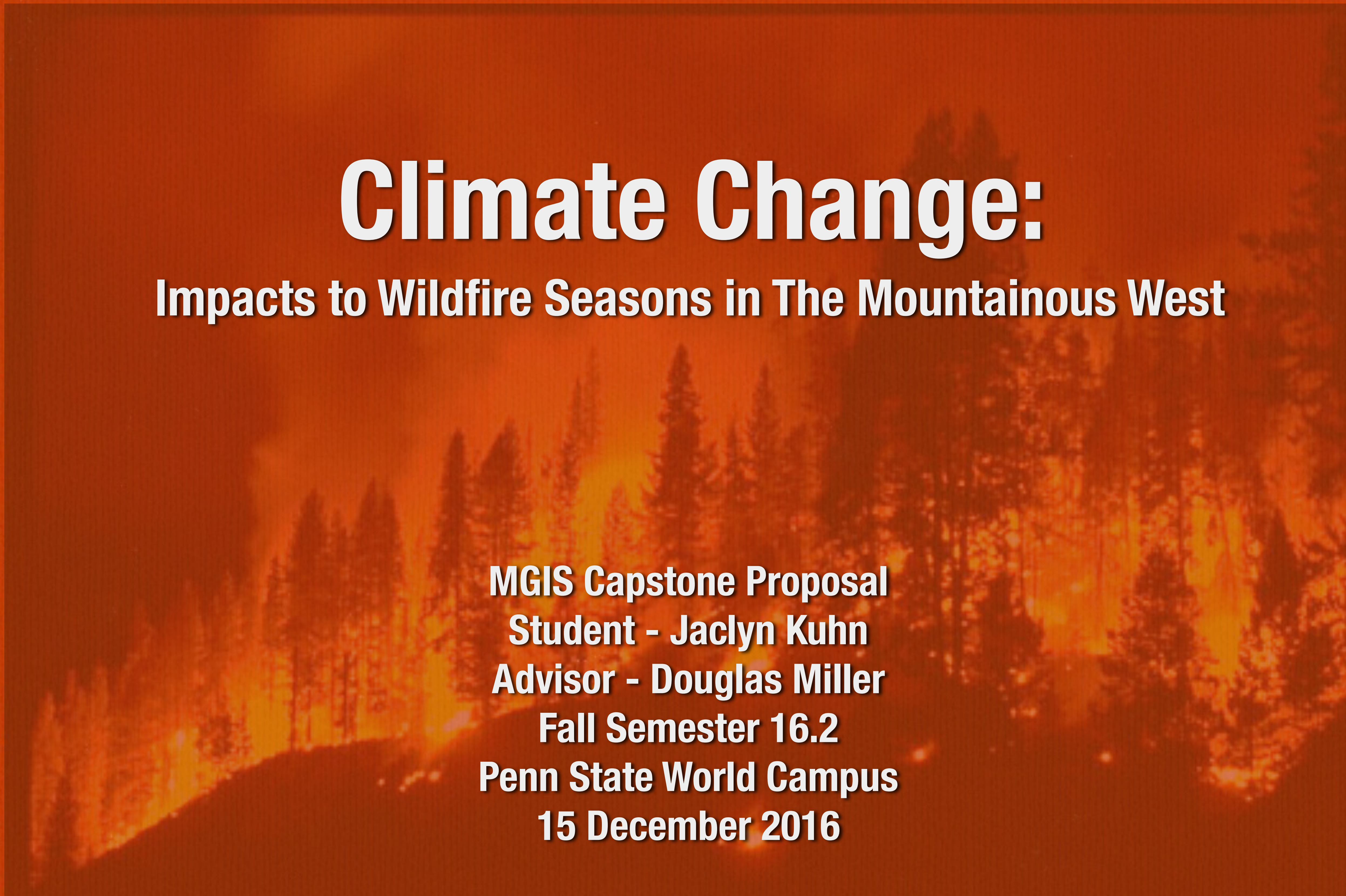

Climate Change:

Impacts to Wildfire Seasons in The Mountainous West

MGIS Capstone Proposal
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Fall Semester 16.2
Penn State World Campus
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Outline

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- ☐ Background
- ☐ Previous Research
- ☐ Objectives
- ☐ Methods
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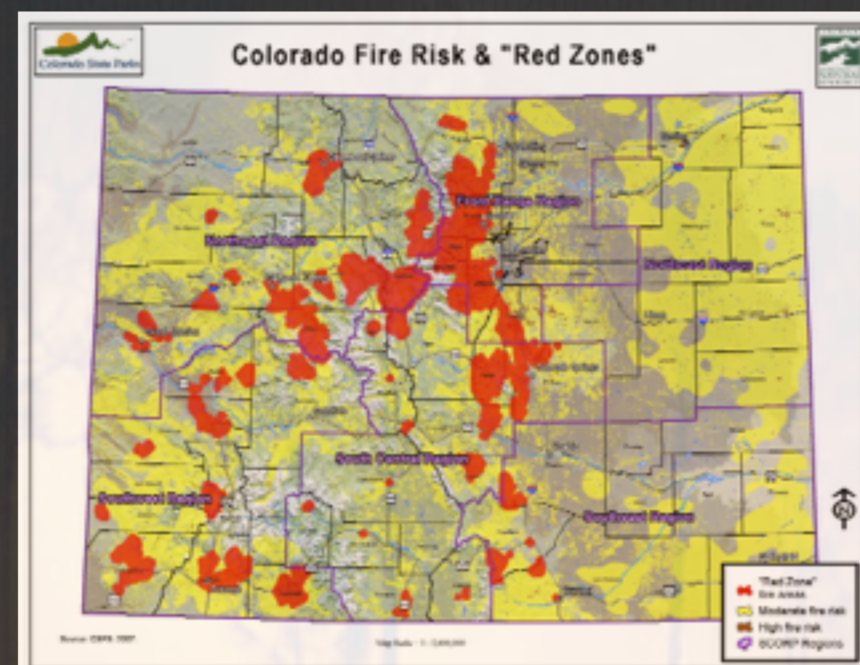
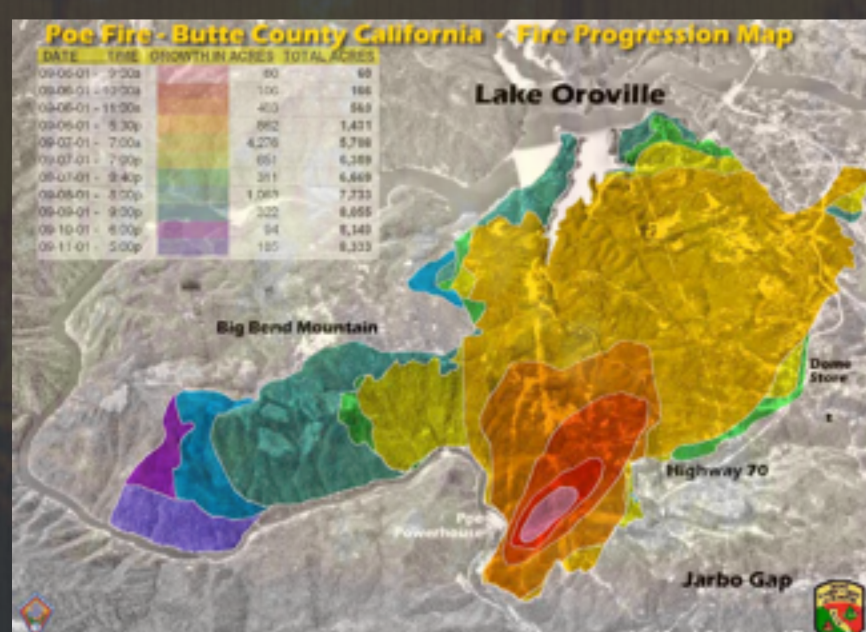
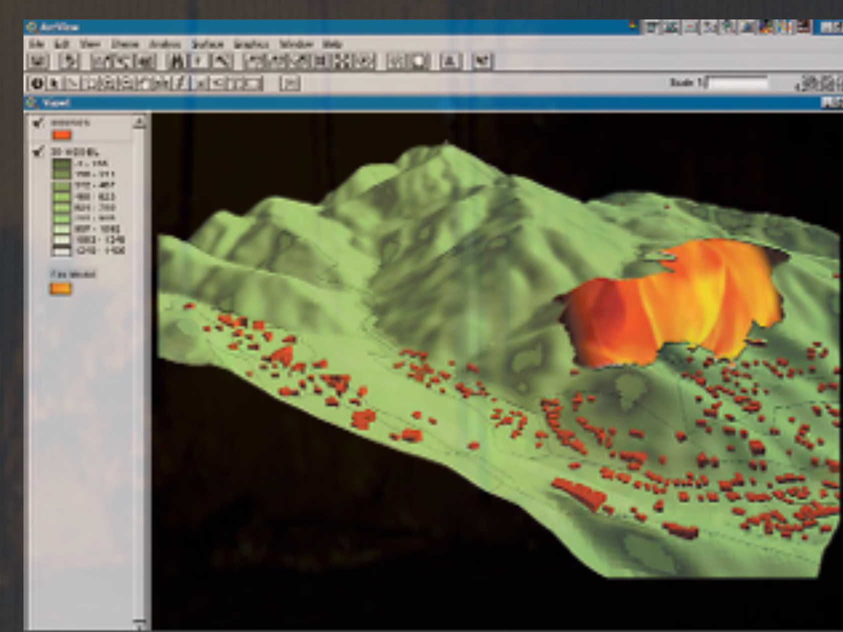
- ☐ Anticipated Results
- ☐ Summary
- ☐ Conclusions

Executive Summary

- Purpose
- Use of GIS





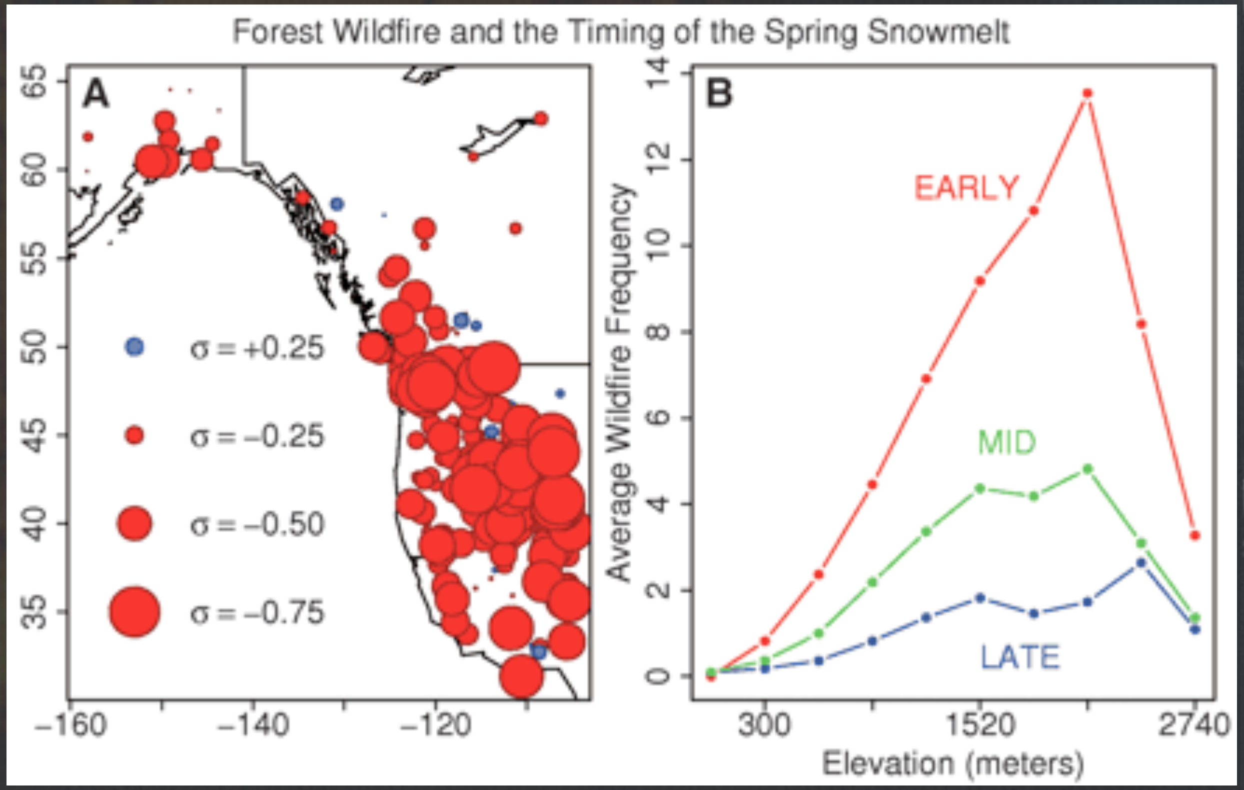


Background

- Drastic increase in wildfire activity in the Mountainous West (1).
- Possible change in length and/or severity of certain wildfire seasons.
- All areas of the Mountainous West are experiencing more frequent, and more severe wildfires (1).
- Key environmental factors are contributing to this change in fire season to include precipitation amounts, average temperatures and dew point temperatures, as well as decreased annual snowpack and earlier snow melt.

Previous Research

- In the 70's and 80's, significant research was focused on the idea that land use was the main cause for the increase of wildfires out West (1).
- By the early 2000's, it became apparent that large wildfire occurrences increased suddenly and markedly during the 1980's (1).
- Research throughout the turn of the century showed that large fires were
  - becoming more frequent
  - becoming harder to contain effectively
  - occurring outside of normal fire seasons
  - covering larger areas.

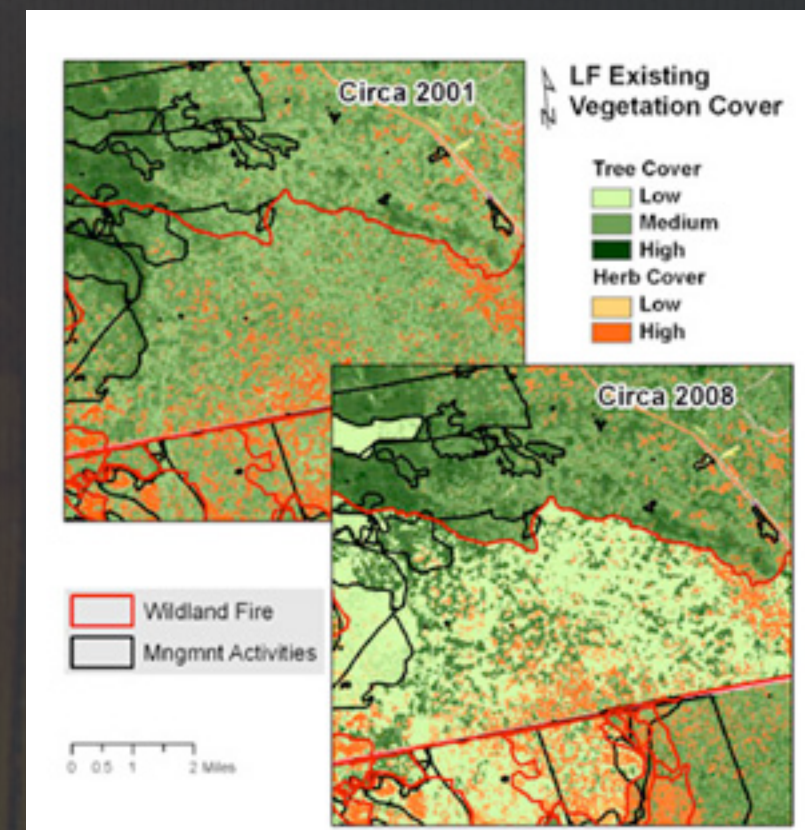


Previous Research

- As early as 2006, scientists were able to identify that these changes were strongly associated with increased spring and summer temperatures as well as an earlier spring snowmelt (1).

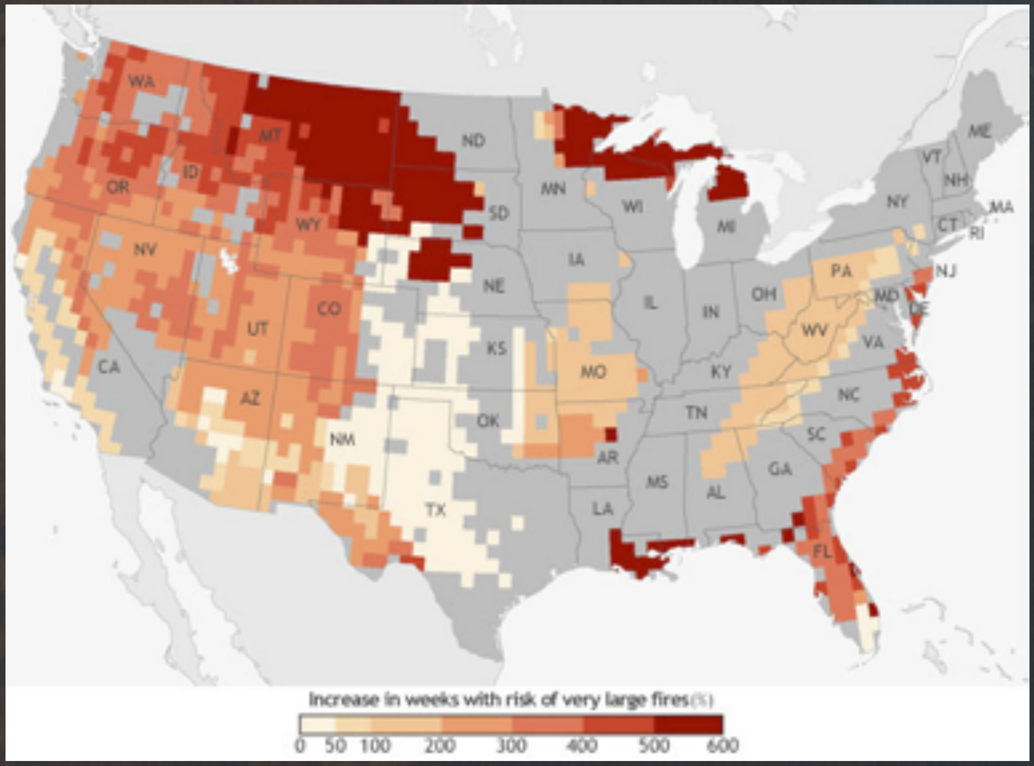
Previous Research

- Consolidated spatial database of wildfires in the United States (2).
- The Landscape Fire and Resource Management Planning Tools (LANDFIRE) offer enhanced vegetation, fuels, and fire regime layers consistently across the entire United States (3).
- This project was a first step towards understanding more about fire seasons and severity from the past, and starting to research likely wildfire season characteristics for the future.



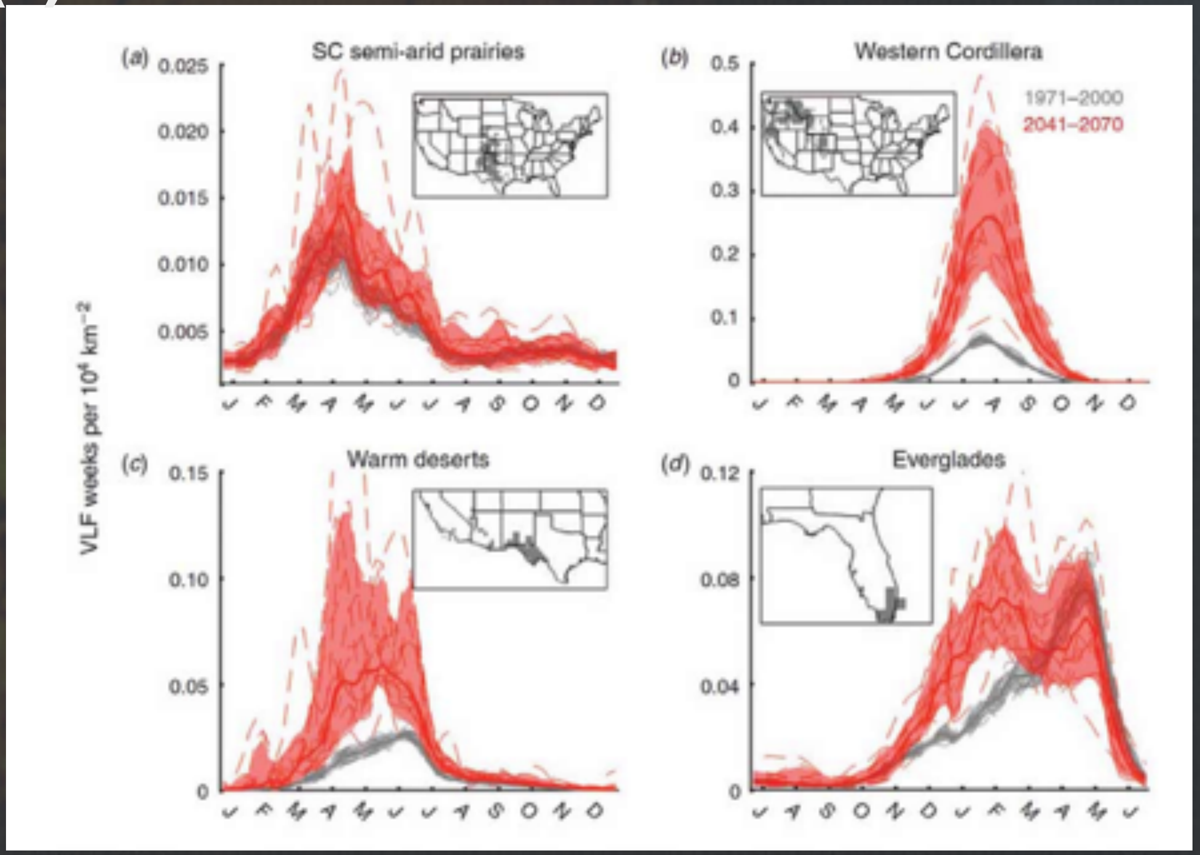
Previous Research

- In 2013, Yongquiang et al. (4) investigated the possibility that changing climate could have an effect on potential for wildfires.
- They used known climate indices: Keetch–Byram Drought Index (KBDI) Fosberg Fire Weather Index (mFFWI)
- Their studies show that fire potential is expected to increase in the Southwest, Rocky Mountains, northern Great Plains, Southeast, and Pacific Coast
- Furthermore, they concluded that fire seasons may become longer in most aforementioned regions (4).



Previous Research

- Similar studies were performed in Canada
- These studies indicated that, by the 2080s, some areas may have 50% more occurrences of large-scale wildfires under the “average” climatic conditions in the future (5).
- This indicates that some regions could have a fundamental probability of experiencing catastrophic fires under the conditions of an extremely “average” summer.



General Objectives

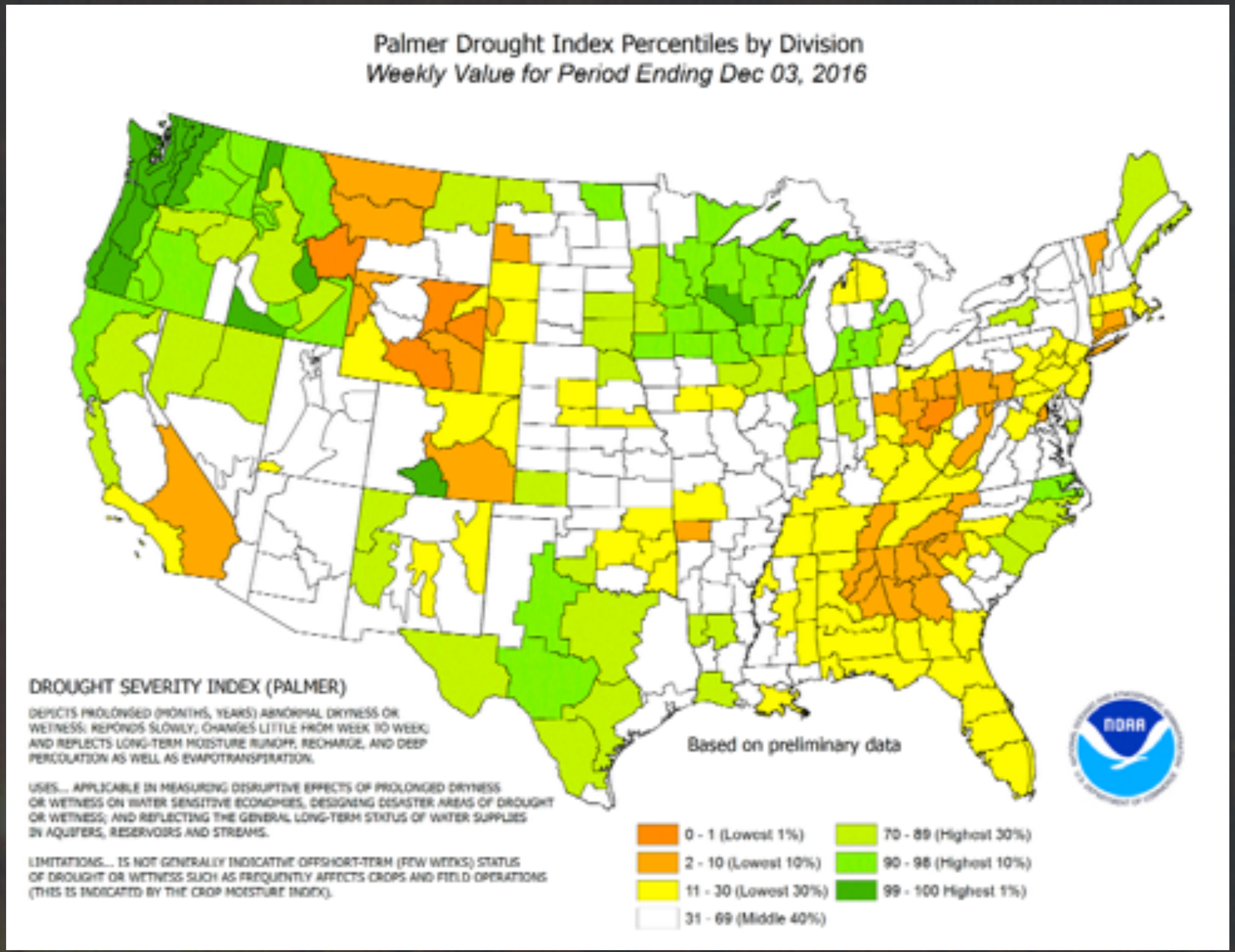
- Perform an environmental analysis of affected regions in order to find more direct correlations between the environment and wildfire behavior.
- Focus on determining what level of change will actually produce a notable result for wildfire seasons.
- The end result will be an increased understanding of what the future may hold for our fire season in the Mountainous West.

Specific Goals

- Determine what potential impacts overall annual precipitation changes are having on wildfire season length/severity.
- Determine what potential impacts changing temperatures and relative humidities are having on wildfire season length/severity.
- Determine what potential impacts changing snow melt dates are having on wildfire season length/severity.
- Make predictions about possible future wildfire season attributes based on current climatic and environmental trends.

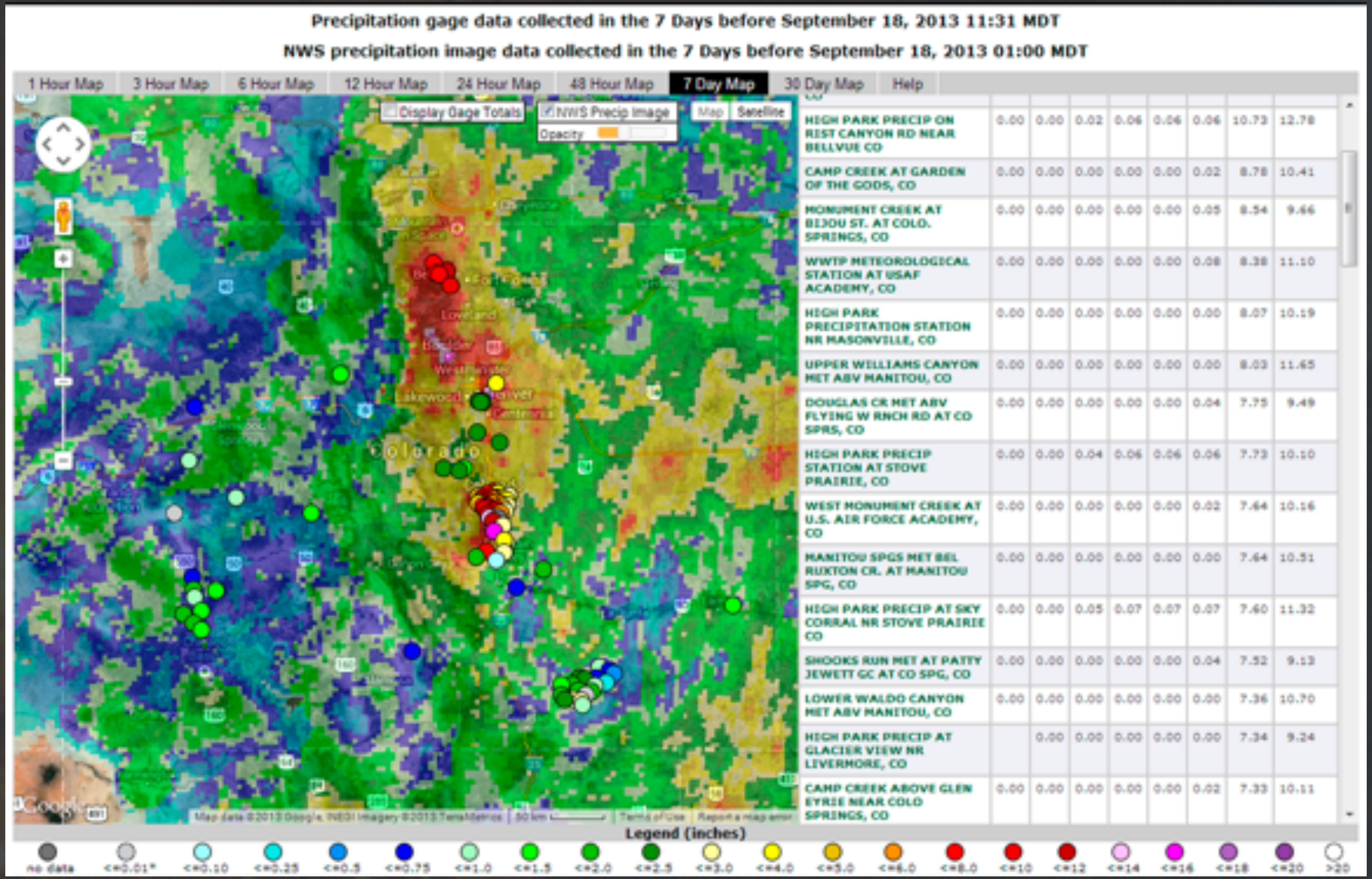
Methods - Precipitation Data

- NCEP
- PDSI



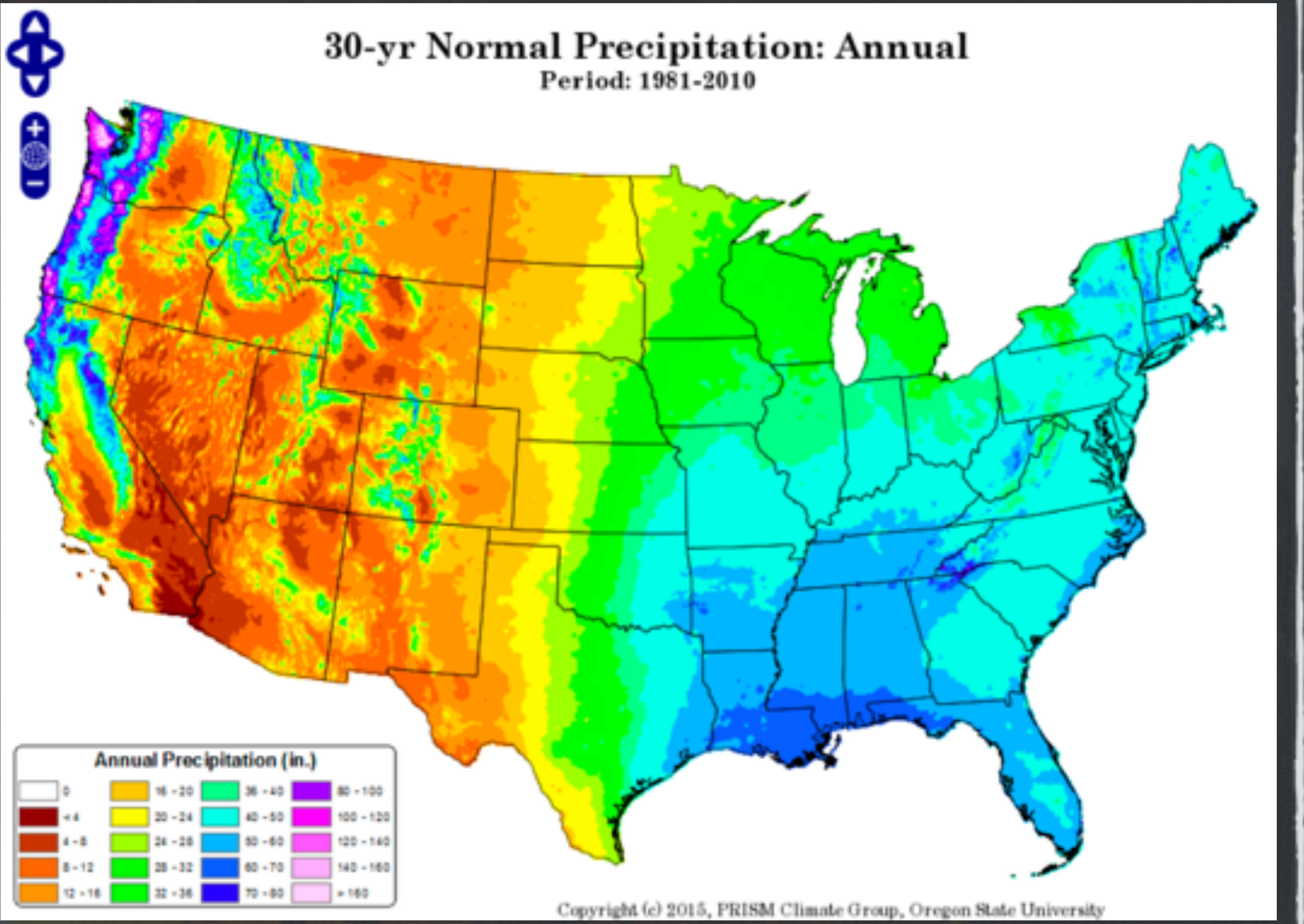
Methods - Precipitation Data

- USGS



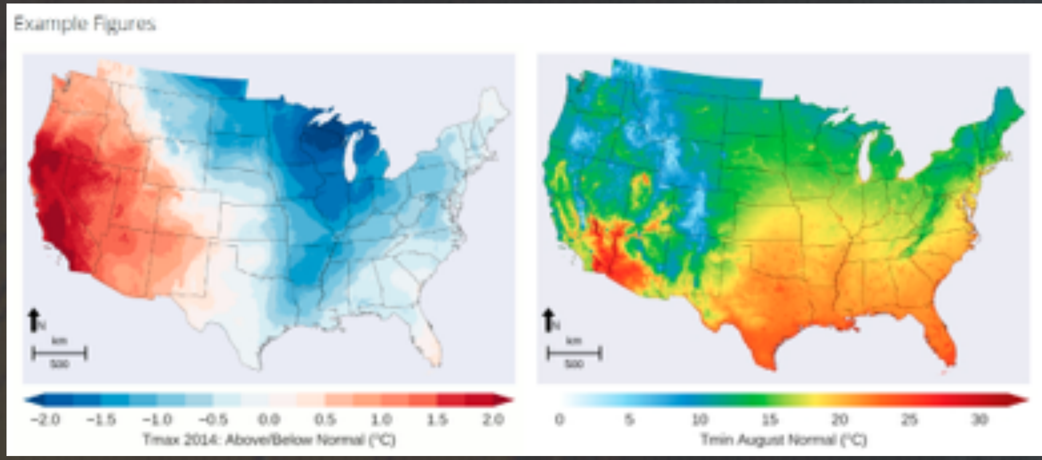
Methods - Precipitation Normals

- PRISM / Oregon State



Methods - Temperature Data

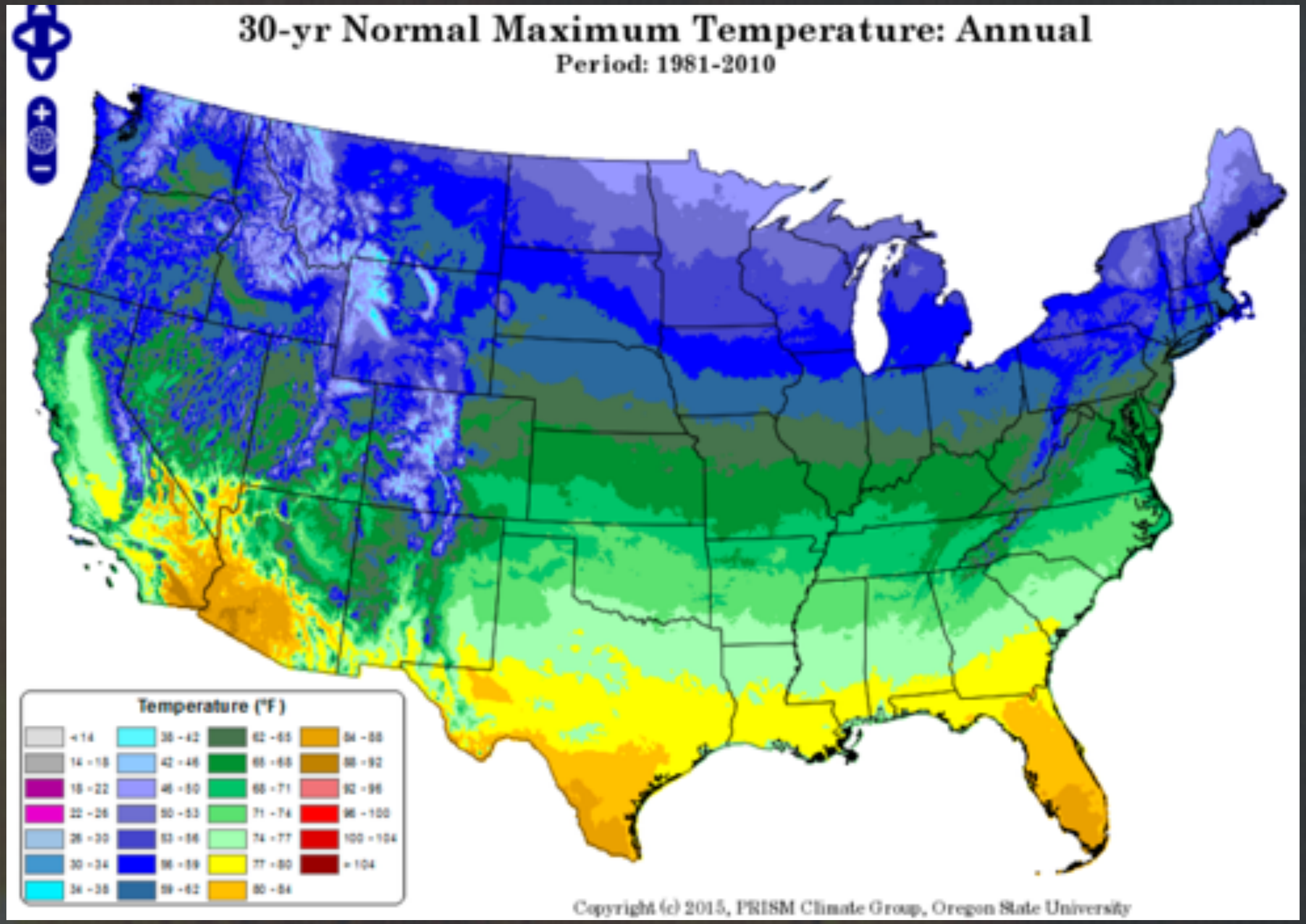
- NetCDF files for climatic temperature data will be obtained for 1984-2014.



- Unpacked in ArcGIS
- NetCDF rasters will then be clipped to show Climatic data for only the State of Colorado during each year.
- Batch tools will be set up to process multiple years at a time.

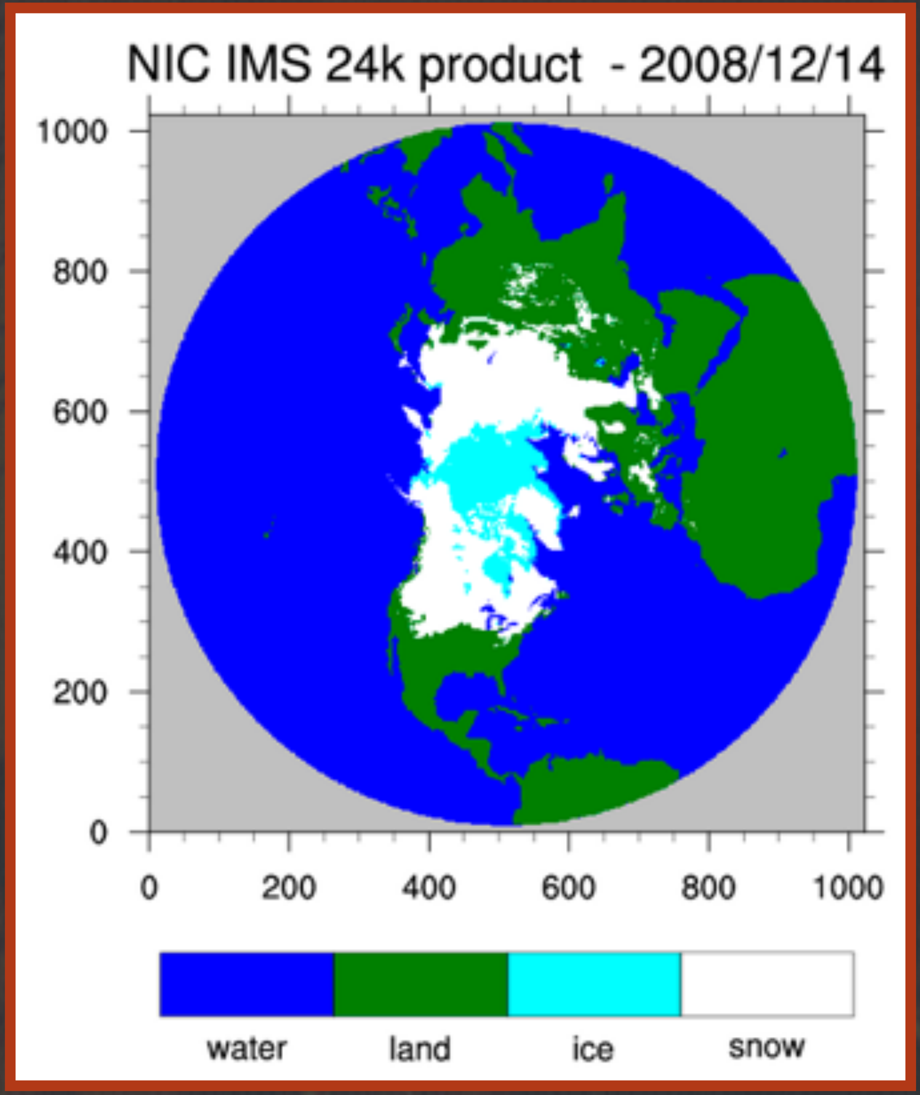
Methods - Temperature Data

- PRISM / Oregon State



Methods - Snow Cover Data

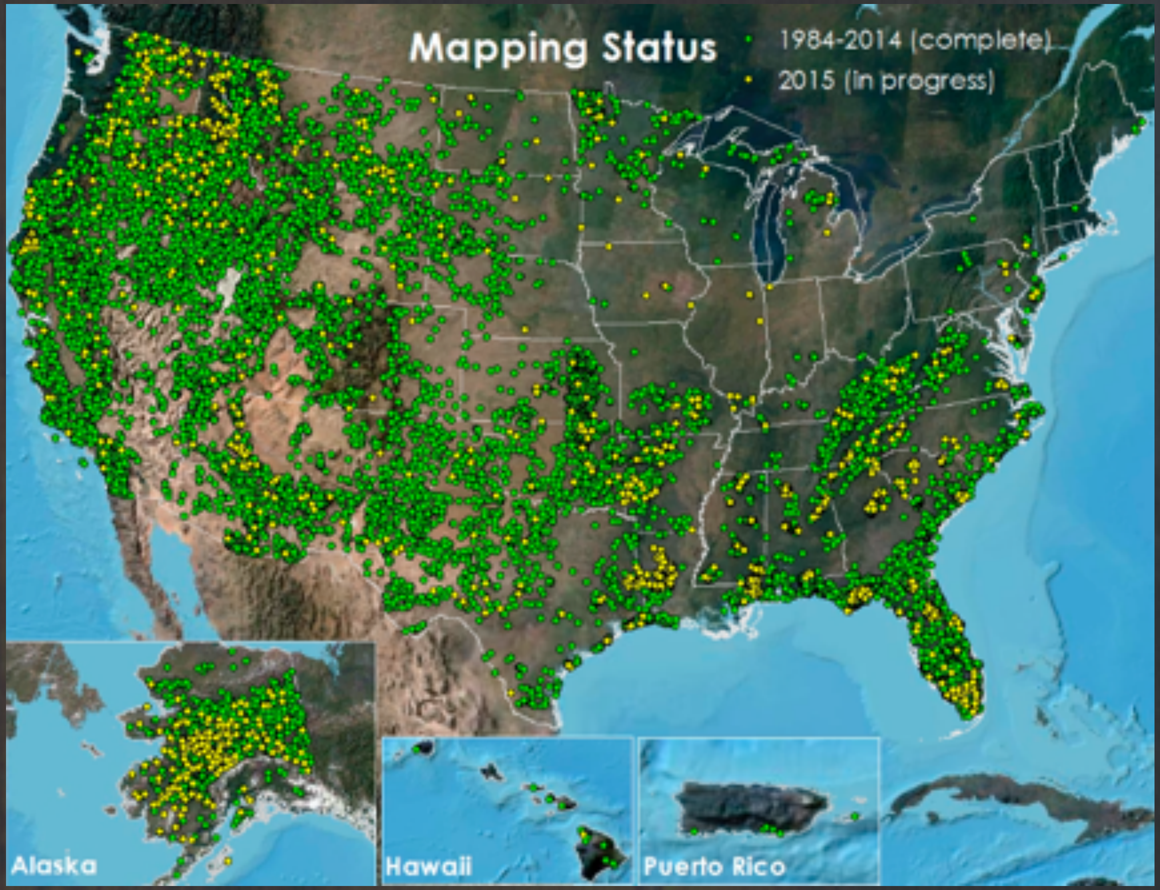
- Snow Coverage
- Snow pack
- NSIDC



Methods - Fire Data

- Data attributes include exact dates, and locations of fires, cause, burnt acreage, size/ severity classification, coordinates/extent, and the monetary cost of the event.

- While a variety of locations and dates may be examined, this project will focus on 1984-2014 in Colorado.



Methods - Fire Data

- Fire mosaics will be obtained from the Forest Service through their “monitoring trends burn severity” services (hereafter referred to as MTBS data).

- Datasets consist of thematic raster images of MTBS burn severity classes for all fires occurring between 1984 and 2014.

- Batch tools will clip .tif files for fires that occurred in only the State of Colorado.

Methods - Analysis

- Search for anomalous or “outlier” weather seasons/events.
- Initial observations will be based on these extreme “outlier” seasons
- How those seasons correlated to fires at that same time, or within the next few months of that time.
- Once extreme events are tied to fire trends in Colorado, general rules and perceptions can be applied to more “average” years in order to confirm or deny initial conclusions.

Project Timeline

December/January 2017	Acquire, process, and organize raw climatic data
Late January	Investigate/Identify extreme and anomalous weather years - compare to snow melt dates!
February	Acquire, process, and organize raw MTBS data
March	Compare extreme weather years to MTBS data, draw initial conclusions
April	Apply initial findings to “average” years
Early May	Conclude investigations and prepare presentation materials
Late May 2017	Present Capstone Research at undetermined venue

Anticipated Results

- Based on previous research, I expect to find that:

1. Warmer, drier years will experience longer, more severe wildfire seasons

2. Winters that experience less precipitation, less snow pack, and earlier snowmelt will also experience a longer, more severe wildfire season.

Questions

Sources

1. Westerling, A. L. et al. "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity." Science, vol. 313, no. 5789, 2006, pp. 940–943. www.jstor.org/stable/3846972

2. http://www.fs.fed.us/rm/pubs_other/rmrs_2014_short_k001.pdf

3. Nelson, K.J., Long, D.G., and Connot, J.A., 2016, LANDFIRE 2010—Updates to the national dataset to support improved fire and natural resource management: U.S. Geological Survey Open-File Report, 2016–1010, 48 p, http://dx.doi.org/10.3133/ofr20161010

4. Yongqiang Liu, Scott L. Goodrick, John A. Stanturf. "Future U.S. wildfire potential trends projected using a dynamically downscaled climate change scenario." Forest Ecology and Management, vol 294, 15 April 2013, pp. 120–135. http://www.sciencedirect.com/science/article/pii/S037811271200388X

5. Akira S. Moria, Edward A. Johnsonb, "Assessing possible shifts in wildfire regimes under a changing climate in mountainous landscapes" Forest Ecology and Management. vol 310, 15 December 2013, pp 875–886. http://www.sciencedirect.com/science/article/pii/S0378112713006506

6. http://www.mtbs.gov/nationalregional/download.html

Image URLs

1. https://routingfreak.wordpress.com/2013/06/23/dns-poisoned-for-linkedin-affects-us-sure-it-does/
2. https://artsandsciences.colorado.edu/mag-old/2015/10/dont-blame-spruce-beetles-for-colorado-wildfires/
3. http://www.justinholman.com/2012/06/28/over-1-million-colorado-residents-live-in-high-fire-risk-locations/
4. http://www.alnozom-egypt.com/en/ser_dit.php?id=3
5. http://www.deercreekgis.com/assessment/
6. http://www.landfire.gov/refresh_overview.php
7. https://en.wikipedia.org/wiki/LANDFIRE
8. http://science.sciencemag.org/content/313/5789/940.full
9. http://footage.framepool.com/en/shot/904403759-snow-crystal-ice-crystal-snowmelt-melting
10. http://wildfiretoday.com/2015/09/02/researchers-attempt-to-quantify-how-climate-change-will-affect-wildfire-seasons/
11. http://prism.oregonstate.edu/normals/
12. http://www.mtbs.gov/nationalregional/download.html
13. http://nsidc.org/data/G02156/versions/1/print/
14. http://water.usgs.gov/floods/events/2013/SepCO/

Image URLs Cont

15. http://www.cpc.ncep.noaa.gov/products/site_index.shtml
16. http://www.scrimhub.org/resources/topowx/