$b_i(\tau)=\alpha_i b_1(\tau-1)+\beta_i b_2(\tau-1)$

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

Predicting the MJO with POAMA Seasonal Forecast System

H. A. Rashid, H.H. Hendon, M.C. Wheeler, O. Alves

Assess intraseasonal forecasts of MJO using POAMA coupled model hindcasts: 10 member ensemble from obs atmos/ocean initial conditions from 1st each month 1980-2007.

Method (consistent with Gotschalck et al 2009):

1. Obtain observed eigenvectors, eigenvalues and normalisations from WH04

2. Form anomalies of latitudinally averaged zonal winds at 850 and 200 hPa and OLR by subtraction of the model climatology (function of lead time and start date) and by removal of the previous 120-day mean (combination of n-days of forecast and 120 - n days of previous analyses for a forecast at n +1 day lead time).

Divide the individual fields by the observed normalizations

3. Project forecast anomalies onto observed eigenvectors and divide by the square root of the observed eigenvalues to obtain forecasts of RMM1 and RMM2.

4. Score the forecasts of the RMM indices using the bivariate correlation) and root-mean-square error (Lin et al 2008)

5. Evaluate average amplitude and average phase error

$$COR(\tau)=\frac{\sum_{i=1}^{N}[a_{1i}(t)b_{1i}(t)+a_{2i}(t)b_{2i}(t)]}{\sqrt{\sum_{i=1}^{N}[a_{1i}^2(t)+a_{2i}^2(t)]}\sqrt{\sum_{i=1}^{N}[b_{1i}^2(t)+b_{2i}^2(t)]}},$$

$$RMSE(\tau)=\sqrt{\frac{1}{N}\sum_{t=1}^{N}([a_1(t)-b_1(t,\tau)]^2+[a_2(t)-b_2(t,\tau)]^2)}$$

a_1 and a_2 are the verification RMM1 and RMM2 at day t , and b_1 and b_2 are the forecasts for day *t* for a lead time of *T* days. *N* is the number of forecasts.

The bivariate amplitude (RMMA) for the verification and forecast are

$$RMMA_{obs}(t)=\sqrt{a_1(t)^2+a_2(t)^2}$$

$$RMMA_{for}(t,\tau)=\sqrt{b_1(t,\tau)^2+b_2(t,\tau)^2}$$

The average phase error (ERRphs) as a function of forecast lead time is:

$$ERRphs(\tau)=\frac{1}{N}\sum_{t=1}^{N}\tan^{-1}\left(\frac{a_1b_2-a_2b_1}{a_1b_1+a_2b_2}\right)$$

Following Lin et al. (2008):

limits of COR are -1 to 1

For a perfect forecast, bivariate RMSE=0.

For a climatological forecast RMSE = $(2)^{1/2}$

Forecasts with observed amplitude but completely random phase RMSE asyms 2

Forecasts deemed skilful for RMSE < $(2)^{1/2}$

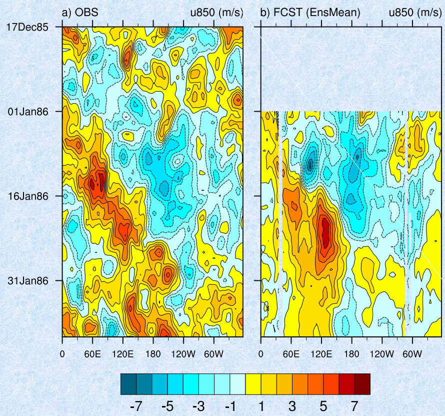
COR drops to about 0.5 at the same lead time when RMSE ~$(2)^{1/2}$ We use COR=0.5 as indication of the limit of a skilful forecast.

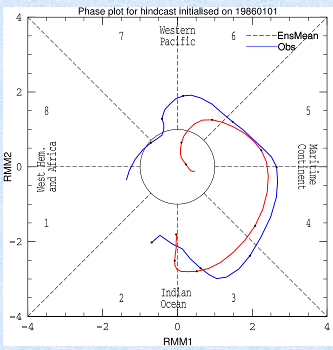
Compare to predictions from autoregressive scheme for RMM1 and RMM2 developed by Maharaj and Wheeler (2005), referred to as vector autoregressive (VAR):

$$b_i(\tau)=\alpha_i b_1(\tau-1)+\beta_i b_2(\tau-1)$$

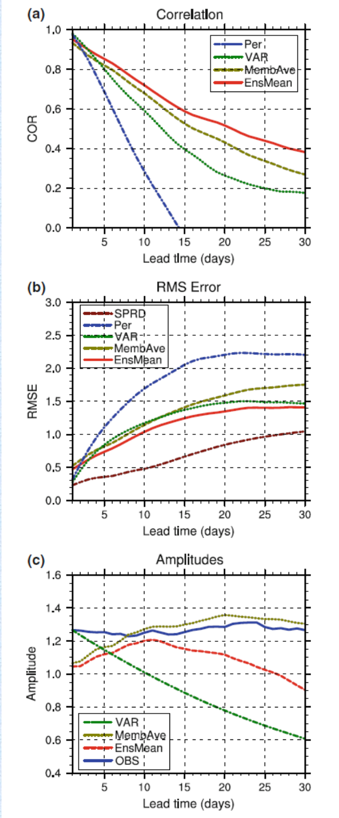
Example of a POAMA forecast and projection onto RMM

POAMA simulates relatively good MJO

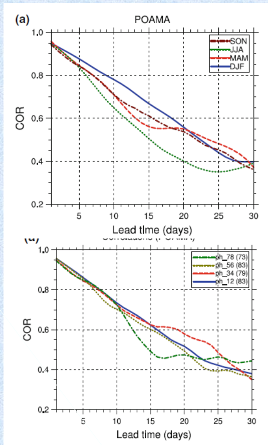




Results



Stratify by season and by phase



Conclusions

Scoring RMM appears to be a useful first step

MJO predictable for about ½ cycle

Little sensitivity to initial phase

Predicted with realistic amplitude (initially too weak) but too slow phase speed: model shortcomings- improved initialization need to be addressed

Rashid, Hendon, Wheeler, and Alves, 2010: Prediction of the Madden–Julian oscillation with the POAMA dynamical prediction system. *Clim. Dyn*. DOI 10.1007/s00382-010-0754-x