Study of MJO Using Atmospheric Radar, Optical Long wave Radiation (OLR) and Tropical Rainfall Measurement Mission (TRMM)

Ibnu Fathrio [1], Eddy Hermawan[1], Juniarti Visa[1], Ining Sunarsih [2]
[1]Center For Application of Atmospheric Science and Climate, LAPAN (National Institute of Aeronautics and Space) , Indonesia
[2]Department of Geophysics and Meteorology, Bogor Agricultural University (IPB), Indonesia
E-mail: ibnufathrio@yahoo.com, eddy_lapan@yahoo.com

INTRODUCTION

Indonesia is located in the equatorial region, surrounded by two oceans and two continents. The interaction between land and ocean causes convection activity become more dominant over Indonesia which happened not only in seasonal time scales, but also having experienced the intraseasonal phenomenon known as Madden Julian Oscillation (MJO). MJO is an equatorial traveling pattern of anomalous rainfall that is planetary in scale. Eastward propagation of MJO is usually obvious from the western Indian Ocean and continues to move east to the western Pacific region. MJO cause part of Indonesia region undergo enhanced rainfall activity and cause flood in some regions. LAPAN as one of atmospheric research institution carry out research in studying MJO characteristic over Indonesia by using EAR (Equatorial Atmosphere Radar) and BLR (Boundary Layer Radar) installed inKototabang, Pontianak and Biak (located near the equatorial line). All radars were installed as part of research collaboration between RISH-Kyoto Univ, JAMSTEC, LAPAN, BPPT and BMG. We also use OLR data from NOAA satellite and precipitation data from TRMM satellite to observe the MJO signal over Indonesia. Time series of zonal wind velocity from EAR-WPR and precipitation data from TRMM are used in local data analysis by applying spectral analysis to the data. While OLR data and NCEP/NCAR reanalysis data are used in global data analysis with Empirical Orthogonal Function (EOF). Both analysis were carried out in order to study the characteristics of MJO signal over Indonesia, especially during summer in southern hemisphere, when stronger MJO signal exist.

GLOBAL DATA ANALYSIS

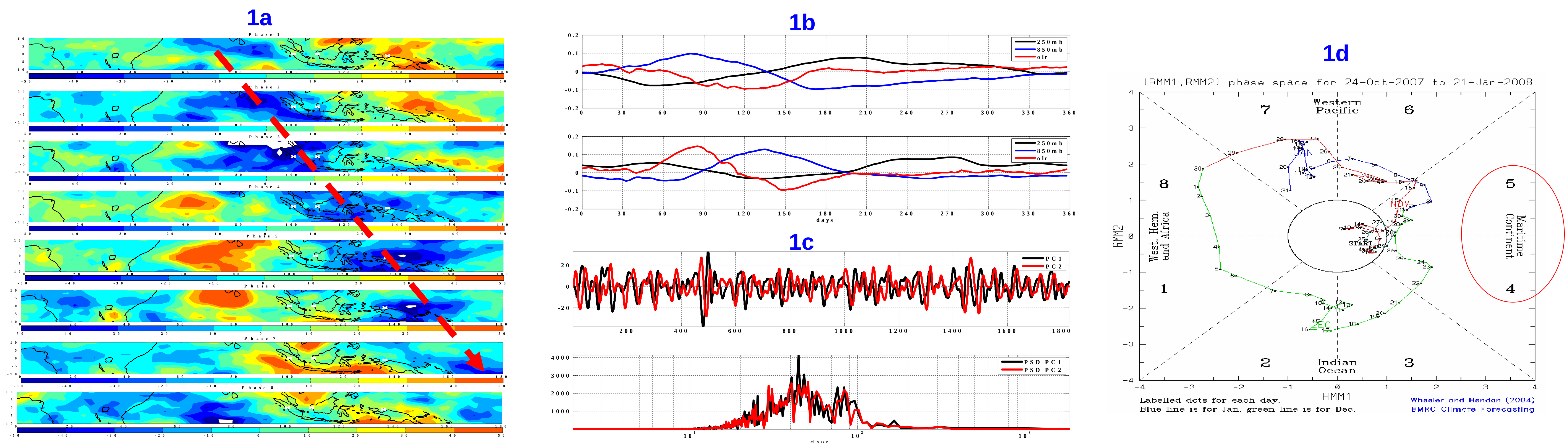

Figure 1. **(a)** Composite OLR anomalies from 1-Dec-2007 to 31-March 2008,showing eastward propagation of MJO (dashed red line) based on Real Time Multivariate MJO Index **(b)** Spatial structure of EOFs 1 and 2 of the combined EOF analysis of OLR data (red) and zonal wind data at 850mb (blue) & 200mb (black). Five years (2004-2008) NCEP/NCAR reanalysis data are used to investigate spatial-temporal pattern of MJO. **(c)** Time series of PC-1 (black) and PC-2(red) show 43 days dominant oscillation periods. **(d)** Real Time Multivariate MJO phase space for 24 Oct 2007 to 21 Jan 2008 is provided by NOAA (http://www.cpc.noaa.gov/products/precip/CWlink/MJO/ARCHIVE/).

LOCAL DATA ANALYSIS

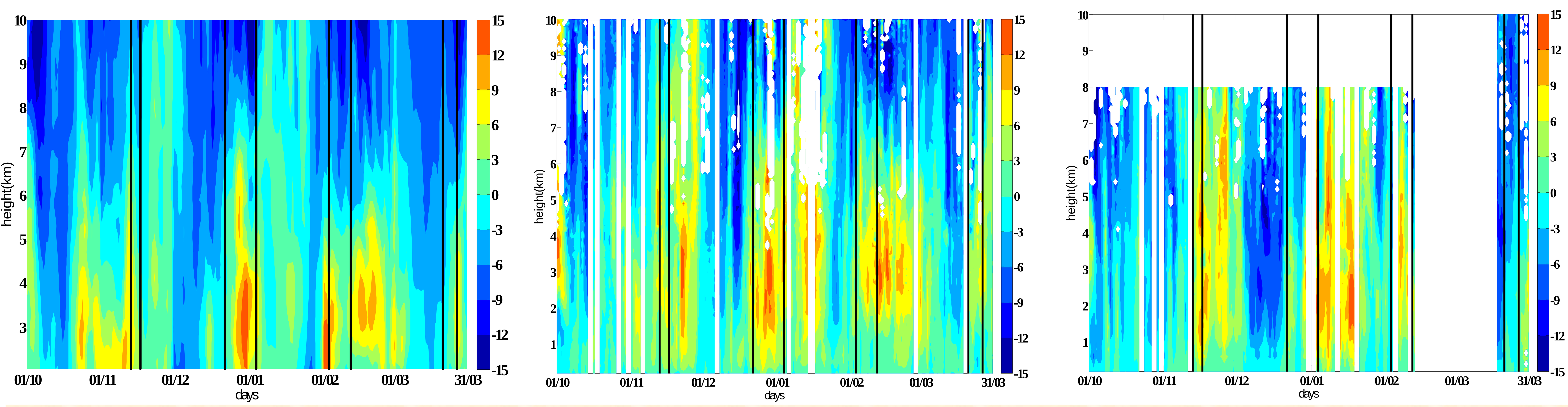

Figure 2. Zonal wind profile of (a) EAR at Kototabang (left), BLR at Pontianak (middle) and Biak (right). Black dashed lines indicate MJO active period over maritime continent from 1-Oct-2007 to 31-March 2008.

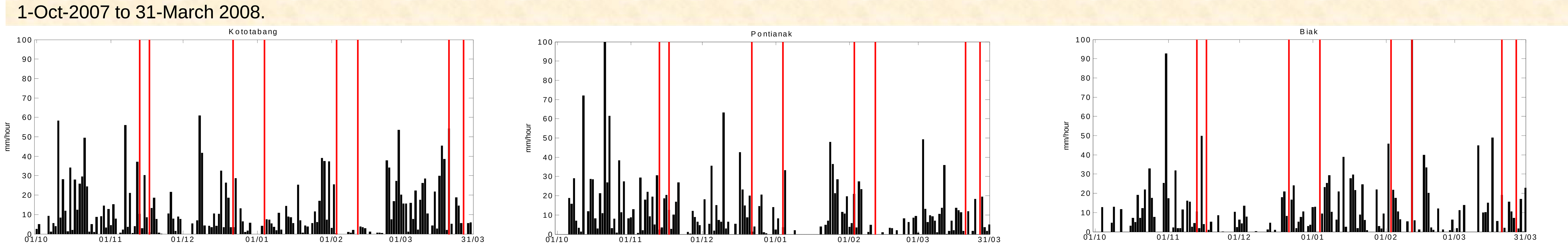

Figure 3. Time series of daily rainfall for Kototabang (left), Pontianak (middle) and Biak (right). They are derived from TRMM 3B42 data. The red lines indicate active period of MJO over maritime continent from 1-Oct-2007 to 31-March 2008.

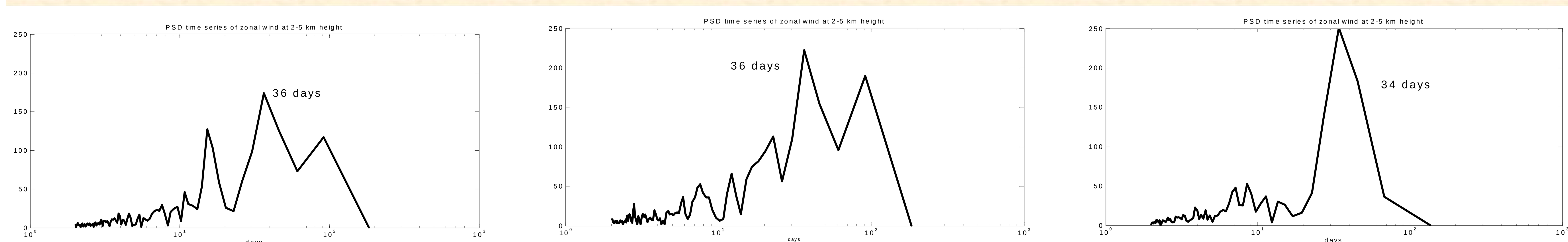

Figure 4. Power Spectral Density (PSD) of zonal wind time series at 5-20km height in Kototabang (left), Pontianak (middle) and Biak (right).

DISCUSSION

Local Data Analysis. EAR and WPR indicate MJO active periods by the increase of westerly wind velocity up to 12-15 m/s observed at 2-5km height over Kototabang. While in Pontianak and Biak, we found that the increase of zonal wind velocity occur at higher elevation up to 8 km. By applying PSD to zonal wind data, we observe that the dominant oscillation periods is about ~35 days. TRMM 3B42 data show that precipitation over Kototabang, Pontianak and Biak occur before active period of MJO. This may be related to local circulation activity which may play a role in the moistening the troposphere. It also shows that local convective activities may be controlled by MJO **Global data Analysis.** By applying band pass filter with cut off 20-100 days on OLR data, eastward propagation of OLR can be observed. Combined EOF methods show that favorable conditions for precipitation are indicated by negative OLR anomaly, accompanied by positive 850mb zonal wind anomaly and negative 200mb zonal wind anomaly. Time series of EOF (PC-1 and PC-2) also show 43 days for dominant oscillation periods.

CONCLUSION

By using EAR,WPR and TRMM precipitation data, study of MJO characteristic over maritime continent could be revealed more clearly. Both local data and global data have show dominant oscillation period of MJO within 30-60 days interval. In order to enhance our understanding in study the interaction between MJO to local convective activities, we should consider the availability of ground based data (local data) ,not only over the land but also over the ocean (such as sea surface temperature data).

ACKNOWLEDGEMENT

We are thankful for EAR & WPR data provided by RISH-Kyoto Univ, JAMSTEC and BPPT

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