J5.5

Reviewing 2024 Western US Extreme Heat and Wildfire Risk using the NOAA High Resolution Rapid Refresh

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Joint Session J5 - Intersection of Wildfire and Power Grid Safety
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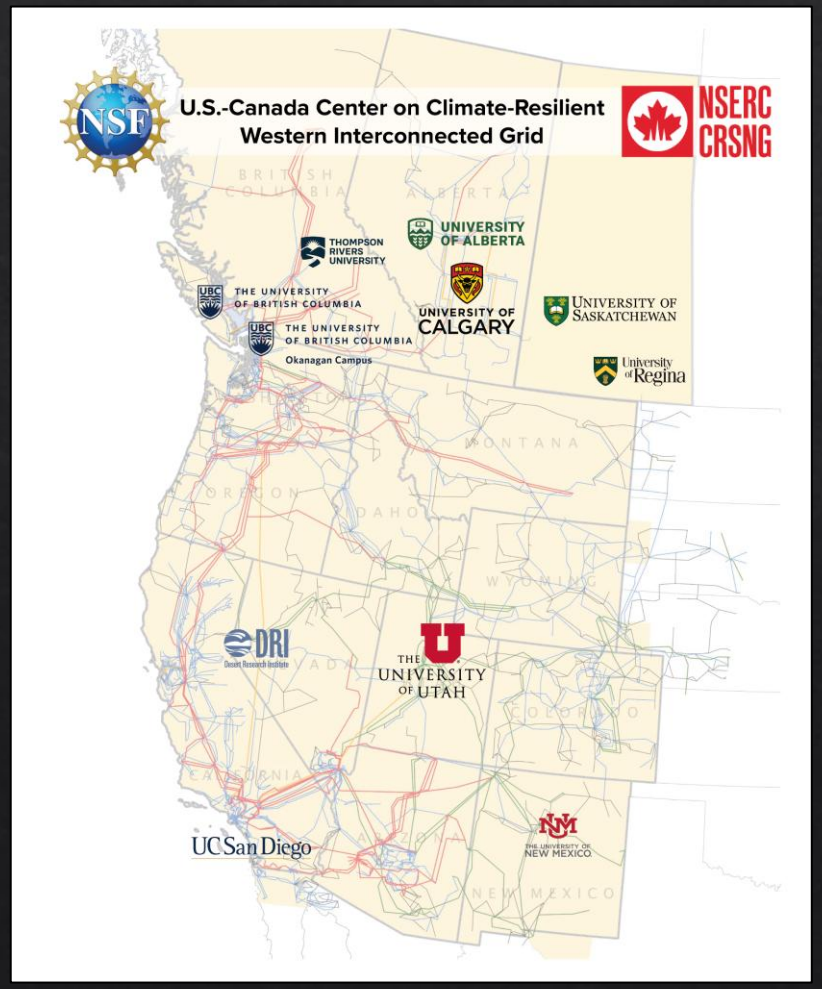
Introduction: NSF WIRED Global Center

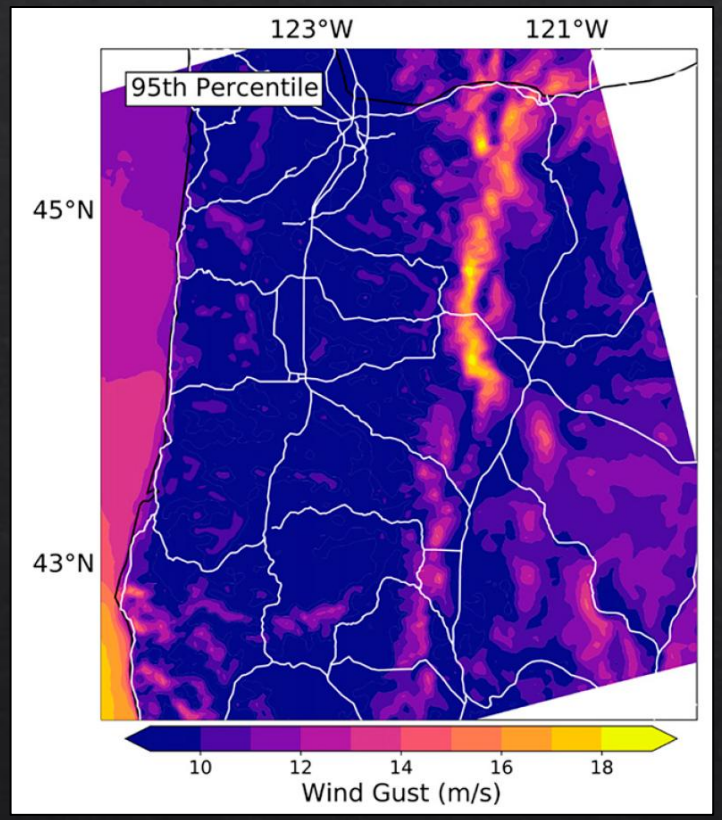
- U.S.-Canada Center on Climate-Resilient Western Interconnected Grid
  - Awarded in 2023 through joint funding by NSF (U.S.) and NSERC (Canada)
  - "Innovative hub committed to strengthening the resilience of power infrastructure"



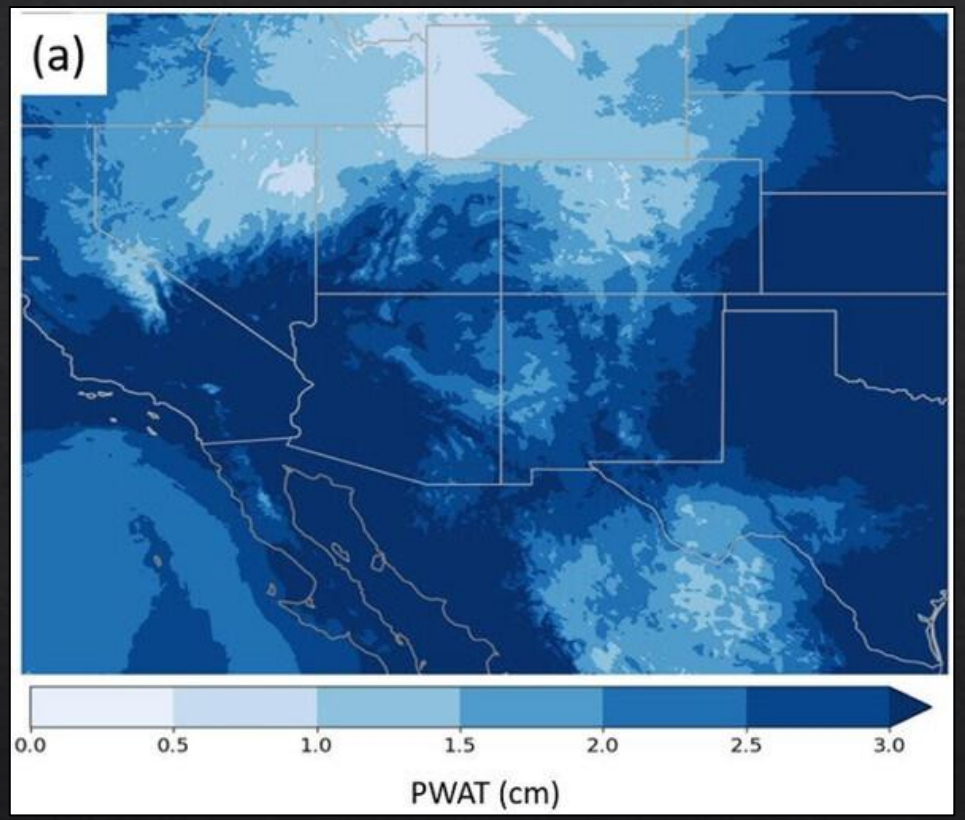
- **Use Inspired Research** - Team role for WIRED involves:
  - *Contributing information on atmospheric observational and gridded dataset resources*
  - *Applying data reduction techniques with a focus on extreme heat and meteorological conditions favorable for wildfire activity*
- Center Website: https://resilience.utah.edu/

Background and Prior Research

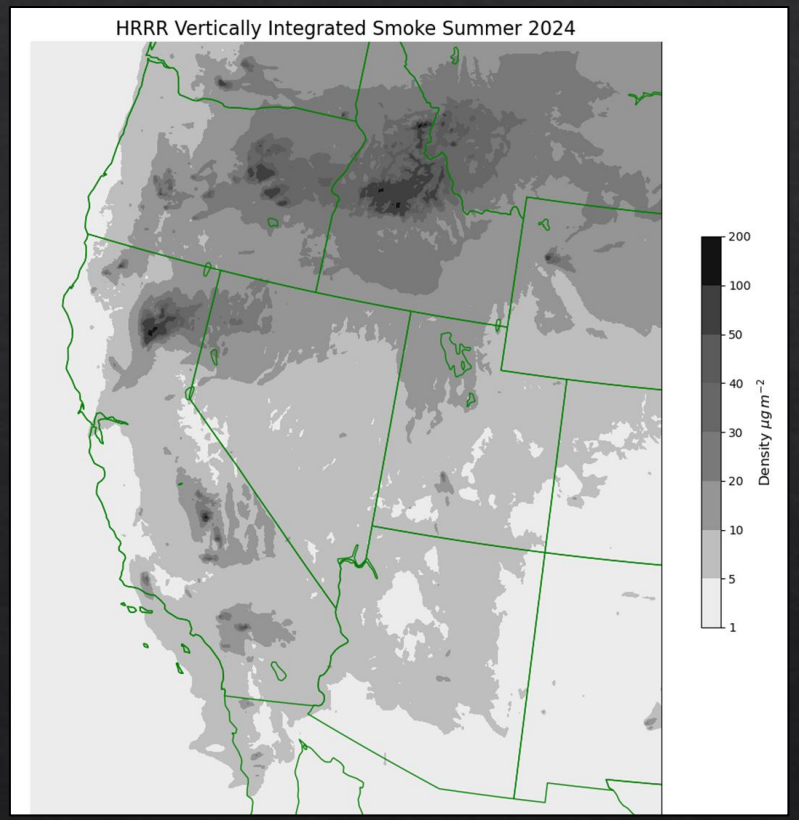
- Operational NOAA High Resolution Rapid Refresh (HRRR) has been a critical resource for prior and ongoing research initiatives



Gowan et al. (2022)



Horel and Powell (2024)



HRRR Smoke (1 Jun - 30 Sep 2024)

- Research team has been collecting and maintaining archives of select HRRR grids in Zarr format through the Amazon Sustainability Data Initiative (ASDI)

Data Reduction: HRRR Percentile Dataset Methodology

- **Goal:** Probabilistic dataset for WIRED-focused research applications

- 8 Years (2016-2023) of hourly HRRR Analyses (F00) acquired from ASDI Zarr archive:

  - Direct Variables:
    - ***2m Temperature***
    - ***2m Relative Humidity***

  - Calculated Quantities:
    - ***10m Wind Speed:*** via earth-corrected U and V wind speed components
    - ***Vapor Pressure Deficit (VPD):*** via 2m Temperature and Relative Humidity
    - ***Surface-based Hourly Hot-Dry-Windy Index (HDW)***
      - Simplified version of the Hot-Dry-Windy Index from Srock et al. (2018)
      - Product of the calculated VPD and 10m Wind Speed

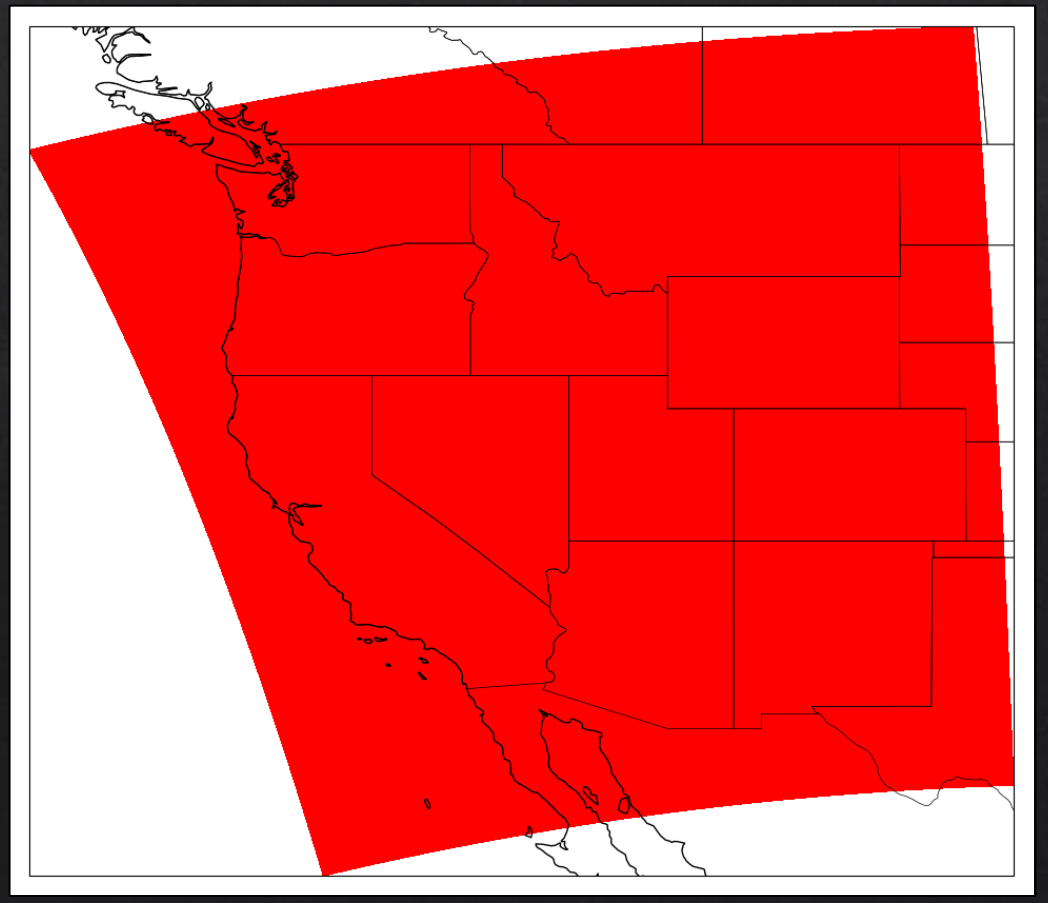
Data Reduction: HRRR Percentile Dataset Methodology

- Percentiles at each HRRR spatial grid point for the domain shown were computed for each hour of the calendar year (e.g., 22 UTC on 10 July)

- Sample Size: Percentiles computed from HRRR analyses within ±3 days and ±1 hours of a given calendar hour

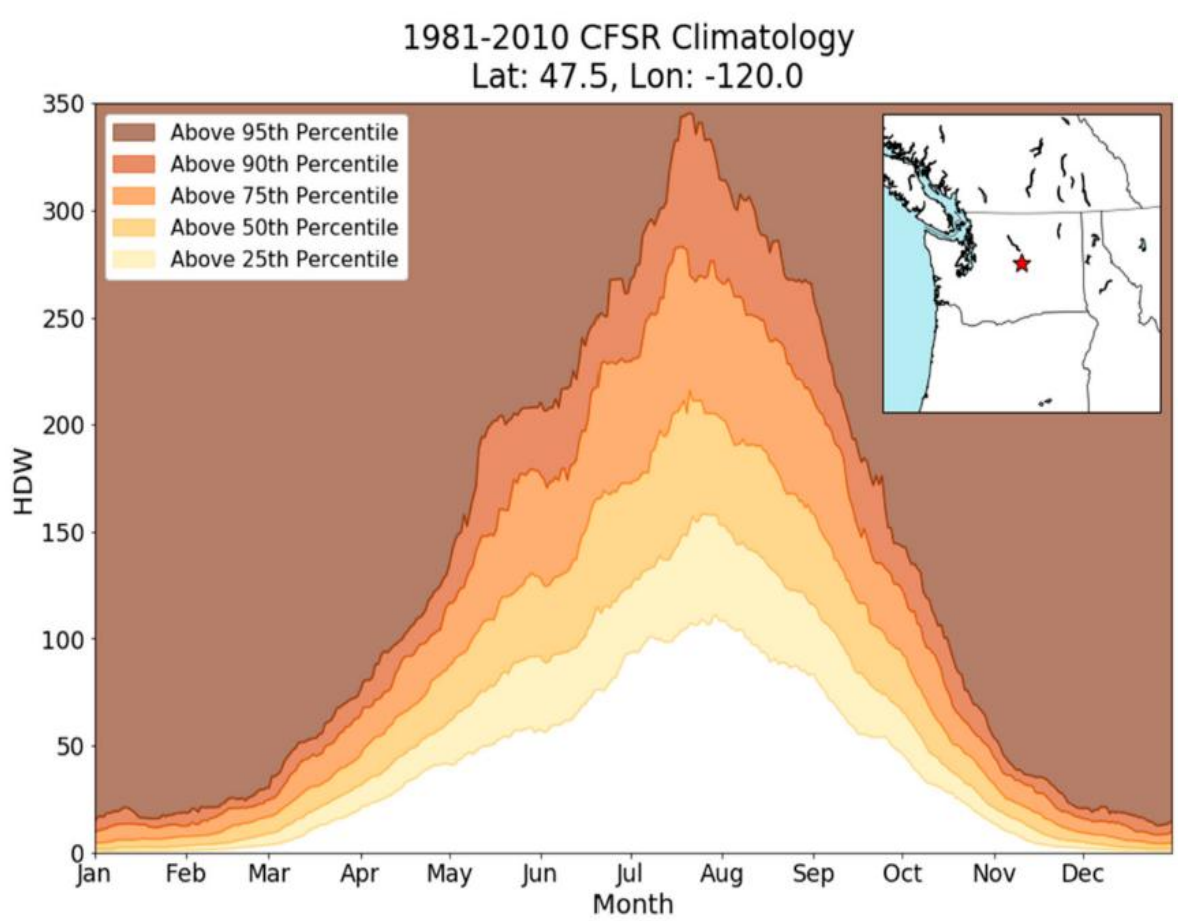
- E.g., 22 UTC on 10 July computed from:
  - 21-23 UTC from 7-13 July each year
  - 8 years of archive (2016-2023)
  - Max sample size of 168 (8*7*3) grids
  - No spatial averaging across grid points

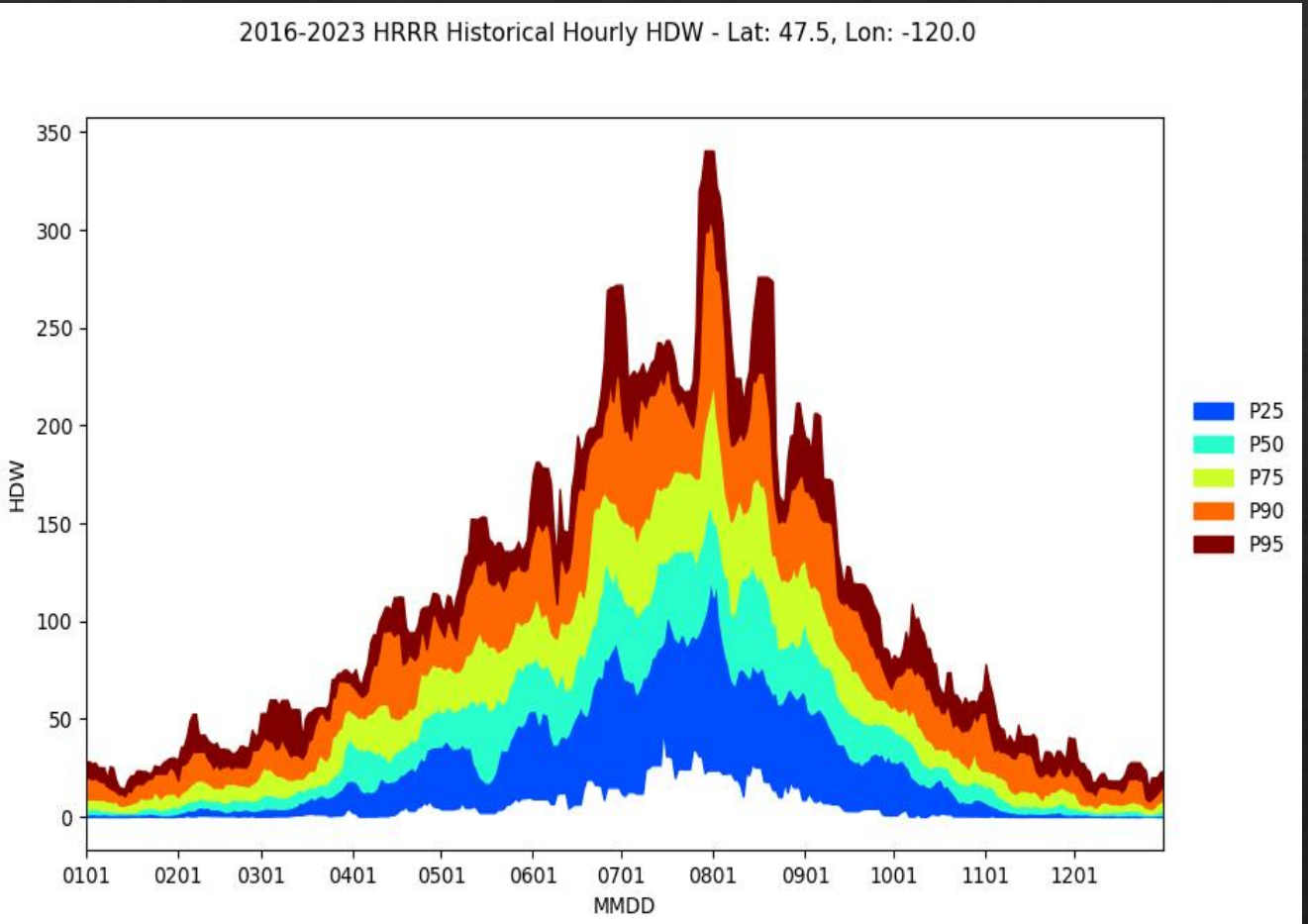
- Calendar Year 2024 not included in this version of percentile dataset



Initial Comparison of HRRR HDW Percentile Dataset

- Percentile time series of the computed 8-year HRRR peak daily HDW compared to similar distribution from CFSR 30-year climatology (McDonald et al. 2018)

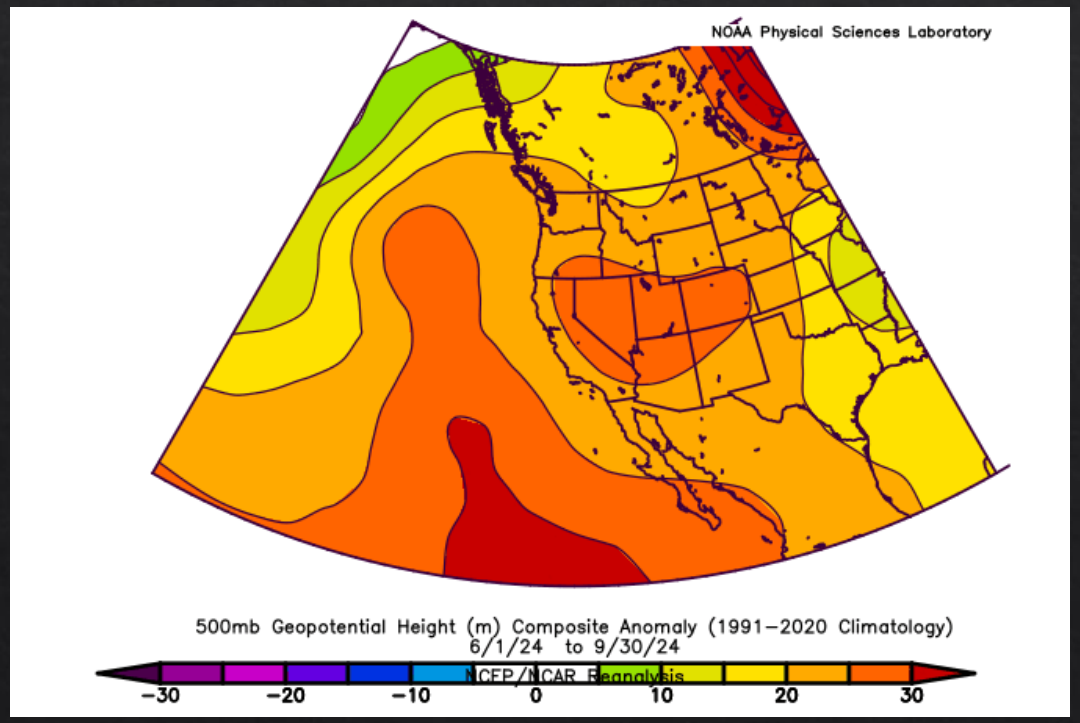




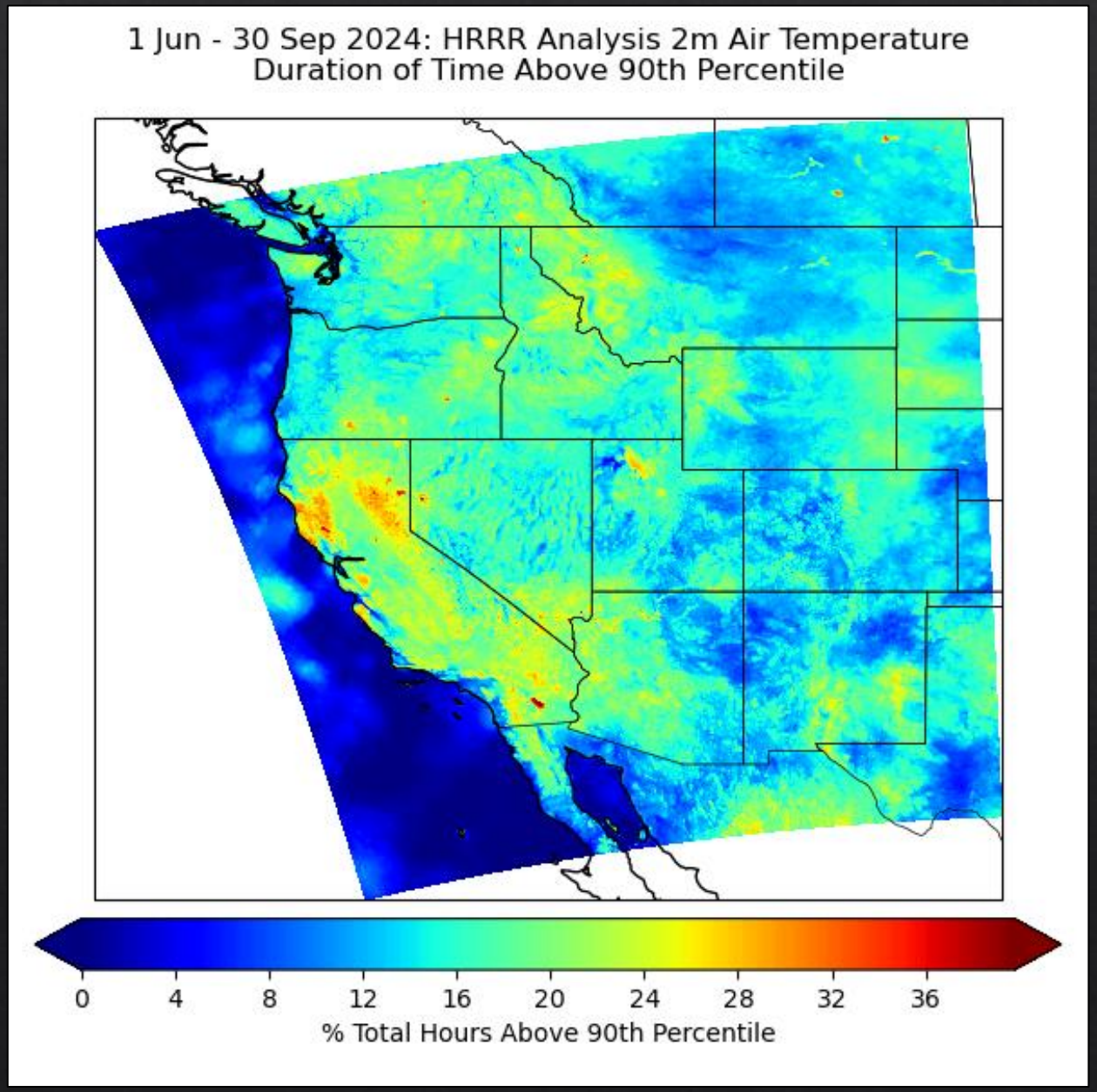
McDonald et al. (2018)

Evaluating Summer 2024 Against HRRR Percentiles

- Significant portions of western US experienced hourly temperatures higher than the 90th percentile for more than a fifth of June - September

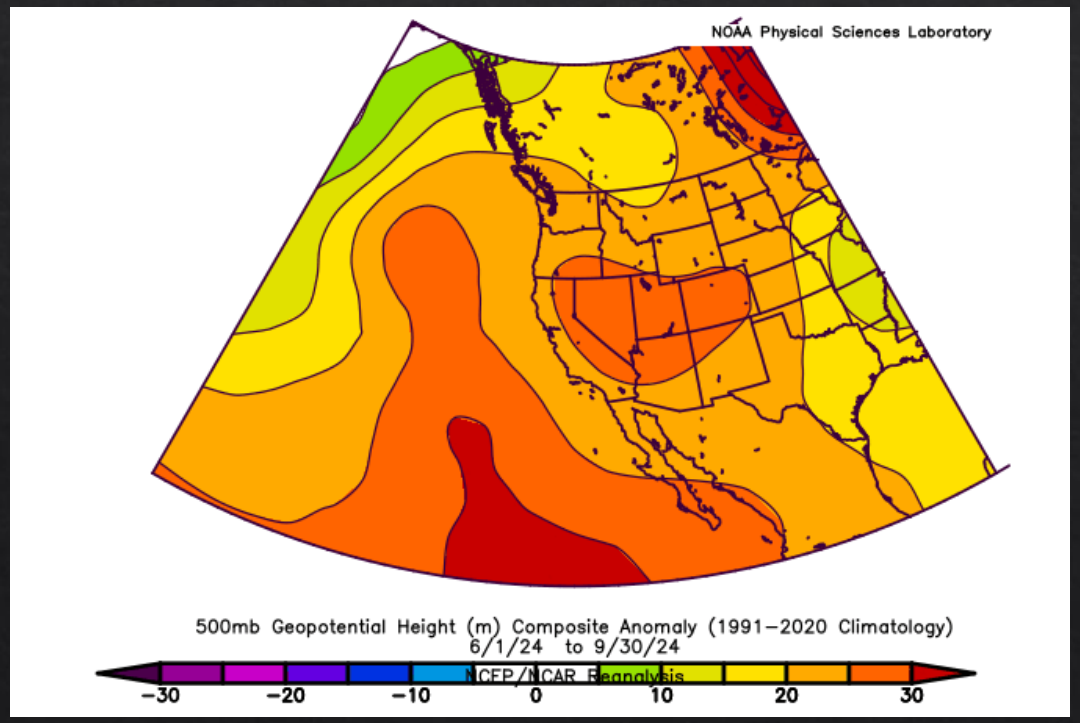


500hPa Geo. Height Composite Anomaly (1 Jun - 30 Sep 2024)
Image Courtesy: NOAA PSL



Evaluating Summer 2024 Against HRRR Percentiles

- Multiple extreme heat wave episodes occurred during timeframe
- Major wildfire activity across northern California and eastern Oregon



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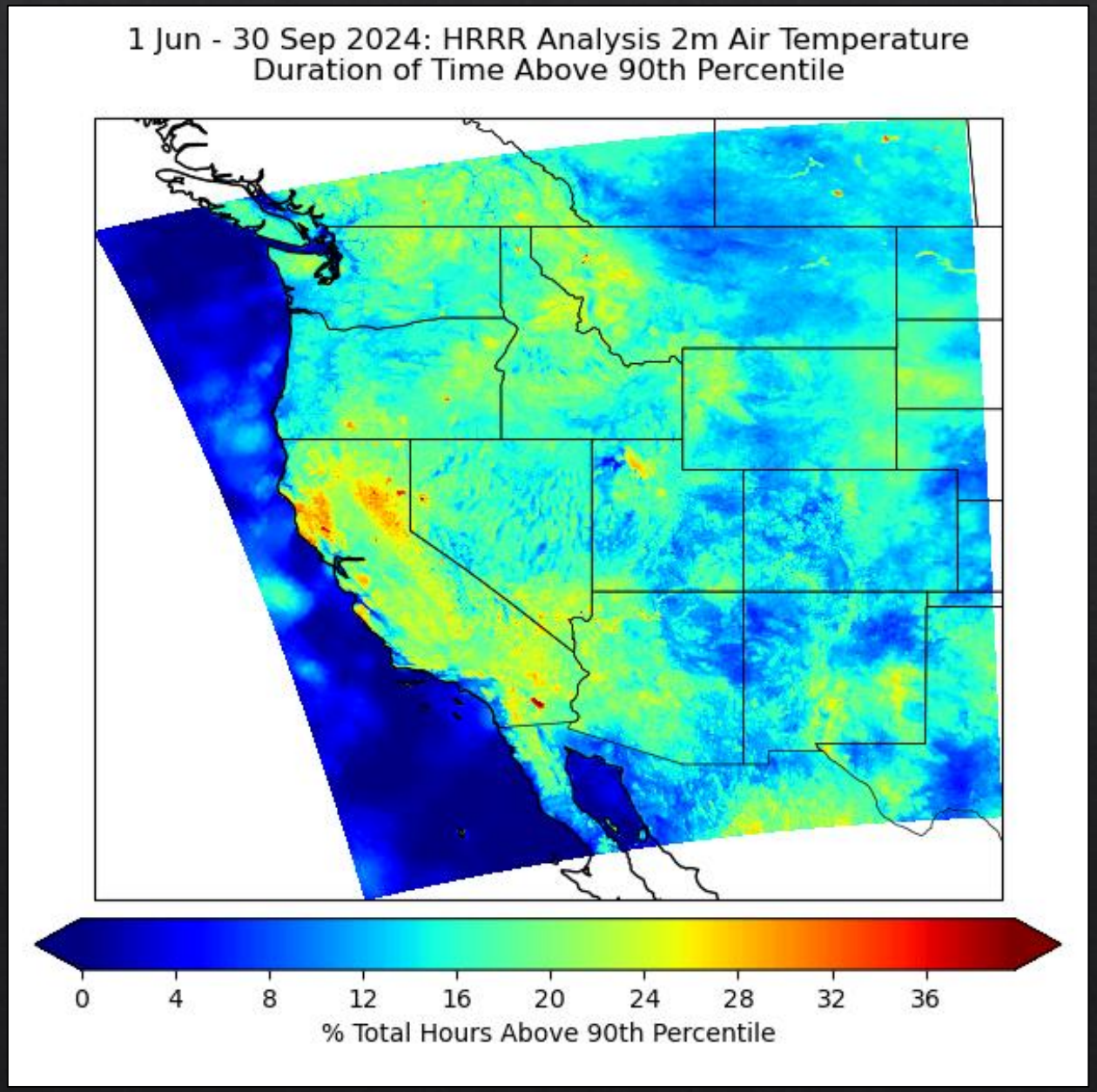
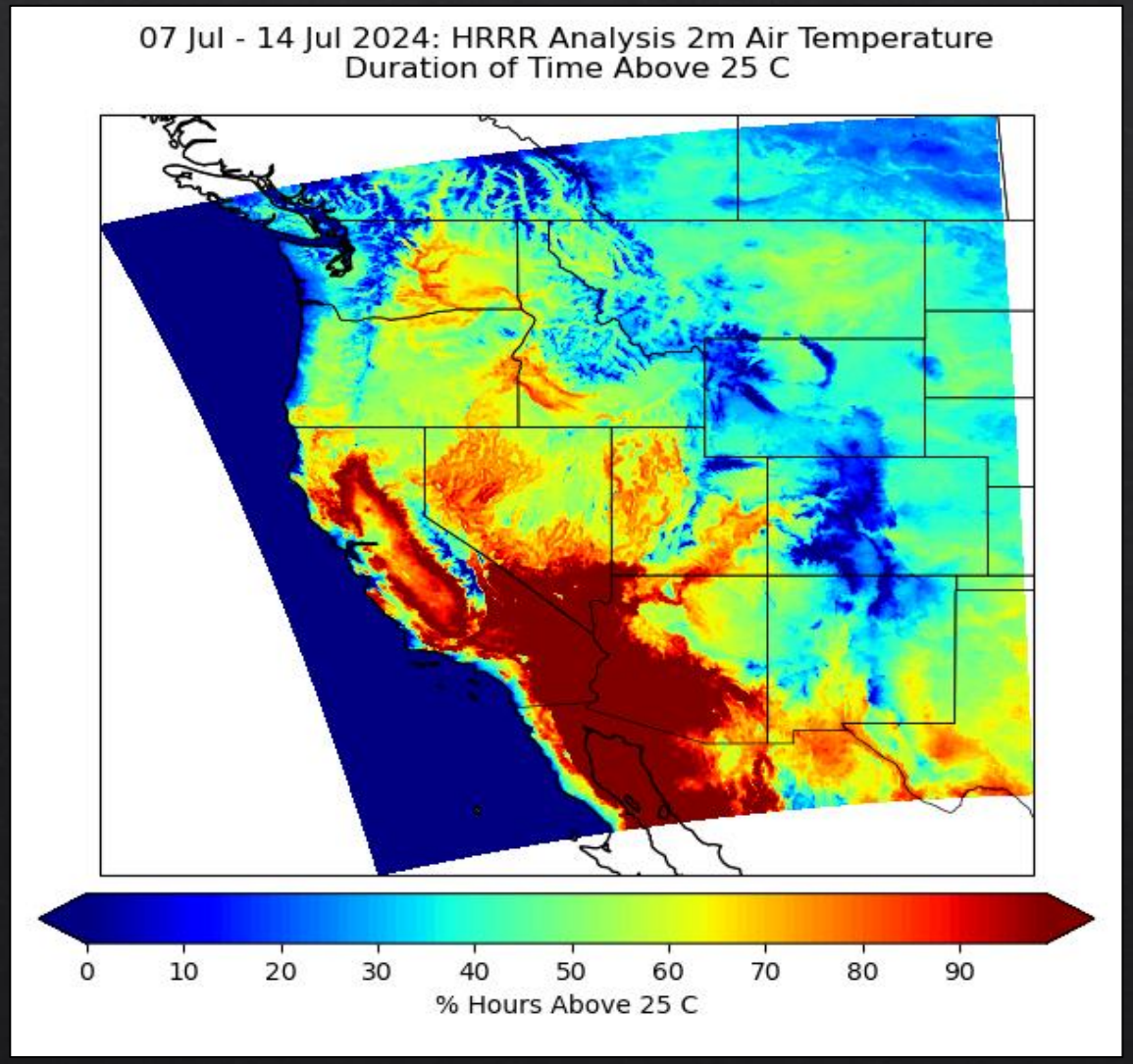
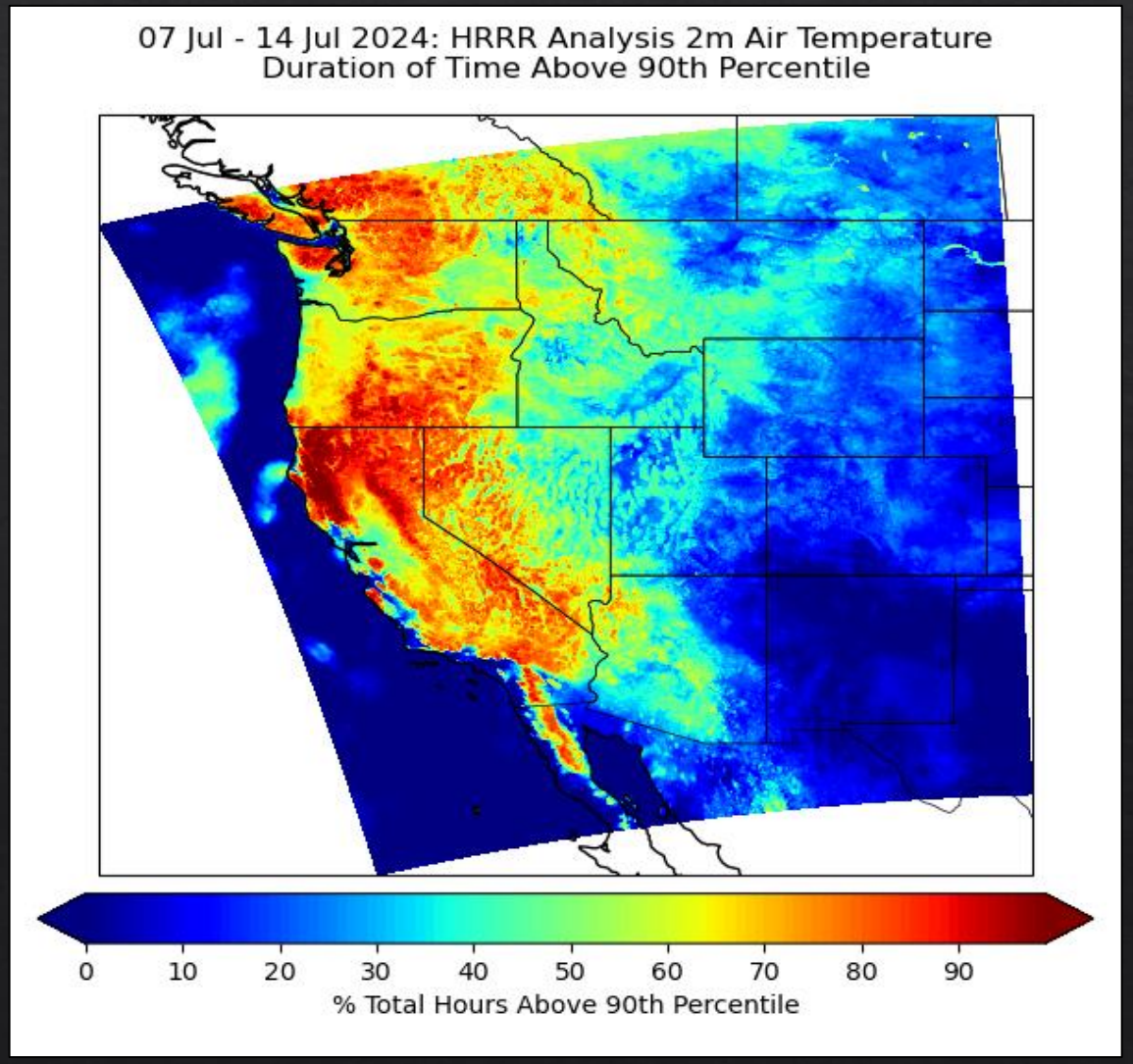


Early July 2024: Western US Extreme Heat Wave

- 10 July: Western Interconnection set peak demand record (California ISO Report)
- Extreme and anomalous heat with little overnight relief across western coastal states





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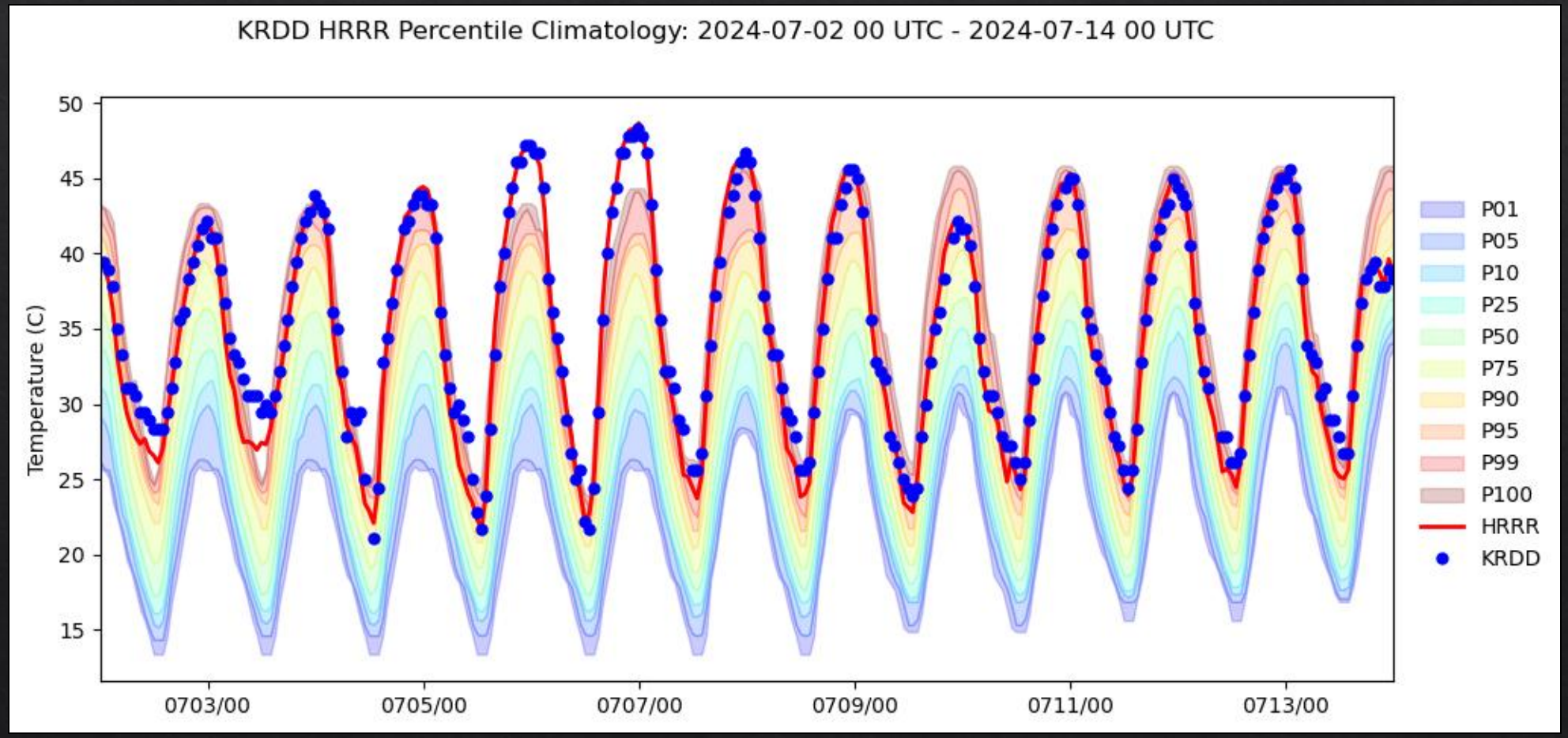
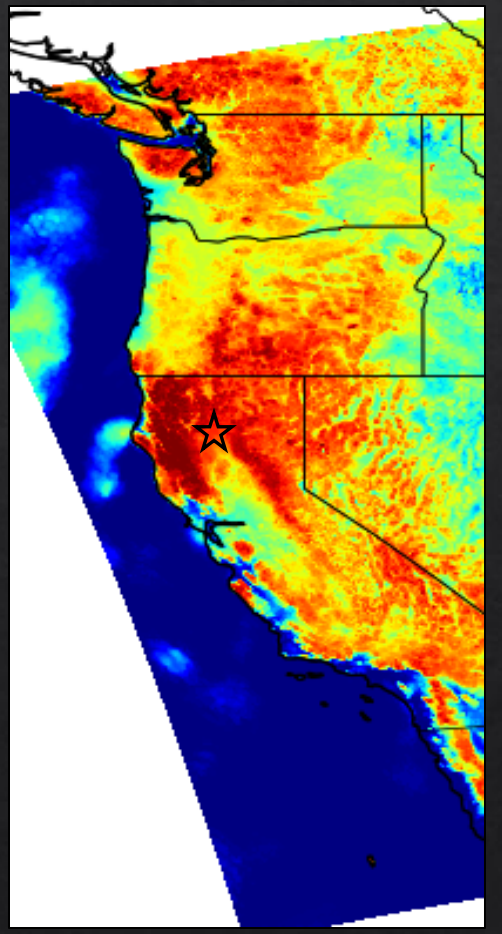
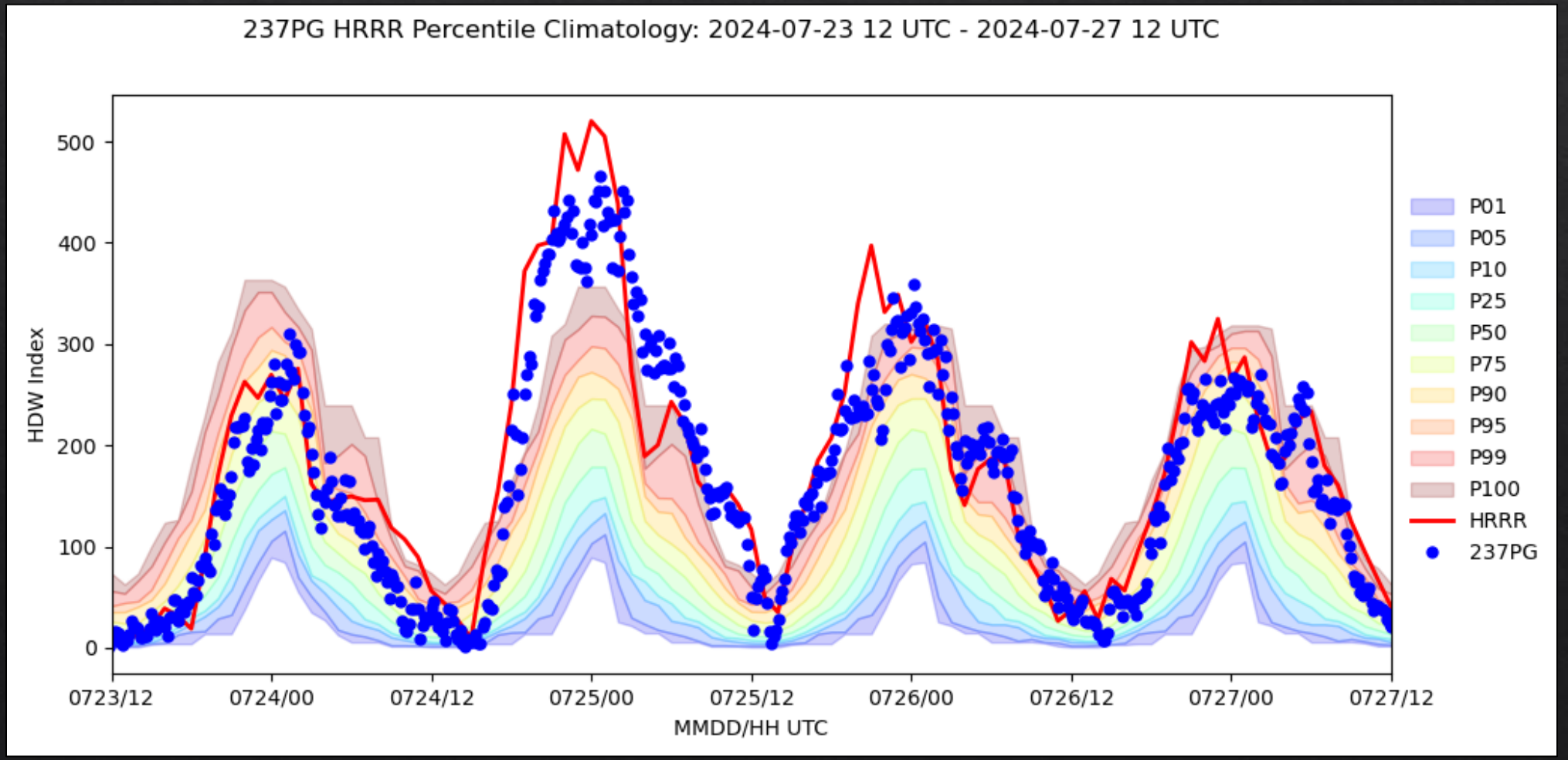


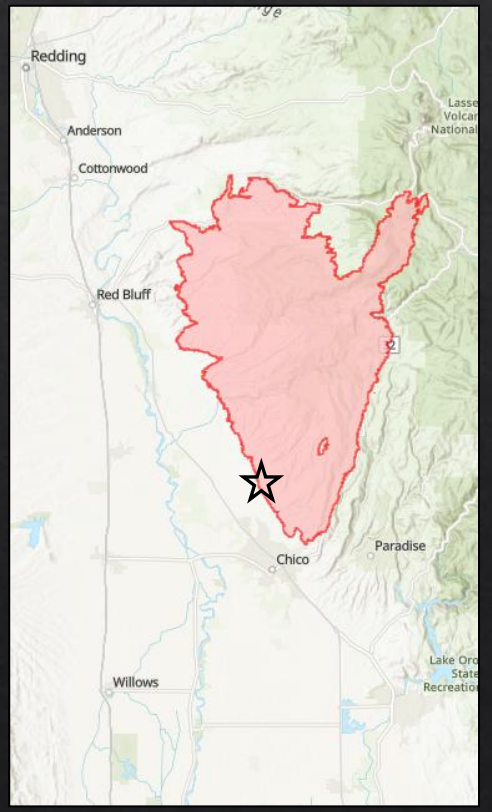


- Redding, CA: Multiple days and overnights at or over HRRR historical dataset

Hot-Dry-Windy Index: Park Fire Ignition and Rapid Growth

- Calculated HDWs from HRRR Analyses and nearby PG&E weather station observations
  - Extremely high during afternoon of 24 July (fire ignition)
  - Remained at or above HRRR historical record during initial rapid growth stage

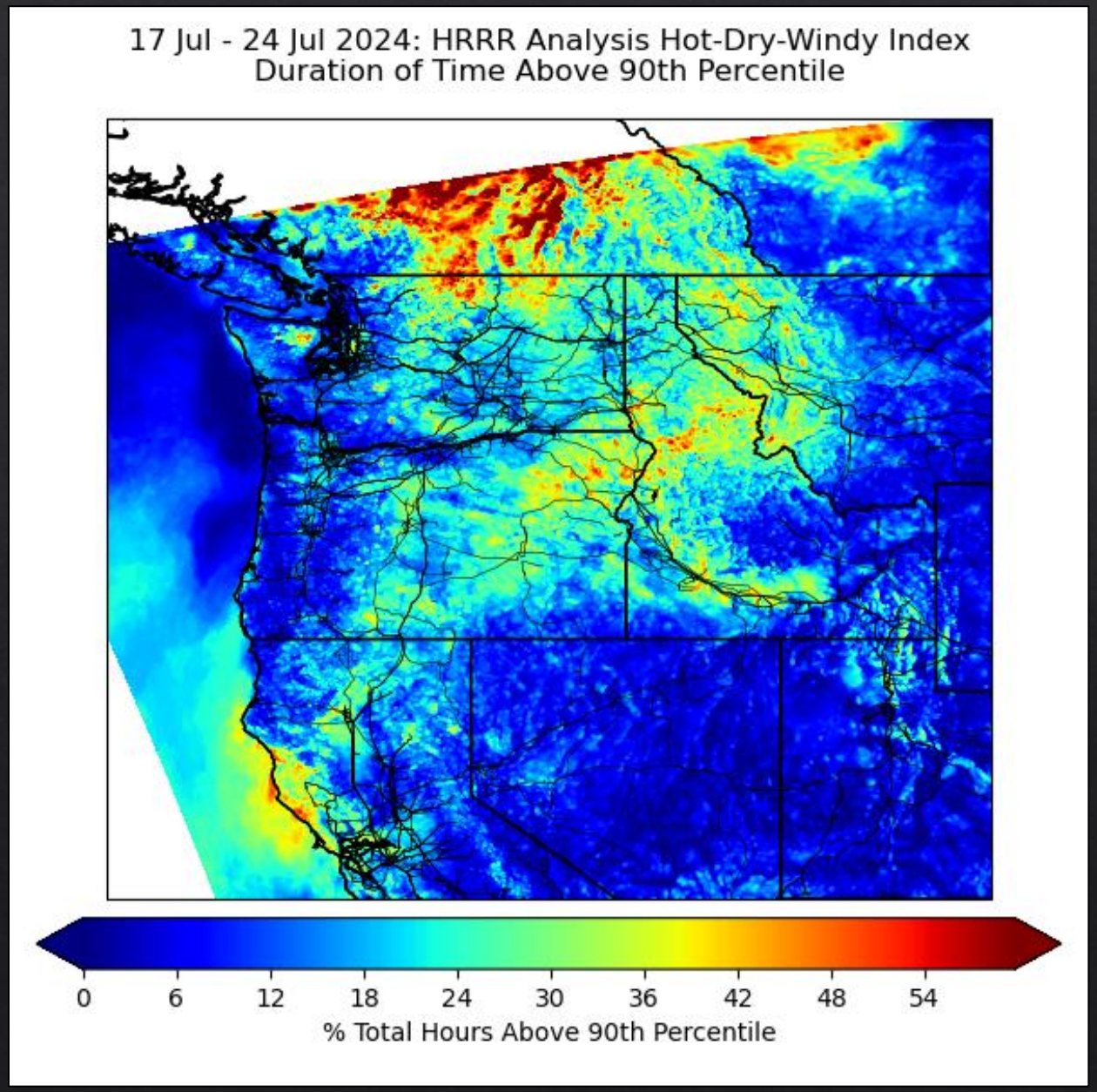




Perimeter: WFIGS 2024 Interagency Fire Perimeters

Hot-Dry-Windy Index: July Eastern Oregon Wildfire Activity

- Hot and dry conditions across northwestern US
- Eastern Oregon: Extended periods of time with HDWs above HRRR 90th percentile
- Multiple incidents ignited or already ongoing with further rapid growth:
  - Durkee Fire
  - Battle Mountain Complex Fires
  - Falls Fire



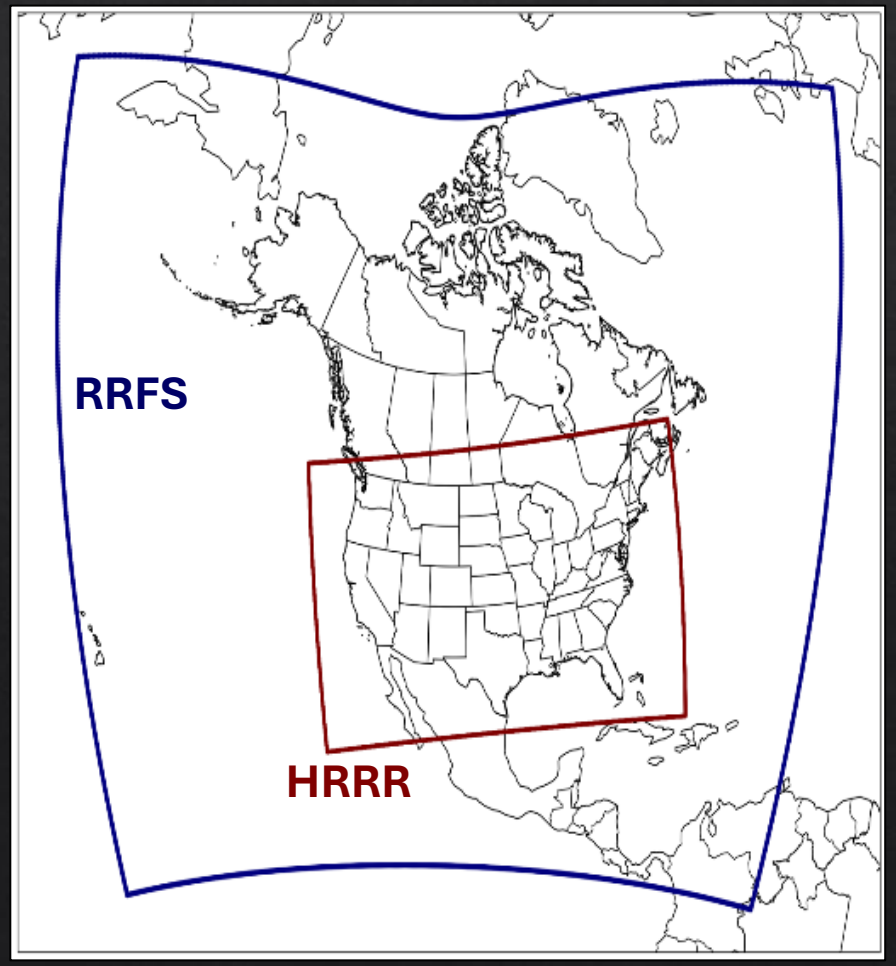
Ongoing and Future Initiatives

- Continuing projects archiving Zarr-formatted HRRR data for WIRED initiatives
  - ASDI archive being utilized for near real-time solar forecast data
  - Development of University-hosted yearly Zarr analysis archives

- Continue quantitative evaluation of 2024 against 2016-2023 percentiles

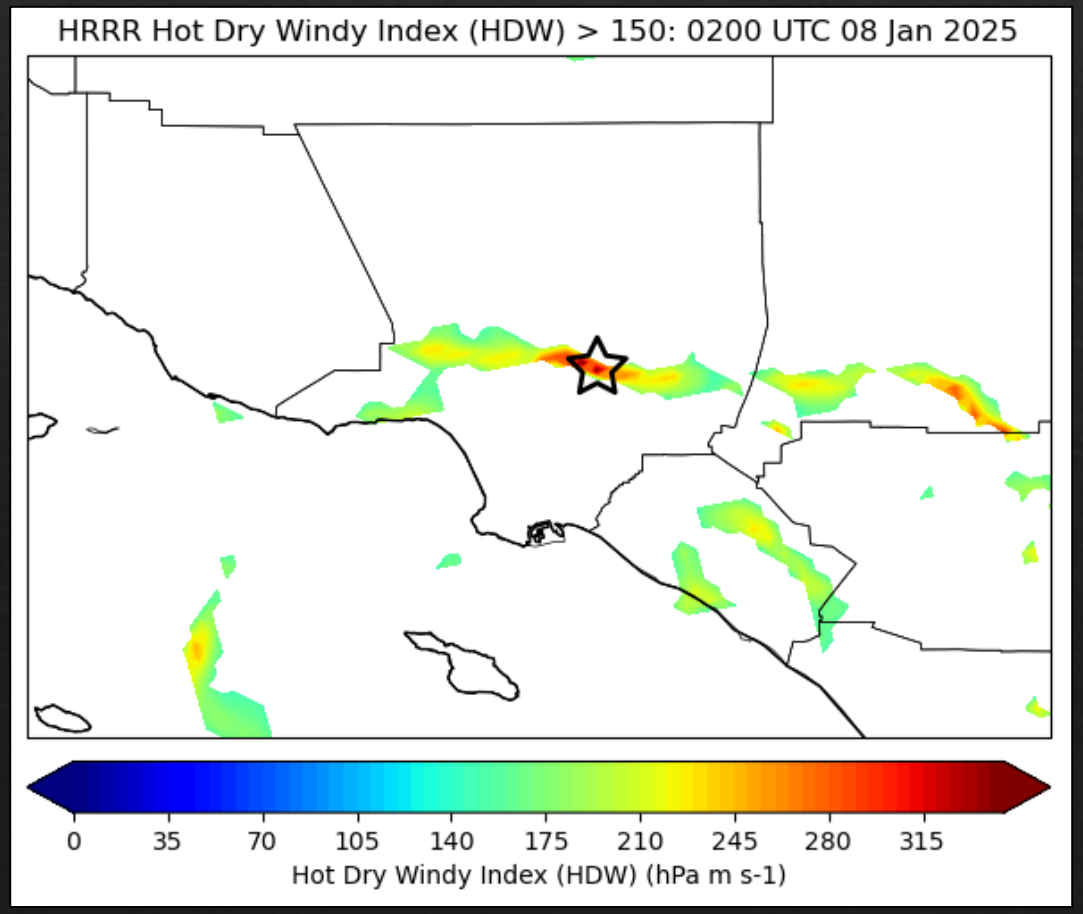
- Incorporate 2024 data into updated percentiles
  - Expand to full HRRR CONUS domain
  - Potential addition of more variables or calculated quantities

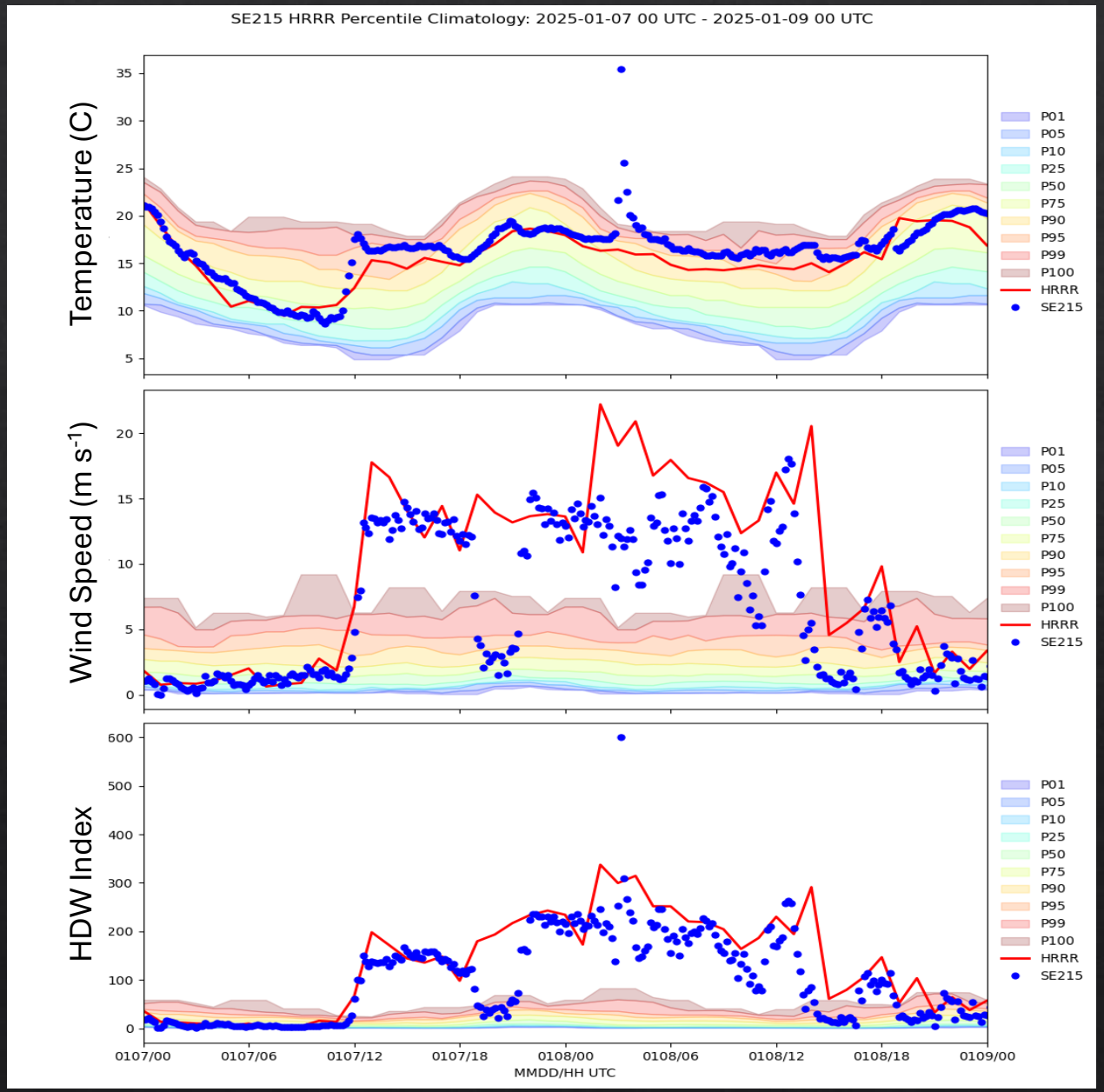
- Explore how new versions of Rapid Refresh Forecast System (RRFS) could be utilized and compared against percentiles archive



Los Angeles County: January 2025 Catastrophic Wildfires

- Beginning to review early 2025 data
- Weather station shown located within perimeter of the Eaton Fire





Acknowledgements

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- We thank the University of Utah CHPC for providing ongoing compute resources for the calculation of the HRRR percentiles archive, web resources for documentation and dataset access, and storage support through the Pando object storage system.

- We thank the Amazon Sustainability Data Initiative for continuing support of the S3 storage and access to the near real-time HRRR Zarr-formatted repository effort.

Questions?

References

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