



Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

Forecast Products based on the 200-Member West-WRF Ensemble

A CW3E and NWS Western Region Collaborative Effort

AMS WAF/NWP Conference
18 July 2023 / Madison, WI, USA

Jon Rutz (Center for Western Weather and Water Extremes - CW3E)
Brian Kawzenuk, Luca Delle Monache, Dan Steinhoff, Matthew Simpson, Julie Kalansky (CW3E)
Matt Jeglum, Jon Suk (NWS)

UC San Diego



SCRIPPS INSTITUTION OF
OCEANOGRAPHY

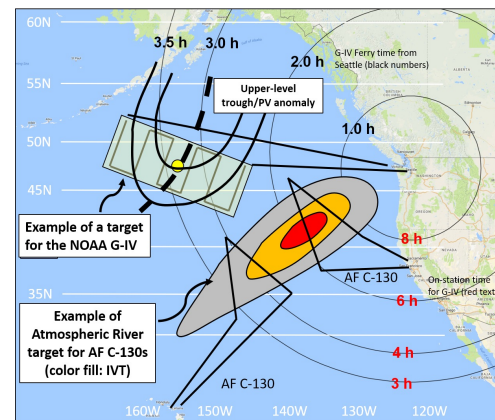
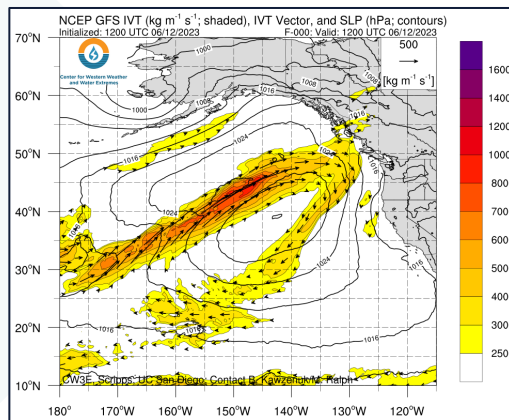
What is CW3E? The Center for Western Weather and Water Extremes

Mission

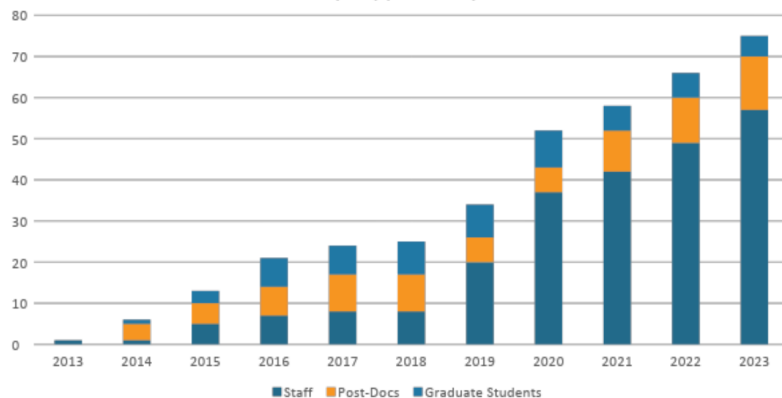
Provide 21st Century water cycle science, technology, and outreach to support effective policies and practices that address the impacts of extreme weather and water events on the environment, people, and economy of Western North America.

Goal

Revolutionize the physical understanding, observations, weather predictions, seasonal outlooks, and climate projections of extreme events in Western North America, including atmospheric rivers, the North American summer monsoon, and their impacts on floods, droughts, hydropower, ecosystems, and the economy.



Primarily Supported by CW3E

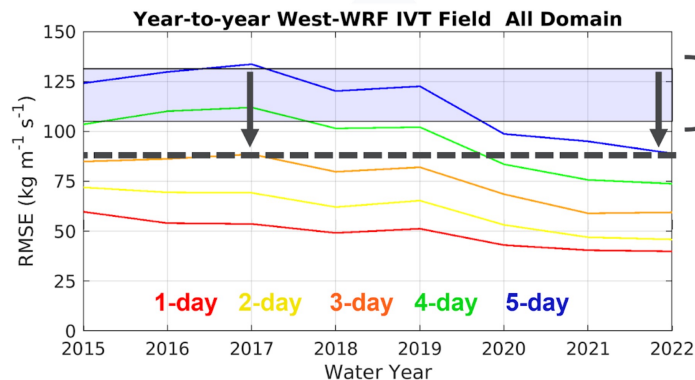
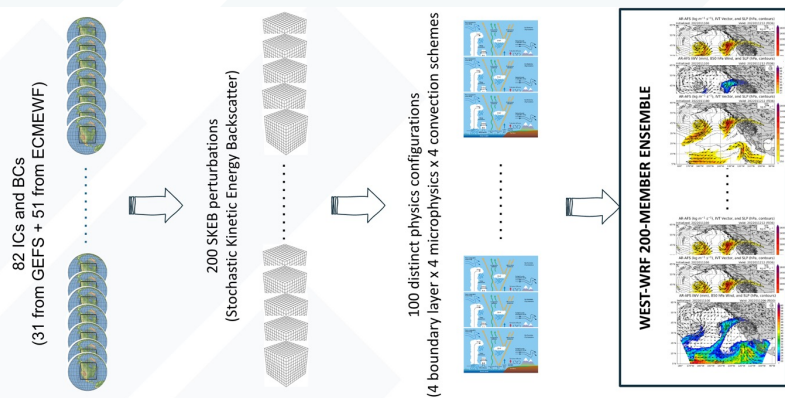
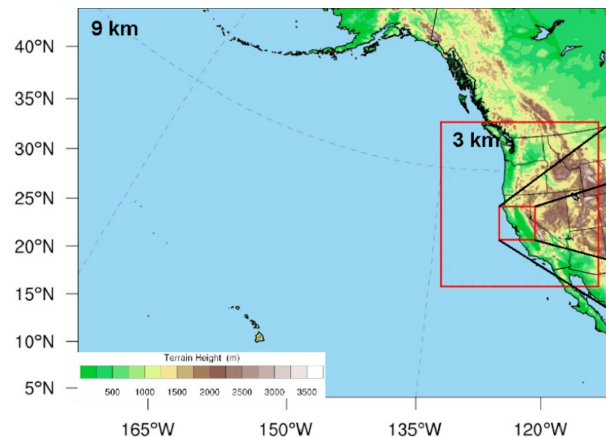


What is West-WRF?

A regional, seasonal WRF model with 4 sets of simulations...

- (1) GFS-based deterministic (using version 4.4.1), 100 levels, 9/3/1 km
- (2) ECMWF-based deterministic (using version 4.4.1), 100 levels, 9/3/1 km
- (3) GFS-based deterministic, (using version 4.1.2), 60 levels, 9/3 km
- frozen since 2019-2020, for machine learning purposes
- (4) **200-member ensemble** (using version 4.4.1), 60 levels, 9-km
- *this is what we will focus on today*

For more details, please see Dan Steinhoff's talk 12:00pm Wed:
"The 200-Member West-WRF Near Real-Time Forecast Ensemble"



WY2022 RMSE is lower than the minimum value found in the 30+year West-WRF Reforecast

5-day forecasted errors are as good as 3-day forecasts pre-WY2018 (~35% reduction)

Shaded area represents min/max RMSE from 30-year West-WRF 5-day reforecast

What are CW3E and NWS Western Region (WR) Collaborative Efforts?

CW3E is unique in focus on the Western U.S. and focus on applications, making it an ideal partner for NWS WR

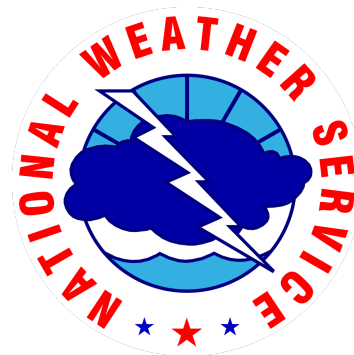
- There is a long history of collaborations between CW3E and NWS WR dating back to 2014, including applied research on atmospheric rivers, associated precipitation, and novel tools that diagnose and predict these events
- Given the NWS' increased emphasis on probabilistic forecasts, the 200-member West-WRF ensemble is a very exciting development

In Fall 2021, CW3E and NWS WR began collaborating on probabilistic West-WRF forecast products tailored specifically to NWS interests

The initial version of these products was presented to NWS WR users in Fall 2022, and improvements were made over the course of Winter 2022/2023



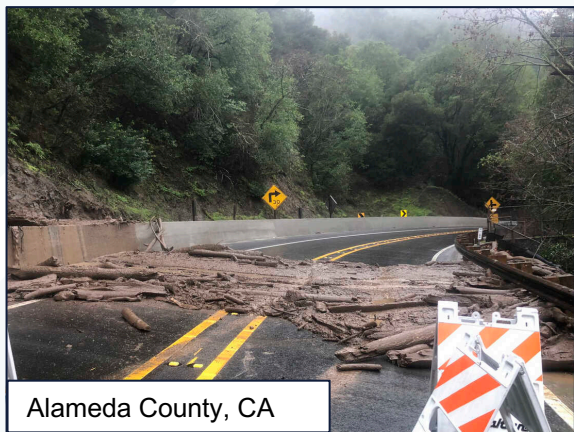
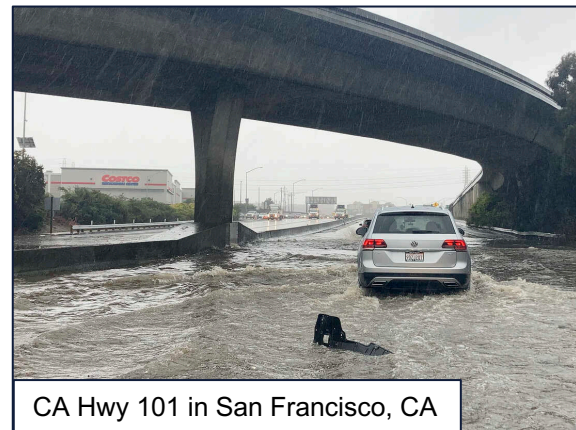
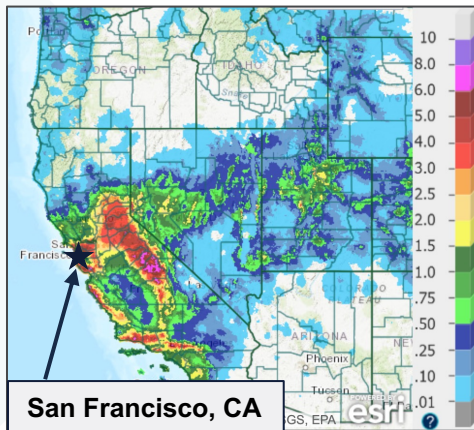
CW3E



31 Dec 2022: California, Nevada, Utah (Summary)

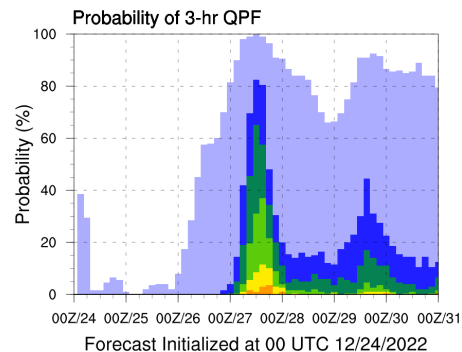
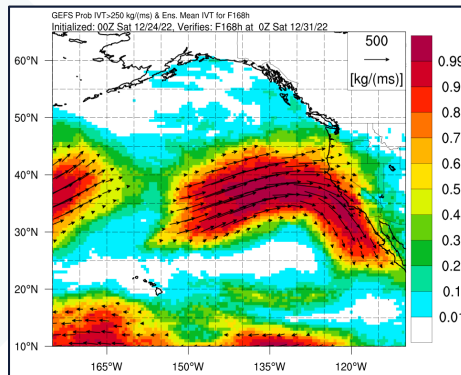
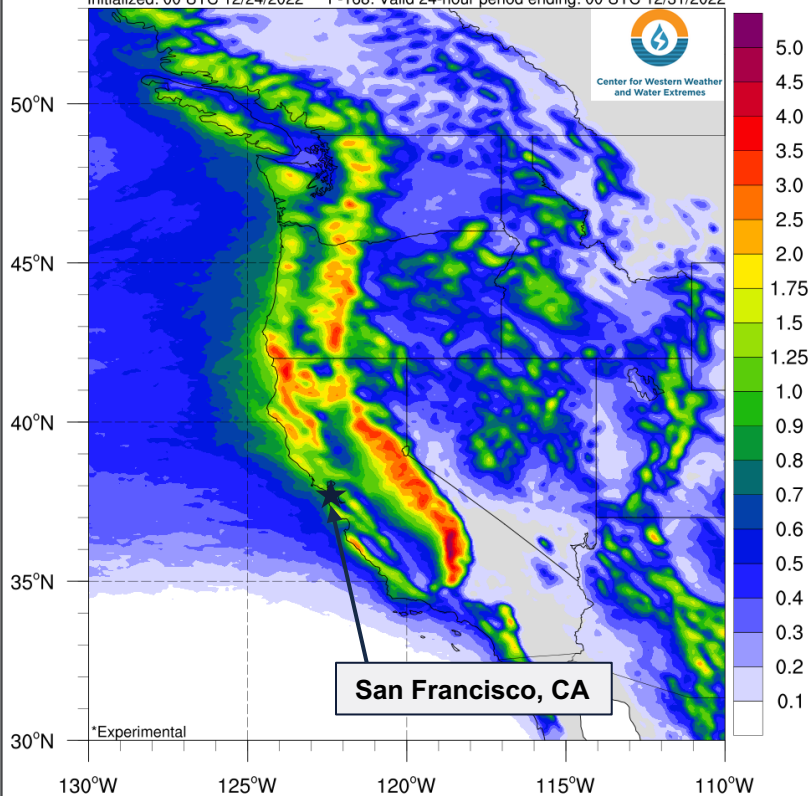
An intense landfalling atmospheric river along the CA coast produced numerous precipitation records including...

- Record wettest day in Oakland, CA (5.0")
- 2nd largest 24-hour rainfall in San Francisco, CA (5.46")



31 Dec 2022: California, Nevada, Utah (168-h Lead Time)

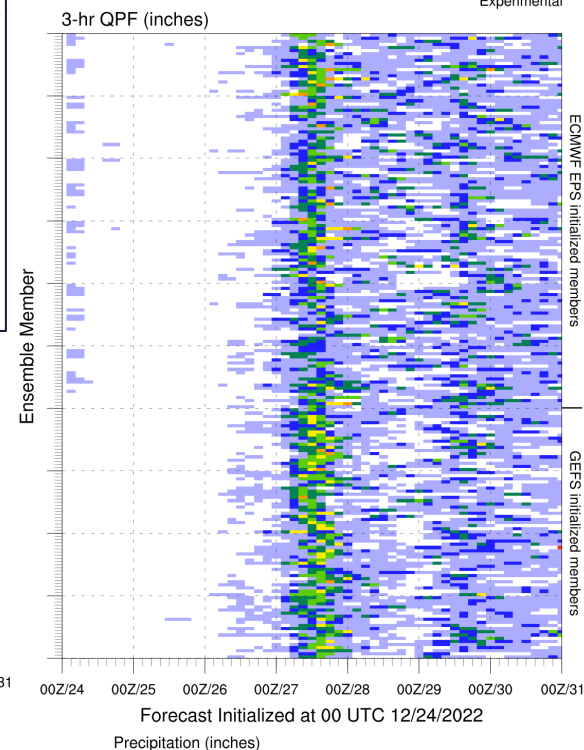
West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 12/24/2022 F-168: Valid 24-hour period ending: 00 UTC 12/31/2022



12/24/2022

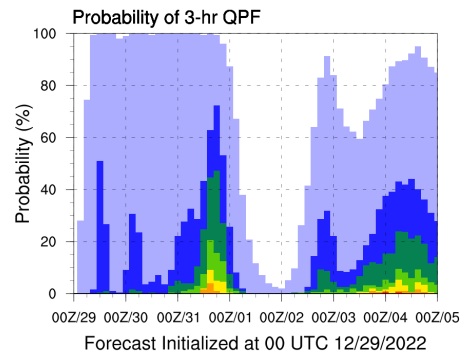
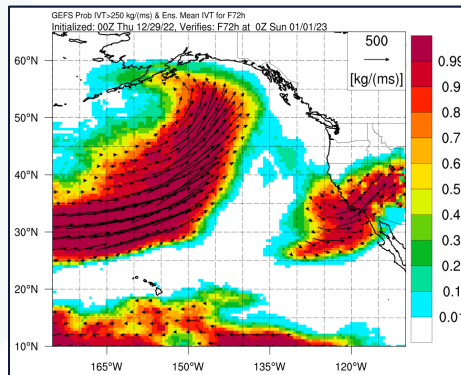
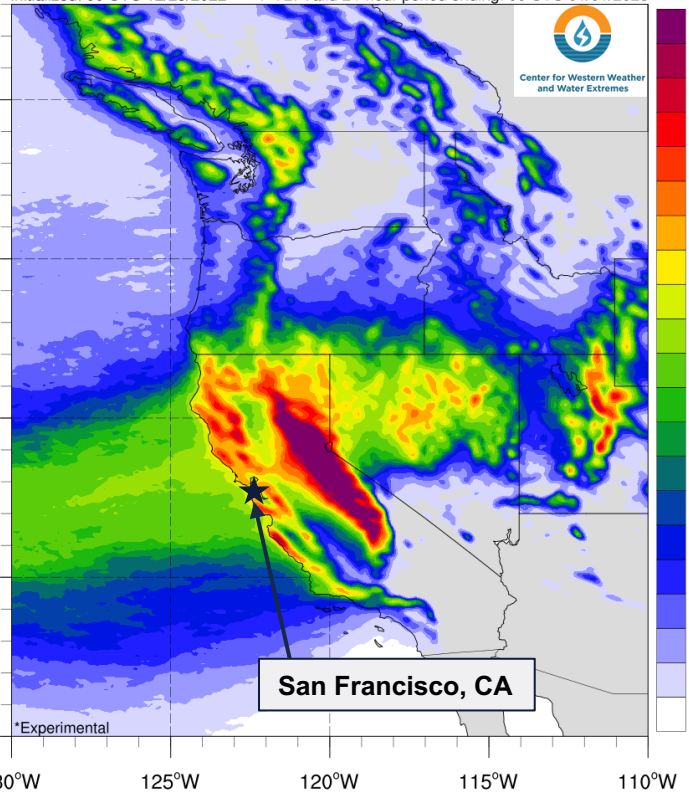
San Francisco International Airport

*Experimental

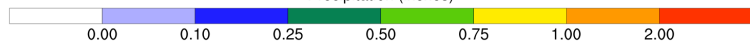
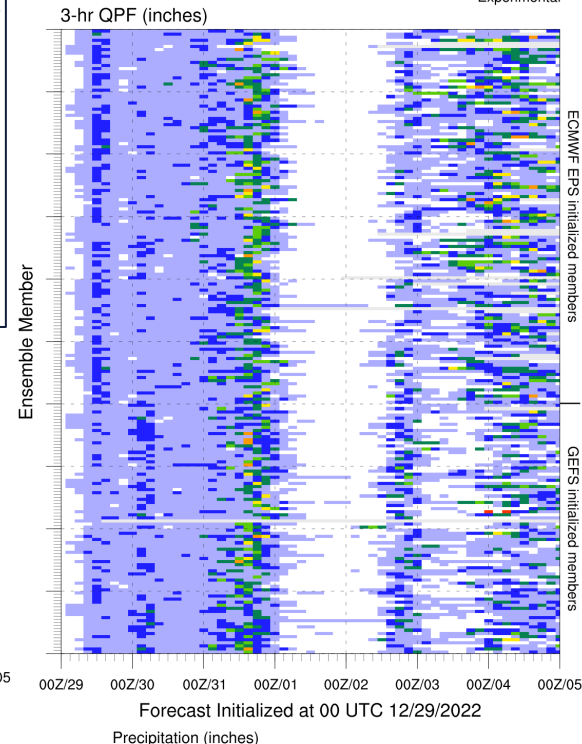


31 Dec 2022: California, Nevada, Utah (72-h Lead Time)

West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 12/29/2022 F-72: Valid 24-hour period ending: 00 UTC 01/01/2023

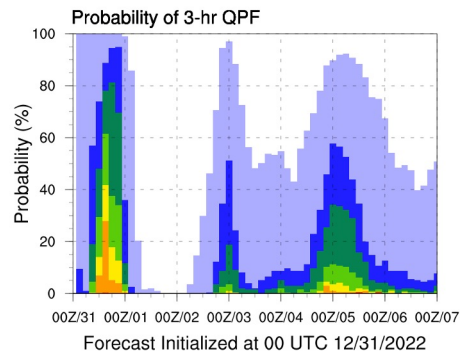
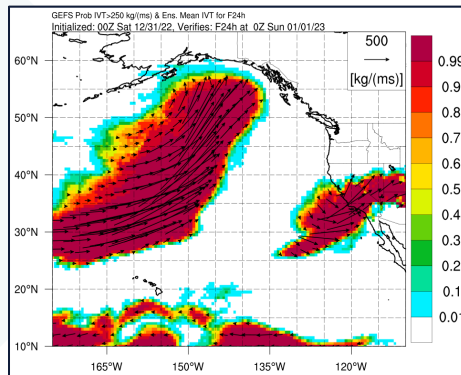
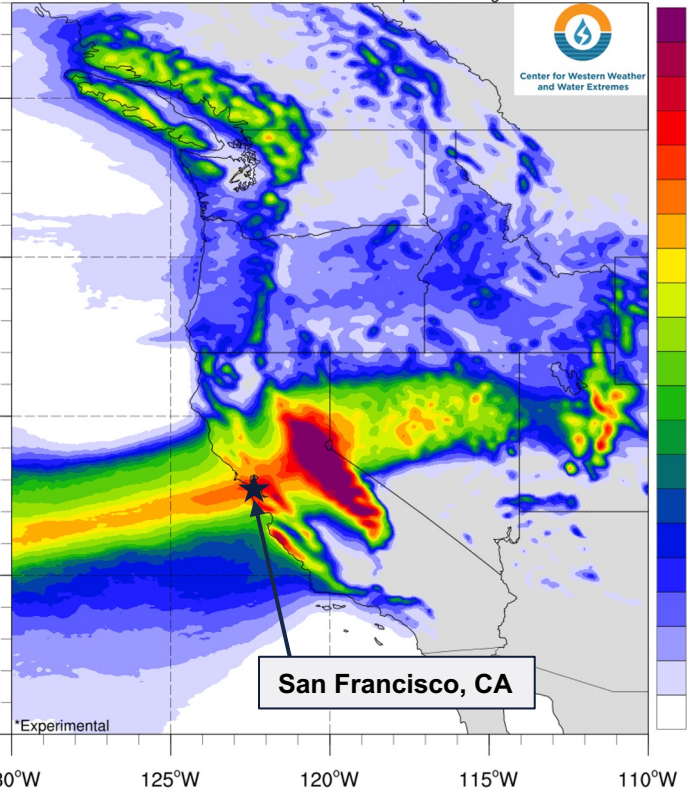


12/29/2022 San Francisco International Airport
*Experimental

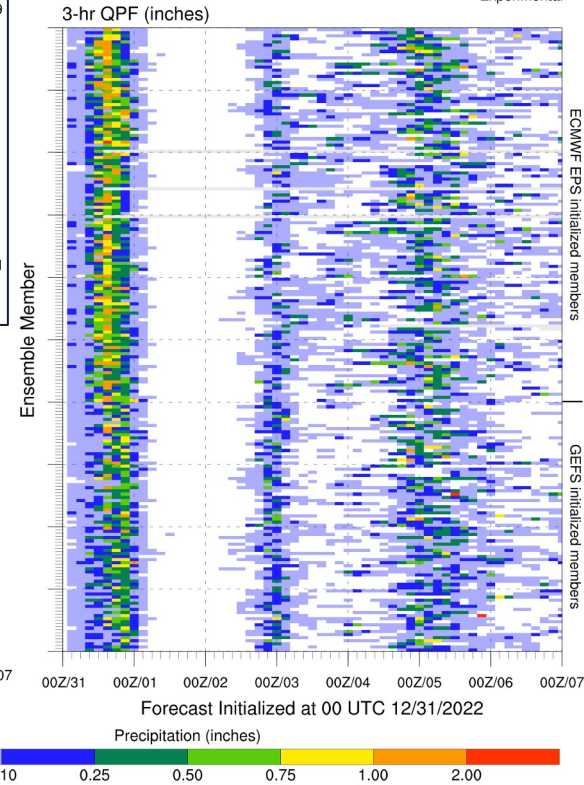


31 Dec 2022: California, Nevada, Utah (24-h Lead Time)

West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 12/31/2022 F-24: Valid 24-hour period ending: 00 UTC 01/01/2023



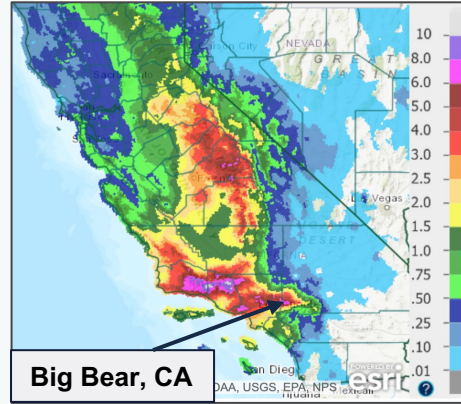
12/31/2022 San Francisco International Airport
*Experimental



25 Feb 2023: Southern California (Summary)

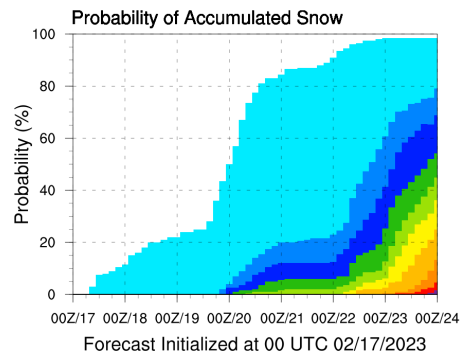
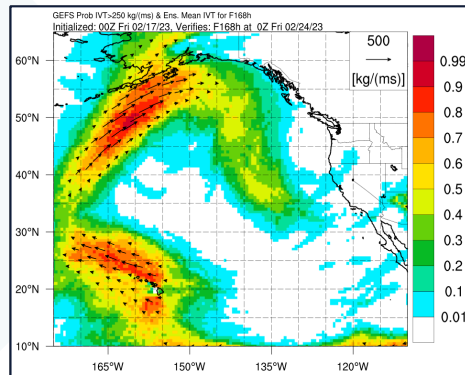
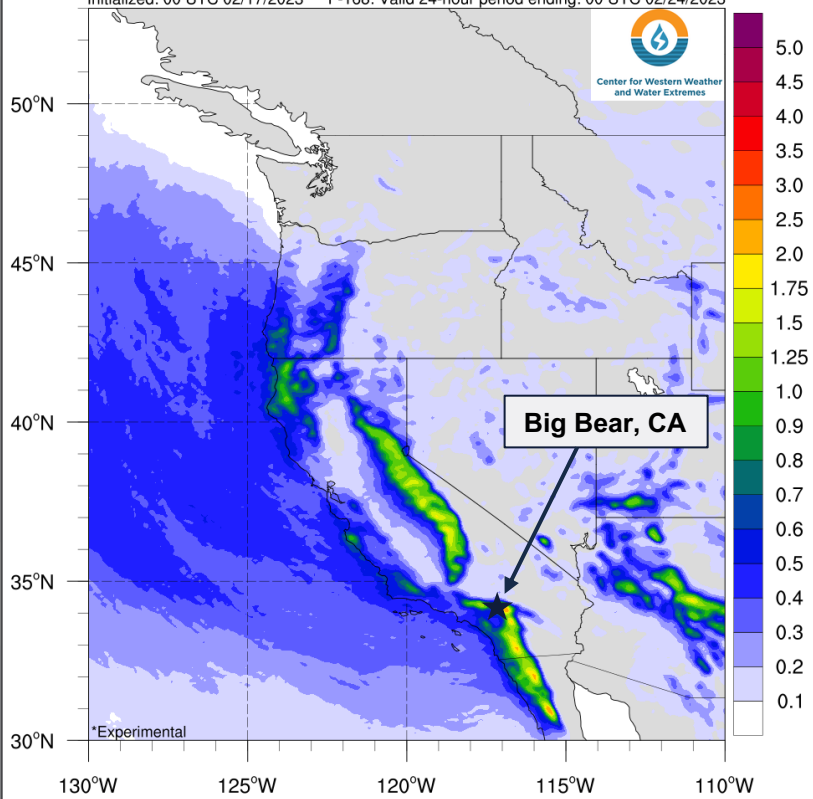
A strong cyclone and atmospheric river combined with a cold airmass to produce extremely heavy snowfall in the San Bernardino Mountains...

- Many residents were stranded for up to 7 days (unfortunately, at least 12 deaths have been attributed to the storm)



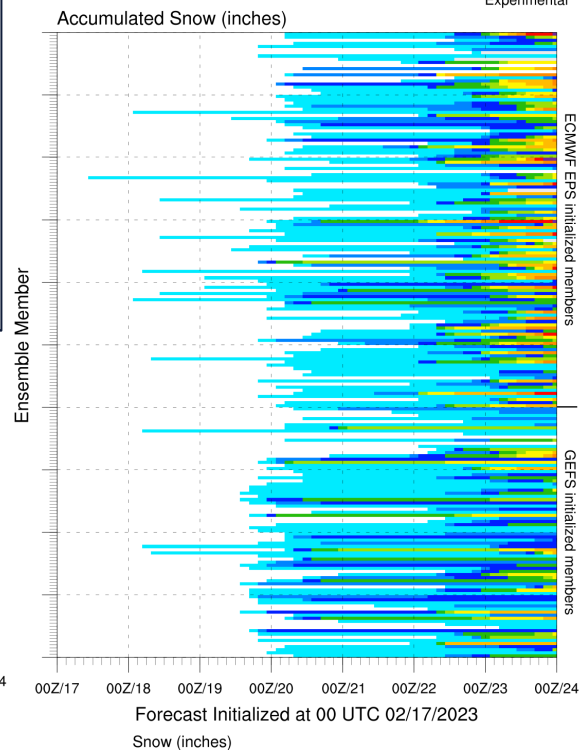
25 Feb 2023: Southern California (168-h Lead Time)

West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 02/17/2023 F-168: Valid 24-hour period ending: 00 UTC 02/24/2023



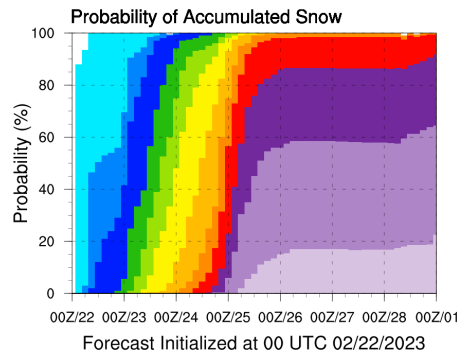
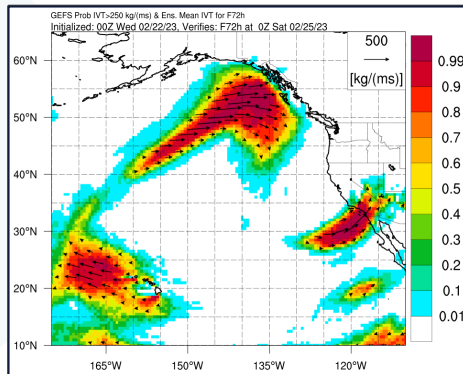
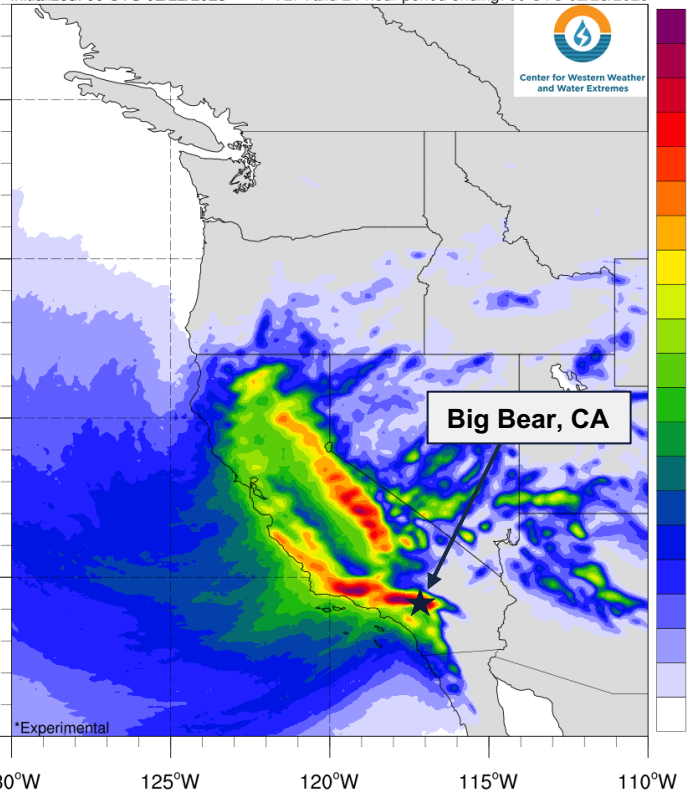
02/17/2023

Big Bear City (34.26°N, 116.86°W)
*Experimental



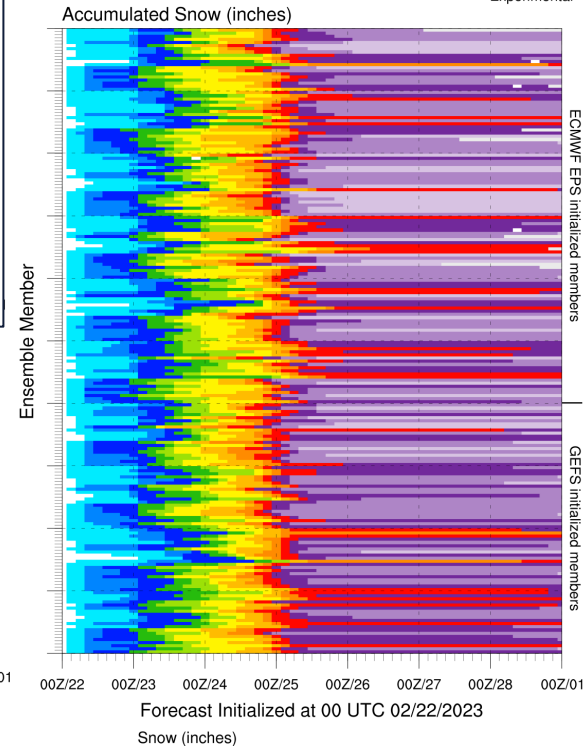
25 Feb 2023: Southern California (72-h Lead Time)

West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 02/22/2023 F-72: Valid 24-hour period ending: 00 UTC 02/25/2023



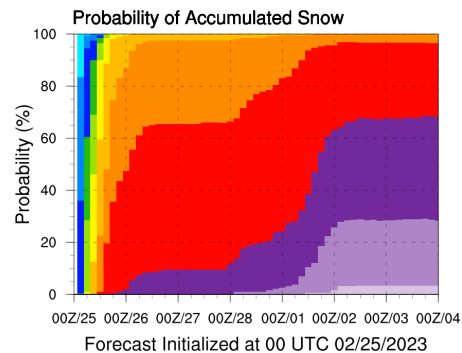
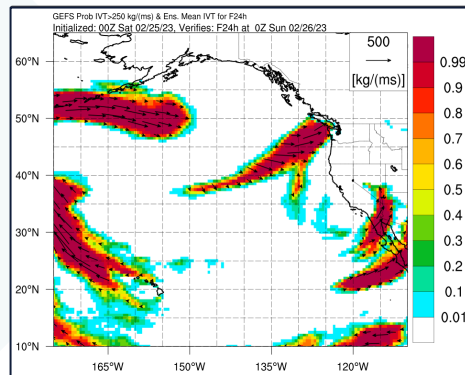
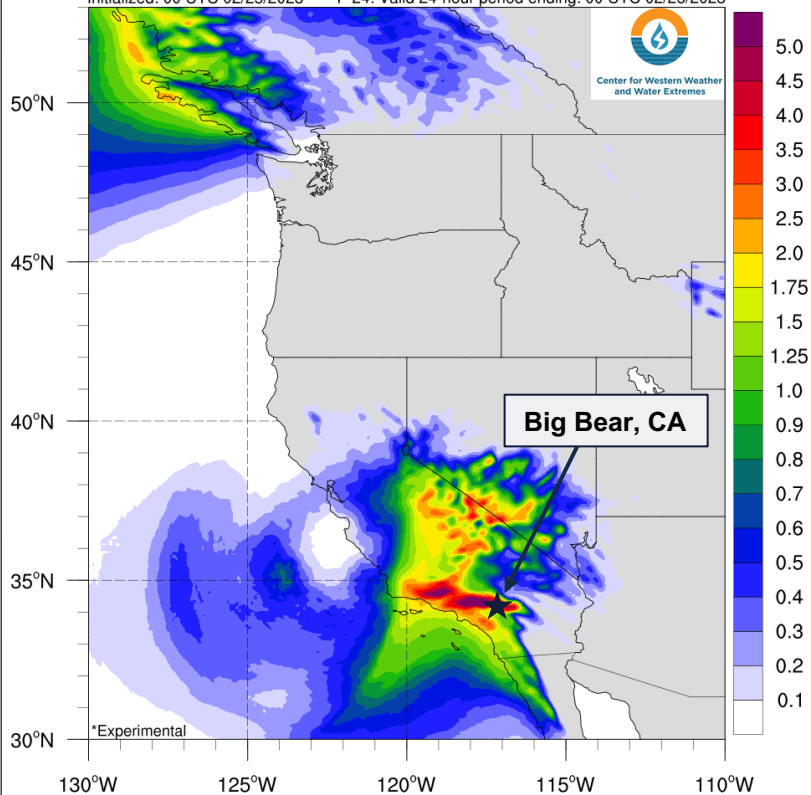
02/22/2023

Big Bear City (34.26°N, 116.86°W)
*Experimental



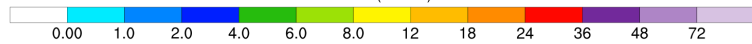
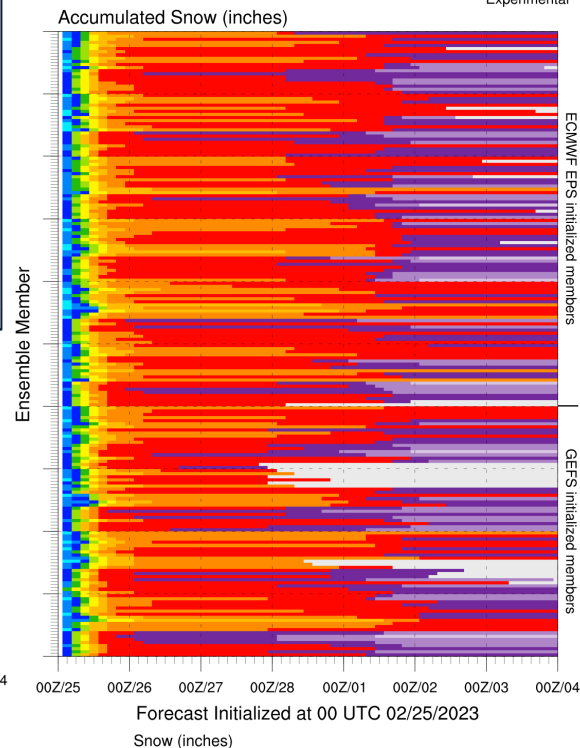
25 Feb 2023: Southern California (24-h Lead Time)

West-WRF Ensemble 90th Percentile of 24-hr Accumulated Precipitation (in)
Initialized: 00 UTC 02/25/2023 F-24: Valid 24-hour period ending: 00 UTC 02/26/2023



02/25/2023

Big Bear City (34.26°N, 116.86°W)
*Experimental



Summary

CW3E recently developed a large suite of forecast products based on the 200-member West-WRF ensemble tailored to NWS Western Region operational needs

- Only a fraction of these were highlighted today; see Data Access at right for more information
- Other products include percentile forecast maps, probability of exceedance maps, and joint probabilities (e.g., wind and RH for fire weather; wind and snow for blizzard)
- Represents a strong collaboration between CW3E and NWS Western Region

What's Next?

- West-WRF forecasts within DESI framework: see Travis Wilson's talk on "Dynamic Ensemble-based Scenarios for IDSS (DESI)..."

Contact

Jon Rutz (jruz@ucsd.edu)
CW3E / NWS Collaborations Lead

Information / Data Access

West-WRF Ensemble Forecast Products:
https://cw3e.ucsd.edu/west-wrf_ensemble/

