

# CW3E Atmospheric River Outlook: 10 January 2023

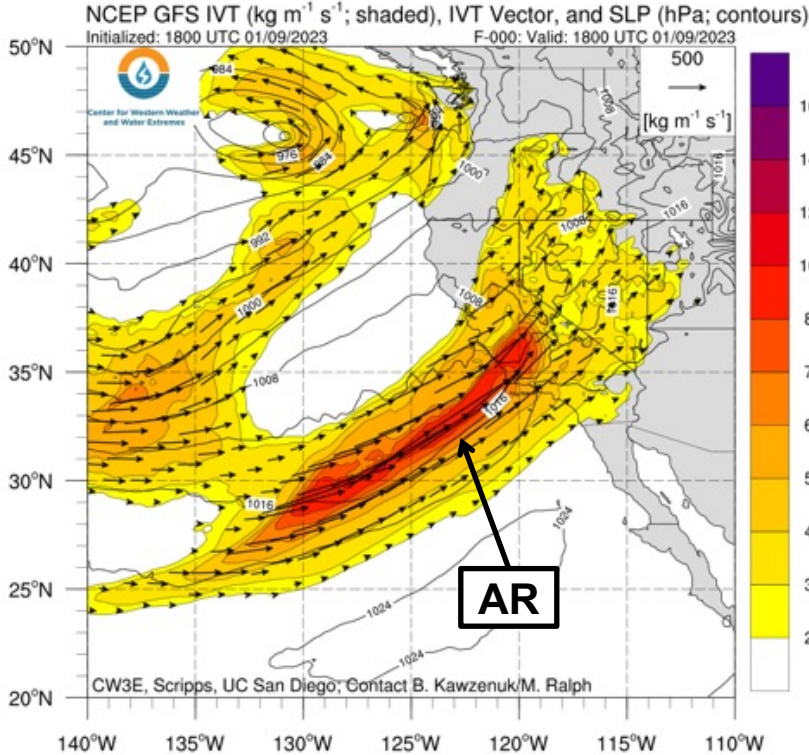
## Increased Atmospheric River Activity Forecast to Continue over California during the next 7–10 days

- A strong atmospheric river (AR) made landfall Sunday night, resulting in very heavy rainfall and flooding in portions of Central and Southern California
- This episode of increased AR activity across the Western U.S. is forecast to continue with four additional ARs predicted to make landfall over the next week
- The first AR will bring long duration and southerly AR conditions to a portion of the North-Coast tomorrow into Friday
- The storm track is forecast to shift southward as two additional ARs are forecast to make landfall over Central California on Saturday and Sunday
- A fourth AR is then forecast to make landfall next week over Northern California, though there is large forecast uncertainty associated with this fourth AR
- The NOAA Weather Prediction Center has issued a slight risk for precipitation to exceed flash flood guidance where the first AR is forecast to extend inland for several days
- Large model-to-model uncertainty in precipitation forecasts currently exists over the Russian River watershed as any slight shift in the location of the first AR will result in large differences in AR magnitude and duration
- **Stay alert to official NWS forecasts, watches, and warnings at [weather.gov](https://www.weather.gov) and follow guidance from local emergency management officials**

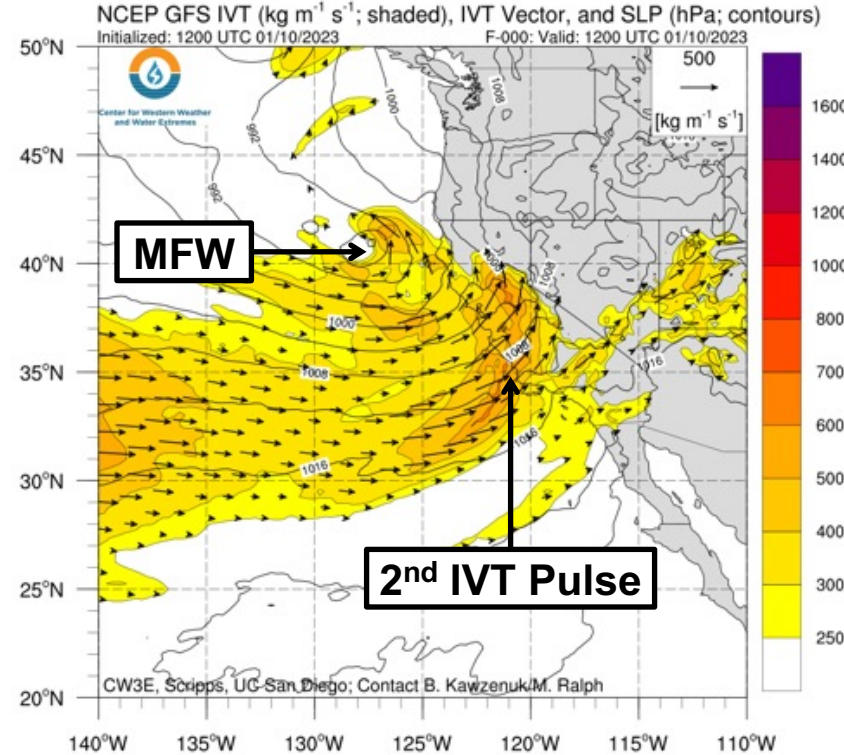
# CW3E AR Outlook: 10 January 2023

## GFS IVT & SLP Analyses of the Ongoing Storm

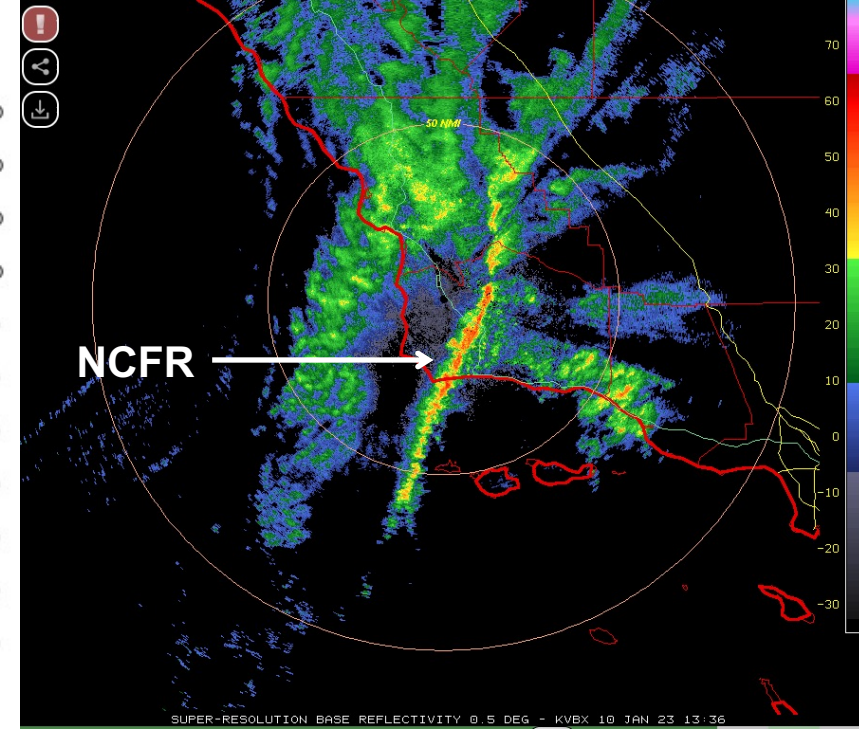
(A) Valid: 10 AM PT 9 Jan



(B) Valid: 4 AM PT 10 Jan



KVBX Vandenburg Base Reflectivity



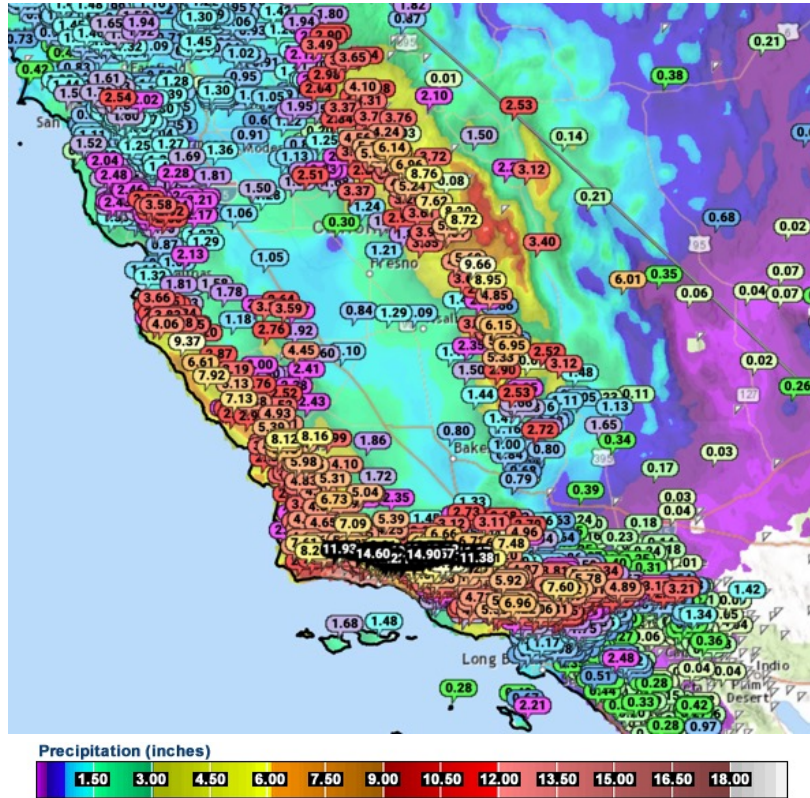
Source: College of DuPage

- A strong AR made landfall late Sunday night, bringing IVT magnitudes  $> 800 \text{ kg m}^{-1} \text{ s}^{-1}$  and very heavy rainfall to portions of Central and Southern California (Figure A)
- Following the main AR, a second pulse of moisture transport associated with an intensifying mesoscale frontal wave (MFW) brought IVT magnitudes  $> 500 \text{ kg m}^{-1} \text{ s}^{-1}$  to Central California early this morning (Figure B)
- A narrow cold-frontal rainband formed within the core of the second IVT pulse and produced another brief period of intense rainfall
- The southwesterly orientation of these IVT pulses led to orographic enhancement of precipitation over the Sierra Nevada and Transverse Ranges

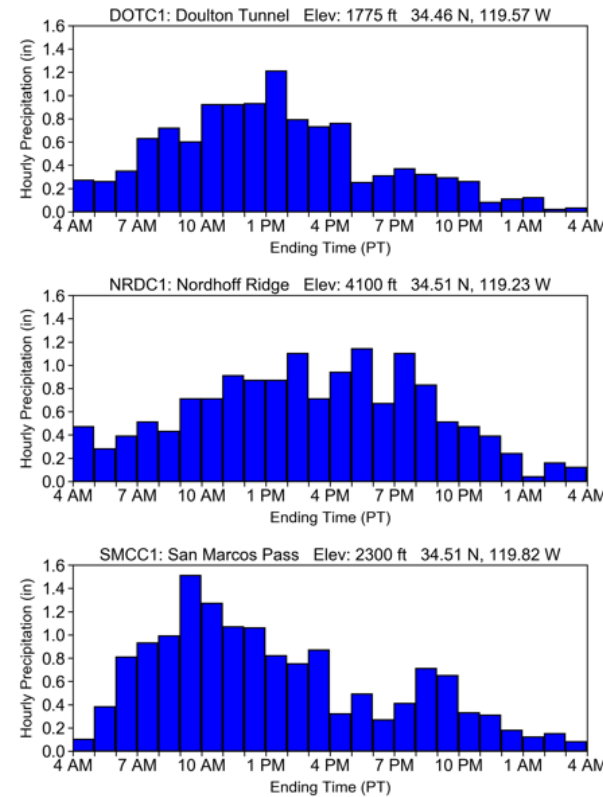
# CW3E AR Outlook: 10 January 2023

## Observed & Forecast Precipitation from the Ongoing Storm

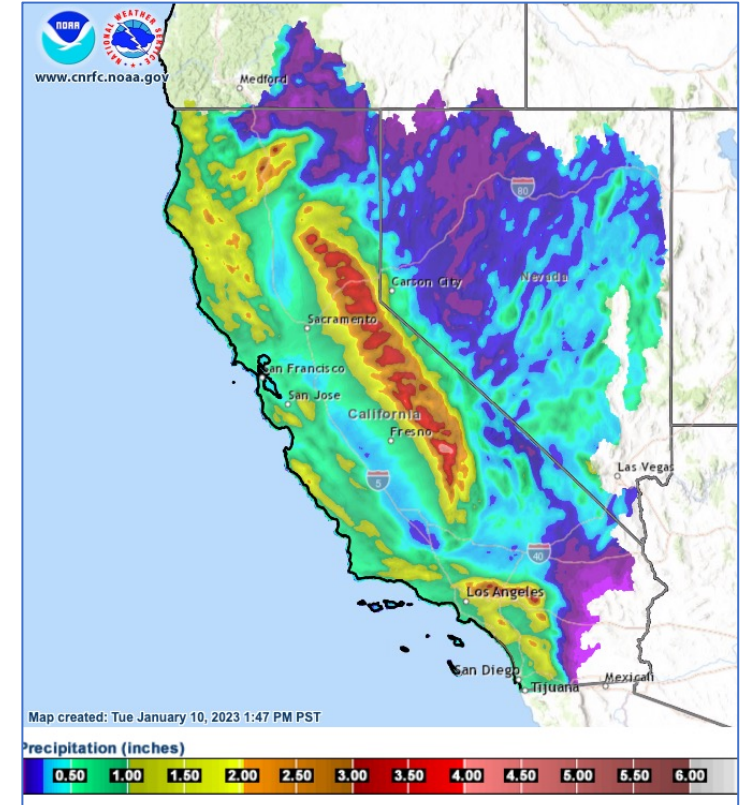
CNRFC 24-h QPE: Valid 4 AM PT 10 Jan



Hourly Precipitation: Valid 4 AM PT 9–10 Jan



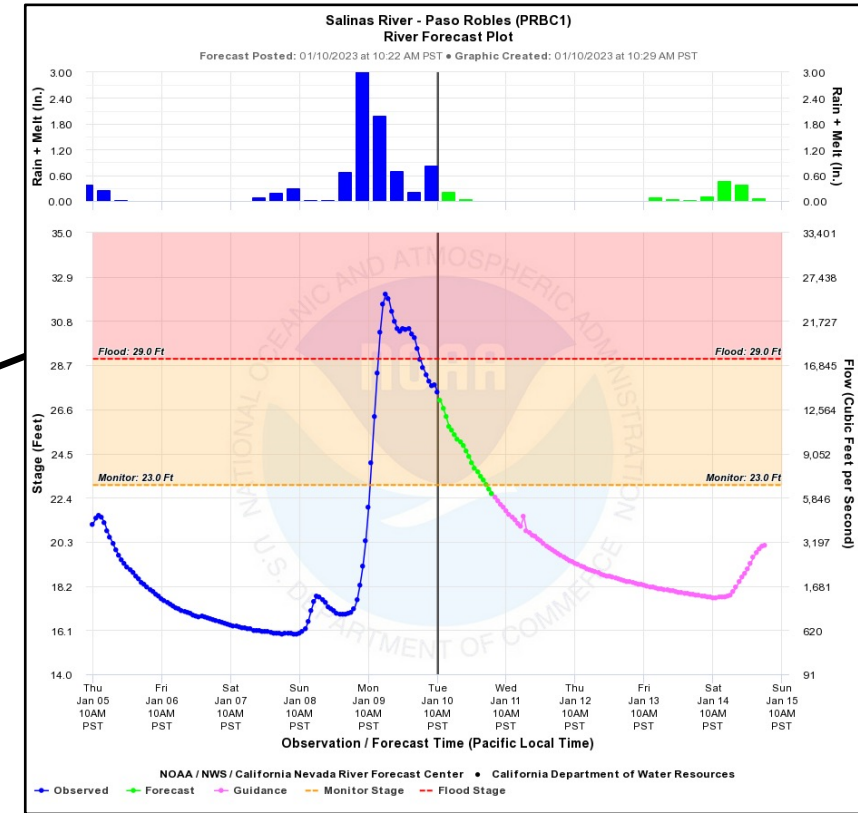
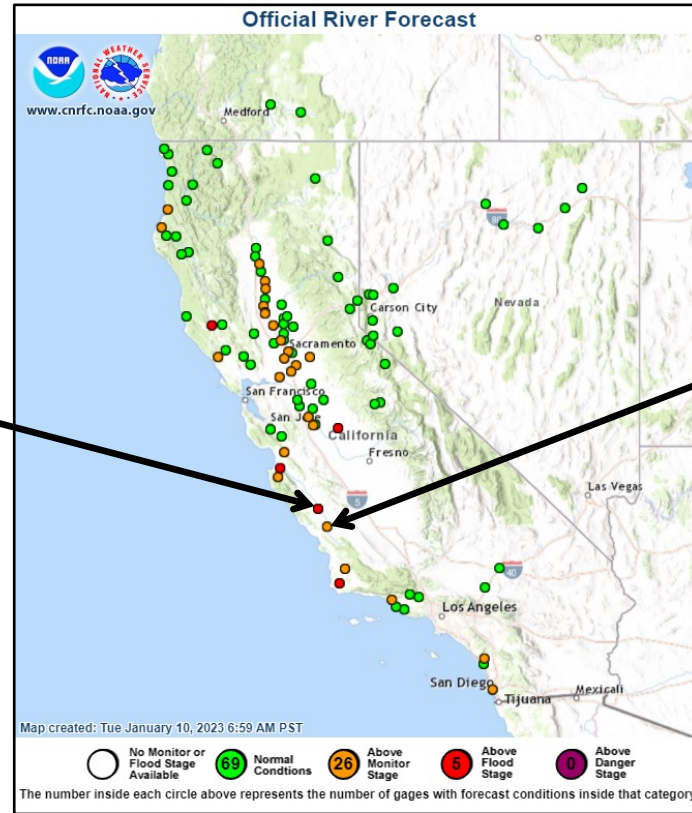
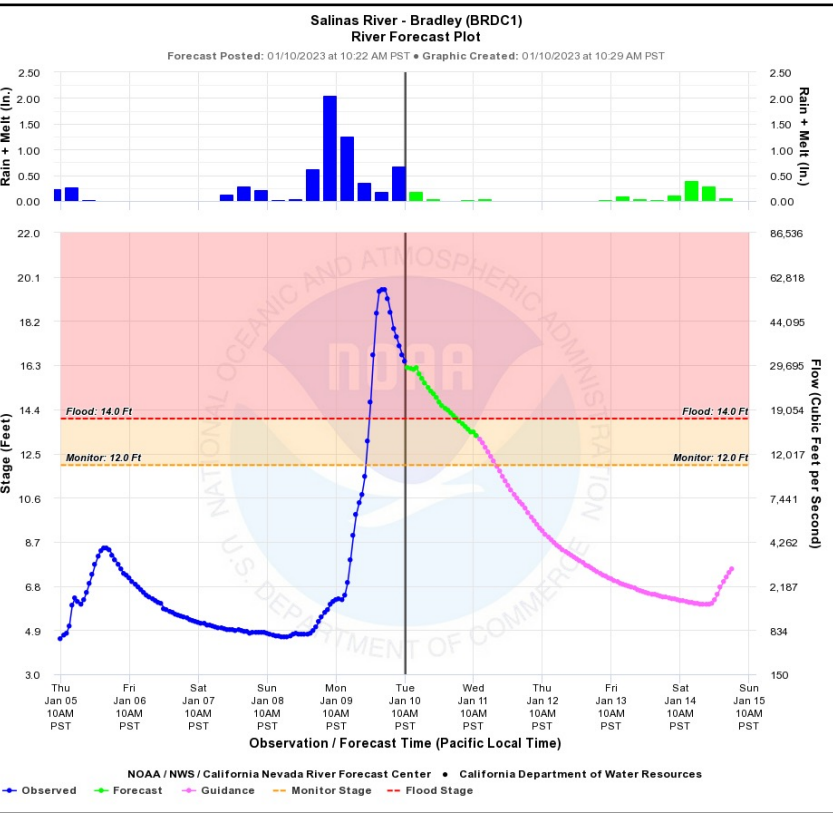
CNRFC 24-h QPF Valid 4 AM PT 11 Jan



- This storm produced at least 4–8 inches of precipitation in a 24-hour period over the Southern Sierra Nevada, Central California Coast Ranges, and eastern Transverse Ranges
- Some locations in the mountains of Santa Barbara and Ventura Counties received more than 10 inches of precipitation, with sustained hourly rainfall rates in excess of 0.50 inches/hour
- An additional 2–4 inches of precipitation are expected by Wednesday morning in the Sierra Nevada, with 1–3 inches expected in the California Coast Ranges, Transverse Ranges, and Peninsular Ranges

# CW3E AR Outlook: 10 January 2023

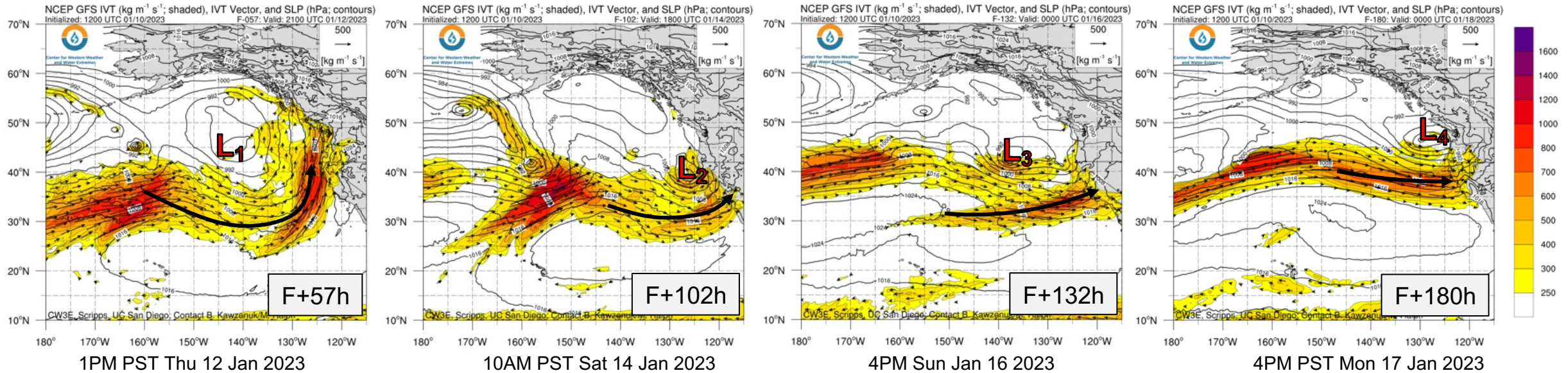
## Hydrologic Impacts from the Ongoing Storm



- Heavy rain from this AR resulted in widespread flooding over California, particularly along the Salinas River
- The Salinas River at Bradley rose 13.1 feet in 12 hours, reaching a maximum stage of 19.88 feet (the 3rd-highest peak stage since records began at this site in 1948)
- The Salinas River at Paso Robles rose 15.1 feet in 12 hours, reaching a peak stage of 32.1 feet

# CW3E AR Outlook: 10 January 2023

NCEP GFS Model IVT and SLP Forecast (initialized 1200 UTC 10 January 2023)

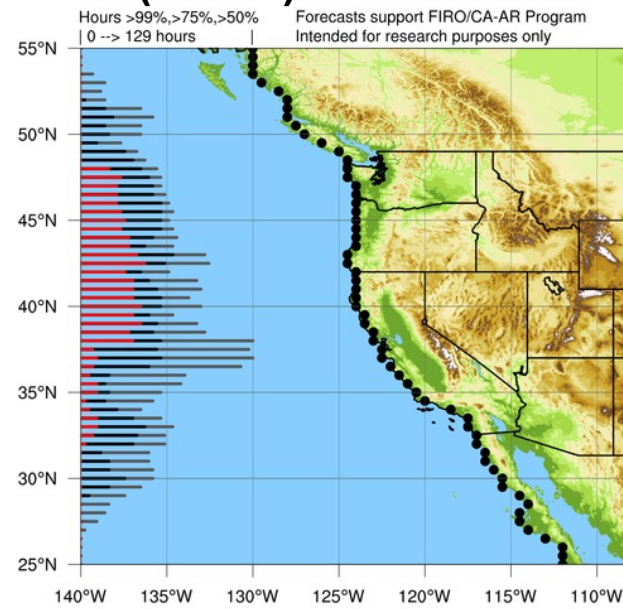
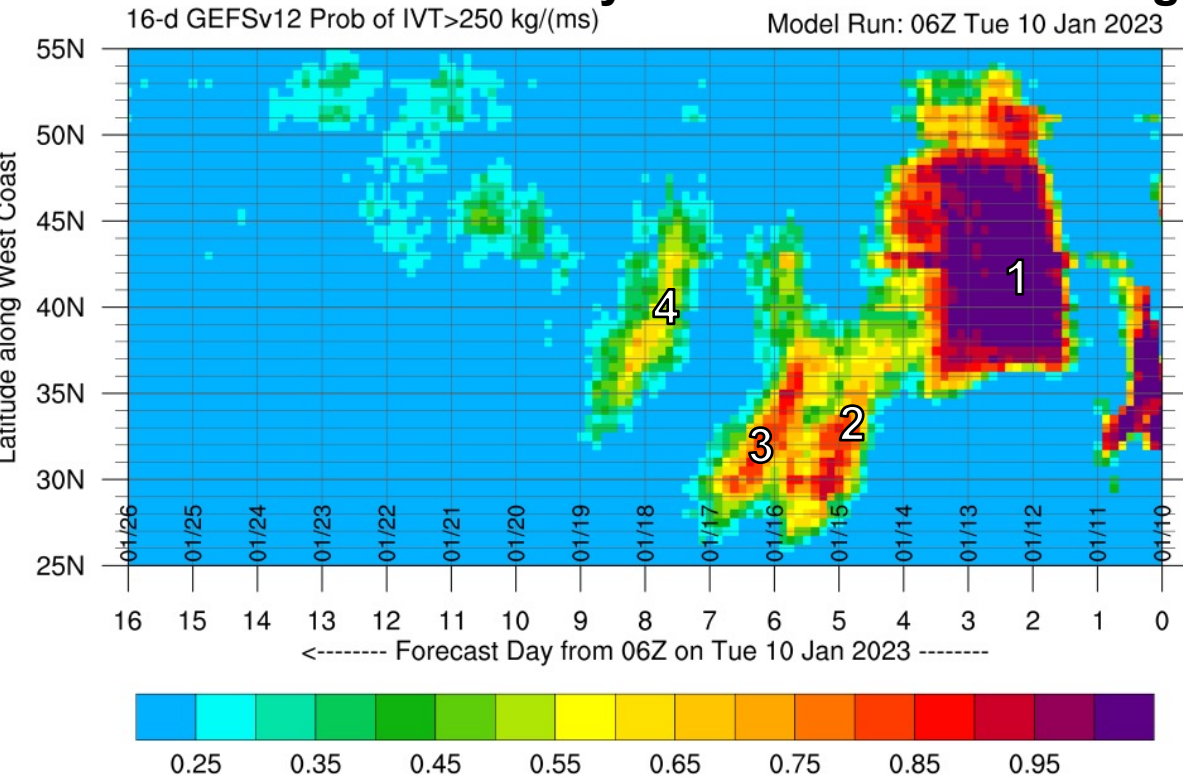


## **Four Atmospheric Rivers are forecast to make landfall over U.S. West Coast over the next week**

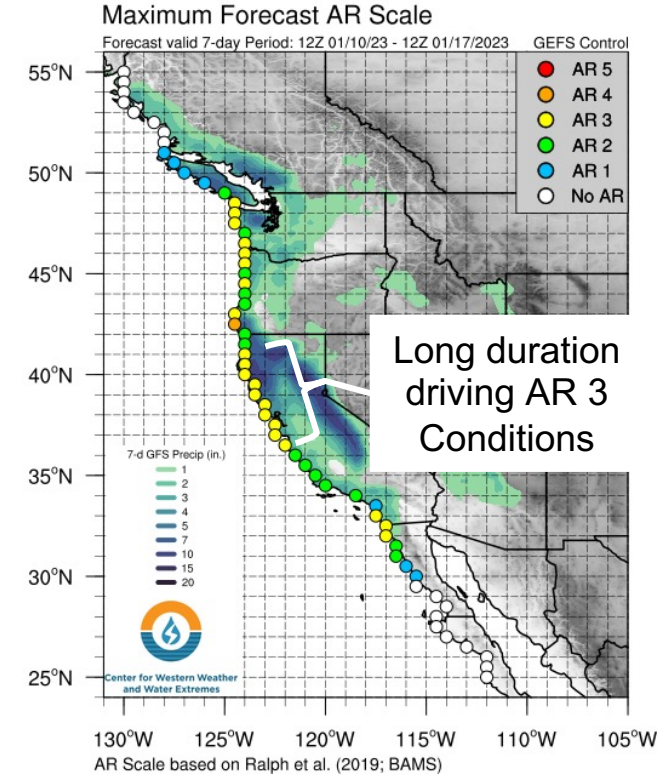
- The first AR is forecast to make landfall around 7 AM 11 January, bringing moderate-to-strong southerly AR conditions to coastal locations across Northern CA, OR, & WA
- The second AR is forecast to make landfall over the Central CA coast around 1 AM on the 14<sup>th</sup>, bringing moderate AR conditions to coastal points south of Monterey
- A third AR is then forecast to make landfall over a similar location to the second at ~7AM on the 15<sup>th</sup>
- The large-scale flow regime is then forecast to shift northward and a fourth, moderate-to-strong, AR is forecast to make landfall over Northern CA at ~10 AM on the 17<sup>th</sup>

# CW3E AR Outlook: 10 January 2023

## Probability of AR Conditions Along Coast (GEFS)



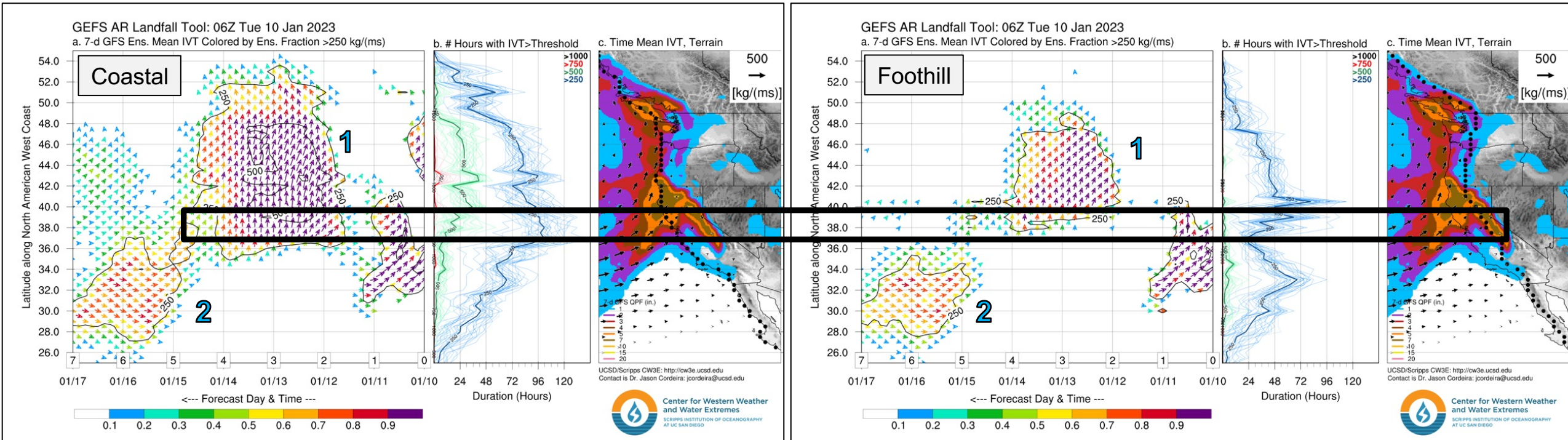
## AR Scale



- The GEFS is highlighting four potential periods of increased AR activity over the U.S West Coast between 11 and 19 January
- GEFS ensembles are illustrating a high probability (~100%) of a long-duration (36–48 hours) AR over Northern CA, OR, & WA
- Ensemble probabilities of AR conditions associated with the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> AR are lower compared to the first (~60–95%)
- The second AR is forecast to merge with the remnant moisture of the first AR on the 14<sup>th</sup>, bringing AR conditions to a majority of CA
- A third AR is forecast to make landfall on the 16<sup>th</sup>, increasing the probability of AR conditions from coastal Central CA to Mexico
- A shift in the large-scale flow regime is then forecast to bring AR activity back north and increase the potential for AR conditions over Northern CA and OR on the 18<sup>th</sup>

# CW3E AR Outlook: 10 January 2023

NCEP GEFS Model Forecast of Coastal (left) and Foothill (right) Probability of IVT magnitudes >250 kg/ms (initialized 0600 UTC 10 Jan 2023)

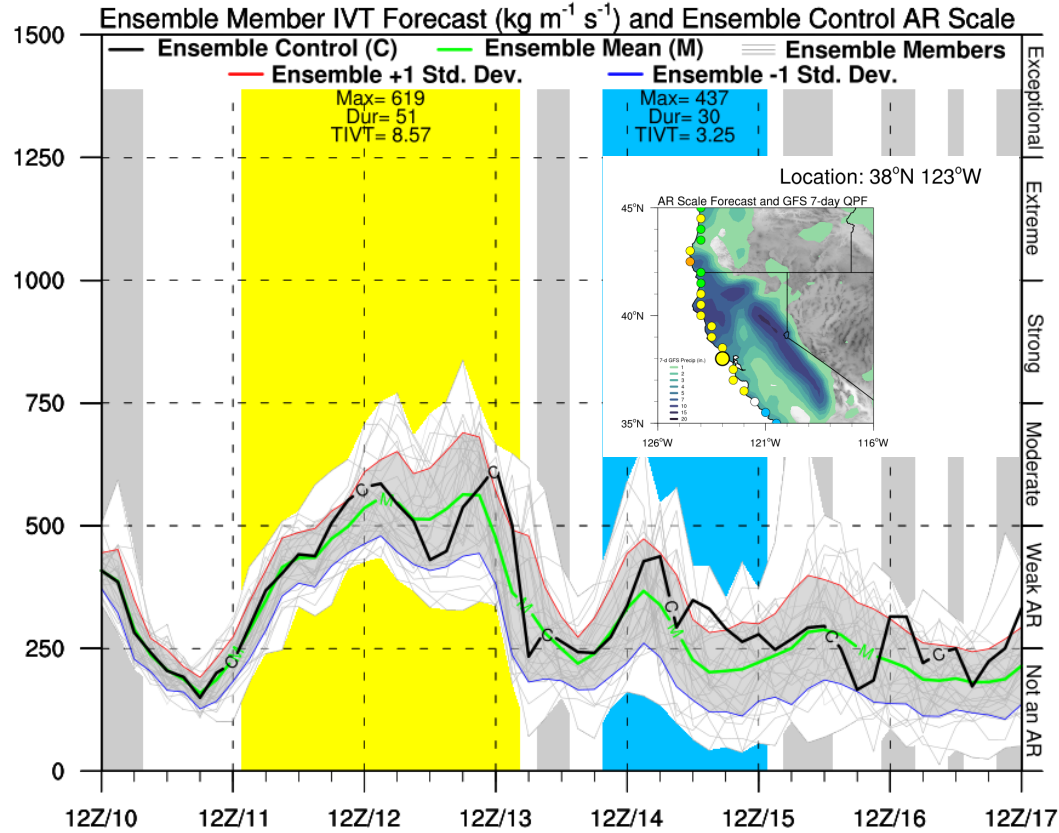


- While the GEFS is forecasting the high probability of AR conditions for an extended period over the N. CA coast, the southerly orientation and slow propagation will inhibit the inland extension of the AR to the N. Sierra
- Best chances of AR conditions over the Northern Sierra (ensemble probabilities >50%) are later on the 13<sup>th</sup> when an upper level-trough swings through, pushing the AR inland over N. CA, though the southerly IVT will be less conducive to upslope moisture flux compared to southwesterly
- The southerly IVT may favor moisture transport up the Sacramento Valley, enhancing precipitation over Mt. Shasta

# CW3E AR Outlook: 10 January 2023

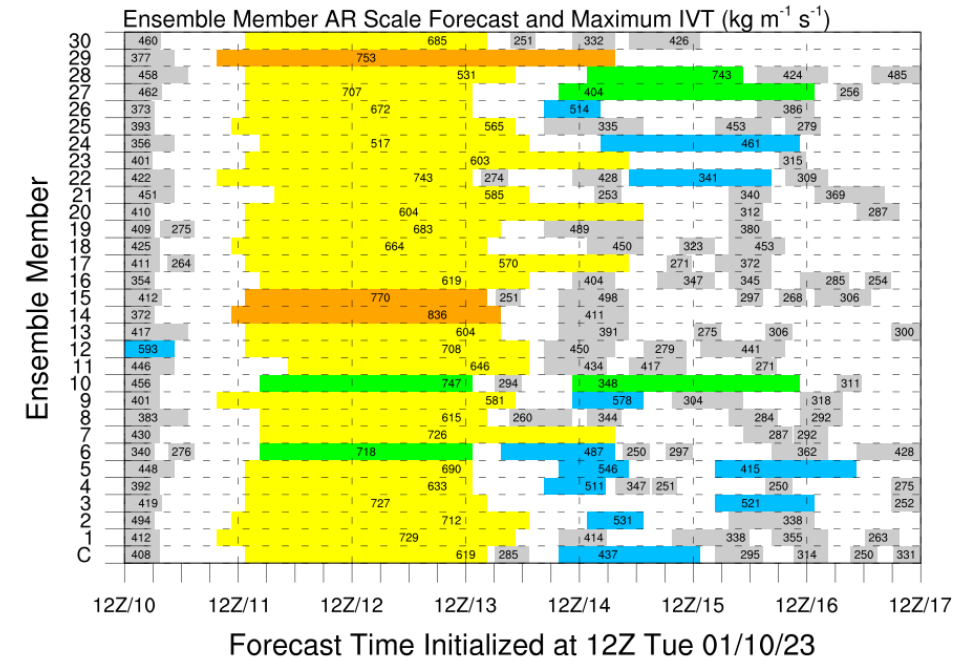
NCEP GEFS Model IVT and SLP Forecast (initialized 1200 UTC 10 Jan 2023)

GFS Ensemble Initialized: 12Z Tue 01/10/23



Categorical AR Strength by Ralph/CW3E

- Due to the orientation and coastally confined nature of the AR, any eastward or westward shift in the AR plume could result in higher or lower AR scale conditions
- Currently, the GEFS suggests the AR will bring **AR 3** conditions to the North Coast with three ensemble members forecasting **AR 4** and two forecasting **AR 2**



AR 1 AR 2 AR 3 AR 4 AR 5

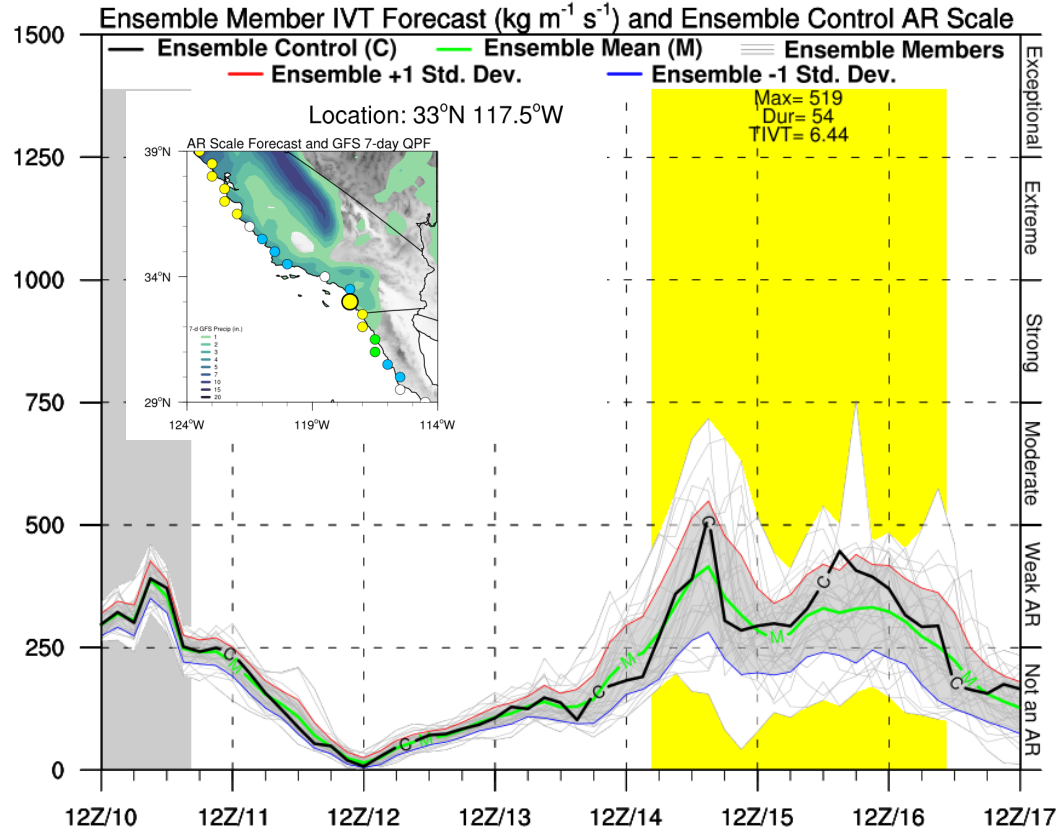
- Forecasts of IVT magnitude along the Sonoma County coast show large uncertainty in the overall timing, magnitude and duration of the first AR between the 11<sup>th</sup> and 13<sup>th</sup>



# CW3E AR Outlook: 10 January 2023

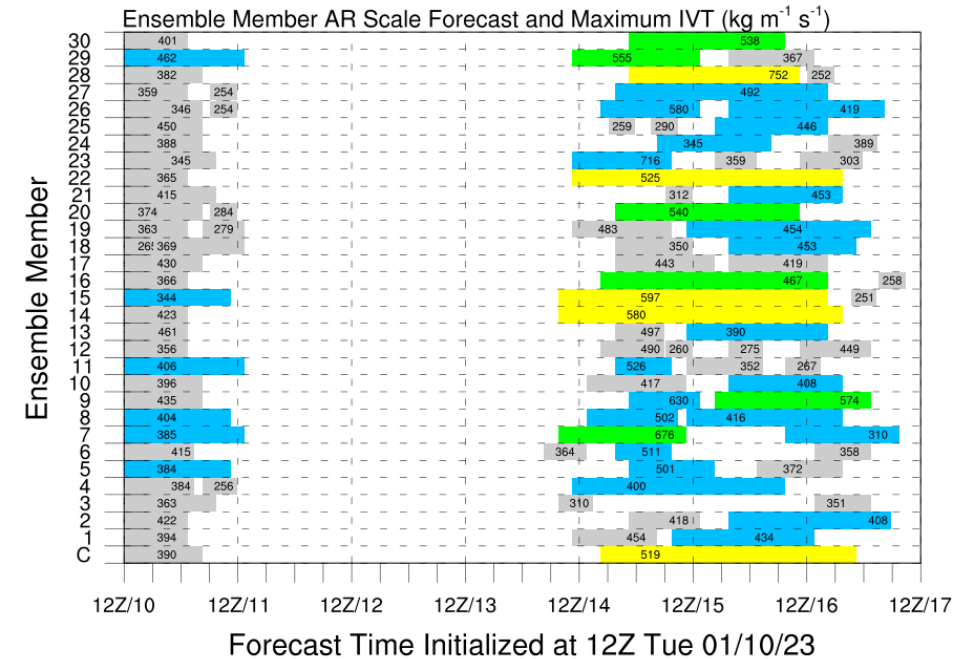
NCEP GEFS Model IVT and SLP Forecast (initialized 1200 UTC 10 Jan 2023)

GFS Ensemble Initialized: 12Z Tue 01/10/23



Categorical AR Strength by Ralph/CW3E

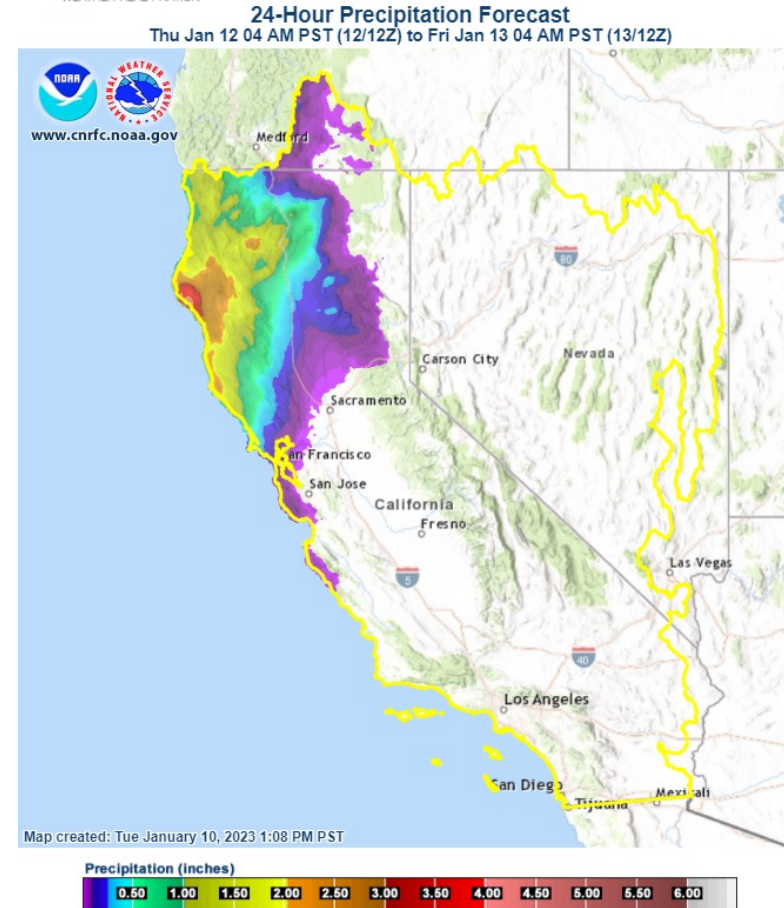
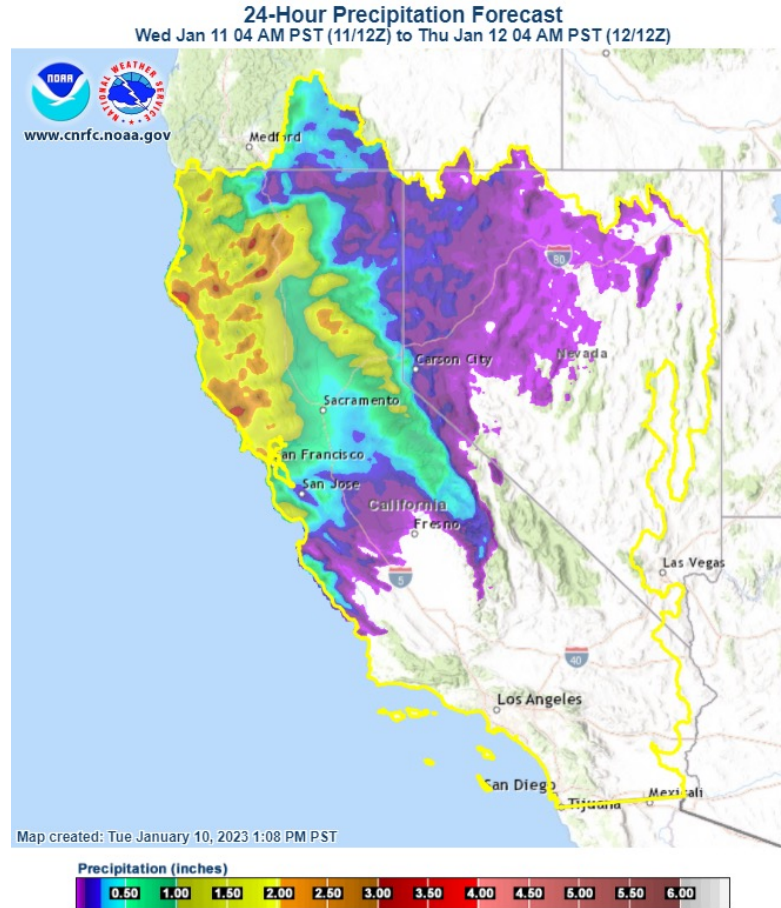
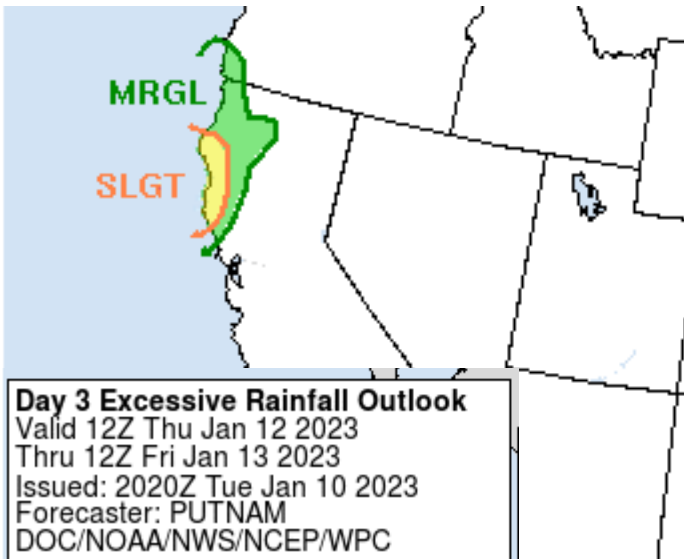
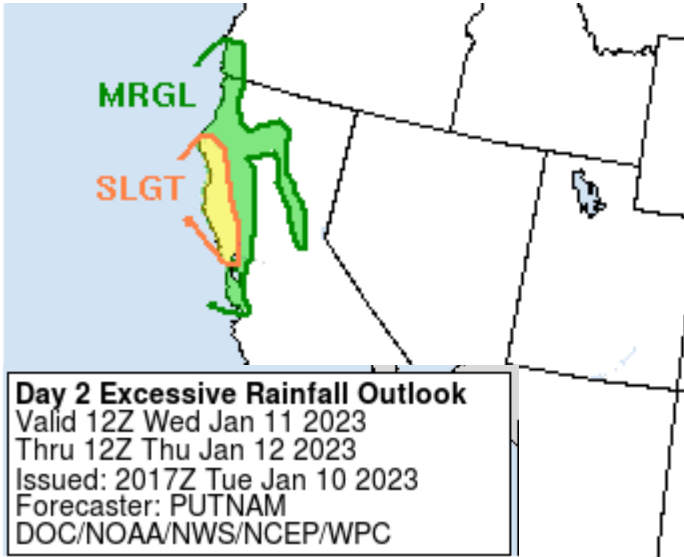
- The large uncertainty associated with the merger of the second and third AR in conjunction with uncertainties surrounding the magnitude and duration of the ARs is resulting in a wide range of AR Scale forecasts
- Currently, the GEFS is forecasting AR 0 to 3 conditions over San Diego County



■ AR 1   
 ■ AR 2   
 ■ AR 3   
 ■ AR 4   
 ■ AR 5

- The GEFS is currently suggesting there could be no break in AR conditions between the second and third AR over San Diego County, extending AR conditions for the region

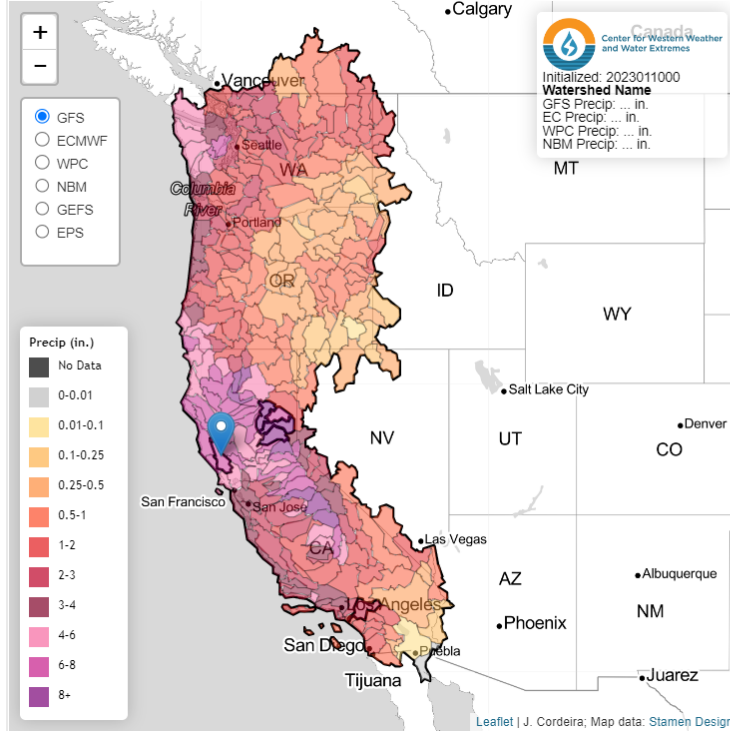
# CW3E AR Outlook: 10 January 2023



- The Weather Prediction Center has issued a slight risk for precipitation to exceed Flash Flood guidance from 11 to 13 Jan over North-Coastal CA where the first AR is forecast to remain over the region for multiple days
- The California-Nevada River Forecast Center is forecasting 3–4 inches of precipitation on both days in locations that favor southerly moisture transport

# CW3E AR Outlook: 10 January 2023

7-day Model Precipitation Forecasts



**Watershed Information:**

Watershed Name: Russian  
 Watershed ID: 18010110  
 Watershed State(s): CA  
 Watershed Area: 950365.01 Acres

**7-day Mean Areal Precipitation (MAP) Forecast**

Model	Initialized	7-day QPF	7-day Volume
GFS (Op)	2023011000	7.48 in.	592 TAF
ECMWF (Op)	2023011000	7.64 in.	605 TAF
NOAA WPC	2023011000	6.06 in.	479 TAF
National Blend	2023011000	6.13 in.	485 TAF
GEFS Ensemble Mean	2023011000	4.94 in. ± 1.63	391 TAF ±129
ECMWF Ensemble Mean	2023011000	8.47 in. ± 1.48	670 TAF ±117

**Daily Mean Areal Precipitation (MAP) for the next 7 days:**

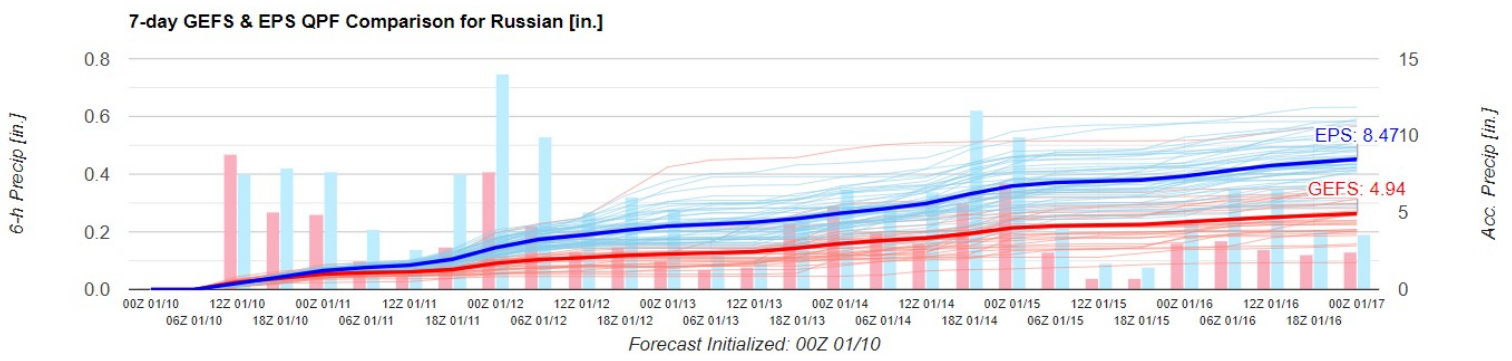
Model	Day-1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7
GFS (Op)	1.11	0.56	0.75	1.74	1.69	0.80	0.84
ECMWF (Op)	1.33	1.82	1.16	0.25	2.22	0.23	0.62
NOAA WPC	1.11	1.33	0.64	0.54	1.12	0.69	0.63
National Blend	1.28	1.31	0.63	0.44	1.26	0.49	0.72
GEFS Ensemble Mean	1.00	0.71	0.60	0.68	1.02	0.37	0.55
ECMWF Ensemble Mean	1.23	1.50	1.40	0.84	1.78	0.64	1.10

- The GFS is currently forecasting the Russian River Watershed to receive 7.5 inches of watershed precipitation over the next 7 days in association with the first AR
- There is large model-to-model & ensemble spread in precipitation forecast over the North-Coast with the ECMWF EPS forecasting 8.5 inches and the GEFS forecasting 4.9

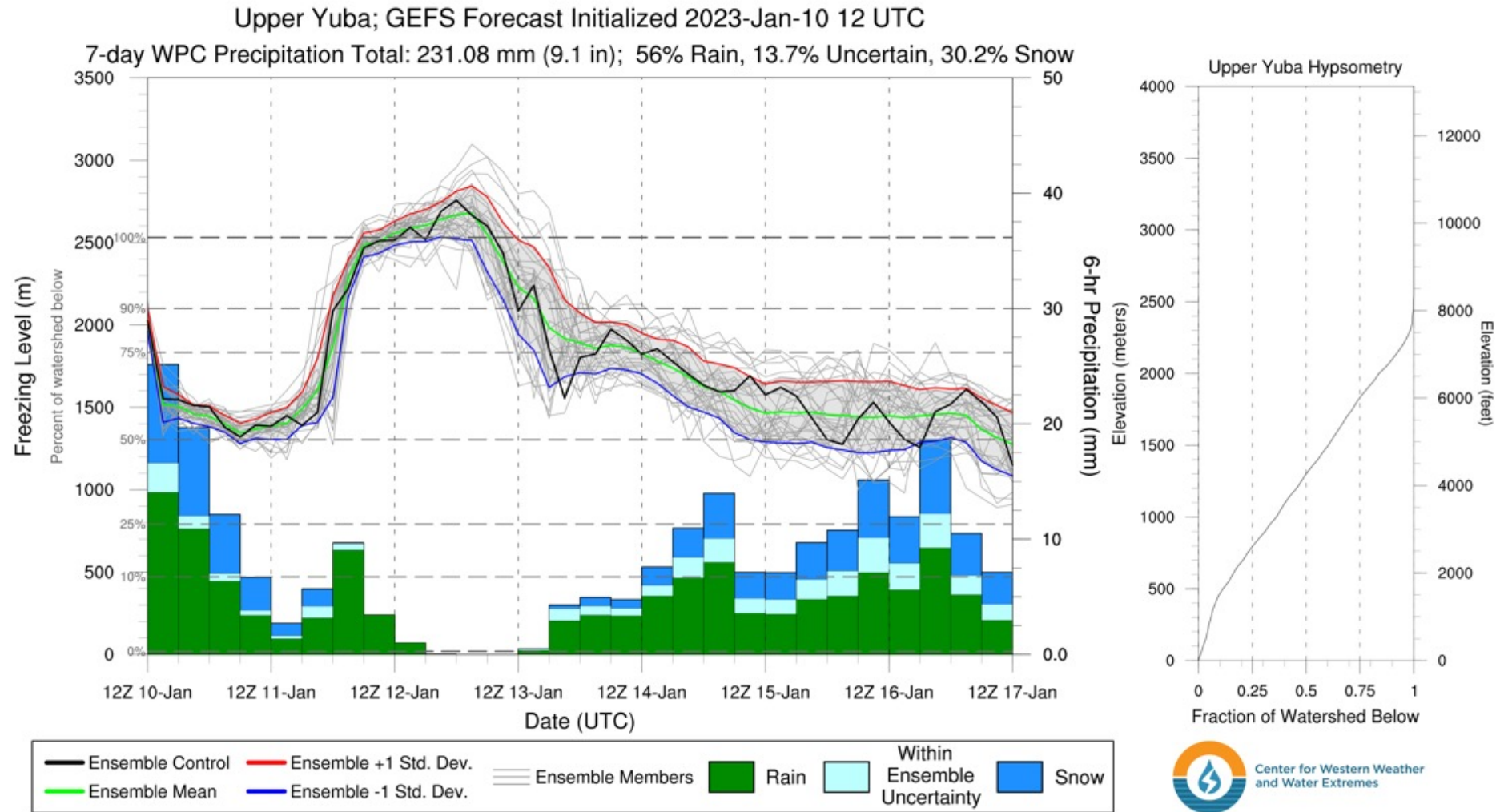
GEFS and EPS Forecast QPF: Russian  
 Forecast initialized: 00Z 01/10 | Through F168

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# CW3E AR Outlook: 10 January 2023



- Melting levels are forecast to remain between 4,000 and 6,000 feet over the Upper Yuba Watershed throughout the majority of precipitation this week/weekend
- GEFS melting level forecast indicates that 56% of precipitation would fall as rain over the next 7 days