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Madden-Julian Oscillation over Jakarta by Relative Measurement of pressure

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Abstract*: The Madden-Julian Oscillation (MJO) is defined as propagation of rainfall from Indian Ocean to west Pacific Ocean with an average velocity of 5ms^{-1}. This phenomenon is mainly occurs at tropics in every 30 - 50 days. The MJO activity over Jakarta is examine because Jakarta is one of the most concentrated using two years Radiosonde data of pressure from January 2013 to December 2014 for the same station. The variation of pressure with altitude has been studied in the same altitude region. MJO is clearly observed with different wavelengths and the frequency of the oscillation is found to be approximately 7-8 oscillation per annum. The results obtained can also helpful to improve forecasting for the region "Jakarta".*

Keywords: *frequency, forecasting, Madden-Julian oscillation, wavelength.*

I. Introduction

The tropical ocean atmosphere system varies on different time scales, as follows.

- The dunial or cycle due to rotation of the earth on its own axis
- Synoptic weather system , few days variability in the atmosphere (example: cyclones, hurricanes and typhoons etc)
- Month to month or intraseasonal variability[7] that last up to 30 - 50days (example: Madden-Julian Oscillation).
- Seasonal cycle due to revolution of the earth around the sun.
- Interannual or year-to-year variability (example: El Nino).

Precise forecasting of these variability's will beneficial to all living being in the tropical atmosphere region and also rest of the people around the globe due to cross correlation between the weather in the tropics[1] and the regions of the earth In this study we are interested on intraseasonal variability[9] i.e Madden-Julian Oscillation discovered by Paul Madden and Julian (1971,1972) and named it as Madden-Julian Oscillation(MJO). It is 30-60days oscillation because preferred time scale.

The MJO is defined as eastwards propagation of rainfall from Indian ocean to the west pacific ocean. This activity is mainly occurs at the tropics[13]. The mean MJO cycle is 30-60days[3] calculated by averaging many individual MJO events. In other words propagation of rainfall means propagation of clouds[12] which results in formation of low pressure. Zhang et al documented the silent features of seasonality in the MJO.

II. Methodology

The weather balloon is launched from Jakarta (6.1745° S, 106.8227° E) at GMT 00Z and 12Z the Radiosonde operates at 403MHz to 1680MHz. It sends a signal in the interval of one minutes and reaches to an altitude of 40km. It is a telemetry instrument carried in to the atmosphere by means of a weather balloon that measures various atmospheric parameters (Altitude, Pressure, Temperature, Relative humidity, Wind direction and wind speed etc) The pressure data altitude for 400hpa and 600hpa is collected for the years 2013 and 2014 from the Radiosonde[2] and the missing values are evaluated by means of linear interpolation method. To study the oscillation the graphs are plotted between the altitudes of pressures with time in days.

III. Result And Discussion

According to Wheeler and Hendon Jakarta is the most concentrated region for MJO[10] activity and the frequency of this activity is seven-eight oscillation per annum this means that the low pressure is propagates over Jakarta around seven-eight times per annum. This activity generates at Indian ocean[8] and moves towards

the west Pacific Ocean via Jakarta with an average velocity of $5m^{-1}$. The figure 4 shows 400hpa pressure variation with altitude plots(actual and smooth) for year 2014. (H-high pressure, L-low pressure) Pressure profiles of each day measured for the observation period from January 2013 to December 2014 as shown in fig.1&2. The pressure 600hpa and 400hpa are found between the altitudes of 7500m to 7650m and 4350m to 4500m. In this study of MJO the relative measurement of pressure has been done by finding the altitude of the pressure for 400hpa and 600hpa with respect to time in days. To trace the oscillation the data is divided in 90 days band for both years. It is found that the pressures altitude varying with respect to time for both the years. It is also observed that 600hpa pressure is initially at an altitude of 4396m. Further it climbed to an altitude of 4422m at 26^{th} day of the year then again drop down to an altitude of 4388m as illustrated in fig1.The wave length of this oscillation[5] is found to be 46 days[4]. Later for the remaining days of the year 2013 it follows the similar fluctuation in the altitude of the 600hpa pressure with different amplitude and wave length. Moreover the frequency of MJO is found to be seven during the year 2013 and similar type of result for the same pressure is noticed for the year 2014 as shown in figure1&3.

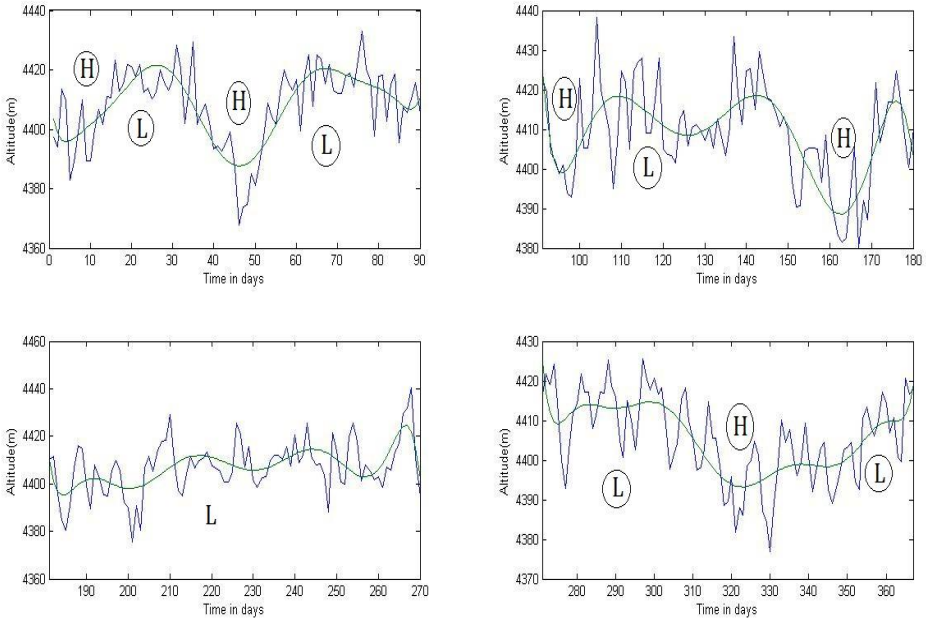

Figure 1 : 600hpa pressure variation with altitude plots(actual and smooth) for year 2013.(H-high pressure, L-low pressure)

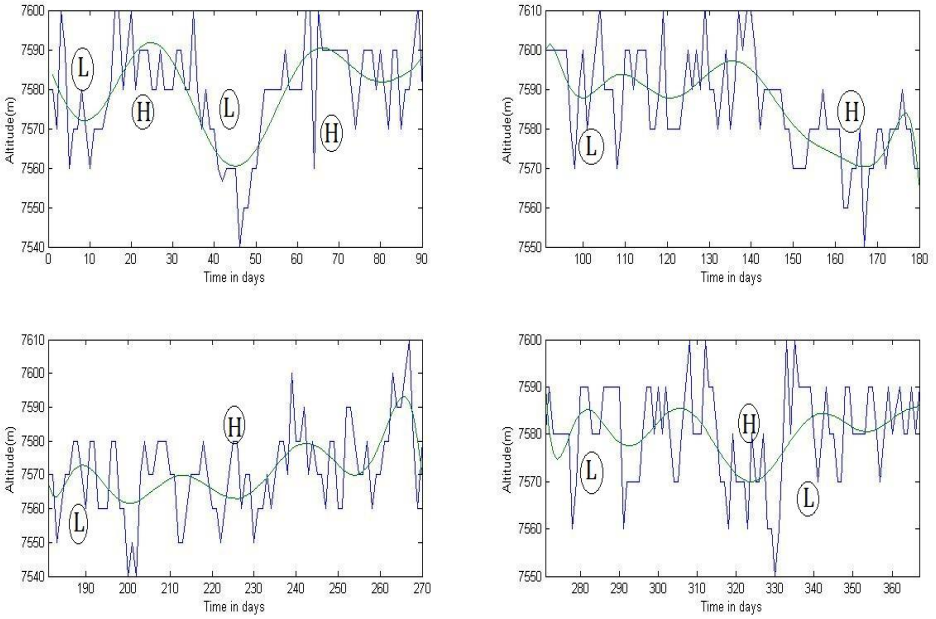

Figure 2 : 400hpa pressure variation with altitude plots (actual and smooth) for year 2013. (H-high pressure, L-low pressure)

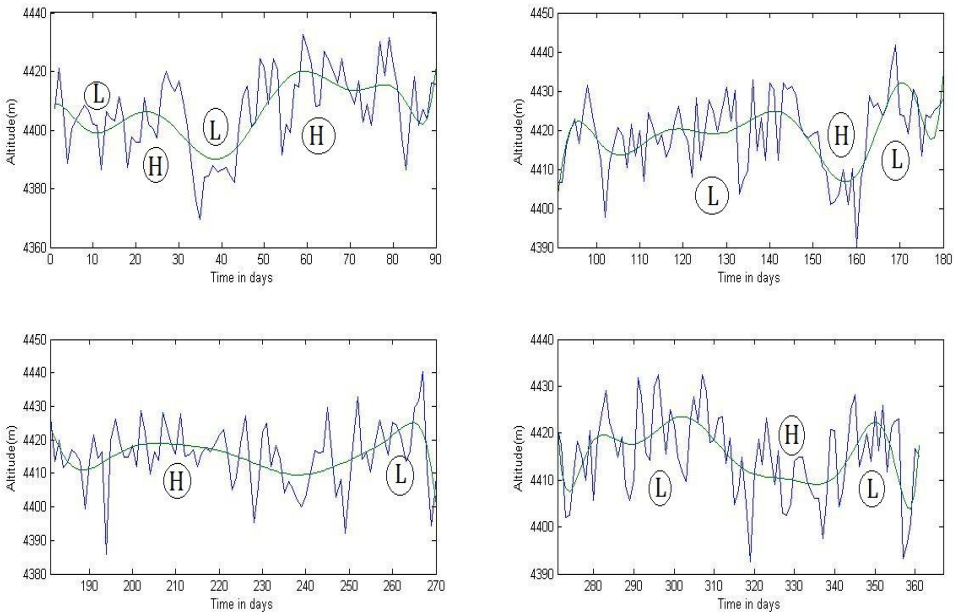

Figure 3 : 600hpa pressure variation with altitude plots(actual and smooth) for year 2014. (H-high pressure, L-low pressure)

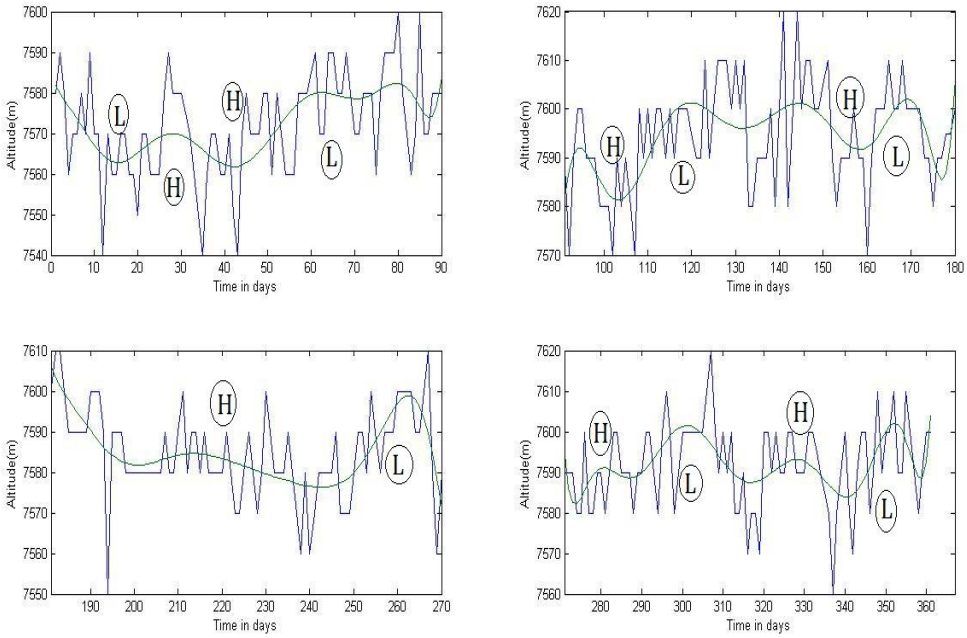

Figure 4 : 400hpa pressure variation with altitude plots (actual and smooth) for year 2014. (H-high pressure, L-low pressure)

As we discussed earlier, the altitude for the pressure 400hpa is ranging from 7500m to 7650m for the years 2013 and 2014 respectively. In this case 600hpa pressure is at an altitude of 7572m at 8th day of the year 2013, later on it ascent to an altitude of 7592m then plunge to an altitude of 7560m as shown in fig2. Similarly this pressure oscillates throughout the year with different amplitude and wavelength. Same trend is observed for the year 2014 as illustrated in fig4. The frequency of this oscillation is found to be seven per annum with wave length lies between 24 to 86 days[6] respectively which clearly indicates that MJO is passing over the atmosphere of Jakarta. These results are good agreement with madden et al[11].

IV. Conclusion

The 600 and 400hpa pressure altitude variation are observed which resembles low and high pressure existence with different magnitude. The frequency of this oscillation is found to seven per annum which is good agreement with Wheeler and Hendon proposed definition of MJO and it is strong evidence of existence of MJO over Jakarta's atmosphere. These results are also help to improve forecasting for the Jakarta.

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