Mapping Post-fire Conifer Regeneration using Snow-on Imagery

Abstract

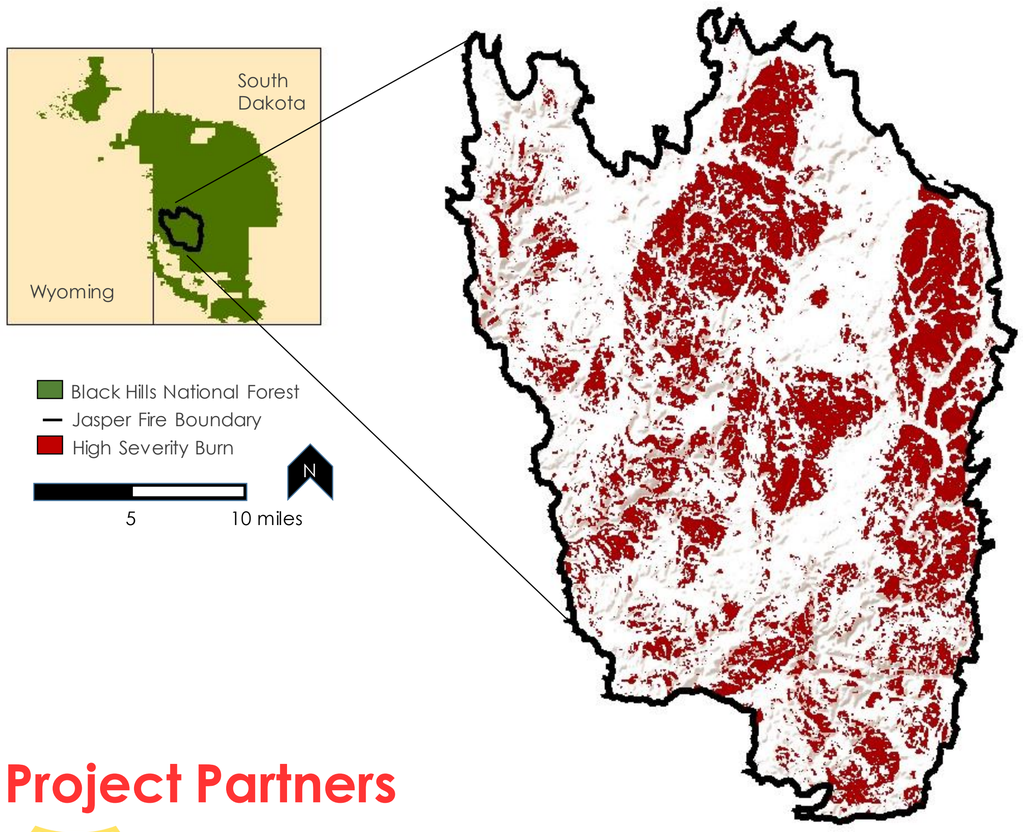
The 2000 Jasper Fire in the Black Hills of South Dakota was the largest wildfire to date in the region, burning over 83,000 acres of ponderosa pine forest. In collaboration with partners from the United States Forest Service (USFS) Black Hills Experimental Forest, USFS Rocky Mountain Research Station, 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 additional reforestation sites planted in 2001–2013. In Google Earth Engine (GEE), the field data and imagery were used to train a Random Forest (RF) model. The RF model classified 2021 conifer regeneration density as low, medium, or high across the high-severity burn area with an overall accuracy of 81.3%. Approximately 45.9% of the high-severity burn 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.

Objectives

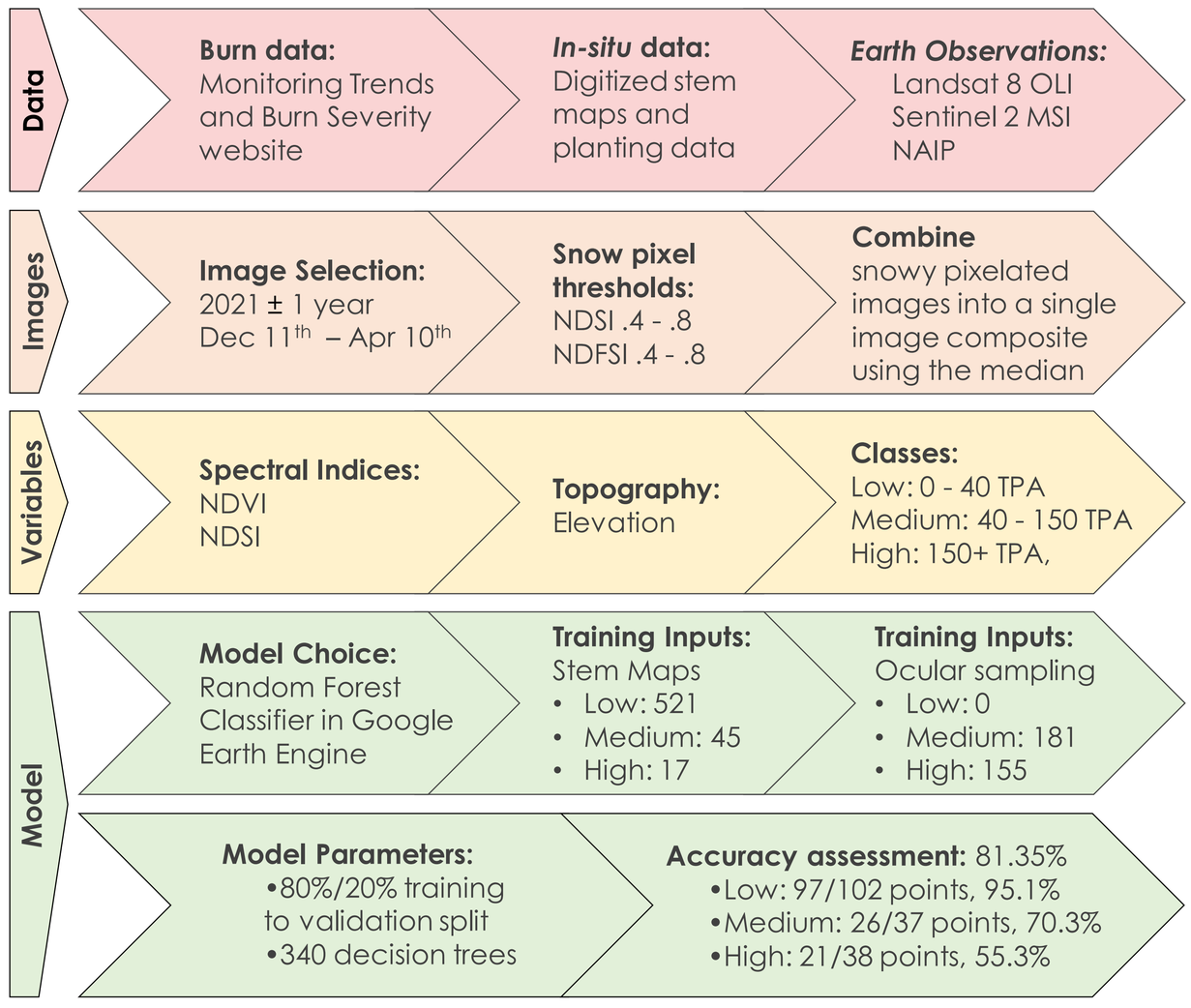
- **Validate** application of snow-on imagery to detect conifer regeneration
- **Quantify** trees per acre (TPA) of conifer regeneration in high-severity burn areas
- **Generate** maps to aid in reforestation management

Study Area

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

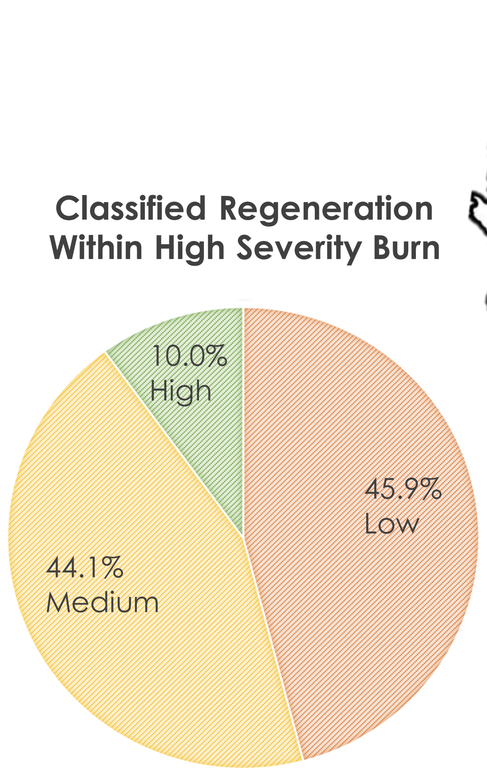


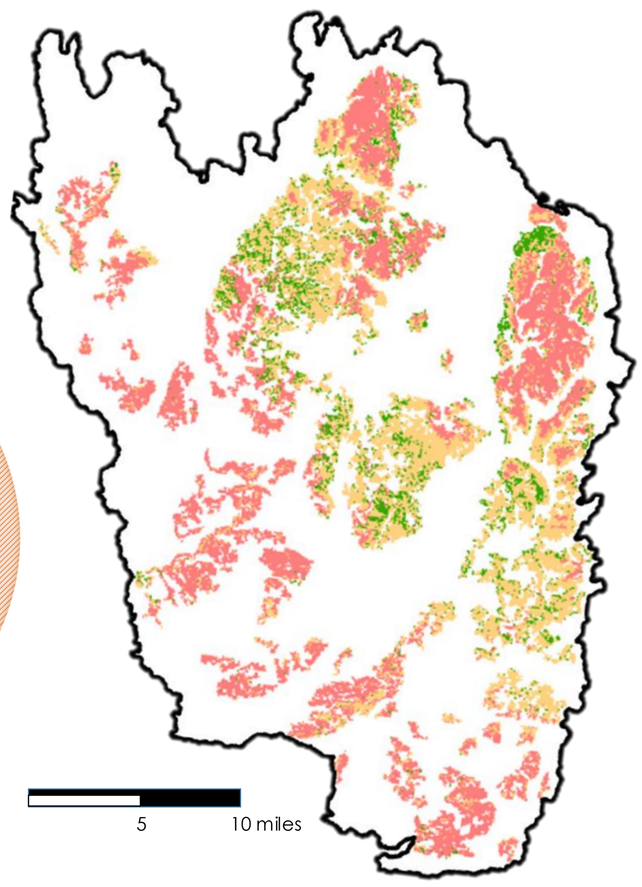
Methodology



Results

The RF model classified 45.9% of the severe burn as low regeneration (0-40 TPA) which amounts to 10,349 acres of priority planting areas, 44.1% of the severe burn as medium regeneration (40-150 TPA) which amounts to 9,943 acres where reforestation efforts may potentially be needed, and 10.0% of the severe burn as high regeneration (150+ TPA) which amounts to 2,254 acres needing minimal reforestation efforts. Our overall model accuracy was 81.4% and performed best in the low regeneration class (85.1%) compared to our medium (70.3%) or high (55.3%) classes.





Conclusions

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

Project Partners

- Black Hills Experimental Forest
- Rocky Mountain Research Station
- Geosciences and Environmental Change Science Center

Team Members

Casey Menick (Project Lead)
Haley Stuckmeyer
Heidi Rogers
Yeshey Seldon

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Black Hills Wildfires