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SHORTER CONTRIBUTIONS

A CRITICAL APPRECIATION OF AN OBJECTIVE TECHNIQUE FOR MAXIMUM TEMPERATURE PREDICTION

by

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The aim of this article is to discuss some of the inherent shortcomings of the objective technique proposed by Maine(1958) and suggest some probable lines of elimination of these difficulties.

The degree of success obtained by straightout application of the method during January, 1959, was heartening. Three of the total number of days were classed as days when the diurnal range was disturbed by a marked air-mass change. Of the remaining 27 days application of the method was inherently unsuitable on 5 occasions. These cases will be discussed later.

Twenty-two days were left and all of these were apparently admissible. Briefly the distribution of the errors, observed minus estimate, was as follows:-

Mean	+0.1
Mean Modulus	2.0
Standard Deviation	3.0
Range	-7 to +5

These figures are comparable with the previous published distributions with the difference that five special days were excluded. It is this type of day which was referred to in the note on page 61 of the 1958 paper. However, some of the reasoning given in the note is now inappropriate in the light of accumulated experience.

Several shortcomings of the present method have been observed. Excluding the days of major air mass change and rain, the opinion is held that the statistical relationships obtained are true only for average conditions, obtained from the original data,

pertaining to a given initial air stream, and that the error in the forecast is chiefly a function of the development in the stream, and the departure of stream conditions from the "average", for quasi static conditions.

In the light to moderate easterly stream situation, which occurs at intervals during the summer, special occurrences have been noted which are relevant to the forecast problem. In this situation anticyclonic centres are located well south of the continent, and no closed surface pressure system is evident. Troughs of low pressure move or develop either in an easterly or westerly direction. In such cases 1700Z 2000 ft winds may either not be related to the surface pressure gradient, back sharply before 9a.m., or steadily veer during the day.

It is also noted that the greatest magnitude of the gradient of D_2 occurs in the easterly quadrants, and consequently greatest uncertainty in estimated maximum is observed in these quadrants. In the past, these cases have been treated by estimating the true gradient or by subjectively considering the effect of existing isallobaric factors in operation. It now seems illogical to assume that the observed wind is a measure (first order) of the advective change in temperature, at all times. At best the relation with wind is purely statistical and it is dangerous to advance physical theories on this basis without adequate justification.

The suggested method of elimination of this difficulty is to include a development factor, obtained by plotting the actual gradient of the isallobaric field on a polar diagram. (Incidentally, Figs 1a and 1b of the earlier paper can be easily combined to leave the total number of diagrams the same). It is expected that this will reduce the largest forecast errors, as, on a subjective basis, consideration of this term has assisted greatly in correcting the estimate. It might be thought that the lack of any estimate of vertical temperature gradients would decrease accuracy of forecasts. However, the parameters chosen indirectly correct for this factor, but only in an average or "normal" fashion. Different streams have characteristic types of temperature structure in the vertical direction. Marked deviation from the average type would then be expected to produce larger errors. The suggested method of overcoming this difficulty is to apply Gold's (1933) method to the latest available temperature sounding (or a suitable parameter from the sounding), and incorporate this in another diagram. This additional aid, to use a popular colloquialism, has often proved a "saver" in easterly situations, and would only increase the total number of diagrams by one, if Figs.1a and 1b are combined. Finally, the method cannot be strictly classed as an objective technique as one of the main variables, cloud, is most subjective, and until some instrumental method is used to estimate cloud amount and heights, this debatable factor must continue to be used in the estimate.

The variation in cloud amounts and types from two closely situated meteorological stations in South Australia (at synoptic hours) is, in the opinion of the writer, disturbing.

As has been implied, in using the method, diurnal variation of low cloud in a stream is assumed average, with major departures estimated by the use of 6a.m. cloud. With middle and high level cloud the situation is different. Probably the most suitable approach is use of the general subjective synoptic methods, incorporating isonephs and 10000 ft and 20000 ft isotachs and streamlines. Resulting conclusions should then temper the early morning cloud value to a representative day value.

It is once again stressed that the method is an empirical one, and all variables are partially dependent on the others. Thus, it is incorrect to refer to Fig 1B as the quantitative effect of insolation upon the diurnal range. It is merely a statistical relationship between the insolation and the range. It contains higher order dependencies due to relationships with cloud, wind and temperature.

Regarding the use of this type of emperical method to obtain the maximum temperatures 9 hours in advance, it seems quite logical to extend the method so that an estimate is provided 24 hours in advance. However, it is quite obvious suitable new parameters must be found. Alternatively, it is probably better to obtain similar types of relationships for overnight temperature fall, cloud, and wind. One is then automatically provided with forecasts of the minimum temperature and early morning weather conditions, and these alone are invaluable to routine forecasting if a reliable method can be produced.

Nevertheless the important omission, of days on which a major air mass change has occurred, still remains to be treated. As the temperature range is directly dependent on the time of day at which the change arises, more accurate estimates of the speeds of movement of changes are required. This problem appears mainly a dynamical one and not much success is expected with temperature forecasting on these days until the arrival time of a change can be estimated to within one hour.

References

Gold, E.	1933	U.K. Met. Off., Prof. Notes, No.63
Maine, R.	1958	Aust. Met. Mag. No. 22