

American Geophysical Union Fall Meeting

December 10, 2024



Investigating the Impact of Climate Variability and Change on the California Current System

Jacqueline Kiszka

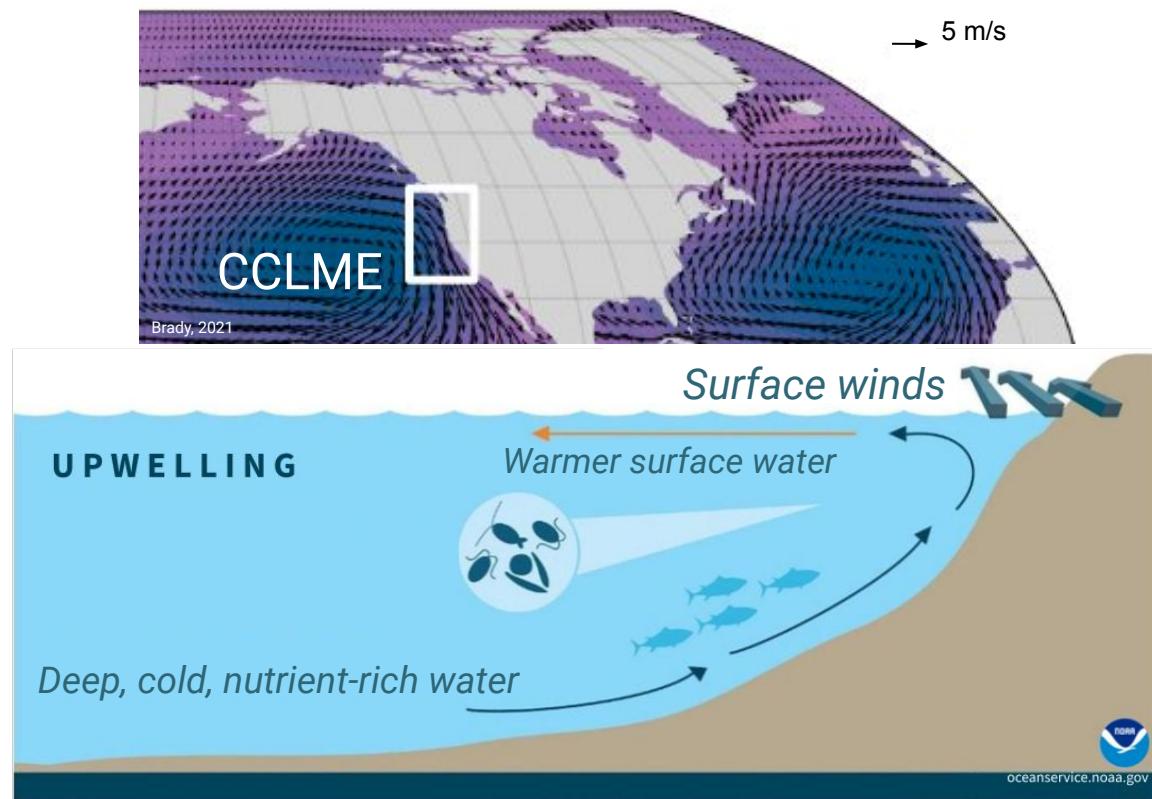
The Pennsylvania State University
NOAA Physical Sciences Laboratory

Natalie Freeman and Dillon Amaya

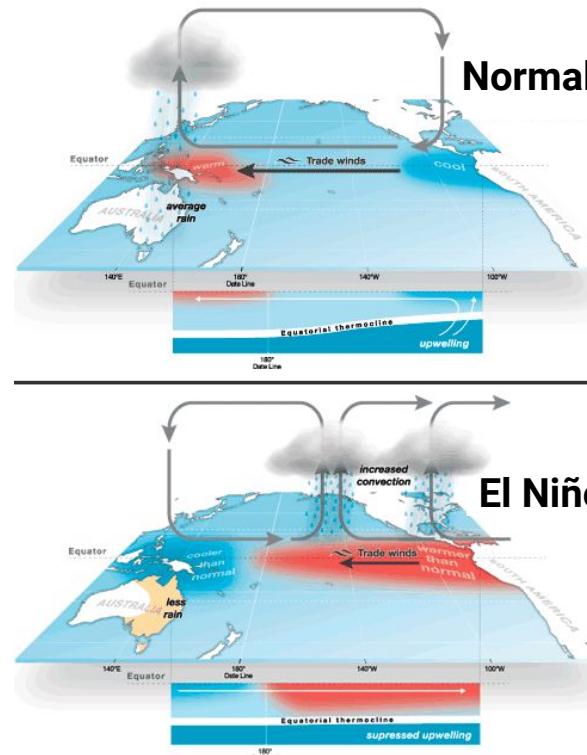
The California Current Large Marine Ecosystem (CCLME)



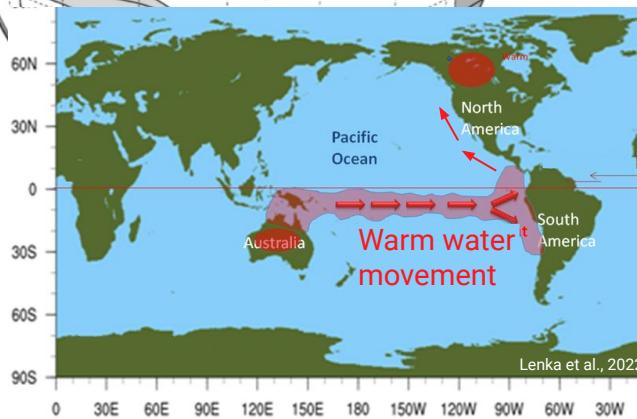
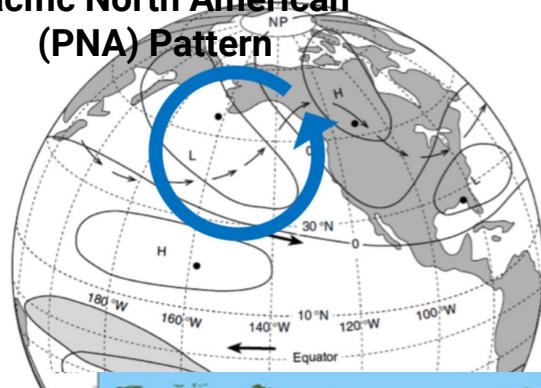
Upwelling Supports a Rich Ecosystem



ENSO–CCLME Teleconnections

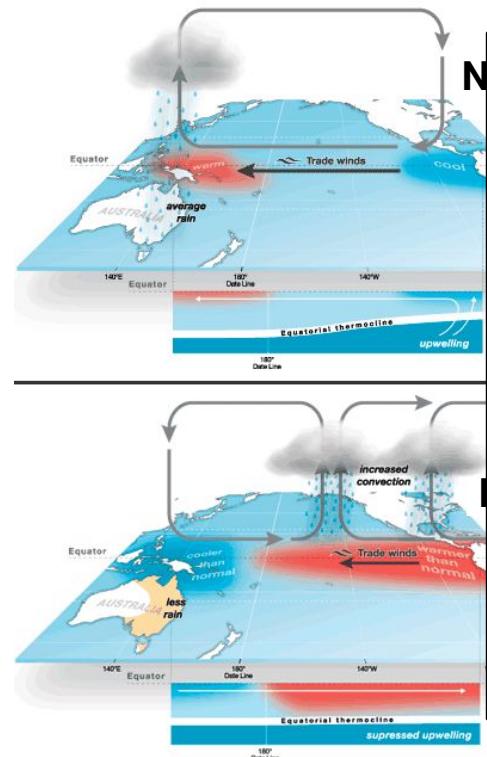


Pacific North American
(PNA) Pattern



Dampened
upwelling
in the
CCLME

ENSO–CCLME Teleconnections



Pacific North American
NP

Motivation:

Short observational records



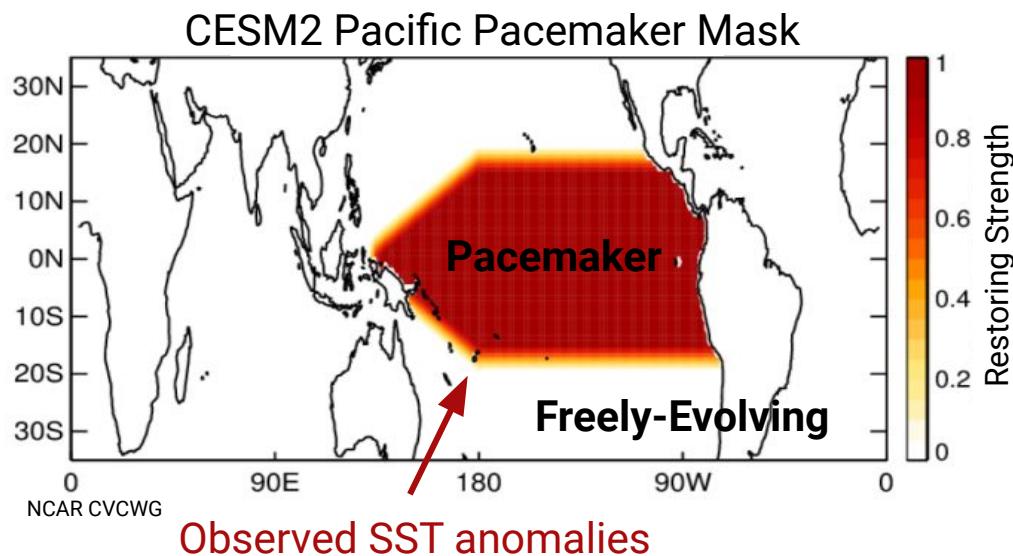
Model the relationship between
ENSO and the CCLME



Inform resource managers on
the range of possible outcomes

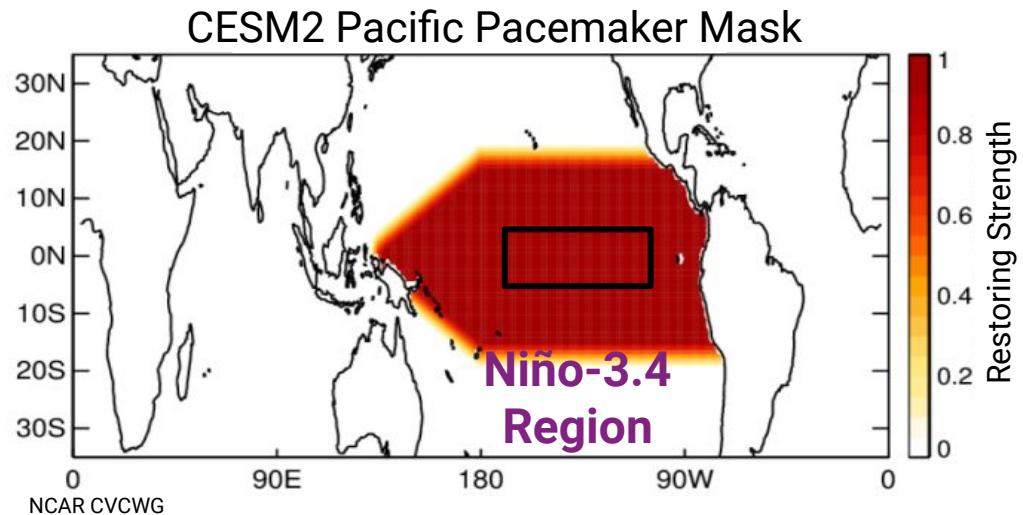
Dampened
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CCLME

CESM2 Pacific Pacemaker Ensemble

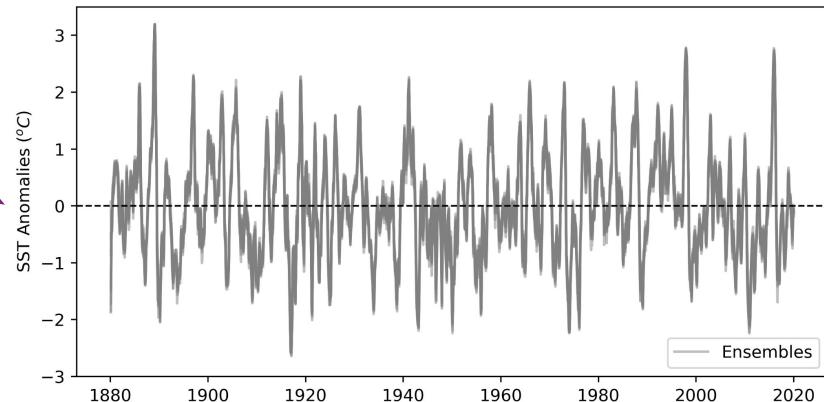
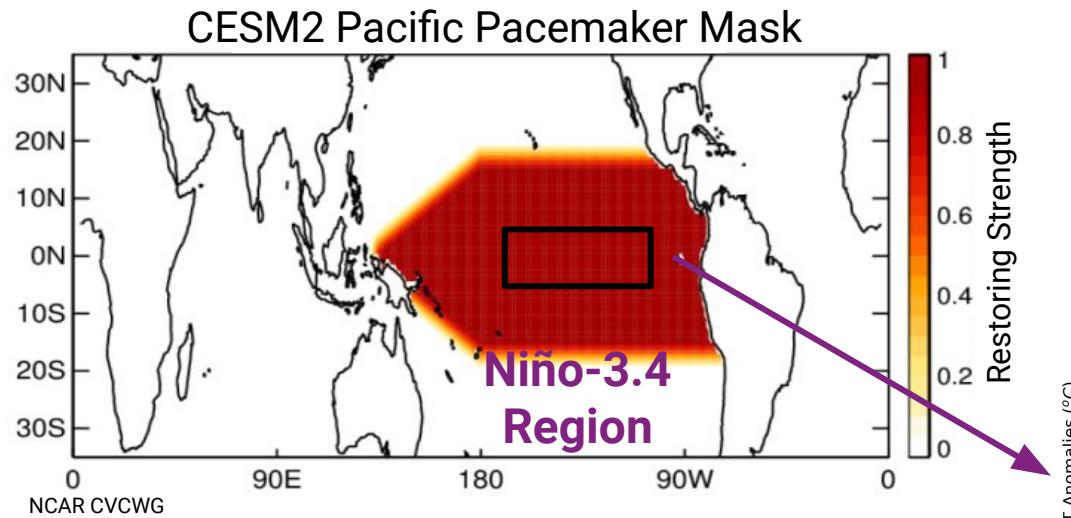


- Fully coupled model, 1° resolution
- 10 ensemble members
- 1880–2019, monthly output
- ERSSTv5 SST anomalies

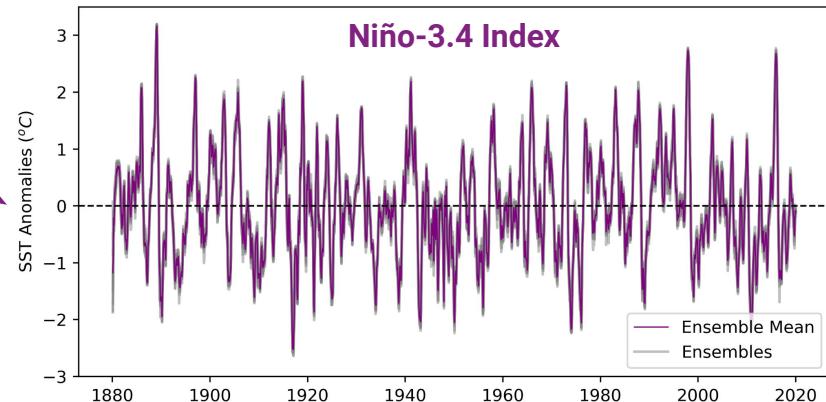
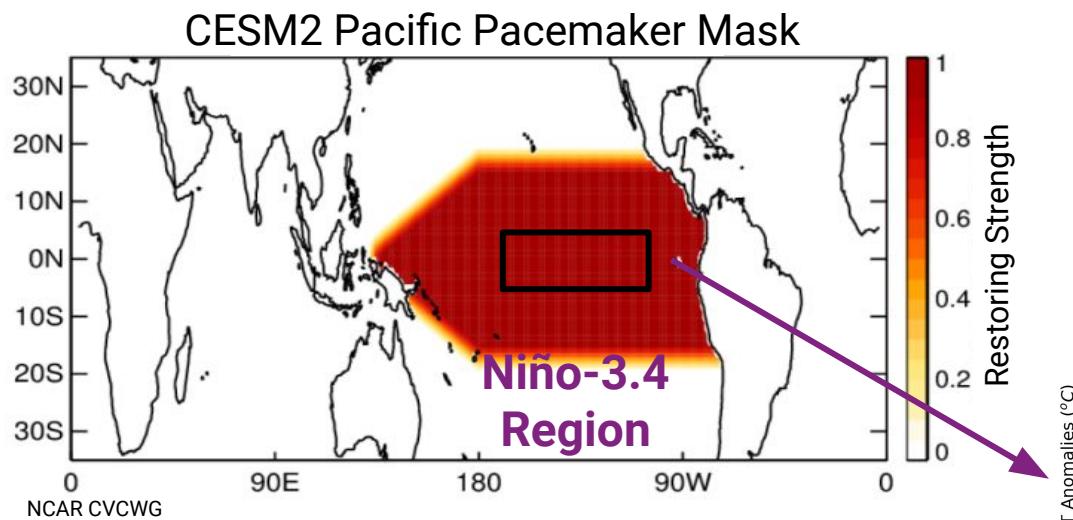
ENSO Region is the Pacemaker



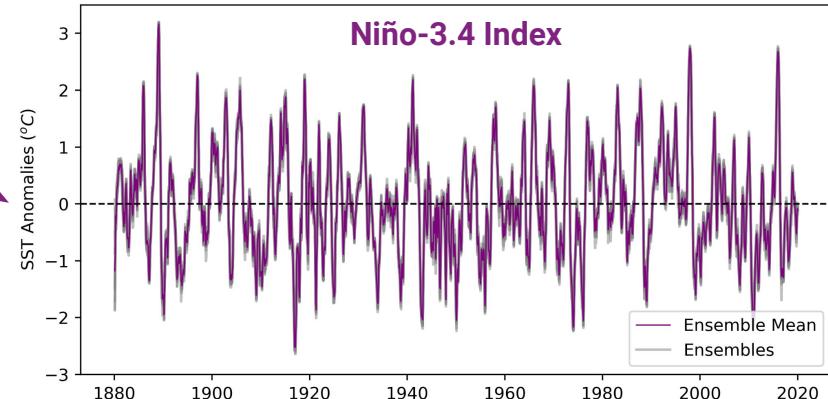
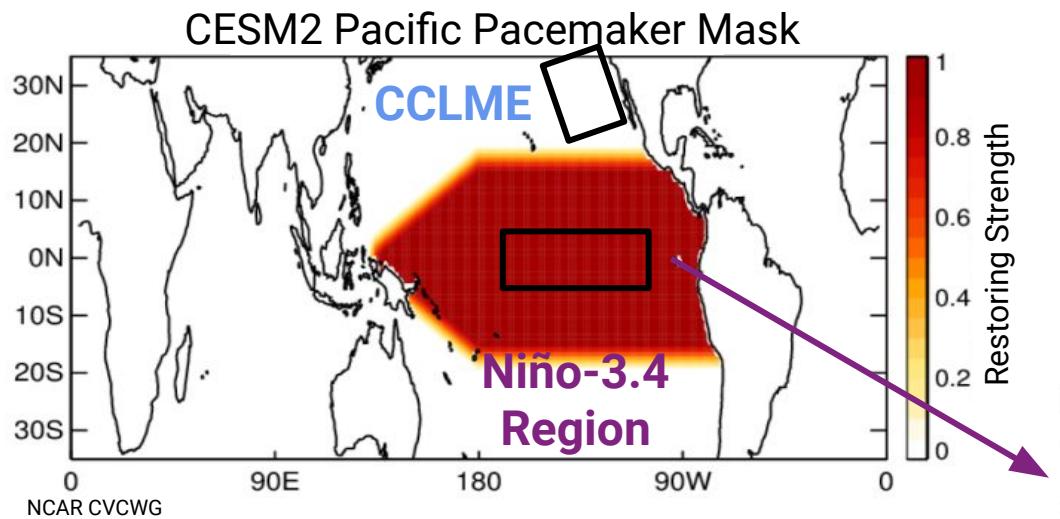
ENSO Region is the Pacemaker



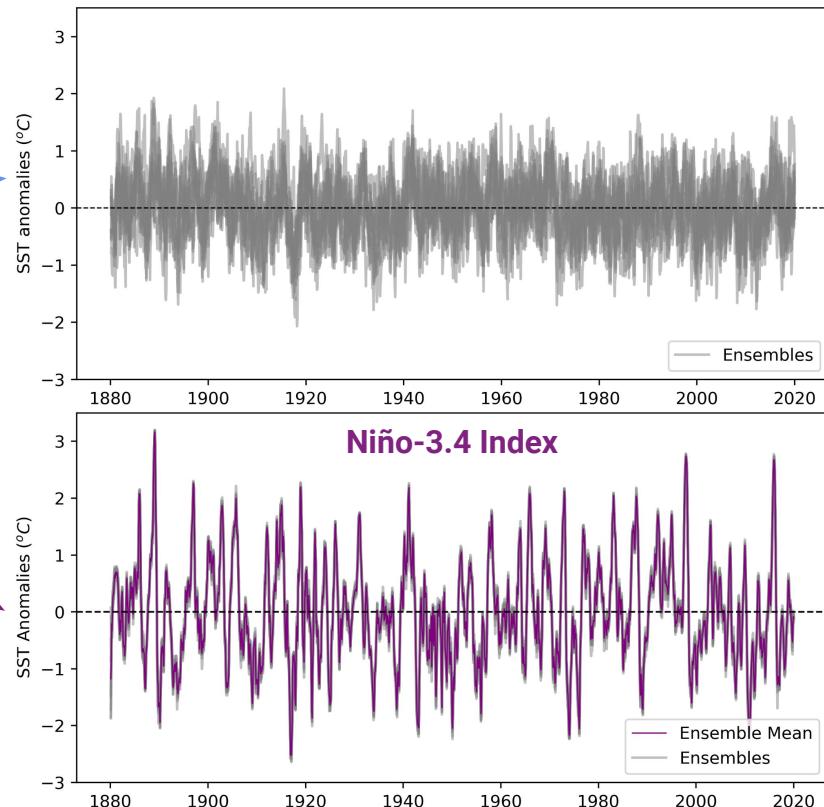
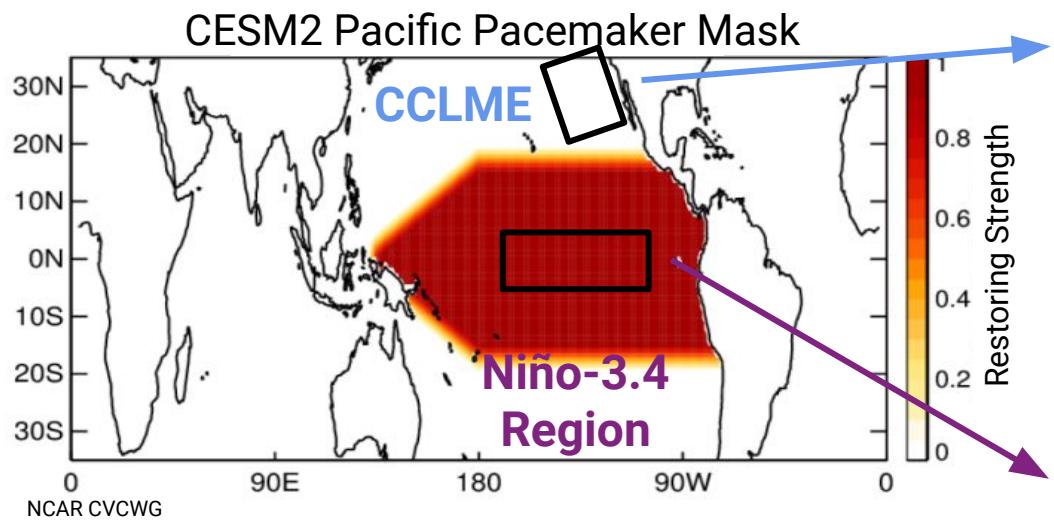
ENSO Region is the Pacemaker



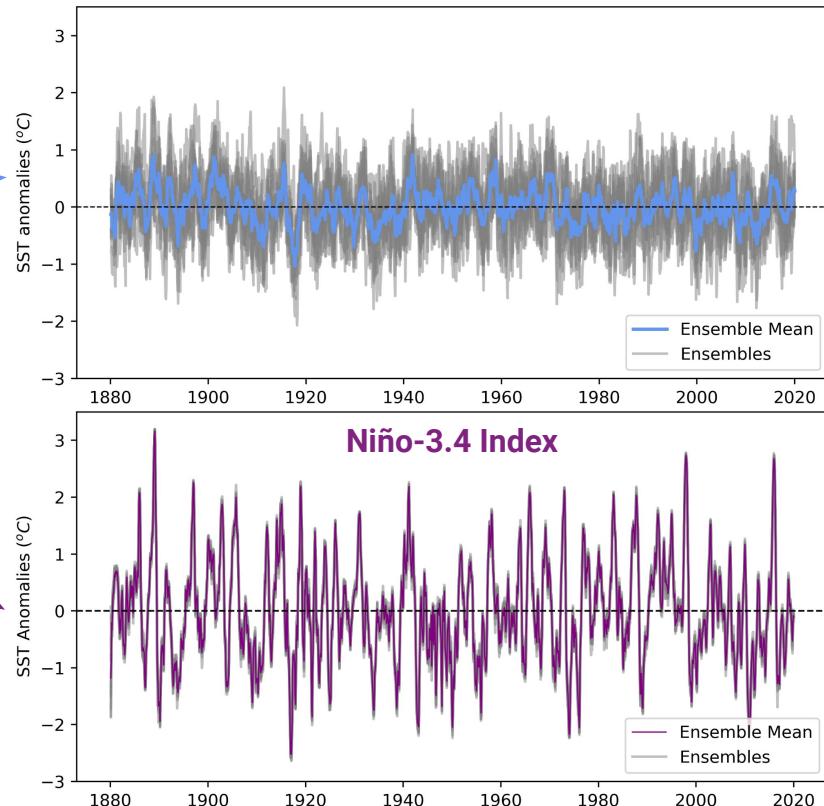
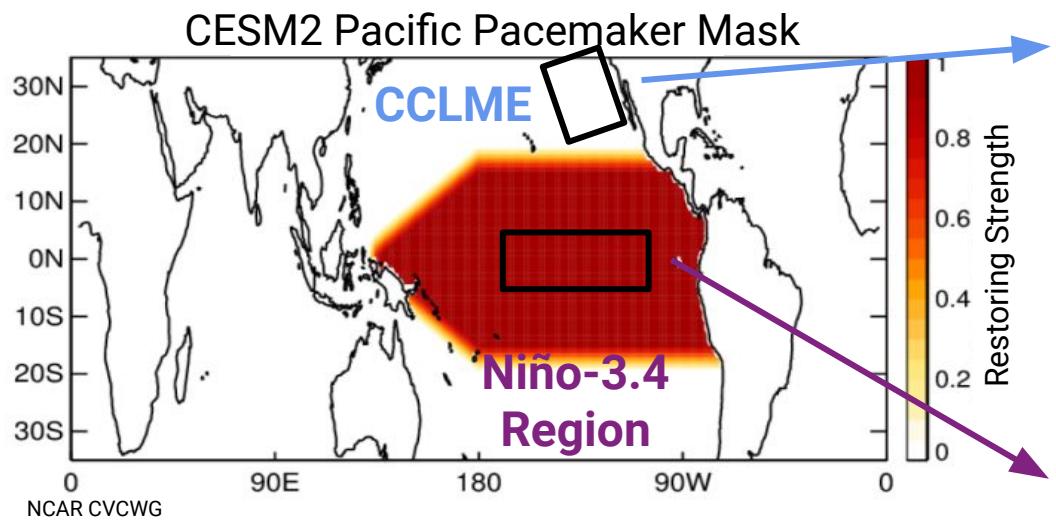
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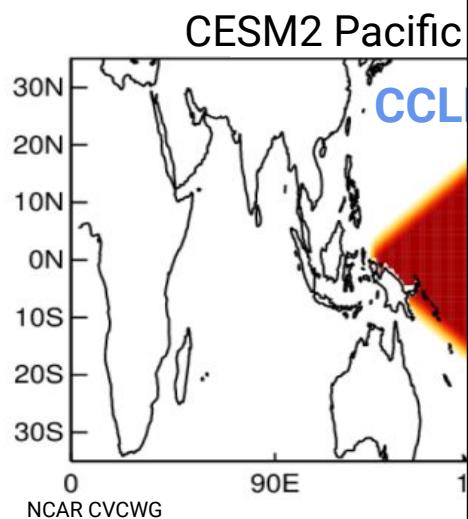
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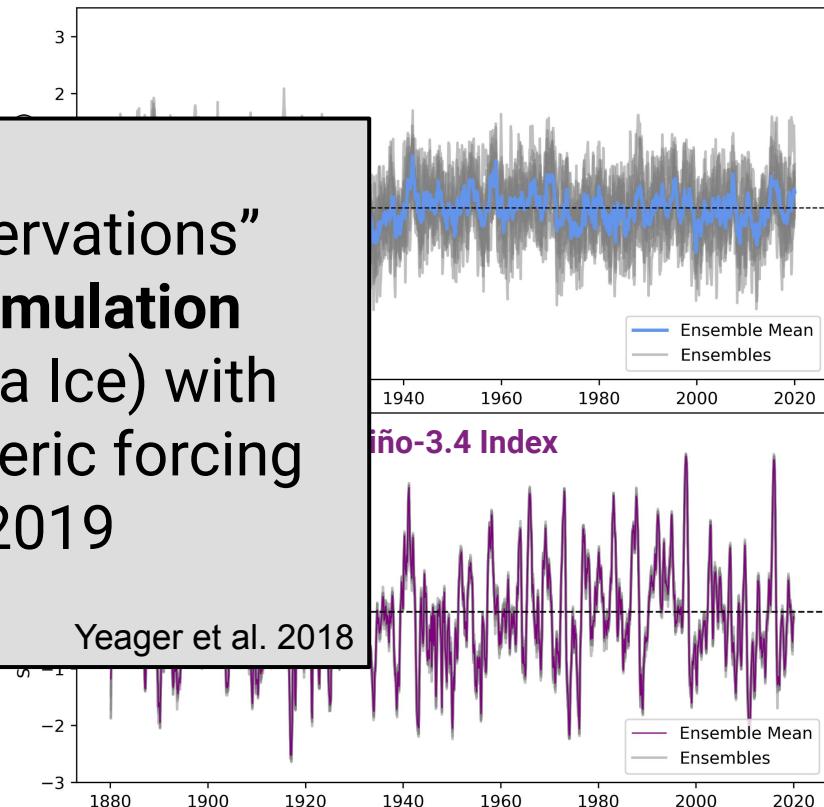


ENSO Region is the Pacemaker

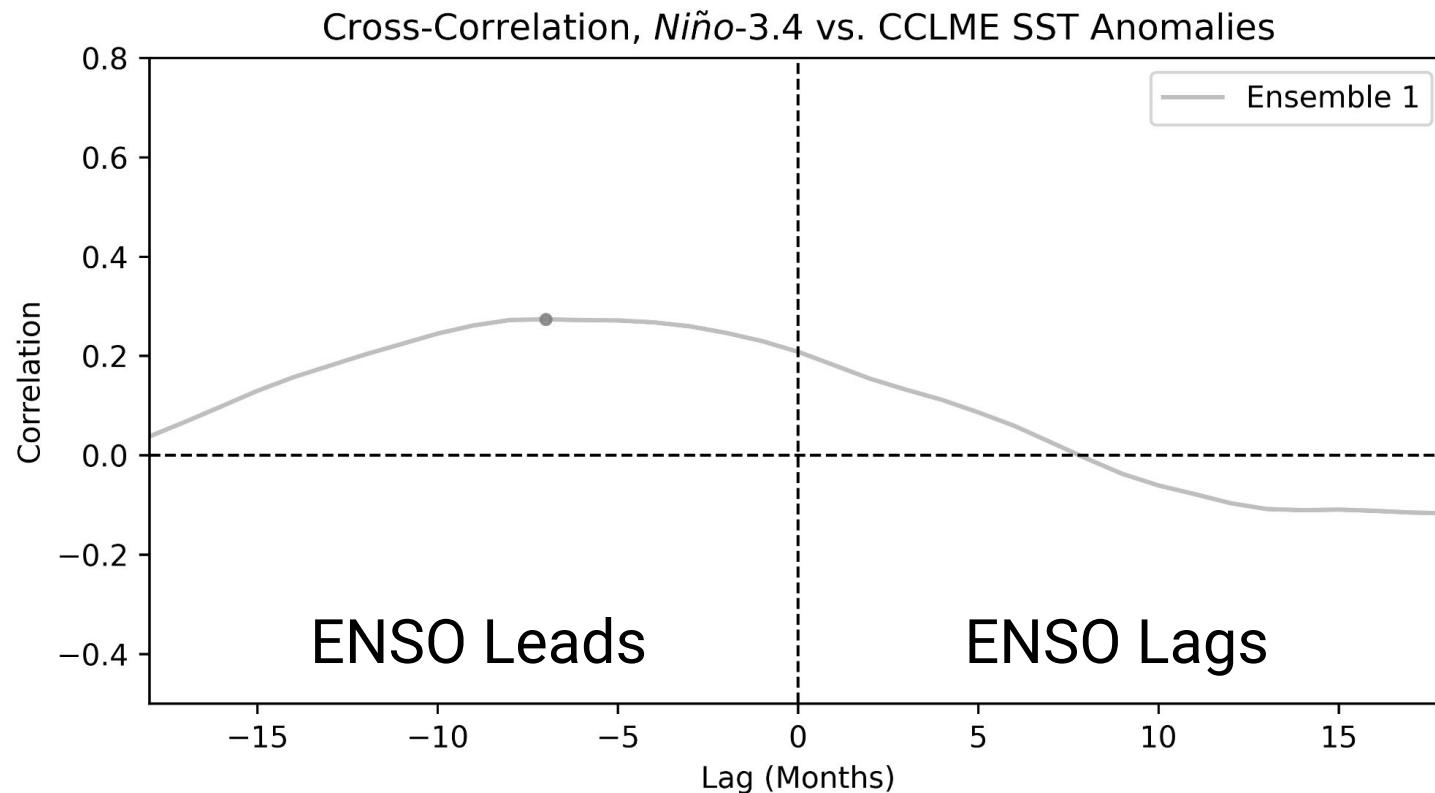


Compare to “observations”
from the **FOSI Simulation**
(Forced Ocean-Sea Ice) with
historical atmospheric forcing
from 1958-2019

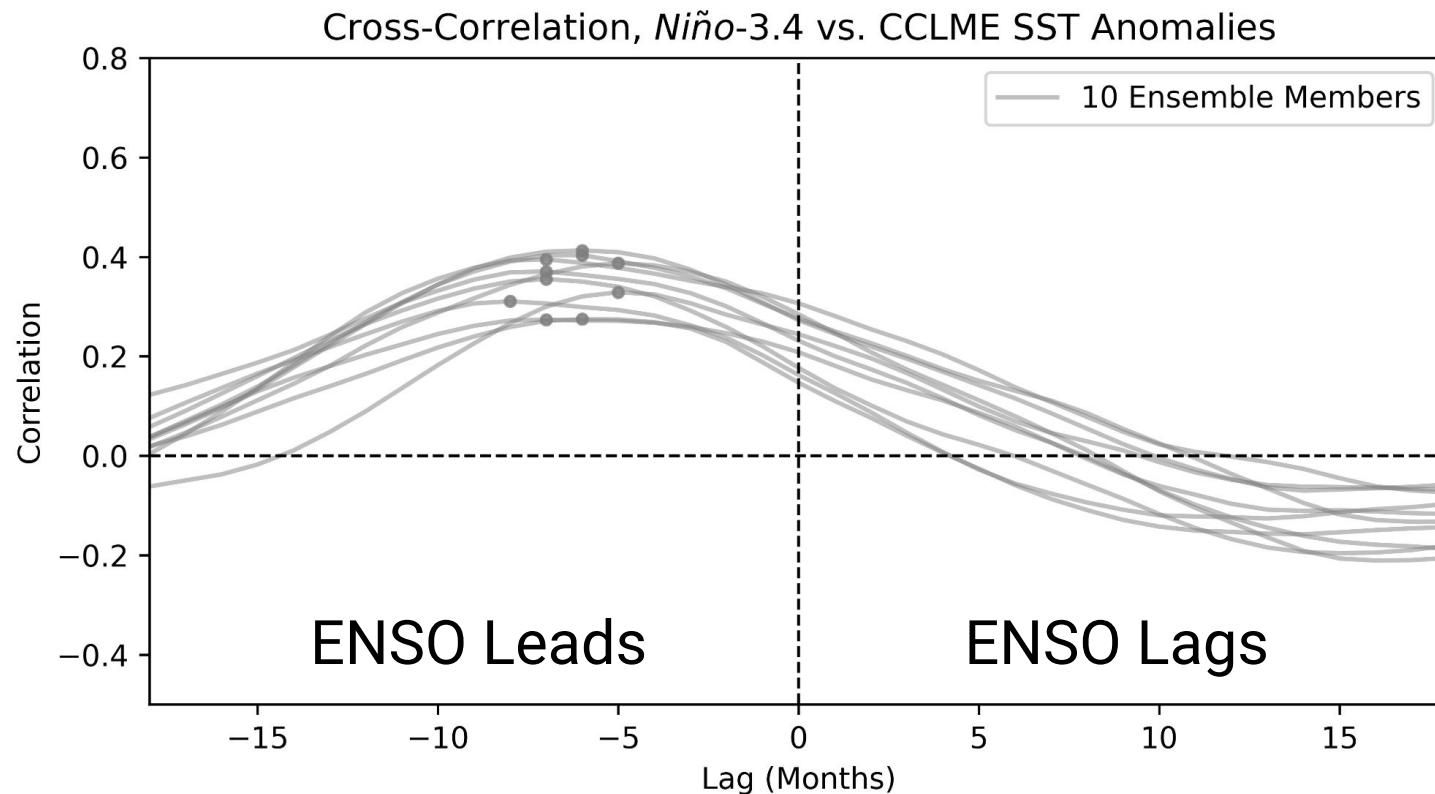
Yeager et al. 2018



Spread in Lagged Correlation

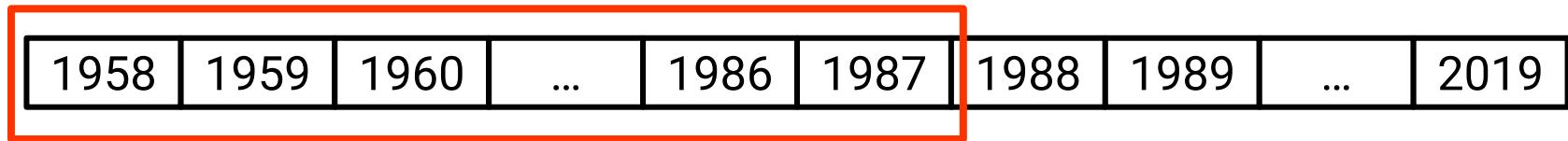


Spread in Lagged Correlation

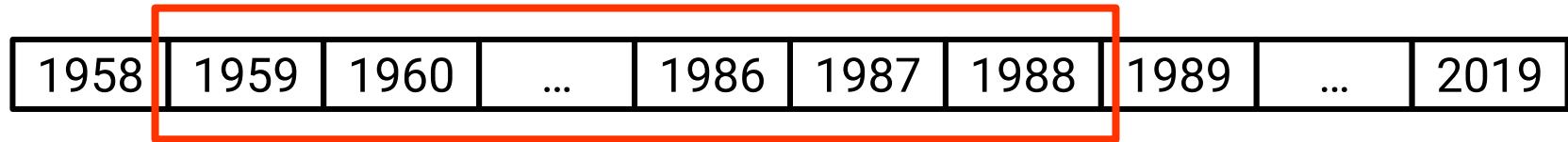


30-Year Sliding Window Resampling

Initial Window

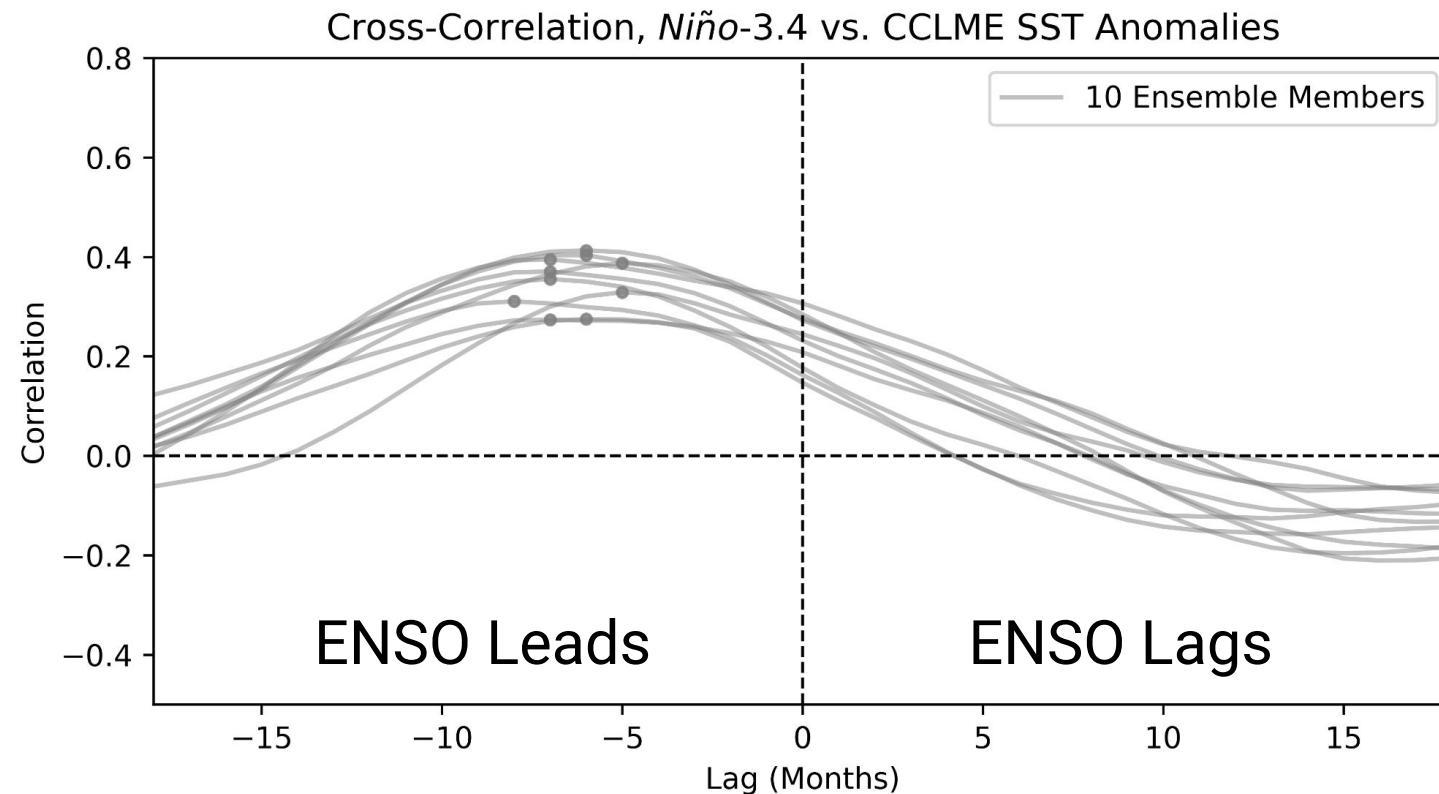


Window Slides

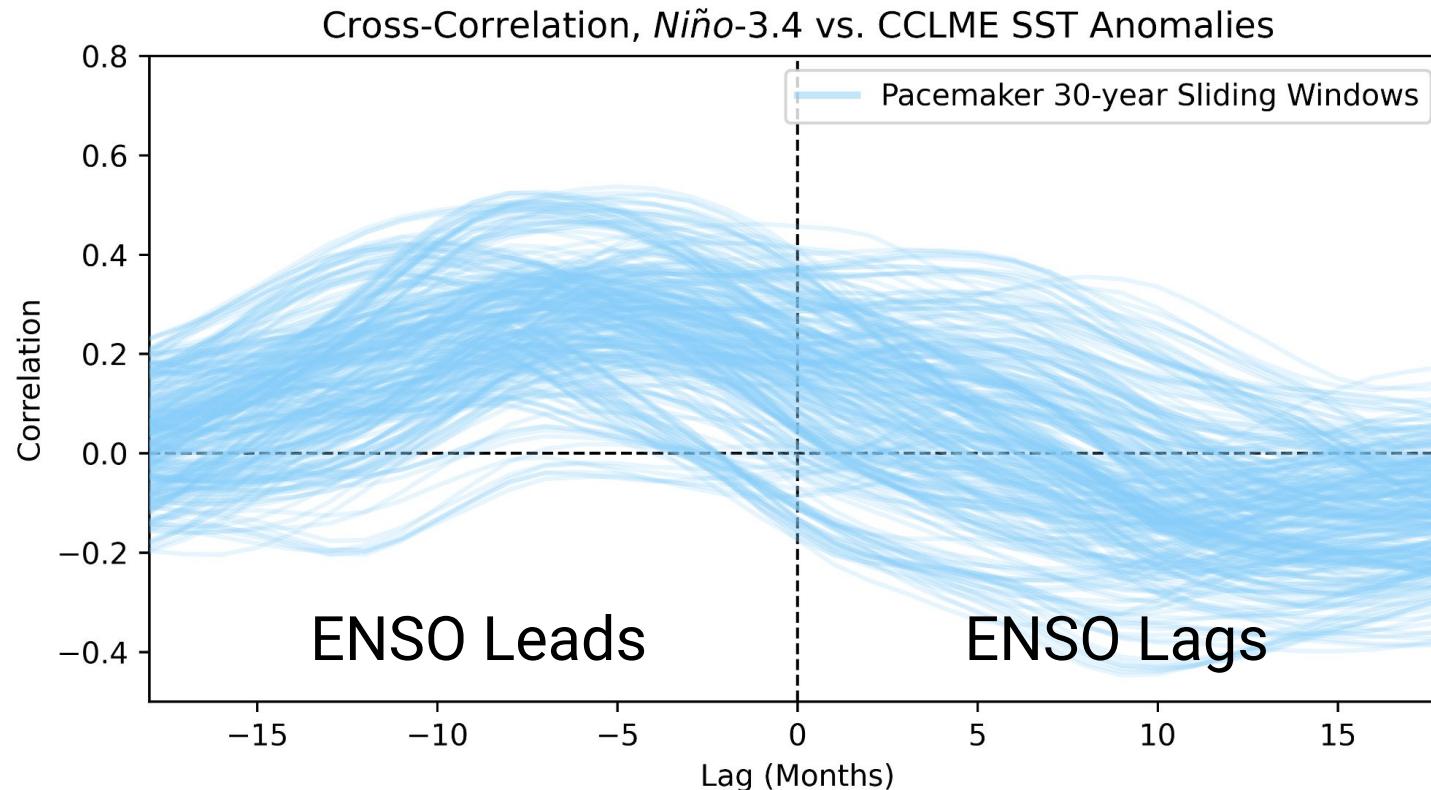


10 correlation values → 310 correlation values

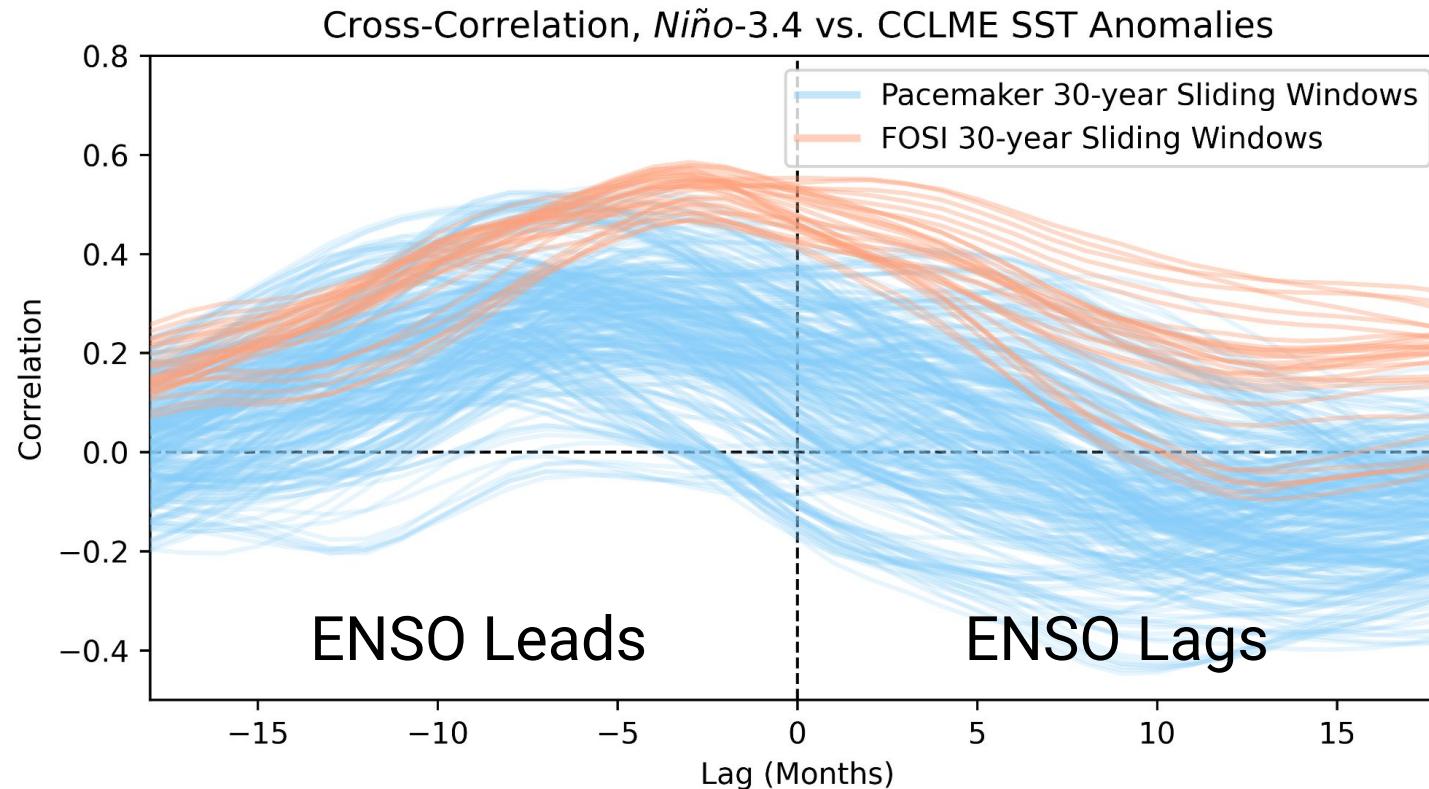
Ensemble Spread in Lagged Correlation



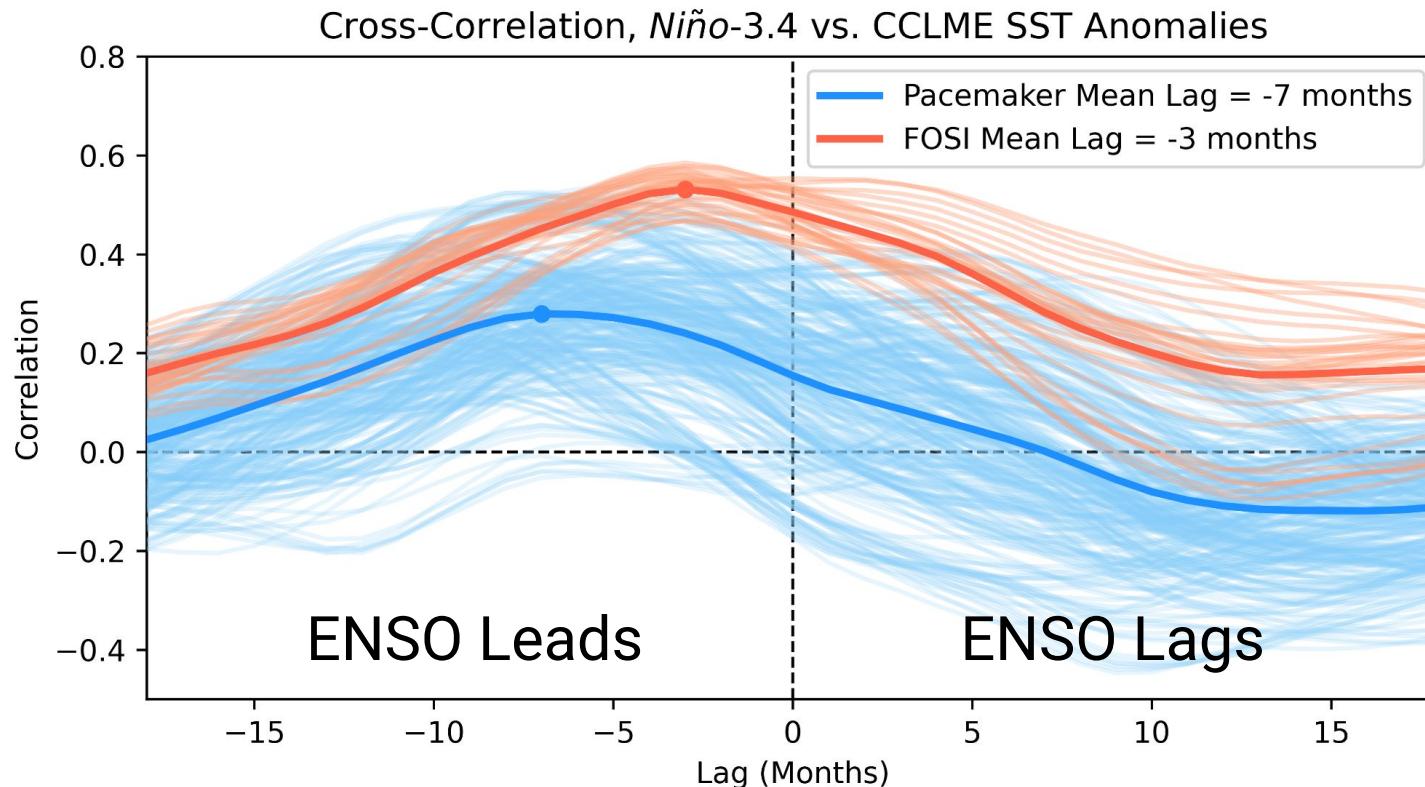
Uncertainty in ENSO–CCLME Relationship



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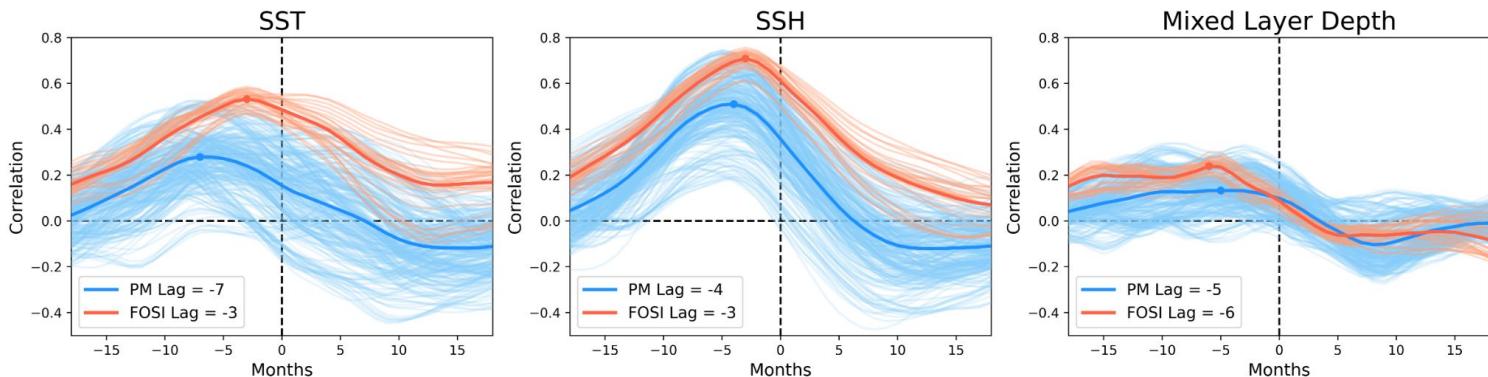


Uncertainty in ENSO–CCLME Relationship

Physical Variables

Cross-Correlation, Niño-3.4 Index vs. CCLME Anomalies

1958-2019



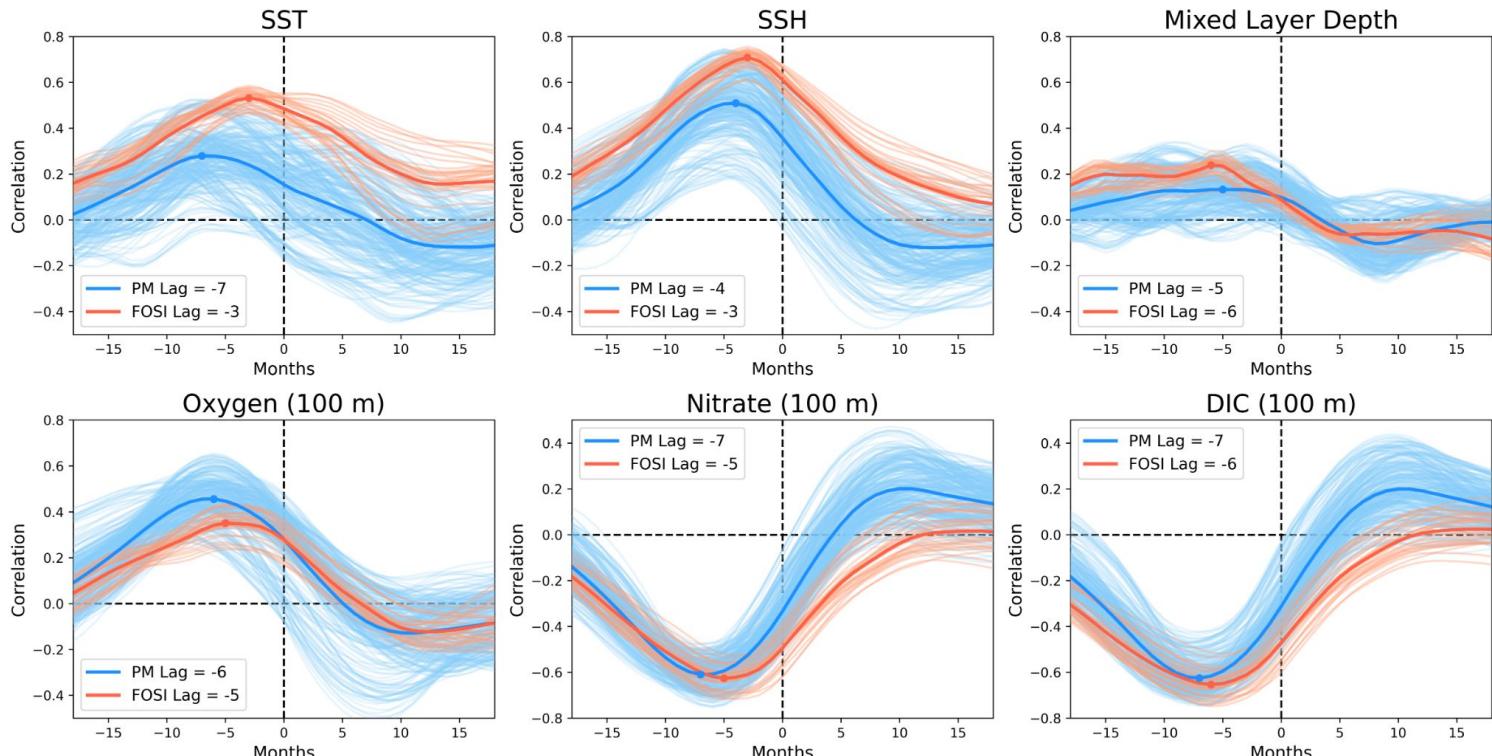
Uncertainty in ENSO–CCLME Relationship

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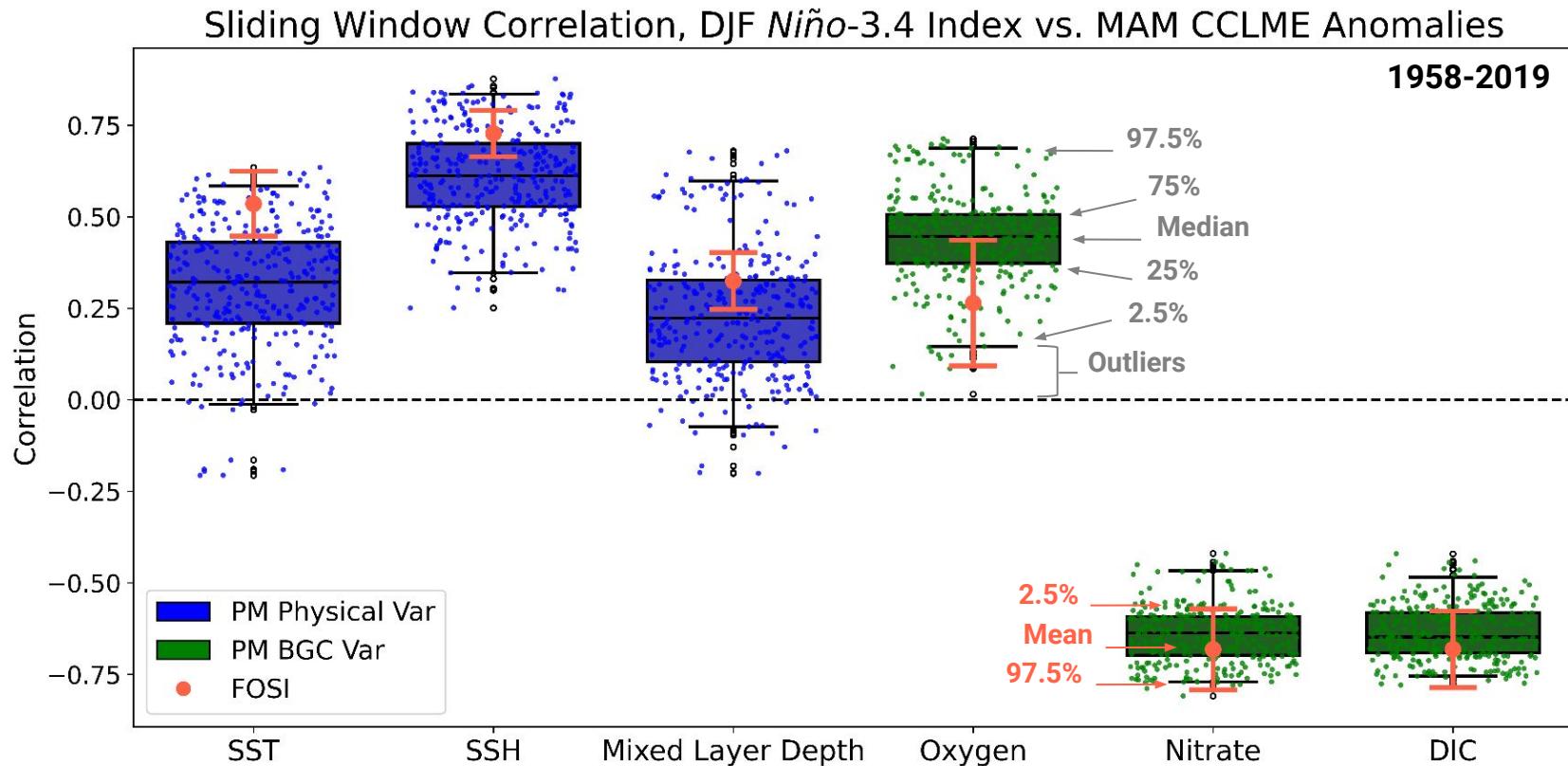
BGC
Variables

Cross-Correlation, Niño-3.4 Index vs. CCLME Anomalies

1958-2019

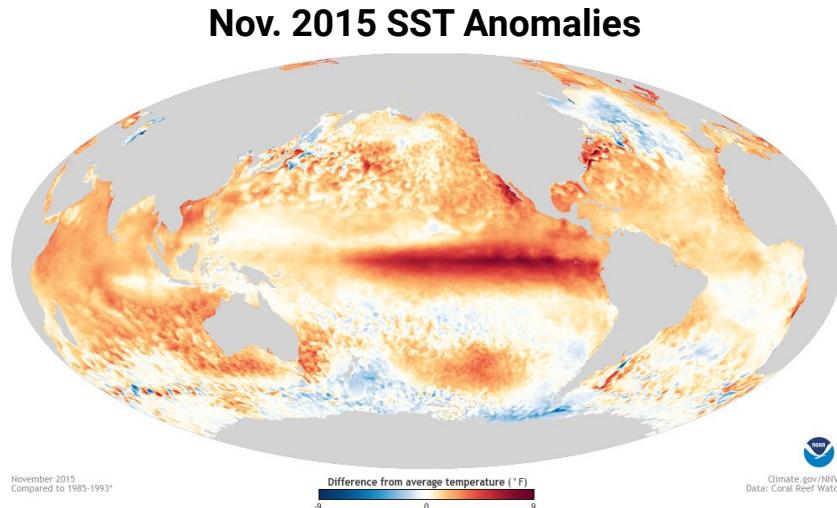


Spread in Seasonal Correlation Values



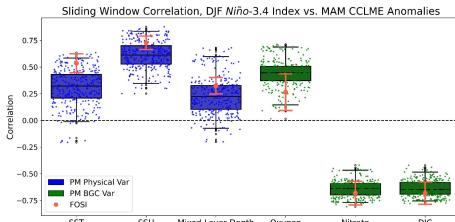
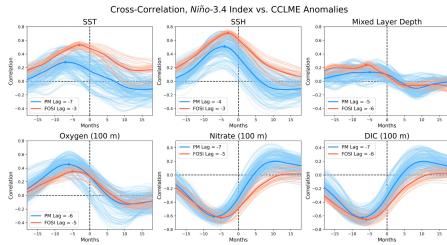
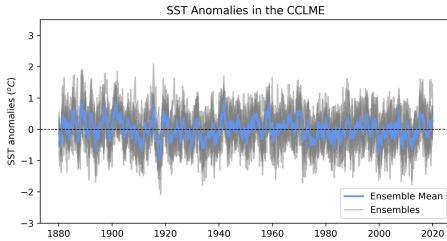
Future Work: Upwelling and Case Studies

- Calculate upwelling indices including CUTI and BEUTI and analyze their correlation with the Niño-3.4 index
- Conduct case studies of major El Niño Events (e.g., 1997-98 and 2015-16)



Summary

- Using the Pacemaker, we investigate uncertainty in the ENSO-CCLME connection, with implications for resource management
- We quantify the maximum lag correlation between these regions, with SST having a mean lag of 7 months
- We identify the expected seasonal lagged response, with a median SST correlation of ~0.35



Acknowledgements

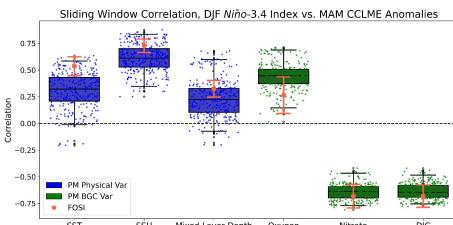
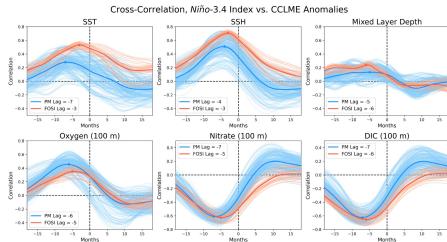
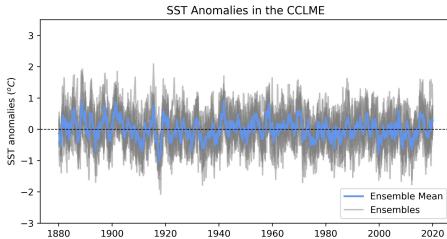
- The CESM2 Tropical Pacific Pacemaker Ensemble was created by the NCAR Climate Variability & Change Working Group (CVCWG)
- The CESM-DPLE FOSI Simulation is from Yeager et al. 2018 with support from DOE/NERSC and NSF/CISL
- Thank you to my mentors and the rest of the NOAA PSL AOPP Division for their help and support on this project
- Funding for this project was provided by the NOAA Ernest F. Hollings Scholarship Program

Summary

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Currently applying to grad school!



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FOSI Simulation

CESM2 Pacific Pacemaker

- 1° resolution, 10 members
- Forced with ERSSTv5 SST anomalies in restoring region
- 1880–2019, monthly output
- POP2 Ocean & MARBL BGC Models
- Polynomial detrending

Forced Ocean-Sea Ice (FOSI)

- CESM1.1, 1° resolution
- Forced with historical atmospheric CORE data
- 1958–2019, monthly output
- POP2 Ocean & BEC BGC Models
- Polynomial detrending
- Treated as “Observations”