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DARWIN TROPICAL DIAGNOSTIC STATEMENT

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DARWIN TROPICAL DIAGNOSTIC STATEMENT

FEBRUARY 1986

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17 March 1986

INDICES

The Darwin mean MSL pressure for February was 1006.9 mb, 0.5 mb above the 1938/83 mean, while the Tahiti monthly mean MSL pressure was 1009.2 mb, 2.0 mb below the long term mean. These give Troup's Southern Oscillation Index as - 11, with a five month running mean, centred on December, of -2. These figures are all based on long term means calculated using the period 1938-1983.

TROPICAL CYCLONES

Six Tropical Cyclones werenamed in the Southern Hemisphere from 70E to 180E during February, all of which formed on the monsoon trough. Unofficial tracks are shown in figs. 1(b)-(f). Winifred formed during January and crossed the North Queensland coast at about 0900Z on February 1, causing extensive damage. Selwyn and Tiffany, which both moved towards the southwest, were short-lived, marginal systems. Rhonda, Keli and Filomena all dissipated over water. The erratic track of Filomena between February 9 and 11 appears to have been due to difficulties in locating the centre twoards the end of its life.

Four of these tropical cyclones occurred between 105E and 165E, close to the February average of 3.8 (Bureau of Meteorology Statistics 1959/1980).

One tropical cyclone Judy, formed in the Northwest Pacific during February. Its unofficial track is shown in fig. 1 (a). Judy formed unusually close to the equator in the equatorial buffer zone and reached typhoon strength before dissipating over water. According to JTWC statistics, Judy was the third typhoon in February in the Northwest Pacific since 1945.

SEA SURFACE TEMPERATURES

The mean sea surface temperature (SST) and SST anomalies averaged over the two week period February 4 to 17 are shown in figures 2 and 3.

Major changes in the SST anomalies in the tropics since January are the disappearance of the cold anomaly south of Java which extended southward along 110E, the disappearance of the warm anomalies in the Bay of Bengal and west of New Guinea, the intensification of a cold anomaly along the Chinese coast in the vicinity and to the south of Taiwan, and a warming trend near the equator east of 160E. The intensification of the cold anomaly along the coast of China may be associated with the stronger than average northerly component of the surface wind in that region during January and February. The data suggest a warming of the central equatorial Pacific with respect to the tropics north and west of Australia. This is consistent with the negative SOI for February.

MSL AND GRADIENT LEVEL FLOW

The mean monthly MSL pressure and anomaly charts are shown in figures 4 and 5. The mean monthly 950 mb streamline and 950 mb anomaly charts are shown in figures 6 and 7. Over the North Pacific the MSL anomaly chart is based on a chart produced by the Japan Meteorological Agency; little confidence is placed in the analysis east of 130E between the equator and 15N, and east of 170E southwards to 30S, due to lack of data.

The 950 mb wind anomalies are similar on the large scale to those of January. A stronger than average northerly component to the trade flow over the South China Sea and east of the Philippines has persisted, with the westerly anomaly east of 150E in January strengthening and extending southwards and westwards. The westerly anomaly over the Bay of Bengal has decreased while the easterly anomaly east of New Guinea appears to have weakened slightly since January. The southerly anomaly near 110E in Australian latitudes has been present since November and has not changed significantly in strength since January.

Although the 950 mb streamline about and the latitudinal cross section along the equator (fig. 19) show a northerly component of flow along the equator over almost all of the region, the anomaly chart shows that on average the cross equatorial flow was weaker than the mean.

The January northwesterly anomalies over the Arafura Sea and the top of Australia's Northern Territory weakened leading to a reduction in monsoonal rainfall over Northern Australia.

At low latitudes the MSL pressure anomalies are also similar to their January values, the main differences being the absence of negative anomaly centres near the northeast and northwest coasts of Australia and east of the Philippines. The most significant anomalies occur in the north Pacific Ocean. In the area covered by our analyses, the strong negative anomaly there appears to have been due to an abnormally large number of low centres propagating through the region north of 20N, particularly during the first and last thirds of the month.

Longitudinal, cross sections at 100E, 130E and 160E (figs. 16-18) show weakening of the monsoon westerlies at 130E and their strengthening 100E when compared with January conditions. The easterly flow south of the equator at 106E is seen to be weaker than in January.

500 MB FLOW

The mean 500 mb streamline analysis and geopotential height anomaly charts are shown in figs. 8 and 9. Again, in the tropics, the flow and anomalies were broadly similar to those in January.

The negative anomalies over the North Pacific and India/Indochina increased, and that over the North Pacific extended eastward. A negative anomaly over Northwest Australia in January was replaced by a positive anomaly in February. This difference may have been due to the weakening of the persistent MSL anticyclone in the Australian Bight and the consequent reduction of cold air advection over the continent at low levels.

The major midlatitude trough in the Northern Hemisphere was further west than in January while the major trough in the Southern Hemisphere was again over the Tasman Sea and stronger than the mean, again extending back into the monsoon shear line to a closed circulation northwest of Darwin.

200 MB FLOW

The mean 200 MB analysis is shown in fig. 10 and the vector wind anomaly chart in fig. 11. The flow was closer to the mean in tropical regions than in January, with stronger than average subtropical jets over Australia and China, and a stronger than average ridge to the east of Japan. The cross equatorial flow was very close to average over most of longitude range, the only exception being to the northeast of the outflow centre near Honiara, which was more active than average. Fig. 19 shows that the greatest upper cross equatorial flow occurred in that region. In January the outflow centre was displaced westward from its climatological position, resulting in reduced storm activity over the Southwest Pacific. By February, however the centre had moved eastward again, with the result that the Southwest Pacific was an area of persistent cloudiness.throughout the month

Figures 16-18 show that the subropical jet in both hemispheres was strongest in Australian latitudes. Their strength was about the same as in January.

DIVERGENT COMPONENT OF WIND

Charts of the 950 mb and 250 mb velocity potential and divergent wind are shown in figs. 12 to 15. They are very similar to the corresponding charts for January. They suggest that the areas of most persistent convection are Indonesia, New Guinea and the Southwest Pacific. Areas of suppressed convection are indicated to be the Bay of Bengal and the northwest half of the South China Sea. Examination of satellite photographs shows this to be essentially correct. The most persistent area of tropical convection was to the east and southeast of New Guinea. Further westward, monsoon activity was more sporadic particularly over Northern Australia where the monthly rainfall was well below average. Major changes since January were the lack of convective activity over the Bay of Bengal and the movement of the main centre of monsoon activity from Indonesia and Northern Australia to the Southwest Pacific. Neither of these changes is obvious from figs. 12 to 15.

SUMMARY

In the Southern Hemisphere the monsoon trough was most active over the Southwest Pacific. In Indonesian and Australian longitudes activity was intermittent and generally well north of Australia, leading to below average rainfall over northern Australia. These trends are consistent with the SOI being negative.

In the Northern Hemisphere stronger than average trade winds continued over the South China Sea.

The most notable anomalies for the month occurred in the midlatitudes of both hemispheres where large negative anomalies in MSL pressure and 500 mb geopotential height were recorded.

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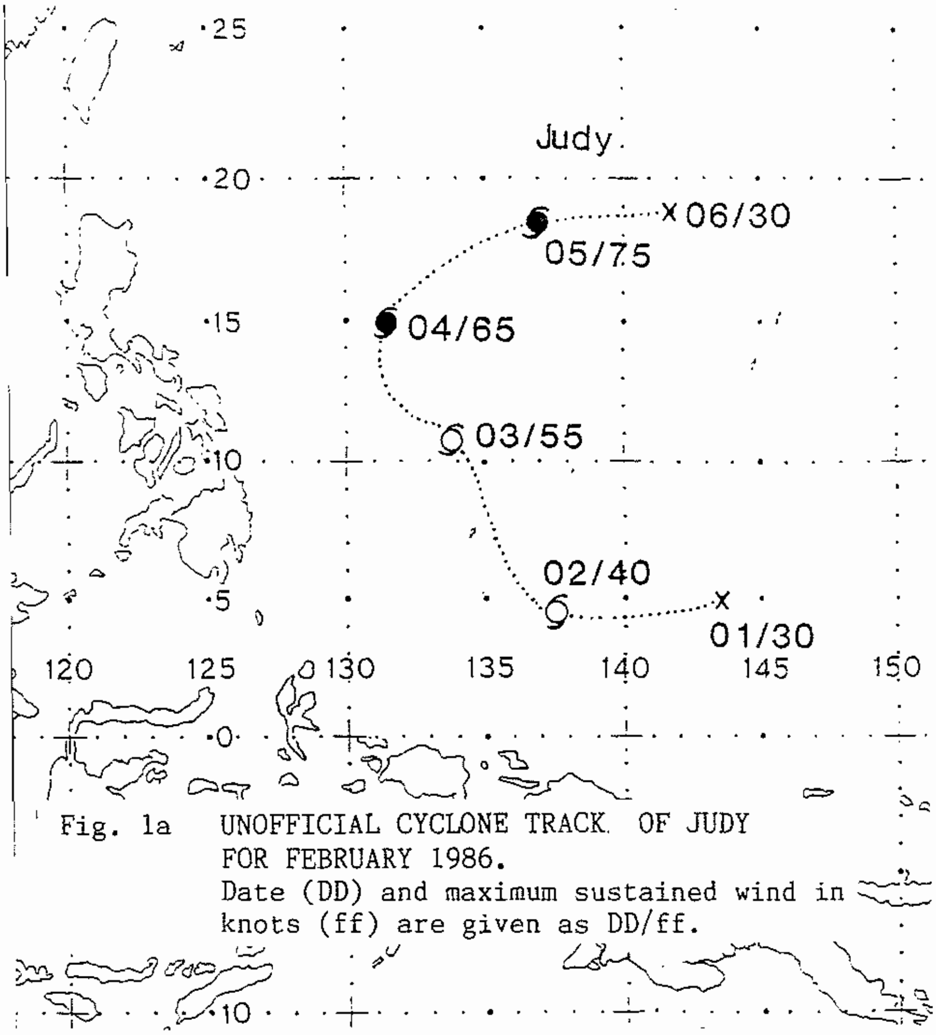

Fig. 1a UNOFFICIAL CYCLONE TRACK OF JUDY FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in knots (ff) are given as DD/ff.

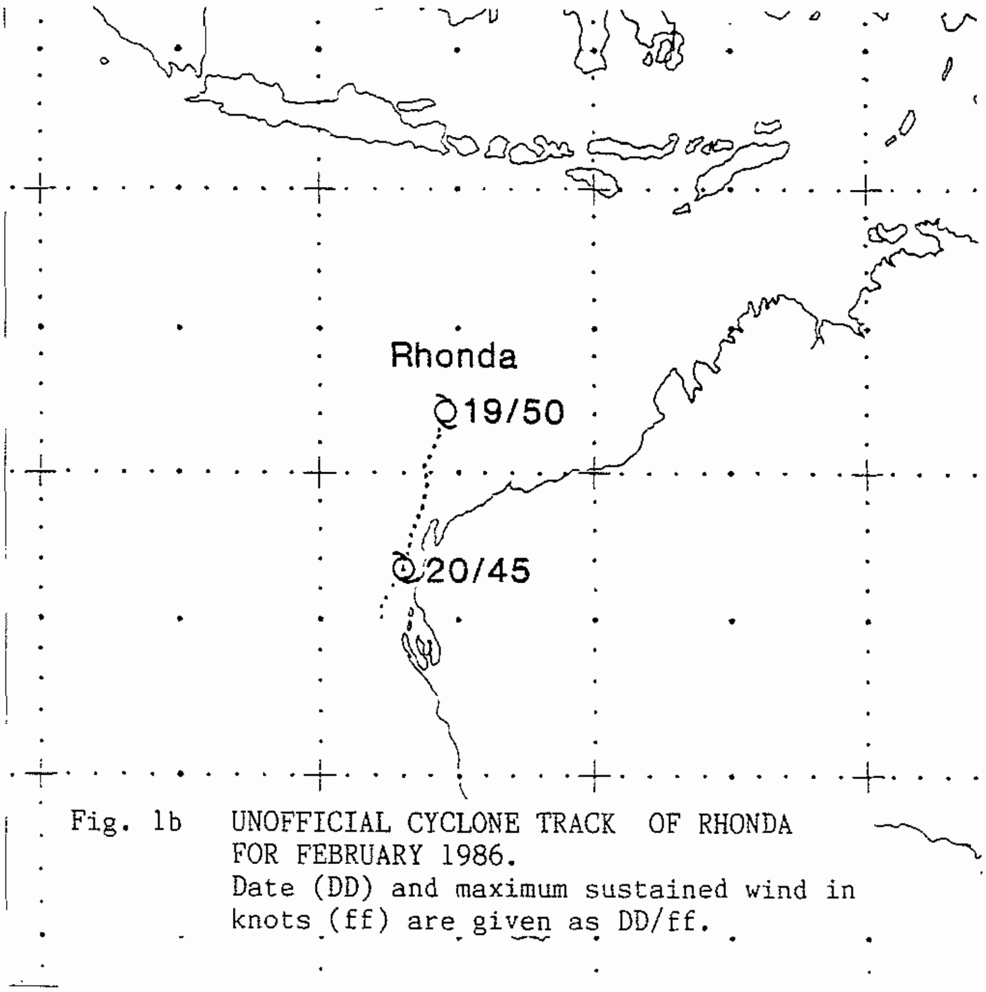

Fig. 1b UNOFFICIAL CYCLONE TRACK OF RHONDA FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in knots (ff) are given as DD/ff.

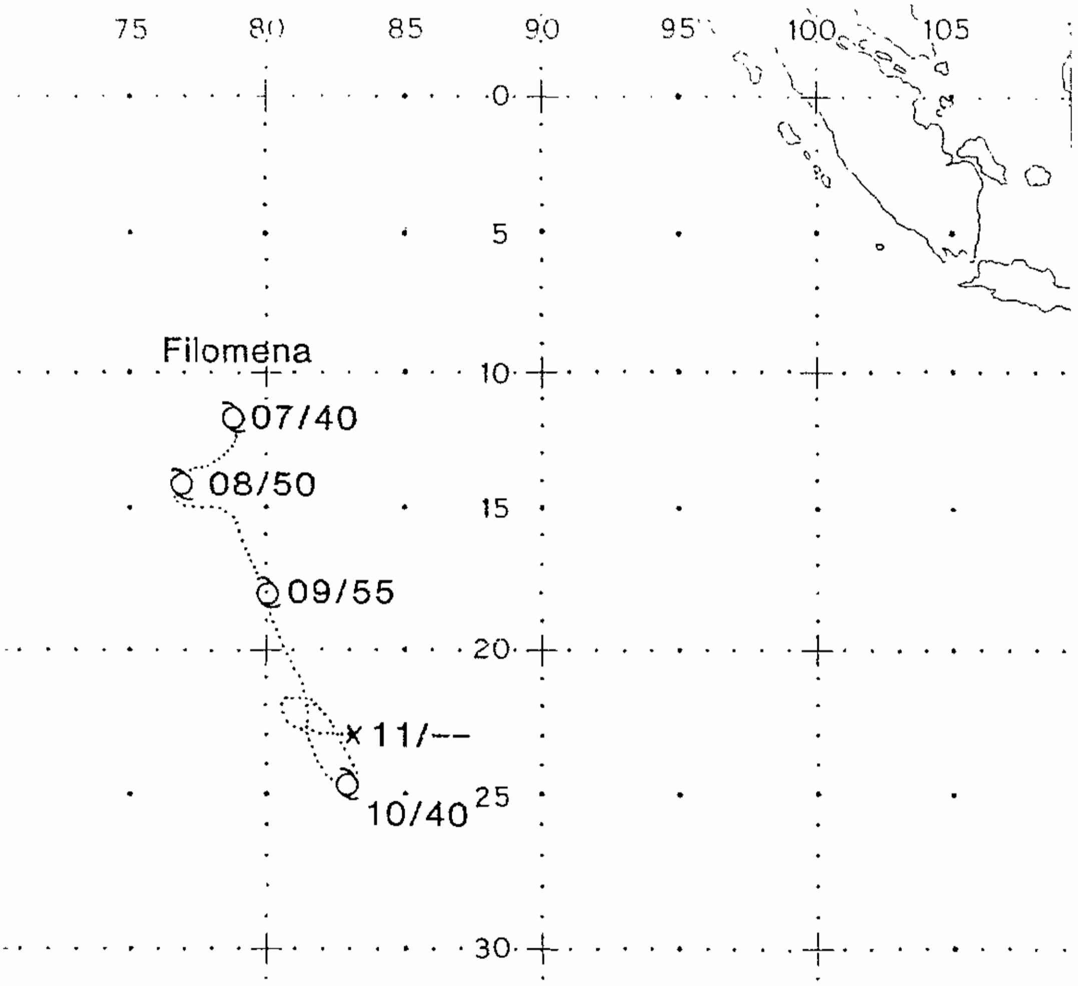

Fig. 1c UNOFFICIAL CYCLONE TRACK OF FILOMENA
FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in
knots (ff) are given as DD/ff.

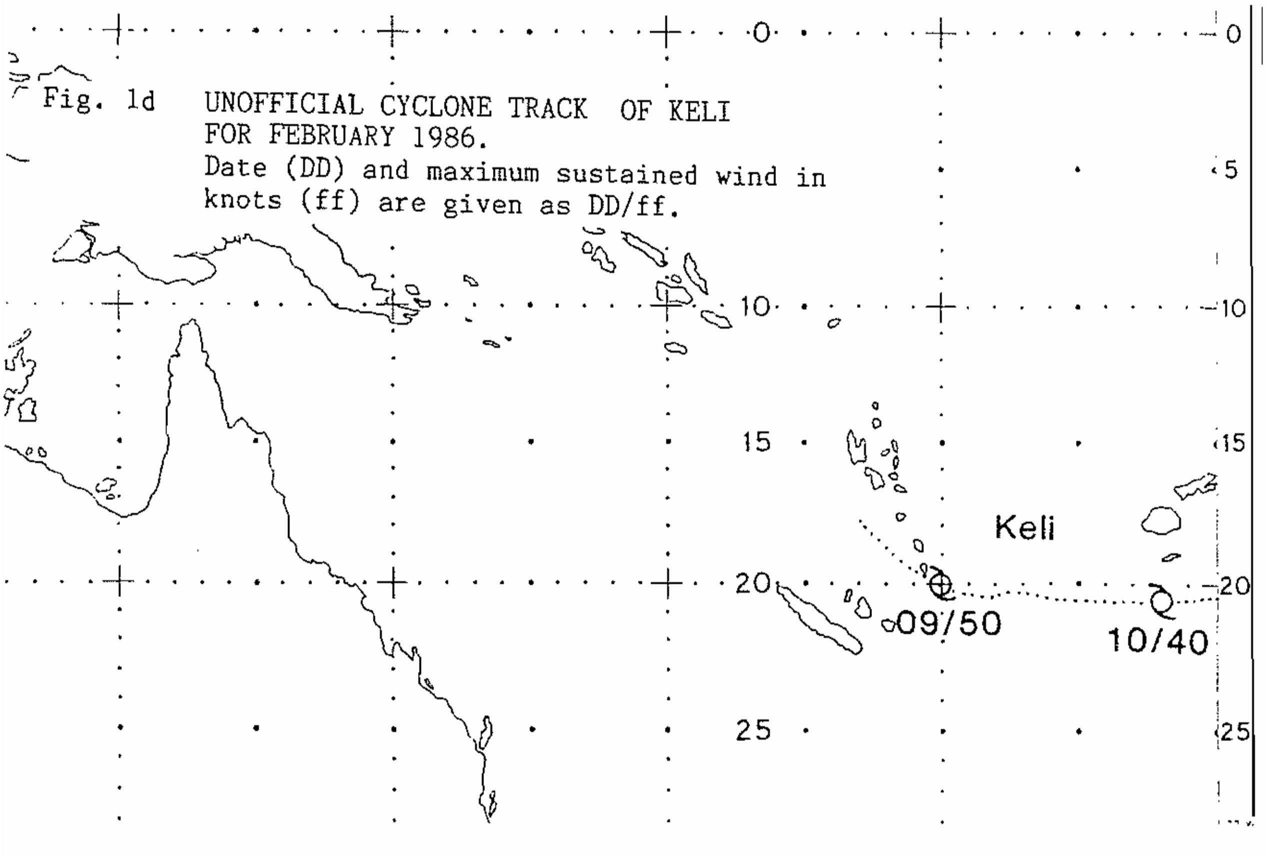

Fig. 1d UNOFFICIAL CYCLONE TRACK OF KELI
FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in
knots (ff) are given as DD/ff.

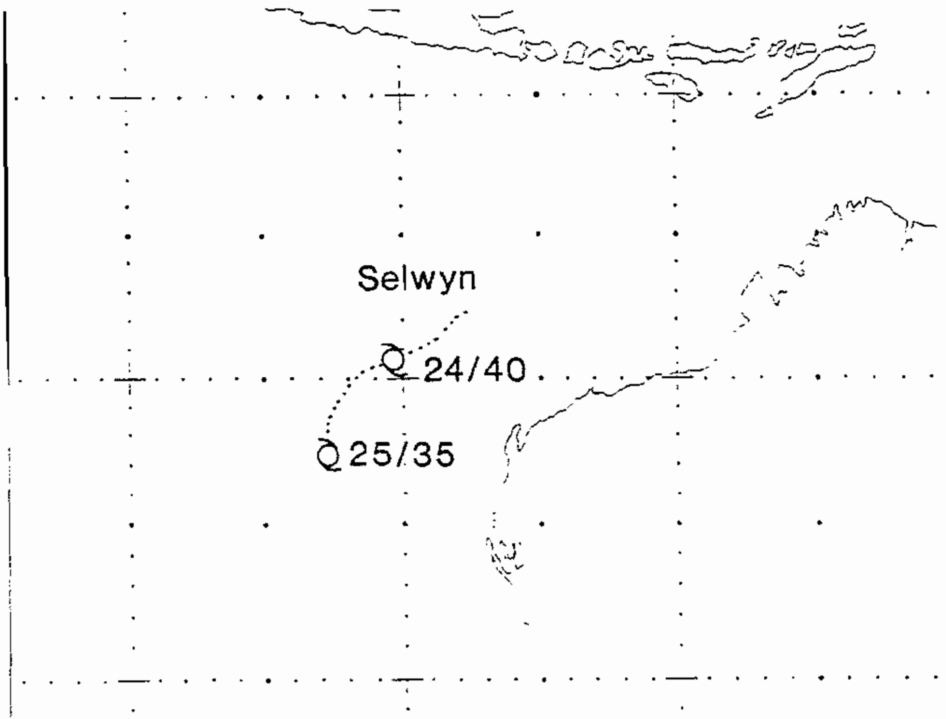

Fig. 1e UNOFFICIAL CYCLONE TRACK OF SELWYN FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in knots (ff) are given as DD/ff.

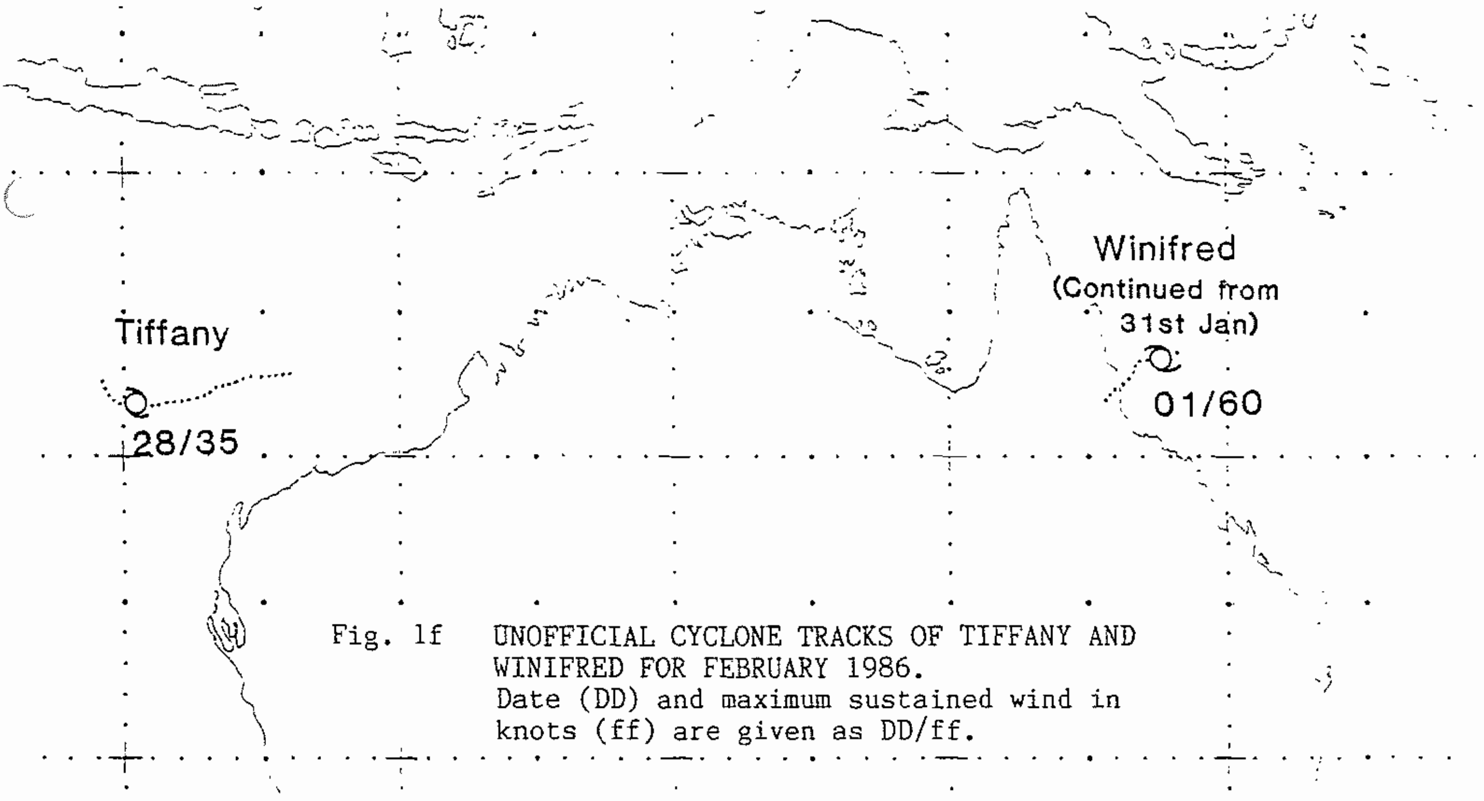

Fig. 1f UNOFFICIAL CYCLONE TRACKS OF TIFFANY AND WINIFRED FOR FEBRUARY 1986.
Date (DD) and maximum sustained wind in knots (ff) are given as DD/ff.

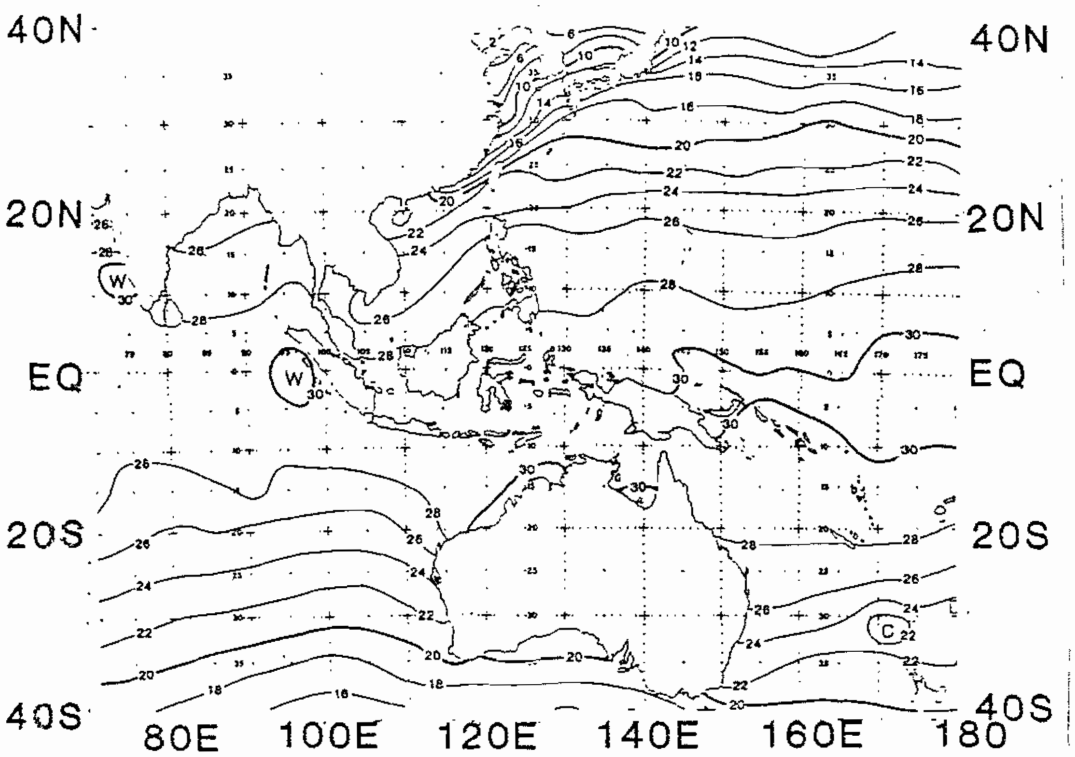

Fig. 2 MEAN SEA SURFACE TEMPERATURES, BASED ON DARWIN RMC ANALYSIS AVERAGED OVER THE MIDDLE 2 WEEKS OF FEBRUARY 1986. (CONTOUR INTERVAL 2°C).

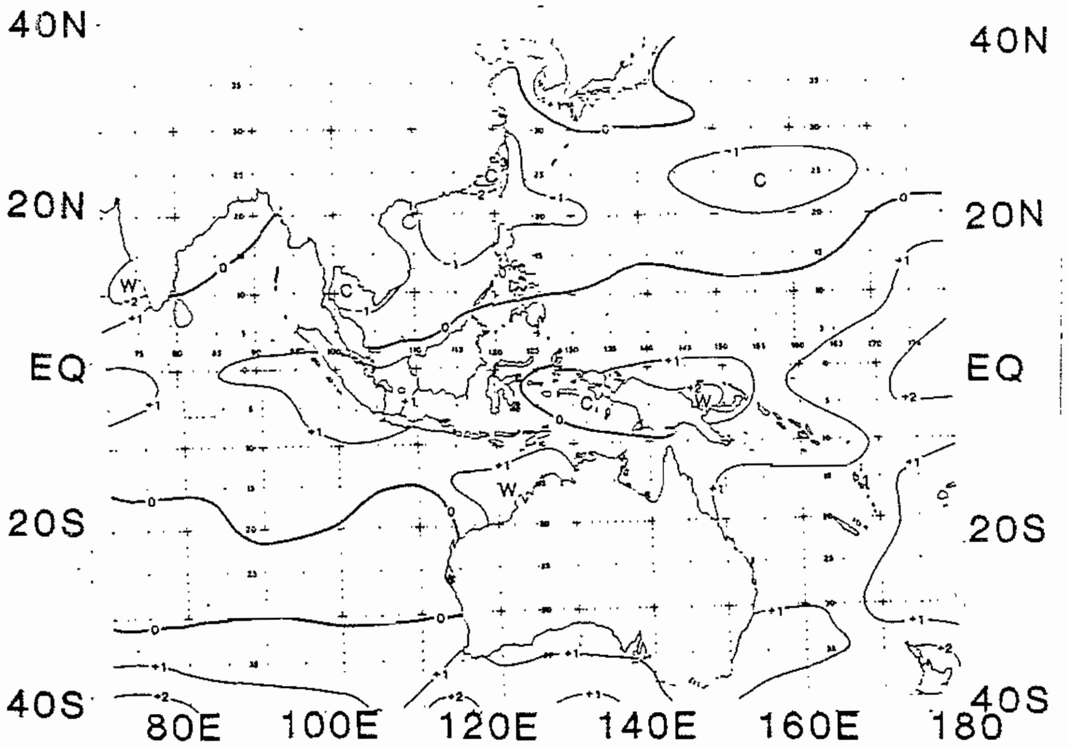

Fig. 3 SST ANOMALY CHART, BASED ON FIG. 2 AND THE CLIMATOLOGY OF REYNOLDS, NOAA REPORT NWS 31, 1983. (CONTOUR INTERVAL 1°C).

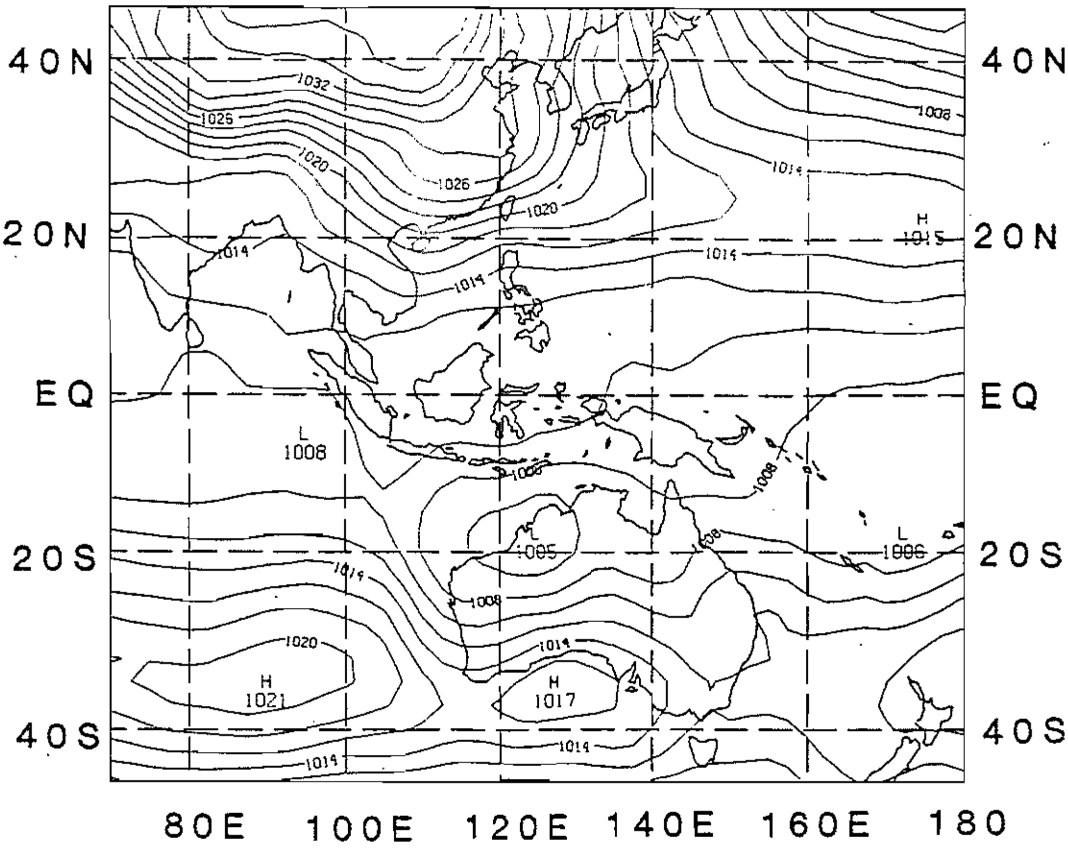

Fig. 4 FEBRUARY 1986 MONTHLY MEAN MSL PRESSURE (CONTOUR INTERVAL 2 mb).

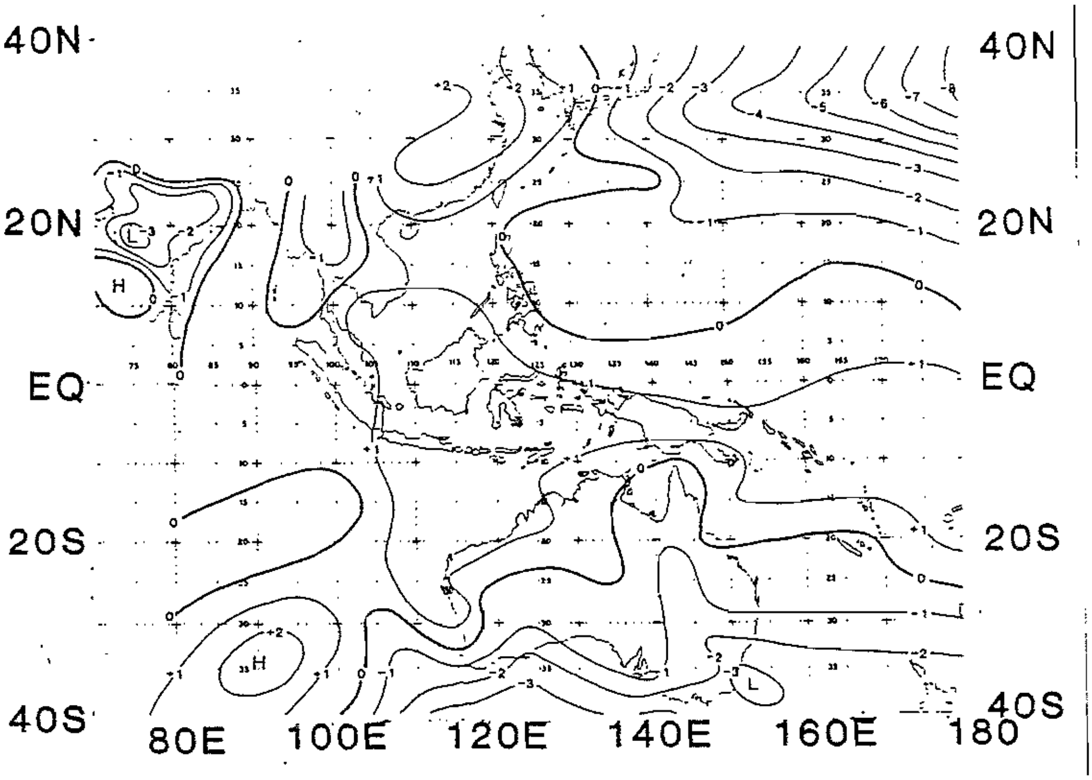

Fig. 5 MSL PRESSURE ANOMALY BASED ON MELBOURNE WMC DATA SOUTH OF 10°S, ADJUSTED TO FIT CLIMATE MESSAGES WHERE AVAILABLE. (CONTOUR INTERVALS 1 mb).

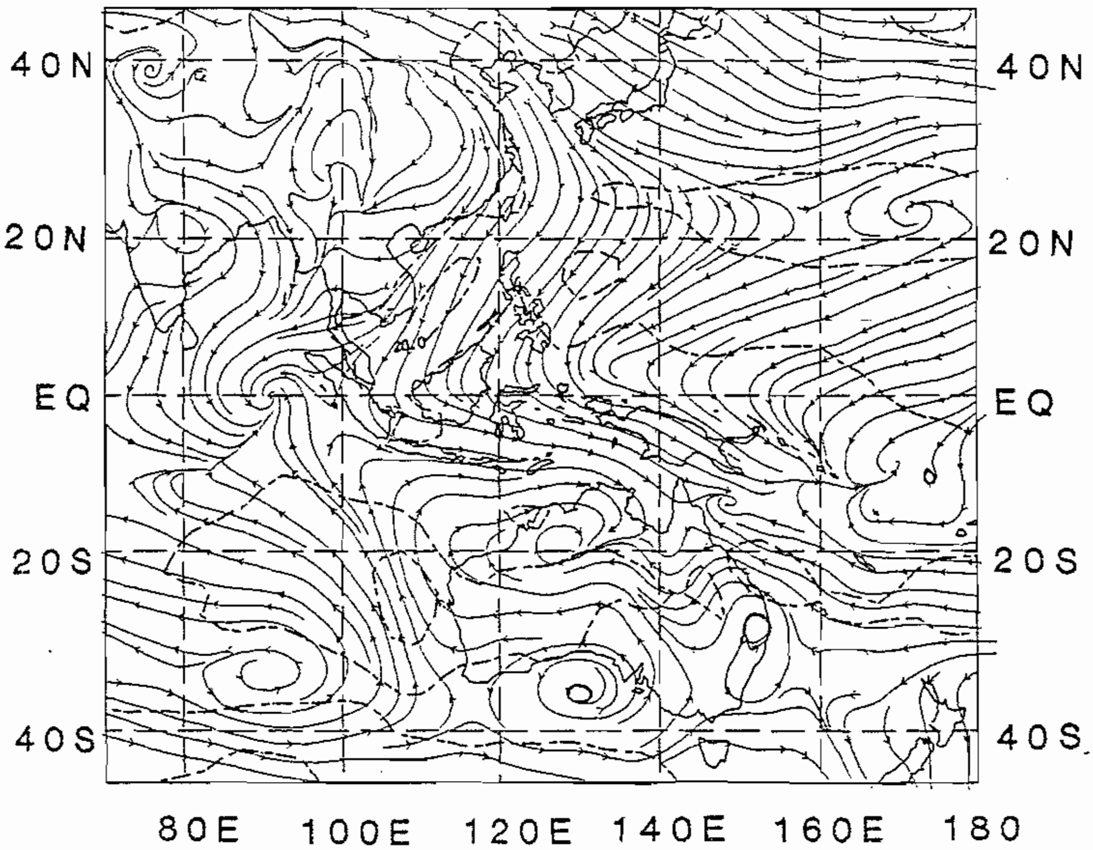

Fig. 6 FEBRUARY 1986 950 mb STREAMLINE/ISOTACH ANALYSIS. (10 KNOT INTERVAL ISOTACHES DASHED LINE).

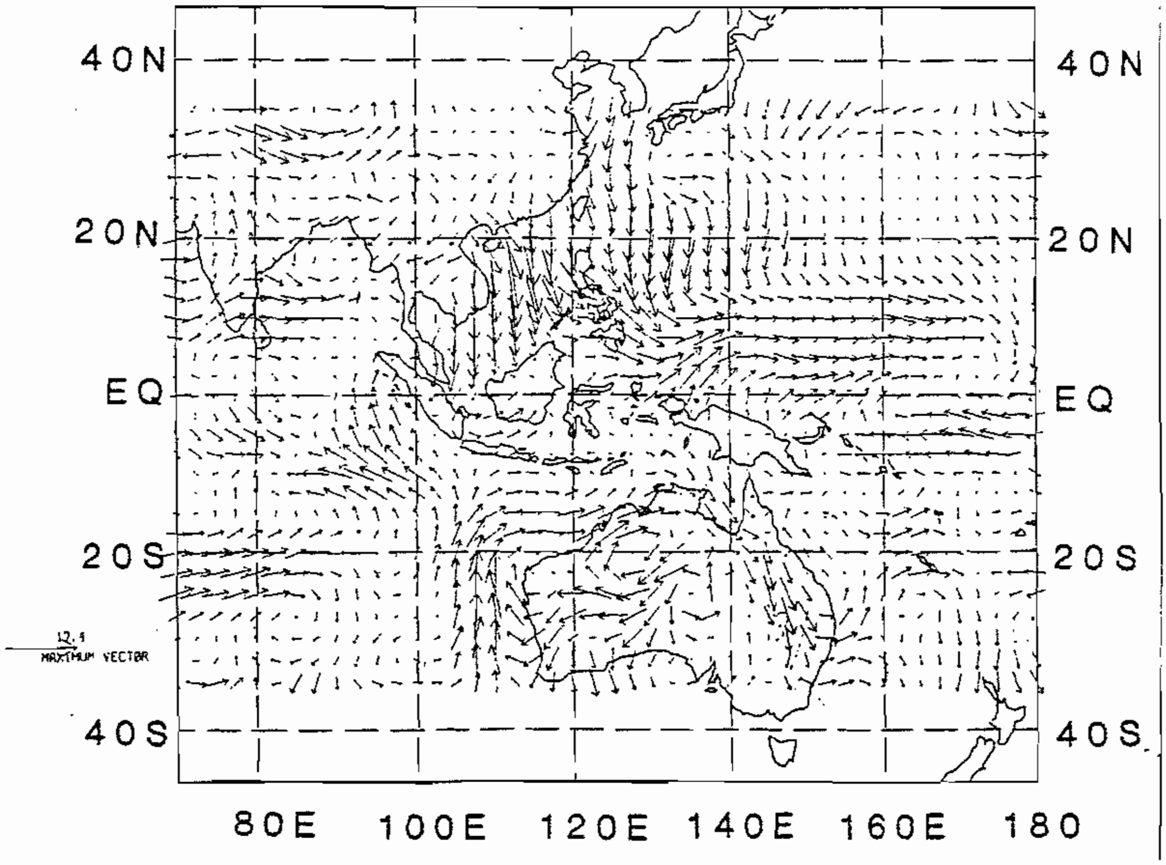

Fig. 7 950 mb VECTOR WIND ANOMALY BASED ON FIG. 6 (ARROW LENGTH INDICATES MAGNITUDE).

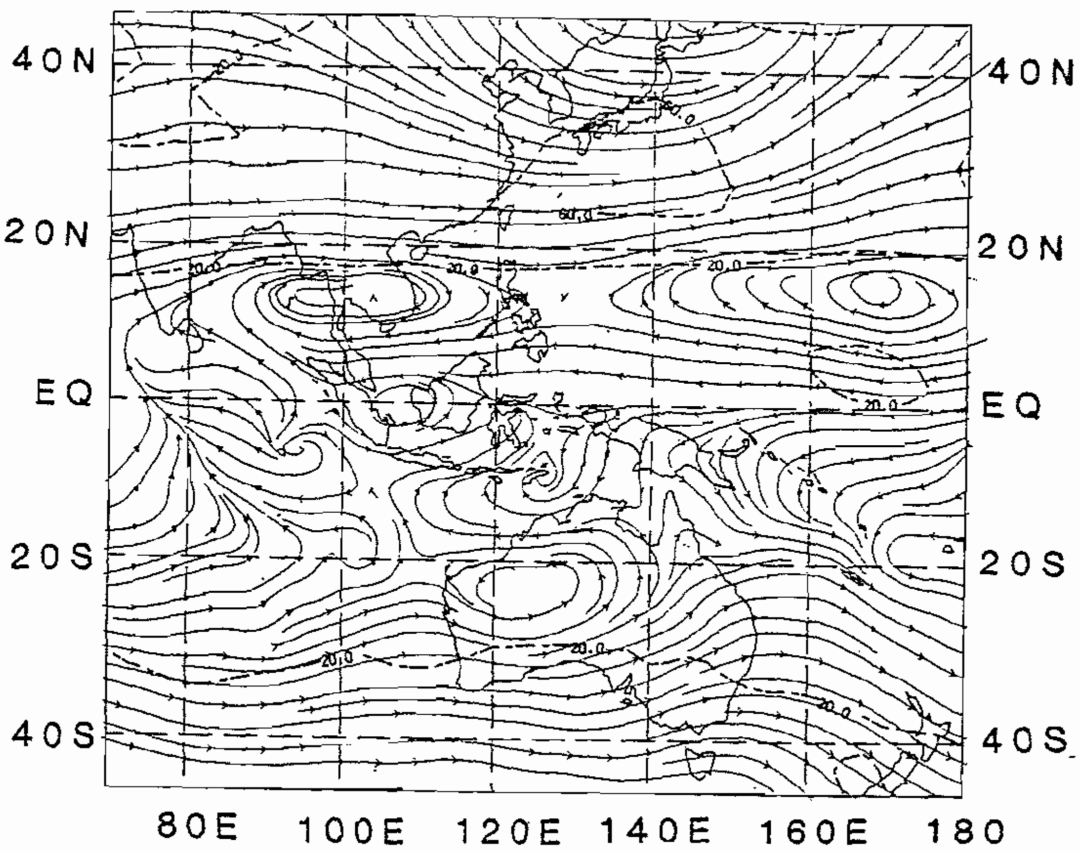

Fig. 8 FEBRUARY 1986 500 mb STREAMLINE/ISOTACH ANALYSIS. (10 KNOT INTERVAL ISOTACHS DASHED LINE).

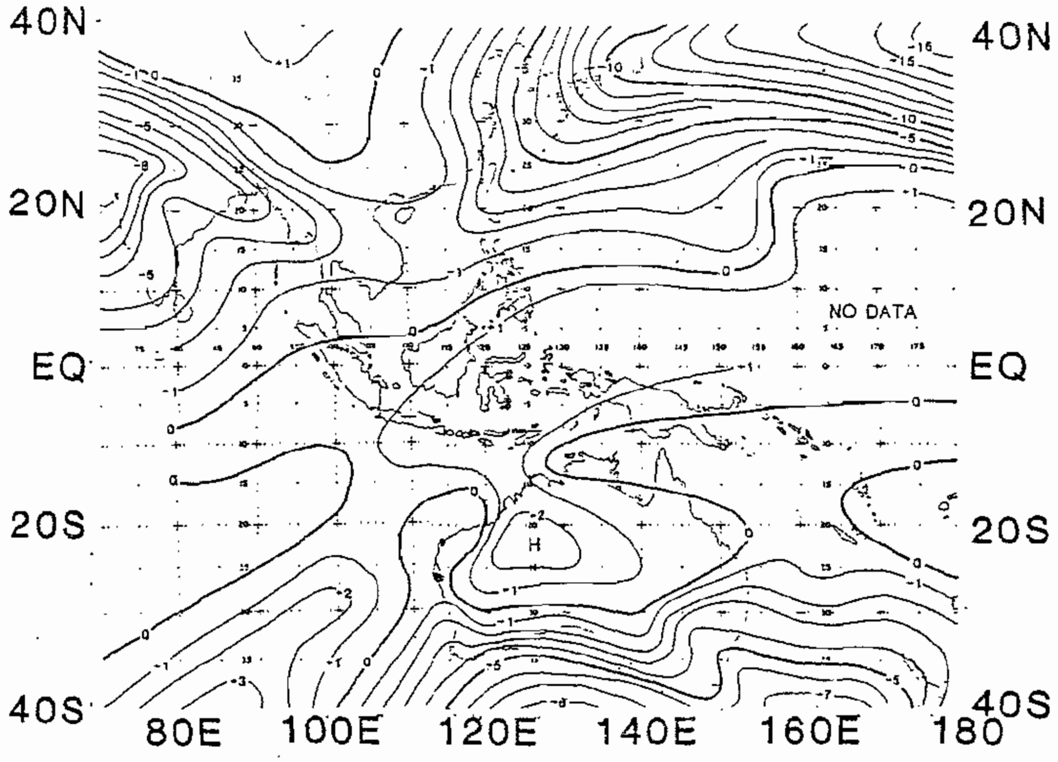

Fig. 9 FEBRUARY 1985 500 mb GEOPOTENTIAL HEIGHT ANOMALY. (CONTOUR INTERVAL 1 gpdm) (DATA BASE AS PER FIG. 5).

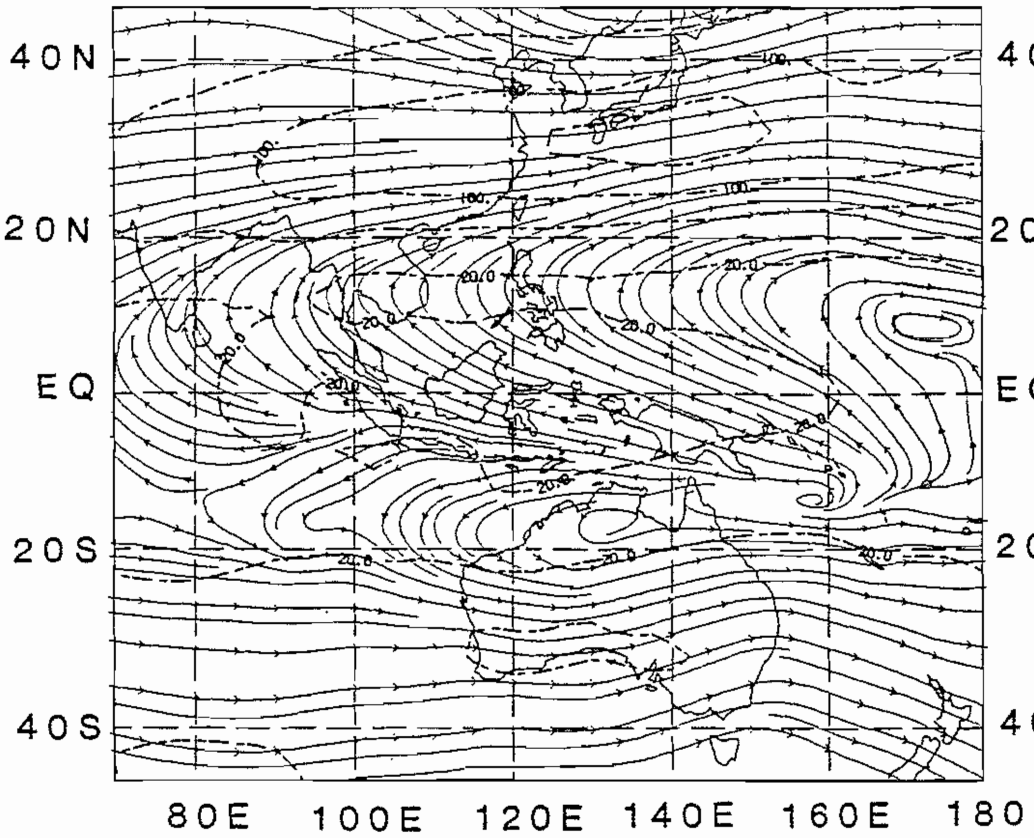

Fig. 10 FEBRUARY 1986 200 mb STREAMLINE/ISOTACH ANALYSIS. (40 KNOT INTERVAL ISOTACH DASHED LINE).

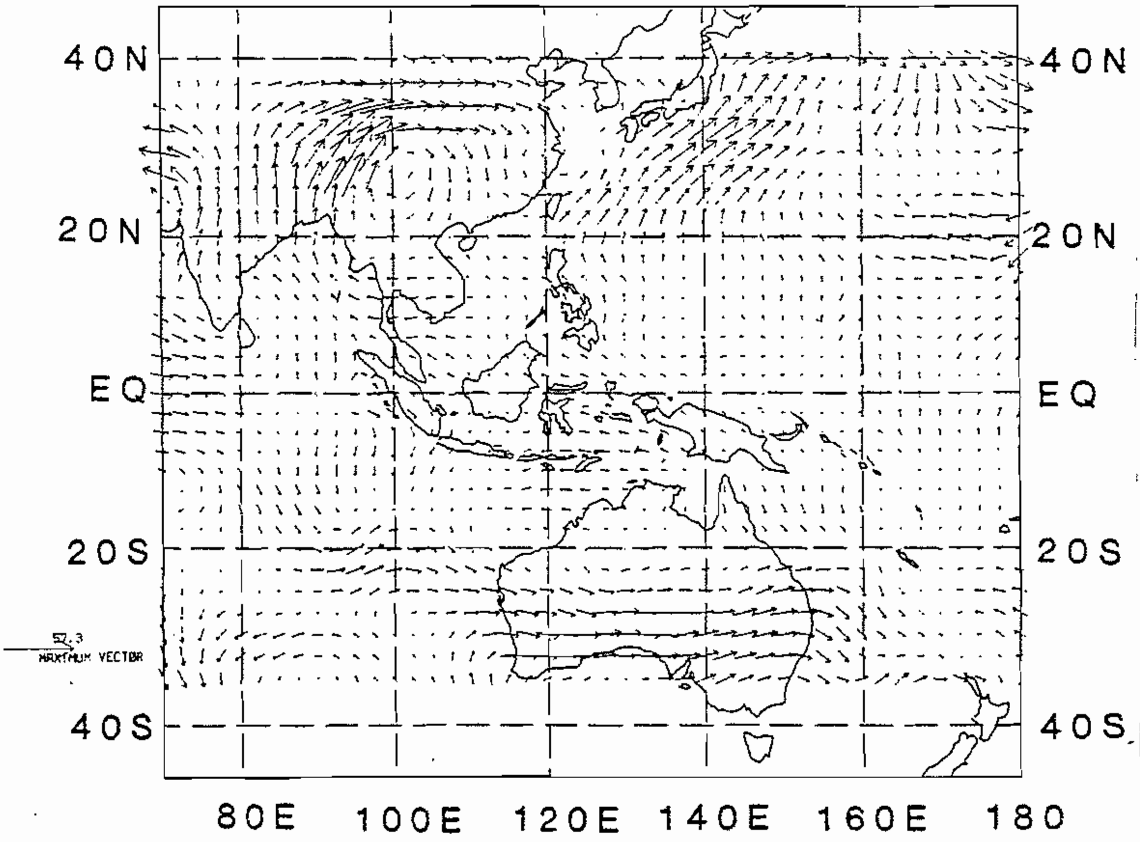

Fig. 11 FEBRUARY 1986 200 mb VECTOR WIND ANOMALY. (ARROW LENGTH INDICATES MAGNITUDE).

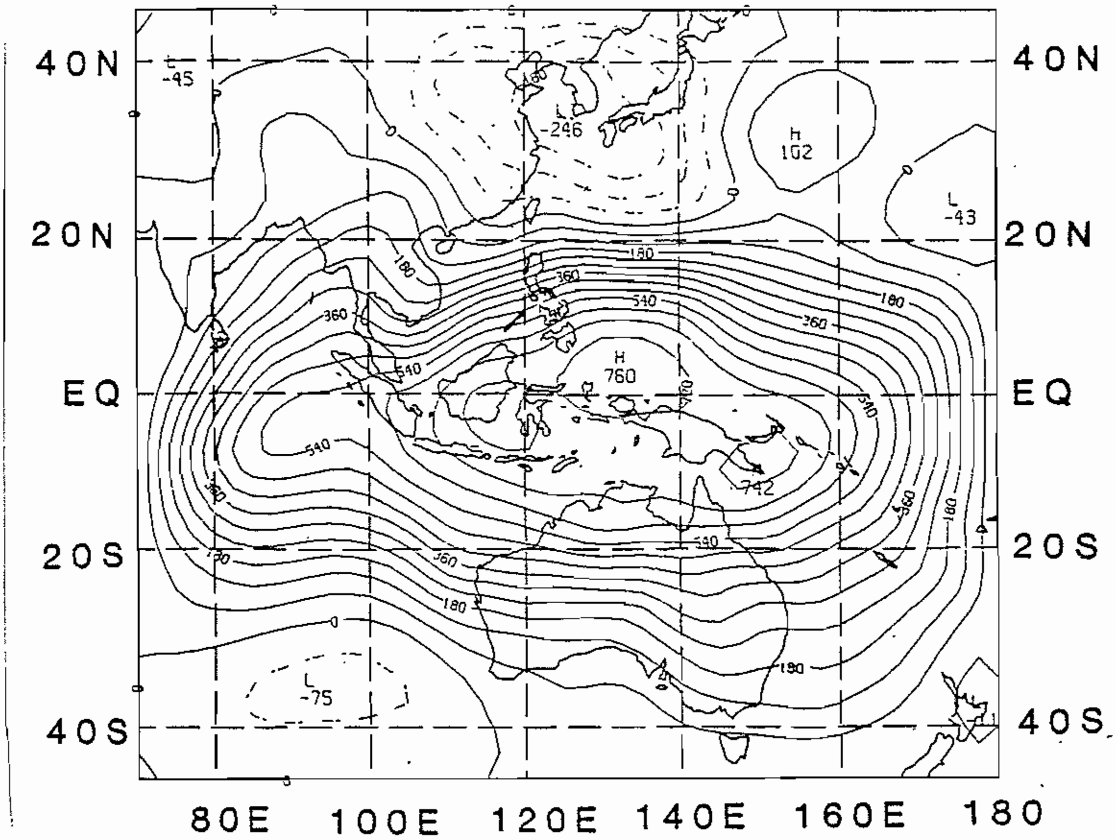

Fig. 12 FEBRUARY 1985 950 mb VELOCITY POTENTIAL.
(CONTOUR INTERVAL 60 x $10^5 M^2 S^{-1}$).

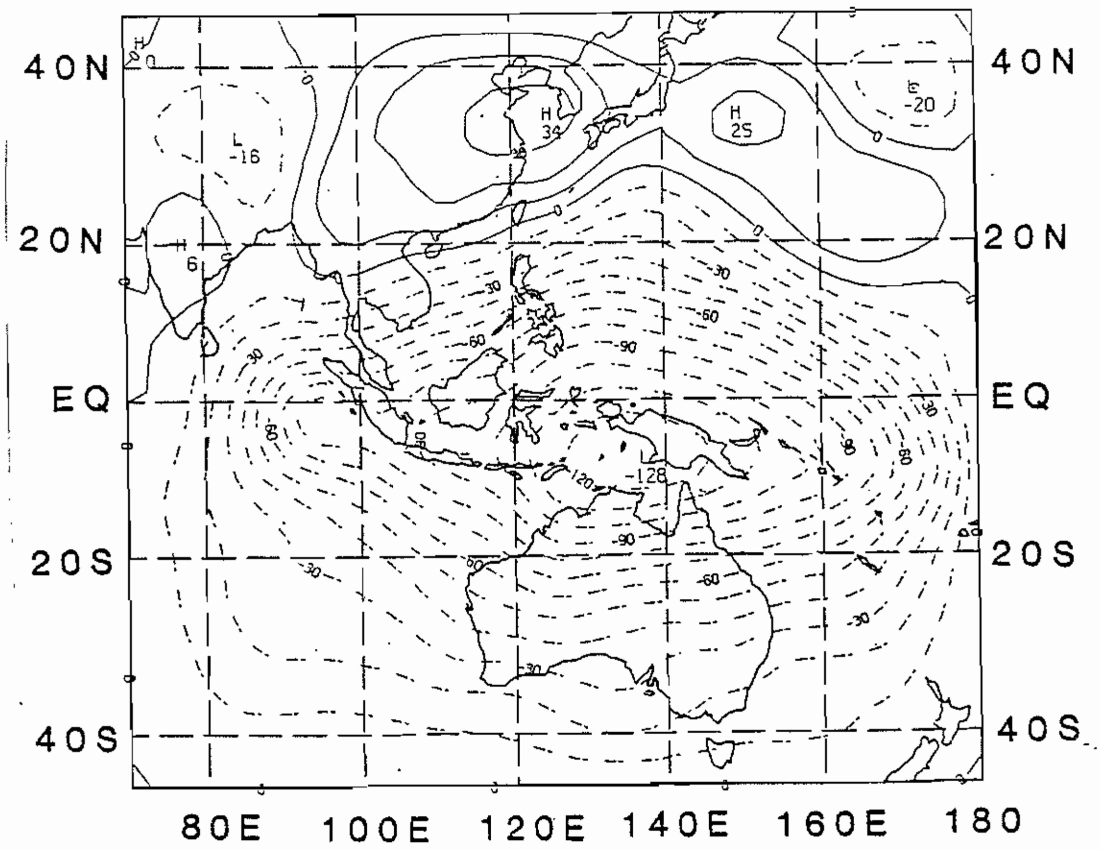

Fig. 13 FEBRUARY 1986 200 mb VELOCITY POTENTIAL
(CONTOUR INTERVAL 10 x $10^5 M^2 S^{-1}$)

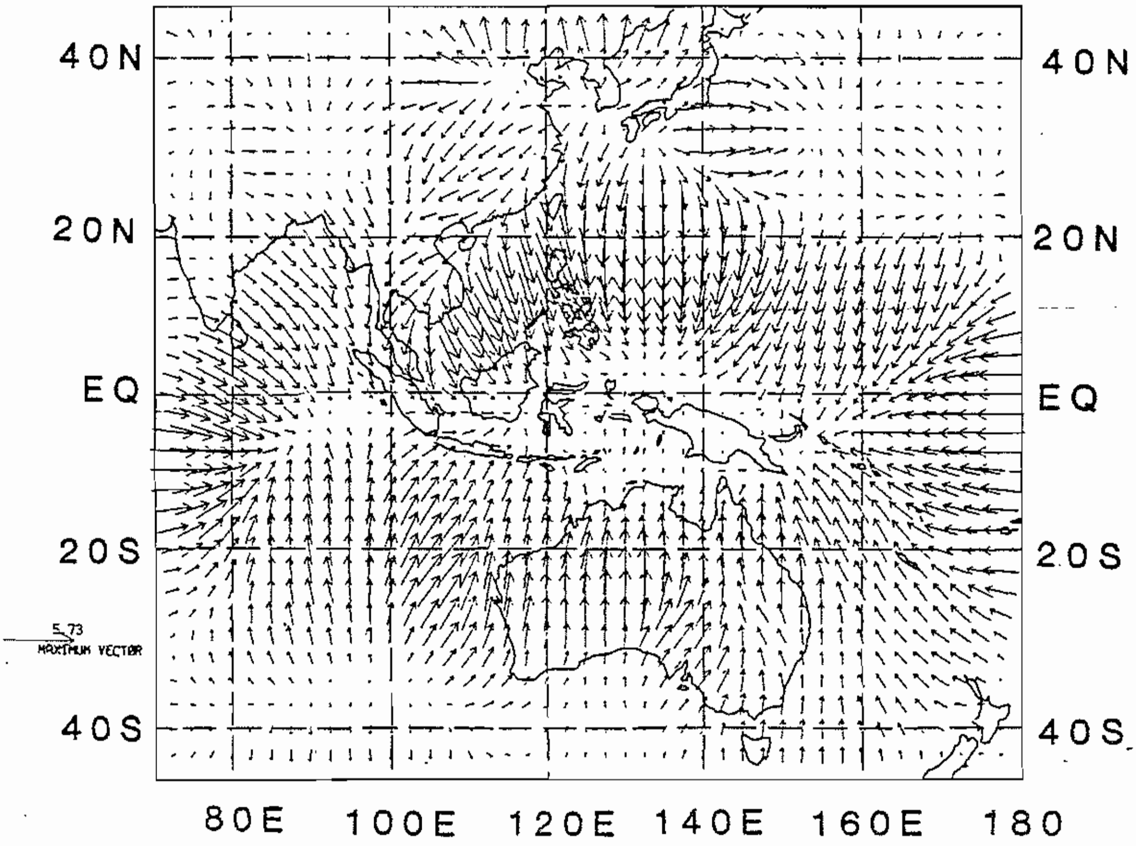

Fig. 14 FEBRUARY 1986 950 mb DIVERGENT WIND.
(ARROW LENGTH INDICATES MAGNITUDE).

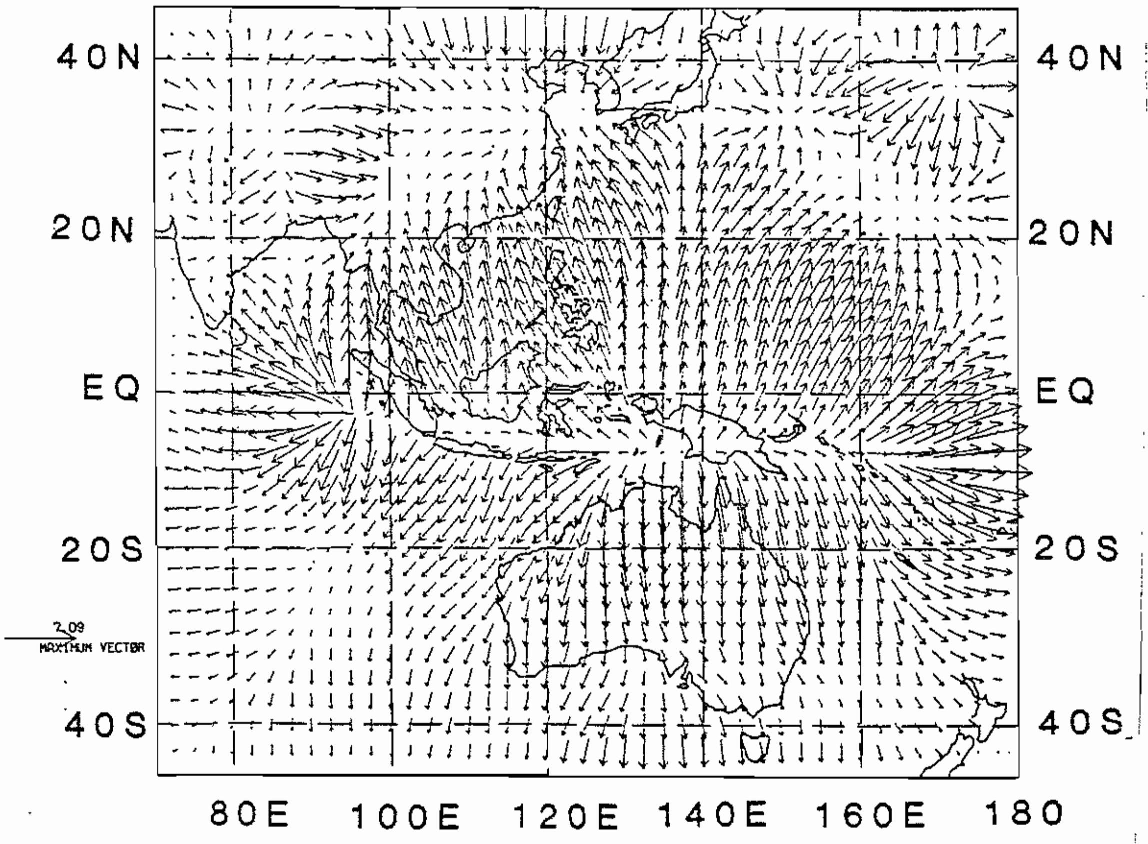

Fig. 15 FEBRUARY 1986 200 mb DIVERGENT WIND.
(ARROW LENGTH INDICATES MAGNITUDE).

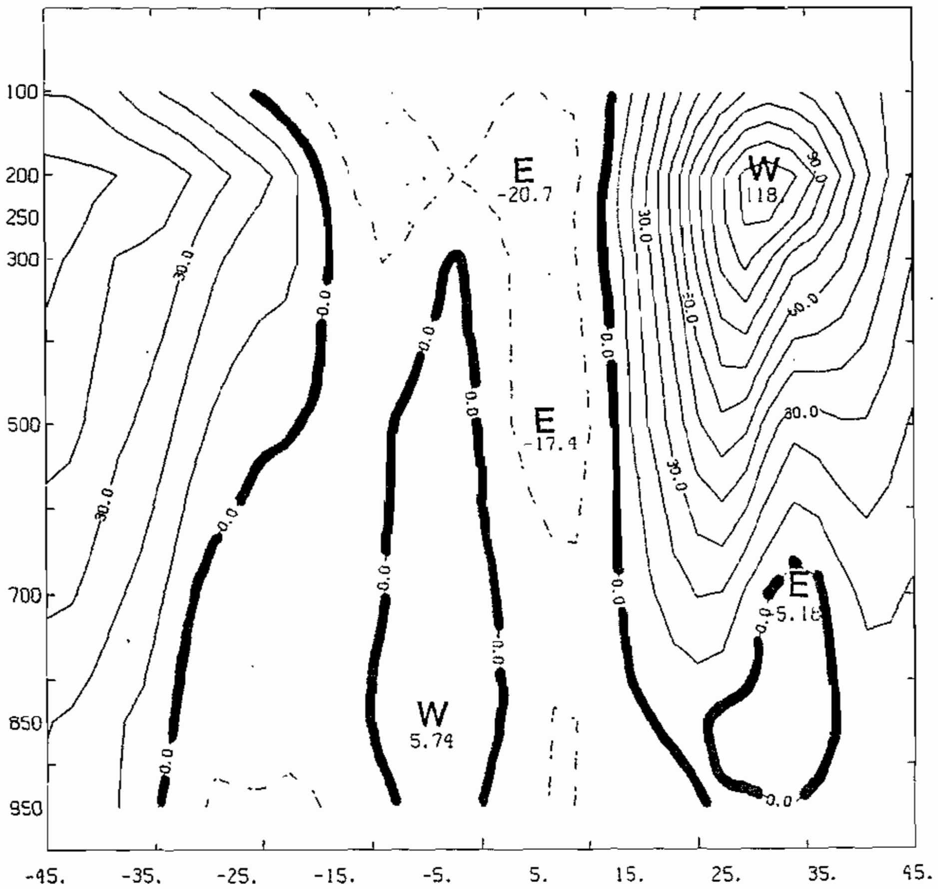

Fig. 16 FEBRUARY 1986 CROSS SECTION OF ZONAL WIND ALONG 100°E (CONTOUR INTERVAL 10 KNOTS).

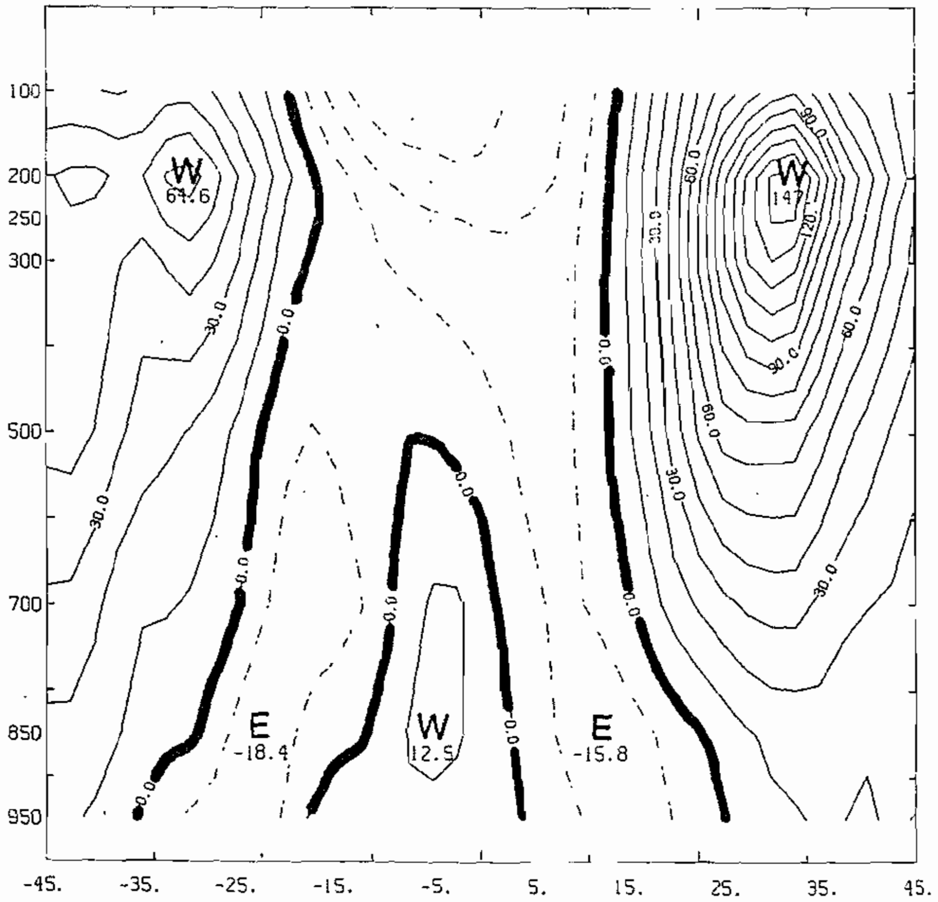

Fig. 17 FEBRUARY 1986 CROSS SECTION OF ZONAL WIND ALONG 130°E (CONTOUR INTERVAL 10 KNOTS).

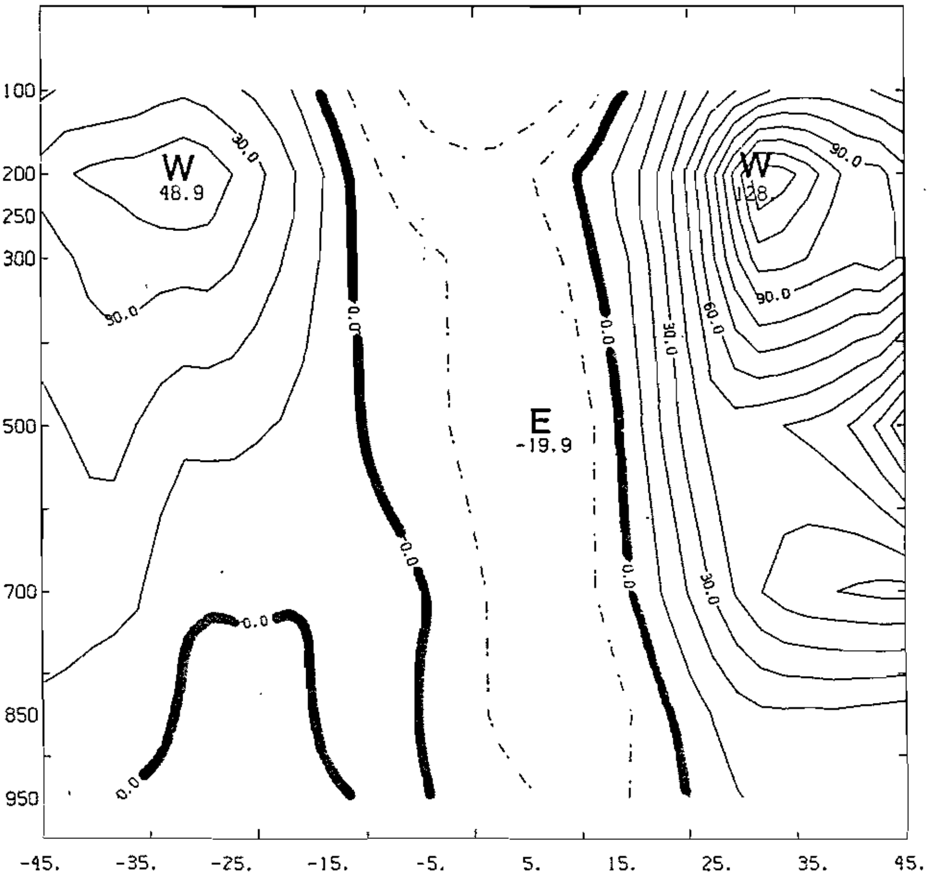

Fig. 18 FEBRUARY 1986 CROSS SECTION OF ZONAL WIND ALONG 160°E (CONTOUR INTERVAL 10 KNOTS).

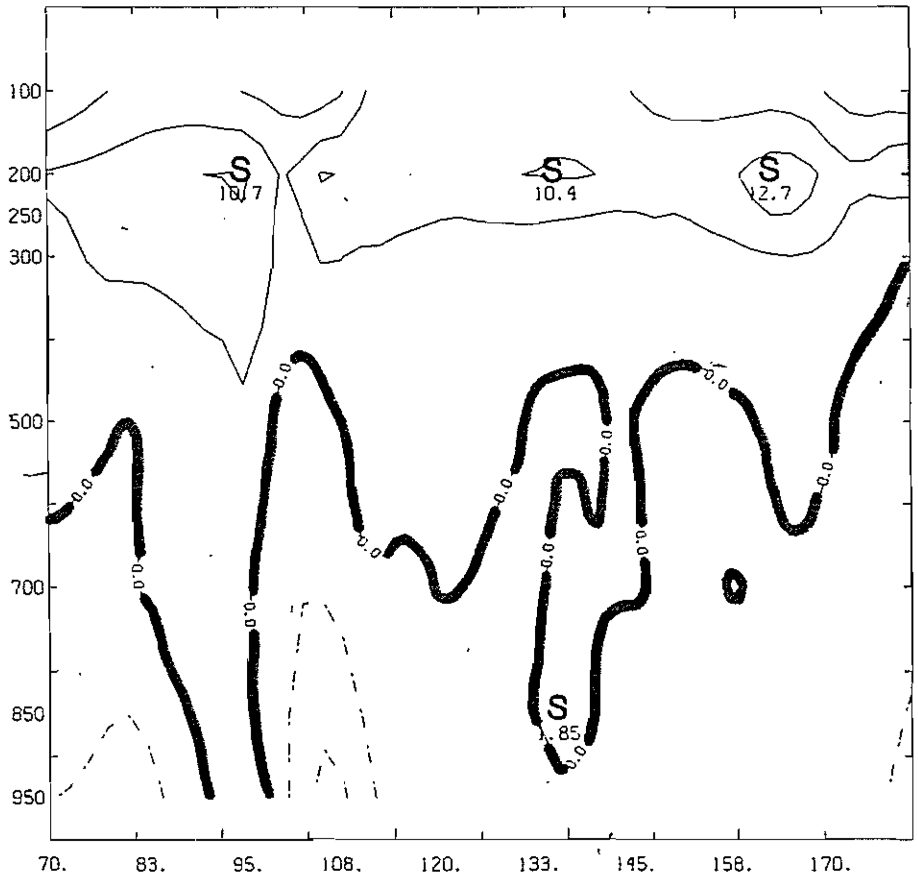

Fig. 19 FEBRUARY 1986 EQUATORIAL CROSS SECTION BETWEEN 70E and 180E (CONTOUR INTERVAL 5 KNOTS).

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

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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95.50 (86.80 ex GST)	12.00 (Australia)	107.50
	24.00 (Asia/Pacific)	110.80
	36.00 (Rest of the world)	122.80

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