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Inconsistencies in the mean fields of temperature, geopotential height and winds over the Indian aerological network during July-August

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सार – सतह से निम्न समतापमण्डल के 25 स्तरों के लिए 1978, 1979 और 1980 के जुलाई और अगस्त के चरम मानसून माहों के लिए 23 रेडियो सोन्दे/रेडियो विंड स्टेशनों के दैनिक वायु विज्ञानीय आंकड़ों का विश्लेषण किया गया है। तापमान के दैनिक मानों के मानक विचलन निम्न क्षोभमन्डल में लगभग 1.5° से 2° से० पाई जाती है जो ऊपरी स्तरों मे इस मान में दोगुनी वृद्धि होती है। निम्न क्षोभमण्डल में आइसोबरिक स्तर की रेंज की भूविभव उच्चता का मानक विचलन 15 से 30 जी. पी. एम. होता है और ऊपरी स्तरों पर इस मान से लगभग चार गुना बढ़ जाता है। तापमान के माध्य क्षेत्रों में क्षैतिज प्रवणता और संजाल में युग्म स्टेशनों के मध्य भूविभव उच्चता काफी असंगतियां दर्शाती हैं जिसे कि उदाहरणों द्वारा समझाया गया है। अनेक वर्षों से माध्य क्षेत्रों में ऐसी असंगतियों की उपस्थिति भी 1989 तक के स्टेशनों के जलवायु ताप आंकड़ों के परीक्षण से पता लगाया गया है। ये खोजें सिनाप्टिक और जलवायु विज्ञानीय अध्ययनों में आंकड़ों के प्रयोग को सीमित करती हैं।

ABSTRACT. The daily aerological data of 23 RS/RW stations for the peak monsoon months of July and August 1978, 1979 and 1980 for 25 levels from the surface to the lower stratosphere have been analysed. The standard deviations of the daily values of temperature are found to be about 1.5 to 2° C in the lower troposphere increasing to about twice this value at upper levels. The standard deviations of geopotential heights of isobaric levels range from 15 to 30 gpm in the lower troposphere increasing to about 4 times this value at upper levels. The horizontal gradients in the mean fields of temperature and geopotential height between pairs of stations in the network show several inconsistencies which are illustrated with examples. The existence of such inconsistencies in the mean fields for several years has also been found from an examination of CLIMAT-TEMP data of the stations up to 1989. These findings impose limitations on the utilisation of the data in synoptic and climatological studies.

Key words — Indian aerological network, Data inconsistencies, Horizontal gradient.

1. Introduction

Numerous studies have been addressed to the understanding of various features of the southwest monsoon and the space-time variations of the rainfall associated with it. The atmospheric circulation during the monsoon months is closely interlinked with the thermodynamic structure of the atmosphere. July and August which together account for a little over 60% of the summer monsoon rainfall are regarded as constituting the established phase of the monsoon. Spells of good rainfall alternate with epochs of little or no rain over different parts of the country during these months, and the present study was undertaken to gain insight into the associated variations in the thermodynamic features of the atmosphere.

For the purpose of the study we have made use of the daily 00 UTC aerological data of 23 RS/RW station from the Indian aerological network shown in Fig. 1, for the months of July and August for the years 1978, 1979 and 1980. The data utilised were kindly made available by the National Data Centre of the India Meteorological Department (IMD). These consist of the values of dry bulb temperature (T), dew point temperature (T_d), geopotential height (Z) and vector winds for 25 levels from the surface to 60 hPa.

As a first step in the study we evaluated the mean values of T, T_d, Z, the zonal wind (u) and the meridional wind (v) for all levels for each of the stations. Various other computations were also carried out. Examination of the fields of the mean values of T, Z and u unexpectedly revealed certain major inconsistencies in the aerological network which appeared sufficiently important to merit a detailed examination. The present paper is addressed to highlight these inconsistencies and their impact in the utilisation of the aerological data for scientific studies.

2. Analysis of the data

Ideally our data set consists of 186 soundings for each of the stations. In the actual data set this number varied from about 150 to 180 at the 850 hPa level diminishing to 30 to 100 at the 60 hPa level for the different stations. The acutal statistics for six levels are presented in Table 1 with the names and co-ordinates of the stations arranged in the order of decreasing latitude.

As a first step, the data were subjected to preliminary screening in which daily soundings for which the value of T or Z at any level differed from the respective mean

TABLE 1

Coordinates of aerological stations and statistics for the soundings

Station	Location			Sounding reaching level (hPa)					
	Lat. (°N)	Long. (°E)	H (m)	850	500	300	200	100	60
Srinagar (SRN)	34° 05′	74° 50′	1587	—	153	146	143	74	33
Patiala (PTL)	30 20	76 28	250	161	155	145	131	59	34
New Delhi (DLH)	28 35	77 12	216	185	182	180	173	148	113
Dibrugarh (DBH)	27 29	95 01	111	132	125	116	107	75	43
Lucknow (LKN)	26 45	80 53	128	178	175	167	161	112	84
Jodhpur (JDP)	26 18	73 01	224	171	160	153	144	108	76
Gwalior (GWL)	26 14	78 15	207	113	103	98	92	42	32
Gauhati (GHT)	26 06	91 35	54	140	138	134	130	106	65
Agartala (AGT)	23 53	91 15	15	102	97	86	79	59	41
Ranchi (RNC)	23 45	85 23	606	158	146	126	111	57	30
Ahmedabad (AHM)	23 04	72 32	55	174	164	153	142	107	80
Calcutta (CAL)	22 39	88 27	6	159	155	150	147	125	79
Nagpur (NGP)	21 06	79 03	310	182	178	168	159	116	79
Bhubaneswar (BWN)	20 15	85 50	46	181	168	156	151	88	31
Bombay (BMB)	19 07	72 51	14	176	170	165	156	131	93
Visakhapatnam (VSK)	17 43	83 14	3	171	161	150	148	85	50
Hyderabad (HYD)	17 27	78 28	545	183	176	170	168	145	105
Panjim (PNJ)	15 29	73 49	55	151	137	128	118	60	36
Madras (MDS)	13 00	80 11	16	178	171	154	143	64	26
Mangalore (MNG)	12 55	74 53	102	169	159	151	143	107	55
Port Blair (PBL)	11 40	92 43	79	171	163	153	138	44	18
Trivandrum (TRV)	8 29	76 57	64	181	174	171	165	149	112
Minicoy (MNC)	8 18	73 00	2	135	119	111	105	55	35

TABLE 2

Mean temperature ($\bar{T}$) (°C) at 12 isobaric levels (hPa)

Station	900	800	700	600	500	400	300	250	200	150	100	70
SRN	—	18.7	12.5	4.4	—4.2	—13.9	—26.5	—35.2	—46.5	—61.1	—75.4	—74.1
PTL	25.7	19.5	12.4	5.1	—2.5	—12.3	—25.6	—35.1	—47.1	—61.7	—75.9	—71.2
DLH	24.3	18.1	11.4	4.4	—3.4	—13.2	—27.6	—37.8	—50.6	—66.3	—79.8	—73.7
DBH	23.3	17.9	11.8	4.9	—3.0	—12.4	—26.1	—35.9	—48.5	—63.9	—77.2	—71.0
LKN	23.3	17.5	11.1	4.5	—3.7	—13.8	—28.7	—39.1	—52.3	—68.5	—81.4	—74.3
JDP	22.4	17.9	11.9	3.3	—4.5	—14.1	—28.8	—39.1	—51.9	—67.1	—79.8	—75.0
GWL	24.2	18.4	12.1	5.4	—2.2	—11.8	—25.2	—34.6	—47.6	—63.2	—75.9	—69.1
GHT	22.9	17.5	11.0	3.9	—4.2	—14.2	—28.9	—39.3	—52.3	—67.7	—79.9	—72.4
AGT	22.8	17.7	12.0	5.5	—2.0	—10.8	—24.6	—34.5	—47.3	—64.0	—78.1	—70.7
RNC	22.5	17.4	11.5	4.6	—3.5	—13.3	—27.5	—37.5	—50.2	—66.5	—79.8	—70.6
AHM	21.5	16.9	12.7	5.2	—2.5	—11.8	—25.6	—35.4	—47.9	—63.8	—77.6	—70.9
CAL	22.9	17.3	11.1	4.1	—4.0	—14.2	—29.1	—39.2	—52.2	—68.0	—81.1	—72.6
NGP	21.9	16.3	10.2	3.4	—4.2	—14.4	—29.4	—39.6	—52.4	—68.3	—81.6	—73.3
BWN	22.9	17.6	11.7	5.2	—2.6	—12.3	—26.1	—35.7	—48.1	—63.6	—78.0	—68.5
BMB	20.4	14.3	9.8	2.5	—5.1	—15.2	—30.3	—40.6	—53.4	—68.9	—81.9	—73.4
VSK	23.2	17.1	10.7	3.8	—3.7	—13.6	—27.9	—37.9	—50.8	—66.5	—80.8	—69.8
HYD	20.6	15.6	10.1	3.2	—4.6	—14.3	—28.7	—38.8	—51.1	—66.5	—78.0	—68.0
PNJ	21.0	15.3	9.9	3.3	—4.1	—14.1	—28.5	—38.4	—50.4	—64.8	—75.4	—65.1
MDS	22.7	16.8	10.1	3.0	—5.0	—14.9	—29.0	—38.8	—51.4	—66.9	—79.7	—70.5
MNG	19.4	13.8	8.5	1.9	—5.7	—15.7	—30.5	—40.9	—53.6	—68.8	—80.0	—69.8
PBL	20.5	15.0	8.8	1.6	—6.4	—16.4	—31.4	—41.6	—54.7	—70.9	—81.4	—69.8
TRV	19.8	14.5	8.6	1.8	—6.2	—16.6	—31.7	—41.7	—53.7	—68.5	—77.2	—67.9
MNC	21.1	15.1	9.0	1.8	—5.9	—16.2	—31.4	—41.8	—54.9	—69.0	—76.7	—69.1

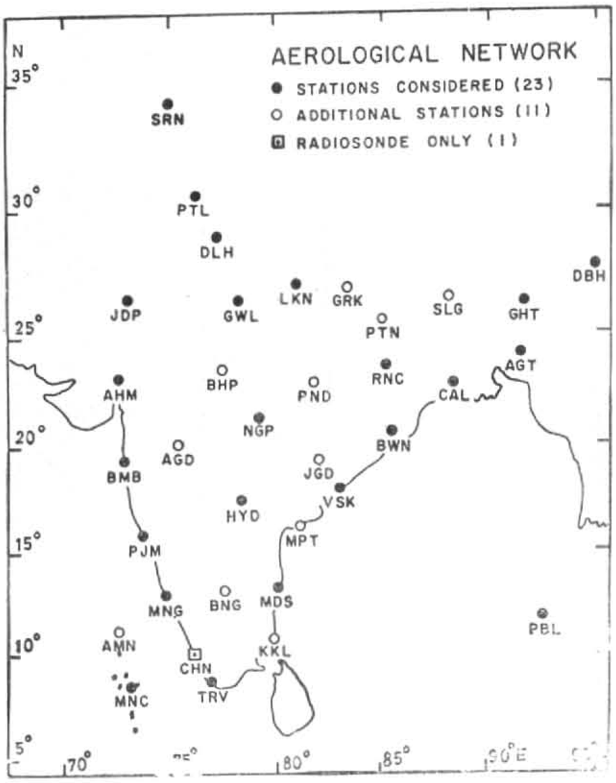

Fig. 1. Network of aerological station

values by more than three times the standard deviation were discarded. About 1 to 2% of the data were thus removed and the remaining data form the basis for further studies. Utilising these data, the mean and standard deviations of T and Z were worked out afresh for each of the stations for all the 25 levels. We shall denote the means by $\bar{T}$ and $\bar{Z}$ the standard deviations by $\sigma(T)$ and $\sigma(Z)$.

The values of $\sigma(T)$ were found to be of the order of 1.5° to 2.0° C below 500 hPa increasing to about twice this value at the higher levels. The corresponding values of $\sigma(Z)$ were of the order of 15 to 30 gpm in the lower troposphere increasing to 60 to 120 gpm aloft. While this is the general pattern there are some differences between individual stations. The actual values of these parameters for the different levels and stations which are available are not presented; the departures from the mean of the daily values of T and Z were roughly Gaussian distributed for all stations and levels.

3. Field of mean temperature ($\bar{T}$)

The mean values of temperature (°C) for 12 isobaric levels from 900 to 70 hPa for the 23 stations are shown in Table 2. Scrutiny of the table shows a number of inconsistencies in the thermal field particularly at the higher levels. In the eastern sector Gauhati and Calcutta are found to have nearly the same temperature at all levels. These are 2° to 4° C lower than those of both Bhubaneswar and Dibrugarh which have nearly the same temperature at almost all the levels. Agartala temperatures are found to be higher than that of all other stations over the eastern region. In the western region Ahmedabad is warmer than Bombay to its south and Jodhpur to its north. This discrepancy was noticed and pointed out by us in an earlier study (Ananthakrishnan and Soman 1989 a,b). Incosistencies between the temperature data of the stations Patiala-Delhi-Gwalior-Lucknow can also be seen from the Table, Gwalior being warmer than both Delhi and Luchnow. Nagpur being cooler than Hyderabad to its south is also not consistent. Along the west coast the conspicuous discrepancy is the lower temperatures at Bombay compared with Goa to its south. In our earlier study relating to the Bombay-Ahmedabad-Jodhpur sector we had assumed that the aerological data of Bombay and Jodhpur are free from errors and came to the conclusion that the fault lay entirely with Ahmedabad. This conclusion needs revision in the light of the present more extensive study covering several stations in the network.

4. Field of mean geopotential height ($\bar{Z}$)

Table 3 gives the mean geopotential heights in gpm and Tables 4,5 give the mean values of the zonal winds $(\bar{u})$ and meridional wind $(\bar{v})$ both in ms^{-1} for the same levels and stations as in Table 2. Since the geopotentials of isobaric levels are derived through the hydrostatic equation utilising the vertical temperature distribution, the inconsistencies in the thermal field are also reflected in the geopotential field. These inconsistencies lead to a situation in which the geostrophic wind corresponding to the zonal pressure gradient between pairs of stations with latitudinal separation and the actual mean zonal wind between the stations are found to be in opposite directions at upper tropospheric levels (violation of Buys Ballots Law). Since we are dealing with averaged data for six monsoon months for each of the stations all of which are north of 8° N we should expect a reasonable degree of agreement between the geostrophic and actual zonal winds. The lack of such agreement is a serious inconsistency in the aerological network.

To illustrate such inconsistencies in the network, the mean geopotential height differences ($\triangle Z$ in gpm) between certain pairs of stations are shown in Table 6. A comparison of the values in this table with the zonal winds at the respective stations highlights the inconsistencies notice, over the different parts of the network. Without giving detailed comments attention may be drawn to one or two points. Notice that the $\triangle Z$ values between Bombay and Panjim (Goa) show westerly winds increasing with height and attaining very high values in the upper troposphere where strong easterlies prevail. Similar inconsistencies exist between Nagpur-Hyderabad, Delhi-Gwalior, Jodhpur-Ahmedabad, Calcutta-Bhubaneswar, Gauhati-Agartala, etc. The large negative values of $\triangle Z$ for (LKN-GWL) would imply strong northerly winds in this sector where the meridional winds are weak and zonal winds strong. All these are examples of violation of Buys Ballots Law over the aerological network.

5. Examination of CLIMAT-TEMP data

We have examined the CLIMAT-TEMP data of Indian stations for the months of July and August for all the years from 1978 to 1989. These publications

TABLE 3

Mean geopotential height ($\overline{Z}$) at 12 isobaric levels (gpm)

Station	900	800	700	600	500	400	300	250*	200*	150*	100*	70*
SRN	—	1949	3081	4354	5814	7541	9680	973	2493	4347	6767	8827
PTL	915	1943	3078	4354	5824	7567	9716	1018	2538	4386	6794	8873
DLH	914	1939	3072	4347	5812	7548	9681	969	2468	4278	6637	8680
DBH	950	1971	3104	4379	5847	7588	9731	1028	2539	4366	6765	8831
LKN	913	1930	3058	4330	5793	7525	9652	929	2419	4212	6541	8562
JDP	913	1928	3061	4332	5787	7517	9643	924	2414	4216	6573	8608
GWL	921	1944	3076	4352	5821	7570	9722	1022	2547	4390	6800	8901
GHT	942	1963	3094	4366	5827	7556	9681	969	2448	4245	6592	8644
AGT	942	1960	3091	4369	5841	7588	9747	1058	2572	4403	6785	8852
RNC	947	1965	3095	4370	5836	7567	9701	990	2486	4308	6668	8764
AHM	932	1944	3075	4351	5816	7560	9709	1017	2528	4360	6734	8801
CAL	932	1952	3083	4356	5818	7548	9675	954	2443	4235	6580	8626
NGP	936	1950	3075	4343	5803	7533	9647	931	2416	4213	6550	8603
BWN	926	1945	3074	4349	5819	7558	9704	1003	2508	4344	6720	8771
BMB	953	1960	3078	4342	5797	7519	9635	906	2385	4172	6505	8534
VSK	943	1964	3093	4363	5824	7559	9693	976	2475	4273	6623	8678
HYD	959	1969	3090	4355	5813	7540	9666	945	2440	4248	6616	8701
PNJ	976	1986	3107	4374	5832	7563	9691	975	2476	4298	6684	8821
MDS	970	1984	3107	4370	5825	7551	9676	955	2447	4243	6597	8677
MNG	991	1999	3117	4380	5833	7557	9671	939	2417	4201	6532	8587
PBL	983	1993	3114	4374	5823	7539	9644	905	2377	4134	6452	8507
TRV	996	2005	3124	4383	5835	7553	9659	924	2402	4188	6550	8648
MNC	1003	2014	3133	4393	5846	7565	9673	941	2406	4181	6539	8623

(* For levels above 300 hPa add 10,000 to the values in Table).

TABLE 4

Mean zonal winds ($\overline{u}$) at 12 isobaric levels (ms^{-1})

Station	900	800	700	600	500	400	300	250	200	150	100	70
SRN	—	—.2	.6	.1	1.0	6.1	10.5	12.1	13.2	10.9	.5	—8.6
PTL	—1.5	—.1	—.1	—.2	.1	2.1	4.6	5.4	4.8	3.5	—5.8	—12.2
DLH	1.3	—.1	—1.0	—1.1	—1.3	—1.0	—.6	—.7	—1.3	—2.6	—9.1	—14.8
DBH	.4	1.4	1.4	1.5	1.0	.4	—1.2	—2.1	—2.4	—4.1	—10.1	—17.0
LKN	—2.7	—2.6	—2.4	—2.2	—3.1	—3.7	—5.1	—5.9	—6.6	—7.3	—13.4	—17.7
JDP	6.8	.6	—1.6	—2.3	—2.3	—2.9	—3.8	—4.5	—6.4	—9.8	—16.0	—19.0
GWL	3.7	.6	—.6	—1.0	—1.5	—3.0	—3.4	—3.9	—6.0	—8.9	—12.0	—14.9
GHT	.3	.6	.0	—.1	—1.1	—2.0	—3.6	—4.8	—6.0	—8.0	—13.9	—17.7
AGT	.3	—.1	—.3	—.8	—1.5	—3.7	—6.8	—7.9	—9.0	—11.3	—14.2	—15.5
RNC	2.1	.5	—.2	—.8	—2.9	—4.6	—8.2	—10.2	—12.8	—15.3	—20.6	—20.8
AHM	7.7	4.8	1.7	—.9	—2.7	—4.4	—7.5	—9.9	—12.4	—16.0	—20.0	—19.2
CAL	.7	.0	—.4	—1.4	—2.9	—5.4	—9.0	—12.4	—14.9	—18.3	—22.3	—22.0
NGP	8.4	6.4	3.6	1.8	—1.4	—4.2	—8.0	—10.9	—15.5	—21.3	—24.8	—19.1
BWN	5.5	4.2	3.4	1.7	—1.2	—4.8	—10.4	—12.8	—16.9	—22.0	—27.2	—23.4
BMB	9.2	7.7	6.4	3.9	.8	—3.1	—8.4	—12.3	—19.1	—26.6	—29.1	—22.0
VSK	8.0	8.2	6.8	4.4	.7	—3.7	—10.6	—14.8	—20.4	—26.5	—30.5	—21.5
HYD	10.9	11.9	8.6	5.5	2.9	—1.9	—8.9	—14.0	—20.8	—28.6	—33.0	—22.5
PNJ	10.4	10.5	8.8	6.1	2.5	—1.9	—8.9	—13.9	—24.1	—33.6	—31.7	—19.1
MDS	11.6	10.0	8.2	7.7	5.9	1.7	—4.5	—10.0	—18.2	—27.6	—31.9	—22.3
MNG	10.6	10.5	9.4	6.7	3.7	—.6	—6.2	—10.7	—18.8	—31.4	—35.8	—22.1
PBL	11.1	9.3	8.0	5.1	3.2	—1.1	—8.6	—13.0	—18.5	—25.0	—28.9	—17.6
TRV	12.2	12.8	10.9	6.4	3.0	—1.9	—8.7	—14.3	—22.6	—33.2	—25.6	—15.0
MNC	11.2	10.3	8.5	5.8	4.2	—1.1	—9.5	—14.4	—22.7	—35.0	—21.8	—13.3

TABLE 5

Mean meridional winds ($\bar{v}$) at 12 isobaric levels (ms—1)

Station	900	800	700	600	500	400	300	250	200	150	100	70
SRN	—	—.7	—.7	—.2	—.1	.3	—.8	—1.1	—1.3	—2.3	—5.3	—1.5
PTL	2.3	.2	—1.3	—.6	.9	1.2	1.4	1.8	1.3	—1.5	—5.3	—2.6
DLH	.5	—1.2	—1.6	—.9	.5	.5	1.0	1.0	.2	—1.6	—4.5	—2.1
DBH	1.3	1.7	1.9	2.3	1.0	.3	—1.2	—1.7	—1.4	—3.9	—5.1	—3.3
LKN	.8	.2	.4	.8	.7	.9	.5	.4	—.5	—2.0	—4.7	—2.3
JDP	3.7	.2	—2.5	—3.5	—1.3	—.3	—.1	.2	.2	—1.0	—3.6	—2.9
GWL	—1.9	—2.5	—2.7	—1.2	—.6	—.7	.1	.1	.3	.1	—1.9	—1.6
GHT	.9	1.8	2.0	2.3	1.9	1.0	.3	—.9	—2.3	—3.1	—4.1	—2.4
AGT	4.3	3.3	2.7	2.7	2.8	3.0	2.3	.6	—.5	—2.9	—1.3	—1.7
RNC	—.1	—.5	.3	1.0	1.4	1.3	.7	—.1	—2.1	—4.3	—2.4	—2.5
AHM	1.5	.5	—1.6	—3.1	—3.0	—.8	—.8	—1.1	—.8	— .3	—1.9	—1.9
CAL	2.8	2.3	2.4	2.7	2.3	1.8	.5	—.7	—3.2	—5.7	—4.9	—3.1
NGP	—2.0	—2.4	—1.2	—.9	—1.0	—.5	—.8	—1.1	—3.2	—4.9	—3.4	—4.6
BWN	—.7	—1.3	—.5	.8	1.1	1.3	1.2	.3	—1.5	—4.0	—3.9	—1.5
BMB	3.0	3.3	—.1	—2.2	—2.2	—1.4	—1.7	—2.1	—2.8	—5.0	—3.0	—4.2
VSK	.7	—1.5	— 1.5	—1.1	—.2	.0	1.0	—.4	—2.3	—4.4	—2.3	—1.4
HYD	—1.1	—3.4	—2.1	—1.7	—.7	—.8	—1.1	—1.0	—2.6	—5.2	—1.5	—1.5
PJN	—1.4	—.6	—.9	—1.2	—1.0—	.8	—.4	—.1	— .8	—1.5	—.5	—3.1
MDS	—2.4	—3.3	—1.6	—.8	.1	.4	.2	—.1	—1.7	—2.8	—3.0	1.0
MNG*	—4.2	—4.0	—3.2	—2.3	—.7	.2	.7	2.1	2.6	2.8	6.3	3.4
PBL	2.7	1.5	.4	.3	1.0	1.3	—.4	—1.7	—3.2	—1.9	1.3	.4
TRV	—5.6	—3.9	—1.4	.1	.0	—.6	—.7	—1.3	—4.8	—9.2	—4.6	—2.1
MNC	—3.6	—4.1	—2.4	—.8	—.6	.7	.8	1.2	—.6	—.1	2.2	1.1

*(For explanation of the positive values of $\bar{v}$ in the upper troposphere vide Ref. 1).

TABLE 6

Mean geopotential height difference ($\triangle Z$) between selected station pairs (in gpm)

Stations pair	900	800	700	600	500	400	300	250	200	150	100	70
(A) DBH–GHT	8	8	10	13	20	32	50	59	91	121	173	187
DBH–AGT	8	11	13	10	6	0	—16	—30	—33	—37	—20	—21
DBH–CAL	18	19	21	23	29	40	56	74	96	131	185	205
GHT–AGT	0	3	3	—3	—14	—32	— 66	—89	—124	—158	—193	208
GHT–CAL	10	11	11	10	9	8	6	15	5	10	12	18
AGT–CAL	10	8	8	13	23	40	72	104	129	168	205	226
CAL–BWN	6	7	9	7	—1	—10	—29	—49	—65	—109	—140	—145
(B) JDP–AHM	—19	—16	—14	—19	—29	—43	—66	—93	—114	—144	—161	—193
AHM–BMB	—21	—16	—3	9	19	41	74	111	143	188	229	267
(C) PTL–DLH	1	4	6	7	12	19	35	49	70	108	157	193
DLH–GWL	—7	—5	—4	—5	—9	—22	—41	—53	—79	—112	—163	—221
LKN–GWL	—8	—14	—18	—22	—28	—45	—70	—93	—128	—178	—259	—339
(D) GWL–NGP	—15	—6	1	9	18	37	75	91	131	177	250	298
NGP–HYD	—23	—19	—15	—12	—10	—7	—19	—14	—24	—35	—66	—98
(E) BMB–PNJ	—23	—26	—29	—32	—35	—44	—56	—69	—91	—126	—179	—287
BMB–MNG	—38	—39	—39	—38	—36	—38	—36	—33	—32	—29	—27	—53
BMB–TRV	—43	—45	—46	—41	—38	—34	—24	—18	—17	—16	—45	—114
PNJ–MNG	—15	—13	—10	—6	—1	6	20	36	59	97	152	234

(In each station pair the second station has a lower latitude than the first. Hence the geostrophic wind is westerly for negative values of $\triangle Z$ and easterly for positive values) do not contain the date of five stations covered by our study. These are Patiala, Gwalior, Ranchi, Dibrugarh and Agartala. Our examination shows that the type of inconsistencies noticed by us have persisted in the network, apparently unnoticed, at least from 1978. We have also found an additional inconsistency between Cochin and Trivandrum similar to that between Bombay and Goa. Details of this study are not presented, but are available with us.

6. Discussion and conclusions

The study presented in this paper relates to only 23 out of the 35 stations in the aerological network. The standard deviations of the daily values of T and Z appear to be too large compared with the probable day to day variations of these parameters in the monsoon field at individual stations. This aspect taken in conjunction with the lack of compatibility in the mean data of geopotential heights and winds impose serious limitations on the utilisation of the daily aerological data from the network in synoptic studies. These aspects have to be kept in mind also in climatological studies using the monthly mean temperatures and geopotential heights of the stations in the network.

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