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A climatological study of heat and cold waves in Karnataka State

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सार — कर्नाटक राज्य में, पिछले दो दशकों की अवधि के दौरान उष्ण व शीत लहर की तीव्रता, आवृत्ति, क्षेत्रीय प्रसार, विकास, गति व क्षय का विश्लेषण किया गया है। ऐसा देखा गया है कि पूरे कर्नाटक में शीत लहर के दिनों की संख्या उष्ण लहर के दिनों की संख्या से अपेक्षाकृत अधिक है। जैसे-जैसे हम राज्य के पूर्वी हिस्से की ओर बढ़ते हैं उष्ण लहरें तीव्र परिमाण में मिलती हैं जबकि शीत लहर के मामले में इसके विपरीत है। राज्य के मैदानी क्षेत्र में प्रचंण्ड लू चलने की अधिक सम्भावना रहती है, जब कि तटीय व घाटी क्षेत्र भीषण शीत लहर के प्रभाव में होते हैं।

ABSTRACT. The intensity, frequency, areal extent, development, movement and decay of heat and cold waves in Karnataka State have been analysed during the period of the past two decades. It is observed that the total number of cold wave days are comparatively more than the heat wave days over the whole State. The magnitudes of severity in intensity of occurrence of heat waves are steeper as we move towards the eastern side of the State while it is reversed in the case of cold waves. The Maidan region of the State is most prone to severe heat waves while the coastal and a part of the Ghat regions are highly susceptible to severe cold waves.

1. Introduction

It is well known that the air temperatures are important factors in the control of the growth and yield of crops as well as human comfort and that extremes of heat and cold are injurious to both plant and animal kingdoms [Ganesan (1983), Subrahmanyam *et al.* (1980)]. Karnataka State extends over an area of 1.92 lakh sq. km occupying around 6 per cent of area of the country. Nearly 92 per cent of the State lies between the elevation ranges of 300 to 1,350 metres above mean sea level. It has a variety of topoclimatic variations with physiographic divisions comprising the coastal region (Uttar and Dakshina Kannada districts), Malnad region (Shimoga, Chikmaglur, Hassan and Coorg districts), sourthern Maidan region (Mysore, Mandya, Bangalore, Kolar, Tumkur and Chitradurga districts) and northern Maidan region (Bidar, Gulbarga, Bijapur, Raichur, Belgaum, Dharwar and Bellary districts).

Out of the total of 175 taluks in the State, 76 taluks fall in the arid areas, 65 taluks in semi-arid areas and 34 taluks in high rainfall areas. The occurrence and persistency of droughts in the State have the periodic cycle of 3 years in the northern Maidan districts and 4 years in the southern Maidan districts. During the past 20 years of study in the State, the southwest and northeast monsoon seasons as well as annual rainfall patterns varied in the ranges of 9 years: nromal, 8 years: below normal and the remaining 5 years above normal.

The heat and cold waves are the main important weather hazards in Karnataka State apart from the common occurrences of agricultural droughts. This kind of study of heat and cold waves is useful to the agriculturists and industrialists in the State (Skerman 1956 and Manral 1983). The prolonged persistence of heat waves cause deaths due to heat strokes and crop failures, while cold waves cause thick fogs and frosts. Raghavan (1966, 1967), later Subbaramayya *et al.* (1976) have studied the occurrence of heat and cold waves over the Indian sub-continent in detail. In the present study the authors have attempted to analyse the life history of occurrence of heat and cold waves in Karnataka State in particular.

2. Data and methodology

The daily departure of air temperatures from normals, recorded at 14 different meteorological stations in the district headquarters of Karnataka State (given in the *Indian Daily Weather Reports*, published by India Met. Dep.) over a period of 20 years from 1964 to 1983 are collected and analysed for this purpose. The severity of heat and cold waves is demarcated according to the degrees of depatures from normals of the date of both day and night temperatures (moderate when ± 6 to ± 7°C and severe when ± 8°C). The total number of heat and cold wave days of two different categories, namely moderate and severe are computed monthwise and the annual totals for the 14 India Met. Dep. stations in the State are shown in Table 1 while Table 2 gives the monthly totals of both the categories. The areal extent of the spread, development, movement and decay of heat and cold waves over the coastal plains, Western Ghat regions and Karnataka plateau comprising Malnad

TABLE 1

Total number of heat and cold wave days of different intensities in Karnataka State (based on 20 years daily data from 1964 to 1983)

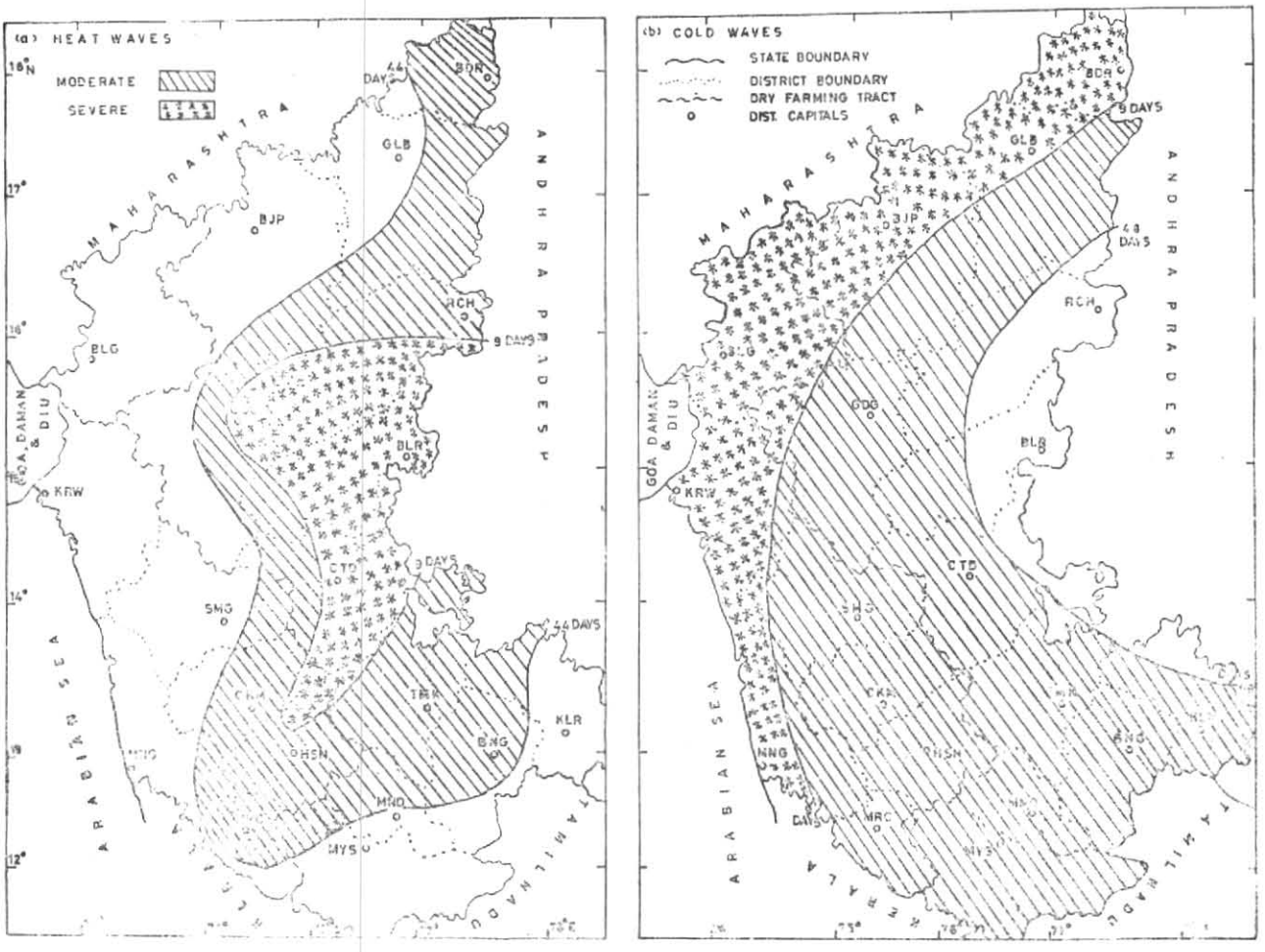
Station (Abbrevation)	Geographical location of the station (m a.s.l.)	Heat waves		Cold waves	
		Moderate	Severe	Moderate	Severe
Bangalore (BNG)	12° 58′N, 77° 35′E, 921 m	21	6	39	4
Belgaum (BLG)	15° 51′N, 74° 32′E 753 m	84	21	45	7
Bellary (BLY)	15° 09′N, 76° 51′E, 449 m	95	14	61	7
Bidar (BDR)	17° 55′N, 77° 32′E, 660 m	48	9	30	9
Bijapur (BJP)	16° 49′N, 75° 43′E, 594 m	33	9	43	8
Chitradurga (CTD)	14° 14′N, 76° 26′E, 733 m	35	12	34	10
Gadag (GDG)	15° 27′N, 75° E, 727 m	59	8	31	Nil
Gulburga (GLB)	17° 21′N, 76° 51′E, 458 m	28	5	38	8
Honavar (HNV)	14° 17′N, 74° 28′E, 4 m	32	9	25	6
Karwar (KWR)	14° 47′N, 74° 28′E, 4 m	32	2	46	6
Mangalore (MNG)	12° 52′N, 74° 51′E, 22 m	30	5	23	2
Mercara (MRC)	12° 25′N, 75° 44′E, 1152 m	57	7	129	40
Mysore (MYS)	12° 25′M, 76° 44′E, 767 m	11	10	32	7
Raichur (RCH)	16° 12′N, 77° 21′E, 410 m	51	8	93	15
Total for the State		660	125	669	129
Average		44	9	48	9

TABLE 2

Monthly total number of heat and cold wave days in Karnataka State (based on 20 years daily data from 1964 to 1983)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bangalore	1 (1)	1 (10)	2 (0)	0 (0)	0 (1)	7 (0)	4 (0)	1 (6)	6 (0)	1 (2)	2 (19)	2 (4)	27 (43)
Belgaum	1 (10)	0 (4)	0 (9)	9 (0)	17 (0)	38 (0)	11 (0)	5 (0)	4 (0)	7 (5)	13 (21)	0 (3)	105 (52)
Bellary	3 (13)	2 (6)	10 (11)	11 (7)	20 (4)	23 (7)	11 (1)	0 (0)	10 (0)	9 (2)	8 (10)	2 (7)	109 (68)
Bidar	1 (8)	0 (4)	0 (4)	2 (6)	0 (7)	25 (0)	19 (4)	0 (0)	0 (0)	3 (0)	2 (1)	5 (5)	57 (39)
Bijapur	2 (13)	1 (4)	0 (13)	7 (0)	0 (2)	23 (2)	4 (0)	0 (0)	0 (0)	1 (9)	3 (7)	1 (1)	42 (51)
Chitradurga	1 (3)	3 (4)	1 (8)	0 (2)	5 (2)	7 (2)	10 (0)	3 (0)	1 (0)	9 (3)	5 (8)	2 (12)	47 (44)
Gadag	1 (0)	1 (0)	0 (6)	0 (6)	7 (2)	15 (0)	2 (0)	1 (1)	0 (0)	29 (0)	11 (7)	0 (9)	67 (31)
Gulburga	1 (6)	0 (1)	2 (7)	2 (5)	1 (0)	11 (2)	2 (6)	0 (0)	0 (2)	7 (0)	5 (11)	2 (6)	33 (46)
Honavar	2 (3)	8 (2)	2 (4)	3 (2)	4 (5)	8 (2)	2 (2)	0 (0)	4 (0)	3 (0)	5 (4)	0 (7)	41 (31)
Karwar	3 (8)	9 (12)	6 (2)	1 (2)	1 (1)	1 (1)	2 (0)	0 (0)	4 (0)	5 (0)	2 (9)	0 (17)	34 (52)
Mangalore	2 (1)	1 (3)	5 (3)	1 (4)	5 (2)	3 (5)	6 (0)	5 (0)	0 (2)	5 (0)	1 (1)	1 (4)	35 (25)
Mercara	4 (33)	2 (20)	4 (15)	5 (6)	1 (9)	6 (2)	25 (12)	6 (51)	4 (2)	1 (2)	2 (3)	4 (14)	64 (169)
Mysore	2 (6)	0 (1)	0 (3)	4 (0)	0 (1)	4 (1)	0 (3)	0 (4)	1 (0)	0 (4)	6 (10)	4 (7)	21 (40)
Raichur	2 (14)	0 (11)	0 (5)	3 (10)	3 (17)	12 (12)	20 (2)	6 (0)	7 (1)	2 (7)	4 (17)	0 (12)	59 (108)
Total for the State	26 (119)	28 (82)	32 (90)	48 (50)	64 (53)	183 (36)	118 (30)	27 (62)	41 (7)	82 (34)	69 (128)	23 (108)	741 (799)
Average	2 (8)	2 (6)	2 (6)	3 (4)	5 (4)	13 (3)	8 (2)	2 (4)	3 (1)	6 (2)	5 (9)	2 (8)	53 (57)

Note : Figures inside the brackets are the number of cold wave days.



Figs. 1 (a & b). Average number of days of different types of (a) heat waves and (b) cold waves in Karnataka

and Maidan regions are shown in Figs. 1(a & b) and marked suitably with the State average number of days, line demarcating each category.

3. Results and discussions

3.1. *Heat waves*

The occurrence of heat waves over the State are from westerly blowing winds especially during the prolonged monsoon break periods and the frequency of severity increases towards eastern side of the State due to the persisting predominent heat high over the Deccan plateau. The severest heat wave on record for the past two decades is on 14 June 1980 in which Mercara observatory has recorded a departure of 13°C. Bellary district has experienced the highest number of 109 heat waves days while Belgaum district has recorded the highest number of 21 severe heat wave days as shown in Table 1. Mysore district has experienced the lowest number of 21 heat wave days while Karwar has the lowest number of two severe heat wave days. The heat waves have the tendency to persist longer in the month of June over the State and their normal highest duration period on record is from 6 to 7 days. The narrow belt between Maidan and Malnad regions named as Semi-Malnad area has experienced the highest duration of moderate heat waves as shown in Fig. 1(a).

A perusal of Table 2 reveals that on an average the highest number of 13 heat wave days in the State have occurred during the month of June followed by 8 days in July. The lowest number of 2 heat wave days in the State have come across during the winter season. The northern and southern Maidan regions are occupied by the highest number of severe heat waves (Fig. 1a). Large part of the State is covered by heat waves at the time of onset of the southwest monsoon over the State and when once the onset has spread over the entire State, little parts of the State are associated with heat waves as envisaged from Fig. 1(a).

The highest number of 95 moderate heat wave days have occurred in Bellary district while the highest number of 21 severe heat waves days occurred in Belgaum district. Generally the number of heat waves over the State are much less on western longitude of 74°E and northern latitude of 15°N. The heat waves over the State have a cyclic periodicity of occurrence along with the droughts and the prominent characteristic features of the south-west monsoon like onset, persistence, break and with-drawal (Krishna Rao 1984).

3.2. *Cold waves*

The cold waves over the State are associated with the western disturbances occurring during the winter season from November to March. [The coastal plains and Western Ghat regions experienced the highest number of severe cold waves (Fig. 1b)]. The intensity of occurrence of cold waves are freakish on eastern longitudes and southern latitudes of the State compared to the north-western part as shown in Fig. 1(b). The cold waves over the State are formed mainly due to the extension of the cold waves from north and central India during the winter season. The severest cold wave in the State on record for the past two decades, has occurred on 22 March 1967 in Bijapur with the recorded departure of 12°C. The highest number of 129 days of moderate and 40 days of severe cold waves have occurred in Coorg district. Table 2 shows that the highest number of 128 cold waves days over the State have been experienced in the month of November followed by January during the winter season. The lowest number of 7 cold waves days over the State have occurred in the month of September followed by July.

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