THE INTERDIURNAL VARIABILITY OF SURFACE-AIR TEMPERATURE OVER THE NORTH ATLANTIC OCEAN

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(Original manuscript received 30 March 1959; revised manuscript received 16 June 1959)

ABSTRACT

This paper gives the results of an investigation of the interdiurnal variability of surface-air temperature at 9 of the North Atlantic Ocean Vessel Stations. Computations were performed for each month of the year over a four-year study period. Several aspects of the computational results are discussed in relation to the analogous statistics at land stations.

1. Introduction

One of the most important characteristics of a climate is the interdiurnal variability of temperature [1, p. 51; 4, p. 115]. In this paper, the interdiurnal variability of surface-air temperature at nine of the North Atlantic Ocean Vessel Stations (hereafter called OVS) is analyzed. The stations and their positions are indicated by fig. 1. The period of study for the investigation comprises the years 1951 through 1954 for the months January through June and the years 1950 through 1953 for the months July through December.

To avoid confusion, two terms will be defined at this point. The magnitude of the difference between two consecutive mean daily temperatures will be called the "interdiurnal variability of temperature" and will be abbreviated to IDV. When the IDV are averaged over the entire study period for a particular month, the resulting quantity will be called the "mean interdiurnal variability of temperature" and will be abbreviated to MIDV.

The mean daily temperatures used in these computations are simple arithmetic means of the eight 3-hourly temperatures reported for each day (Zone Time). In cases where one or more of the observations were either missing or "off station," the mean daily temperature was computed as the average of the remaining observations, provided that there were at least 4 "on station" observations. Days with less than 4 "on station" observations are not considered. Table 1 gives the number of IDV computed for each month at each OVS.

2. Mean interdiurnal variability of temperature

Tables 2 through 10 give frequency distributions of IDV for each month at each OVS. Table 11 gives the MIDV computed from these distributions. Some general comments on the MIDV and their annual variations are given in this section.

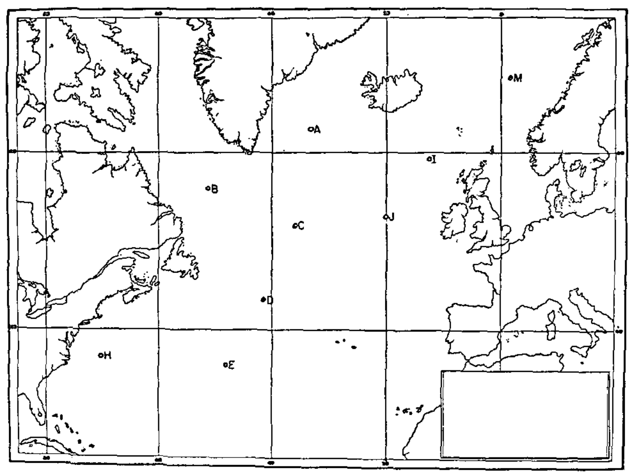

FIG. 1. Positions of North Atlantic ocean vessel stations.

As was to be expected from the literature [4], table 11 shows MIDV to be largest in the cold season (when advective temperature changes are most frequent and most intense) and smallest in the warm season (when advective temperature changes are least frequent and least intense). MIDV is greatest in January at all stations with the exception of E, where it is largest in February. Smallest MIDV are found in June, July and/or August, depending on the particular OVS. However, at most stations, the differences in MIDV between any two of these three months are only 0.1F or 0.2F.

At land stations, it has been found that winter MIDV are approximately twice as large as summer MIDV [4]. Table 12, which contains ratios of the maximum MIDV to the minimum MIDV, has been prepared for the purpose of determining whether or not this is also true over the oceans. The table indicates that at 6 of the OVS (A, C, D, E, I, and J) the

[1] The research reported in this article was sponsored by the U. S. Weather Bureau under Contract No. Cwb-9272.

TABLE 1. Number of IDV computed for each month at each OVS.

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
A	87	92	99	79	87	73	89	81	85	94	73	93
B	112	108	120	110	120	116	116	120	112	120	114	117
C	113	109	112	115	115	116	120	115	110	118	101	112
D	105	102	109	114	119	111	116	119	105	115	116	120
E	113	107	115	116	114	116	120	114	111	94	105	118
H	117	106	118	112	120	116	114	116	111	114	116	116
I	87	95	108	114	109	116	104	97	97	107	101	95
J	119	109	115	110	94	103	104	103	96	95	96	111
M	118	106	120	110	120	112	118	120	114	120	116	119

TABLE 2. Percentage frequency of the various values of IDV (F) at station A.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	11.5	12.0	21.2	21.5	29.9	31.5	33.7	35.8	22.4	23.4	24.7	21.5
0.5– 1.5	27.5	30.4	19.2	25.3	36.7	50.7	40.5	48.2	55.3	29.8	35.6	24.7
1.5– 2.5	19.5	20.7	21.2	17.8	24.1	15.0	19.1	13.6	15.3	18.1	23.2	23.7
2.5– 3.5	14.9	13.0	14.2	11.4	02.2	02.7	05.6	01.2	05.9	12.8	06.9	10.8
3.5– 4.5	06.8	05.4	11.2	14.0	02.2	00.0	01.1	00.0	00.0	08.5	04.1	08.6
4.5– 5.5	05.6	08.6	07.0	05.1	02.2		00.0	00.0	01.1	04.2	02.7	04.3
5.5– 6.5	06.8	04.4	04.0	03.8	01.1			00.0	00.0	01.1	00.0	04.3
6.5– 7.5	04.6	02.2	01.0	01.3	00.0			00.0		01.1	02.7	01.1
7.5– 8.5	00.0	01.1	01.0	00.0	01.1			01.2		01.0	00.0	01.1
8.5– 9.5	01.1	01.1	00.0		00.0			00.0		00.0		00.0
9.5–10.5	02.2	00.0										
10.5–11.5	00.0											

TABLE 3. Percentage frequency of the various values of IDV (F) at station B.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	06.3	16.5	21.7	25.5	28.3	38.8	27.6	36.7	20.5	20.8	16.7	14.5
0.5– 1.5	23.2	14.7	27.5	35.5	48.3	34.4	54.3	39.1	36.6	28.3	30.7	21.4
1.5– 2.5	16.9	11.0	22.5	13.7	17.5	13.8	12.1	20.8	20.5	27.5	22.8	21.3
2.5– 3.5	11.7	18.4	12.5	10.0	05.0	11.2	05.1	02.5	12.5	10.8	15.8	12.8
3.5– 4.5	12.6	11.0	07.5	06.3	00.8	01.8	00.9	00.8	07.2	07.5	03.5	10.3
4.5– 5.5	05.4	07.4	03.4	07.2	00.0	00.0	00.0	00.0	00.9	01.7	04.4	11.1
5.5– 6.5	09.0	07.4	02.5	00.9					01.8	02.5	03.6	02.6
6.5– 7.5	03.6	02.7	00.0	00.9					00.0	00.8	00.9	03.4
7.5– 8.5	02.7	02.7	01.7	00.0						00.0	00.9	01.7
8.5– 9.5	01.8	03.6	00.8								00.0	00.0
9.5–10.5	02.7	00.0	00.0								00.9	00.0
10.5–11.5	01.8	00.9									00.0	00.0
11.5–12.5	00.9	00.0										00.9
12.5–13.5	00.9	00.9										00.0
13.5–14.5	00.0	01.8										
14.5–15.5	00.9	00.0										
15.5–16.5	00.0	00.0										
16.5–17.5		00.0										
17.5–18.5		00.9										
18.5–19.5		00.0										

TABLE 4. Percentage frequency of the various values of IDV (F) at station C.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	08.8	06.4	21.4	21.8	27.0	23.3	30.8	28.7	22.7	15.3	15.8	12.5
0.5– 1.5	20.4	26.6	31.3	32.8	34.8	46.5	45.9	43.5	30.9	23.8	32.7	30.4
1.5– 2.5	17.7	21.1	20.5	17.6	26.9	20.7	15.8	21.8	28.2	19.5	17.8	23.2
2.5– 3.5	15.1	21.1	13.4	10.1	04.4	07.8	05.0	05.2	14.6	22.9	14.9	09.0
3.5– 4.5	11.5	08.2	04.5	06.7	05.2	01.8	00.8	00.0	02.7	12.7	08.9	09.9
4.5– 5.5	05.3	06.5	04.5	07.6	01.7	00.0	00.0	00.9	00.9	05.1	05.0	02.7
5.5– 6.5	05.3	04.6	03.6	01.7	00.0		01.6	00.0	00.0	00.8	01.0	05.4
6.5– 7.5	07.1	03.6	00.0	00.0			00.0			00.0	01.0	02.7
7.5– 8.5	02.7	01.8	00.9	01.7							02.0	04.5
8.5– 9.5	04.5	00.0	00.0	00.0							00.0	00.0
9.5–10.5	00.0										01.0	
10.5–11.5	00.9										00.0	
11.5–12.5	00.0											
12.5–13.5	00.0											
13.5–14.5	00.9											
14.5–15.5	00.0											

TABLE 5. Percentage frequency of the various values of IDV (F) at station D.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	08.8	10.8	09.2	13.2	22.7	20.7	25.0	19.3	14.3	09.6	08.6	07.5
0.5– 1.5	14.2	16.7	34.0	21.9	27.7	36.9	30.2	33.8	26.6	11.3	25.9	19.2
1.5– 2.5	09.7	09.8	12.8	12.3	16.8	20.7	22.4	24.3	20.0	18.3	14.6	17.5
2.5– 3.5	08.0	14.7	09.2	19.3	13.4	10.8	12.1	10.1	10.5	13.1	14.6	06.7
3.5– 4.5	10.6	08.9	11.9	10.5	08.3	05.4	05.2	03.4	14.3	13.0	08.6	07.5
4.5– 5.5	09.7	07.9	08.3	07.0	04.2	03.6	04.3	07.6	05.8	10.4	07.7	10.9
5.5– 6.5	04.5	06.8	02.8	03.5	04.2	00.9	00.9	00.8	02.9	06.1	07.7	06.6
6.5– 7.5	09.7	06.8	05.6	06.1	01.7	00.0	00.0	00.8	01.0	08.6	02.6	08.3
7.5– 8.5	06.2	04.0	02.7	00.9	00.8	00.9		00.0	03.8	06.1	03.5	02.5
8.5– 9.5	05.3	04.9	00.9	02.7	00.0	00.0			01.0	00.9	01.8	03.4
9.5–10.5	04.4	02.0	00.9	00.0					00.0	01.8	02.6	03.4
10.5–11.5	02.7	00.0	00.0	00.9						00.9	01.7	02.5
11.5–12.5	01.8	03.0	01.8	01.8						00.0	00.0	01.6
12.5–13.5	02.7	01.0	00.0	00.0								01.6
13.5–14.5	00.0	00.0										00.8
14.5–15.5	00.9	03.0										00.0
15.5–16.5	00.0	00.0										
16.5–17.5	00.9											
17.5–18.5	00.0											

TABLE 6. Percentage frequency of the various values of IDV (F) at station E.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	24.8	23.4	29.6	31.0	36.8	50.9	54.2	52.6	42.3	35.1	28.6	33.1
0.5– 1.5	25.6	32.7	29.5	41.4	43.9	40.5	35.0	36.8	34.2	36.1	41.9	33.9
1.5– 2.5	23.9	15.9	15.6	16.4	14.9	06.0	06.6	09.7	15.3	08.5	17.2	17.0
2.5– 3.5	11.5	09.3	14.8	00.9	02.6	01.7	02.5	00.9	05.4	11.7	06.7	05.9
3.5– 4.5	08.9	07.5	07.0	03.5	01.8	00.0	00.0	00.0	00.9	04.2	03.8	03.3
4.5– 5.5	02.7	05.6	00.9	01.7	00.0	00.9	00.0		00.0	03.2	01.0	05.9
5.5– 6.5	02.7	02.8	00.9	02.6		00.0	00.0		00.0	00.0	01.0	00.8
6.5– 7.5	00.0	02.8	02.6	00.0			00.0		00.0	01.1	00.0	00.0
7.5– 8.5		00.0	00.0	00.9			00.0		00.0	00.0		
8.5– 9.5				00.0			00.0		00.0			
9.5–10.5				00.0			00.0		00.0			
10.5–11.5				00.9			00.0		00.0			
11.5–12.5				00.9			00.0		00.0			
12.5–13.5				00.0			00.8		00.0			
13.5–14.5							00.0		00.0			
14.5–15.5							00.0		00.0			
15.5–16.5							00.0		00.0			
16.5–17.5							00.8		00.0			
17.5–18.5							00.0		00.9			
18.5–19.5									00.9			
19.5–20.5									00.0			

TABLE 7. Percentage frequency of the various values of IDV (F) at station H.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	06.0	02.8	10.1	12.5	20.8	25.9	34.2	37.1	23.4	17.5	11.2	08.6
0.5– 1.5	13.6	14.2	16.1	26.7	34.1	36.2	50.9	37.9	36.0	30.7	24.2	18.1
1.5– 2.5	12.8	18.8	10.1	15.1	17.5	25.8	11.4	17.2	22.5	14.0	14.6	16.4
2.5– 3.5	12.0	10.4	11.9	10.8	10.8	10.4	03.5	06.0	08.1	15.8	12.9	13.8
3.5– 4.5	11.9	10.4	11.2	12.5	05.0	00.9	00.0	00.9	05.4	08.8	12.1	10.4
4.5– 5.5	12.8	08.5	11.8	07.2	05.8	00.0		00.9	02.7	04.4	09.4	06.0
5.5– 6.5	04.3	09.5	05.9	05.4	04.1	00.9		00.0	00.9	02.6	04.3	06.9
6.5– 7.5	06.0	01.9	04.2	04.5	00.8	00.0			00.0	01.8	03.5	06.0
7.5– 8.5	02.6	04.7	00.8	01.8	00.0				00.9	02.7	04.3	00.0
8.5– 9.5	03.5	05.7	02.5	00.0	00.8				00.0	00.9	00.9	
9.5–10.5	02.6	00.0	00.8	01.8	00.0					00.0	00.9	
10.5–11.5	06.1	01.9	00.8	00.9						00.0	00.9	
11.5–12.5	01.8	00.0	01.7	00.9						00.9	00.0	
12.5–13.5	02.6	00.9	00.0	00.0						00.0	00.9	
13.5–14.5	00.9	00.9									00.0	
14.5–15.5	00.0	00.9										
15.5–16.5	00.9	00.0										
16.5–17.5	00.0											

TABLE 8. Percentage frequency of the various values of IDV (F) at station I.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	14.9	14.7	23.1	22.8	21.1	30.2	45.2	44.3	29.9	27.1	19.8	12.6
0.5– 1.5	29.8	33.7	30.5	33.4	52.2	38.7	42.3	37.2	46.4	32.7	40.6	33.7
1.5– 2.5	19.5	20.0	19.5	16.7	19.3	21.6	12.5	14.4	16.5	18.7	15.8	25.2
2.5– 3.5	26.1	16.9	09.3	11.4	04.6	09.5	00.0	04.2	04.2	13.1	10.9	06.4
3.5– 4.5	06.8	07.4	07.4	08.8	01.8	00.0		00.0	02.0	05.6	06.0	09.5
4.5– 5.5	06.8	03.2	02.8	03.5	00.9				01.0	00.0	02.0	05.3
5.5– 6.5	01.1	02.1	04.7	03.5	00.0				00.0	01.8	03.0	03.2
6.5– 7.5	01.1	01.1	01.8	00.0						00.9	00.0	02.0
7.5– 8.5	01.1	01.1	00.0							00.0	02.0	02.0
8.5– 9.5	01.1	00.0	00.9								00.0	00.0
9.5–10.5	00.0		00.0									
10.5–11.5	01.1											
11.5–12.5	00.0											

TABLE 9. Percentage frequency of the various values of IDV (F) at station J.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	15.1	19.3	27.0	32.7	45.7	35.0	36.5	32.0	28.1	23.2	21.9	18.9
0.5– 1.5	27.7	39.5	32.2	27.2	28.8	42.7	46.2	53.4	37.5	26.3	36.4	26.1
1.5– 2.5	18.5	18.3	18.3	13.7	18.1	13.6	16.4	10.7	24.0	30.5	19.8	21.6
2.5– 3.5	11.8	11.0	08.7	13.7	05.3	06.8	00.0	01.9	08.4	10.6	12.6	09.0
3.5– 4.5	11.7	01.8	06.0	07.3	02.2	00.0	01.0	00.0	02.0	06.3	03.1	15.3
4.5– 5.5	06.7	06.5	06.9	04.5	00.0	00.0	00.0	00.0	00.0	01.1	03.1	04.5
5.5– 6.5	04.2	02.8	00.9	00.9		00.0		01.0		01.1	03.1	03.8
6.5– 7.5	02.5	00.0	00.0	00.0		00.0		01.0		01.1	00.0	00.0
7.5– 8.5	00.8	00.9				02.0		00.0		00.9		00.0
8.5– 9.5	00.8	00.0				00.0				00.0		00.0
9.5–10.5	00.0											00.9
10.5–11.5												00.0

TABLE 10. Percentage frequency of the various values of IDV (F) at station M.

IDV	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
0.0– 0.5	16.9	21.7	16.7	17.3	30.0	29.5	28.8	34.2	33.3	30.8	22.4	20.2
0.5– 1.5	27.9	27.4	29.1	28.2	30.9	40.2	43.2	38.3	31.6	32.5	29.3	24.4
1.5– 2.5	22.9	20.7	15.9	20.9	20.0	24.1	21.2	23.4	21.0	17.5	19.8	21.8
2.5– 3.5	15.2	16.0	14.2	19.1	11.7	04.5	05.9	04.1	10.5	06.6	12.9	16.8
3.5– 4.5	07.6	04.7	10.8	05.4	05.8	00.9	00.8	00.0	02.7	09.2	08.6	07.5
4.5– 5.5	02.5	03.8	05.0	02.7	00.0	00.9	00.0		00.9	01.6	05.1	05.0
5.5– 6.5	02.5	02.8	02.5	03.6	01.6	00.0			00.0	00.8	00.9	01.6
6.5– 7.5	03.4	00.9	00.8	01.8	00.0					00.8	00.0	00.8
7.5– 8.5	00.8	00.0	01.6	00.9						00.0	00.9	00.8
8.5– 9.5	00.0	00.9	00.8	00.0							00.0	00.8
9.5–10.5		00.0	01.6									00.0
10.5–11.5			00.0									
11.5–12.5			00.0									
12.5–13.5			00.0									
13.5–14.5			00.0									
14.5–15.5			00.8									
15.5–16.5			00.0									

TABLE 11. Mean interdiurnal variability of temperature (F) at the North Atlantic OVS.

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
A	2.7	2.4	2.2	2.1	1.3	0.9	1.0	0.9	1.1	1.8	1.5	2.0
B	4.6	3.6	1.9	1.7	1.0	1.0	1.0	0.9	1.6	1.8	2.0	2.6
C	3.4	2.7	1.8	1.9	1.3	1.2	1.1	1.1	1.5	2.1	2.1	2.4
D	5.0	4.3	2.9	3.1	2.0	1.6	1.6	1.8	2.5	3.8	3.3	4.2
E	1.7	1.9	1.6	1.4	0.9	0.6	0.8	0.6	1.2	1.3	1.2	1.3
H	4.8	4.6	4.0	2.9	1.9	1.3	0.8	1.0	1.5	2.3	3.1	3.9
I	2.3	2.0	1.9	1.8	1.1	0.9	0.7	0.8	1.1	1.5	1.7	2.2
J	2.4	1.7	1.6	1.5	0.9	1.1	0.8	0.9	1.2	1.6	1.6	2.1
M	2.1	1.9	2.4	2.1	1.4	1.1	1.1	1.0	1.2	1.4	1.8	2.0

TABLE 12. Maximum MIDV divided by minimum MIDV.

Station	Ratio
A	3.0
B	5.1
C	3.1
D	3.1
E	3.2
H	6.0
I	3.3
J	3.0
M	2.1

maximum (winter) MIDV is about three times greater than the minimum (summer) value. The two most striking cases are stations B and H, where the ratios are 5.1 and 6.0, respectively. Only at station M does one find a ratio close to 2. These results indicate that the seasonal changes of MIDV tend to be more marked over the North Atlantic Ocean than over land.

Landsberg [4] points out that MIDV is usually smaller in maritime climates than in continental climates and that this statistic is a good indicator of the relative continentality of a climate. A table given by Landsberg, in support of this hypothesis, is reproduced here as table 13 (with Landsberg's Centigrade MIDV converted to Fahrenheit). The values of continentality found in this table are Johansson's index (K), defined by

TABLE 13. Change of interdiurnal temperature variation with continentality (after Landsberg [4]).

Territory	MIDV (F)	Continentality
Ocean	1.8	0
North America, West Coast	2.7	3
Central North America	6.3	60
North America, East Coast	5.2	56
Western Europe	3.2	27
Western Russia	4.7	45
Siberia	5.8	86

$$K = \frac{1.6A}{\sin \phi} - 14,$$

where A is the annual temperature amplitude (degrees C), ϕ is the latitude, and K is measured in per cent. For purposes of comparison, annual averages of IDV have been computed for each OVS. These are given by table 14. On the whole, this table gives results which are consistent with Landsberg's statements and with table 13. However, the annual MIDV for station D (3.0F) is almost as large as that given for Western Europe (where the continentality is 27 per cent) and is greater than the annual MIDV given for the west coast of North America (however, the continentality here is only 3 per cent). It is of interest that station H, which lies off the east coast of North America, has the same annual MIDV as the west coast of North America. This is consistent with the well known fact that west coasts of mid-latitude continents tend to have marine climates and western portions of mid-latitude oceans tend to have continental climates.

TABLE 14. Annual averages of the IDV (F).

Station	Annual MIDV
A	1.7
B	2.0
C	1.9
D	3.0
E	1.2
H	2.7
I	1.5
J	1.5
M	1.6

3. Frequency distributions of IDV

With three notable exceptions, the primary modes of the frequency distributions of IDV (tables 2 through 10) tend to persist, throughout the year, in the 0.5F- to 1.5F-class interval. The noteworthy exceptions are: (1) station E, where, during the months June through September, the primary mode shifts to the 0.0F- to 0.5F-class interval; (2) station I, where the same shift is found in July and August; and (3) station J, where a similar effect is found in April and May.

The tendency for the mode to remain fixed indicates that the annual variation of MIDV does not result from a bodily shift, without change of shape, of the frequency distribution to higher or lower values of IDV. Rather, changes of MIDV are accompanied by changes of shape of the distribution, with the mode remaining anchored during the change.

Tables 2 through 10 also show that one of the significant annual changes in the frequency distributions of IDV is a winter to summer recession of the right-hand tail. That is, the spread between the model class interval and the class interval of the largest observed IDV is considerably greater in winter than in summer. Furthermore, the model classes of these distributions fall well below the midpoints of the observed ranges of IDV; the distributions, therefore, have positive skewness. Since the observed ranges of IDV decrease from winter to summer, and since the modes remain fixed, the skewness of the distributions also decreases from winter to summer. Hence, the result is that larger MIDV occur with greater skewness.

To put these arguments on a more quantitative basis, the median IDV (table 15) and the difference between the mean and median IDV (table 16) have been computed for each month at each OVS. As one would expect on the basis of the previous paragraph, there is a very distinct annual variation in the differences given by table 16. Larger differences occur in the cold season, verifying that skewness is greater

TABLE 15. Median interdiurnal variability of temperature (F) at the North Atlantic OVS.

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
A	2.1	1.9	1.9	1.7	1.0	0.9	0.9	0.8	1.0	1.2	1.2	1.7
B	2.8	2.9	1.5	1.2	0.9	0.8	0.9	0.8	1.3	1.5	1.6	2.2
C	2.7	2.3	1.4	1.4	1.2	1.1	0.9	1.0	1.4	2.1	1.6	1.8
D	4.4	3.4	2.0	2.6	1.5	1.3	1.3	1.4	2.0	3.3	2.6	3.4
E	1.5	1.3	1.2	1.0	0.8	0.5	0.5	0.4	0.7	0.9	1.0	1.0
H	4.0	3.9	3.7	2.2	1.4	0.7	0.8	0.8	1.2	1.6	2.5	3.0
I	1.8	1.6	1.4	1.3	1.1	1.0	0.6	0.7	0.9	1.2	1.2	1.6
J	1.9	1.3	1.2	1.1	0.6	0.9	0.8	0.8	1.1	1.5	1.3	1.7
M	1.9	1.5	1.8	1.7	1.1	1.0	1.0	0.9	1.0	1.1	1.4	1.7

TABLE 16. Mean interdiurnal variability of temperature (F) minus median interdiurnal variability of temperature (F).

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
A	0.6	0.5	0.3	0.4	0.4	0.0	0.1	0.1	0.1	0.6	0.3	0.3
B	1.8	0.7	0.4	0.5	0.1	0.2	0.1	0.1	0.3	0.3	0.4	0.4
C	0.7	0.4	0.4	0.5	0.1	0.1	0.2	0.1	0.1	0.0	0.5	0.6
D	0.6	0.9	0.9	0.5	0.5	0.3	0.3	0.4	0.5	0.5	0.7	0.8
E	0.2	0.6	0.4	0.4	0.1	0.1	0.3	0.2	0.5	0.4	0.2	0.3
H	0.8	0.7	0.3	0.7	0.5	0.6	0.0	0.2	0.3	0.7	0.6	0.9
I	0.5	0.4	0.5	0.5	0.0	0.1	0.1	0.1	0.2	0.3	0.5	0.6
J	0.5	0.4	0.4	0.4	0.3	0.2	0.0	0.1	0.1	0.1	0.3	0.4
M	0.2	0.4	0.6	0.4	0.3	0.1	0.1	0.1	0.2	0.3	0.4	0.3

during this season. Smaller differences occur in the warm season, indicating that skewness is smaller during this time of the year. The spatial relationship between MIDV and skewness is not nearly so clear cut. Comparisons between tables 11 and 16, during particular months, reveal only a tendency for largest values of mean minus median to occur with the largest values of the mean.

It was pointed out earlier that one of the most marked winter-to-summer changes in the frequency distributions of IDV is the recession of the right-hand tail. To illustrate this point, table 17 gives the ratios which result when the annual ranges of the 90 per cent points are divided by the annual ranges of the medians. The table shows that the annual range of the 90 per cent point is two to three times greater than that of the median.

TABLE 17. Annual ranges of the 90 per cent points of the IDV divided by the annual range of the medians of IDV.

Station	Ratio
A	2.5
B	2.8
C	2.8
D	2.2
E	2.9
H	2.6
I	2.7
J	2.6
M	3.0

Some further comments concerning table 16 are in order. A surprising feature of this table is the fact that the values of mean minus median are fairly small. Only one of the values exceeds 1.0F (1.8F at station B in January). Eighty-seven of the differences are less than, or equal to, 0.5F. Of the 21 differences which exceed 0.5F, 19 are found in the months October through March. Hence, regardless of the skewness of the distributions, the MIDV can, for practical purposes, be used to approximate the median IDV. Such an approximation would, in most cases, be in error by less than 1F in the cold season and by 0.5F or less in the warm season.

4. Spatial variability of MIDV

A complete explanation of the spatial variations of MIDV during each of the twelve months of the year is very likely impossible. Even if possible, such a discussion would be too cumbersome to present here. The ensuing paragraphs will, therefore, be limited to some comments concerning the spatial variations of MIDV during January. Spatial variations of MIDV reflect differences in the frequency and intensity of aperiodic temperature changes at the various OVS. Since aperiodic temperature variations are mainly a result of horizontal advection, one would expect the MIDV to be large where the horizontal temperature gradient is, in the mean, large.

In January, the MIDV (table 11) at stations D, H, and B are considerably larger than those at the other OVS. Inspection of climatological charts [6] shows that the magnitudes of the resultant temperature gradients at these stations are indeed large compared to those at the other OVS. At stations D and H, the large gradients probably result from two related effects. The first of these is the tightening of the thermal field produced by the Gulf Stream and the North Atlantic Drift. Secondly, in January, these stations are quite close to the mean position of the North Atlantic Polar Front (see Plate XVI, Haurwitz and Austin [3]).

At station B, the tightness of the thermal field is a reflection of the fact that this station lies on the eastern edge of the Labrador Current. In addition to the tight thermal field, two other factors probably make significant contributions to the large MIDV at this station. The first of these is that station B lies between Greenland and Labrador. Hence, cold offshore winds will alternate with warmer winds from the sea to the south. This in itself might be expected to produce a large MIDV. Added to this, however, is the fact that, although B lies on the eastern edge of the Labrador Current, just further to the northeast lies a branch of the Gulf Stream (see page 14, Goode's Atlas [2]). As pointed out by Miller [5], oscillations of these two currents produce large variations of air temperature at points which alternately lie above one of the currents and then above the other.

The smallest MIDV for January is found at station E. However, consulting [6] again, it is found that E has, by no means, the smallest resultant temperature gradient for this month. Also, as was the case with stations D and C, station E is fairly close to the mean position of the North Atlantic Polar Front. However, as can be verified by a glance at the pressure charts given by [6], the weather at station E is strongly dominated by the subtropical anticyclone. Hence, although the potentiality for a larger MIDV is present in the form of the polar front and fairly strong temperature gradients, the passage of fronts and cold domes over station E is probably "blocked" by the persistence of the subtropical anticyclone.

5. Summary

The MIDV at the OVS, according to expectation, were found to be largest in the cold season and smallest in the warm season. The annual variation of MIDV was found to be more marked than that which is usually found at land stations. At land stations, the ratio of the winter MIDV to the summer MIDV is usually about 2. This ratio is 3 or more at all OVS with the exception of M, where the ratio is 2.1. At stations H and B, ratios of 6.0 and 5.1, respectively, were found. The annual MIDV at the OVS were found to be, with the exceptions of stations D and H, either less than, or close to, the value of 1.8F given by Landsberg for an ocean area with zero continentality. Station D, on the other hand, showed an annual MIDV only 0.2F less than that given by Landsberg for Western Europe, where the continentality is 27 per cent.

It was found that the primary modes of the frequency distributions of IDV tend to persist in the 0.5F- to 1.5F-class interval during the entire year. This led to the conclusion that the annual variation of MIDV is not accompanied by a bodily shift, without change of shape, of the frequency distribution of IDV from higher to lower values of IDV (or vice versa). Rather, it was concluded that changes of MIDV are associated with variations in the shape of the frequency distribution, the mode remaining more or less constant during the change. These frequency distributions were found to have positive skewness which was greater in winter and smaller in summer.

Acknowledgment. The writer wishes to record his appreciation for the assistance rendered by Professors Werner A. Baum and Thomas A. Gleeson of the Department of Meteorology, Florida State University. The support of Dr. H. Landsberg and Mr. W. Haggard of the Office of Climatology, U. S. Weather Bureau, and Messrs. L. Smith and N. Canfield of the National Weather Records Center should not go unmentioned. The author also wishes to acknowledge Messrs. F. Crosby, P. Hebert, and W. Brown for computational assistance.

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