





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

Lead: Taylor Grace, Global Climate Change Postdoctoral Fellow Contributors: Tracy Mallard, Sarah Medepalli

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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 ٠
- End Date: November 11, 2020 ٠
- Total Acres Burned: 1,032,648 ٠
- Estimated Damage Cost: \$115 million US •



Wildfire Perimeters 2020



February 18, 2020 (Released Thursday, Feb. 20, 2020) Valid 7 a.m. EST

Intensity:

Author:

David Miskus

NOAA/NWS/NCEP/CPC

None

D1 Moderate Drougt

D2 Severe Drouth

D3 Extreme Drought

D4 Exceptional Drough

The Drought Monitor focuses on bross rine unought Monitor tocuses on broad-aca conditions. Local conditions may vary. For in information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aapx

NDHE droughtmonitor.unl.edu

California

U.S. Drought Monitor California

August 11, 2020 Released Thursday, Aug. 13, 2020) Valid 8 a.m. EDT



November 17, 2020 (Released Thursday, Nov. 19, 2020) Valid 7 a.m. EST



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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)
 - o 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

Summer Season Weather Regimes

West Coast Ridge (WCR) [18.11%]



East Pacific Ridge (EPR) [18.15%]



Aluetian High (AH) [22.00%]

Arctic High (ArH) [19.38%]



Arctic Low (ArL) [22.36%]







Winter Weather Regimes

Winter Season Weather Regimes



Arctic High (ArH) [17.39%]



Pacific Trough (PT) [20.59%]



West Coast Ridge (WCR) [21.23%]







Land Conditions: Before, During and After

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



Land Conditions: Before, During and After



VegDRI



March 21, 2020

April 19, 2020

June 21, 2020

Temperature & Surface Conditions

Surface Conditions on August 16, 2020 in California



Temperature & Surface Conditions



Weather Regimes: Before

Arctic Low (ArL) [22.36%]



July 30 - August 9, 2020 [ArL]





Weather Regimes: During

Arctic High (ArH) [19.38%]



August 16 - August 21, 2020 [ArH]





Weather Regimes: After

Arctic Low (ArL) [24.36%]



November 4 - November 21, 2020 [ArL]





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 Al/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 <u>two weeks prior</u> to the extreme event
- At the onset and the rapid spreading of multiple fires, ArH summer weather regime dominated from <u>August 16-21, 2020</u>
- Toward the ending of the August Complex Fire, ArL winter weather regime was present from <u>November 4-21, 2020</u>
- <u>Future Work:</u> employ AI/ML techniques to simulate the complex landatmospheric interactions during wildfire cases

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Taylor Grace

Global Climate Change Postdoctoral Fellow

Taylor.Grace@noblis.org



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