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Bureau of Meteorology

DARWIN TROPICAL DIAGNOSTIC STATEMENT

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DARWIN TROPICAL DIAGNOSTIC STATEMENT

JANUARY 1987

ISSUED BY DARWIN RMC.

INDICES

The Darwin mean MSL pressure for January was 1007.1 hPa, which was 0.8hPa above the long term (1882-1985) mean.

Tahiti's mean MSL pressure for January was 1010.2hPa, 0.7hPa below the 1882-1985 mean.

This gives a value of minus 7 for the Southern Oscillation Index, with a five month running mean centred on November, of minus 7.

TROPICAL CYCLONES

Six tropical cyclones occurred between 70E and 180 during January 1987. Unofficial tracks are shown in figures 1a-c.

Two of these, Norris and Orchid, occurred in the Northwest Pacific, although Norris dissipated late on the 1st. January. The average number of cyclones for January in the Northwest Pacific is 0.5 (JTWC statistics, 1959-1984). Orchid, although relatively short lived, attained typhoon intensity for 24 hours. As will be shown later, Orchid had a profound effect upon the mean monthly analyses and their anomalies during the month of January.

Two short lived cyclones, S6 and Alinina, formed in the southern Indian Ocean. Neither of these survived longer than 36 hours before dissipating over water.

Cyclones Connie and Irma formed in the Australian Region. Tropical cyclone Connie formed on the 17th January when a low pressure system moved off the Australian mainland onto the warm tropical Indian Ocean. Once over the sea, Connie underwent rapid development, reaching typhoon intensity before making landfall on the 19th January. Cyclone Irma formed in the Gulf of Carpentaria under the influence of a surge in the middle level northwesterlies to the north of the monsoon trough. It tracked steadily southwestwards until landfall the following day.

There were no cyclone genesis events in the southwest Pacific west of the dateline in January.

SEA SURFACE TEMPERATURES

Figures 2 and 3 show mean sea surface temperatures (SST) and associated anomalies during January 1987.

There are few significant anomalies in figure 3. In the northern hemisphere, a broad weak warm anomaly is evident west of 110E whilst a broad weak cool anomaly is evident east of the Philippines. It is notable that the broad anomalously cool area which existed in the Tasman Sea during December has warmed slightly. Figure 3 shows a broad warm anomaly in the area during January, although waters immediately to the north of New Zealand have remained cool.

MEAN SEA LEVEL (MSL) PRESSURE AND THE GRADIENT LEVEL FLOW

January mean MSL pressure and anomaly charts are shown in figs.4 and 5, and gradient level (950 hPa) streamline and associated wind anomaly charts in figs. 6 and 7.

A considerable southwesterly anomaly exists over the Bay of Bengal. This indicates that the northeasterly trade winds over the area were weaker than one would normally expect during January. This is consistent with the broad warm SST anomaly mentioned in the previous section.

Northerly gradient wind anomalies dominate the north Pacific in fig.7, with a maximum to the east of the Philippines. This is consistent with the cool SST anomalies referred to earlier, and indicates that the northeasterly trade winds are stronger than usual in the area east of 110E. Anomalously high pressures in the northwest Pacific as shown in fig.5 suggest a stronger than normal sub-tropical ridge in this area, which would clearly be associated with the anomalous trades.

In the southern hemisphere, the monsoon trough in the south Indian Ocean was weaker than usual, as evidenced by the southeasterly gradient wind anomaly near 5 degrees south. This is to be expected bearing in mind the weak nature of the northeasterly trades in the north Indian Ocean.

The southeasterly gradient wind anomaly at low latitudes near 160 degrees east was partly caused by cyclone Orchid, and partly by anomalously strong ridging in the Tasman Sea. This Tasman Sea ridging was perhaps responsible for the aforementioned warming of SST's in the area.

The equatorial westerly wind anomaly between 140 degrees east and 180 as evidenced in December, diminished west of 170 degrees east in January.

Overall, the mean monthly gradient level flow for January indicates a fairly normal monsoon. While the trades in the Indian Ocean were weaker than normal, those in the northwest Pacific were stronger, and the monsoon trough in the southwest Pacific was well formed throughout the month.

200 hPa FLOW.

The mean 200hPa streamline and vector wind anomaly charts for January are shown in figs. 8 and 9.

The anticyclonic wind anomaly near 25 degrees south in the southwest Pacific was replaced by a distinct cyclonic anomaly in January. A persistent upper level trough remained in this area for most of January, over the anomalous surface ridging in the Tasman Sea. These features are indicative of stability in the southwest Pacific area west of the dateline, and are consistent with the absence of cyclone genesis in this area during January.

The equatorial easterly anomaly noted in December contracted to east of 160 degrees east in January.

In mid-latitudes, the sub-tropical jet stream near Japan appears to have been slightly stronger than usual, as evidenced by the westerly wind anomalies in the area.

VELOCITY POTENTIAL AND DIVERGENT WIND

Charts for the 950 and 200 hPa velocity potential and divergent wind for January are shown in figs. 10,11,12 and 13.

The velocity potential at 200 hPa has a minimum value over Sumatra, Indonesia. This represents an expected southward movement of the convection maximum since December. Inspection of satellite imagery of the region shows that convection was particularly active during January as the monsoon northwesterlies progressed southwards, arriving at Darwin on the 14th January.

The particularly fine conditions over the Tasman Sea as discussed previously are well demonstrated by the divergent wind analyses. The divergent nature of the 950 hPa analysis, coupled with the convergence evident on the 200 hPa chart are consistent with the generally cloud-free conditions experienced in the area.

WIND CROSS-SECTIONS

Cross sections of zonal wind along 100, 130, and 160 are shown in figs. 14,15, and 16 respectively, whilst an equatorial cross section of meridional wind is shown in fig.17.

The equatorial cross section at fig.17 is perhaps the most striking. It can be clearly seen that the southern hemisphere monsoon was well established between 70 and 180 degrees east during January, with northerly cross-equatorial flow almost everywhere below the 600 hPa level. Southerly return flow is well established in the upper levels.

SUMMARY

Although the SOI for January,1987 was minus 7, and the five month running mean centred upon November was also minus 7, the diagnostic charts herewith do not support the occurrence of a significant weakening of the Walker circulation and large scale shift of convection to the mid-Pacific.

After the onset of monsoonal northwesterlies at Darwin, the rainfall has been above average. Fig.18 shows the daily rainfall at Darwin during January 1987. In total, 606.2mm were recorded at Darwin Airport in January, despite a long term mean of just 399mm. The peak in rainfall between the 14th and 18th of the month is consistent with the arrival of monsoon westerlies on the 14th.. Such activity of the monsoon trough must be associated with a cessation of any climate control effects in the North Australian region associated with the weak El Nino conditions. However, it should be noted that the monsoon onset was approximately one month later than the long term average.

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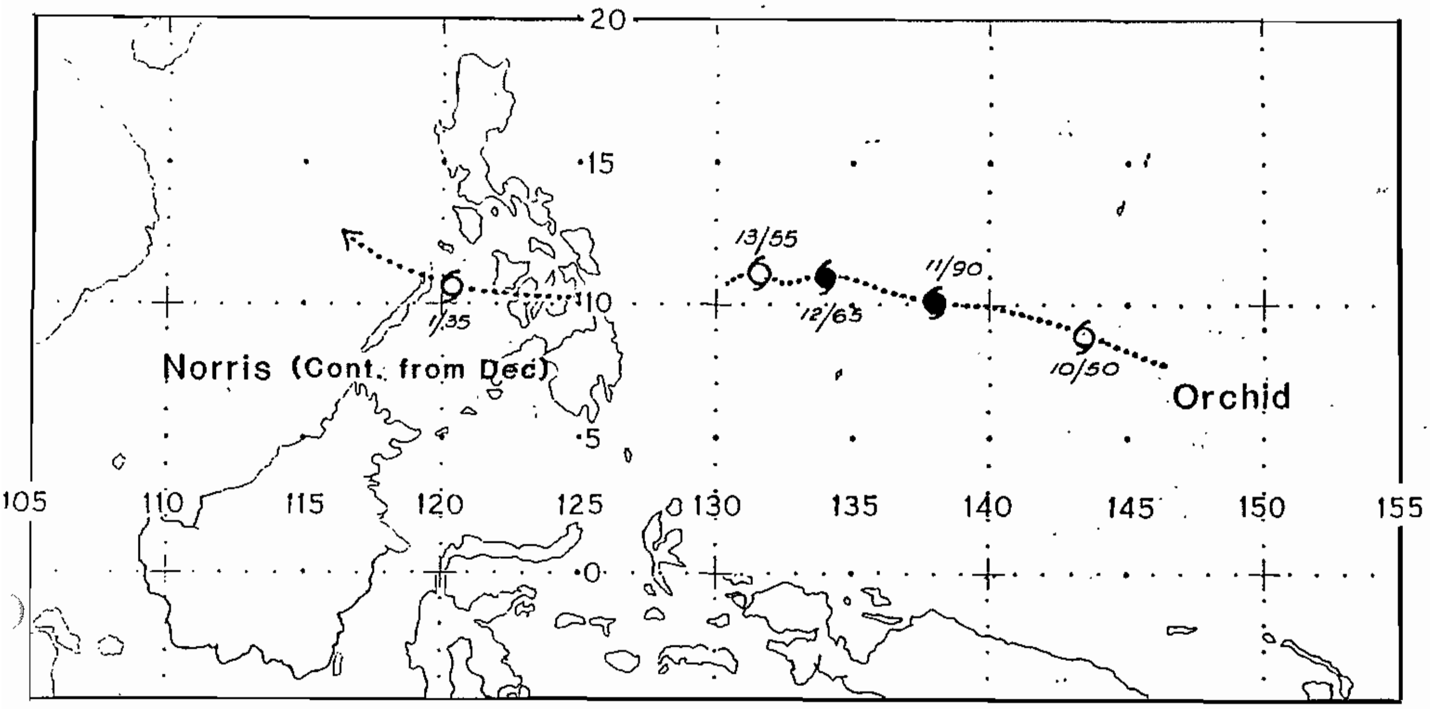

Fig 1a UNOFFICIAL TRACKS OF CYCLONES NORRIS AND ORCHID FOR JANUARY 1987

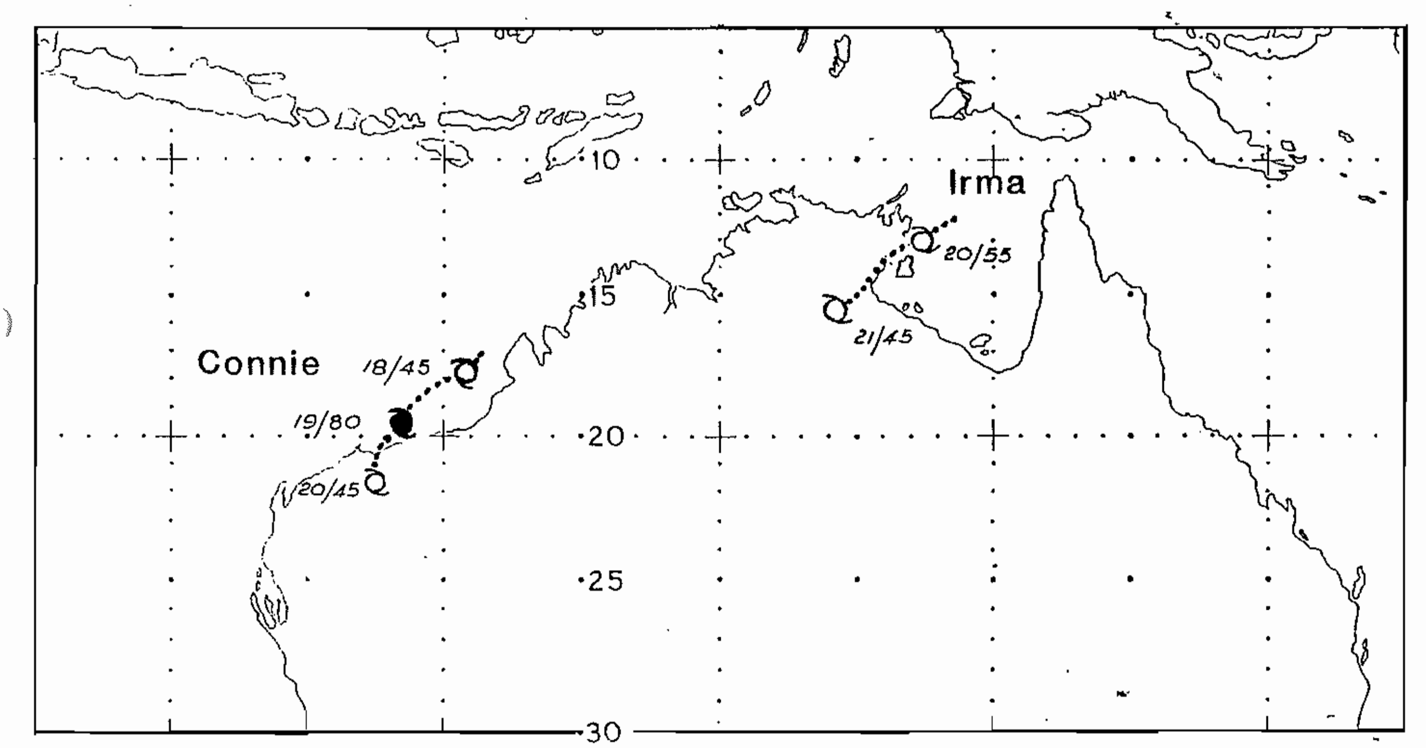

Fig. 1b UNOFFICIAL TRACKS OF CYCLONES CONNIE AND IRMA FOR JANUARY 1987

Date (DD) and maximum sustained wind (ff) in knots denoted by DD/ff.

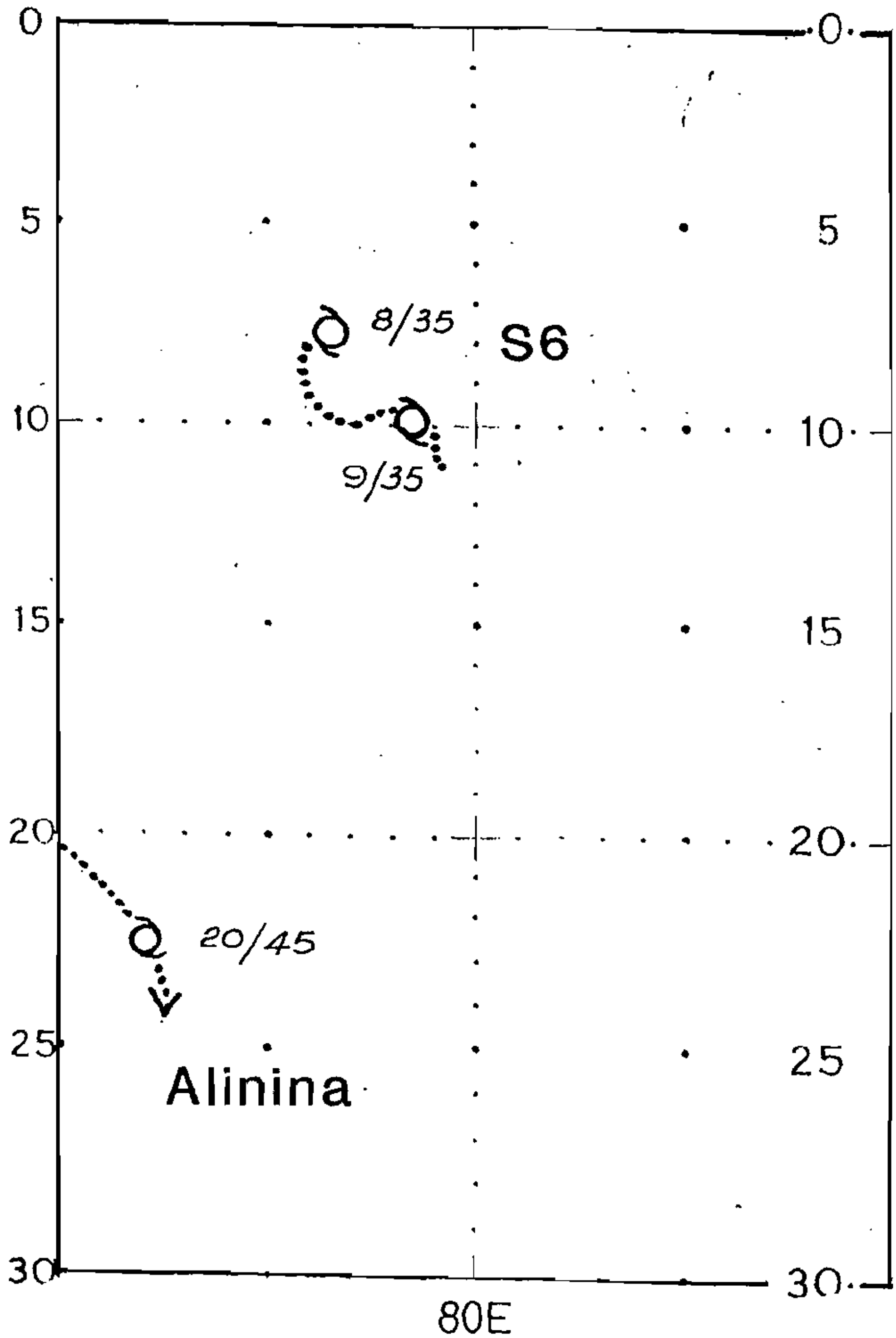

Fig. 1c UNOFFICIAL TRACKS OF CYCLONES S6 AND ALININA JANUARY 1987

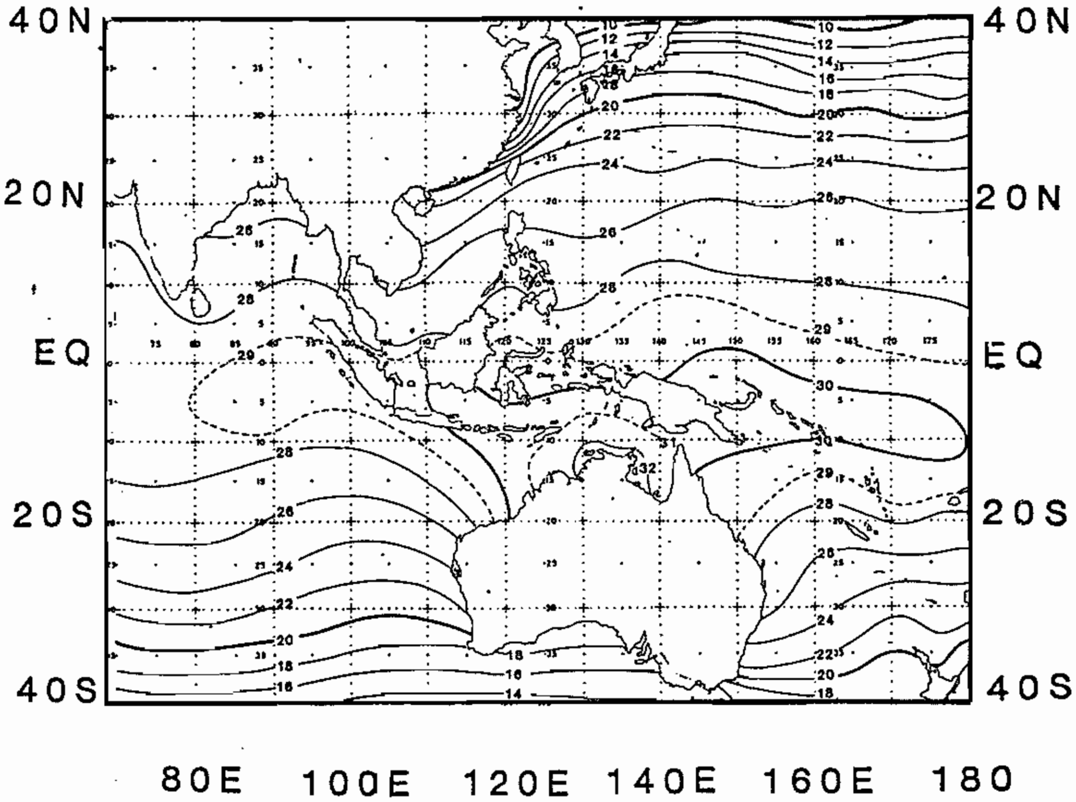

Fig. 2 MEAN SEA SURFACE TEMPERATURES, BASED ON DARWIN RMC ANALYSES AVERAGED OVER THE PERIOD 2nd-4th JANUARY 1987
Isotherm interval 2 deg C.

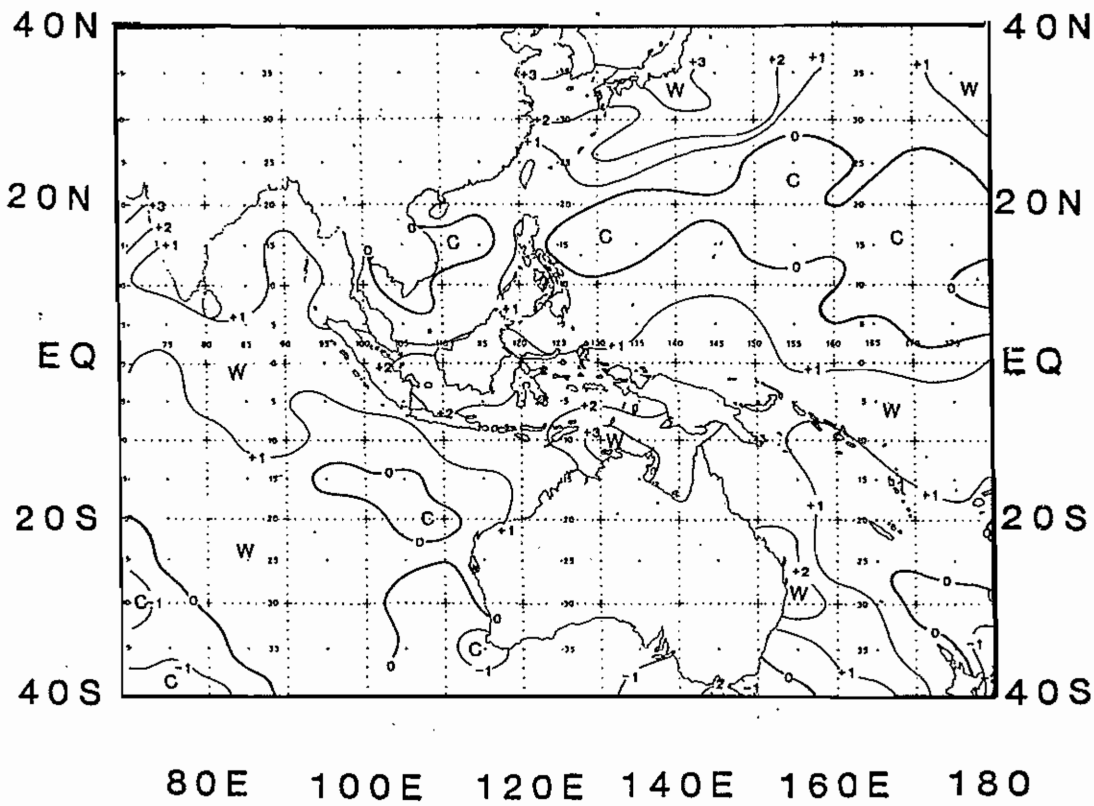

Fig. 3 SST ANOMALY CHART, BASED ON FIG. 2 AND THE CLIMATOLOGY OF REYNOLDS, NOAA REPORT NWS 31, 1983
Isotherm interval 1 deg C.

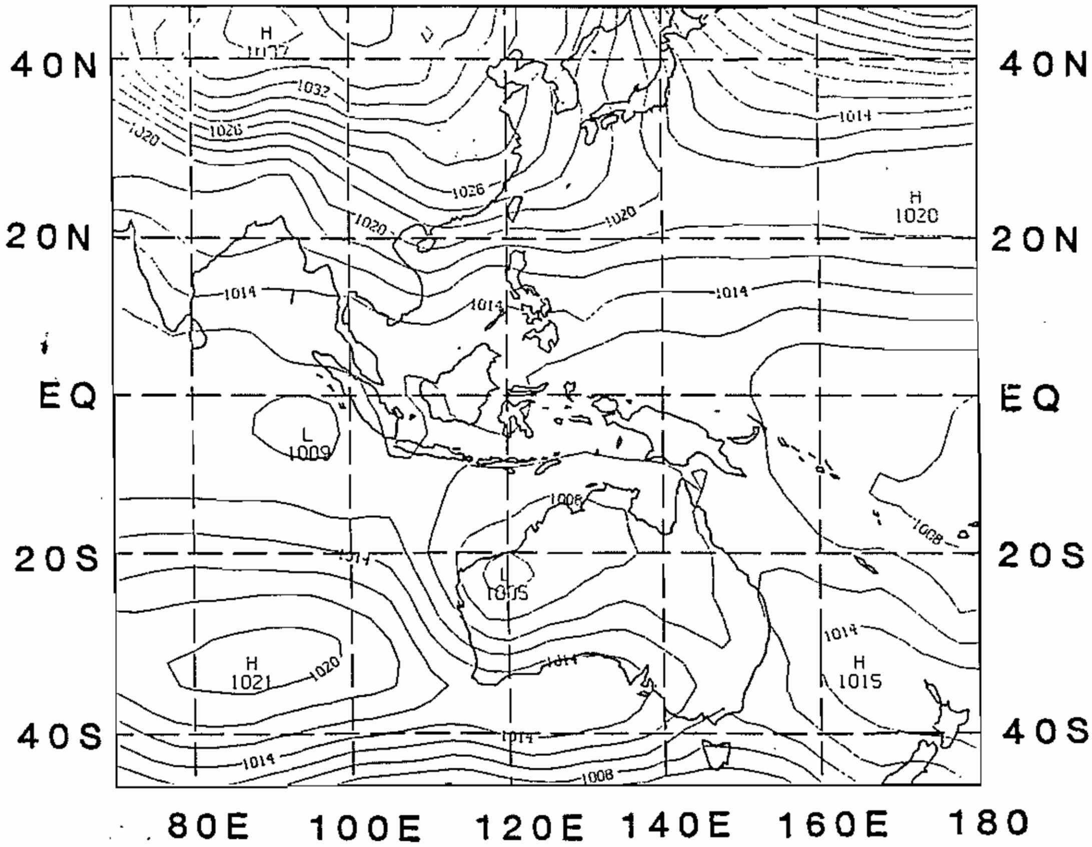

Fig. 4 MONTHLY MEAN MSL PRESSURE, JANUARY 1987
Isobar interval 2 hPa.

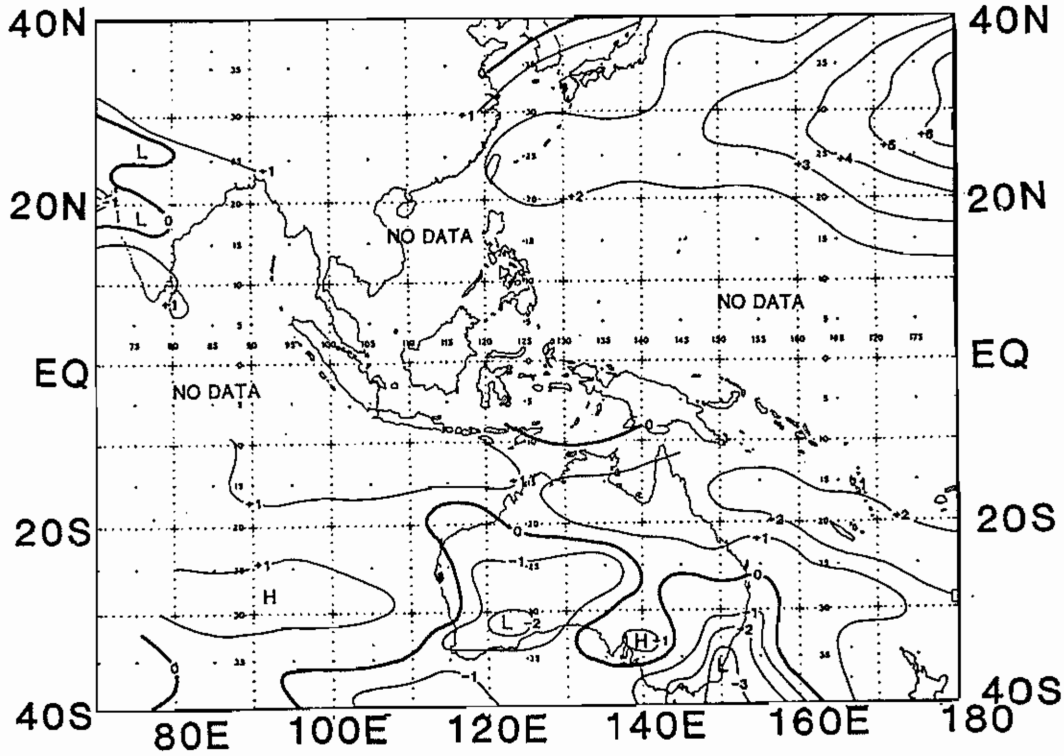

Fig. 5 MSL PRESSURE ANOMALY BASED ON CLIMAT MESSAGES
(AND MELBOURNE WMC DATA SOUTH OF 10 S)
Contour interval 1 hPa.

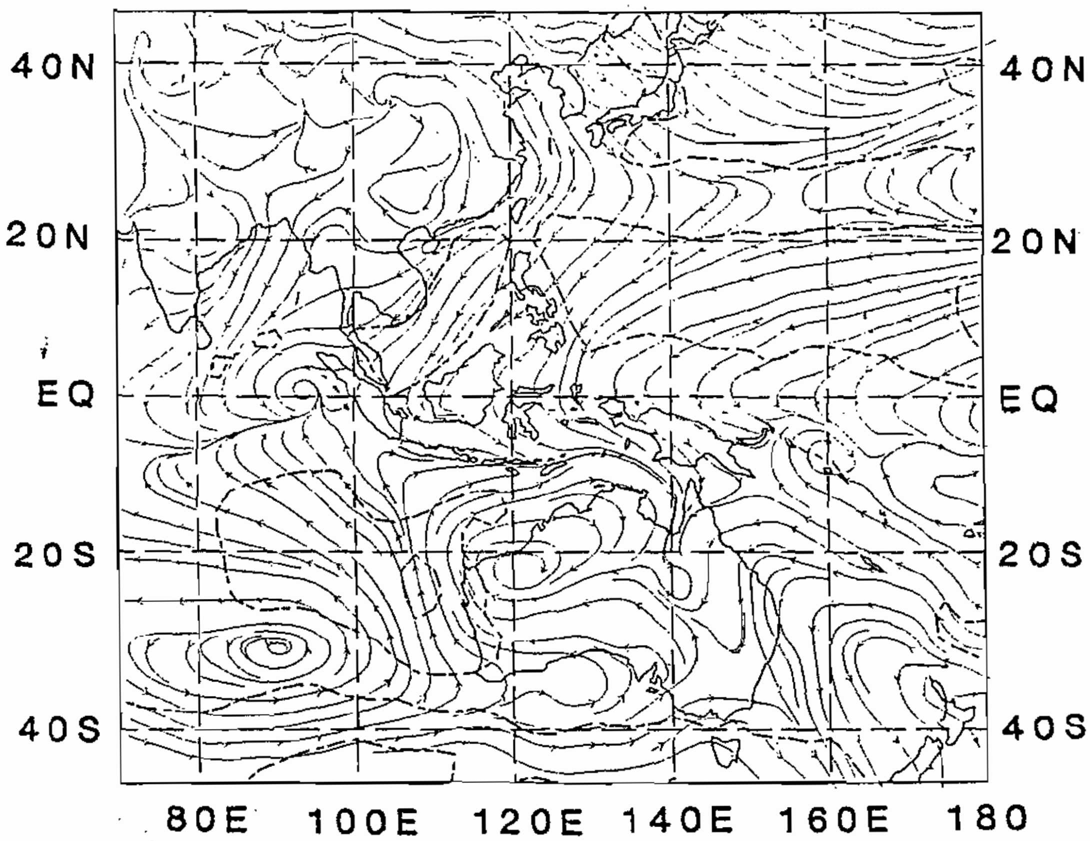

Fig. 6 950 hPa STREAMLINE ANALYSIS, JANUARY 1987
Isotachs (dashed line) at 10 knot intervals.

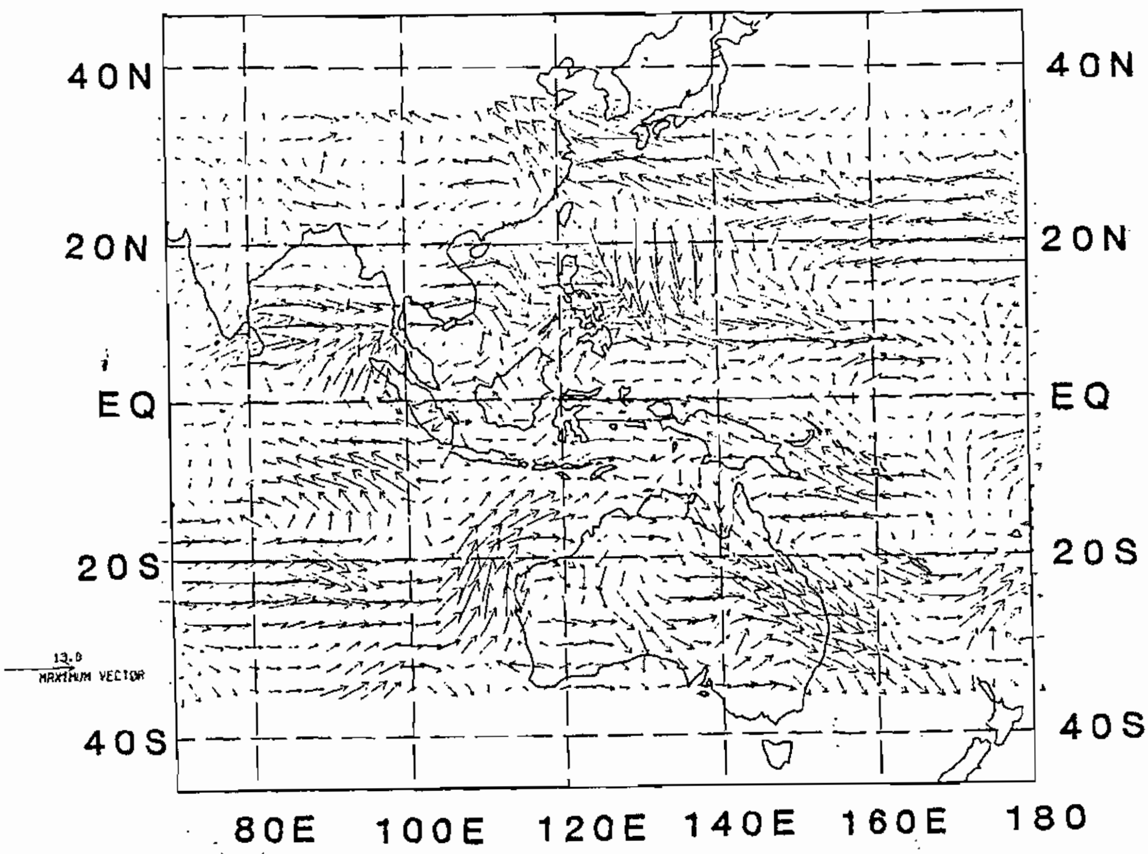

Fig. 7 950 hPa VECTOR WIND ANOMALY BASED ON FIG. 6
(Arrow length indicates magnitude).

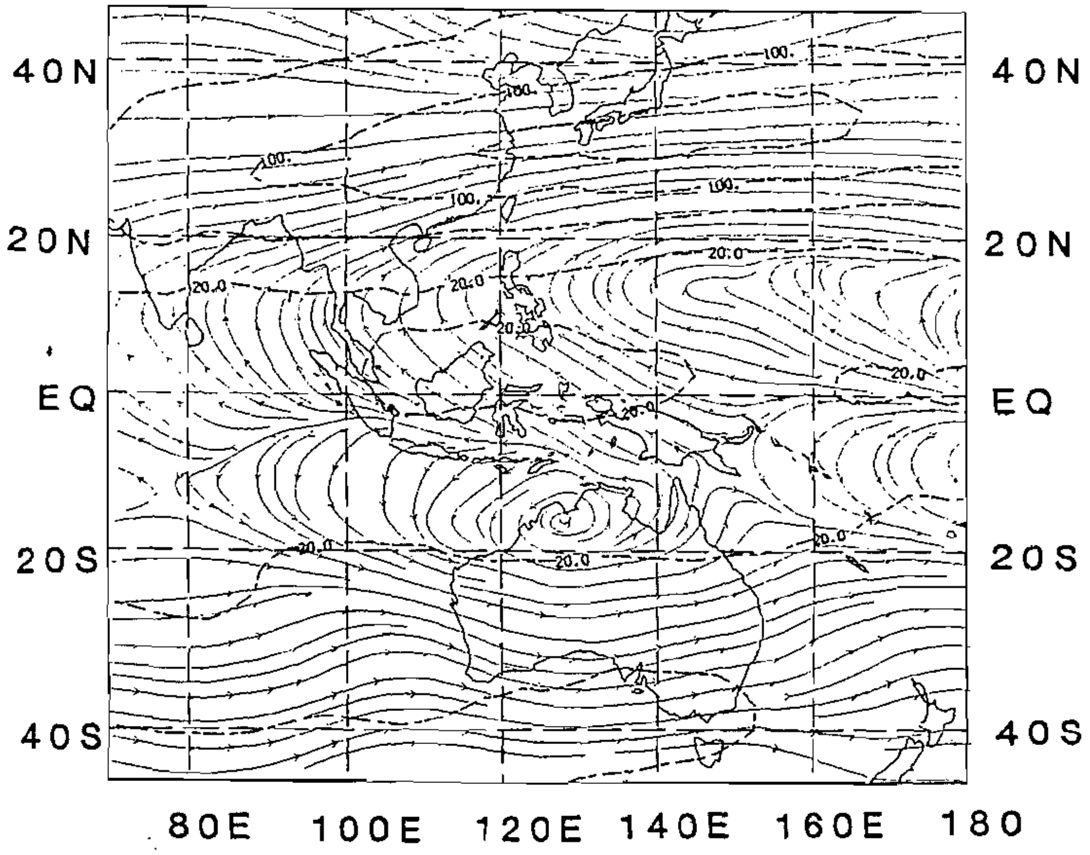

Fig. 8 200 hPa STREAMLINE ANALYSIS, JANUARY 1987
Isotachs (dashed line) at 40 knot intervals.

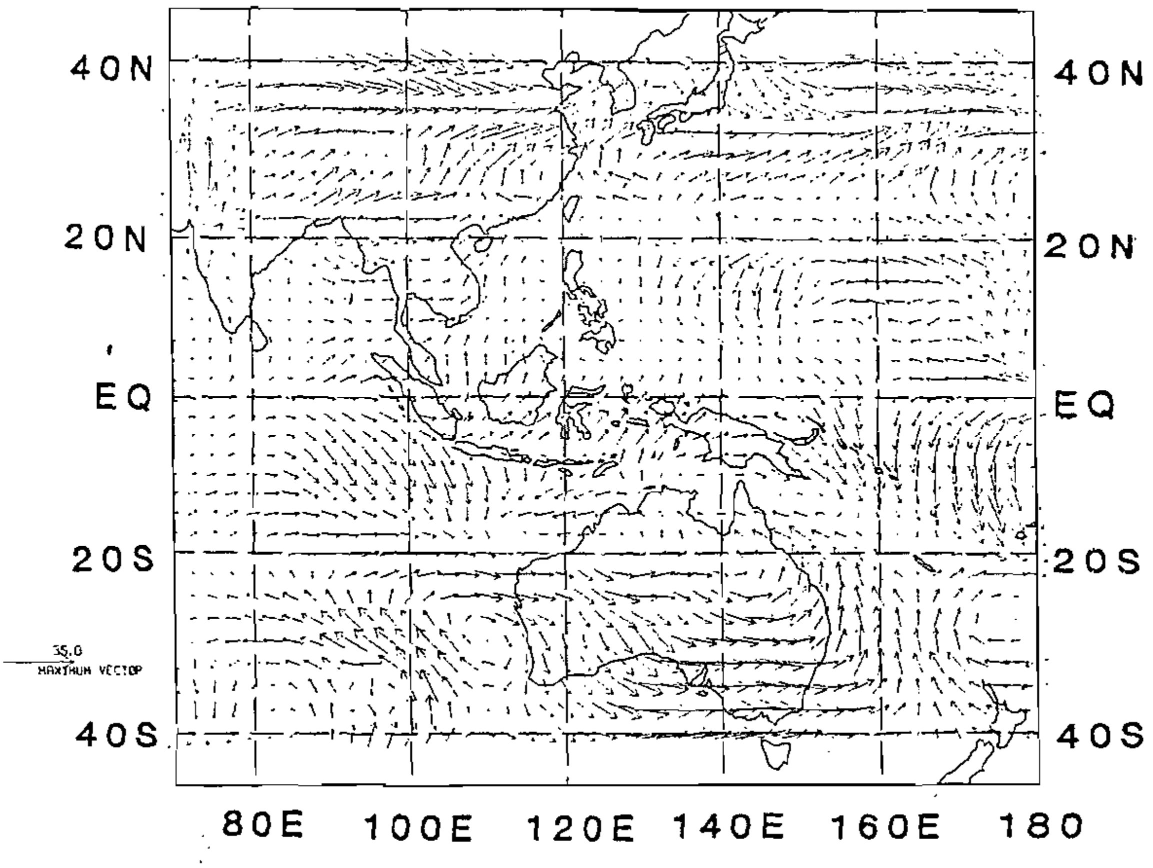

Fig. 9 200 hPa VECTOR WIND ANOMALY BASED ON FIG. 8
(Arrow length indicates magnitude).

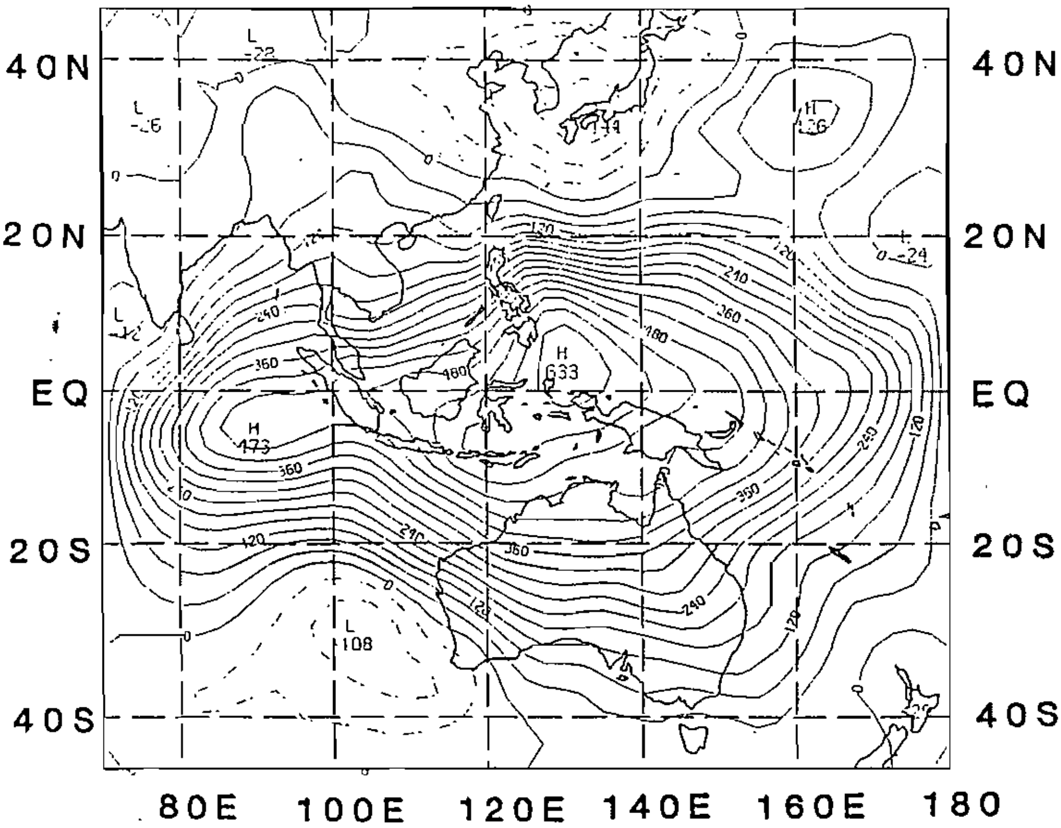

Fig. 10 950 hPa VELOCITY POTENTIAL, JANUARY 1987
Contour interval 40 x 10^5 m^2 /s

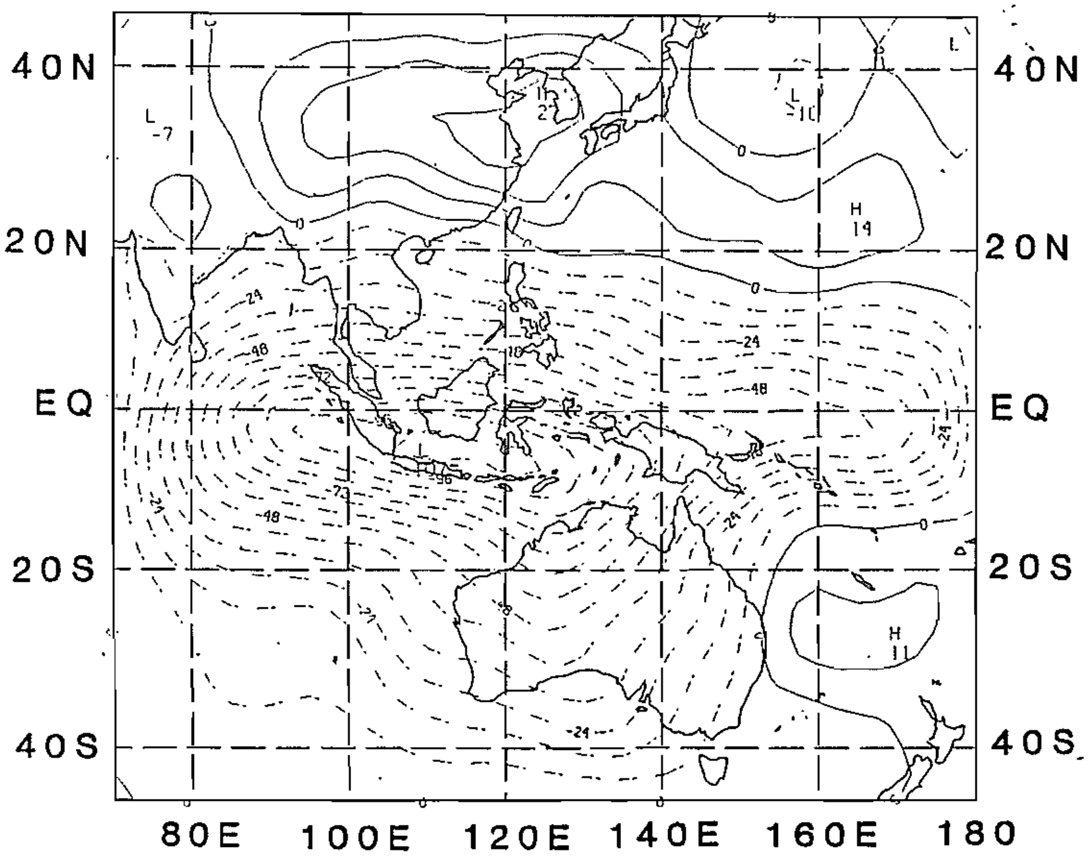

Fig. 11 200 hPa VELOCITY POTENTIAL, JANUARY 1987
Contour interval 8 x 10^5 m^2 /s

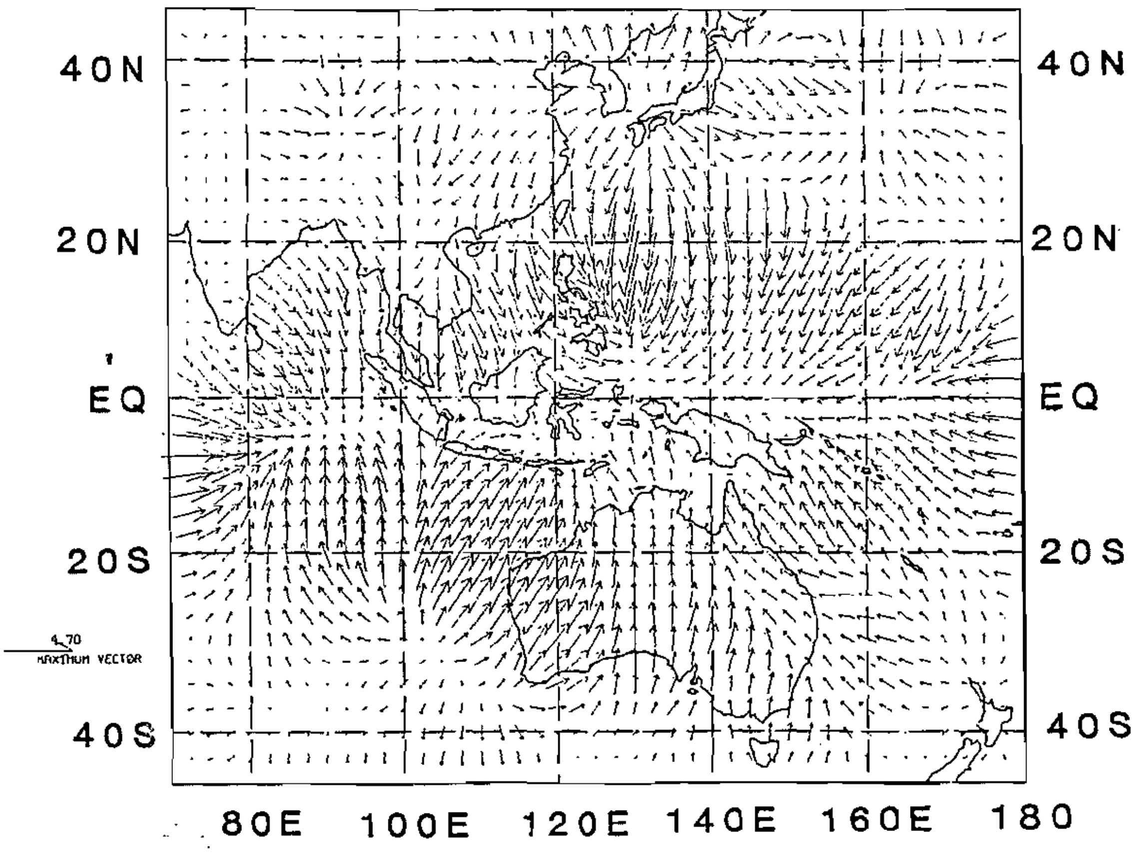

Fig. 12 950 hPa DIVERGENT WIND, JANUARY 1987
(Arrow length indicates magnitude).

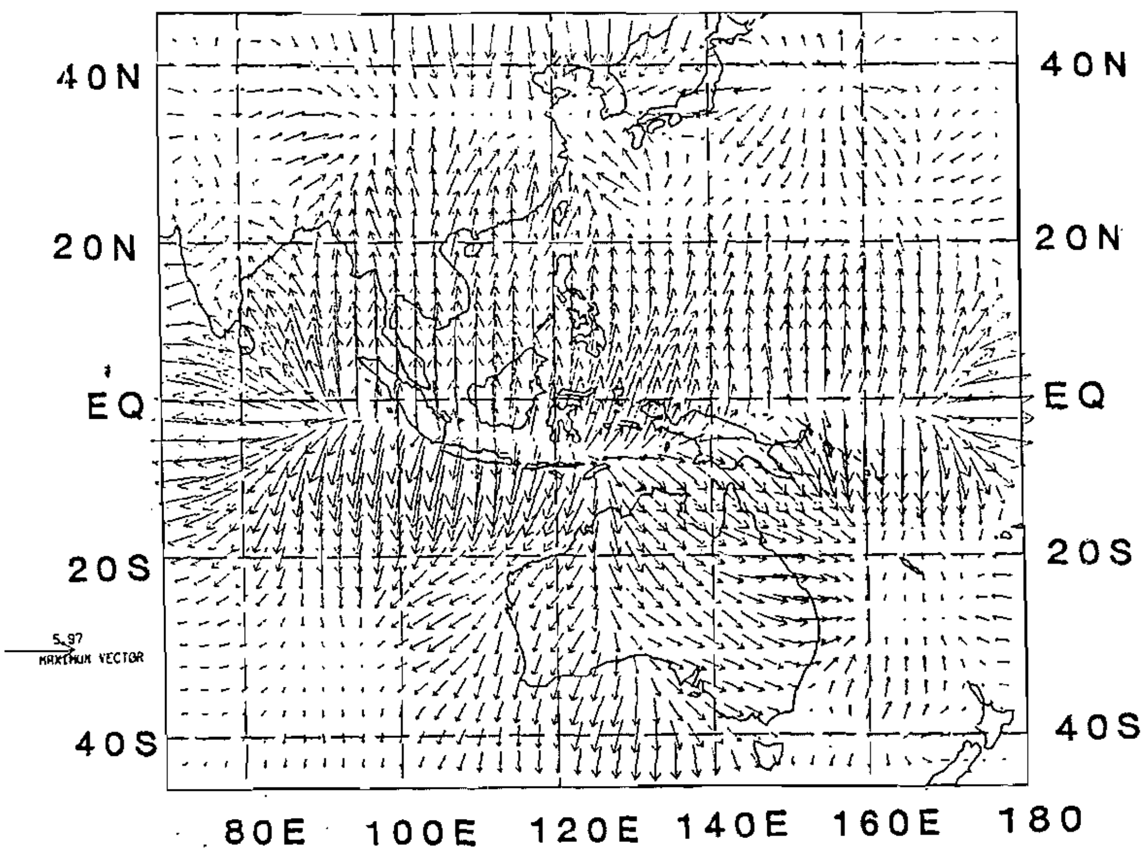

Fig. 13 200 hPa DIVERGENT WIND, JANUARY 1987
(Arrow length indicates magnitude).

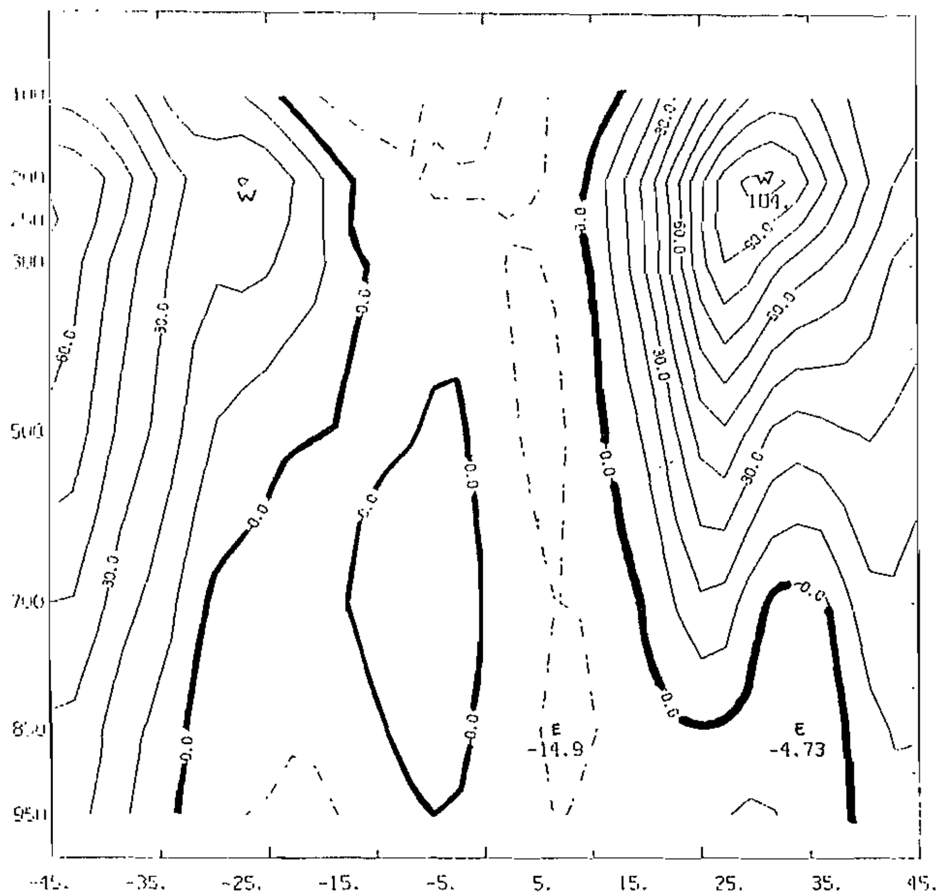

Fig. 14 CROSS-SECTION OF ZONAL WIND ALONG 100 E, JAN 1987
Isotach interval 10 knots.

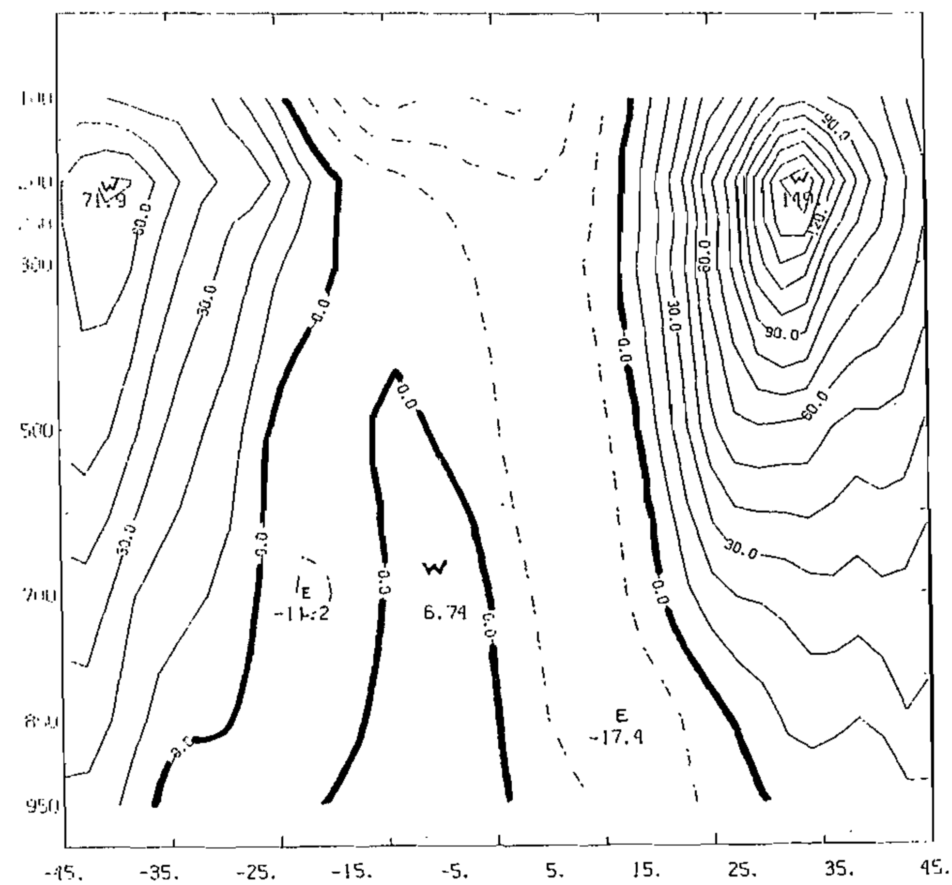

Fig. 15 CROSS-SECTION OF ZONAL WIND ALONG 130 E,JAN 1987
Isotach interval 10 knots.

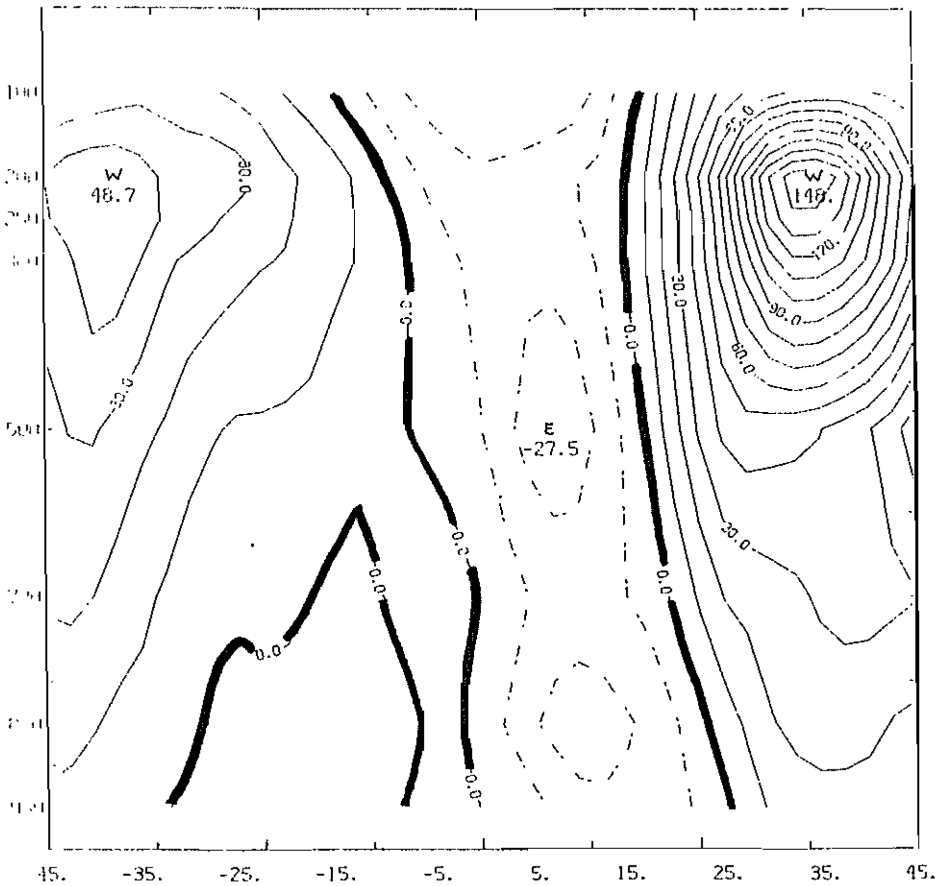

Fig. 16 CROSS-SECTION OF ZONAL WIND ALONG 160 E, JAN 1987
Isotach interval 10 knots.

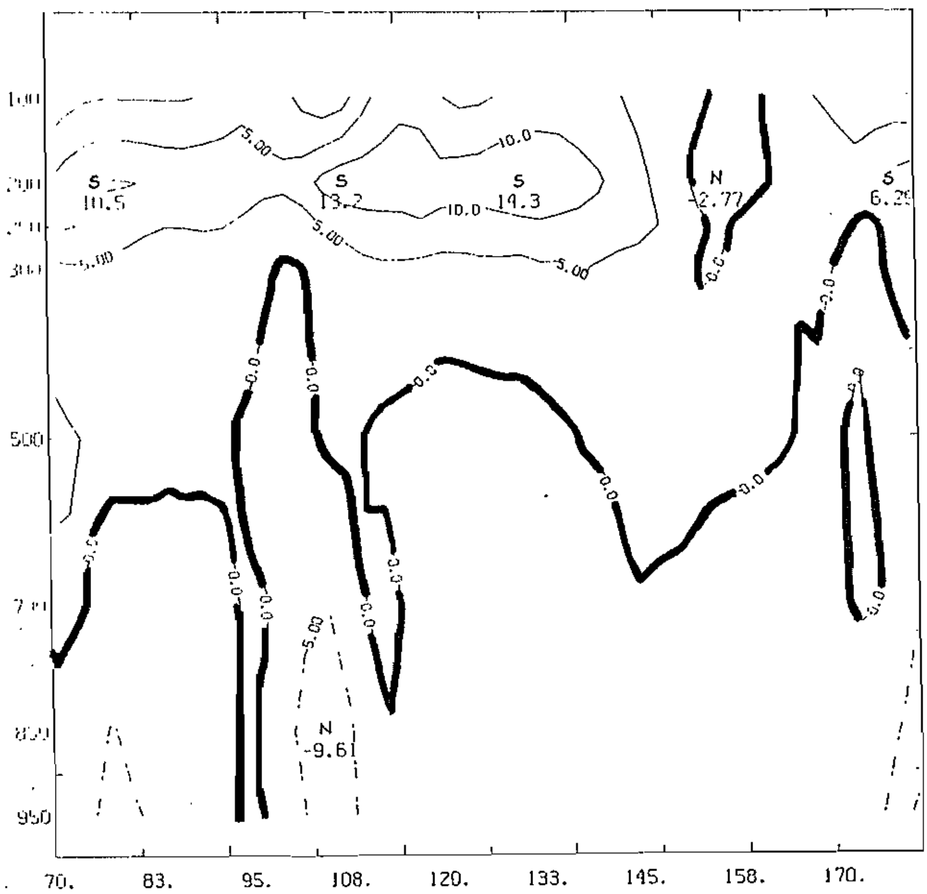

Fig. 17 EQUATORIAL CROSS-SECTION OF MERIDIONAL WIND
BETWEEN 70E AND 180E, DEC 1986. 5 knot isotachs.

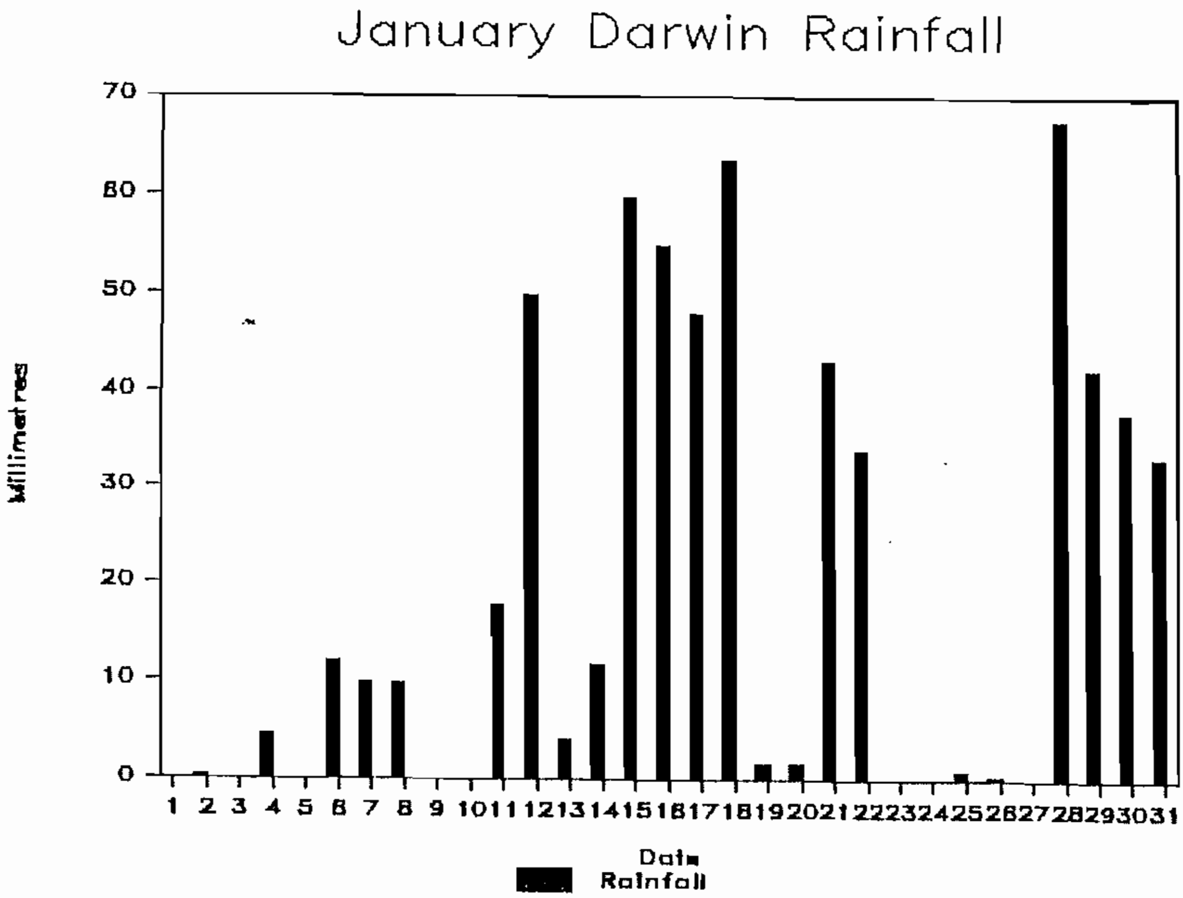

FIG.18 DAILY RAINFALL TOTALS FOR DARWIN AIRPORT DURING JANUARY 1987.

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(ΔP_{TAH} - ΔP_{DAR}) /σ

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