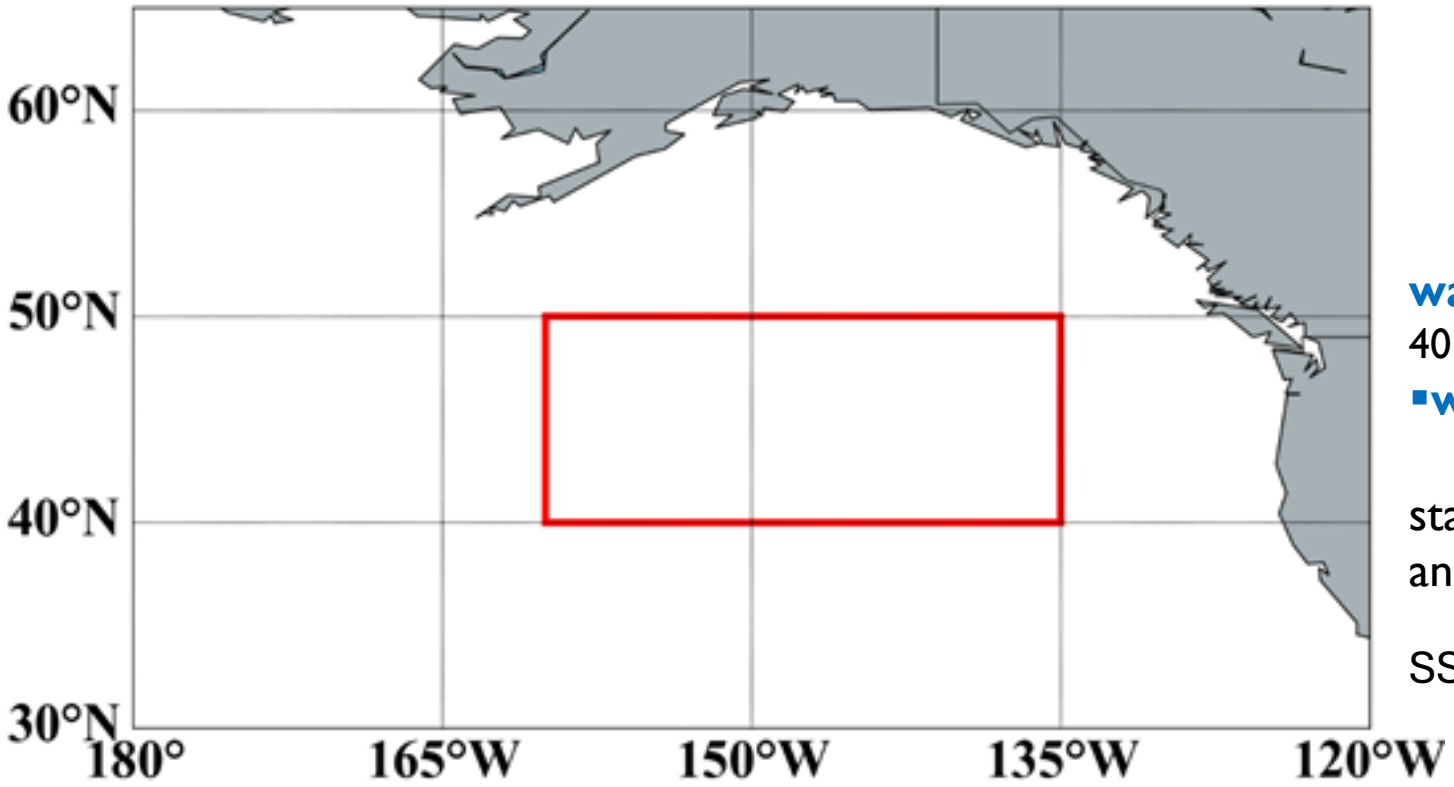
Assessing Weather Trends in Alaska: Here Comes the BLOB!

Dr. Timothy Eichler
Meteorologist
NRC Office of Nuclear Regulatory Research/Division of Risk Analysis/Fire and External Hazards Branch

https://www.rottentomatoes.com/m/the_blob

What Is “The Blob”?



warm blob area:
40°N–50°N, 160°W–135°W

- **warm blob index**

standardized monthly SST anomalies averaged over study area

SST: Sea Surface Temperature

- **warm blob event definition**

intensity threshold: larger than 0.75 of warm blob index

duration threshold: no fewer than 5 months with at most 1-month interruption

Shi et al. 2023. “Changes and mechanisms of long-lived warm blobs in the Northeast Pacific in low-warming climates.” European Geosciences Union General Assembly 2023, Vienna, Austria, April 23–28, 2023. EGU23-3723. https://doi.org/10.5194/egusphere-egu23-3723.

How Do We Assess Sea Surface Temperature Patterns?

EOF 1 (or "The Pacific Decadal Oscillation" [PDO])

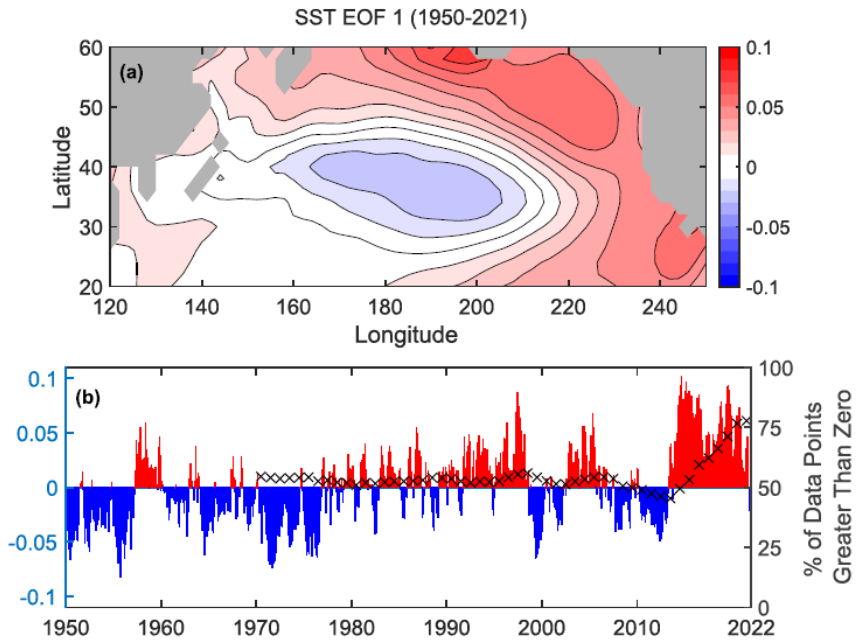


Figure 3. (a) The first EOF of SST over the PDO region for the entire time series (1950–2021). (b) The principal component for the first EOF is shown on the left *y*-axis, with red bars indicating positive years and blue bars indicating negative years. The right *y*-axis (x symbols) shows the percentage of grid points greater than zero in the first EOF from 1970 to 2021.

EOF 2 (or "The Blob")

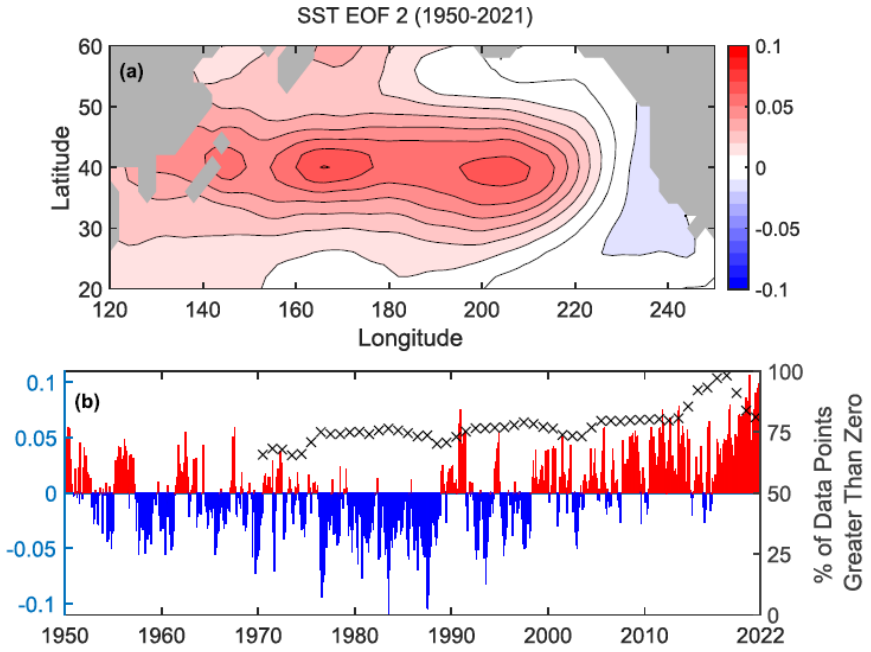


Figure 6. (a) The second EOF of SST over the PDO region for the entire time series (1950–2021). (b) The principal component for the second EOF is shown on the left *y*-axis using colored bars. The right *y*-axis (*x* symbols) shows the percentage of data points greater than zero in the second EOF from 1970 to 2021.

EOF: Empirical Orthogonal Function

Role: Statistical method to uncover spatial patterns of variability in data

How it works: Highest EOF (i.e., the first) explains the most variability, with subsequent EOFs explaining decreasing variability sequentially

Interpretation: EOFs 1 and 2 are usually the most relevant in assessing physically relevant patterns.

Werb, B.E., and D.L. Rudnick. 2023. "Remarkable Changes in the Dominant Mode of North Pacific Sea Surface Temperature." ***Geophysical Research Letters*** **50(4). https://doi.org/10.1029/2022GL101078.**

What Has Been Changing??? (EOF 1 AKA “The PDO”)

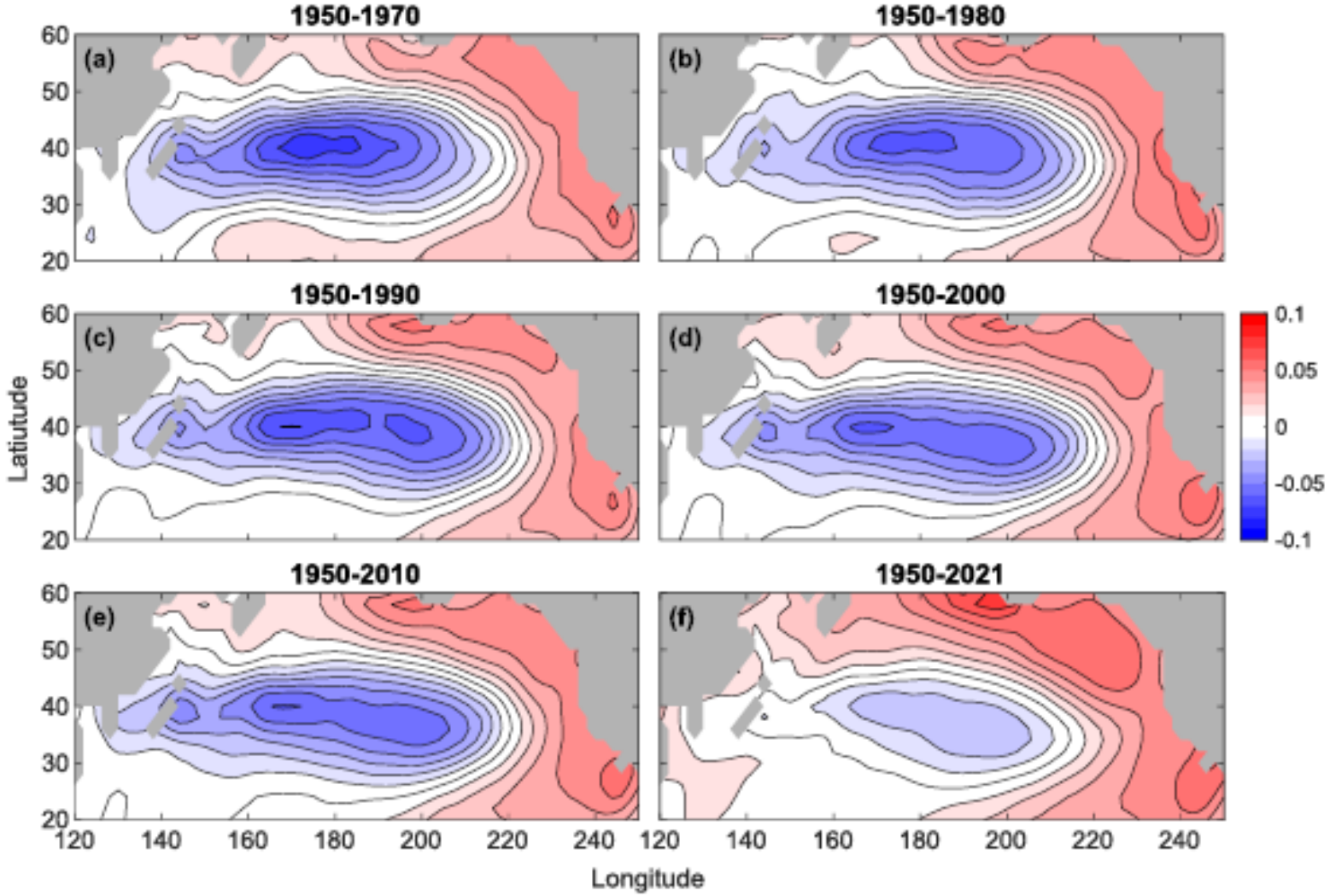


Figure 2. The first EOF of SST over the PDO region (120°E–110°W 20°N–60°N). Panels (a–f) show the same spatial pattern calculation with a changing time series highlighting the effects of ocean warming in the last decade.

Werb, B.E., and D.L. Rudnick. 2023. “Remarkable Changes in the Dominant Mode of North Pacific Sea Surface Temperature.” *Geophysical Research Letters* 50(4). https://doi.org/10.1029/2022GL101078.

What Has Been Changing??? (EOF 2 AKA “The Blob”)

EOF 2 by Decade

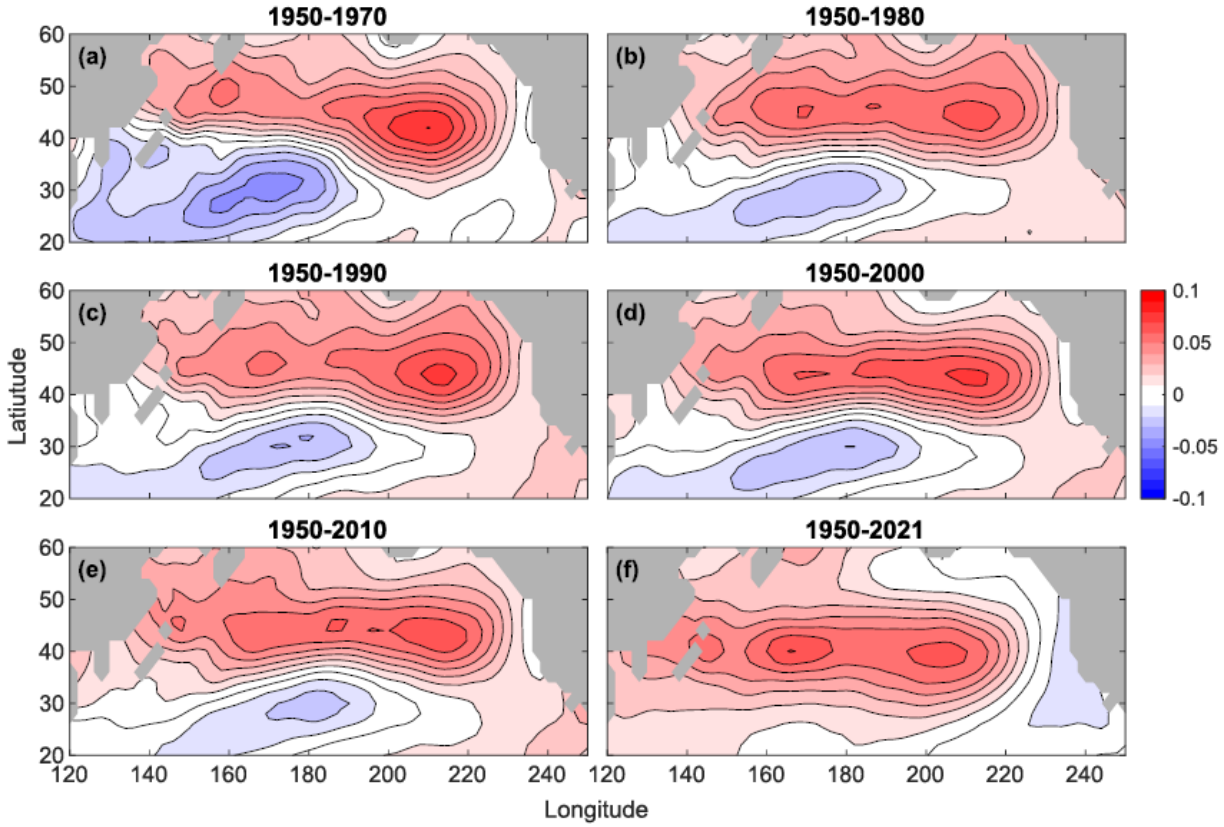


Figure 5. The second EOF of SST over the PDO region (120°E–110°W 20°N–60°N). Panels (a–f) show the same spatial pattern calculation with a changing time series.

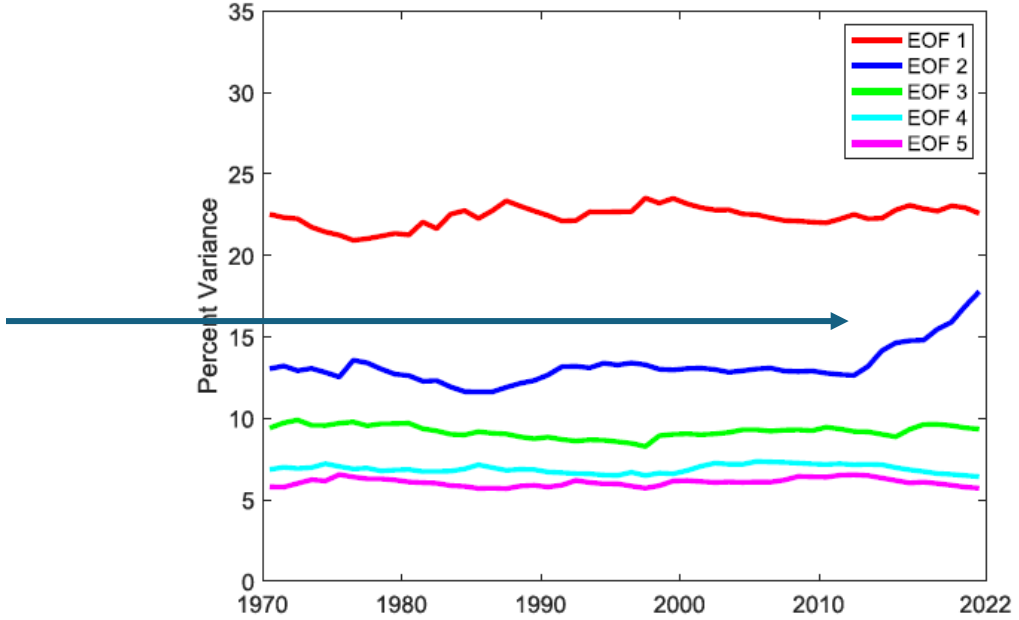


Figure 4. The percent variance accounted for by each EOF of the SST data set over the period of 1970–2021.

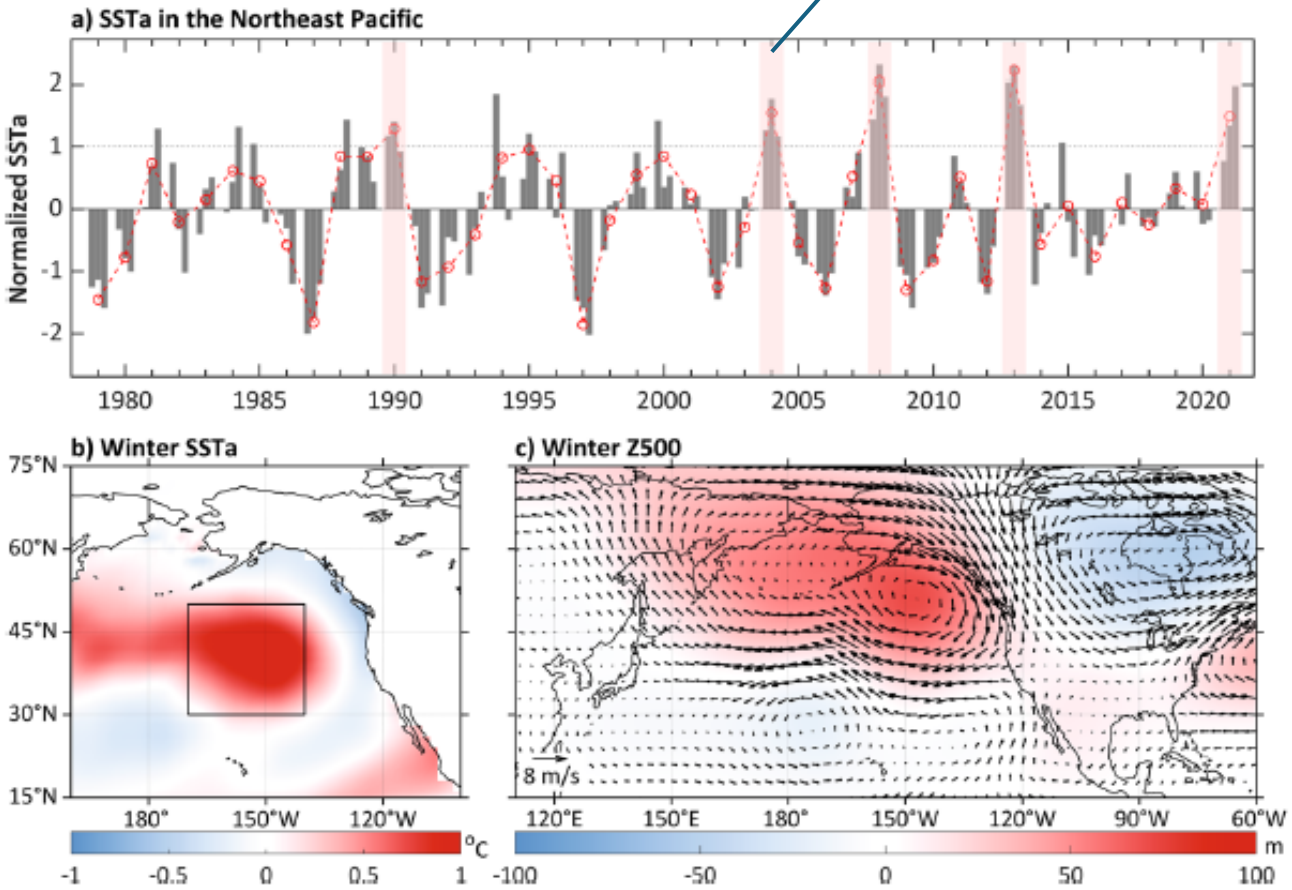
Note: EOF 1 is the PDO and EOF 2 is “The Blob.” Note in the last decade the rapid increase in explained variability for EOF 2. EOFs 3–5 explain much less variability; they are included to demonstrate that EOF 2 is the only one undergoing rapid change in the past several decades.

Werb, B.E., and D.L. Rudnick. 2023. “Remarkable Changes in the Dominant Mode of North Pacific Sea Surface Temperature.” *Geophysical Research Letters* 50(4). https://doi.org/10.1029/2022GL101078.

Here Comes “THE BLOB”!

Shaded areas indicate “Blob” events

Fig. 1 | Evolution of winter SST anomalies and atmospheric responses to warm blobs in the NE Pacific from 1979 to 2021. a Time series of normalized winter (DJF) SST anomalies from 1979 to 2021 based on ERSST v5 dataset. The gray bars represent the monthly SST anomalies, while the dotted red line signifies the winter SST anomalies averaged in NE Pacific (black box; 140°–170°W, 30°–50°N). The pink shadings indicate the warm blobs. Composite anomalies of **b** SST and **c** 500-hPa geopotential height (Z500) along with winds associated with the identified warm blobs in the NE Pacific.

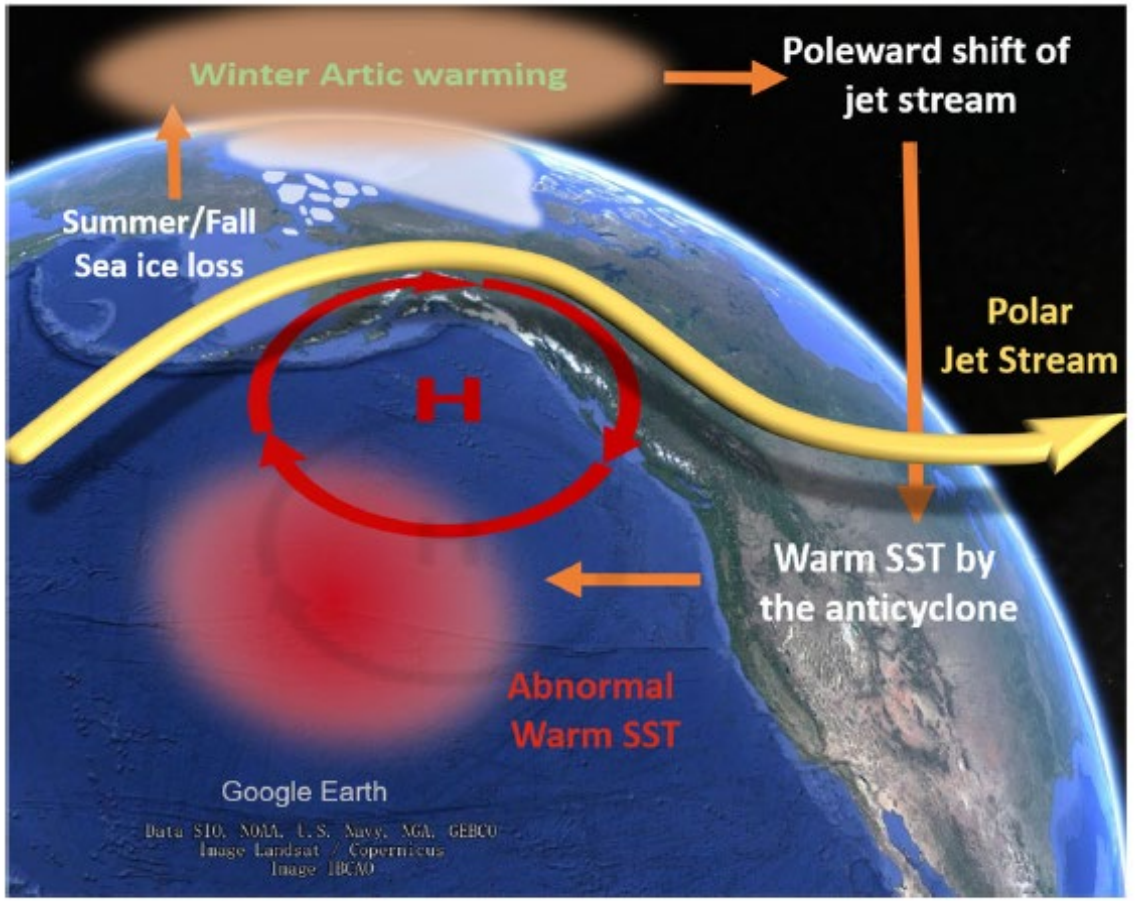


Z500: 500 hectopascals (hPa) in height (a good proxy for the general circulation)

Chen et al. 2025. “Arctic warming as a potential trigger for the warm blob in the northeast Pacific.” *NPJ [Nature Partner Journals] Climate and Atmospheric Science* 8:111. https://doi.org/10.1038/s41612-025-00900-9.

Why Should We Care???

Fig. 5 | The pathway of ES-CS warming leading to the occurrence of winter warm blobs in the NE Pacific. Schematic diagram illustrating the physical mechanisms of the teleconnection between Arctic warming and NE Pacific warm blobs in winter (Background image from Google Earth: Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Image Landsat/ Copernicus; Image IBCAO).



Answer: It alters the polar jet stream and hence regional weather patterns!

Chen et al. 2025. "Arctic Warming as a Potential Trigger for the Warm Blob in the Northeast Pacific." *NPJ Climate and Atmospheric Science* 8:111. https://doi.org/10.1038/s41612-025-00900-9.

Trending Blob?

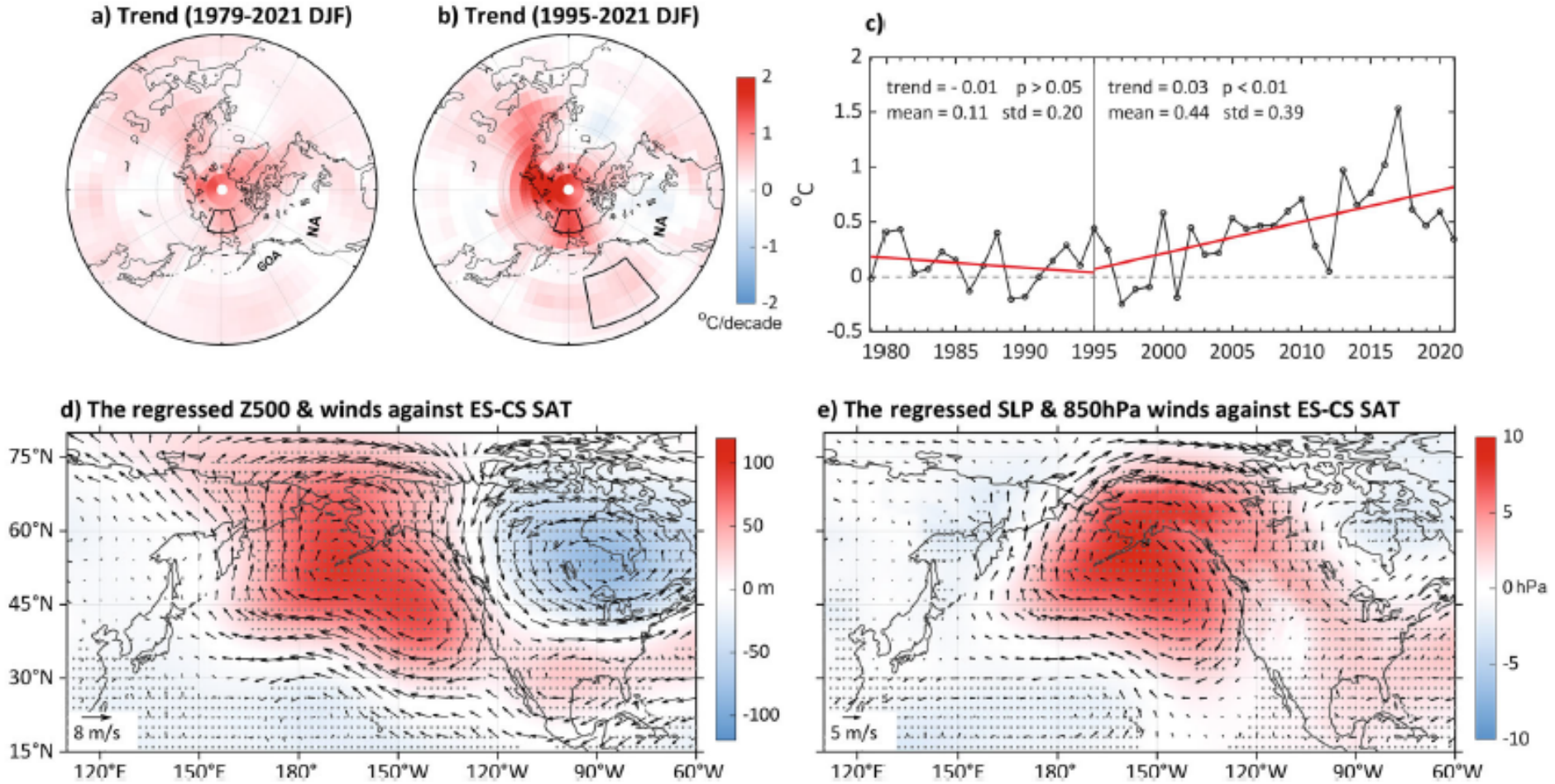
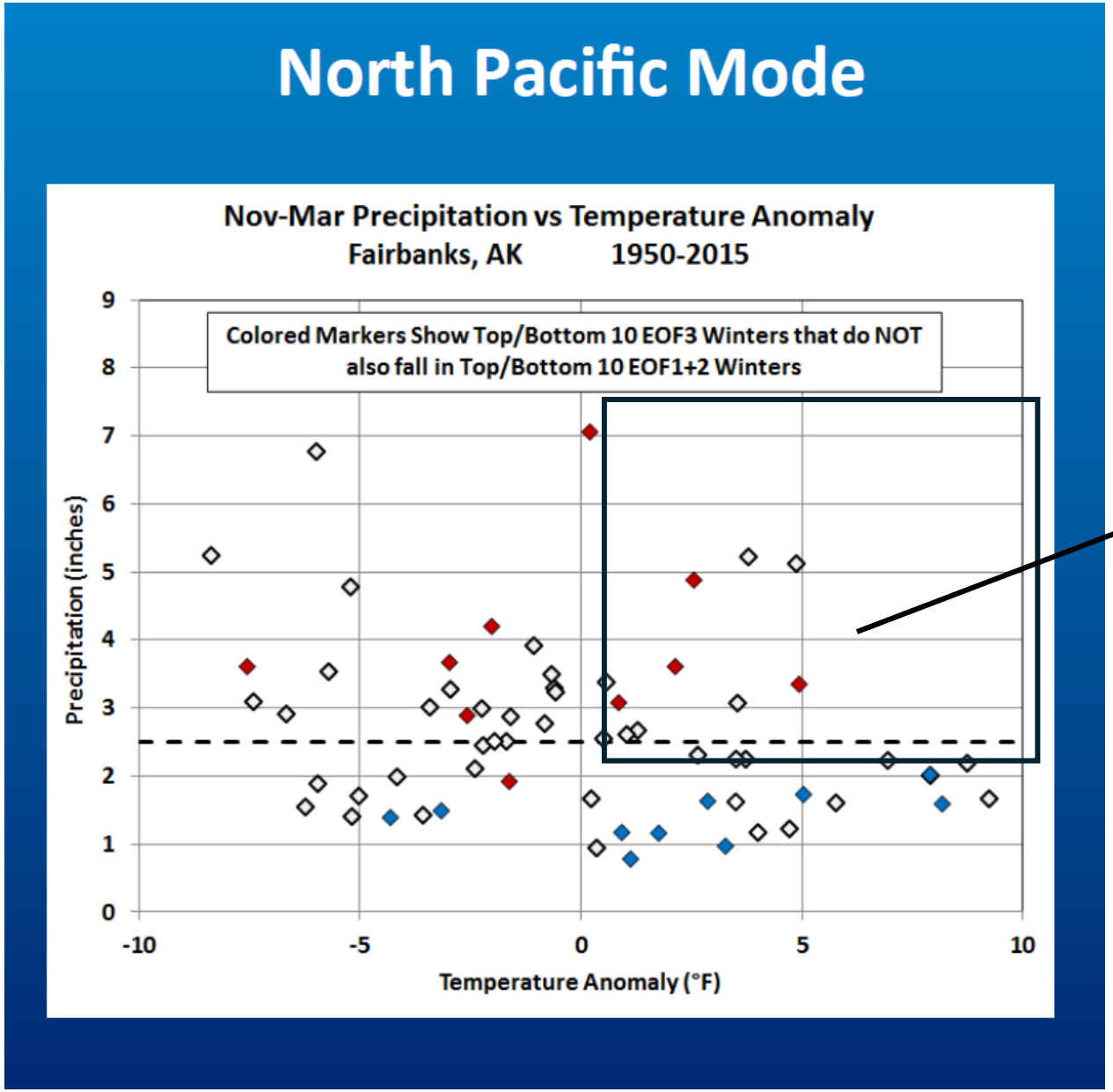


Fig. 2 | Temporal evolution of historical SAT, along with atmospheric circulation responses to the ES-CS SAT in boreal winter. Trends in winter (DJF) SAT from **a** 1979 to 2021 and **b** 1995 to 2021 based on observed data. The black boxes indicate the ES-CS (160°E–160°W, 70°–80°N) and NE Pacific regions (140°–170°W, 30°–50°N). **c** Time series of DJF-mean ES-CS SAT anomalies during winter from 1979 to 2021 (black line), with linear trends shown in red lines. Mean values and standard deviations of ES-CS SAT anomalies were calculated for the periods before and after mid-1990s. GOA: Gulf of Alaska; NA: North America. Spatial patterns of winter **d** Z500 and wind anomalies, **e** 850-hPa geopotential height (Z850) and wind anomalies regressed onto the ES-CS SAT from 1979 to 2021. Dotted regions indicate areas that satisfy the 95% confidence levels.

Chen et al. 2025. "Arctic warming as a potential trigger for the warm blob in the northeast Pacific." *NPJ Climate and Atmospheric Science* 8:111. https://doi.org/10.1038/s41612-025-00900-9.

Blob Effects on Fairbanks Winter Temperature and Precipitation



Blob effects on Fairbanks winter temperature and precipitation: tendency toward warm and wet!

Reason: Onshore winds from the North Pacific (previous slide)

James, R. 2015. "The North Pacific SST 'Blob' and Alaska Winter Climate." Prescient Weather, Ltd. Presented to the University of Alaska, Fairbanks. September 21, 2015. https://s2s.worldclimateservice.com/wcs/uaf_sep2015_north_pacific_sst_blob.pdf.

Conclusions

- As much as I would like to take credit, calling it “The Blob” was not my idea!
- “The Blob” is the “new kid on the block” regarding SST patterns in the North Pacific (EOF 2).
- The positive phase represents an “oceanic heat wave.”
- “The Blob” impacts the polar jet stream and hence, regional weather.
- The positive phase impacts the Alaska winter (Fairbanks) by making it warmer and wetter.
- “The Blob” may represent a new trend in SSTs across the North Pacific.
- A seasonal forecast implication is that “The Blob” may help with predictability of the Alaskan winter when present, since SSTs change more slowly than the atmosphere.
- Research is needed to investigate weather extremes on a regional basis. For example, does Alaska have more extreme warmth (cold) and more floods (droughts) when “The Blob” is in a positive (negative) phase? What are implications for assessing the location for a nuclear reactor?

I have Alaska in my sight! (what eyes?)

https://www.rottentomatoes.com/m/the_blob