Supporting Access to Meteorological and Fuel State Conditions for Wildland Fire Managers in the Great Lakes and Alaska Regions

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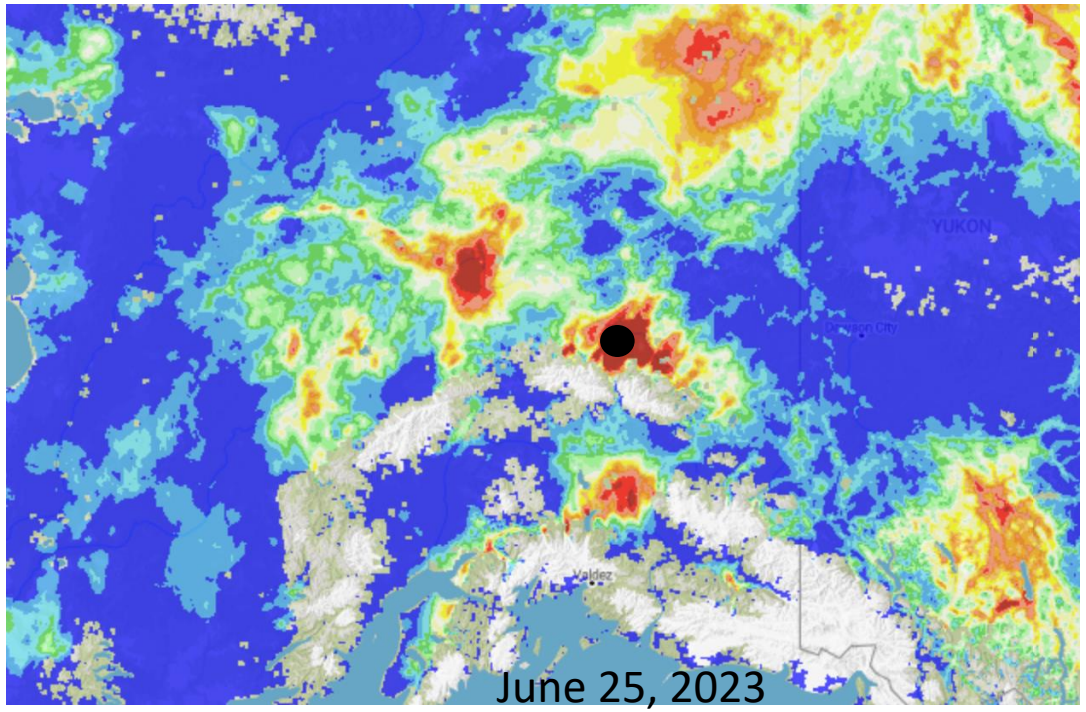
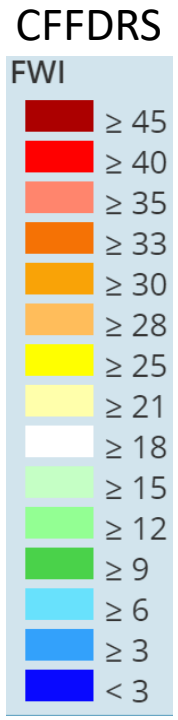
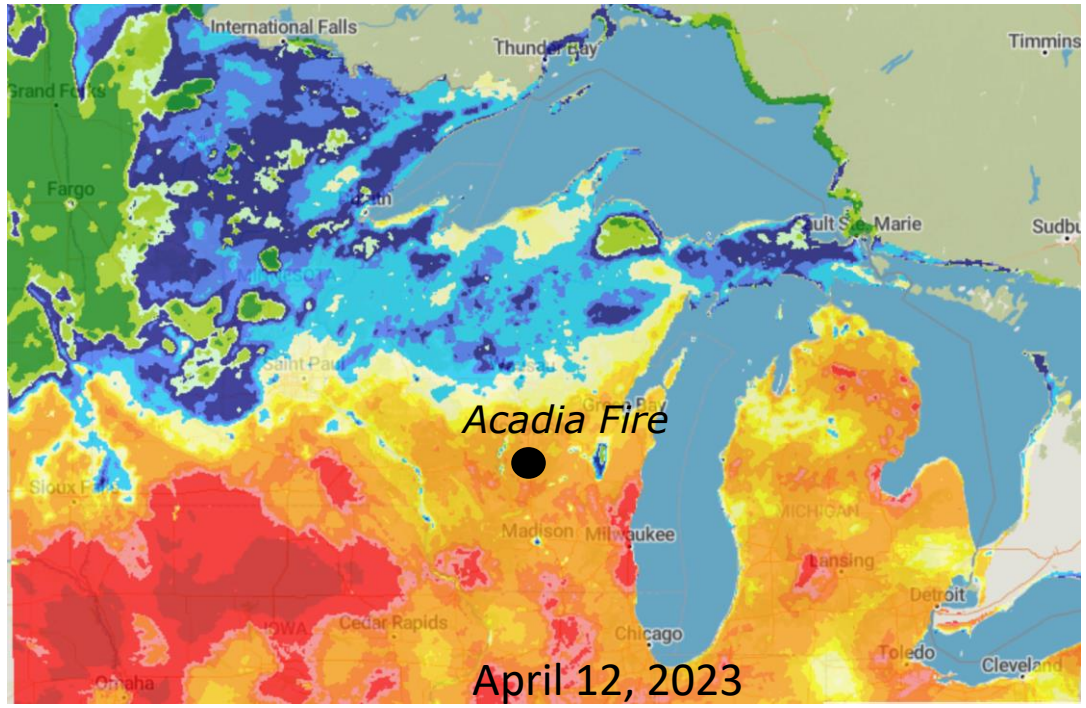
THE UNIVERSITY OF UTAH







Outline

- Operational decision support tools for Great Lakes and Alaska regions
- WIRED: NSF/NSERC U.S. Canada Center on Climate-Resilient Western Interconnected Grid
- Transitioning fire-related research from High Resolution Rapid Refresh (HRRR) to Rapid Refresh Forecast System (RRFS) and National Blend of Models (NBM) for wildfire decision support tools

University of Utah MesoWest Fire Weather Software Development

- 2002 — RAWS (Remote Automated Weather System) observations provided by federal, state, and local wildfire agencies began to be distributed by MesoWest and now handled by MADIS & Synoptic Data PBC

- 2003 — 2010: ROMAN (Realtime Observation Monitoring and Analysis Network) software provided realtime weather data to meteorologists and land managers dealing with wildland fire nationwide

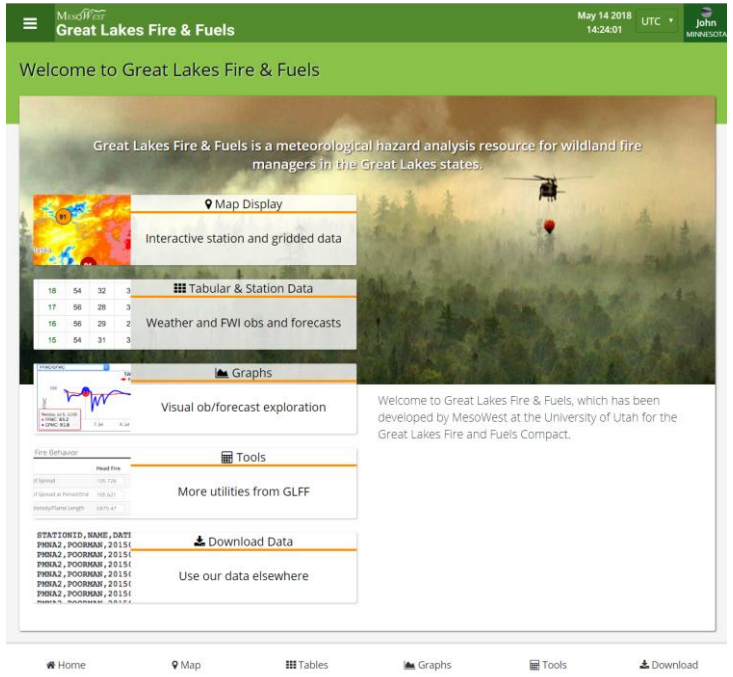
- 2008 — GLFF (Great Lakes Fire and Fuels Information System) developed to support wildland fire decisions by state agencies in the Great Lakes region (Horel et al. 2014)
  - 2013 — Technical update completed for GLFF
  - 2023-2024 — Technical refresh underway

- 2014 — AKFF (Alaska Fire and Fuels System) developed to support wildland fire decisions by BLM in the Alaska region
  - 2022 — Technical refresh completed for AKFF

Great Lakes Fire & Fuels (GLFF)

https://glff.mesowest.org/

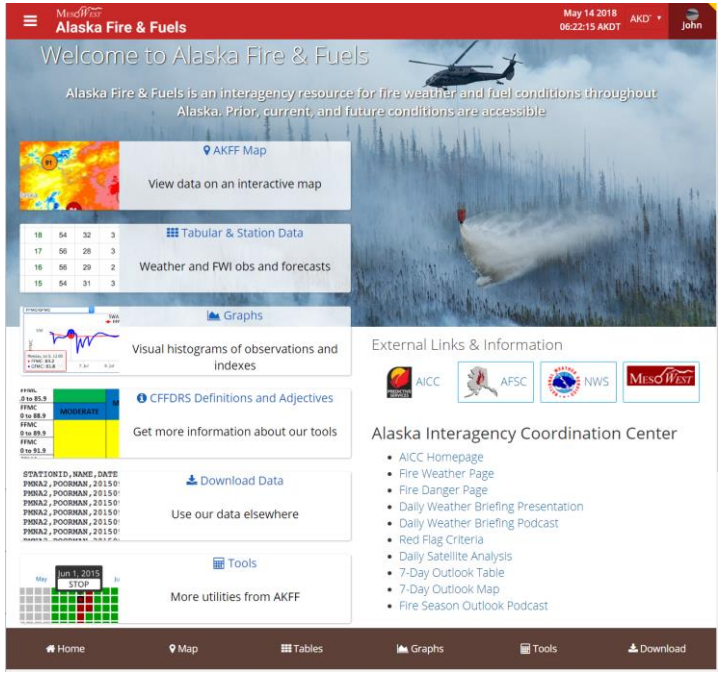
Funded by MN, WI, MI



Alaska Fire and Fuels (AKFF)

https://akff.mesowest.org/

Funded by Alaska BLM



Objective:

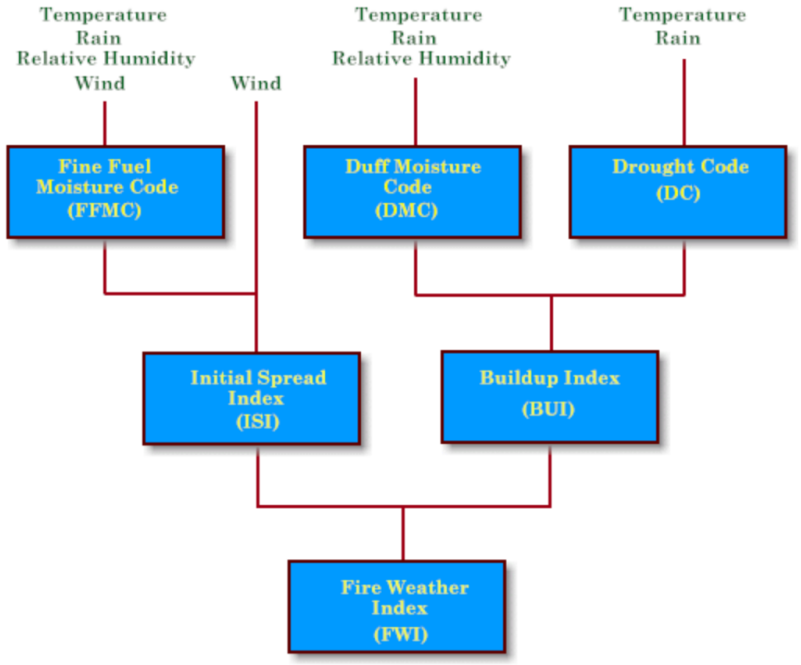
Support wildland fire decisions via web-based tools that integrate weather, fire danger and fire behavior information for past, current, and future conditions

Applications:

- *Daily briefings*
- *Personnel & resource deployments*
- *Prescribed burn planning*

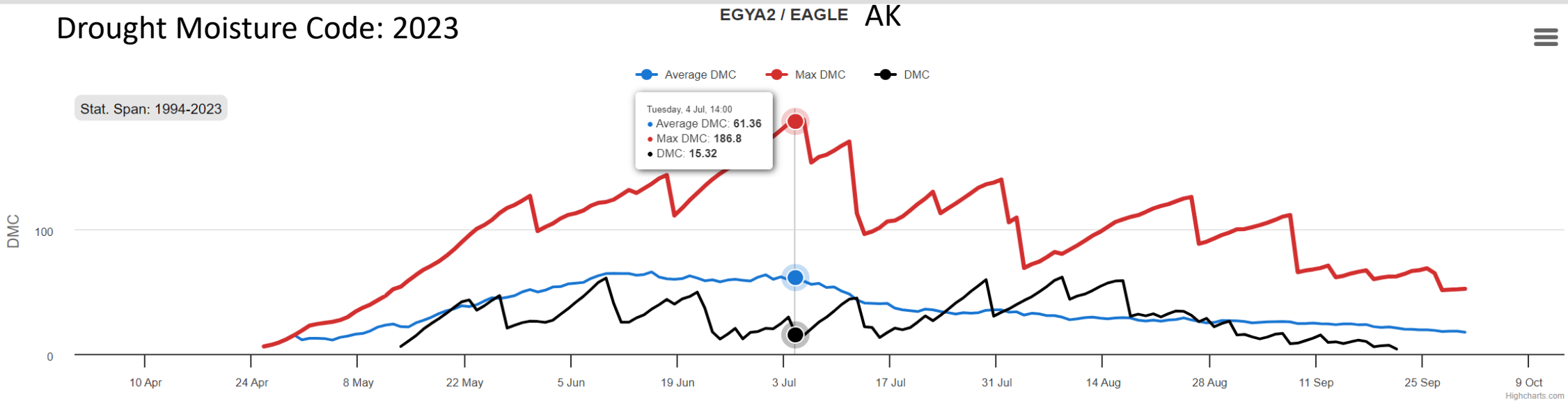
Canadian Forest Fire Danger Rating System (CFFDRS)

- Requires specifying fuel state parameters at beginning of season
- Fuel state during season evolves according to wind, moisture, temperature

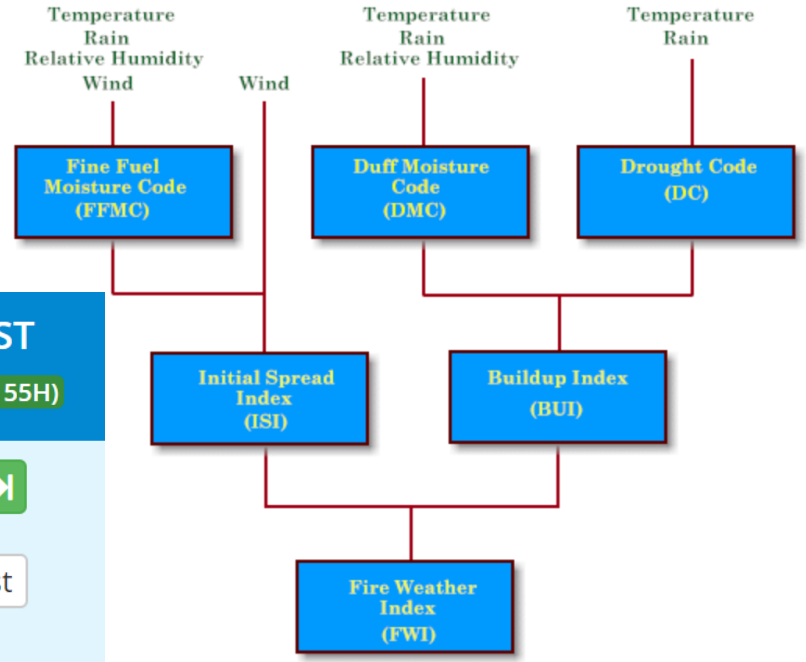


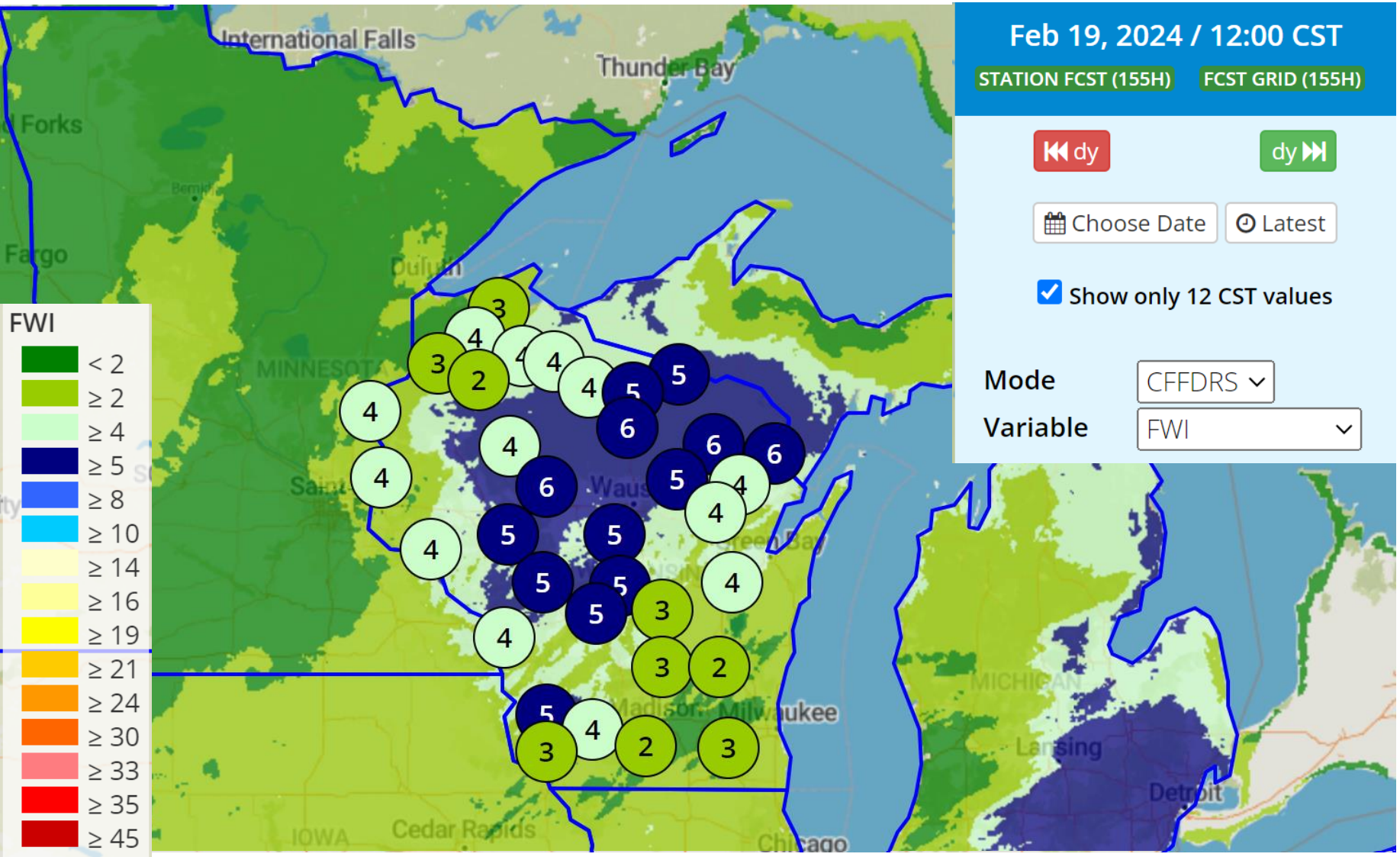
MesoWest
Alaska Fire & Fuels

Drought Moisture Code: 2023



Canadian Forest Fire Danger Rating System(CFFDRS)





MesoWest
Great Lakes Fire & Fuels

MesoWest Great Lakes Fire & Fuels

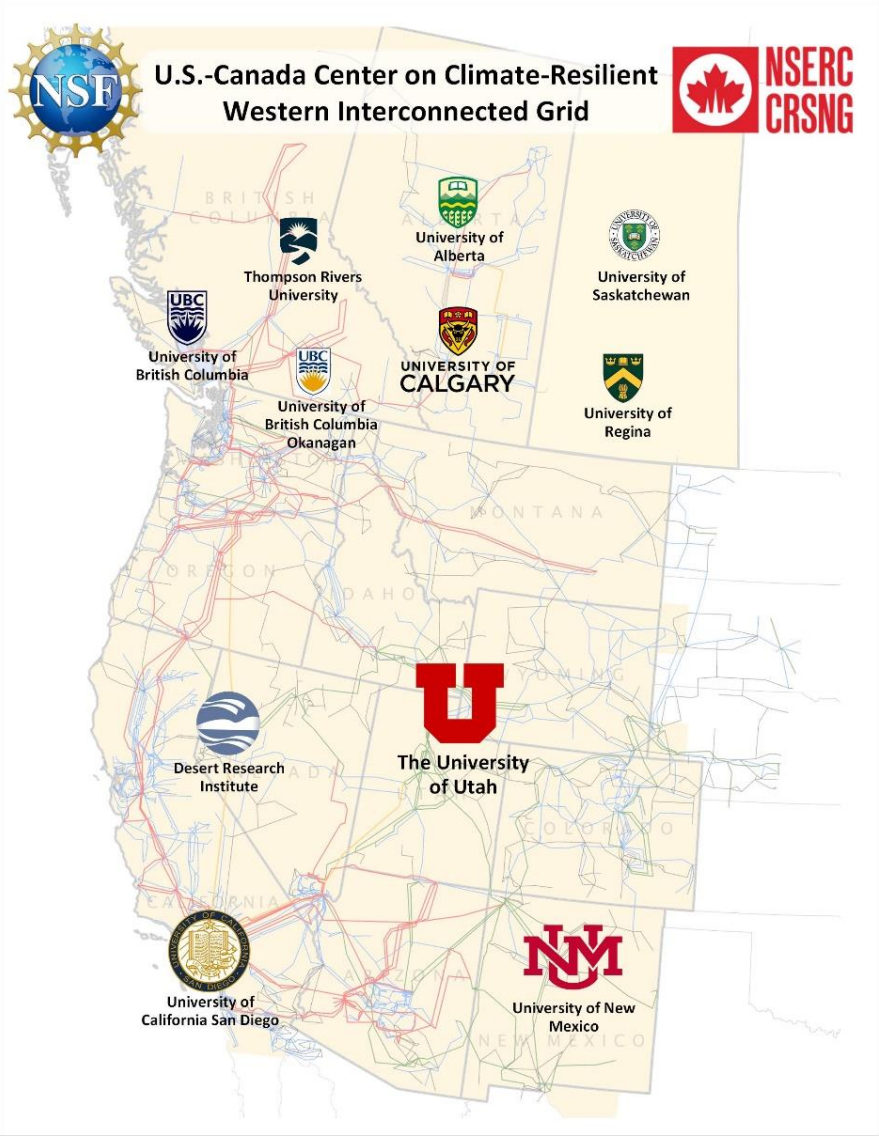
MesoWest Alaska Fire & Fuels

Next steps/Issues

- Expand GLFF forecast lead time from current 2 days based on NDFD grids to 7 days using NBM grids
- Extend into southern Canadian provinces through reliance on NBM guidance
- Incorporate updates to CFFDRS FWI into GLFF
- Integrate REDapp V2 fire behavior model into GLFF
- Maintain software through 2026 fire season for both Great Lakes and Alaska regions

- Possibly extend GLFF domain across eastern U.S. and adjacent Canadian provinces
- Stakeholders' decision: will FEMS (Fire Environment Mapping System) meet needs? https://fems.fs2c.usda.gov/ui

WIRED: NSF-NSERC U.S. Canada Center on Climate-Resilient Western Interconnected Grid



- Western Interconnected Grid: One of the two major power grids in North America serving over 75 million people
- WIRED: NSF-NSERC sponsored center of excellence for research, innovation, and work force development for power grid resiliency in the face of climate-related extreme disturbances

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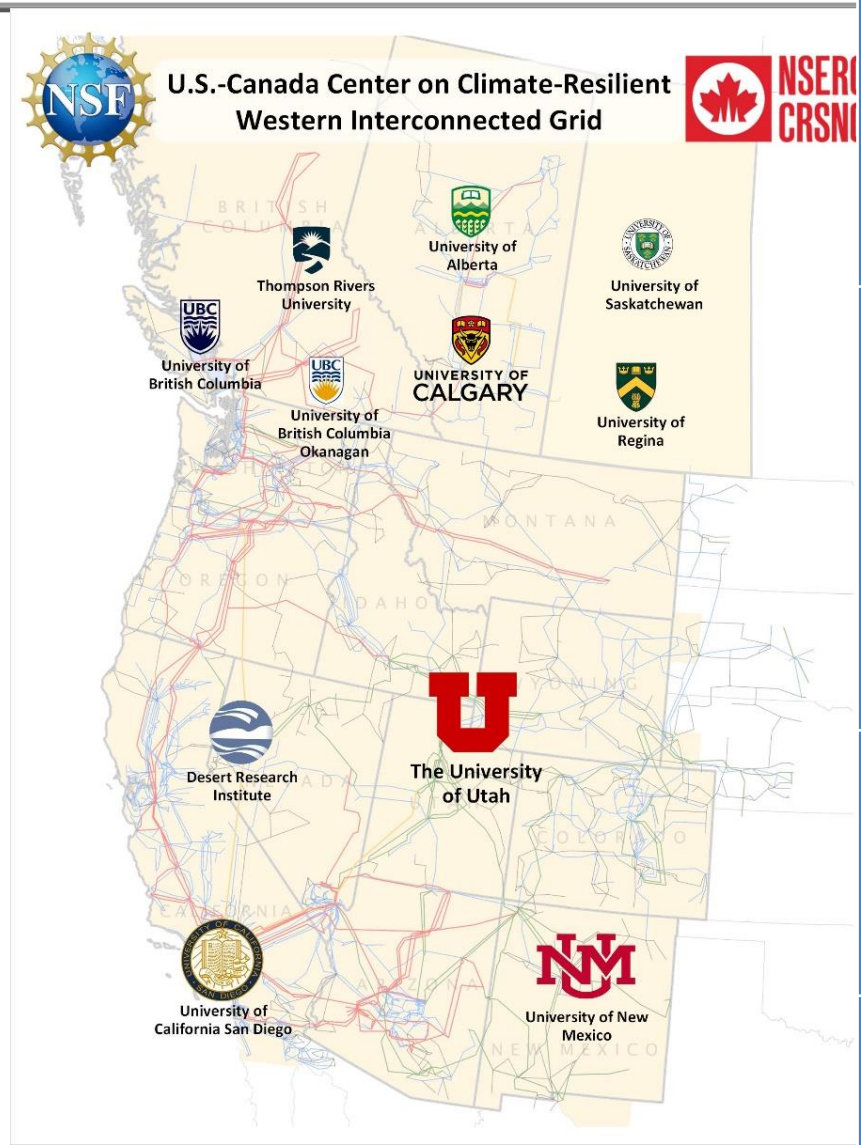
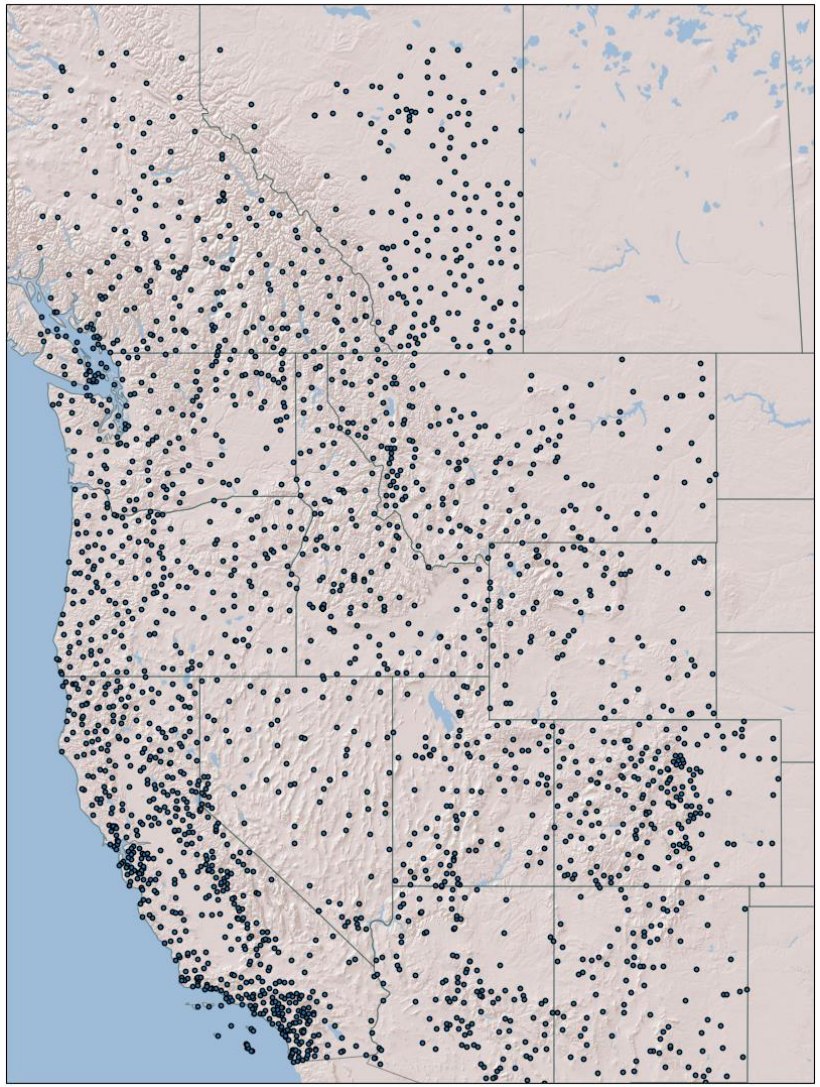
WIRED Center Partners



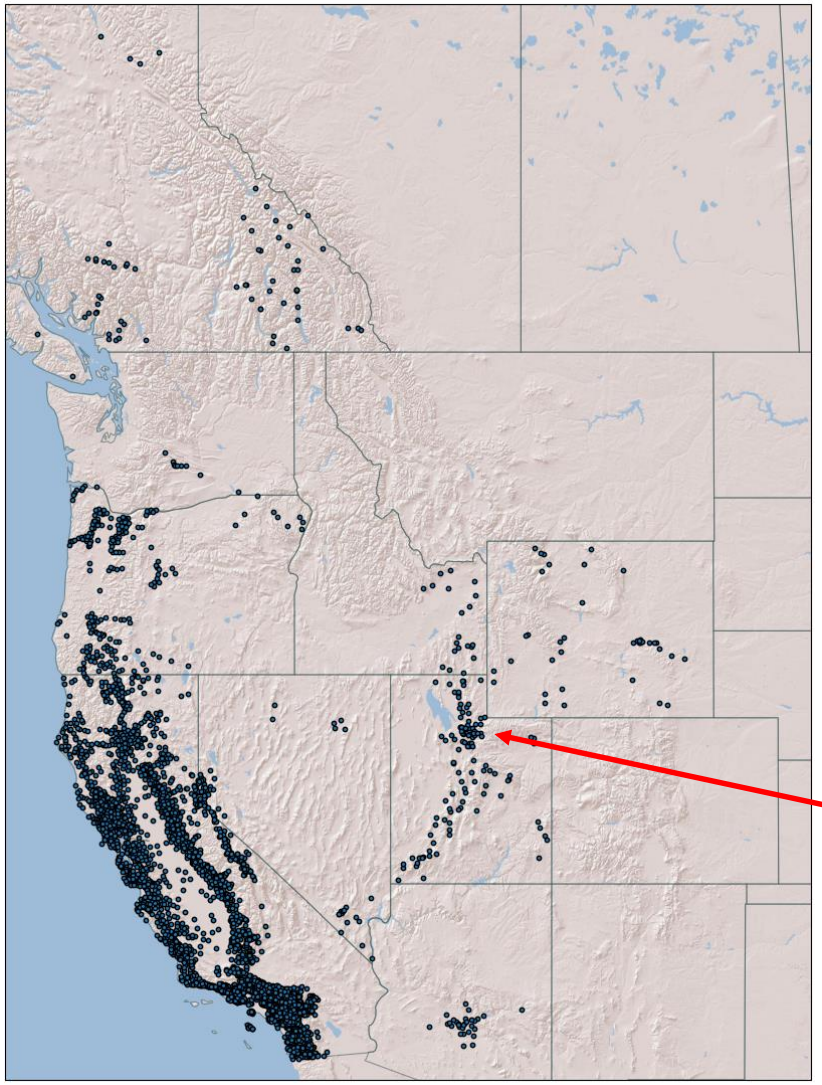
Sectors	U.S. Institutions
Academic Institutions	University of Utah, Univ. of Calgary, UC San Diego, Univ. of New Mexico, Desert Research Institute, Univ. of Washington, Univ. of British Columbia (UBC), UBC-Okanagan Campus, Univ. of Alberta, Thompson Rivers Univ., Univ. of Saskatchewan, Univ. of Regina
Power Utility and Industry	Pacific Gas and Electric, Portland General Electric, PacifiCorp, Public Service Company of New Mexico, San Diego Gas and Electric, Southern California Edison, NV Energy, Synoptic Data, FYBR Solutions Inc., Manitoba Hydro, BC Hydro, First Nation Power Authority, Alberta Power Industry Consortium (APIC)
Government Agencies	Western Electricity Coordinating Council (WECC), United States Forest Service (USFS), Federal Emergency Management Agency (FEMA) Region 8, Utah Division of Emergency Management
Consortia, Non-Profits, Innovation Hubs	Natural Hazards Center, Climate and Wildfire Institute (CWI), Canada Wildfire, University of Utah PIVOT center, Lassonde Entrepreneur Institute, Hunter Hub for Entrepreneurial Thinking

Objectives: Help manage metadata and data access, interoperability, and discovery and collaborate with modeling teams to access, archive, and display weather forecasts relevant for power grid performance and resilience

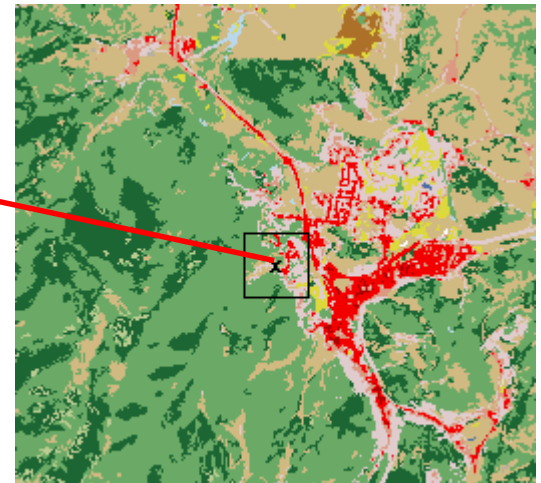
Selected Government Agency Networks
2262 stations



Utility Networks
4106 stations



PC066: Thaynes Canyon

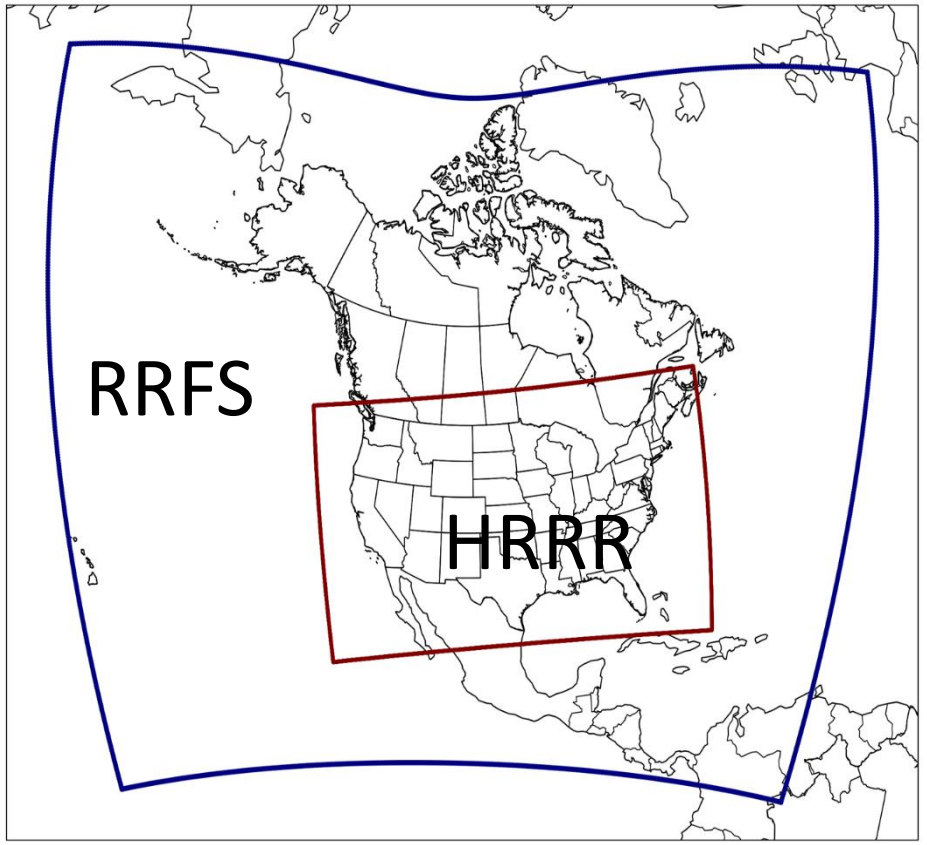


Objective: Apply cloud computing to utilize operational model output for diverse applications including resilience of power grid

- AWS Open Data Program NOAA High-Resolution Rapid Refresh (HRRR) data archive

- HRRR: 3 km, hourly analyses & forecasts from 2014 – 2024 https://rapidrefresh.noaa.gov/hrrr/

- Our work: use Zarr format to store and efficiently access HRRR output in subdomains https://mesowest.utah.edu/html/hrrr/



- Regional Rapid Refresh System (RRFS): 3 km, hourly analyses and ensemble forecasts out to 36 h for Northn American domain https://rapidrefresh.noaa.gov/RRFS/

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PacifiCorp settles another lawsuit over Labor Day fires

Kelly Andersson December 6, 2023 Wildfire Archie Creek, lawsuit, PacifiCorp

6-10 Sep 2020

Mass C. , D. Ovens, R. Conrick, J. Saltenberger, 2021: The September 2020 Wildfires over the Pacific Northwest
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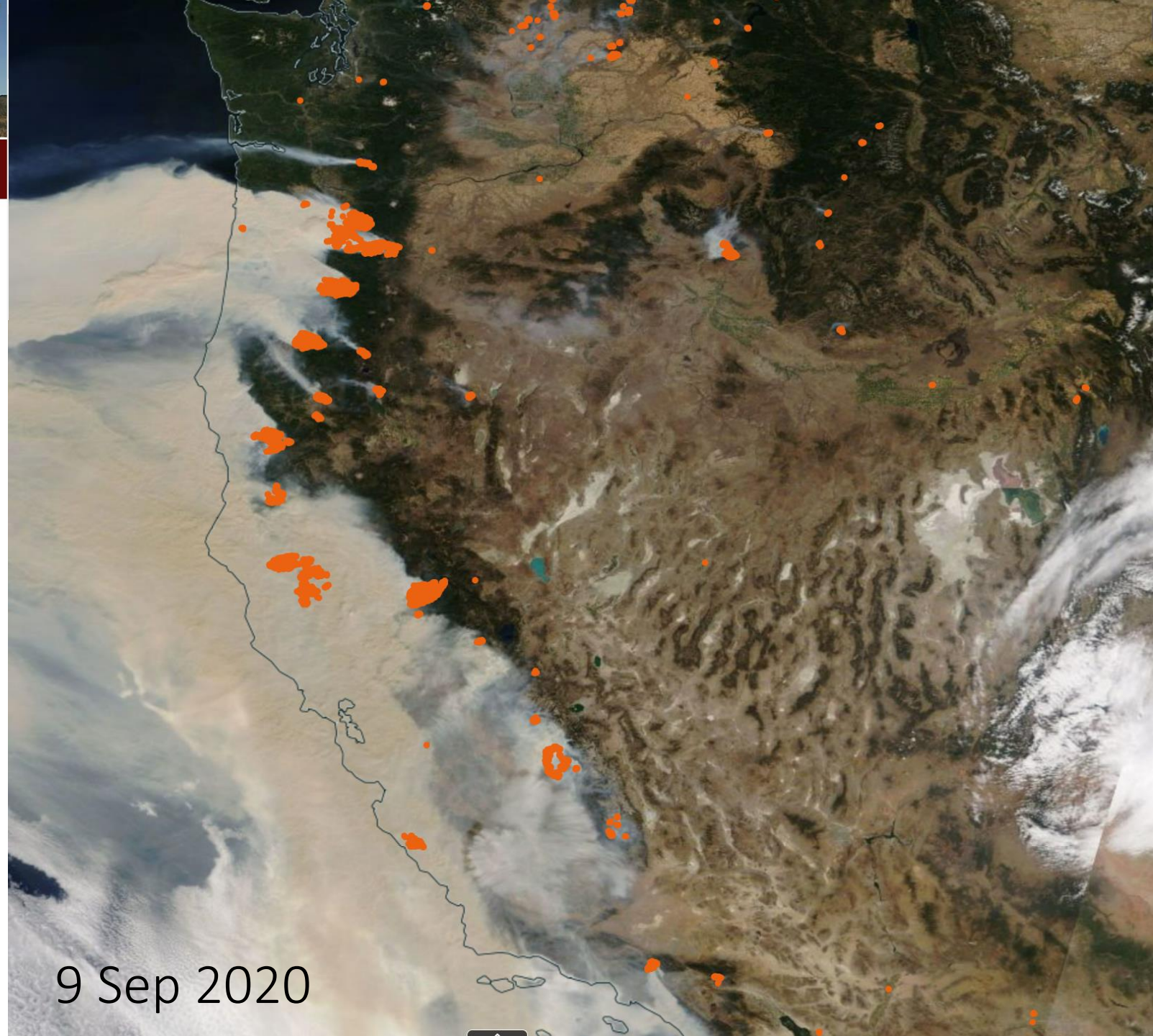
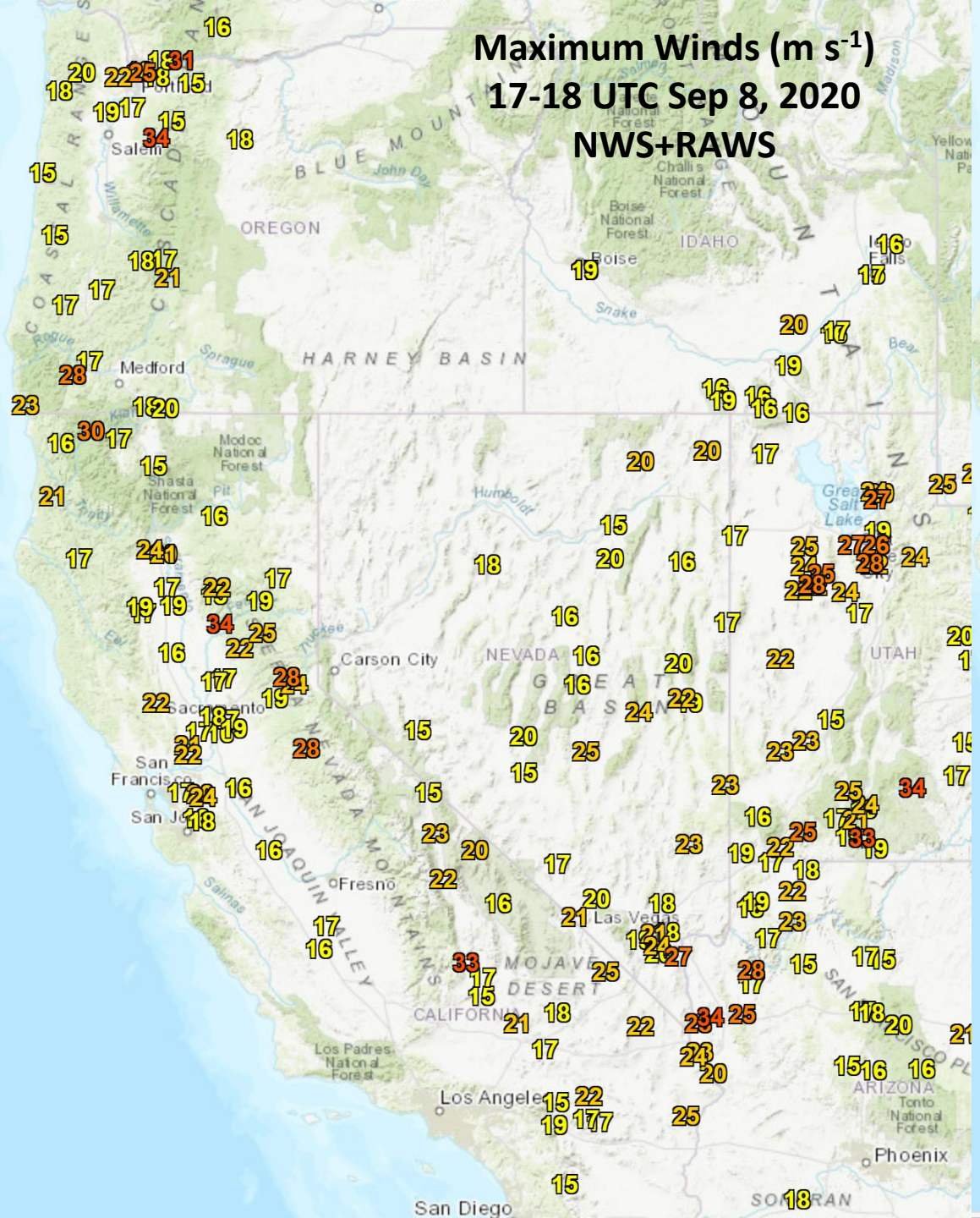
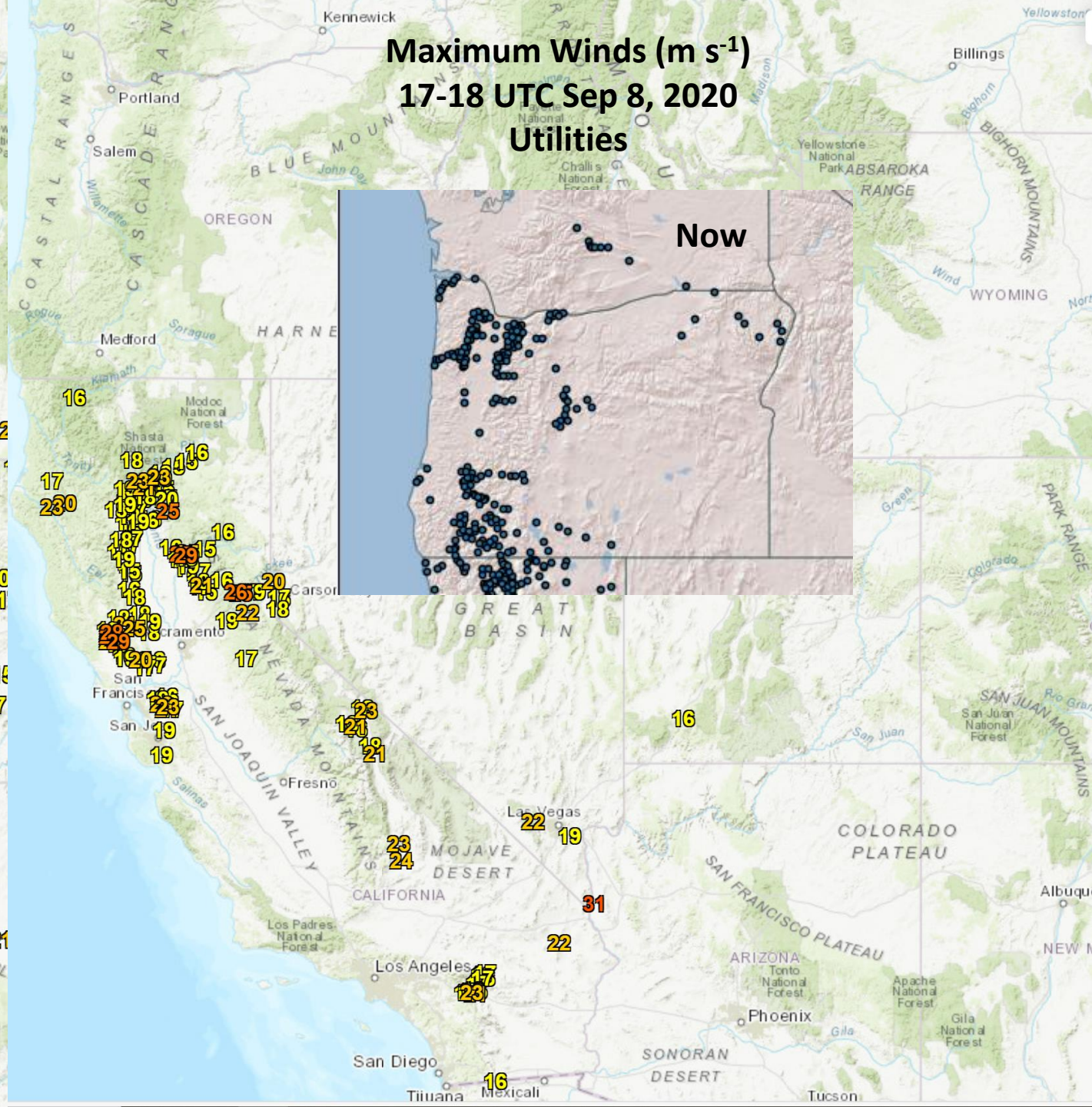
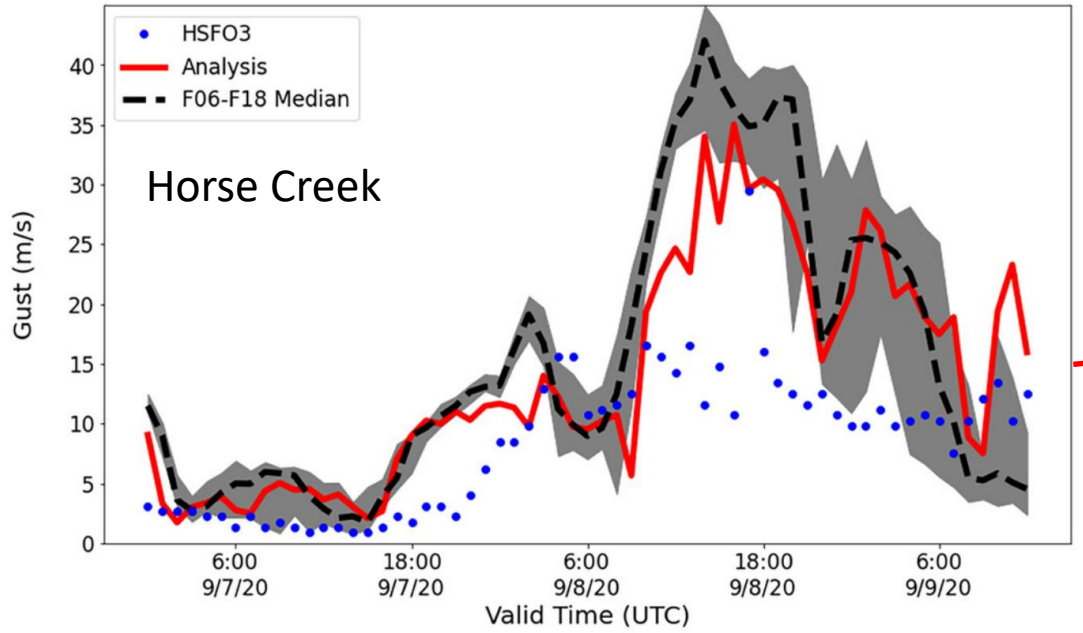
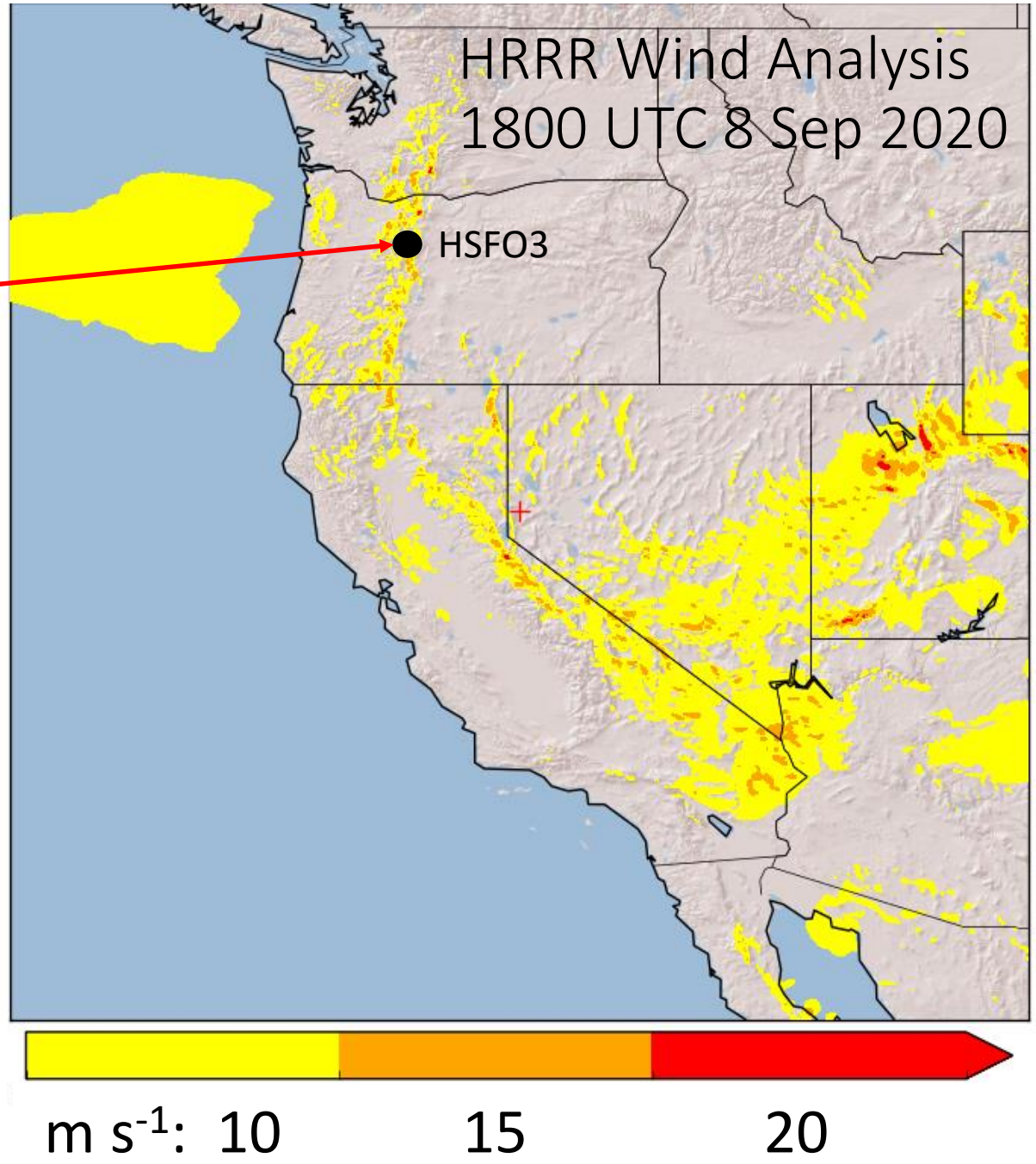
Reilly, M. et al. 2022: Cascadia Burning: The historic, but not historically unprecedented, 2020 wildfires in the Pacific Northwest, USA. *Ecosphere*, *13*(6), e4070. https://doi.org/10.1002/ecs2.4070




Maximum Winds (m s-1)
17-18 UTC Sep 8, 2020
NWS+RAWS


Maximum Winds (m s-1)
17-18 UTC Sep 8, 2020
Utilities
Now





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- Blaylock, B., J. Horel, 2020: Comparison of Lightning Forecasts from the High-Resolution Rapid Refresh Model to Geostationary Lightning Mapper Observations. *WAF.* 10.1175/WAF-D-19-0141.1
- Blaylock, B., J. Horel, C. Galli, 2018: High-Resolution Rapid Refresh Model Data Analytics Derived on the Open Science Grid to Assist Wildfire Weather Assessment. *JTECH.* 10.1175/JTECH-D-18-0073.1
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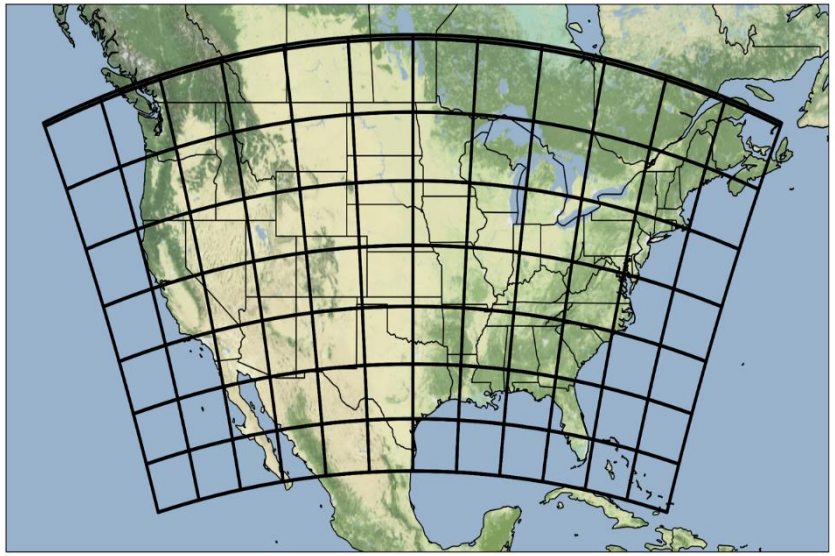
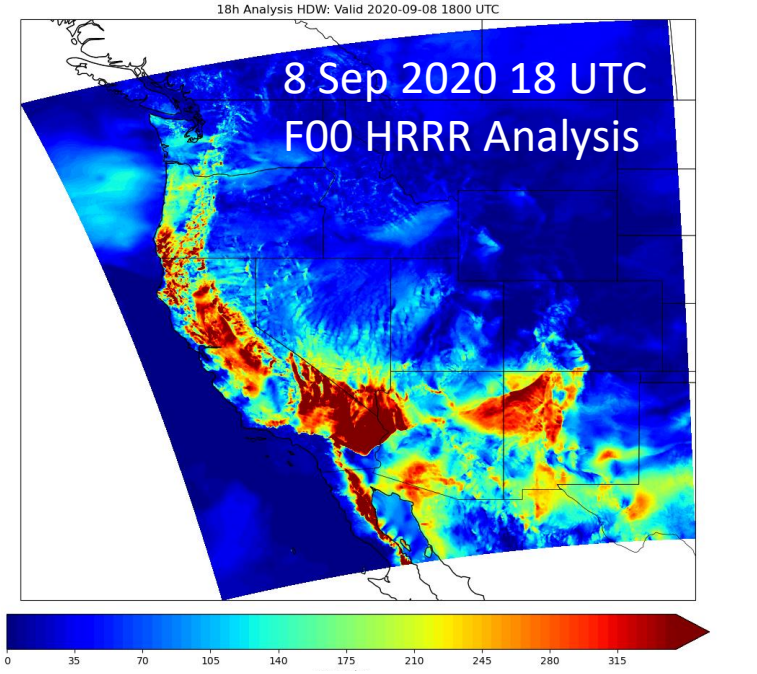
HRRR Analytics Using Zarr
https://mesowest.utah.edu/html/hrrr/

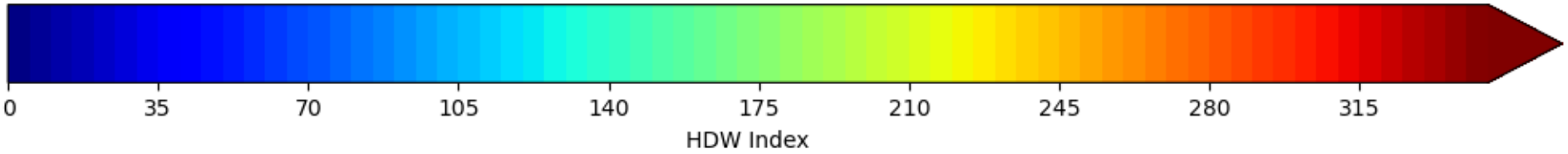
- HRRR V2-V4 1799 x 1059 analysis fields broken up into 96 150 x 150 chunks
- HRRR V2-V4 analysis grids: 2016-present; HRRR V3-V4 forecast grids: 2018-present



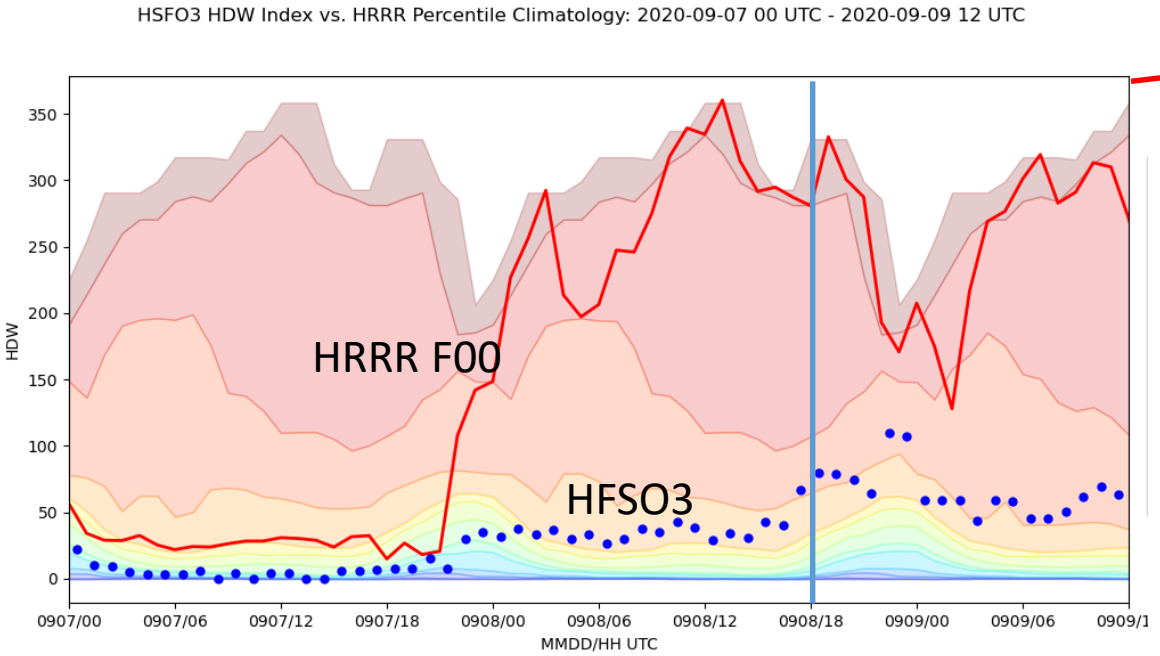
Proof of Concept:

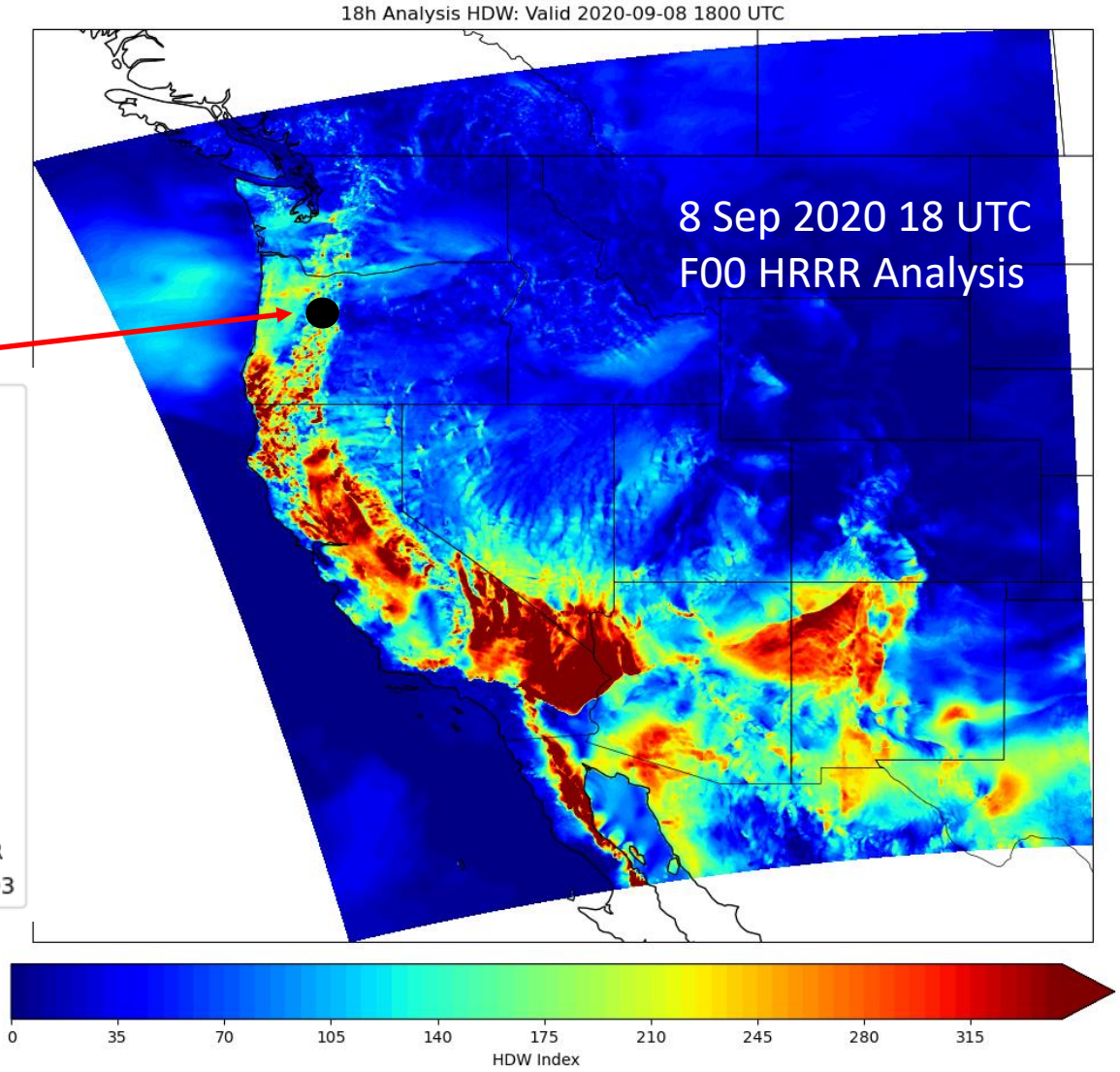
- what are typical Hot-Dry-Windy (HDW) conditions for each 3 x 3 km gridpoint for each hour of each calendar day within western U.S.?
- How do prior and current observations & HRRR/RRFS analyses and HRRR/RRFS forecast values compare to ~8 year HRRR climatology?
- For western U.S. region, compute HRRR analysis percentile statistics for each calendar hour using 168-member samples (± 1 h, ± 3 d, 8 y)



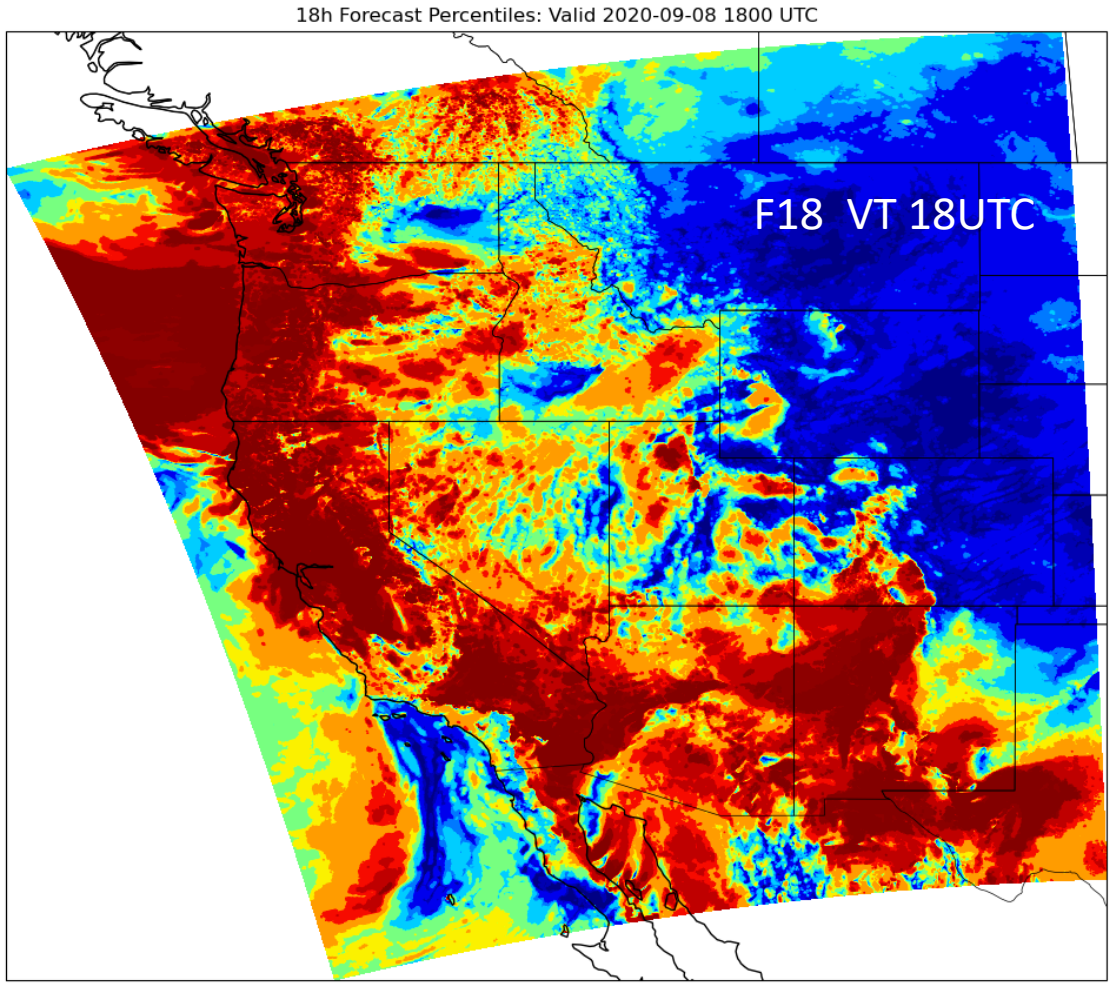


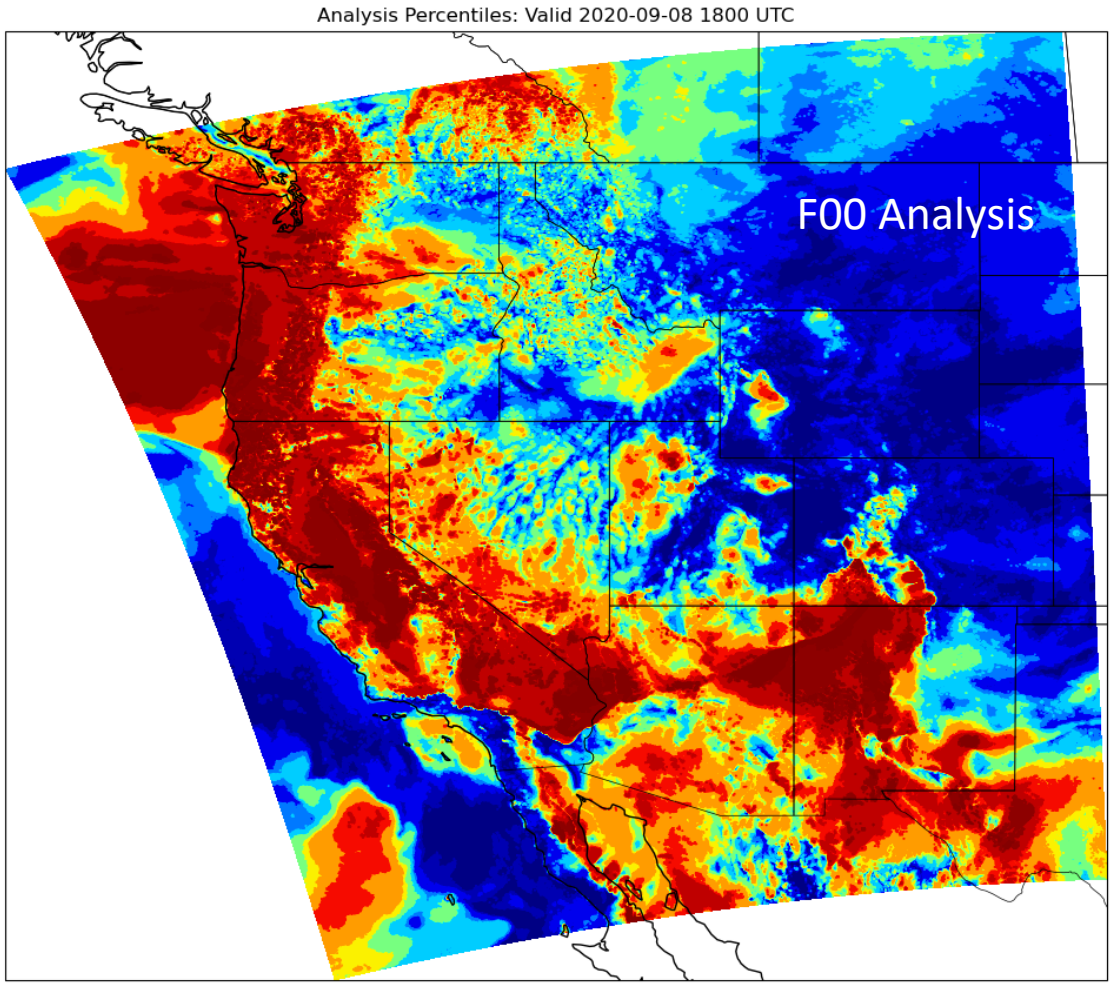
HRRR HDW: 7-8 Sep 2020
Relative to 2016-2023 Percentiles

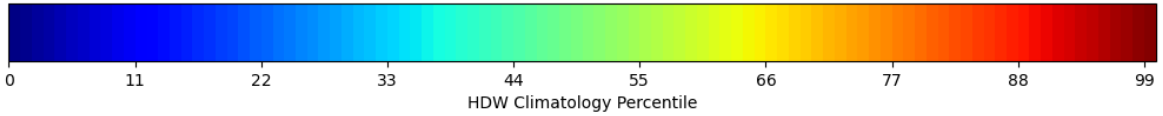


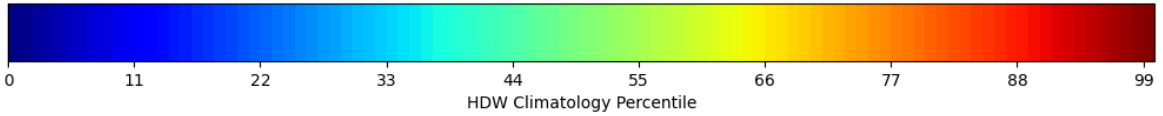


HRRR HDW Percentile Values: 1800 UTC 8 Sep 2020

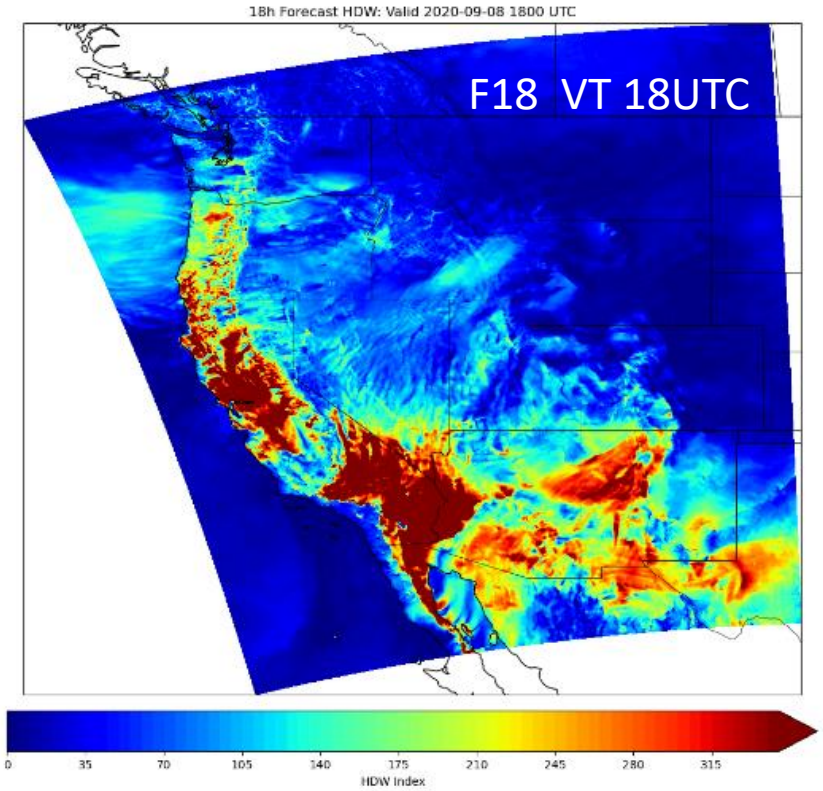
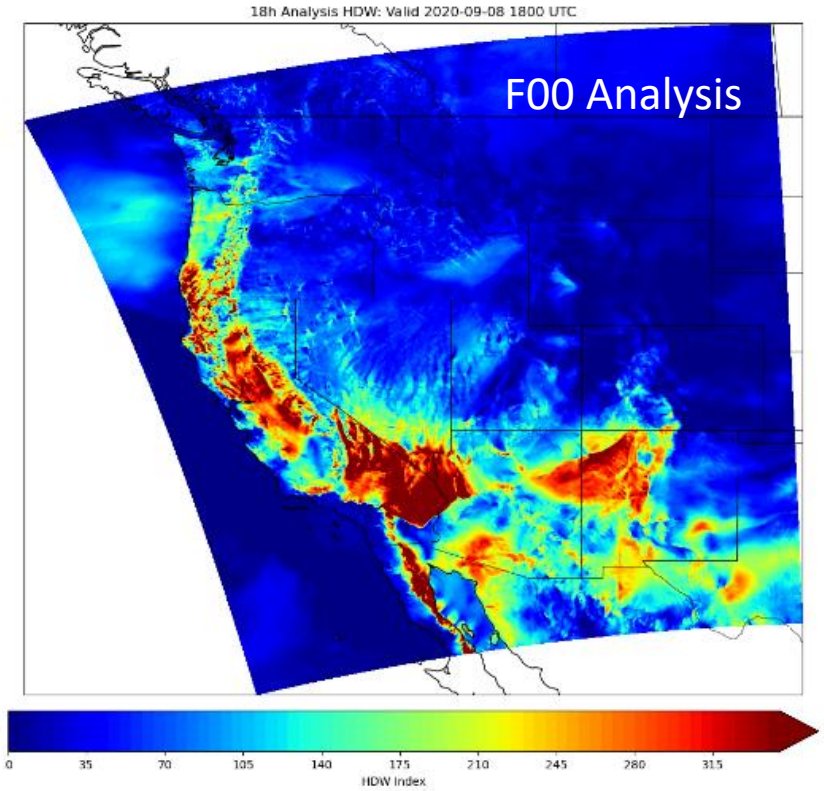
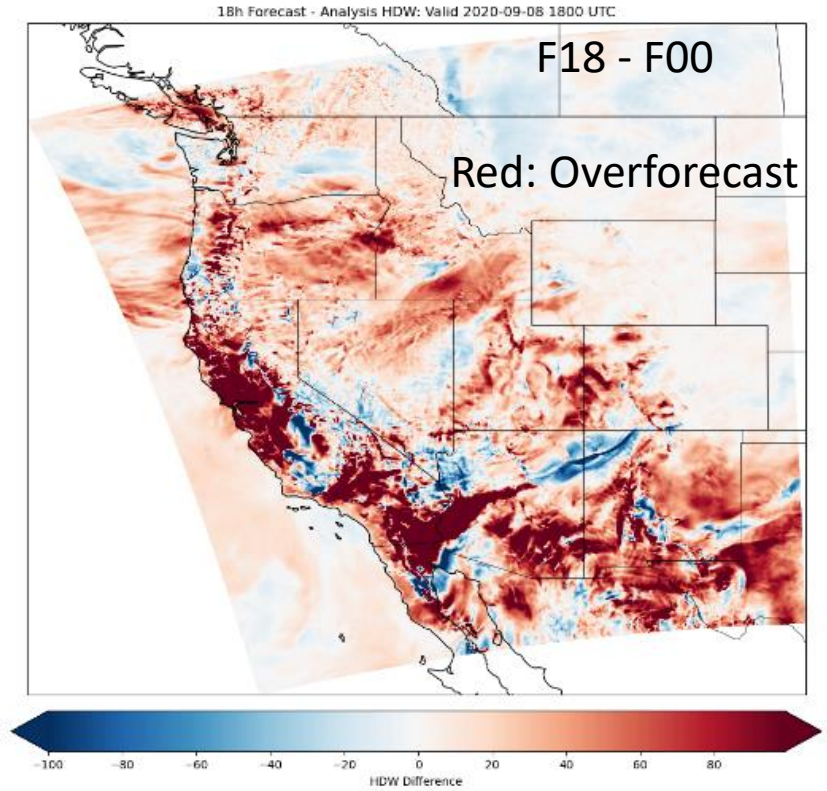








Next steps/Issues?

- AKFF/GLFF: Software support after 2026 provided by FEMS or…?
- WIRED- collaborative framework for addressing research and operational needs to enhance resilience of western power grid
- Reorganize structure of existing HRRR Zarr archive for machine learning applications
- Use quantile mapping to bias correct future HRRR/RRFS forecasts of parameters such as HDW
- Develop and test machine learning approaches to estimate power grid circuit-level risks to extreme weather using RRFS ensemble forecasts trained from HRRR analyses/forecasts during 2016-2024
- How to deal with increasing stakeholder needs and increasing volume of RRFS model output across North America (15 Pbytes annually)?

HRRR HDW Indices: 1800 UTC 8 Sep 2020