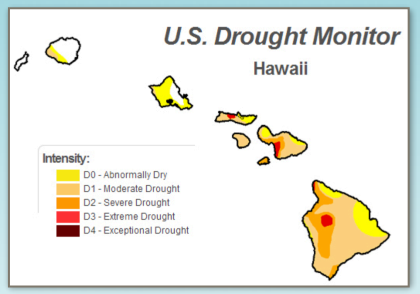
Pacific Fire Exchange
Climate Change Series | September 2022
Joint Fire Science Program

Changing Climate and Wildfire in Hawai'i:
Current Observations and Future Projections

As the climate crisis intensifies, weather extremes such as drought, intense rainfall and wildfires are expected to increase in Hawai'i with the most drastic effects expected by mid-century.

As our climate warms, Hawai'i as we know it is changing.



Weather extremes such as drought and intense rainfall are already happening and are expected to become more frequent as the climate warms, causing fires to be more frequent, widespread & last longer lasting.

More than 25% of the state is covered in non-native grasses, making our landscape especially sensitive to more variable and unpredictable rainfall. Vegetation "green-up" after rainy events followed by drought creates high fire risk in both leeward and windward areas.

The largest increase in future fire risk is expected across upper elevation areas. This may pose challenges for both ecosystem conservation and fire suppression since road and water access in these areas are typically limited.

Regional spotlight
Maui 2019 fires

With little rain and record-breaking heat, more than 25,000 acres burned on Maui in 2019. This marked the island's worse fire year ever.

Specifically, multiple fire responders pointed to climate change, in particular, when discussing the 9,000 acre Waiko Road Fire. They said that the speed and intensity of this grassland fire was something they "had never experienced before." Along with high winds, the temperature topped 93 degrees at Kahului, 9 degrees above average, with very low relative humidity (34%).

As a result, the fire growth was explosive with little chance for containment and incredibly dangerous conditions for fire responders and the community. The Waiko Road Fire also threatened Maui Electric Co.'s Ma'alaea Power Plant that supplies electricity to 80% of the island.

This fact sheet was co-produced by Hawai'i Wildfire Management Organization and University of Hawai'i Cooperative Extension Wildland Fire Program on behalf of the Pacific Fire Exchange project, which is funded by the Joint Fire Science Program. Photo credits: U.S. Drought Monitor and The Maui News/Matthew Thayer.

HAWAI'I WILDFIRE HWMO MANAGEMENT ORGANIZATION
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Fire Science Summary

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Scope & Methodology

- Using an analysis developed for Hawai'i Island[1], **fire probability maps for the state of Hawai'i** were created using historical large fires (>50 acres, 1999-2018), grass and forest cover, and short-term and long-term rainfall prior to each fire.[2]
- Two types of fire probability prediction maps were made using: (1) **historical combinations of heavy rainfall and drought**[3] (Fig 1) and (2) **future climate scenarios** (Fig 2).[4,5]
- To look at average conditions and future change, fire probability was converted to the expected frequency of fires over time (fire return interval). For wet/dry periods, fire probability values were categorized as low, moderate, high and very high based on probabilities observed during historical fires in each county.[6]

Historical fire & rainfall data point to the increased risk of wildfires due to vegetation buildup during rainy periods.

Results based on Historical Rainfall

- Fire predictions under observed rainfall scenarios (Figure 1) show how **long-term (12-month) excess rainfall dramatically increases fire risk due** to grassy fuels build up.
- This **risk is worsened by short-term drought, but can even persist with short-term wet conditions.**

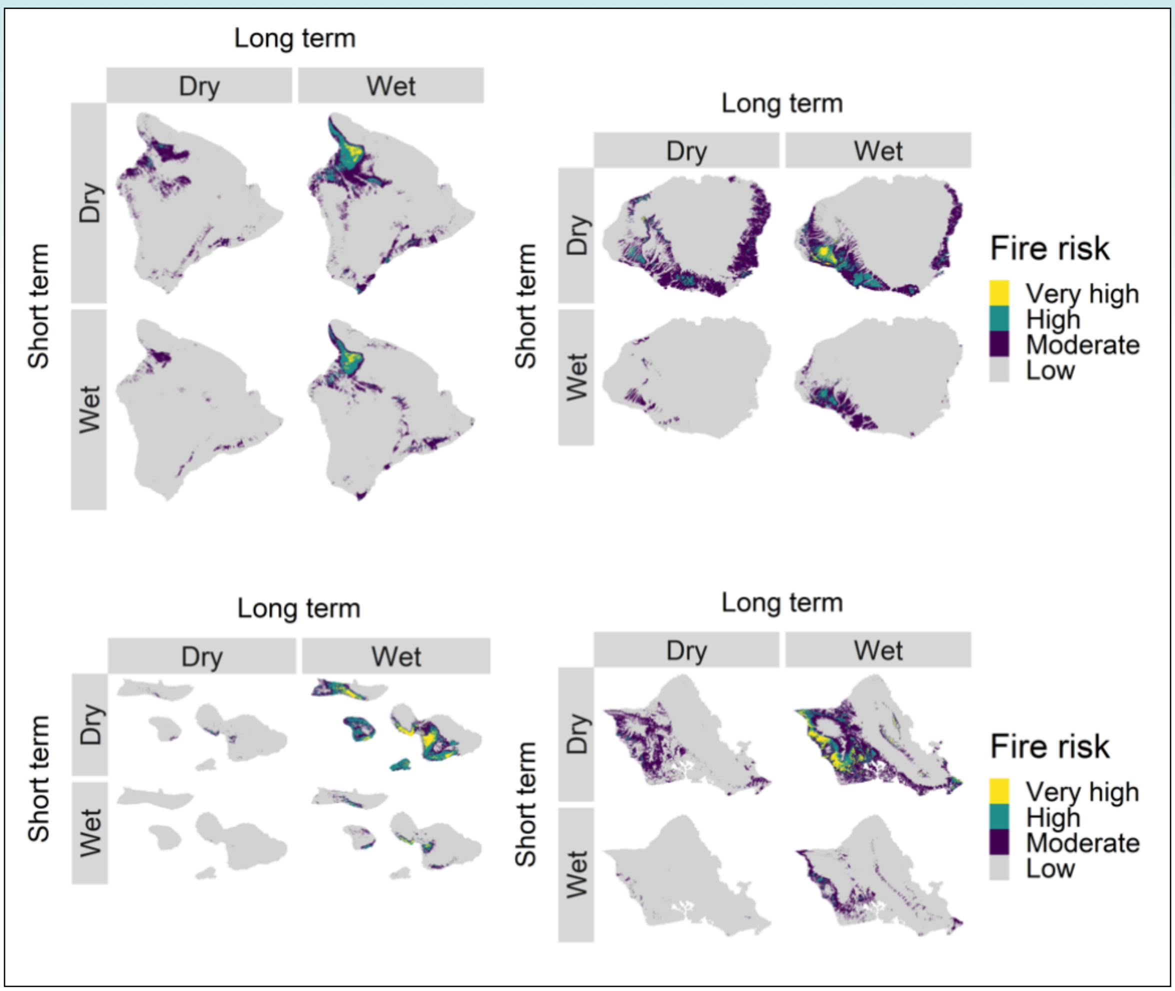

Figure 1. Fire risk scenarios for the main Hawaiian Islands under different combinations of short- (3 month) and long-term (12 month) cumulative rainfall. "Wet" and "Dry" were defined as the 75th and 25th percentiles of historical rainfall, respectively. Clockwise from top: Hawai'i Island, Kaua'i, O'ahu, Maui Nui (not to scale).

Climate Crisis: Predictions for Hawai‘i

Future Climate Results

- The footprint of **highest fire risk is expected to increase in extent and move upwards in elevation** while **fire risk may decrease in the driest low elevation areas** (Fig 2).
- The **greatest changes are expected to occur over the next several decades** (based on mid- and late century predictions).

Key Takeaways

- **Climate projections predicting future fire risk are limited** because climate models are not designed to examine and predict the variability in annual or month-to-month extremes.
- **Short-term wet/dry extremes are critical to predicting fire risk.** In particular, determining “green-up” events will help communities prepare for wildfire prevention.
- **Sporadic deluges and droughts are already happening statewide.** This suggests that **future estimates of fire risk are conservative** (based on average conditions).
- **Examining historical environmental extremes may provide a better understanding of fire risk,** pointing to the need for improving climate models.

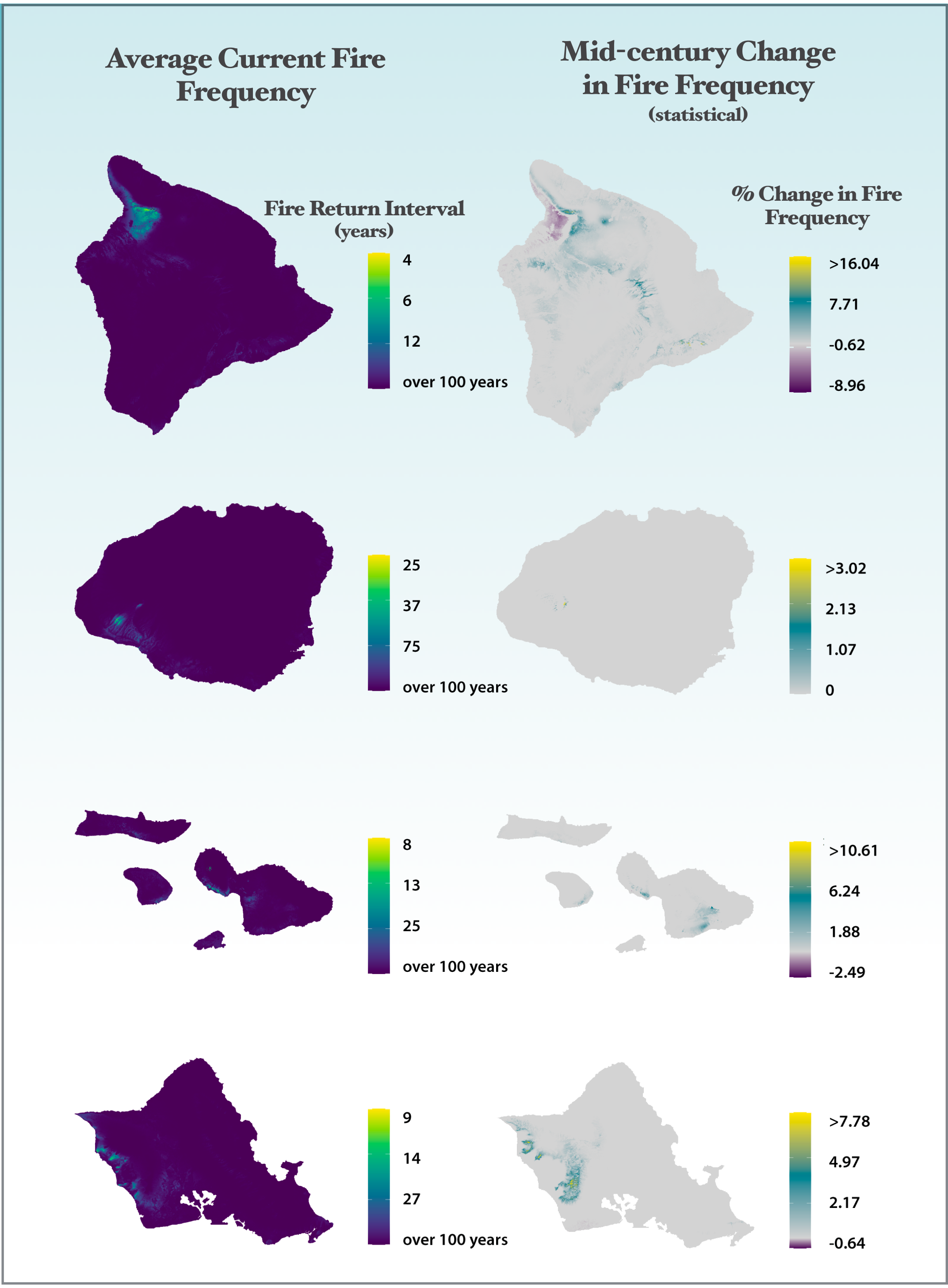

Figure 2. Current average fire frequency and the future percent change in frequency predicted for mid-century, Hawaiian Islands (2050; using statistically downscaled RCP8.5 scenario). From top: Hawai‘i Island, Kaua‘i, Maui Nui, O‘ahu (not to scale).

References & Notations: 1.Trauernicht, C. 2019. Vegetation—Rainfall interactions reveal how climate variability and climate change alter spatial patterns of wildland fire probability on Big Island, Hawai‘i. Sci of the Total Env (650: 459-469). 2. Short-term rainfall = 3 mo, long-term rainfall = 12 mo. 3. Heavy rainfall is 75th percentile of observed rainfall and drought is 25th percentile. 4. Timm, O.E., Giambelluca, T.W. and Diaz, H.F., 2015. Statistical downscaling of rainfall changes in Hawai‘i based on the CMIP5 global model projections. Jour. of Geophys. Res.: Atmospheres, 120 (1), pp.92-112. 5. Zhang, C., Wang, Y., Hamilton, K., Lauer, A., 2017. Dynamical downscaling of the climate for the Hawaiian Islands. Part II: projection for the late twenty-first century. J. Clim. 29, 8333-8354. 6. Fire risk is categorized as very high (>75th percentile), high (>50th percentile), moderate (>25th percentile), and low (<25th percentile). Fire probability values are based on fire risk values (25th, 50th, 75th percentiles) estimated for all historical fires.