

CW3E Atmospheric River Outlook: 24 February 2022

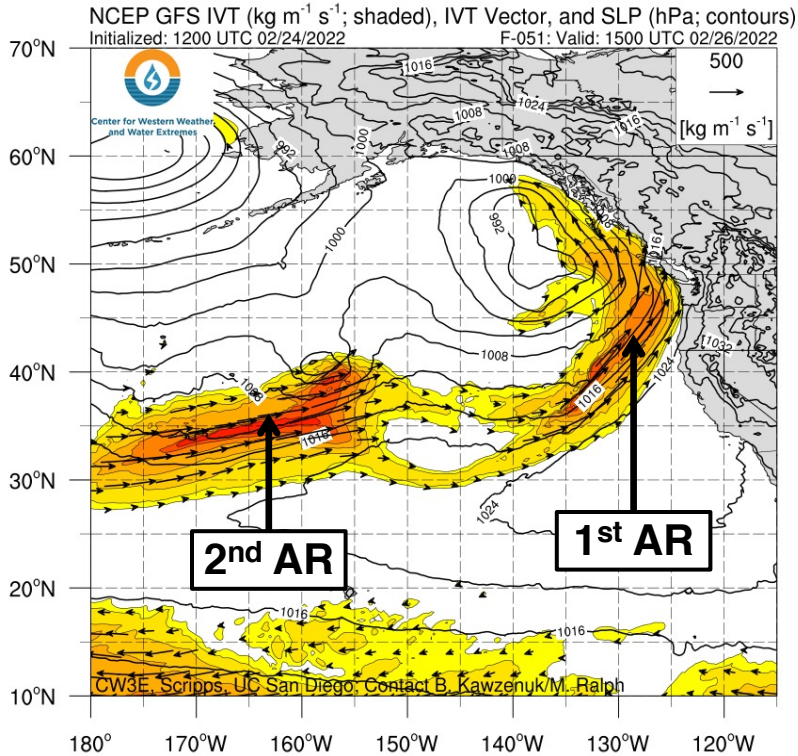
Multiple Atmospheric Rivers to Impact the US West Coast

- Multiple atmospheric rivers (AR) are forecasted to make landfall over the US West Coast this weekend into early next week
- The first AR is forecasted to make landfall on 26 Feb and bring AR 1-2 conditions (based on the Ralph et al. 2019 AR Scale) to coastal Washington and Oregon
- A second and stronger AR is forecasted to make landfall on 27 Feb, but there is substantial uncertainty in the timing, location, and duration of AR conditions
- The 00Z ECMWF EPS is forecasting the second AR to make landfall earlier and bring stronger AR conditions to southern Oregon and far Northern California
- The 00Z GEFS is forecasting the second AR to make landfall later and bring stronger AR conditions to northern Oregon and southern Washington
- Heavy precipitation is possible in western Washington, western Oregon, and far northwestern California during the next 7 days, but models disagree on the location of the heaviest precipitation associated with the second AR
- Compared to the 12Z GFS, the 12Z ECMWF is forecasting much higher precipitation in southwestern Oregon and northwestern California, and much lower precipitation in western Washington

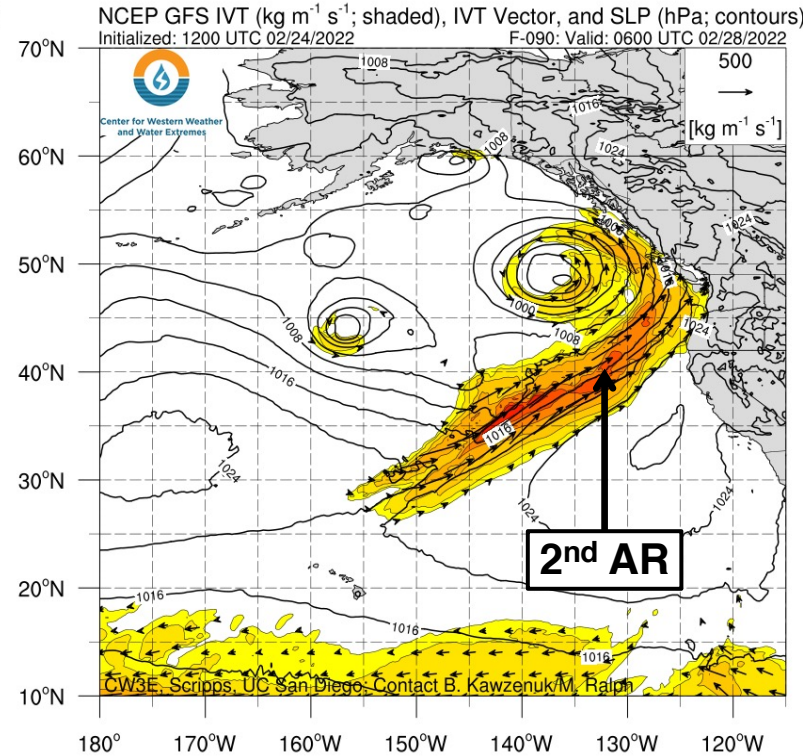
CW3E AR Outlook: 24 February 2022

GFS IVT & SLP Forecasts

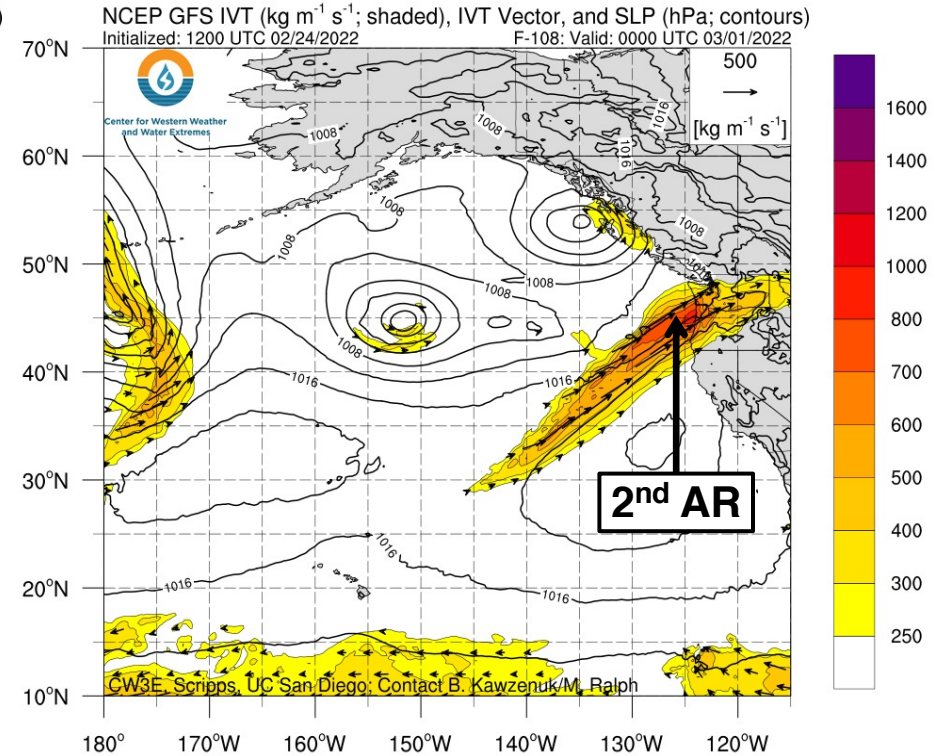
(A) Valid: 7 AM PT 26 Feb (F-51)



(B) Valid: 10 PM PT 27 Feb (F-90)



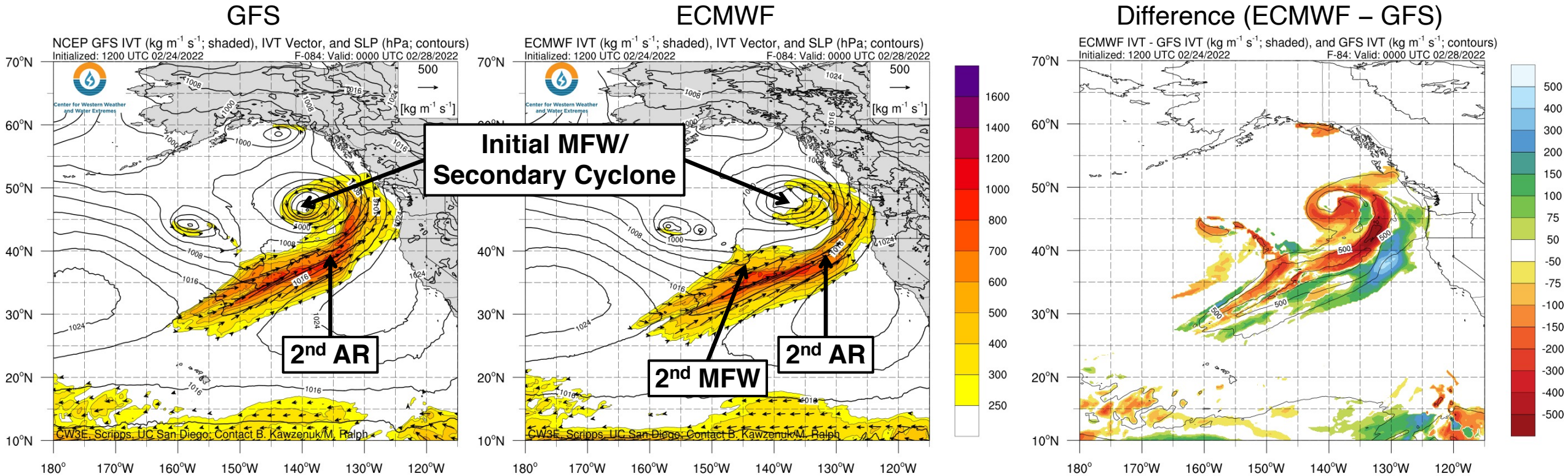
(C) Valid: 4 PM PT 28 Feb (F-108)



- The first AR is forecasted to make landfall over the Pacific Northwest and British Columbia during the morning of 26 Feb (Figure A)
- Most locations are expected to SLP weak AR conditions ($IVT < 500 \text{ kg m}^{-1} \text{ s}^{-1}$) during the first AR
- A second AR is forecasted to develop north of Hawaii and make landfall along the US West Coast during the evening of 27 Feb (Figure B)
- The strongest moisture transport during the second AR is forecasted to occur during the afternoon of 28 Feb, with maximum IVT values $> 800 \text{ kg m}^{-1} \text{ s}^{-1}$ over central coastal Oregon (Figure C)
- There is considerable forecast uncertainty in the timing, location, and duration of the second AR due to uncertainty in the evolution of multiple associated mesoscale frontal waves (MFWs) and secondary cyclogenesis events

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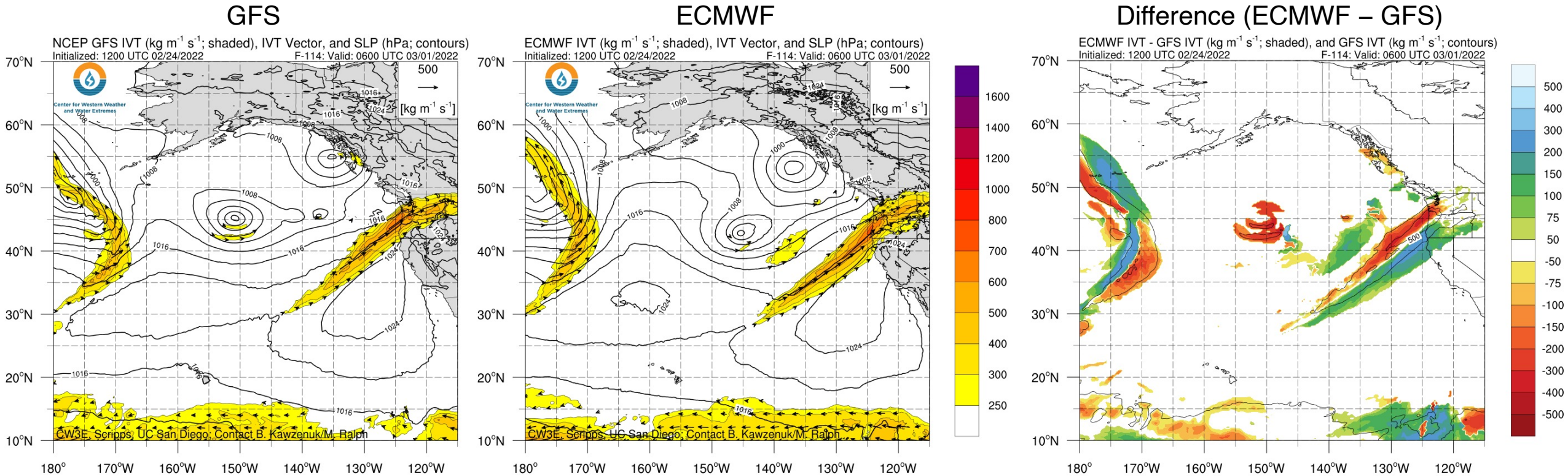
GFS vs. ECMWF IVT Forecasts: Valid 00Z 28 Feb



- There are large model-to-model differences in the evolution of the second AR and the associated MFWs/secondary cyclones
- The 12Z ECMWF is forecasting the initial MFW/secondary cyclone to propagate eastward more rapidly, allowing the AR to make landfall several hours earlier than forecasted by the GFS
- The ECMWF is also forecasting a second MFW to develop near the trailing portion of the AR, but this MFW is weaker and farther west in the GFS

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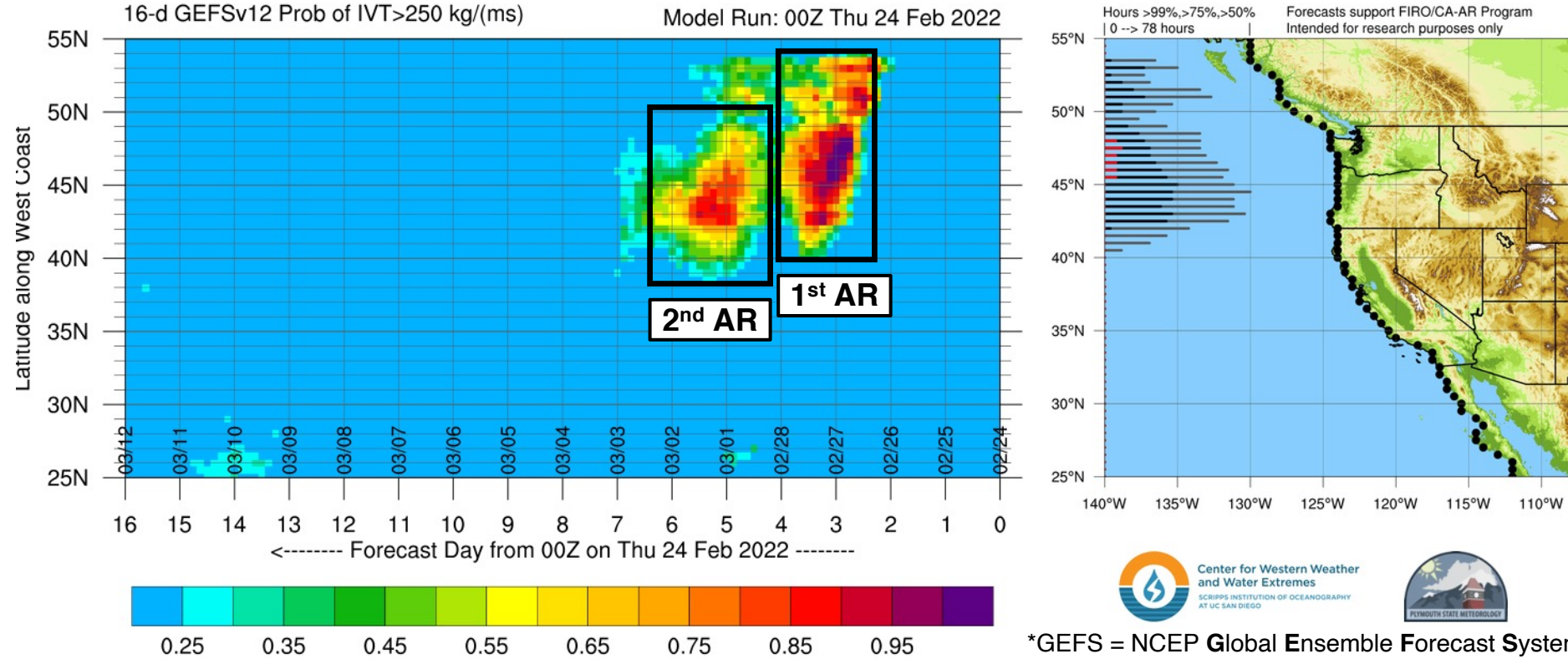
GFS vs. ECMWF IVT Forecasts: Valid 06Z 1 Mar



- There are also differences in the forecast location of the AR core after the AR makes landfall, with the GFS forecasting higher IVT to the north, and the ECMWF forecasting higher IVT to the south
- These differences in the forecast location of the strongest IVT lead to differences in the forecast location of heaviest precipitation during the second AR

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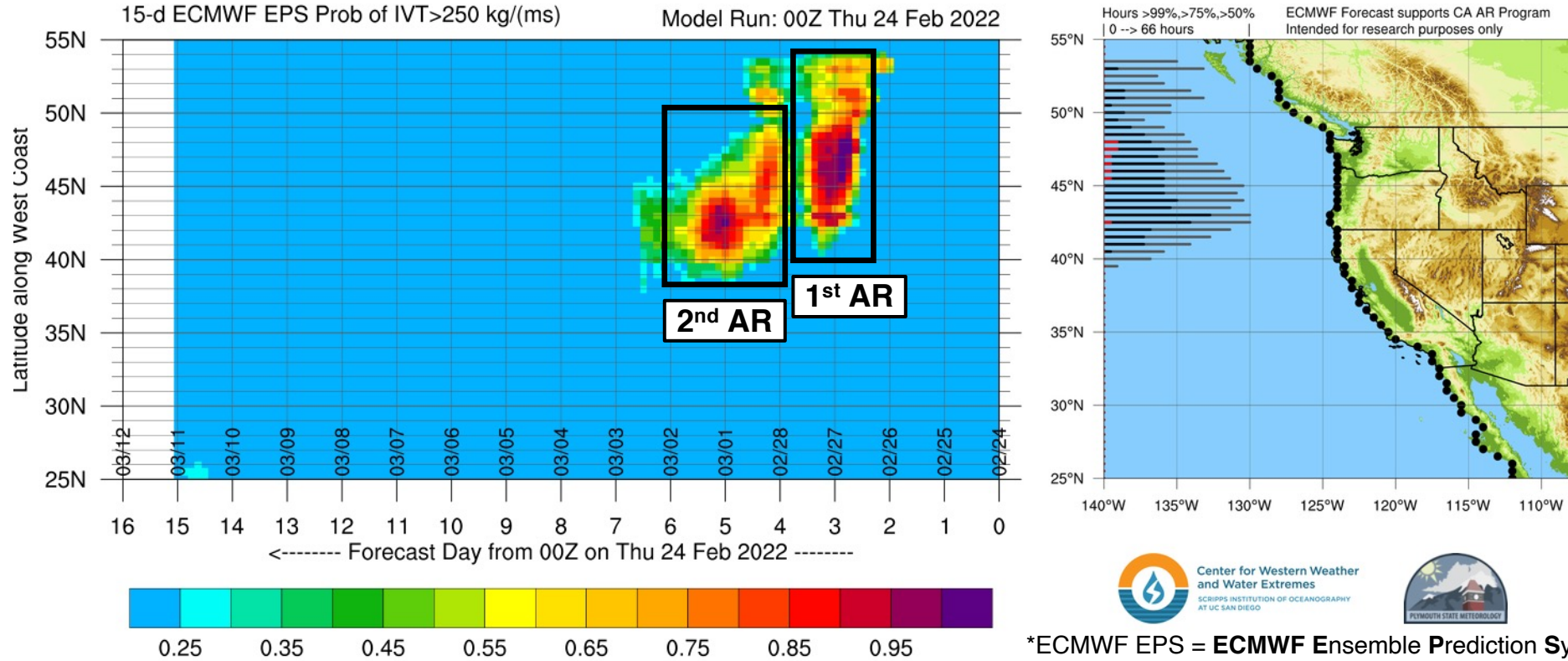
Probability of AR Conditions Along Coast (GEFS)



- The 00Z GEFS is showing high confidence (> 90% probability) in AR conditions ($IVT > 250 \text{ kg m}^{-1} \text{ s}^{-1}$) over coastal Washington and Oregon in association with the first AR
- The 00Z GEFS is also showing high confidence (> 80% probability) in AR conditions over coastal Oregon in association with the second AR
- There is large uncertainty in the location and duration of AR conditions during the second AR

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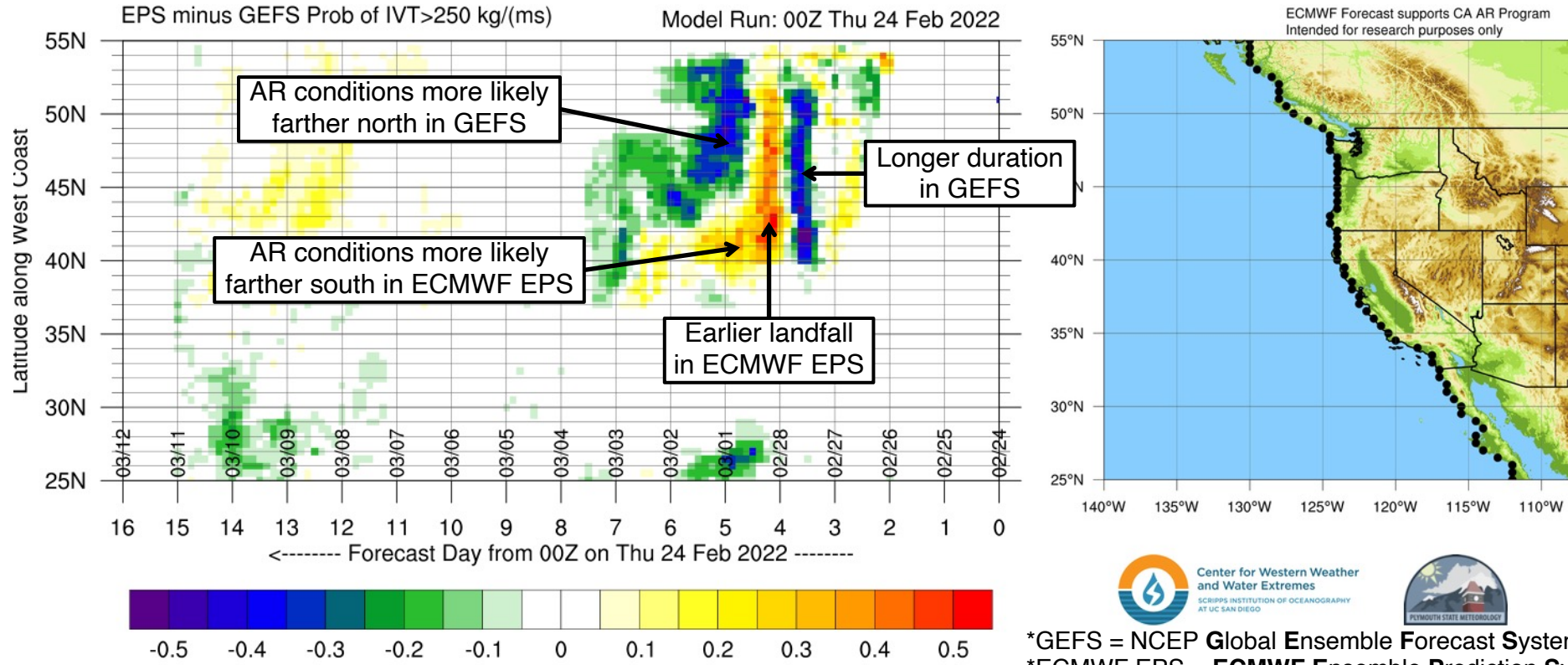
Probability of AR Conditions Along Coast (ECMWF EPS)



- The 00Z ECMWF EPS is showing high confidence (> 90% probability) in AR conditions over coastal Washington and Oregon in association with the first AR
- The 00Z ECMWF EPS is also showing high confidence (> 80% probability) in AR conditions over coastal Oregon and far northwestern California in association with the second AR
- There is large uncertainty in the location and duration of AR conditions during the second AR, with some members forecasting a short break in AR conditions on 28 Feb

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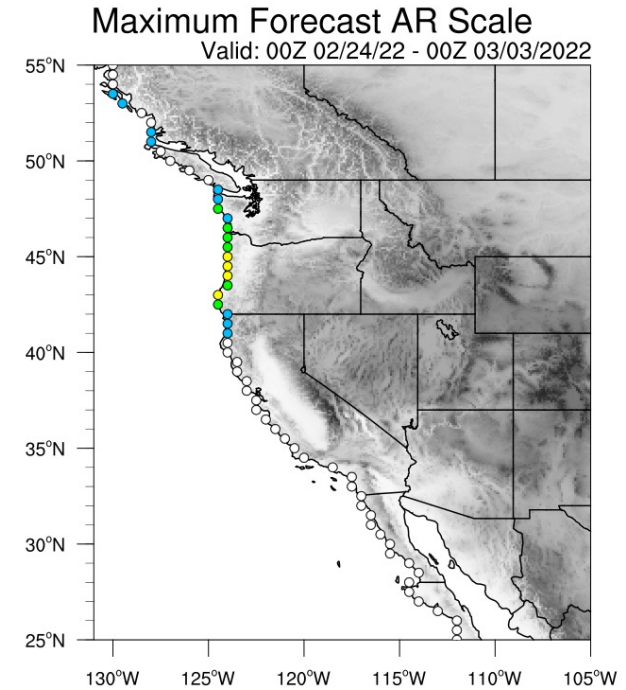
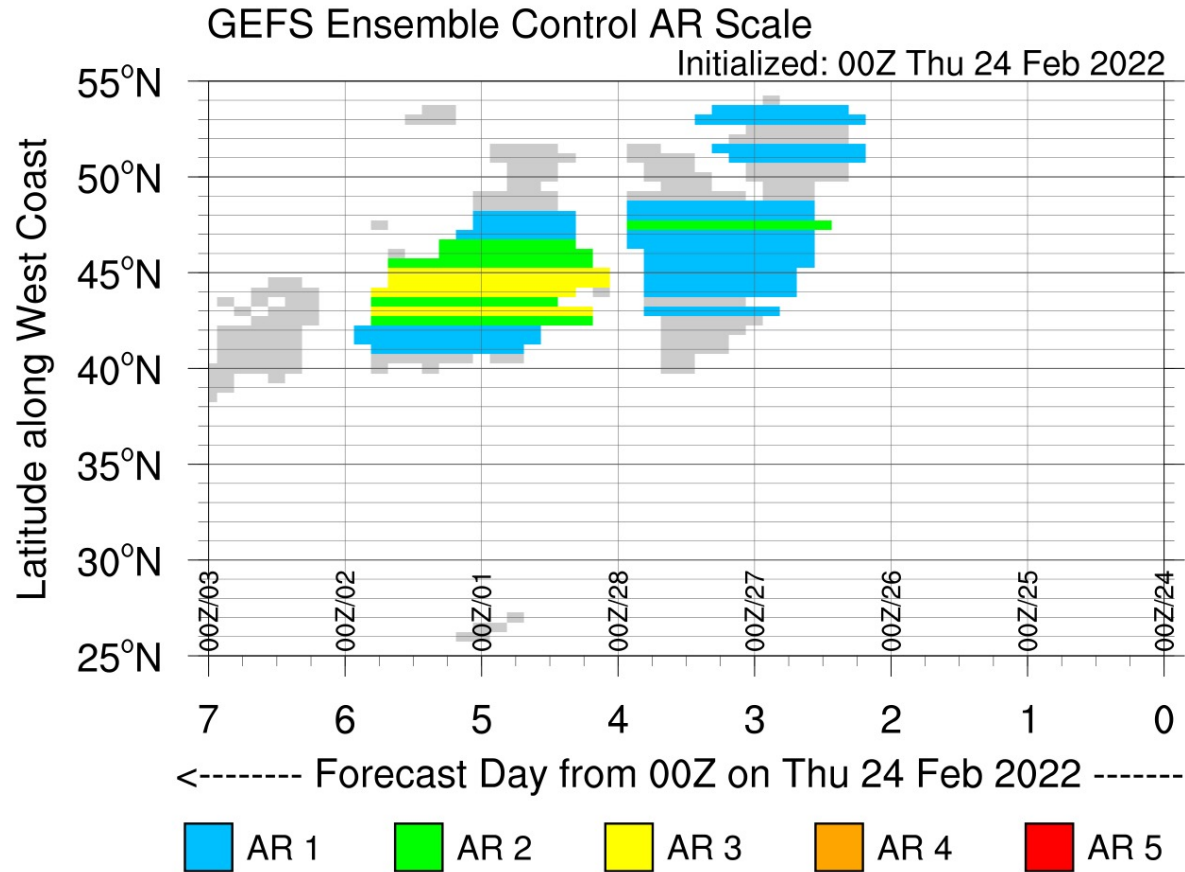
Probability of AR Conditions Along Coast: ECMWF EPS Minus GEFS



*GEFS = NCEP **Global Ensemble Forecast System** (United States)
*ECMWF EPS = **ECMWF Ensemble Prediction System** (Europe)

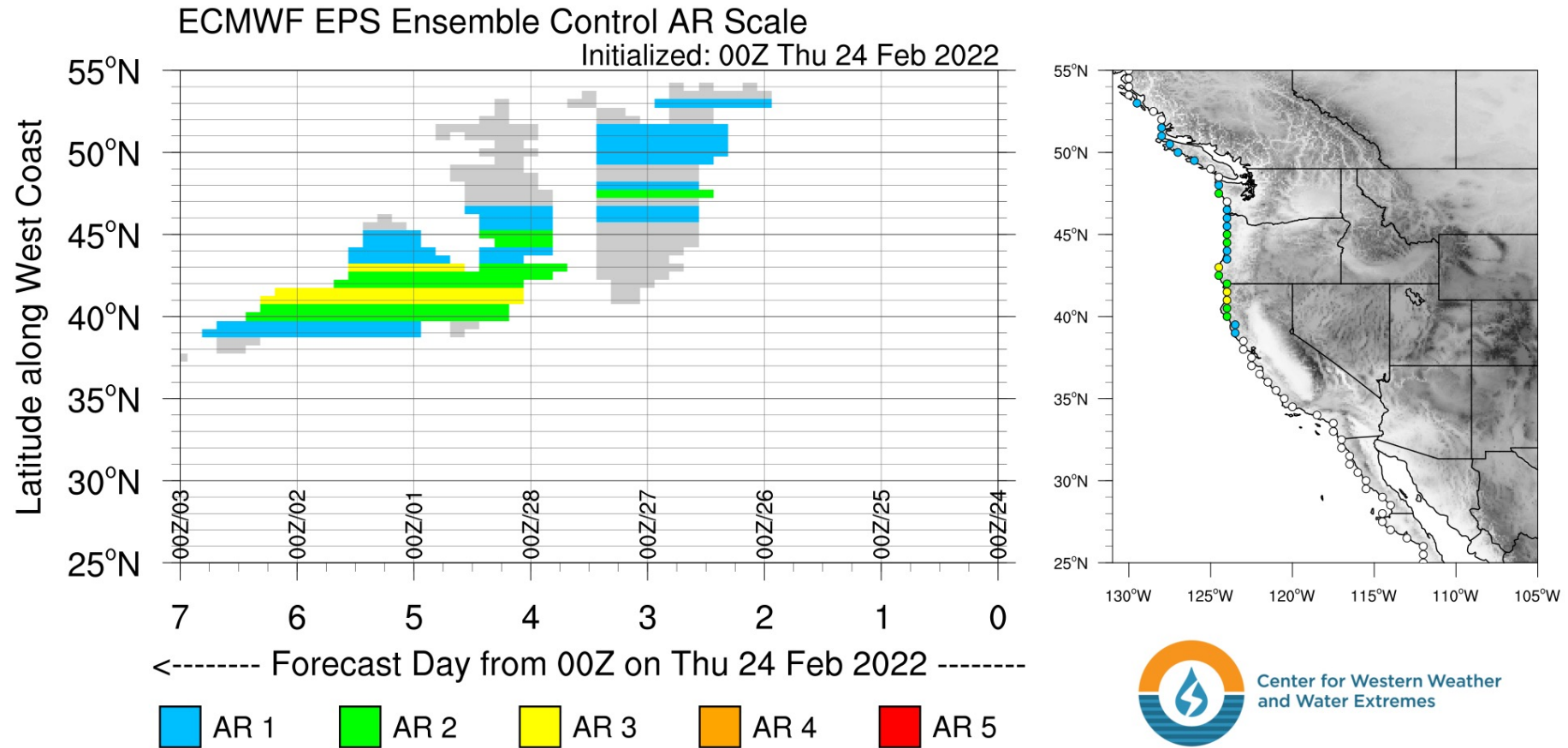
- There are substantial model-to-model differences in the forecast timing, location, and duration of both ARs
- The GEFS is forecasting the first AR to persist about 6–12 hours longer than the ECMWF EPS
- The ECMWF EPS is forecasting the second AR to make landfall about 6–12 hours earlier than the GEFS
- The GEFS is forecasting higher probabilities of AR conditions in northern Oregon and Washington during the second AR, whereas the ECMWF EPS is forecasting higher probabilities of AR conditions in Northern California

GEFS AR Scale Forecasts



- The 00Z GEFS control run is forecasting AR 1-2 conditions over coastal Washington and Oregon in association with the first AR
- For the second AR, the GEFS control run is forecasting AR 2-3 conditions over coastal Oregon and AR1 conditions over coastal Washington and far Northern California

ECMWF EPS AR Scale Forecasts



- The 00Z ECMWF control run is forecasting AR 1-2 conditions over coastal Washington in association with the first AR
- Compared to the GEFS control, the ECMWF control is forecasting a shorter duration of AR conditions during the first AR
- For the second AR, the ECMWF control run is forecasting AR 2-3 conditions over southern coastal Oregon and far Northern California

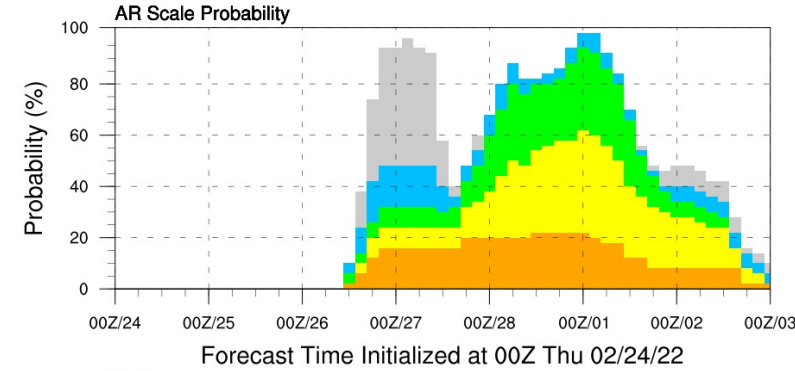
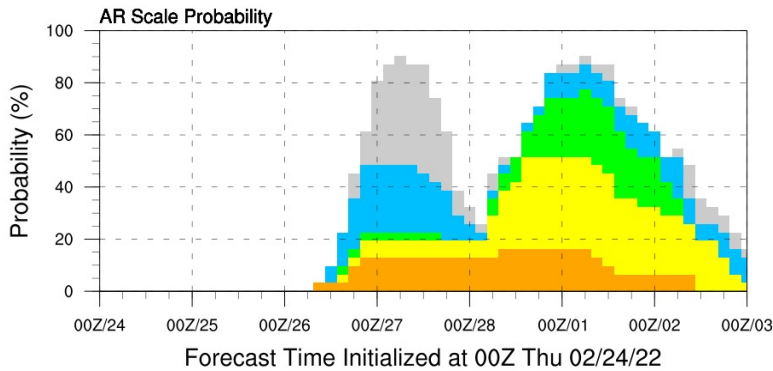
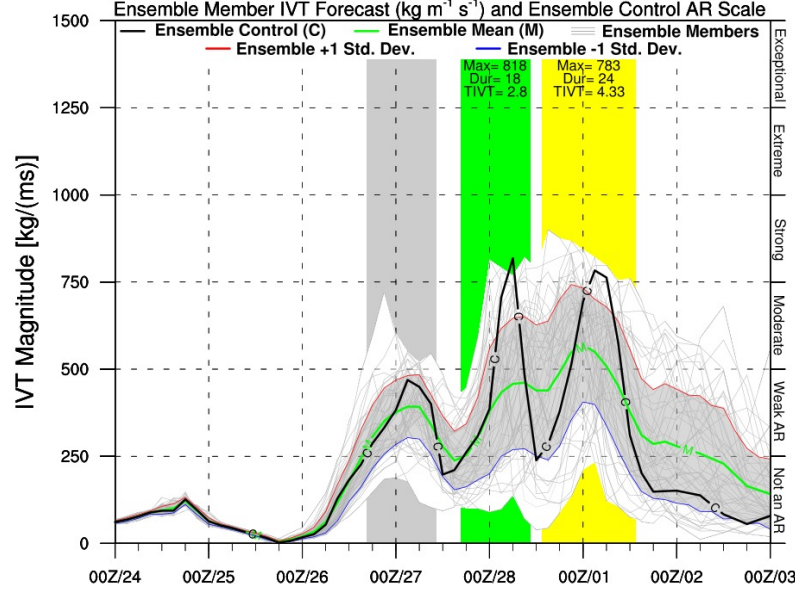
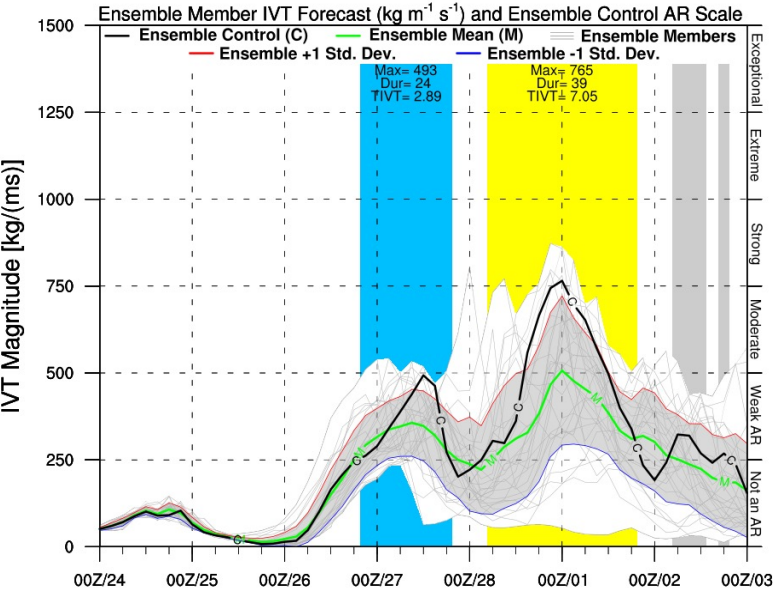


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AR Scale and IVT Forecasts: GEFS vs. ECMWF EPS

GFS Ensemble Initialized: 00Z Thu 02/24/22

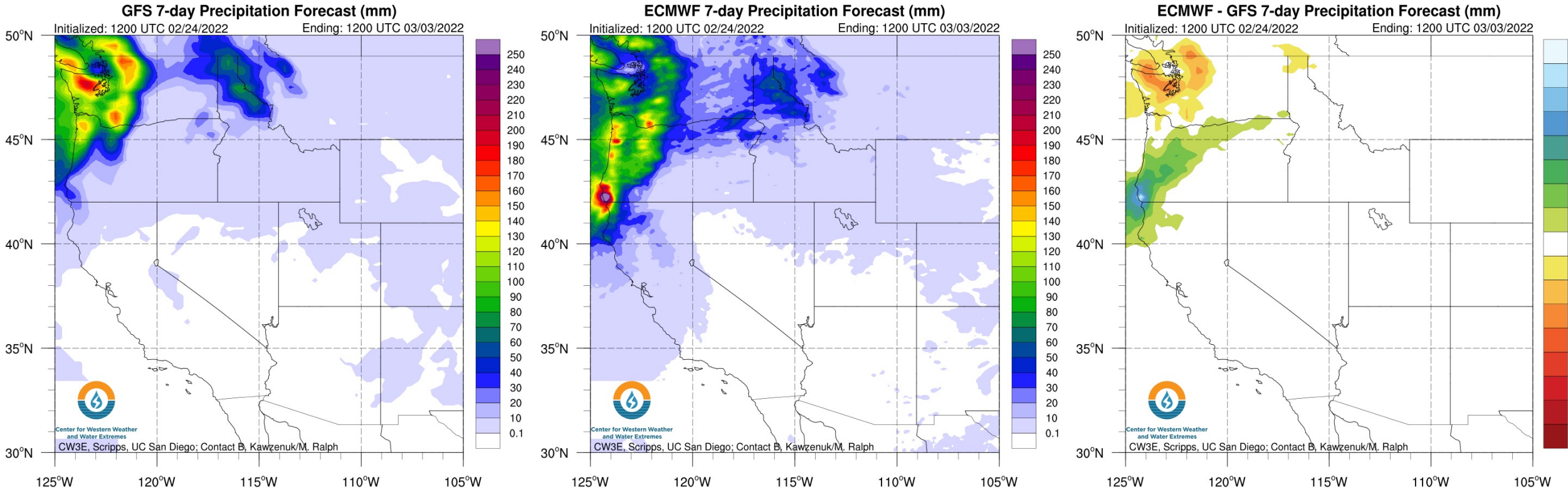
ECMWF Ensemble Initialized: 00Z Thu 02/24/22



■ AR 1 ■ AR 2 ■ AR 3 ■ AR 4 ■ AR 5

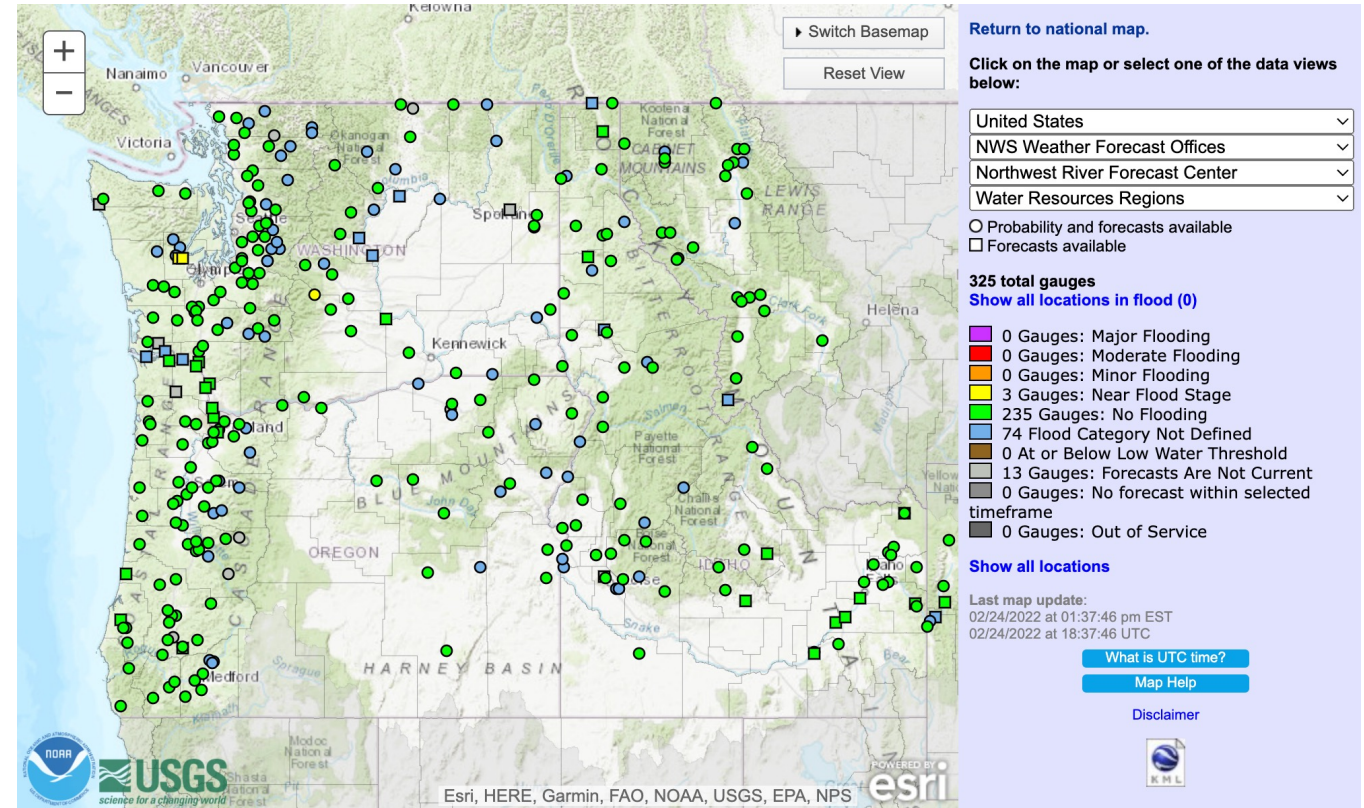
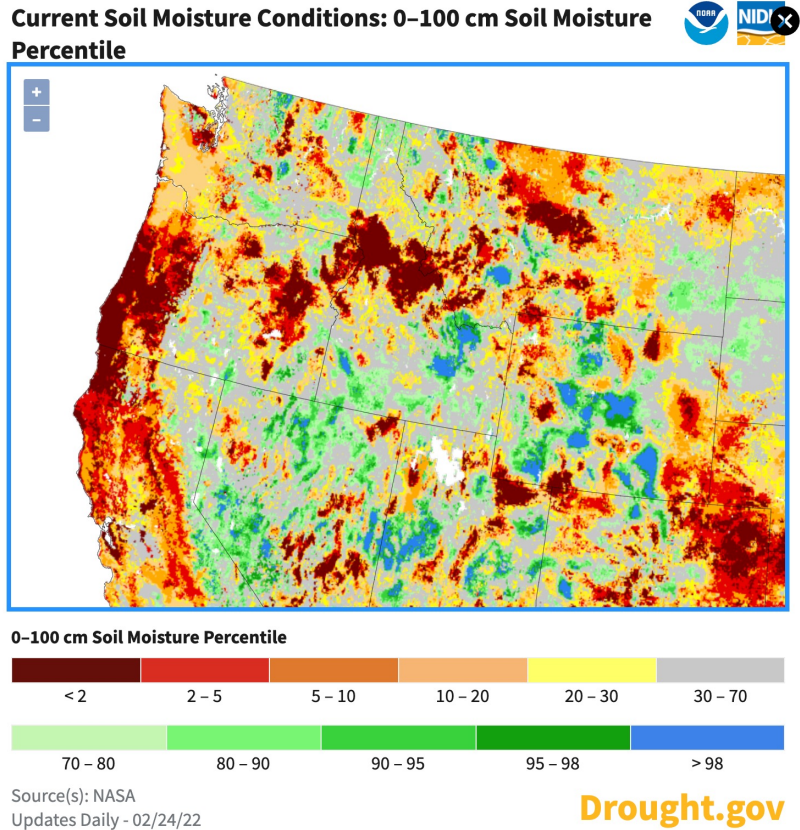
- The 00Z GEFS and ECMWF EPS control runs are both forecasting AR 3 conditions (based on the Ralph et al. 2019 AR Scale) at 43°N, 124.5°W (southwestern OR) in association with the second AR
- However, the GEFS control is forecasting a single peak in IVT around 00Z 1 Mar, whereas the ECMWF control is forecasting two distinct peaks in IVT
- The ECMWF control is also predicting a short break in AR conditions around 12Z 28 Feb
- Both ensemble systems are showing at least 50% probability of an AR 3 or AR 4 at this location

Model QPF: GFS vs. ECMWF



- Global models are showing substantial differences in forecast precipitation over the next 7 days
- These differences are primarily due to the uncertainty in the evolution of the second AR
- Compared to the 12Z GFS, the 12Z ECMWF is forecasting much higher precipitation totals over southwestern Oregon and northwestern California and lower precipitation totals over western Washington
- 7-day QPF differences are > 8 inches near the Oregon–California border
- Both models are showing the potential for more than 5 inches of precipitation in some areas

Hydrologic Impacts



- Due to the lack of recent precipitation, soils are anomalously dry along the US West Coast, especially in southwestern Oregon
- Widespread flooding is not anticipated, despite the possibility of heavy rainfall in portions of western Washington and Oregon