Mapping the Flames: Identifying Atmospheric and Surface Factors that Influenced the August Complex Fire as Foundation for an Early Warning Wildland Fire System

Taylor Grace, Tracy Mallard, and Sarah Medepalli

Noblis, Reston, VA

Correspondence: Taylor.Grace@noblis.org

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For the best of reasons

Key Points

- **Drought conditions began in northern California which was tied to multiple extreme heat events from November 2019 through February 2020**
- **Aleutian High summer weather regime caused persistent high pressure over northern California 3 weeks leading up to the first wildfire ignition**
- **Atmospheric and surface interaction conditions promoted dry vegetation fuel and supported wildfire development**

Data & Methods

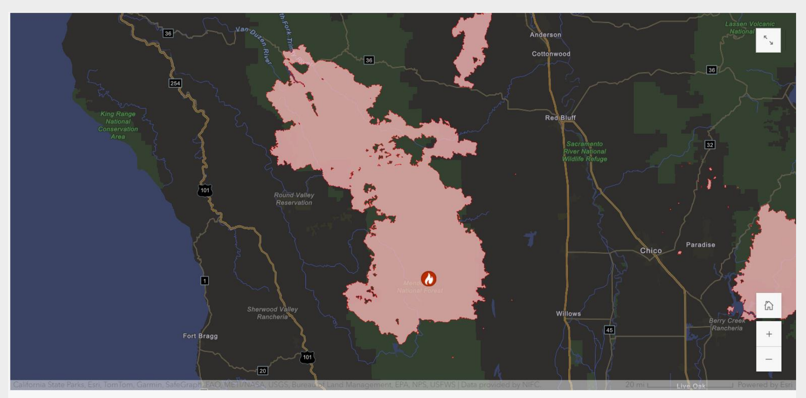
- 5th generation the European Centre for Medium-Range Weather Forecasts (ECMWF) Atmospheric Reanalysis (Herbasch et al. 2020) – spatial resolution (0.25°x0.25°)
  - 2-m temperatures
  - 500 hPa geopotential heights
- Automated Surface Observing Systems (ASOS; NOAA et al. 2005)
- All anomalies were derived using the 1950-2022 climatology period on a daily timestep

Background

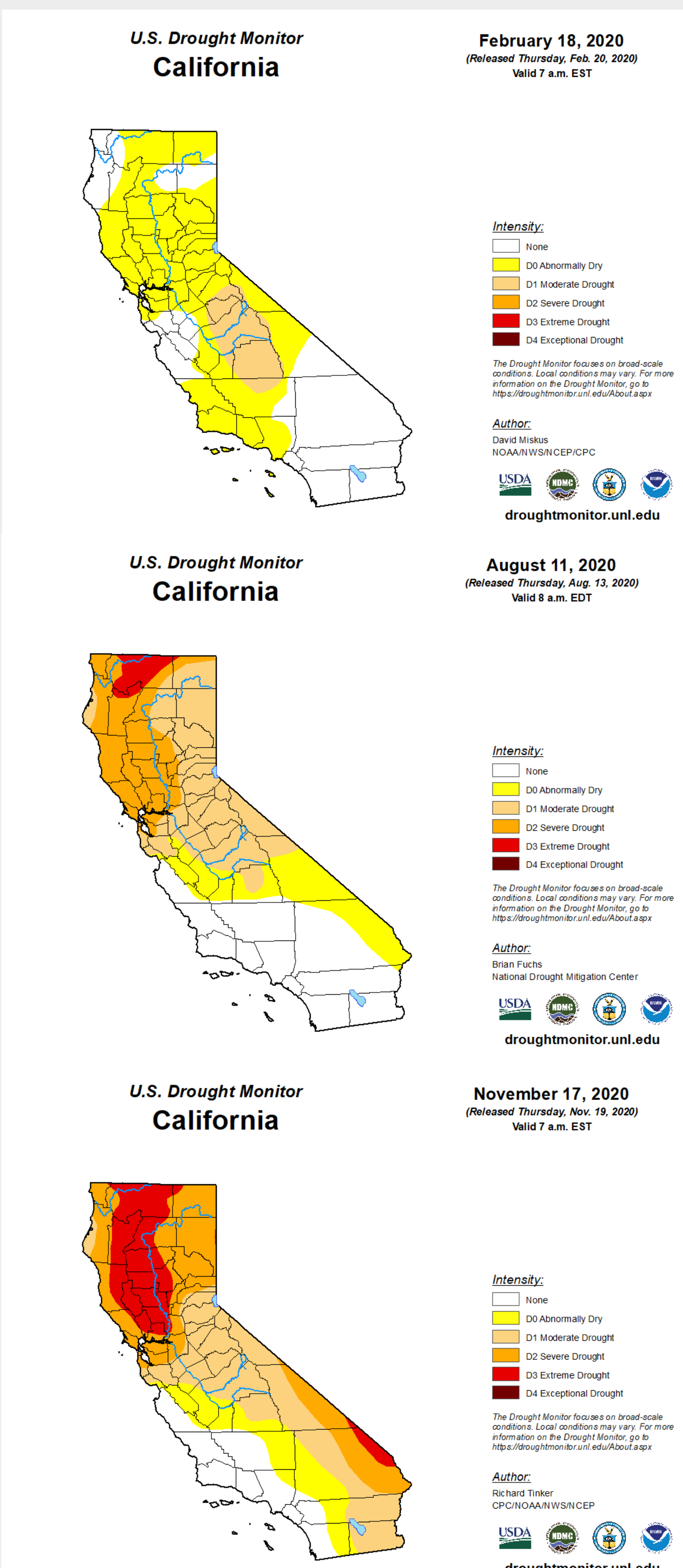
The August Complex Fire is the leading largest wildfire that has impacted California.

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

Tropical Storm Fausto dispersed a plume of moist air northward. This column of moist air interacted with hot & dry conditions over California and Nevada that was present for months. The plume of moisture resulted in atmospheric instability producing more than *12,000 cloud-to-ground lightning strikes* over three days (8/16-8/18/2020). Over 500 ignitions were generated, which **37 fires** would progress to classify the August Complex Fire. (NICC, 2020; Cal Fire, 2022)



Cal Fire- Forest Health Program, 2022



USDM, 2020

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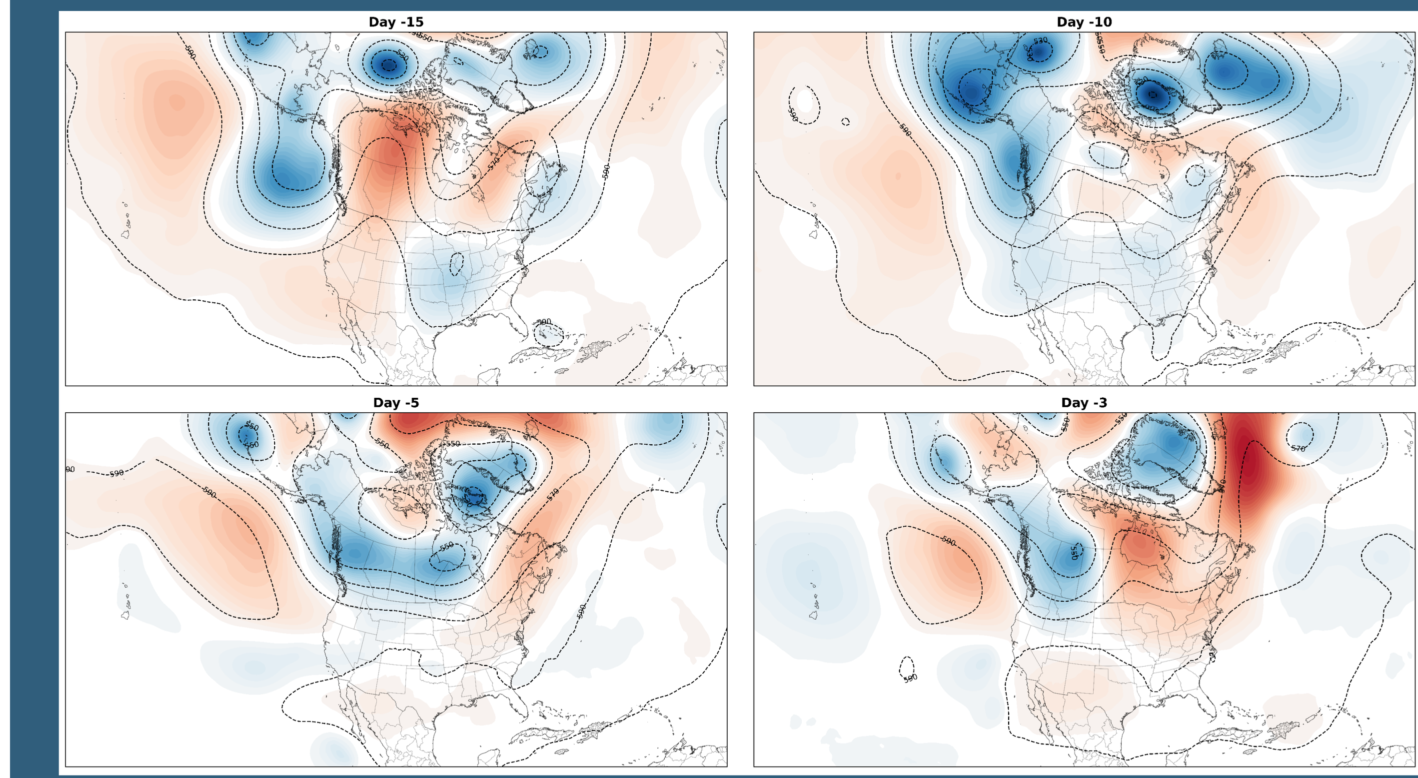
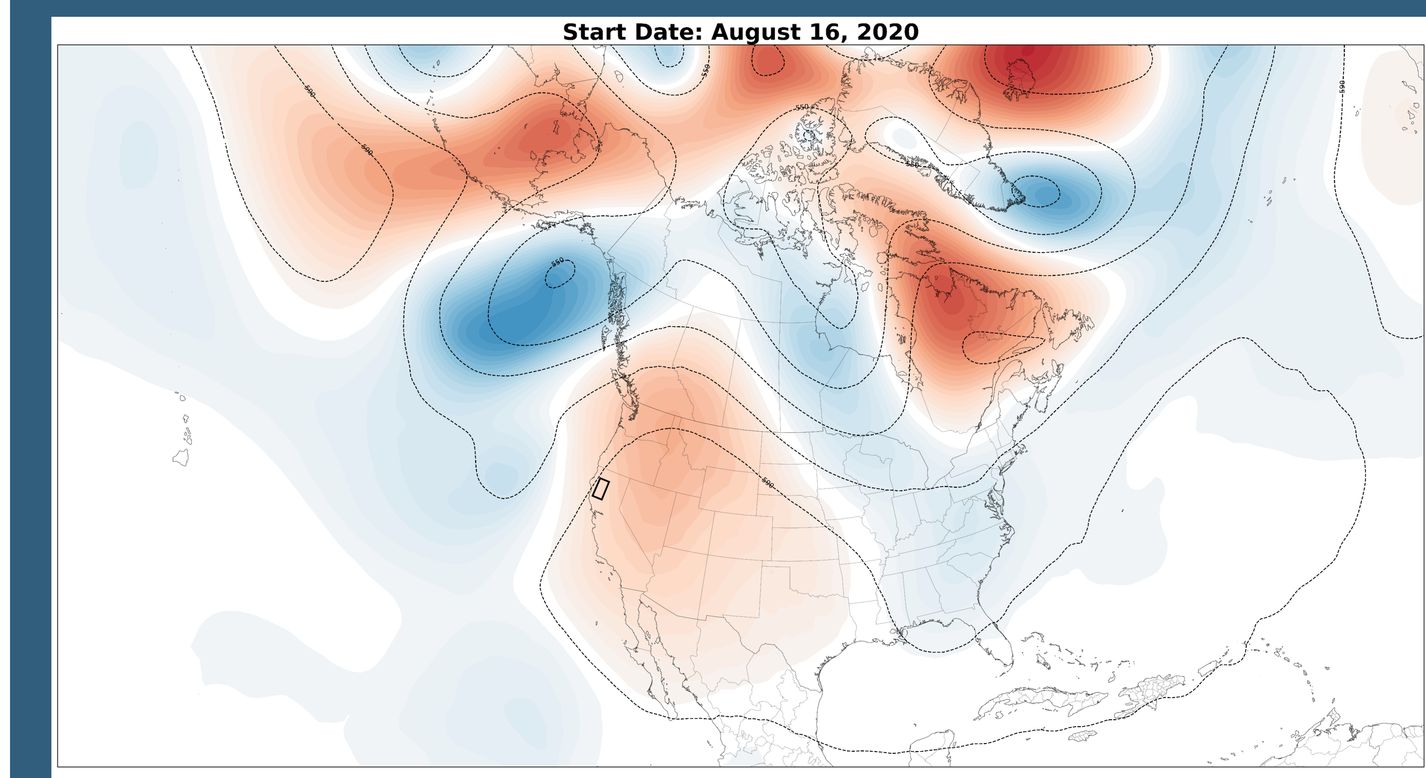
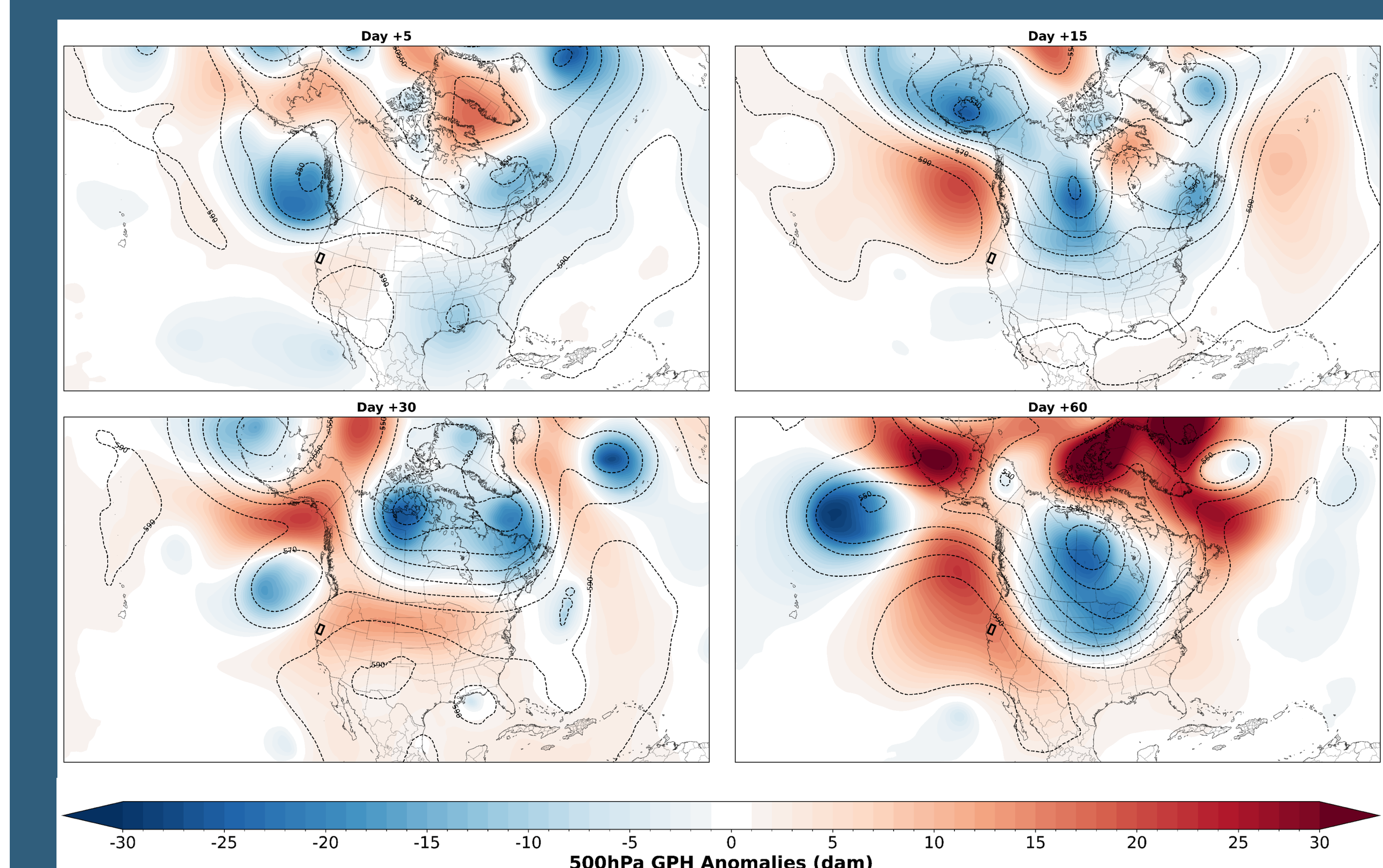
500 hPa Geopotential Heights

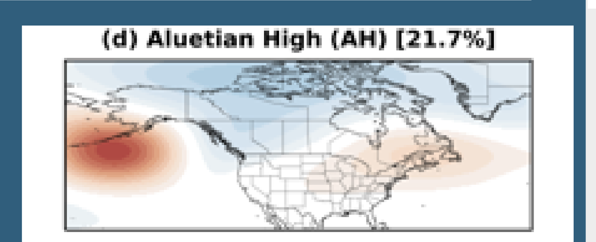


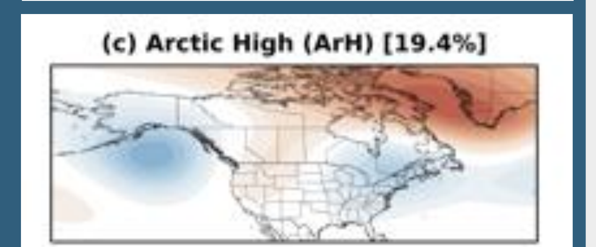




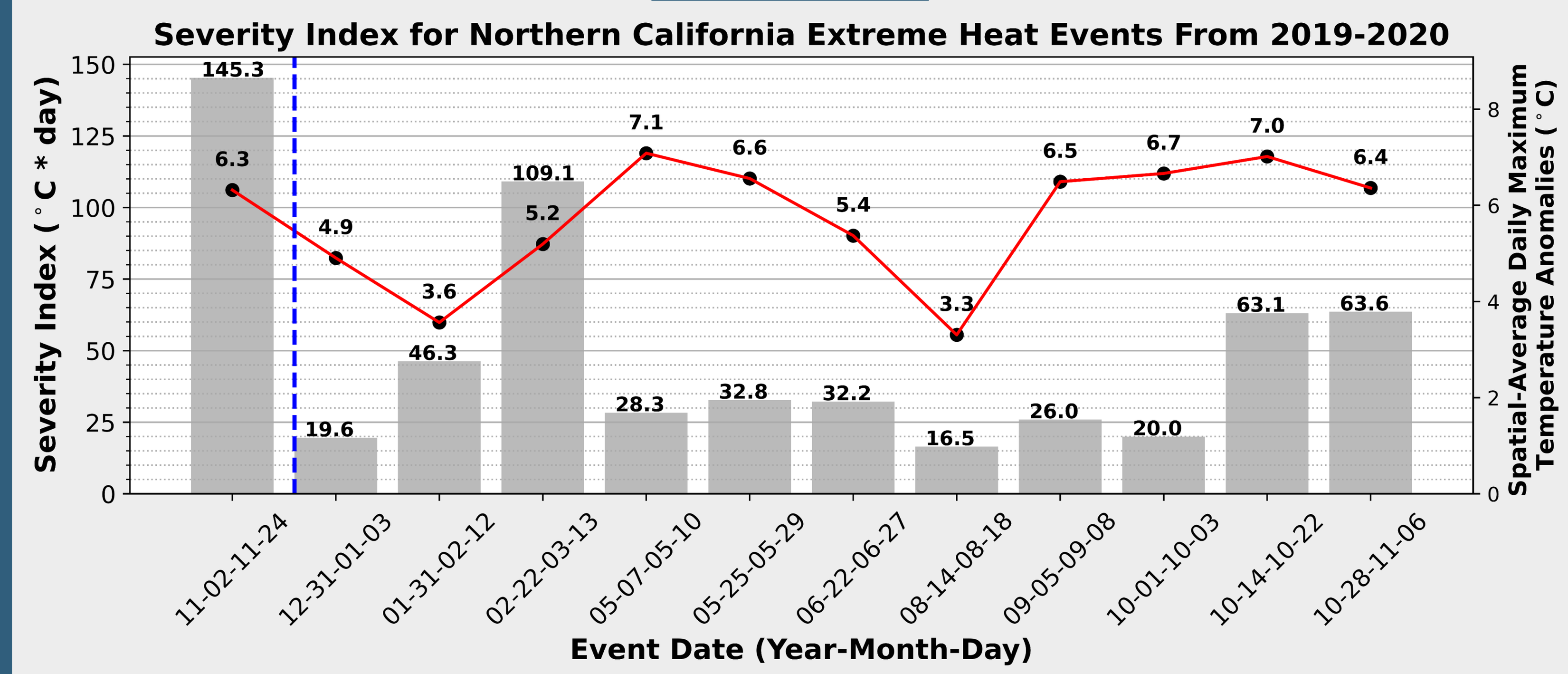
Persistent atmospheric ridging (i.e, high pressure) was frequent across northern California before, during, and after the initial ignition of the August Complex Fire.

July 30, 2020, through August 10, 2020, Rossby wave pattern was classified as ***an Aleutian High summer weather regime***. This regime transitioned into an ***Arctic High summer weather regime*** from August 16, 2020, through August 28, 2020.





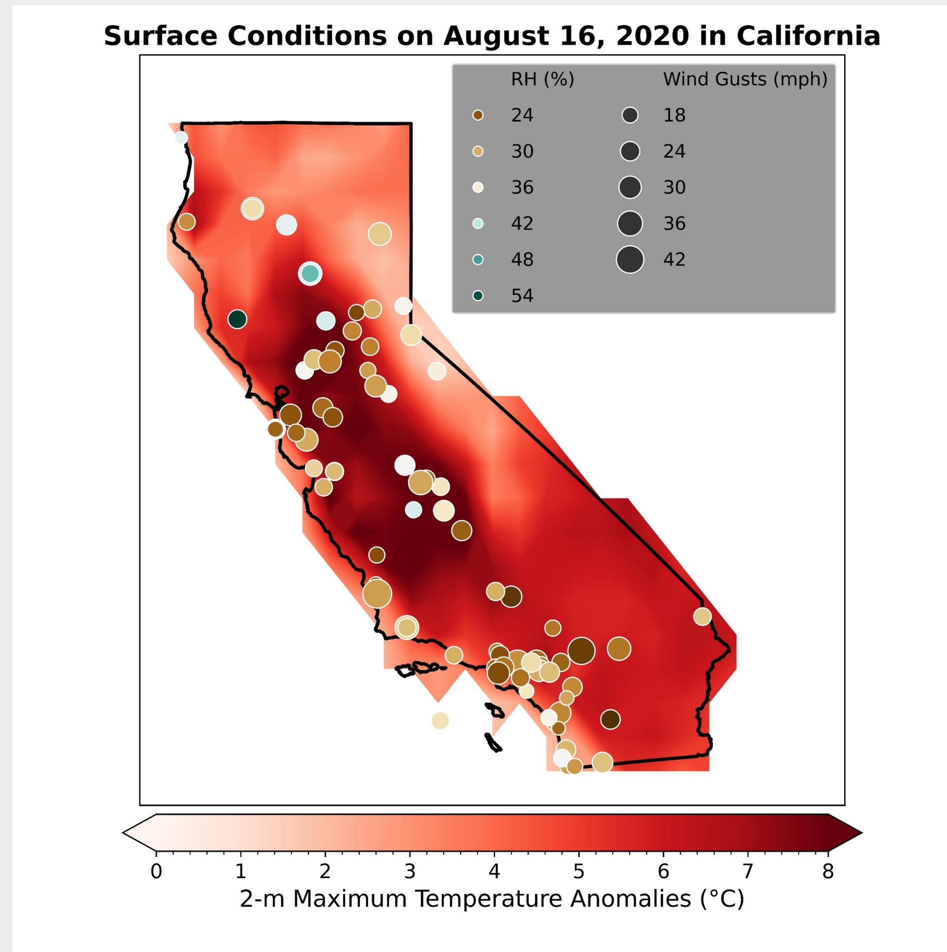
Extreme Heat

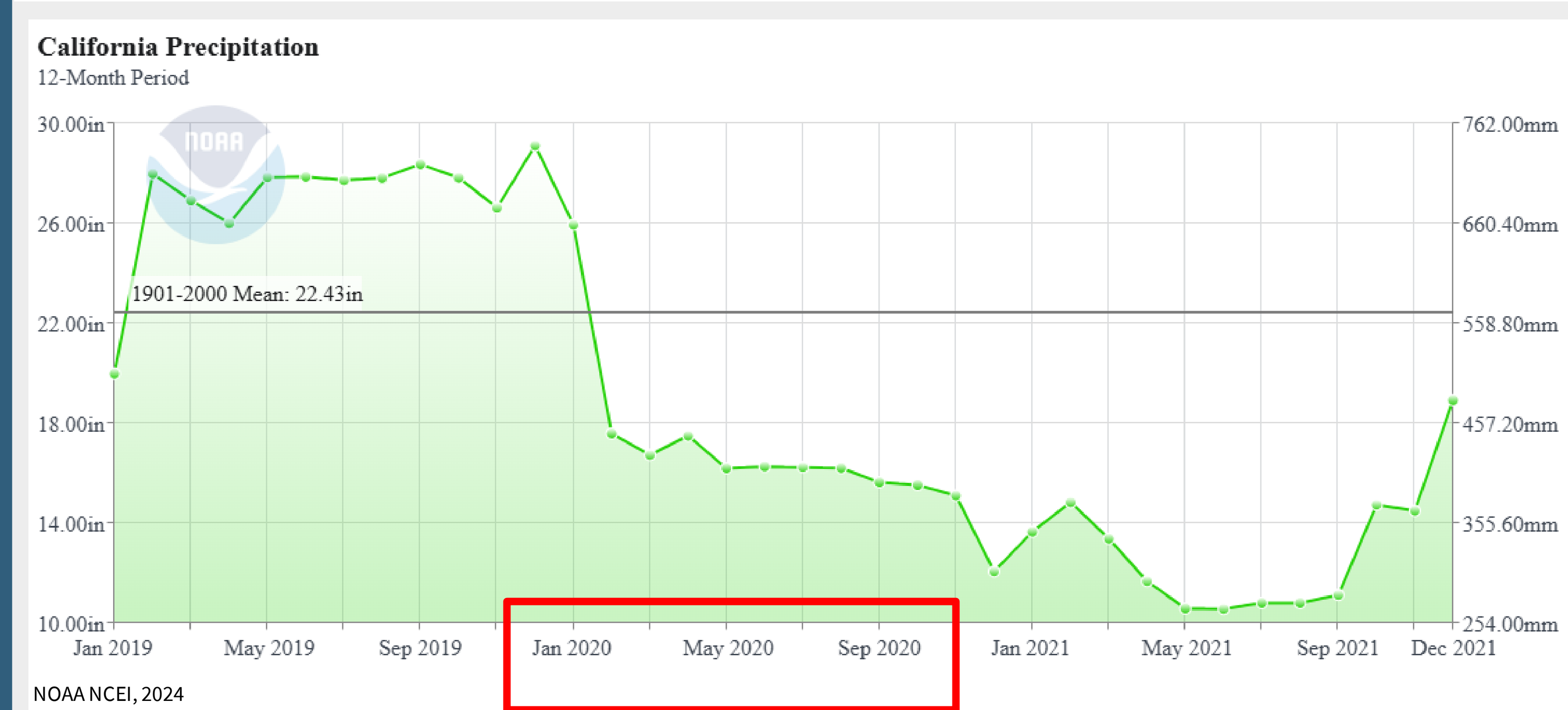


Above normal precipitation until January **followed by several extreme heat events** during February resulted in an **early green-up in vegetation** across California.

Multiple extreme heat events that contained high daily maximum temperature anomalies (> 5°C) **coupled with below normal precipitation** resulted in **quick drought and drying of flourished vegetation at the surface** → ***fuel for wildfires***

Further, **low relative humidities and high wind gusts (> 25 mph) increased *ignition and spread*** **Multiple extreme heat events** during the burning of the 37 wildfires ***fed increased fire behavior***





Motivation for Noblis Sponsored Research Enhanced Monitoring for Better Emergency Response (EMBER) Project

- An above normal significant wildfire potential starting on the June 2020 outlook was outlined for northern CA, Nevada, and southern Oregon (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**
- ***The NSR EMBER project can leverage AI/ML techniques with subseasonal-to-seasonal (i.e., 2 weeks – 2 months) weather extreme expertise to build upon foundations of current wildfire modeling and crucial wildfire occurrence resources to enhance predictive models.***