

# Near real-time subseasonal forecasting of atmospheric rivers during Winter 2017-2018 and 2018-2019

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Contains key figures/concepts from:

1. DeFlorio et al. 2018a, **Global assessment of atmospheric river prediction skill**, J. Hydromet., **19**, 409-426, doi:<https://doi.org/10.1175/JHM-D-17-0135.1>.
2. DeFlorio et al. 2018b, **Global evaluation of atmospheric river subseasonal prediction skill**, Clim. Dyn., doi:[10.1007/s00382-018-4309-x](https://doi.org/10.1007/s00382-018-4309-x).
3. Waliser, DeFlorio, Ralph et al., **Experimental subseasonal forecasting of atmospheric rivers over the Western U.S. during Winter 2017-2018/2018-2019**, in prep.
4. Guan and Waliser 2015, **Detection of atmospheric rivers: Evaluation and application of an algorithm for global studies**, J. Geophys. Res., **120**, 12514-12535.
5. Waliser and Guan 2017, **Extreme winds and precipitation during landfall of atmospheric rivers**, Nat. Geosci., **10**, 179-183.

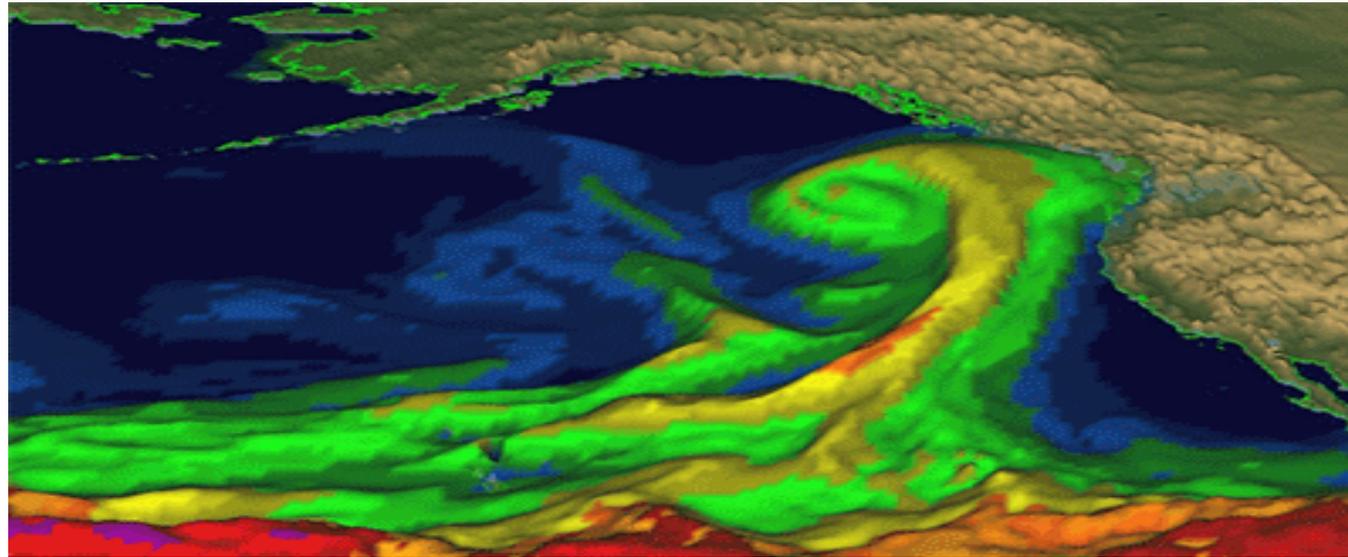
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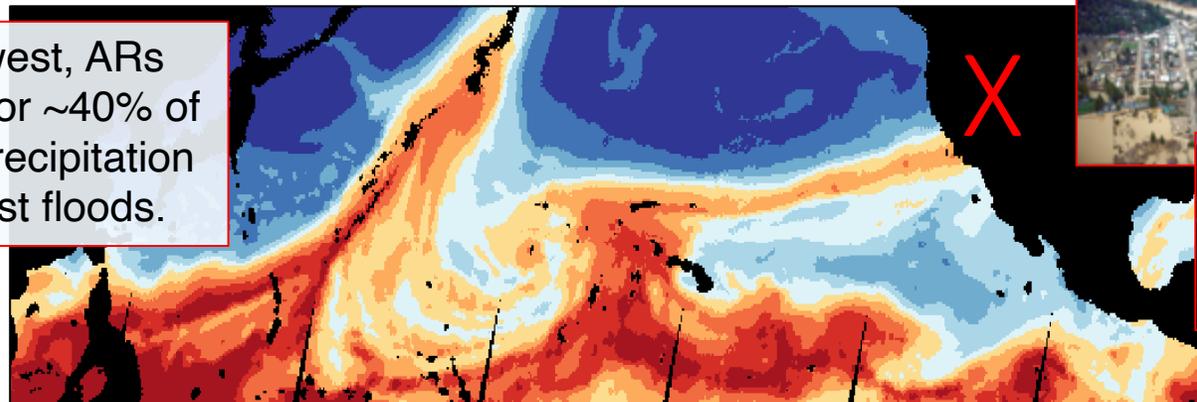
# Atmospheric rivers and their associated flood and hazard risks occur globally and influence climate and water extremes.



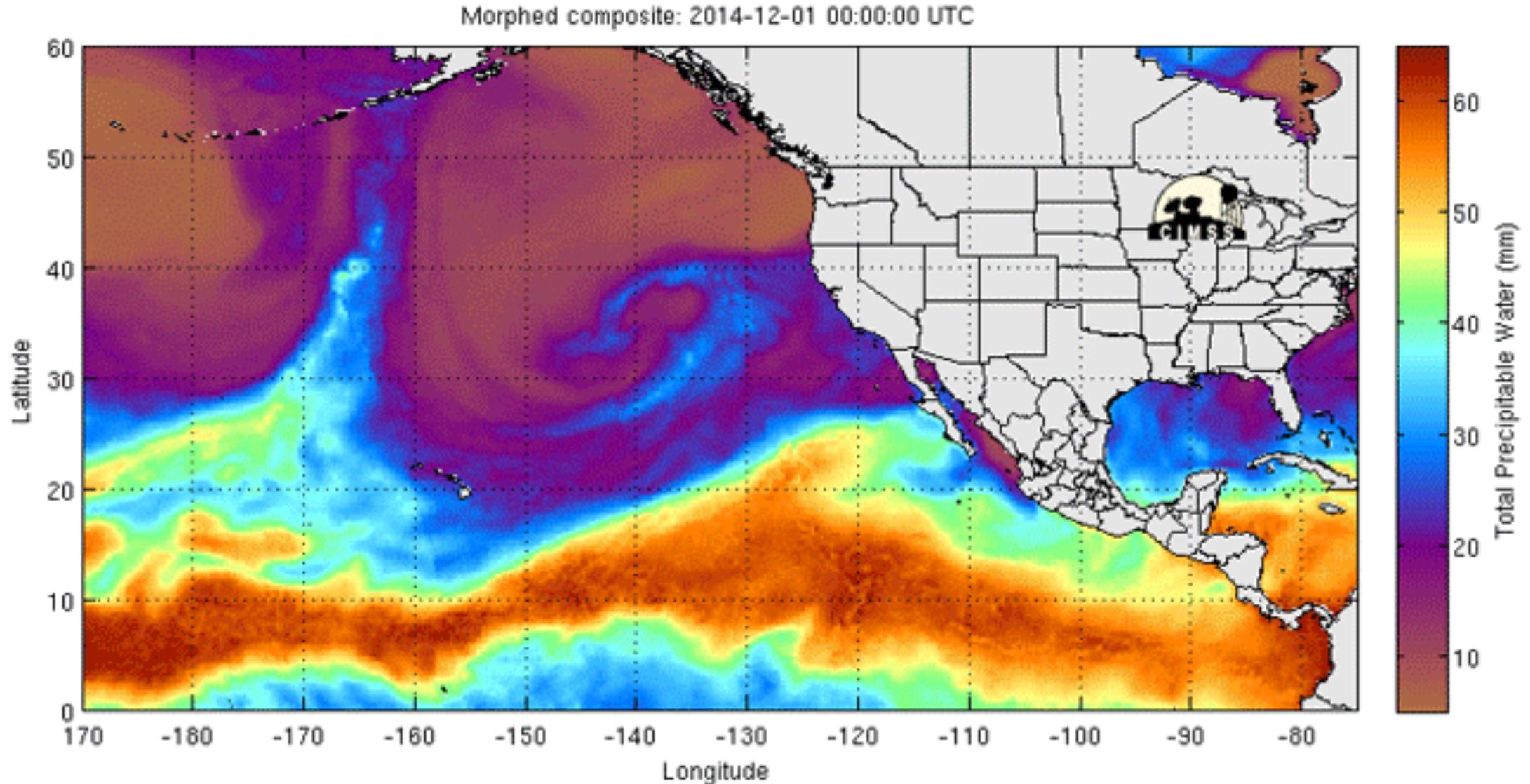
NOAA ESRL

Over 90% of poleward moisture transport at midlatitudes is by ARs that take up only ~10% of the zonal circumference.

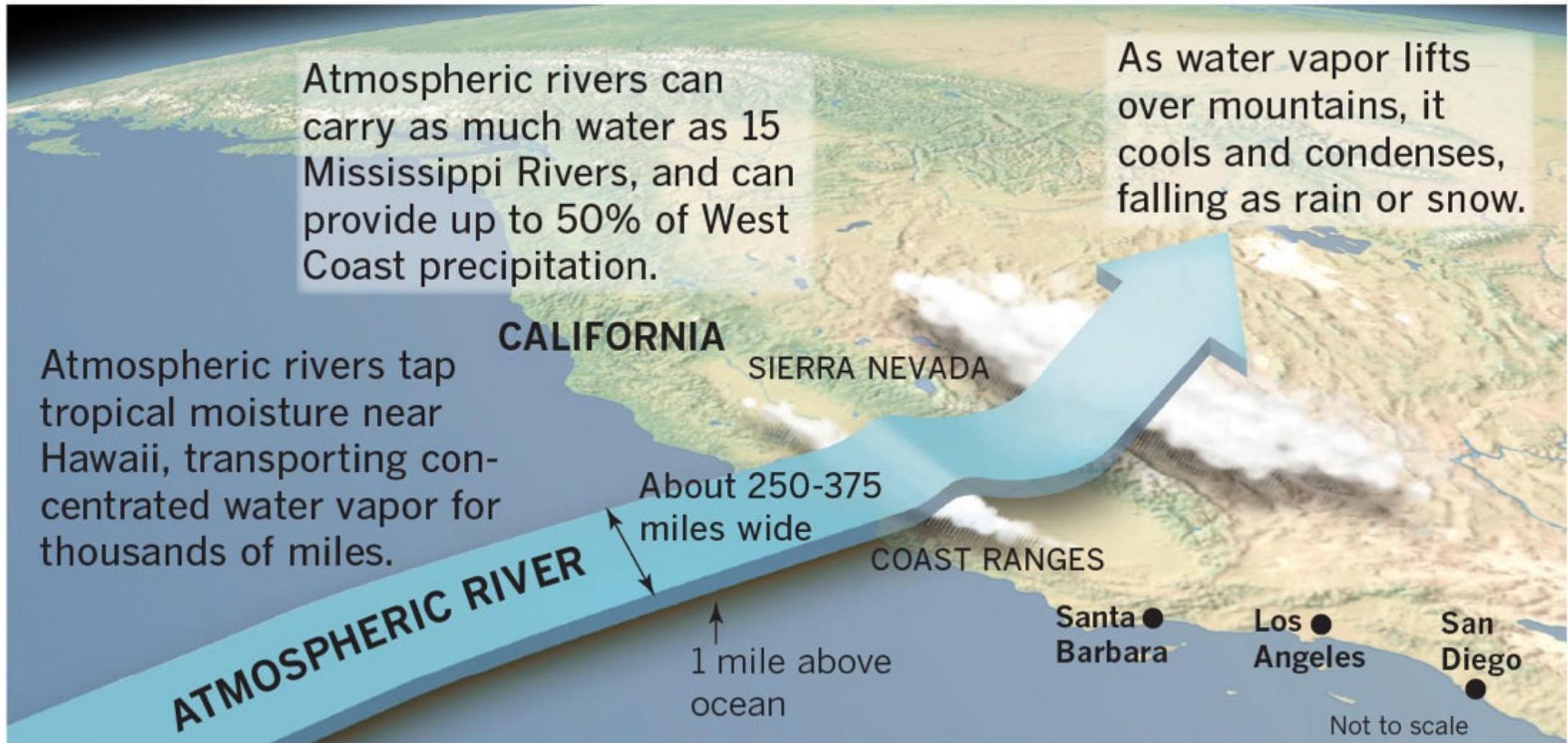
In the west, ARs account for ~40% of annual precipitation and most floods.



# What does an Atmospheric River look like from space?



# How an atmospheric river works

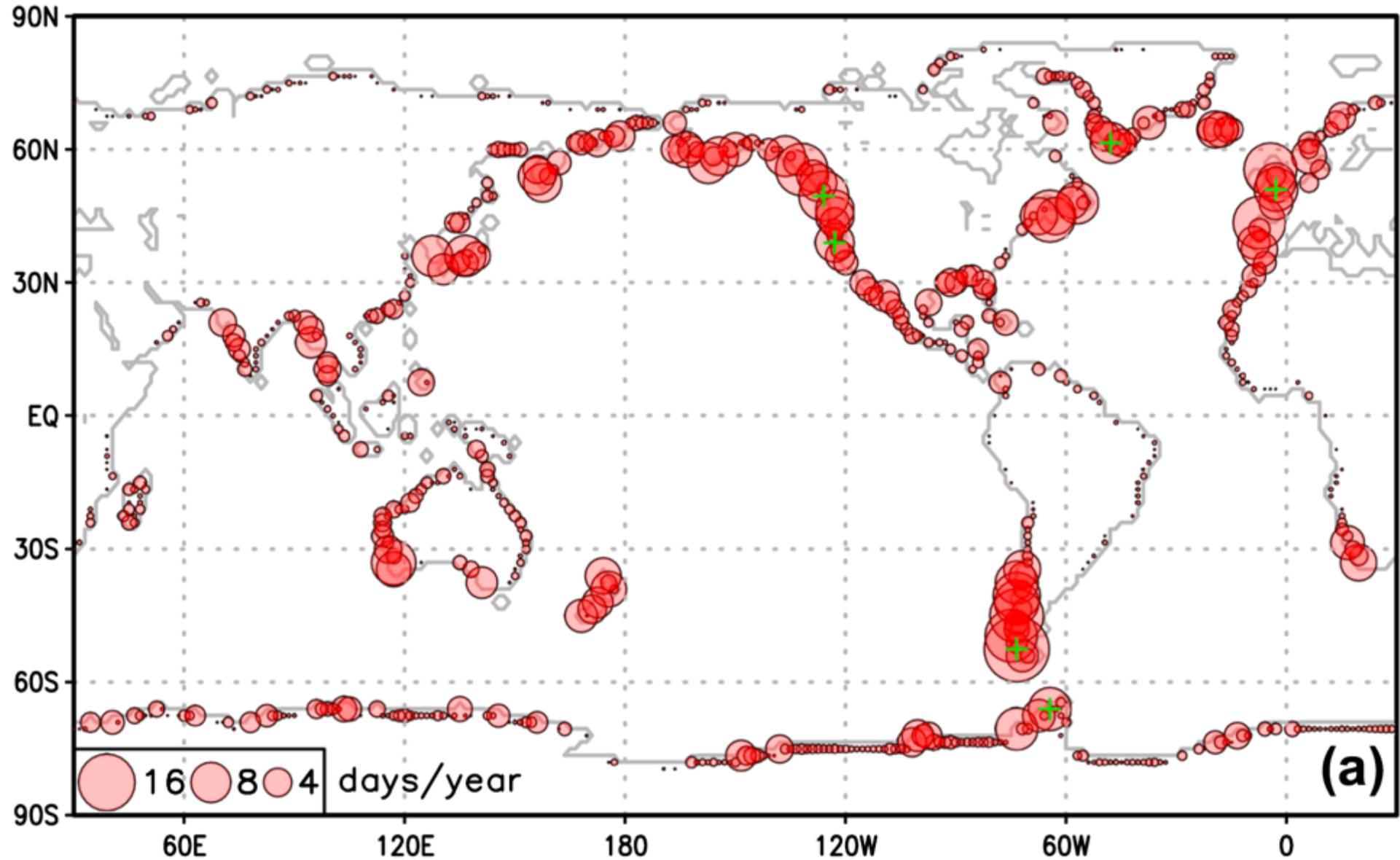


Sources: National Weather Service, Scientific American

@latimesgraphics

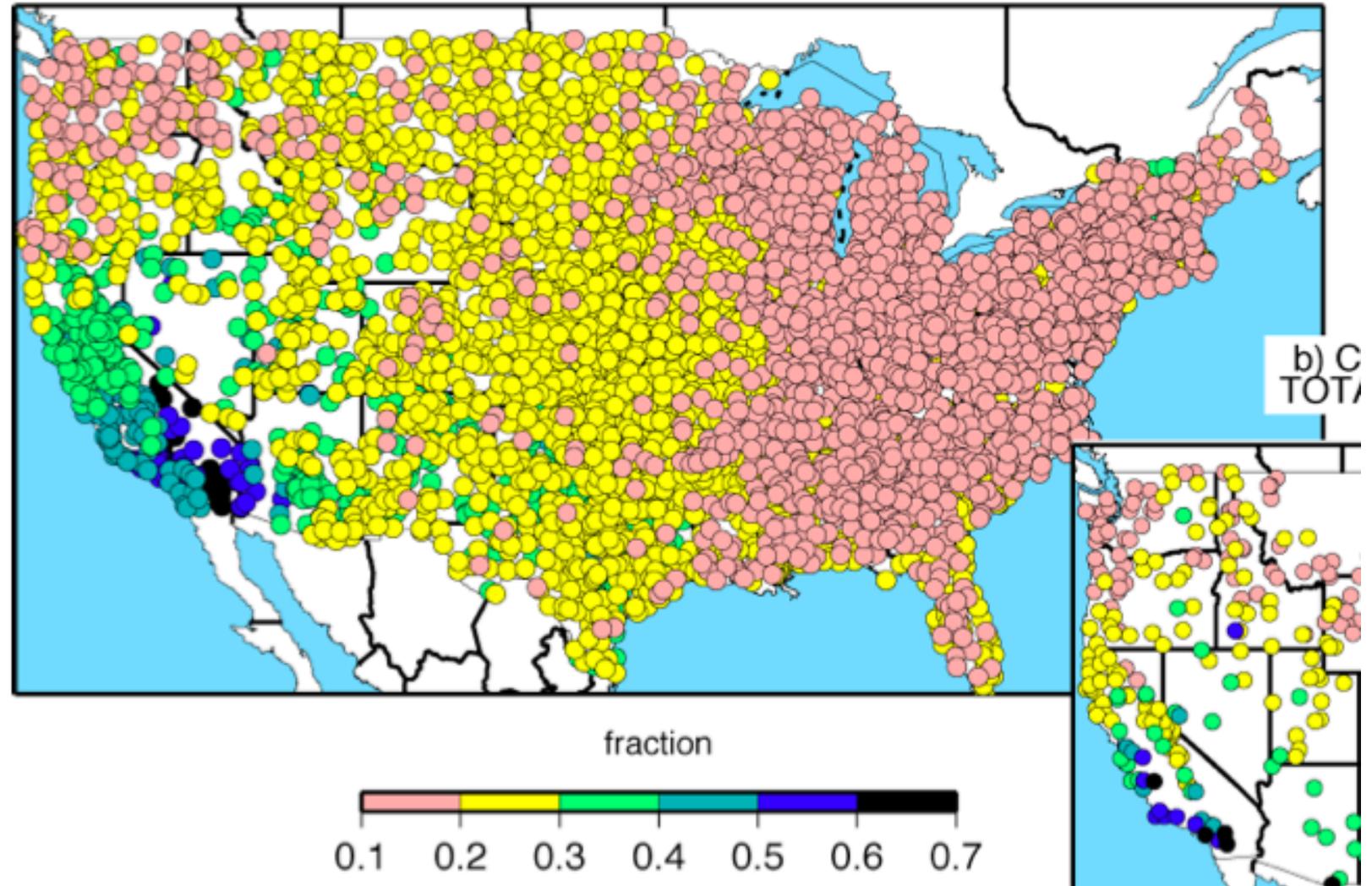


# Where do atmospheric rivers make landfall most often?

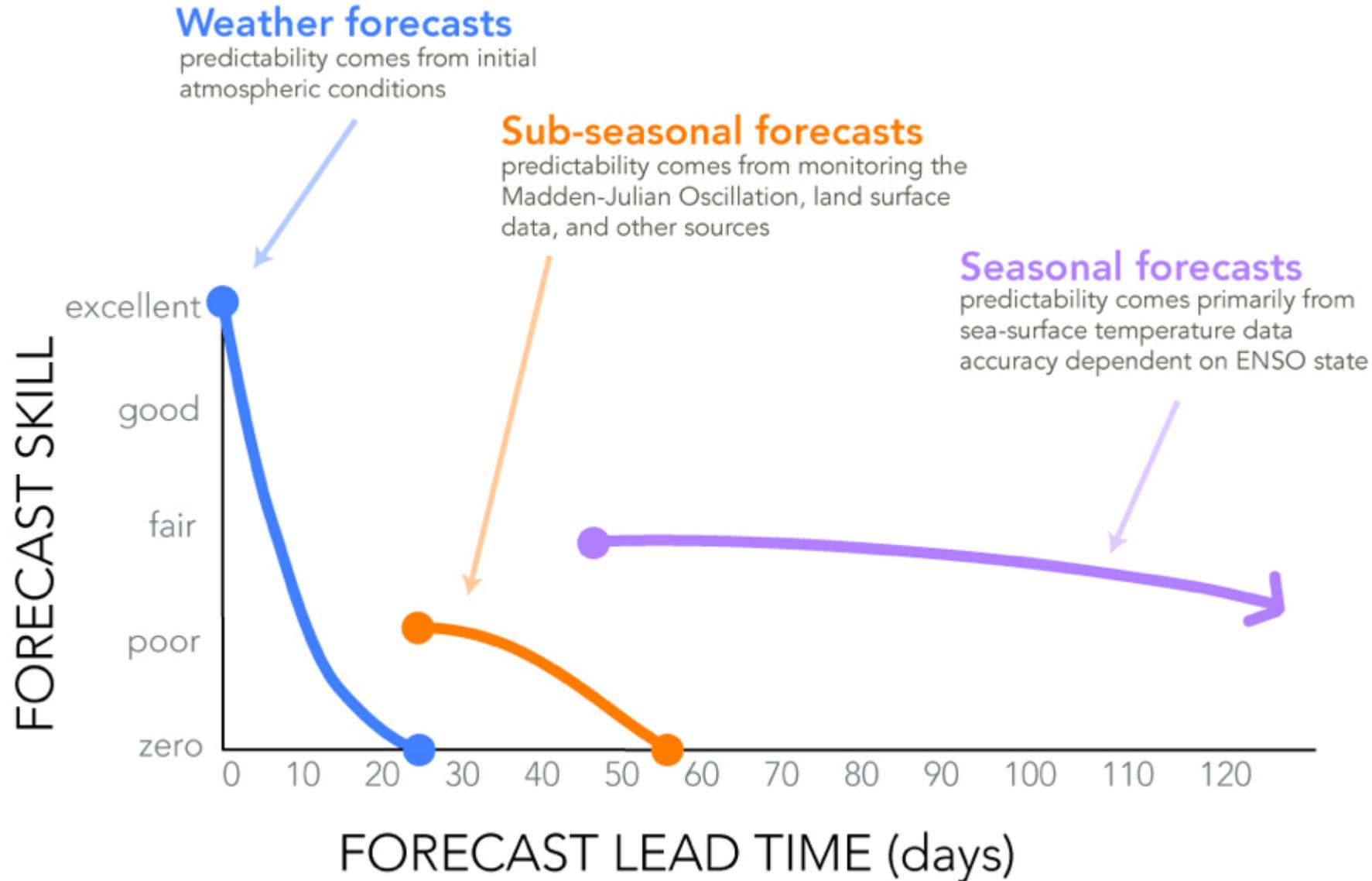


# How does total annual precipitation vary from year-to-year?

- Year-to-year precipitation amount over California **uniquely variable**
  - This is primarily because California's annual precipitation totals are dependent on precipitation from **just a few large storms** – very often “**atmospheric river**” events



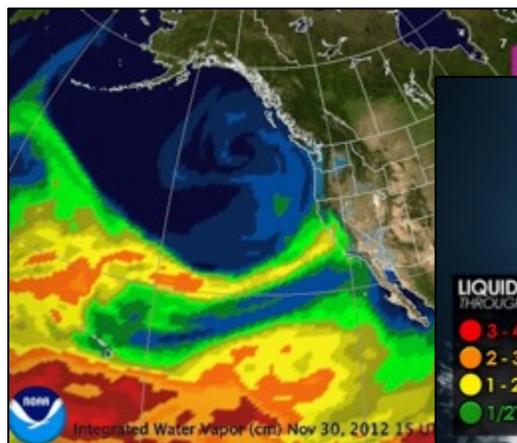
# What is subseasonal-to-seasonal (S2S) forecasting?



# Weather Forecasts (0-14 Days)



## Hurricanes



## Atmospheric Rivers



... cold spells, heat waves, thunderstorms/tornados, nor'easters, santa ana winds, etc

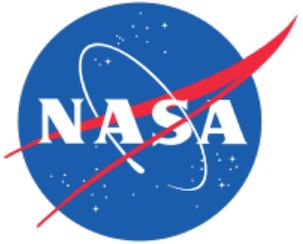


# S2S Forecasts: Atmospheric Rivers (2 –12 weeks)



- How can we predict atmospheric rivers 2 weeks to 3 months in the future?
- Rather than try to predict the occurrence or evolution of a single atmospheric river at such long leads, should we predict the likelihood of an atmospheric river or expected frequency of atmospheric rivers?
- Can we do that? How do we do that?

# Experimental S2S AR forecasting for winter 2017-18 and 2018-19



Duane Waliser  
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Alex Goodman



Bin Guan



Marty Ralph  
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Sasha Gershunov



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# Review of winter 2017-2018 activities and winter 2018-2019 goals

## Winter 2017-2018: what we did

- Create an automated pipeline to:
  - **calculate IVT fields** from ECMWF, ECCO, and NCEP forecast systems
    - Twice-a-week for ECMWF
    - Weekly or bi-monthly for ECCO, NCEP
  - apply Guan and Waliser 2015 **AR detection** algorithm to IVT fields
  - **calculate AR1wk forecast skill for week-1, week-2, and week-3 lead windows** and compare to hindcast skill benchmarks [DeFlorio et al. 2018b; DeFlorio et al. 2018c (in prep)]
- **Disseminate experimental forecasts and solicit feedback** during CW3E S2S weekly teleconferences
- **Develop verification statistics using MERRA2 reanalysis data** for winter 2017-2018 outlooks (nearly completed) and for winter 2018-2019 outlooks (next spring/summer)

## Winter 2018-2019: what we'll do

- **Produce near real-time week-3 AR1wk occurrence forecasts** for ECMWF, ECCO, and NCEP forecast systems, stratified by mean AR intensity (>250 kg/ms, >500 kg/ms)
- Display week-3 outlooks on protected CW3E website
- Engage in NCEP CPC week-3/week-4 Friday discussions (POC: Jon Gottschalck, NCEP/NOAA)



# Multi-model Experimental S2S Week-3 Atmospheric River Forecast\*

Issued on Thursday, May 10, 2018 for the Western United States

## Contents:

**Definition of “Subseasonal”** - US west coast weather/precipitation forecast for week 3 considering the number of atmospheric river days predicted to occur in the given forecast week.

*Novelty – an S2S forecast presented only in terms of AR likelihood - specifically for week 3, an extended/long-range or “subseasonal” prediction*

**Slide 1:** ECMWF (European Centre for Medium-Range Weather Forecasts) forecast system



**Slide 2:** NCEP (National Centers for Environmental Systems) forecast system



**Slide 3:** ECCC (Environment and Climate Change Canada) forecast system

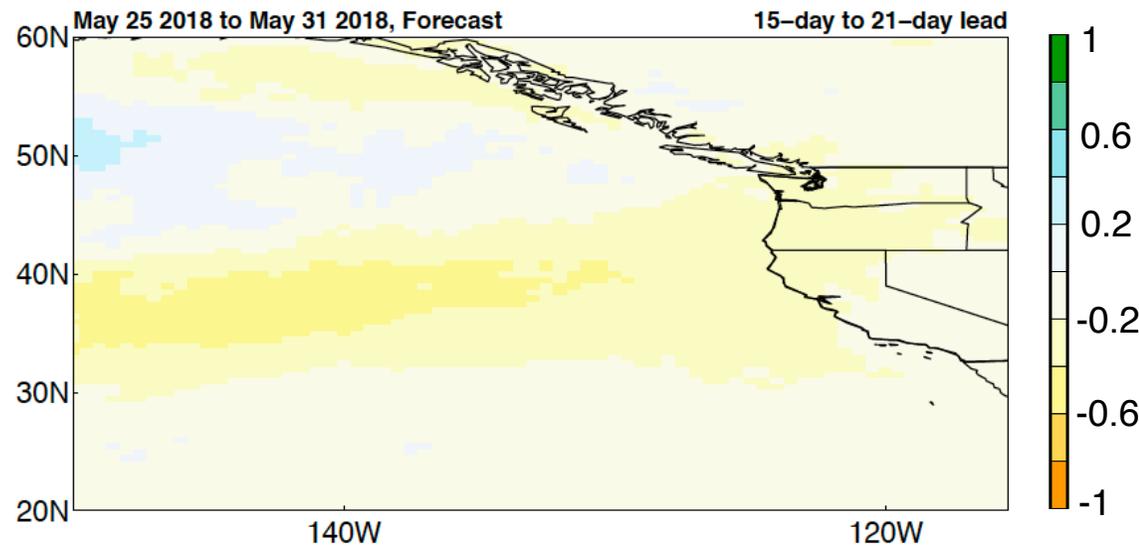
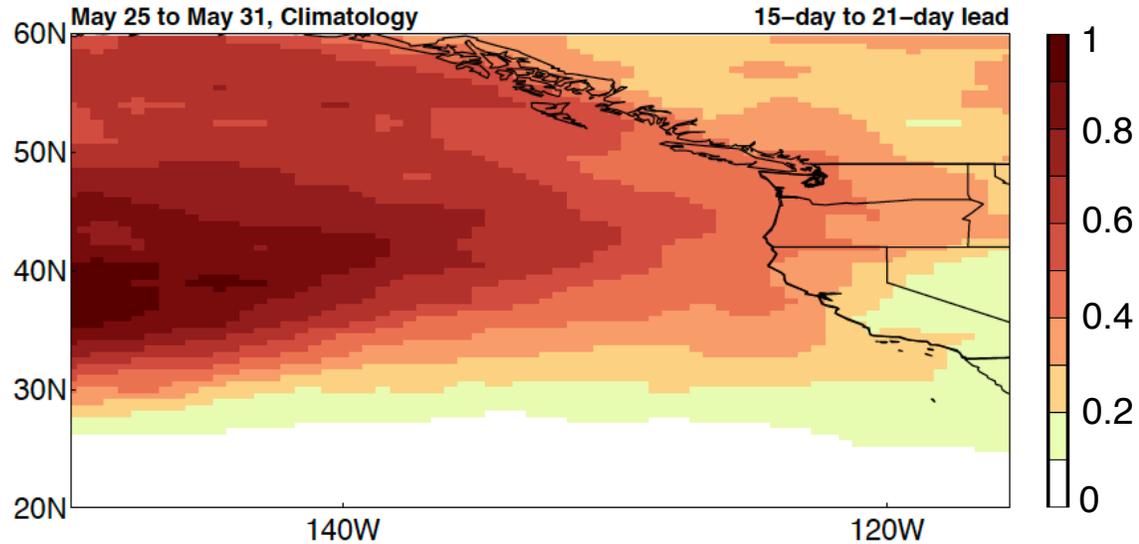


*\*This is an experimental activity for the 2017-18 and 2018-19 winters. Methodologies and hindcast skill are documented in DeFlorio et al. (2018a,b). Further validation of the real-time forecast results is required and underway. This phase of the research includes gathering stakeholder input on the presentation of information – feedback is welcome.*

POC: Michael J. DeFlorio (michael.deflorio@jpl.nasa.gov)

# \*\*\*EXPERIMENTAL S2S AR FORECAST\*\*\*

May 10, 2018 forecast: number of AR days during week-3



Above average #ARs  
Below average #ARs

## 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)

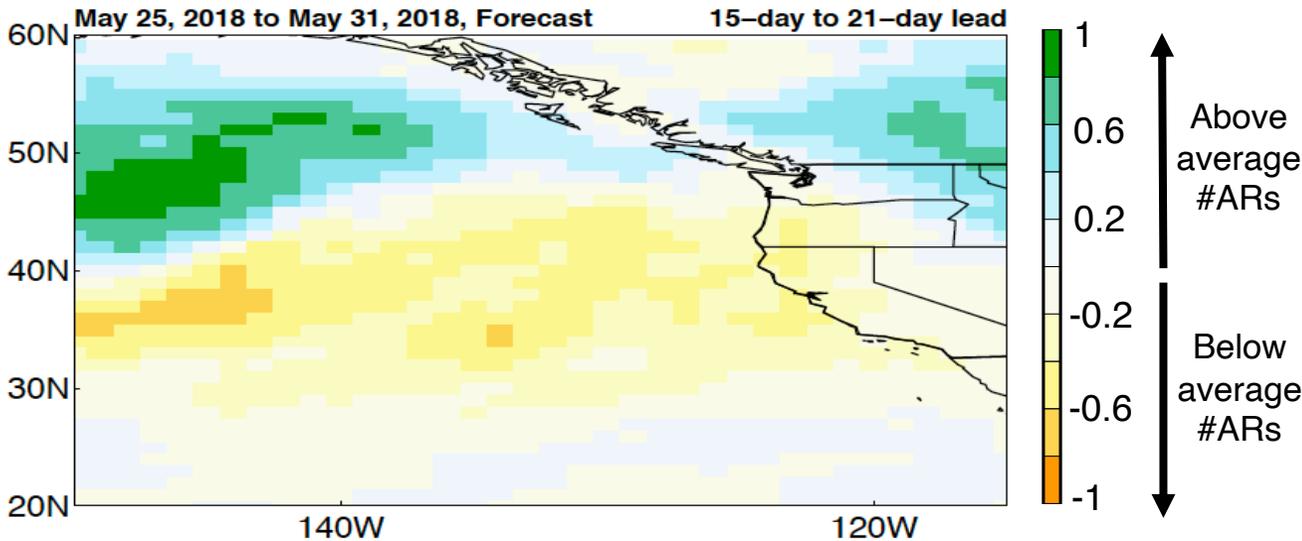
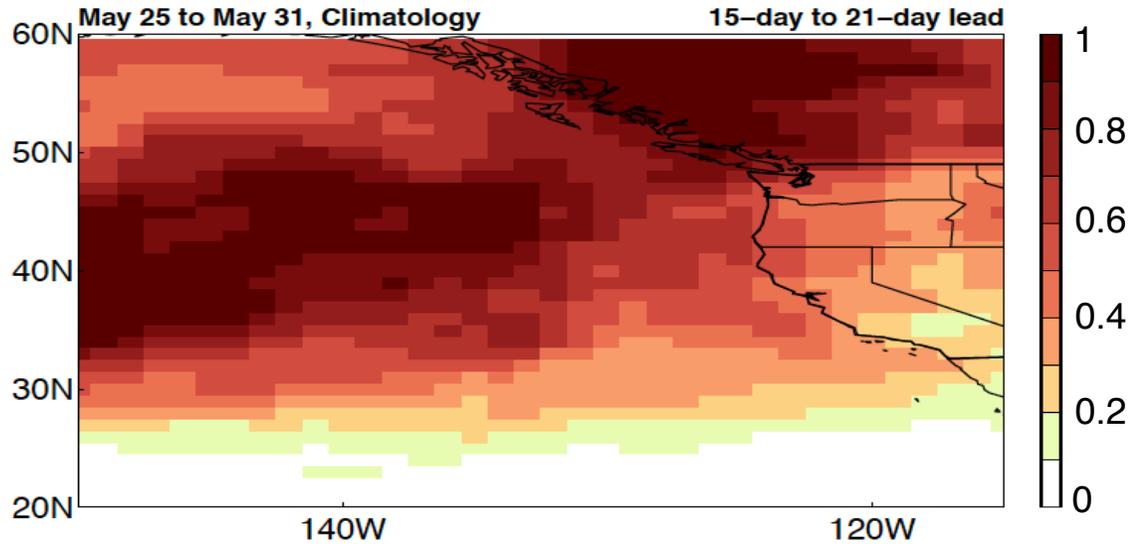
**Experimental AR forecast** issued on Thursday, May 10, 2018 by M. DeFlorio, D. Waliser, B. Guan, A. Goodman, A. Subramanian, and F. M. Ralph using 51-member real-time ECMWF data for an **Experimental AR Forecasting Research Activity** sponsored by California DWR



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# \*\*\*EXPERIMENTAL S2S AR FORECAST\*\*\*

May 10, 2018 forecast: number of AR days during week-3



## Week-3

(Combined 15-day to 21-day lead)

Top row: **hindcast climatology** (NCEP 1999-2010 data)  
Bottom row: **real-time forecast** (NCEP 16-member ensemble)

**Experimental AR forecast** issued on Thursday, May 10, 2018 by M. DeFlorio, D. Waliser, B. Guan, A. Goodman, A. Subramanian, and F. M. Ralph using 16-member real-time NCEP data for an **Experimental AR Forecasting Research Activity** sponsored by California DWR



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California Institute of Technology

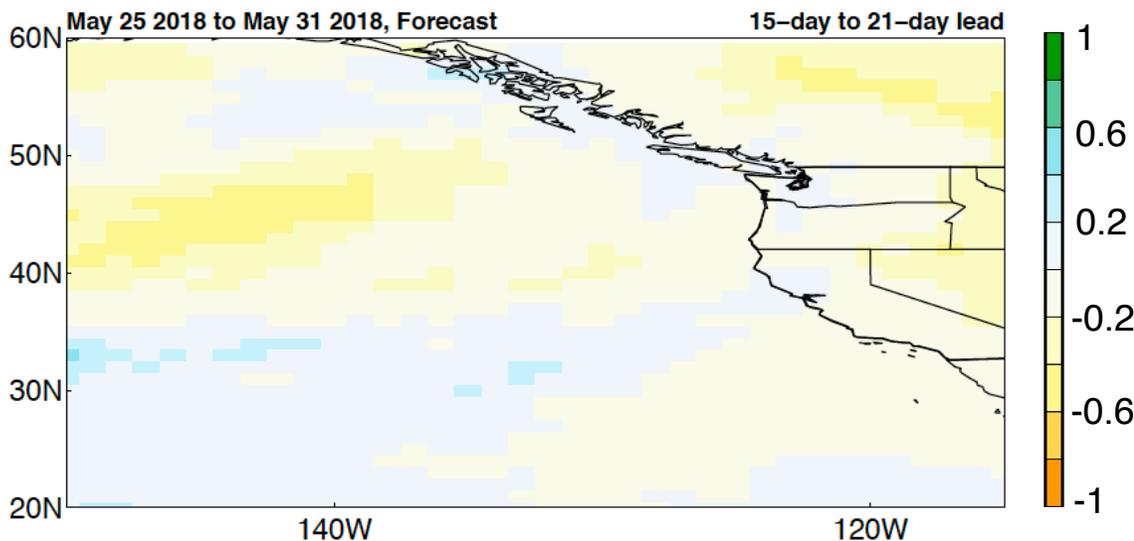
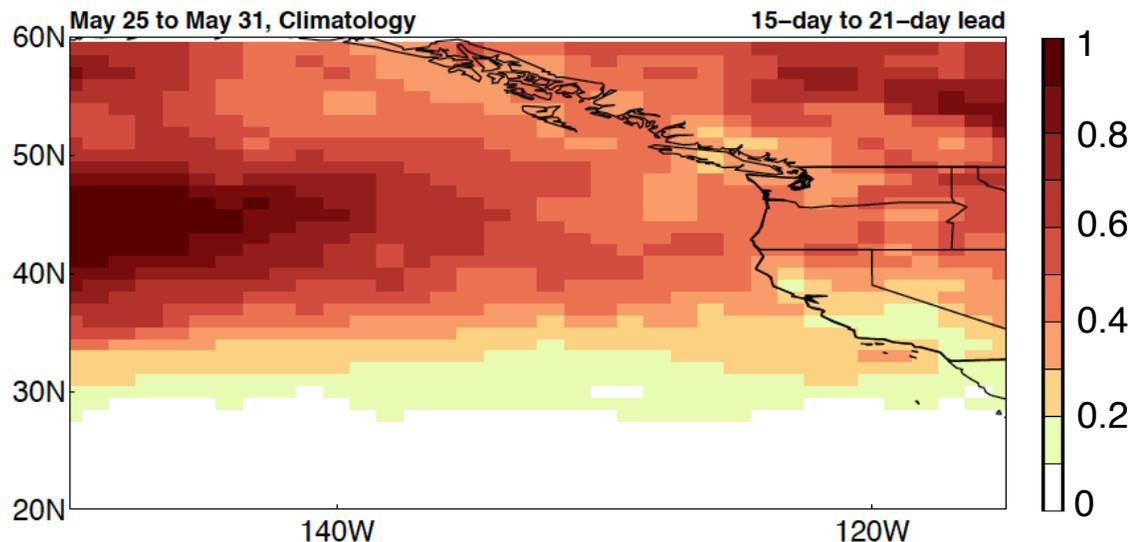


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# \*\*\*EXPERIMENTAL S2S AR FORECAST\*\*\*

May 10, 2018 forecast: number of AR days during week-3



## Week-3

### (Combined 15-day to 21-day lead)

Top row: **hindcast climatology** (ECCC 1995-2014 data)  
Bottom row: **real-time forecast** (ECCC 21-member ensemble)

**Experimental AR forecast** issued on Thursday, May 10, 2018 by M. DeFlorio, D. Waliser, B. Guan, A. Goodman, A. Subramanian, and F. M. Ralph using 21-member real-time ECCC data for an **Experimental AR Forecasting Research Activity** sponsored by California DWR

Above average #ARs  
Below average #ARs



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