Towards Subseasonal Prediction with the NMME

Kathy Pegion
NOAA/ESRL/PSD & University of Colorado/CIRES

NMME Subseasonal Team

Can the NMME provide skillful predictions to inform forecasts on subseasonal timescales?

Challenges

- Initialization frequency

- Significant increase in amount of data (over monthly fcsts)

- Balance of operational needs with what is feasible given current resources & the science missions of participating modeling groups

> *What can we say about potential for NMME to improve subseasonal forecasts given the current dataset?*
>
> *Is the potential improvement worth the resource investment?*

A Preliminary Look at MJO Skill with Some NMME Data

NMME Data

Model	Years	Initial Conditions	Lead	Ensemble members	Output Frequency
NCEP/CFSv2	1982-2009	Dec 27 (0,6,12,18Z)	9 months	4	daily
RSMAS/NCAR-CCSM4	1982-2005	Dec 25,26,27,28	12 months	4	daily

➡ Note: this is a small sample – 28 years of Dec forecasts

Verification Data

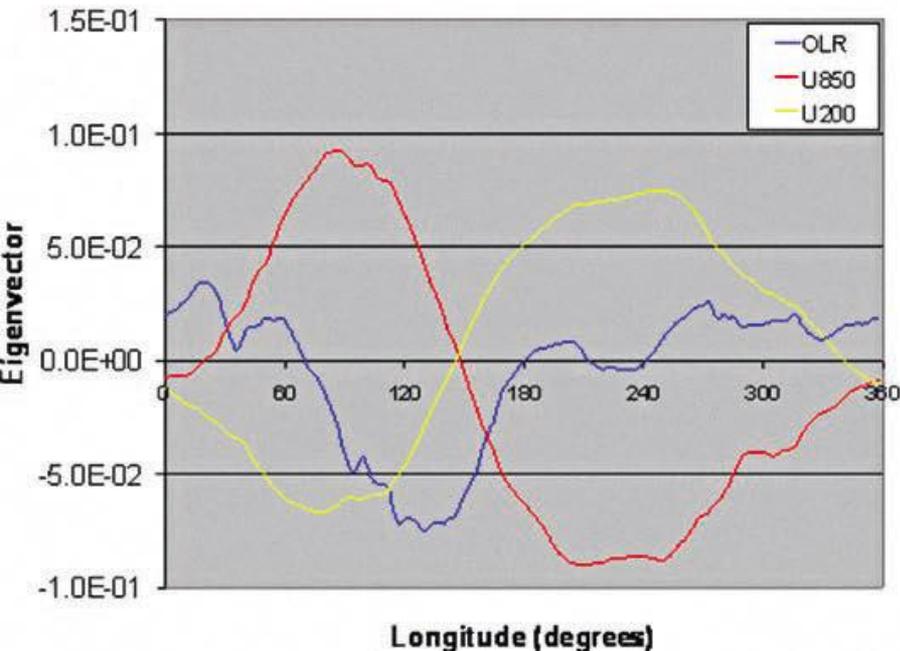All Season Real-time Multivariate MJO Index (Wheeler and Hendon 2004)

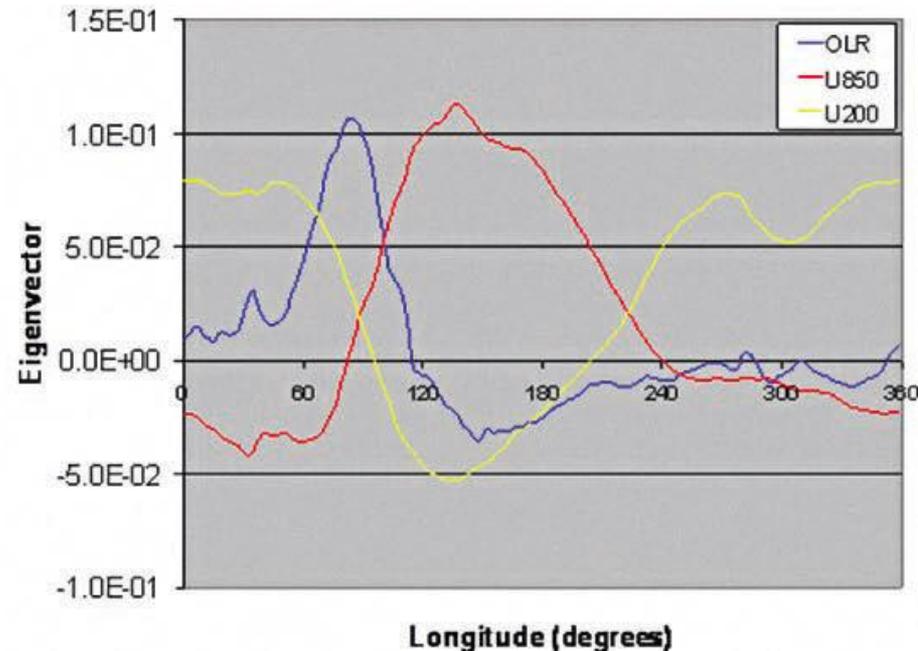➡ Focus on weekly forecasts for Jan 1-7 through Jan 21-27

MJO Index

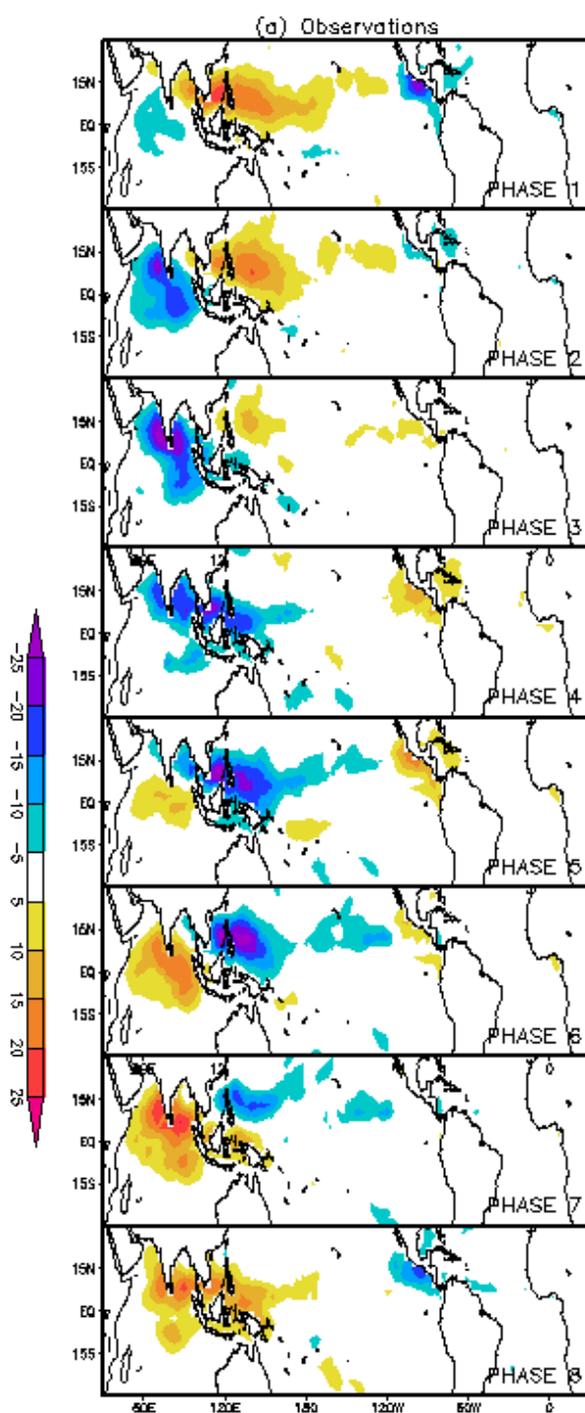Real-time Multivariate MJO Index (Wheeler and Hendon 2004)

1. Based on combined EOFs of U200, U850, and OLR

2. First two PC timeseries (RMM1 & RMM2) represent the MJO amplitude and phase

From Gottschalck et al. (2010)

(a) Observations

PHASE 1
PHASE 2
PHASE 3
PHASE 4
PHASE 5
PHASE 6
PHASE 7
PHASE 8

Western Pacific

Phase 7   Phase 6

Phase 8   Phase 5

W. Hemisphere & Africa

RMM2

Maritime Continent

Phase 1   Phase 4

Phase 2   Phase 3

RMM1
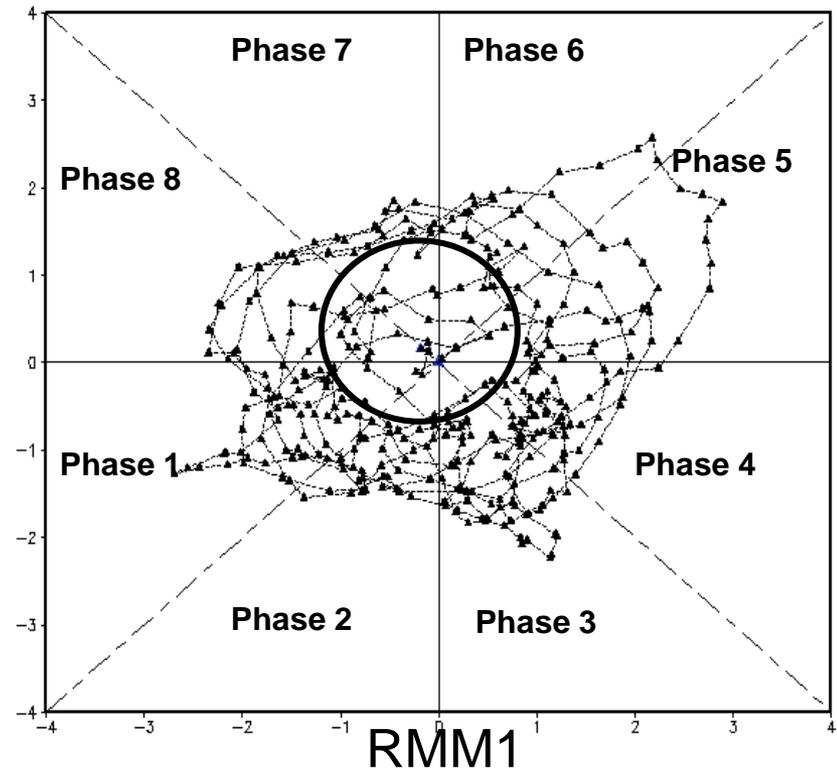
Indian Ocean

Bivariate Correlation (Gottschalck et al. 2010)

$$\mathrm{COR}(\tau) = \frac{\sum\limits_{t=1}^{N}\left[a_1(t)b_1(t,\tau) + a_2(t)b_2(t,\tau)\right]}{\sqrt{\sum\limits_{i=1}^{N}\left[a_1^2(t) + a_2^2(t)\right]}\sqrt{\sum\limits_{i=1}^{N}\left[b_1^2(t,\tau) + b_2^2(t,\tau)\right]}}, \quad (1)$$

Weekly Forecast Skill

Model A

Model B

Bivariate Correlation RMM Index (y-axis)

Lead Time (sliding weeks) (x-axis)

Ensemble Mean
Ensemble Members

Week 2
Jan 8-14

Week 3
Jan 15-21

WEEKLY FORECAST SKILL

Model A + Model B

Bivariate Correlation RMM Index
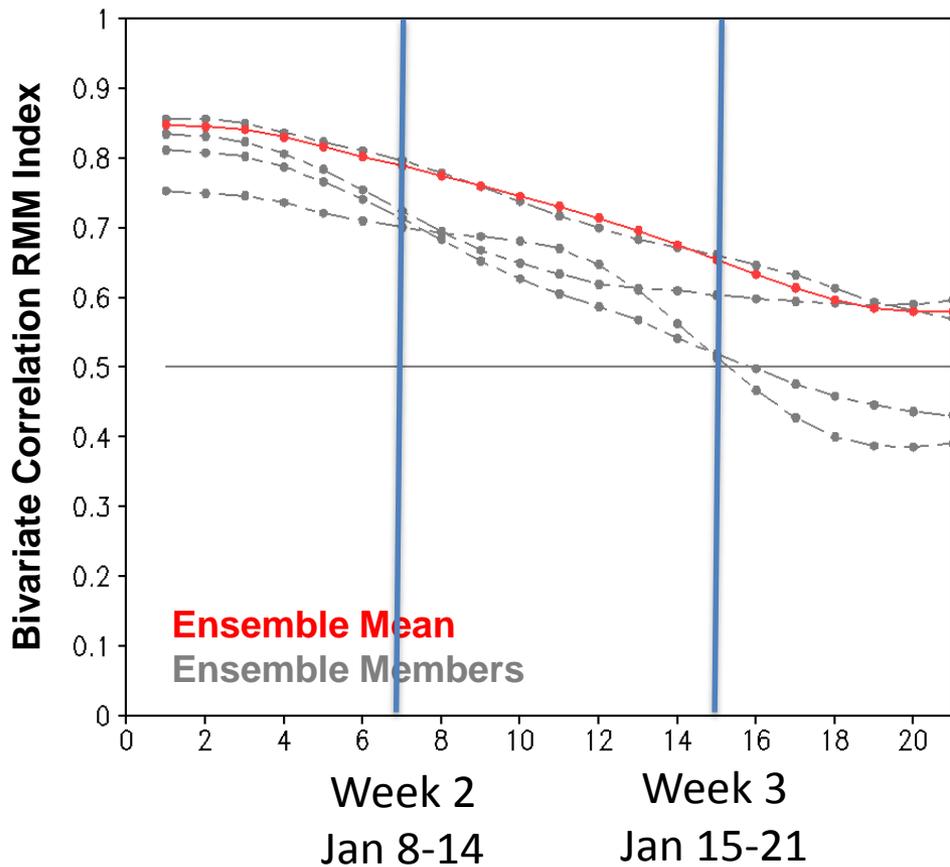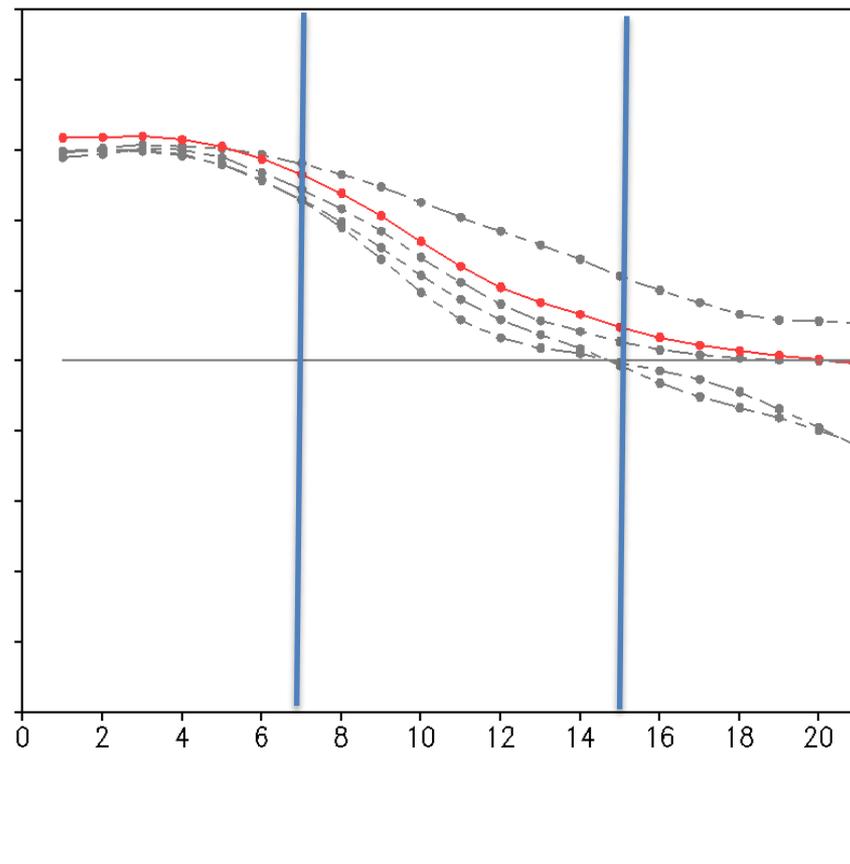
Lead Time (sliding weeks)

Model A
Model B
Model A+Model B

The MME is among the best forecasts, but not always the best.

CCSM4 adds skill to CFSv2 even with old forecasts. What is the balance between additional information from adding models vs. old information?
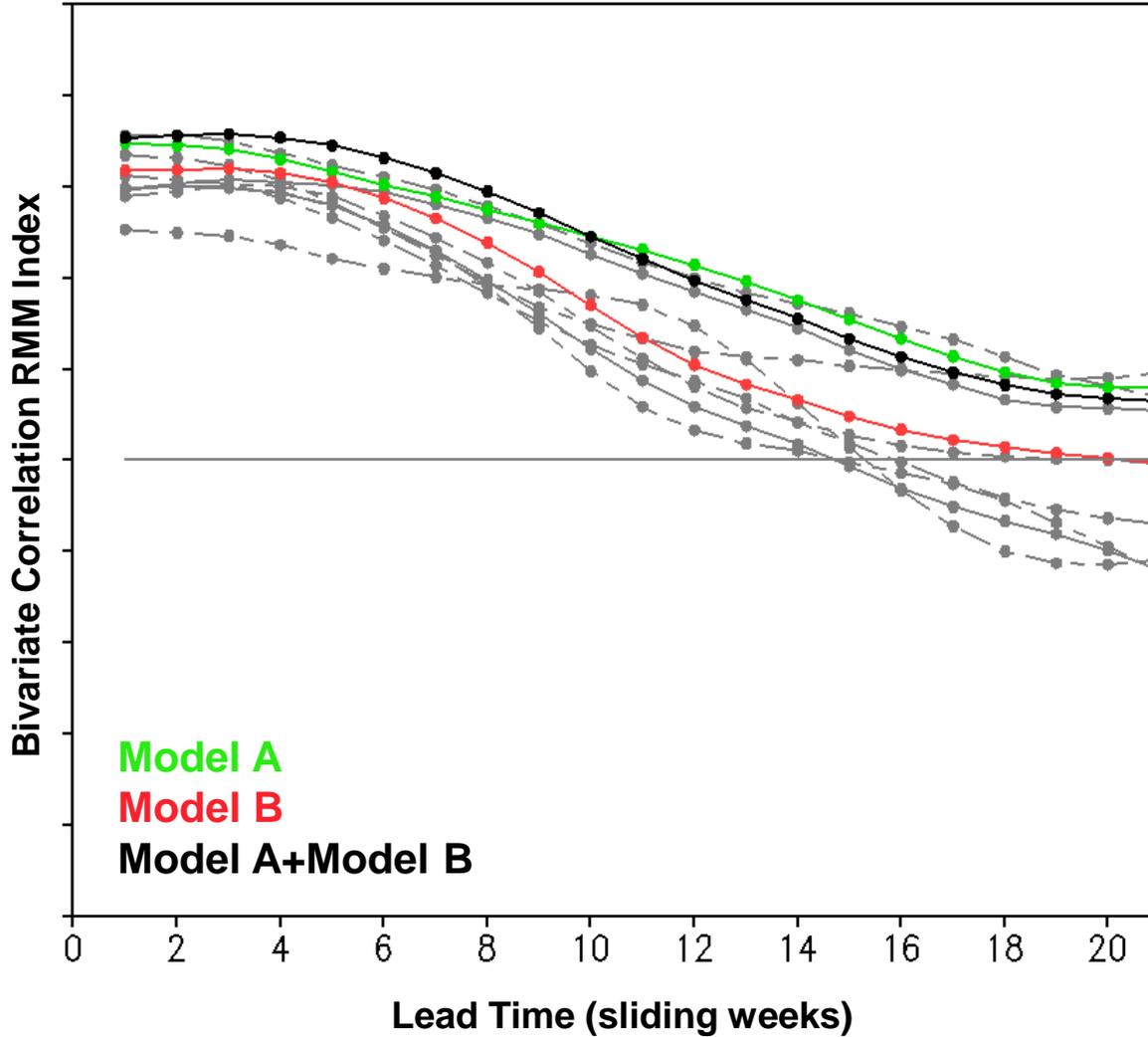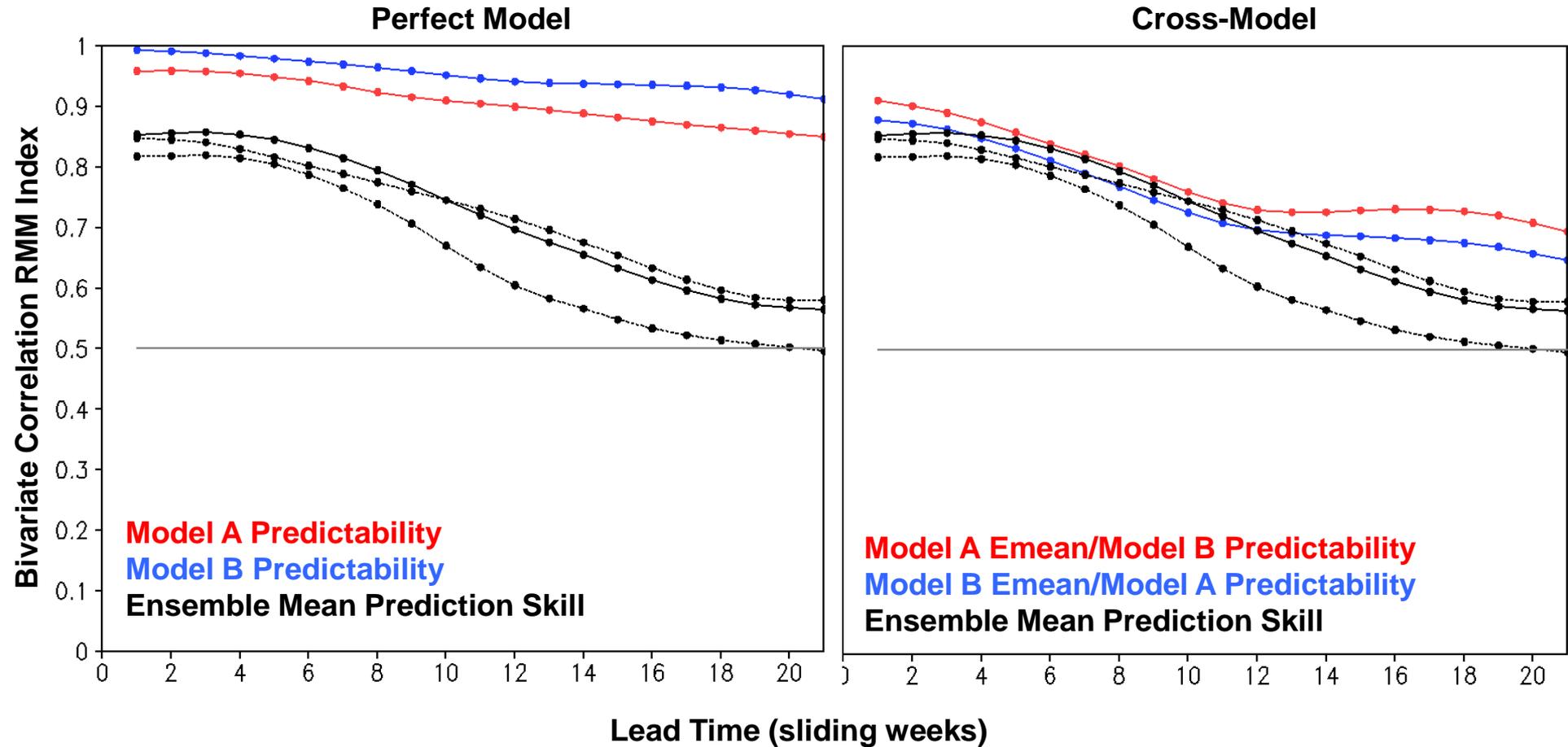
More frequently initialized forecasts are necessary to answer this question.

How much skill is left to be realized?

Perfect Model

Cross-Model

Bivariate Correlation RMM Index

Lead Time (sliding weeks)

Model A Predictability
Model B Predictability
Ensemble Mean Prediction Skill

Model A Emean/Model B Predictability
Model B Emean/Model A Predictability
Ensemble Mean Prediction Skill

Two estimates of predictability:

(1)   Perfect model estimate indicates that there is still potential for more skill.

(1)   Cross-model estimate indicates that the ensemble means are near max skill for weeks 2 and 3, but there is potential for higher skill beyond week 3.

A larger dataset of re-forecasts are needed to understand the potential for improving MJO skill with the NMME.

NMME Subseasonal Experiment

Goals

- To demonstrate the potential benefit of a subseasonal NMME in a retrospective context
- To provide a framework for a future real-time subseasonal NMME

NMME Subseasonal Team

Kathy Pegion (University of Colorado/CIRES & NOAA/ESRL/PSD)
Ben Kirtman (University of Miami/RSMAS)
Siegfried Schubert (NASA/GMAO)
Jin Huang (NOAA/NCEP/CPC)
Jon Gottschalck (NOAA/NCEP/CPC)
Huug van den Dool (NOAA/NCEP/CPC)
Paul Dirmeyer (George Mason University/COLA)
Jim Kinter (George Mason University/COLA)
Malaquias Pena (NOAA/NCEP/EMC)

NMME Subseasonal Experiment

Protocols

a) Reforecasts for 1999-2012
b) November (possible future summer initializations?)
c) 45-days
d) ICs: 2nd, 7th, 12th, 17th, 22th, 27th
e) Ensemble members >= 3
f) Limited set of variables: SST, U200, U850, OLR, Precip, MSLP, Z200.

*Initial Participating Models* (Additional models welcome!)

a) NCEP-CFSv2 (4-members)
b) NASA-GMAO (5-members)
c) RSMAS/NCAR-CCSM4 (3-members)

Data Management/Archive: COLA

Connection to CPC Operational Products: Test contribution of NMME subseasonal experiment to MJO prediction for GTH product

Preliminary Results from NMME Subseasonal Experiment

RMM Bivariate Correlations (1999-2009)
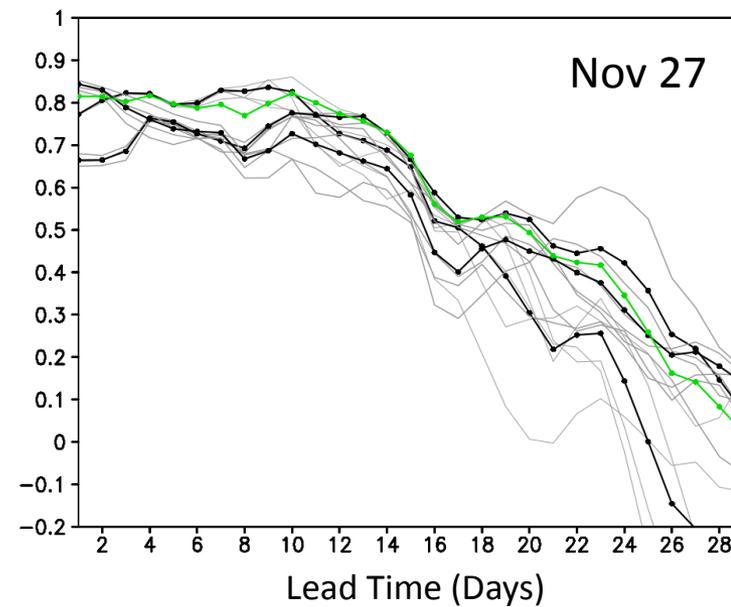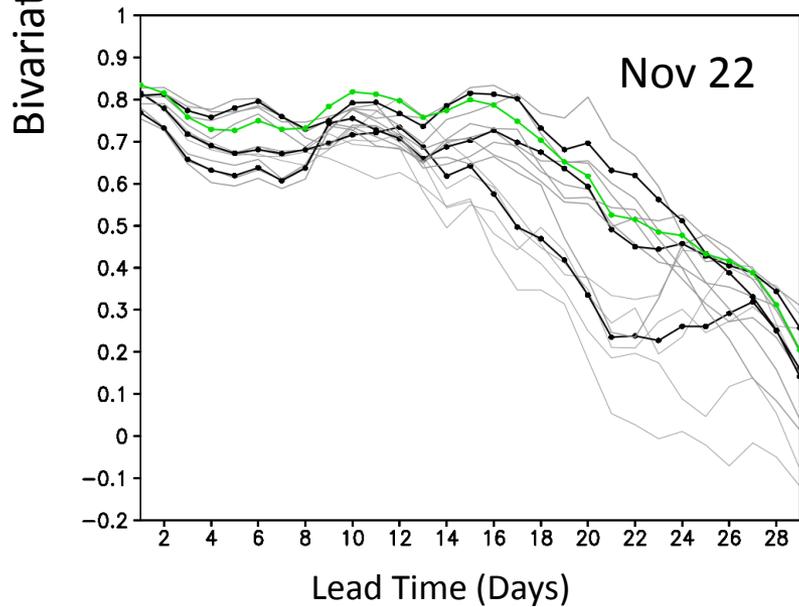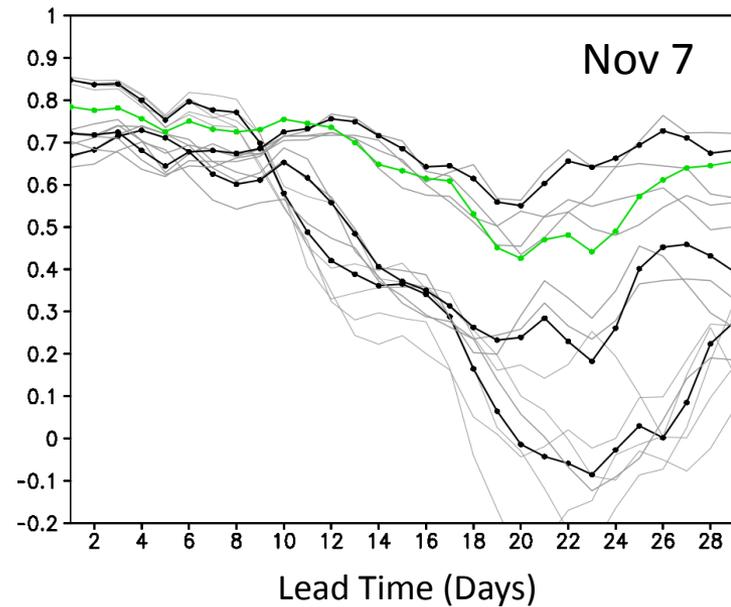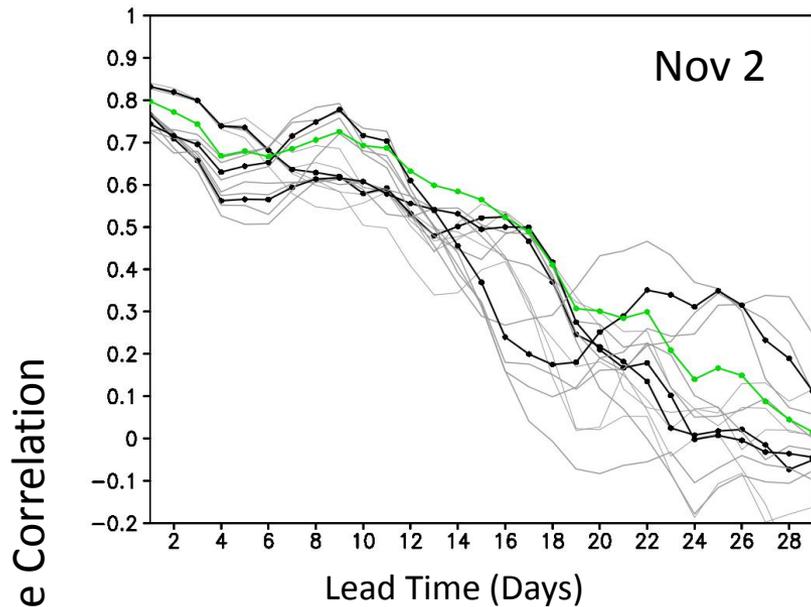
Summary and Potential Collaborations with CWB

- We are still assessing the benefit of subseasonal NMME for MJO in terms of actual skill and potential skill

- Preliminary results look promising that a MME benefits subseasonal prediction. Cost=benefit?

- Still investigating role of lagged ensembles and their potential to benefit operational predictions

- So far, only focused on MJO skill as a test case, but a summer set of initial conditions is also needed to assess subseasonal predictability for precipitation

- Additional model contributions are welcome as part of this subseasonal assessment