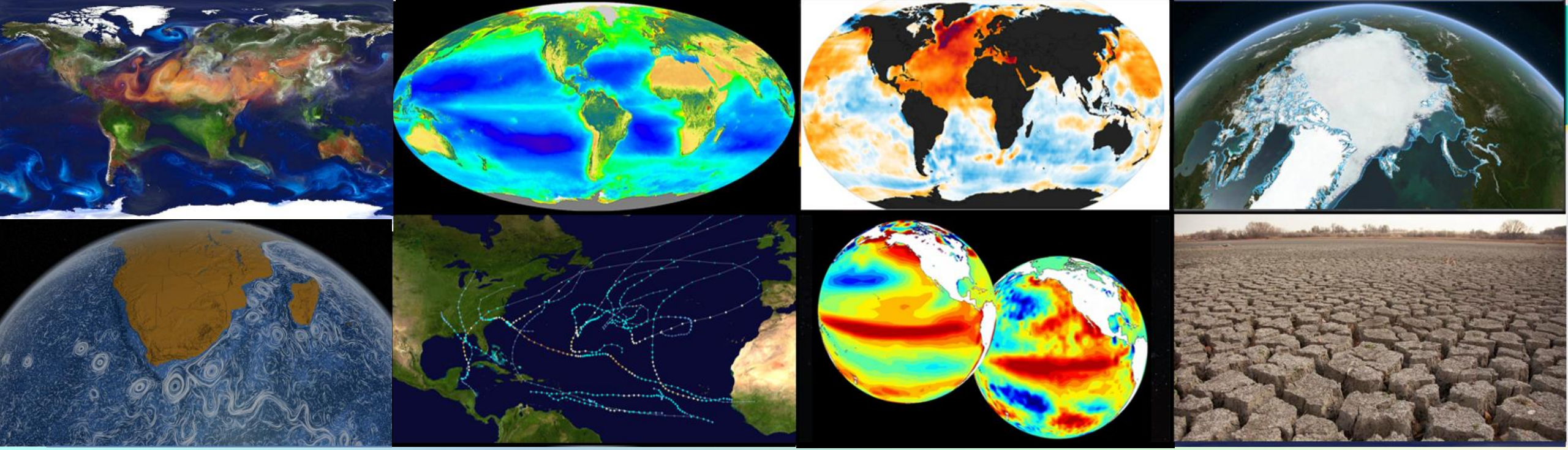


WGSIP Ocean Prediction and Temperature Trends Projects

Bill Merryfield and Hongli Ren

WGSIP 25/WGNE 39

4-8 November 2024

Toulouse, France

ESMO Earth System Modelling and Observations

WCRP World Climate Research Programme

WGSIP Ocean Prediction project

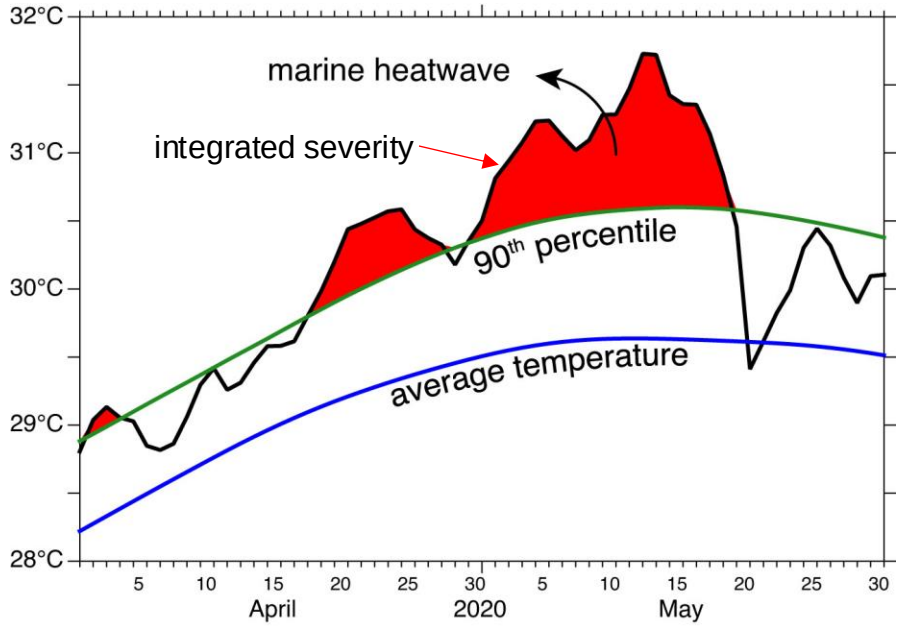
Objectives

- Systematically **evaluate prediction capabilities for ocean variables** besides temporal mean SST across time scales and for multiple climate prediction systems
- Assess **performance of individual prediction systems** in relation to their initialization, resolution, etc.
- Assess **multi-model performance gains**
- Assess **properties and suitability of different verification datasets**, utility of multi-product verification
- Assess **sources of predictability** and ability of models to represent them
- Facilitate useful **real-time forecasting of ocean properties** having societal impacts

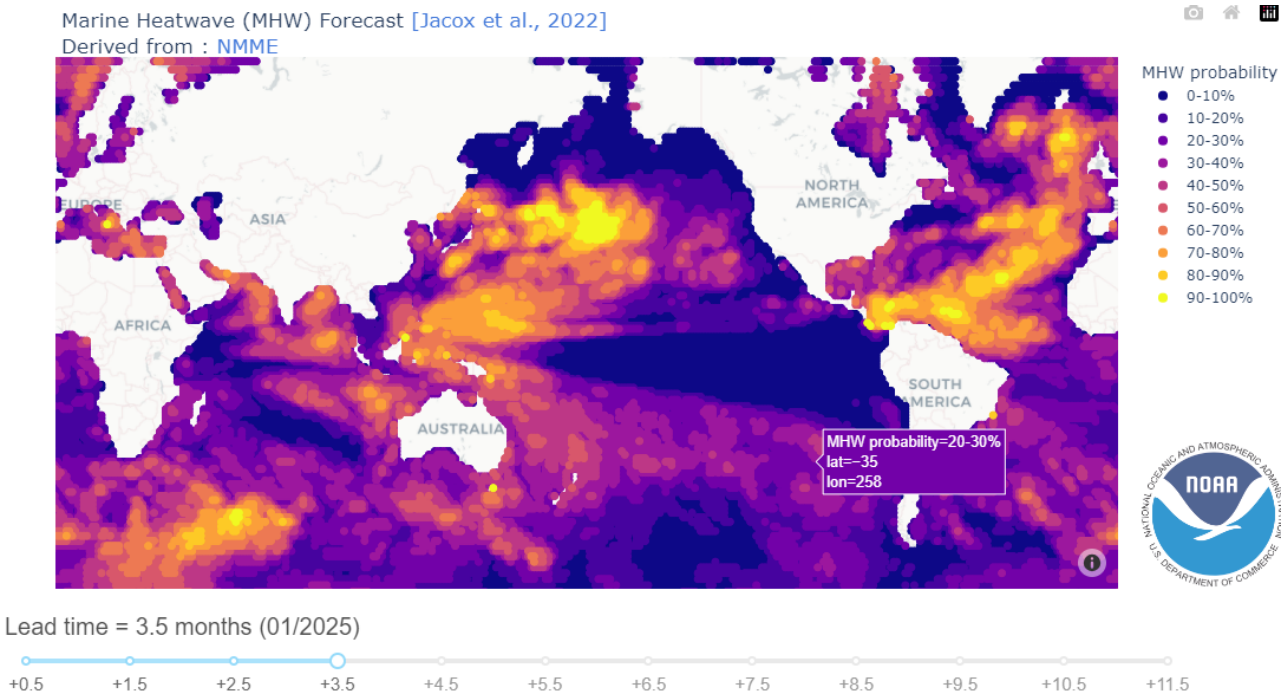
Main focuses: marine heat waves (MHW), mixed-layer depth (MLD), sea surface height (SSH)

MHW prediction

https://www.climate.rocksea.org



- Can daily SST data e.g. from C3 seasonal systems enable skillful probabilistic forecasts of **integrated heat wave severity**, vs **probability of heat wave occurrence** methodology based on monthly SST? ↓



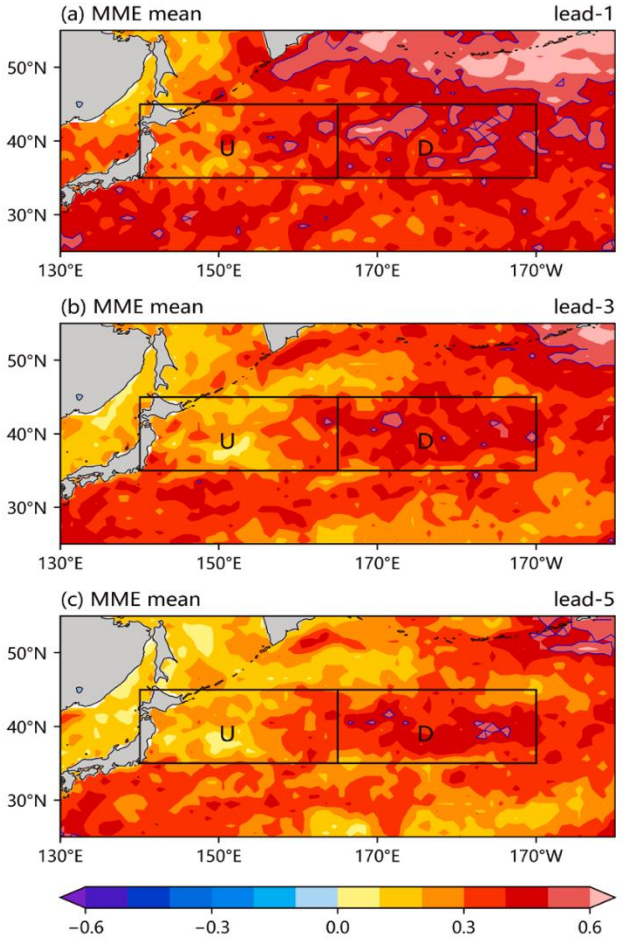
https://psl.noaa.gov/marine-heatwaves

- Elise Olson and Bill Merryfield at CCCma working on methodologies for this

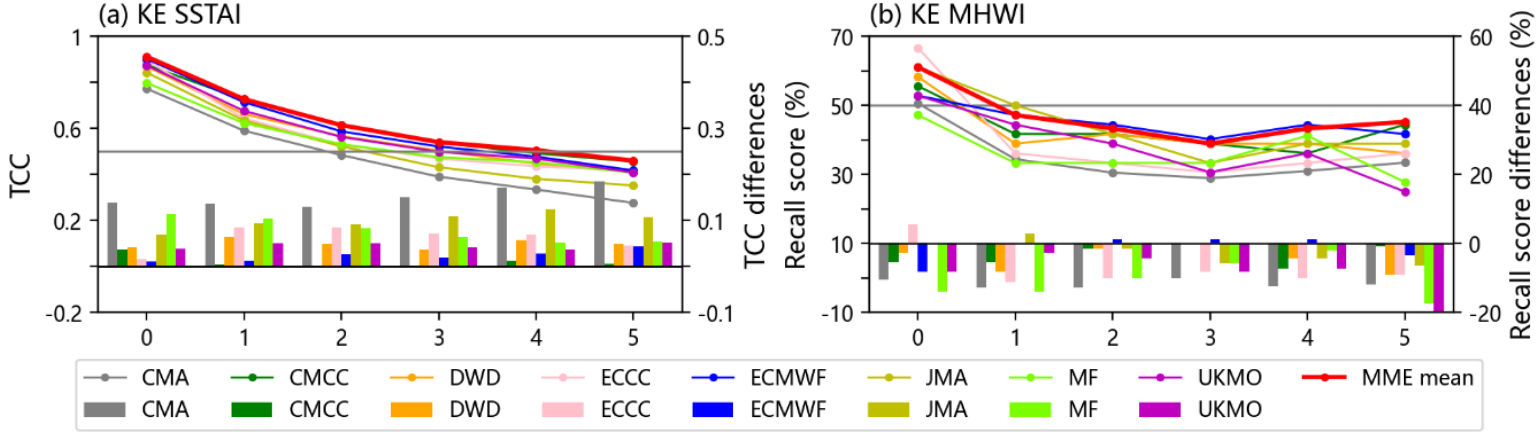
Seasonal Predictability of SST-based Marine Heatwaves (MWHs) over the Kuroshio Extension Region

Contributed from Hong-Li Ren (CMA): Zhou Ren* et al., Ocean Modelling 2024

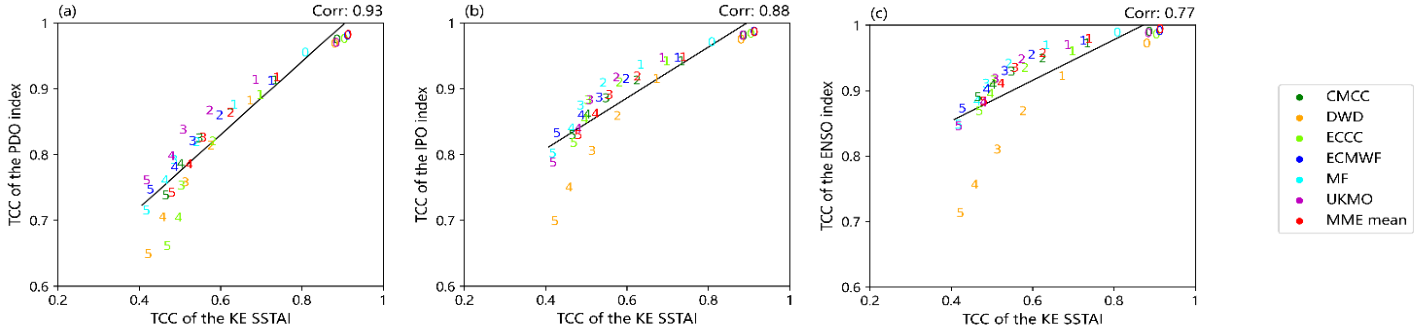
- The MME mean of C3S models can improve prediction skills of KE-SSTAs and KE-MHWs, but they are difficult to accurately predict KE-MHWs.
- Major predictability sources of KE-SSTAs and KE-MHWs are from PDO, IPO, and ENSO.



Comparison of KE-SSTA index and KE-MHW index between C3S models

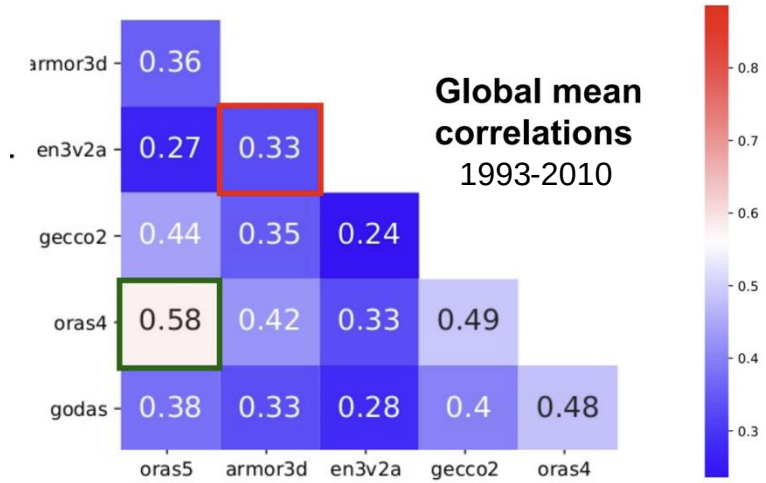


TCCs of KE-SSTA index v.s. TCCs of PDO, IPO, Nino3.4 indices



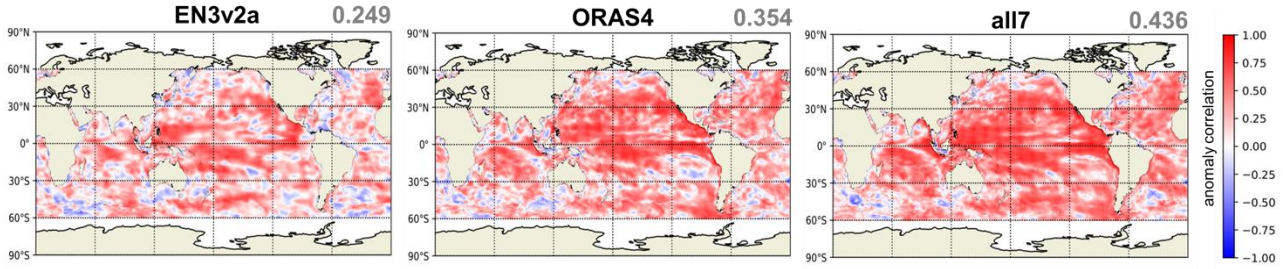
MLD prediction

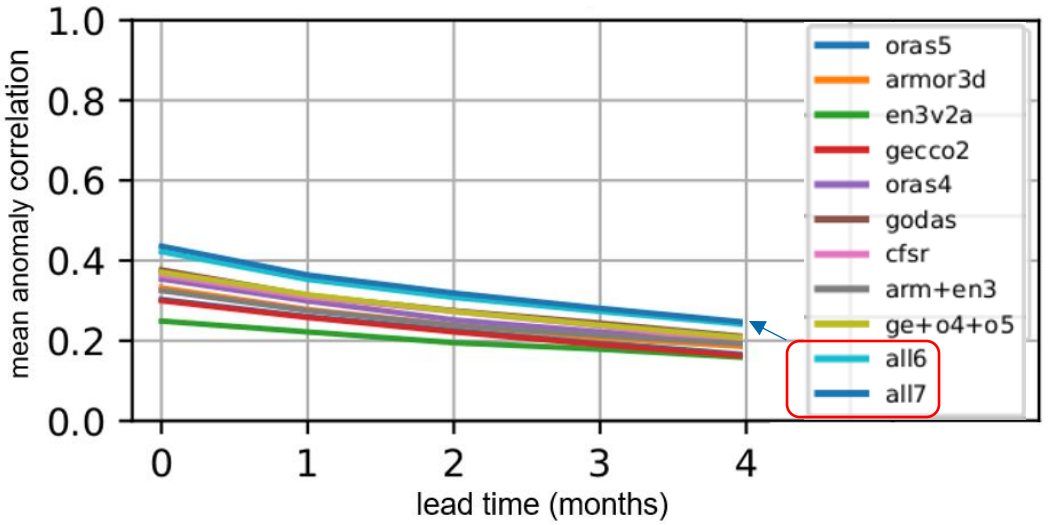
Bill Merryfield & Woosung Lee, CCCma



- MLD important for ecosystems, atmosphere-ocean interactions
- Limited agreement between potential verification products →
- Assessed skill of CHFP seasonal forecast systems vs 7 verification products **& combinations thereof**
- **Multi-product verification** consistently yields higher skill scores across models:

Example: JMA-MRI CGCM1, Nov initialization

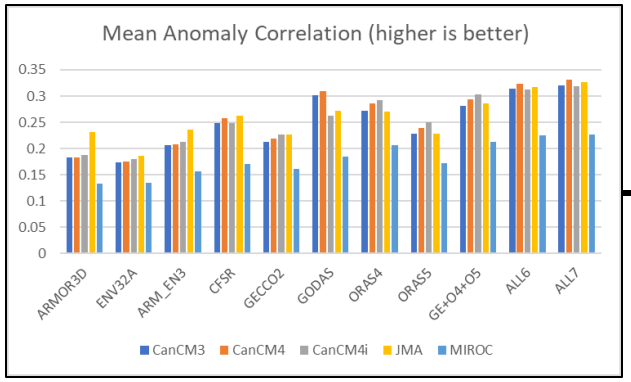




- WCRP OSC 2023 presentation “Prospects for seasonal prediction of ocean mixed-layer depth”, paper in progress
- MLD from C3S seasonal systems offers additional resource

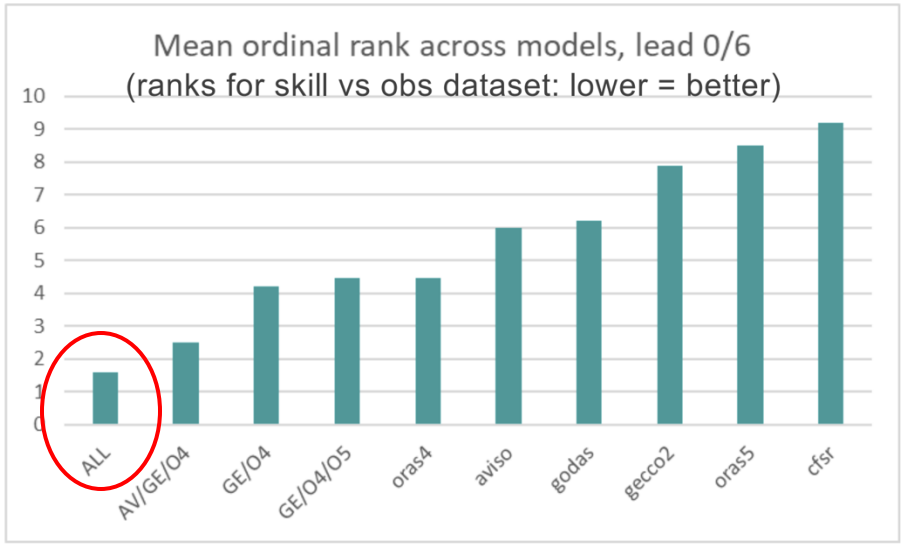
Multi-product verification for MLD vs SSH

- Even though SSH is relatively well observed, skill is enhanced by multi-product verification, much as for MLD
- Illustration using CHFP models and available MLD, SSH analyses: consider mean ordinal ranks of anomaly correlation and RMSE for all combinations of models and individual + multi-verification products at lead times of 0-6 months:

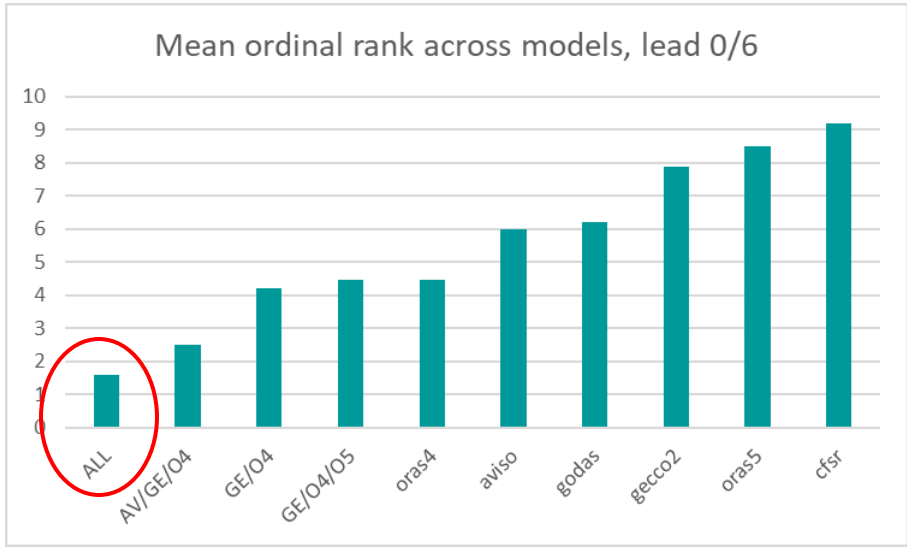


MLD mean AC 60S-60N
Lead 3 mon

MLD



SSH



Ocean prediction poster cluster at OSC23

WCRP OSC 2023

WORLD CLIMATE RESEARCH PROGRAMME
OPEN SCIENCE CONFERENCE
23 - 27 OCT. 2023 | RWANDA
Advancing Climate Science for a Sustainable Future

Poster Cluster 15: Ocean Predictability and Prediction on Subseasonal to Decadal Timescales

Convenors

William Merryfield, Environment and Climate Change Canada
Charlotte Demott, Colorado State University (USA)

Kigali, Rwanda, 23-27 October 2023, in-person and online

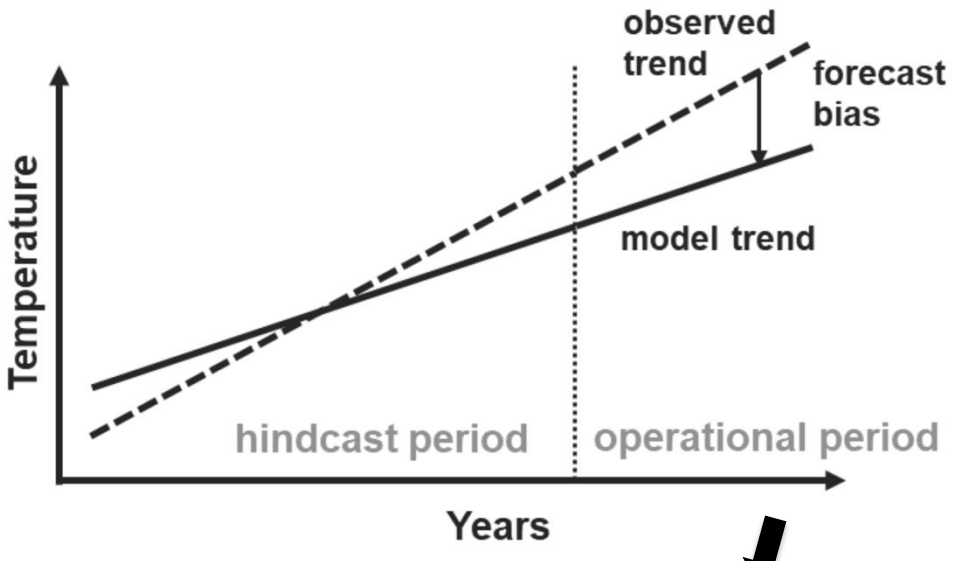
ESMO Earth System Modelling and Observations

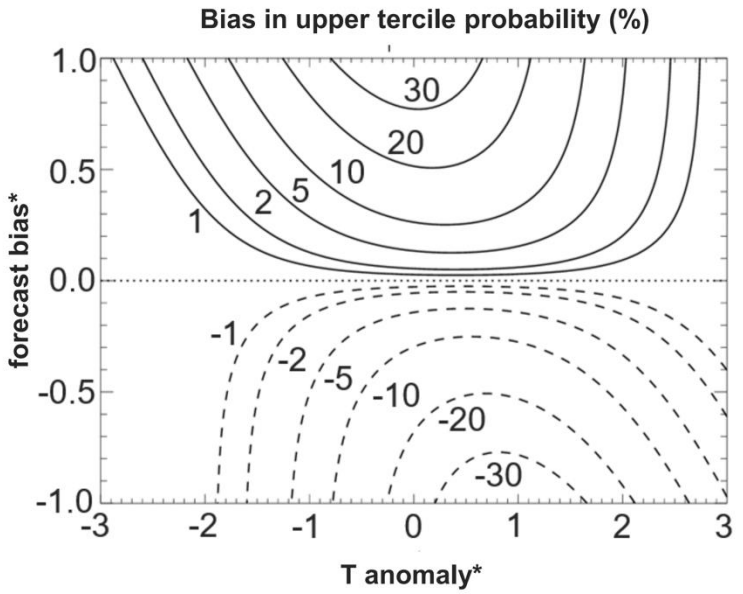
WCRP World Climate Research Programme

WGSIP Temperature Trends project

Objectives

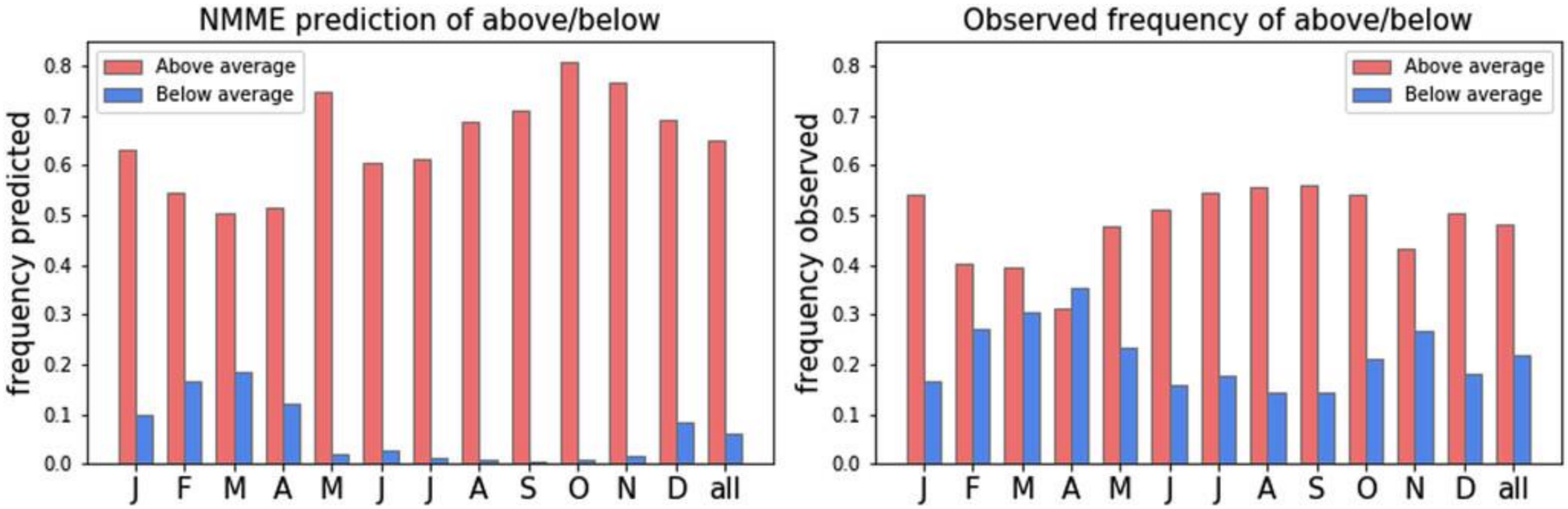
- Assess long-term global and regional **temperature trend errors** as a function of lead time across many seasonal prediction systems
- Assess extent to which temperature trend errors **impact temperature prediction skill**
- Relate trend errors to radiative forcings and initialization methodologies
- Develop a **synthesis** of previous & new results for the community





*in units of standard deviations of the forecast distribution

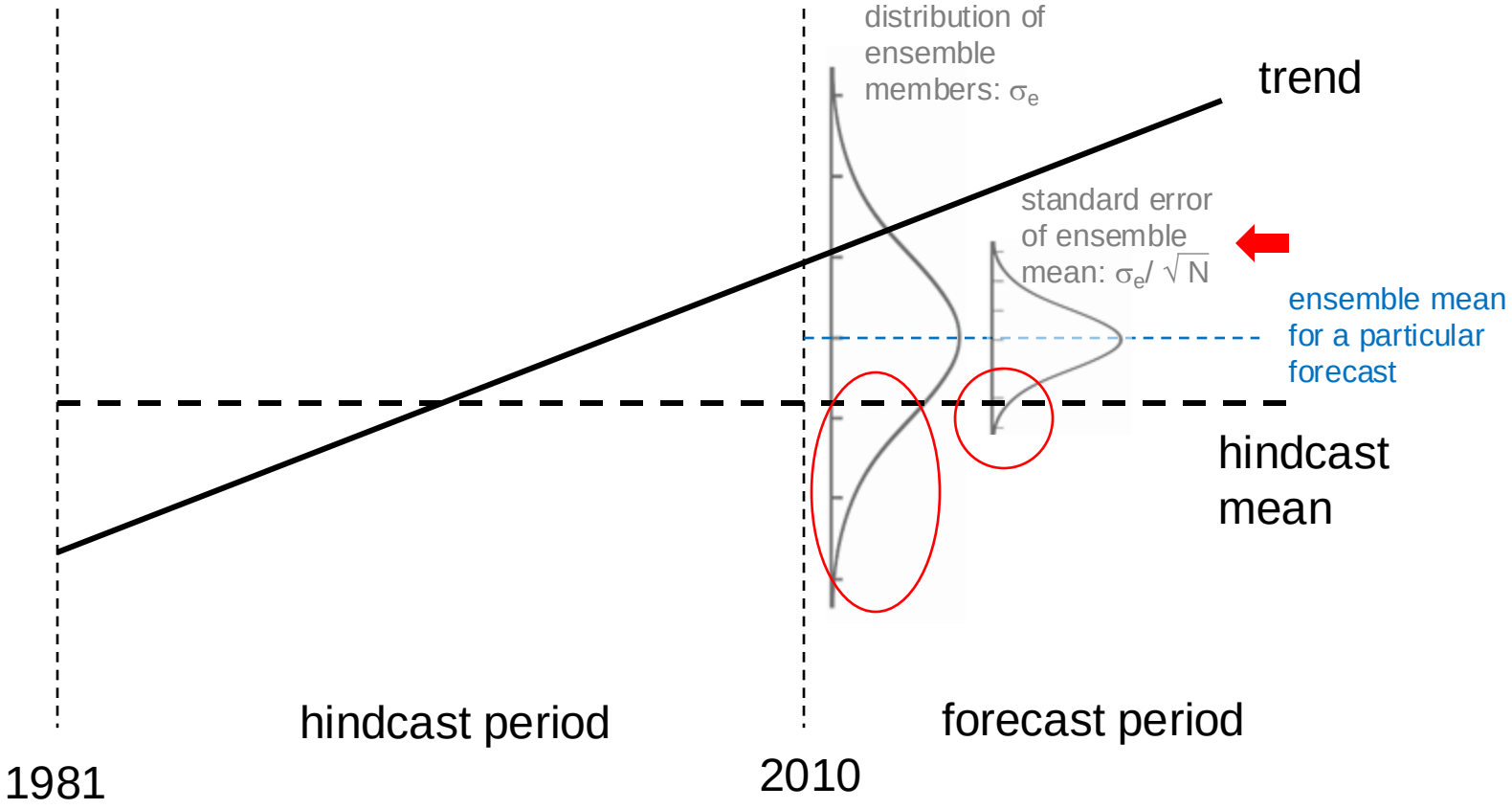
Is above normal category overpredicted in seasonal forecasts?

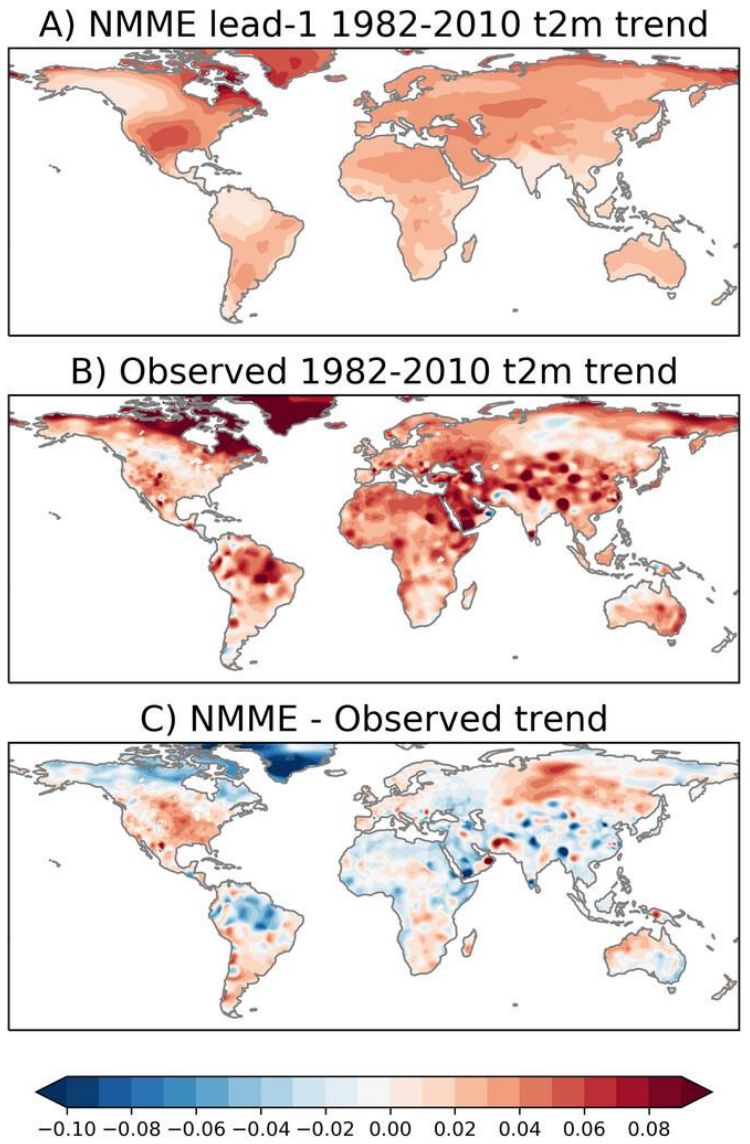


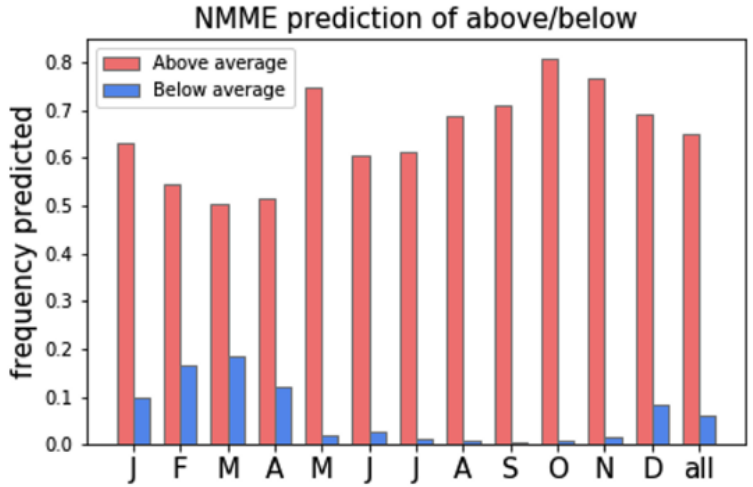
Frequency of prediction of above-average (upper tercile) and below-average (lower tercile) monthly mean land surface temperature anomaly in North America during the NMME real-time period of 2011–20. NMME prediction is shown for a 1.5-month lead and is the multimodel ensemble-mean anomaly of eight equally weighted models.

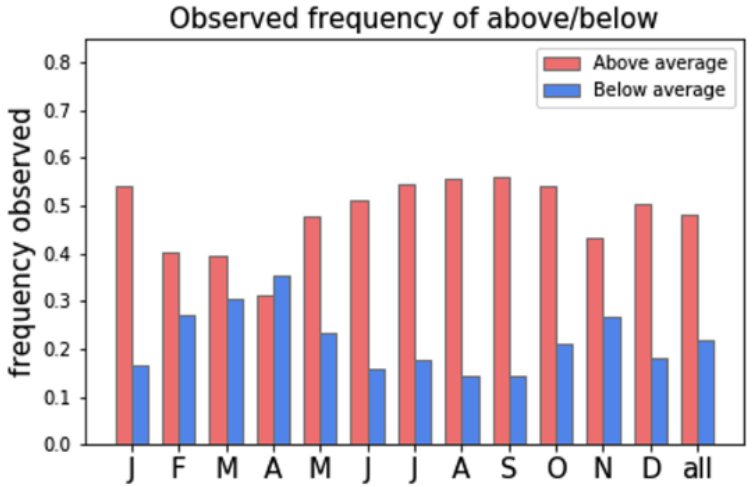
Is above normal category overpredicted in seasonal forecasts?

- This supposed discrepancy is suggested to be an overly strong NMME temperature trend over much of the US →
- Is an apparent flaw in this reasoning the consideration of ensemble means rather than individual ensemble members?

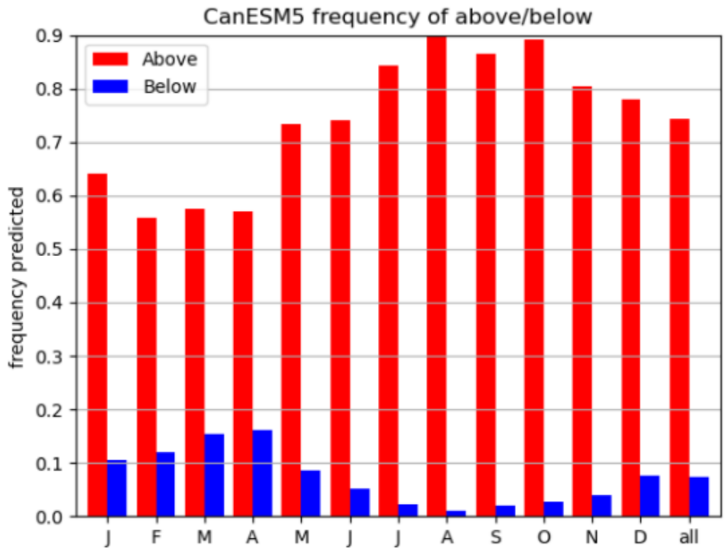




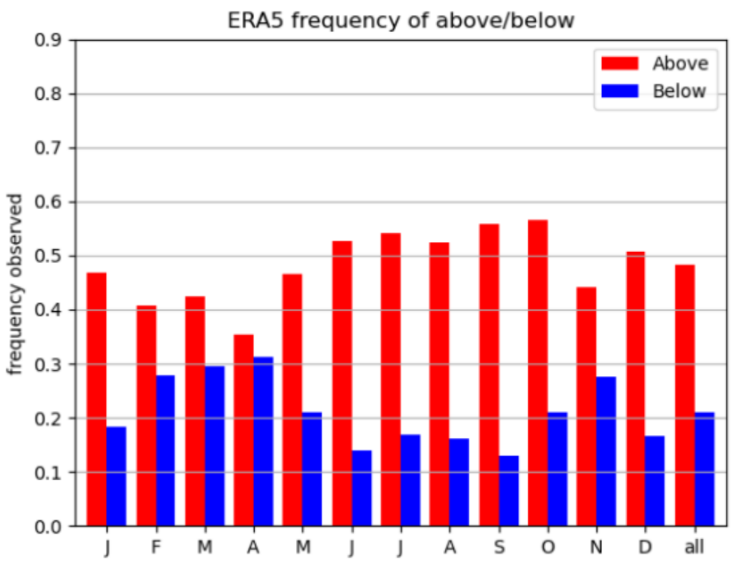


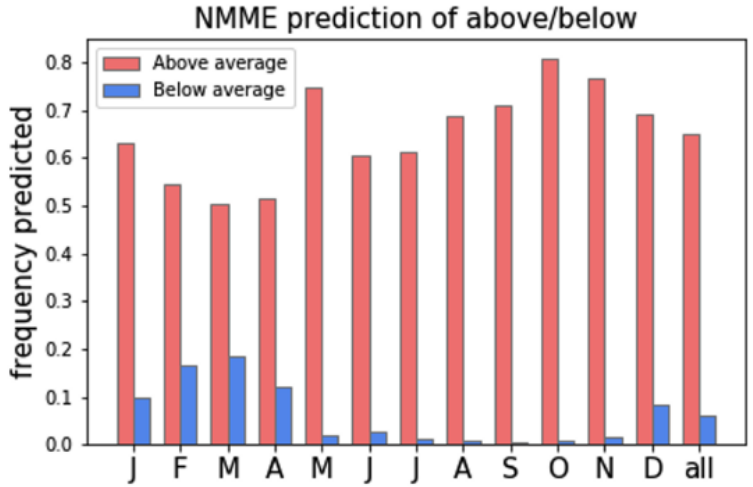


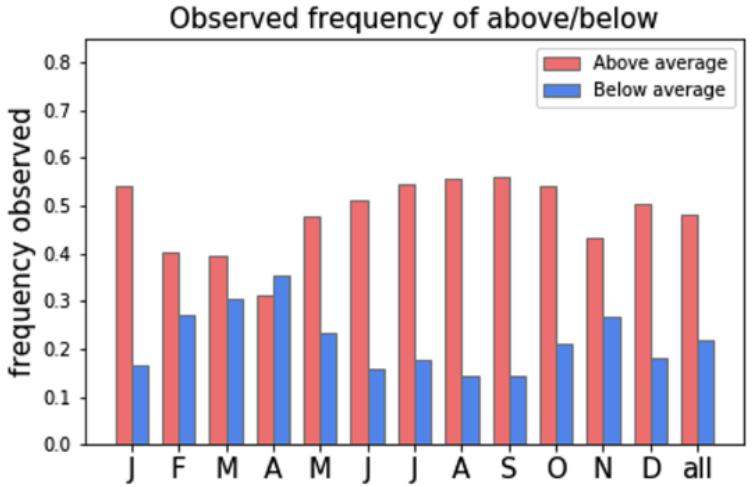
CanESM5 ens mean



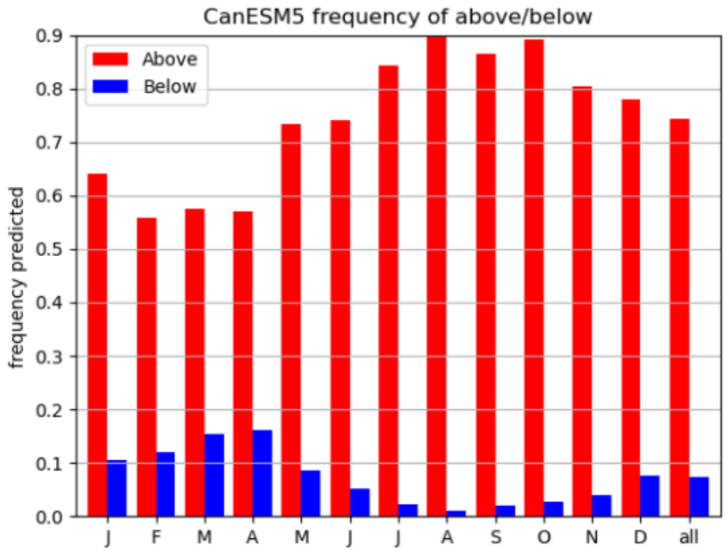
Observed (ERA5)







CanESM5 ens mean



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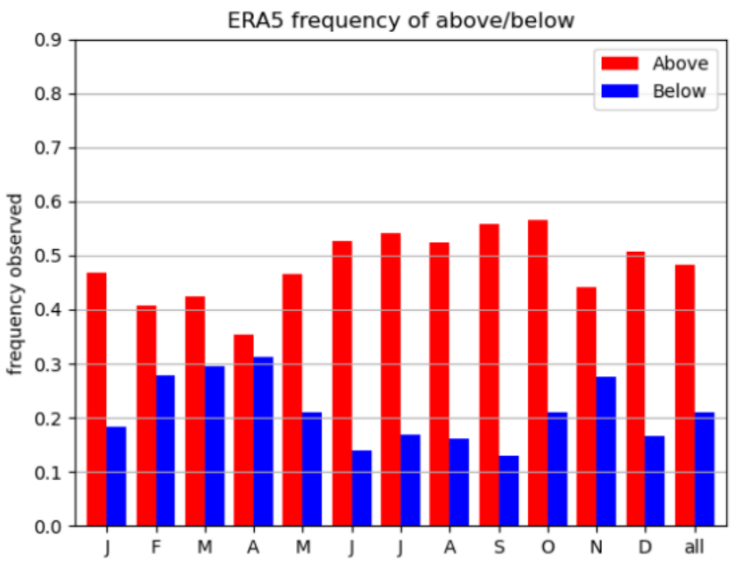
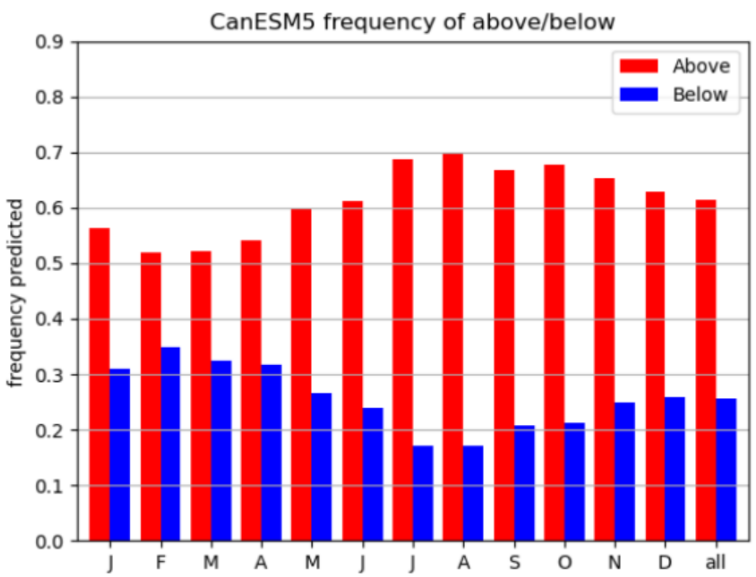


CanESM5 ens members



For discussion

- Is there an impetus for ocean prediction activity to continue?
- Same for temperature trends (viewed as culminating with review/synthesis paper)