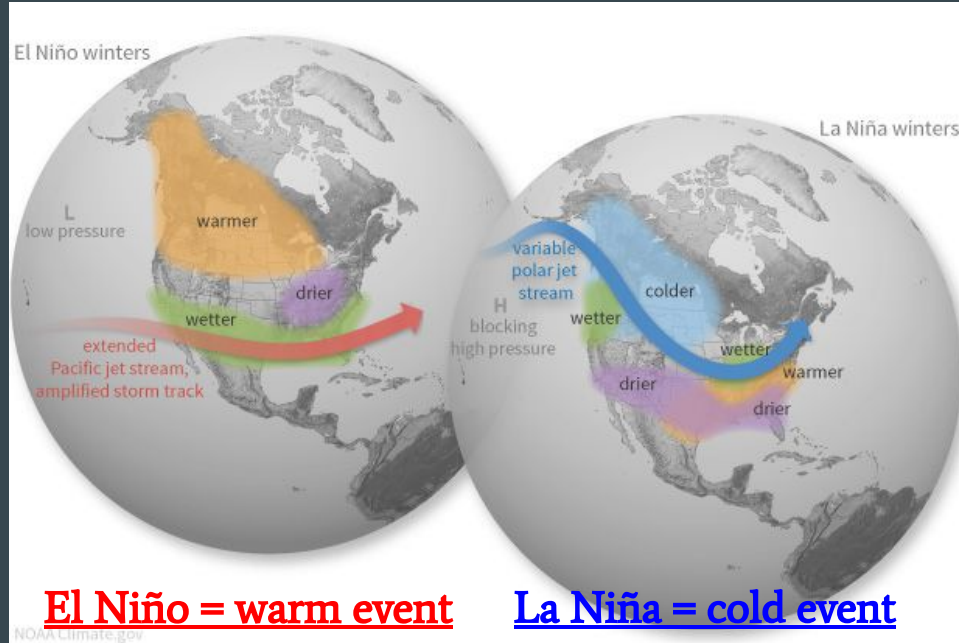


# Does ENSO have a significant, predictable cycle?

...

Alex Vand  
EDS 222  
2021-12-07

# Background - El Niño Southern Oscillation (ENSO) cycle



Drier and warmer (northern U.S. and Canada)

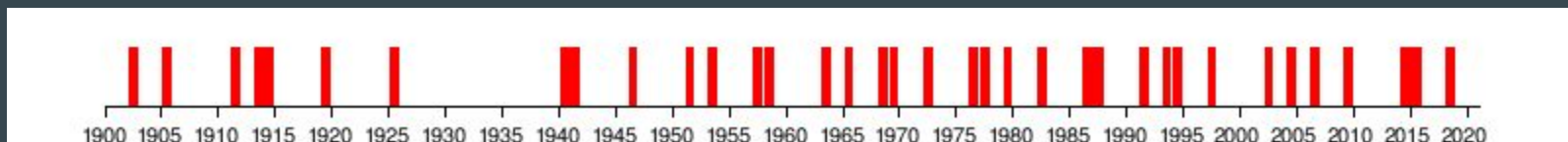
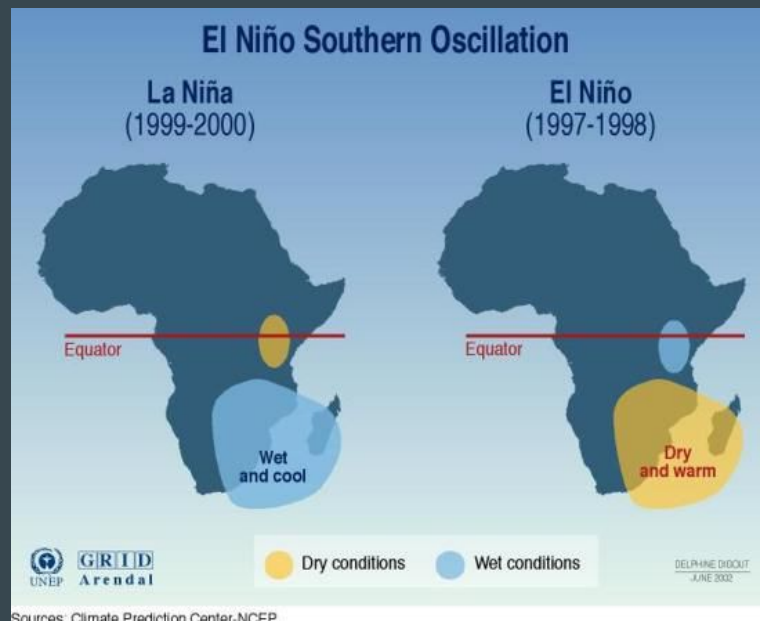
Heavy rains and flooding (Pacific Northwest and Canada)

Wetter with increased flooding (the U.S. Gulf Coast and Southeast)

Drought (southern U.S.)

# Motivation - How accurately can we predict ENSO?

- Global impacts
  - Agriculture: crop yields
  - Economies: fishing
  - Human health: undernutrition
  - Weather: wildfire, hurricanes
- Varying research suggests there is some pattern
  - 2-7 year cycle?
  - Irregularity in ENSO occurrence



# Data

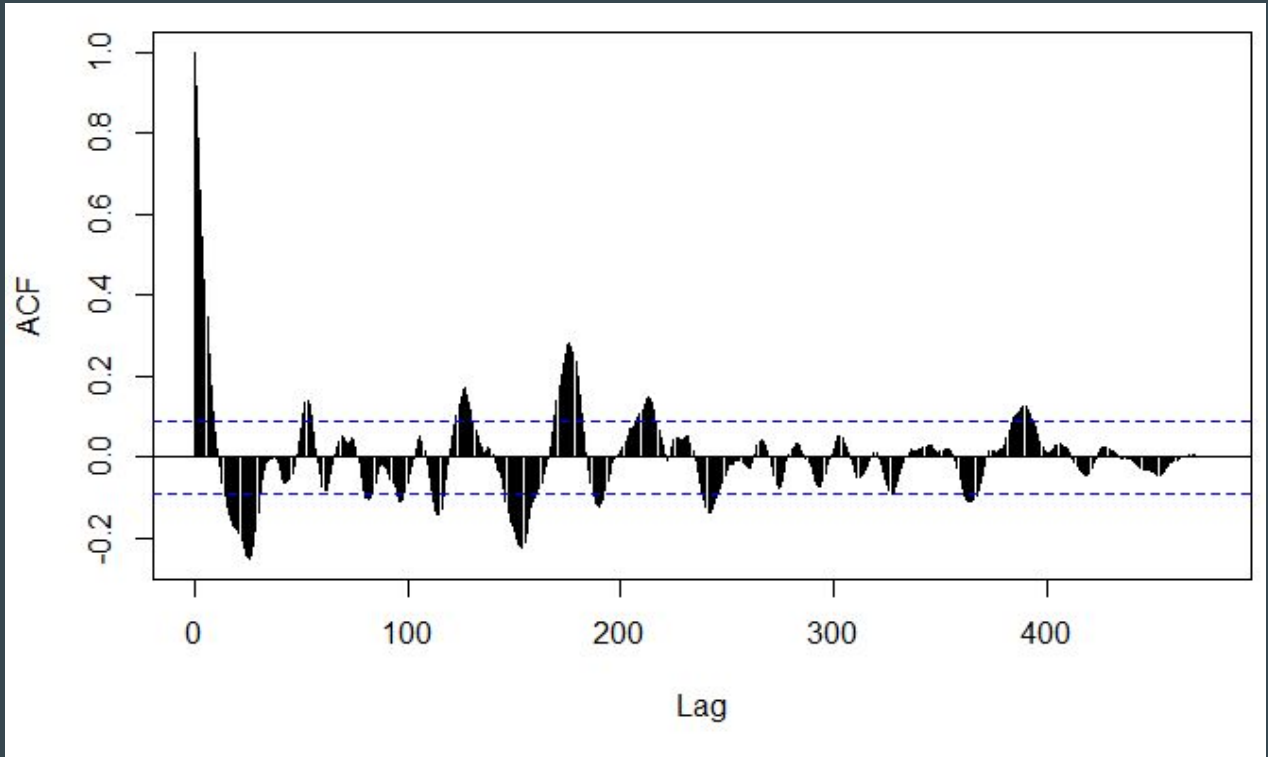


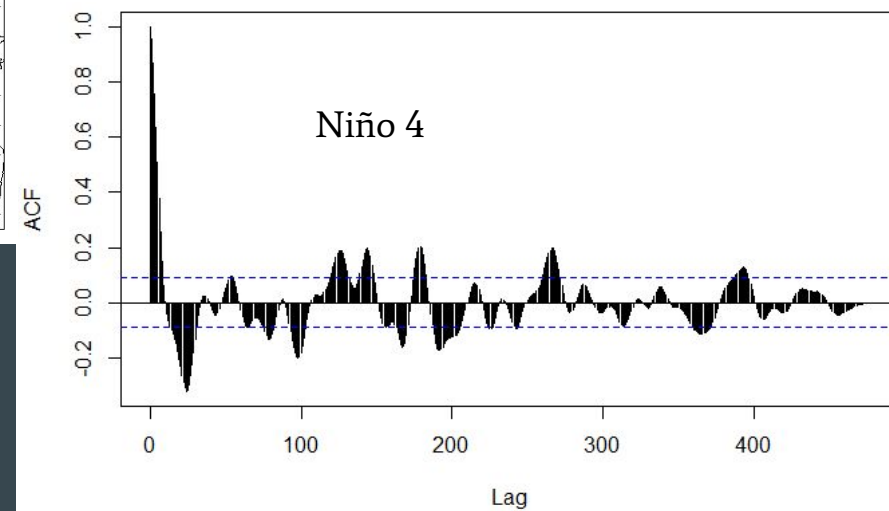
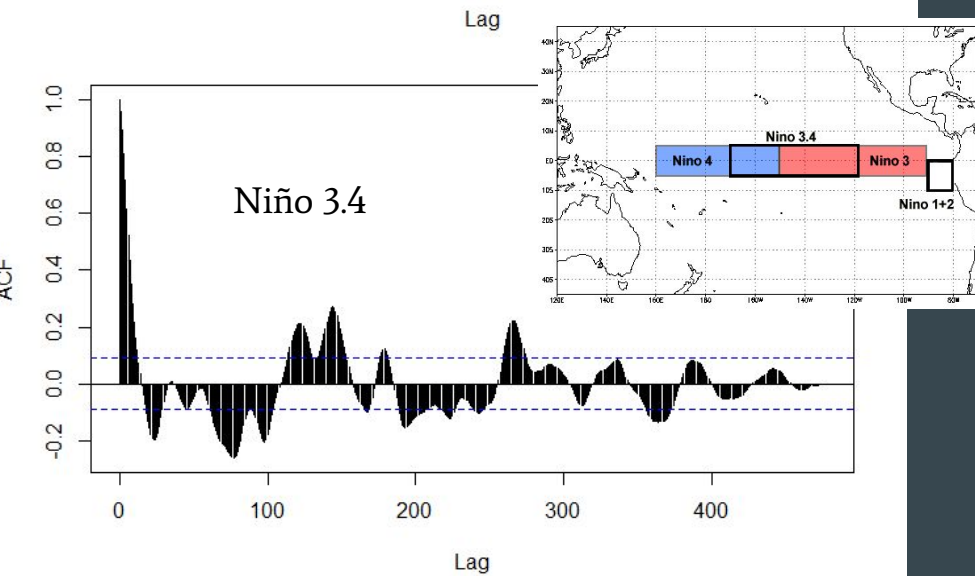
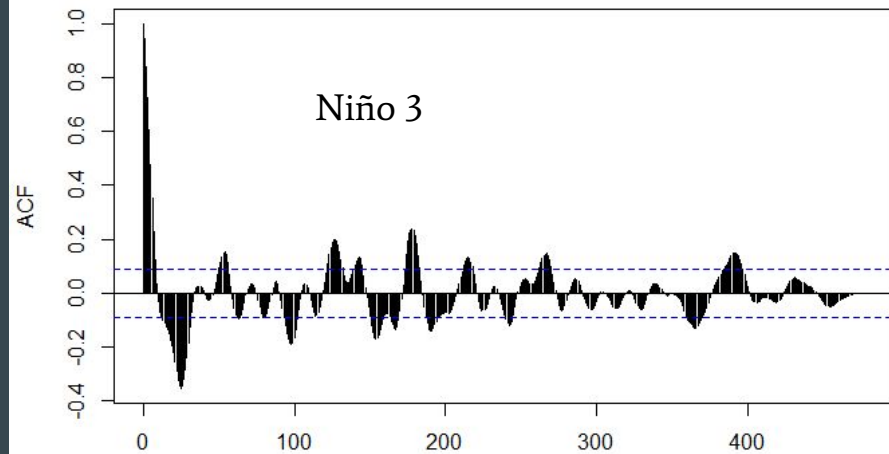
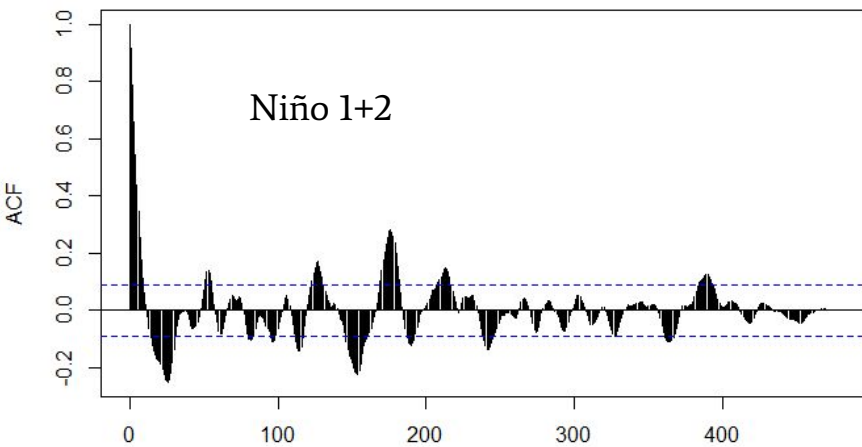
- Measurements of **monthly SST anomalies** across four regions of the **Pacific**
- **NOAA's** National Weather Service Climate Prediction Center
- From January 1982 to October 2021 (~40 years)
- Sea surface temperature (SST) measured in degrees Celsius
- .csv format

	yr	mon	nino1_2	anom_4	nino3	anom_6	nino4	anom_8	nino3_4	anom_10
1	1982	1	24.29	-0.17	25.87	0.24	28.30	0.00	26.72	0.15
2	1982	2	25.49	-0.58	26.38	0.01	28.21	0.11	26.70	-0.02
3	1982	3	25.21	-1.31	26.98	-0.16	28.41	0.22	27.20	-0.02
4	1982	4	24.50	-0.97	27.68	0.18	28.92	0.42	28.02	0.24
5	1982	5	23.97	-0.23	27.79	0.71	29.49	0.70	28.54	0.69
6	1982	6	22.89	0.07	27.46	1.03	29.76	0.92	28.75	1.10

# Results & Analysis - Autocorrelation

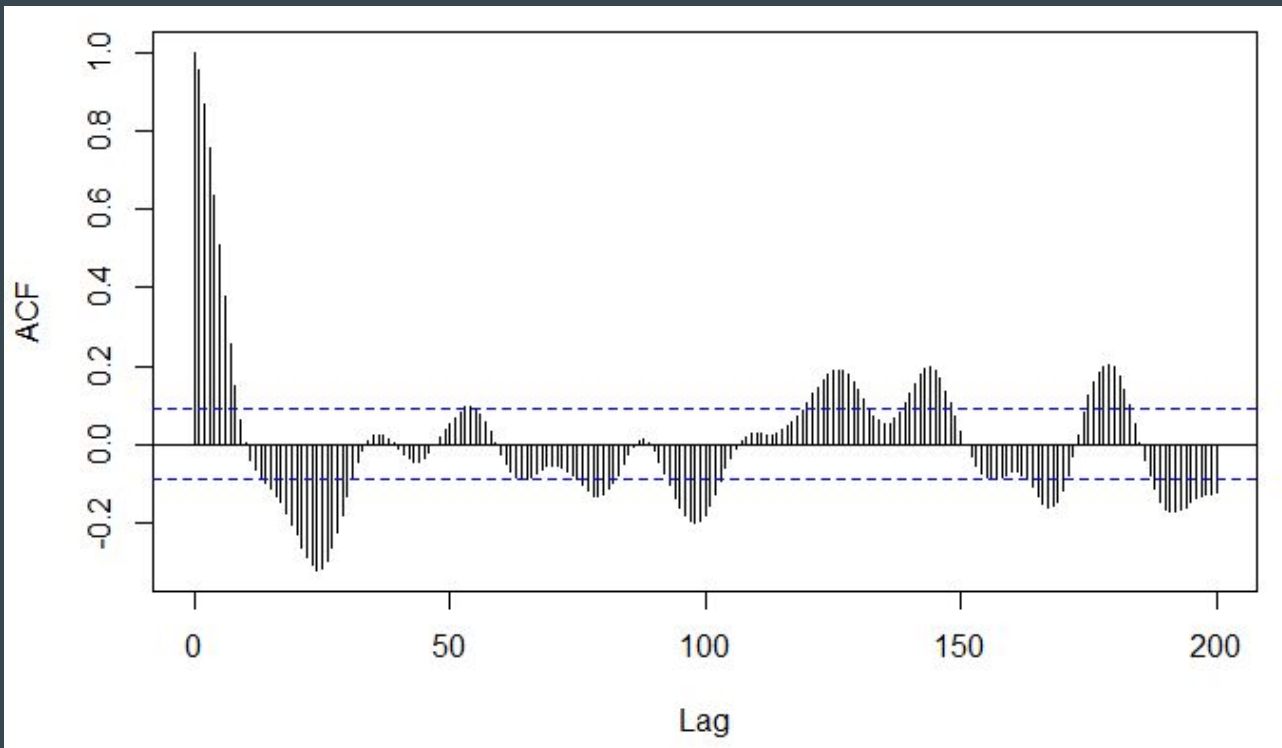
- Autocorrelation function: `acf()`
- **Statistically significant** lag months where acf is outside of the blue dotted lines





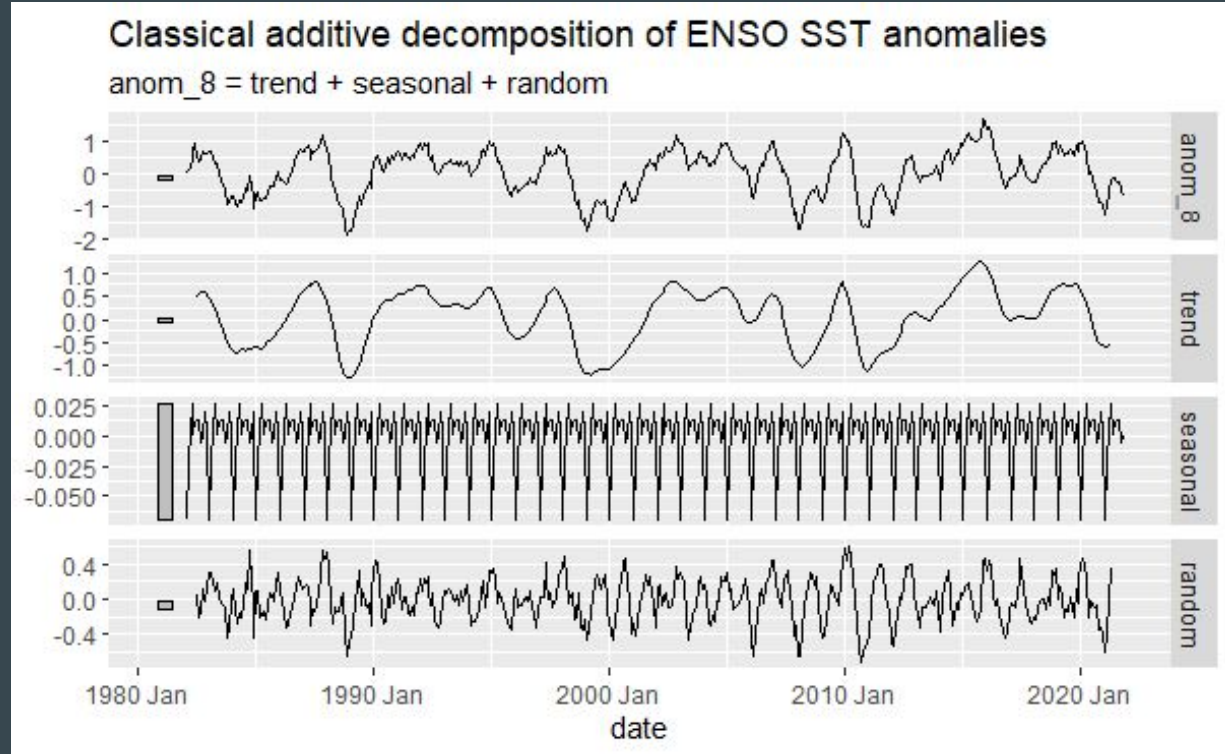
# Results & Analysis - Autocorrelation

- [Lag] = months
- 25 months ~ 2 years
- 100 months ~ 8 years
- 125 months ~ 10 years
- 175 months ~ 15 years



# Results & Analysis - Classical Decomposition

- **Trend:** statistically significant, appears to repeat cyclically
- **Seasonal:** no statistically significant seasonal pattern
  - Could find a more meaningful output by adjusting the length of seasonality





# Future Research

- Search for patterns with other indicators of human welfare
  - Help us prepare for extreme weather events
- Compare crop yield time series data to ENSO anomalies
  - Is corn or cassava more “ENSO-tolerant”?

## References

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6.US Department of Commerce, N. O. and A. A. What are El Nino and La Nina? <https://oceanservice.noaa.gov/facts/ninonina.html>.

7. Anttila-Hughes, J.K., Jina, A.S. & McCord, G.C. ENSO impacts child undernutrition in the global tropics. *Nat Commun* 12, 5785 (2021). <https://doi.org/10.1038/s41467-021-26048-7>

