

CW3E Winter Storm and AR Outlook: 21 February 2023

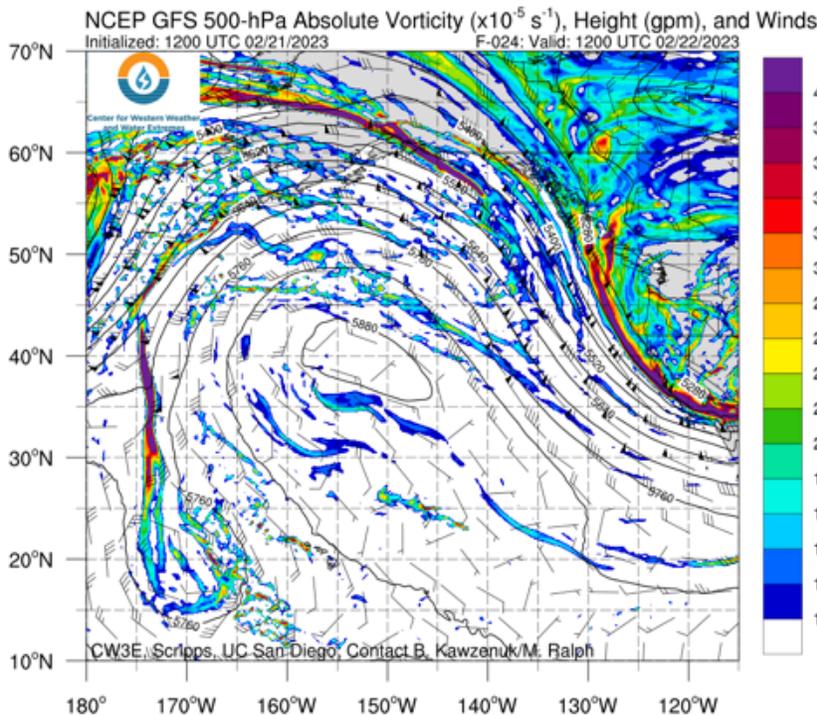
Winter Storm and Atmospheric River Forecast to Bring Heavy Rain and Snow to Southern California

- An amplifying upper-level shortwave trough will continue to produce unsettled weather over much of the western US during the next few days
- As time progresses, a cutoff low and a weak atmospheric river (AR) are forecast to develop near the California coast and bring a period of heavy precipitation to Southern California
- The 00Z ECMWF EPS control is predicting AR 1 conditions (based on the Ralph et al. 2019 AR Scale) over coastal San Diego County and AR 2 conditions near the California–Mexico border
- The NWS CNRFC is forecasting at least 2–5 inches of total precipitation in the Sierra Nevada and coastal Southern California, with higher amounts expected in the eastern Transverse Ranges and Peninsular Ranges
- The NWS Weather Prediction Center has issued a marginal risk of rainfall exceeding flash flood guidance in coastal Southern California Friday into Sunday
- Major winter storm impacts are expected over portions of the Sierra Nevada and Transverse Ranges from Thursday through Saturday
- Low freezing levels will support significant snowfall accumulations in the higher terrain in Southern California
- Damaging wind gusts are also possible over much of the southwestern US today into Thursday
- As part of CW3E's Atmospheric River Reconnaissance Program (AR Recon), the 53rd Weather Reconnaissance Squadron will continue to provide additional weather observations over the North Pacific, sampling the atmosphere upstream of this storm

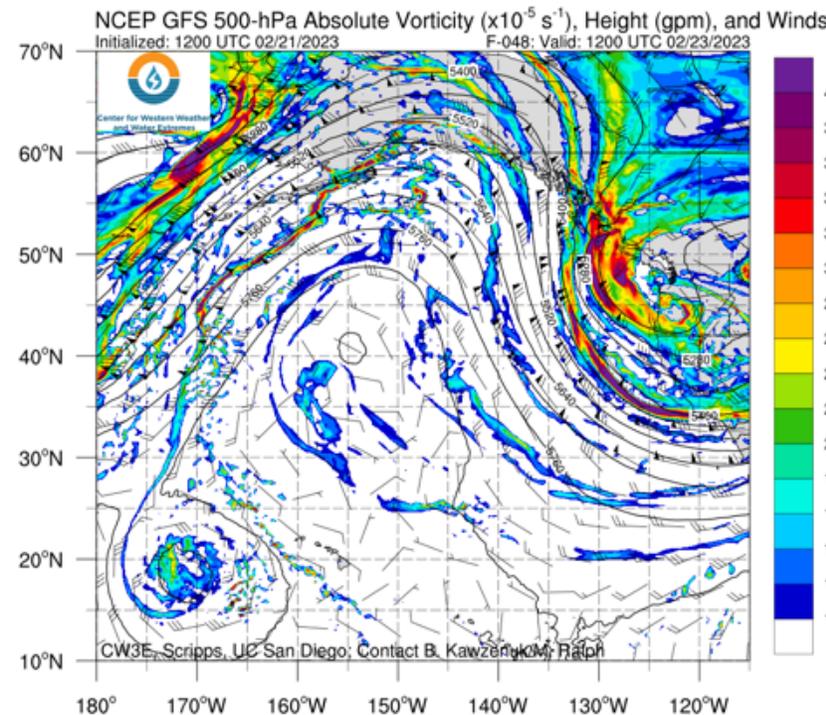
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GFS 500-hPa Vorticity, Height, and Wind Forecasts

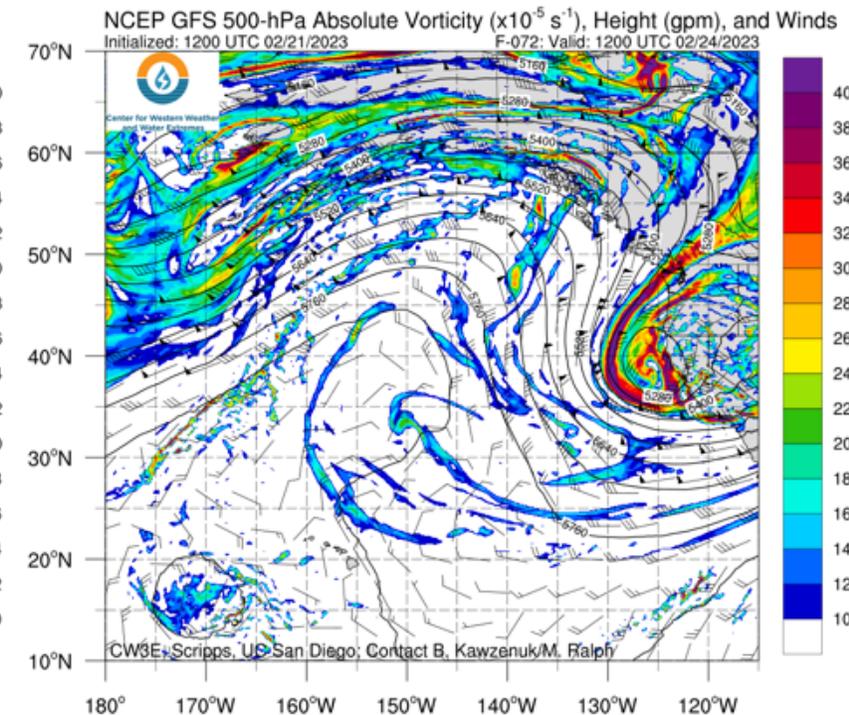
Valid: 4 AM PT 22 Feb (F-24)



Valid: 4 AM PT 23 Feb (F-48)



Valid: 4 AM PT 24 Feb (F-72)

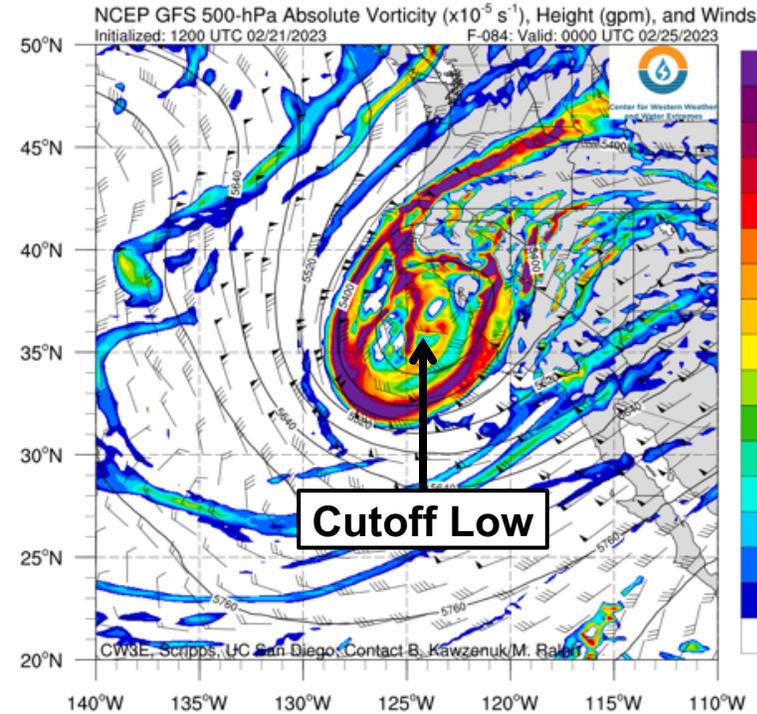


- An upper-level shortwave trough over the US West Coast will continue to bring unsettled weather to much of the western US during the next few days
- As time progresses, the large-scale flow will become more amplified over the Northeast Pacific, leading to the development of a cutoff low near the California coast
- This cutoff low is forecast to bring a period of heavy precipitation to Southern California Thursday through Saturday

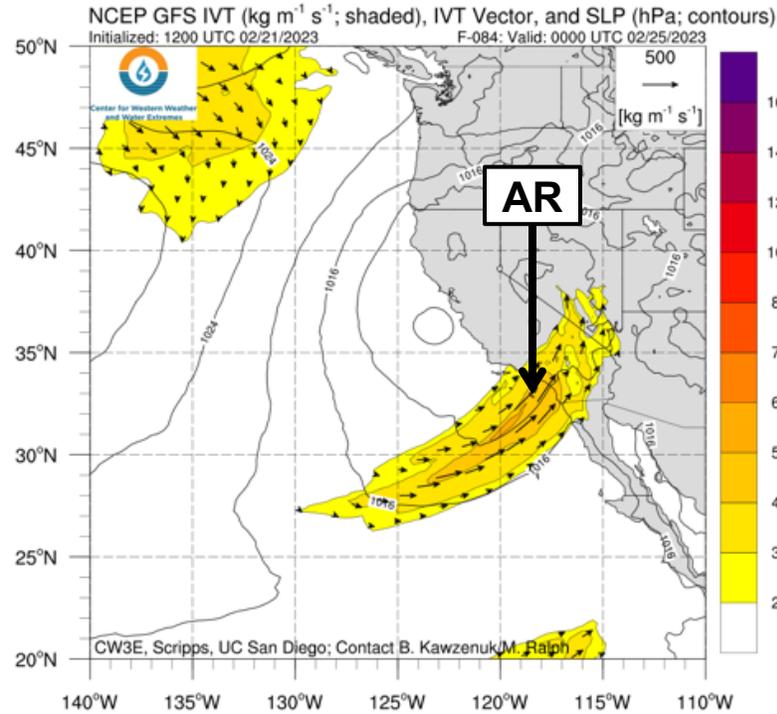
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GFS Model Forecasts: Valid 4 PM PT 24 Feb (F-84)

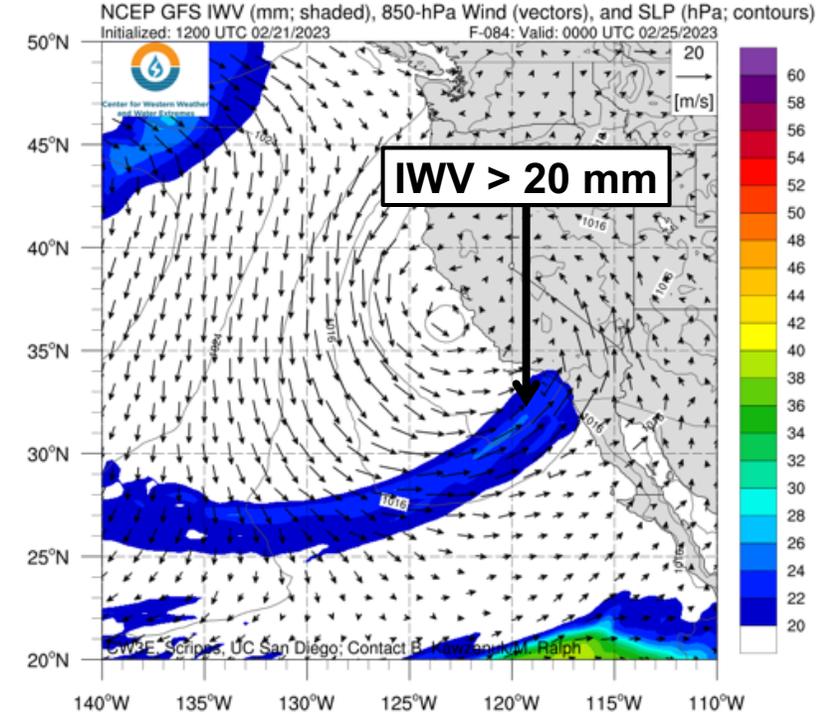
500-hPa Vorticity, Height, and Wind



IVT and SLP



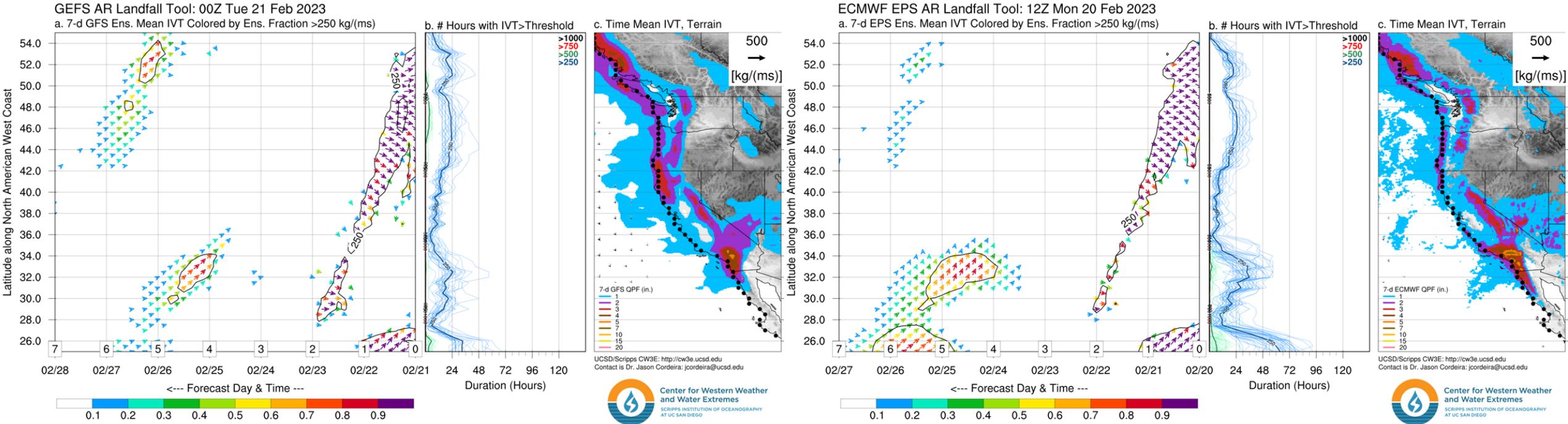
IWV, SLP, and 850-hPa Wind



- As the cutoff low moves down the California coast, strengthening low-to-mid level southwesterly flow is forecast interact with a region of IWV > 20 mm, resulting in the formation of a weak atmospheric river (AR) over Southern California
- Despite the lack of tropical moisture, strong low-level southwesterly flow will support upslope moisture flux over the eastern Transverse Ranges and Peninsular Ranges

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Probability of AR Conditions Along Coast, Control IVT Magnitude/Direction, and 7-day QPF



*GEFS = NCEP Global Ensemble Forecast System (United States)

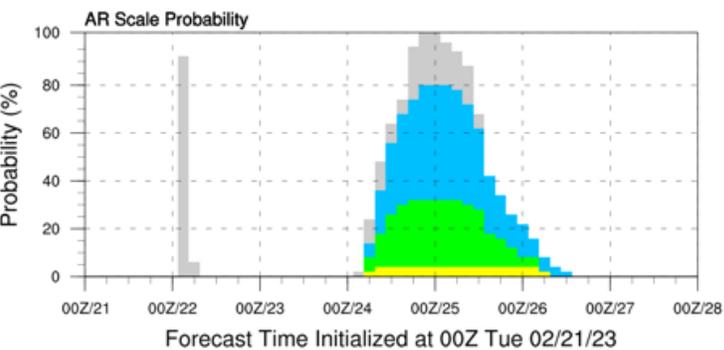
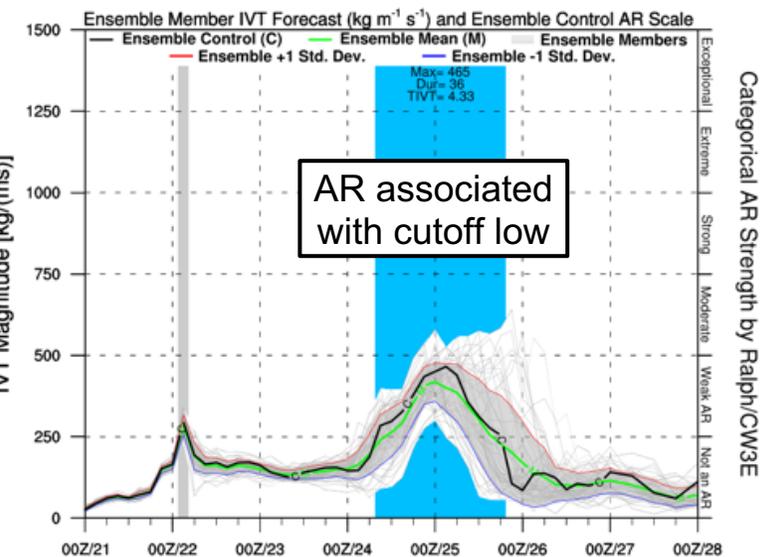
*EPS = ECMWF Ensemble Prediction System (Europe)

- The GEFS is showing moderate-to-high confidence (60–90% probability) in a brief period of AR conditions (IVT > 250 kg m⁻¹ s⁻¹) over coastal Southern California on 24–25 Feb
- The EPS is also showing moderate-to-high confidence in AR conditions in this region, but for a longer duration than GEFS
- The EPS control forecast IVT direction is more southerly compared to the GEFS control, and thus more favorable for orographic enhancement of precipitation over the Transverse Ranges

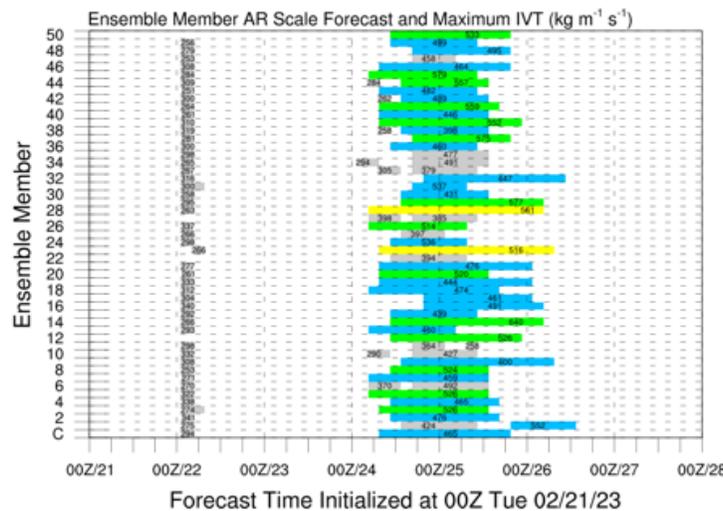
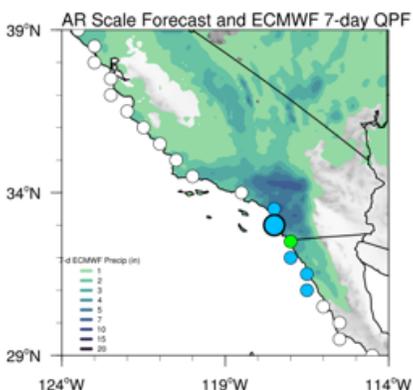
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ECMWF AR Scale and IVT Forecasts

ECMWF Ensemble Initialized: 00Z Tue 02/21/23



Location: 33°N 117.5°W



- The 00Z ECMWF EPS control is forecasting an AR 1 (based on the Ralph et al. 2019 AR Scale) over coastal San Diego County and an AR 2 near the California–Mexico border
- 36/51 (71%) ensemble members are predicting an AR 1 at 33°N, 117.5°W, and 13/51 (25%) are forecasting an AR 2
- 19/51 (37%) ensemble members are predicting a maximum IVT magnitude $\geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$ at this location
- The 00Z GEFS (not shown) is forecasting a much lower probability of AR Scale conditions due to a shorter duration of IVT $\geq 250 \text{ kg m}^{-1} \text{ s}^{-1}$
- There is still considerable forecast uncertainty in the timing and duration of AR conditions



Image created: 08 UTC 02/21/2023

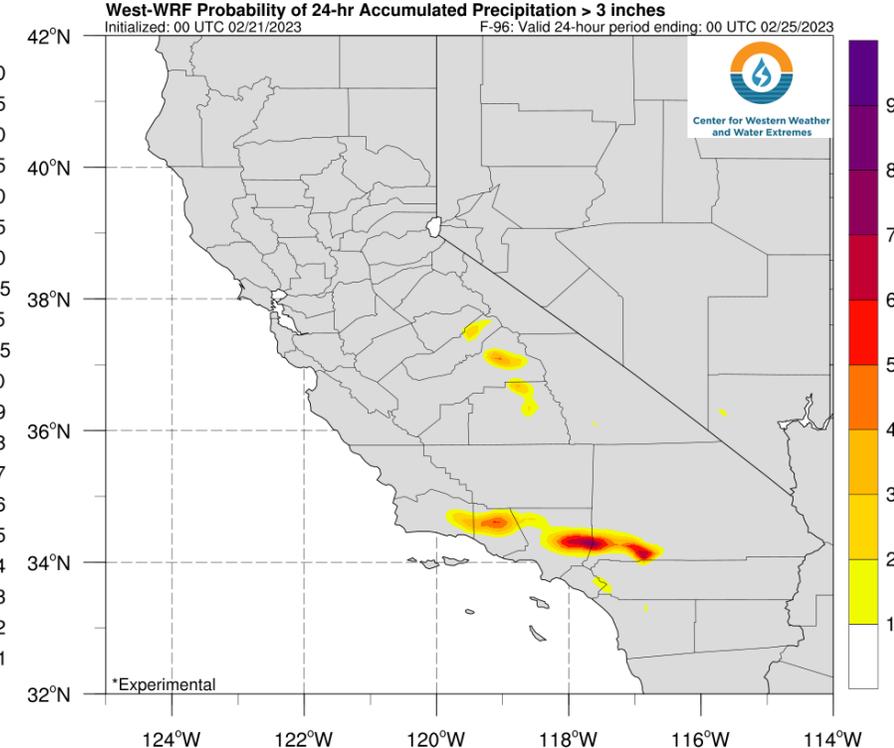
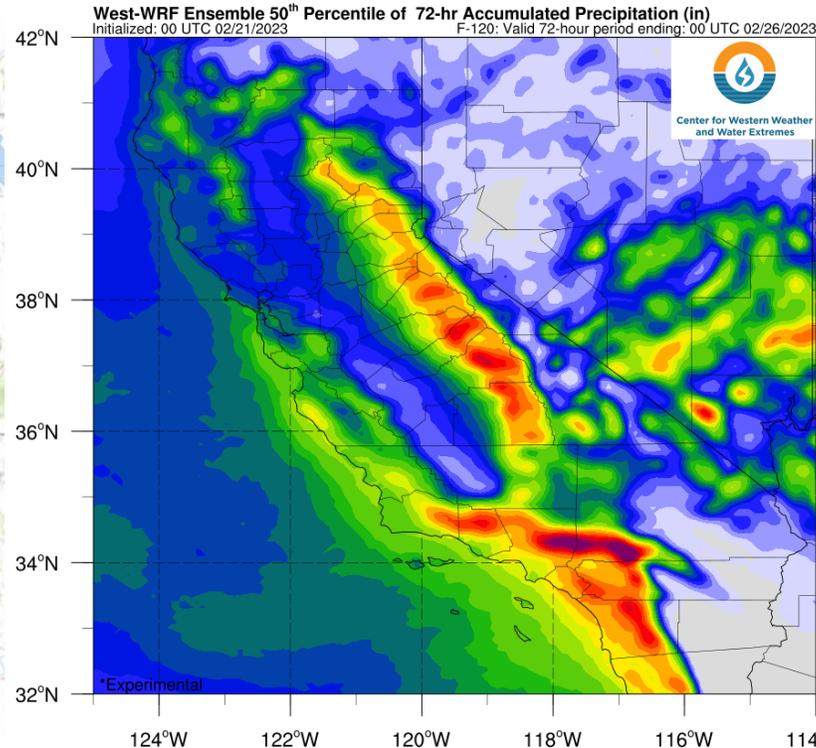
AR 1 AR 2 AR 3 AR 4 AR 5

More information: <http://cw3e.ucsd.edu> AR Scale based on Ralph et al. (2019; BAMS), contact M. Ralph

Precipitation Forecasts

6-Day Precipitation Forecast

Tue Feb 21 04 AM PST (21/12Z) to Mon Feb 27 04 AM PST (27/12Z)

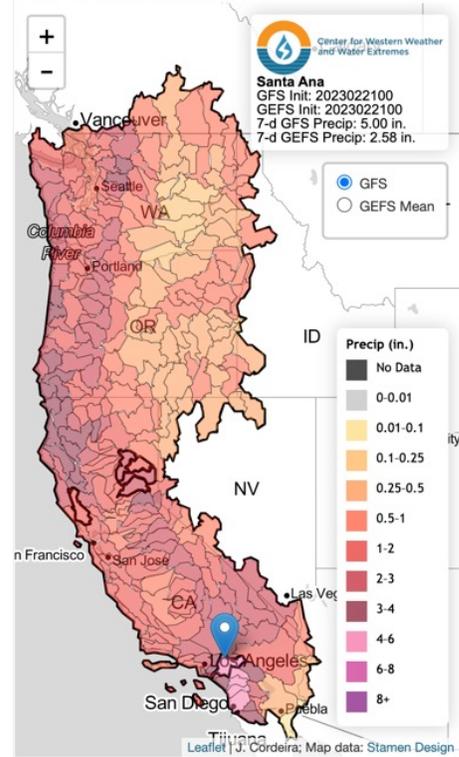


- This storm is forecast to produce at least 2–5 inches of precipitation over the Sierra Nevada and coastal Southern California, with higher amounts expected in the eastern Transverse Ranges and Peninsular Ranges
- More than 50% of CW3E’s West-WRF ensemble members are forecasting > 5 inches of total precipitation during the 72-hour period ending 4 PM PT 25 Feb in the San Gabriel and San Bernadino Mountains
- The heaviest precipitation is forecast to occur Friday into Saturday as the AR makes landfall, with more than 50% of West-WRF ensemble members forecasting > 3 inches of precipitation in a 24-hour period in these areas

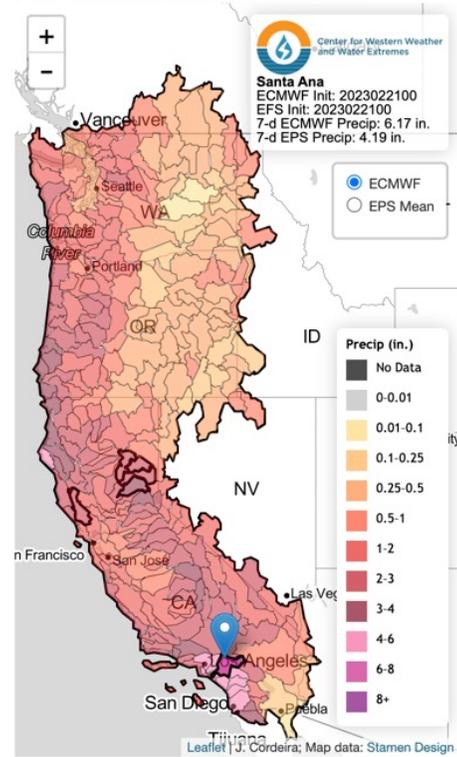
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Watershed Precipitation Forecasts: Santa Ana Watershed

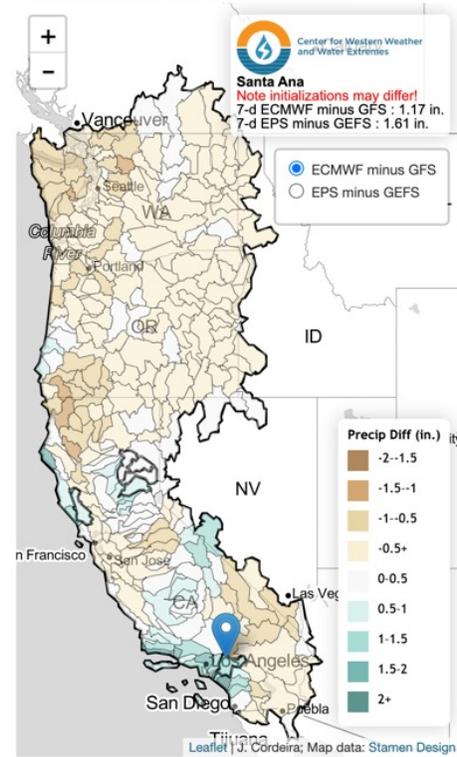
7-day GFS/GEFS Precipitation Forecasts



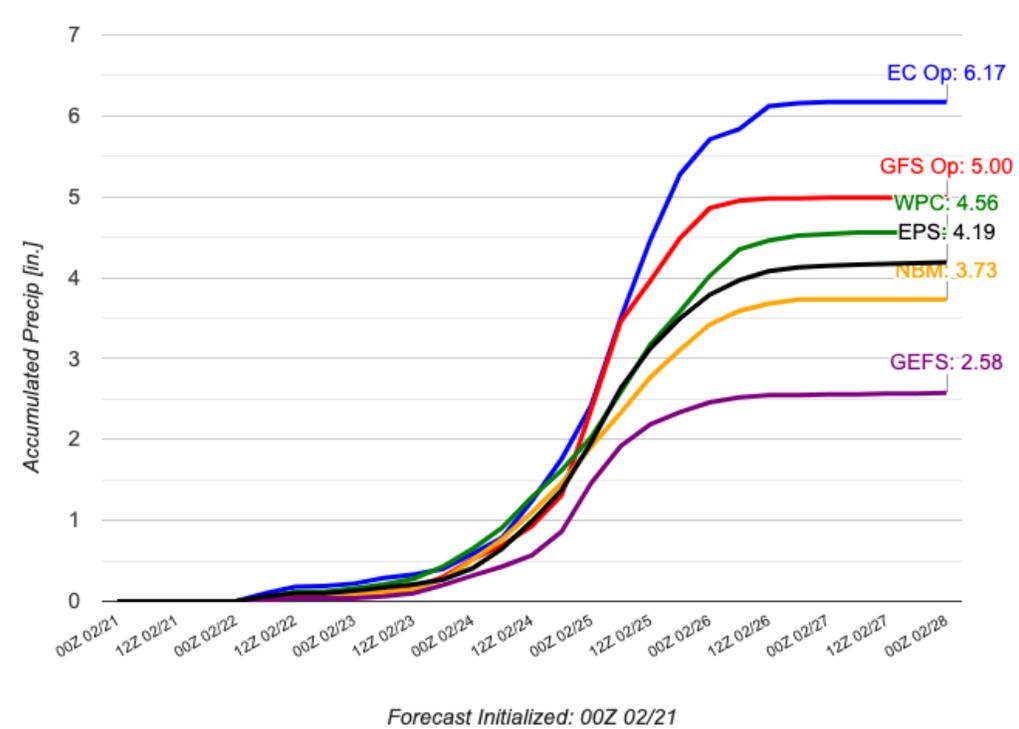
7-day ECMWF/EFS Precipitation Forecast



7-day Difference Precipitation Forecast

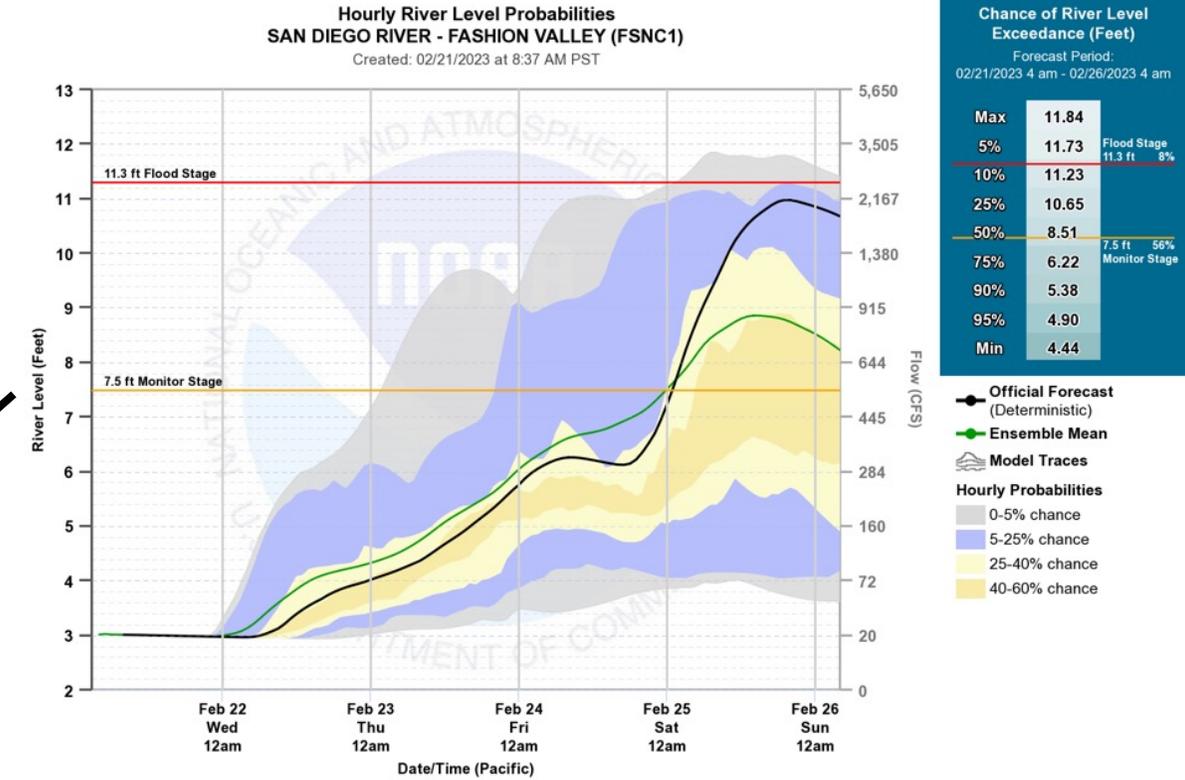
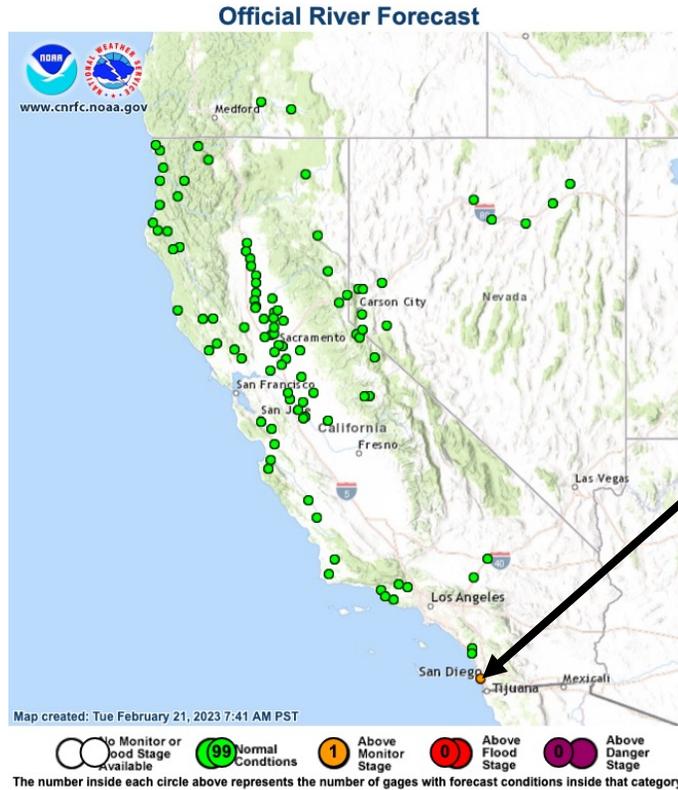


7-day Multi-Model QPF Comparison for Santa Ana [in.]



- The 00Z ECMWF is forecasting higher precipitation amounts in coastal Southern California and lower precipitation amounts over the Mojave Desert compared to the 00Z GFS
- The 00Z ECMWF is forecasting 6.2 inches of mean areal precipitation in the Santa Ana watershed during the next 7 days, whereas the 00Z GFS is forecasting 5.0 inches of mean areal precipitation
- The ECMWF ensemble system (EPS) is also forecasting higher precipitation amounts in the Santa Ana watershed compared to the NCEP ensemble system (GEFS)

Hydrologic Impacts



- The NWS Weather Prediction Center is showing a marginal risk of rainfall exceeding flash flood guidance over coastal Southern California Friday through Saturday
- The San Diego River at Fashion Valley is forecast to rise above monitor/action stage (7.5 feet) early Saturday morning
- The NWS CNRFC hydrologic ensemble forecast system (HEFS) is showing a 56% probability of this stream gage exceeding monitor/action stage over the next 5 days

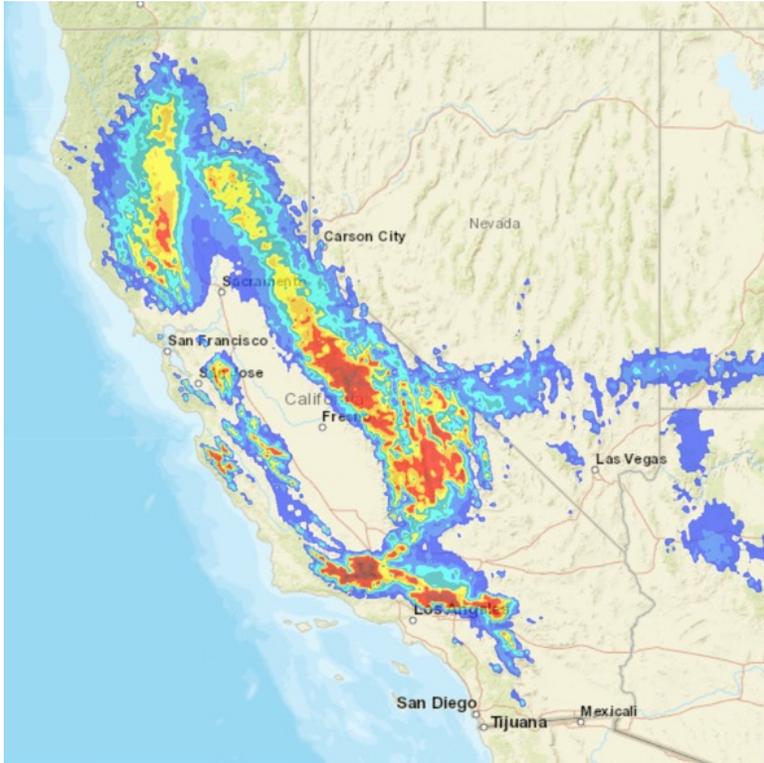
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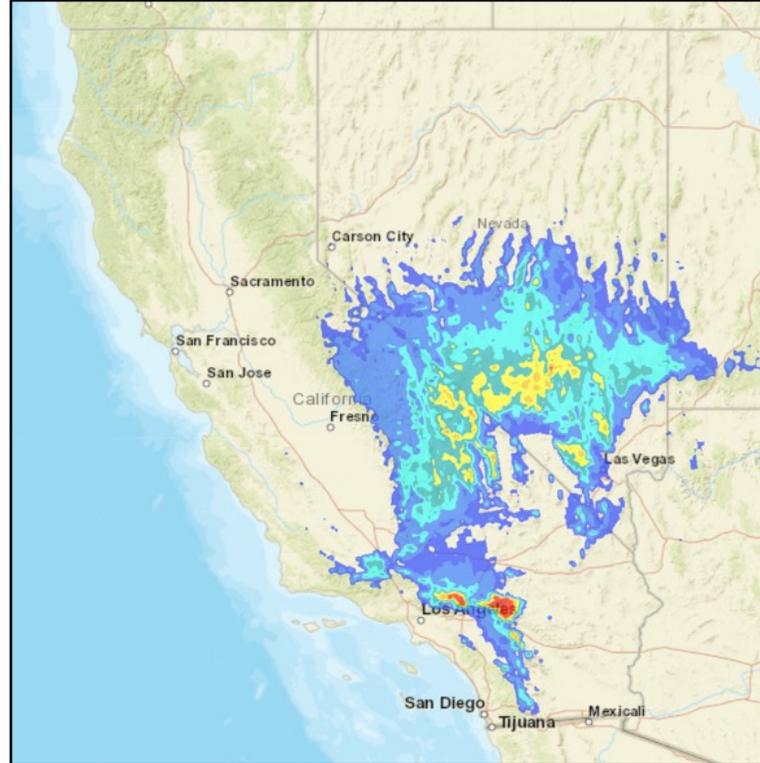
Winter Weather Hazards

Experimental Probabilistic Winter Storm Severity Index

Valid: 4 PM PT 23 Feb – 4 PM PT 24 Feb



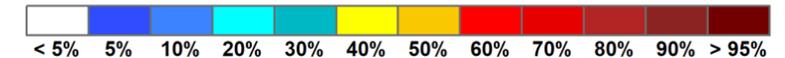
Valid: 4 PM PT 24 Feb – 4 PM PT 25 Feb



Source: NOAA/NWS Weather Prediction Center

Potential Winter Storm Impacts	
Minor Impacts	<p>Expect a few inconveniences to daily life.</p> <ul style="list-style-type: none"> Winter driving conditions. Use caution while driving.
Moderate Impacts	<p>Expect disruptions to daily life.</p> <ul style="list-style-type: none"> Hazardous driving conditions. Use extra caution while driving. Closures and disruptions to infrastructure may occur.
Major Impacts	<p>Expect considerable disruptions to daily life.</p> <ul style="list-style-type: none"> Dangerous or impossible driving conditions. Avoid travel if possible. Widespread closures and disruptions to infrastructure may occur.
Extreme Impacts	<p>Expect substantial disruptions to daily life.</p> <ul style="list-style-type: none"> Extremely dangerous or impossible driving conditions. Travel is not advised. Extensive and widespread closures and disruptions to infrastructure may occur. Life-saving actions may be needed.

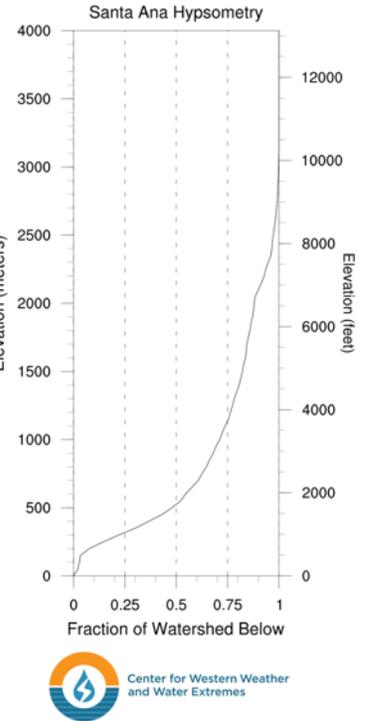
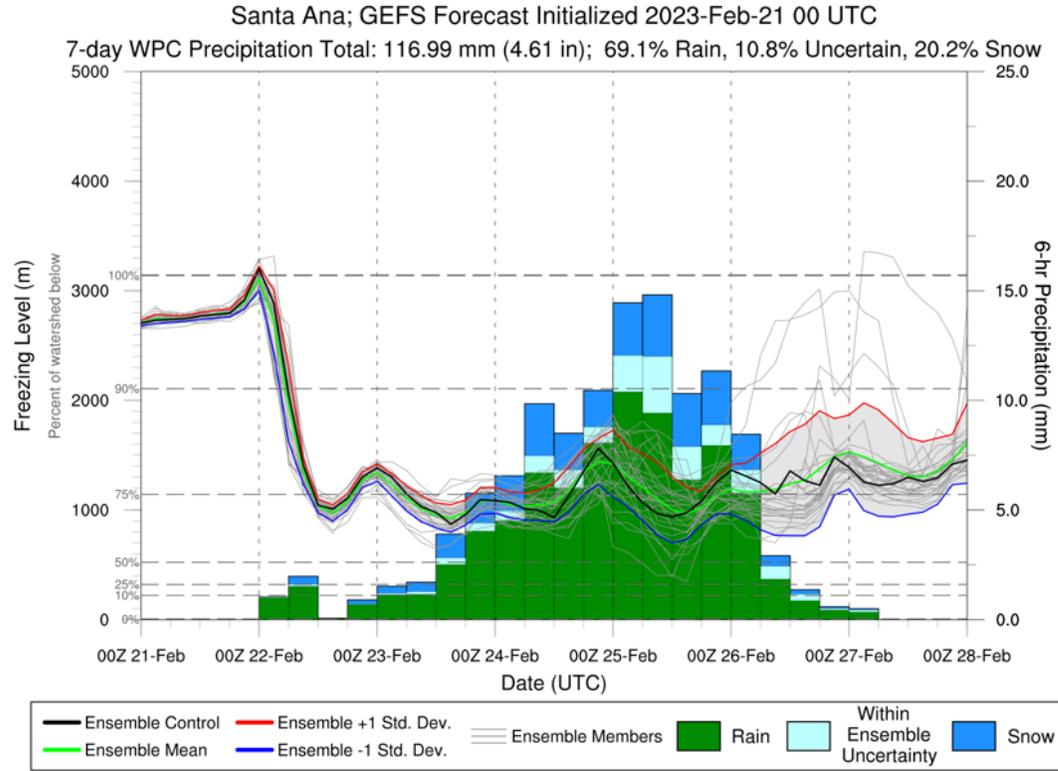
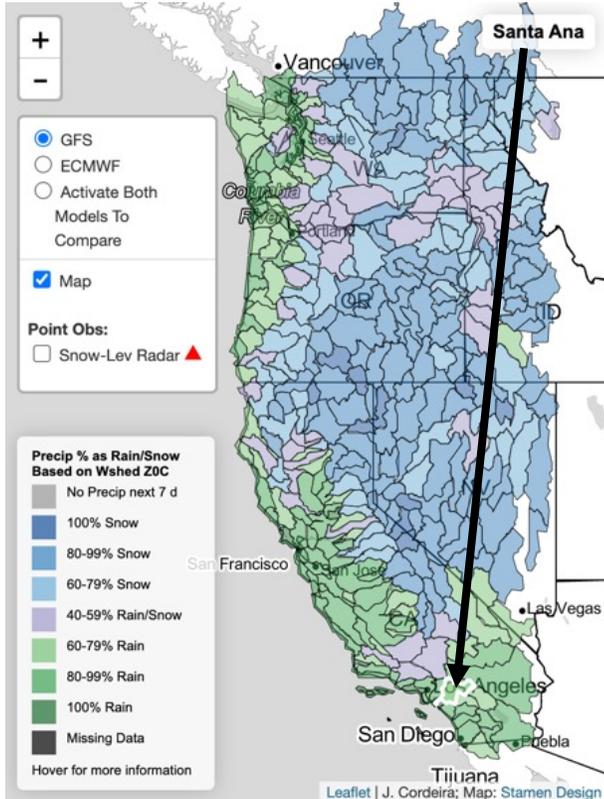
Likelihood of Impact



- The NWS Weather Prediction Center is forecasting a greater than 80% probability of **major** winter storm impacts (i.e., dangerous travel conditions, widespread disruptions to infrastructure) in portions of the Sierra Nevada and Transverse Ranges
- There is also a greater than 50% probability of **major** winter storm impacts in the higher terrain of the California Coast Ranges

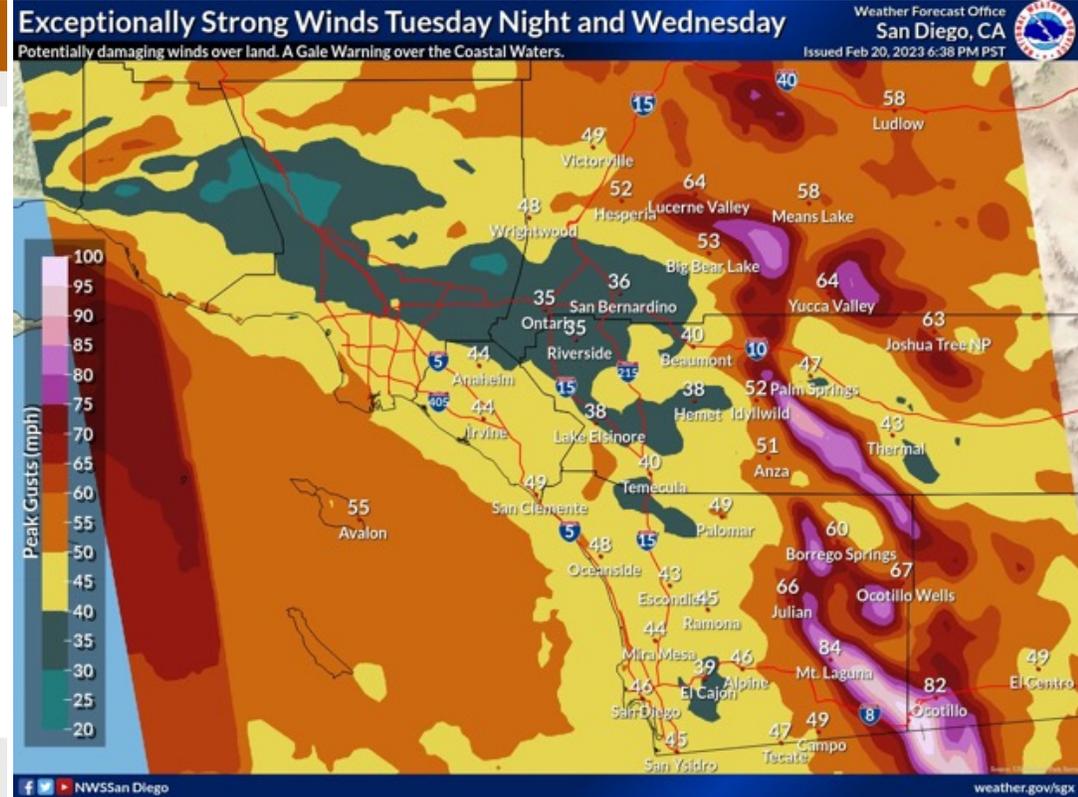
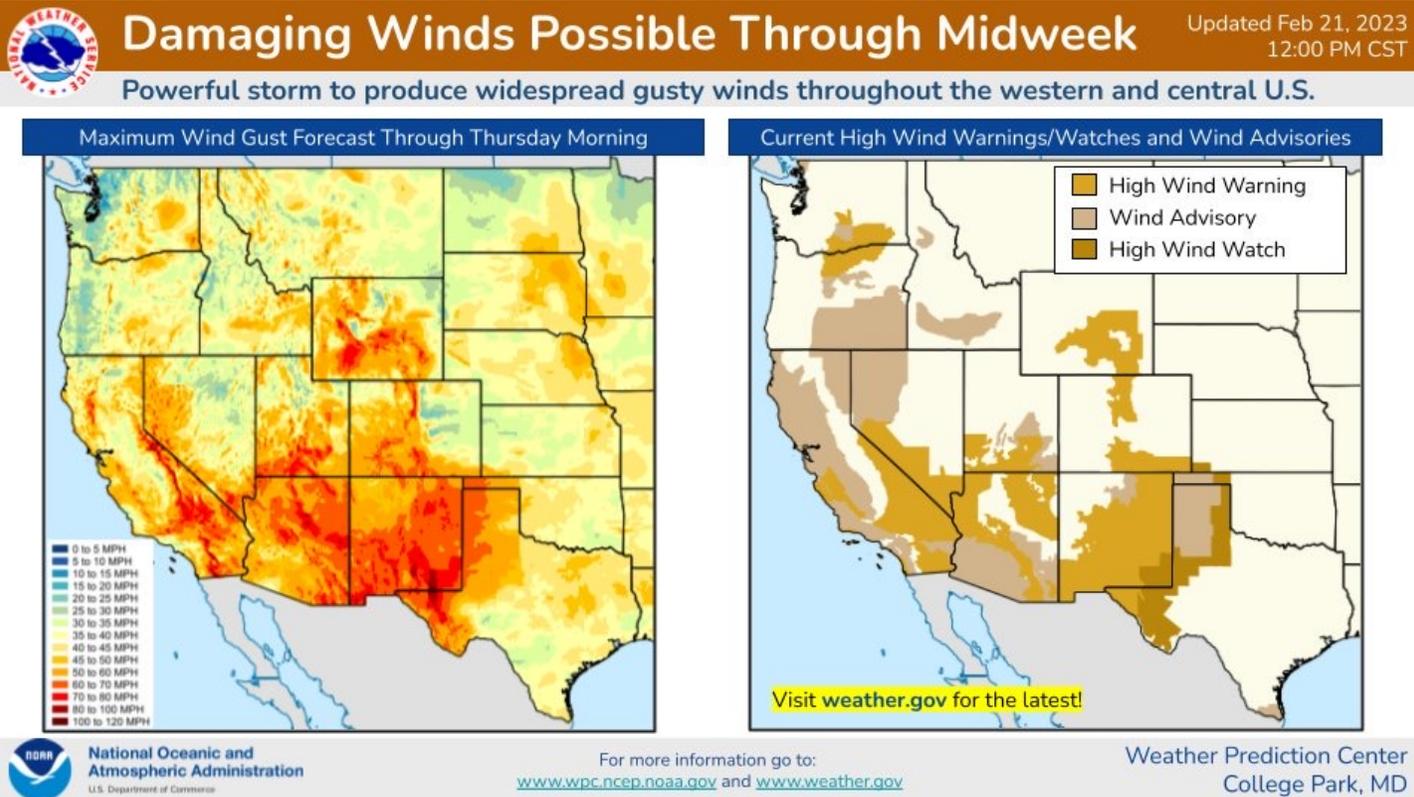
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Watershed Freezing Level Forecasts



- Due to low freezing levels, a majority of the precipitation is forecast to fall in the form of snow over the Cascades, Klamath Mountains, and Sierra Nevada
- Freezing levels in the Santa Ana watershed are forecast to drop below 4,000 feet on Wednesday and remain below 6,000 feet through Sunday
- The CW3E watershed freezing level tool is forecasting 20% of the total precipitation over the next 7 days to fall in the form of snow in the Santa Ana watershed

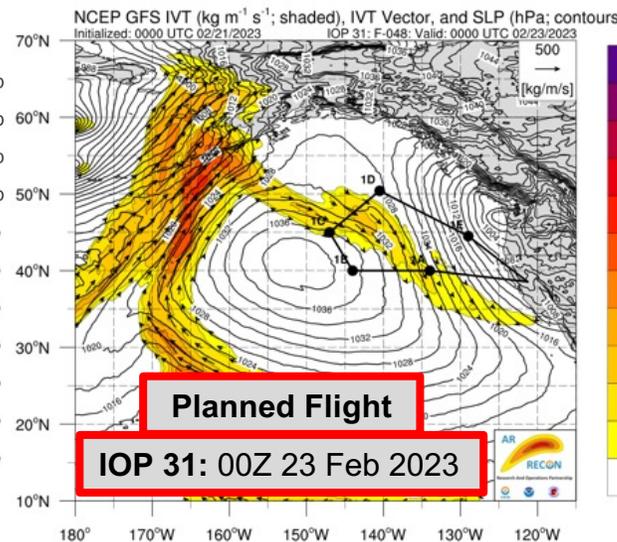
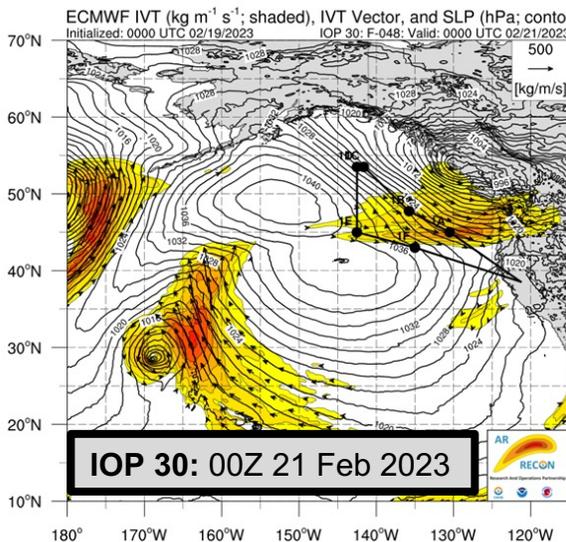
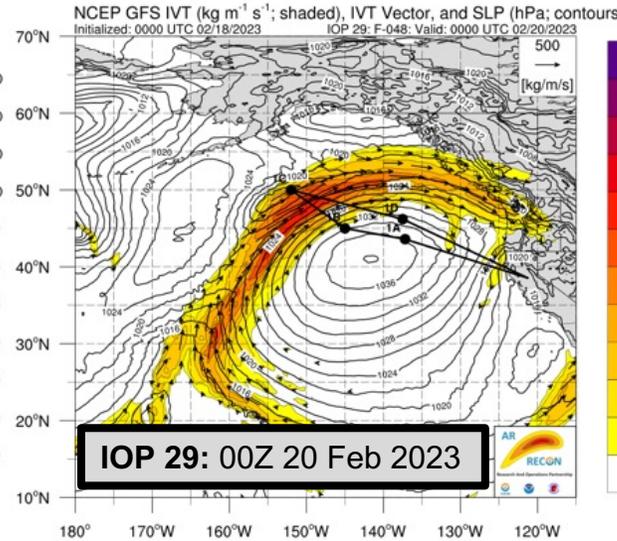
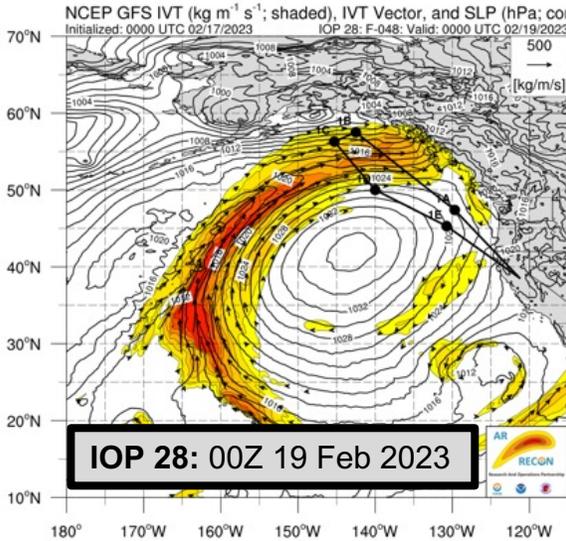
Wind Impacts



- The NWS has issued numerous wind advisories and high wind warnings throughout the southwestern US for today into Thursday
- Peak wind gusts are forecast to exceed 40 mph over much of coastal Southern California, with hurricane force wind gusts (> 74 mph) possible in the higher terrain of Riverside and eastern San Diego Counties
- Wind gusts in excess of 70 mph are also forecast along the eastern slopes of the Sierra Nevada and the Mohave Desert

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AR Recon Flights over the North Pacific



- The 53rd Weather Reconnaissance Squadron continues to provide additional observations by deploying dropsondes over the North Pacific as part of CW3E's Atmospheric River Reconnaissance (AR Recon) field campaign.
- AR Recon has conducted multiple flights sampling the upstream environment of the prior AR and current mid-level trough development
- Additional flights have been planned to sample the trough offshore on Wednesday as the system slides down the US West Coast
- CW3E's AR Recon team and collaborators will continue to meet throughout the week to plan for additional flights to sample this system