

Preconditions for Extreme Wet Winters over the Contiguous United States



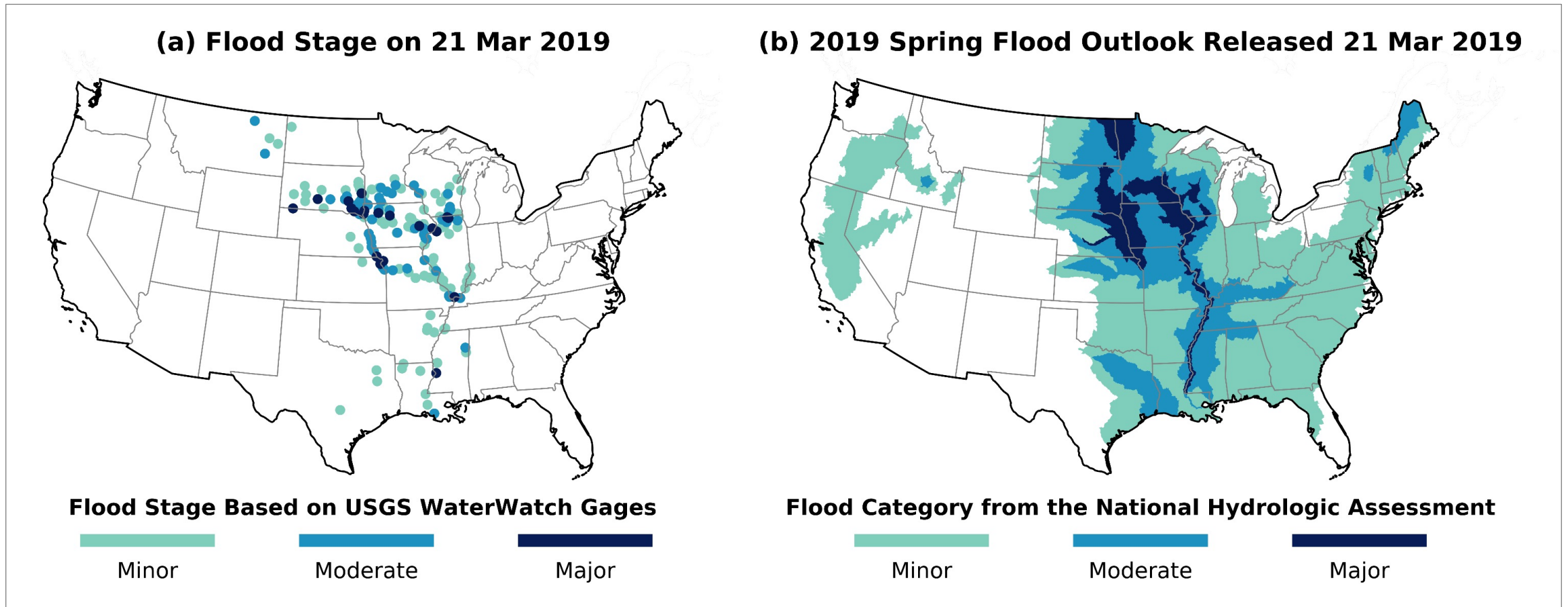
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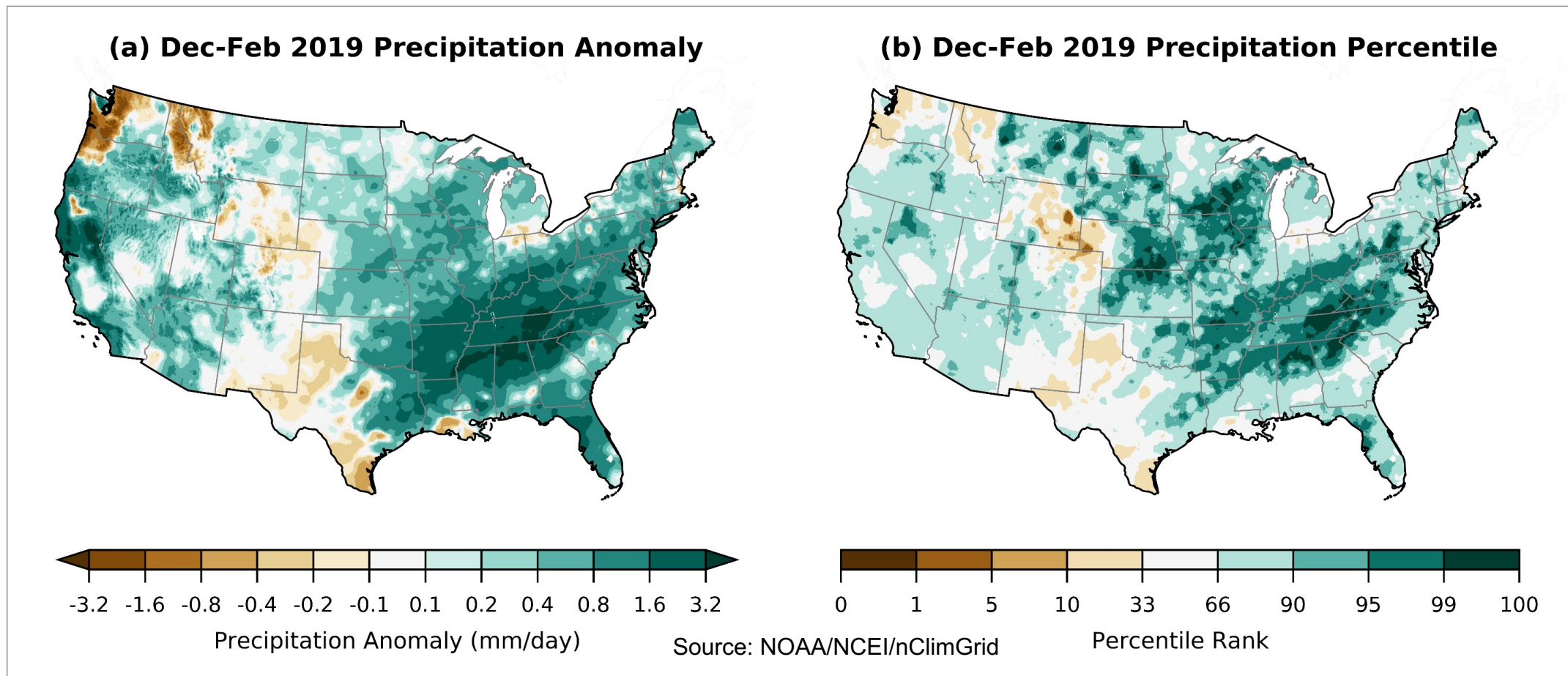
In Spring 2019, abundant land surface moisture storage led to record flooding

The National Hydrologic Assessment attributed the abundant land surface moisture to exceptional precipitation during the prior winter



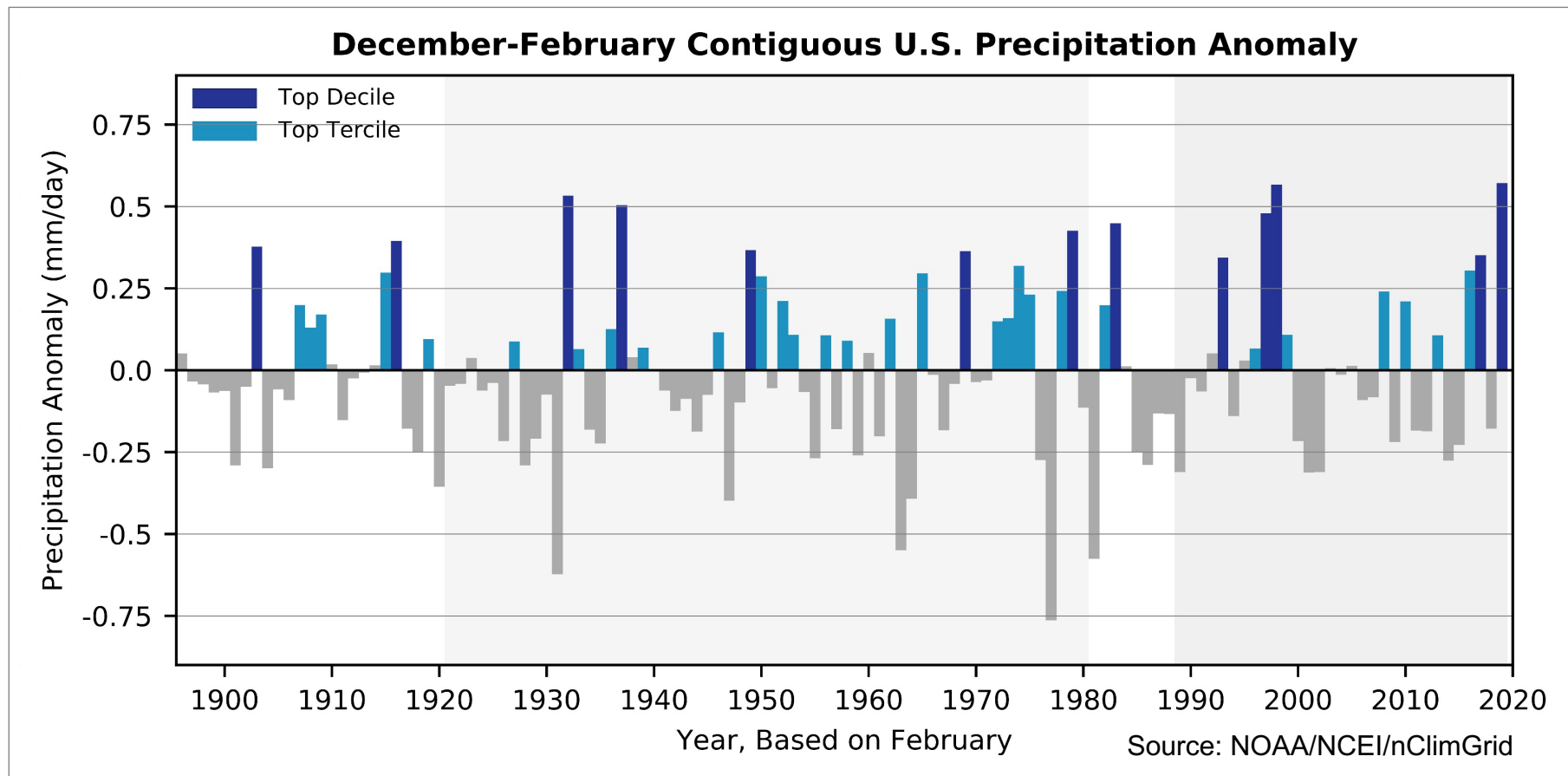
December 2018 – February 2019 was the wettest winter since 1895-1896

**Widespread above average precipitation
with record and near-record wetness in the Midwest and Southeast**



December 2018 – February 2019 was the wettest winter since 1895-1896

**2018-2019 narrowly exceeded 1997-1998 and 1931-1932 over CONUS
2010s were among the wettest decades during winter**



Outline

1

Preconditions

Preconditions for wet winters and if they offered a window of opportunity for anticipating such an event in Winter 2018-2019

2

Initialized Forecasts

Initialized forecast performance in Winter 2018-2019 and if they could have been used to anticipate the observed wetness

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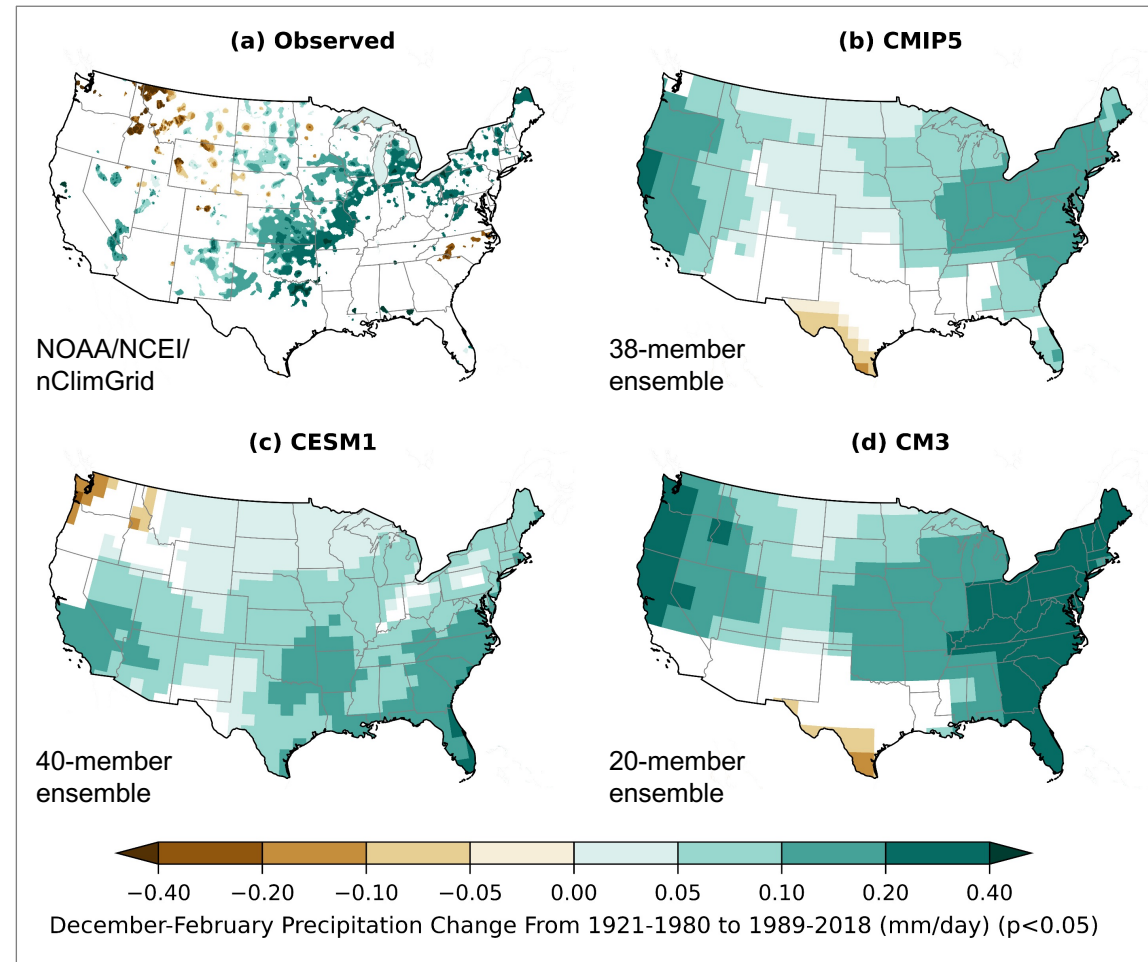
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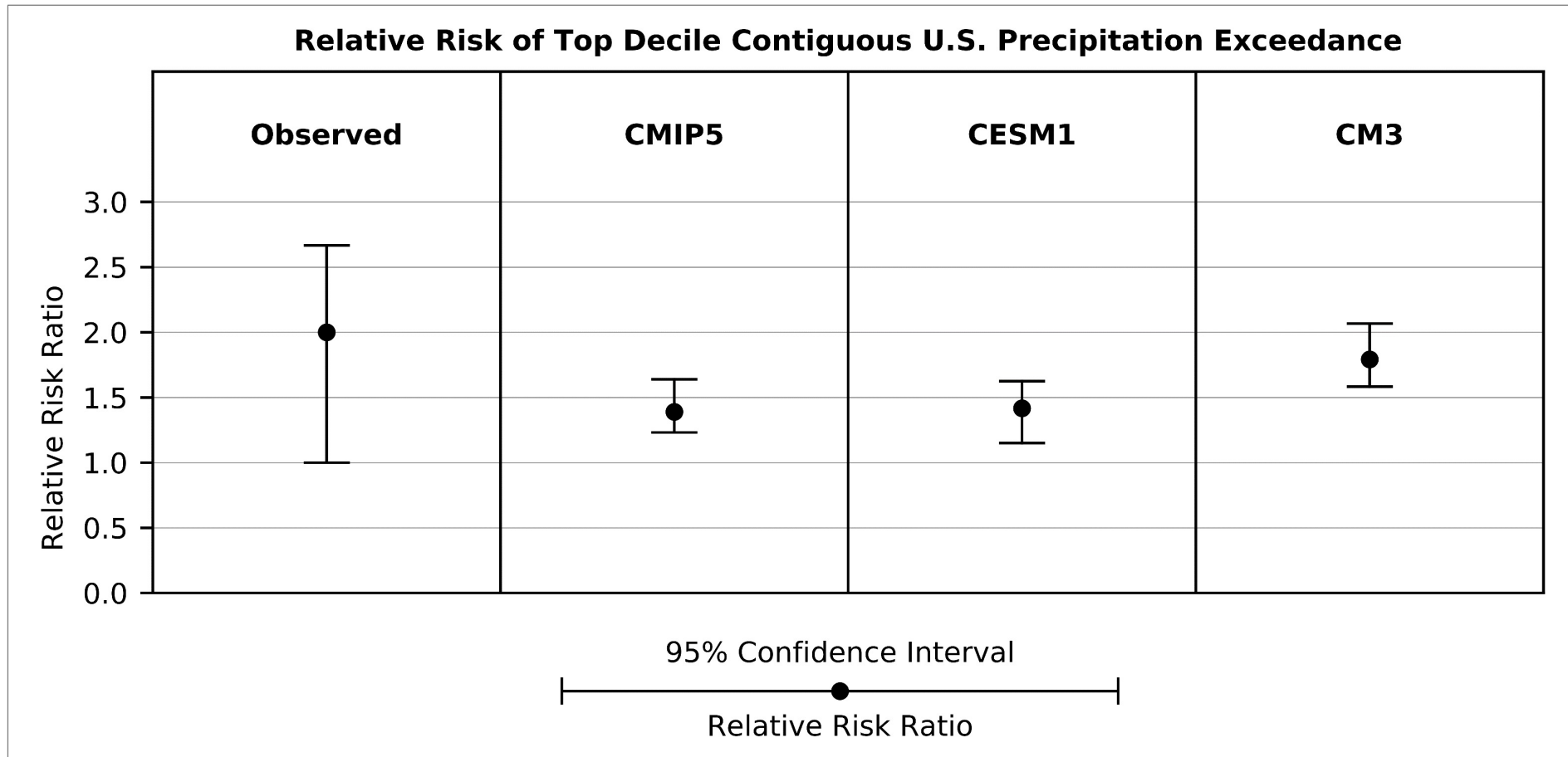
A trend to wetter winters over much of the contiguous United States

Midwest, Southwest, Great Lakes, and Northeast among the wetter areas



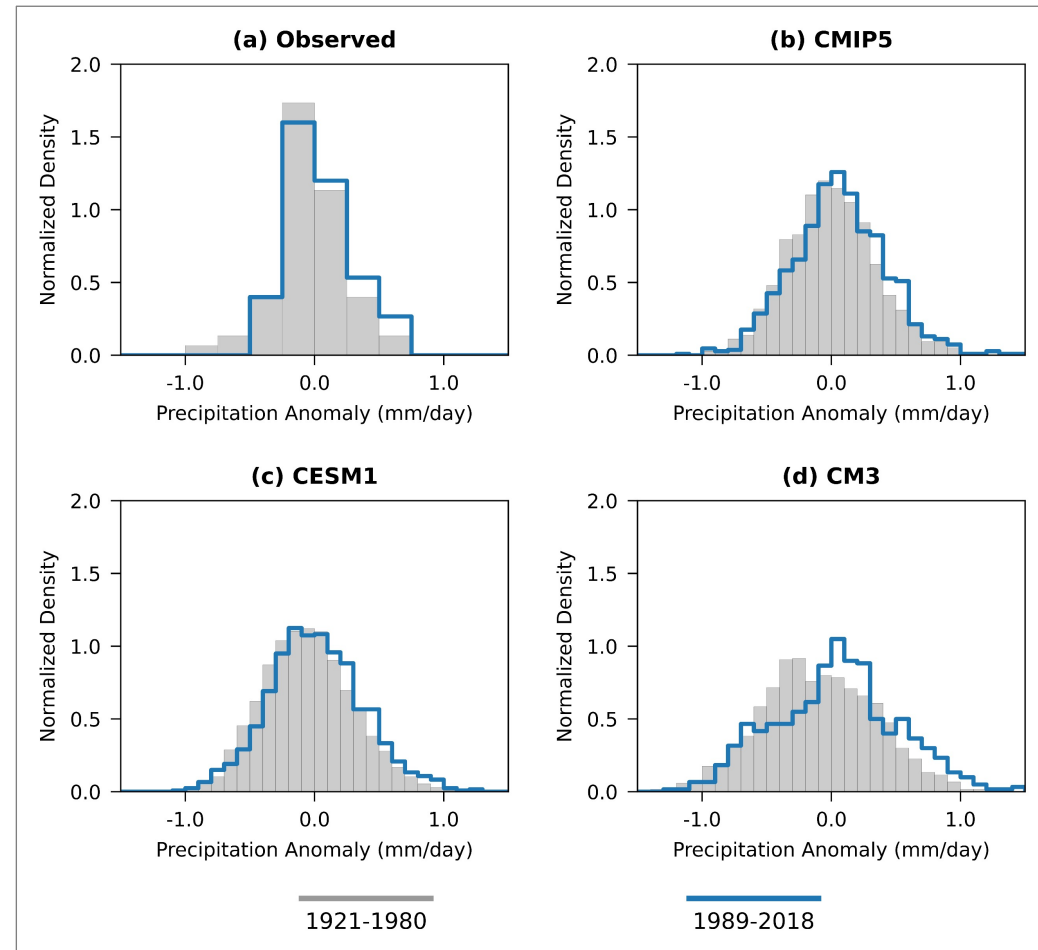
Up to a doubling of the risk of a winter in the top decile

Statistically significant increases in risk from 1921-1980 to 1989-2018



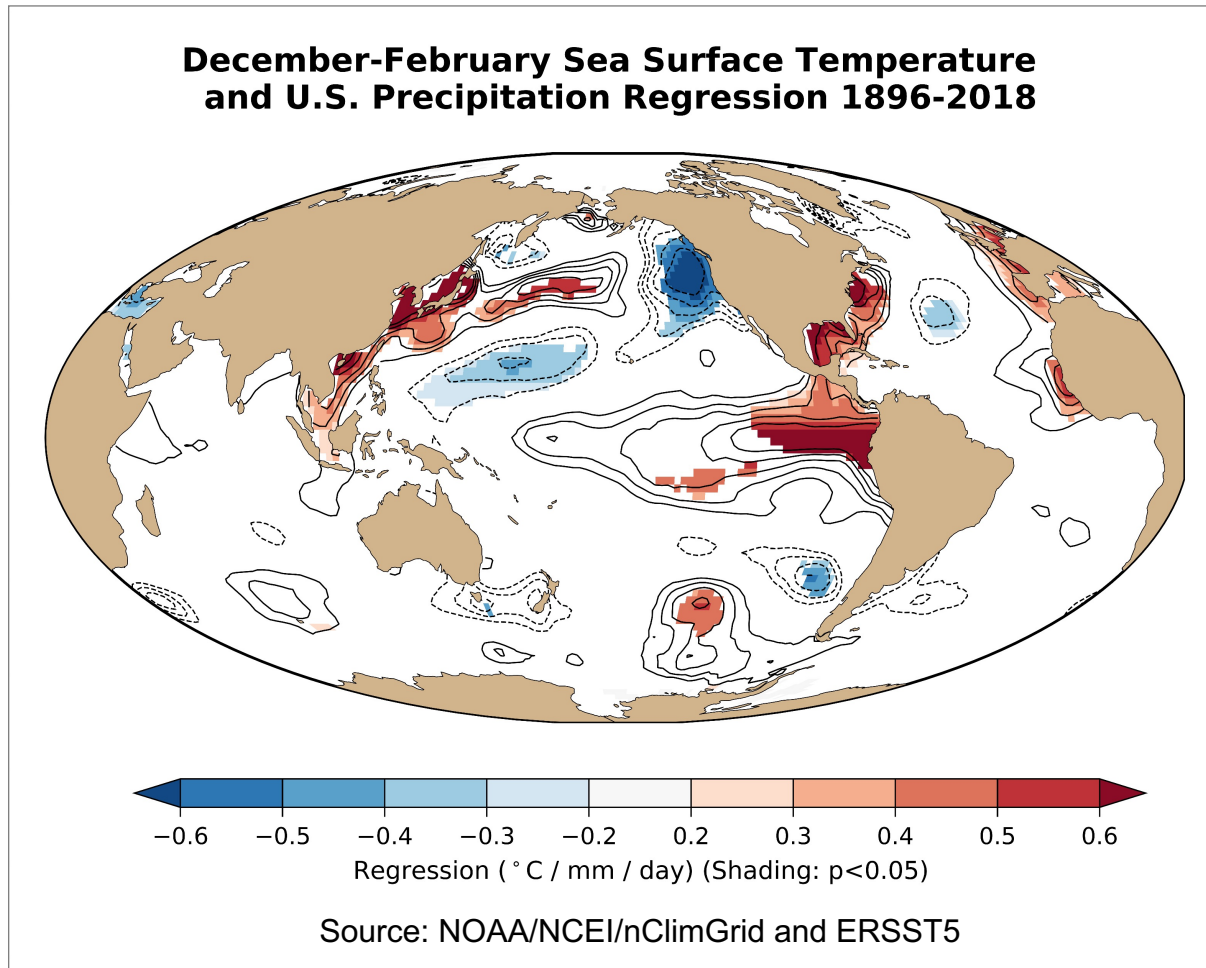
However, trends to wetter winters cannot forewarn of wetness in a given winter

The range of possible outcomes is still large



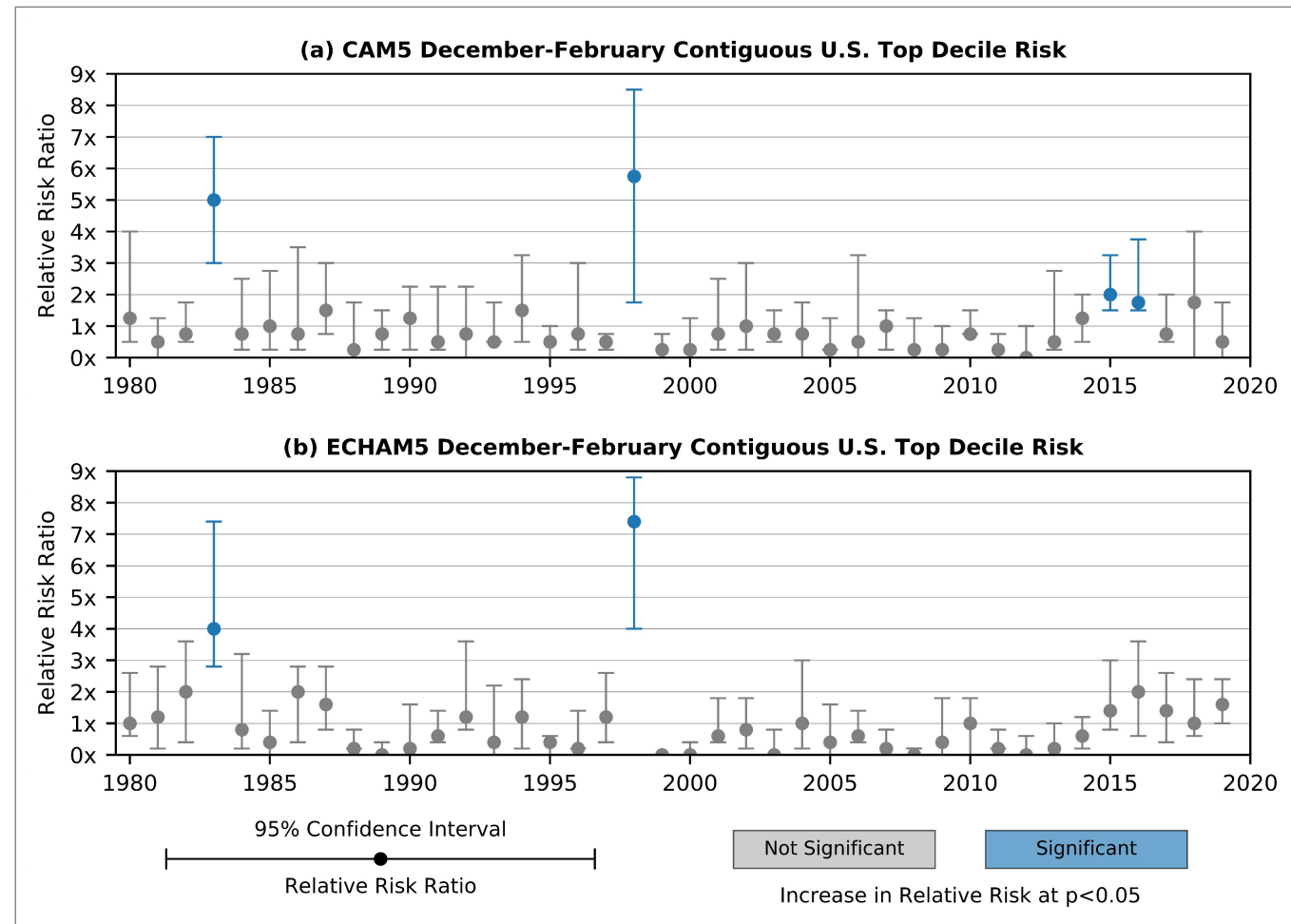
Contiguous U.S. winter precipitation is related to ENSO

The magnitude of the relationships suggest that other factors may be important



Atmospheric model simulations indicate El Niño increases risk of wet winters

Strong El Niño events like 1982-1983 and 1997-1998 are most effective

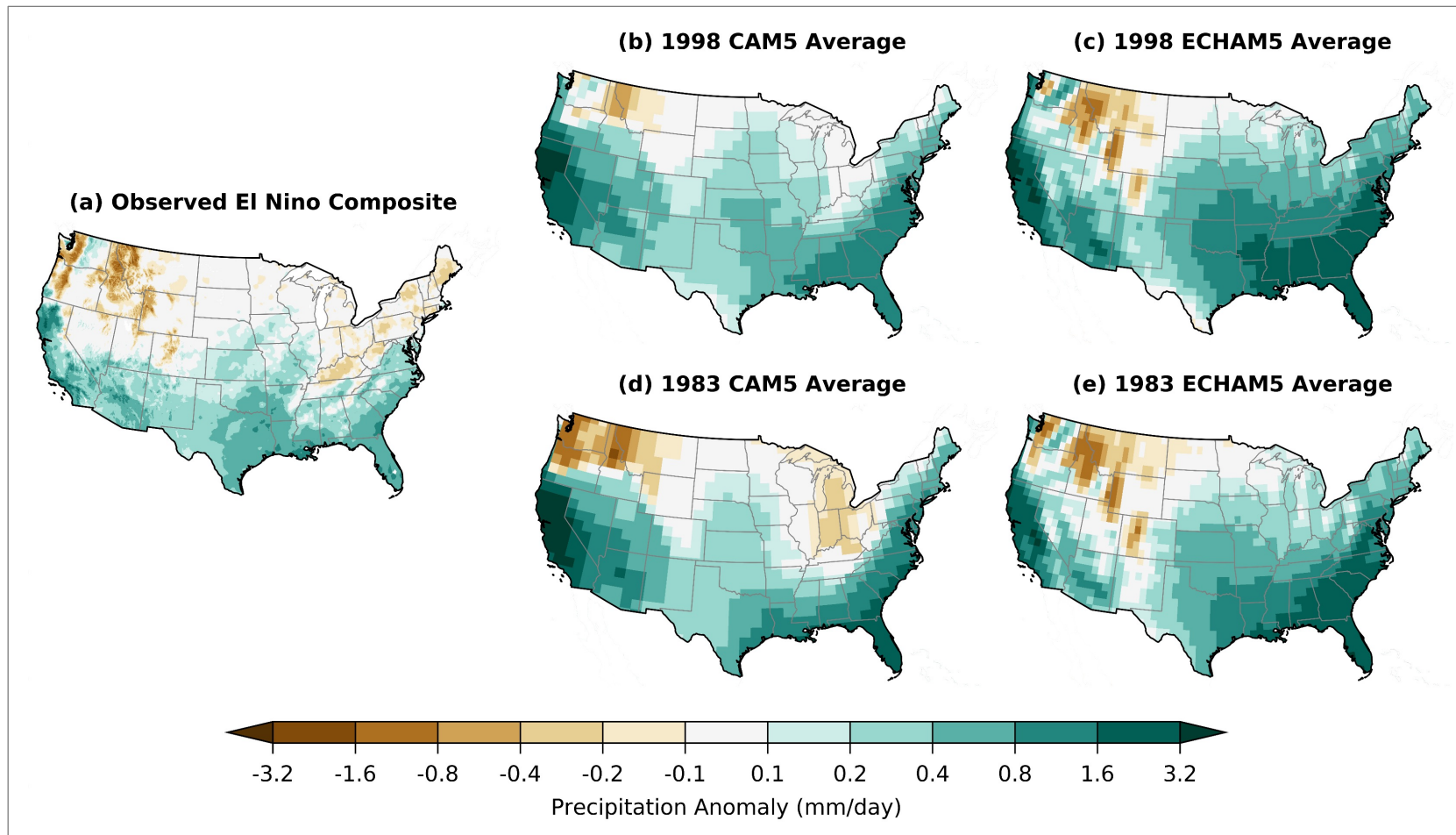


CAM5: 40 member ensemble of Community Atmosphere Model version 5 exposed to time-varying SSTs and GHGs.

ECHAM5: 50 member ensemble of ECHAM model version 5 exposed to time-varying SSTs and GHGs.

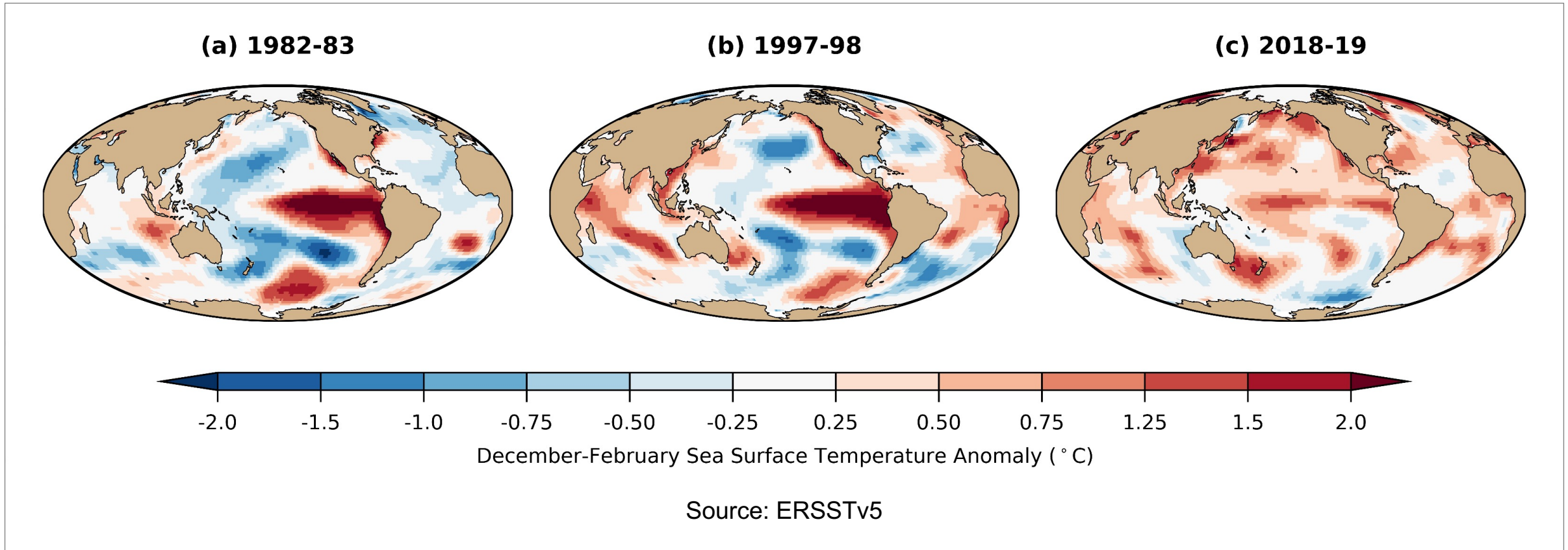
Strong El Niño is related to widespread abundant winter precipitation

All areas as in the El Niño composite plus the Midwest and Ohio Valley



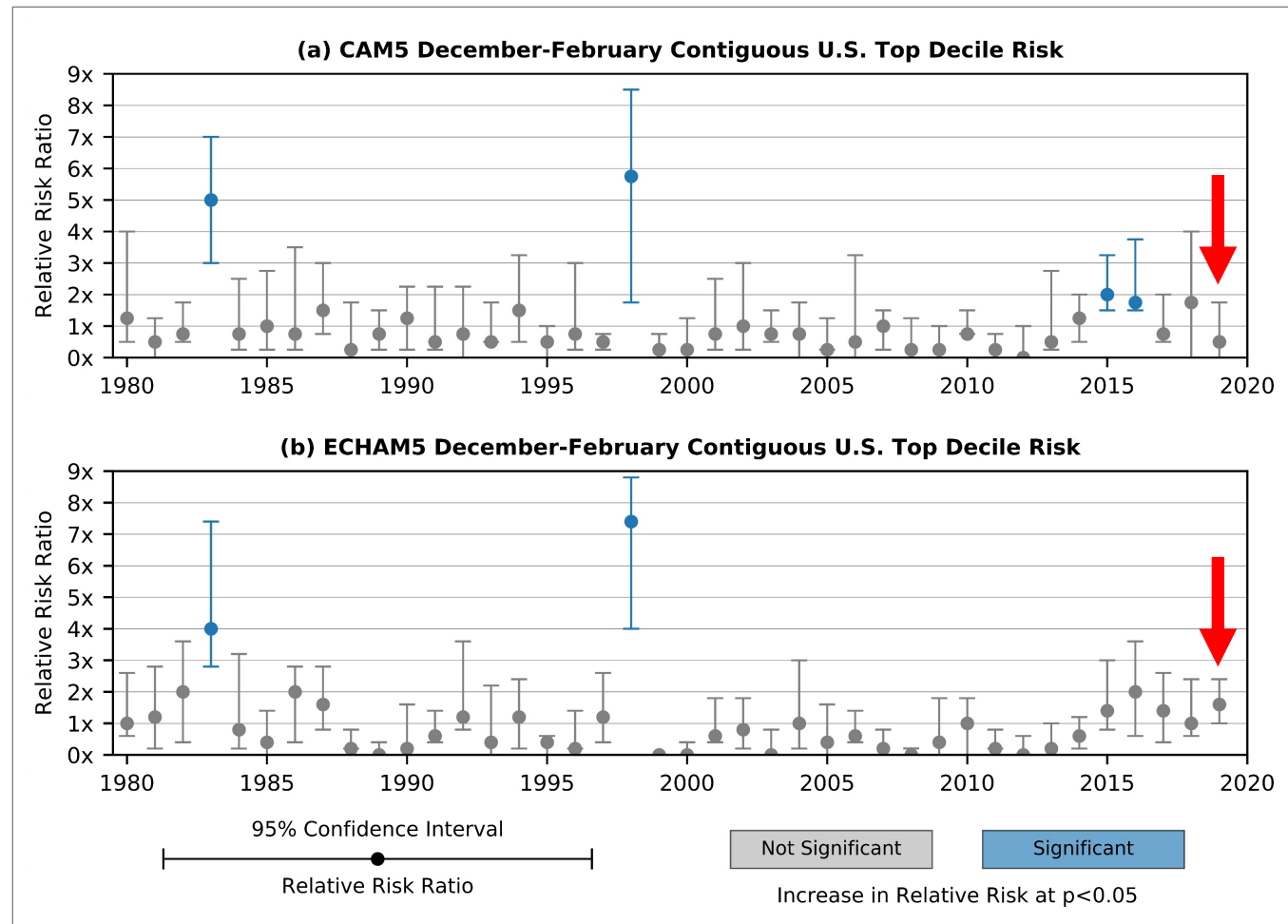
Winter 1982-83 and 1997-98, not 2018-19, were strong El Niño events

SST anomalies in 2018-19 much weaker and spread out across the tropical Pacific



Atmospheric model simulations do not indicate an increased risk of wet winter in 2019

Neither ensemble indicates statistically significant risk of wet or dry

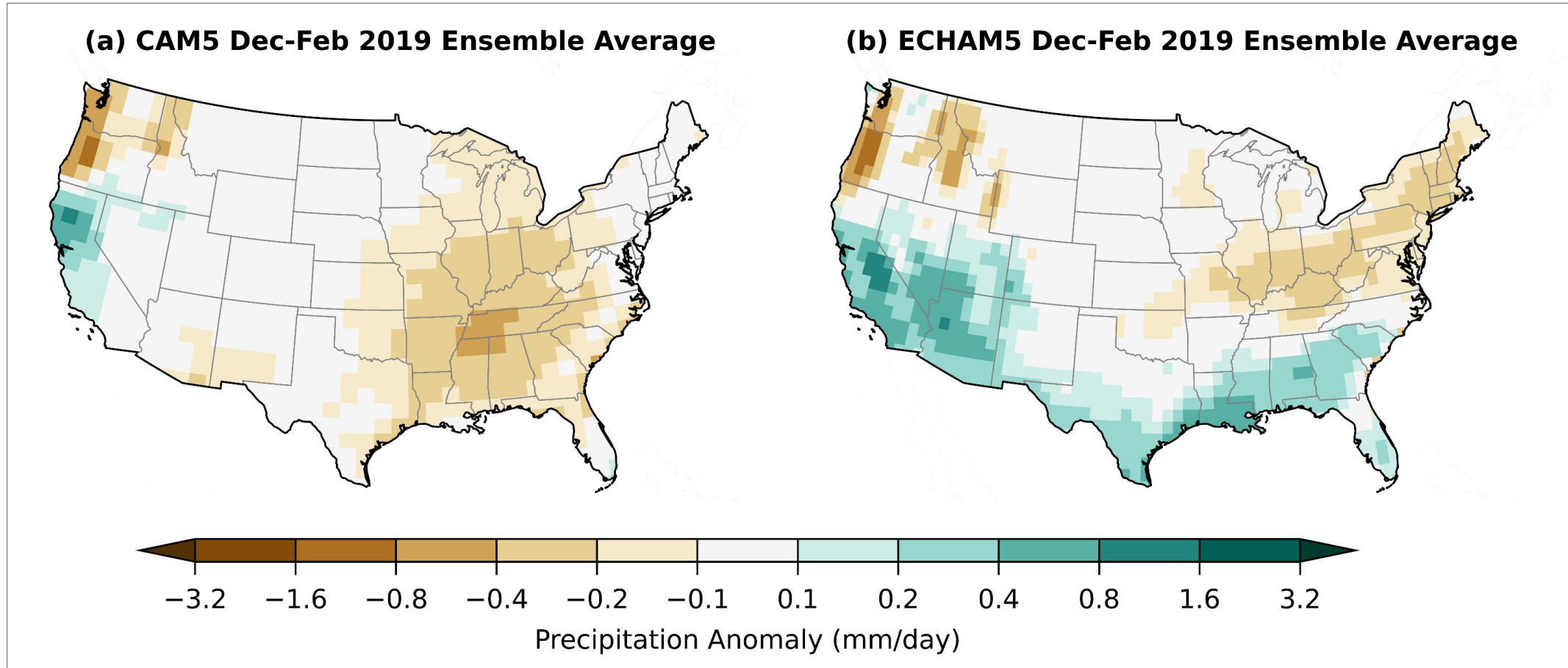


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Atmospheric model simulations do not indicate widespread wetness in Winter 2018-2019

CAM5 indicates more dryness than wetness



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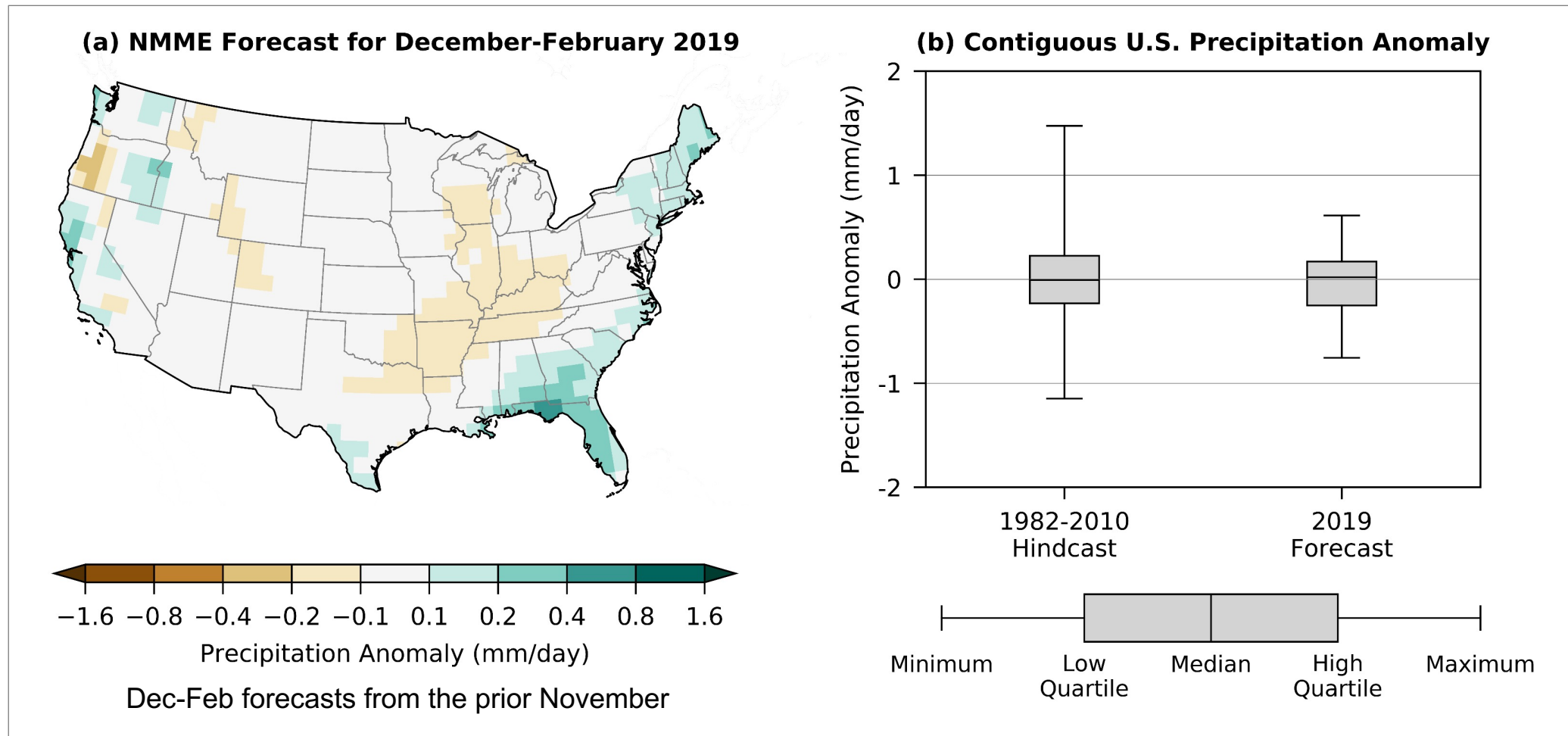
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Initialized Forecasts

Initialized forecast performance in Winter 2018-2019 and if they could have been used to anticipate the observed wetness

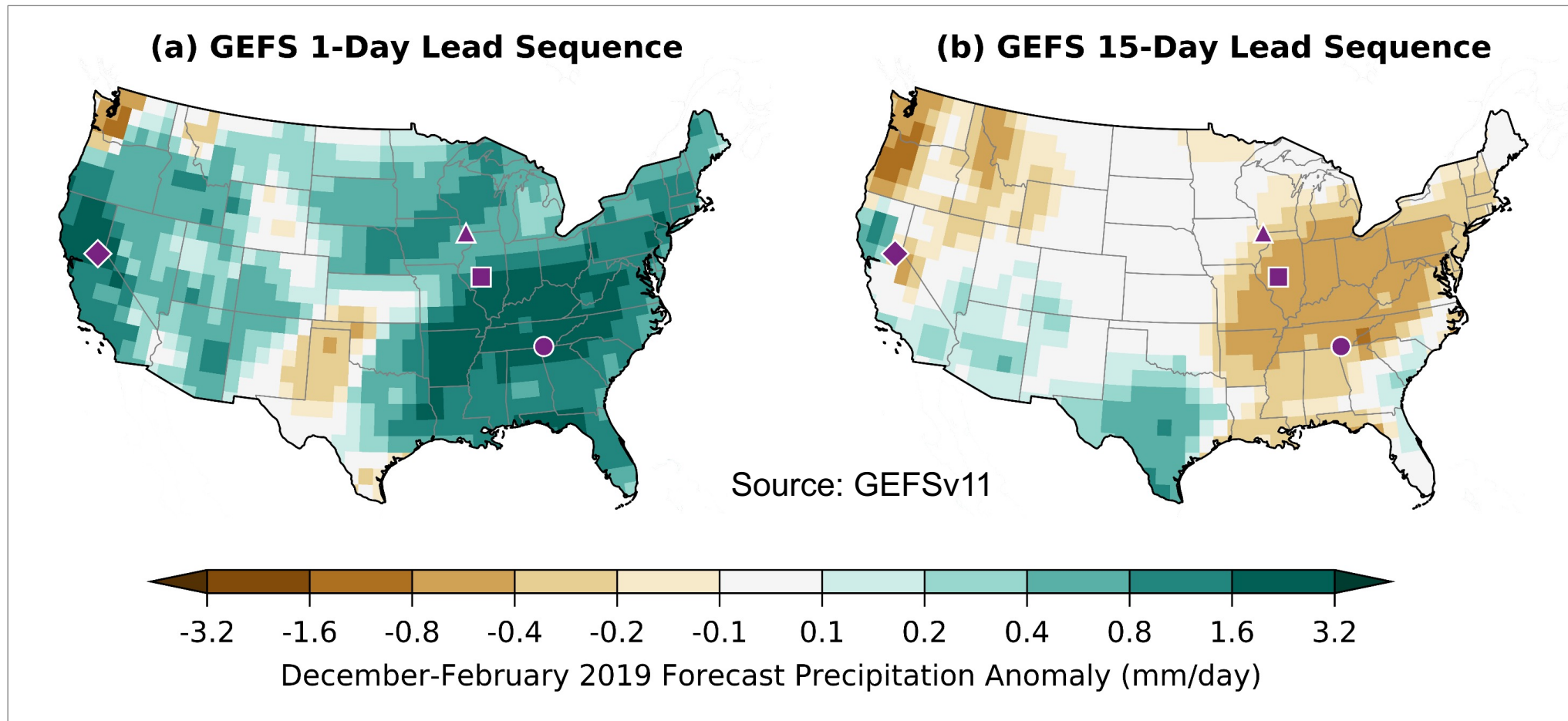
No indication from NMME of an increased likelihood of a wet winter in 2018-2019

Exceptional wetness over the Midwest and Great Lakes not forecast



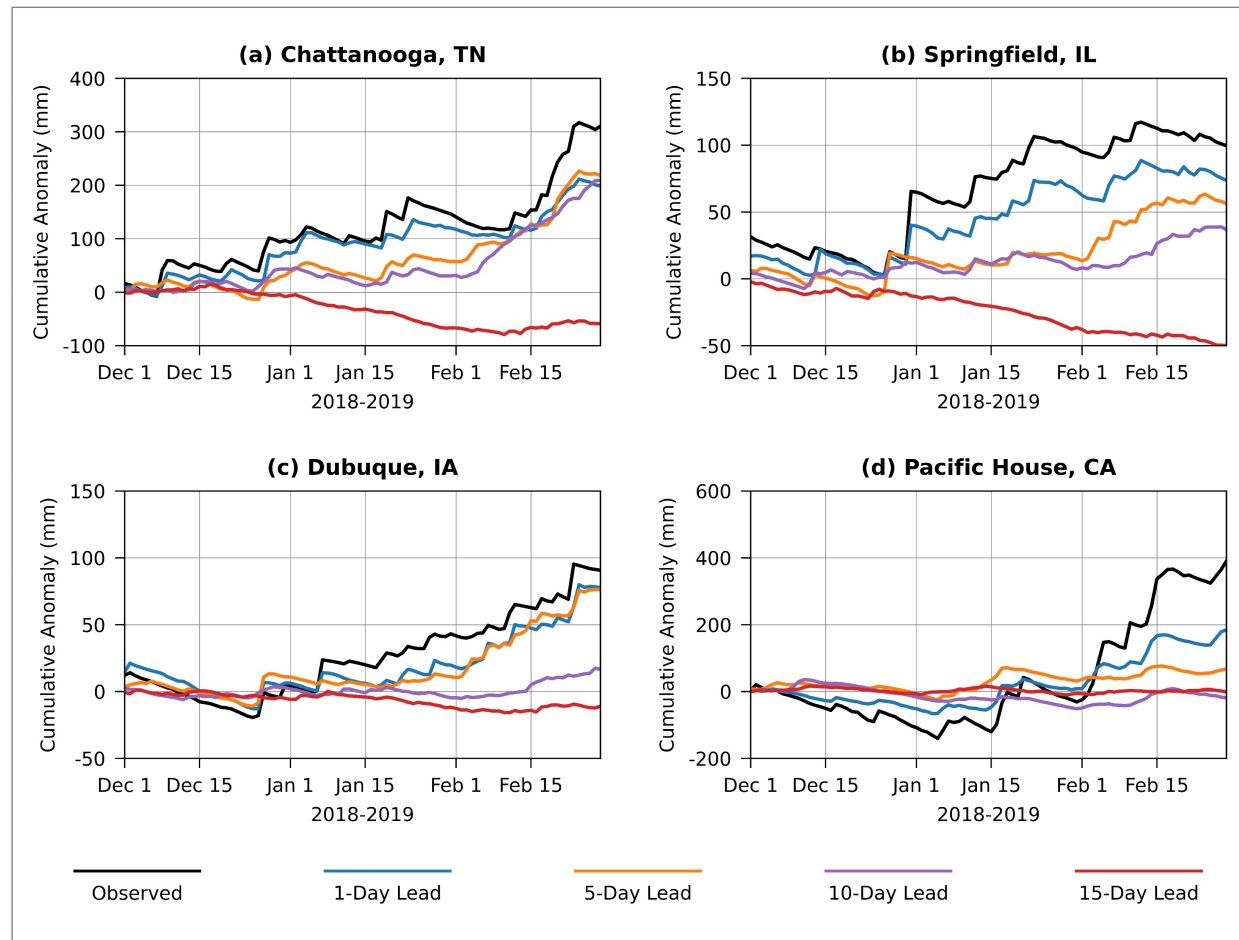
Winter 2018-2019 wetness not predictable at long leads

Forecast accuracy degrades greatly after about five days



Winter 2018-2019 wetness not predictable at long leads

Forecast degradation depends on location, but generally 5-10 days



Source: GEFSv11

Summary

1

Preconditions

- Trends to wetter conditions cannot forewarn of extreme wetness in a given winter
- Strong El Niño events are related to extreme wet winters over the contiguous U.S.
- El Niño in 2018-2019 did not increase the likelihood of a wet winter

2

Initialized Forecasts

- NMME: Extreme wetness in Winter 2018-2019 not predictable in Nov. 2018
- GEFS: Winter 2018-2019 wetness was not predictable beyond lead times of ~5 days

Extra slides

Exceptional flooding in Spring 2019 led to billions in losses



Highway 281 is seen damaged after a storm triggered historic flooding on March 16 in Niobrara, Neb. (Office of Governor Pete Ricketts/Reuters) (Handout/Reuters)



The swollen Pecatonica River spills into downtown Darlington, Wis., on March 14. (Dave Kettering/Telegraph Herald/AP)

Damage estimates are emerging from the state of Nebraska, and although preliminary, they are staggering: \$439 million road and bridge infrastructure, \$85 million in private residential and property, \$400 million in cow-calf losses, \$440 million in crop losses, 41 businesses destroyed, 2,067 homes destroyed, 200 miles of state roads damaged, 16 state highway bridges that are unpassable.

Agriculture.com, March 20, 2019

Iowa Gov. Kim Reynolds said Friday that recent flooding in the state has caused an estimated \$1.6 billion in damage, pushing the total costs from the devastating Midwest flooding to at least \$3 billion.

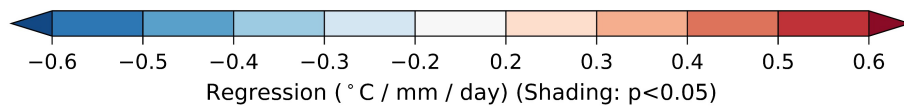
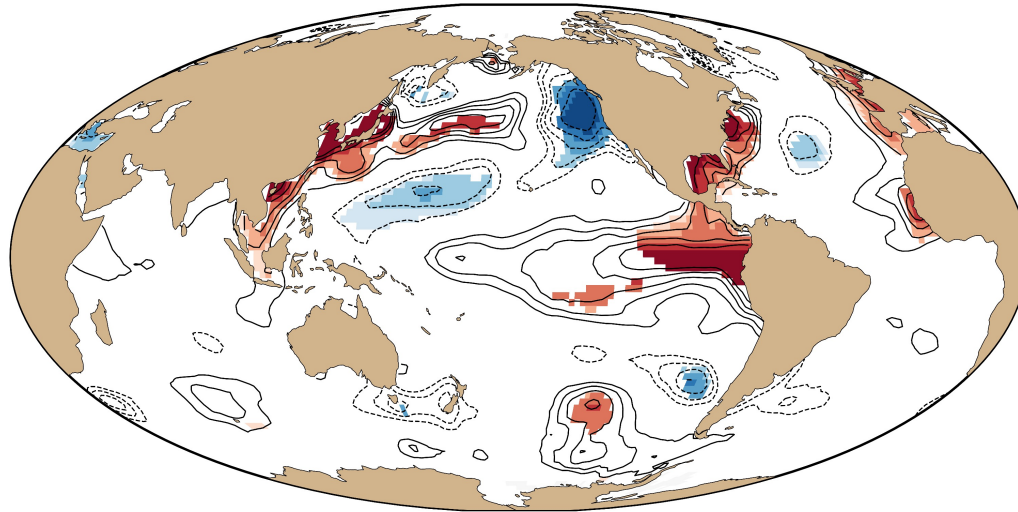
AP, March 22, 2019

"Taking into account the further losses in the valley from farming and manufacturing, we're definitely north of \$2 billion in impacts," said MRCTI executive director, Colin Wellenkamp. *NPR, June 25, 2019*

Contiguous U.S. winter precipitation is related to ENSO

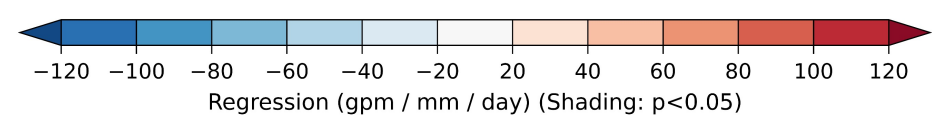
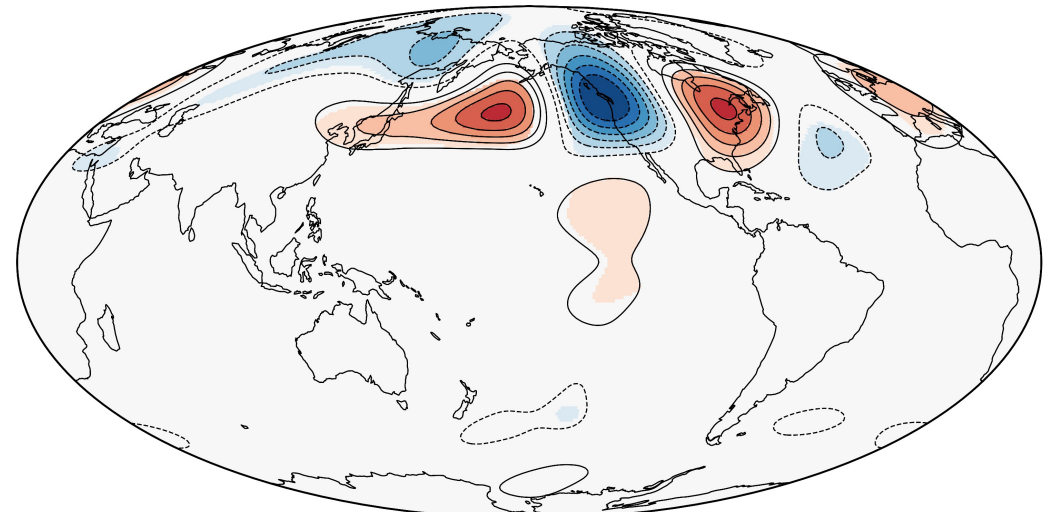
The magnitude of the relationships suggest that other factors are important

**December-February Sea Surface Temperature
and U.S. Precipitation Regression 1896-2018**



Source: NOAA/NCEI/nClimGrid and ERSST5

**December-February 250 hPa Geopotential Height
and U.S. Precipitation Regression 1896-2015**



Source: NOAA/NCEI/nClimGrid and 20th Century Reanalysis

NMME forecasts also indicate strong El Niño increases wet winter chances

Like atmospheric models, NMME forecast widespread wetness in 1983 and 1998

