Building Capacity to Use Earth Observations in Addressing Environmental Challenges in Bhutan

Day 2 – Monitoring Post-Fire Conditions

Objectives

By the end of this presentation, you will be able to:

- Recognize post-fire impacts
- Demonstration in GEE:
  - Create post-fire burn severity maps from satellite imagery
  - Calculate burned area using satellite imagery

Outline

- Post-Fire Impacts
- Data Products Relevant for Assessing Post-Fire Impacts
- Demonstration:
  - Create a Burn Severity Map and Calculate Burned Area
  - Case Study: April 8-16, 2023 Fires in Mongar District of Bhutan

Post-Fire Impacts

Post-Fire Impacts

- Fires have long-lasting impacts to the surrounding environment, human lives, and infrastructure.
- Some of the major post-fire impacts on the environment include:
  - Release of carbon dioxide and soot particles in the atmosphere, thereby influencing climate
  - Change in soil chemistry and reduction in soil fertility
  - Destruction of vegetation, leading to increased runoff and soil erosion
  - Influence on nutrient cycling and flow
  - Destruction of ecosystems and wildlife

http://www.geog.leeds.ac.uk/courses/level3/geog3320/studentwork/groupd/positiveandnegative.html

Burn Severity

- Burn Severity: The effect of a fire on ecosystem properties, often defined by the degree of mortality of vegetation.
- Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time

Example of high severity burned area. Image Credit: USDA Forest Service Gen. Tech. Rep. RMRS-GTR-243. 2010

Soil Burn Severity

- **Soil Burn Severity:** The fire-induced changes in physical, chemical, and biological **soil properties** that impact hydrological and biological soil functions.

Image Credit: Stefan Doerr

Low

Moderate

High

Image Credit: co-co.org

Effects of Fire on Land Surface

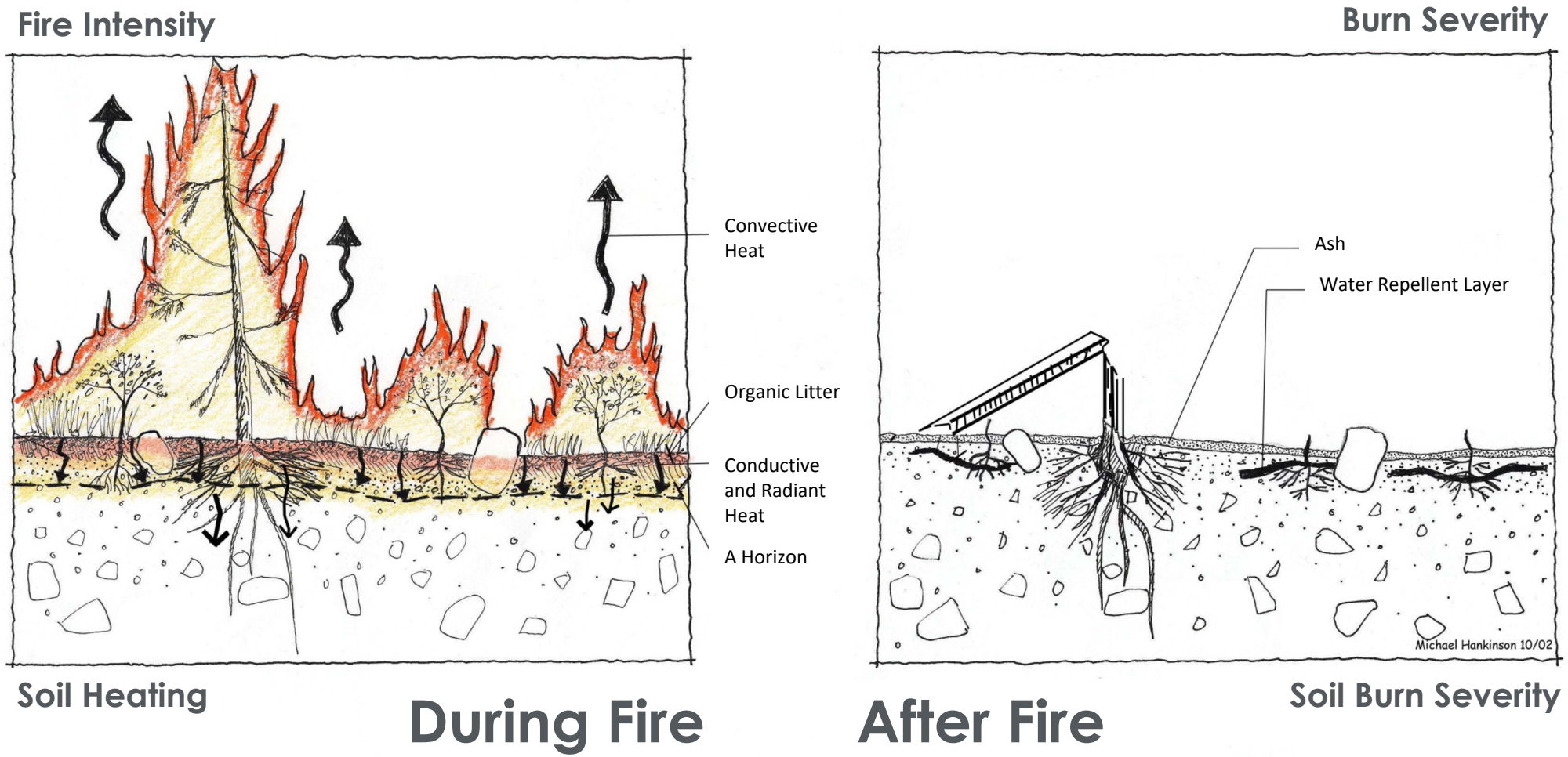
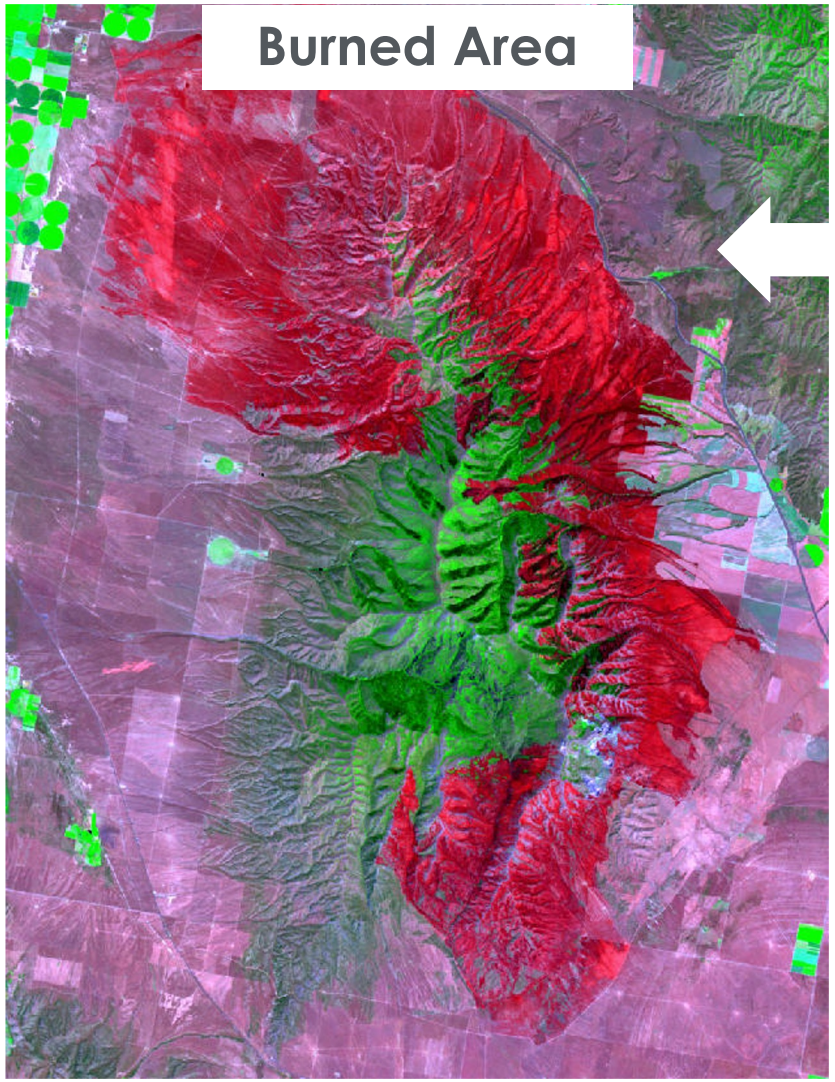
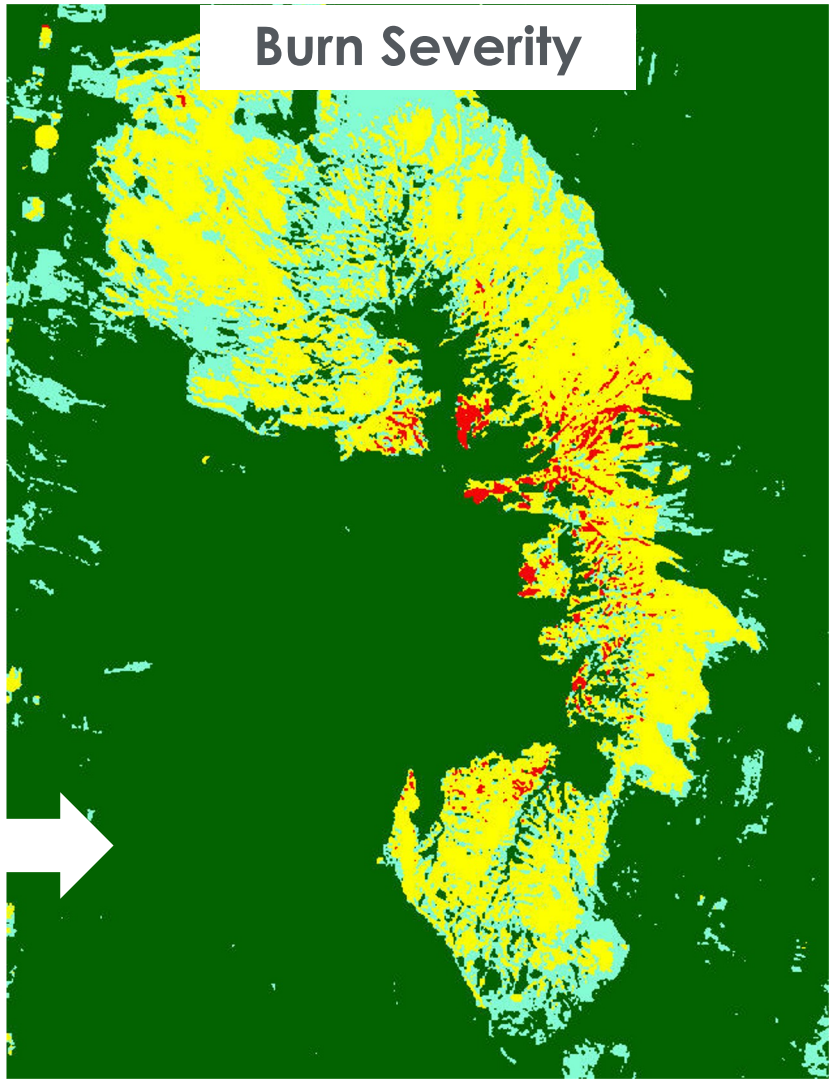


Image Credit: USDA Forest Service Gen. Tech. Rep. RMRS-GTR-243. 2010

Remote Sensing Perspective: Burned Area and Burn Severity

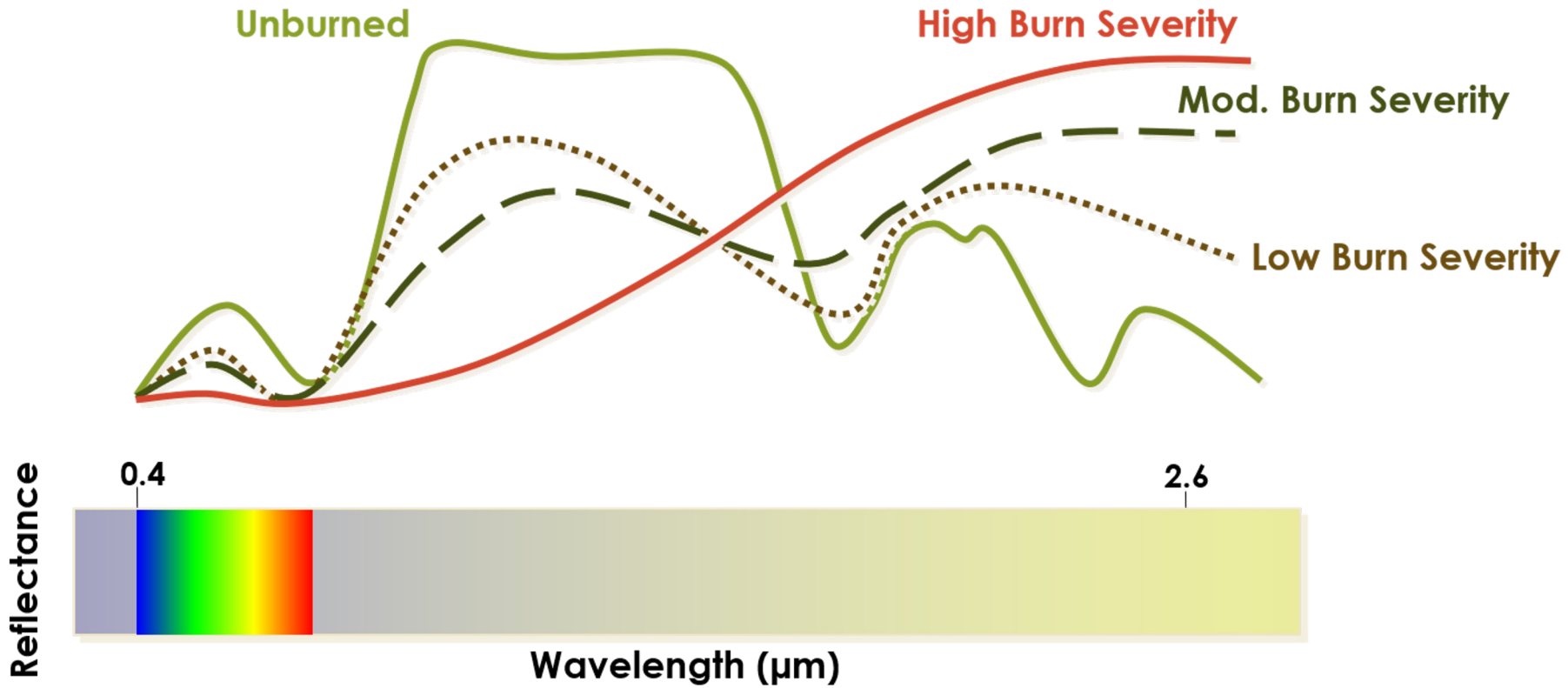


- Burned area uses imagery to assess the extent of impacts on vegetation for a particular fire event.
- Burn severity compares burned area information to pre-fire imagery to assess relative magnitude of burn impacts.



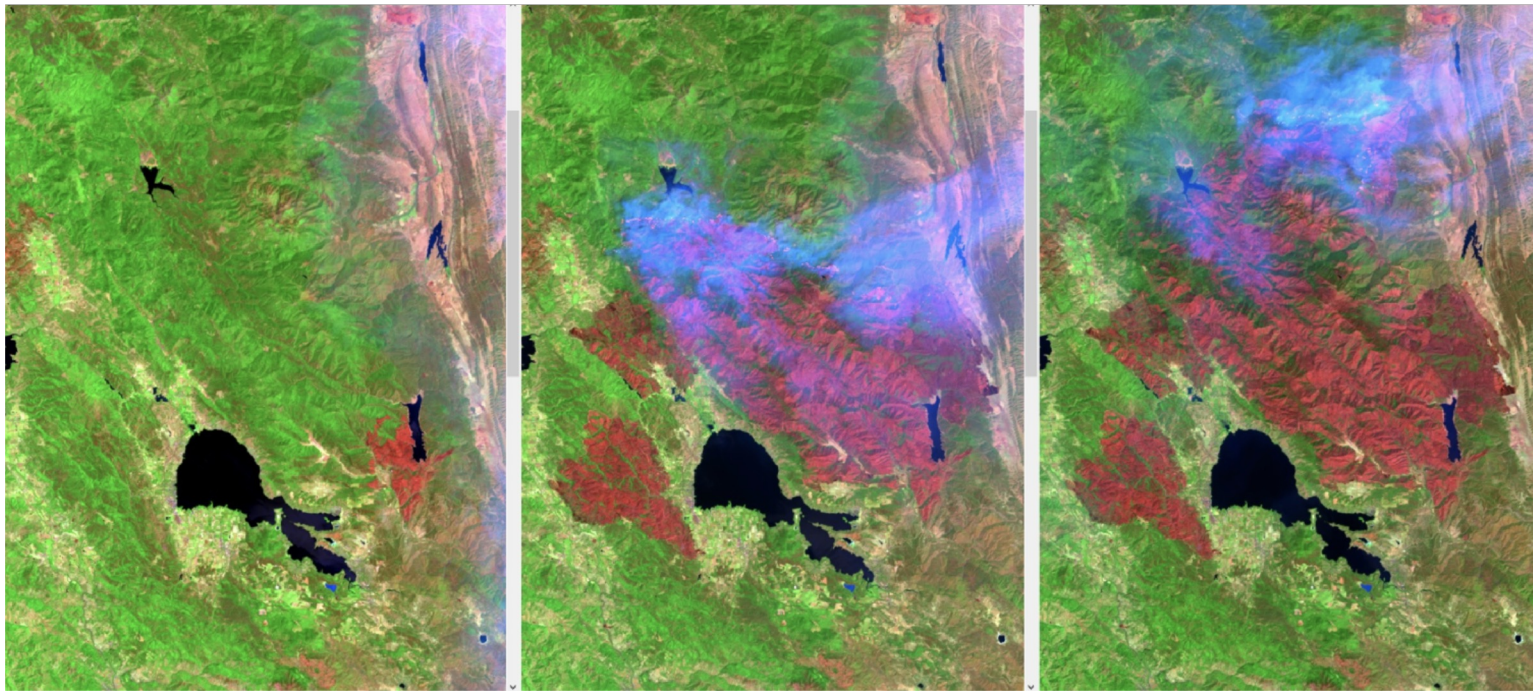
Healthy Vegetation vs. Burned Areas

Exploiting Spectral Response Curves



Burned Area: Normalized Burn Ratio (NBR)

- Used to identify burned areas
- Compare pre- and post-burn to identify burn extent and severity



July 26 Aug 11 Aug 27

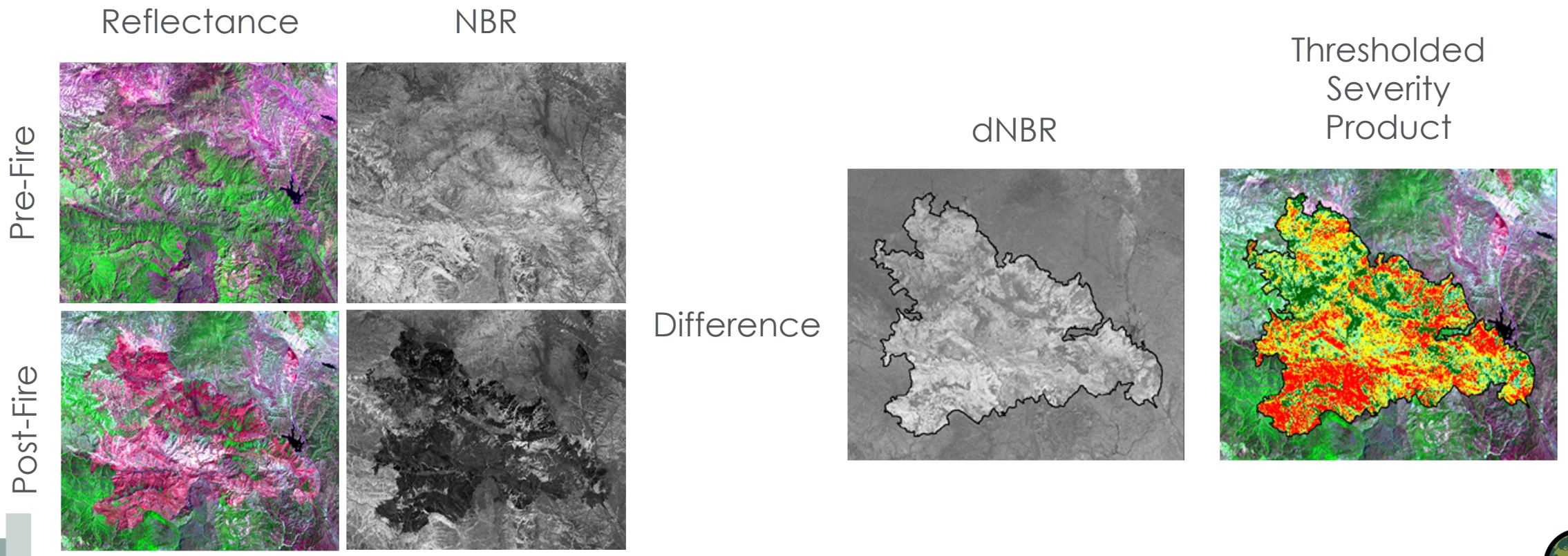
Mendocino Complex Fires, 2018

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

Burn Severity: Differenced Normalized Burn Ratio (dNBR)

- **Normalized Burn Ratio (NBR)**
- Establishes extent of burned area before and after fire event

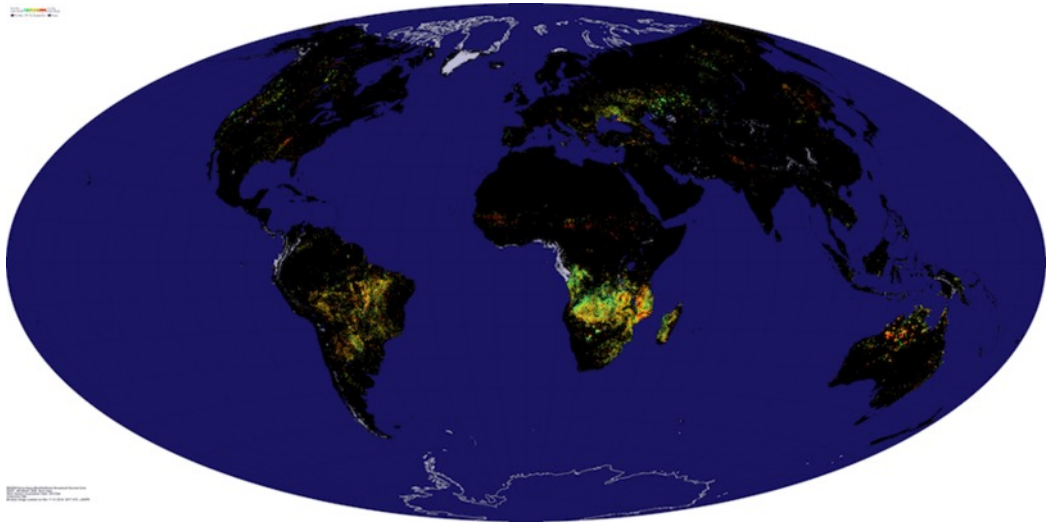
- **Differenced Normalized Burn Ratio (dNBR)**
- Provides a comparison of pre- and post-fire conditions to determine severity
- dNBR = Pre-Fire NBR – Post-Fire NBR



Burned Area from MODIS

MCD64A1 Burned Area Product

- The Terra and Aqua Combined MCD64A1 Version 6.1 Burned Area Data Product
- Monthly, global, gridded, 500m product containing per-pixel burned-area and quality information.
- MODIS Burned Area Product User's Guide
- MCD64A1.061 product access through GEE



Demonstration:

Create Post-Fire Burn Severity Map and Calculate Burned Area

Fires of April 2023 In GEE

For this exercise we will:

1. Select the study area
2. Select the date range
3. Select the satellite platform (Landsat 8)
4. Identify what the user selected in steps 1–3
5. Apply a cloud mask and a snow mask
6. Mosaic and clip images to the study area
7. Calculate the NBR for the pre- and post-fire images
8. Calculate the dNBR
9. Add all the image layers to the map
10. Calculate burned area
11. Add a legend to the map
12. Export the dNBR image
13. Export the burned area statistics as a .csv