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A study of unusually heavy to very heavy rainfall over Kerala in October 1999

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सार – केरल में अक्तूबर 1999 के दौरान भारी से बहुत भारी वर्षा हुई जिसके परिणामस्वरूप अक्तूबर के महीने में बीसवीं शताब्दी की 54.6 से.मी. वर्षा का रिकार्ड बना। मध्य केरल के कुछ स्थानों जैसे कि पुन्नलूर, अलप्पूझा, कोट्टयम, कोन्नी, आर्यनकवू, छरतल, तोडुपूझा और मन्नारधाट में अक्तूबर के महीनें में बीसवीं शताब्दी की भारी वर्षा रिकार्ड की गई। इस क्षेत्र में हुई भारी वर्षा के लिए उत्तरदायी सिनॉप्टिक विशेषताओं की जाँच की गई है। यह पता चला है कि केरल में अक्तूबर 1999 में लगभग बीस दिनों तक भारी से बहुत भारी वर्षा के होने के मुख्य कारण निचले एवं मध्य क्षोभमंडल में 10 डिग्री अंक्षाश उत्तर में पूर्वी–पश्चिमी द्रोणी/अपरूपण रेखा की अनुकूल स्थिति तथा लक्षद्वीप और दक्षिणी केरल में उत्तरी अंडमान सागर और पूर्वी मध्य खाड़ी के आरपार संचरित होने वाले तंत्रों से संबद्ध पश्चिमाभिमुखी पवनों का शक्तिशाली होना है।

ABSTRACT. Kerala received heavy to very rainfall in October 1999 being a record rainfall of 54.6 cm of the twentieth century for the month of October. A few stations in central Kerala like Punalur, Alappuzha, Kottayam, Konni, Aryankavu, Chertala, Thodupuzha and Mannarghat reported record October month rainfall of the twentieth century. Synoptic features responsible for these heavy rains have been examined. It was found that favourable position of the east-west trough/shear line running across latitude 10° North in the lower and middle troposphere and the strengthening of westerly winds over Lakshadweep and south Kerala in association with systems moving across north Andaman Sea and east central Bay are the prime causes leading to heavy to very heavy rainfall in October 1999 over Kerala for about 20 days in October.

Key words – Very heavy rainfall, Kerala.

1. Introduction

The onset of southwest monsoon and its further progress is dramatic where as the withdrawal of the southwest monsoon is usually sluggish and sometimes sudden especially when cold pool of dry northerly air from the continent pushes the monsoon trough as low as latitude 5° North especially in the period of transition from southwest monsoon to northeast monsoon. According to Das (1968) " In fact on many occasion there is no clear indication between the withdrawal of summer monsoon in India and the onset of the winter monsoon . One tends to merge with the other." The year 1999 was one such case when the southwest monsoon was withdrawn on 20 October and the northeast monsoon was brought in on 21 October. Srinivasan and Ramamurthy (1973) mentioned that the typical synoptic situations affecting weather over southern peninsula during the northeast monsoon season are :

(*i*) Storms and depressions which form over the sea areas and move towards the coast.

(*ii*) Low pressure areas (surface and upper air) and low pressure waves.

(*iii*) East west oriented trough line across the peninsula, seasonal trough over Bay well marked or a trough of low pressure off Kerala coast.

They also mentioned that active to vigorous northeast monsoon conditions prevail hardly on 5 % of the occasion and they are only in October when the trough system across the peninsula is marked. Again Sikka and Gadgil (1980) studied satellite imagery of the period April to October 1973 to 1977 for maximum cloud zone and ITCZ in Indian longitude between 70° E and 90° E and concluded that "the onset phase of monsoon comprises one or more northward propagation of the tropical convergence zone from the equatorial Indian ocean onto to heated continent with each successive propagation culminating at a higher latitude and finally leading to the establishment of tropical convergence zone (TCZ) in the monsoon zone over the continent around the beginning of July". They also showed that "over the Indian region during the summer monsoon of maximum cloudiness zone

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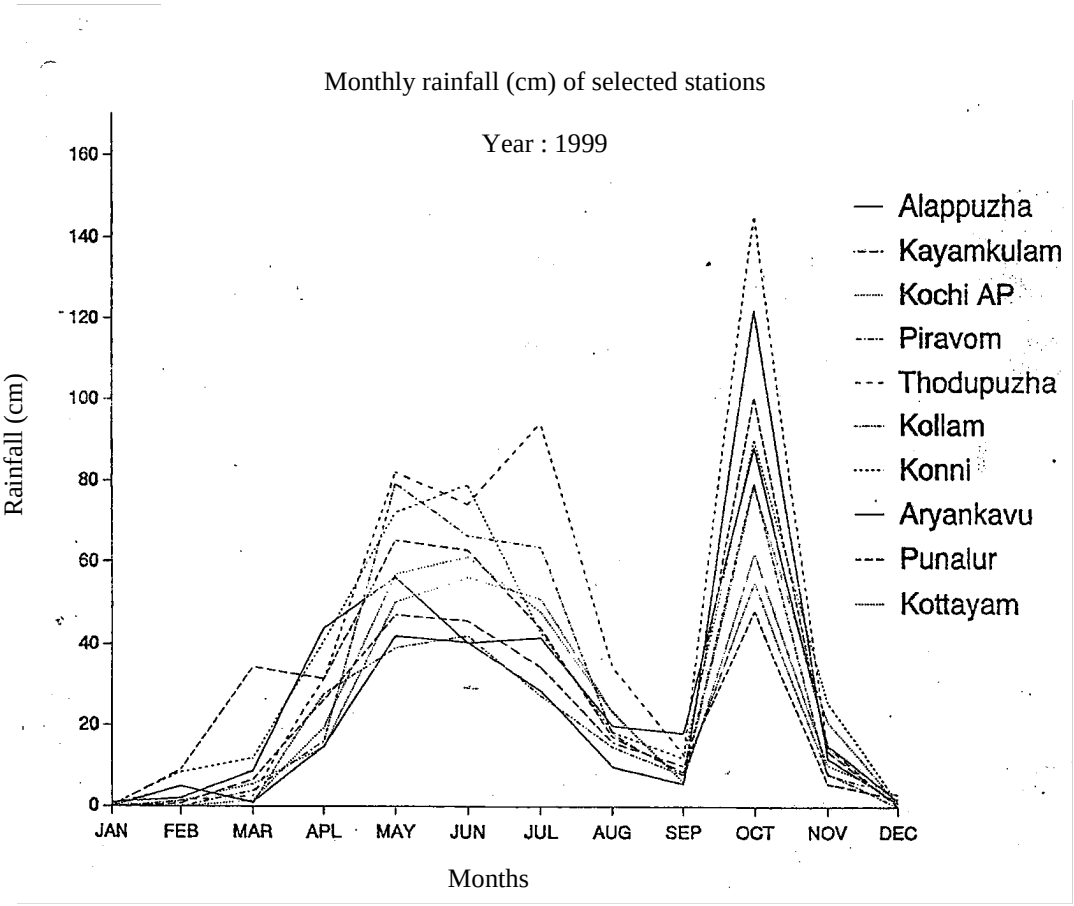


Fig. 1. Monthly rainfall of selected stations during the year 1999

coincides with the trough zone at 700 hPa and is a associated with large scale cyclonic vorticity above the boundary layer, strong low level convergence and intense moist convection. Gadgil (1988) mentioned that "the retreat of the monsoon is also characterized by northward propagation with each successive propagation culminating at a lower latitude."

In the year 1999, the monsoon trough retreated down to a very low latitude in the first week of October. The monsoon trough/shear line which is seen in a low latitude slowly moves north and settles down around 12° N in the month of October with northeasterly winds over north Tamil Nadu and with westerly winds over south Kerala and south Tamil Nadu. The trough oscillates with the movement of weather systems that form in the trough.

1.1. *Rainfall of October 1999 over Kerala*

Kerala received a rainfall of 54.6 cm in October 1999 as against a normal of 29.7 cm. It may be mentioned that the normal rainfall for the season October to December is 50.5 cm and thus in October itself Kerala rains exceeded the seasonal rainfall of October to December. October 1999 rainfall is record rainfall of the twentieth century for the month of October for Kerala. The details of stations reporting very heavy rainfall and the rainfall amounts for October 1999 in Kerala and Lakshadweep is given below :

Date	*Station*	*Very heavy rainfall amount (cm)*
1	Aryankavu	13
2	Thodupuzha	13
	Aryankavu	13
3	Aryankavu	14
4	Aryankavu	21
5	Aryankavu	20
	Parambikulam	16
14	Konni	14
15	Agathi airport	30
16	Kozhikode airport	17
	Ponnani	13
17	Vythiri	16
18	Chalakudy	13
19	Peermade	13
24	Thodupuzha	13
25	Thodupuzha	13

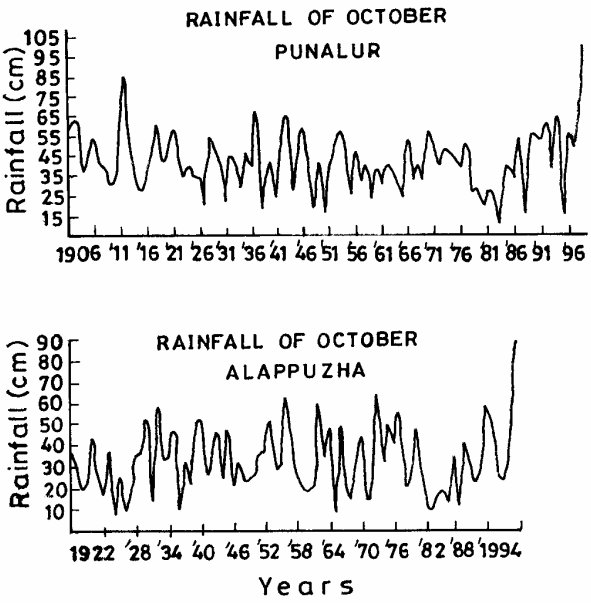


Fig. 2. Hundred years October rainfall of Punalur and Alapplizha

Kerala received very heavy rainfall in two spells in October 1999, the first spell being between 1 to 5 and the second spell from 14 to 25. In the first spell from 1 to 5 Kerala received a rainfall of 7.7 cm as against a normal of 4.9 cm and in the second spell from 14 to 25, 29.3 cm as against a normal of 12.2 cm. A few stations in central Kerala, like Punalur, Alapppuzha, Kottayam, Konni, Aryankavu, Chertala, Thodupuzha and Mannarghat reported record October rainfall of the century and their details are given below :

S. No.	*Station*	*Normal rainfall for Oct (cm)*	*Rainfall (cm) in Oct 1999*	*Earlier highest rainfall (cm) in the month of October*	*Year*
1.	Punalur	38.8	100.7	86.5	1972
2.	Alappuzha	36.7	88.1	67.1	1956
3.	Kottayam	35.1	78.8	73.3	1912
4.	Konni	40.5	90.0	84.9	1994
5.	Aryankavu	33.7	120.7	82.1	1997
6.	Cherthala	30.3	71.7	66.6	1982
7.	Mannarghat	33.3	78.5	66.5	1913
8.	Thodupuzha	43.4	145.4	75.0	1998

The highest rainfall of 145.4 cm for the stations in Kerala was reported by Thodupuzha for the month of October and this is the highest for the month of October for the twentieth century. About 30 % of the stations reported record rainfall for the month of October during the last two decades. It may be mentioned that a large

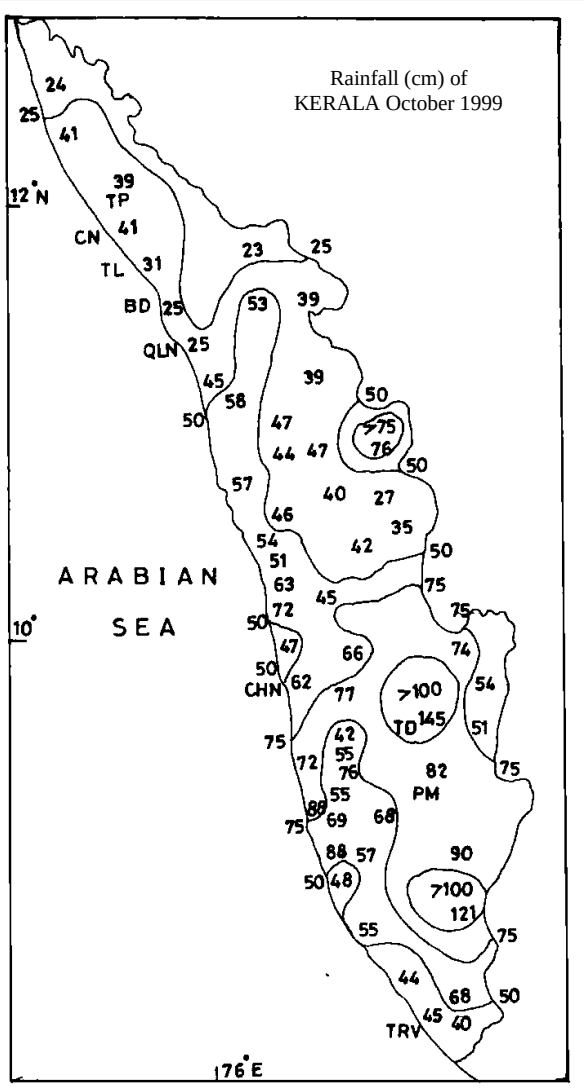
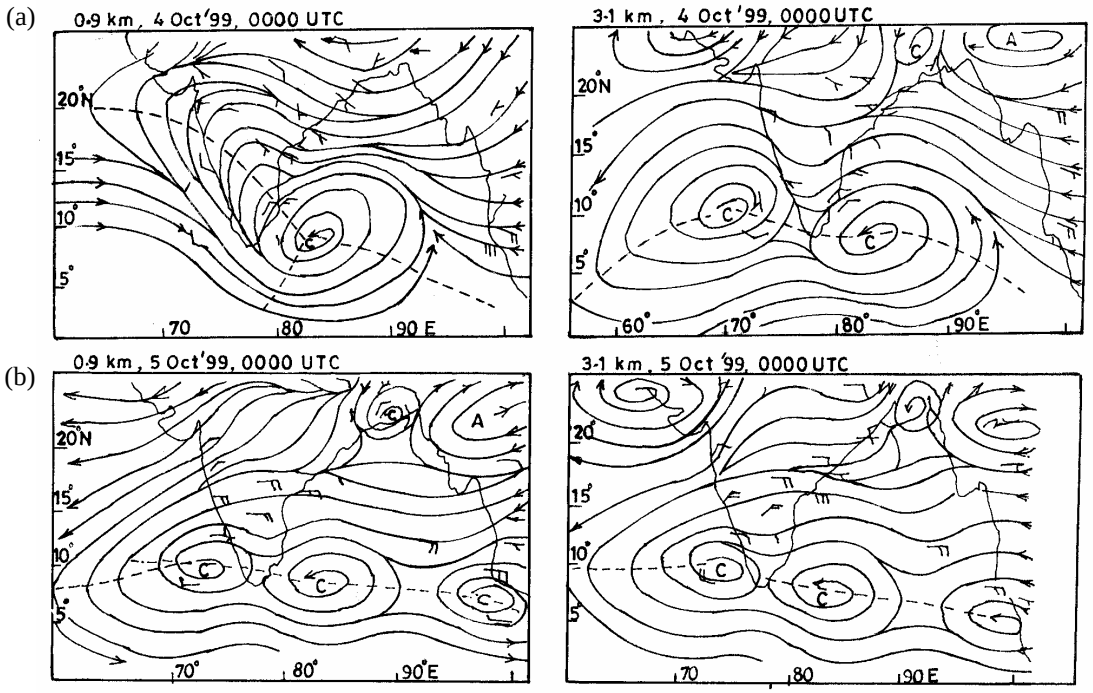


Fig. 3. Rainfall of Kerala for different stations during October 1999

number of stations received much higher rainfall in October than the rainfall of peak monsoon months of June and July. Monthly rainfall of the year 1999 received by selected stations is given in Fig. 1. One can easily note the predominance of October rainfall over the monsoon rainfall of June and July months peak rainfall, an interesting feature indeed. A plot of hundred years of rainfall of Punalur and Alapuzha for the month of October is given in Fig. 2. Rainfall received by stations in Kerala in October 1999 is given in Fig. 3.

1.2. *Chief synoptic features in October 1999*

The chief significant weather systems in October 1999 were two cyclonic storms which moved northwestwards from North Andaman Sea to Orissa coast across East Central Bay between 16 and 18, the first one



Figs. 4(a&b). Upper air chart of 0.9 and 3.1 km asl on (a) 4 October 1999 and (b) 5 October 1999

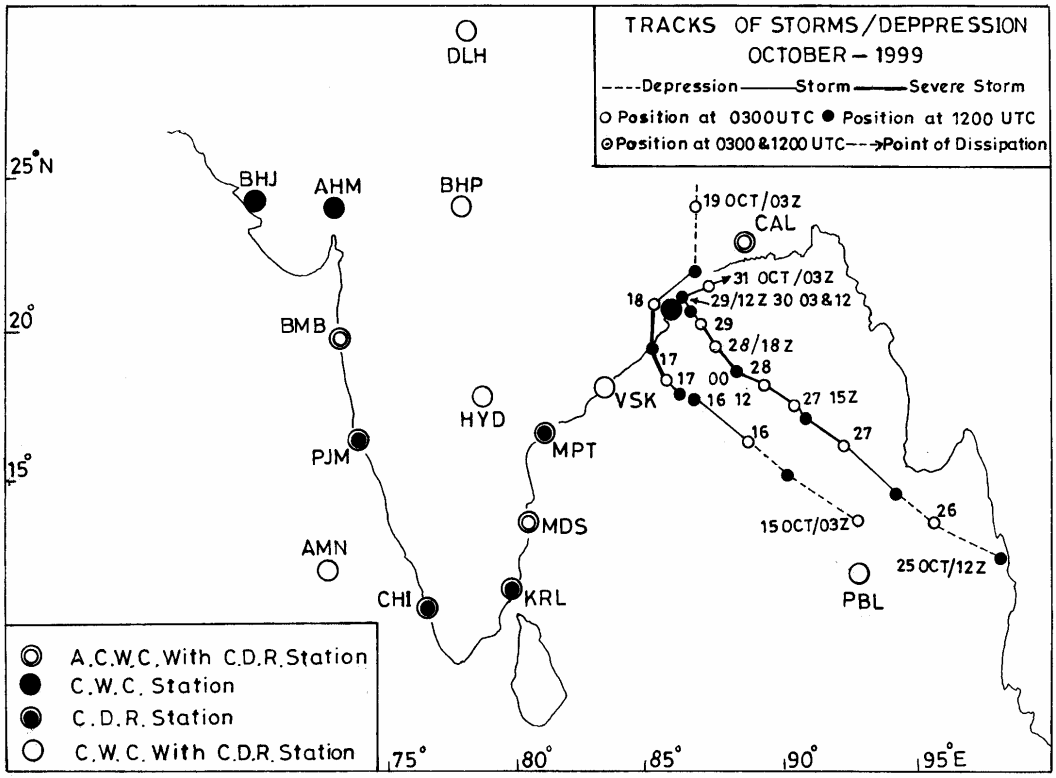
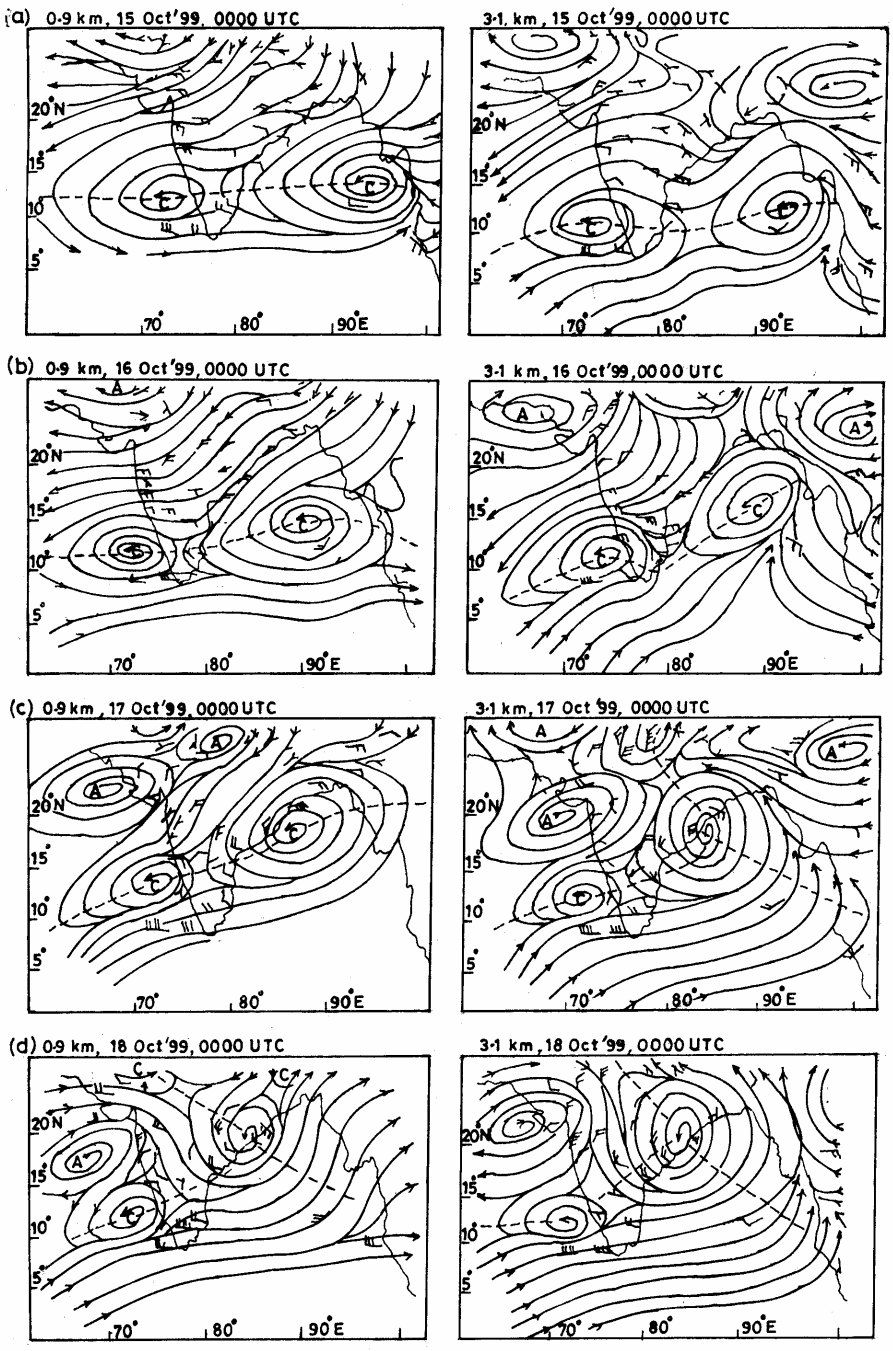


Fig. 5. Tracks of severe cyclonic storm during October 1999



Figs. 6(a-d). Upper air charts of 0.9 and 3.1 km asl for the period (a) 15 October 1999, (b) 16 October 1999, (c) 17 October 1999 and (d) 18 October 1999

crossing Orissa coast on 17 midnight as a very severe cyclonic storm and another one between 28 and 29 crossing Orissa coast on 29 as a super cyclonic storm causing widespread damage to life and property in Orissa. During the period between 1 and 5 October certain places in the ghats area of Kerala reported very heavy rainfall. On a perusal of the synoptic and upper air charts, it was noticed that a low pressure area lay over southwest Bay off Tamil Nadu coast between 2 and 5. Whenever some weather system forms in Southwest Bay, the trough of low off Kerala coast also gets activated. The east west shear line ran northwest to southeast across around latitude

11° N and was very prominent during this period and later the low pressure area over South West Bay weakened.

Again during the period 14 to 25 October Kerala reported very heavy rain. The synoptic and upper air charts show that a cyclonic storm which developed over north Andaman Sea on 15 moved northwestwards into east central Bay gradually intensifying and crossing Orissa coast as a very severe cyclonic storm on 18 morning.

2. Discussion

On a perusal of upper air charts it can be easily seen that during the period 1 to 5 the east west shear line was marked and was seen around latitude 11° North. The upper air chart of 0.9 and 3.1 km a.s.l. on 4 and 5 October are given in Fig. 4.

A depression formed over north Andaman Sea on 15 and intensified into a cyclonic storm on 16 and moving in a northwesterly direction it further intensified into a very severe cyclonic storm on 17 morning. It crossed Orissa coast as a very severe cyclonic storm on the midnight of 17. The tracks of the severe cyclonic storm and the track of the super cyclone are given in Fig. 5. The upper air charts of 0.9 and 3.1 km a.s.l. for the period 15 to 18 October is given in Fig. 6. It can be easily seen that on 15 itself the westerly winds over Kerala and Lakshadweep in the lower and mid troposphere started strengthening under the influence of the weather system over north Andaman Sea. In fact on 16 Minicoy reported wind speed of 50 knots at 0.9 km a.s.l. The trough off west coast got activated and a cyclonic circulation extending up to mid tropospheric levels developed on 15 over Lakshadweep and Kerala coast and persisted till 18. Later as the severe cyclonic storm which crossed Orissa coast weakened, the lower tropospheric flow pattern returned to normal by 20 with northeasterlies over north Tamil Nadu and with westerlies over south Kerala and south Tamil Nadu with the east west shear line running around latitude 10° North. The significant feature about the rainfall over Kerala during this period is that the cyclonic circulation off Kerala coast and Lakshadweep was very well marked and produced enormous amount of heavy to very heavy rainfall over Kerala. Thus the severe cyclonic storm which crossed Orissa coast though it did not bring the winds over Kerala into its field, it activated the trough off Kerala coast leading to upper air cyclonic circulation extending up to mid tropospheric levels with a strong east west shear line running across latitude around 11° North. It may be mentioned that easterly jet stream was reported from Minicoy on 15, 16 and 17 at 20 hPa with speed 60 knots, at 14.1 hPa with speed 80 knots and at 13.0 hPa with speed 75 knots respectively. The other weather system which formed on 26 became a cyclonic storm on 27 morning and as a super cyclonic storm on 28 night and crossed Orissa coast as a super cyclonic storm on 29 early morning. The track of this super cyclonic storm was little north and parallel to the earlier severe cyclonic storm. The other noticeable feature of the super cyclonic storm is that it brought dry northerly to northwesterly winds over Kerala into its fold an as such it did not produce much significant rainfall to Kerala during the period 26 to 30 October 1999. Kerala had about 20 days of heavy to very heavy rainfall in October 1999 leading to some stations reporting record rainfall for the month of October in the twentieth century.

3. Conclusion

Favourable position of the east west shear line running across latitude 11° North in the lower and middle troposphere and the strengthening of westerly winds over Lakshadweep and south Kerala in association with systems moving across north Andaman Sea and east Central Bay aided by topography are the main factors leading to heavy to very heavy rainfall for about 20 days in October 1999 over Kerala and to record October rainfall of the twentieth century in central Kerala stations of Punalur, Alappuzha, Kottayam, Konni, Aryankavu, Chertala, Thodupuzha and Mannarghat.

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