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Bureau of Meteorology

DARWIN TROPICAL DIAGNOSTIC STATEMENT

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DARWIN TROPICAL DIAGNOSTIC STATEMENT

DECEMBER 1985

ISSUED BY DARWIN RMC

14 JANUARY 1986

INDICES

The Darwin mean MSL pressure for December was 1007.6mb (0.2mb above 1938/83 average), with Tahiti's mean MSL pressure being 1011.5 (0.6mb above the 1938/83 average).

This gives a Troup's Southern Oscillation Index of +2.2, with the 5 month running mean (centred on October) at +0.3.

TROPICAL CYCLONES

Four tropical cyclones existed in the region during December (unofficial tracks shown in figure 1), chiefly at the start and middle of the month.

The two cyclones existing in the north Pacific region (T.C. Irving and Typhoon Hope) maintained the above average season in this area (monthly average: 0.6 typhoons, 1.2 combined tropical storms and typhoons; JTWC statistics 1959/84). This possibly reduced the activity in the Australian region, with one cyclone, T.C. Nicholas, forming late in November (compared to a 1959/80 average of 1.9).

In the Bay of Bengal, cyclone 06B developed and made landfall on the east India coast, in the same region in which cyclone 05B made landfall in November.

SEA SURFACE TEMPERATURES

Mean sea surface temperature (SST) and anomaly charts, averaged over the middle two weeks of December, are shown in figures 2 and 3 respectively.

The broad band of anomalous warm SST, which over the past year extended from the Southern Indian Ocean into the Tasman Sea, is gradually being replaced by a weak cold anomaly now in the Indian Ocean and off the south west Australian coast. This cold anomaly started to become apparent in October and continued over the past couple of months.

A warm anomaly continued in the Arafura Sea and along the east Australian coast, though not as distinct as in November when large +2°C anomalies were present.

In the northern hemisphere the tongue of warm SST anomaly mentioned in November, continued to weaken and drift eastwards. A large band of anomalous cold SST developed along the Chinese coast, replacing a warm anomaly previously in that region. This cold anomaly is associated with stronger than usual north-easterly monsoon cold surges through the South China Sea (see fig 7).

MSL PRESSURE

The mean monthly MSL pressure and anomaly charts (figures 4 and 5) show a significant low pressure region over the Philippines resulting from the cyclone activity in that region. Corresponding to this negative anomaly in the northern hemisphere, is a strong positive anomaly over the Arafura Sea/Torres Strait region; the resultant pressure gradient being the reverse to the norm resulted in a breakdown of the cross-equatorial monsoon flow into the Australian region.

Darwin rainfall from 1 September to 31 December totalled 224mm compared with the long term mean of 463mm for the same period; reflecting this lack of monsoonal activity. The Darwin pressure however was near normal during December with an anomaly of only +0.3mb, this was probably influenced by the broad negative anomaly over the majority of Australia. Thus the lack of rainfall over Northern Australia has been attributed to a weaker than usual Hadley Cell, the Walker Circulation continues to flow at near normal strength.

The negative anomaly over Australia, centred around Tasmania, is a consequence of a blocking pattern established in late November, with the sub tropical ridge much further south than normal at about 55S.

The Siberian high became firmly established west of 120E in December, while a strong ridge extended over China.

950mb

Mean 950mb streamline analysis and anomaly charts are shown in figures 6 and 7 respectively. Over the northern hemisphere these show very little change from November due to the strong cyclonic activity in the north west Pacific. Flow through the South China Sea retained the strong northerly component evidenced in November, instead of the usual strong northeasterly flow. While east of the Philippines a northeasterly flow predominated, reinforced by the ridge now extended from the Siberian High across China. The anomalous westerly flow across the Bay of Bengal was also maintained.

The momentum of the intense cold surges appears to have been dissipated in cyclonic systems in the Bay of Bengal rather than through increased cross equatorial flow. It is unclear whether those flows were a result of the anomalous cross-equatorial pressure gradient or the cause of it.

To the north of Australia, anomalous cross-equatorial flow occured away from the region of positive pressure anomaly in the the Arafura Sea. Over northern Australia the westerly flow mentioned in November was maintained under the influence of the positive pressure anomaly in the Arafura Sea and the strong negative anomaly pattern around south eastern Australia.

500mb

The 500mb streamline analysis and geopotential height anomaly charts are shown in figures 8 and 9 respectively. These strongly reflect the MSLP blocking pattern over south eastern Australia and the southward displacement of the subtropical ridge, with very stong negative anomalies extending along 30/40S.

Over Japan strong negative anomalies continued from November, though becoming weaker. This resulted from the subtropical ridge being extended southwards through China and into the Pacific Ocean, as indicated on the MSL and 950mb charts.

200mb

The 200mb streamline analysis and anomaly charts (figures 10 and 11 respectively) shows a strong subtropical jet in the Australian region.

It is unusual to see the subtropical jet so well established over the Australian continent during December. The failure of the summer time Hadley cell during December combined with the persistent troughing in the southeast Australia region undoubtably led to this situation.

The northern hemisphere's subtropical jet is displaced southwards as indicated by the anomalously strong southeasterly winds south of Japan.

Cross equatorial flow at 200mb was weak and chiefly from the northern hemisphere west of 100E and east of 140E; further indicating a breakdown in the monsoonal pattern in the Australian region.

VELOCITY POTENTIAL AND DIVERGENT WIND

Comparison of the velocity potential and divergent wind charts (figures 12 to 15) at 950mb and 200mb with those of November, indicate that the regions of maximum surface convergence and maximum ascent changed very little into December. Only to the west of 100E did some southward movement occur as would normally be expected at this time of year.

WIND CROSS-SECTIONS

Cross-sectional wind charts for 100E, 130E and 160E are shown in figures 16 to 18. As expected with the breakdown of the monsoonal pattern there is only a narrow band of weak westerly winds in the southern hemisphere's tropical zone.

The subtropical jet in the northern hemisphere generally increased in strength, while in the southern hemisphere the jet decreased slightly at 100E and 160E but actually increased by 23W at 130E.

Figure 19 shows the equatorial cross-section between 70E and 180E; in December this indicated very weak flow at all levels.

SUMMARY

Strong cyclone activity over the Philippines and South China Sea resulted in a breakdown in the monsoonal pattern about the Australian region. This was evidenced in the weak cross-equatorial flow at all levels, positive MSL pressure anomaly in the Arafura Sea, and well below normal rainfall at Darwin.

The Siberian high became well established during December, though negative pressure anomalies still exist around Japan with the anticyclone tending to extend a ridge across China and into the Pacific Ocean.

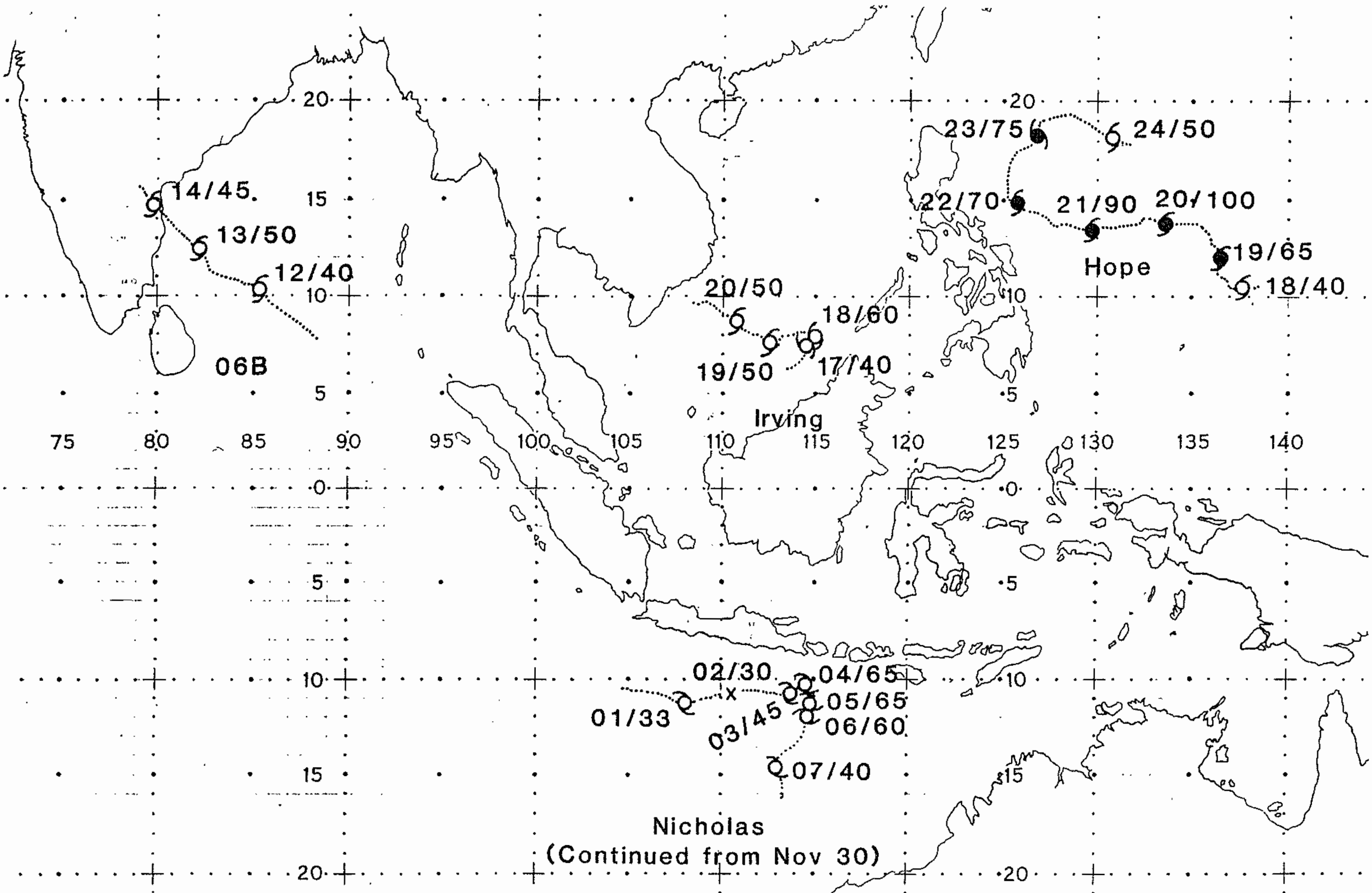

Fig. 1. UNOFFICIAL CYCLONE TRACKS OF 06B, IRVING, HOPE AND NICHOLAS.

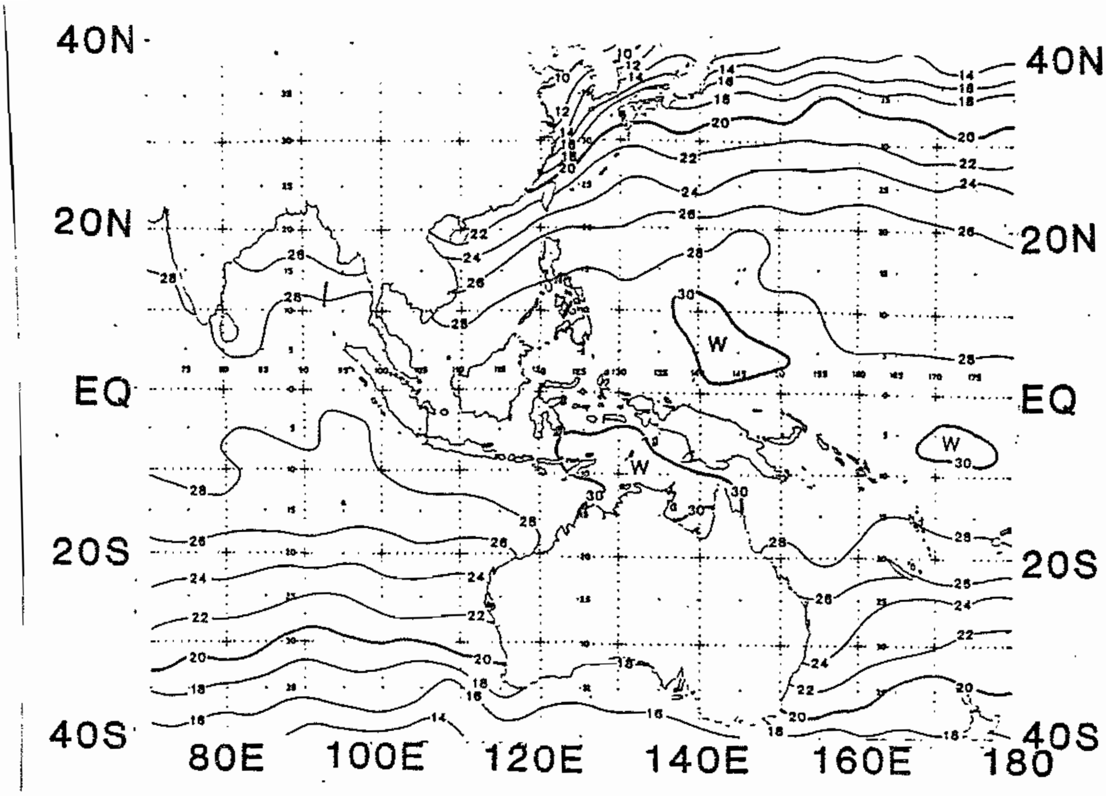

Fig. 2. MEAN SEA SURFACE TEMPERATURES, BASED ON DARWIN RMC ANALYSIS AVERAGED OVER THE MIDDLE 2 WEEKS OF DECEMBER 1985. (CONTOUR INTERVAL 2^{o}C).

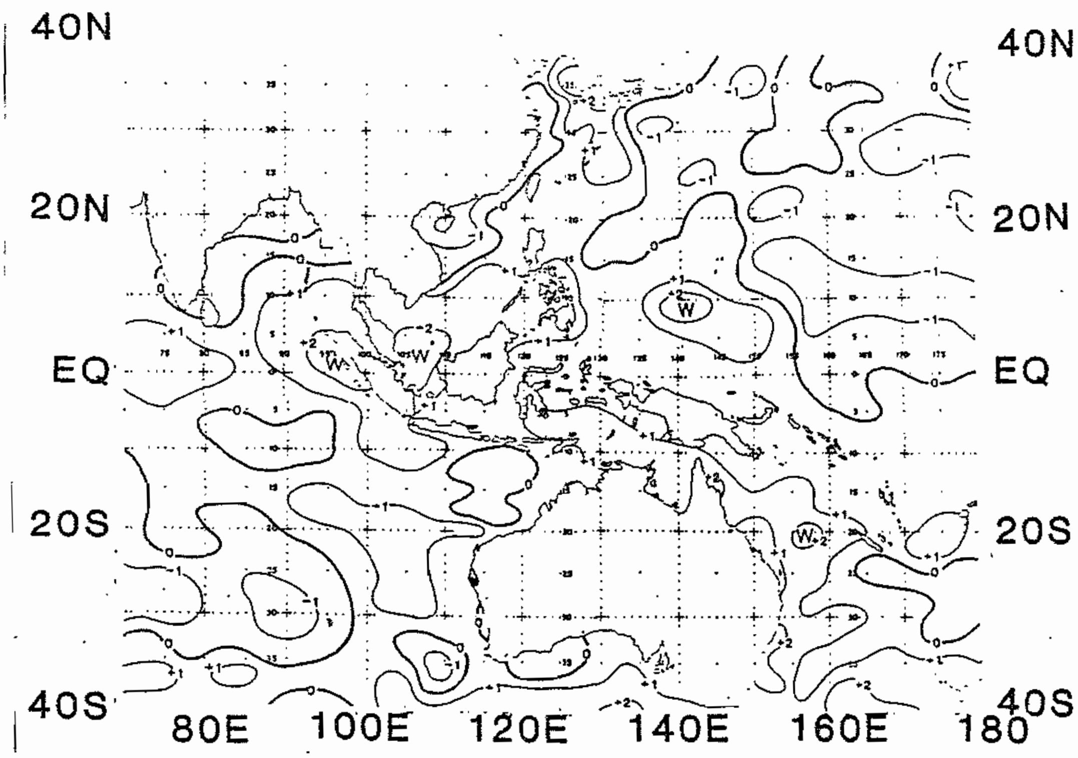

Fig. 3. SST ANOMALY CHART, BASED ON FIG. 2 AND THE CLIMATOLOGY OF REYNOLDS, NOAA REPORT NWS 31, 1983.(CONTOUR INTERVAL 1^{o}C).

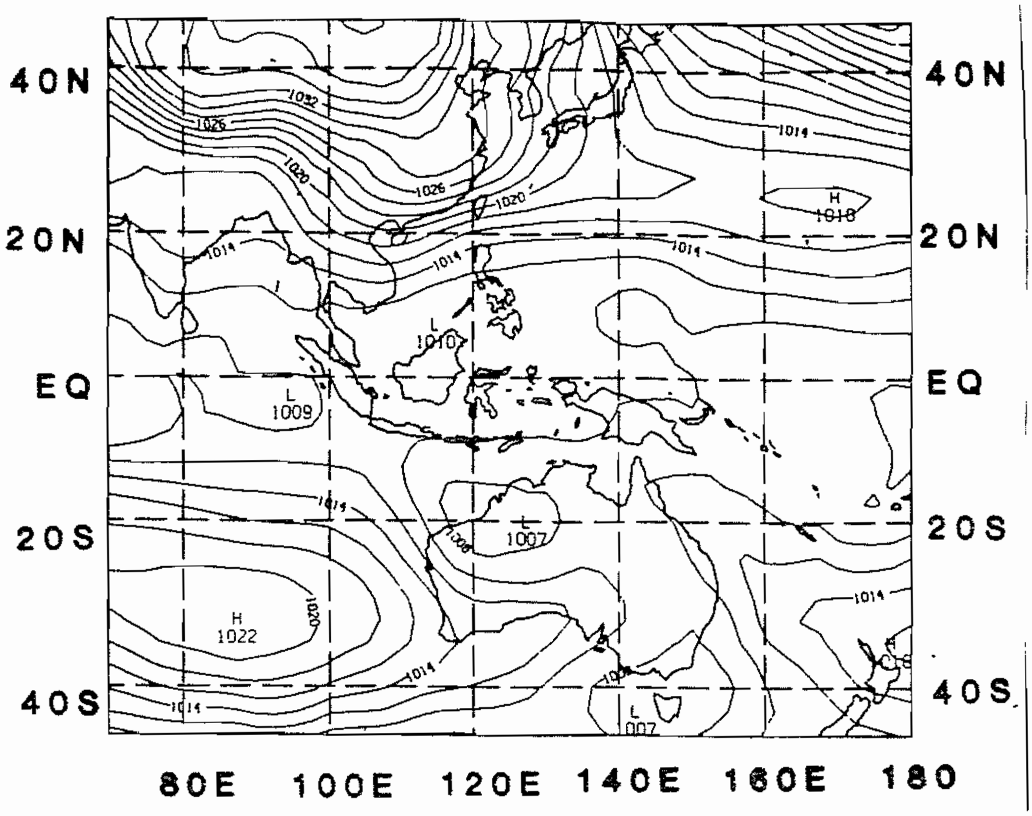

Fig. 4. DECEMBER 1985 MONTHLY MEAN MSL PRESSURE. (CONTOUR INTERVAL 2 MB).

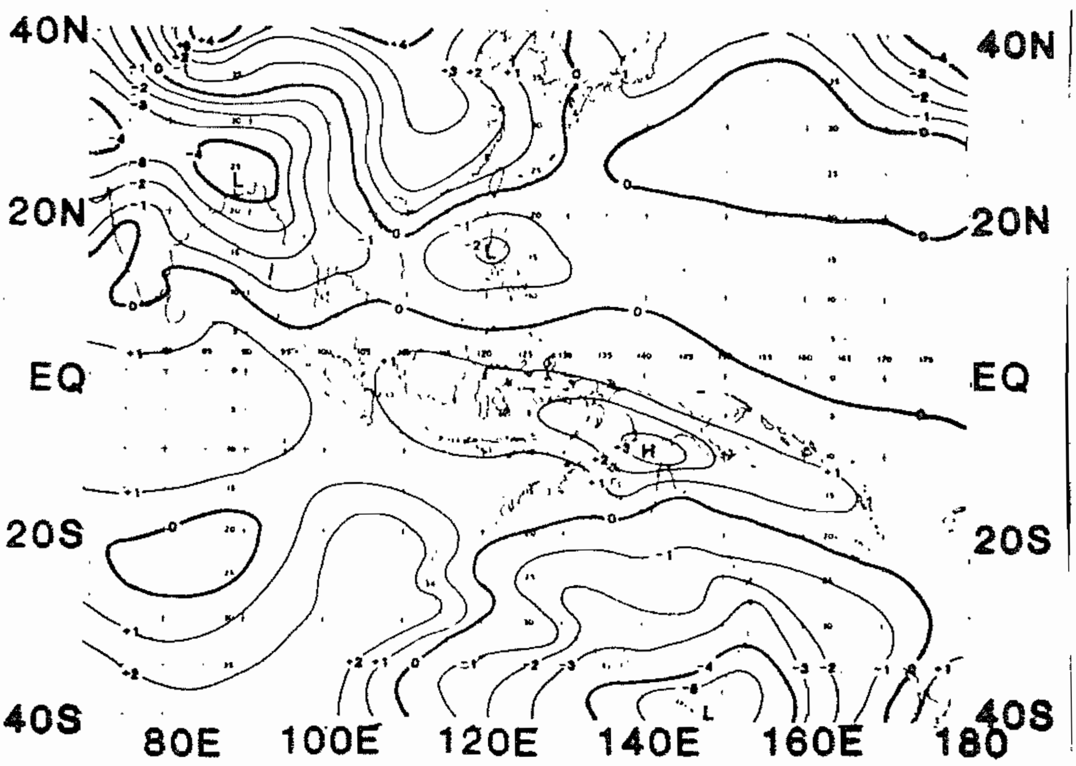

Fig. 5. MSL PRESSURE ANOMALY, BASED ON MELBOURNE WMC DATA SOUTH OF 10°N, ADJUSTED TO FIT CLIMATE MESSAGES WHERE AVAILABLE. (CONTOUR INTERVALS 1 MB).

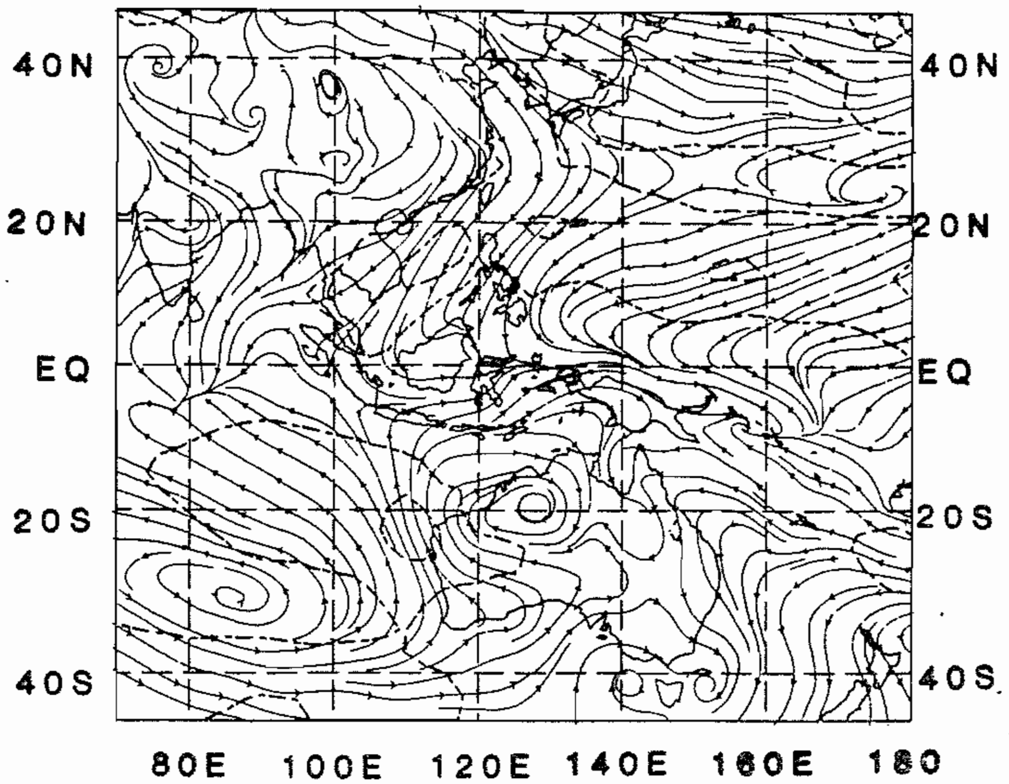

Fig. 6. DECEMBER 1985 950 MB STREAMLINE/ISOTACH ANALYSIS. (10 KNOT INTERVAL ISOTACHS DASHED LINE).

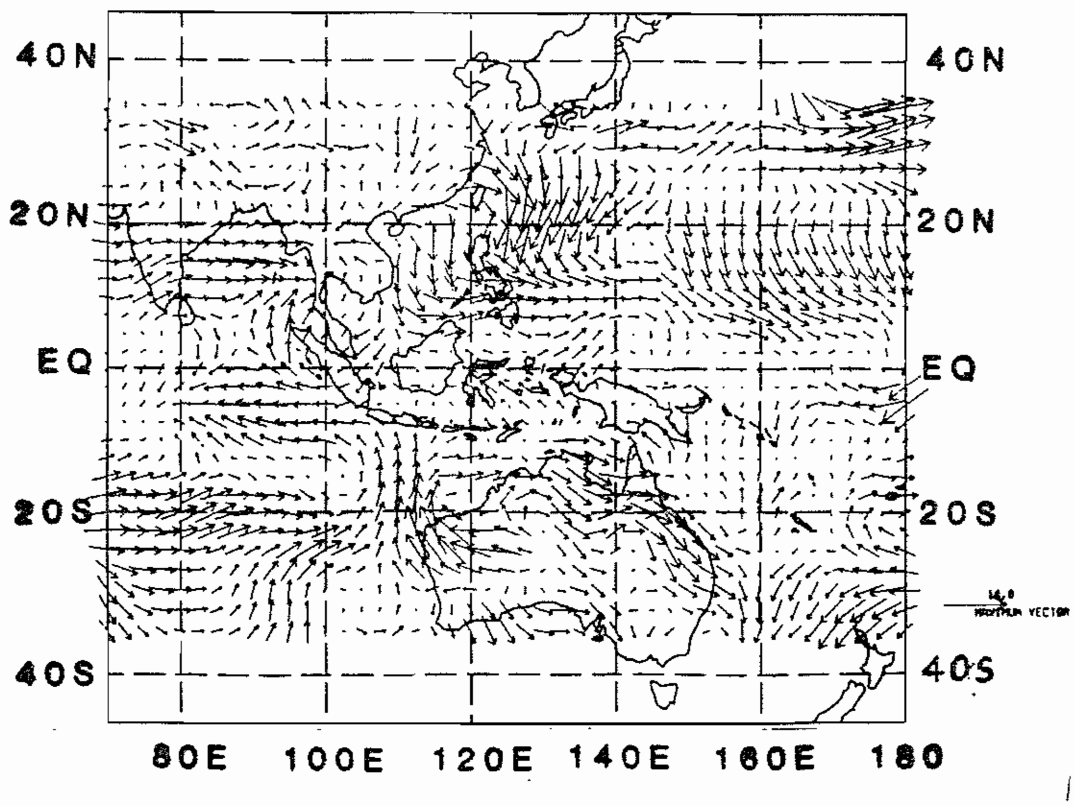

Fig. 7. 950 MB VECTOR WIND ANOMALY BASED ON FIG. 6. (ARROW LENGTH INDICATES MAGNITUDE).

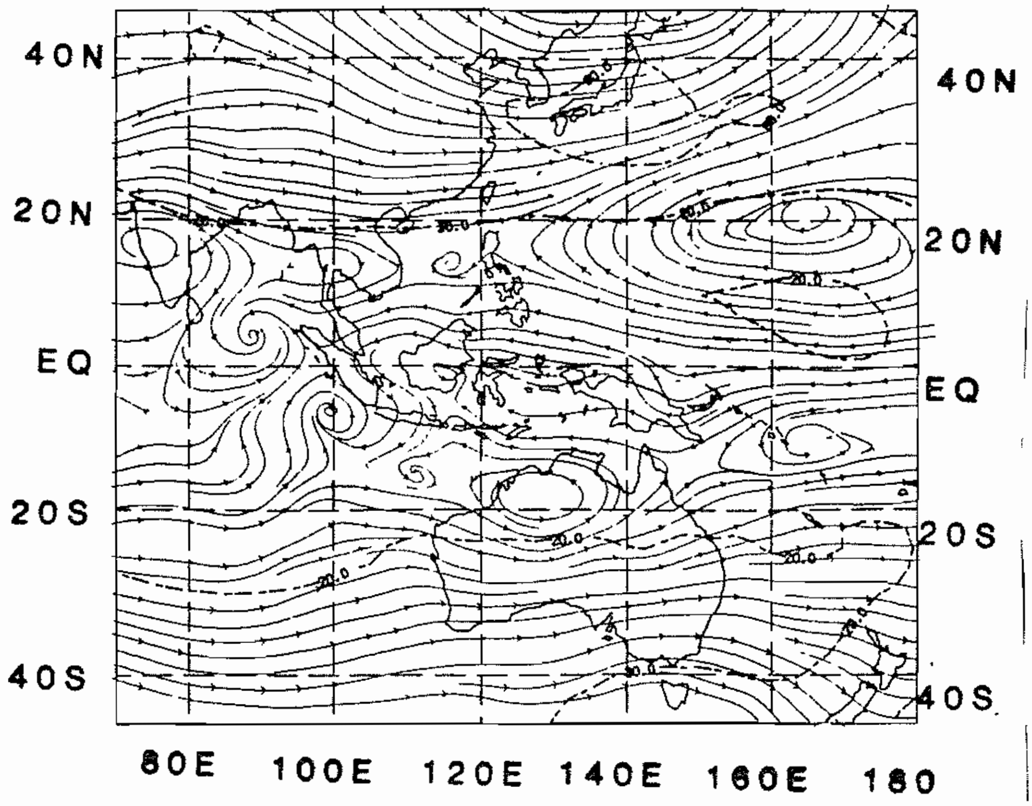

Fig. 8. DECEMBER 1985 500MB STRAMLINE/ISOTACH ANALYSIS. (10 KNOT INTERVAL ISOTACHS DASHED LINE).

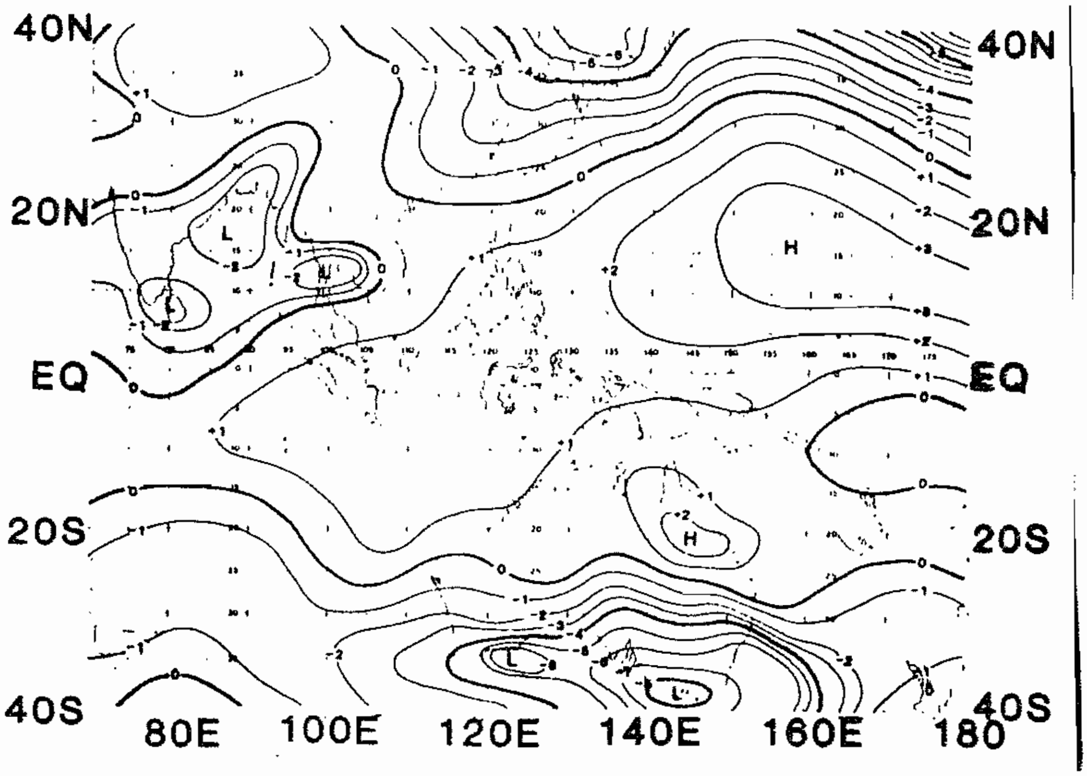

Fig. 9. NOVEMBER 1985 500MB GEOPOTENTIAL HEIGHT ANOMALY. (CONTOUR INTERVAL 1gpm) (DATA BASE AS PER FIG. 5.)

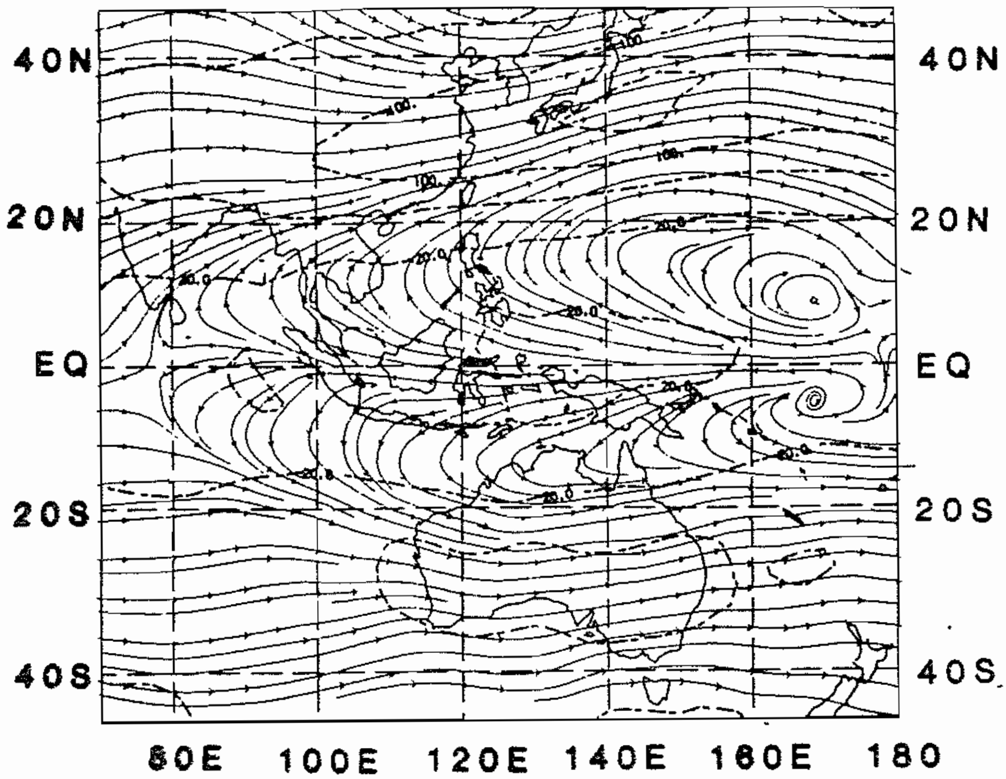

Fig. 10. DECEMBER 1985 200MB STREAMLINE/ISOTACH ANALYSIS. (40 KNOT INTERVAL ISOTACH DASHED LINE).

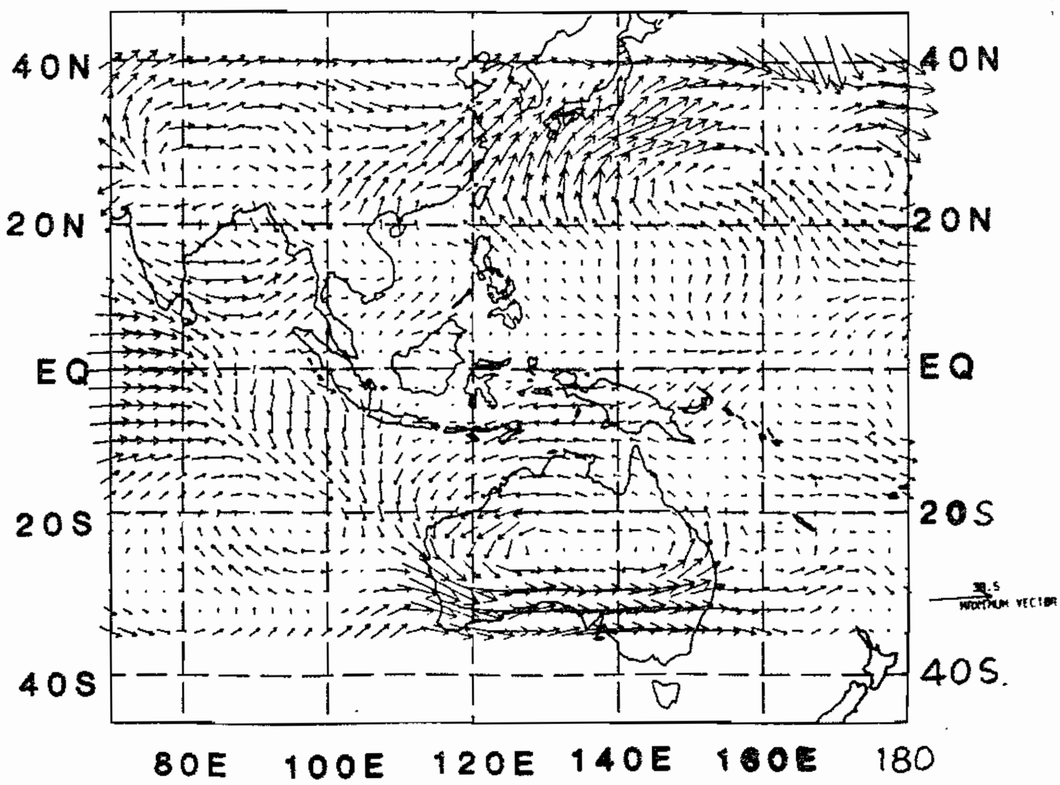

Fig. 11. DECEMBER 1985 200MB VECTOR WIND ANOMALY. (ARROW LENGTH INDICATES MAGNITUDE).

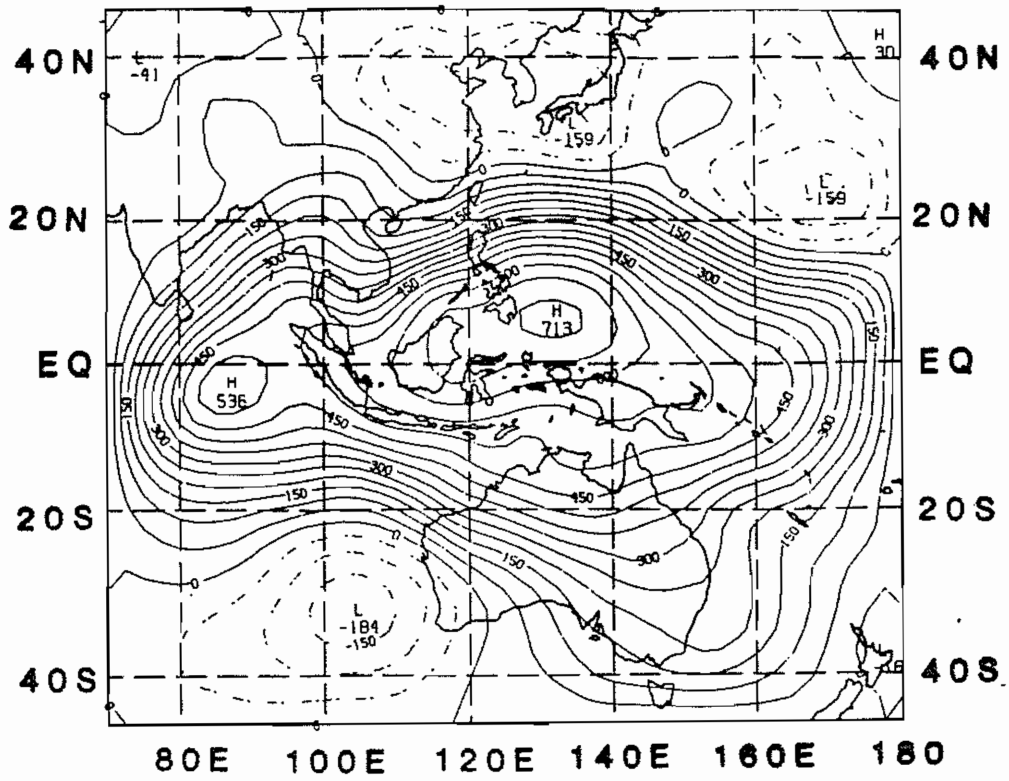

Fig. 12. DECEMBER 1985 950 MB VELOCITY POTENTIAL (CONTOUR INTERVAL 50 X $10^5 M^2 S^{-1}$).

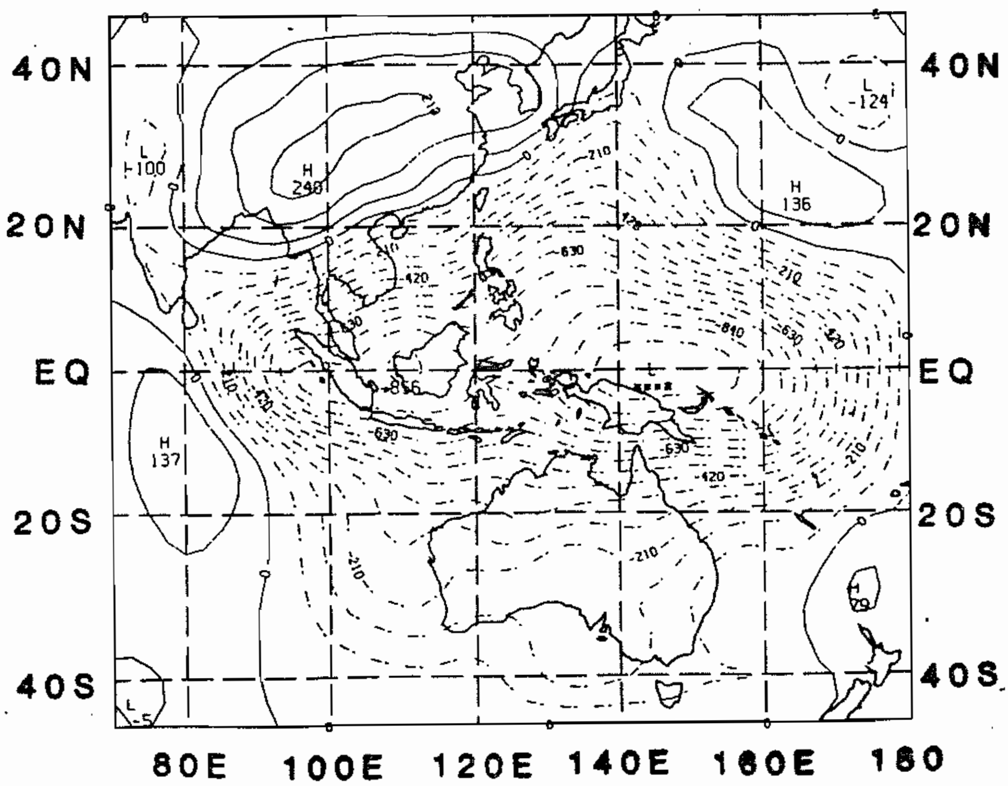

Fig. 13. DECEMBER 1985 200MB VELOCITY POTENTIAL (CONTOUR INTERVAL 70 X $10^5 M^2 S^{-1}$).

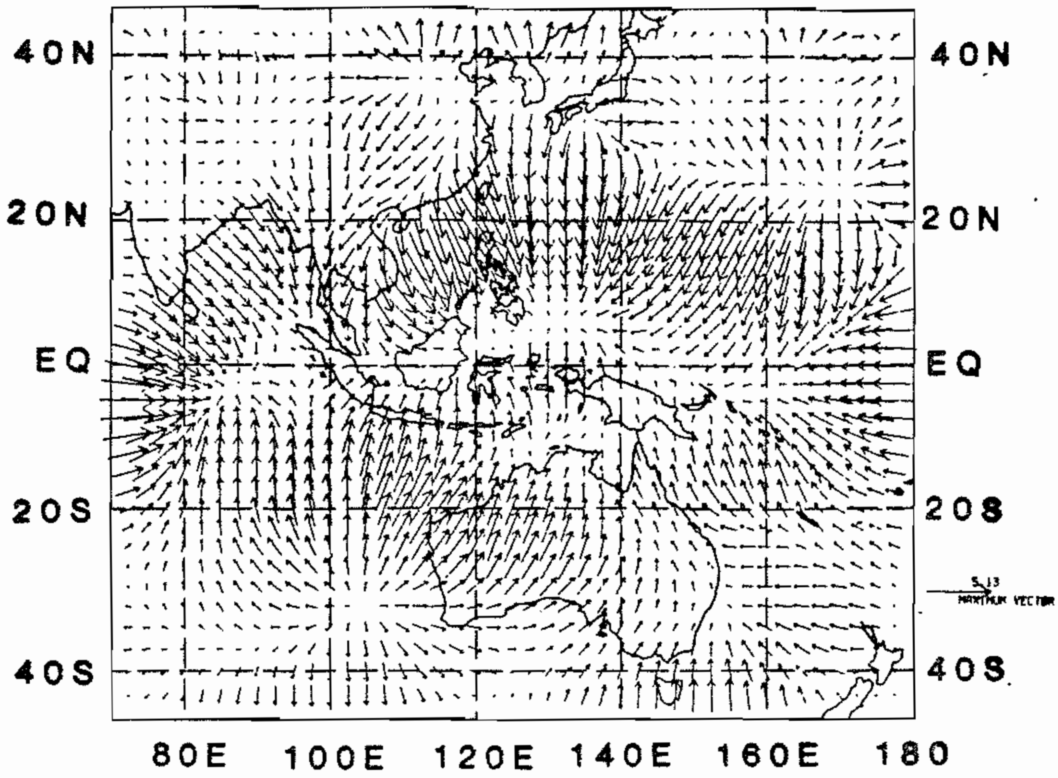

Fig. 14. DECEMBER 1985 950 MB DIVERGENT WIND. (ARROW LENGTH INDICATES MAGNITUDE).

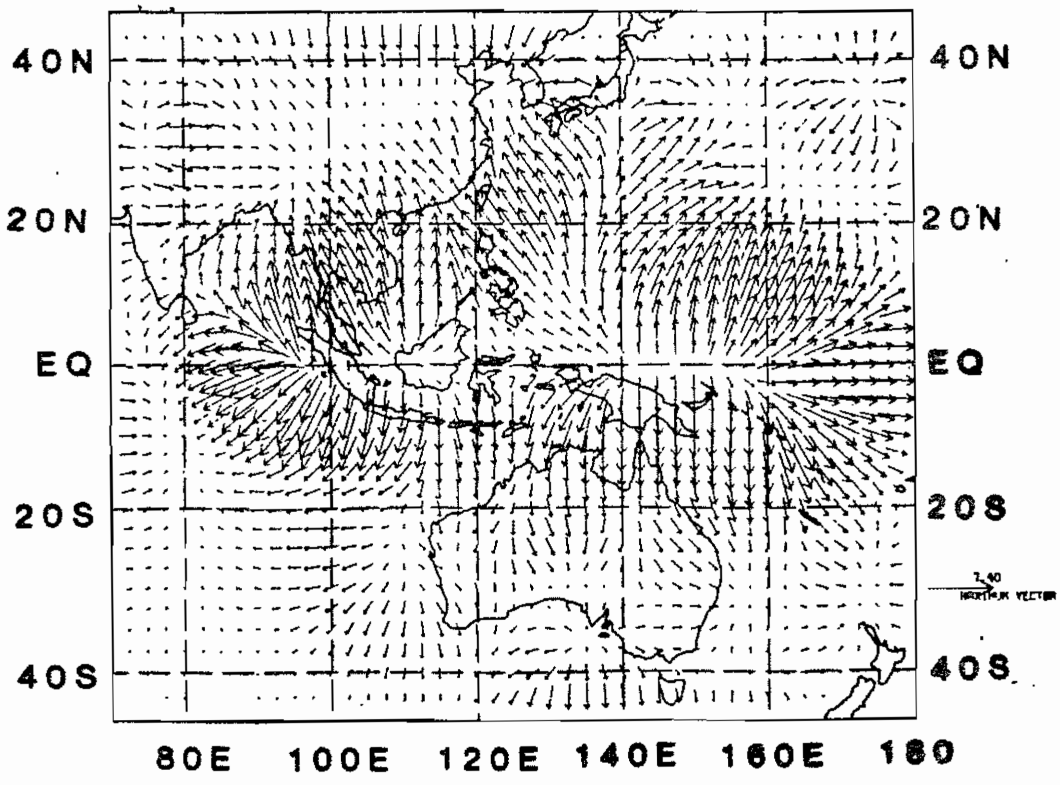

Fig. 15. DECEMBER 1985 200 MB DIVERGENT WIND. (ARROW LENGTH INDICATES MAGNITUDE).

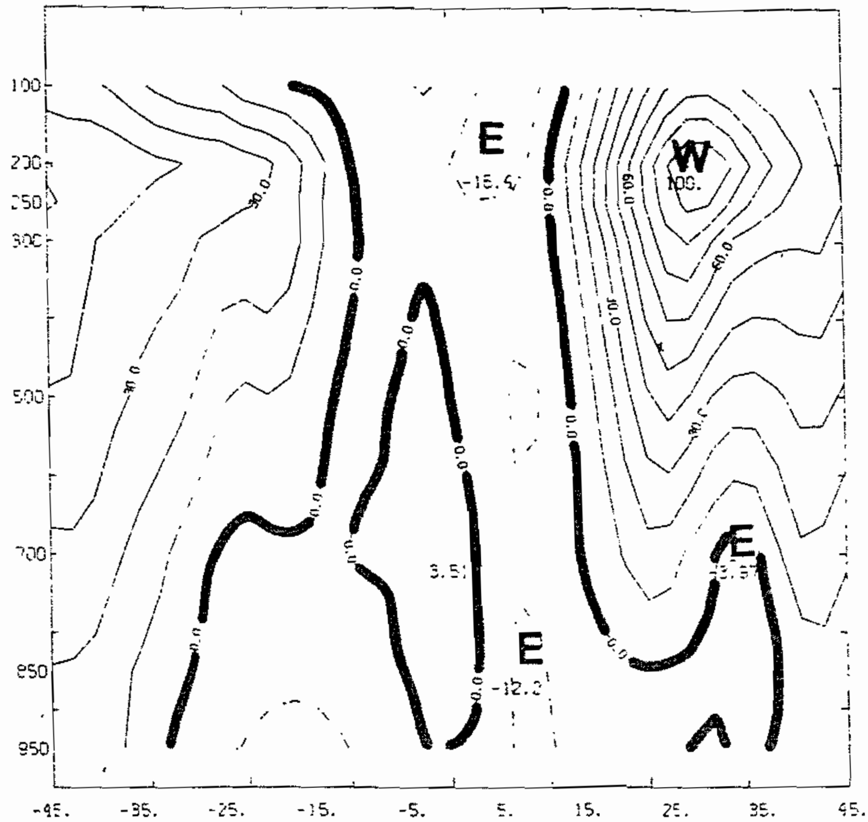

Fig. 16. DECEMBER 1985 CROSS SECTION OF ZONIAL WIND ALONG 100°E (CONTOUR INTERVAL 10 KNOTS).

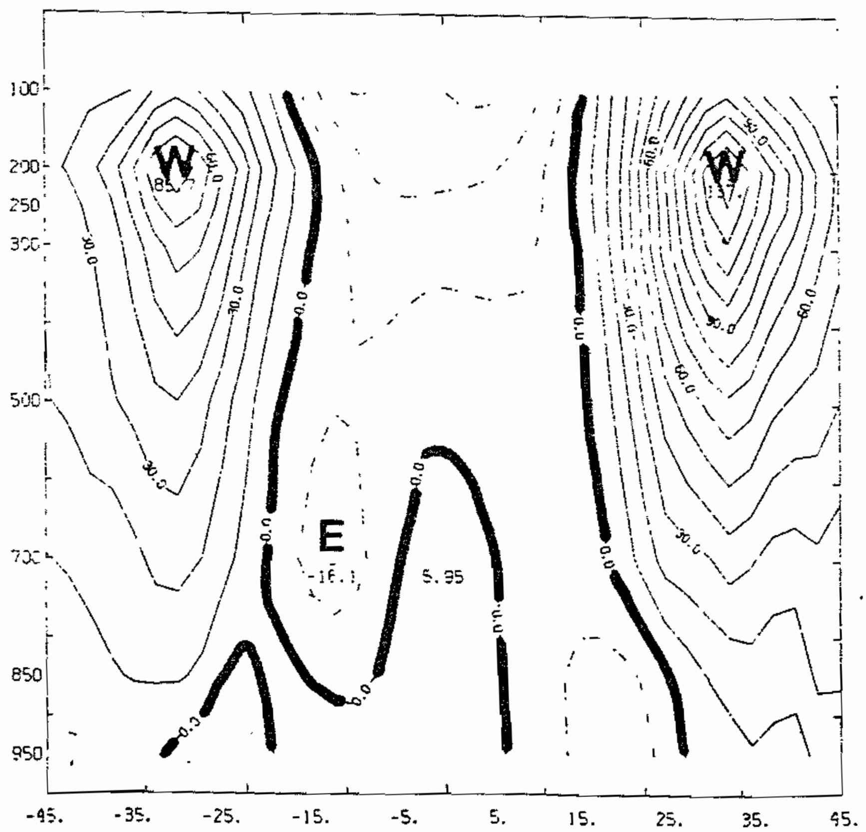

Fig. 17. DECEMBER 1985 CROSS SECTION OF ZONIAL WIND ALONG 130°E (CONTOUR INTERVAL 10 KNOTS).

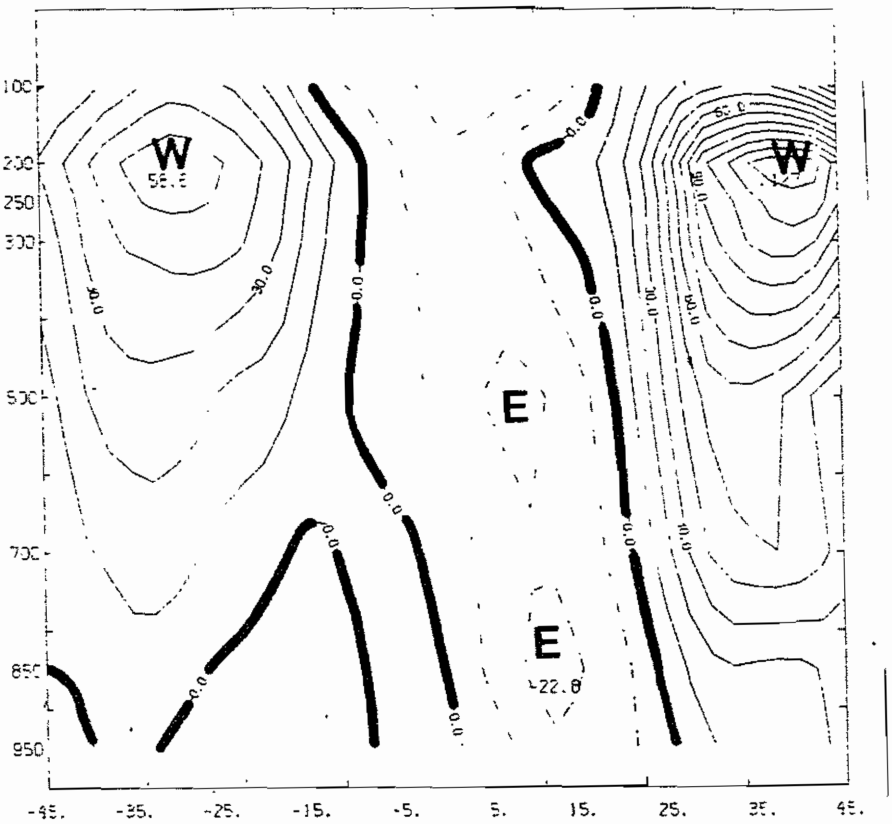

Fig. 18. DECEMBER 1985 CROSS SECTION OF ZONIAL WIND ALONG 160°E (CONTOUR INTERVAL 10 KNOTS).

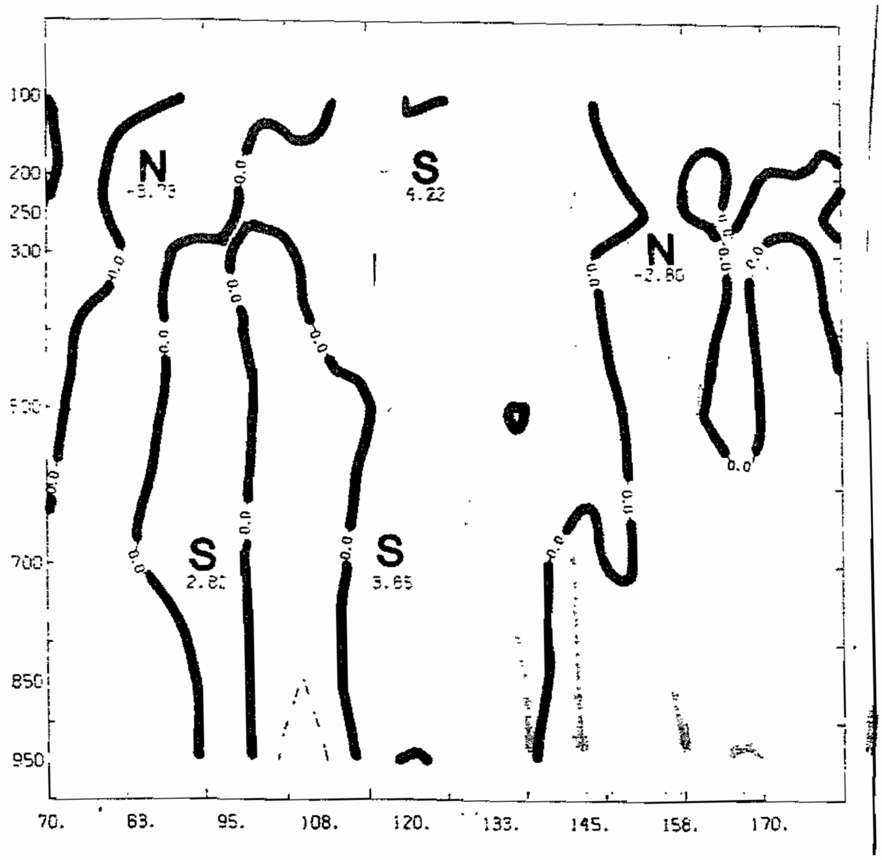

Fig. 19. DECEMBER 1985 EQUATORIAL CROSS SECTION BETWEEN 70E AND 180E (CONTOUR INTERVAL 5 KNOTS).

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(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
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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