On the Meridional Local Eddy Flux of Relative Momentum over India

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1. Method of computation

The local meridional eddy flux of relative momentum, M, at any station is given by

$$M=\frac{1}{g}\int_0^{P_0}\overline{v'u'}dp, \tag{1}$$

where v is the north component of the wind velocity, u is the east component of the wind velocity, g is the gravity, and P_0 is the surface pressure. The bar denotes a time mean and the prime denotes a departure from that time mean. This flux has been computed at the same Indian stations used in an earlier study of the heat flux (Rao, 1962). The wind data used were the same as in the earlier study, except that in 1954–55 eddy flux was also calculated at the 200-mb level at the four stations, Delhi, Nagpur, Calcutta and Bombay. The limitations of the results are therefore the same as in the previous study.

2. Results

In Fig. 1, $\overline{v'u'}$ values are shown as a function of pressure. Values of M in (1) are presented in Fig. 2. From these self-explanatory figures the following conclusions can be drawn.

1) For stations north of 15N the local eddy flux of relative momentum increases generally with height attaining maximum values in the upper troposphere. This is in line with the observations of previous workers. For stations south of 15N further work with better data is required to draw any conclusions.

2) The integrated flux values show a maximum in winter months. This is due to an increase in the northward flux values at the jet level in winter.

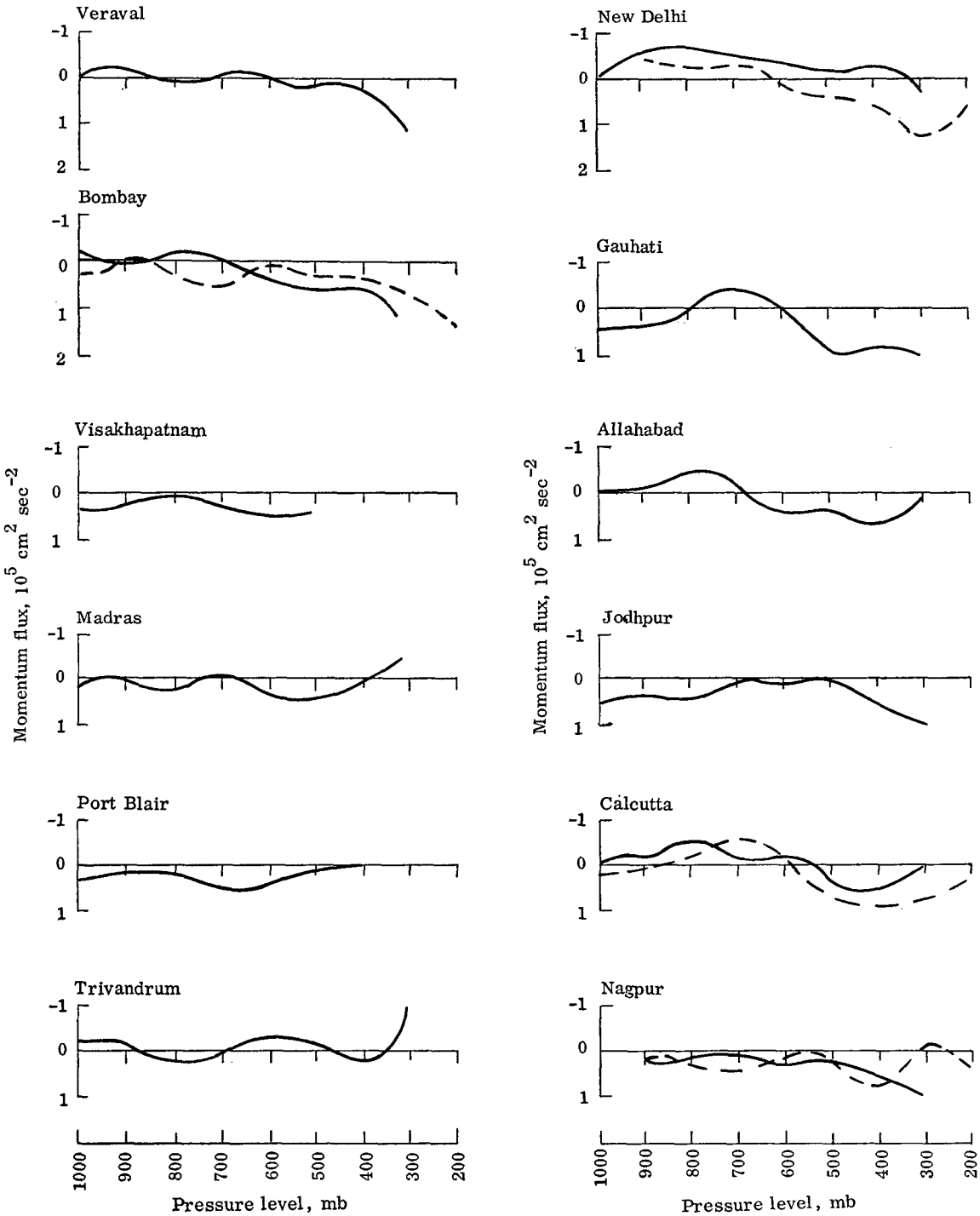

FIG. 1. Vertical variation of momentum flux $\overline{v'u'}$. Dashed line represents 1954–1955; solid line represents 1956–1957.

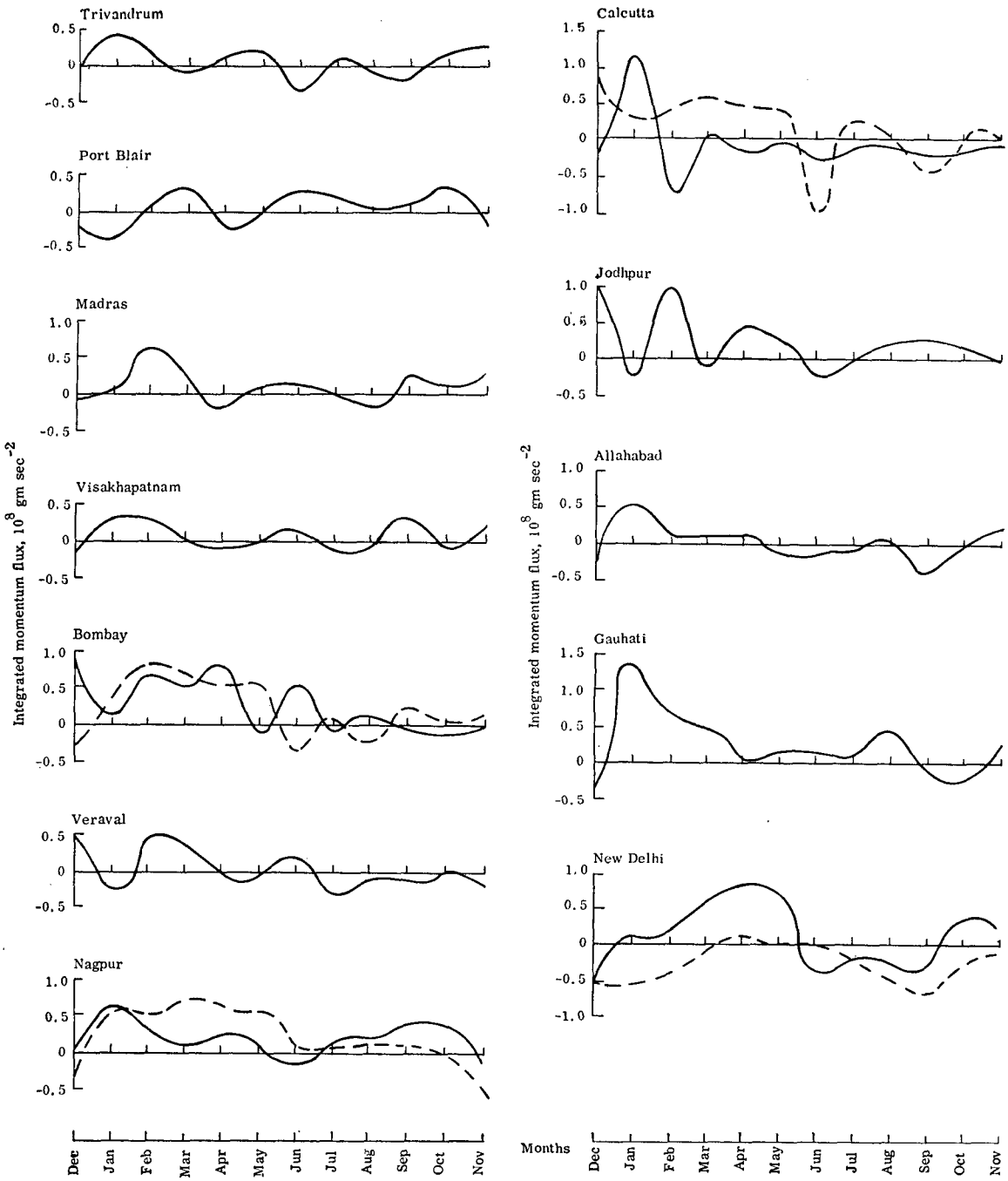

FIG. 2. Monthly variation of integrated momentum flux M. Dashed line represents 1954–1955; solid line represents 1956–1957.

3) The angular momentum flux across latitude circles ($=2\pi a^2 \cos^2\varphi M$, where a is the radius of the earth and φ the latitude) was computed with the same crude station-latitude correspondence as used in the earlier study on the heat flux. These values are listed in Table 1.

TABLE 1. Eddy flux of angular momentum across latitude circles, assuming Indian data to be representative of the entire latitude circle, and neglecting contributions above 300 mb.

Latitude	29N	26N	21N	18.5N	13N	8.5N
Flux in 10^{25} gm cm^2 sec^{-2} (1956–1957)	−5.12	3.74	1.57	5.57	1.95	0.76

The negative values at 29N (represented by Delhi) may be due to the data truncation at 300 mb. The flux across 26N is only 10 per cent of that necessary to balance frictional torques, although a higher percentage can be expected if the important levels above 300 mb could be included. Although some doubtful assumptions are involved in this study and in the earlier one (Rao, 1962), we can provisionally conclude that the transient eddy flux up to the 300-mb level seems to play a relatively minor role in transporting heat or momentum poleward in this tropical region.

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