

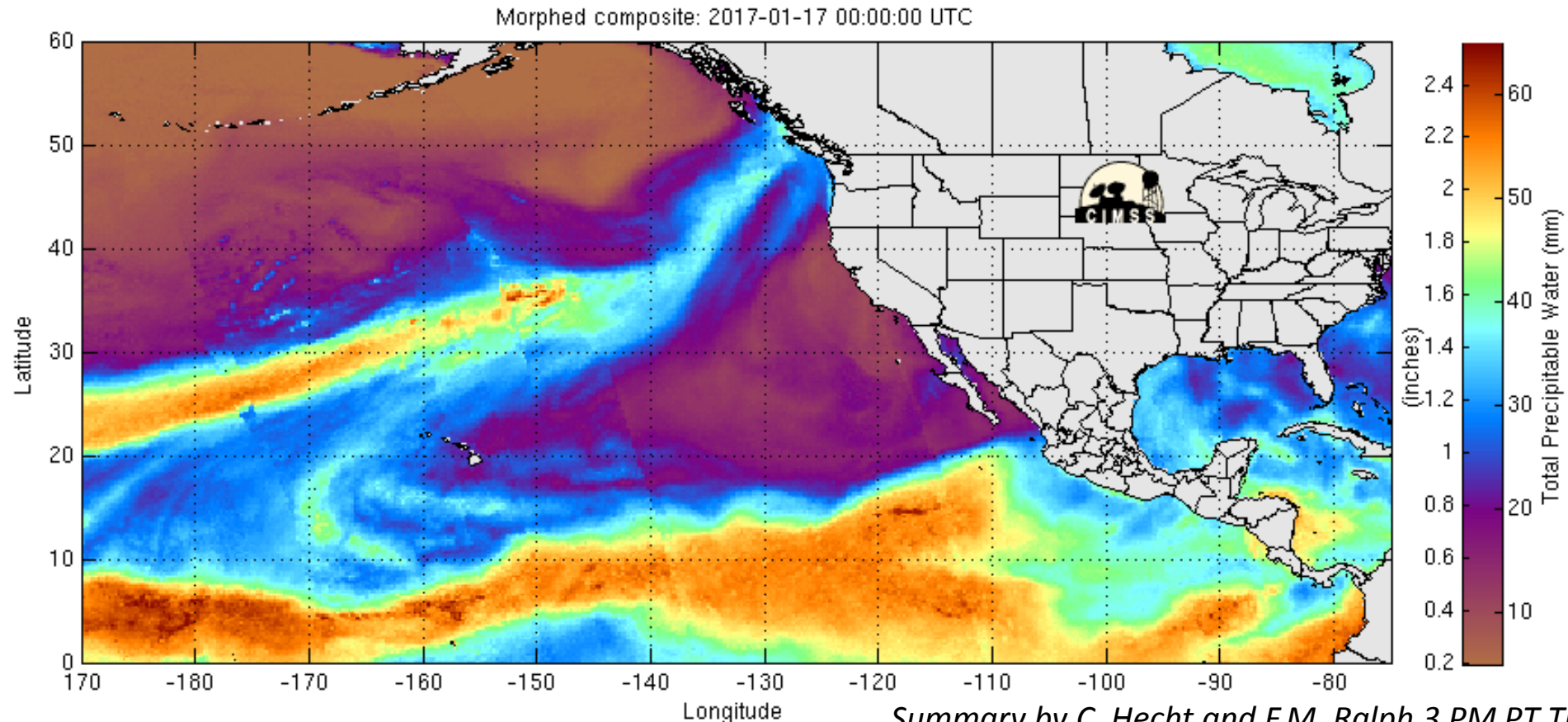
CW3E Atmospheric River Update and Outlook



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Update on 3 ARs Forecast to Impact the West Coast Over Next Several Days

- AR 1 made landfall over the Pacific Northwest and propagated southward impacting the entire U.S. West Coast
- 1–6 inches of precipitation have fallen over the last 48-h over portions of California
- AR 2 and 3 are forecast to make landfall over Southern and Central CA, respectively, over the next 5 days
- Forecast certainty is high for AR2 but still low for AR 3
- NOAA Weather Prediction Center precipitation forecasts for the next 5 days in Southern CA are as high as 10 inches over the high elevations and 1–5 inches in the valleys



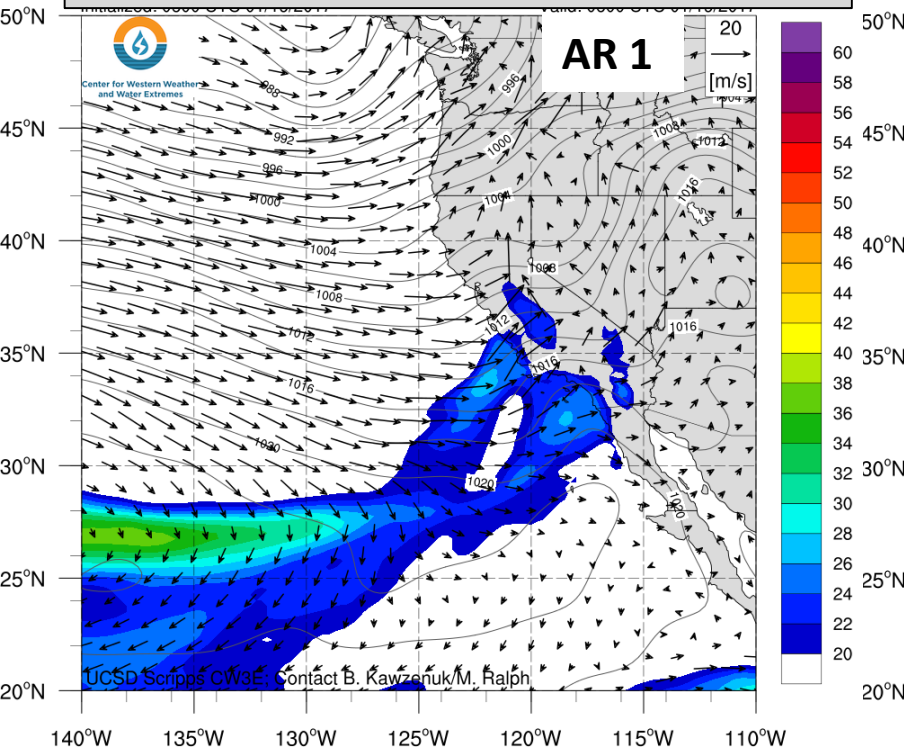
AR Update: 19 January 2017

For California DWR's AR Program

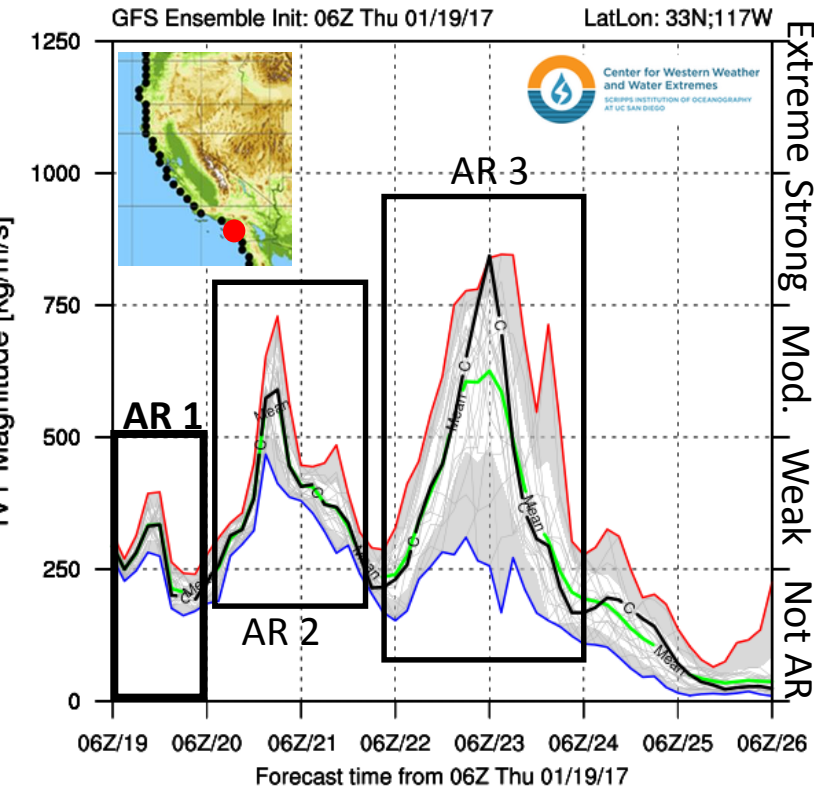
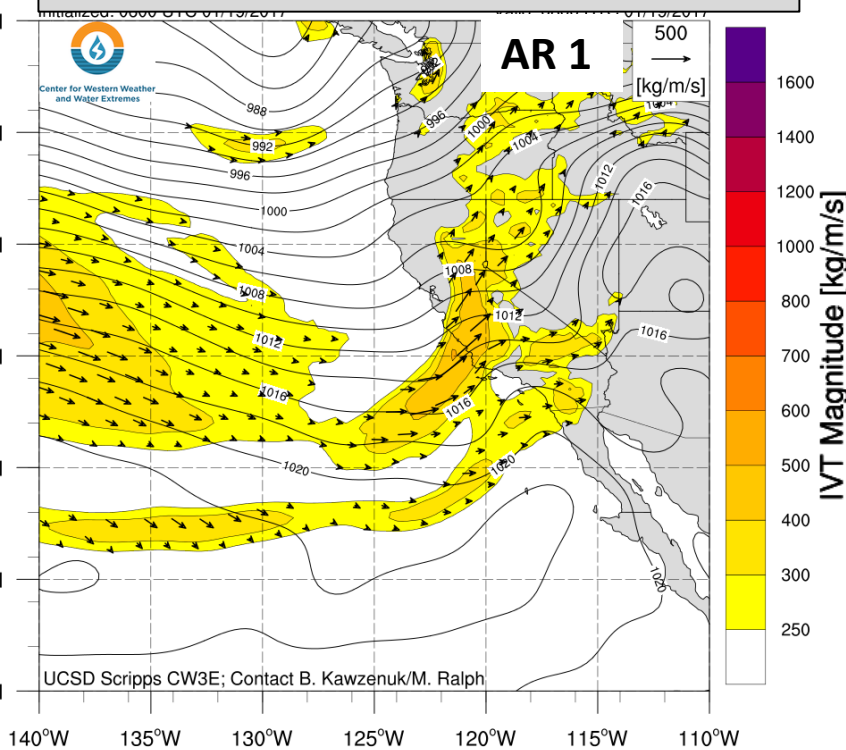


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NCEP-GFS IWV for 10 PM PST 18 Jan 2017



NCEP-GFS IVT for 10 PM PST 18 Jan 2017



- AR 1 has propagated over Southern CA where weak AR conditions are expected to end by late morning 19 Jan
- AR 2 and 3 are forecast to also impact southern CA
- There is a large amount of uncertainty in AR onset, magnitude, and duration in forecasts of AR 3 over Southern CA

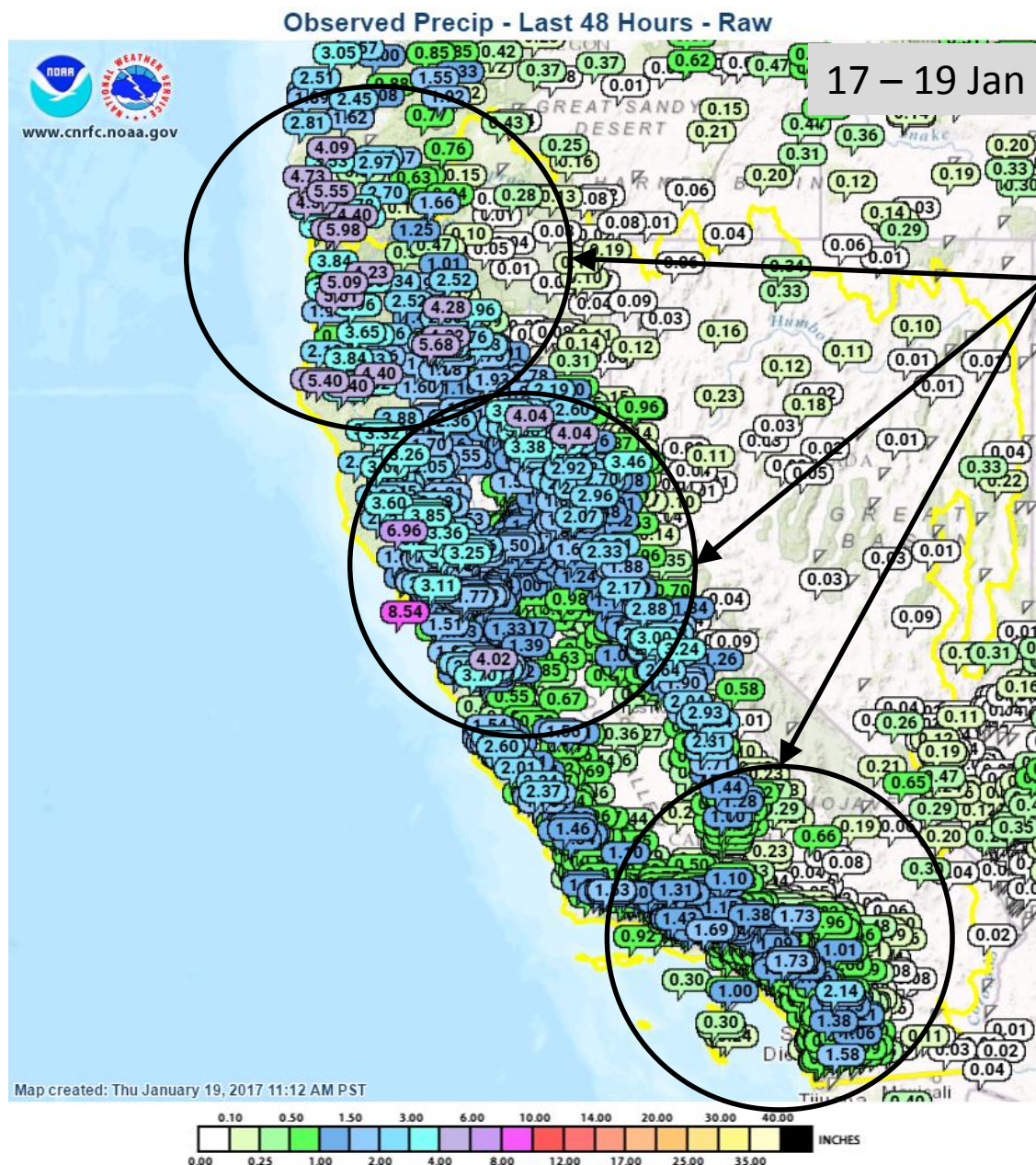
Summary by C. Hecht and F.M. Ralph 3 PM PT Thurs 19 Jan. 2017

AR Update: 19 January 2017

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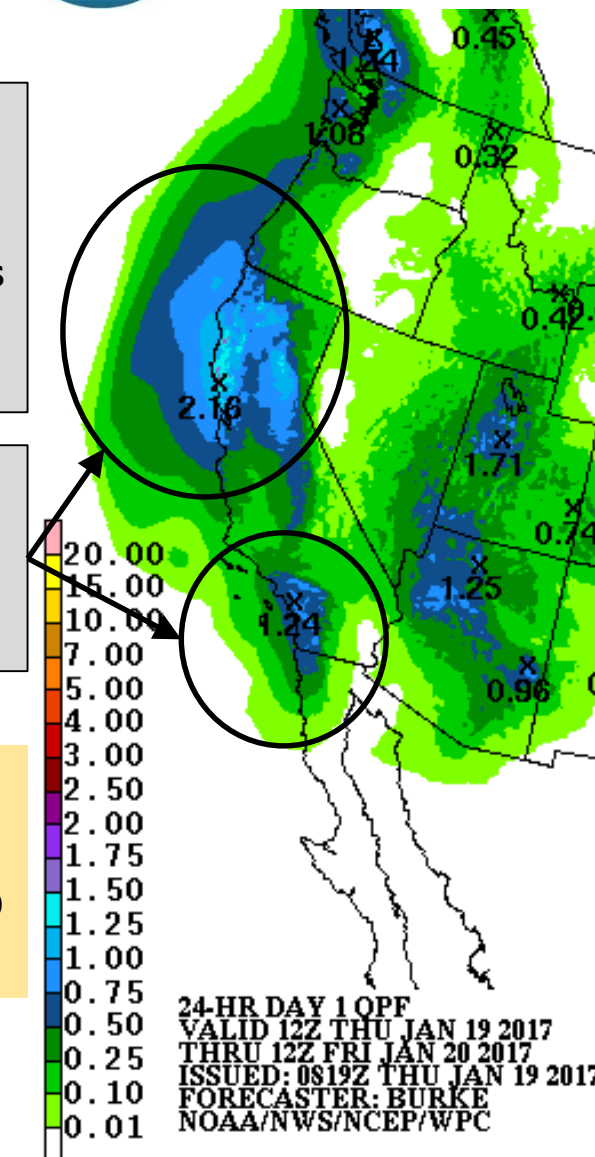
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Observed 48-h precipitation accumulations associated with AR 1 range from ~1.5 inches in Southern California to ~4 inches in Central California to ~6 inches in Northern California

Portions of Northern and Southern California could receive another 1 – 2 inches over the next 24 hours

For Official NOAA-NWS Precipitation Forecasts see www.wpc.ncep.noaa.gov/qpf/qpf2.shtml



Summary by C. Hecht and F.M. Ralph 3 PM PT Thurs 19 Jan. 2017

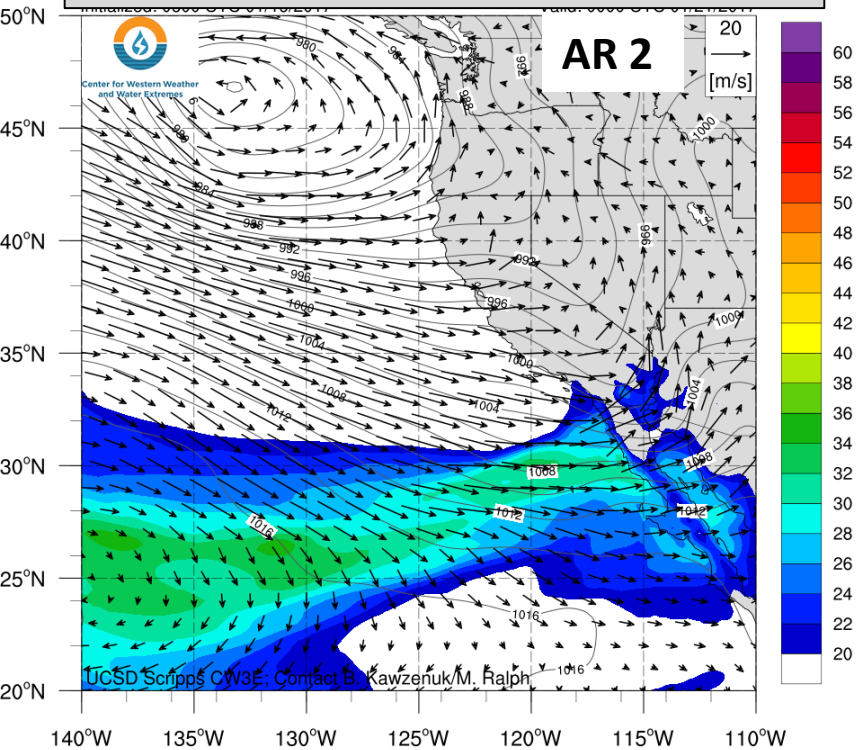
AR Outlook: 19 January 2017

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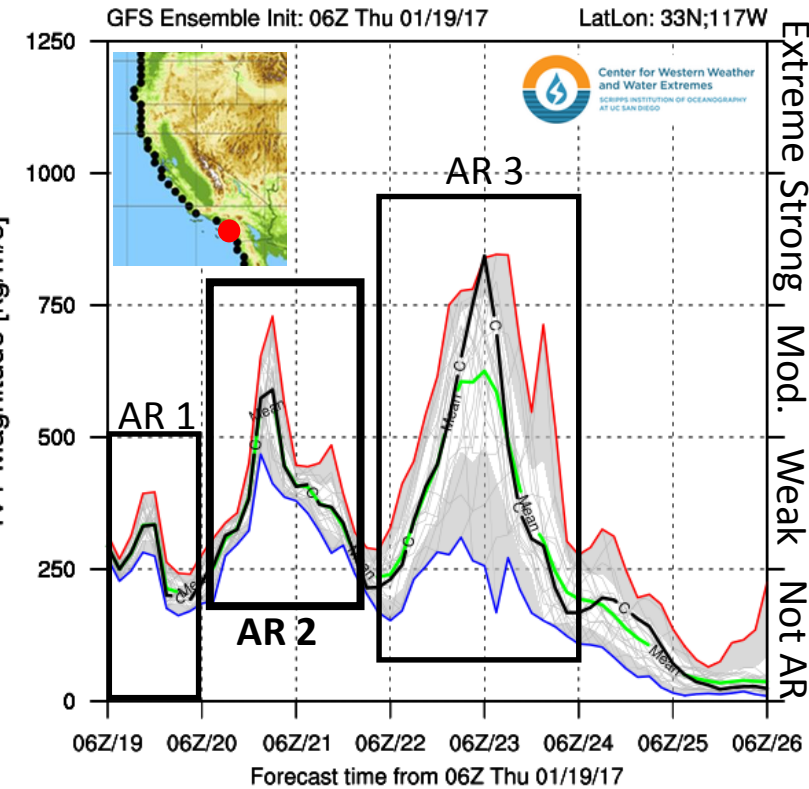
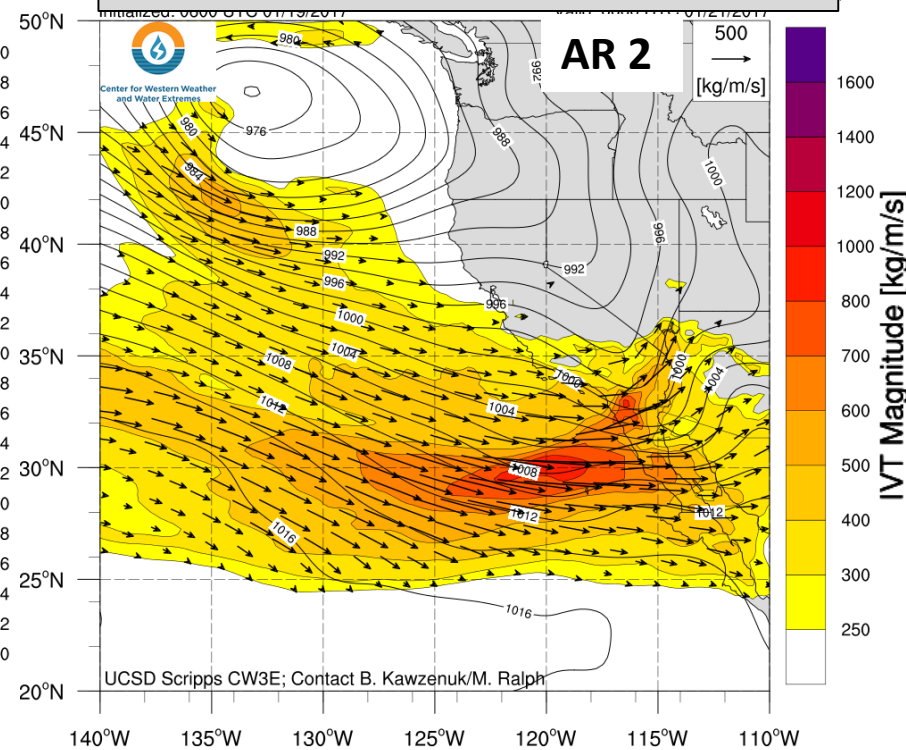


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NCEP-GFS IWV for 4 PM PST 20 Jan 2017



NCEP-GFS IVT for 4 PM PST 20 Jan 2017



- AR 2 is forecast to impact Southern California from 20 to 22 Jan 2017
- Forecasts of IVT magnitude range from ~ 400 to $750 \text{ kg m}^{-1} \text{ s}^{-1}$ (Weak to Moderate AR)

Summary by C. Hecht and F.M. Ralph 3 PM PT Thurs 19 Jan. 2017

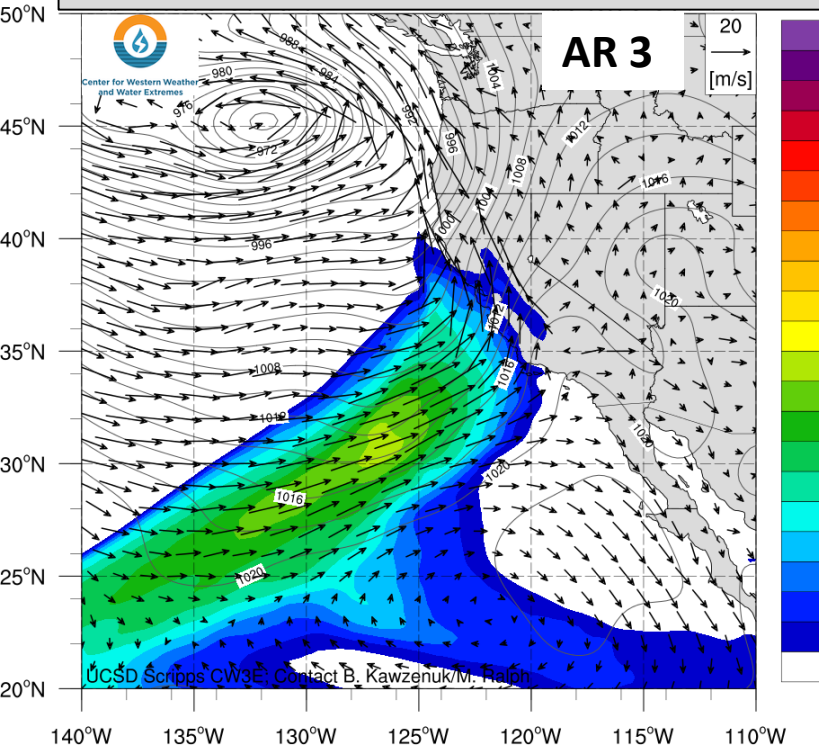
AR Outlook: 19 January 2017

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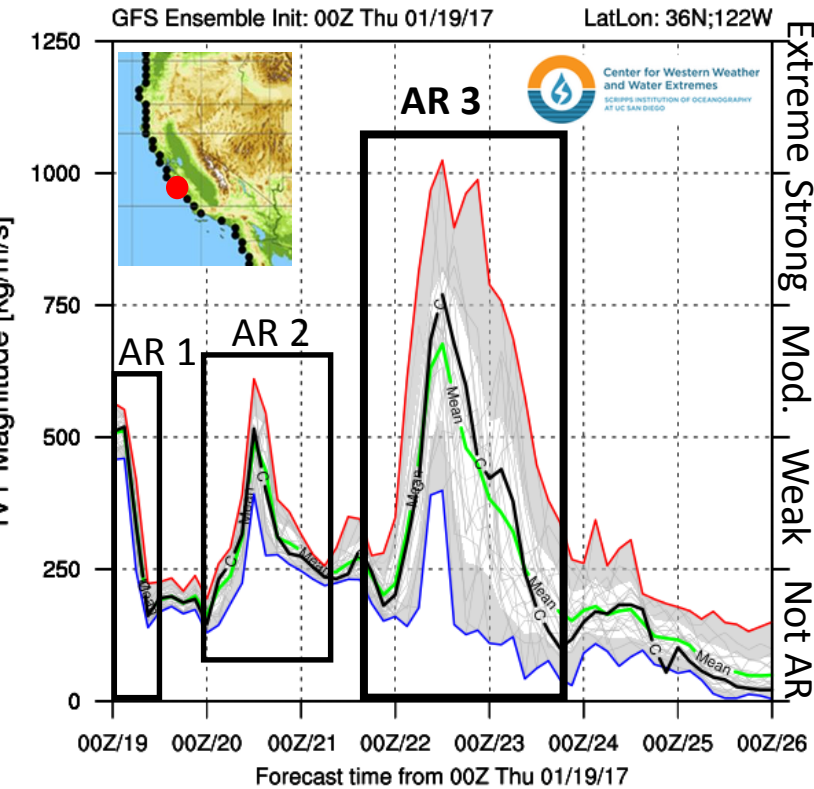
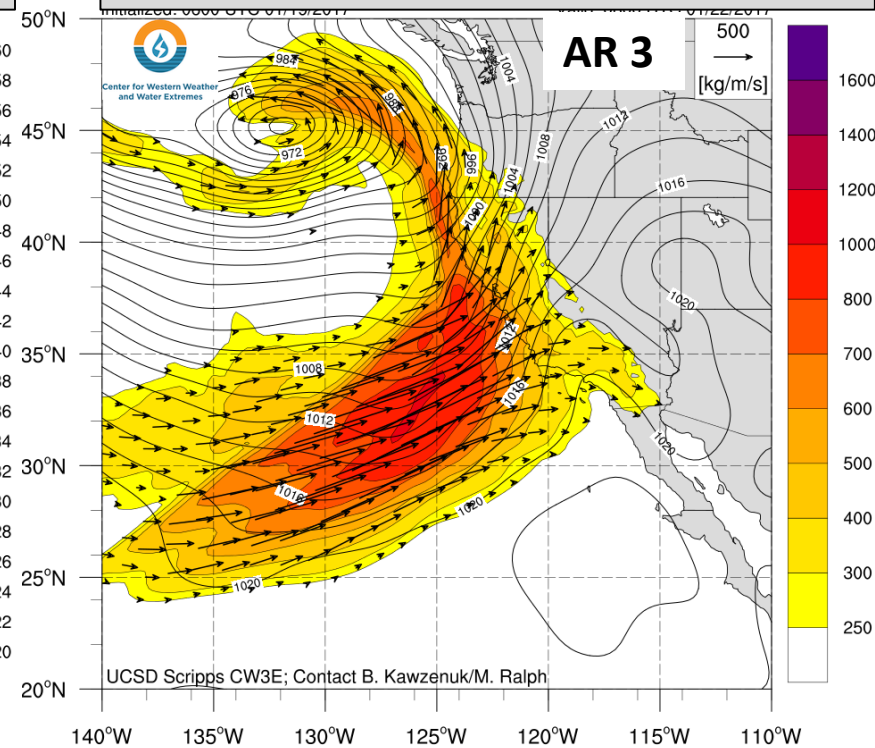


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NCEP-GFS IWV for 10 PM PST 21 Jan 2017



NCEP-GFS IVT for 10 PM PST 21 Jan 2017



- AR 3 is forecast to make landfall over Central CA on 22 Jan 2017
- Since Tuesday, forecasts of AR 3 landfall have shifted southward
- AR 3 is forecast to propagate southward from 22 to 24 Jan 2017 impacting portions of Southern CA
- Forecasts of IVT magnitude range from ~ 400 to $>1000 \text{ kg m}^{-1} \text{ s}^{-1}$ (Weak to Strong AR)
- There is still large amounts of uncertainty in the onset, magnitude, and duration of AR conditions

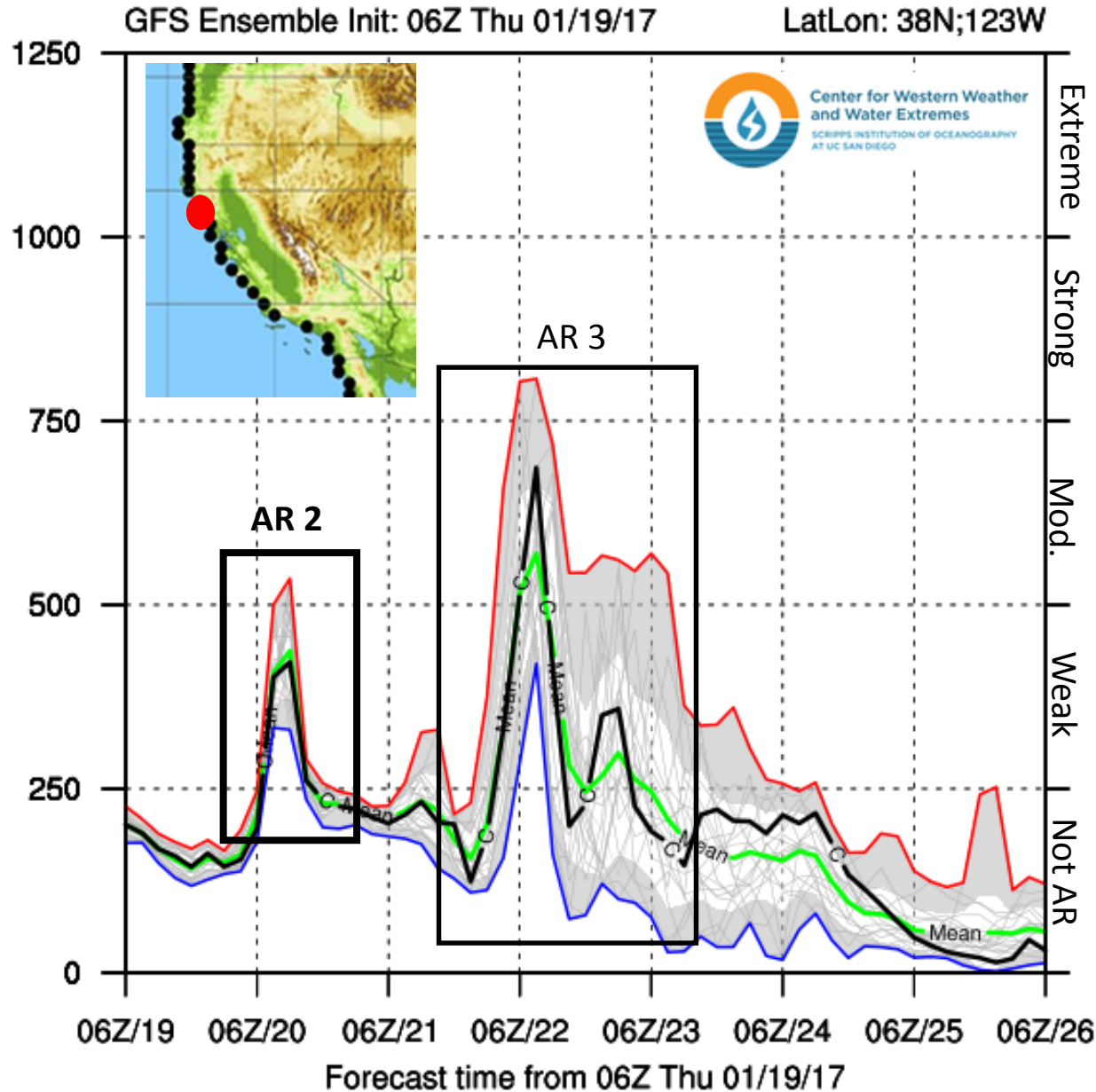
Summary by C. Hecht and F.M. Ralph 3 PM PT Thurs 19 Jan. 2017

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Recent forecasts have shifted the landfall of AR 2 southward with the core of the AR making landfall south of San Francisco

While landfall is forecast to occur further south, Bodega Bay is still forecast to experience AR conditions for ~12 hours from 10 PM PST 19 Jan to 4 AM PST 20 Jan

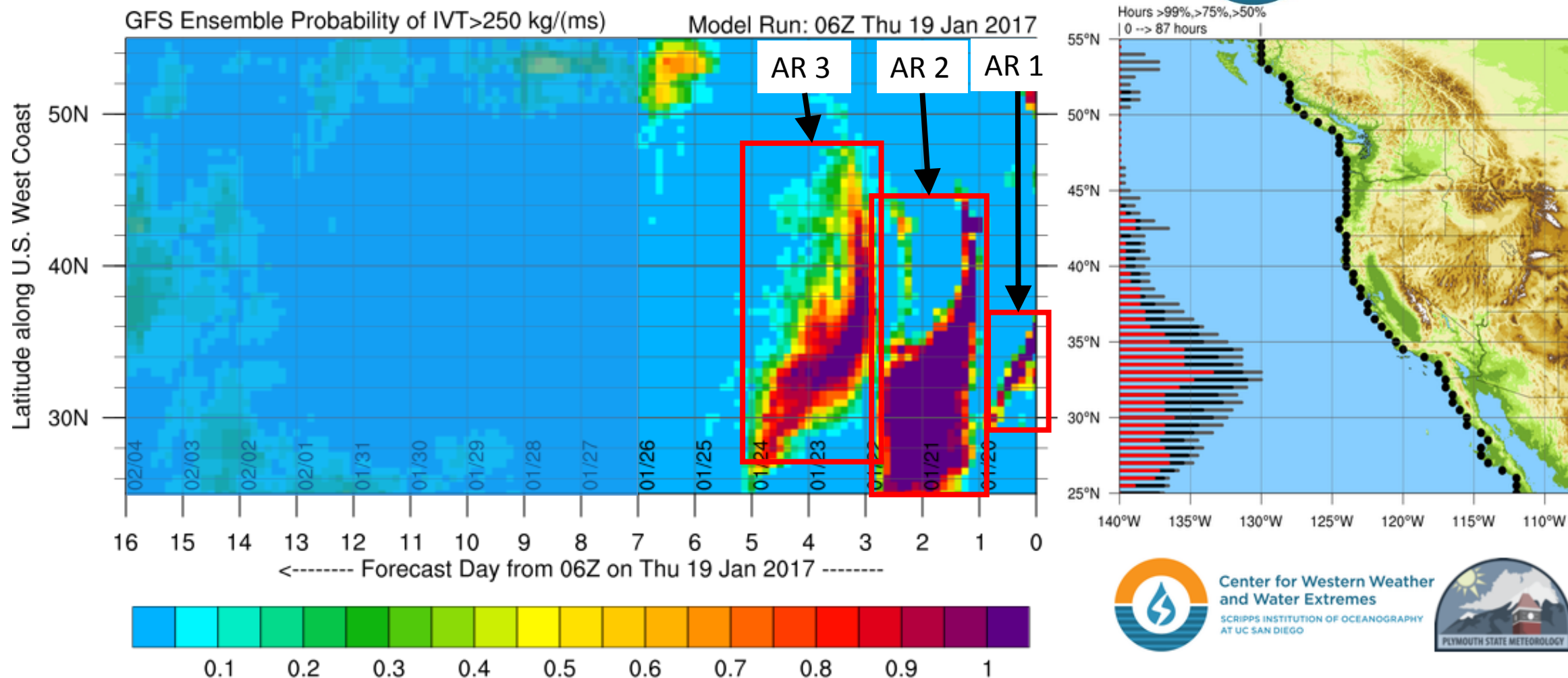
Bodega Bay could potentially experience Strong AR conditions ($\text{IVT} > 750 \text{ kg m}^{-1} \text{ s}^{-1}$) during AR 3 ~10 PM PST on 21 Jan, but uncertainty is still high

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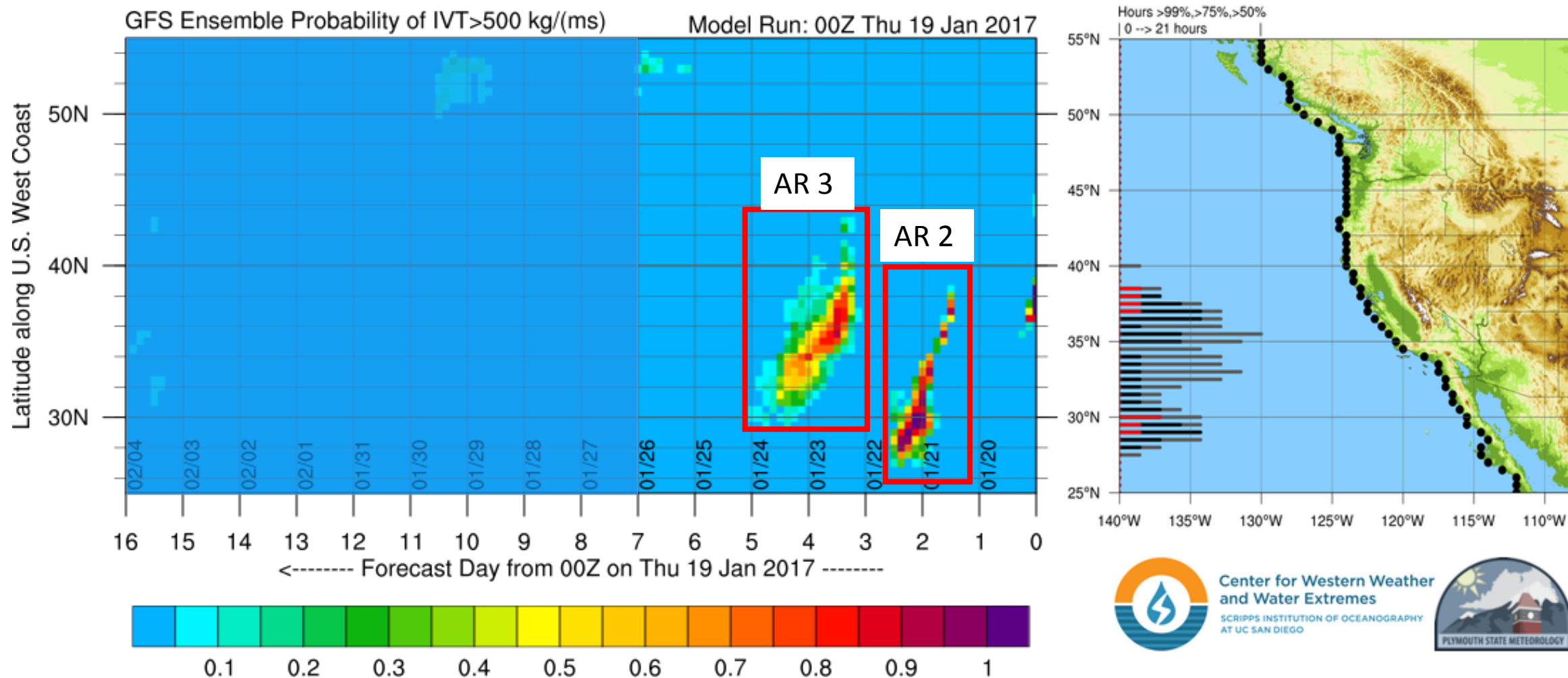
- High probability of AR conditions ($\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) lasting till ~18Z (10 AM PST) today over Southern CA
- High probability of AR conditions ($\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) associated with AR 2 for ~24-h (~1 AM 20 Jan to ~1 AM 21 Jan)
- High probability of at least AR conditions ($\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) associated with AR 3 over most of CA for 6–12 hours
- High uncertainty in onset and duration of AR conditions ($\text{IVT} > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) associated with AR 3

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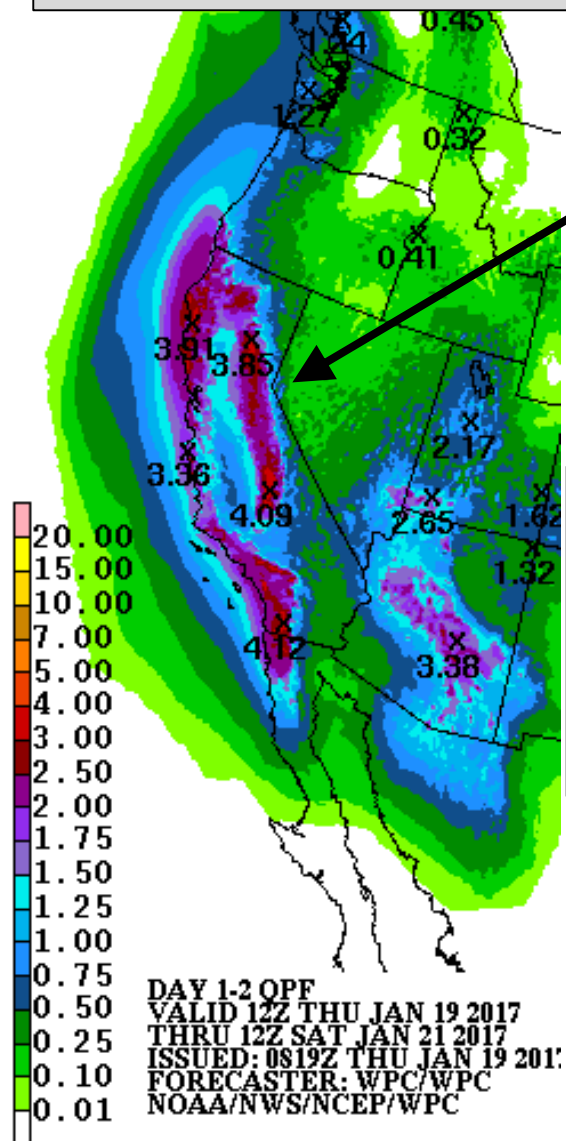
- High probability of moderate AR conditions for a short period over Southern CA and Baja California Norte ($\text{IVT} > 500 \text{ m}^{-1} \text{ s}^{-1}$) with AR 2
- High uncertainty in forecasts of moderate AR conditions associated with AR 3 ($\text{IVT} > 500 \text{ m}^{-1} \text{ s}^{-1}$)

Summary by C. Hecht and F.M. Ralph 3 PM PT Thurs 19 Jan. 2017

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4 AM Jan, 19 - 4 AM Jan, 21

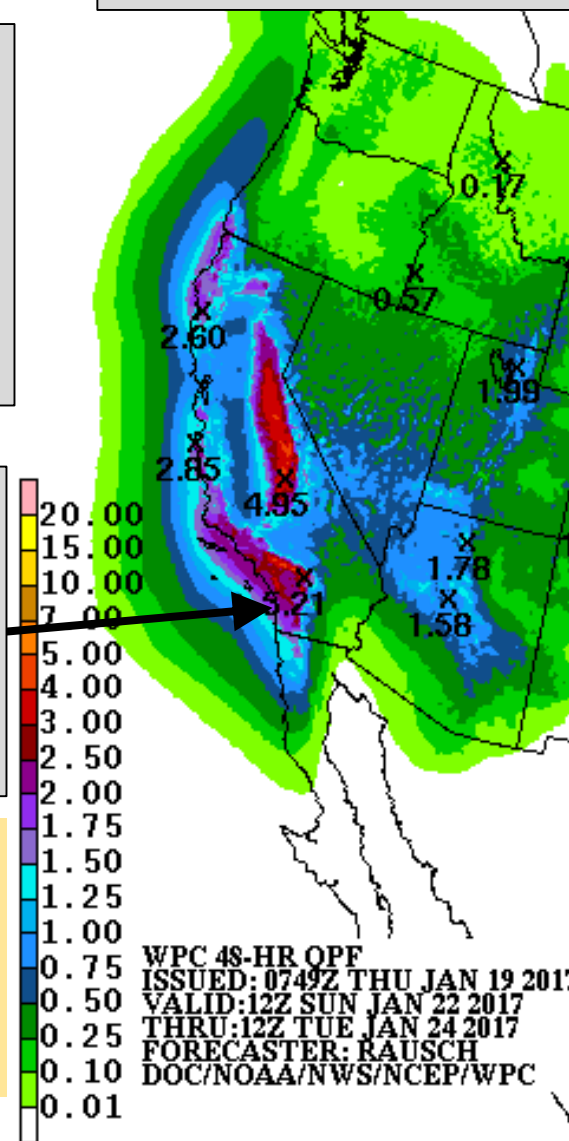


1-2 day WPC precipitation forecasts range from 3-4 inches over the Coast and Sierra Nevada Mts. associated with AR 2

Day 4/5 WPC precipitation forecasts range from 2-5 inches over California associated with AR 3

For Official NOAA-NWS Precipitation Forecasts see www.wpc.ncep.noaa.gov/qpf/qpf2.shtml

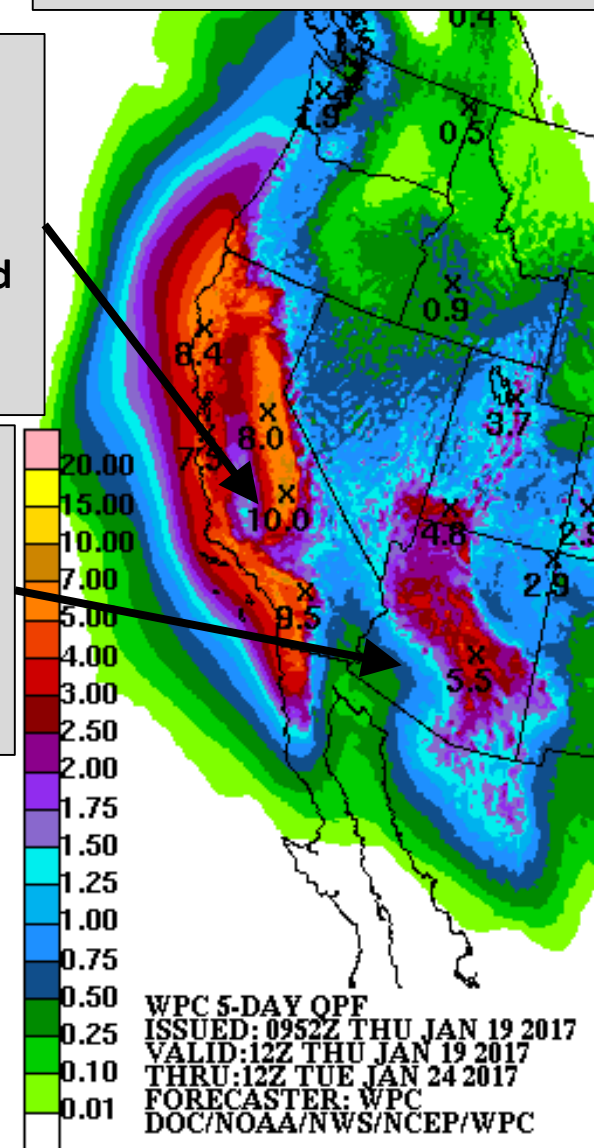
4 AM Jan, 22- 4 AM Jan, 24



1-5 day WPC total precipitation forecasts as high as 10 inches in the southern Sierras and 9.5 inches in Southern CA

Portions of Arizona are forecast to receive 2 - 5.5 inches (See next slide for an explanation)

4 AM Jan, 19- 4 AM Jan, 24



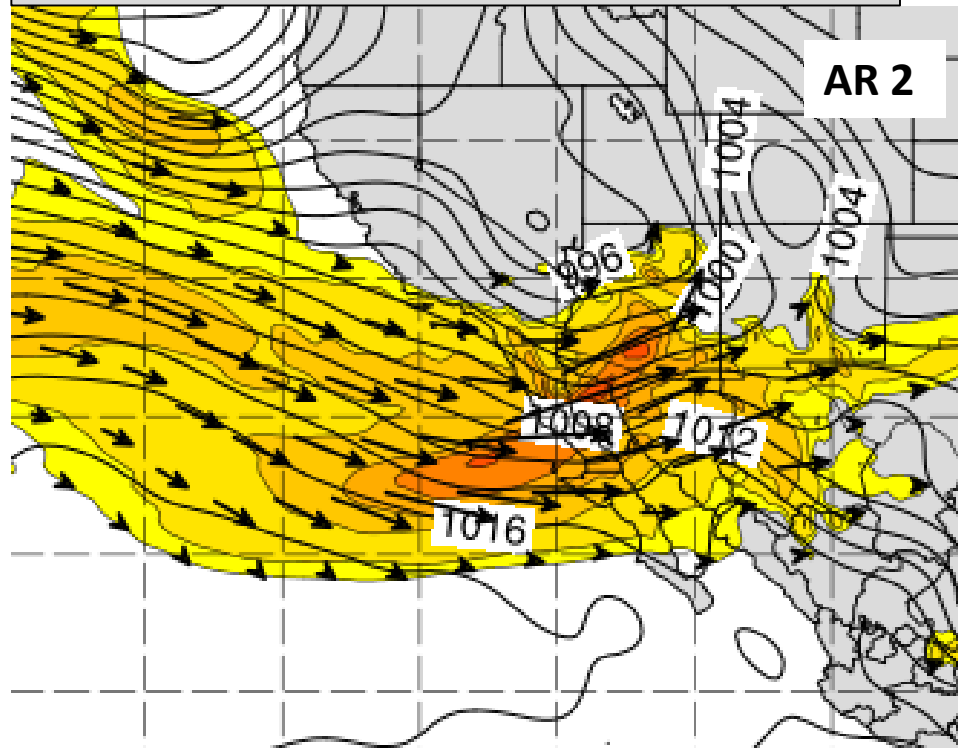
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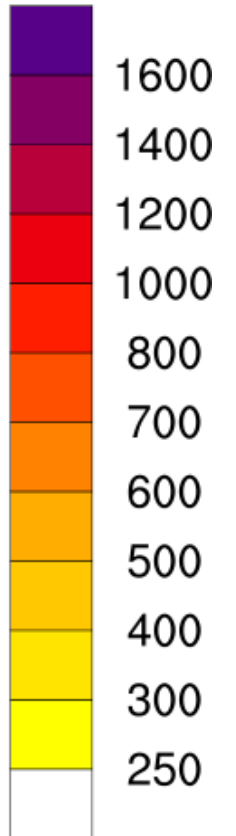
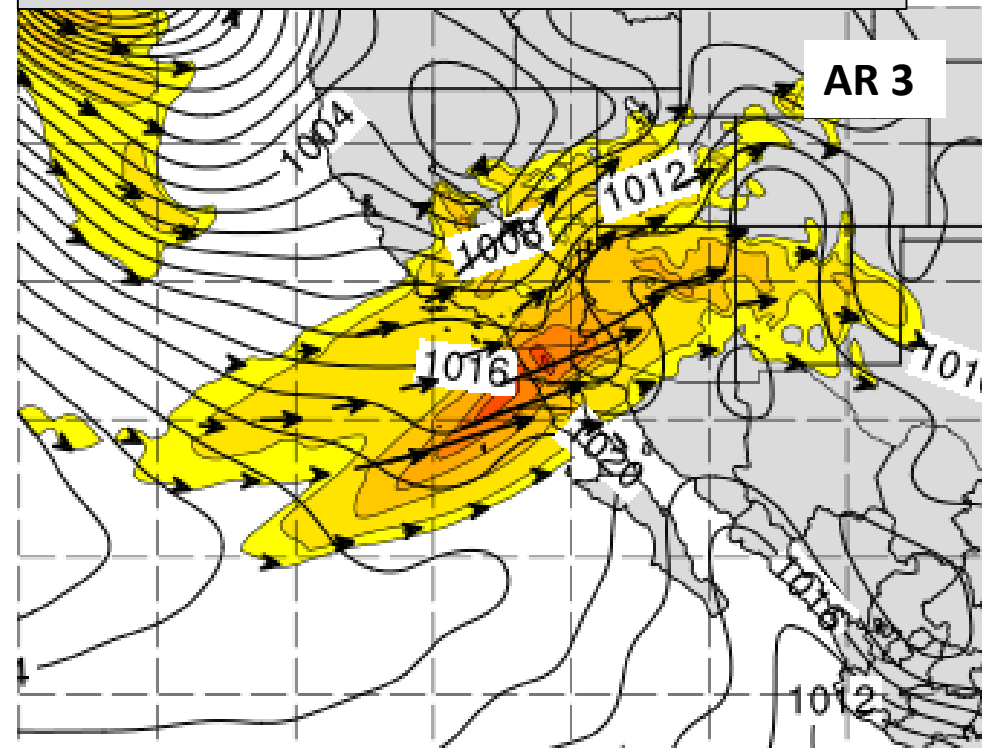


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NCEP-GFS Forecast for 10 PM PST 20 Jan 2017



NCEP-GFS Forecast for 10 PM PST 22 Jan 2017



- The inland penetration of AR of IVT during both AR 2 and AR 3 over the U.S. West Coast is forecast to bring AR conditions to Arizona
- Central Arizona could experience IVT magnitudes as high as $\sim 700 \text{ kg m}^{-1} \text{s}^{-1}$ during both ARs
- The higher elevations of Arizona could receive as much as 5.5 inches of precipitation (see previous slide for full forecast)

AR Outlook: 19 January 2017

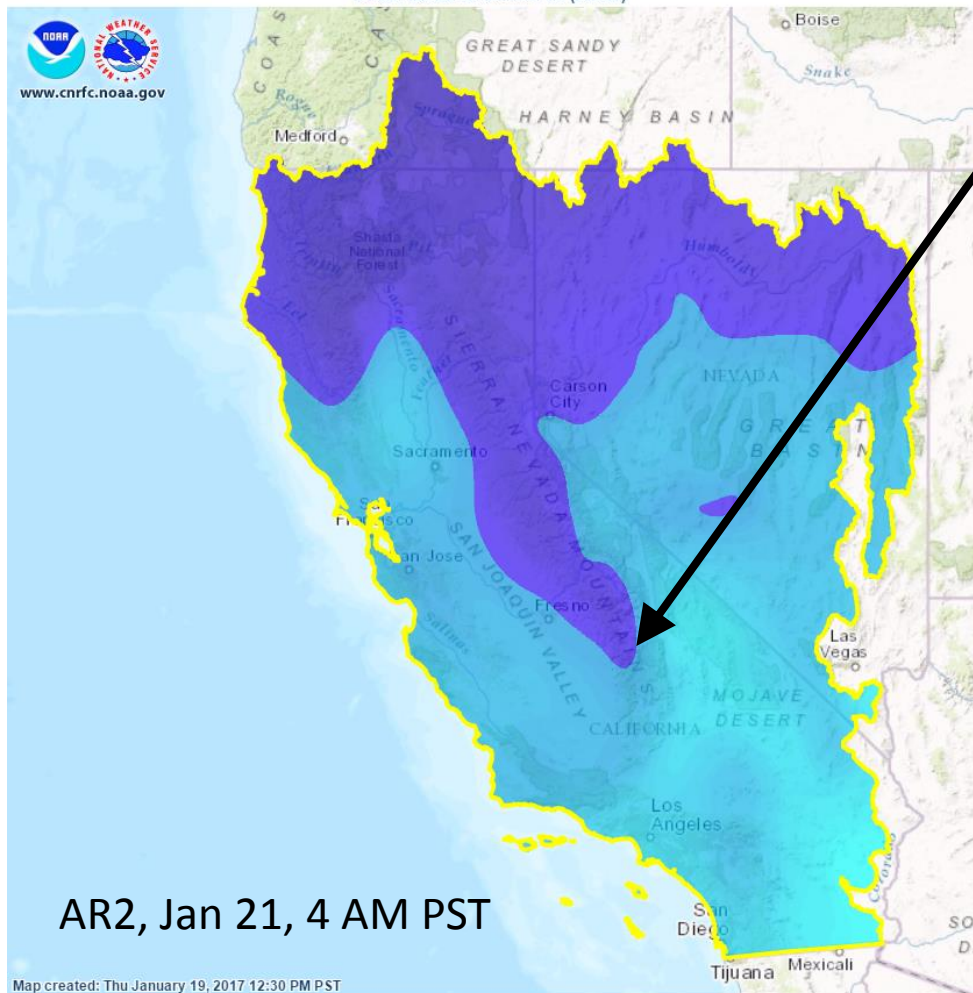
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Points: Observed Freezing Levels

Areal: Sat Jan 21 04 AM PST (21/12Z)



AR2, Jan 21, 4 AM PST

Freezing Level (feet)

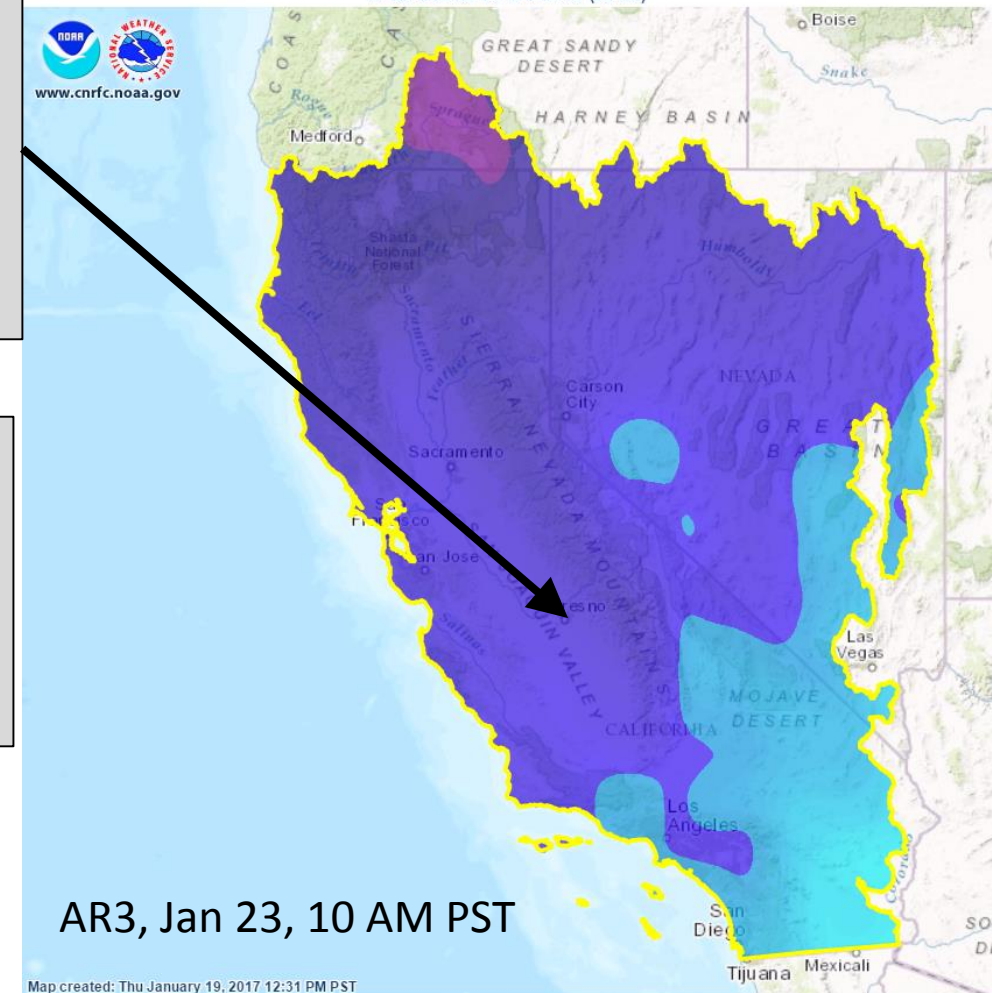


While the high elevations of the Southern Sierra Nevada Mts. Are forecast to receive 10 inches of precipitation during AR 2 and 3, freezing levels are forecast to be low (3,000–4000 feet)

While large accumulations of snow will be beneficial to the hydrologic cycle and water supply, it will make travel difficult and dangerous in the Southern Sierra Mountains

Points: Observed Freezing Levels

Areal: Mon Jan 23 10 AM PST (23/18Z)



AR3, Jan 23, 10 AM PST

Freezing Level (feet)

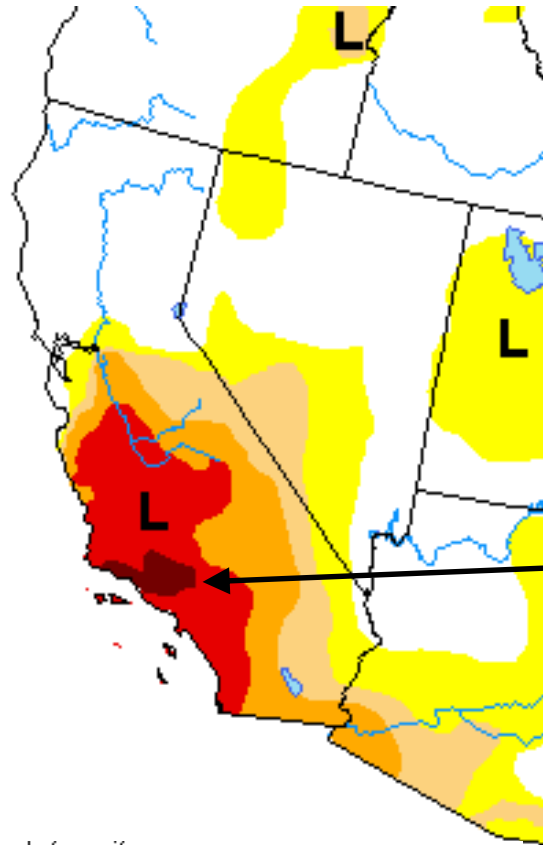


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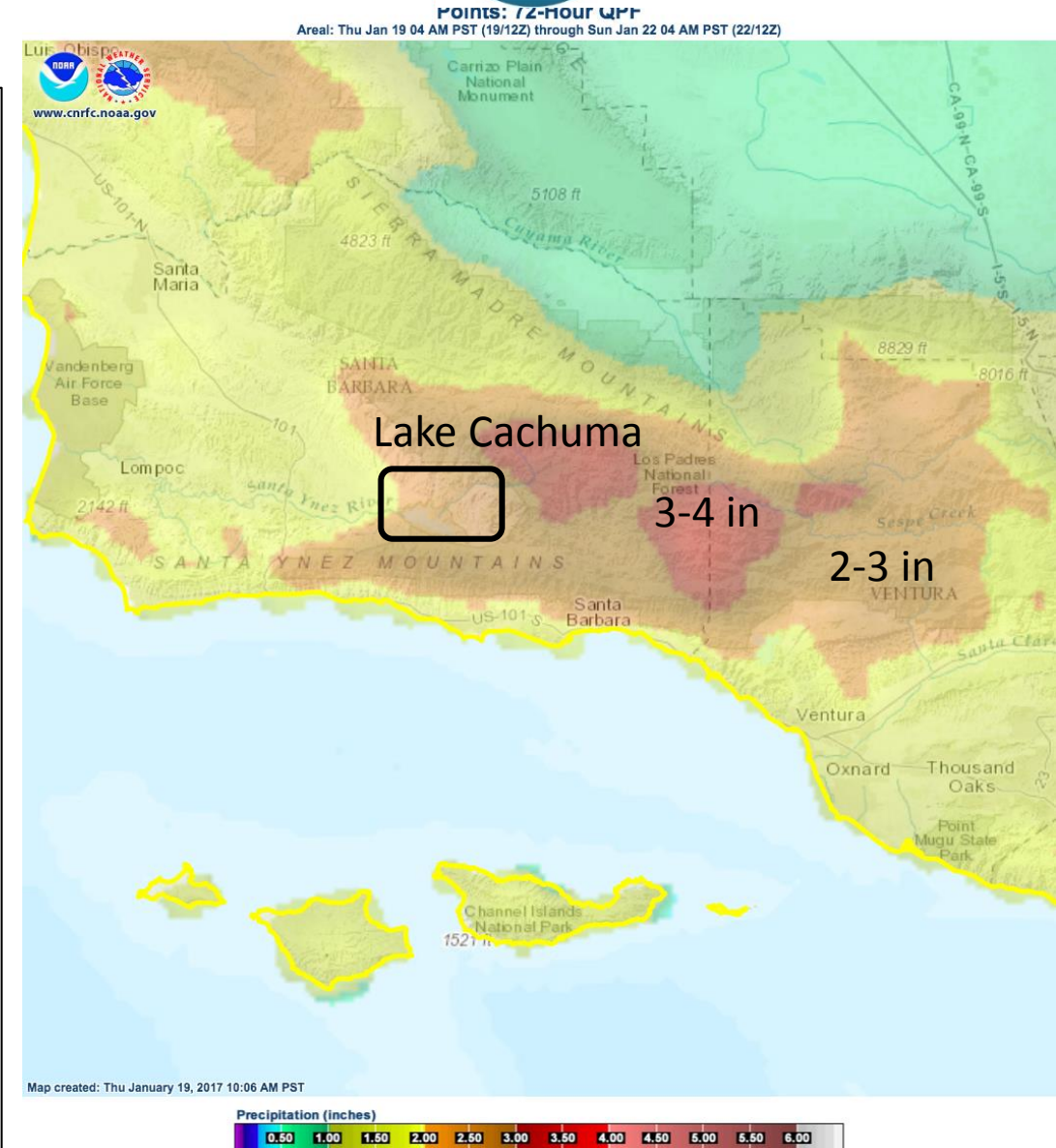
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Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

- While a majority of California has received a large amount of precipitation due to ARs over the past month that has contributed to drought mitigation, the Santa Barbara area has remained in Exceptional Drought
- The southerly orientation of AR 3 may be more favorable for upslope moisture flux in the Transverse Ranges and could lead to more precipitation
- As of Jan 18, Lake Cachuma is at 17,795 acre-feet; 9% of capacity
- Forecast totals up to 4 inches in contributing area of Lake Cachuma



Provided by Nina Oakley Thurs 19 Jan. 2017

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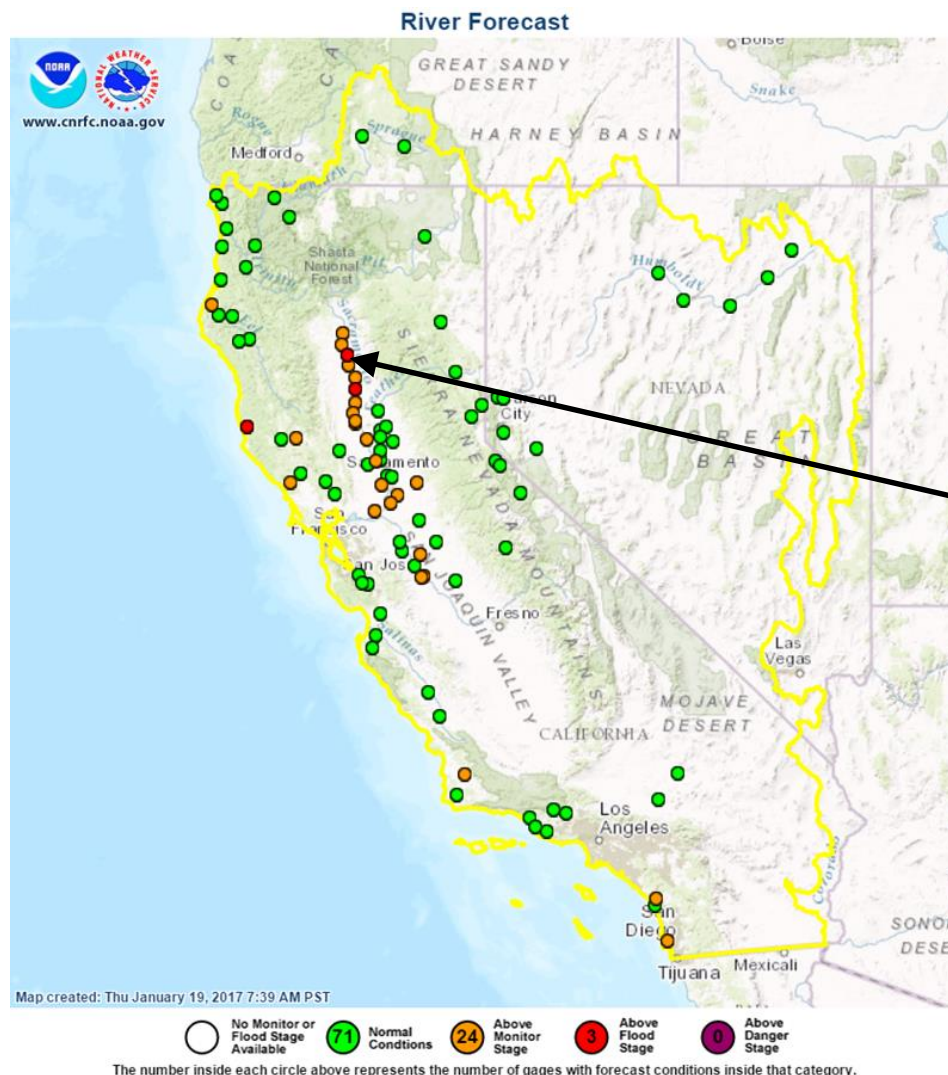
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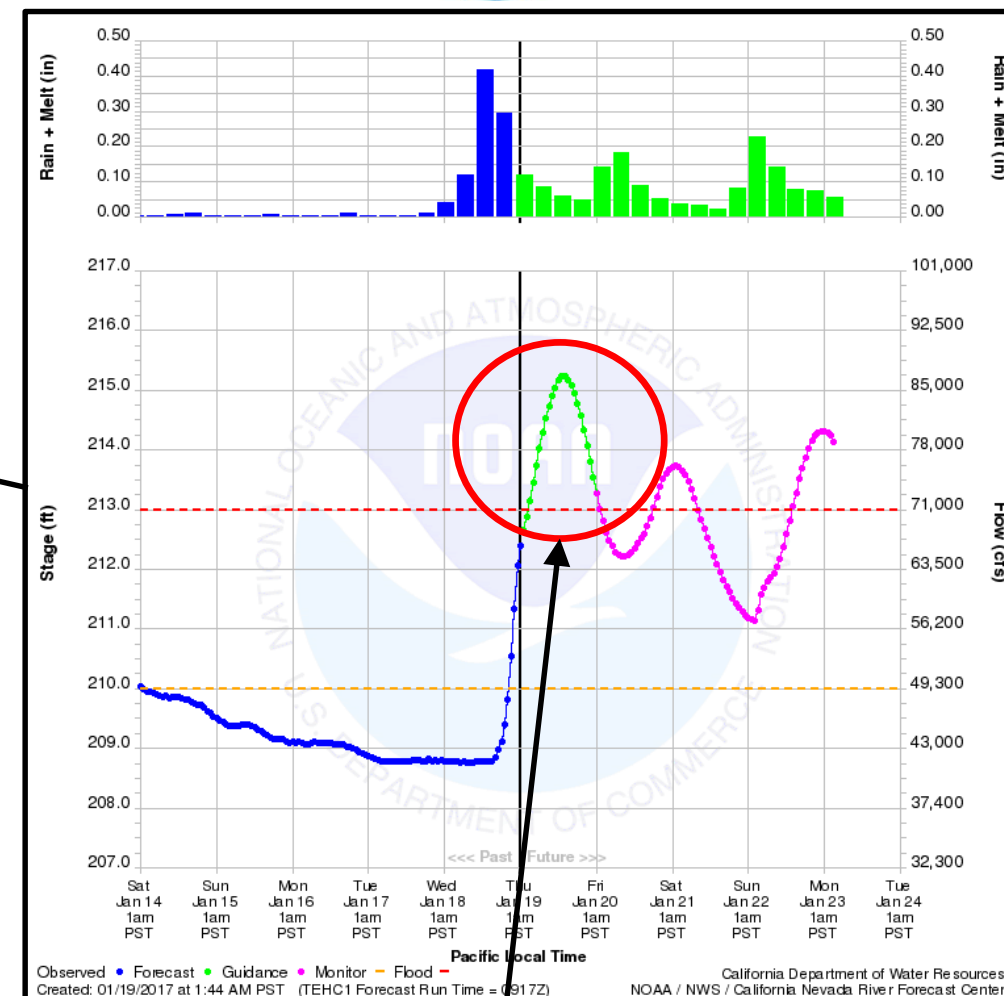
There are currently three
river gauges that are at or
forecast to rise above
flood stage on the
Sacramento River

There are an additional 24
gauges that are above or
expected to rise above
monitor stage

For official NOAA-NWS
CNRFC Streamflow
Forecasts see
cnrfc.noaa.gov/rfc_guidance.php



The National Weather Service has issued numerous Flood and Flash Flood Watches, Flood Advisories, and Flood Warnings across California. Visit weather.gov for more information and point specific forecasts, watches, advisories, and warnings



The Sacramento River at Tehama Bridge is forecast to rise to 215.2 feet, ~2 feet above flood stage

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Weak AR hits Southern CA

Likely Moderate AR Forecast for Friday (1/20) to impact Southern CA

Possibly Strong AR for Sunday (1/22)

Summary AR 1:

- AR 1 made landfall over the Pacific northwest before propagating southward impacting a majority of the U.S. West Coast
- AR conditions over Southern CA are expected to end by late morning on the 19th
- Observed 48-h precipitation ranges from 1–6 inches across California

Summary AR 2:

- Weak to moderate AR conditions (IVT $250\text{--}750\text{ kg m}^{-1}\text{ s}^{-1}$) forecast to impact Southern California 20–22 Jan 2017
- Higher confidence in forecasts of AR conditions since Tuesdays outlook
- 48-h (19–21 Jan) precipitation forecasts range from 3–4 inches over the higher elevations of Southern CA and 1–3 inches at lower elevations

Summary AR 3:

- Potentially strong AR conditions (IVT $>750\text{ kg m}^{-1}\text{ s}^{-1}$) forecast to impact Central California 22–24 Jan 2017
- Still very high uncertainty in timing, duration, and magnitude of AR conditions
- 48-h (22–24 Jan) precipitation forecasts range from 3–5 inches over the higher elevations of Central and Southern CA and 1–2 inches at lower elevations