2 (TIRS-2)

→ Landsat8 and Landsat9 launched from Vandenberg Air Force Base, California

→ 8-day revisit interval between the two

→ Increased radiometric resolution for Landsat9

Figure 5. NASA set to launch Landsat9 into orbit from the California coast. (NASA HQ PHOTO, 2021) Reproduced here for educational purposes only.

Problem Statement

→ Water surfaces and shadows in imagery can often be confused with burned areas due to their similar spectral properties, affecting the accuracy of burnt area estimates derived from remotely sensed data. (Pereira et. al., 1999)

Study Area

Marshall Fire

→ 12/30/2021 – 01/01/2022

→ 6,026 acres burned

→ Over 1,000 structures destroyed

→ Millions of dollars in losses

→ 35,000 people displaced

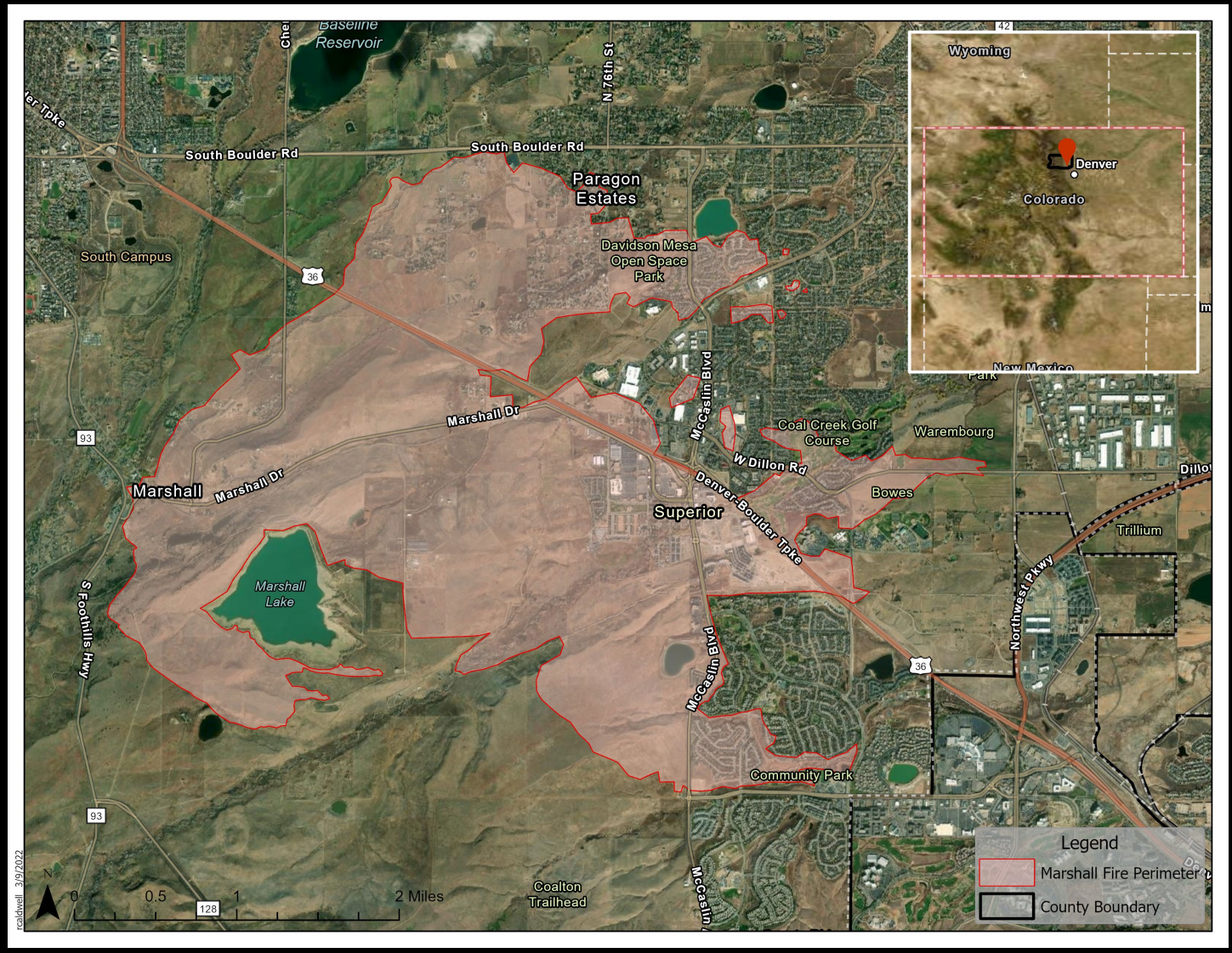


Figure 6. Marshall Fire perimeter, Boulder County, Colorado. Fire perimeter shape acquired from Boulder County GIS Department. (BoulderCounty Admin, 2022)

Study Area

Boulder County, Colorado

Demographics *(U.S. Census Bureau, 2020)*

→ Population: 330,758

→ Housing units: 140,551

Study Area

Boulder County, Colorado

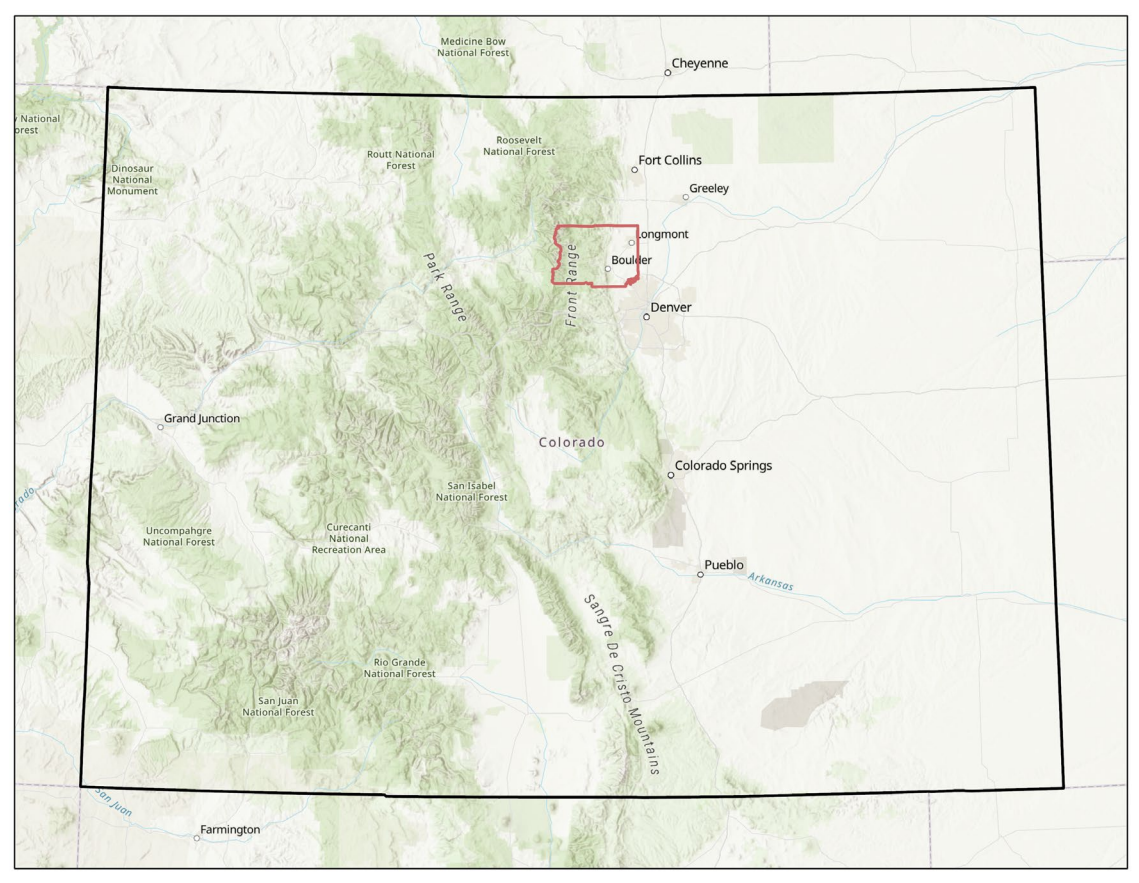


Figure 7. Boulder County location map. Colorado state boundary acquired from the Colorado Dept. of Public Health & Environment. (CDPHE Open Data, 2018) Boulder county boundary acquired from the Boulder County GIS Dept. (BoulderCounty Admin, 2020)

→ 25 miles northwest of Colorado state capitol, Denver

→ 740 square miles

→ Diverse geography

Goals & Objectives

The goal of this study is to evaluate and compare the accuracy of burn scar detection and burn area mapping between imagery and spectral data acquired from Landsat8 OLI-2/TIRS-2 and Landsat9 OLI-2/TIRS-2 satellites, using the Marshall Fire burn area as a case study.

Goals & Objectives

1. To define spectral profiles for landcover and use types within the Marshall Fire project area from Landsat8 and Landsat9 imagery.
2. To identify and compare burn scars detected in Landsat8 and Landsat9 imagery using band combinations.
3. To classify the Landsat8 and Landsat9 imagery using supervised pixel-based methods.
4. To assess the accuracy of classification results to identify burn areas.

Expected Results

Increased radiometric resolution on Landsat9 will result in more accurate burn area detection and mapping.

Proposed Methodology

1. Define the study area
2. Collect and preprocess imagery
3. Create spectral profile interpretation keys
4. Identify burn scars using band combinations
5. Perform supervised pixel-based classification
6. Perform accuracy assessment
7. Analyze and discuss results

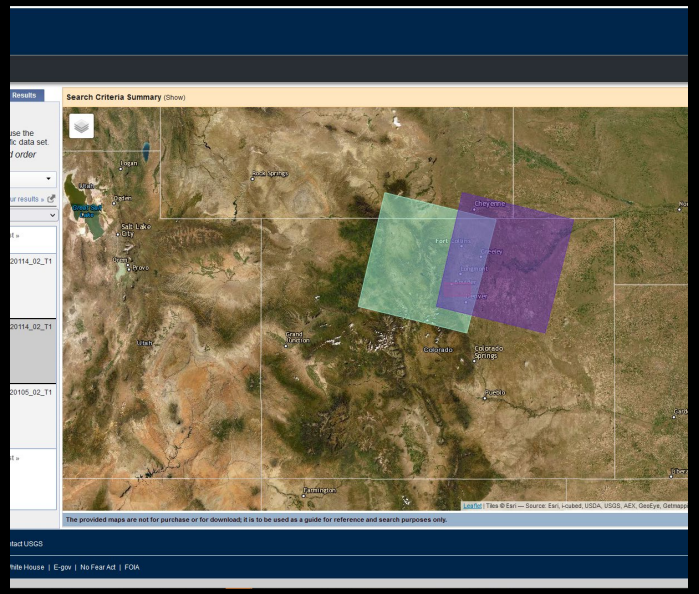
Proposed Methodology

1. Define the study area

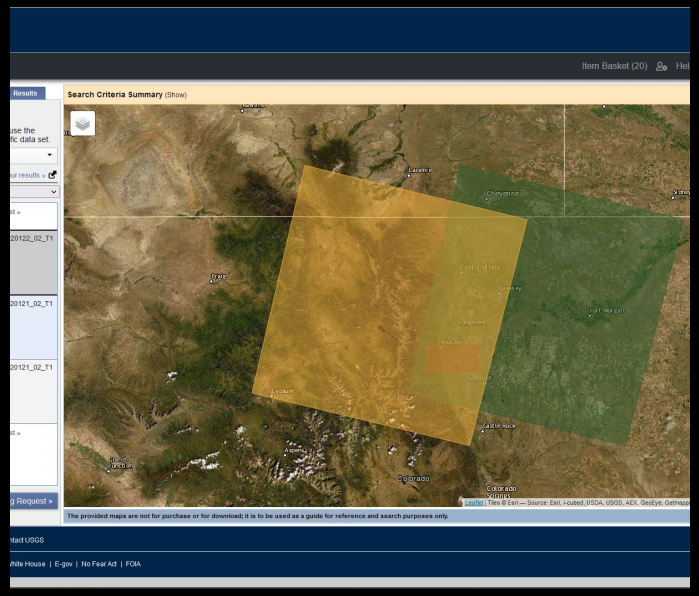
The Marshall Fire study area is ideal to test the ability of the new Landsat9 satellite to detect subtle differences in spectral properties across various land cover and land use types.

Proposed Methodology

Landsat8 Scene Footprint



Landsat9 Scene Footprint



2. Collect and Preprocess Imagery

- → USGS EarthExplorer
- → Free

Figure 8. (top) & Figure 9. (bottom). Landsat8 and Landsat9 scene footprints overlayed on Marshall Fire study area.

Proposed Methodology

3. Create spectral profile interpretation keys of land cover & use classifications

- Buildings
- Water
- Trees
- Grass
- Pavement
- Roads
- Shadows

Object	Red	Blue	Green	NIR	NDVI	Homogeneity	Contrast
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Figure 10. Example of spectral profile interpretation key.

Proposed Methodology

4. Identify burn scars using band combinations and burn indices

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

Figure 11. NBR formula.

- Normalized Burn Ratio (NBR)
- difference Normalized Burn Ratio (dNBR)

Proposed Methodology

5. Perform supervised pixel-based classification to map burn area

Classification using the Maximum Likelihood Classification algorithm

Proposed Methodology

6. Perform accuracy assessment

ClassValue	Burned	Unburned	Total	User's Accuracy
Burned	**54**	9	63	**0.86**
Unburned	6	**31**	37	**0.84**
Total	60	40	100	
Producer's Accuracy	**0.9**	**0.78**		

Overall Accuracy 0.68

Figure 12. Example of error matrix created as part of an accuracy assessment.

Proposed Methodology

7. Analyze and discuss results; identify limitations

Projected Timeline

Project Start: 04/01/2022

Project Close-Out: 07/15/2022

Project Duration: 3 months, 2 weeks

→ Image data collection and preprocessing: **1 week**

→ Create spectral profiles: **1 week**

→ Identify burn scars using band composite: **1 week**

→ Supervised classification: **1 week**

→ Accuracy Assessment: **1 week**

→ Analyze results: **2 weeks**

→ Create graphics, map exhibits, tables, charts, etc.: **1 week**

→ Analysis report: **1 month**

→ Presentation: **2 weeks**

Possible Presentation Venues

- → 2022 ESRI User Conference
  - → July 2022
  - → San Diego, California
- → Regional GIS or Remote Sensing User Group
- → Regional Fire or Emergency Management Group

Thank you!

Questions?

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