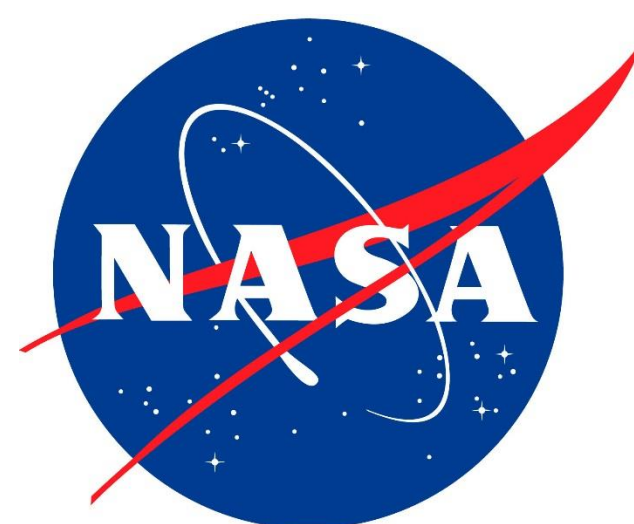




Mapping Post-fire Conifer Regeneration using Snow-on Imagery

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ABSTRACT

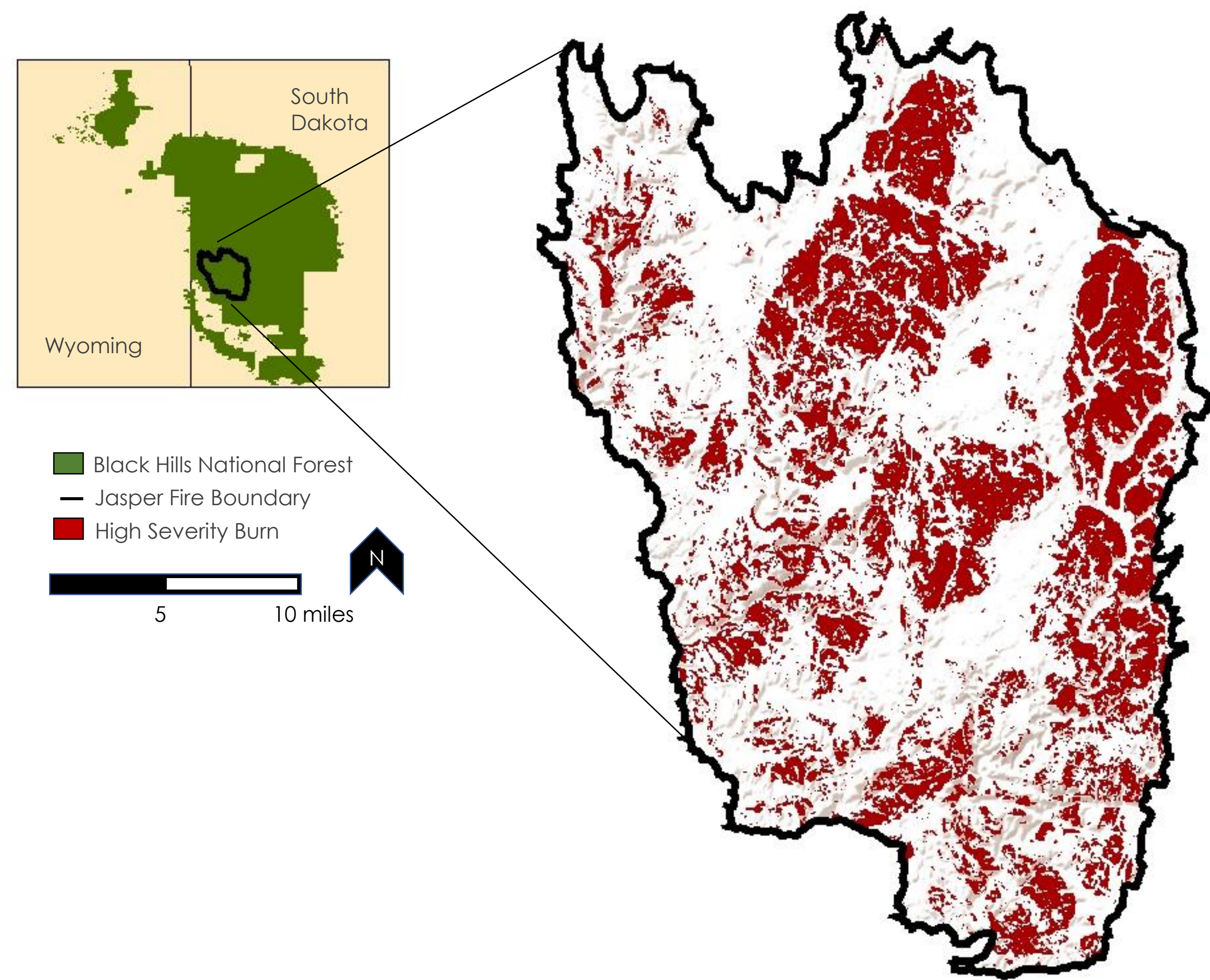
The 2000 Jasper Fire in the Black Hills of South Dakota was the largest wildfire to date in the region, burning over 83,000 acres of ponderosa pine forest. In collaboration with partners from the United States Forest Service (USFS) Black Hills Experimental Forest, USFS Rocky Mountain Research Station, and United States Geological Survey Geosciences and Environmental Change Science Center, we characterized post-fire forest regeneration within high severity burn patches. We accomplished this by implementing novel conifer detection techniques using a snow index mask to create a winter, snow-on image composite from Landsat 8 Operational Land Imager (OLI) and Sentinel-2 Multispectral Instrument (MSI) data. We utilized 2015 USFS stem maps of field-observed regeneration plots and ocularly sampled reforestation sites planted from 2001–2013. The field data and imagery were used to train a Random Forest (RF) model in Google Earth Engine. The RF model classified conifer regeneration density as low, medium, or high across the high-severity burn area with an overall accuracy of 81.3% for 2021. Approximately 45.9% of the high-severity burn area had low or no regeneration (0-40 trees per acre) 20 years post-fire. Given our partners' desire to find easily accessible low conifer regeneration zones, we identified 4,079 acres of priority planting sites that were within 1,500 feet of roads, had not been planted previously, and were larger than 50 acres. This method supports the use of snow-on imagery as a successful technique to identify conifer regeneration in a post-wildfire landscape.

OBJECTIVES

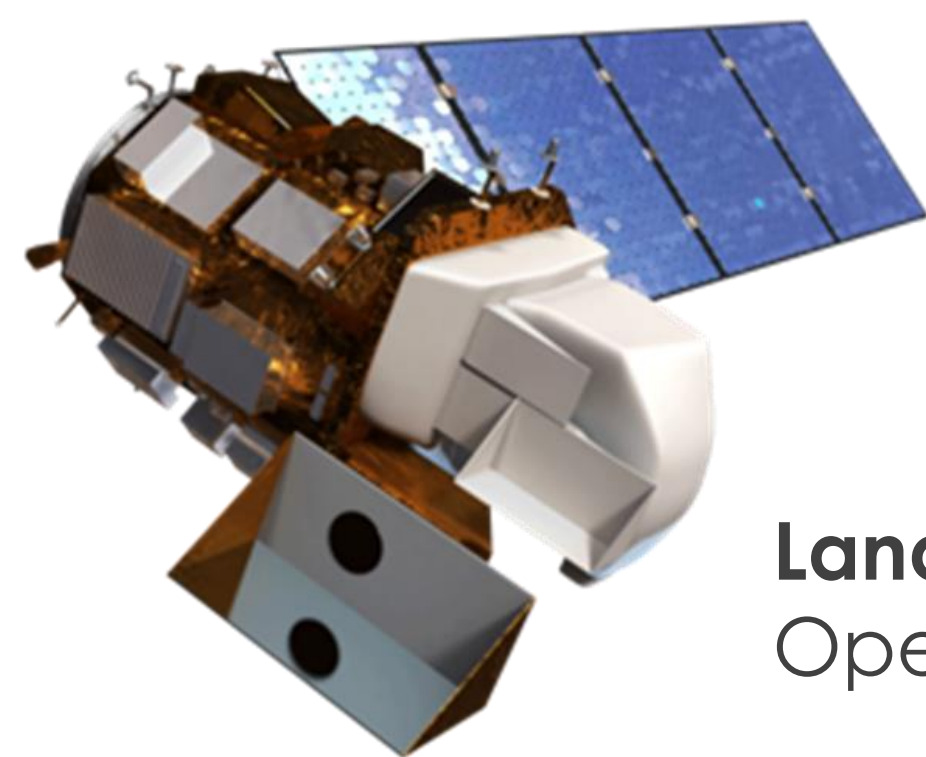
- **Validate** application of snow-on imagery to detect conifer regeneration
- **Quantify** Trees per Acre (TPA) of conifer regeneration in high-severity burn areas
- **Generate** maps to aid in reforestation management

STUDY AREA

- The Jasper Fire occurred in 2000 within Black Hills National Forest.
- 27% of the 83,508-acre fire burned at high-severity.



EARTH OBSERVATIONS

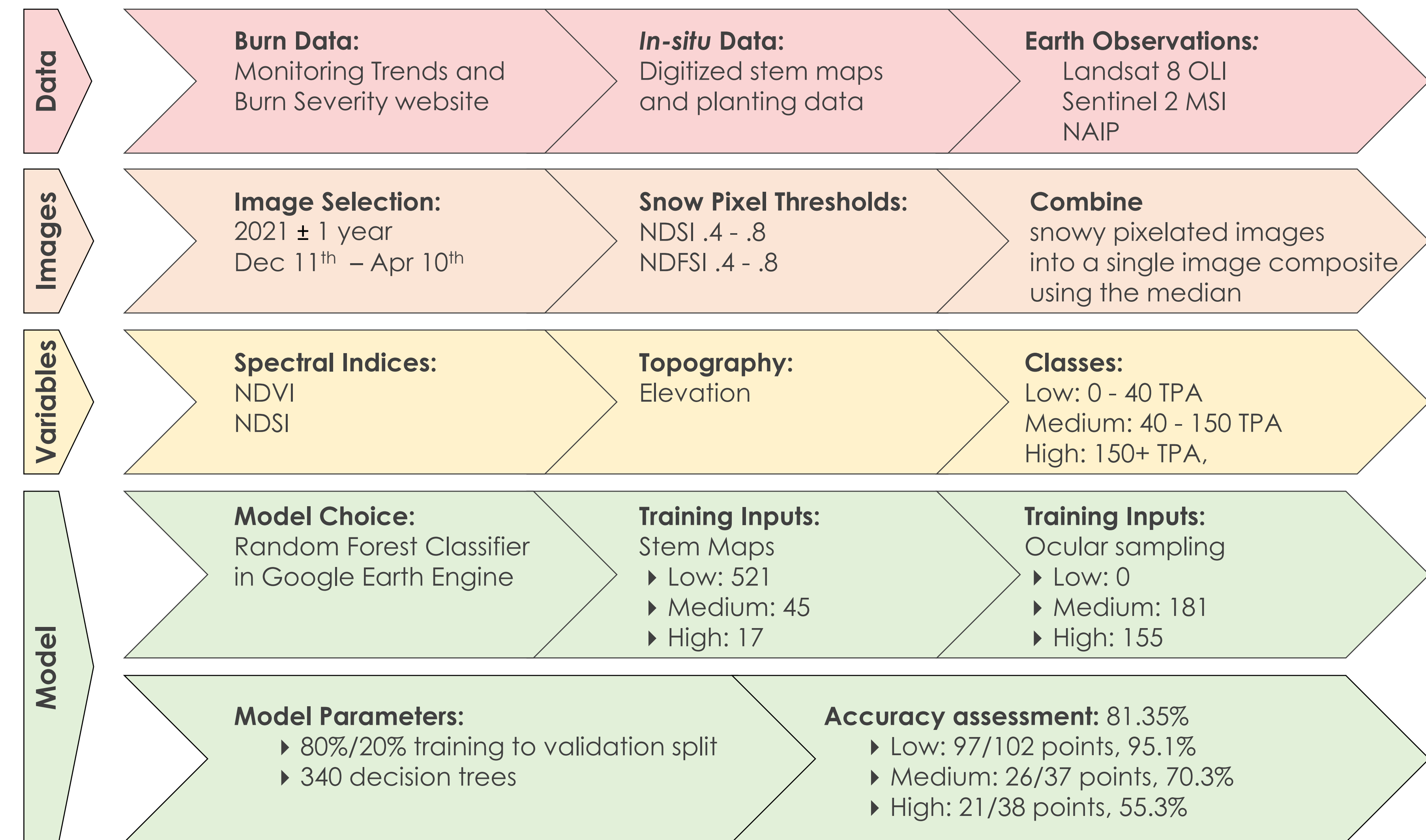


Landsat 8
Operational Land Imager (OLI)

Sentinel-2
MultiSpectral Instrument (MSI)

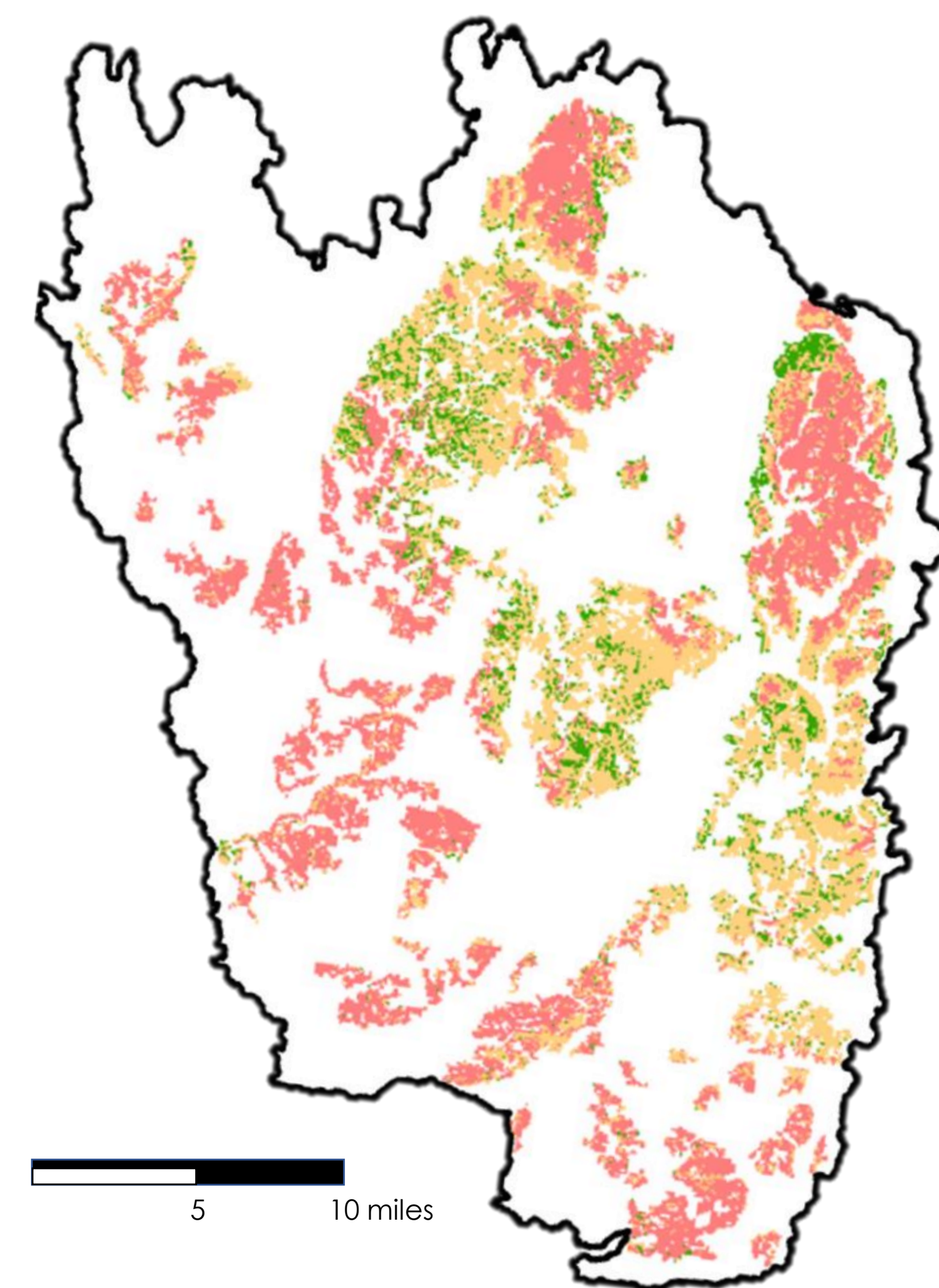


METHODOLOGY

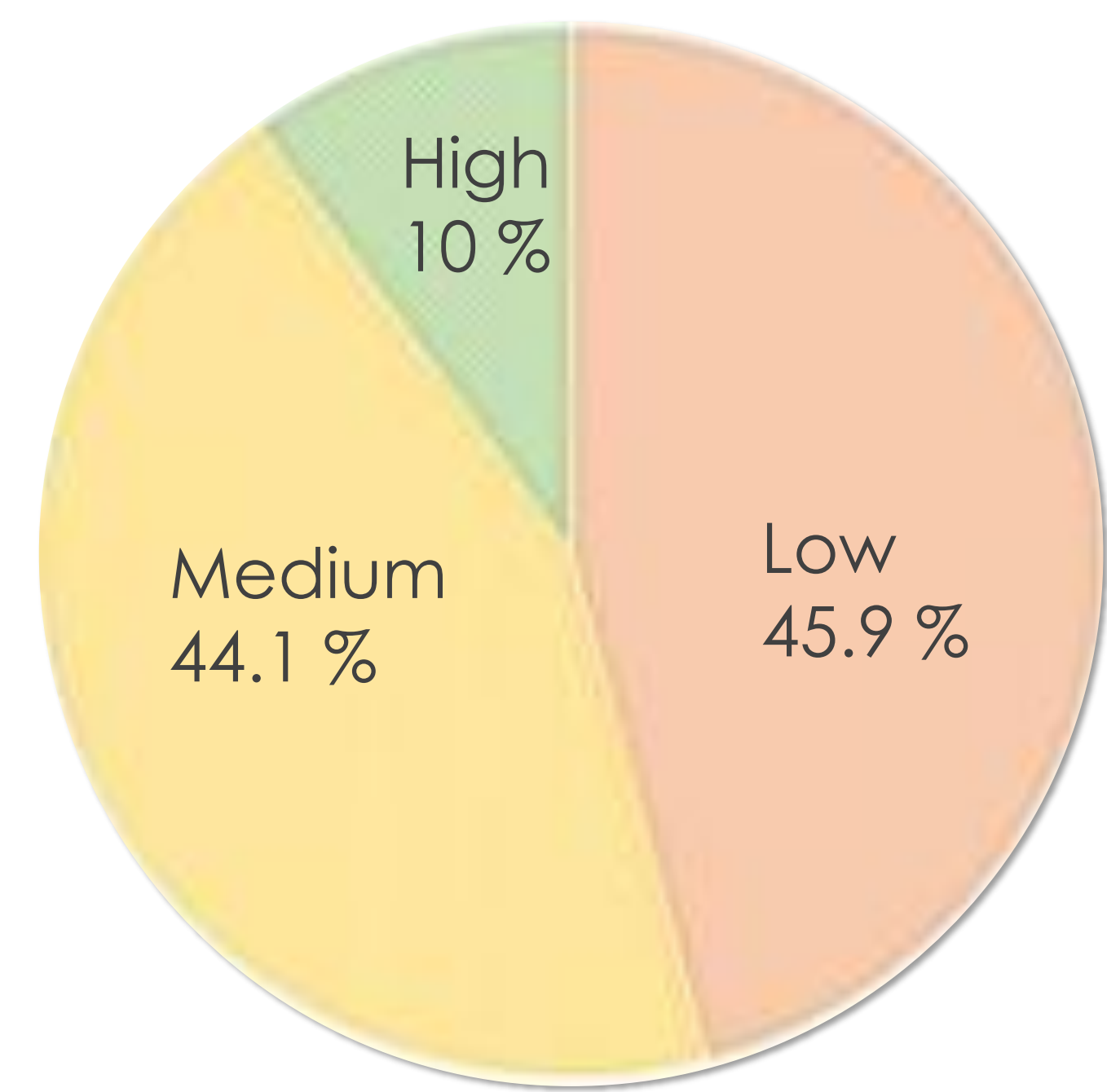


RESULTS

The random forest model classified 45.9% of the severe burn as low regeneration which amounts to 10,349 acres of priority planting areas, 44.1% of the severe burn as medium regeneration which amounts to 9,943 acres where reforestation efforts may potentially be needed, and 10.0% of the severe burn as high regeneration which amounts to 2,254 acres needing minimal reforestation efforts. The overall model accuracy was 81.4% and performed best in the low regeneration class (95.1%) compared to our medium (70.3%) or high (55.3%) classes.



Classified regeneration within high severity burn



CONCLUSIONS

- Snow-on imagery is a viable technique to identify conifer regeneration.
- Areas of low regeneration were clustered near lower elevations.
- 4,079 acres were identified as high priority and suitable for planting.

ACKNOWLEDGEMENTS

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