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Impact of Madden Julian Oscillation on Basic Parameters of Atmosphere

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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 5m/s. the purpose of this paper is to study the impact of mjo on basic parameters of atmosphere like, temperature, wind velocity, wind direction and pressure. To study this, the Radiosonde data of Jakarta (A low latitude station from which MJO is passing) for the years 2014 and 2015 is collected. Finally some variation is noticed in the temperature, wind velocity, wind direction and pressure. This study is helpful for forecasting and understands the dynamics of atmosphere.*
Keywords: *Madden Julian Oscillation, Pressure, Temperature, Meridional Wind & Zonal Wind*

I. Introduction

The madden Julian oscillation is the intraseasonal variability[1] in the tropical atmosphere. It was first observed in the year 1971 by Paul madden and Ronald Julian [2] when they are analyzing the zonal wind pattern over the Singapore region. The madden Julian oscillation is defined as propagation of rainfall from Indian ocean to west pacific ocean with an average velocity of $5ms^{-1}$ through warm pool from Indian ocean to pacific ocean[3]. The madden Julian oscillation is characterized by enhanced rainfall in Indian ocean at same time suppressed rainfall in Pacific Ocean[4]. The activity is generates due to the sea surface temperature (SST)[5].When sea surface temperature is raised $28^{o}C$ and above. It triggers low pressure in the atmosphere which results in the formation of clouds. Then clouds condense and precipitate. Depending upon the time scale the madden Julian oscillation is further classified in to short period and long period the wavelength of short period oscillation is 30 - 50 days where as the wavelength of long period oscillation[6] is 60 – 90 days.Madden Julian oscillation propagates from Indian Ocean to west Pacific Ocean via Indonesia, Singapore and the other regions. Jakarta (capital city of Indonesia) is chosen in this study because it is the one of the most concentrated region of madden Julian oscillation and what are the effects of madden Julian oscillation on basic atmospheric parameters such as pressure, temperature, wind velocity and wind direction when it is passing through the jakarta

II. Methodology

The Radiosonde data is collected for the years 2014 and 2015 respectively. The Radiosonde is telemetry device operating in between 403MHz and 1680MHz frequency. it is consists of pressure, temperature, wind direction, wind velocity wind direction and relative humidity sensors which measure all these parameters up to an altitude ~40km in atmosphere. It launches twice a day with the help of a balloon filled with helium or hydrogen gas at GMT 00Z and 12Z. it sends the radio signal at regular interval of time and the other end a receiver receive the signal.The Madden Julian oscillation is nothing but the propagation of rainfall in turn low pressure generates, results in formation of clouds and the clouds lies between 200hpa – 800hpa[7] the altitude of these pressure is over Jakarta is measured by downloaded the data from "university of Wyoming" laramia USA. The missing values of this data are interpolated by linear interpolation method. To study the impact of mjo on basic parameters of atmosphere, the middle pressure of the clouds is taken in to consideration. The 400hpa pressure altitude is considered as the mean pressure of the cloud the graph is plotted between the altitudes of pressure with respect to days and smoothed it by using Matlab curve fitting tool. Similarly monthly temperature and wind profiles are calculated.

III. Result And Discussion

3.1 Pressure

The pressure altitudes are varies for both the years i.e. 2014 and 2015. From the fig 1 it is observed that the pressure is initially at 4410m for the year 2015(Altitude is taken in meters for precise mesurement). Then jump up to an altitude of 4420m at 20th day of the year as shown in the fig1. Then pressure altitude is gradually drop down to an altitude of 4410 at 60th day of the year the area under the curve act as low pressure and this phenomenon take 40 days. Again the same trend is observed the pressure altitude jump to 4430m then drop down 4400m in 35 days. Similar trend is noticed up to the month of September. Finally in the last three months of the year there is no significant change in the pressure. The same trend is observed for the year 2014 with less variation of pressure altitude. According to definition of madden Julian oscillation the low pressure passes over Jakarta in every 30 – 50 days[8] or 60 – 90 days Over Jakarta. Hence from the above results it is concluding that there is a variation of pressure due to madden Julian oscillation.

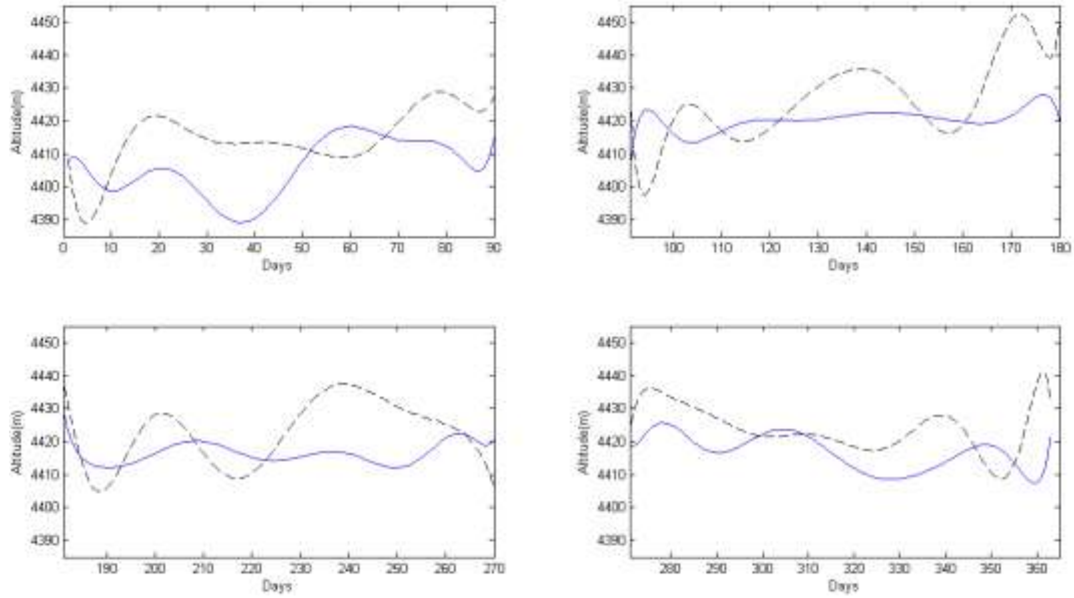

Figure 1: Pressure variations for the years 2014 and 2015(dot curve 2015 & line curve 2014)

3.2 Temperature

As we know that temperature are decreases gradually up to altitude of tropopause. The same phenomenon is observed over Jakarta's atmosphere from surface of the earth to certain altitude. The average temperature at the surface for both the years is 25^{o}C and it decreases in the range of cloud altitude (i.e. 0-12km) as shown in the fig2. It is notice that the temperature varying by 0.5C at 400hpa (middle pressure for the cloud formation pressure range) [10] either in the interval of two or three consecutive months for both the years.

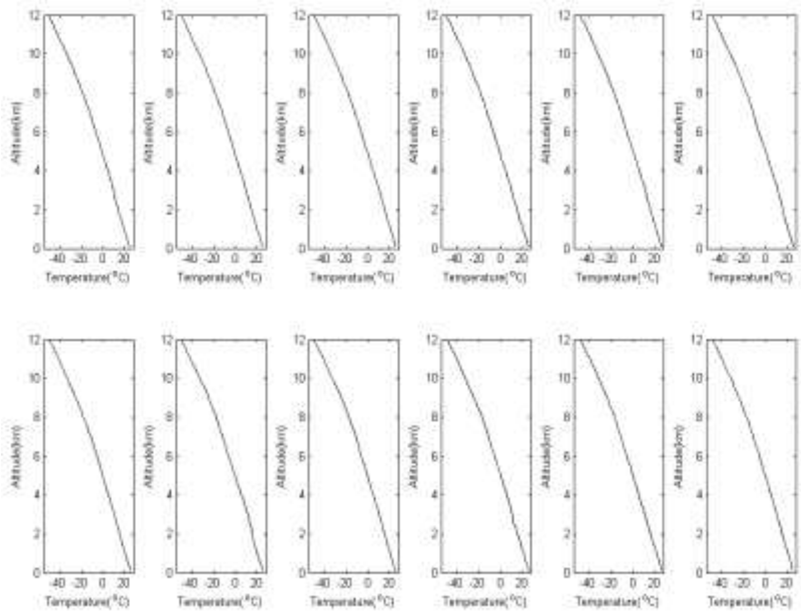

Figure 2: temperature variation for years 2014 & 2015(dot curve 2015 & line cuve 2014)

The variation of temperature in every two months is due to the short period (30-50 days) MJO and variation temperature is three months in case of long period (60-90 days) MJO. The frequency of variation of temperature is exactly match with the frequency [11] of the MJO. It also proves that whenever the oscillation is passing over Jakarta's atmosphere it slightly changes temperature of the Jakarta.

3.3 Meridional and zonal winds

The wind blowing from northern to southern hemisphere and vice versa is known as Meridional wind. The direction of wind towards southern hemisphere is called southerlies and moving towards northern hemisphere is called northerlies. The wind flows from east to west of the globe is called as zonal wind. The wind moving towards east is called easterlies and opposite to it is westerlies the observed wind pattern for Meridional and zonal wind zonal wind during the years 2014 and 2015 is as shown in a fig.3&4. the dash lines represents the Meridional wind and solid line for zonal wind. For Meridional wind and zonal wind the positive direction indicates southerlies and easterlies respectively. During the first six months it is found that for the moths of January and February the Meridional wind is northerlies from ground to the altitude of ~2km with the magnitude of $5ms^{-1}$ and $8ms^{-1}$ respectively[9]. Above 2km the winds are southerlies. For the months of March and April it is completely southerlies from 0-2km. Again northerlies are noticed for the month of May, June and July at an altitude of 3km, 8km and 11km respectively with velocity of $3ms^{-1}$ and $2ms^{-1}$. Finally from July to December the southerlies are noticed from August to December in increasing magnitude of velocity up $11ms^{-1}$. It clearly observed that during first six months wind direction changes in every ~60days and for the last six months it changes around ~90days due to short and long period MJO[6].

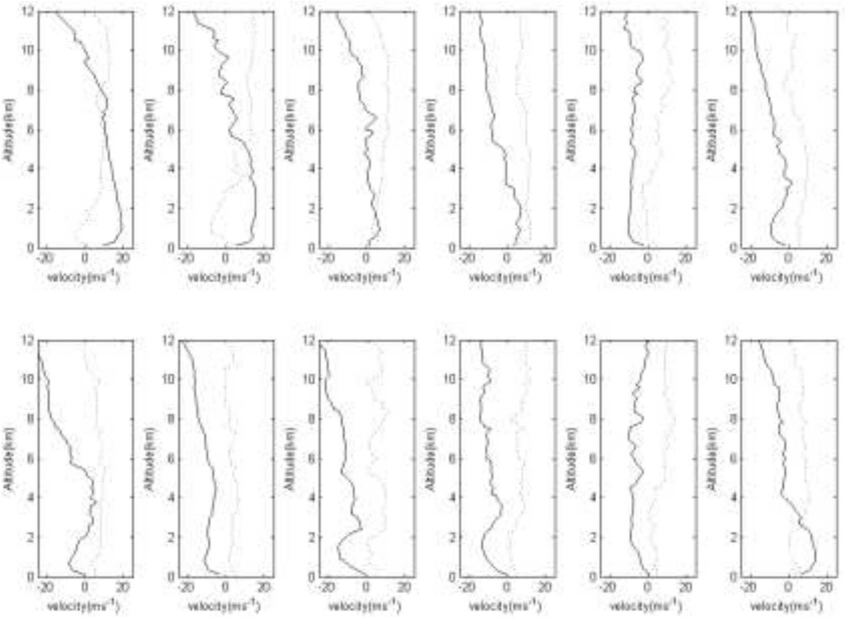

Figure 3 zonal and Meridional wind velocity for the year 2014(dot curve Meridional & line Curve zonal wind)

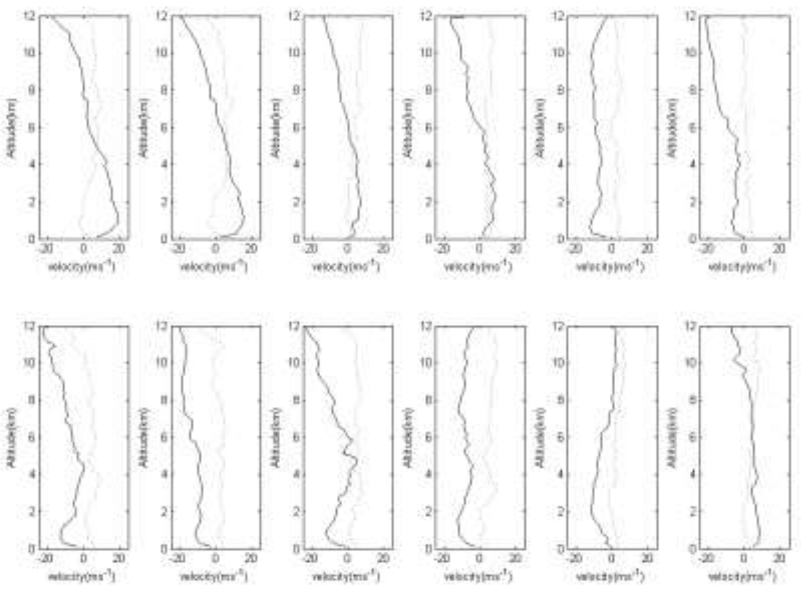

Figure 4 zonal and Meridional wind velocity for the year 2015(dot curve Meridional & line Curve zonal wind)

3.4 Zonal wind

From January to April Westerlies, are observed up to an altitude 6km. The wind velocity is decreases from January to April. Above 6km easterlies are found as shown in the fig.3&4. From May to November easterlies are noticed from 0-12km altitude again in the month of December westerlies are dominating easterlies up to altitude of 6km but for the whole years 2014 and 2015 the easterlies are found at certain altitudes with maximum wind velocity of $21ms^{-1}$. According to wheeler and Hendon MJO is define as eastwards propagation of rainfall with an average velocity of $5ms^{-1}$. Hence it found that winds are always blowing towards east direction at different altitude within the cloud formation range i.e. 2 – 12km. Hence these results hold good agreement with definition of Madden Julian oscillation proposed by Wheeler and Hendon [3].

IV. Conclusion

From the above observation it is concluded that there is significant changes in pressure, temperature, wind velocity and wind direction due to madden Julian oscillation. These variations in basic parameters are noticed either 30 - 50 days or 60 - 90 days of period.

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