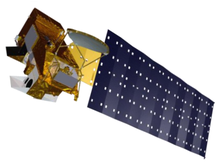
Enhancing Pre- and Post-Wildfire Vegetation Type Characterization Using NASA Earth Observations

Abstract

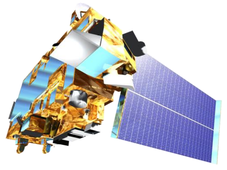
Increasing wildfire frequency has emphasized the importance of post-wildfire recovery efforts in southern Idaho's sagebrush-steppe ecosystem. The changing fire regime favors annual invasive grass species while hindering native grasses and sagebrush habitat regeneration, causing a positive feedback cycle of invasive plants. Due, in part, to this undesirable process the sagebrush-steppe ecosystem is one of the most endangered in the US. In this project, the Idaho NASA DEVELOP team partnered with the Bureau of Land Management, Idaho Department of Fish and Game, and the US Department of Agriculture to characterize ecosystem recovery following the 2006 Crystal wildfire. Vegetation recovery following the Crystal fire (2006) was observed from 2001 to 2016 using NASA Earth observations Landsat 5 Thematic Mapper (TM), Landsat 8 Operational Land Imager (OLI), Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS), and the Shuttle Radar Topography Mission (SRTM). In addition, significant factors affecting recovery were identified, and recovery of the landscapes carbon sequestration capacity was assessed. Key variables analyzed included biomass production, seasonally accumulated precipitation, max seasonal temperature, and elevation including slope and aspect. These factors affect land management by driving the success or failure of recovery efforts.

Earth Observations

Aqua MODIS

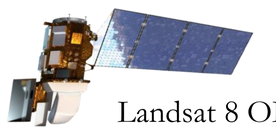


Terra MODIS



SRTM

Landsat 8 OLI



Landsat 5 TM

Objectives

- **Identify** the key ecological variables responsible for long term wildfire recovery
- **Quantify** the rate of recovery within the Crystal fire area
- **Detect** the change in sagebrush-steppe habitat and the introduction of non-native vegetation

Methodology

Processed Data — Used NDVI and MSAVI2 to identify vegetation and growth productivity

Temporal Analysis — Monitored vegetation indices over time, specifically pre- and post- wildfire

Regression Analysis — Identified key variables (slope, aspect, rainfall, growing degree days, previous fire exposure) necessary for ecosystem recovery and how their affects on productivity over time

Project Partners

- US Bureau of Land Management (BLM)
- USDA Agricultural Research Service
- Idaho Department of Fish and Game (IDFG)
- NASA RECOVER Science Team

Team Members

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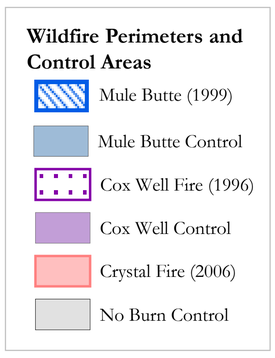
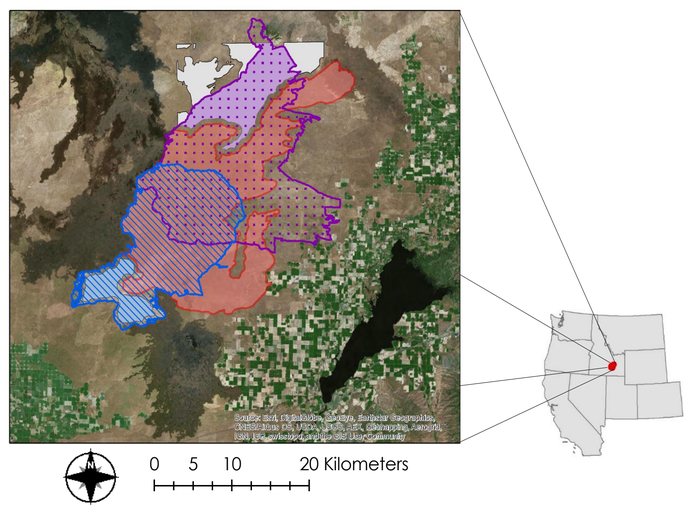
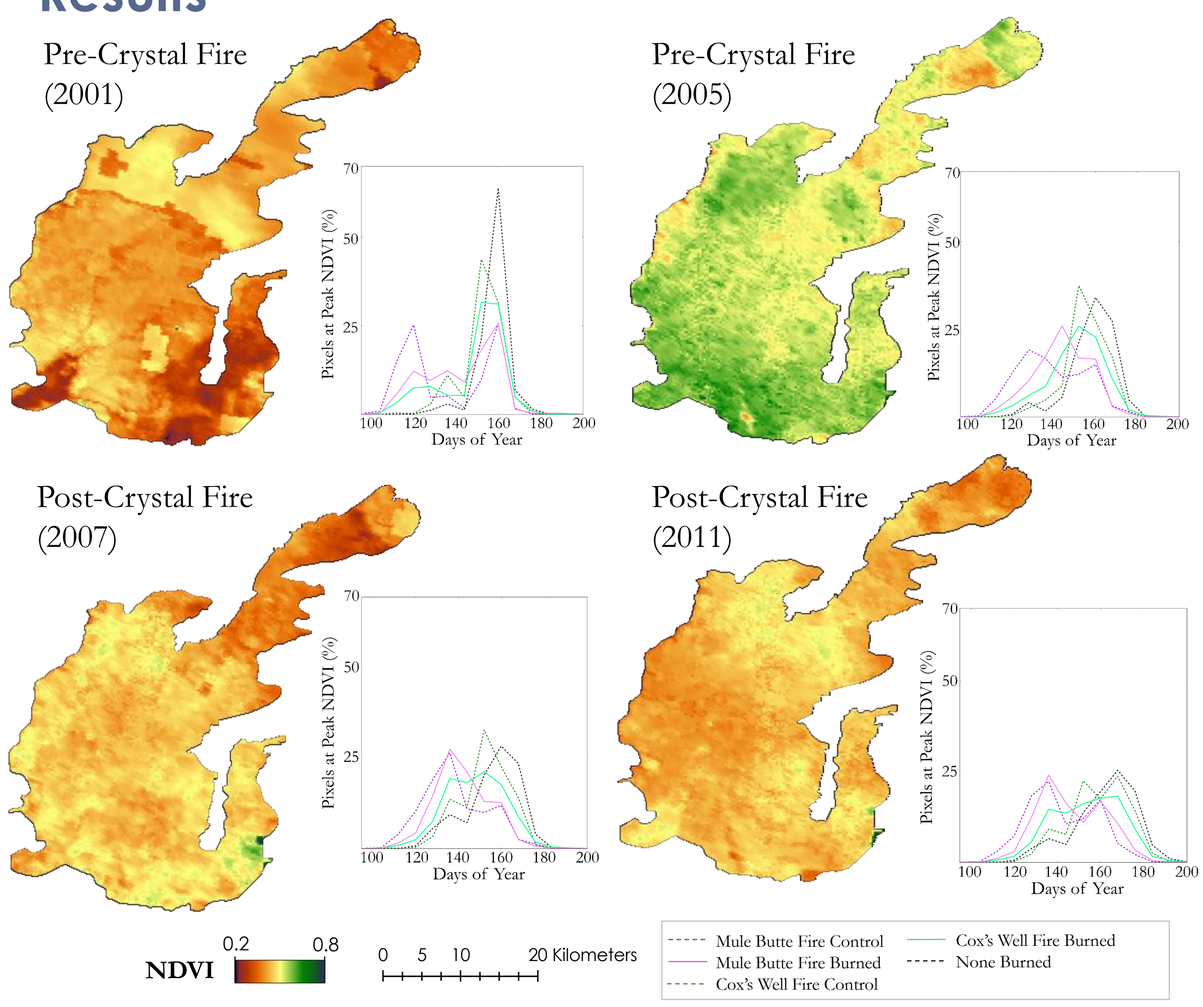
Study Area





Results



NDVI maxima are shown for two pre-fire and two post-fire years within the 2006 Crystal Wildfire boundary. Corresponding graphs show the seasonality of the values shown in each image. Dashed lines represent areas of the 1999 Mule Butte fire and the 1996 Cox's Well fire which did not burn during the 2006 Crystal fire, while solid lines represent areas of these fires that burned again during the Crystal fire. The increasing magnitude and bimodality of the maximum NDVI data suggests that the presence of cheatgrass has increased in the region since 2006. The Crystal fire is likely to have contributed to this expansion.

	Crystal vs. Cox Well	Mule Butte + Crystal vs. Mule Butte	Crystal vs. Never Burned	Mule Butte + Crystal vs. Never Burned	Mule Butte + Crystal vs. Crystal
2001	2E07	5E06	**2E07**	1E07	3E07
2005	1E08	4E07	**9E07**	6E07	2E08
2007	2E08	9E07	**1E08**	1E08	4E08
2011	4E08	2E08	**3E08**	2E08	8E08

The inner product was used to compare the similarity of each burned region to each other, the corresponding historically similar control, and the unburned since 1950 control. The larger the inner product value the more similarity between the vectors being compared. Above the pre- Crystal fire values were much different then areas that have never been burned, suggesting recovery has not occurred. In addition, previous 2006 fires may still influence current recovery efforts.

Conclusions

- The magnitude and timing of paired vegetation peaks suggests that invasive cheatgrass had increased in the years following the fire and became further established in the combined Mule Butte/Crystal Fire area.
- After the Crystal fire, vegetation in the burned region continues to experience earlier vegetation peaks than in corresponding controls. This suggests that full recovery may not have occurred by 2015, nine years after the fire.

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