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SOUTH WEST MONSOON MONTHLY MEAN WIND SPEED TREND IN VARIOUS PHYSIOGRAPHIC REGION OF KERALA

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***Abstract**: In order to understand the impact of climate change over Kerala select cities Thiruvananthapuram, Ernakulam and Kannur, a study has been extended over the long term meterological data such as windspeed. A period twelve years beginning 2000 has been chosen. The method of linear trend model has been used for the study. From the result of study overall trend of windspeed starts decreasing throughout the study period. It is inferred that decreasing trend in Windspped could be attributed to climate change.*

***Keyword**: Windspeed, linear trend Model, Climate change, Kerala, South West monsoon*

I. INTRODUCTION

Heat and moisture are very important in envirornment but another element of Wind play an important role in the climate change. Rainfall, Wind, Temperatures, etc., are the important weather factors which affect and control the life of flora and fauna as well as planet earth. People of the country very much dependant on the climatic factors such as Energy generation, food habits, transportation, etc., Monsoon winds are the basis of the setting of monsoon and therefore windspeed analysis closely linking it with the rainfall need importance. Reduction in Windspeed has been reported over 88% of weeather stations in Australia during 1975-2006 (Mc Vicar etal., 2008). In the comprehensive synthesis and review of 148 published studies of windspeed trends all over the world have concluded near surface wind speed decline across the globe (Mc Vicar etal., 2012). Topography, urbanization, sea breezes and other localized circulations can alter winds on hourly basis (Klink, 2002). Local building changes, such as building locations or vegitations cover at observation site can also change near-surface wind speed.

II. DATA AND METHODOLOGY

The Windspeed data of Kerala region for 12 years covering 2000-2012 have been collected from the Indian Meteorological department Thiruvanathapuram, analysed by monthly Mean seasonal rainfall trends. The wind run during the period from 8:30hrs (IST) and 17:30 hrs (IST) are used for the study period. The method of least square fit of straightline has been used for performing the trend analysis of the behaviour of South West monsoon windspeed.

III . RESULT AND DISCUSSION

A. South West monsoon monthly mean Wind speed trend of Thiruvanathapuram at 8.30am

The monthly Mean South West monsoon wind speed trend of Thiruvanathapuram is given in the figures 3.1a & 3.1b. Thiruvanathapuram is the state capital of kerala. The city is located at 8.5^{o}N 76.9^{o}E on the West coast. The city is bounded by Arabian Sea to its West and Western Ghats to the east. The Mean elevation of the city is 16ft above the sea level. The maximum temperature of the city is 34^{o}C and minimum temperature is 21^{o}C

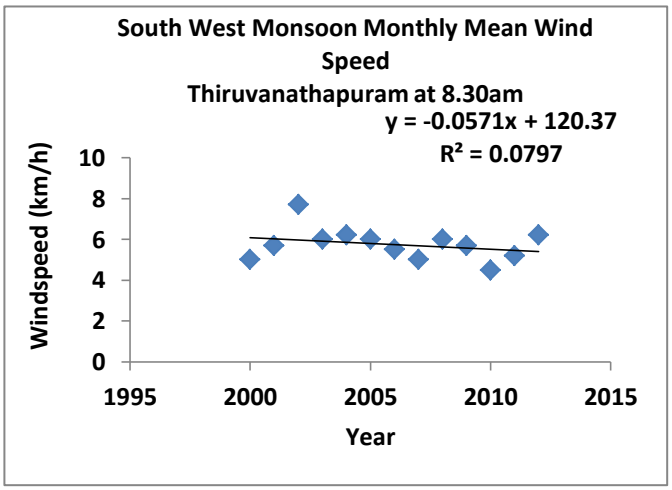


Fig.3.1a Monthly Mean Wind speed trend at Thiruvanathapuram

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Table1 Monthly Mean Wind speed at 8.30am

Location	Windspeed (km/h) at 8.30 am			
Thiruvanathapuram	June	July	August	September
Maximum	6	8	8	8
Minimum	4	5	4	3

The maximum and minimum wind speed is given in table 1, it is a twelve year Mean windspeed data starting the year 2000. Wind speed obtained during the month July recorded the maximum of 8km/h and minimum of 5km/h which is higher than all the other months. Also it is the maximum rainfall received over all months of the year. The receiding month of South West monsoon September recorded the maximum wind speed of 8km/h & minimum of 3km/h. The monsoon setting month recorded the maximum rainfall of 6km/h and minimum of 4km/h. The South West monsoon August recorded the maximum windspeed of 8km/h and minimum of 4km/h. The mean wind speed during South West monsoon for the study reveals the maximum of 7.5km/h at Thiruvanathapuram.

B.South West monsoon monthly Mean Wind speed trend of Thiruvanathapuram at 17.30pm

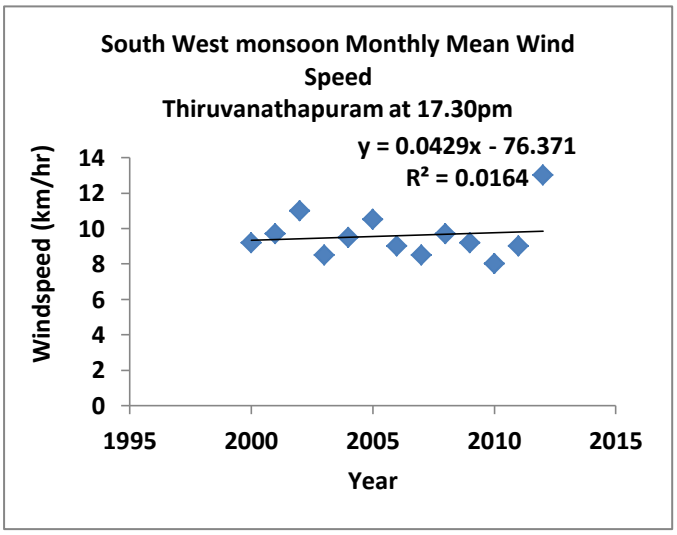


Fig.3.1b Monthly Mean Wind speed trend at Thiruvanathapuram

Table 2 Monthly Mean Wind speed at 17.30am

Location	Wind Speed (km/h) at 17.30pm			
Thiruvanathapuram	June	July	August	September
Maximum	12	16	12	13
Minimum	8	12	9	8

C. Monthly Mean Wind speed at 17.30pm

Similarly the figure 3.1b, it is found that wind speed shows a slight increasing trend. From the table 2, it reveals that Maximum rainfall receiving month July recorded the maximum windspeed of 16 km/h and minimum of 12km/h which is higher than wind speed obtained all the other months. During August maximum windspeed of 12 km/h and minimum of 9km/h have been found. Similarly maximum windspeed of 13km/h and minimum of 8km/h have been found the month September. The mean wind speed during South West monsoon for the study reveals maximum of 13.25 km/h.

D.South West monsoon monthly Mean Wind speed trend of Ernakulam at 8.30am

Table 3 Monthly Mean Wind speed at 8.30am

Location	Wind Speed (km/h) at 8.30am			
Ernakulam	June	July	August	September
Maximum	9	10	8	8
Minimum	5	4	3	4

The monthly Mean South West monsoon windspeed trend of Ernakulam is given in the figures 3.1c & 3.1d. Ernakulam district is locted on the Western coastal plain of India. It is surrounded by Thrissur distict to the north, Idukki district to the east, Alappuzha district and Kottayam district to the south & Arabian Sea to West. The longest river Periyar flows through the district. The district is known as commercial capital of Kerala. Cochin international airport is located in the northern part of the district. Rice is the principal crop cultivated in the wet land. The areas under paddy cultivation in the district have been decreasing steadily over the past three decades.

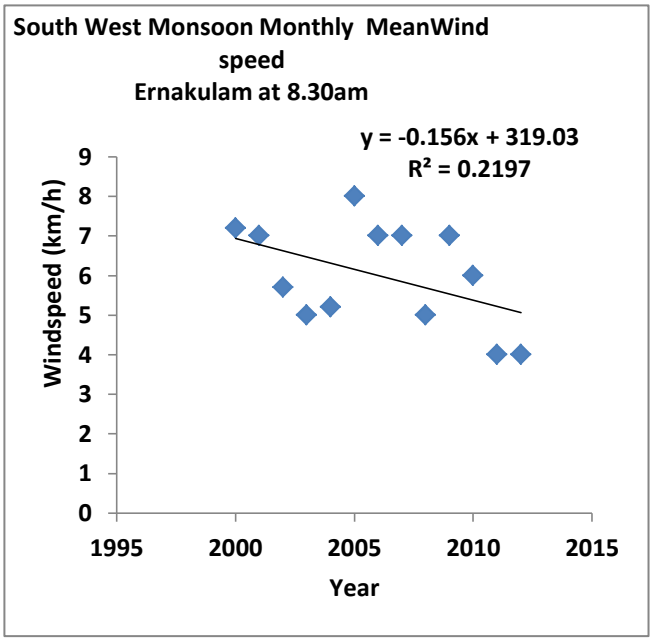


Fig.3.1c Monthly Mean Wind speed trend at Ernakulam

From the figure 3.1c, the twelve year (8:30am) study reveals that there is a decreasing trend in wind speed. The table 3, reveals that during July maximum wind speed of 10km/h and minimum wind speed of 4km/h have been found. Similarly monsoon receiding months August and September recorded a maximum windspeed of 8km/h and minimum of 3 and 4 km/h respectively. The monsoon setting month June recorded the maximum wind speed of 9km/h and minimum of 5km/h respectively. Finally it is noted that the month July has the maximum windspeed recorded over all other months of the year. The mean wind speed during South West monsoon for the study reveals maximum of 8.75 km/h and minimum of 4 km/h.

E. South West monsoon monthly Mean Wind speed trend of Ernakulam at 17.30pm

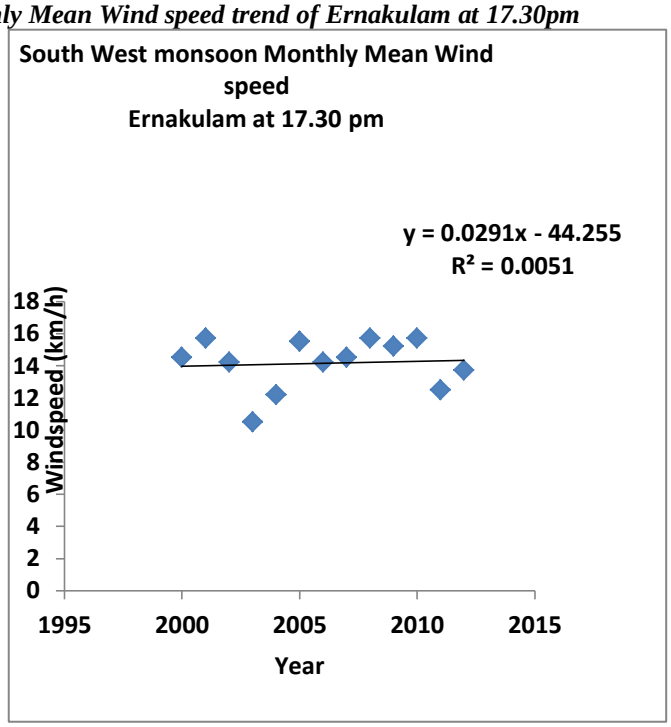


Fig.3.1d Monthly Mean Wind speed trend at Ernakulam

Table 4 Monthly Mean Wind speed at 17.30pm

Location	Wind Speed (km/h) at 17.30pm			
Ernakulam	June	July	August	September
Maximum	15	17	18	17
Minimum	11	9	12	13

Similarly the figure 3.1d reveals (17:30h) that there is a increasing trend in wind speed. From the table 4, it is found that during the month August recorded the maximum wind speed of 18km/h and minimum of 12 km/h. The month July and September recorded the maximum windspeed of 17km/h and minimum of 13km/h and 9km/h. Monsoon setting month June received a maximum of 15km/h and minimum of 11km/h. The maximum Mean wind speed received the study period is 16.75km/h. The district Ernakulam received maximum wind speed than the other two districts of kerala.

F. South West monsoon monthly Mean Wind speed trend of Kannur at 8.30am

The monthly Mean South West monsoon windspeed trend of Kannur is given in the figures 3.1e and 3.1f. Kannur district is known as the land of loons and lores. The district is the major centre of theyyam. The district lies between lattitude $11^{o}40'$ to $12^{o}48'$ and longitude $74^{o}52'$to $76^{o}07'$ East. The district nearest part of Western Ghats and are covered by rainforests, plantation of coffee, tea and different types of species like cardamom. Six riverse are flowing through Kannur.

Table 5 Monthly Mean Wind speed at 8.30am

Location	Wind Speed (km/h) at 8.30am			
Kannur	June	July	August	September
Maximum	3	2	2	2
Minimum	0	0	0	0

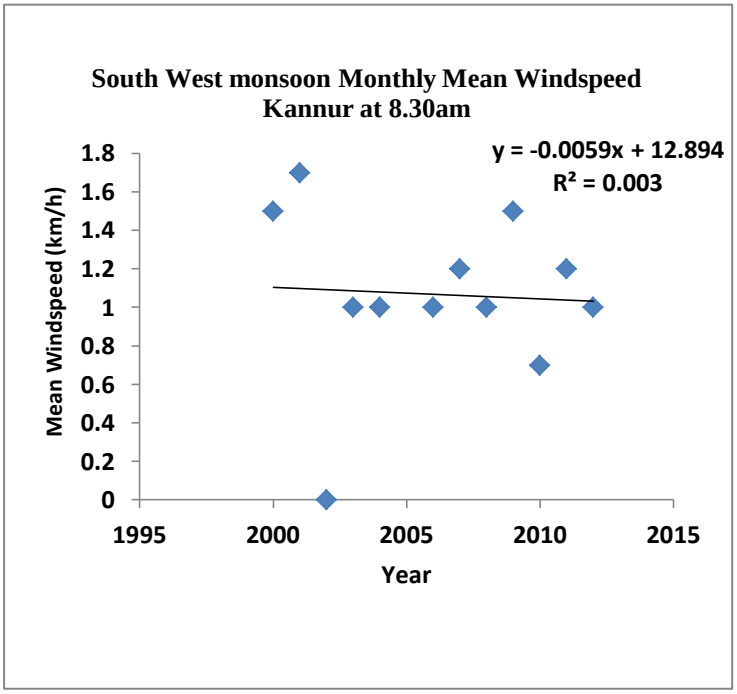


Fig.3.1e Monthly Mean Wind speed trend at Kannur

From the figure 3.1e, the twelve years study reveals that there is a decreasing trend in windspeed of -0.03. The table 5, it shows that very less windspeed compared to the other district of Kerala. The monsoon setting month June recorded a maximum windspeed of 3km/h and other the three months shows a maximum windspeed of 2km/h. All South West monsoon months of Kannur shows a nil minimum windspeed.

G. South West monsoon monthly Mean Wind speed trend of Kannur at 17.30pm

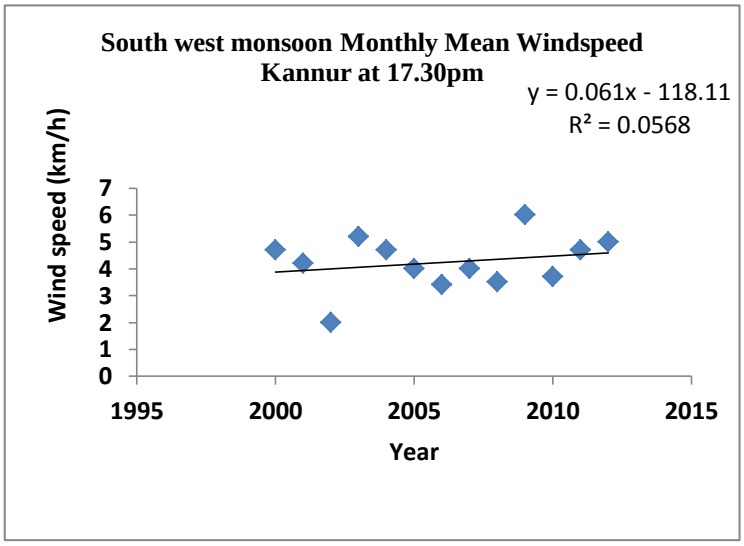


Fig.3.1f Monthly Mean Wind speed trend at Kannur

Table 6 Monthly Mean Wind speed at 17.30am

Location	Wind Speed (km/h) at 17.30pm			
Kannur	June	July	August	September
Maximum	6	4	8	9
Minimum	2	1	2	3

The figure 3.1f, a twelve year study reveals that there is an increasing trend in windspeed of 0.0568. The monsoon setting month June recorded a maximum of 6 km/h and minimum of 2 km/h. The month July recorded the maximum of 4km/h and minimum of 1km/h. The monsoon receiding months august and September recoded a maximum of 8 &9 km/h and minimum of 2 & 3 km/h.

H. South west monsoon Monthly mean wind speed trend of Thiruvanathapuram

The monthly mean wind speed of South West monsoon over the years of study period computed for the windspeed data during morning and evening hours have been averaged to bring unified data for the trend analysis.

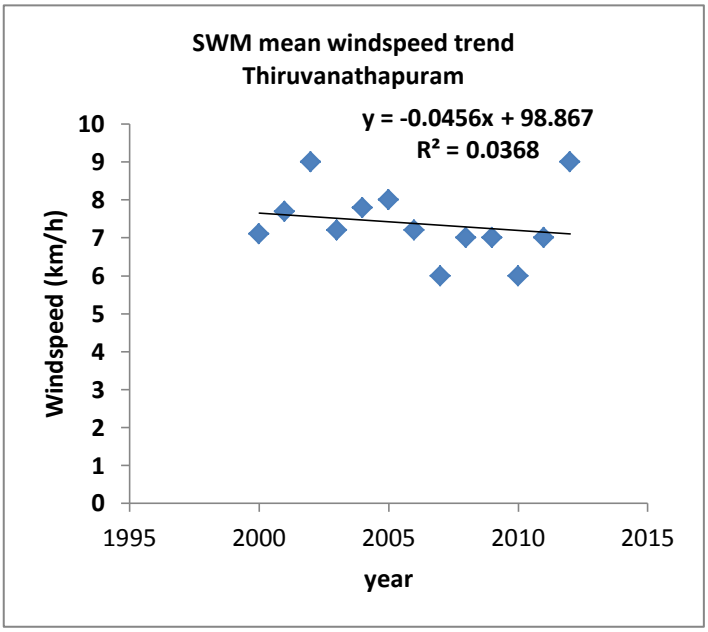


Fig.3.1g Monthly mean wind speed trend of Thiruvanathapuram

Table 7 Monthly Mean Wind speed at Thiruvanathapuram

Location	*Windspeed(km/h)*			
Thiruvanathapuram	*June*	*July*	*August*	*September*
Maximum	*9*	*10*	*10*	*9*
Minimum	*5.5*	*6.5*	*6*	*5*

From the figure 3.1g, the twelve year study on monthly mean wind speed at Thiruvanathapuram reveals that there is a decreasing trend seen in the wind speed of -0.036. From the table 7, it is found that the months July and August recorded a maximum wind speed of 10 km/h and a minimum of 6.5 and 6km/h. The monsoon setting month June recorded a maximum wind speed of 9km/h and minimum of 5.5km/h. Similarly monsoon receeding month September recorded a maximum of 9km/h and minimum of 5km/h.

I. South West monsoon Monthly mean wind speed trend of Ernakulam

The monthly mean wind speed of South West monsoon over the study year computed for the windspeed data during morning and evening hours has been averaged to bring unified data for the trend analysis.

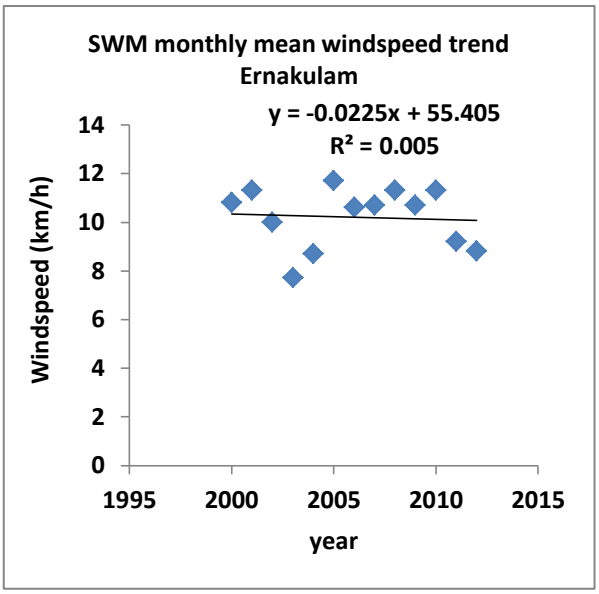


Fig.3.1h Monthly mean wind speed trend of Ernakulam

Table 8 Monthly Mean Wind speed at Ernakulam

Location	Windspeed			
Ernakulam	June	July	August	September
Maximum	11.5	12	14	13
Minimum	8	7	8	7.5

From the figure 3.1h, a twelve year study yields that there is a decreasing trend in wind speed of -0.005. The month June recorded a maximum of 11.5km/h & minimum of 8km/h and the month July recorded a maximum of 12km/h and minimum of 7km/h. The monsoon receeding month August and September received a maximum of 14km/h & 13km/h and minimum of 8km/h & 7.5km/h respectively.

J. South West monsoon Monthly mean wind speed trend of Kannur

The monthly mean wind speed of South West monsoon of the year computed and analysed for the windspeed data during morning and evening hours has been averaged to bring unified data for the trend analysis.

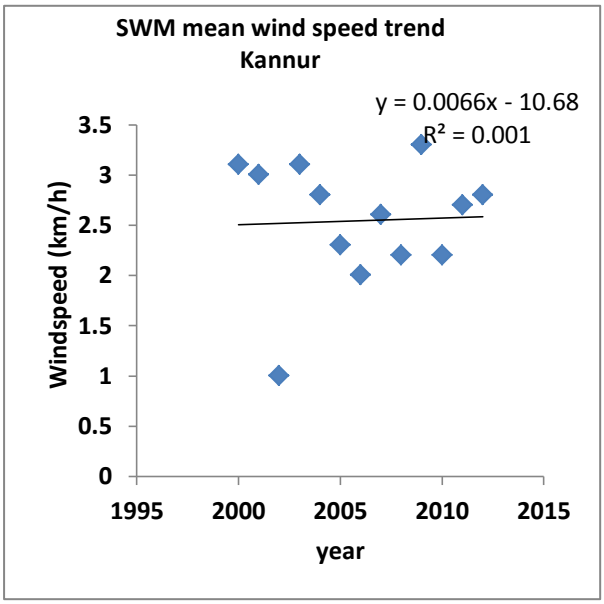


Fig.3.1i Monthly mean wind speed trend at Kannur

Table 9 Monthly Mean Wind speed at Kannur

Location	Windspeed			
Thiruvanathapuram	June	July	August	September
Maximum	4.5	3	3	5
Minimum	1	0.5	1	1.5

From the figure 3.1i, a twelve year study reveals that a marginal increase in wind speed. From the table 9, it reveals that the monsoon setting month June received maximum wind speed of 4.5km/h and a minimum of 1km/h. Similarly the month July received a maximum wind speed of 3km/h and a minimum of 1km/h. The monsoon receeding months August and September recorded a maximum wind speed of 3& 5km/h and minimum of 1& 1.5 km/h respectively.

H. Combined Analysis

Comparison of the maximum and minimum wind speed regrssion co-efficient indicating trend of the locations Thiruvanathapuram, Ernakulam and Kannur have been provided in the table.

Table 10

Locations	Maximum Mean Wind speed (km/h)	Minimum mean Wind speed(km/h)	Trend
Thiruvanathapuram	9.5	5.7	-0.036
Ernakulam	12.6	7.6	-0.005
Kannur	3.8	1	0.001

As a table the maxima and minima of the wind speed are found high in Ernakulam and low in Kannur. The regression co-efficients computed clocked negative values at thiruvanathapuram and Ernakulam and marginally positive value at Kannur. Altogether it is seen that a negative trend in wind speed emerges over the study period in all the locations and the depth of the negative trend is maximum at Thiruvanathapuram. Based on the trend it can be concluded that the degree of the climate change varies from marginal to the deeper levels in Kerala.

IV. Conclusion

The trend analysis of the South West monsoon mean wind speed reveals that the trend is declining during morning hours and slight incrimental increase during evening hours over the study period. The trend computed from the unified data infess that there is an abrupt decrease in trend at Thiruvanathapuram and Ernakulam and marginal increase in Kannur over the study period. Taking in to account the trend analysis of mean monthly wind speeds at South West monsoon for the morning and evening hours and also using the unified data, it can be concluded that the climate change is prevalent in the chosen locations. Analysis of wind speed over Kerala ranges from 1 to 18 km/h. The mean wind speed during South West monsoon for the study period revelas maximum 8.5 km/h at Ernakulam following 7.5 km/h at Thiruvanathapuram and least Mean in 2.25 km/h at Kannur. The dynamic decline of the windspeed over the twelve years study period it is understood that climate change has its impression in the region.

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