Interdiurnal Variability of Temperature Extremes in the United States

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THE idea of showing the magnitude of irregular changes in the weather of a particular area by calculating the average day-to-day change in temperature is old and well established.1 Such studies have been confined, however, to the interdiurnal changes in the average temperature. This study investigates the interdiurnal variability of the extremes of temperature—the minimum temperatures for January, and the maximum temperatures for July. Averages were compiled for 99 stations in the United States for the 10-year period 1936 through 1945.

The Minimum Temperatures for January

Interdiurnal variations in the average daily temperature for January are greatest in the northern Great Plains area (Fig. 1). They are, in fact, the highest in the world.2 This variability declines outward in all directions though the rate of decline is much faster toward the west than toward the east.3 In gross pattern the map of variability of the January daily minima (Fig. 2) is similar. Variability is greatest in the northern Great Plains region. High variability of the minima has its greatest areal extent in the Mississippi valley, where the isolines all bend far to the south. Certain differences may be noted. The lower limit of the mean variability of the extreme is everywhere above 2°F, whereas Greely's map shows a strip of the coast of California as being below that figure. The average variability of the mean in January is considerably greater over most of eastern United States than is the interdiurnal variability of the minimum temperatures. This would indicate that the greater variation in temperatures in winter in the eastern United States is due to the variability in the maximum temperatures. Whereas Figure 1 shows the isolines bending sharply southward and then back north to include an area in central Texas within areas of greater variability, the map of variability of the minima (Fig. 2) has an enclosed area surrounded by the isoline of 6°. Four stations to the north of this area, all having less average variability than 6°, three of them less than 5.5°, seems to make an enclosed area a better representation.

The greatest difference between the two maps, however, is the area of great variability in interior New England and northern New York which appears on the map of variability of the extremes, but which does not appear at all on the map of the variability of average temperatures. Greely may not have used any stations in this area in constructing his map. In fact, the steepest interdiurnal variability gradient of minimum temperatures in the United States is in New England, where southern New England and New York have variabilities of less than 6° while the interior, less than 200 miles distant, has variabilities of over 8°. The highest figures in the United States—8.4° for Greenville, Maine and 10.7° for Northfield, Vermont—are found in this area. It should be kept in mind in this connection that variations of 4, 6, 8, and 10° represent 2, 3, 4, and 5 times the lowest variabilities occurring in the United States. This New England area of high variability may be accounted for by its position between the waters of the Atlantic to the south and east and the cold interior of Quebec to the north, and to the large number of storms which leave the continent by way of the St. Lawrence Valley.

The Maximum Temperatures for July

Areal differences in the variability of the maximum temperatures for July are less than for the minima in January. With the exception of the west coast area, the maximum temperature variability isolines in July roughly follow latitude lines. The area of greatest variability lies in the northern plains states (Fig. 3), as was true of conditions for the minima in January. The lowest values, similarly, are along the Pacific and Gulf coasts. The Great Lakes bring about a rise in the average interdiurnal variability of the maxima for July in their vicinity. Chicago with 6.0°; Duluth, 6.4°; and Alpena with 5.8° are typical. This is not true everywhere, however; note Ludington with 3.8° and Buffalo, 4.1°. The high figures for the lake stations are due to the presence of water at considerably lower temperatures than the land

2 Supan, op. cit., p. 155.
3 For a more extended description and analysis of this map see Ward, op cit., p. 125.
surface. Shifts in wind direction that would not cause much change in the maximum temperature at inland stations may cause major changes for lake stations because of the juxtaposition of two surfaces of markedly different temperatures.

The localized high of variability for January in New England is completely absent on the map for July.

**Comparison of Five and Ten Year Averages**

Because of the discouragingly great number of calculations required for any extensive study of interdiurnal variations in temperature, the averages for a five-year period were cast up and compared with the ten-year averages. It was found that averages for 15 percent of the stations were identical. In 62 percent of the cases the differences between the five- and ten-year averages were .2° or less, and in 84 percent of the cases the difference was .4° or less. All the stations with greater differences were in extreme northern United States. This would indicate that for some purposes fairly short periods might be used for such calculations. However, this does not agree with the findings of v. Ficker with regard to the reliability of short-term results.4

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4 v. Ficker, *op cit.*