Monthly Weather Review: **Vol. 101, No. 11, pp. 803–816.**

Temporal Variation of Low-Latitude Zonal Circulations

PETER J. WEBSTER

Department of Meteorology, University of California, Los Angeles, Calif.

(Manuscript received June 29, 1973, September 11, 1973

ABSTRACT

The response of the tropical atmosphere to steady forcing for all four seasons is computed using a simple two-layer linear primitive-equation model allowing an arbitrary basic flow with two-dimensional shear. The character of each seasonal response is studied, and two distinct forms of behavior are found. Near the Equator, the forcing excites a slowly varying Kelvin wave of the time scale of months while, in midlatitudes, the atmosphere responds via the Rossby mode. Both regimes are separated by the critical latitudes existing on the poleward limits of the easterly channel of the basic flow. The long-wave scale response of the equatorial motions noted by Krishnamurti are shown to be the results of the natural filtering of the slowly varying Kelvin wave. The temporal variation of this zonal circulation is discussed.

The analysis is extended to infer the behavior and location of transient disturbances in the upper tropical troposphere for time scales much less than seasonal. Also shown is that the zonal mean flow plus the standing eddies are locally barotropically unstable, providing preferred geographical locations for the development and maintenance of transient disturbances. Such locations are shown to vary seasonally.

Variations of the tropical atmosphere of time scales much greater than seasonal also are investigated. It is shown that the correlations of Walker may be thought of as long-term variations in the seasonal standing eddies, which themselves provide a mode of communication throughout the tropical atmosphere. Also suggested is that the Walker circulation of the tropical Pacific Ocean may be thought of as the slowly varying filtered Kelvin wave response, within the easterly channel of the basic flow, weighted toward the long-wave heating distribution of low latitides.

[1] Now with the Department of Atmospheric Sciences, University of Washington, Scattle, Wash.