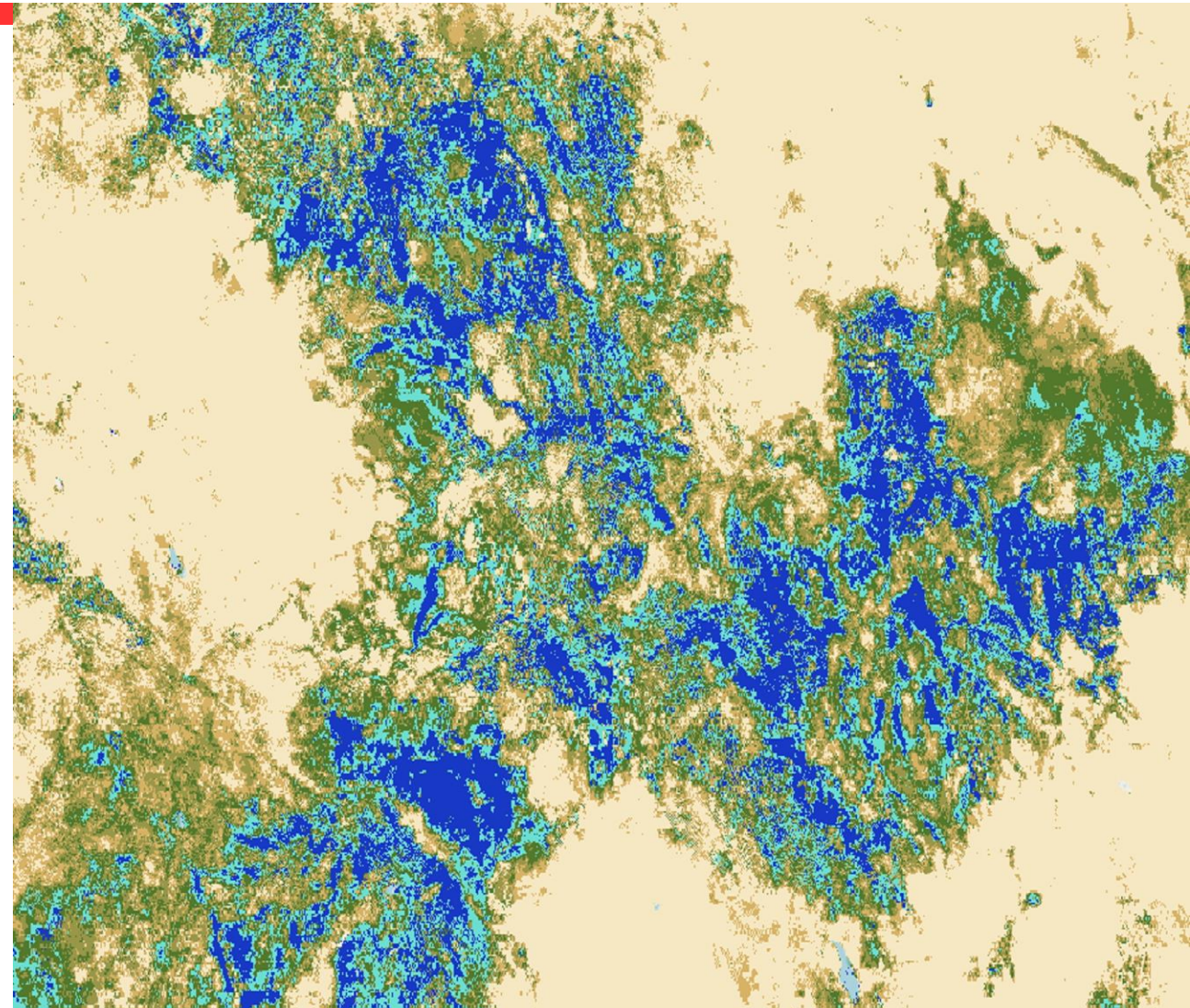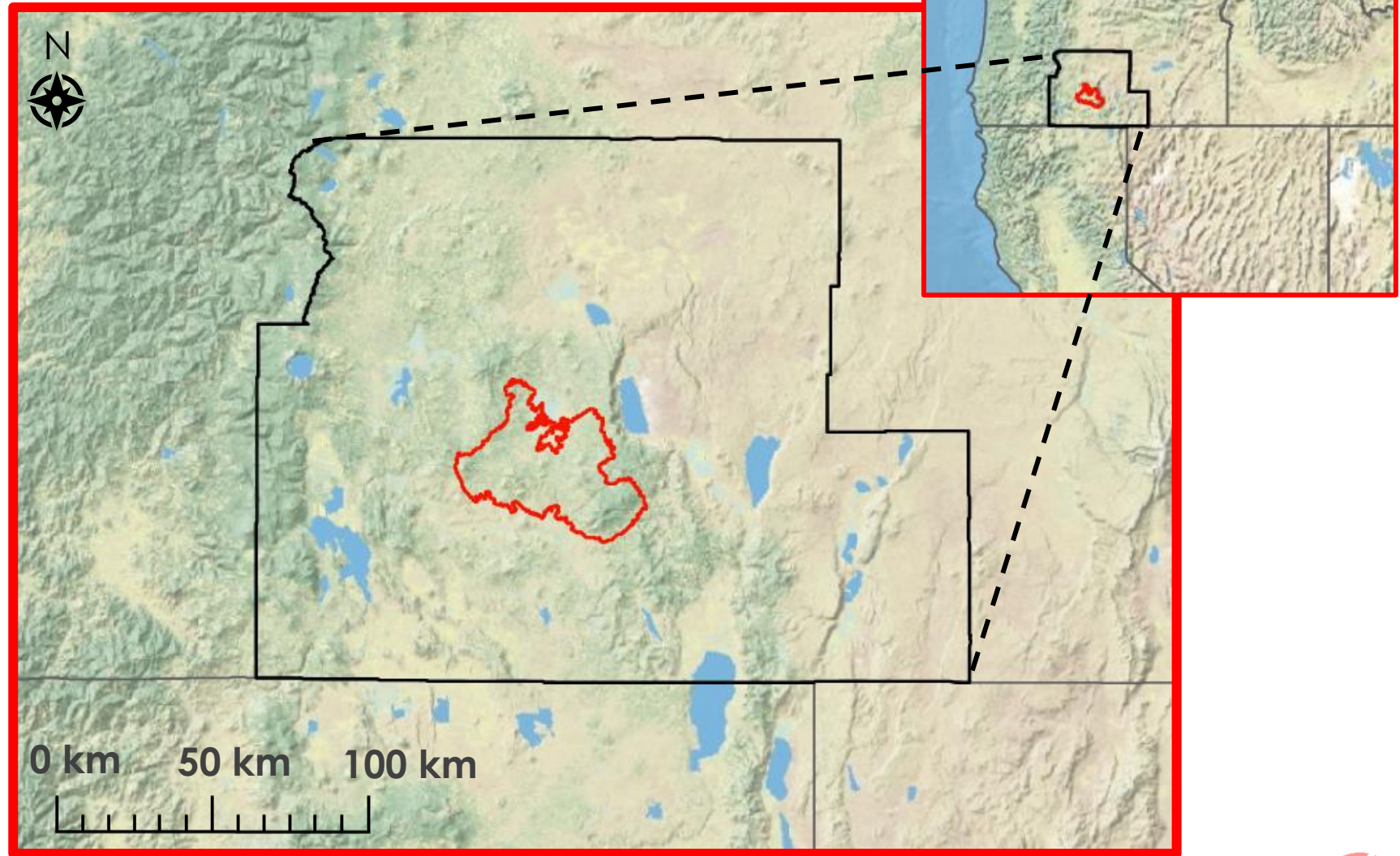# OREGON
Wildfires

Integrating ECOSTRESS to Map &
Analyze Vegetation Moisture for Wildfire Modeling

Brenna Hatch
Kenya Creer
Jennifer Sobolewski
Nicole Roberts

Study Area

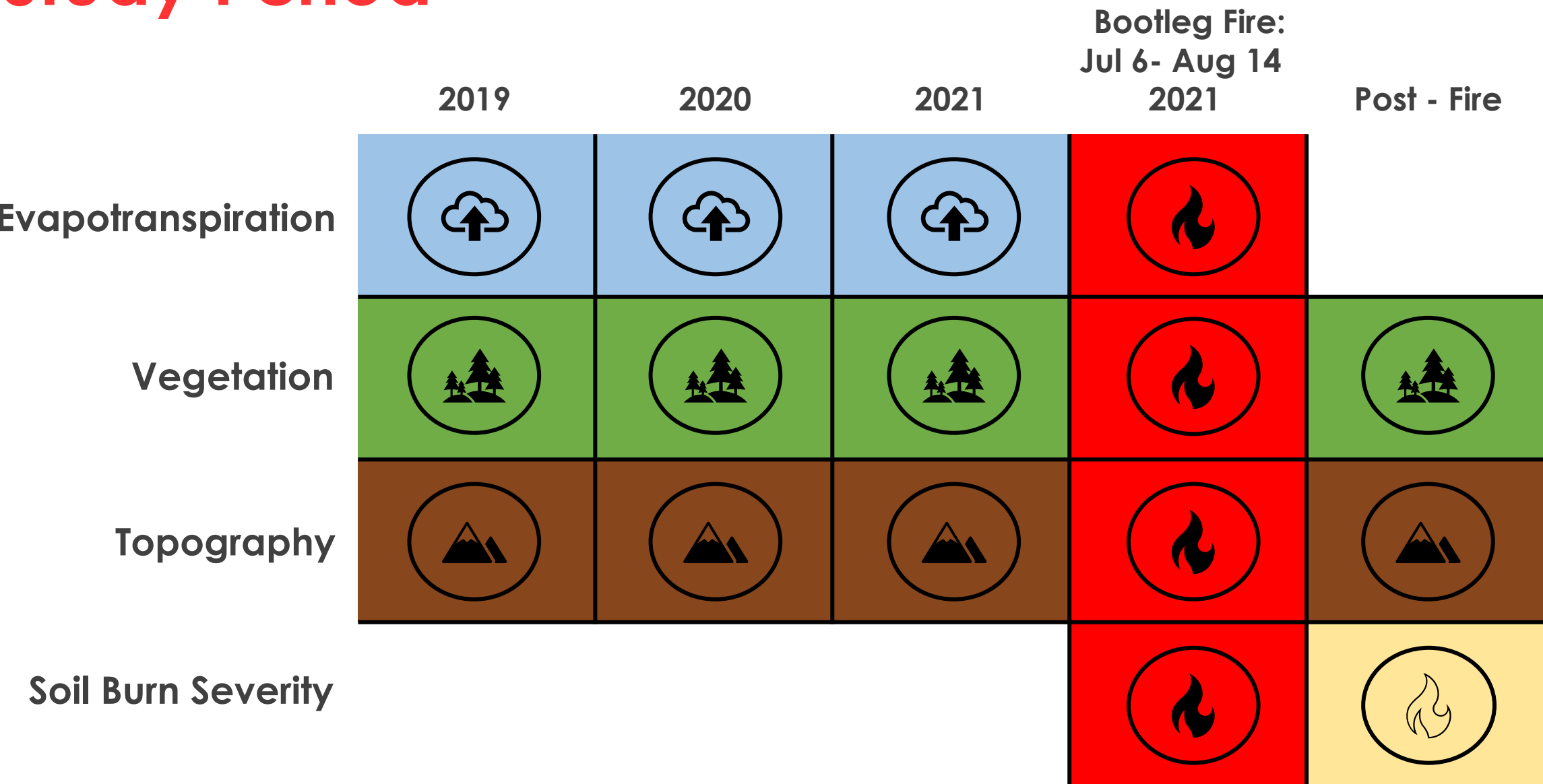Klamath & Lake Counties in Southern Oregon

Bootleg Fire Heat Perimeter

0 km   50 km   100 km

Base map: Esri, USGS | Esri, HERE, Garmin, FAO, NOAA, USGS, EPA

Study Period

Project Partners

Pacific Northwest National Laboratory (PNNL)

Community Concerns

Wildfire activity across the western US has increased in the past 50 years

Increased fire activity and a growing urban-wildland interface may lead to:

▶ Larger fires

▶ Longer fire season

▶ More severe burn areas

▶ Increased economic and health impacts

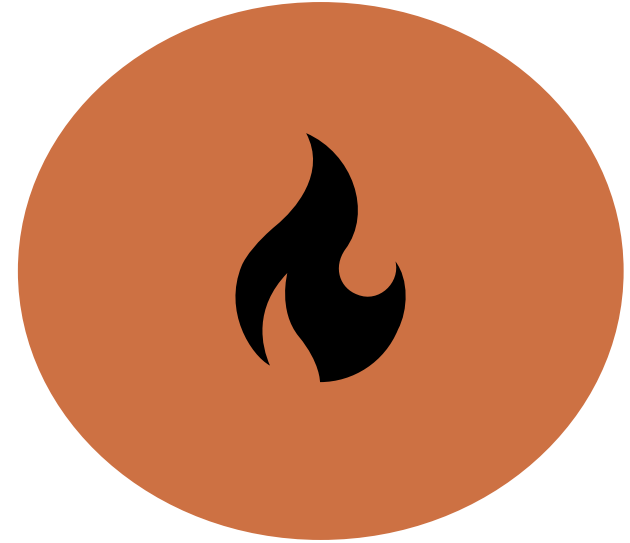Image Credit: National Interagency Fire Center

Objectives
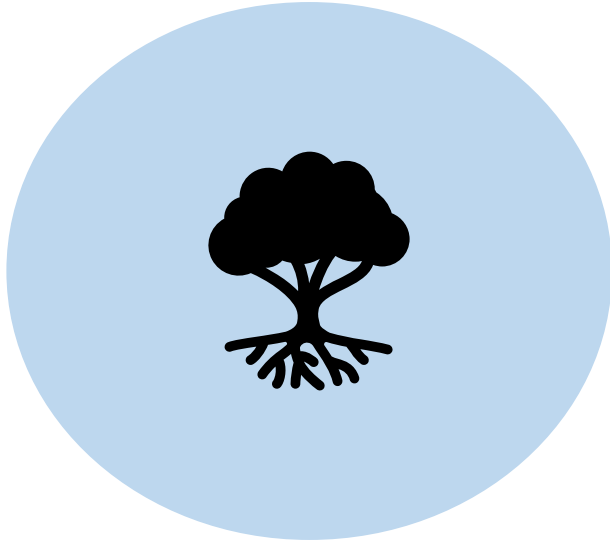
Produce pre-fire vegetation moisture maps of the Bootleg Fire

Identify vegetation type and topographical characteristics of the Bootleg Fire

Determine the feasibility of incorporating pre-fire ET dataset in future wildfire modeling

Datasets

Space Shuttle Endeavour

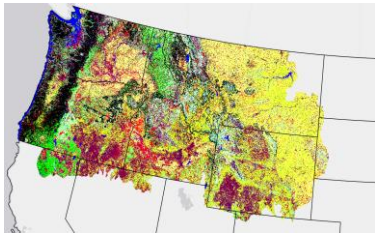Shuttle Radar Topography Missions (SRTM)

Topography

International Space Station

ECOsystem Spaceborne Thermal Radiometer Experiment (ECOSTRESS)

Evapotranspiration

National Land Cover Database (NLCD) & LANDFIRE (LF)

NLCD

LF Existing Vegetation Type (EVT)

Vegetation

Burned Area Emergency Response

Soil Burn Severity

Image Credit: USGS NLCD, LANDFIRE, NASA, USDA BAER

Methods: Vegetation Moisture Analysis

Methodology – Vegetation Moisture Maps

ECOSTRESS Evapotranspiration Median Seasonal Summer Composite
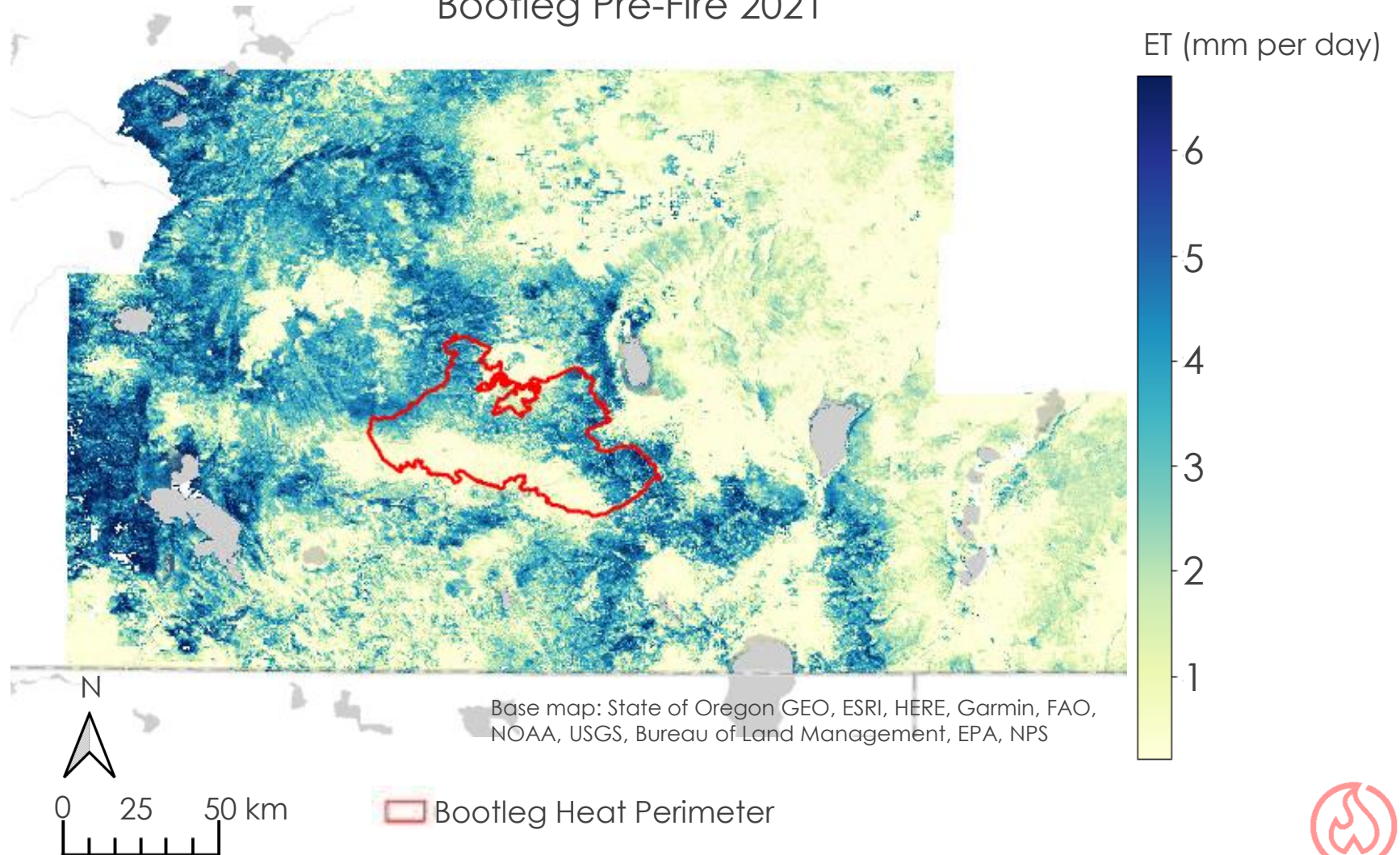Bootleg Pre-Fire 2021

Data Acquisition:
Daily ET

Data Processing:
Filtered daily ET
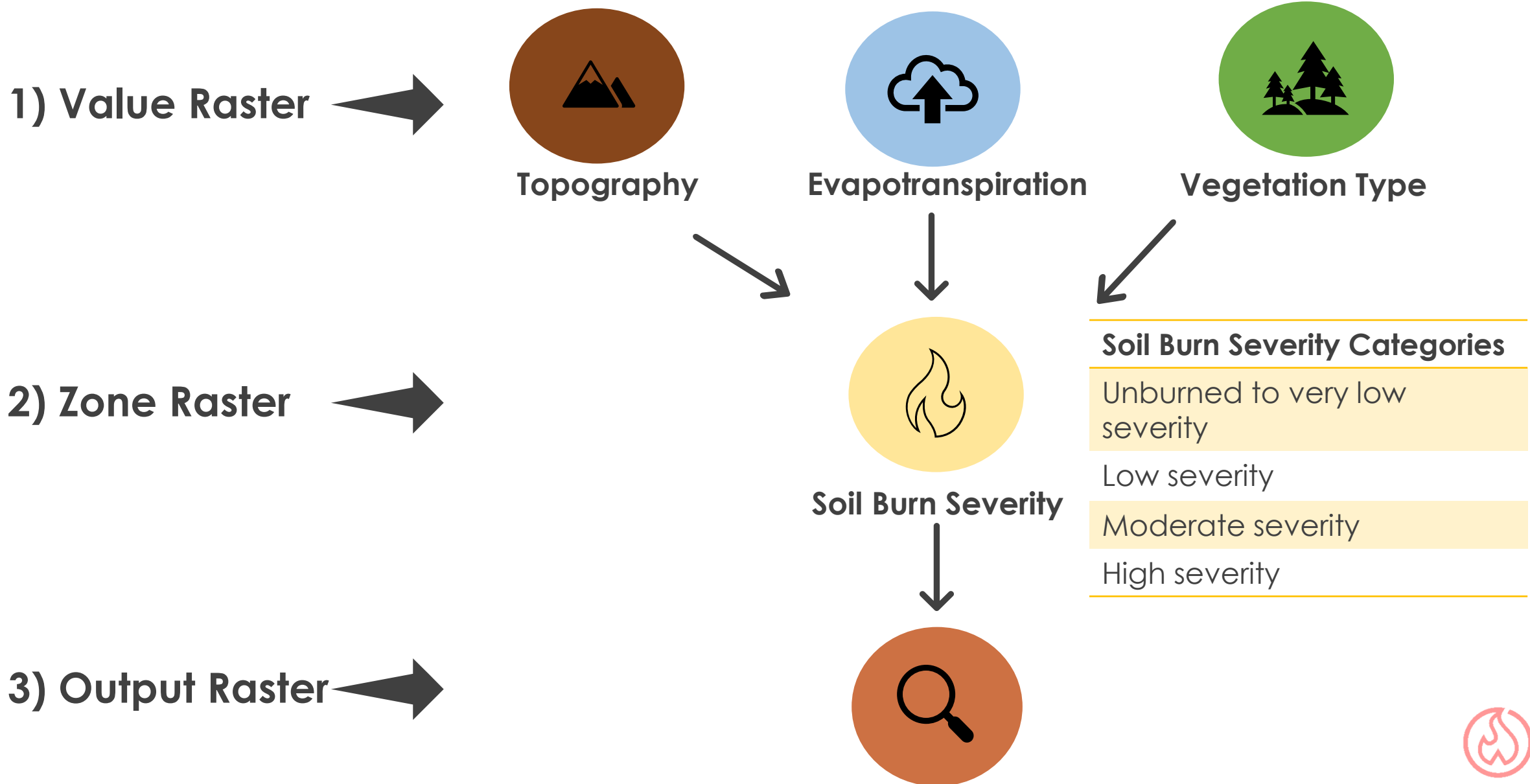to create a median
seasonal summer
composite 2019-2021

Data Analysis:
Calculating
timeseries, differences and
percent change

ET (mm per day)

6

5

4

3

2

1

N

0   25   50 km

Base map: State of Oregon GEO, ESRI, HERE, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS

☐ Bootleg Heat Perimeter

Methods: Zonal Statistics

Methodology – Soil Burn Severity Zonal Statistics

1) Value Raster →

Topography

Evapotranspiration

Vegetation Type

2) Zone Raster →

Soil Burn Severity

Soil Burn Severity Categories
Unburned to very low severity
Low severity
Moderate severity
High severity

3) Output Raster →

Methodology – Vegetation & Topography

Data Acquisition:
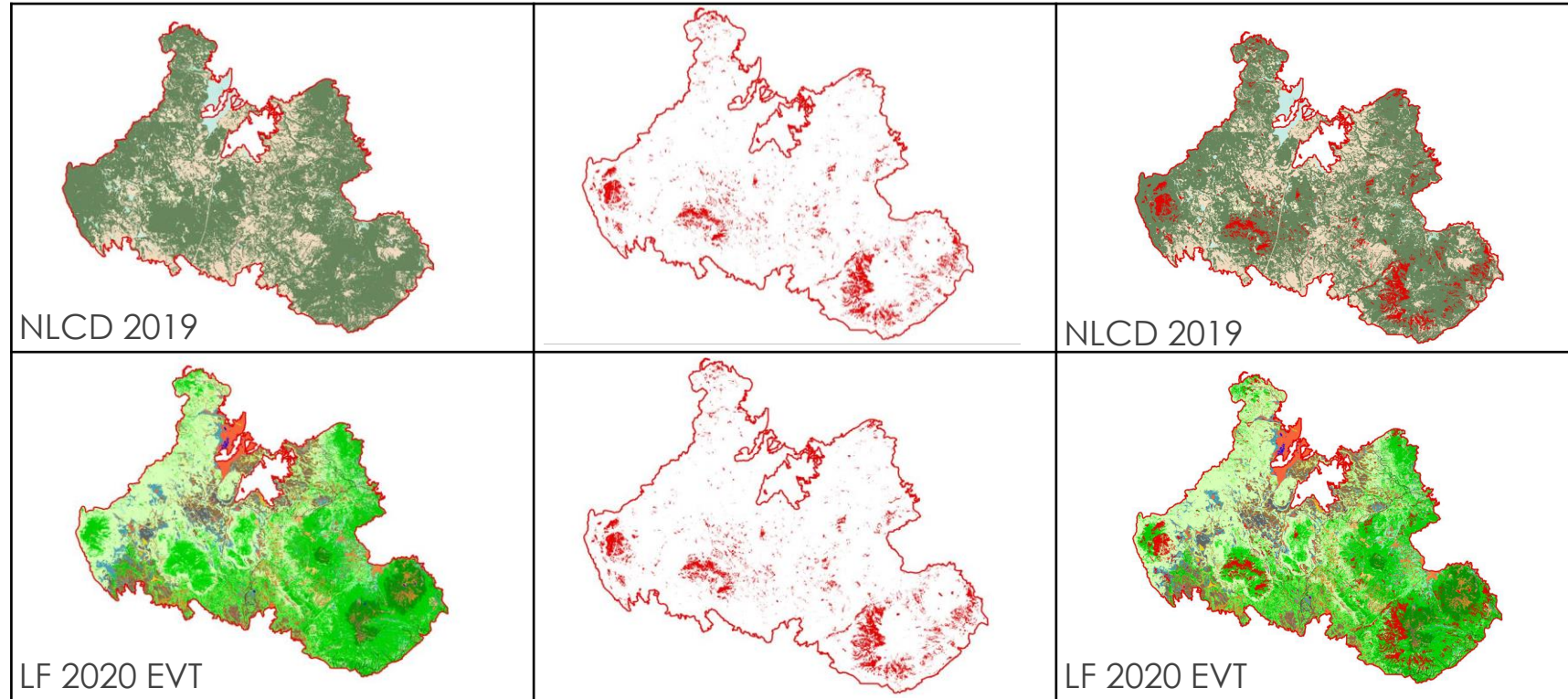NLCD 2019 (CONUS), Landfire 2020 & SRTM

Data Processing:
Geoprocessing and Spatial Analyst Tools

Data Analysis:
Land cover and existing vegetation type in high soil burn severity areas

NLCD 2019

NLCD 2019
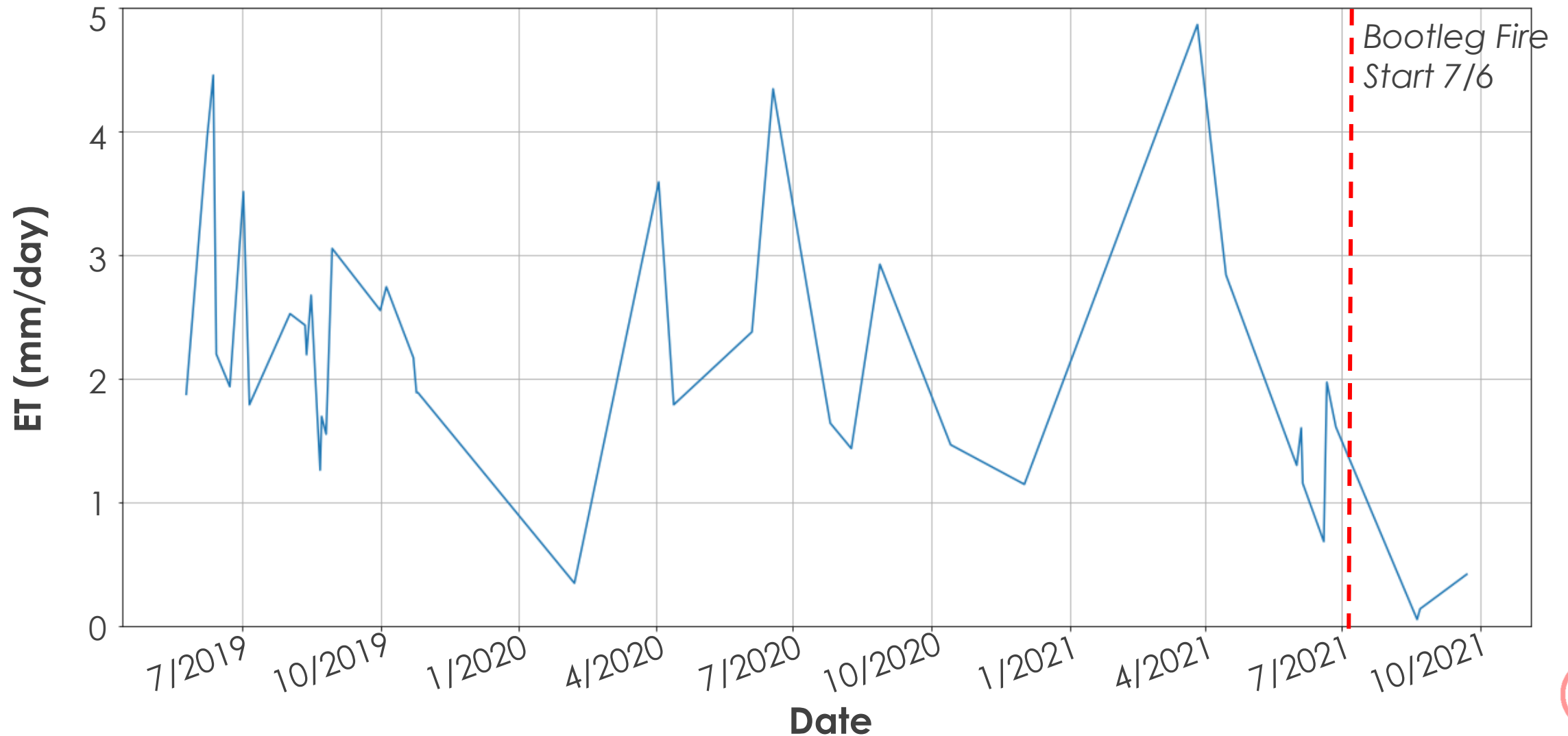
LF 2020 EVT

LF 2020 EVT

N

High Soil Burn Severity (HSBS) Layer

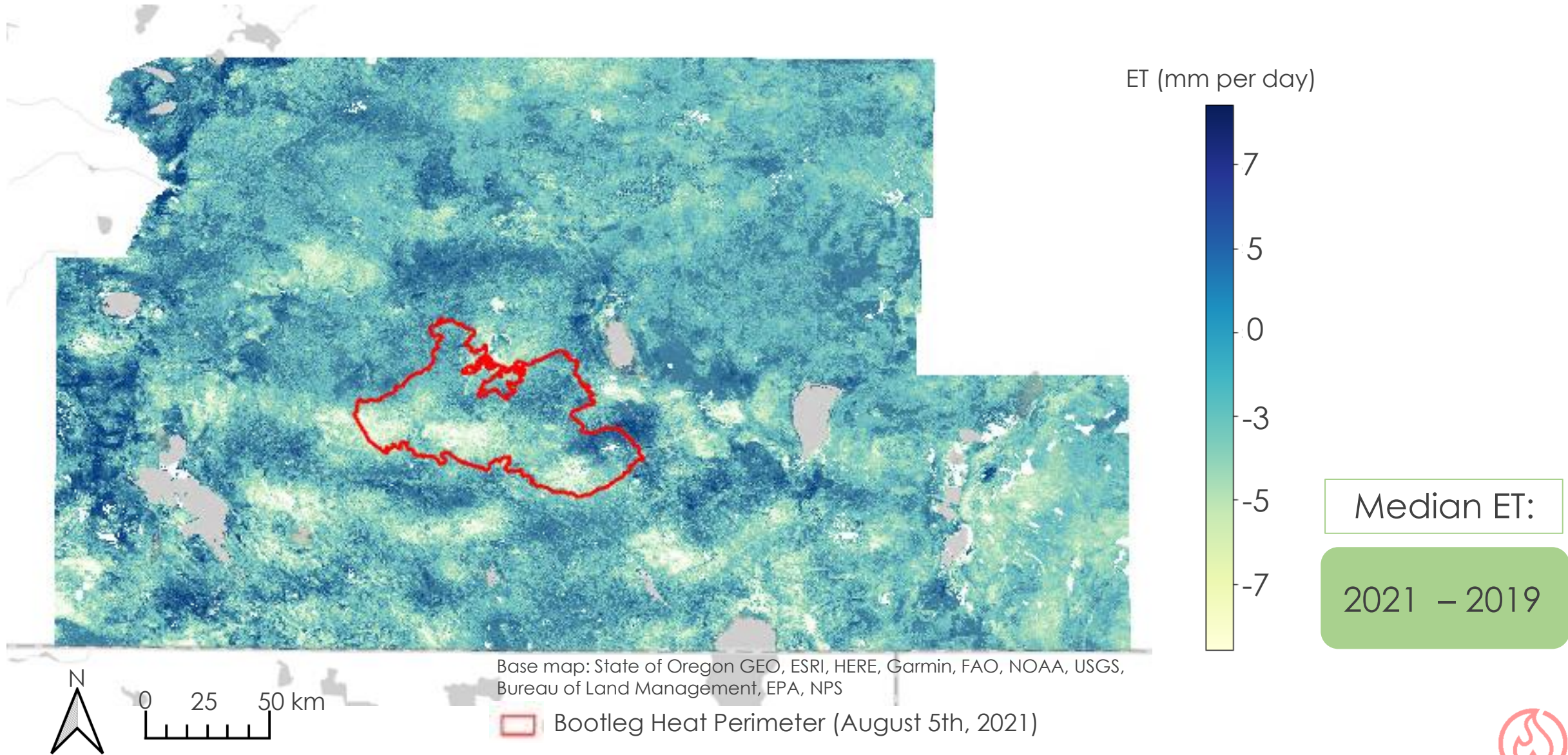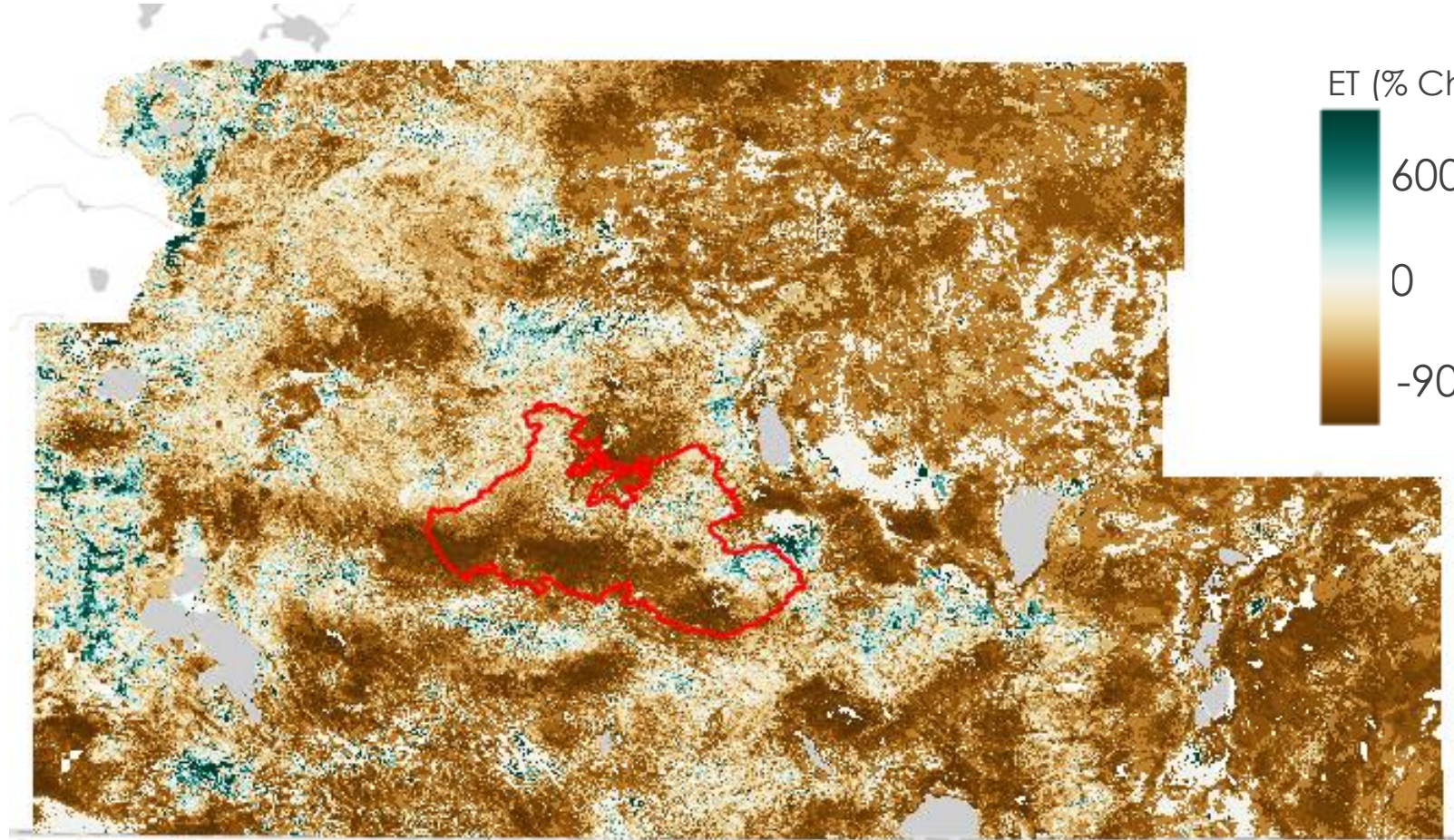# Results: Vegetation Moisture Analysis

ECOSTRESS ET: Time Series

Average Daily ET for the Bootleg Fire Area

ECOSTRESS ET 2021 & 2019: Difference

ECOSTRESS ET 2021 & 2019: Percent Change

ET (% Change)

600

0

-90

Median ET:

$$\frac{2021 \ - 2019}{2019} \ \times \ 100$$

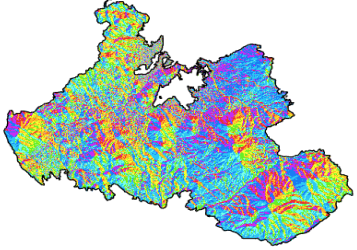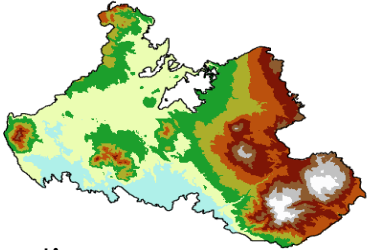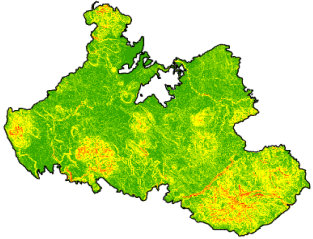Base map: State of Oregon GEO, ESRI, HERE, Garmin, FAO, NOAA, USGS, Bureau of Land Management, EPA, NPS

Bootleg Heat Perimeter (August 5th, 2021)

N

0   25   50 km

Results: Zonal Statistics

Topography Zonal Statistics

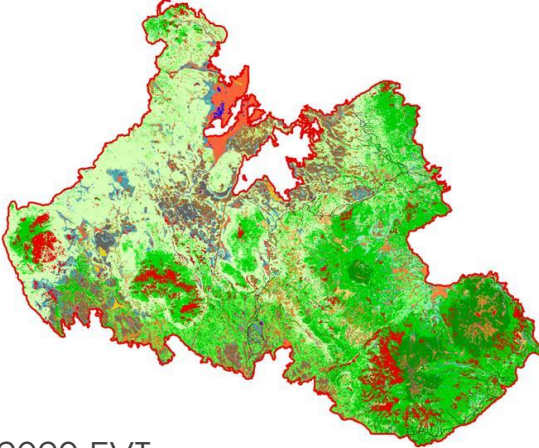|	
 Aspect	• Northwestern-facing slopes dominate the HSBS area. • Southwestern-facing slopes dominate the unburned areas.
 Elevation	• The average elevation within the HSBS class is 1800.5 m. • In unburned areas, the average elevation of 1645.5 m.
 Slope	• In areas with HSBS, slopes gradients predominantly range between 15 – 30%. • Unburned areas occur in flat areas.

Vegetation Type Zonal Statistics

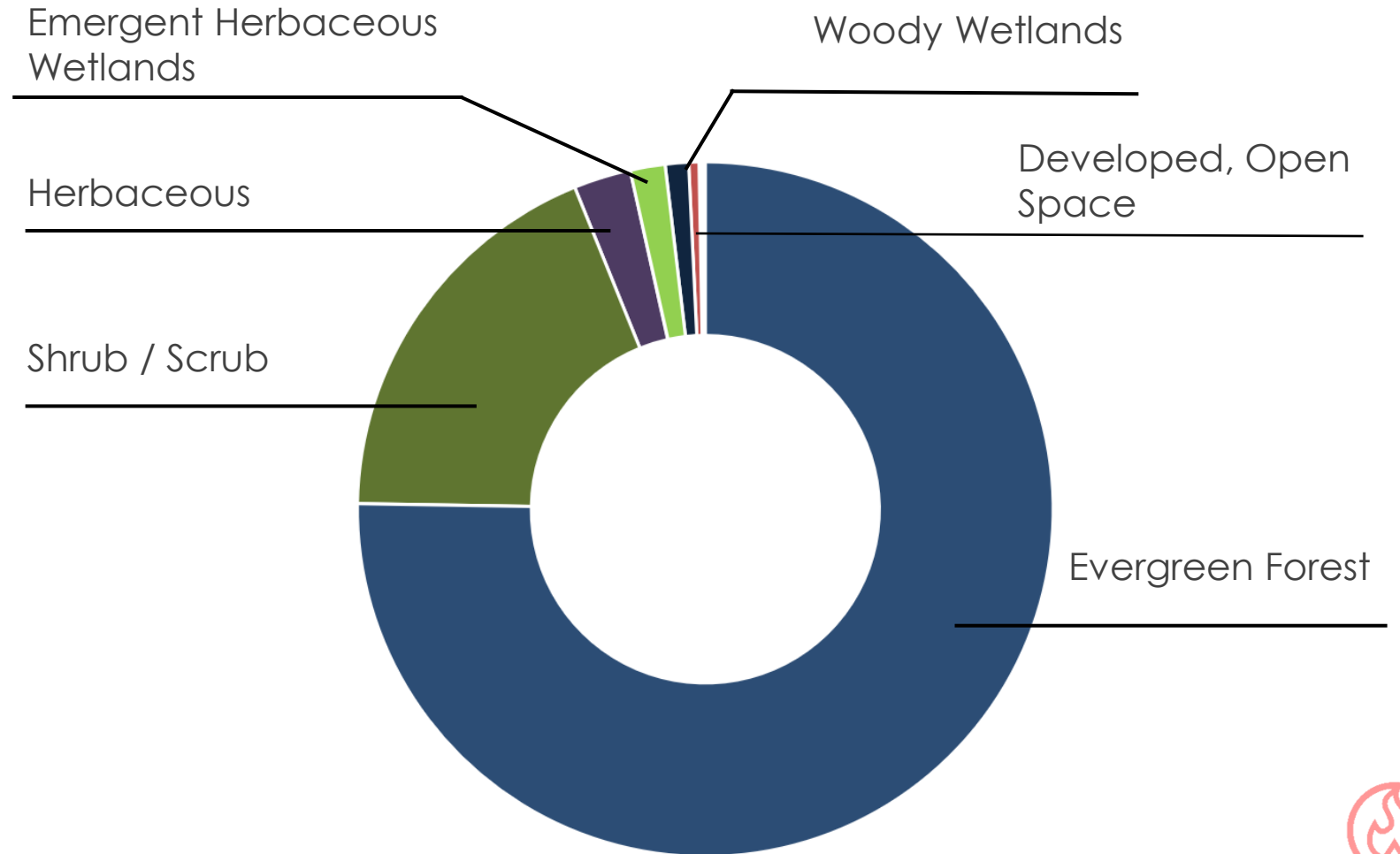|		
 NLCD 2019	Land cover class and HSBS areas	Majority: ■ Evergreen Forest
		Percent Area of Evergreen Forest in HSBS areas: **94%**
 LF 2020 EVT	Existing Vegetation Type and HSBS areas	Majority: ■ Sierran-Intermontane Desert Western White Pine-White Fir Woodland
		Percent Area of Sierran-Intermontane in HSBS areas: **42%**

High Burn Severity and ET*

*ET 2021 Median Composite

High ET / Low Moisture

Moderate ET

Low ET / High Moisture

N
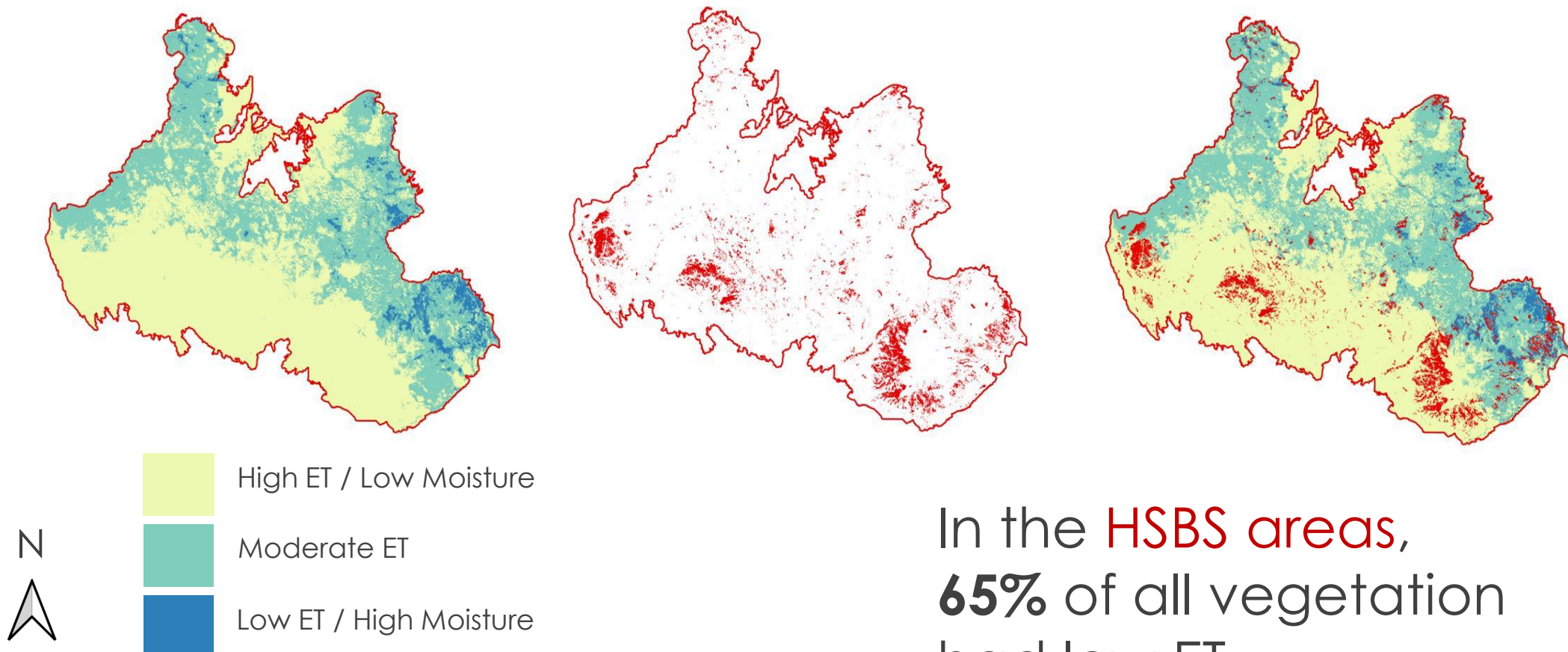
In the HSBS areas,
65% of all vegetation
had low ET

Interactions with Topography & Land Cover

Evergreen forest exists in high proportions across slope gradients and directions within the fire boundary

Northwest-facing Slopes

Emergent Herbaceous Wetlands

Woody Wetlands

Herbaceous

Developed, Open Space

Shrub / Scrub

Evergreen Forest

Errors & Uncertainties

▸ Uncertainty in ECOSTRESS ET end-product

▸ Land Cover Database is from 2019

▸ Case study of one wildfire may not be applicable to all wildfires

▸ Smoke hinders ECOSTRESS observations and reduces the usable data for active-fire analysis

▸ ECOSTRESS observations are only available since 2018

Image Credit: Intermountain Forest Service

Conclusion

Soil Burn Zonal Statistics:

- Mean ET decreased in each soil burn severity group
- Increased burn severity with increasing elevation

Vegetation Zonal Statistics:

- Evergreen forest made up 94% of high burn severity areas
- In the high burn severity areas, 65% of all vegetation had low ET.

Vegetation Moisture Analysis:

- Spring-Summer 2021 ET was drier than the previous two years
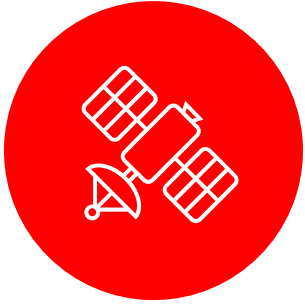- Large decrease in pre-fire ET in 2021, indicating water-stressed vegetation.

ECOSTRESS ET can be used as a vegetation moisture input for wildfire modeling
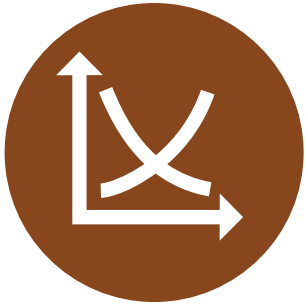

Image Credit: US Forest Service

Future Work

Long-term **assessments** of ECOSTRESS ET for other wildfire events both pre- and post- fire

Employ other **vegetation moisture** datasets such as Evaporative Stress Index and Water Use Efficiency

Validate ECOSTRESS daily ET with **in-situ data** from flux towers

ACKNOWLEDGEMENTS

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   ▸ Madeleine Pascolini-Campbell, Scientist

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   ▸ Ben Holt, Scientist

   ▸ Erica Carcelen, NASA DEVELOP JPL Fellow

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▸ **US Forest Service**

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▸ **Pacific Northwest National Laboratory**

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   ▸ Lee Miller, Earth Scientist