Impact of the Madden-Jullian oscillation on Rainfall over the South Pacific Convergence Zone

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Background

The Madden Julian Oscillation (MJO) is the main source of intraseasonal variability in the tropical Pacific and past studies suggest that the location and intensity of the south pacific convergence zone (SPCZ) is largely affected by MJO events (Matthews et al., 1996; Matthews, 2012), however detail understanding on MJO-SPCZ relationship is still limited. Here we extend our understanding on the MJO-SPCZ relationship by using daily TRMM precipitation data and real time multivariate MJO index from 1998 to 2014.

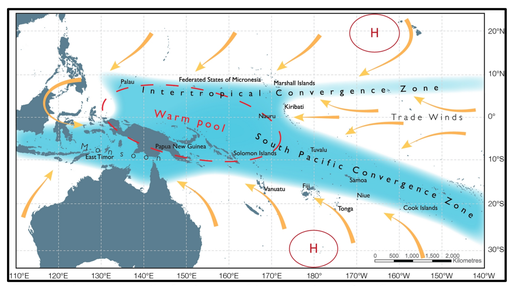

Fig. 1. Major climatic features of the western Pacific region

Method & Data

- **Precipitation:** TRMM 3B42 – daily 0.25 x 0.25 degree (Huffman et al., 2007)

- **MJO Index:** Real time multivariate MJO index obtained from EOFs of the (combined) daily fields of 15°S-15°N averaged OLR, 850 hPa zonal wind, and 200 hPa zonal wind (Wheeler and Hendon, 2004).

RMM1 and RMM2 are principal component (PC1 & PC2) time series derived from the Real-time Multivariate MJO series
MJO magnitude = $RMM1^2 + RMM2^2$

- **Multiple regression:** Daily precipitation (PCP) is regressed with PC1 and PC2 to estimate the explained variance by using following regression equation;

$PCP = \beta_o + \beta_1 PC1 + \beta_2 PC2$

Where, bo, b1 and b2 are regression coefficients

Results

Intraseasonal variability

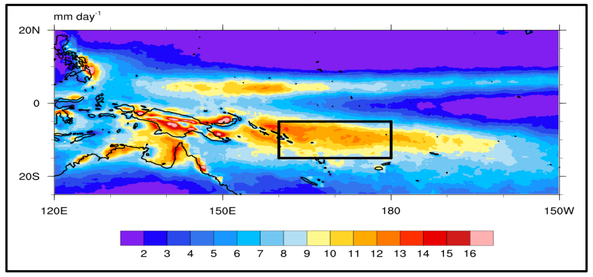

Fig. 2. JFM mean precipitation in mm day^{-1} for the period 1998-2014.

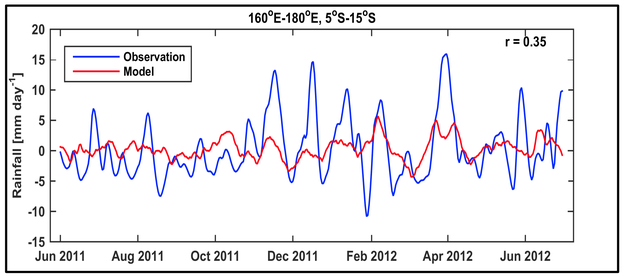

Fig. 3. Time series comparision of observed and modelled 7-day low pass filtered precipitation (averaged over 160°E-180°E, 5°S-15°N) in mm day^{-1} for the period of June 2011 to June 2012.

Correlation and multiple regression

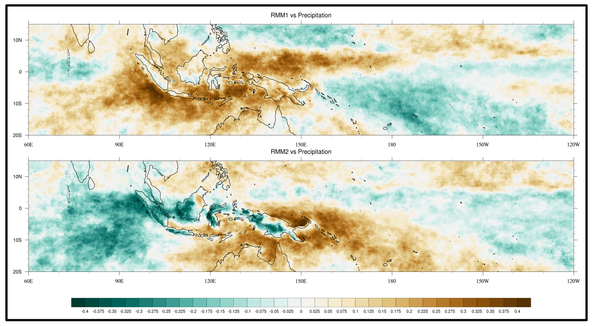

Fig. 4. Correlation coefficients for 7 day low pass filtered MJO indices and precipitation for JFM from 1998 to 2014. RMM1 vs precipitation (*top*) and RMM2 vs precipition (*bottom*).

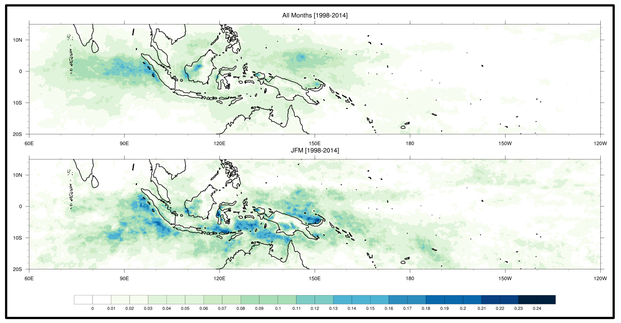

Fig. 5. Total precipitation variance explained by the MJO while regressing 7 day filtered RMM1 & RMM2 with precipitation from 1998 to 2014 for all months (*top*) and JFM (*bottom*).

Phase composite anomaly and spectrum

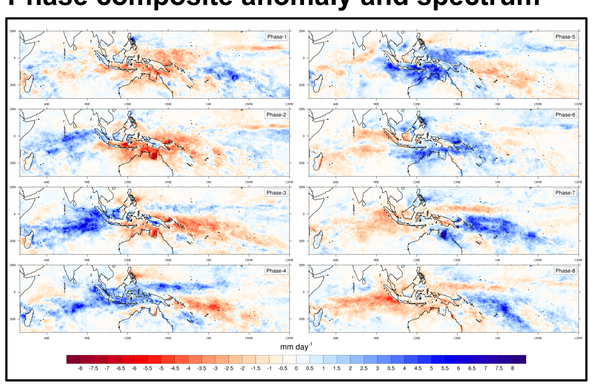

Fig. 6. JFM phase composite of 7 day filtered precipitation anomaly in mm day^{-1} for the periof of 1998 to 2014.

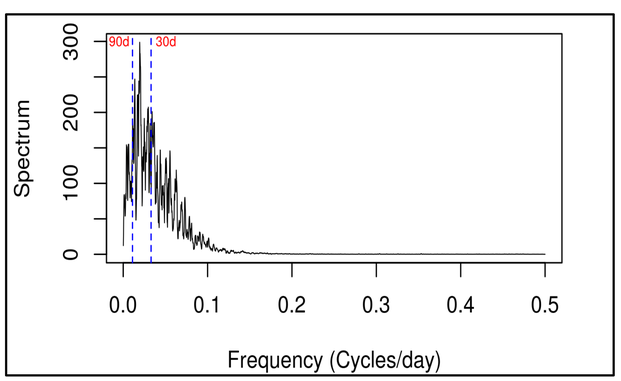

Fig. 7. JFM power spectrum for 7 day low pass filtered and inter-annual variability removed precipitation averaged over 160°E-180°E, 5°S-15°N from 1998 to 2014.

Conclusions

- About 10 to 15% of the precipitation variability is explained by the MJO
- MJO has a relatively less impact on precipitation over land than ocean as indicated by less explained variance over land
- The Impact of the MJO on daily rainfall during positive and negative phases is ±6 mm day^{-1}.
- High precipitation over SPCZ during phase 6,7,8 and below normal during phase 2,3,4
- Peak spectrum observed within the typical time scale of MJO i.e. 30 to 90 days

Future perspective

- About 10 to 15% of the precipitation variability is explained by the MJO; where the rest of the variability comes from?
- Develop a statistical prediction model for precipitation over the south Pacific region
- Impact of MJO on diurnal precipitation cycle over the south Pacific

References

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