Vermont Wildland Fires

Quantifying the Role of Antecedent Conditions and Recent Environmental Trends in Exacerbating Fire Potential and Risk in Vermont

Project Synopsis

Wildland fire risk in the northeastern United States is poorly understood. Most fires in Vermont are less than half an acre in size and occur between spring snowmelt and green-up when dry fuels accumulate. During this time, environmental drivers, such as evapotranspiration, soil moisture, wind speed, precipitation, and relative humidity, impact fire risk in complex and dynamic relationships. This study combines Vermont wildland fire data, NASA Earth observations, and archival climate datasets to quantify the impact of environmental conditions and long-term phenological changes on fire risk. These results provide insights into fire forecasting and foster a framework for understanding fire risk in humid climates.

Objectives

- **Increase** understanding of how climate change affects fire risk in the northeastern U.S.
- **Extract** changes in fire season based upon long-term phenological trends in snow and vegetation data
- **Analyze** environmental trends indicative of flash droughts prior to fires at a regional and various temporal scales
- **Provide** updated fire climatology visualizations and information for community decision-makers

Methodology

Long-Term Phenological Analysis:

2001 — *January 1st – December 31st, 2001–2023* — 2023

Variables	Processing	Analysis
• Land Cover Phenology (MODIS) • Snow Water Equivalent (SNODAS)	1. Classified data per FDRA 2. Extracted dates of green-up 3. Calculated dates of snowmelt	1. Summary statistics and visualizations 2. Trend analyses within study period

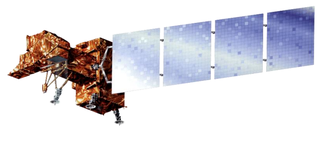
Antecedent Condition Analysis:

2008 — *March 1st – November 30th, 2008 – 2023* — 2023

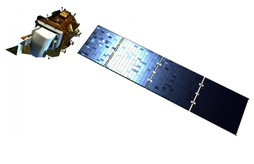
Variables	Variables	Analysis
• Relative Humidity (GridMet) • Precipitation (NClimGrid) • Soil Moisture (GLDAS) • Evaporative Stress Index (NASA SERVIR) • Wind Speed (GridMet)	1. Computed 7- and 30-day moving averages 2. Divided data into seasons based on phenological processes	1. Seasonal linear regressions 2. Pearson linear correlations 3. Random Forest models 4. Maps of environmental condition trends

Earth Observations

Landsat 5 TM

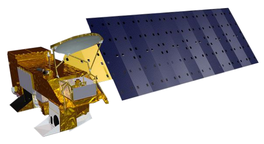


Landsat 7 ETM+

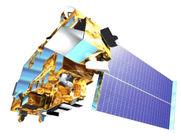


Landsat 8 OLI/TIRS

Landsat 9 OLI-2/TIRS-2



Aqua MODIS



Terra MODIS

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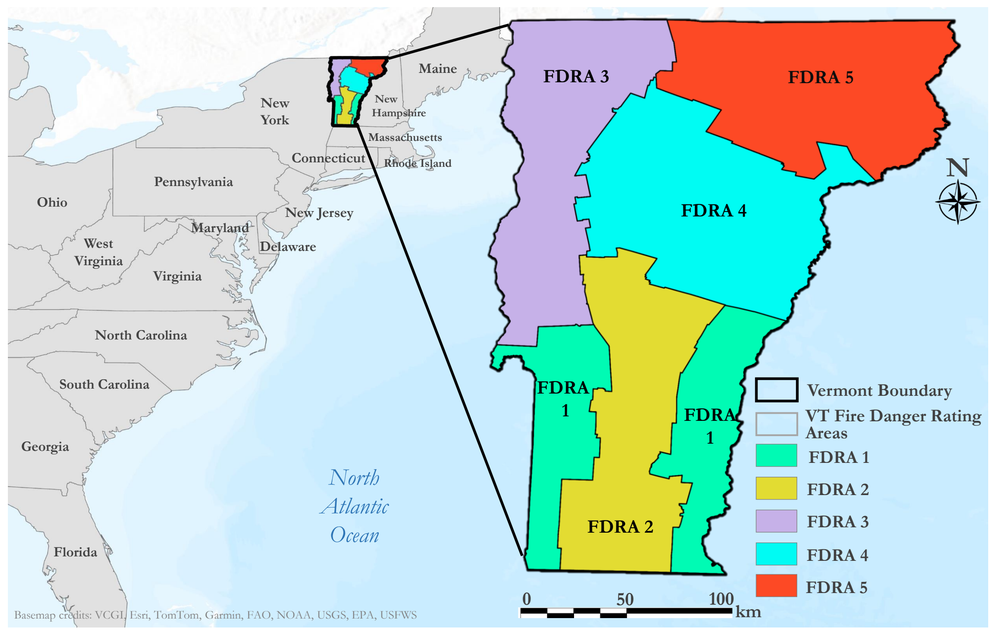
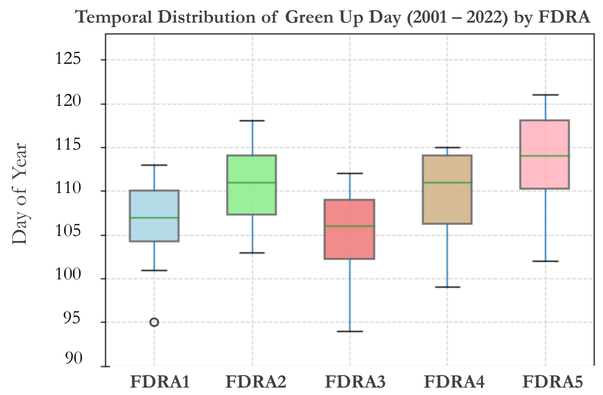
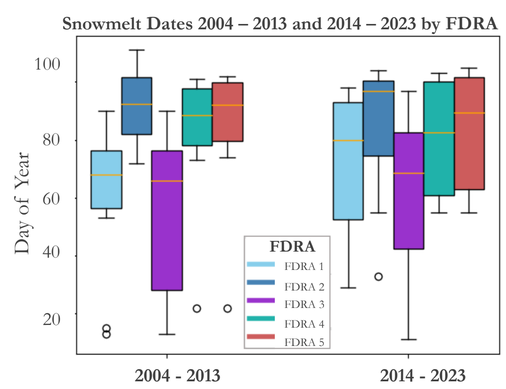
Study Area



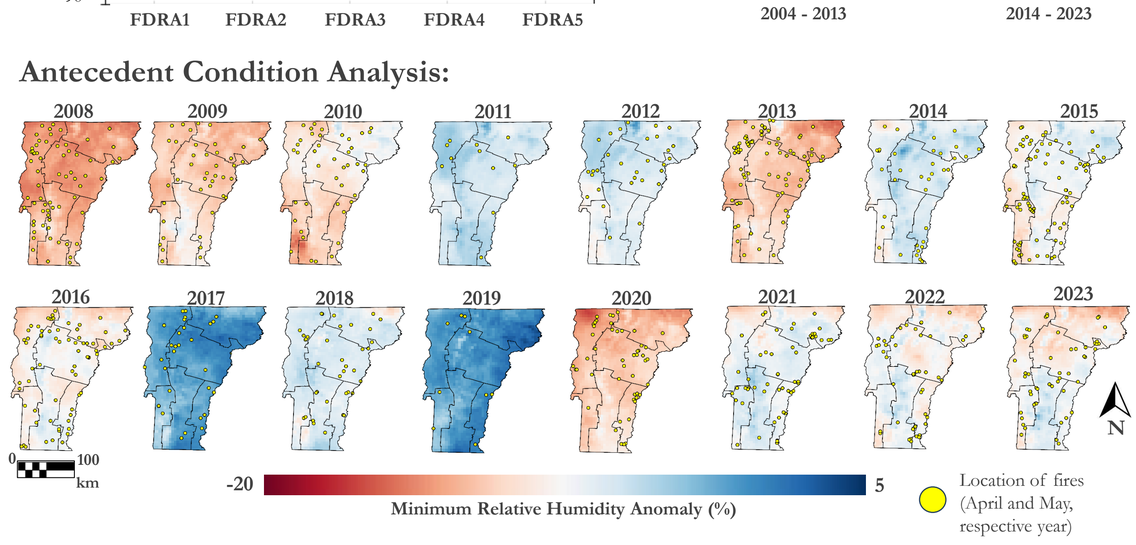
Results

Long-Term Phenological Analysis:





Antecedent Condition Analysis:



Conclusions

- Relative humidity is the most significant environmental variable associated with wildfire risk in Vermont, at the daily, seven-day, and 30-day timescale.
- Green-up dates over the study period remain stable while snowmelt dates indicate increasing variability.

Project Partners

- NOAA National Weather Service, Burlington, VT Weather Forecast Office
- Vermont Agency of Natural Resources, Department of Forests, Parks and Recreation - Division of Forests
- University of Vermont
- NOAA National Integrated Drought Information System

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