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Letters to the Editor

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A NOTE ON THE MAGNITUDE OF HORIZONTAL DIVERGENCE

In his famous paper on scale analysis, Charney (1948) suggested that the two terms, *i.e.*, $\partial u/\partial x$ and $\partial v/\partial y$ comprising the horizontal divergence D ($D = \partial u/\partial x + \partial v/\partial y$) tend to compensate and therefore, the net value of divergence is less than either of the terms $\partial u/\partial x$ or $\partial v/\partial y$ by scale considerations.

The purpose of this note is to examine this aspect in the light of actual computations of the value of $\partial u/\partial x$, $\partial v/\partial y$ and divergence.

In an earlier paper one of the authors, Sajnani (1968) had reported the results of computation of all the terms of the equations of motion. In that connection, values of $\partial u/\partial x$ and $\partial v/\partial y$ were computed for five-day period in the months of January and July. A special smoothing procedure was adopted to eliminate the small scale divergence. The same values have been utilised in the present study. The method of analysis of data and method of computing divergence have been described in detail in that paper.

The present study, however, pertains only to the data for the five-day periods 18-22 January 1958 and 12-16 July 1958 for the three levels, 900, 700 and 500 mb over 64 grid points covering the Indian region. The choice of the period under consideration has been on the basis of availability of data. Due to sparse network of upper wind observatories, levels above 500 mb are not considered.

We will, however, like to mention that we recognise the various limitations of wind data accuracy and grid length used for finite difference evaluation for calculating divergence. But, the fact that the computed divergences depict reasonable patterns which are also synoptically consistent with other concurrent features and exhibit systematic changes from day to day and from one level to another lends support in favour of the reliability of the computed divergence. Contingency technique is used for the present study. 2×2 contingency tables are prepared where cell frequencies give the number of occasions when both terms had same and opposite sign. The data for the five day period in one month at one level at 64 grid points is utilised to make one contingency table. Thus the sample used for one table is 320. Then χ^2 test is made to test the hypothesis that no association exists between the signs of the two terms. The computed value of χ^2 reveal that even at 1 per cent significance level the hypothesis of no association is not contradicted.

Table 1 gives such contingency tables for 3 levels for the month of January and July. The theoretical values of χ^2 for 2×2 contingency table at 1 per cent level of significance and actual value of χ^2 is also given below the table. Since actual value is always less than the theoretical value, the hypothesis that there is no association between the signs of the two terms, is not contradicted.

It may be concluded, therefore, that if these computations are to be relied upon, there is no association between the sign of two terms of divergence and smallness of divergence over India may not be due to compensation between the two terms comprising the horizontal divergence. It is further postulated that wherever the horizontal divergence is found to be smaller than the vertical component of vorticity it may be because both terms comprising D, *i.e.*, $\partial u/\partial x$ and $\partial v/\partial y$ are even individually smaller compared to the two terms, *i.e.*, $\partial v/\partial x$ and $\partial u/\partial y$ comprising the vertical component of vorticity and the effect of mutual compensation between the two terms comprising the horizontal divergence may not be the primary reason for smallness of horizontal

TABLE 1

Contingency table giving the frequency of occurrence of + ve and — ve signs for $\partial u/\partial x$ and $\partial v/\partial y$ for 5-day period (a) 18-22 January 1958 and (b) 12-16 July 1958 for different isobaric levels

(a) 18-22 January 1958

900 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	65	75
—	99	81

$\chi^2 = 2.3157$

700 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	93	116
—	59	52

$\chi^2 = 2.1779$

500 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	64	60
—	118	78

$\chi^2 = 2.2855$

(b) 12-16 July 1958

900 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	95	76
—	72	77

$\chi^2 = 1.6696$

700 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	83	72
—	102	63

$\chi^2 = 2.2410$

500 mb

$\partial v/\partial y$ \ $\partial u/\partial x$	+	—
+	71	98
—	67	84

$\chi^2 = 0.1809$

(Theoretical value of χ^2 for 2×2 contingency table at 1 per cent level of significance=6.634)

divergence. These conclusions are, however, tentative and a more detailed study with more accurate data may be necessary before arriving at a final conclusion.

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*It is stated with regret that P.P. Sajnani of Meteorological Office, Poona expired on 30 August 1970