

NOTES AND CORRESPONDENCE

An Unusually Large Westerly Amplitude of the Quasi-Biennial Oscillation¹

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ABSTRACT

A time-height section of the quasi-biennial oscillation is presented from 1950 to 1978 and the presence of an unusually large westerly amplitude during the winter 1977-78 is noted.

In an effort to keep documentation of the quasi-biennial oscillation up to date an extension has been made of a time-height section which was originally published by Wallace (1973). Fig. 1 shows the entire time-height section. The data are from the Canal Zone station through June 1970 and from Kwajalein from July 1970 through April 1978. Both stations are near 9°N. The removal of the annual and semiannual cycles as well as the mean zonal wind was accomplished by subtracting 15-year average monthly mean zonal winds. The original time-height section ended with June 1971 so the extension includes over 6 years of additional data.

The most striking feature in the new data is the unusually strong westerly phase which occurred in the winter of 1977-78. The magnitude of the westerly amplitude in December 1978 is over 60 m s⁻¹ at and above 10 mb. (Note that the dashed intermediate contours at 5 m s⁻¹ intervals are discontinued in this portion of Fig. 1.) November amplitudes at the same levels were only 25 m s⁻¹. This sudden acceleration of the westerly wind has also occurred during other years in Fig. 1, most noticeably the winter of 1970-71, but amplitudes as large as those of the winter of 1977-78 have not been previously observed. As shown more clearly in Fig. 2, a time series taken from Fig. 1, the most recent peak westerly amplitude is about twice as large as past peak westerly amplitudes at 30 mb.

The easterly phase below the westerly phase of the 1977-78 winter was also unusually large as shown in Fig. 1, implying an apparent large vertical wind shear. However, because the 15-year average monthly mean zonal wind for December is about 10 m s⁻¹ easterly at and above 10 mb and close to zero below

10 mb the actual wind shear at Kwajalein is not as large as in Fig. 1. Inspection of the daily data at Kwajalein for December 1977-February 1978 shows the average westerly wind at 10 mb to be 35 m s⁻¹ with variations on the order of 30 m s⁻¹ occurring on a time scale of about 10-15 days. December has the strongest winds with a monthly average of 57 m s⁻¹ at 10 mb and values as large as 80 m s⁻¹ on individual days.

The other features in the new data are consistent with past observations. The downward propagation is still apparent and the shear zone marking the leading edge of the westerly regimes is usually sharper than the corresponding easterly shear zone as noted by Wallace (1973). The cycles are close to 2 years from 1971-74 but the most recent cycle (1975-77) increases to about 2.5 years. The average period of the quasi-biennial oscillation from 1950 to 1977 is about 27 months with the periods varying from about 2 to 2.5 years.

In order to obtain a picture of both the semiannual and quasi-biennial oscillation Fig. 3 was constructed to show a time-height section of the zonal wind using monthly averaged rawinsonde and rocketsonde data in which only the annual cycle has been removed by harmonic analysis of the 6 years shown. It also provides an estimate of zonal winds on the equator. A $\frac{1}{4}-\frac{1}{2}-\frac{1}{4}$ filter was applied in the time domain to facilitate computer plotting. While the computer plot is not as aesthetically appealing as a careful hand analysis it has the advantage of being more objective. Fig. 3 is similar to Fig. 4 in Wallace (1973) but for a different time period. The semiannual cycle is seen to dominate the upper stratosphere while the quasi-biennial oscillation dominates the lower stratosphere. There is a transition region in between where both cycles exist.

¹ Contribution No. 473, Department of Atmospheric Sciences, University of Washington.

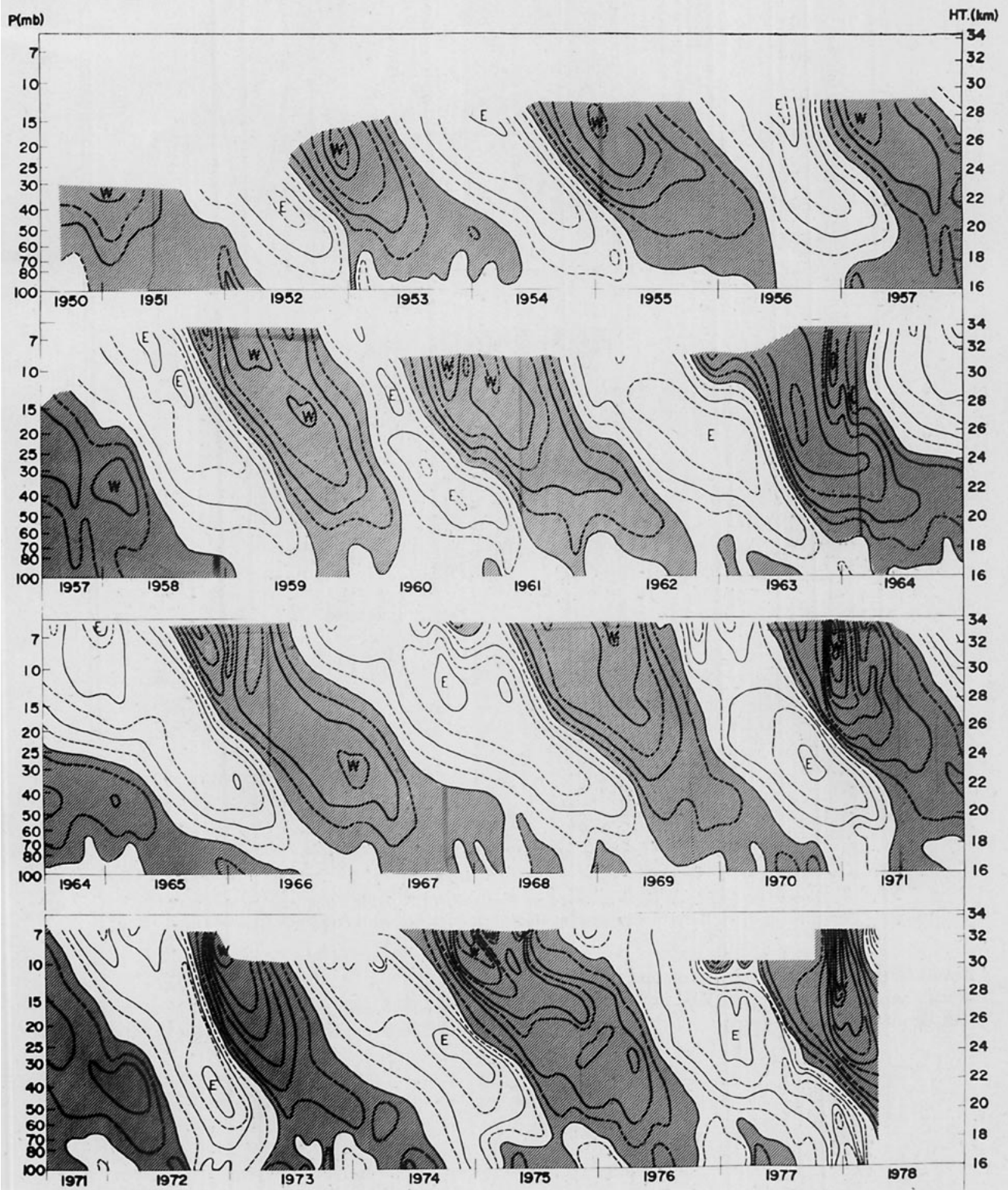


FIG. 1. Time-height section of the zonal wind near 9°N with the 15-year average of the monthly means subtracted to remove annual and semiannual cycles. Solid isotachs are placed at intervals of 10 m s⁻¹. Shaded areas indicate westerlies.

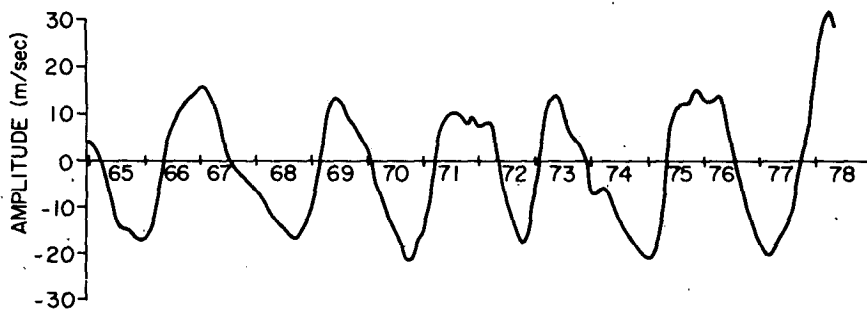


FIG. 2. Time series at 30 mb for January 1965 through April 1978 taken from Fig. 1.

FIG. 3. Time-height section of the zonal wind at Kwajalein (9°N) with the annual cycle removed by harmonic analysis. Isotachs are placed at 10 m s^{-1} intervals. Shaded areas indicate westerlies.

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REFERENCE

Wallace, J. M., 1973: General circulation of the tropical lower stratosphere. *Rev. Geophys. Space Phys.*, **11**, 191-222.