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DARWIN TROPICAL DIAGNOSTIC STATEMENT

AUGUST 1986

ISSUED BY DARWIN RMC

INDICES

The Darwin mean MSL pressure for August was 1012.0 hPa, 0.8 hPa below the 1882/1985 mean. The Tahiti mean MSL pressure for August was 1012.5 hPa, 2.0 hPa below the 1882/1985 mean. These give a value of the SOI of -7 with a five month running mean centred on June of -0.5.

In July the mean pressures at both stations were very close to their long term means. This month, while Darwin's pressure is approaching one standard deviation below its mean, Tahiti's pressure has dropped to almost two standard deviations below its long term mean. The standard deviations of monthly mean pressures for August are: Darwin 0.87 hPa; Tahiti 1.14 hPa.

TROPICAL CYCLONES

Five tropical cyclones formed in the northwest Pacific during August four of which reached typhoon status. The long term (26 years) frequency for tropical cyclones in this region is 5.4. Tracks are shown in Figs 1a - c.

The first two cyclones which formed early in the month, Sarah and Georgette, were relatively short-lived and well behaved systems. Both formed in the monsoon trough to the east of the Philippines, Sarah moving generally northeast and Georgette northwest, both coming under the influence of the upper westerly winds and decaying. Georgette attained typhoon status on the 11th August.

The last three tropical cyclones were long-lived and showed erratic movement.

Tip moved both westwards and eastwards, but maintained a general poleward component throughout its life. Vera had an eastwards component for the first half of its life before turning abruptly westwards and accelerating to the northwest and then northwards and becoming extra tropical.

Wayne formed in the South China Sea and developed rapidly to typhoon status within 48hours. Cyclone Wayne impinged on the Chinese coast before moving northeast and crossing Taiwan. The crossing of mountainous Taiwan destroyed Wayne's lower structure and the system weakened temporarily.

Then Wayne moved steadily southwest over a three day period before weakening on the 25th August. The low level circulation was maintained and moved northeast where under favourable conditions Wayne regenerated attaining typhoon status for the second time on the 31st August.

The erratic movement of the later cyclones is characteristic of the weakening of the northern mid-level sub-tropical ridge and the intrusion of the westerly moving troughs into the lower latitudes, events which were evident on the daily 500 hPa charts.

In the southern hemisphere a 24 hour tropical cyclone (34S) formed near 7.7S 77.9E and moved steadily westward with estimated maximum winds of 40 knots. No statistics are available for formation of cyclones in this region for August but experience dictates that it is an infrequent event.

SEA SURFACE TEMPERATURES

The mean sea surface temperature (SST), during August 1986, and SST anomalies averaged over the two week period 12-26 August are shown in figs 2 and 3.

In the southern hemisphere the large area of warm anomalies in the tropical region has persisted since July between 105 and 165E. The warming is in response to the continuing weaker than normal southeast trade flow in this region during August.

Stronger cold anomalies have developed near 70S 173E and have intruded into our region near 30S from the west.

Warm anomalies persist in the East China and Yellow Seas with some warming during August in the Yellow Sea.

The small area of warm anomaly near the equator and the date line in July has moved further northwards and expanded westwards to 155E in August.

The cold anomalies in the northeast part of northwest Pacific, have moved little but contracted in area.

MSL AND GRADIENT LEVEL FLOW.

The August mean MSL pressure and anomaly charts are shown in figs 4 and 5, and the gradient level (950 hPa) streamline and anomaly charts in figs 6 and 7.

A noteworthy feature of the low level flow is a region of westerly anomalies about the equator east of 150E. These are consistent with the lower than average monthly mean pressure at Tahiti. A similar anomaly was present in July.

The charts also show that the SW monsoon was weaker and further south than average over India and stronger than average over the NW Pacific. The monsoon trough extended further east (to 150E rather than to 120E) at 20N before dipping towards the equator. In the first third of the month the monsoon trough over the NW Pacific was further south, close to its mean position, but later it extended along 20N to at least 180E at most times. During this period the trough was dominated by Tip , Vera and Wayne. The anomalies also indicate that the North Pacific anticyclone was weaker than the mean while there was an anomalous SW flow south of 15N, 120E-160E and stronger than average SE trade flow SE of New Guinea. The anomalously strong trades were associated with the normal Australian anticyclone being weaker but further east than average and with the formation of a deep low over the Tasman Sea during the middle of the month.

Associated with the weaker monsoon over India, were weaker than average SE trades over the western Indian Ocean. A stronger than average monsoon flow is evident over the South China Sea, with the SE trades over the central Indian Ocean showing a stronger than average equatorward component, and the pressure in the eastern Indian Ocean being relatively high. The

Australian anticyclone being weaker and further east led to weaker than average trades to the north of the continent.

500 hPa FLOW.

Mean 500 hPa streamline analysis and geopotential height anomaly charts are shown in figs 8 and 9 respectively.

Only sparse anomaly data were available between 20N and 10S and in the equatorial Indian Ocean. The maximum in the flow north of 40N near 170E is probably due to spurious observations.

Negative height anomalies were again evident over Australia, though centred further east than in July. They reflect persistent troughing over the continent during the first half of the month. The positive anomalies in the eastern Indian Ocean, which began in February and have persisted since then, are still present, though they have weakened slightly since July.

In the northern hemisphere, the trough which, in the mean, extends from 20N, 70E to 15N, 115E, was deeper than average. Examination of the streamline chart shows that it also extends further east than average, connecting with a weak higher latitude trough near 20N, 150E. To the south of this trough the flow was southwesterly rather than southeasterly as in the mean. This anomalous pattern was a persistent feature during the latter half of the month, and corresponded to the similar behaviour of the surface trough.

200 hPa FLOW.

The mean 200hPa streamline and anomaly charts for August are shown in figs. 10 and 11.

In the long term mean for August an upper trough extends from 25N, 180E to 20N, 135E. The mean flow for August 1986 shows two troughs in this region (see fig 10). Examination of the daily charts shows that this double structure is typical of most of the month, only the last few days showing a pattern closer to the mean. The northern hemisphere subtropical ridge is further north than the mean and the outflow to its south is stronger with greater than average cross-equatorial flow east of 120E. The tropical easterly jet was slightly stronger than average east of 120E as a consequence. The outflow from the Tibetan anticyclone appears to have been weaker than the mean, leading to a slightly weaker than average easterly jet to the South of India.

The Southern Hemisphere subtropical jet was considerably stronger than average over Australia.

VELOCITY POTENTIAL AND DIVERGENT WIND.

Charts for the 950 and 200 hPa velocity potential, and the 950 and 200 hPa divergent wind for August are shown in figs. 12, 13, 14, and 15 respectively.

The charts indicate that the expected areas of active convection for the month are over the Bay of Bengal and in the region 15 - 20N , 120-160E. This is confirmed by examination of GMS-3 satellite pictures. The maximum convection over the north Pacific was further North than in July , in accord with the monsoon trough being further North.

WIND CROSS-SECTIONS.

Cross-sections of zonal wind taken through 100E, 130E and 160E, together with a cross-section of the meridional component taken along the equator are shown in figs 16, 17, 18, and 19 respectively.

As noted in the section on 500hPa flow, the maximum in westerly speed near 500 hPa at 40 - 45N, 160E is probably due to spurious observations.

The southern hemisphere subtropical jet is 20 to 30 knots greater in strength than the mean at 130 and 160E, but about normal at 100E. The tropical easterly jet is slightly weaker than average at 100E and slightly stronger than average at 130 and 160E. At 130E there is a stronger than average westerly component from the equator to 20N at low levels. Both the upper jet and low level westerlies are considerably stronger than in July, particularly at 130E and 160E.

The meridional component of the wind along the equator shows slightly greater than average cross equatorial flow in the upper atmosphere. West of 100E the flow has decreased since July, while to the east it has increased. At low levels the maximum cross equatorial flow is displaced about 20 degs eastward of its mean position for the month. As a result, the low level cross equatorial flow east of 100E has increased markedly since July.

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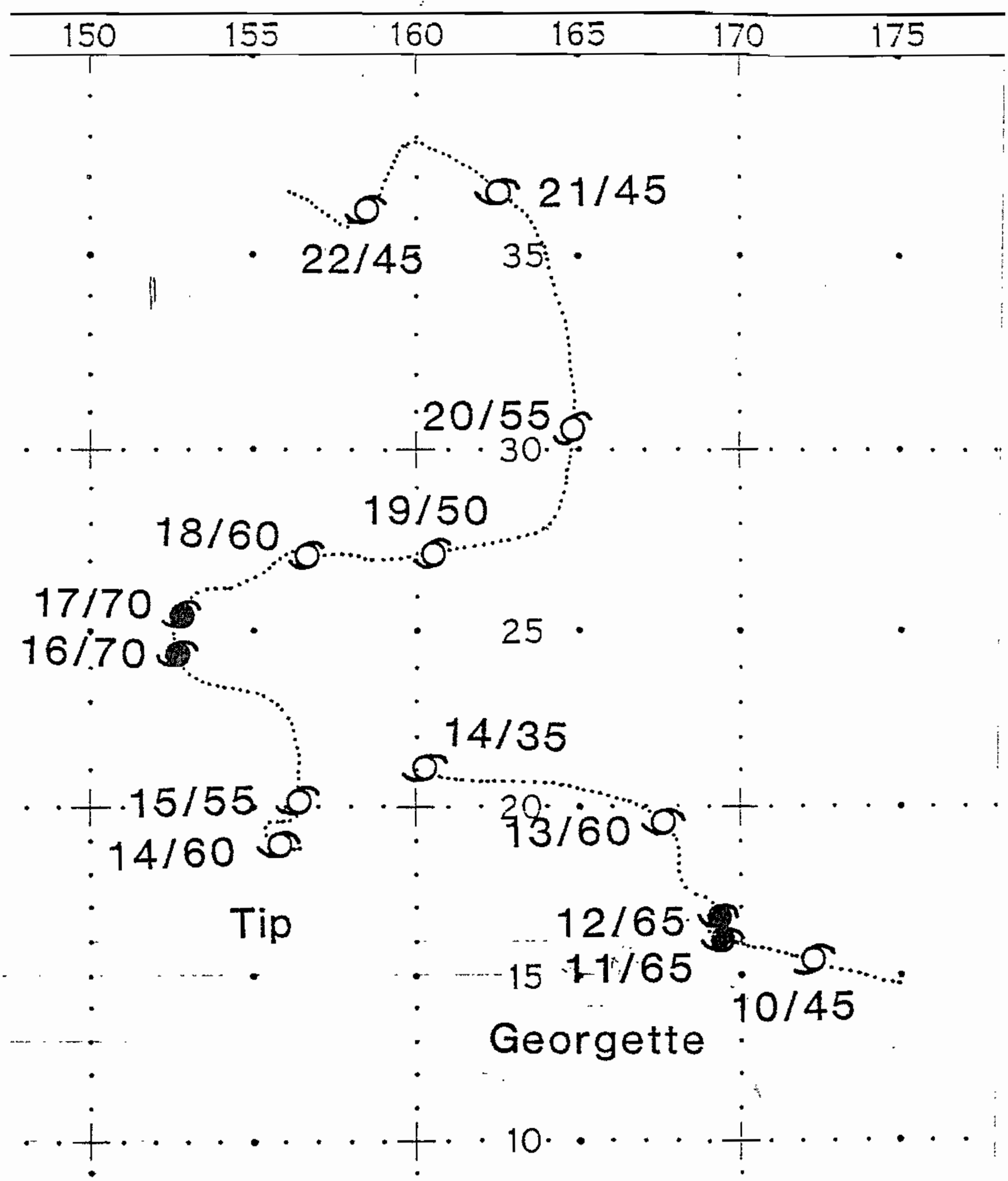

Fig.1a UNOFFICIAL CYCLONE TRACKS OF CYCLONE TIP AND GEORGETTE FOR AUGUST 1986
Date (DD) and maximum sustained wind in knots (ff) are given as DD/ff.

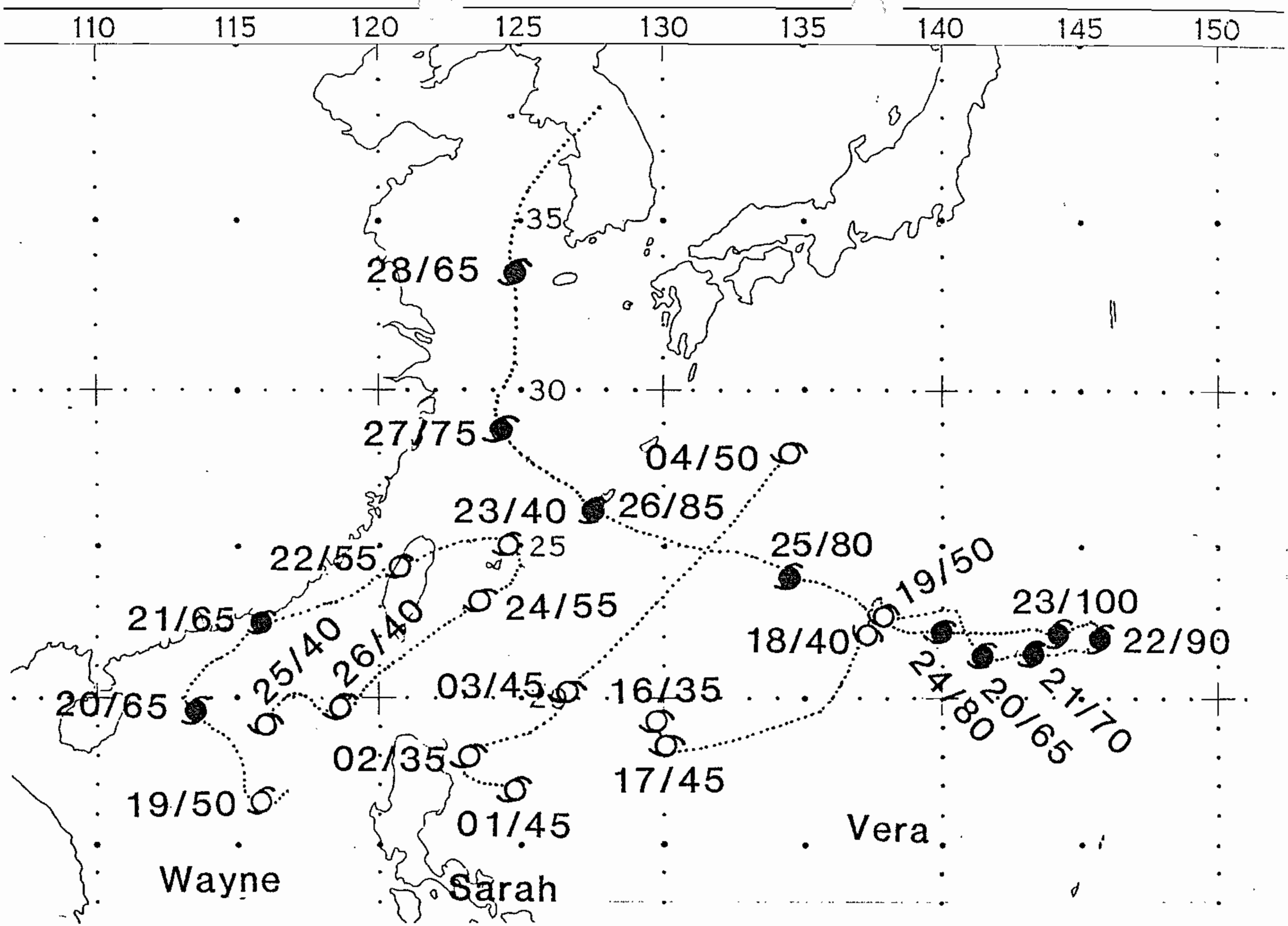

Fig. 1b UNOFFICIAL CYCLONE TRACKS OF CYCLONES WAYNE, SARAH AND VERA FOR AUGUST 1986
Date (DD) and maximum sustained wind in knots (ff) are given as DD/FF

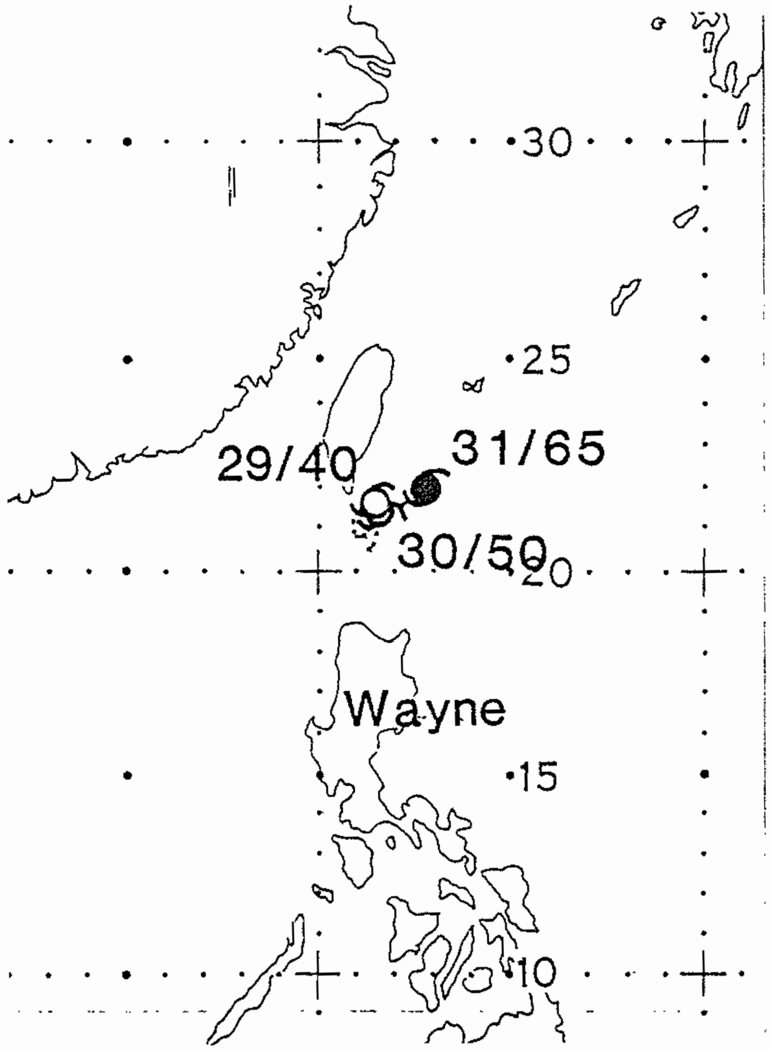

Fig. 1c UNOFFICIAL CYCLONE TRACK OF WAYNE AFTER REDEVELOPMENT FOR AUGUST 1986
Date (DD) and maximum sustained wind in knots (ff) are given as DD/FF

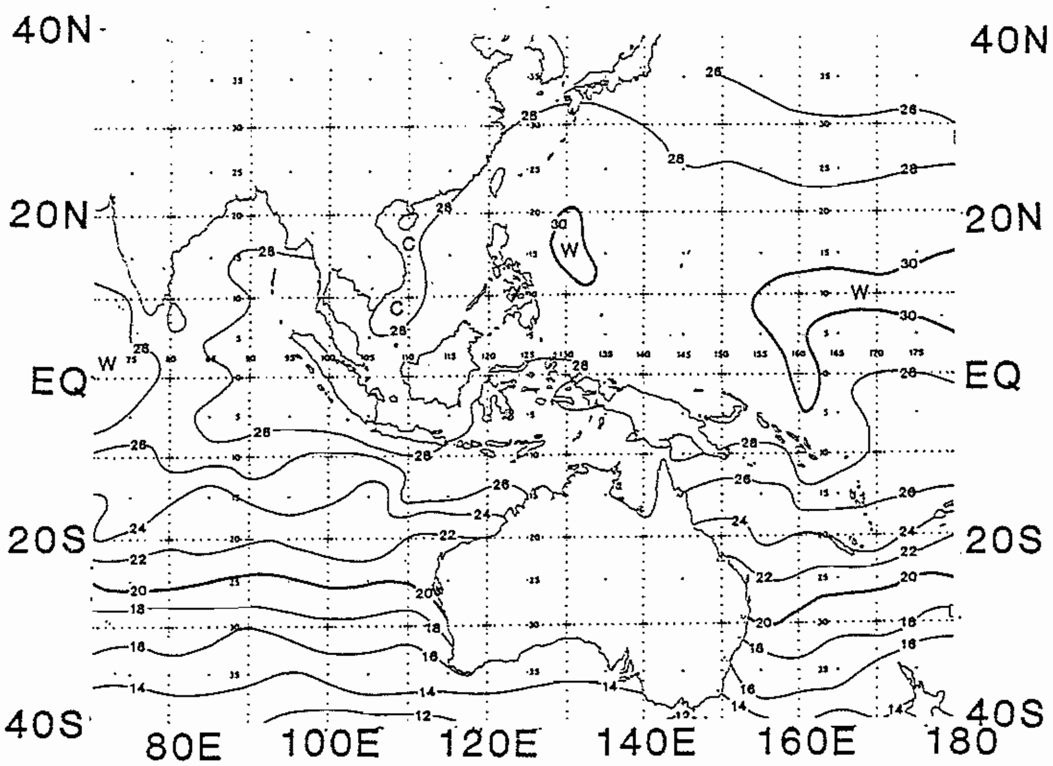

Fig.2 MEAN SEA SURFACE TEMPERATURES, BASED ON DARWIN RMC ANALYSIS AVERAGED OVER THE MIDDLE 2 WEEKS OF AUGUST 1986. (CONTOUR INTERVAL 2 deg C).

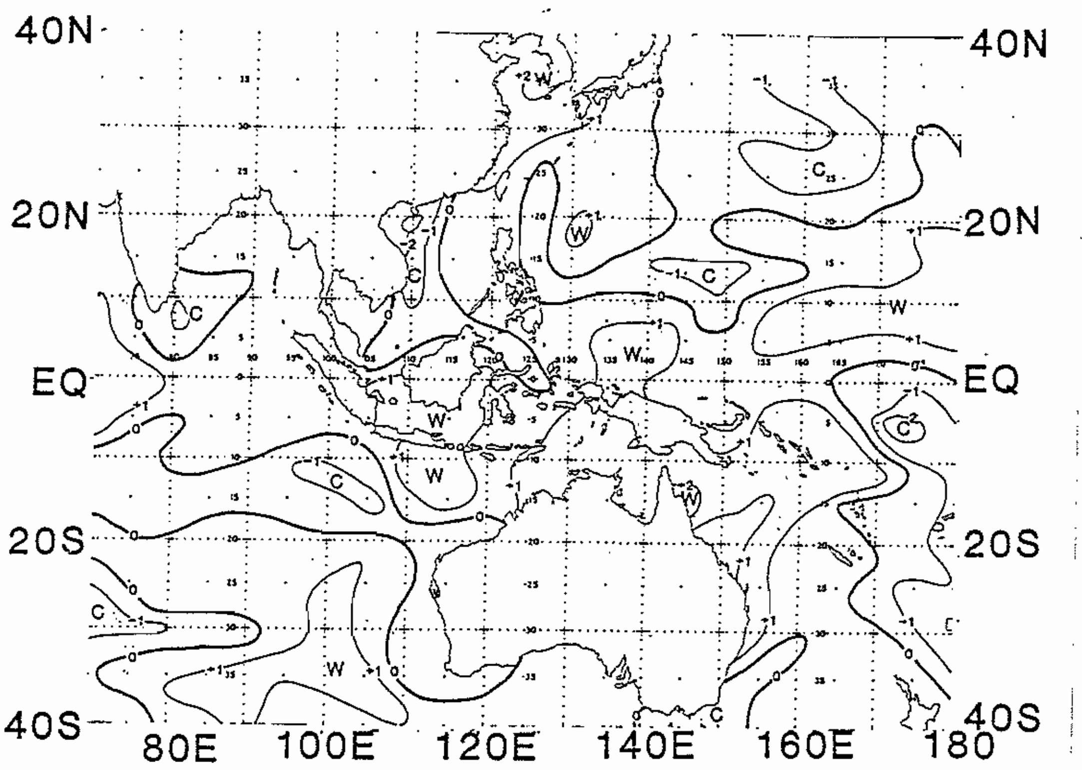

Fig. 3 SST ANOMALY CHART, BASED ON FIG. 2 AND THE CLIMATOLOGY OF REYNOLDS, NOAA REPORT NWS 31, 1983. (CONTOUR INTERVAL 1 deg C).

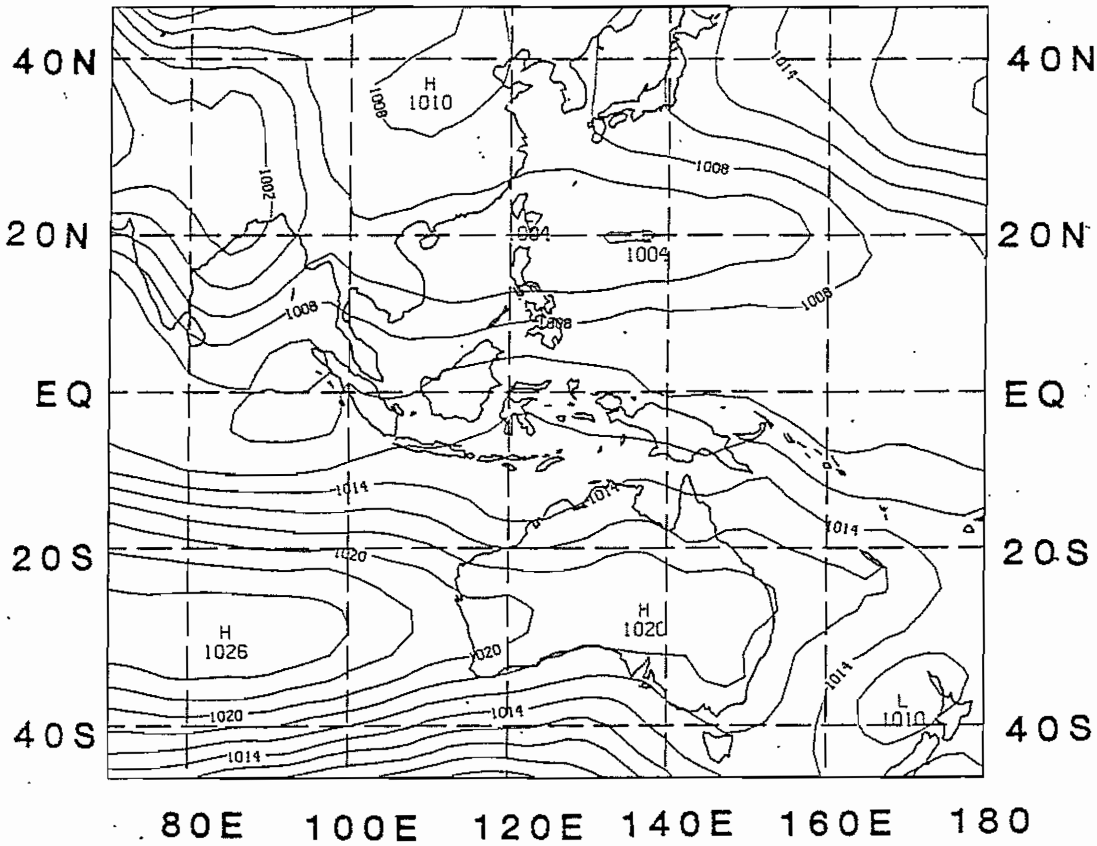

Fig. 4 AUGUST 1986 MONTHLY MEAN MSL PRESSURE (CONTOUR INTERVAL 2 hPa).

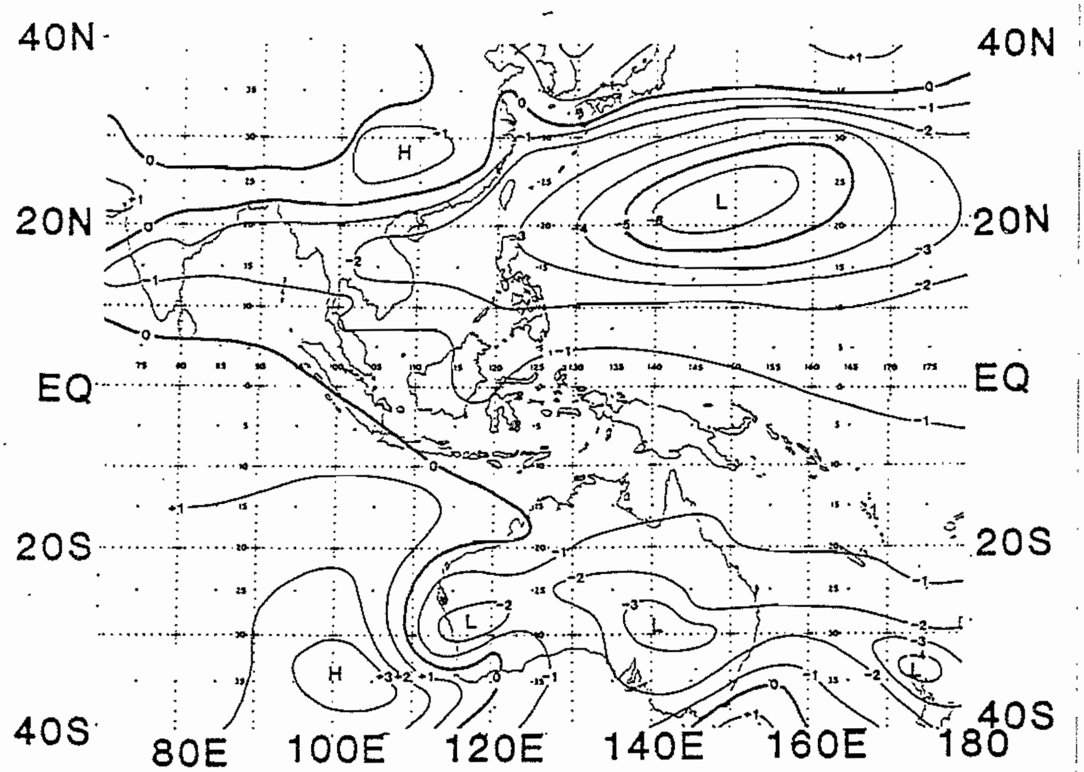

Fig. 5 MSL PRESSURE ANOMALY BASED ON MELBOURNE WMC DATA SOUTH OF 10 DEG S, ADJUSTED TO FIT CLIMATE MESSAGES WHERE AVAILABLE. (CONTOUR INTERVALS 1 hPa).

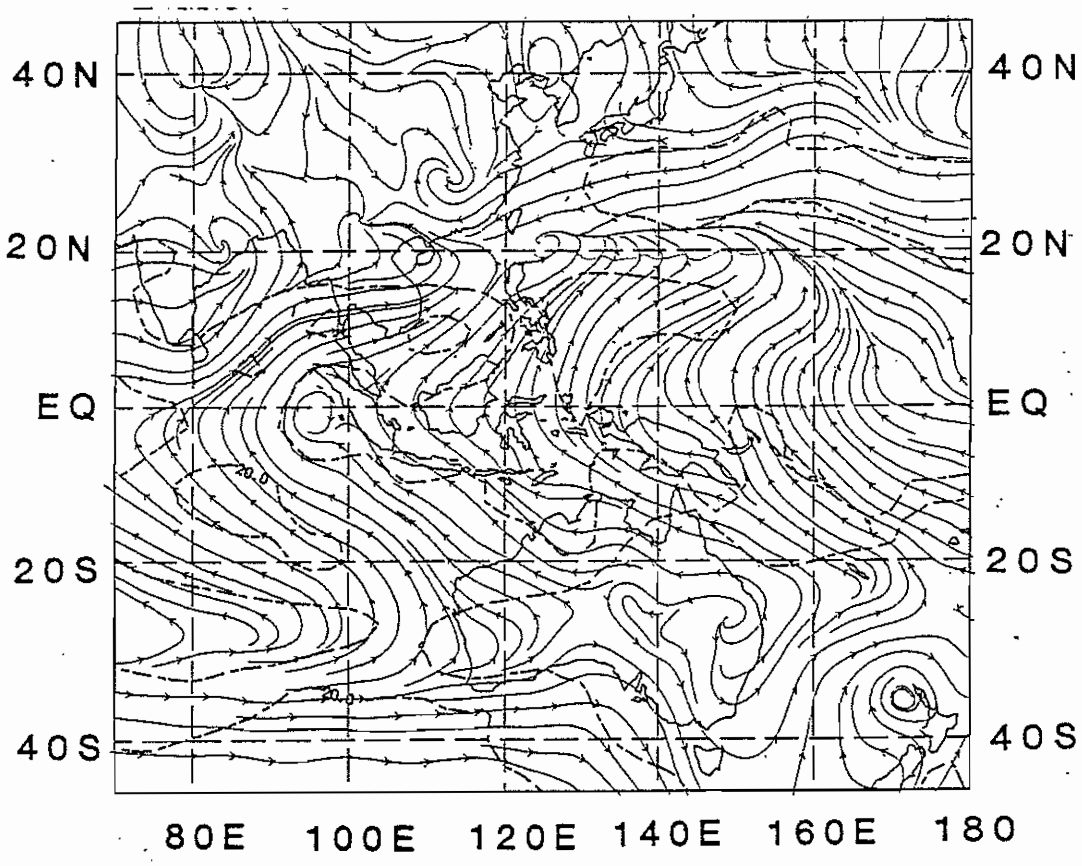

Fig. 6 AUGUST 1986 950 hPa STREAMLINE/ISOTACH ANALYSIS. (10 KNOT INTERVAL ISOTACHS DASHED LINE).

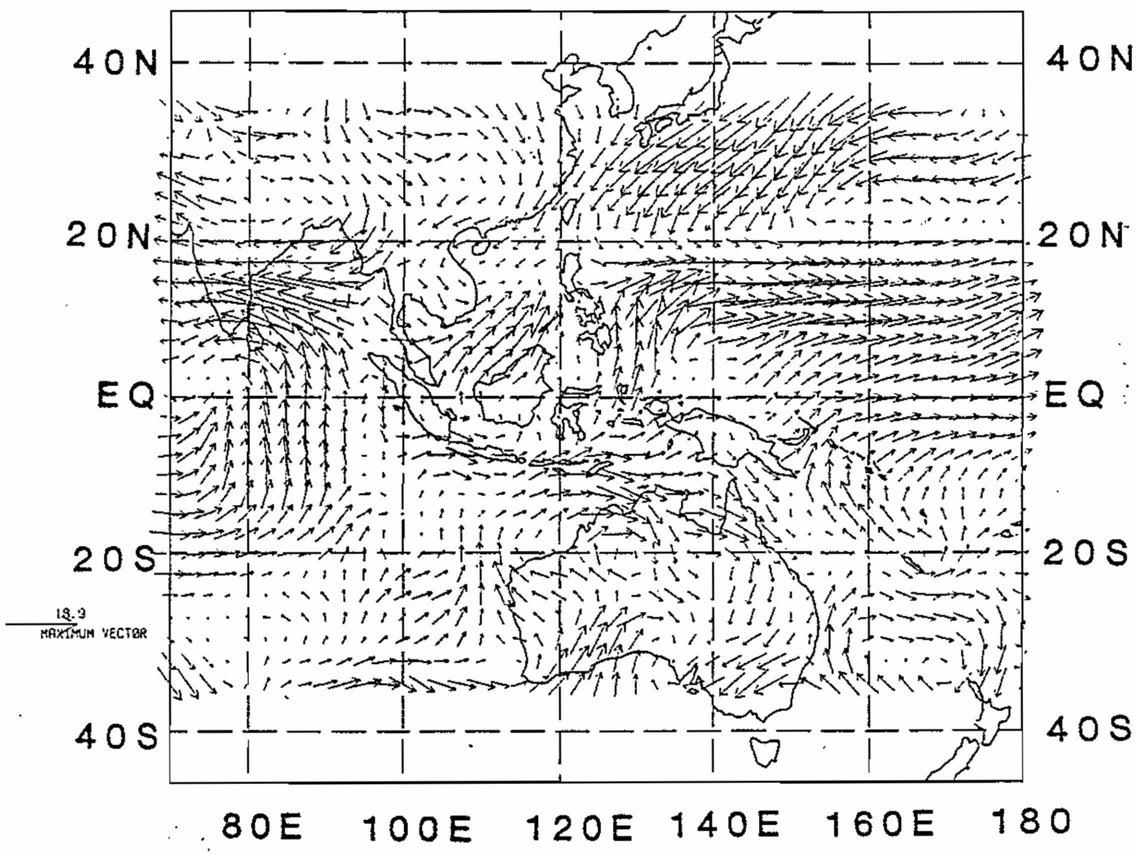

Fig. 7 950 hPa VECTOR WIND ANOMALY BASED ON FIG. 6. (ARROW LENGTH INDICATES MAGNITUDE).

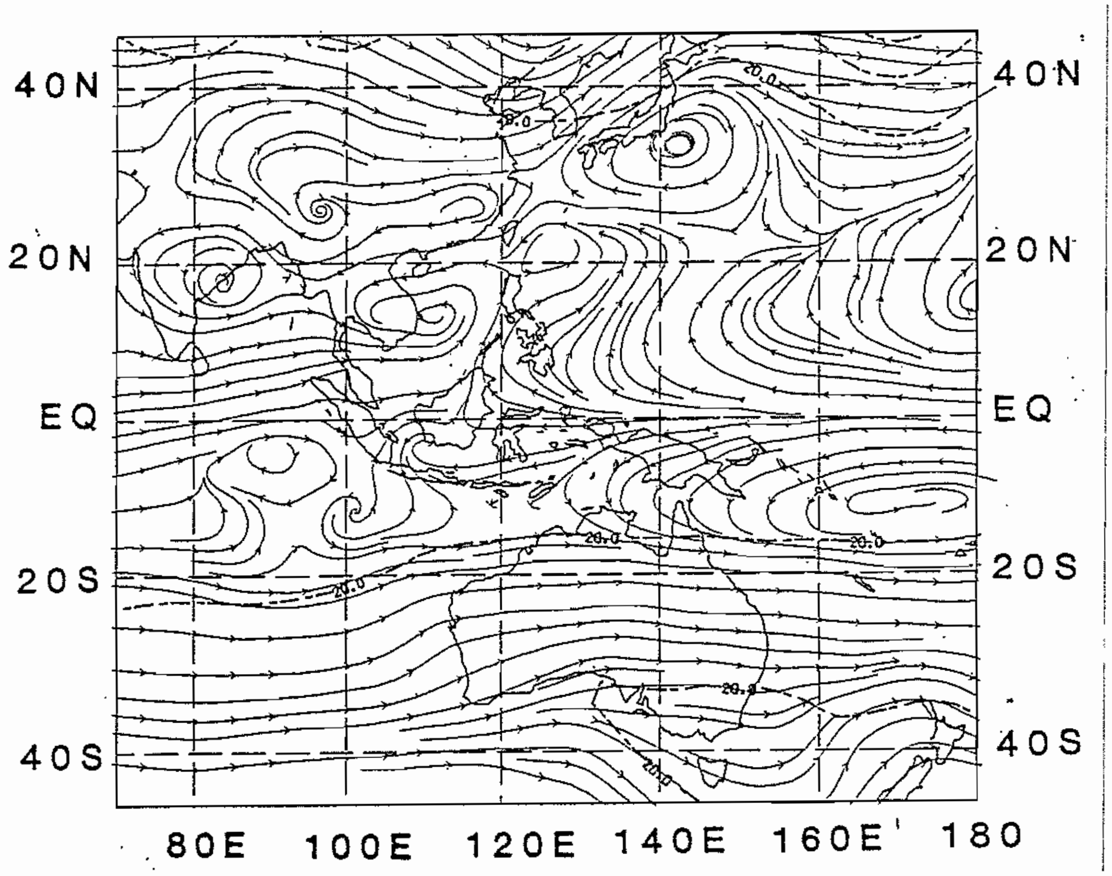

Fig. 8 AUGUST 1986 500 hPa STREAMLINE/ISOTACH ANALYSIS. (20 KNOT INTERVAL ISOTACHS DASHED LINE).

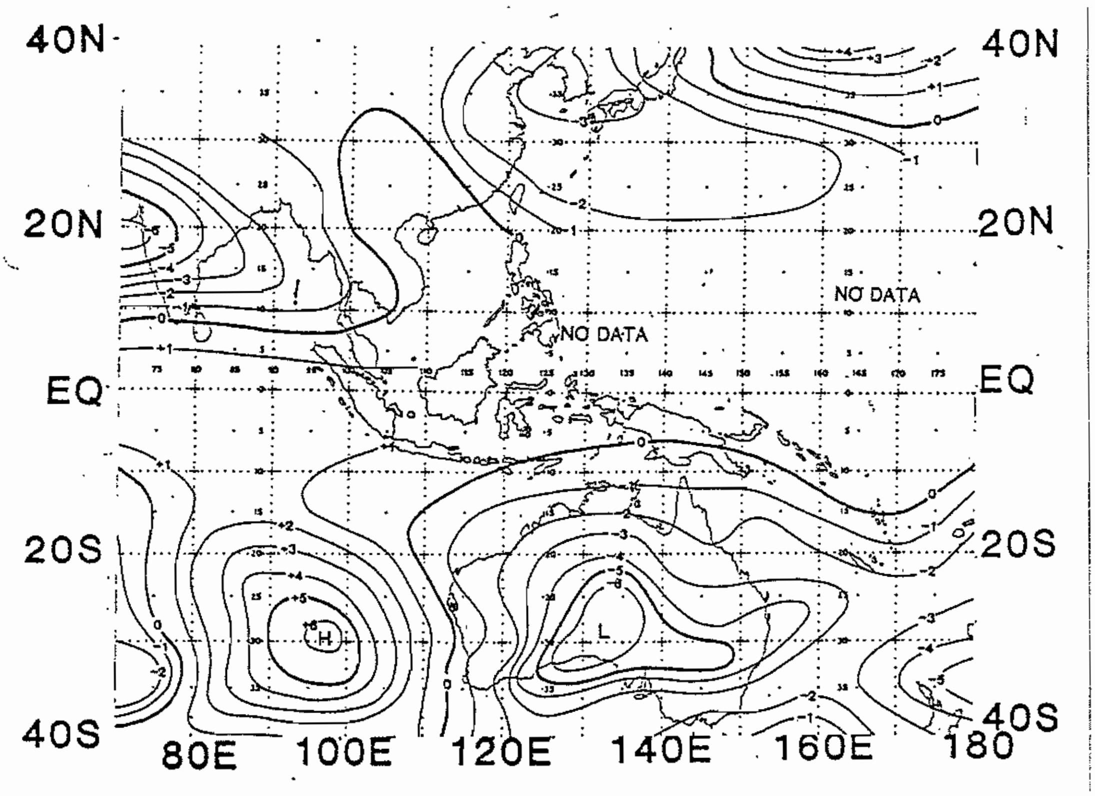

Fig. 9 AUGUST 1986 500 hPa GEOPOTENTIAL HEIGHT ANOMALY. (CONTOUR INTERVAL 1 gpdm) (DATA BASE AS PER FIG. 5).

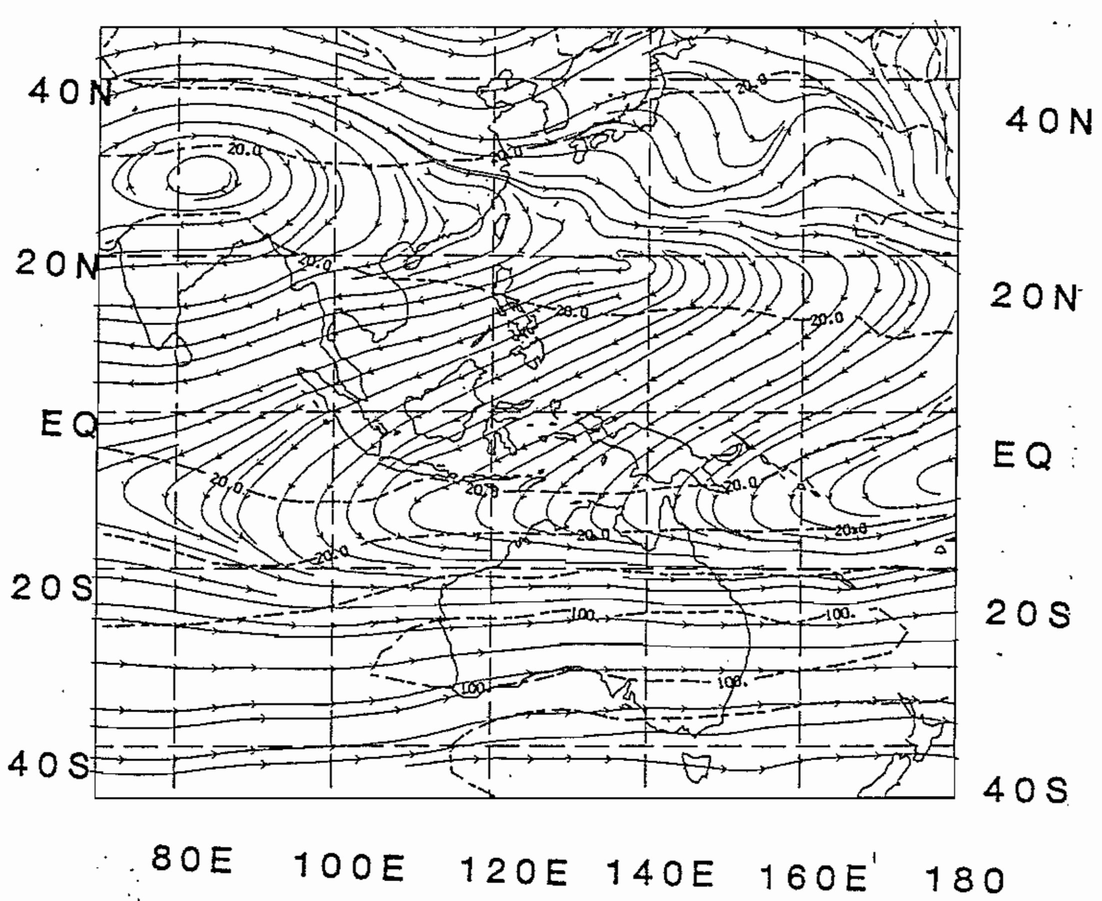

Fig. 10 AUGUST 1986 200 hPa STREAMLINE/ISOTACH ANALYSIS.
(40 KNOT INTERVAL ISOTACH DASHED LINE).

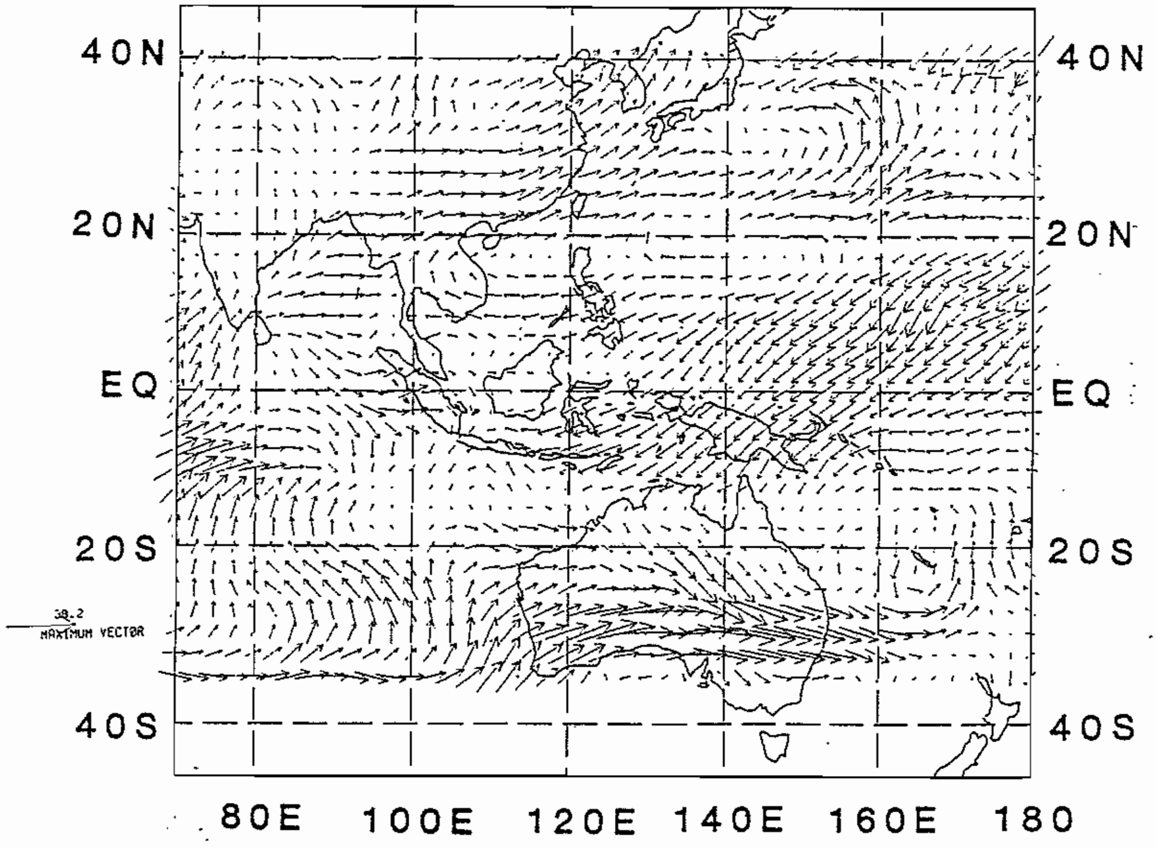

Fig. 11 AUGUST 1986 200 hPa VECTOR WIND ANOMALY.
(ARROW LENGTH INDICATES MAGNITUDE).

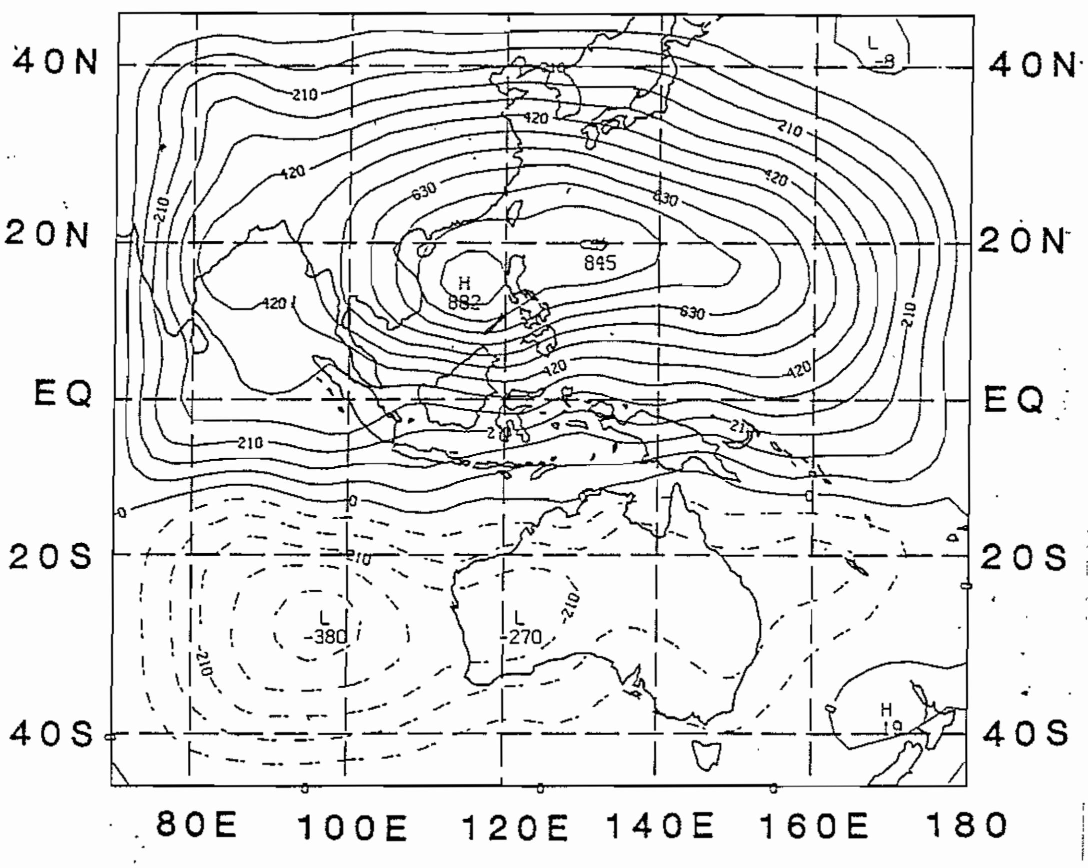

Fig. 12 AUGUST 1986 950 hPa VELOCITY POTENTIAL
(CONTOUR INTERVAL 70 X 10^{5} M^{2} S^{-1}).

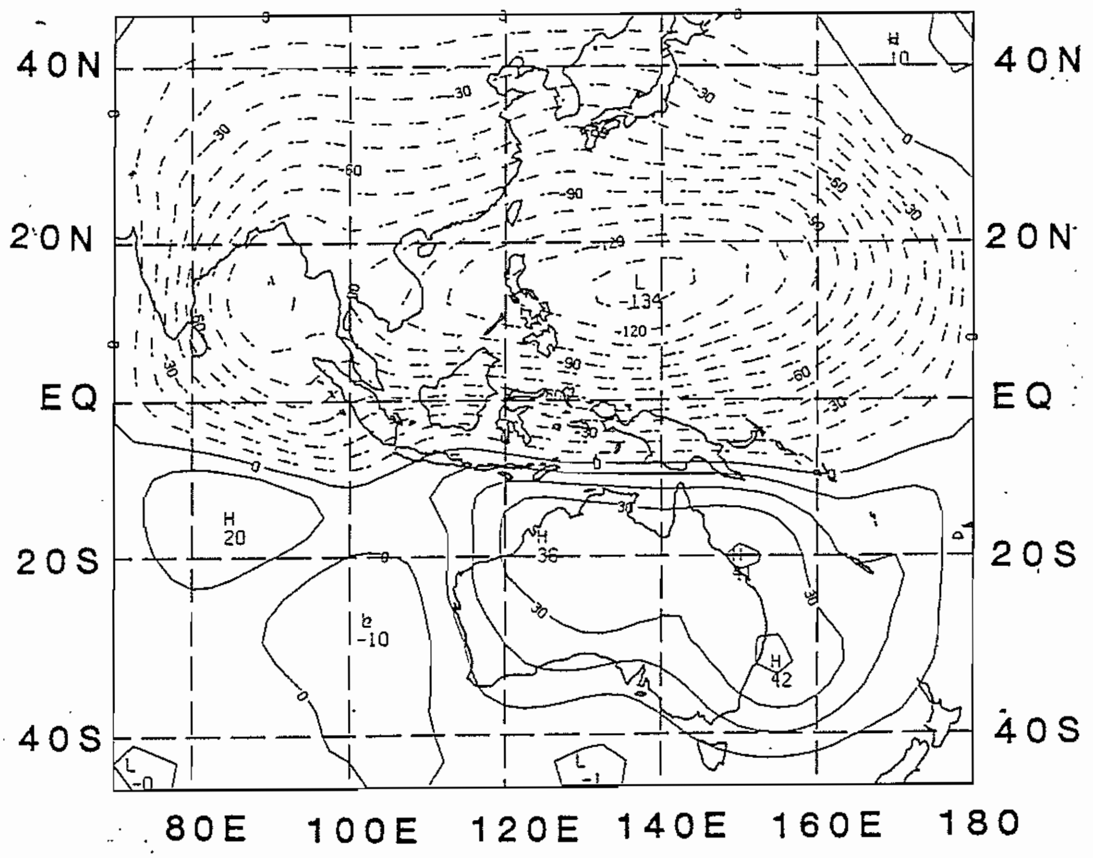

Fig. 13 AUGUST 1986 200 hPa VELOCITY POTENTIAL
(CONTOUR INTERVAL 10 x 10^{5} M^{2} S^{-1})

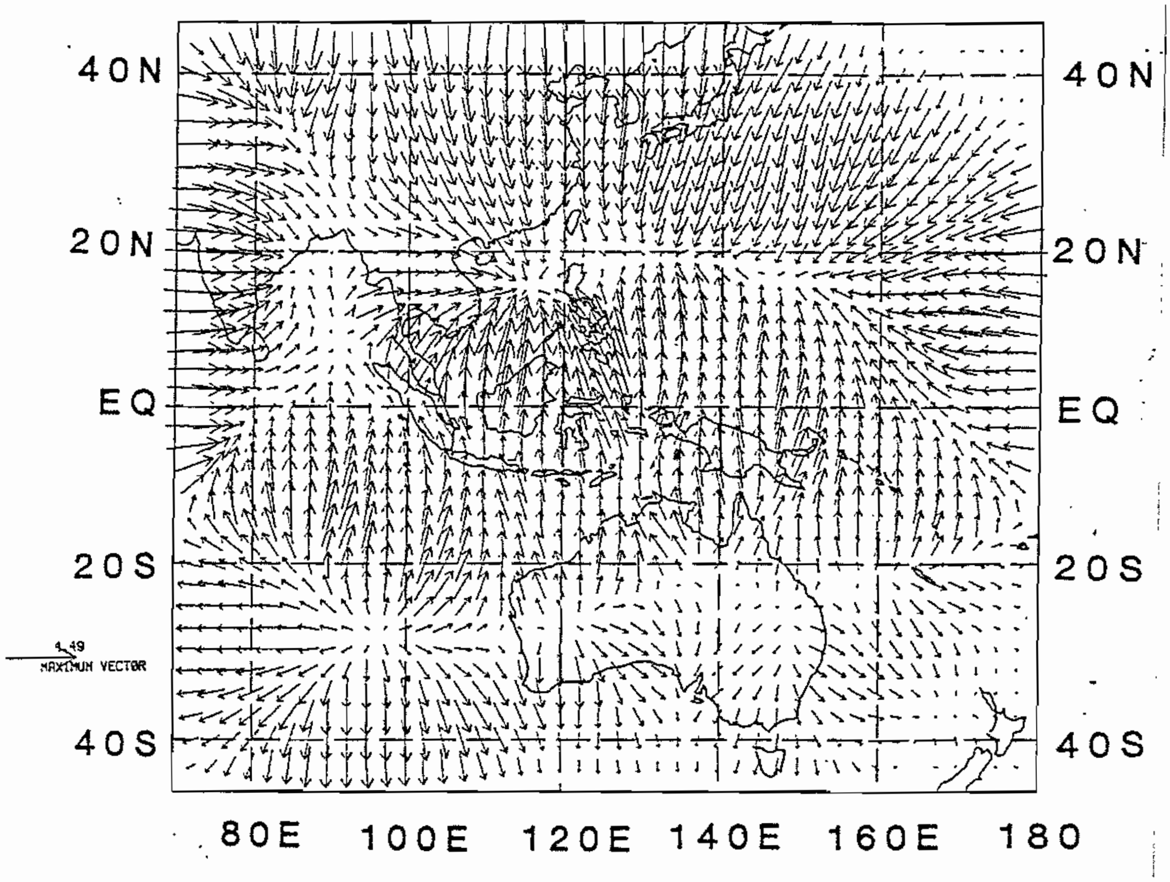

Fig. 14 AUGUST 1986 950 hPa DIVERGENT WIND.
(ARROW LENGTH INDICATES MAGNITUDE).

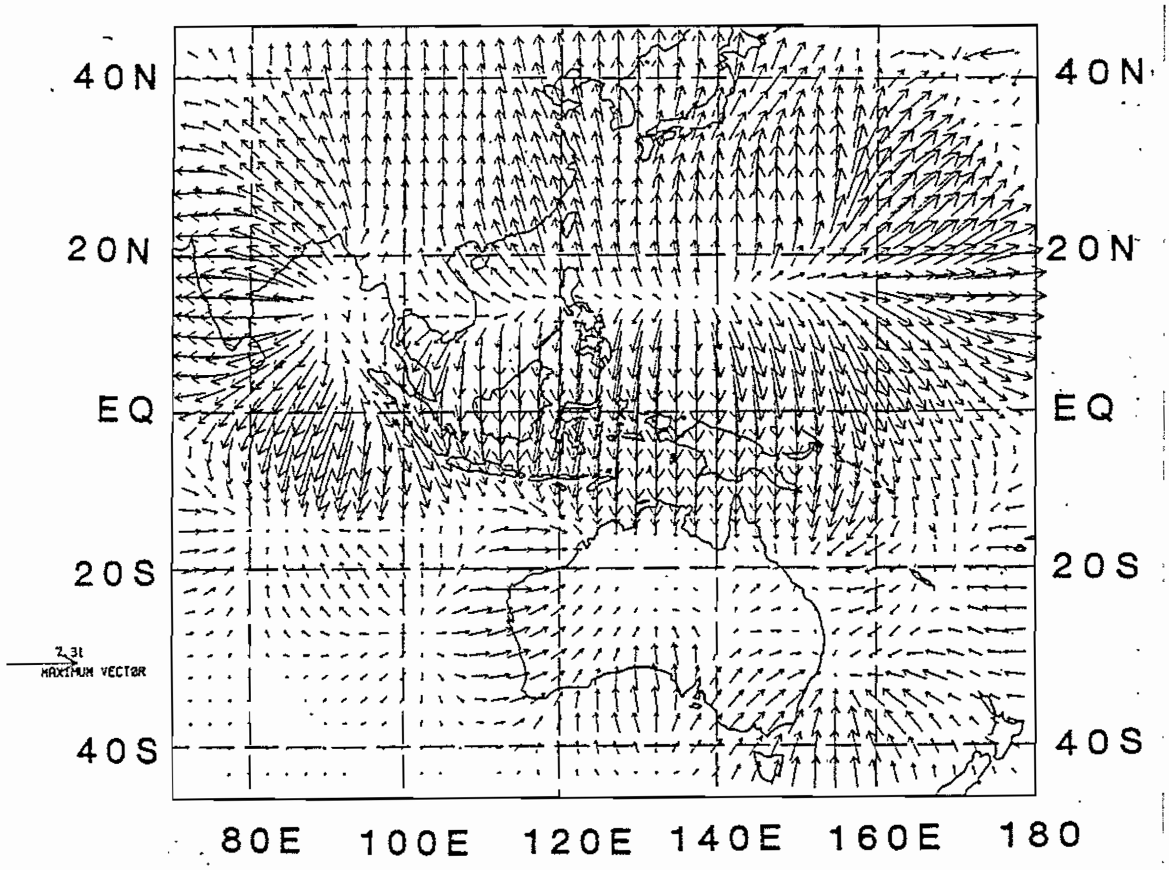

Fig. 15 AUGUST 1986 200 hPa DIVERGENT WIND.
(ARROW LENGTH INDICATES MAGNITUDE).

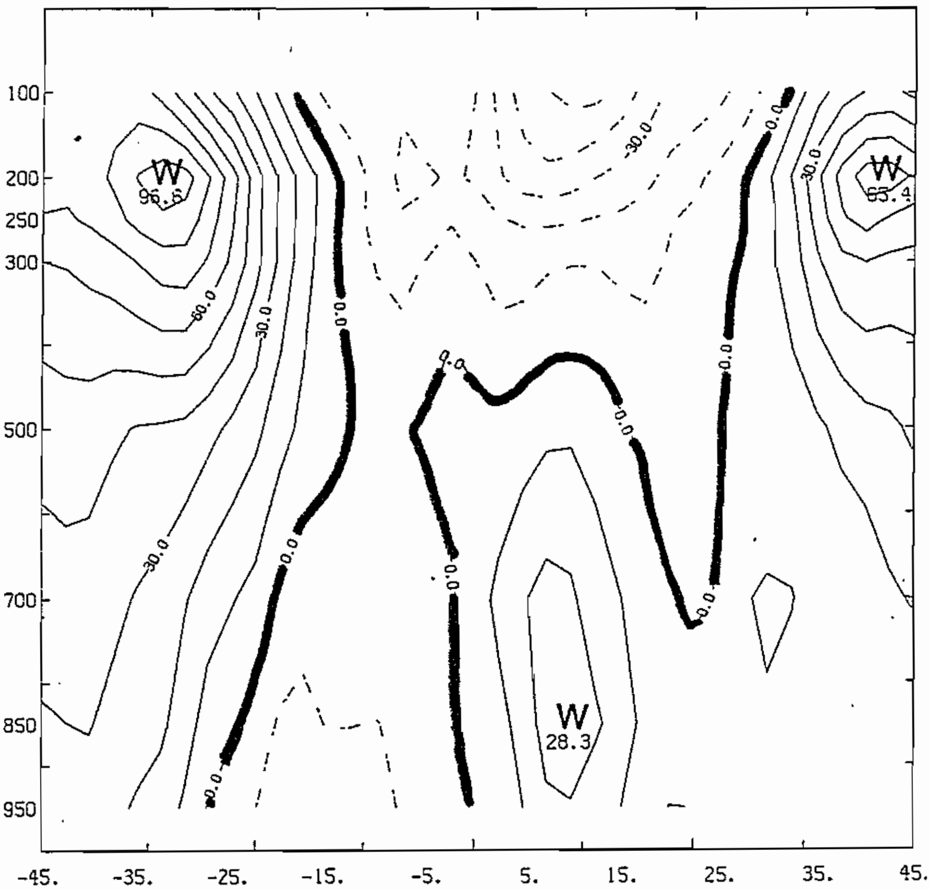

Fig. 16 AUGUST 1986 CROSS SECTION OF ZONAL WIND ALONG 100 DEG E (CONTOUR INTERVAL 10 KNOTS)

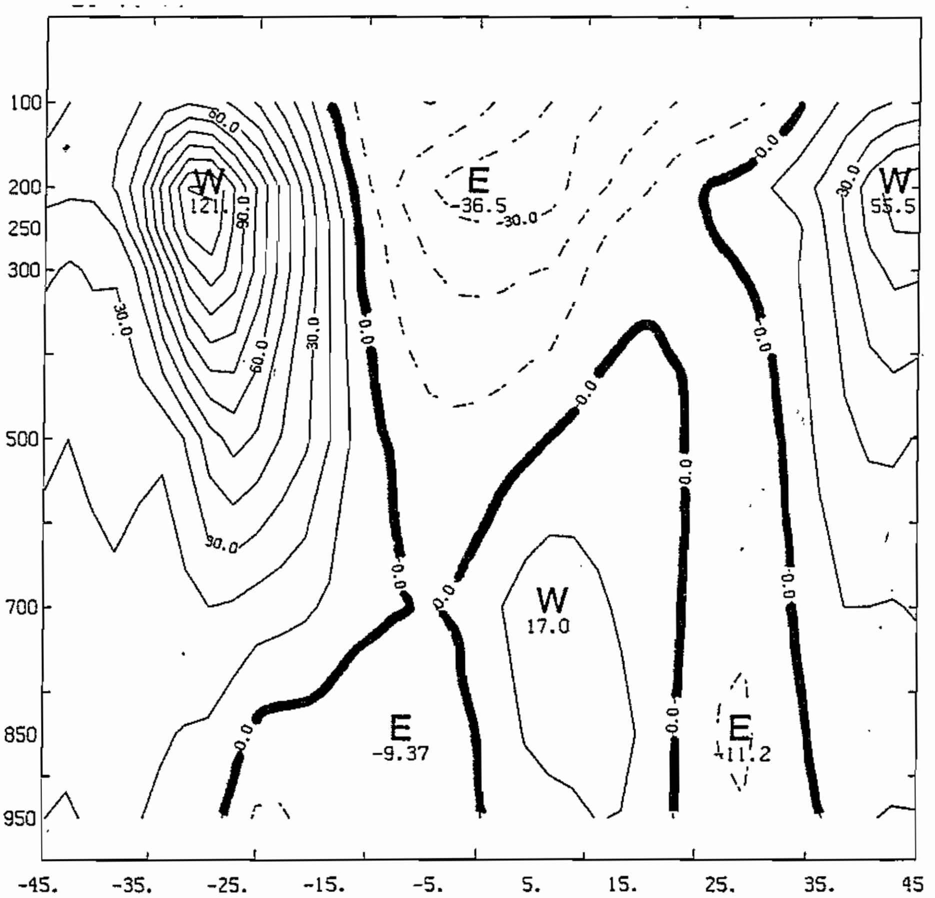

Fig. 17 AUGUST 1986 CROSS SECTION OF ZONAL WIND ALONG 130 DEG E (CONTOUR INTERVAL 10 KNOTS)

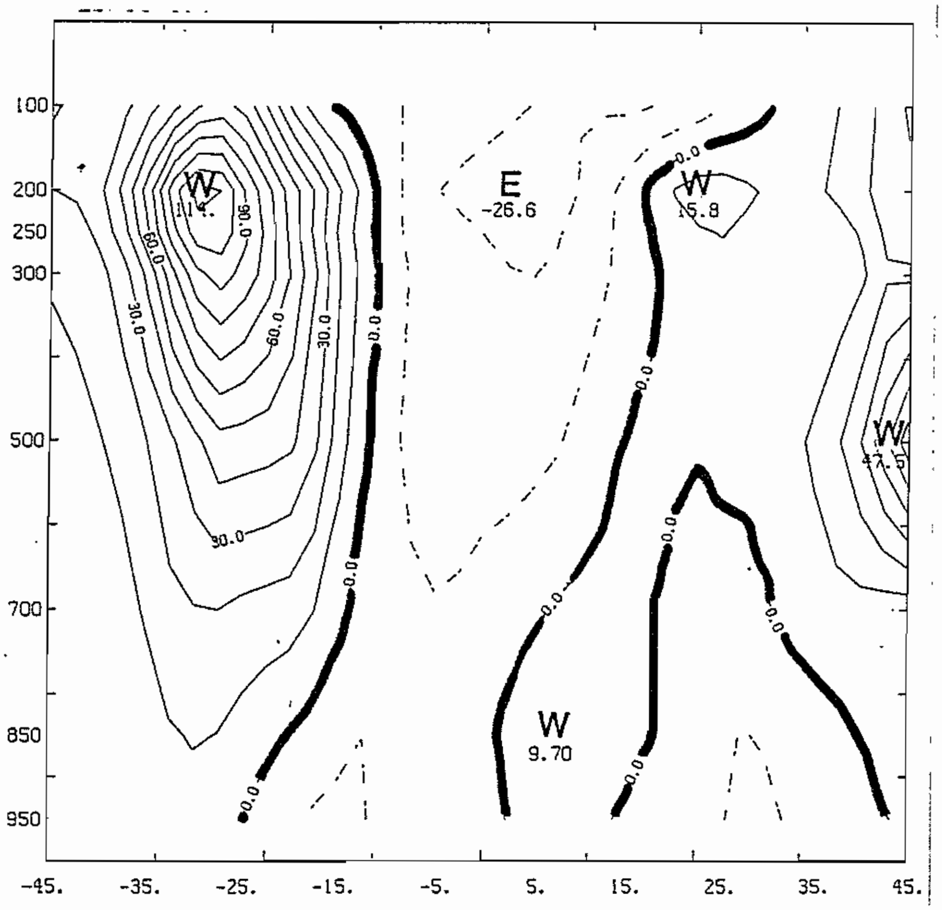

Fig. 18 AUGUST 1986 CROSS SECTION OF ZONAL WIND ALONG 160 DEG E (CONTOUR INTERVAL 10 KNOTS).

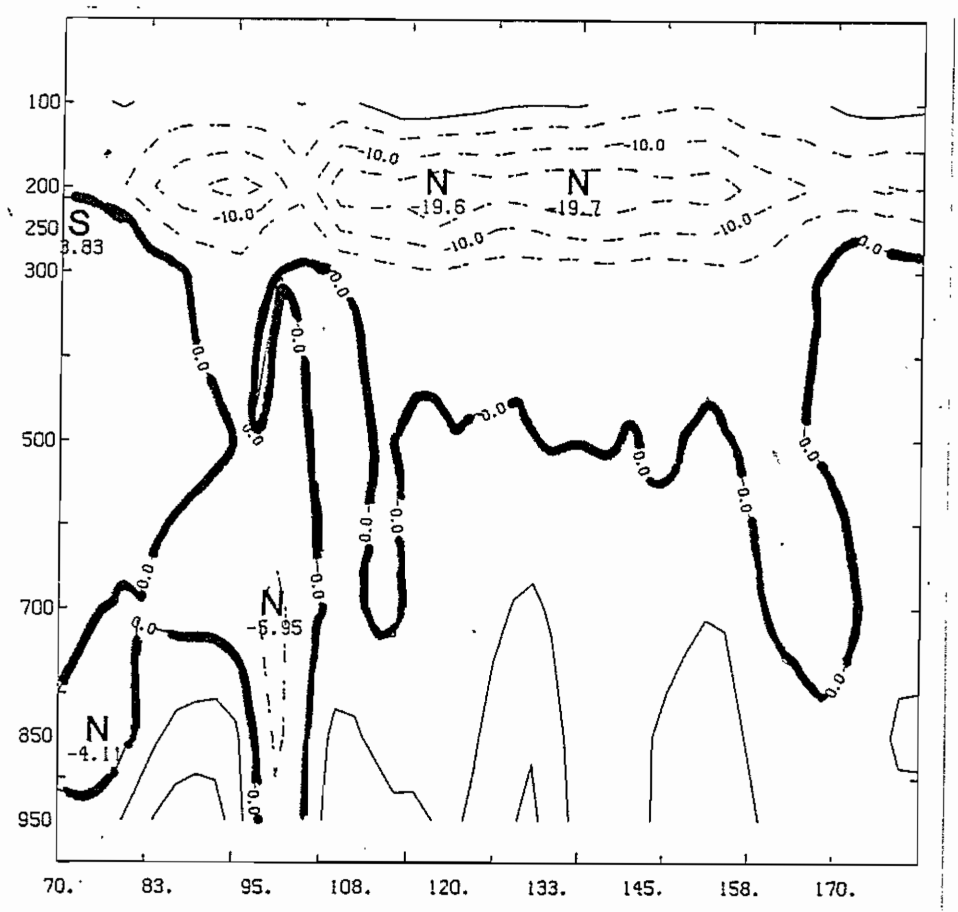

Fig. 19 AUGUST 1986 EQUATORIAL CROSS SECTION BETWEEN 70E and 180E (CONTOUR INTERVAL 5 KNOTS).

Explanatory Notes

1. **Darwin Tropical Diagnostic Statement** is a near real-time monthly diagnostic summary of the major tropical circulations within the Darwin Regional Specialised Meteorological Centre (RSMC) area of analysis responsibility, which covers 40°N-40°S, 70°E-180°. Caution does need to be exercised when quoting from this publication as not all information within it has been confirmed.

2. **Features** discussed generally include:

- . El Niño - Southern Oscillation (ENSO) aspects
- . Tropical cyclone (TC) occurrence
- . Sea surface temperature (SST)
- . Mean sea level pressure (MSLP).
- . Lower and upper level wind
- . Up-motion and convection
- . Intra-seasonal variability

3. **Data sources:**

(i) $SOI = 10 \times (\Delta P_{TAH} - \Delta P_{DAR}) / \sigma$

where ΔP_{TAH} =Tahiti (91938) monthly pressure anomaly (monthly mean minus 1933-1992 mean, averaging 3-hourly observations)

ΔP_{DAR} = Darwin (94120) monthly pressure anomaly (monthly mean minus 1933-1992 mean, averaging 0900, 1500LT observations)

σ = monthly deviation of the difference.

(ii) Operational tropical cyclone tracks based upon Darwin RSMC manual operational analyses. A tropical cyclone or cyclonic storm is defined as having mean wind > 17 ms^{-1} (34 kn) or a named system. Standard practice is to accept intensity and position as promulgated by the responsible warning agency, whenever possible. This may cause apparent discontinuities in intensity or track when cyclones cross warning area boundaries. Limited post analysis may sometimes be performed when warranted. A severe TC (equivalent to typhoon or hurricane) or very severe cyclonic storm is defined as having mean wind > 32 m s^{-1} (63 Kn).

(iii) Tropical cyclone climatology for the northwest Pacific and the south Indian and Pacific Oceans is based on *2004 Annual Tropical Cyclone Report*, by Atangan, J.F. and Preble, A., (2004), US Naval Pacific Meteorology and Oceanography Center/ Joint Typhoon Warning Center, Pearl Harbour, Hawaii, USA, (available at https://metoc.npmoc.navy.mil/jtwc/atcr/2004atcr/), which contains a climatology of 59 years. North Indian Ocean records are taken from WMO *Technical Document No. 430, Tropical Cyclone Report No.TCP-28* (Mandal, 1991), which contains a 99 year climatology.

(iv) SST analysis based on Darwin RSMC automated operational analyses (RSMC subset of the Australian National Meteorological and Oceanographic Centre (NMOC) global analysis: blended *in situ* and satellite data, 1°C resolution). The 1°x 1° global SST climatology from the US National Centers for Environmental Prediction (Reynolds and Smith 1995). A high resolution global sea surface temperature climatology, *J. Clim., 8*, 1571-1583 is used for the calculation of anomalies and as the default field for the analysis first guess.

(v) Mean MSLP, upper wind data, anomalies and velocity potential data from the Bureau of Meteorology's Global Assimilation and Prediction System (GASP - refer Bourke et al 1990. The BMRC global assimilation and prediction system. *ECMWF Seminar proceedings: Ten years of medium-range weather forecasting*, Sep 89) and NCEP2 22 year climatology, 1979-2000. MSLP anomaly analysis modified using CLIMAT messages.
Upper level equatorial cross section derived from Darwin RSMC real-time Tropical Limited Area Prediction Scheme (TLAPS - refer Puri et al, 1996, *BMRC Research Report No. 54, 41*).

(vi) The mean seasonal cycles for the Darwin 850 hPa wind components were constructed by averaging daily values over 39 years (1950 to 1988), each curve smoothed with 600 passes of a three day running mean weighted 1-2-1.

(vii) OLR time longitude plots and maps derived from the US National Oceanic and Atmospheric Administration.

4. **Some commonly-used acronyms:**

ISO	- Intra-seasonal oscillation
JMA	- Japan Meteorological Agency
JTWC	- Joint Typhoon Warning Center, Pearl Harbour
MT	- Monsoon trough
NET	- Near-equatorial trough
PAGASA	- Philippine Atmospheric, Geophysical and Astronomical Services
PNG	- Papua New Guinea
RSMC	- Darwin Regional Specialised Meteorological Centre (see note 1)
SCS	- South China Sea
SPCZ	- South Pacific convergence zone
STR	- Subtropical ridge
TD	- Tropical depression
TC	- Tropical cyclone (see note 3(ii))
STC	- Severe tropical cyclone
CS	- Cyclonic storm
VSCS	- Very severe cyclonic storm
TS	- Tropical storm (generally used for TC in northern Hemisphere sector)
TUTT	- tropical upper tropospheric trough

5. **Subscription rates** All costs in $AUSTRALIAN:

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	36.00 (Rest of the world)	122.80

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