S2S Prediction with CESM1

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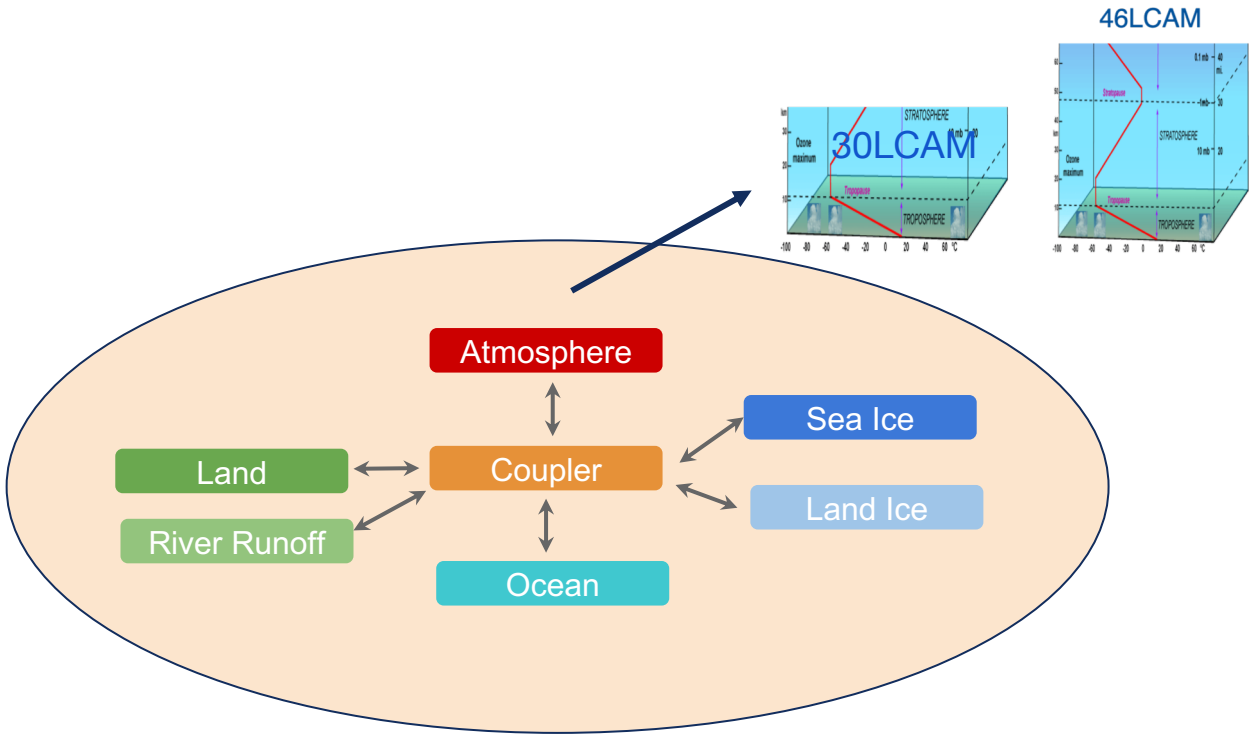
Introduction

- S2S efforts at NCAR started with a NOAA funded proposal: J. Perlwitz (NOAA/ESRL) and J. Richter (NCAR)
- Initial main goal: to investigate role of stratosphere on NAO predictability
- Learnt several lessons in the process…

S2S with CESM1: Hindcast Set-up



	Subseasonal (45 day runs)
	Hindcasts following SubX protocol 1999 - 2015 10 ens with default 30L model 10 ens with 46L model
INITIALIZATION ATMOS	**ERAI** **Ensembles: Random Field Perturbation Method**
LAND	**CRU-NCEP**
OCEAN	**JRA-55 Forced Ocean Hindcasts**

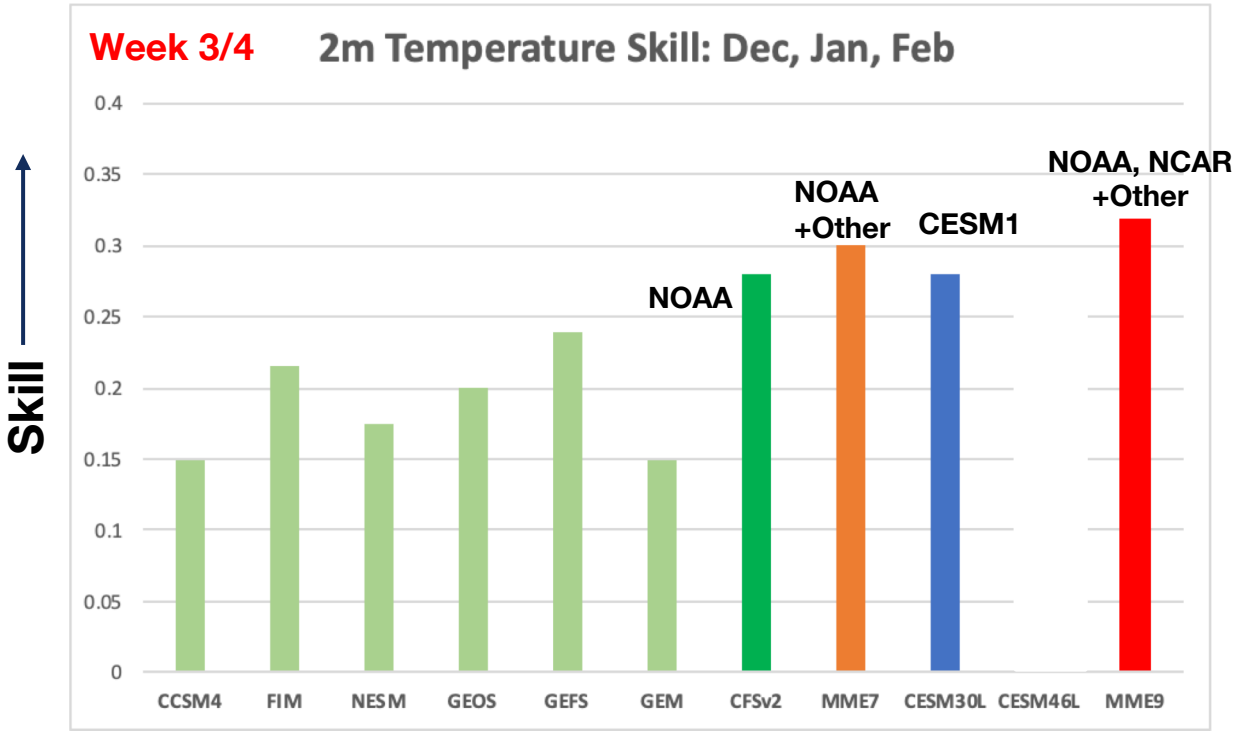
DATA AVAILABLE IN THE IRI LIBRARY WITH SUBX MODELS

https://iridl.ldeo.columbia.edu/SOURCES/.Models/.SubX/

I. Infrastructure

- Computational infrastructure for S2S hindcasts is complicated
- 1999-2015: Hindcast set:
  20 years x 52 starts x 10 ens = 8840 model runs
- Leveraged scripting created by J. Caron/J. Tribbia for NMME contributions with CESM1
- Even ‘automatic’ running requires a lot of human time and error fixing
- Not easily transferable to community (at this point)

II. CESM1 S2S SKILL

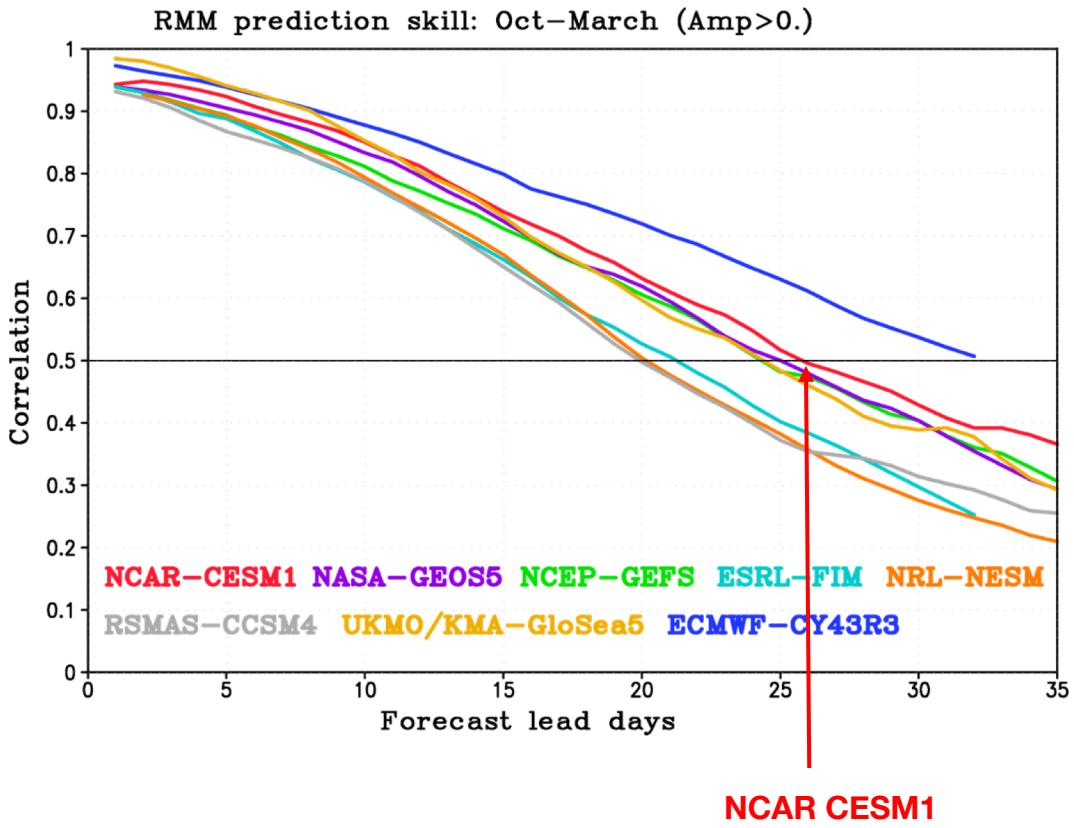


- CESM1 has 2m Temperature and precipitation skill comparable to NOAA's operational model
- CESM1 has better skill than most other US models participating in SubX

Richter et al. (2020), revision

II. CESM1 S2S SKILL

MJO Prediction:

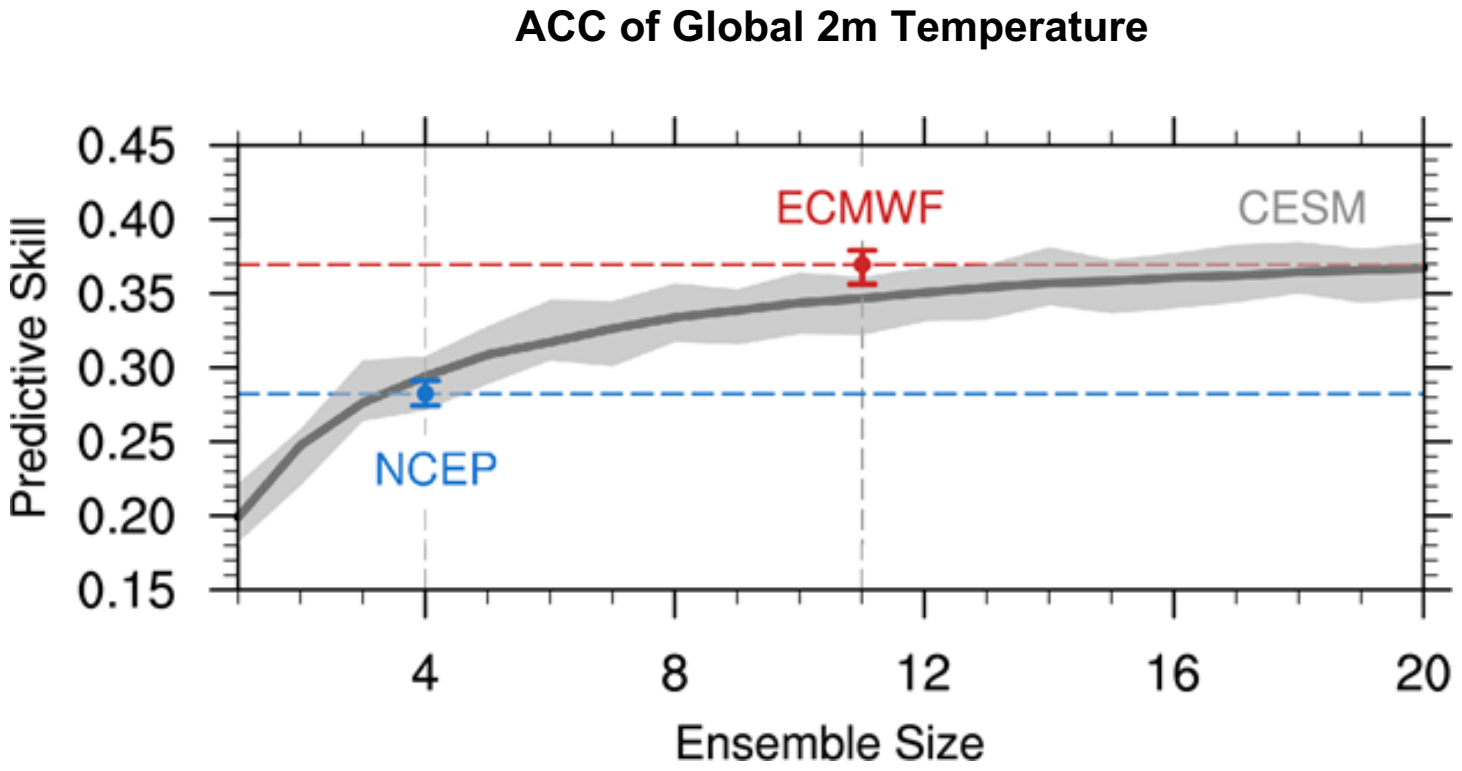


MJO Prediction skill also really good in CESM1

RMM skill = bivariate correlation coefficient MJO skill

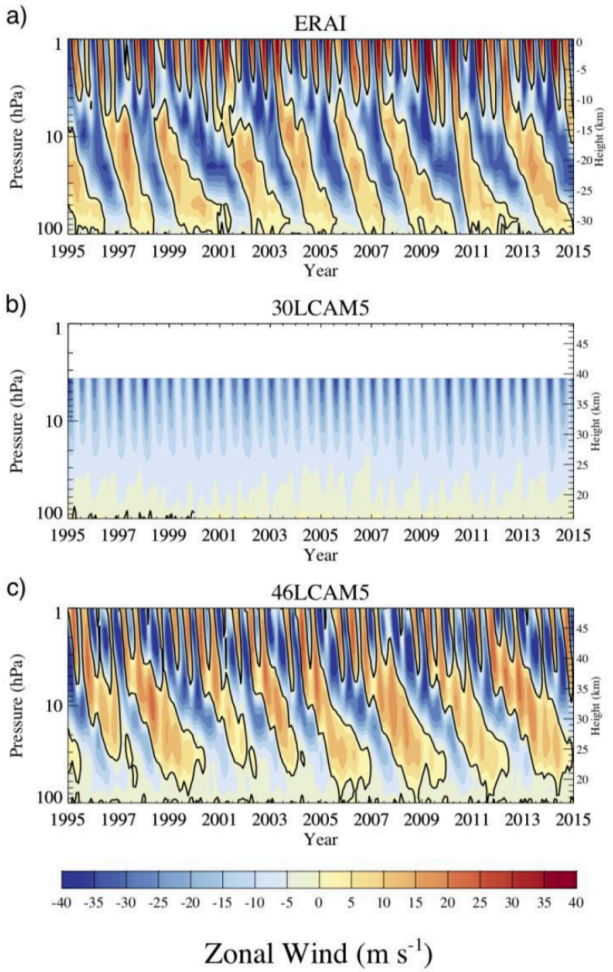
Kim, Richter, Zane (2019)

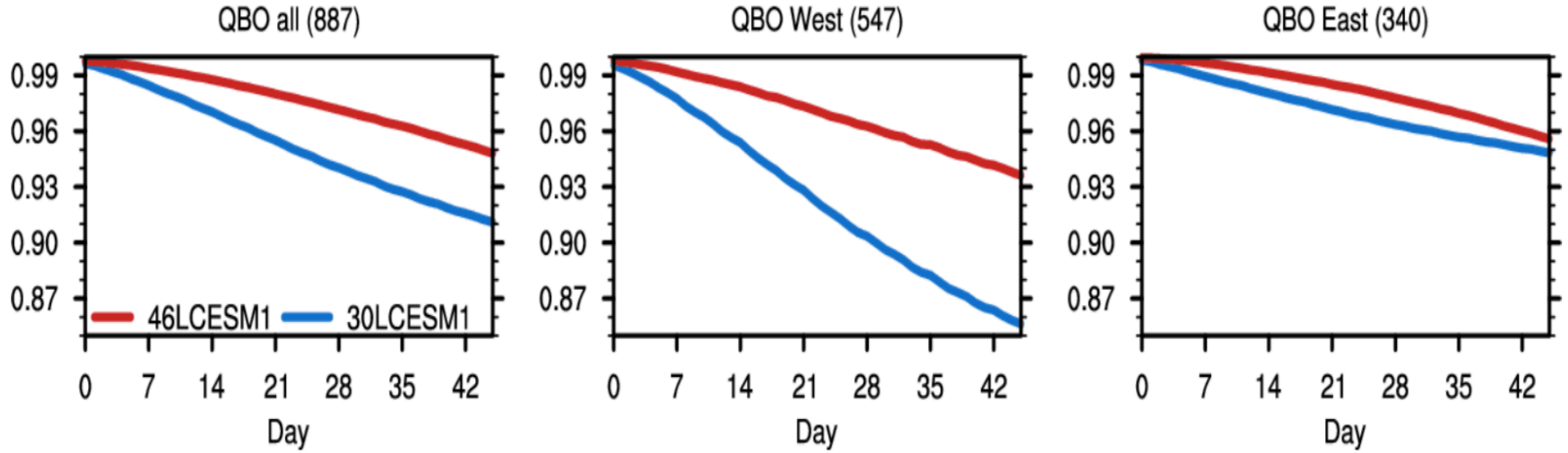
III. Ensemble size matters a lot



Meehl et al. (2020), In revision

IV. Better stratospheric model -> better stratospheric predictability

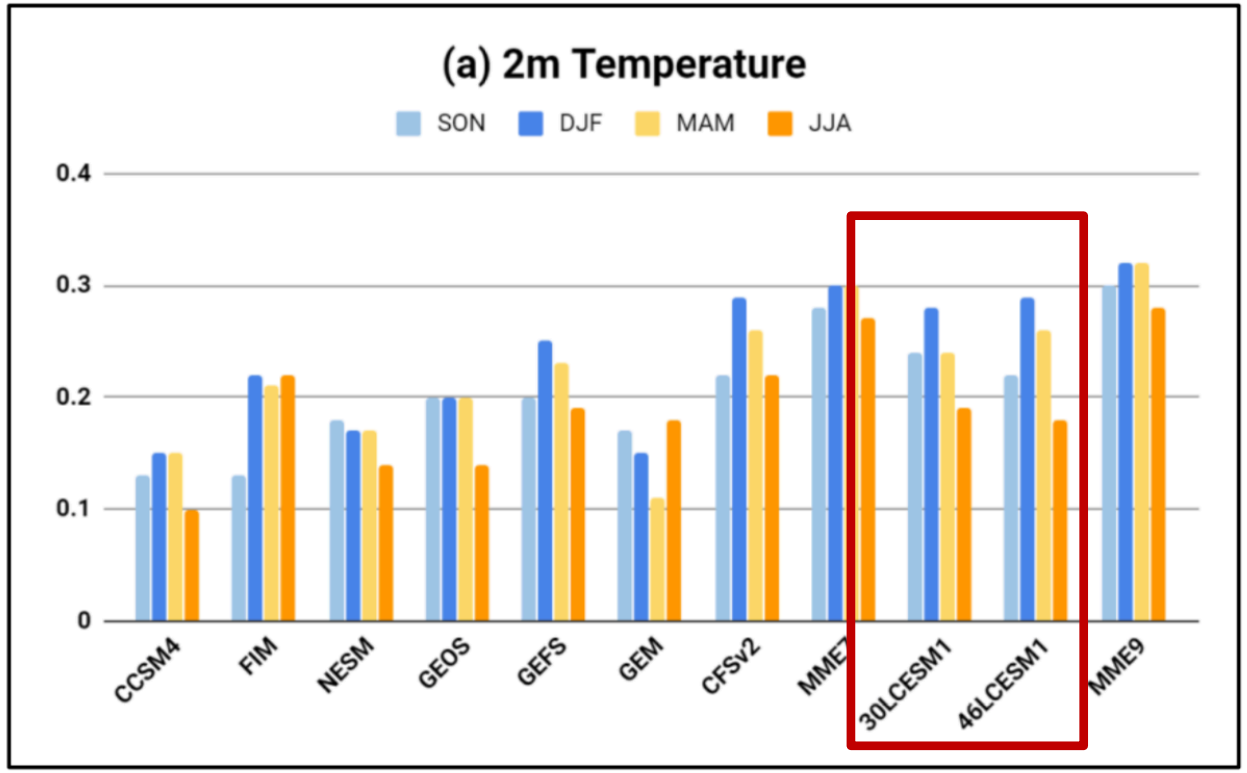


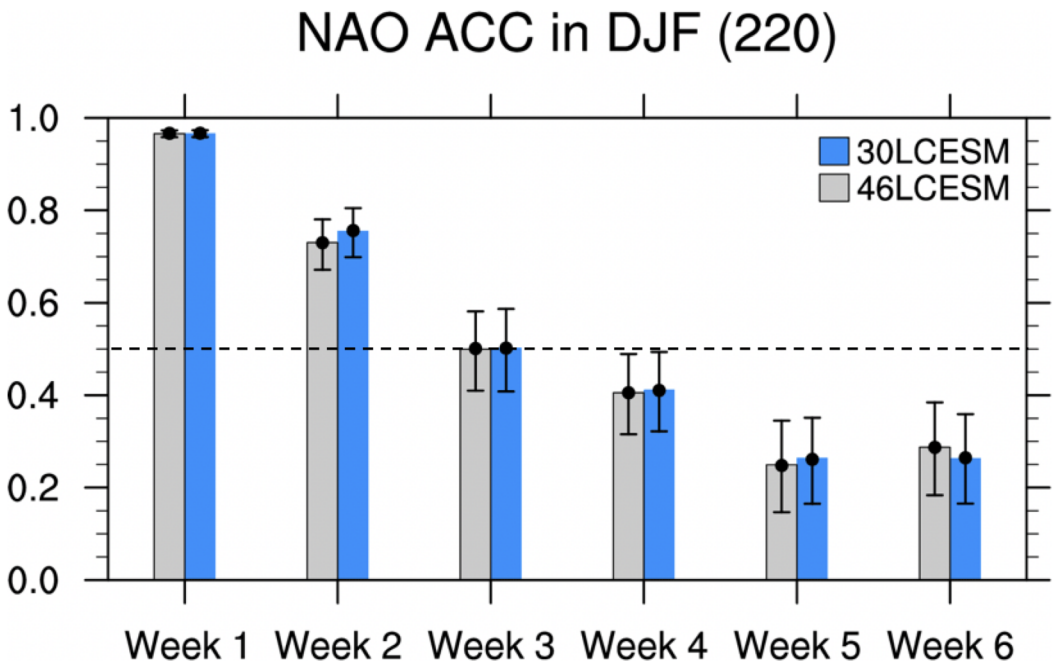


Predictability of the QBO much better in 46L vs 30L CESM1

Richter et al. (2020), in revision

V. Better stratospheric model -> surface skill unchanged

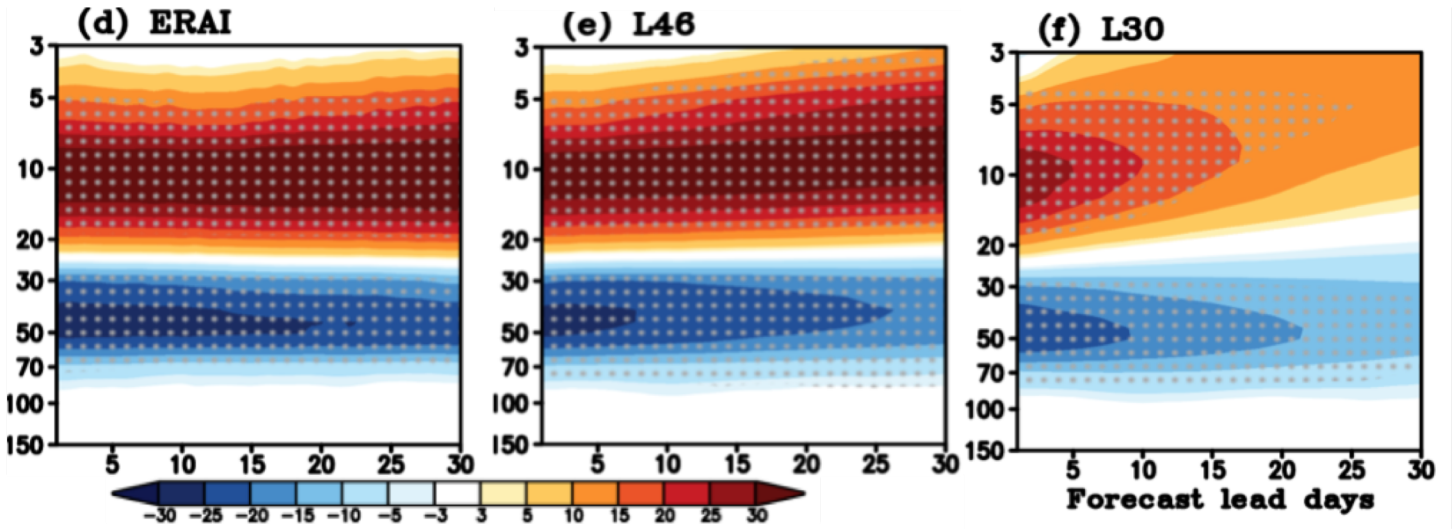




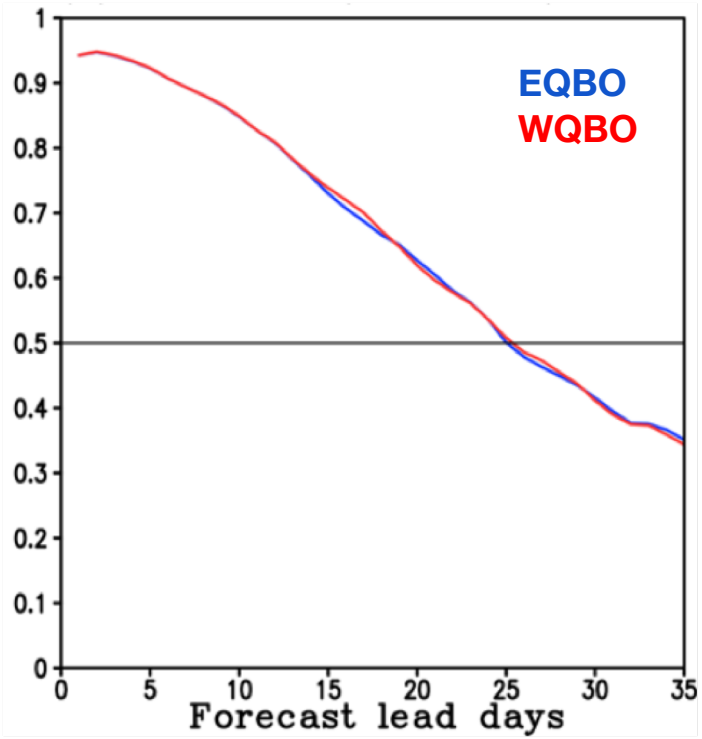
Richter et al. (2020), in revision

V. Better stratospheric model -> surface skill unchanged

[U]:
10S to 10N



MJO Predictability



46LCESM1 and 30LCESM1 hindcasts can be combined into a 20-member ensemble for most purposes…

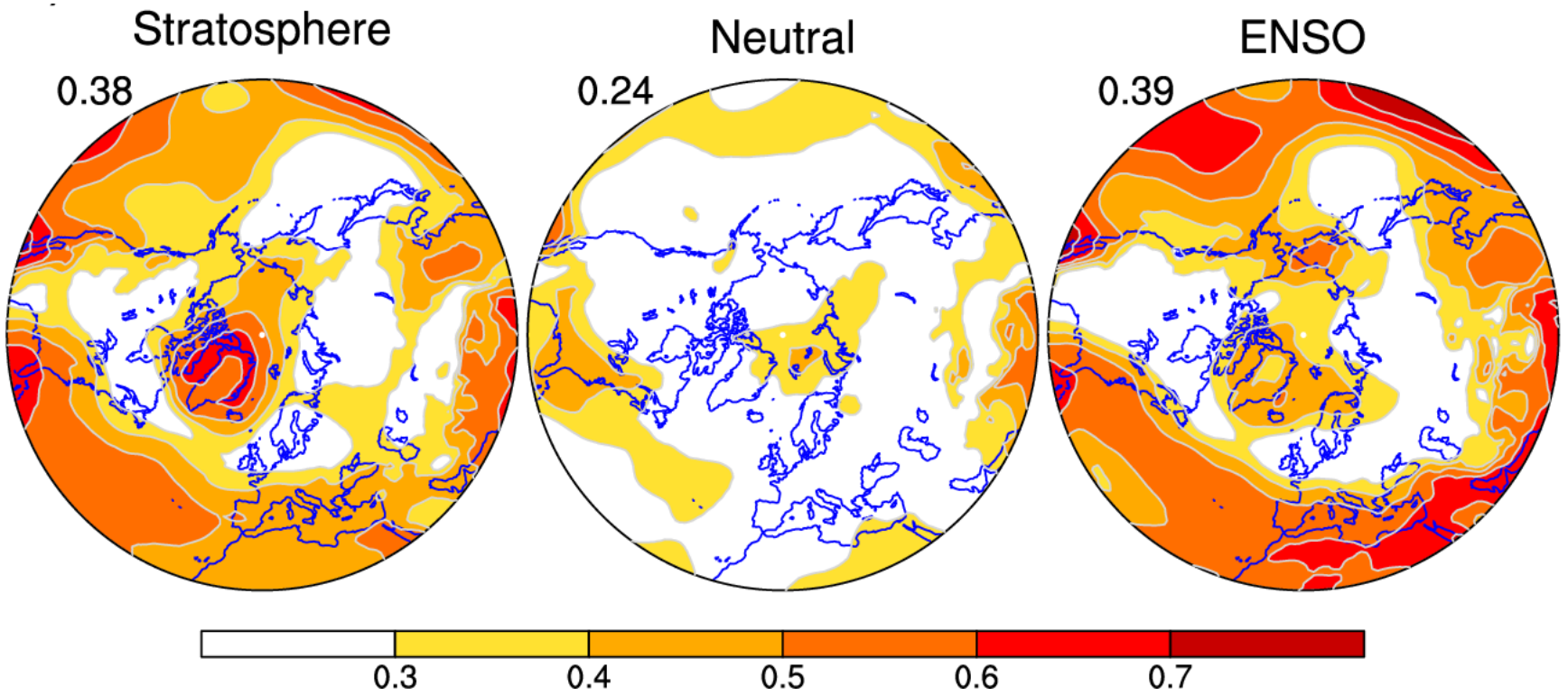
L46-CESM1:
→ better QBO, identical MJO

Kim, Richter, Zane (2019)

VI. CESM1 20-mem ensemble: useful for basic research on predictability

Attribution of NAO predictability

Strong and Weak Polar Vortex Events



Stratospheric variability and surface lower boundary forcing can both contribute to NAO predictability

Sun et al. (2020), In Preparation

Summary

- We’ve demonstrated the utility of CESM1 as a tool for S2S research
- Due to the high logistical burden of hindcasts, WG is a perfect venue for coordinated experiments
- CESM1 has overall really good subseasonal skill
- Better representation of the stratosphere does not increase predictability -> Increased ensemble size is more beneficial