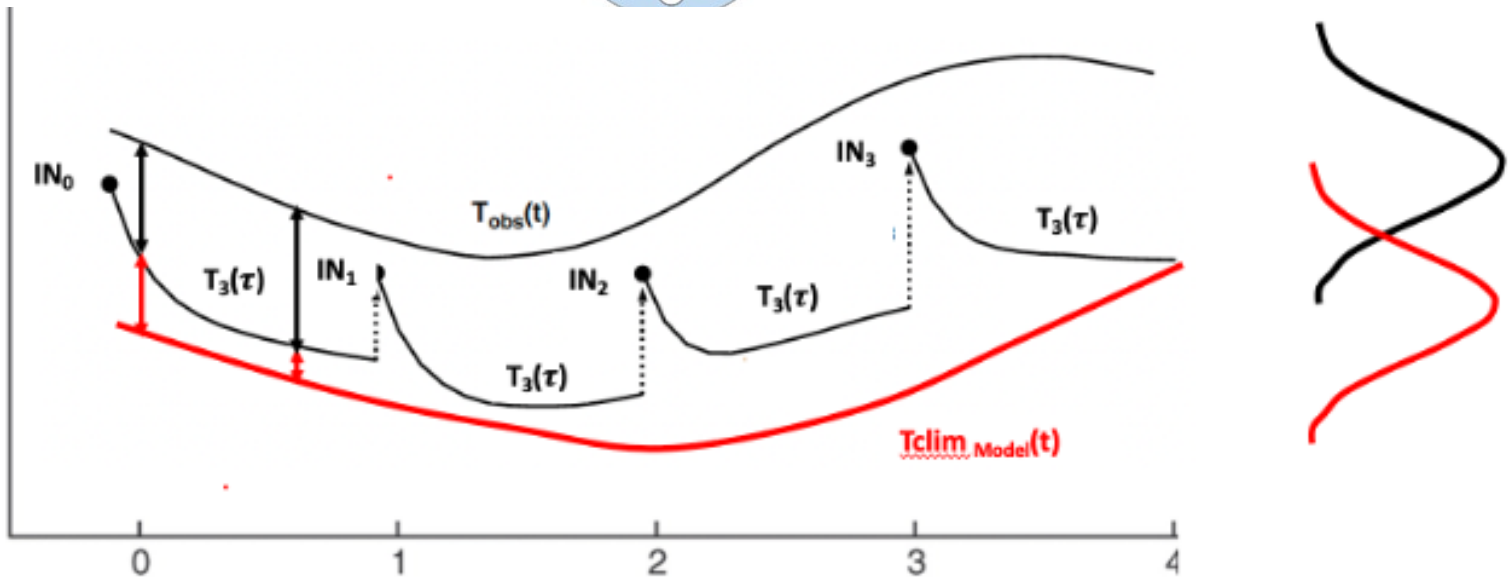

Benefits of online bias-correction versus post-processing

Judith Berner, Abigail Jaye, Will Chapman
NSF National Center for Atmospheric Research – Boulder, CO

CESM workshop, Boulder – June 11, 2025

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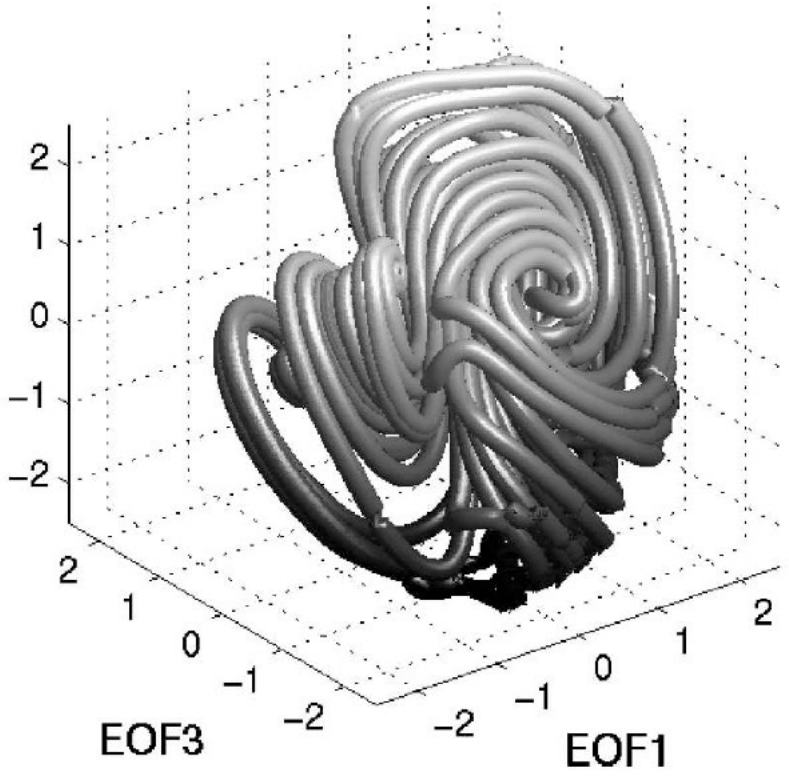
Motivation

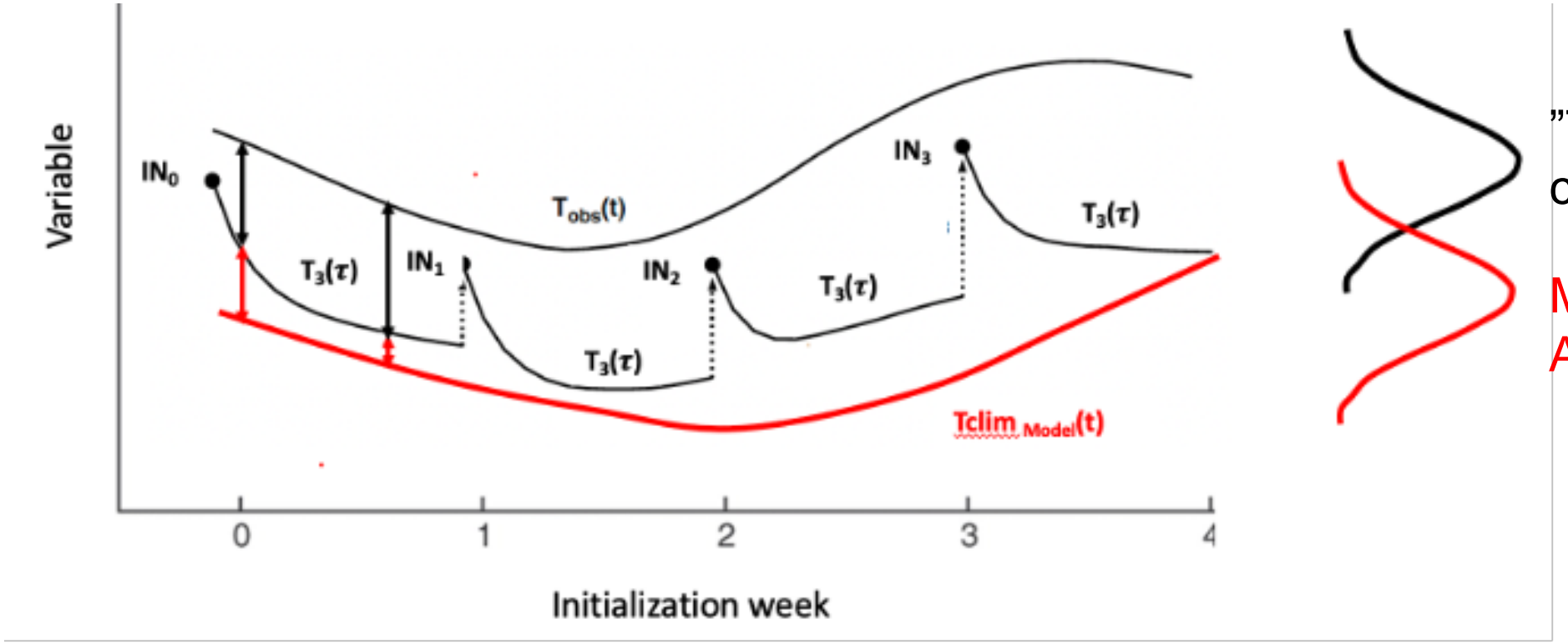
- Subseasonal to seasonal have generally little skill
- Here, we study the impact of an online bias correction on forecast skill and compare it to a a posterior bias-correction
- Typically, we need to remove the lead-time dependent forecast bias which requires a set of hind-casts
- Systematic biases reduce forecast skill (Abby's talk)



Experiment Setup

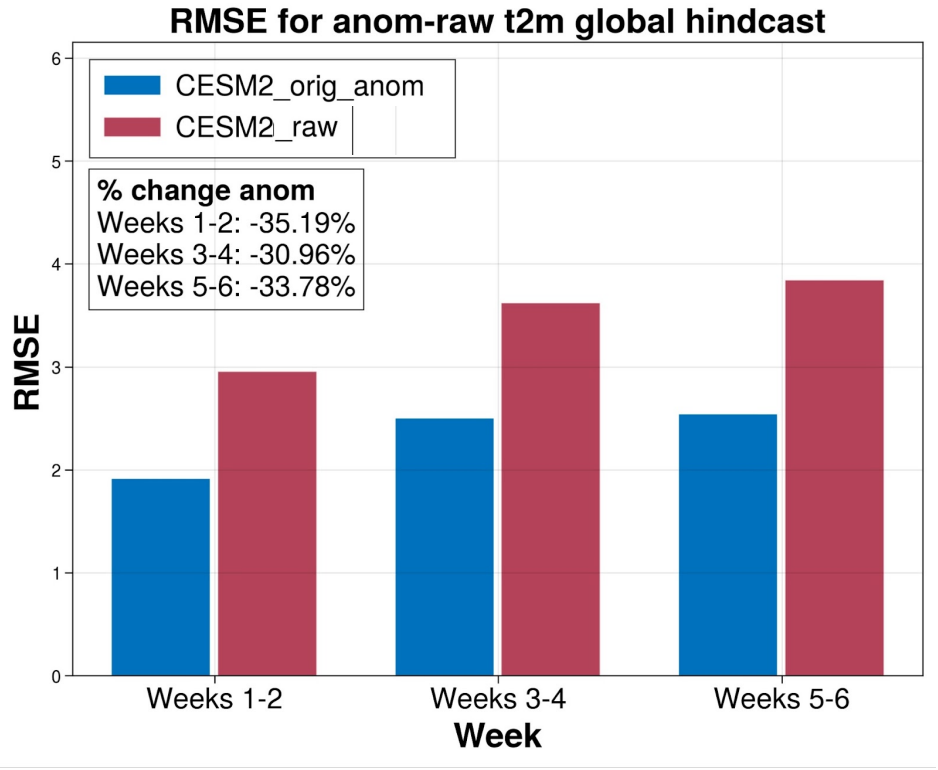
- Coupled Global Climate Model (CESM2)
- 1 degree horizontal resolution in atmosphere and ocean
- Subseasonal to seasonal runs follow SubX protocol
  - Weekly initializations from 1999-2022
  - Initialization from NCEP CFSv2
  - 11 ensemble members via anomaly initialization

Leadtime dependent forecast bias



- Forecast drifts to the model attractor due to initialization drift and systematic model-error

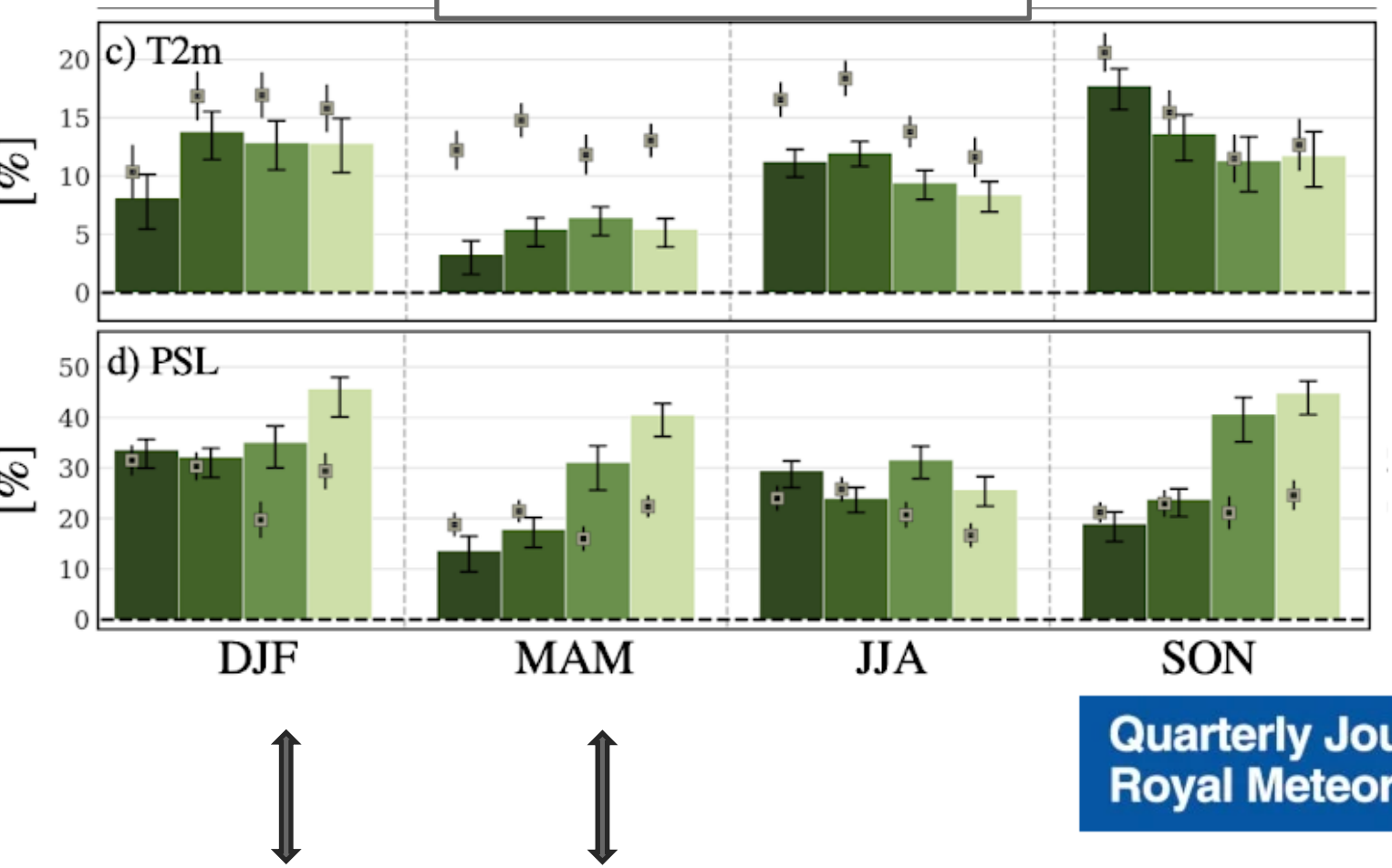
Removing the lead-time dependent bias, T2m



- Removing the leadtime-dependent forecast bias ("anom") decreases RMSE of T2m by ca 30%.

Online model-bias correction

Chapman and Berner, 2024



- Mean nudging tendencies (toward ERAI) re-inserted at run-time
- RMSE percent improvement of ca 10% for T2m and up to 40% for PSL
- Experiment “determ”

Quarterly Journal of the Royal Meteorological Society
RMetS

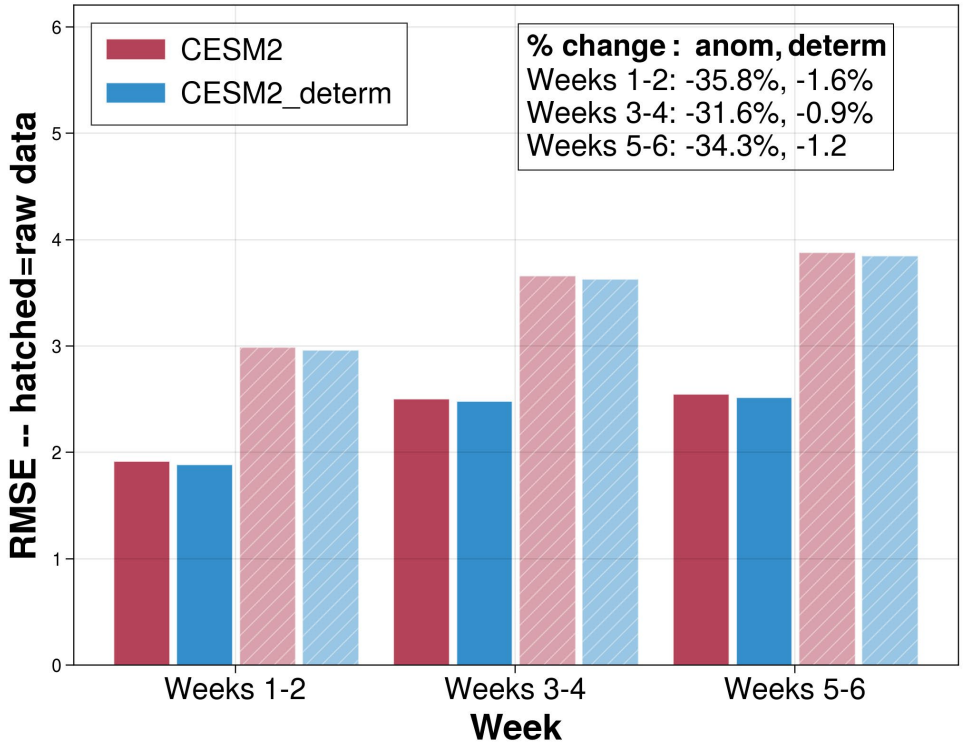
RESEARCH ARTICLE

Deterministic and Stochastic Tendency Adjustments Derived from Data Assimilation and Nudging

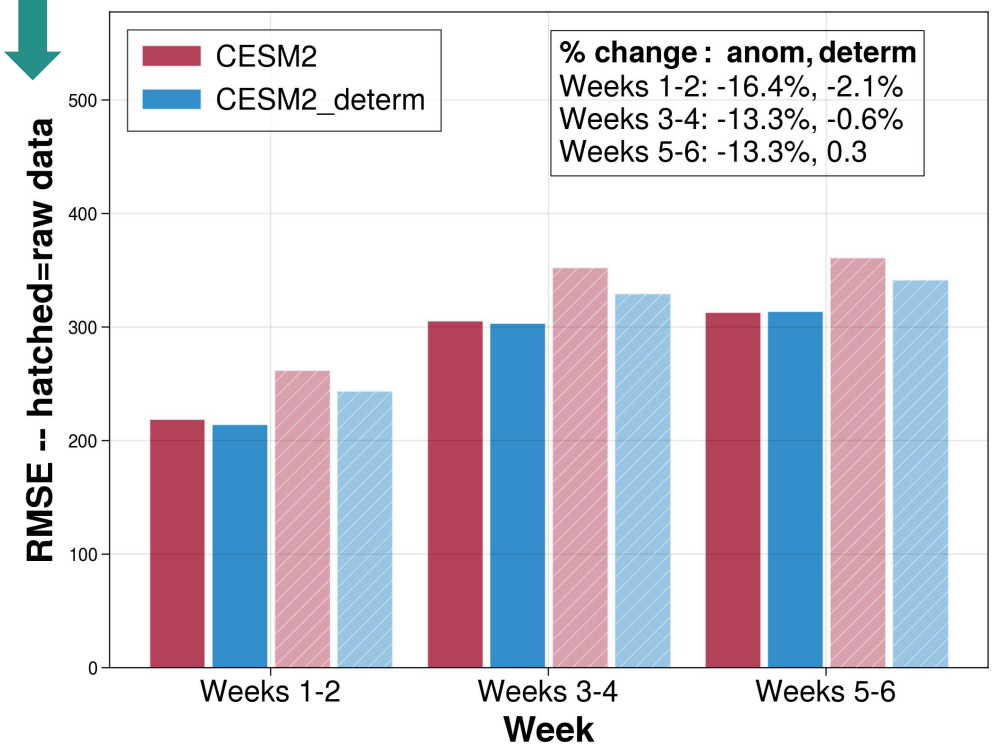
William E. Chapman PhD, Judith Berner PhD

Impact on RMSE

T2m



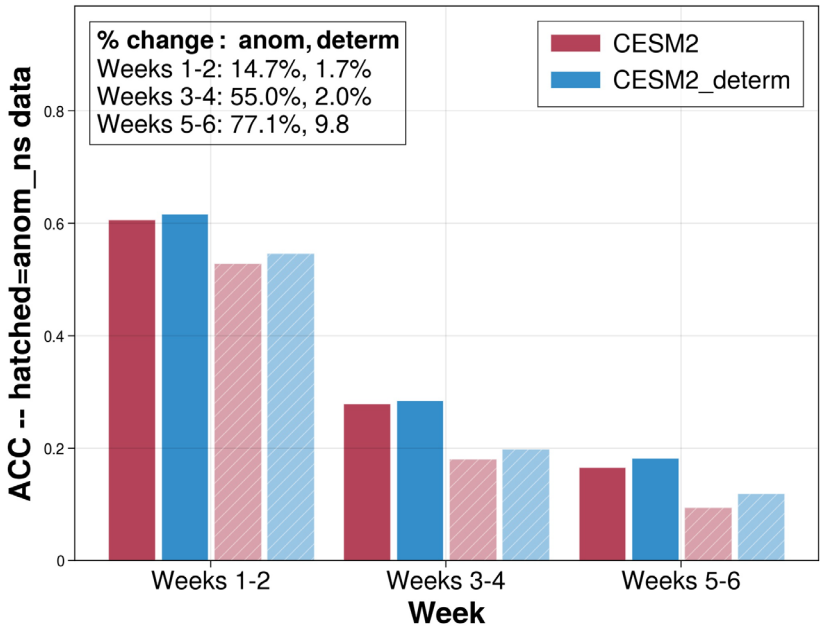
PSL



- Removing the lead-time dependent forecast bias has biggest impact
- An online model-bias correction reduces RMSE further

Impact on ACC

T2m



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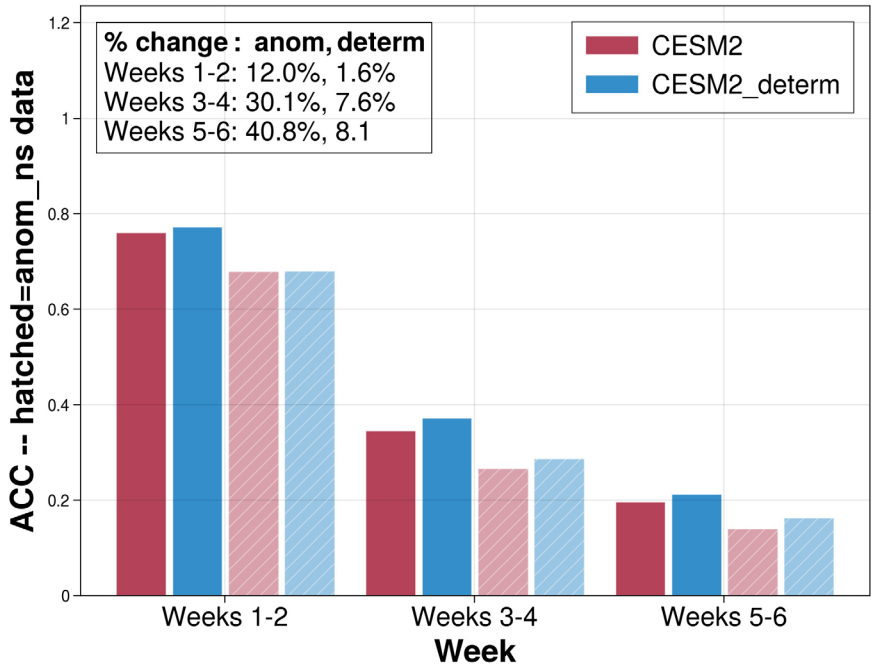


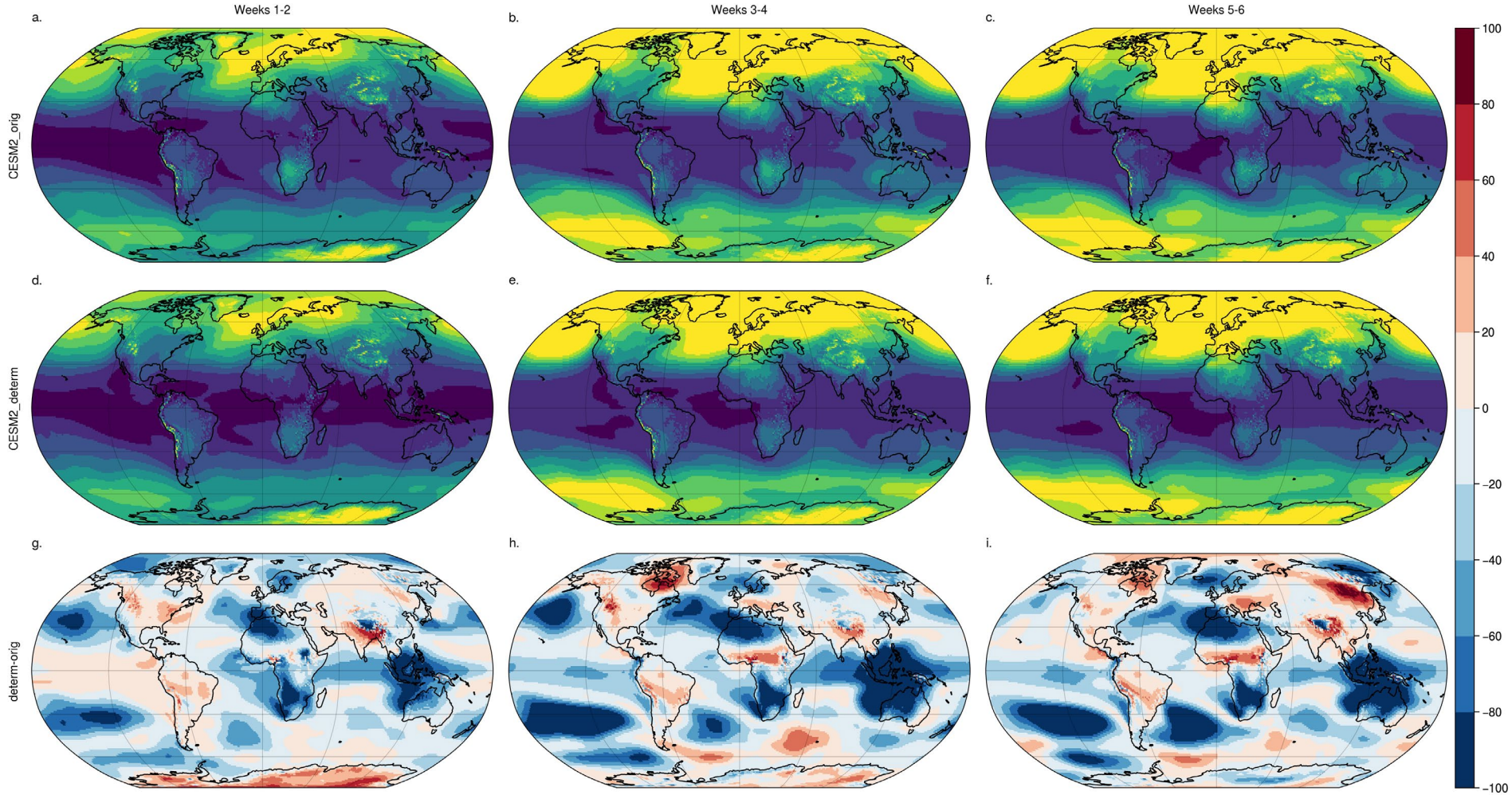
- A online model-bias correction increases ACC by a few percent

Questions? – berner@ucar.edu

RMSE

CESM

CESM_determ



Conclusions/Future work

- Removing the lead-time dependent bias is improves the RMSE in subseasonal-to-seasonal forecasts with CESM.
- An online model-error representation improves the RMSE further.

- Future: Use machine-learned state-dependent model-error representation (Chapman and Berner 2025, GRL)