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For the best of reasons

Decoding the August Complex Fire: Investigating the Atmospheric and Surface Characteristics Driving One of California's Largest Wildfires

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Motivation

- Dry, hot, and windy conditions are known to be primary conditions for ignition and spreading of wildfires
- Increasing trend in wildfire frequency and size across the western United States (Westerling et al., 2006; Dennison et al., 2014; Weber and Yadav, 2020)
- Many models (e.g., Fast Fuels, QUIC-Fire, Wildfire Digital Twin model, etc.) are mostly utilized for modeling active-fire behaviors
- Responding to wildland fires requires extensive collaborations so as much warning prior to an extreme event may lower costs, resources, and mitigate damages

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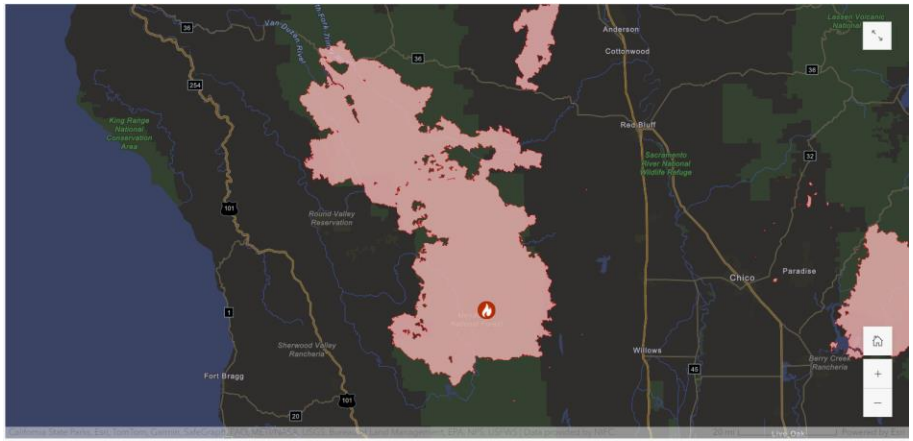
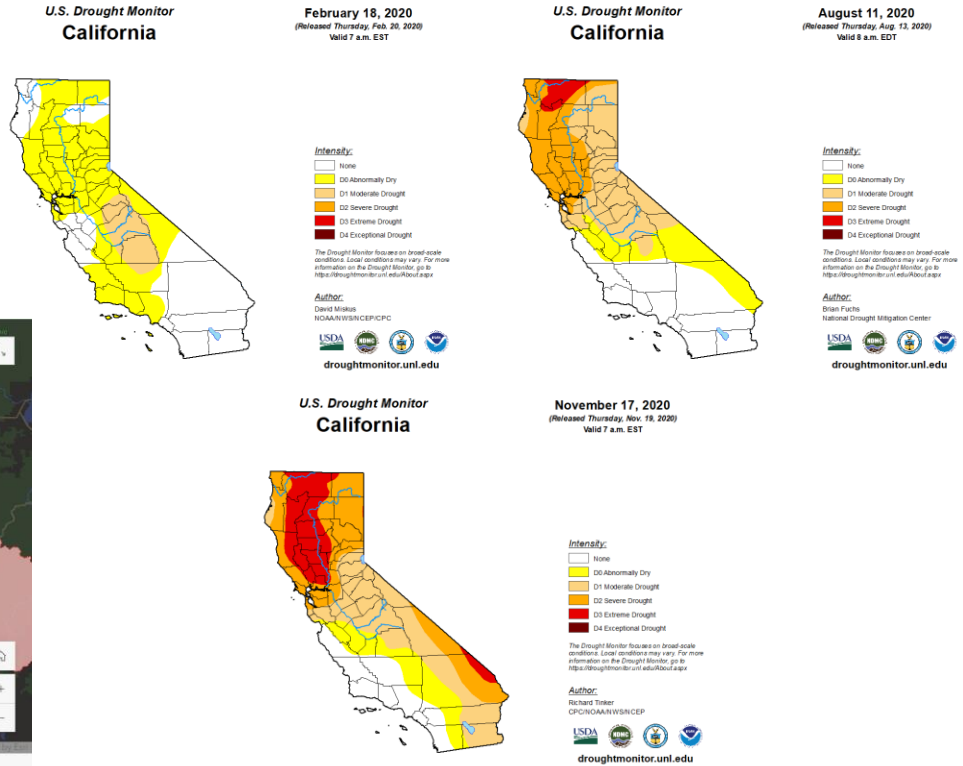
August Complex Fire: Background

- Start Date: August 16, 2020
- End Date: November 11, 2020
- Total Acres Burned: 1,032,648
- Estimated Damage Cost: $115 million US

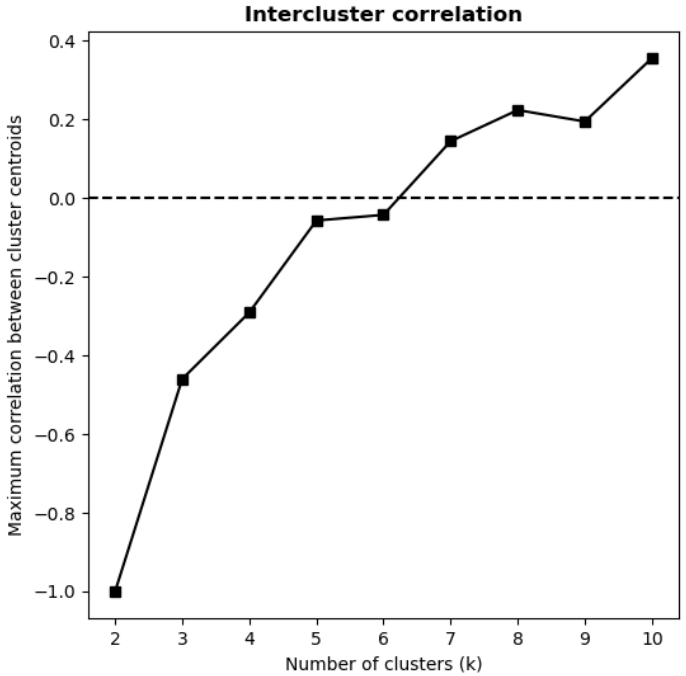


Wildfire Perimeters 2020

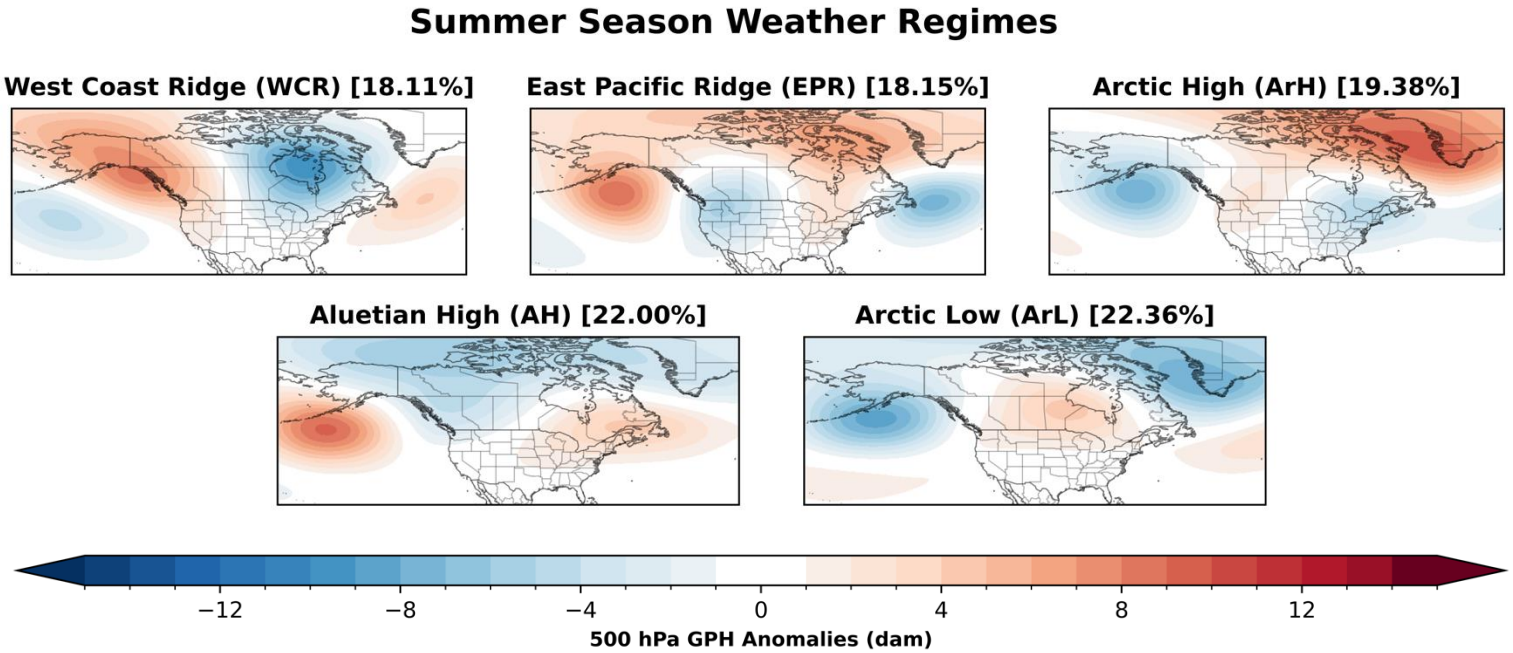


Weather Regimes Methods

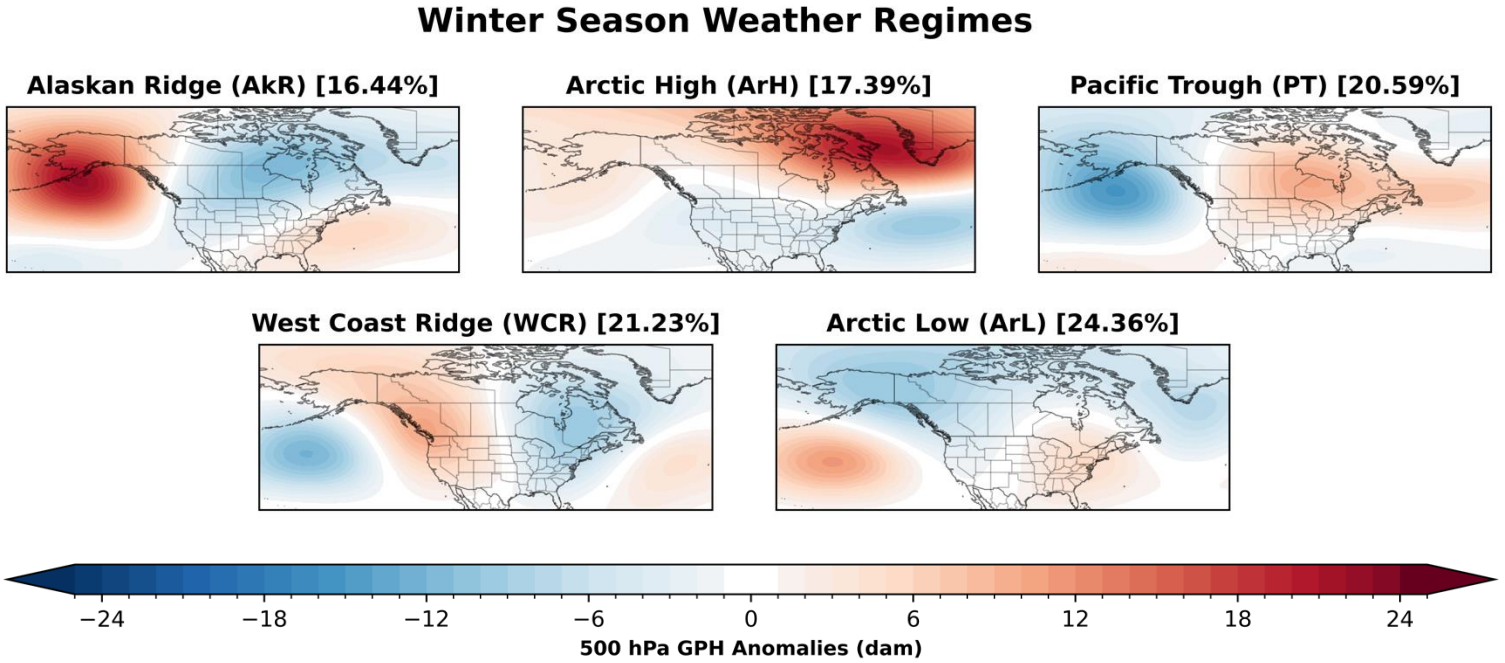
- Pacific-North American Region (180°-30°W, 20°-80°N)
- The empirical orthogonal function (EOF) was applied to linearly detrended summer (winter) 500 hPa geopotential height anomalies [ERA5] from May (November) 1950 through September (March) 2023 (Lee et al. 2019, Millin et al. 2022, Lee et al. 2023)
  - 16 leading Principal Component explains 80% of variance → summer
  - 12 leading Principal Component explains 80% of variance → winter
- The optimal k-means cluster size (k) was determined through intercluster correlation analysis
  - Correlation between each centroid based on the k-means cluster size (Lee et al. 2023)



Summer Weather Regime Classifications



Winter Weather Regimes



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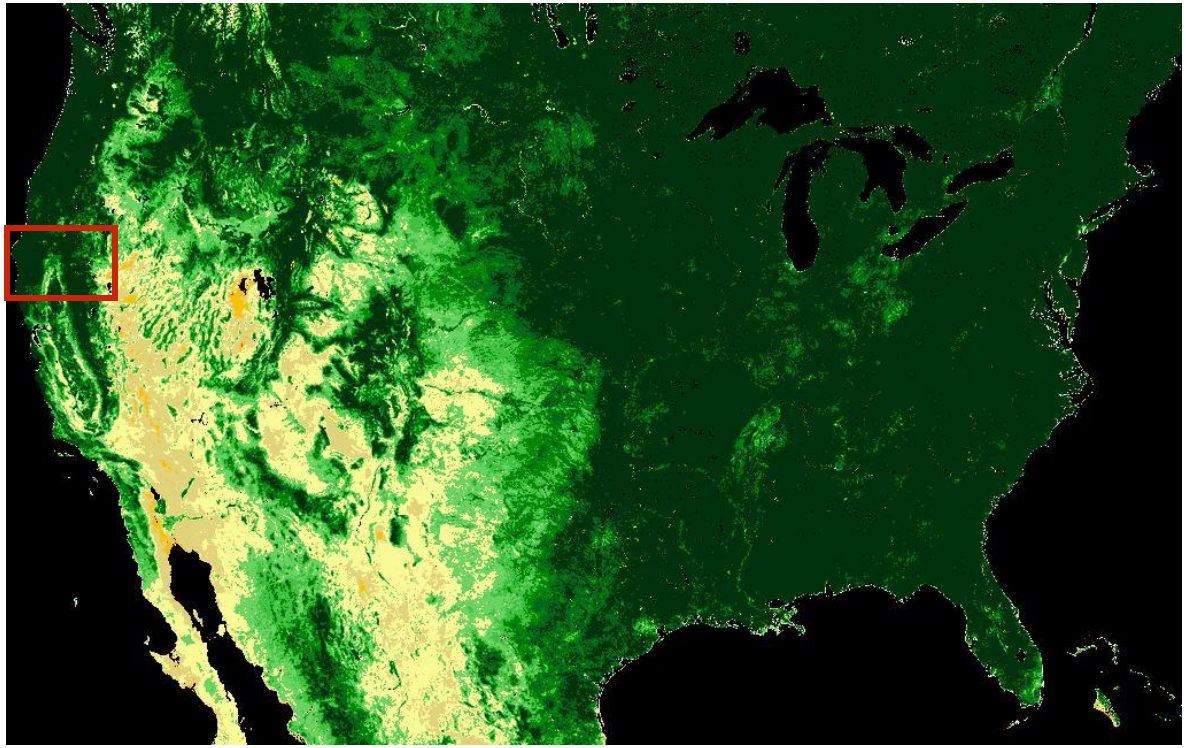
Land Conditions: Before, During and After

Normalized Difference Vegetation Index (NDVI) on June 29, 2020



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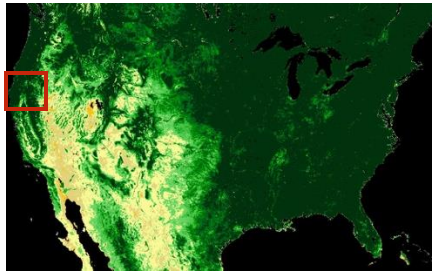
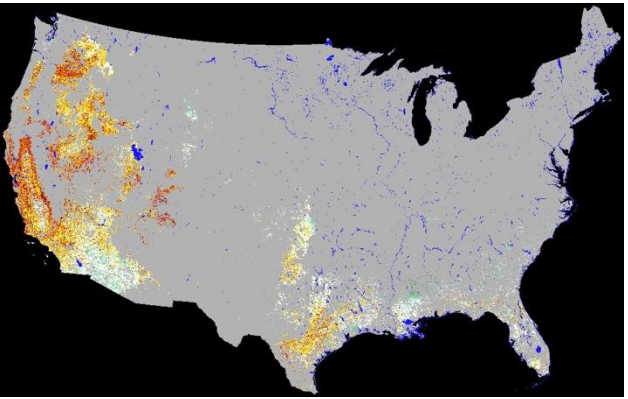
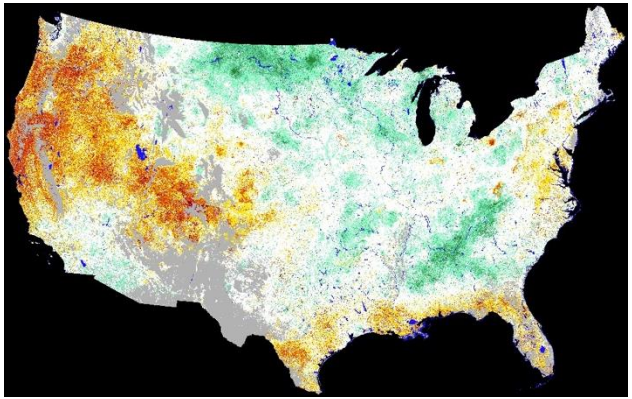
Land Conditions: Before, During and After



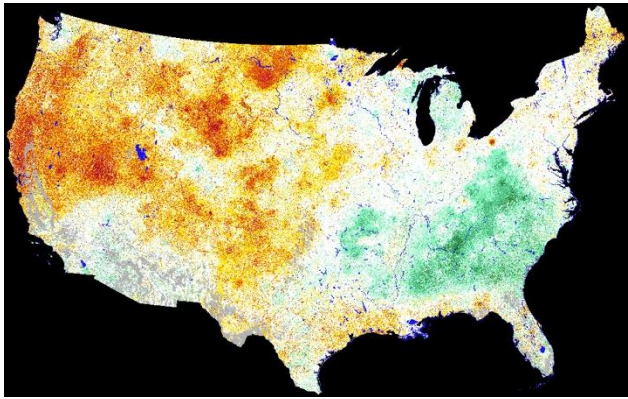
VegDRI



March 21, 2020



April 19, 2020



June 21, 2020

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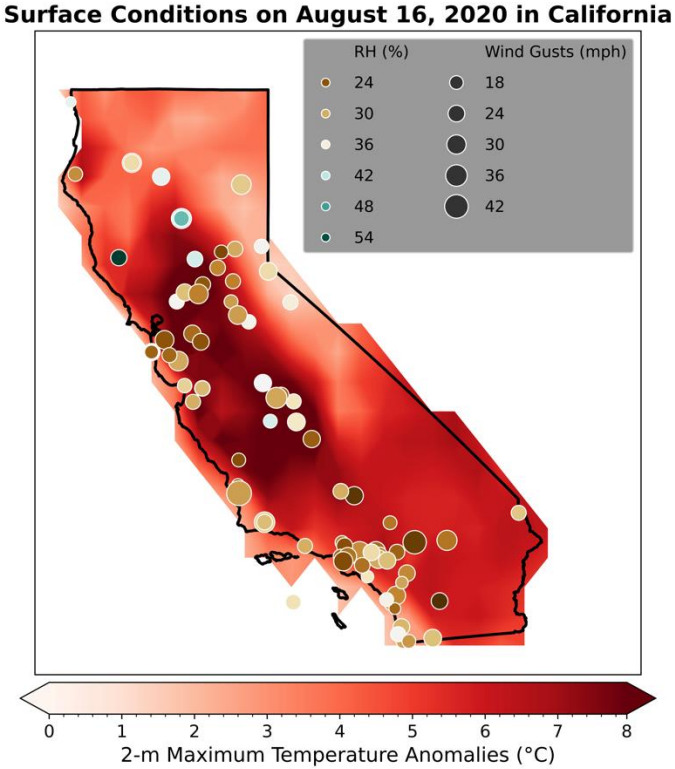
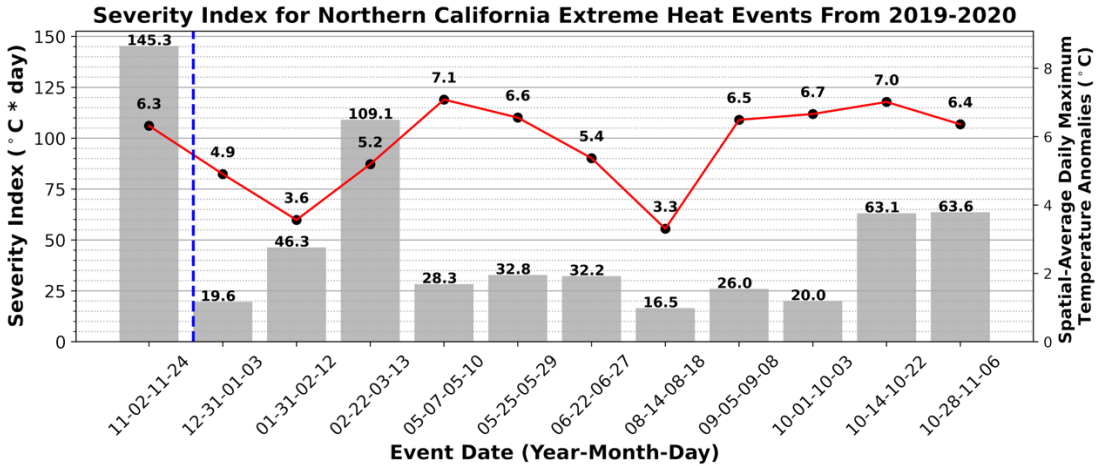
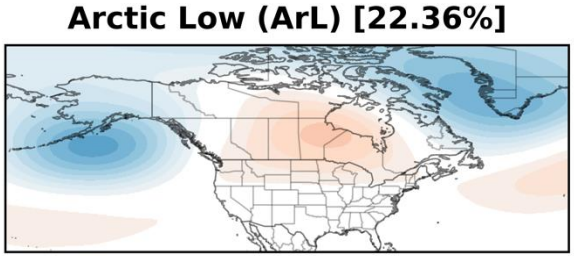
Temperature & Surface Conditions

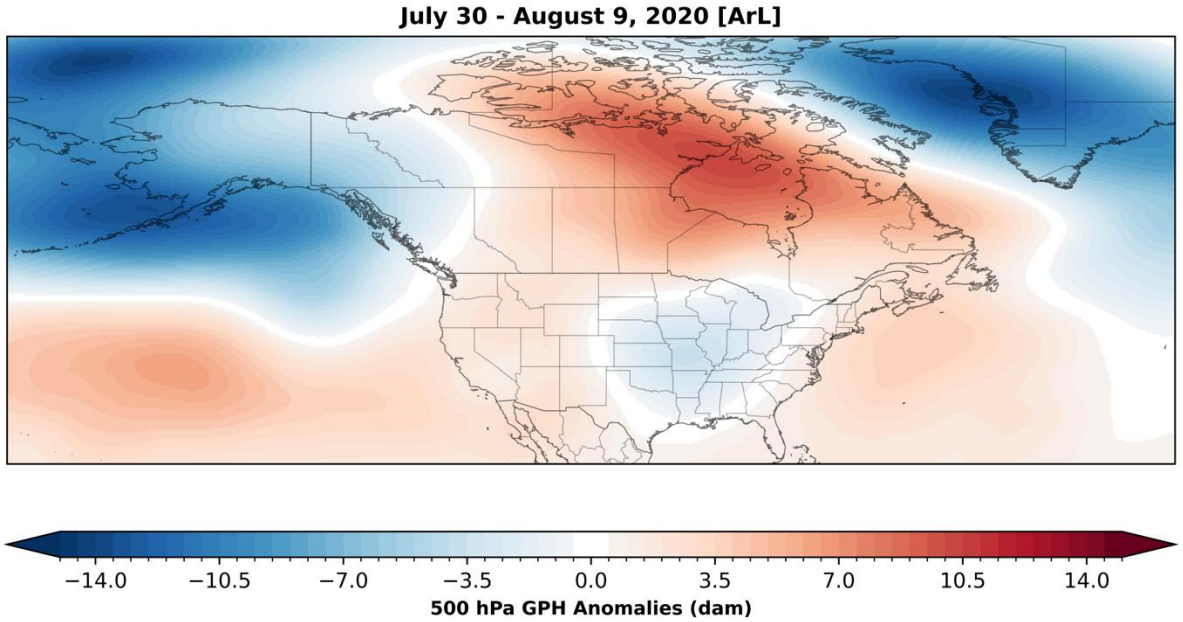




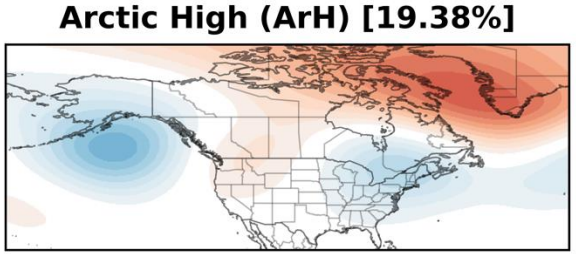
Temperature & Surface Conditions

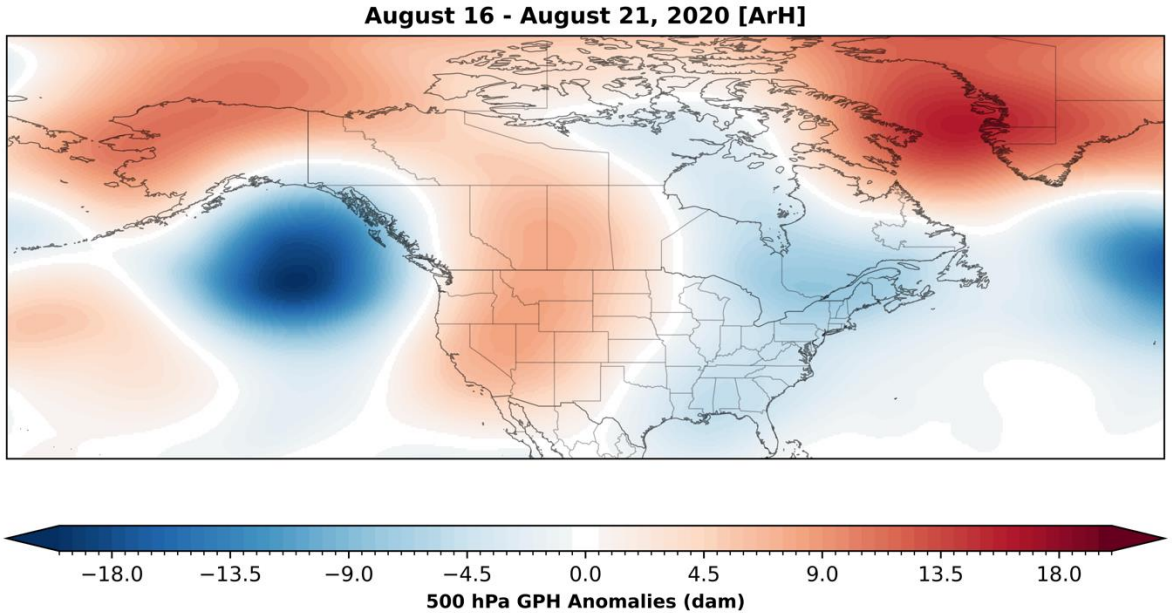
Weather Regimes: Before



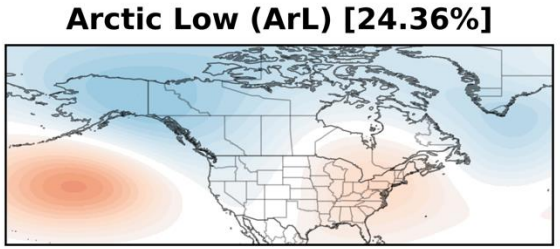


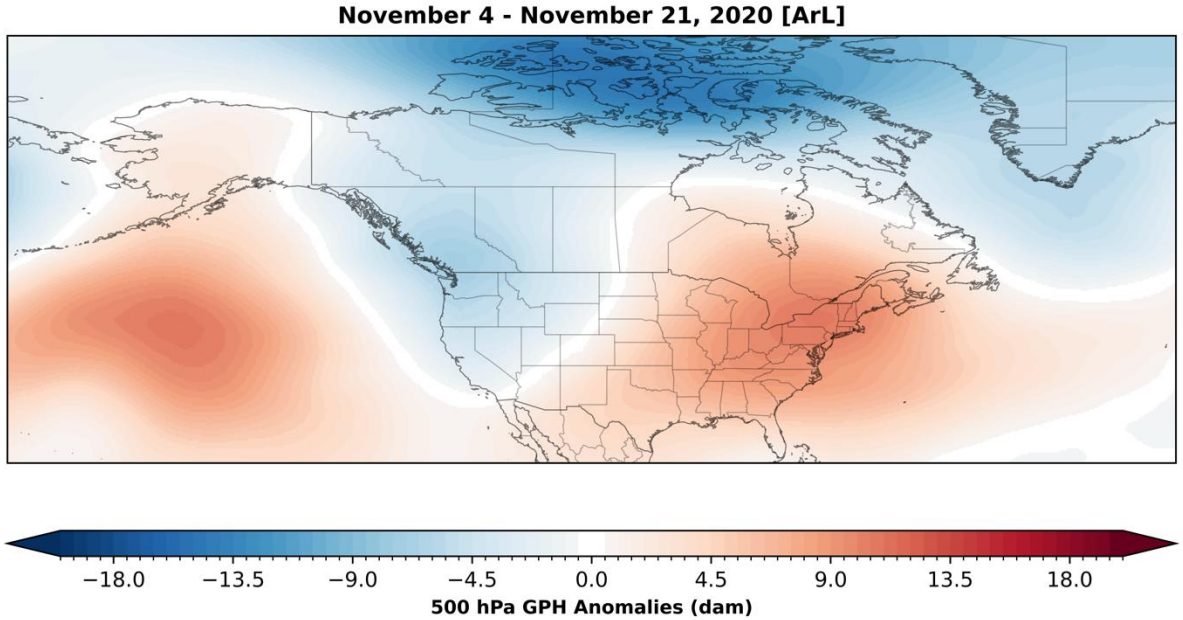
Weather Regimes: During





Weather Regimes: After





What does this mean for wildfire prediction?

- An above normal significant wildfire potential starting on the June 2020 outlook was outlined for northern CA, NV, and southern OR (NIDIS, 2020) → **important proactive resource**
- **Extreme weather events that aid wildfire development and influence fire behavior currently have low predictions greater than 5-10 days**
- ***A Noblis project aims to leverage AI/ML techniques with subseasonal-to-seasonal (i.e., 2 weeks – 2 months; S2S) weather extreme expertise to build upon foundations of current wildfire modeling and crucial wildfire occurrence resources to enhance predictive models***
  - Weather regime classifications could serve as a S2S predictor

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Conclusions & Future Work

- Extremely dry land conditions with lavish vegetation led to increased risk of wildfire fuel prior to the August Complex Fire
- Prior to the August Complex Fire, ***ArL summer weather regime*** dominated the Rossby wave pattern **two weeks prior** to the extreme event
- At the onset and the rapid spreading of multiple fires, ***ArH summer weather regime*** dominated from **August 16-21, 2020**
- Toward the ending of the August Complex Fire, ***ArL winter weather regime*** was present from **November 4-21, 2020**

- Future Work: employ AI/ML techniques to simulate the complex land-atmospheric interactions during wildfire cases

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Thank You

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