Using NASA Earth Observations to Monitor Vulnerability, Wildfire Damage, and Recovery in the Appalachian Forests

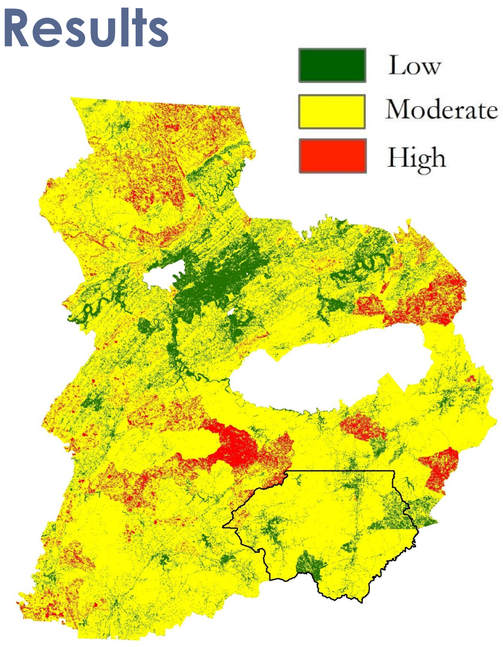
Abstract

Wildfires in the southeastern US are understood less than those in other portions of the nation. In October and November 2016, over sixty individual wildfires ignited among seven states in the Southern Appalachian region. These fires damaged hundreds of buildings, caused numerous power outages, and resulted in fatalities. These unusually destructive events highlight the need to improve awareness of fire susceptibility and risk in the southeastern US. The US Forest Service requires a thorough understanding of wildfire vulnerability, damage, and recovery to effectively help local communities respond to and prepare for these events. The DEVELOP team partnered with the US Forest Service's Southern Research Station to assess vegetation dynamics before and after the 2016 wildfire events, focusing on GA, NC, and TN. This was accomplished by utilizing Landsat 8 OLI, Terra ASTER, and Terra MODIS data to evaluate land cover changes from October to December 2016 and assess the severity of these fires. In addition, this project incorporated demographic data to examine the association between fire risk and under-managed lands, such as heirs' properties, and to construct a model of social vulnerability to wildland fire hazards in the study area. The results of this project provided researchers at the US Forest Service with an increased understanding of how property ownership and community management practices can affect future wildfires, as well as how the spatial distribution of socioeconomic variables affects residents' ability to adapt and recover.

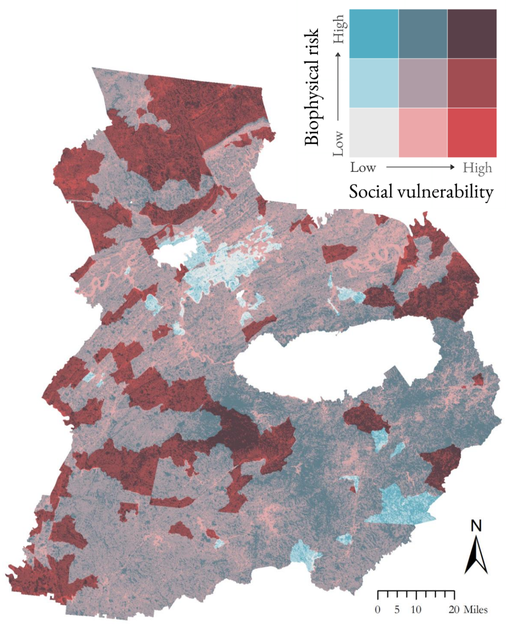
Methodology

Data Acquisition	Inputs and Processing		Output	End Product
Terra MODIS (ForWarn data)	NDVI (250m) Forest Thrive/Decline	Biological Risk Factors	Fire Risk Model	Integrated Wildfire Vulnerability Index
Landsat 8 OLI & Sentinel-2	Land Cover NDVI (30 & 10m) NDMI (30 & 10m) NBRI (10m)			
Terra ASTER & NED	DEM (30 & 10m) Slope (30 & 10m) Aspect (30 & 10m)	Physical Risk Factors		
Socio-Economic Data	CWPPs FireWise Communities Heirs' Properties Census Data	Social Vulnerability Index		
Population Density	Global Population Grid National Land Cover Data	Dasymetry of Vulnerable Population		

Results



Wildfire Vulnerability Index
(Summed Score)



Wildfire Vulnerability Index
(Bivariate)

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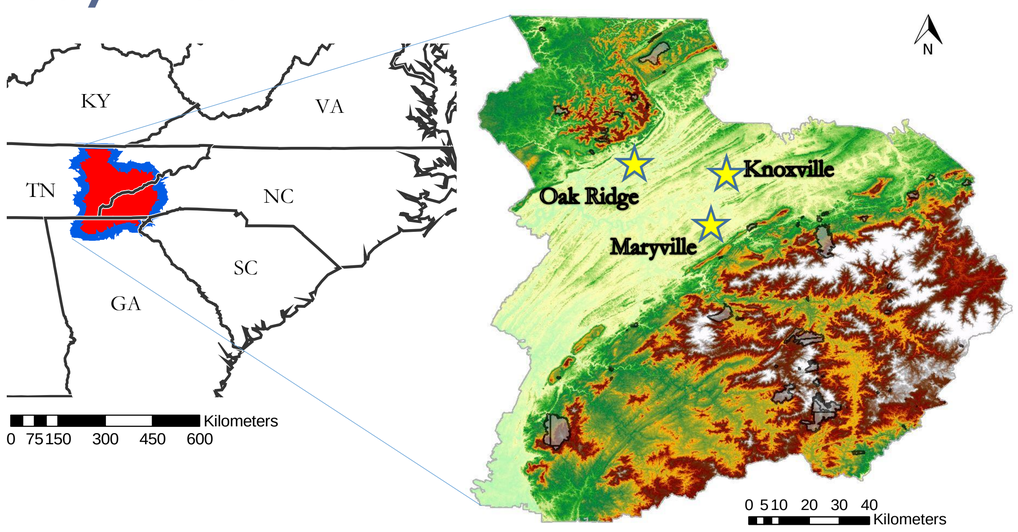
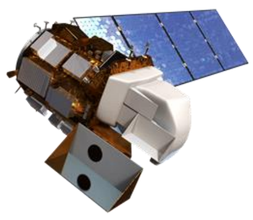
Objectives

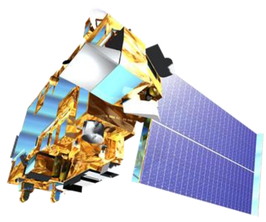
- **Analyze** vegetation and fire fuel change before, during, and after the fall 2016 wildfires using Landsat 8, Terra MODIS, Terra ASTER, and Sentinel-2 MSI data
- **Explore** the physical, biological, and social factors that may lead to increased wildfire susceptibility in the Southern Appalachian region of the United States
- **Create** an integrated wildfire vulnerability model based on a range of environmental factors (elevation, vegetation, and land cover) and socioeconomic factors (income, race, and housing)

Study Area



Earth Observations


Landsat 8, OLI


Terra, ASTER & MODIS

Sentinel-2, MSI

Conclusions

- Additional, high-resolution Earth observation data improved the accuracy of our wildfire risk model.
- Incorporating socioeconomic data allowed this project to explore other dimensions of wildfire vulnerability.
- Our analysis identified clusters of both high wildfire risk and social vulnerability to wildfires in the Southern Appalachia region.
- Suburban areas near Knoxville, TN exhibited low vulnerability, while some rural areas exhibited higher vulnerability.
- Future work could investigate the health and air quality aspects of the 2016 wildfire events.

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Project Partners

Southern Appalachia Disasters II

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