Performance-based MJO Hindcast Evaluation in SubX

Kathy Pegion (GMU/COLA)
Hyemi Kim (Stony Brook University), Wei Li (IMSG @ NCEP/EMC)
Shuguang Wang (Columbia University), Matthew Janiga (NRL)
Deepthi Achuthavarier (NASA/GMAO)

Introduction

The Madden-Julian Oscillation is the largest source of tropical variability on the subseasonal timescale and affects weather around the globe. Given its impacts, prediction of the MJO is considered a key component of a skillful subseasonal prediction system. Therefore, we evaluate its skill in SubX.

This poster provides an initial assessment of the MJO prediction skill in SubX

SubX Models & Data

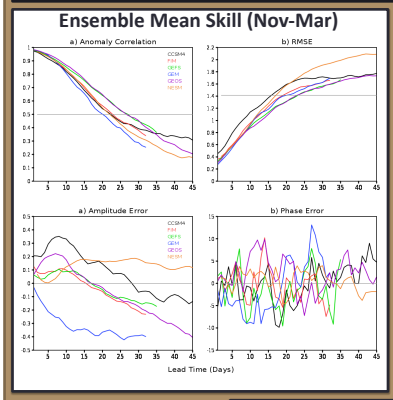
SubX BY THE NUMBERS

- **7** Global Models
- **1+** Years of *Real-time* Forecasts
- **17** Years of *Retrospective* Forecasts
- **3-4** week guidance for Climate Prediction Center Outlooks

Model	Components	Ensemble Members	Length (Days)
NCEP-CFSv2	A,O,I,L	4	45
EMC-GEFS	A,L	11 [21]	35
ECCC-GEM	A,L	4 [21]	32
GMAO-GEOS5	A,O,I,L	4	45
NRL-NESM	A,O,I,L	4	45
RSMAS-CCSM4	A,O,I,L	3 [9]	45
ESRL-FIM	A,O,I,L	4	32

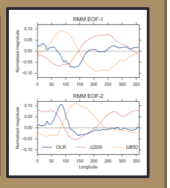
Real-Time Multivariate MJO Index (RMM)

Ensemble Mean Skill (Nov-Mar)



RMM (Wheeler & Hendon 2004)

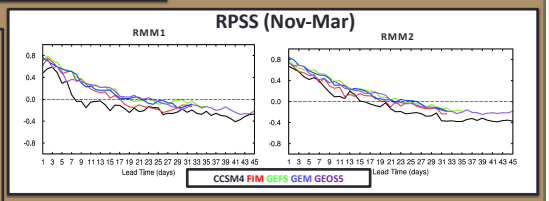
- Combined EOF of tropical U200, U850, & OLR
- Model anomalies projected onto observed EOF patterns
- Dominated by U200 & U850, so primarily represents MJO-related circulation fields



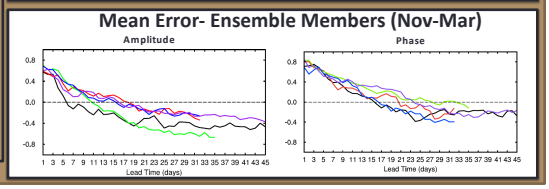
- ACC skill >= 0.5 to ~20-30 days
- RMSE skill >= 1.4 to ~15-25 days
- Most skillful models have very different configurations
- Generally amplitudes are higher than observed initially, but then weaken over time, some exceptions (e.g. NESM & GEM)
- No systematic difference in phase errors with lead time

- Probabilistic skill for RMM1/2 is consistent with deterministic skill
- Mean amplitude for ensemble members is initially larger than observed, but becomes weaker over time
- Mean phase for ensemble members is generally faster than observed initially, but becomes slower over time

RPSS (Nov-Mar)



Mean Error- Ensemble Members (Nov-Mar)

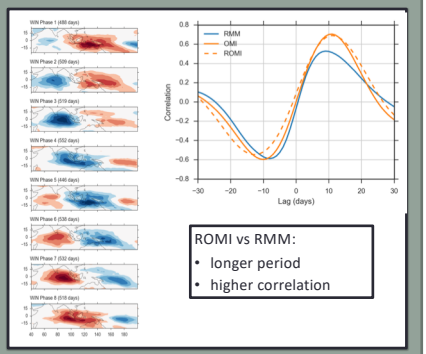


Real-Time OLR-based MJO Index (ROMI)

ROMI (Kiladis et al. 2014)

Real-time OLR MJO index designed to capture MJO-related convection

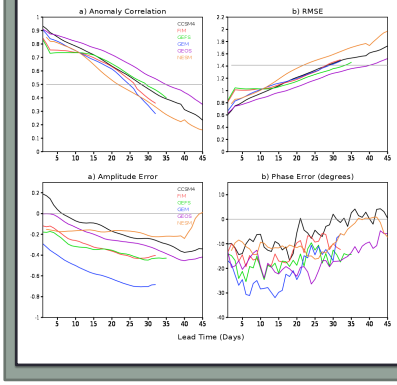
- Calculate forecasted OLR anomalies based on model reforecast climatology, and prepend with observed OLR anomalies
- Subtract previous 40 day mean of OLR anomalies
- 9 day running average, use 4 day future/past values. ok for forecasts.
- Project onto OMI EOFs to compute ROMI from forecasts



ROMI vs RMM:

- longer period
- higher correlation

Ensemble Mean Skill (Nov-Mar)

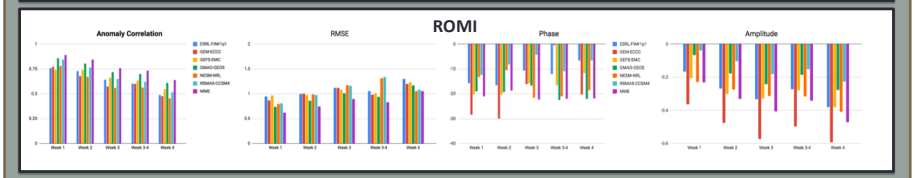


- ACC skill > 0.5 to ~22-35 days; longer than RMM
- RMSE skill >= 1.4 to ~22-40 days, longer than RMM
- GMAO-GEOS5 model is most skillful
- Amplitude of convection is weaker than observed
- Phase speed of the convection is slower than observed

Weekly Skill & Multi-model Ensemble

RMM

ROMI



RMM Skill

- ACC > 0.5 to week 4
- RMSE < 1.4 to week 4
- No systematic phase error
- Amplitude too large at week 1, too small at week 4

ROMI Skill

- ACC > 0.5 to week 4
- RMSE < 1.4 to week 4
- Phase is too slow
- Amplitude is too weak

Impact of MME

- MME is better than individual models for ACC and RMSE for both RMM and ROMI
- Benefit of MME cannot be attributed specifically to phase or amplitude errors.

Summary

- SubX models can skillfully predict MJO to week 3-4 (~14-28 days) in indices of circulation and convection for deterministic and probabilistic skill scores.
- MJO amplitudes that become too weak are a common problem for most models and metrics.
- MME is more skillful than individual models for ACC and RMSE, but this is not clearly attributed to better phase speed or amplitudes.

More Information About SubX...

http://cola.gmu.edu/kpegion/subx