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Madden-Julian Oscillation over Hyderabad (A Low Latitude Station) Using Radiosonde Parameters

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Abstract: *The Madden-Julian Oscillation (MJO) activity over Hyderabad (17.2^{o}N, 78.2^{o}E) a low latitude station is studied using two years of Radiosonde data of pressure (800hpa, 400hpa & 200hpa) from January 2013 to December 2014. This Radiosonde data is obtained from the University of Wyoming. The missing values of data are interpolated by linear interpolation method. These two years of data is divided into weeks in order to get weekly pressure profiles for the year 2013 and 2014 to study the MJO in the atmosphere of Hyderabad at 800hpa, 400hpa and 200hpa pressure. In conclusion, the frequency and wavelength of the oscillations found over Hyderabad's atmosphere is not matched with the MJO which indicates that MJO activity is not happening over the atmosphere of Hyderabad.*

Keywords: *Frequency, Madden Julian oscillation, Oscillation, Pressure, Radiosonde*

I. Introduction

In the year 1971 Ronald Madden and Paul Julian[10] observed 50 - 90 oscillation or intraseasonal variability[7] in atmosphere when they are analyzing zonal wind in the tropical pacific. Early in the 1960's little attention was paid to this oscillation by Madden and Julian and named it as Madden-Julian Oscillation (MJO). The MJO is referred to as 30-50 days (short period)[3] and 50-90 days (long period)[6] oscillation over the tropical atmosphere[4].

The MJO is characterized by an eastwards propagation of rainfall from Indian Ocean to west Pacific Ocean with an average velocity of 5ms^{-1}. The mean MJO cycle is calculated by averaging over many discrete MJO events. The MJO consists of two phases one is the enhanced rainfall phase and the other is suppressed rainfall phase. The two phases produce opposite changes and forms of a dipole of suppressed and enhance rainfall[1].

II. Method of analysis

A Radiosonde[2] is battery powered telemetry instrument launched in the atmosphere by using whether balloon that measure various atmosphere parameters (pressure, humidity, wind speed and wind direction etc). Radiosonde operates at a radio frequency of 403MHz to 1680MHz. The data collected from January 2013 to December 2014 is used to study the pressure at different altitudes in atmosphere. To calculate pressure at different altitudes the following method is adopted.

I. The pressure profiles given by balloon[2] launched every day at 00Z and 12ZGMT are averaged to obtain series of monthly mean profiles.

II. The missing values for data gaps during the period from January 2013 to December 2014 have been obtained by linear interpolation method.

III. The yearly data is divided into 52 weeks and averaging weekly data to calculate weekly pressure in the atmosphere at 800hpa, 400hpa and 200hpa.

III. Results and discussion

Madden Julian Oscillation[11] is define as propagation of rainfall from Indian Ocean to Pacific Ocean in tropical region[13]. It takes 30-90 days to complete one cycle. This means that the clouds are traveling through south Indian region in every 50 -90 days. The altitude of this clouds ranging from 2,000 -13,000m. In turn the

travelling of clouds[12] results in low pressure in the atmosphere. The atmospheric pressure corresponding to these altitudes of clouds lies between 800hpa to 200hpa.

To study oscillation over Hyderabad's atmosphere the pressure, 800hpa, 400hpa and 200hpa has been studied with respect to time, starting from January first week to December last week. There are 52 weeks during this time. The pressure as a function of height is plotted for all 52 weeks for the year 2013 and 2014 as illustrated in the figures. The behavior of the pressure observed in the atmosphere is as follows

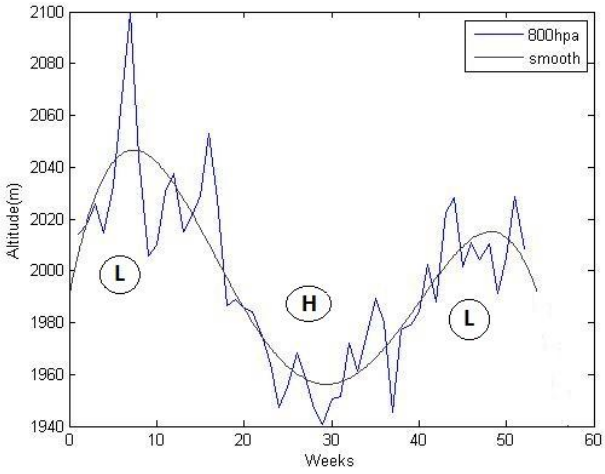

Figure 1: 800hpa pressure variation for year 2013. (H-high pressure, L-low pressure)

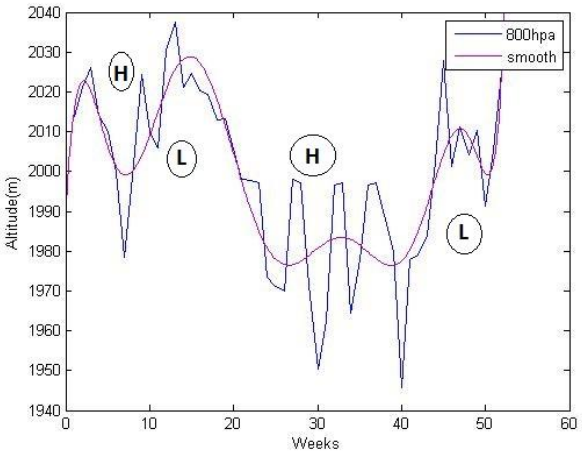

Figure 2: 800hpa pressure variation for the year 20114. (H-high pressure, L-low pressure)

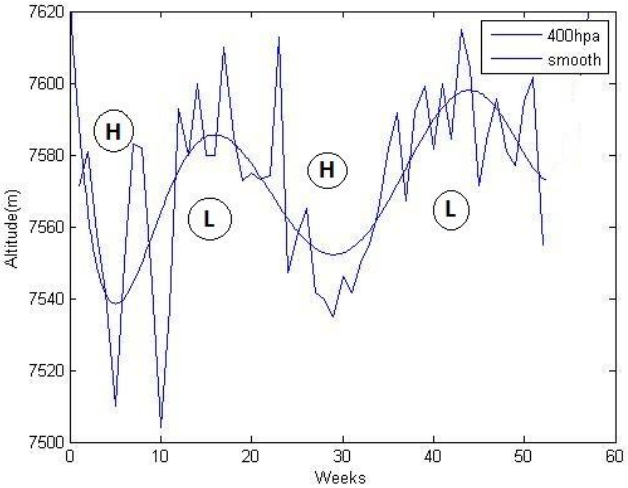

Figure 3: 400hpa pressure variation for the year 2013. (H-high pressure, L-low pressure)

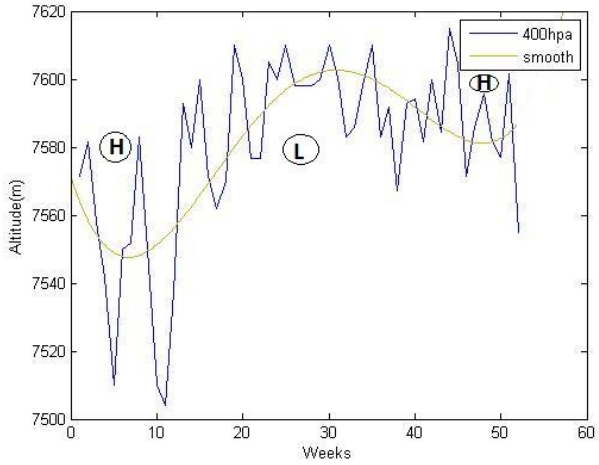

Figure 4: 400hpa pressure variation for the year 2014. (H-high pressure, L-low pressure)

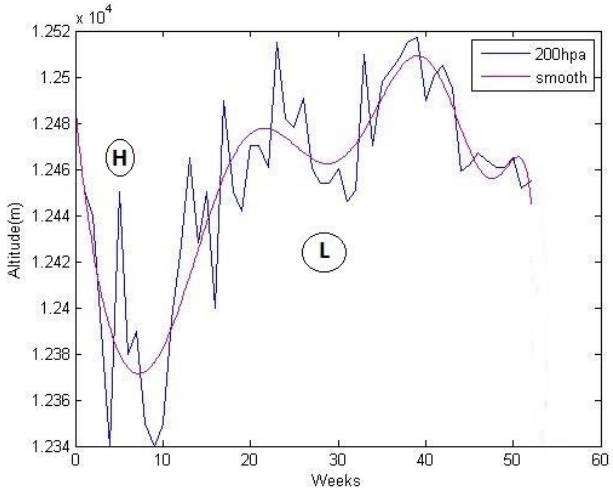

Figure 5: 200hpa pressure variation for the year 2013. (H-high pressure, L-low pressure)

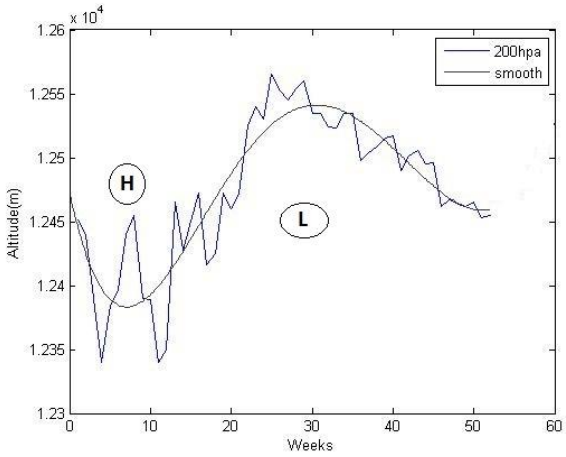

Figure 6: 200hpa pressure variation for the year2014. (H-high pressure, L-low pressure)

I. The 800hpa pressure lies between an altitudes of 1900-2100m. Initially, this pressure is at an altitude of 1995m then rises up to an altitude of 2045m, this means that the area under curve i.e. 0-20 weeks have low pressure Compared to remaining weeks of the year. Similarly, 20- 40 and 40-52 weeks have high and low pressure respectively for both the years as shown in the fig.1&2. The frequency of the oscillation for 800hpa pressure is found to be two per annum.

II. The 400hpa pressure is observed between altitudes of 7500 – 7600m. In the first week of the year, 400hpa pressure is found at an altitude of 7570m and fells down to an altitude of 7540m which indicates low pressure during the first ten weeks of the year. Again it jumps to an altitude of 7600m which results high pressure from 10 -25 weeks relative to other weeks of the year as illustrated in the fig.3&4. Later on low and high pressure is observed for the next 25-35 and 35-52 weeks respectively. The frequency of the oscillation for 400hpa pressure is found to be two per annum.

III. 200hpa pressure lies between an altitudes of 12300- 12500m. The altitude of the clouds[12] is maximum at this level of pressure. Above this level clouds are not formed. From the fig.5&6 it is observed that there is not much variation of the pressure takes place throughout the year. The pressure is high for the first 20 weeks of the year and low for the remaining weeks relative to each other. The frequency of the oscillation for 200hpa pressure is found to be one per annum.

The frequency of the oscillation observed from the given levels of pressure is either one or two per annum and this oscillation does not match with frequency of the MJO. According to standard definition, MJO has approximately 5 - 6 oscillation[9] per annum.

IV. Conclusion

From the above result it is conclude that the frequency and wavelength of the oscillation found in the atmosphere of Hyderabad is one for 200 & 800hpa pressure and two for 400hpa which does not match with the madden-Julian oscillation (~5 - 6 oscillation per annum). Hence, MJO activity is not found over the atmosphere of a low latitude station Hyderabad. This result is good agreement with Wheeler and Hendon[9] .

V. Summary

To study MJO activity over Hyderabad, pressure from the Radiosonde data is used. The missing data is interpolated by linear interpolation method then averaged the weekly pressure data for 800hpa, 400hpa and 200hpa. Graphs are plotted for all given pressures with respect to time (weeks). From the graph, it is observed that there is some oscillation over the atmosphere of Hyderabad. The frequency and wave length of these oscillations are entirely different compared to MJO. In conclusion, MJO activity is not found in the atmosphere of Hyderabad.

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