LETTERS TO THE EDITOR

Diurnal Wind Variation

"*The diurnal variation of the wind*" by G. J. Haltiner, *Tellus*, **II**, pp. 452—458 (1959).

Dear Sir,

In this article, G. J. Haltiner obtained numerical solutions for the diurnal variation of wind in the friction layer, allowing the coefficient of eddy viscosity to vary with height and time. Concluding that the results of this study showed some agreement between the theoretical representation of the diurnal wind variation and observed data evaluated by Buajitti and Blackadar (1957), Dr. Haltiner attributed disagreement in significant features of the wind field to the functional forms used for the coefficient of eddy viscosity. I would like to suggest that there is another possible source of disagreement, namely, the diurnal variation of the geostrophic wind, a factor that apparently has not been considered in models of this type.

To illustrate the likelihood of such an effect, we may compare the magnitudes of the "local acceleration", $\partial u'/\partial t$, and the pressure gradient force in the first of the equations of motion, linearized to satisfy the diurnal variations only (Harris, 1959). For the data in Figure 4 of Dr. Haltiner's paper, a representative value of the amplitude of the wind component in the friction layer appears to be about 2.5 m sec^{-1}, so that the amplitude of $\partial u'/\partial t$ would be about 1.8×10^{-2} cm sec^{-2}. I do not know what corresponding value for the variation of the geostrophic wind would be appropriate to these data, but at Washington, D.C., I found the diurnal variation of the component of the pressure gradient force per unit mass, $\partial p'/\varrho\partial x$, to be

$$1.45 \times 10^{-2} \sin\,(\omega t + 123°)\ \text{cm sec}^{-2},$$

the semidiurnal term being much smaller. This value, which applies to the surface and the month of June, was found by analyzing maps of the amplitude and phase of the diurnal pressure variation for stations in the eastern U.S., graphing the results along a section through Washington, and evaluating the spatial derivatives of the amplitude and the phase.

The value of 1.45×10^{-2} cm sec^{-2}, incidentally, is very nearly an order of magnitude larger than one would infer from the passage of a simple progressive wave of the appropriate amplitude (0.9 mb). It must be somewhat greater than the average for the United States as a whole, for the pressure wave shows unusually marked changes along the Atlantic seaboard. Presumably the magnitude should decrease with elevation, like the pressure wave itself, but I believe it would still be appreciable throughout the friction layer. At Washington in June a representative amplitude for $\partial u'/\partial t$ is about 0.6×10^{-2} cm sec^{-2} for the first harmonic, so that the diurnal variation of the pressure gradient force in the lower layers of the atmosphere at Washington is probably even larger than the acceleration.

It may be that at other localities also the diurnal change of the geostrophic wind is appreciable in comparison with other terms in the equation of motion, and must therefore contribute to the observed wind variation. I feel that one should be aware of this possibility in comparing the results of theoretical models, based on the usual assumptions, with the results of observation.

Sincerely yours,

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REFERENCES

Buajitti, K., and Blackadar, A. J., 1957: Theoretical studies of diurnal wind variations in the planetary boundary layer. *Quarterly Journal of the Royal Meteorological Society*, **83**, pp. 486—500.

Harris, M. F., 1959: Diurnal and semidiurnal variations of wind, pressure, and temperature in the troposphere at Washington, D. C., *Journal of Geophysical Resarch*, **64**, pp. 983—995.