MET O 11 TECHNICAL NOTE NO 59

A simple Pattern Matching Index for verification

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1. Introduction

It is a common-place of verification work that indices based on the usual (forecastminus actual) or (forecast minus analysis) fields do not tell the whole story. They need to be complemented by some measure of the agreement between the pattern of a forecast field and the pattern of the field against which it is being verified. Pattern analysis can be a quite complicated business. What is proposed here is a very simple and easily programmed index to assist in the monitoring and interpretation of the 10-level model forecasts.

2. The Pattern Matching Index (PMI)

Over each m x m sub-block of grid point values the PMI is computed as

$$PMI = \frac{\underline{a} \cdot \underline{b}}{\sqrt{a^2 b^2}} \qquad (1)$$

where $\underline{a}$ is the m^2 x 1 vector of forecast grid-point values.
and $\underline{b}$ is the m^2 x 1 vector of verifying grid-point values.

The components of each vector are measured from their mean over the m^2 grid points. The PMI calculated is then allocated to the grid point at the centre of the m x m block and the program then deals with the next grid-point. The whole field is thus processed in overlapping m x m blocks.

3. Notes

(a) The PMI ranges from +1 for complete agreement to -1 for total disagreement and will be 0 where the gradients of the fields are at right angles to each other. For print-out and Calcomp display it is probably best to multiply by 100 and choose some suitable contour interval.

(b) The interpretation of (1) as an angle is obvious. Alternatively it can be viewed as based on the 3-d vector identity.

$$(\underline{a} \cdot \underline{b})^2 = a^2 b^2 - (\underline{a} \times \underline{b})^2 \qquad (2)$$

which has a determinantal n-space generalization

(c) m should be chosen to suit the physical scale of interest, and should be a variable program parameter.

(d) In addition to the Calcomped contours of 100 x PMI the program can also easily print out the PMI for our local area of interest, namely the M x M block of grid points which more or less exactly boxes the Brith Isles.

4. Illustrations

Fig.1 and Fig.2 show comparisons of 500mb and 1000mb fields, respectively.

The four charts on each page are:-

(a) 36 hour forecast, for 11 May 1976 at 1200 GMT.

(b) the verifying field for that time

(c) the P.M.I. field, using m=6, with the index varying between ± 100

(d) the contour height error field (forecast-actual).

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FIG: 1

COMPARISON OF FORECAST & ACTUAL 500 MB HTS VERIFYING TIME 12Z 11/5/70

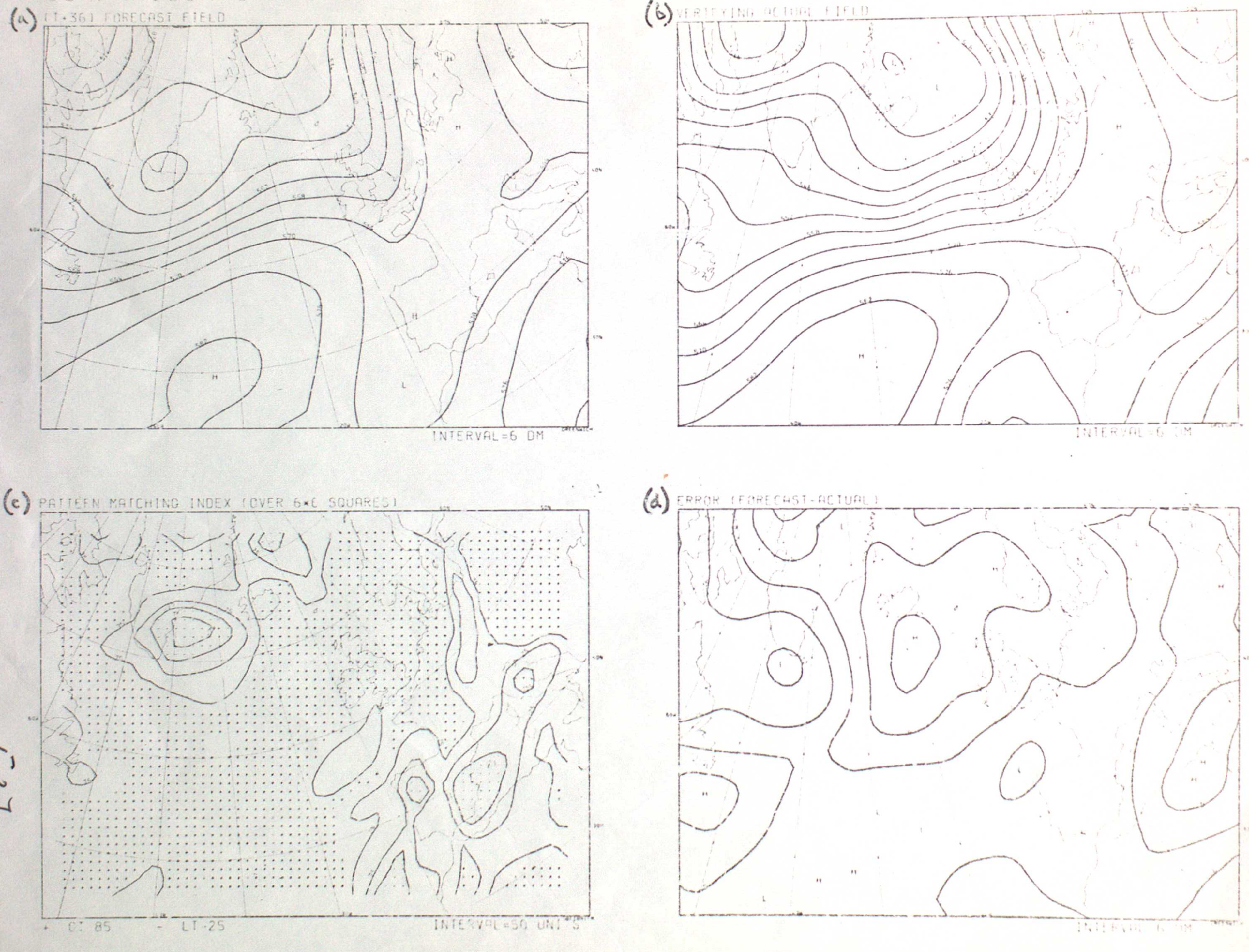

FIG: 2

COMPARISON OF FORECAST & ACTUAL 1000 MB HTS VERIFYING TIME 12Z 11/6/76