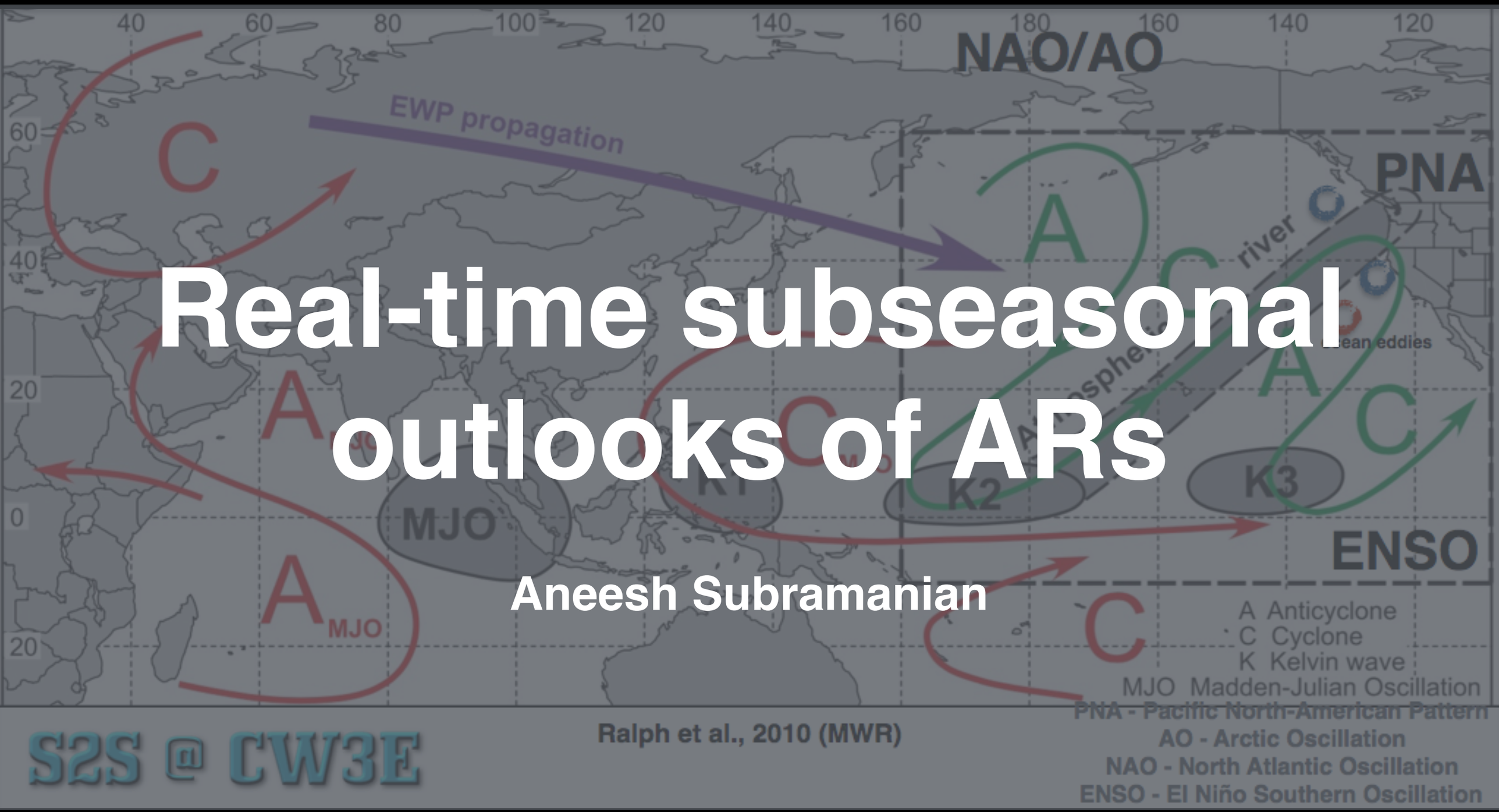


Real-time subseasonal outlooks of ARs

Aneesh Subramanian

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

Week-3 AR Outlooks @ CW3E

PI : Marty Ralph

CW3E S2S Advisory Panel: Marty Ralph (Chair), Dan Cayan, Duane Waliser, Bruce Cornuelle, Art Miller, Elizabeth Barnes

CW3E-SIO Team: Aneesh Subramanian (Lead), Sasha Gershunov, Zhenhai Zhang, Kristen Guirguis, Will Chapman, Tamara Shulgina, Anna Wilson, Minghua Zheng, Brian Kawzenuk

External CW3E collaborators:

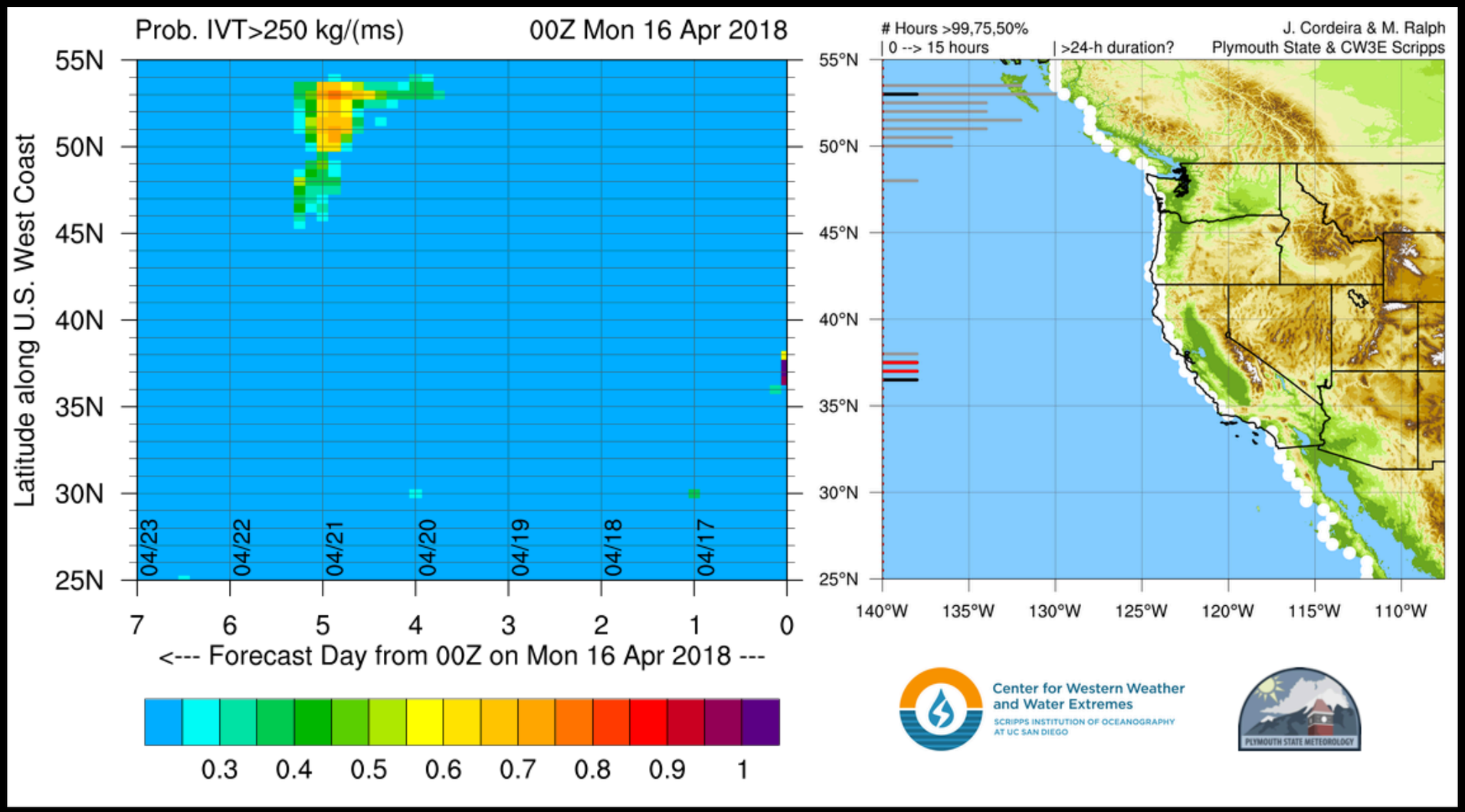
JPL: Duane Waliser, Bin Guan, Mike DeFlorio, Alex Goodman

PSU: Jay Cordeira

CSU: Elizabeth Barnes, Kyle Nardi

Data and collaborations from WCRP / WWRP S2S Project

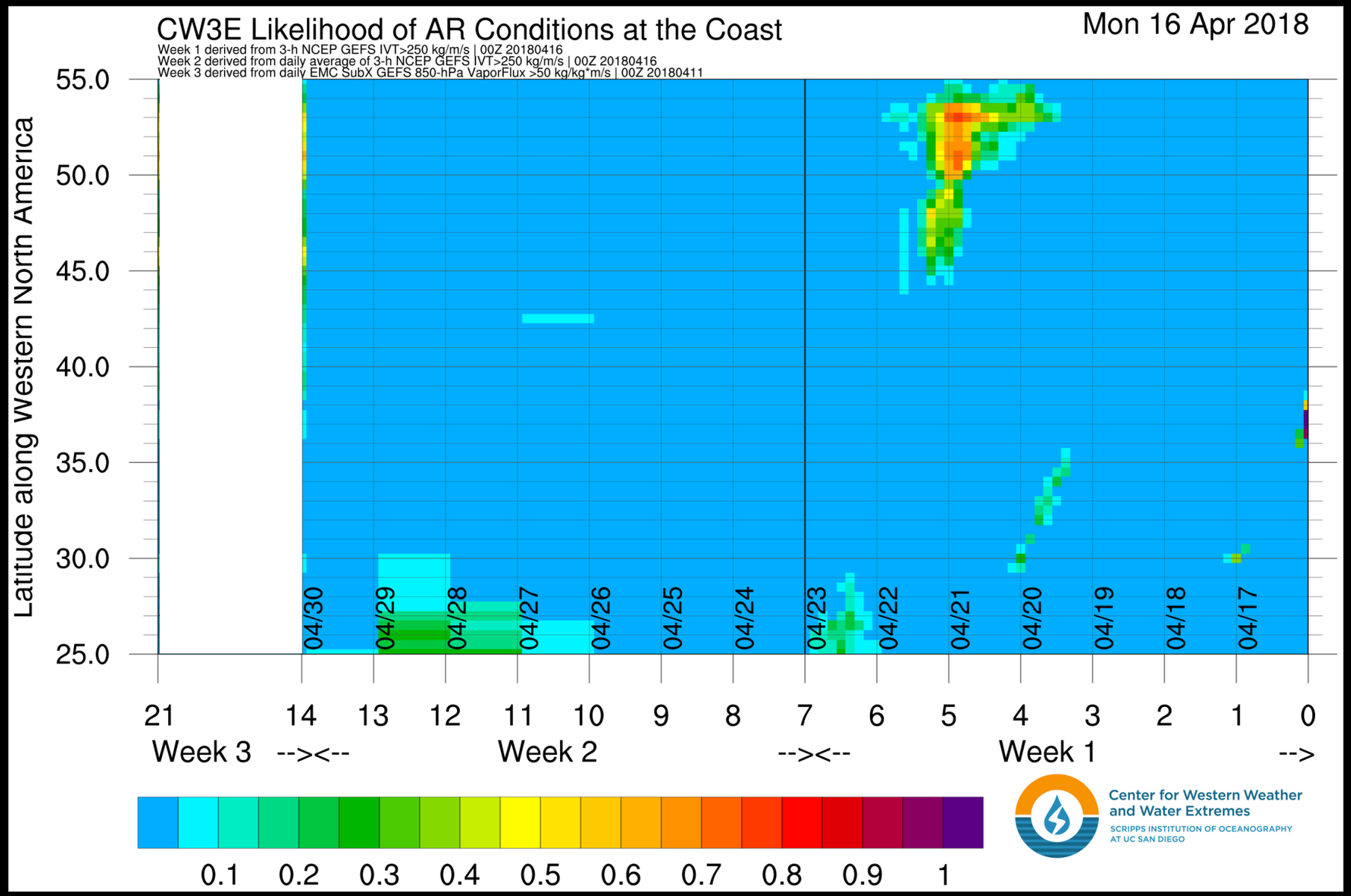
AR Landfall Tool for week-1



3 hourly probability values for IVT > 250 kg/m/s

J. Cordeira, M. Ralph et al.

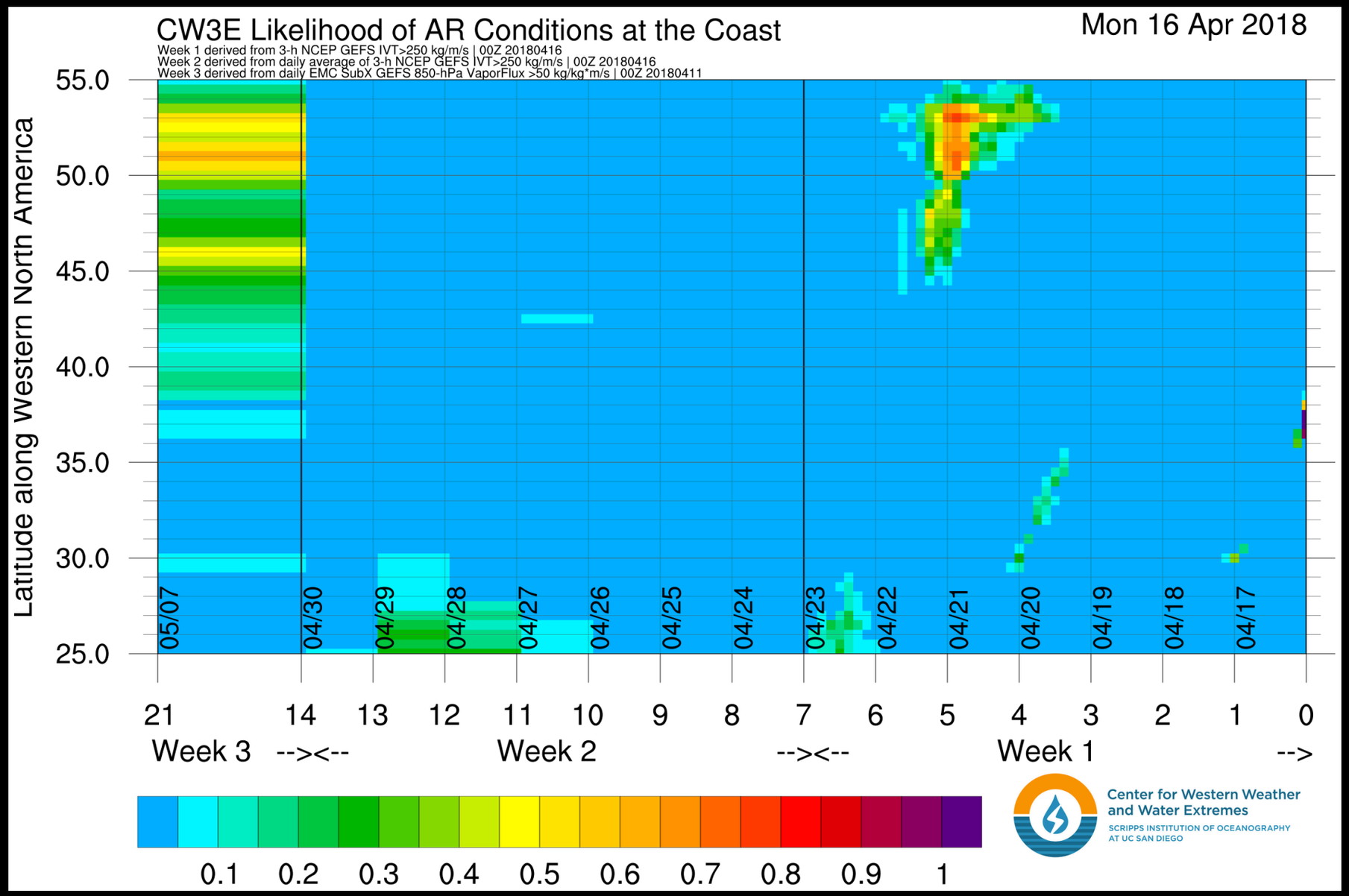
AR Landfall tool extended to week-2



Daily probability values for IVT > 250 kg/m/s in week-2

J. Cordeira, M. Ralph et al.

AR Landfall tool extended to week-3



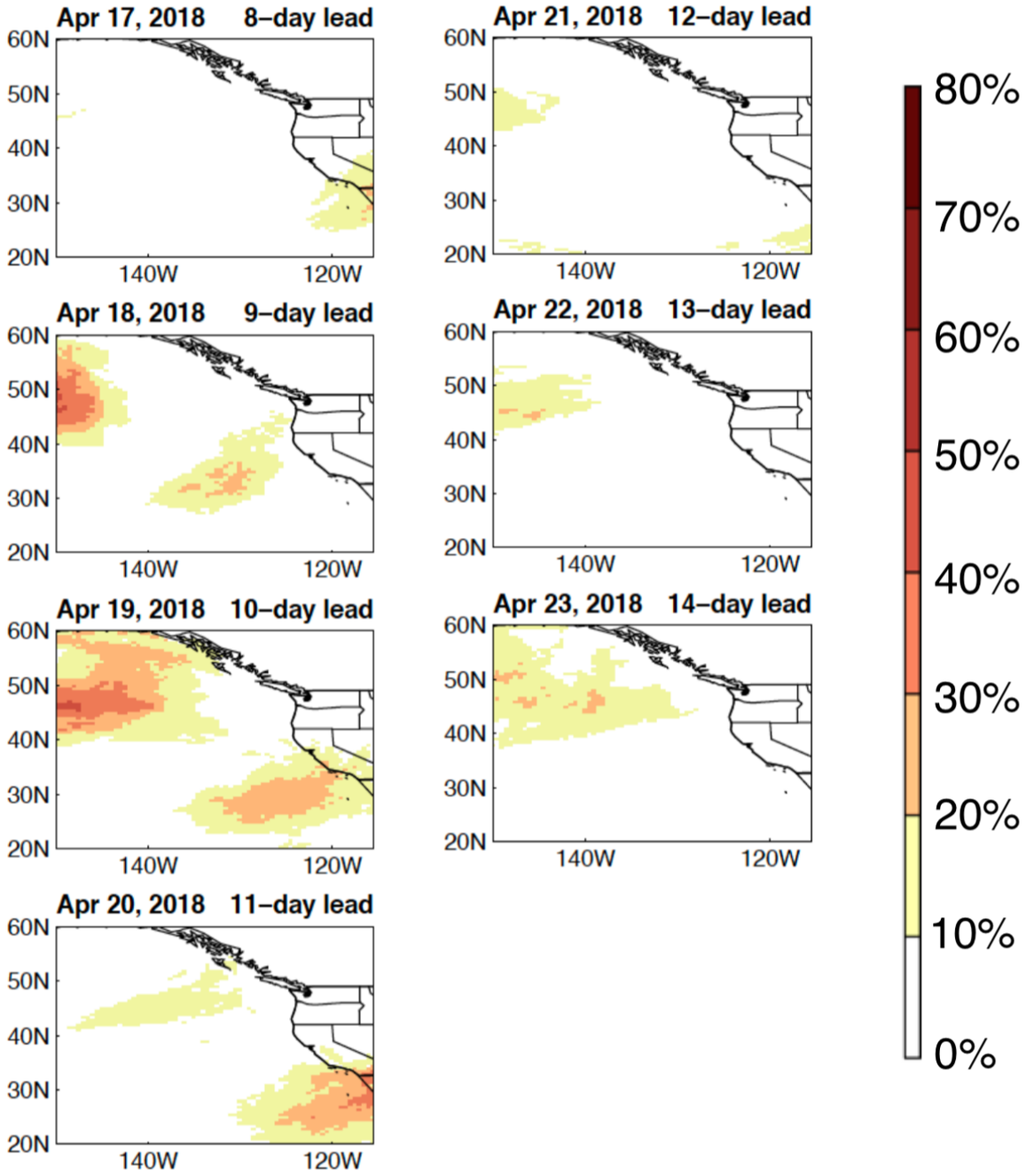
Weekly probability values for IVT > 250 kg/m/s in week-3

J. Cordeira, M. Ralph et al.

AR Probability maps: week-2

EXPERIMENTAL AR FORECAST

April 9, 2018 forecast: probability of AR occurrence during week- 2



Week-2

(8-day to 14-day lead)

ECMWF : 51 ensemble members

Experimental AR forecast issued on Monday, April 9, 2018 by M. DeFlorio, A. Goodman, D. Waliser, B. Guan, A. Subramanian, and M. Ralph using 51-member real-time ECMWF data for an Experimental AR Forecasting Research Activity sponsored by California DWR

Jet Propulsion Laboratory
California Institute of Technology

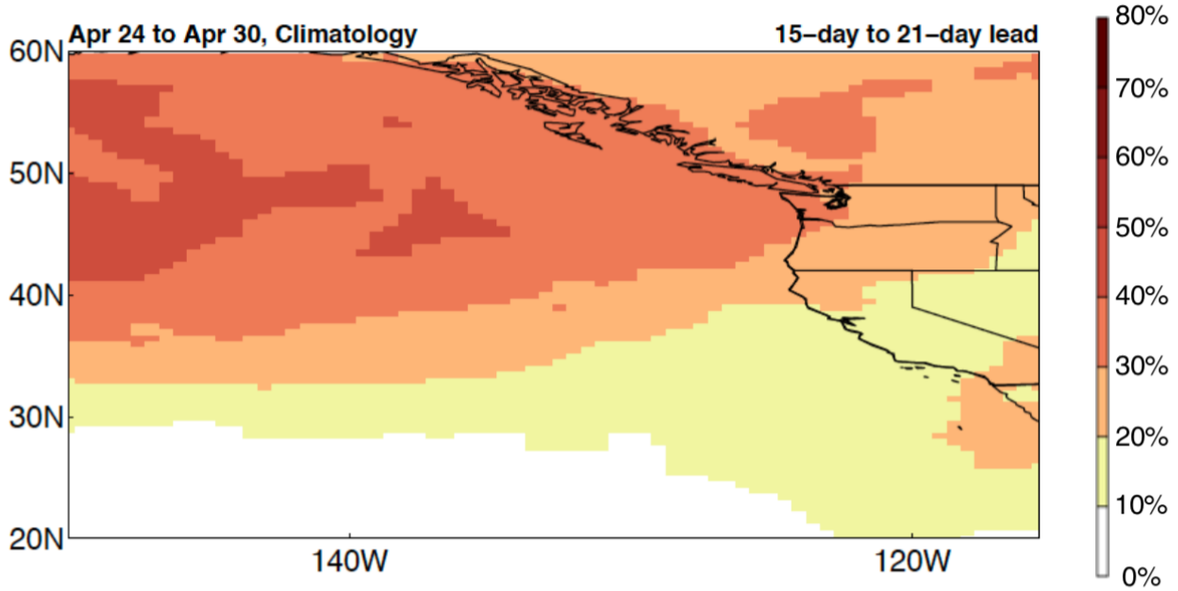
Center for Western Weather and Water Extremes

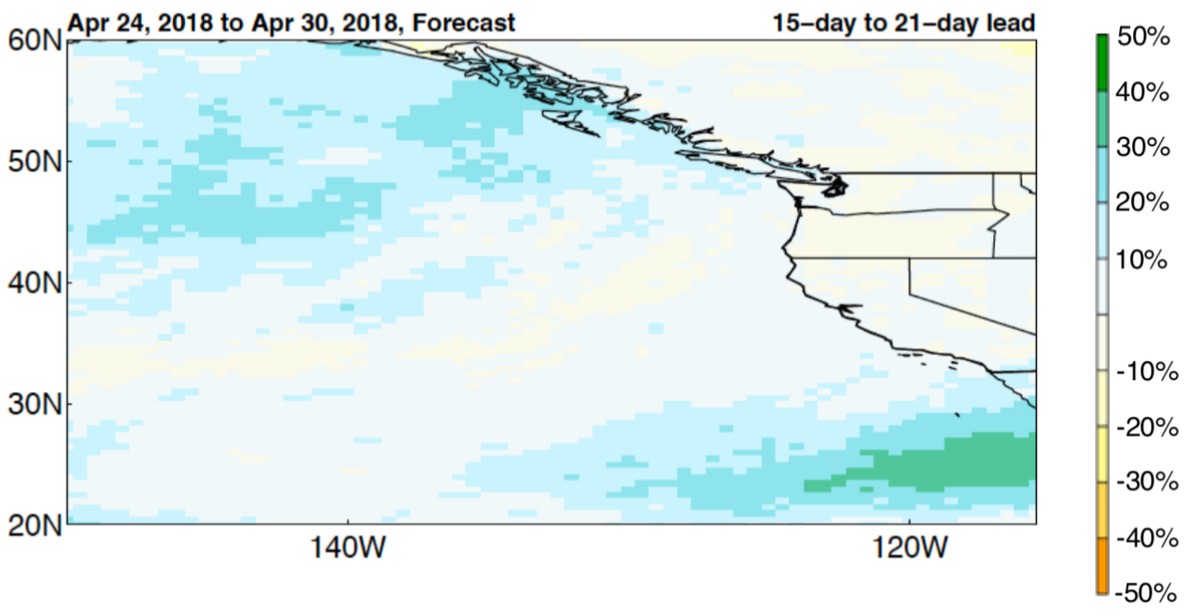
Contact: M. DeFlorio
(michael.deflorio@jpl.nasa.gov)

AR Probability maps: week-3

EXPERIMENTAL AR FORECAST

April 9, 2018 forecast: probability of AR occurrence during week-3
(chance of an AR occurring at any time during week-3)





Week-3

(Combined 15-day to 21-day lead)

Top row: hindcast climatology (ECMWF 1996-2015 data)
Bottom row: real-time forecast minus climatology (ECMWF 51-member ensemble)

Experimental AR forecast issued on Monday, April 9, 2018 by M. DeFlorio, A. Goodman, D. Waliser, B. Guan, A. Subramanian, and M. Ralph using 51-member real-time ECMWF data for an Experimental AR Forecasting Research Activity sponsored by California DWR

Jet Propulsion Laboratory
California Institute of Technology

Center for Western Weather and Water Extremes

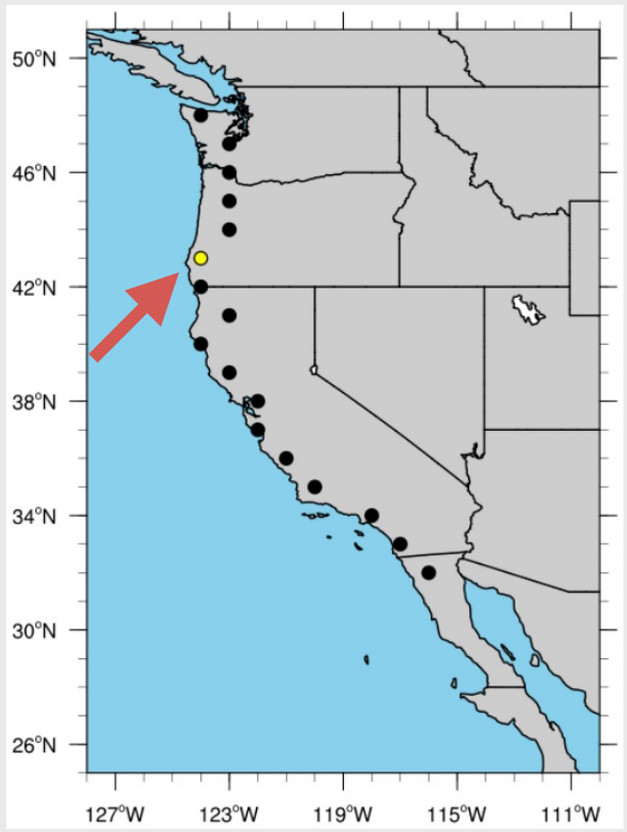
Contact: M. DeFlorio
(michael.deflorio@jpl.nasa.gov)

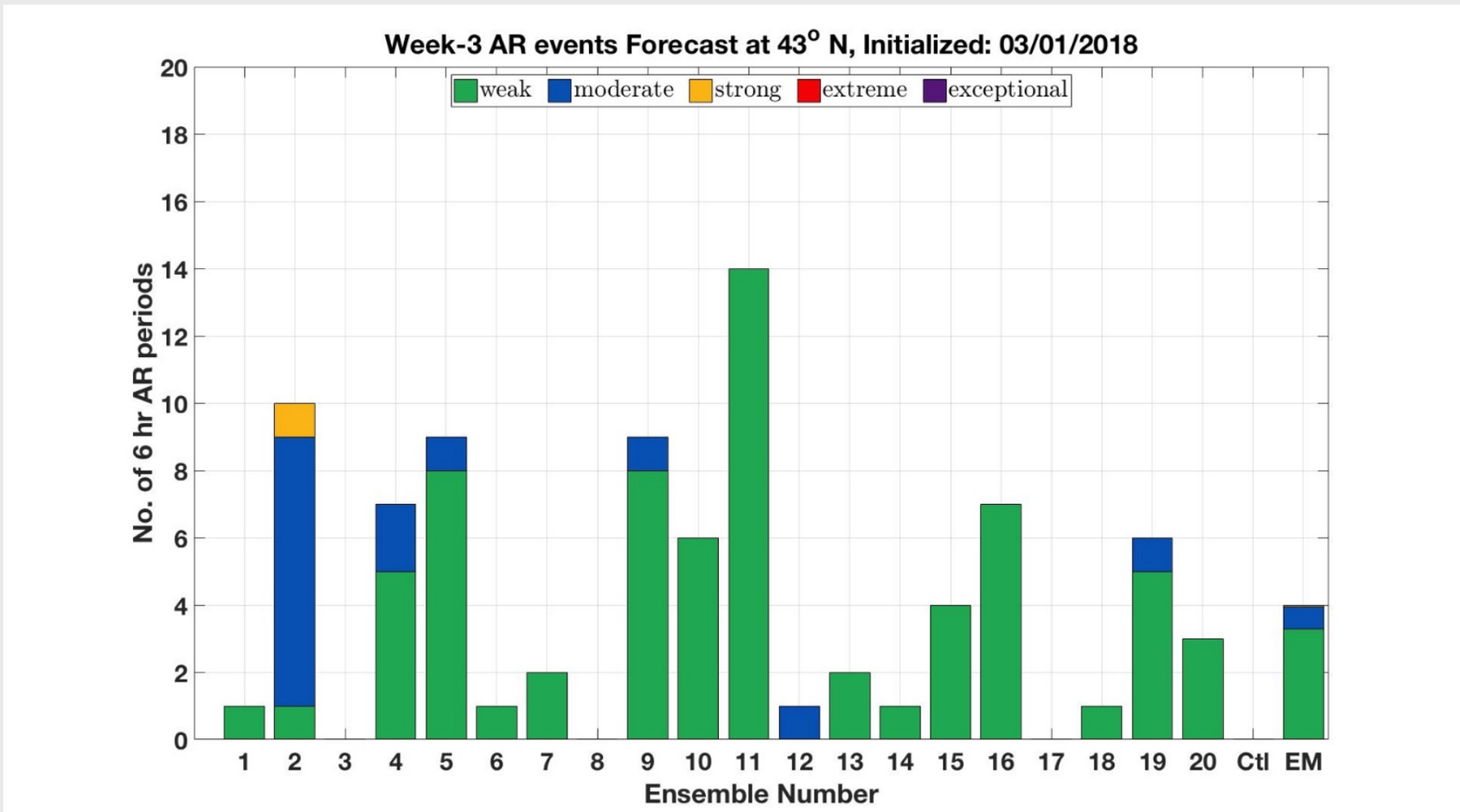
Week-3 AR Activity (6 hr periods)

Env. Canada subseasonal forecast of ARs

Location: 43°N, 124°W

AR Scale defined as Ralph et al., (2018)





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A. Subramanian, Z. Zhang, M. Ralph et al.

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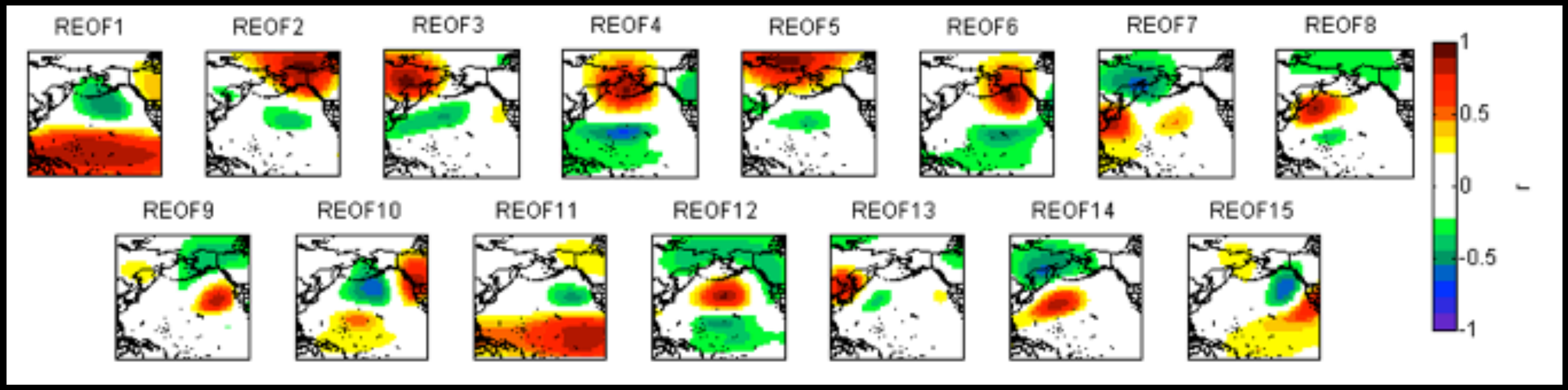
AR Probability: Statistical Forecasts

*Circulation Anomaly Patterns
*1949-2017, Nov-Feb
*Identified using Rotated Principal Components Analysis

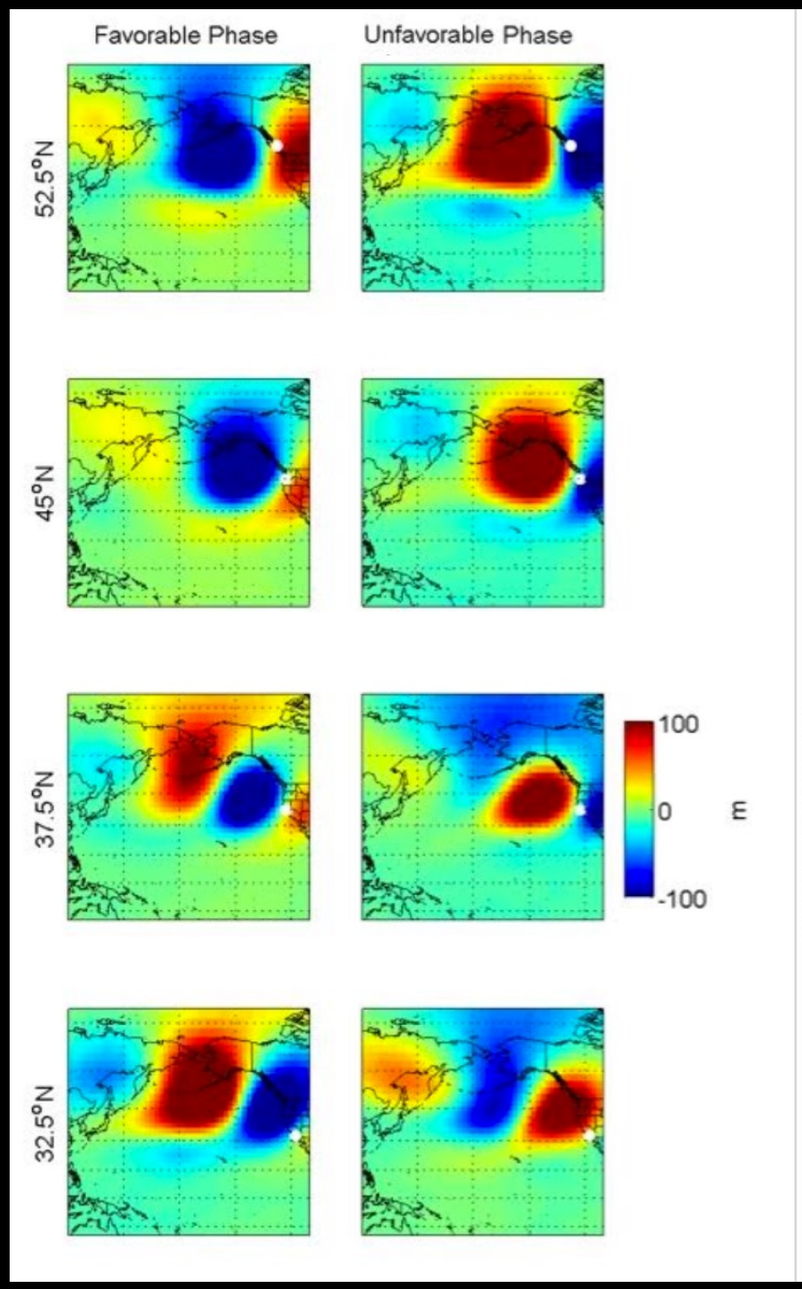


How do these weather patterns interact to modulate Landfalling ARs along the US West Coast?

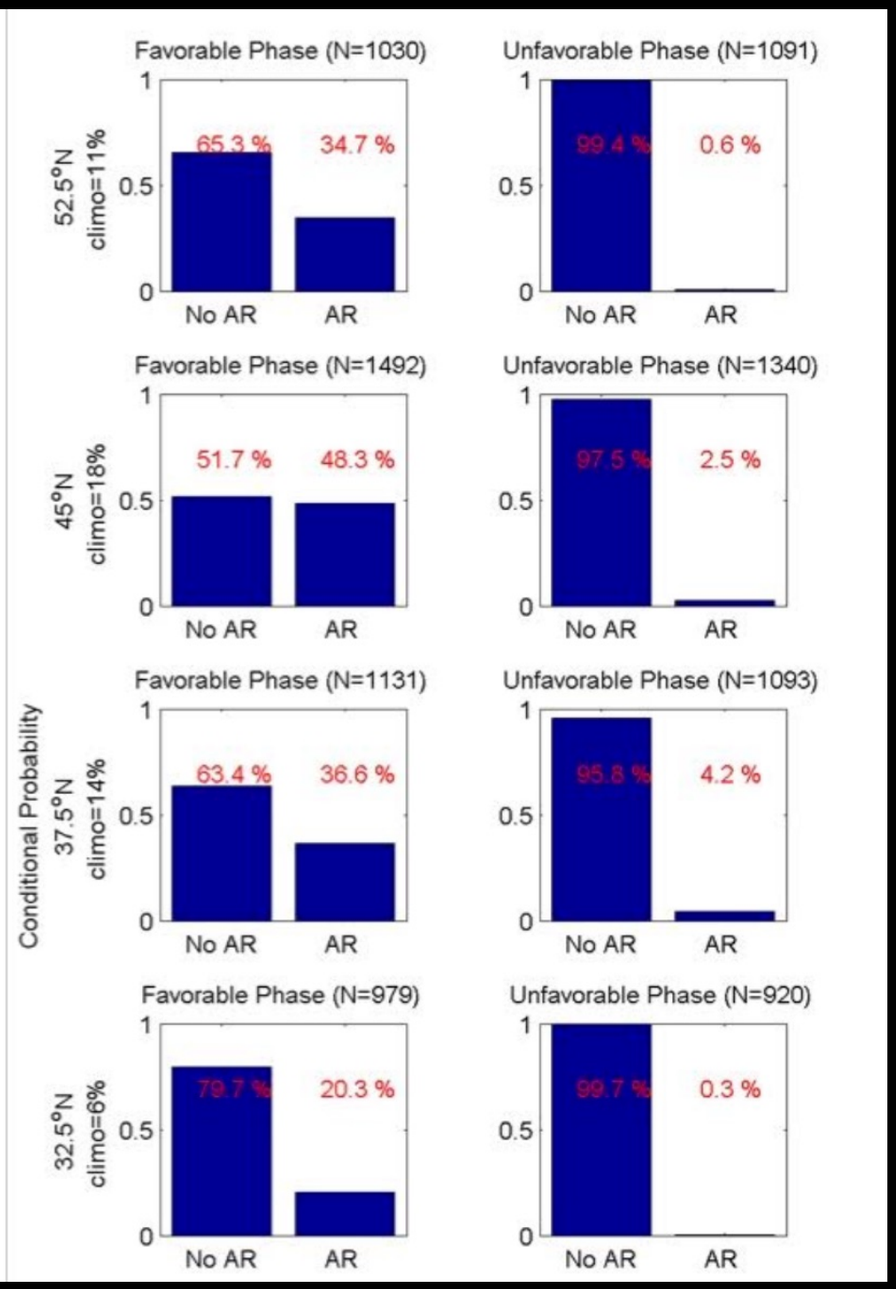
Kristen Guirguis, Sasha Gershunov et al.

Conditional Probabilities associated with the Favorable and Unfavorable Phase

500 mb GPH mode

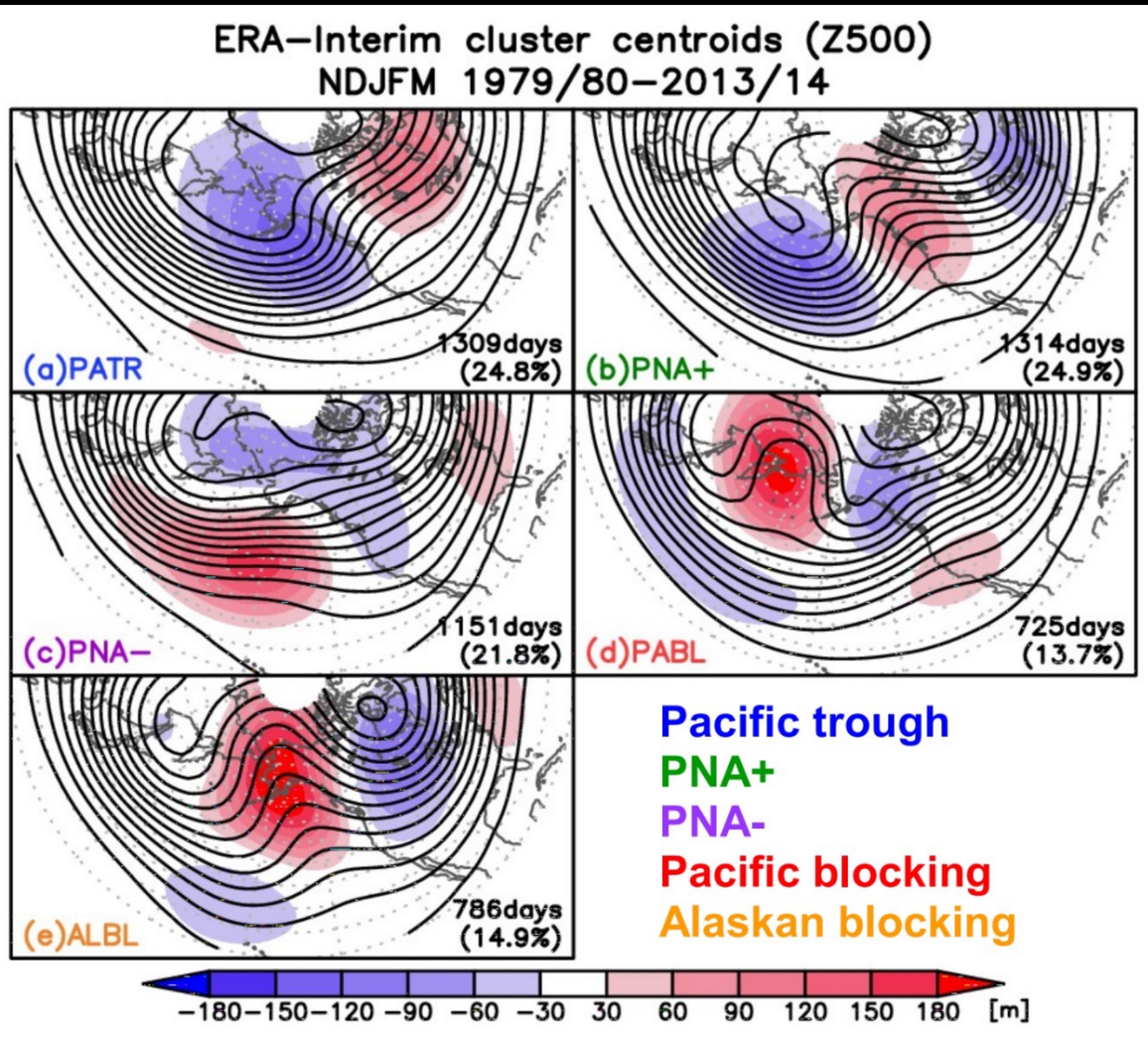


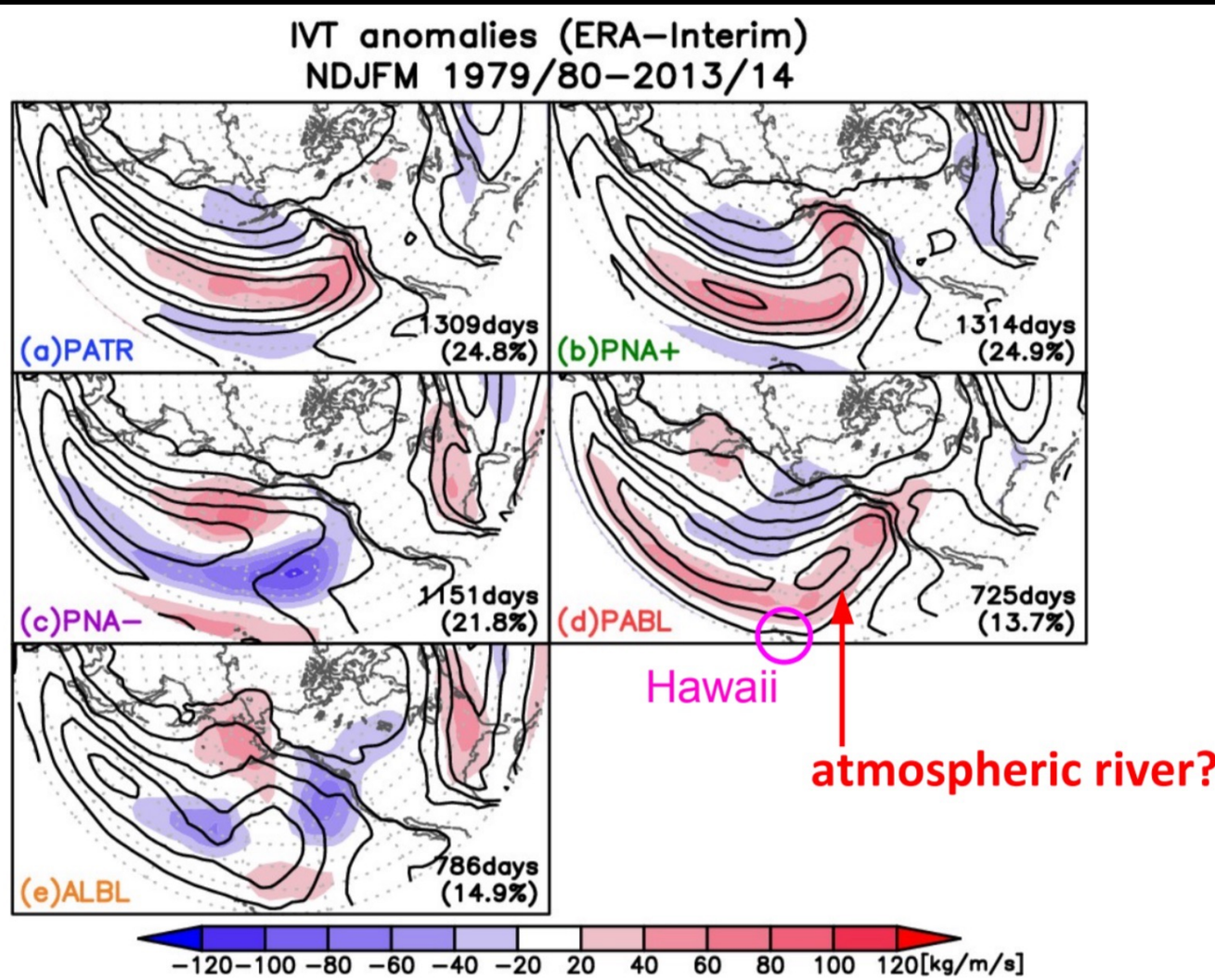
AR occurrence probabilities



Kristen Guirguis, Sasha Gershunov et al.

Weather regimes: precursors to ARs?





Aneesh Subramanian, Mio Matsueda (Univ. of Oxford), Marty Ralph

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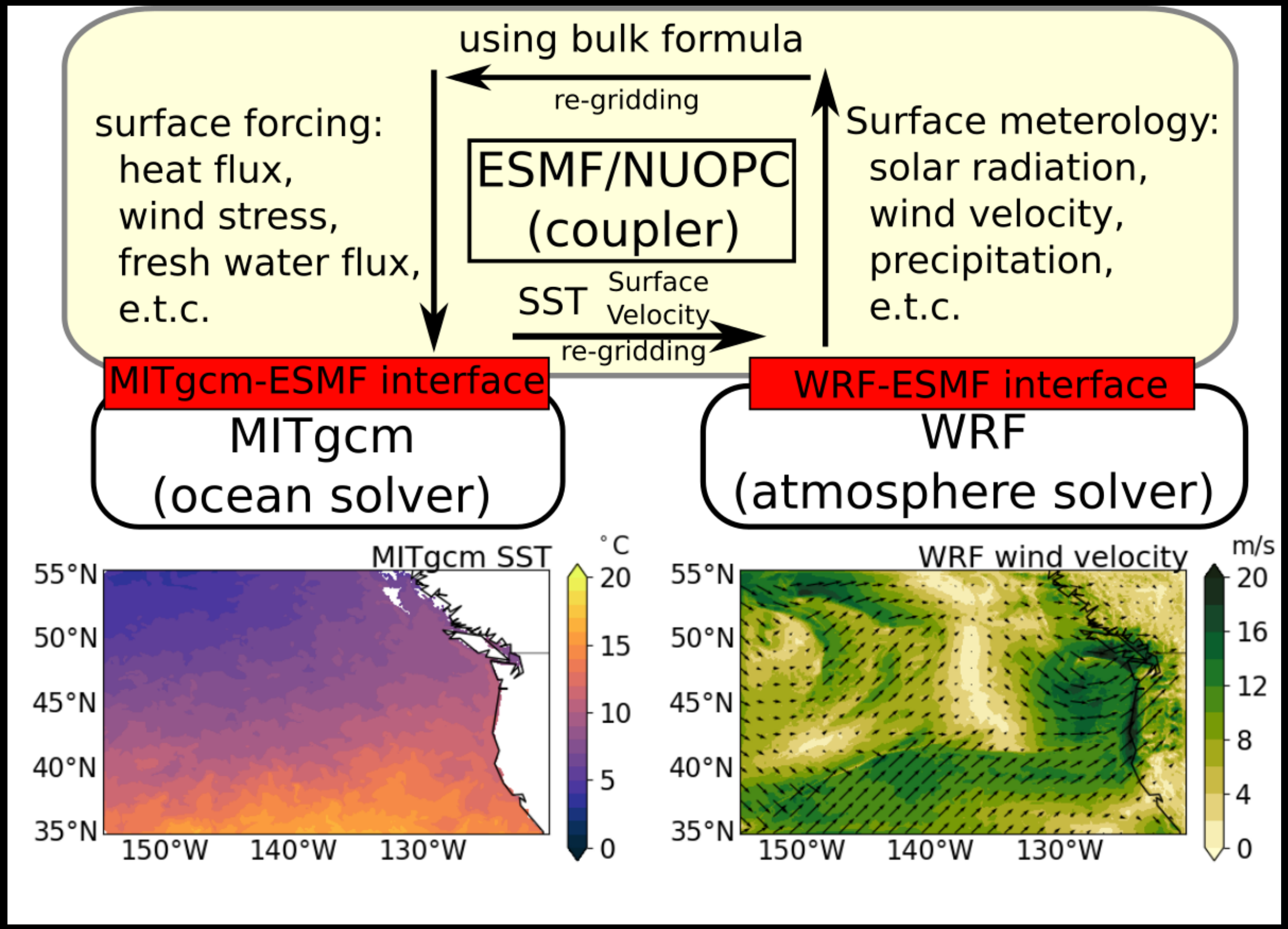
Developing a regional coupled model for AR science and prediction

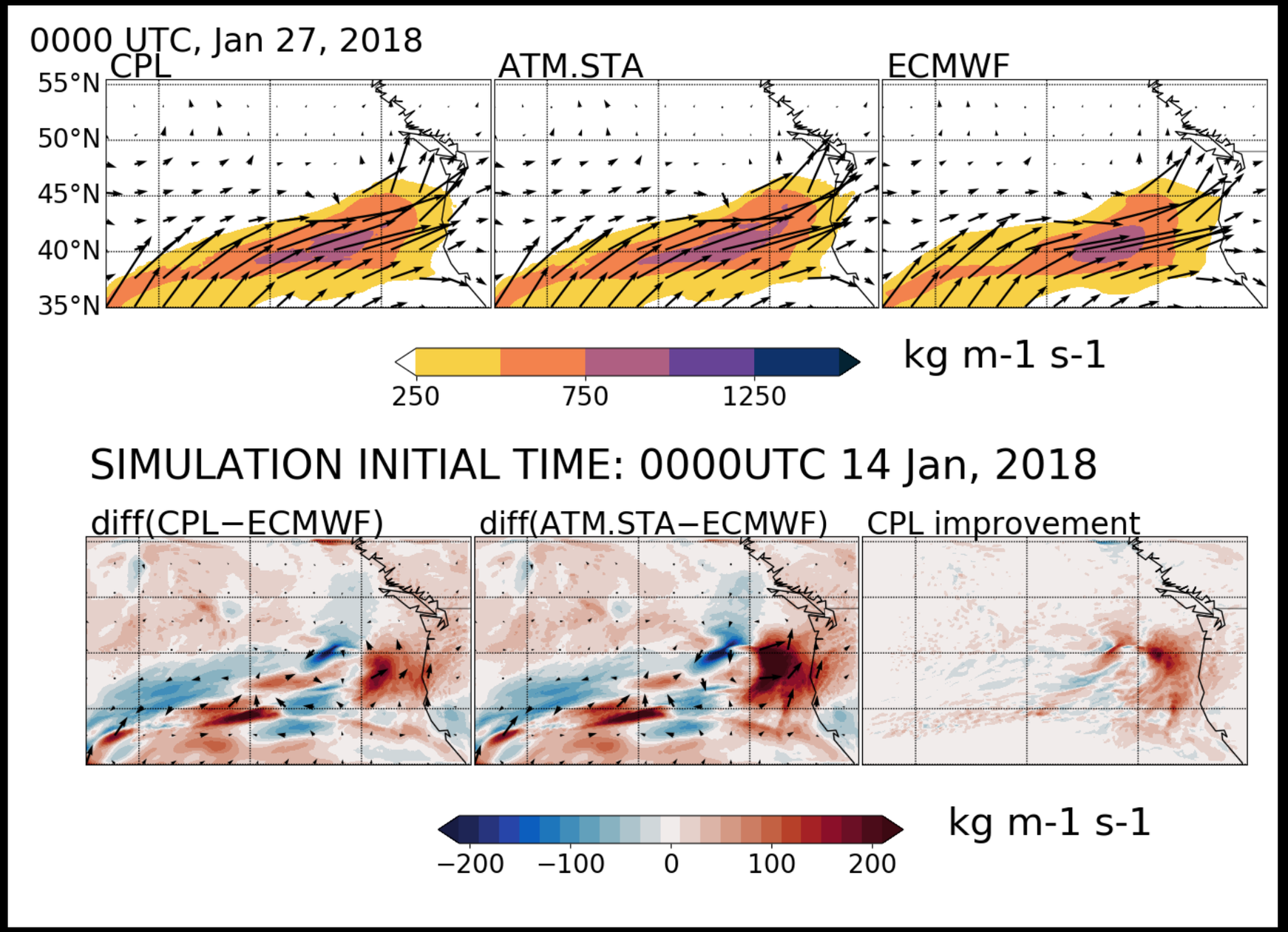
Rui Sun[1], Aneesh Subramanian[1], I. Hoteit[2], Art Miller[1],
Matt Mazloff[1], G. Gopalakrishnan[1], Bruce Cornuelle[1], Marty Ralph[1]

See Poster by Rui Sun

Code Implementations

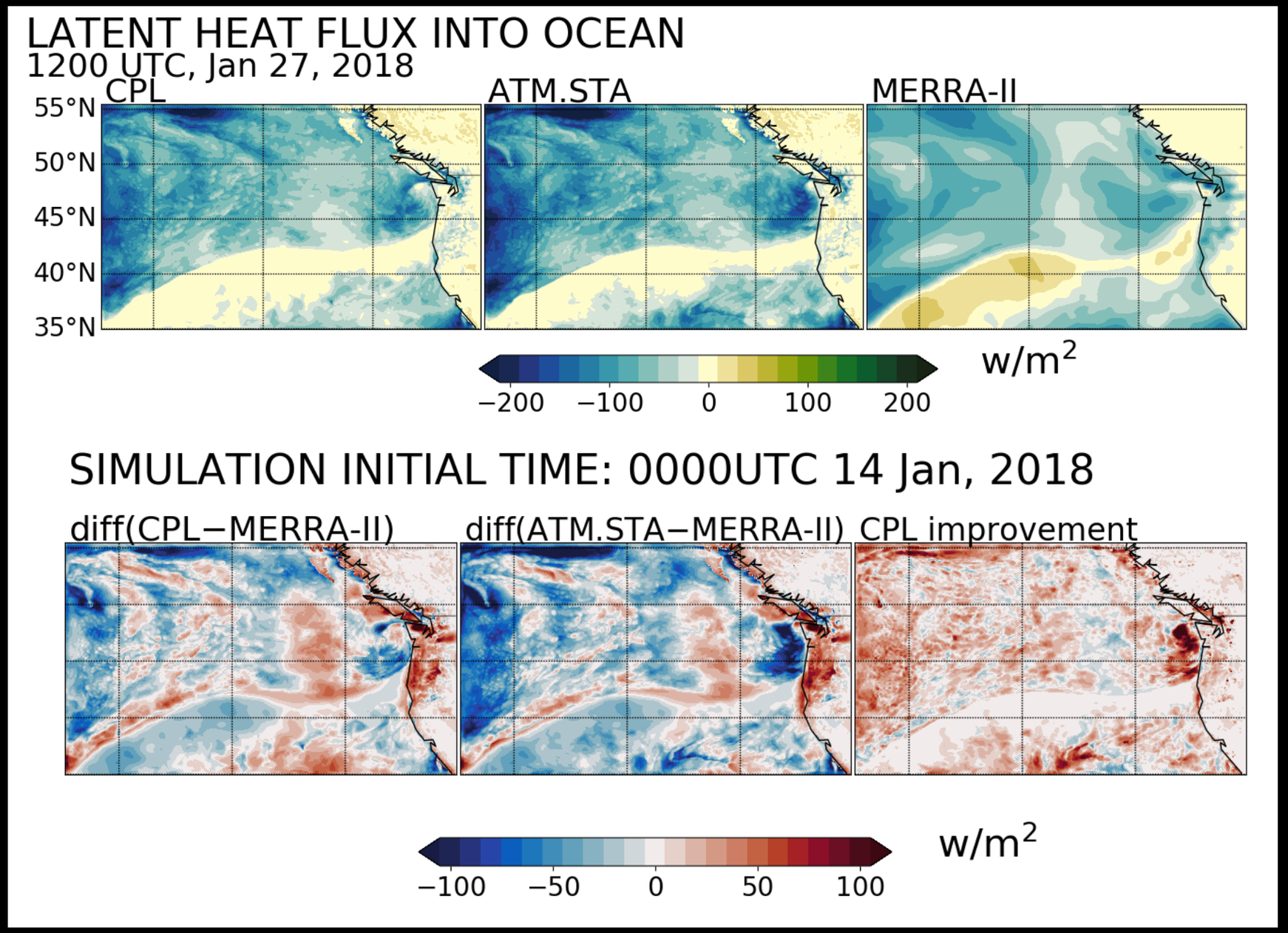


Results: AR forecast for Jan 2018



Comparison of the integrated vapor transport (IVT) during the AR events obtained by the simulations and the ECMWF ERA-5 data.
The simulation initial time is 0000UTC 14 Jan, 2018.

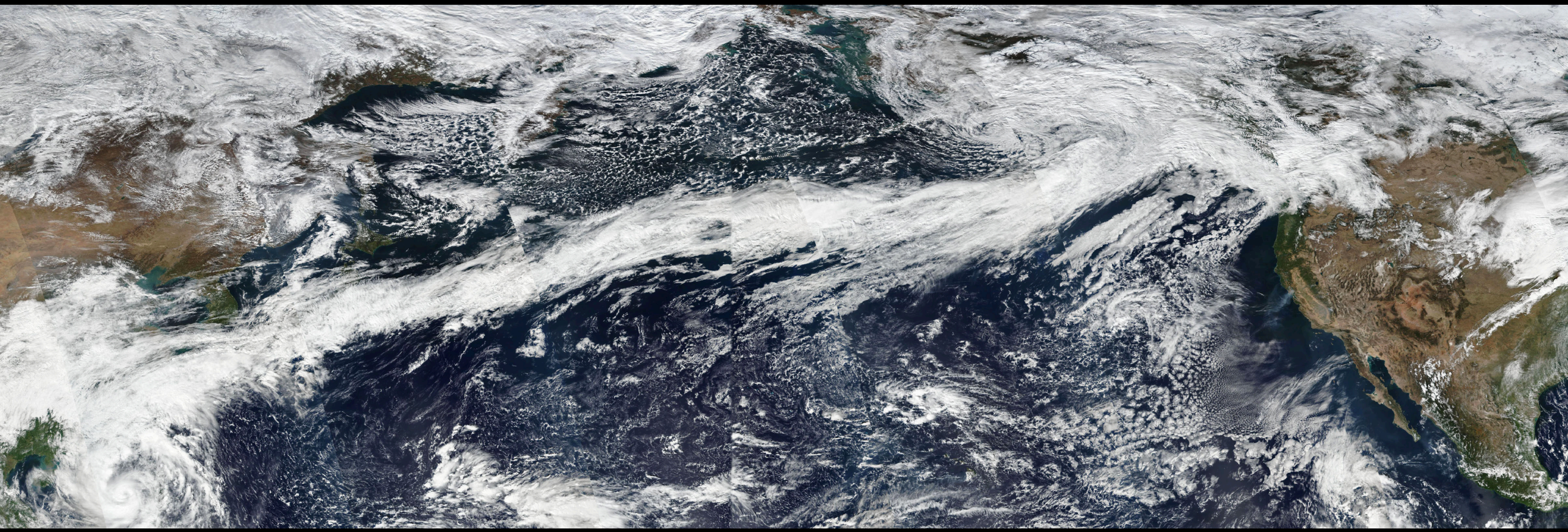
Results: AR forecast for Jan 2018



Comparison of the latent heat into the ocean during the AR events obtained by the simulations and the MERRA-II data.
The simulation initial time is 0000UTC 14 Jan, 2018.

Key Results

- Developed tools and metrics for AR outlooks
- Evaluating the skill of the metrics developed
- Experimental week-3 AR outlooks will be available after the review is successful
- Future research work on improving these forecasts by identifying sources of S2S predictability and helping inform on model improvements based on these findings



source: earth observatory @ NASA

Thank You

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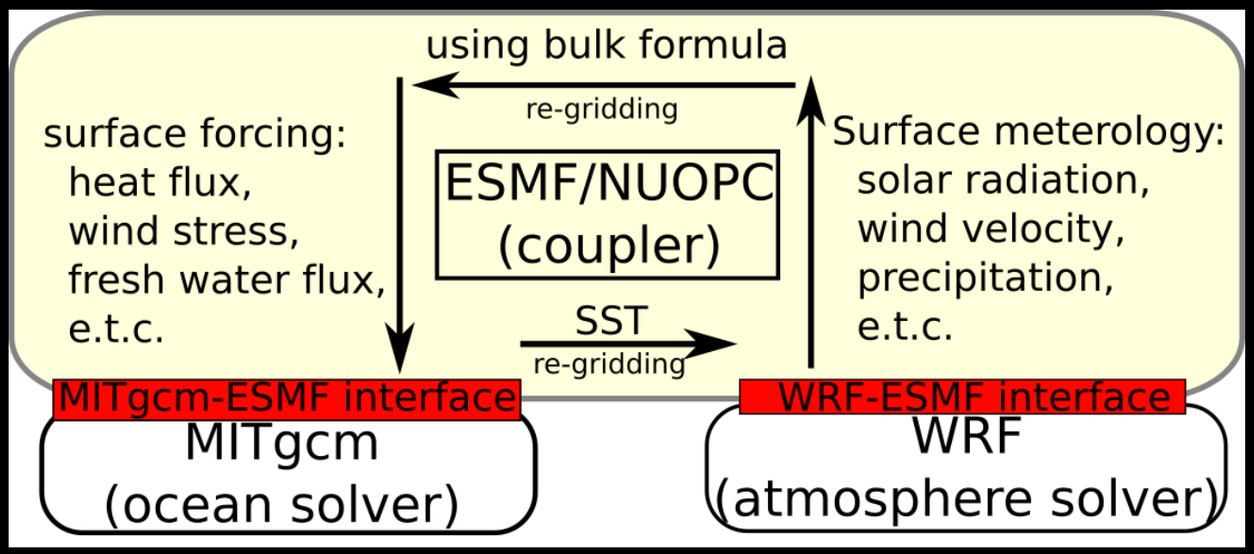
Experiment Design

- Three simulations
  - Two atmospheric river events in East Pacific (Jan 27th and 29th)
  - Simulation initial time: Jan 01/14/21/25/27, 2018
  - Simulation end time: Feb 01, 2018
  - Simulation lead time: 14 days (for IOP 2)
- Simulations:
  - Run 1: OCN.STA (stand-alone ocean)
    - MITgcm uses atmospheric forcing from NCEP global models
  - Run 2: ATM.STA: (stand-alone atmosphere)
    - WRF uses constant SST field as bottom B.C.
  - Run 3: CPL (coupled ocean—atmosphere simulation)
    - Two-way coupled simulation
    - MITgcm uses atmospheric forcing from WRF
    - WRF uses SST and surface ocean velocity from MITgcm

Coupled ocean—atmosphere modeling of AR events

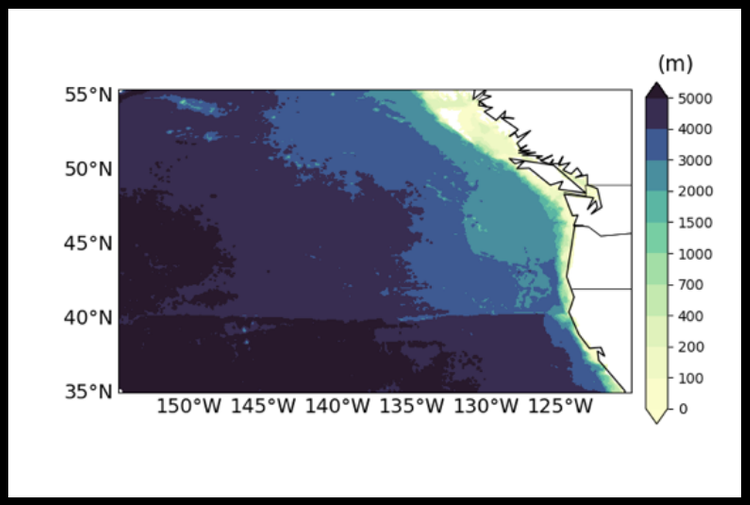
Developing the coupled model



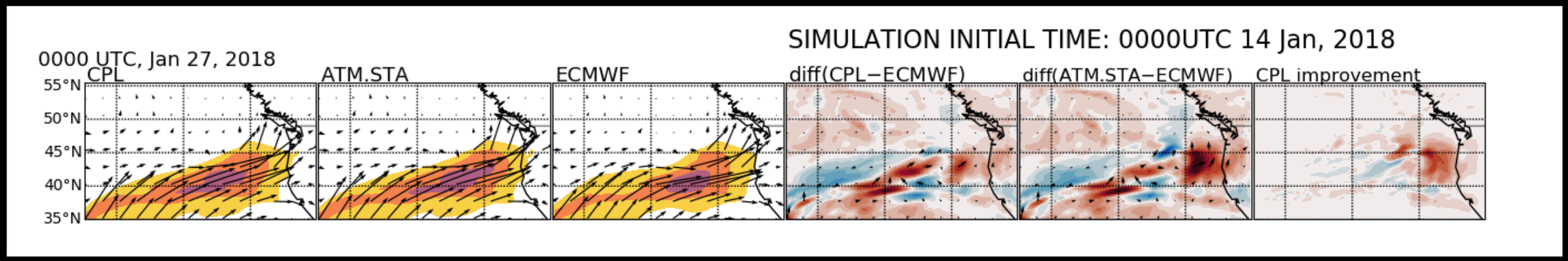
Experiment design:

- Simulation initial time: Jan 14 2018
- Simulation length: 15 days
- CPL run v.s. stand-alone runs

Simulation domain:



Comparison of the results:



On-going work

Linear Inverse Models for IVT

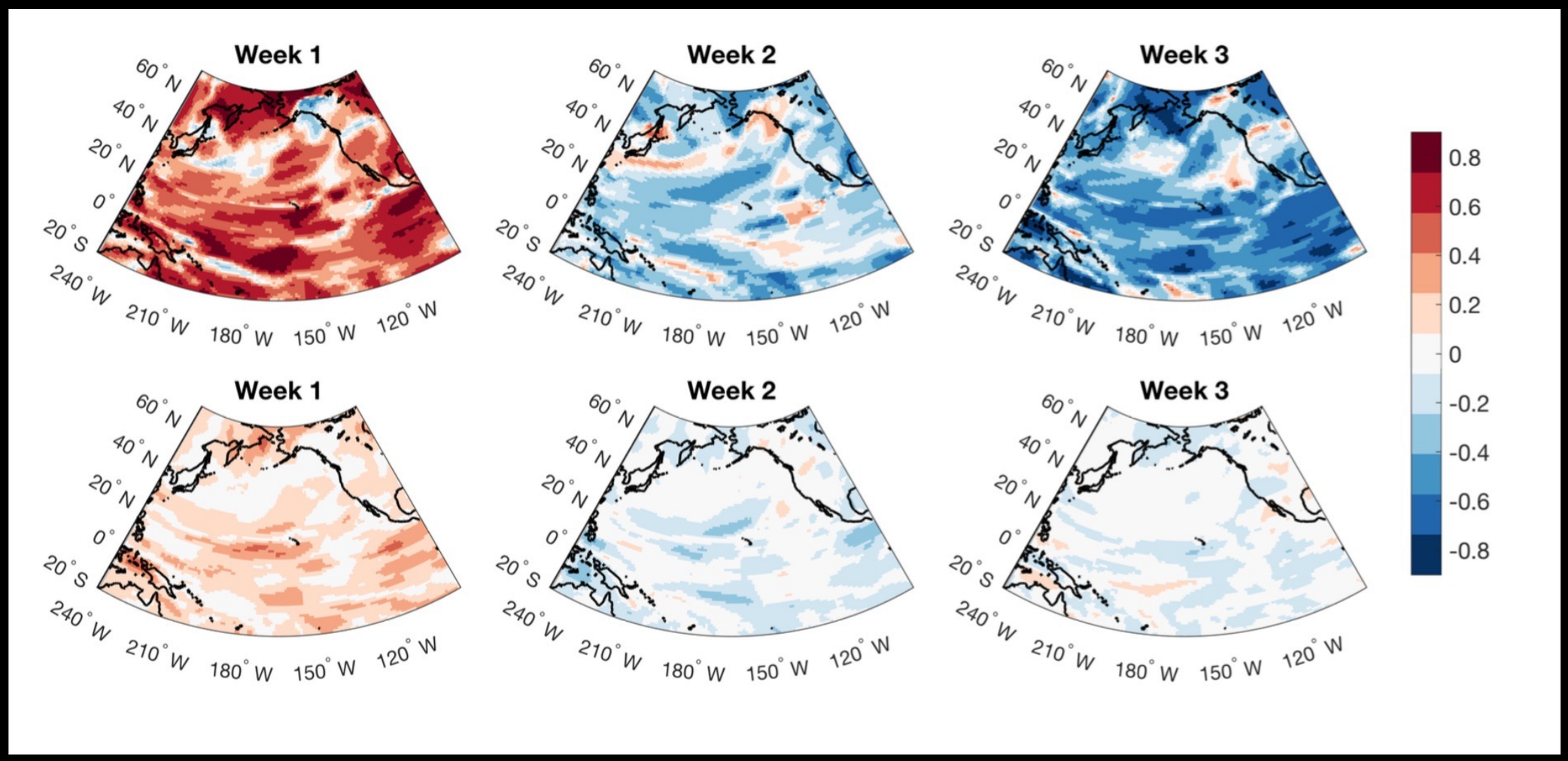
$$\frac{dx}{dt} = Ax + \xi$$

$$B(\tau) = exp(A\tau) = [\frac{C(\tau_0)}{C(0)}]^{\frac{\tau}{\tau_0}}$$

$$\hat{x}(t+\tau) = B(\tau)x(t)$$

LIM

Pers.



Anomaly Correlation Coefficient

Daniela F. Dias

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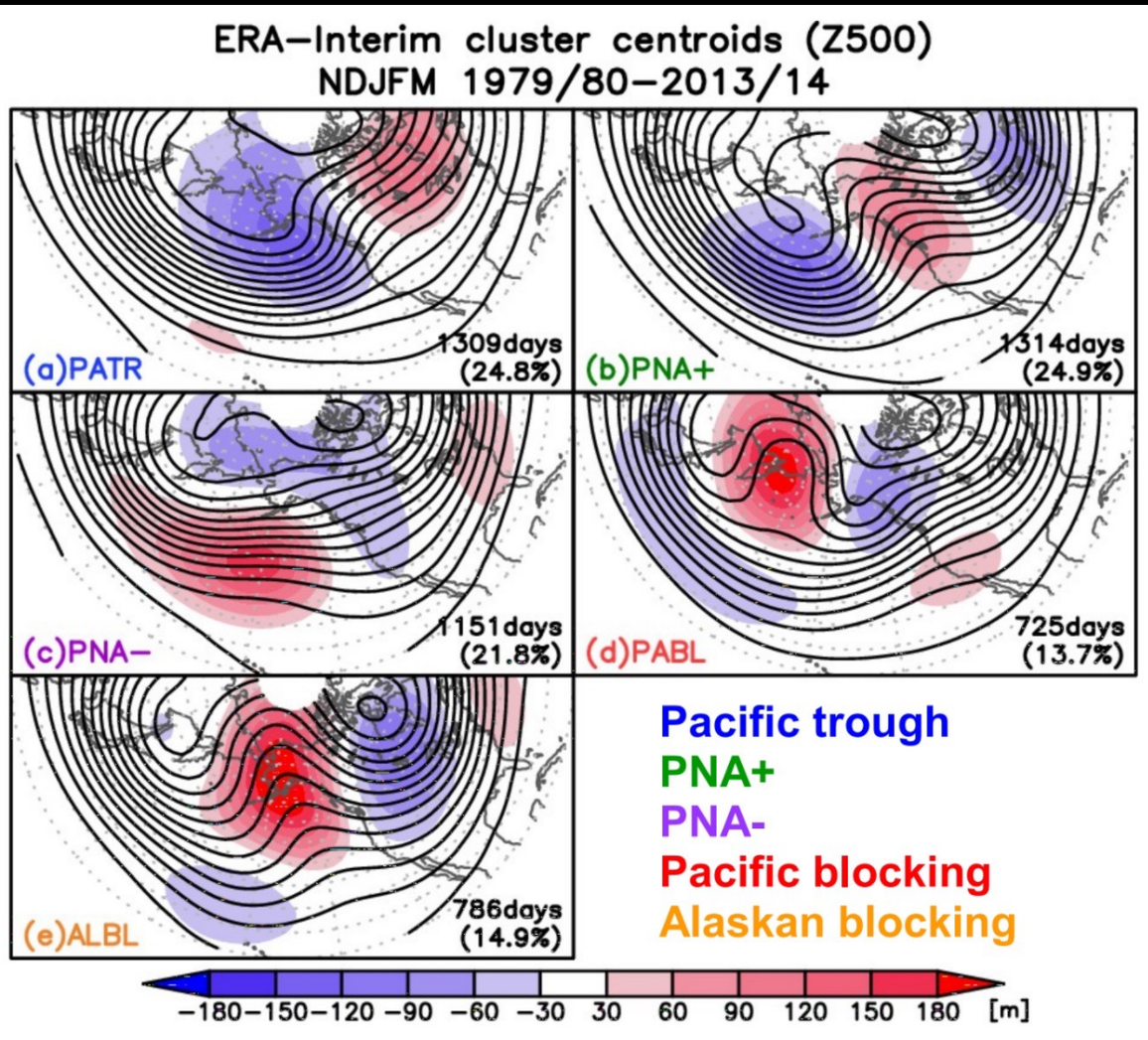
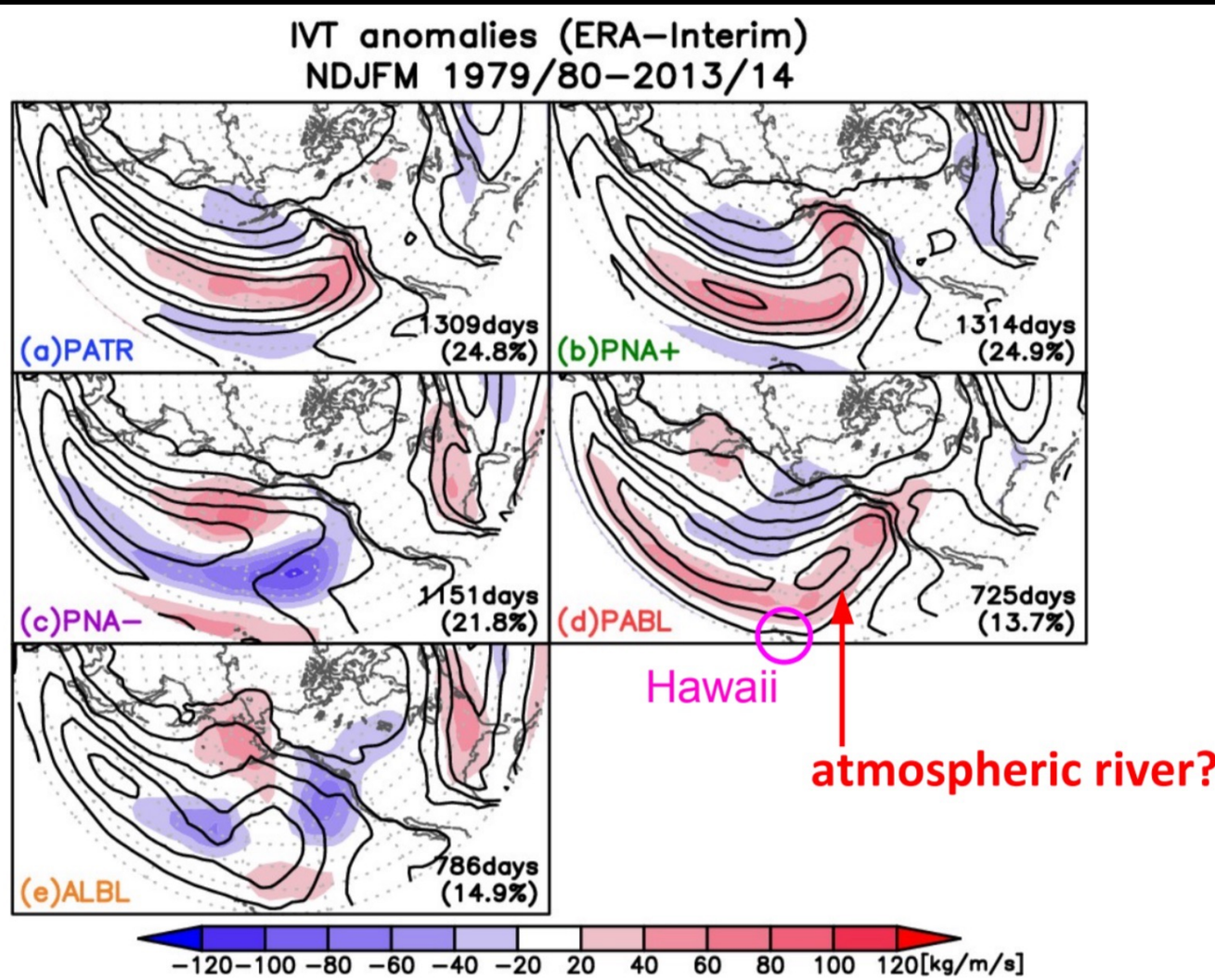
Weather regimes: precursors to ARs?





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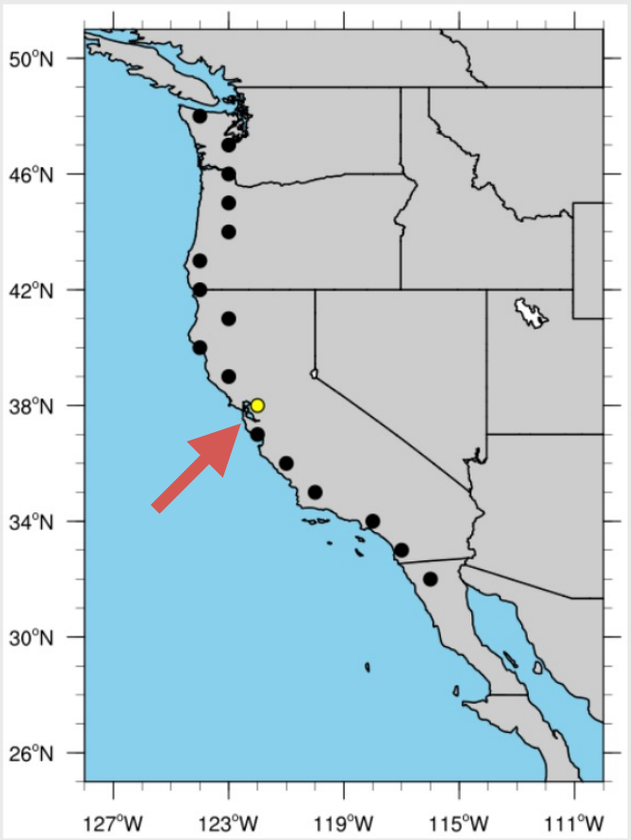
Week-3 Integrated Vapor Transport

Env. Canada subseasonal forecast of IVT

Location: 38°N, 122°W



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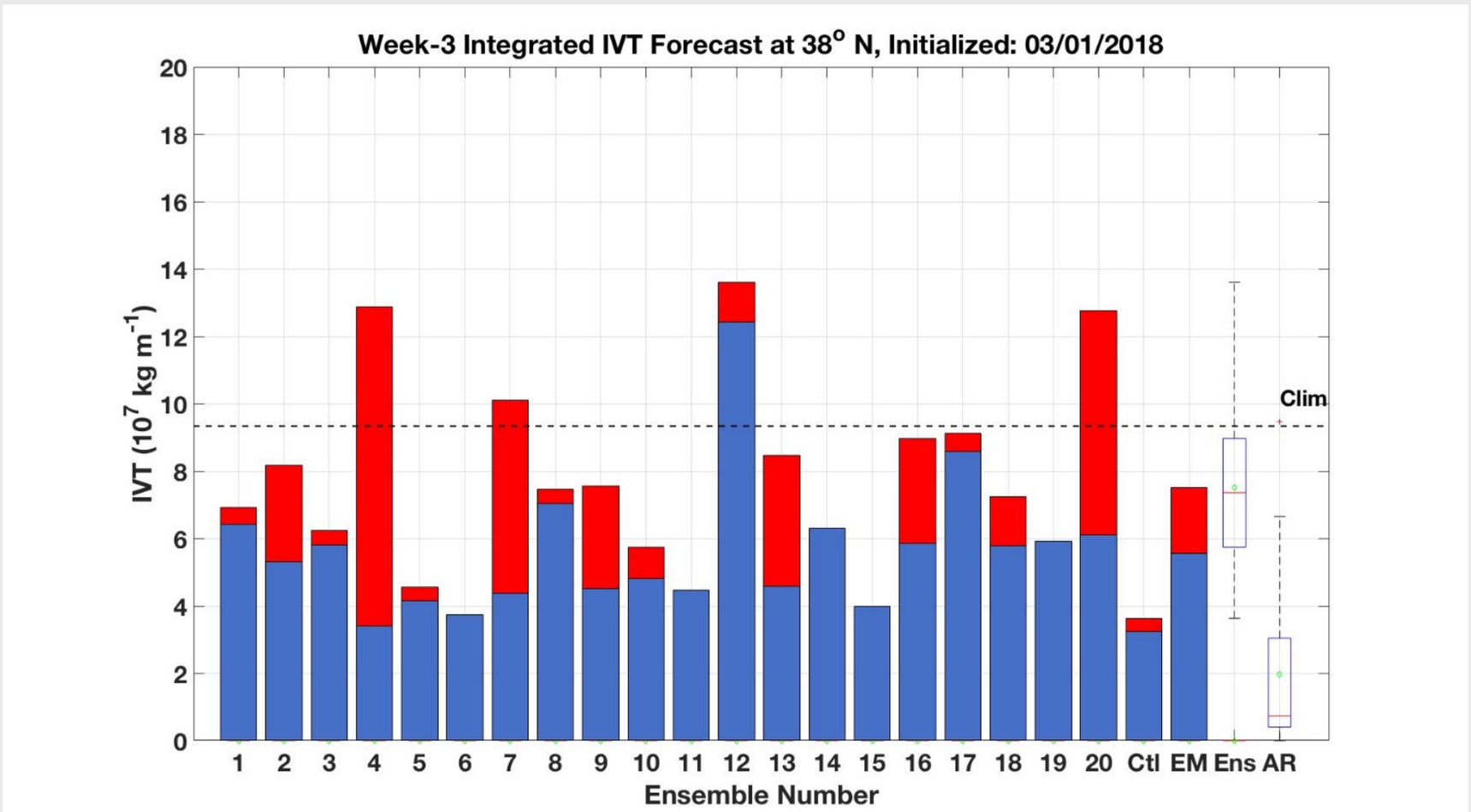

A. Subramanian, Z. Zhang, M. Ralph et al.

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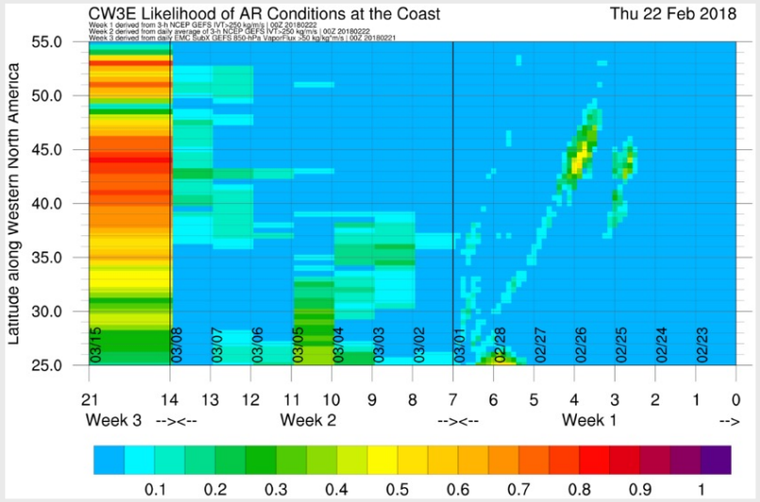
Week-3 AR web-portal

CW3E Week-3 AR Outlook

IVT Forecast for Week-3

Extended Range U.S. West Coast AR Landfall Tool

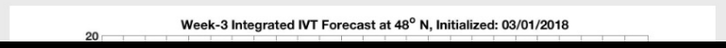
The Landfall Tool displays the probability and timing of AR conditions at each point on the map in a line along the U.S. West Coast from the GEFS model over the next three weeks. The probability of AR conditions represents the number of ensemble members that predict IVT to be greater than 250 kg m^{-1} s^{-1} at the given location and time. Week 1 shows three-hourly temporal resolution, week two is daily averages, and week three is the weekly average. These plots are created by Jason Cordeira, Plymouth State Univeristy.



Dynamical Model Forecasts

The Week-3 AR Outlook for total week-3 IVT (kg m^{-1}) from the Canadian model (NAEFS – GEPS) Ensemble Forecast for the different landfalling locations along the U.S. West Coast is shown below. The total IVT for each ensemble member in the NAEFS-GEPS forecasting system is shown as each bar with the AR and non-AR related IVT in red and blue respectively.
The AR related IVT is detected using the Guan and Waliser(2015) algorithm to detect ARs in the forecast fields. We then accumulate the IVT field in that 1-degree by 1-degree area along the coast over the week-3 period. The ensemble control member (CTL) and ensemble mean (EM) quantities are also plotted. The ensemble total distribution is shown with the box-whisker plot in the Ens column and the AR related ensemble spread and distribution is shown in the AR column. These plots are created by Aneesh Subramanian, CW3E and Zhenhai Zhang (CW3E).

Location: 48°N, 124°W



web development: B. Kawzenuk et al.