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DARWIN TROPICAL DIAGNOSTIC STATEMENT

January 2008

ISSUED BY DARWIN RSMC

SUMMARY

La Niña conditions continued in January. SST in the Pacific displayed classic La Niña conditions with the equatorial Pacific cool tongue cooler than normal and extending well into the central Pacific with OLR anomalies indicating suppressed convection in this area. Cool anomalies in subsurface water of the near-equatorial eastern and central Pacific have existed for much of the year and persist. Trade-winds in the near-equatorial Pacific have generally been stronger than normal. SOI values continued at greater than one standard deviation above the mean. Convection and westerly flow was above normal in the southern monsoon trough area particularly in the southwest Pacific, where broad scale enhanced convection lingered for much of the month. Enhanced convection showed signs of developing in the tropical western Indian Ocean late in the month, coincident with an active phase of the MJO. Three tropical cyclones were analysed in the RSMC area during January.

INDICES

Troup's Southern Oscillation Index (SOI) for January 2008	+ 14
5-month mean (centred upon November)	+ 9
Darwin mean MSL pressure for January 2008	1005.1 hPa
Pressure anomaly (1933 – 1992 mean)	- 1.3 hPa
Tahiti mean MSL pressure for January 2008	1012.5 hPa
Pressure anomaly (1933 – 1992 mean)	+ 1.6 hPa

Time series of Troup's SOI:

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	+13	0	+14	+15	-10	-5	-9	-15	-5	-15	-1	-3
2007	-7	-3	-1	-3	-3	+5	-4	+3	+2	+5	+10	+14
2008	+14											

The above table presents monthly values of the SOI from 2006. Fig.1 shows the monthly SOI and its five-month running mean for the past ten years. While the SOI was mostly positive over the 2005/2006 summer and negative the year later, the values were mostly small and generally not coincident with basin wide ENSO characteristics and so both seasons are probably best described as ENSO neutral. The SOI became positive in August 2007 and has been greater than one standard deviation above the long term mean since November 2007, consistent with the development of La Nina conditions.

TROPICAL CYCLONES [Fig. 2]

Three tropical Cyclones formed in the RSMC area during January, two in the South Pacific reached Severe Topical Cyclone intensity, while a third tropical cyclone formed in the Joseph Bonaparte Gulf, off the northwest coast of Australia. One of these cyclones, Severe Tropical Cyclone Gene, formed in the South Pacific late in January and continued into February. In addition to the above, tropical cyclones Elisa and Gula formed just east and west of the RSMC area respectively.

The comparative long-term means for the tropical cyclone formation are 0.5 tropical storms (0.3 typhoons) for the northwestern Pacific and 6.0 for the south Pacific and Indian Oceans combined while the tropical cyclone formation is rare in the north Indian Ocean.

Tropical Cyclone Helen

Tropical Cyclone Helen formed from a long-lived low that was embedded within the monsoon trough, well inland of Darwin in the Northern Territory before intensifying to tropical cyclone intensity. An equilibrium between the monsoon westerlies to the north and easterlies from a mid level ridge to the south, forced the pre-Helen low to remain over land, causing flooding over the Top End in the last few days of December, before moving east into the Joseph Bonaparte Gulf on 2 January. The low continued to move west towards the Kimberly coast before changing course to the northeast in the monsoon westerly flow as it intensified into a tropical cyclone during the morning on the 4th. Helen continued on an east to northeast trajectory, making landfall to the south of Darwin at around 10pm local time on the same day, near its peak intensity of 50 knots. Tropical Cyclone Helen was downgraded to a low on 5 January, continuing on its eastward track across the Gulf of Carpentaria and into the Coral Sea. Despite moving over water, ex-Tropical Cyclone Helen didn’t redevelop due to unfavourable shear conditions.

Severe Tropical Cyclone Funa

A series of lows west of Vanuatu embedded within the monsoon trough organised into Tropical Cyclone Funa on 16 January. Funa moved east across Vanuatu, before escalating into a Severe Tropical Cyclone on the 18th. Funa then moved in a south to southeast direction, before moving to the southwest when it was near 26°S 175°E. Funa continued on its southwest track, remaining as a Severe Tropical Cyclone, before rapidly dissipating due to cooler sea surface temperatures and increased vertical windshear on the 20th near 30°S, as it merged with an extra tropical frontal system.

Severe Tropical Cyclone Gene

(Will be repeated in the February issue)

Tropical Cyclone Gene formed on 28 January near the northern islands of Fiji out of a westward tracking low in the monsoon trough. Gene tracked in a west to southwest direction, intensifying into a severe tropical cyclone on 30 January, before moving southwards as it reached 170°E. Gene was downgraded to a tropical cyclone on 2 February, continuing in a southeasterly direction, eventually making the transition to an extra tropical low on 6 February near 30°S 175°W, mainly due to cooler sea surface temperatures.

SEA SURFACE TEMPERATURE (SST)

[Figs. 3a, 3b]

A continuation of La Nina type conditions in the SST occurred in the equatorial Pacific, with the east Pacific cool tongue extending as far west as 160°E (anomalies of up to 3°C below normal). Cool anomalies in subsurface water of the near-equatorial eastern and central Pacific persisted during January. Waters around northern Australia were close to normal, with the initial warming during December cooled during the monsoon event in the early part of January. Warm anomalies existed over much of the Indian Ocean and north Pacific

MSL PRESSURE

[Figs. 4a, 4b]

Negative pressure anomalies existed over the south Pacific and Coral Sea, corresponding to an active monsoon trough and the presence of two long-lived cyclones in the area. Positive anomalies over the southern Indian Ocean and China indicate stronger than normal ridging in these areas. Much of the remainder of the tropical RSMC area was close to normal for January.

850 hPa FLOW

[Figs. 5a, 5b]

Stronger than normal 850 hPa westerly flow over northeast Australia, extending east into the Pacific Ocean indicate strong monsoon activity that lingered over the west Pacific for much of the month. The remainder of the RSMC area was close to normal.

200 hPa FLOW

[Figs 6a, 6b]

The upper level flow remained generally close to climatology in the tropical RSMC area. In the northern hemisphere, the position of the upper jet was marginally further north than average, which resulted in an anticyclonic circulation in the anomaly field just west of Japan. In the Southern Hemisphere, persistent upper troughs in the south Pacific created easterly anomalies.

VELOCITY POTENTIAL

[Figs 7a, 7b]

The axis of low-level convergence generally coincides with the upper level divergence over the southwest Pacific, further east from the climatological location of the Maritime Continent. This axis also corresponds to the active area of convection depicted by the OLR, consistent with the enhanced convection that lingered over the region for much of the month.

OUT-GOING LONG-WAVE RADIATION (OLR)

[Figs 8a, 8b]

Maxima in the OLR extended from just north of PNG through to Fiji, coinciding with an active monsoon and MJO which lingered over the area for much of the month. OLR was less then average over Indonesia, due in part to a suppressed phase of the MJO in this area. Convection was also suppressed over the Pacific cool tongue, consistent with the ENSO state.

CROSS-EQUATORIAL INTERACTION

[Fig. 9]

Stronger than normal southerlies in the upper levels east of 160E in the RSMC area indicate good return flow from a vigorous monsoon (coincident with two long lived cyclones). For the remainder, cross equatorial flow was similar to the long term mean, with mostly northerlies below 850hPa and return flow southerlies at 200hPa indicative of an active monsoon in the southern hemisphere. Mid-level winds were close to mean conditions.

850 hPa WIND COMPONENTS AND RAINFALL AT DARWIN

[Figs. 10a, 10b]

January in Darwin began with a developed monsoon trough over the area which lingered for the first half of the month, the result being stronger than normal westerlies prevailing. The surface reflection of the monsoon trough remained south of Darwin for most of January, while in the second half of the month, the 850 hPa trough drifted offshore to the north, turning winds at that level to the east. January 2008 rainfall was 515.2mm, above the long term mean of 419.0mm, chiefly due to a significant rainfall event on the 13^{th}. Persistent thunderstorms produced 242mm for the 24 hours to 9am (with 211.6mm falling in two hours during the early morning), producing the 2^{nd} highest daily rainfall total for January and the 5^{th} wettest day for Darwin on record.

INTRA-SEASONAL VARIATIONS

[Figs. 11, 12, 13]

From early June to mid-October 2007, four active phases of the MJO were observed to develop over the tropical Indian Ocean. The two most recent of these both progressed rapidly across the Indian Ocean, and then lingered over the longitudes of the Maritime Continent and western Pacific. During early December, the next active phase of the MJO appeared in the Indian Ocean, keeping to the 40-50 day cycle of recent times. The progression of this active phase to the Maritime Continent coincided with the onset of the monsoon over northern Australia, which took place late in December and continued into January. As has been the trend in recent months, broadscale enhanced convection lingered in the southwest Pacific for an extended period. Convective activity increased over the western Indian Ocean in the southern hemisphere late in the month, continuing the recent 40-50 day periodicity of the MJO.

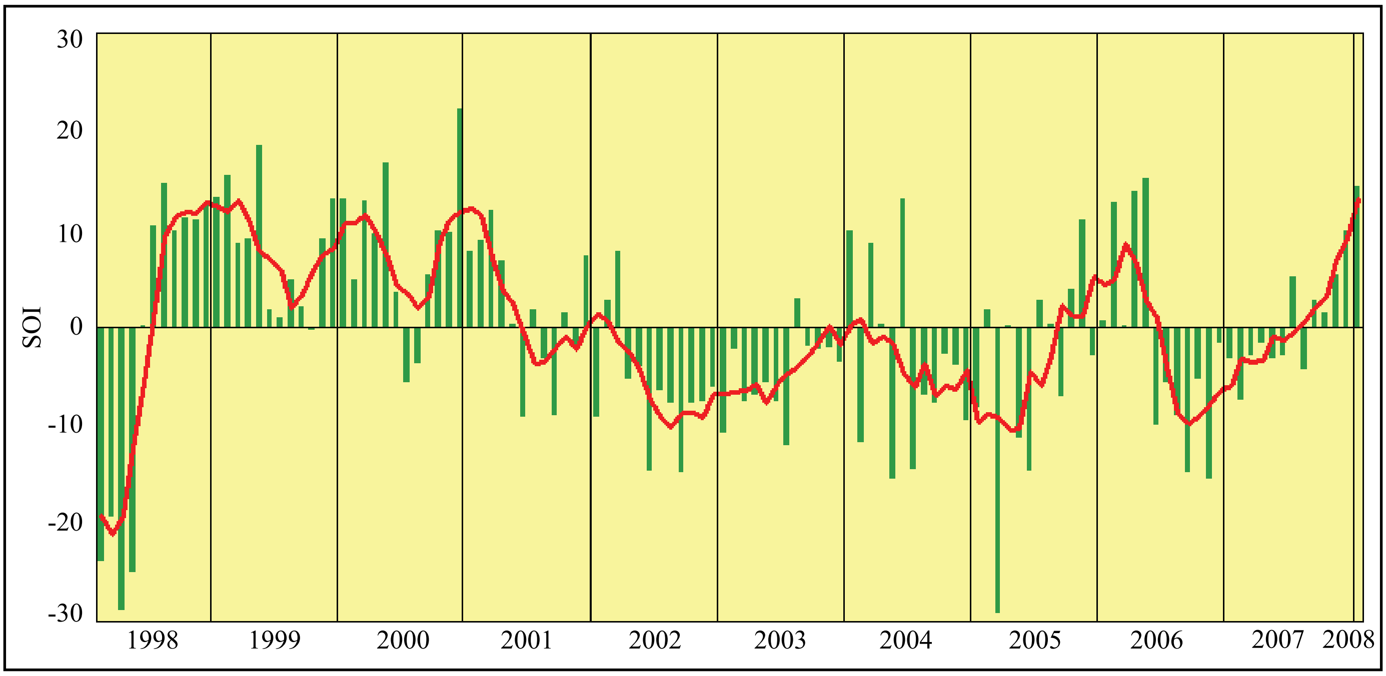

Fig. 1 SOUTHERN OSCILLATION INDEX 1998 - 2008
Monthly SOI (bars) and 5-month running mean SOI.

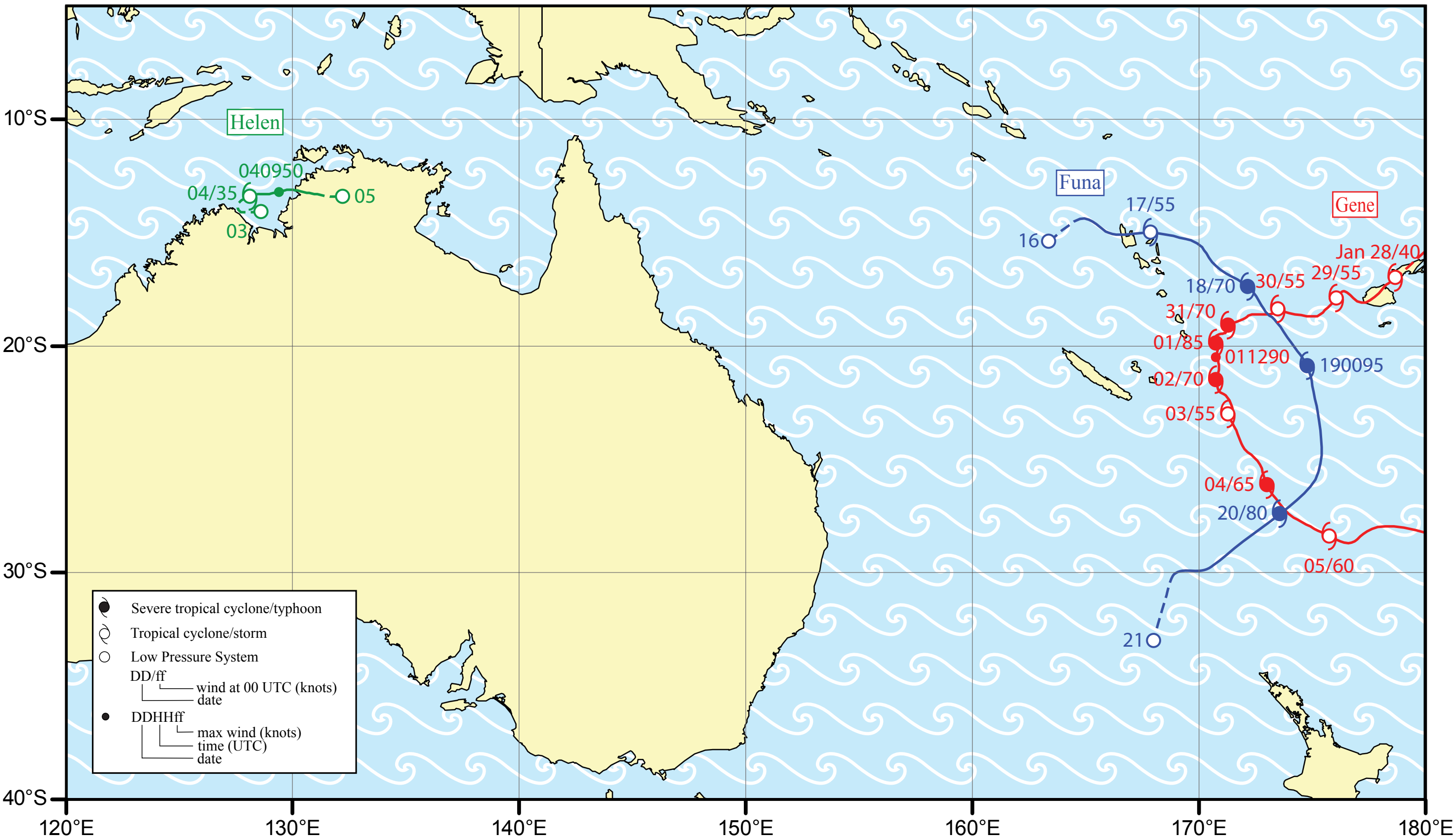

Fig. 2 OPERATIONAL TRACK OF CYCLONES; HELEN, FUNA AND GENE FOR JANUARY 2008.

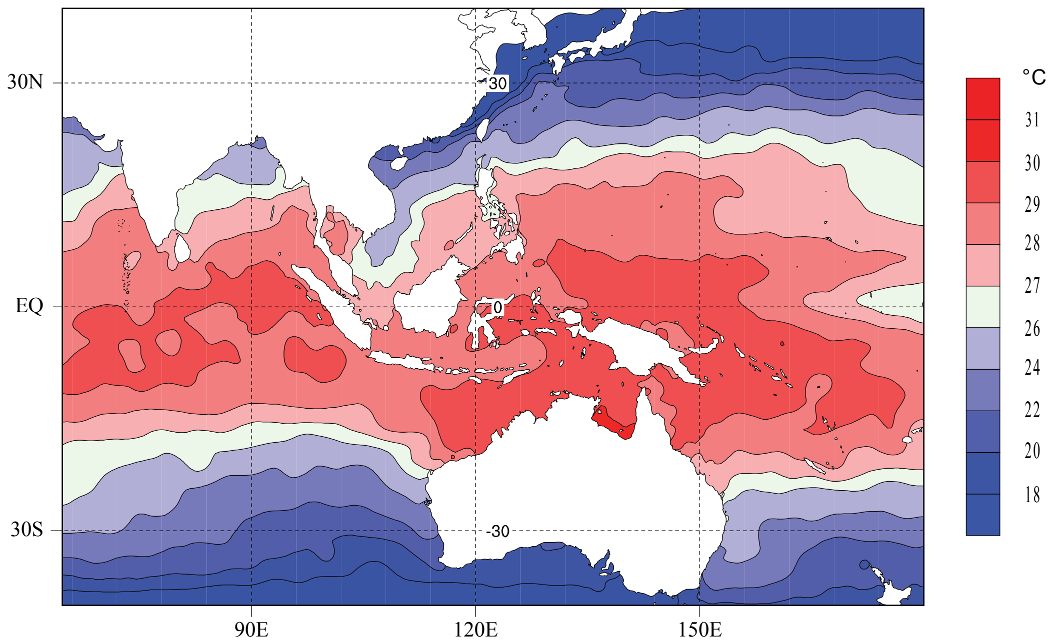

Fig.3(a) SEA SURFACE TEMPERATURE, January 2008.

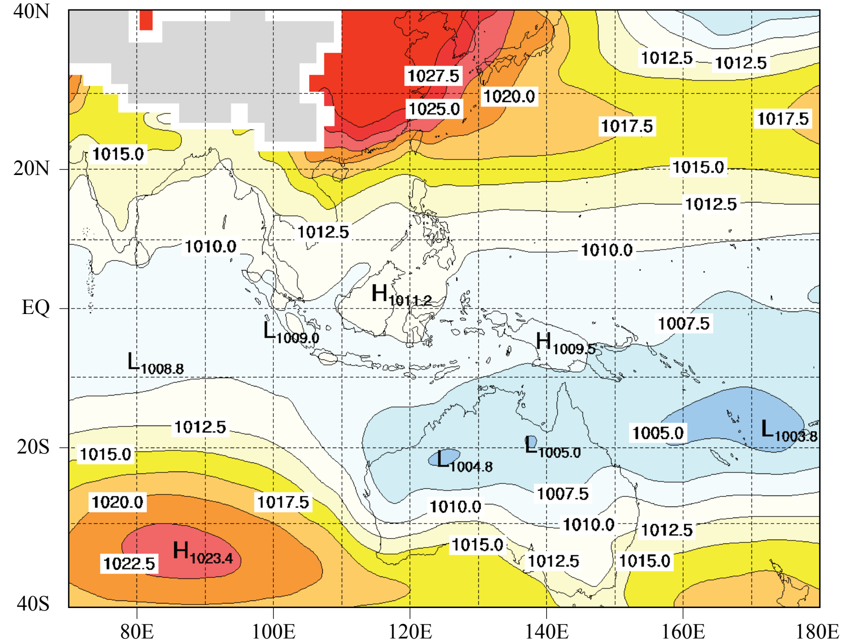

Fig.4(a) MEAN SEA LEVEL PRESSURE, January 2008.
Isobar interval 2.5 hPa

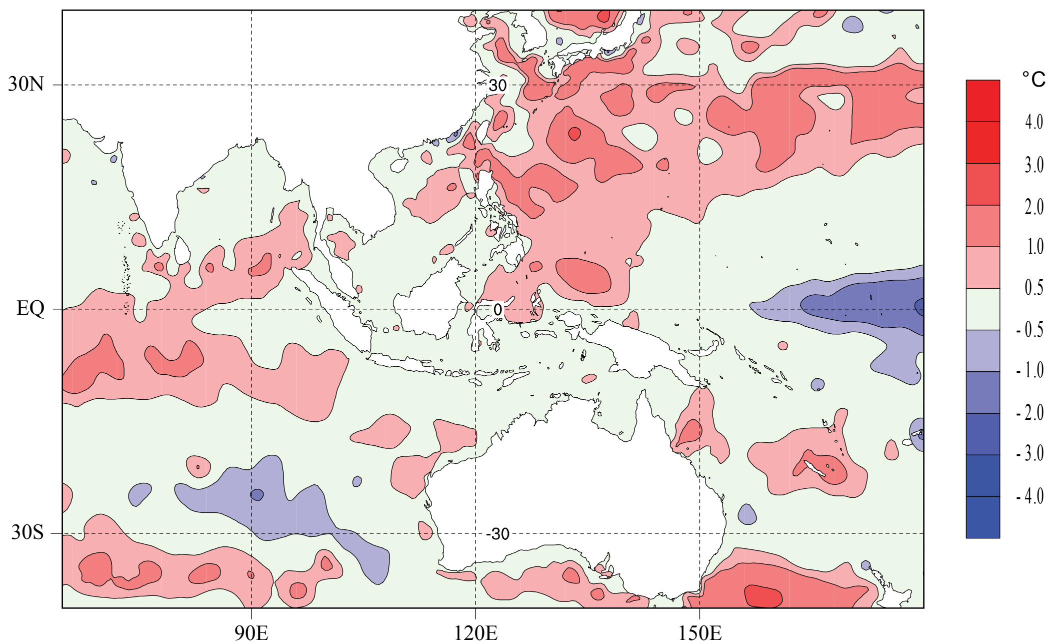

Fig.3(b) SEA SURFACE TEMPERATURE ANOMALY, January 2008.

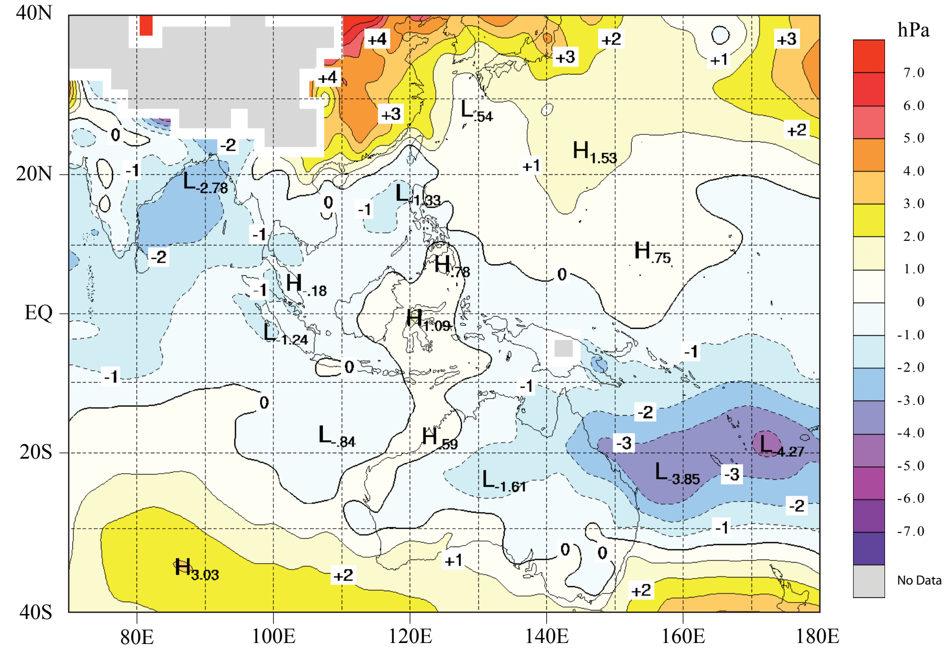

Fig.4(b) MEAN SEA LEVEL PRESSURE ANOMALY, January 2008.
Contour interval 1 hPa. Heavy line represents zero anomaly.

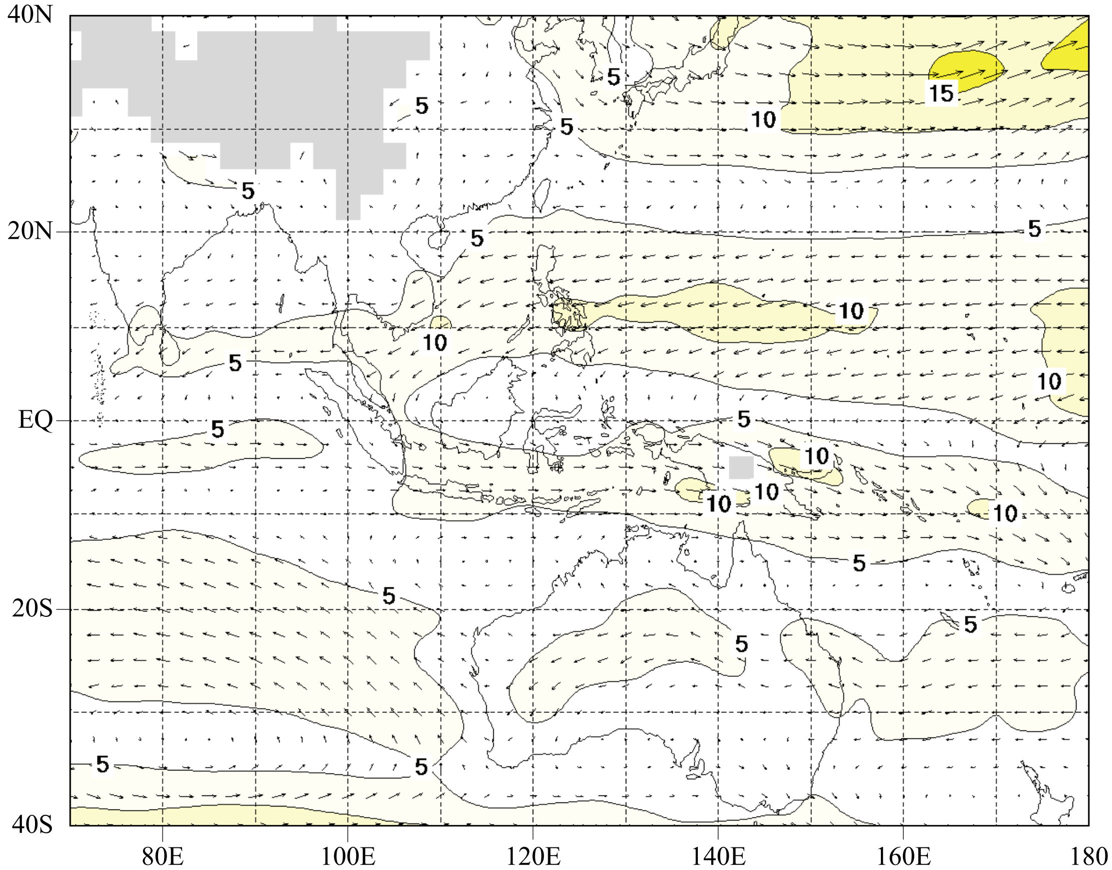

Fig.5(a) 850 hPa VECTOR WIND ANALYSIS, January 2008.
Arrow length indicates relative magnitude. Isotachs at 5ms^{-1} intervals are shaded.

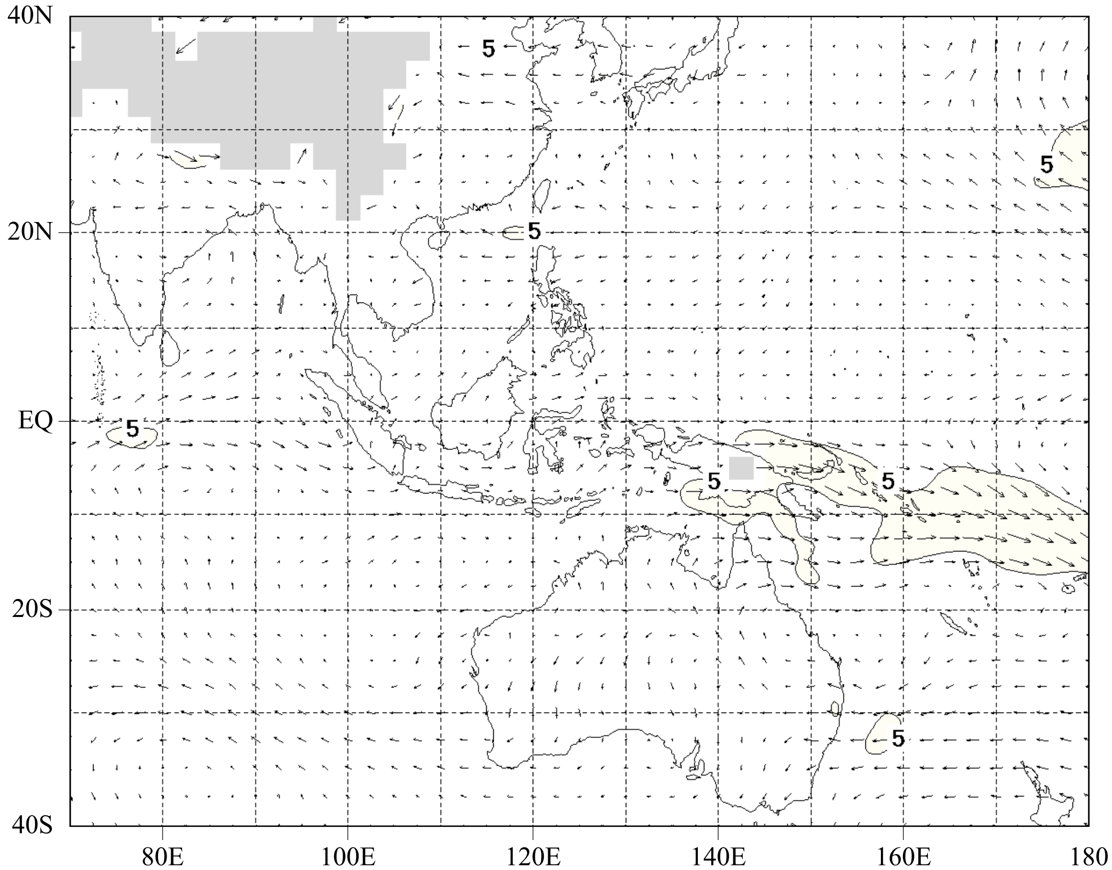

Fig.5(b) 850 hPa WIND ANOMALY, January 2008.
Arrow length indicates relative magnitude. Anomalies > 5 ms^{-1} are shaded.

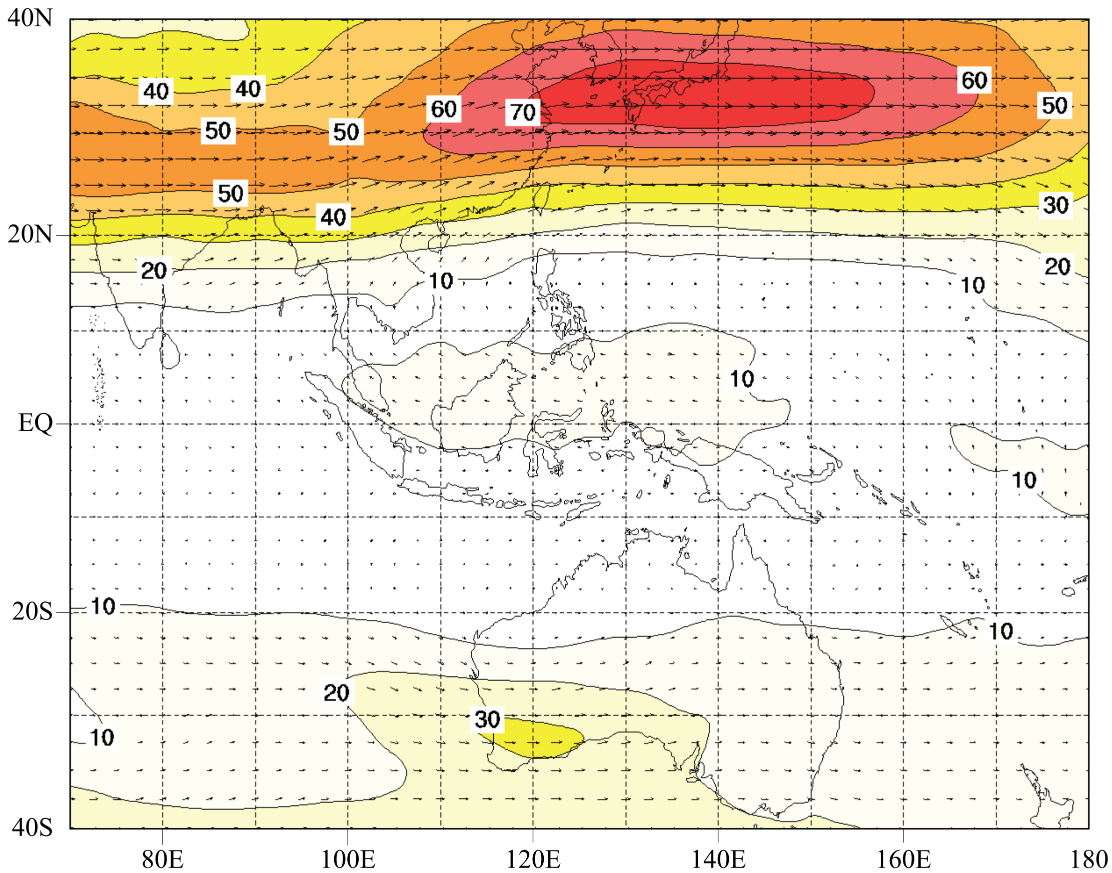

Fig.6(a) 200 hPa VECTOR WIND ANALYSIS, January 2008.
Arrow length indicates relative magnitude. Isotachs at 10ms^{-1} intervals are shaded.

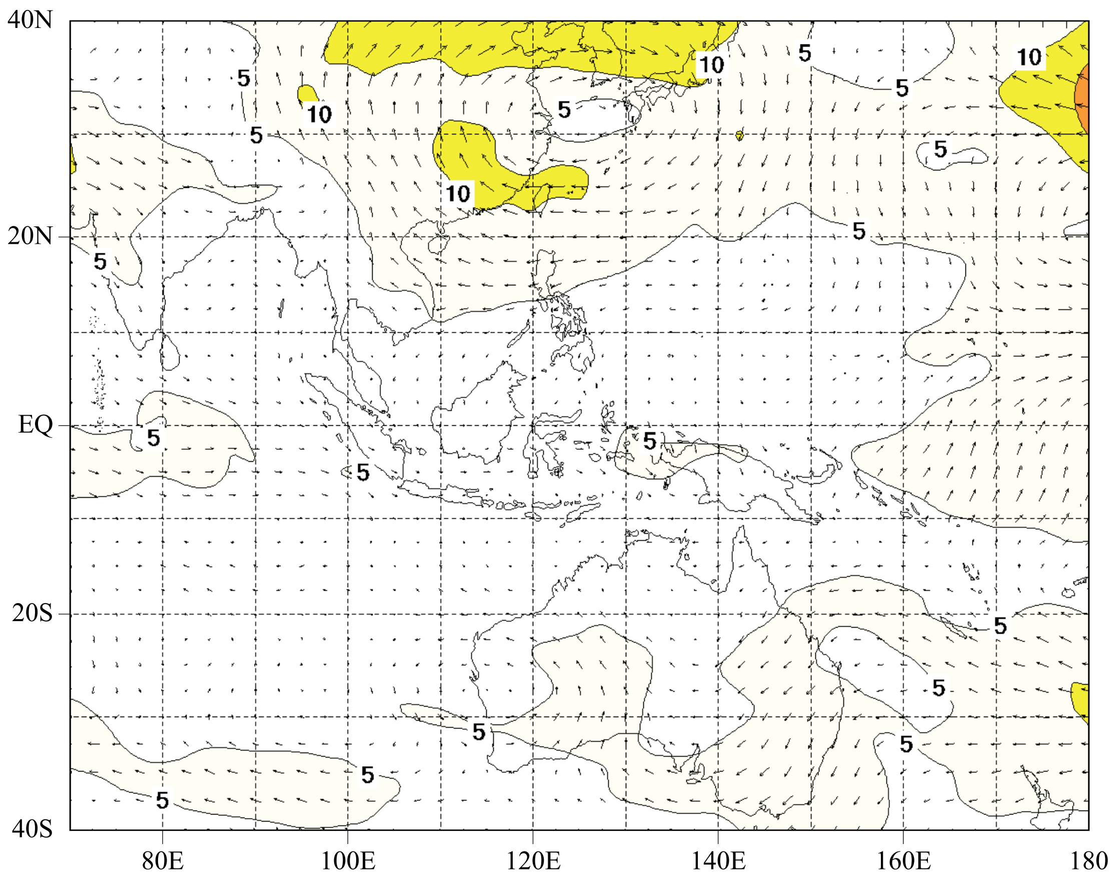

Fig.6(b) 200 hPa WIND ANOMALY, January 2008.
Arrow length indicates relative magnitude. Anomalies > 5 ms^{-1} are shaded.

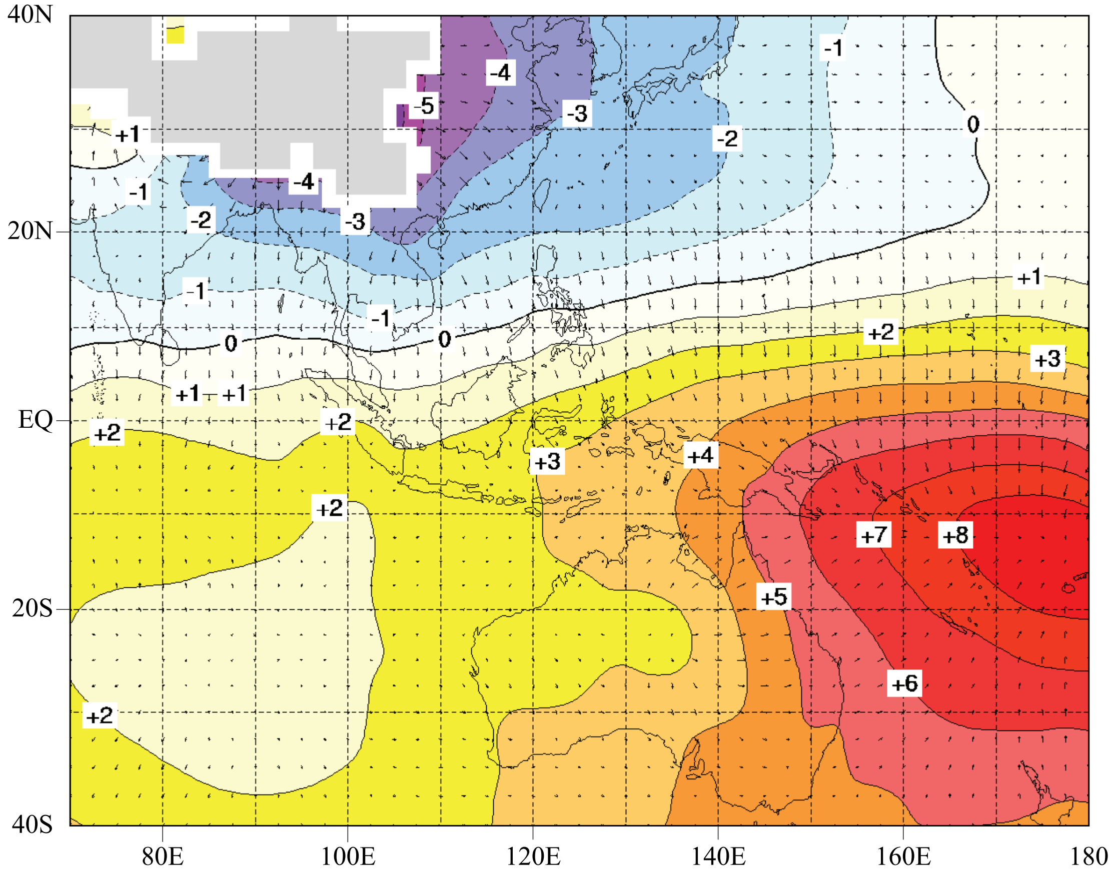

Fig.7(a) 850 hPa VELOCITY POTENTIAL and DIVERGENT WIND, January 2008, (x $10^6 m^2 s^{-1}$).

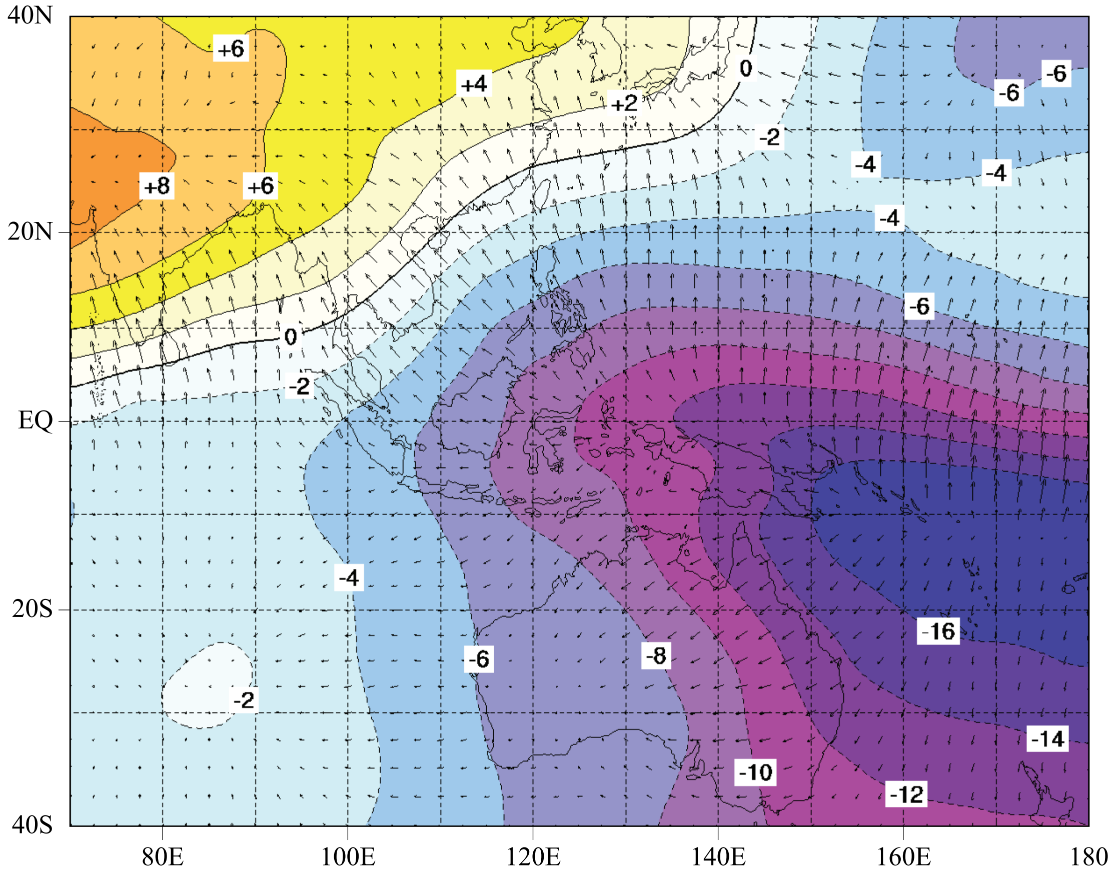

Fig.7(b) 200 hPa VELOCITY POTENTIAL and DIVERGENT WIND, January 2008, (x $10^6 m^2 s^{-1}$).

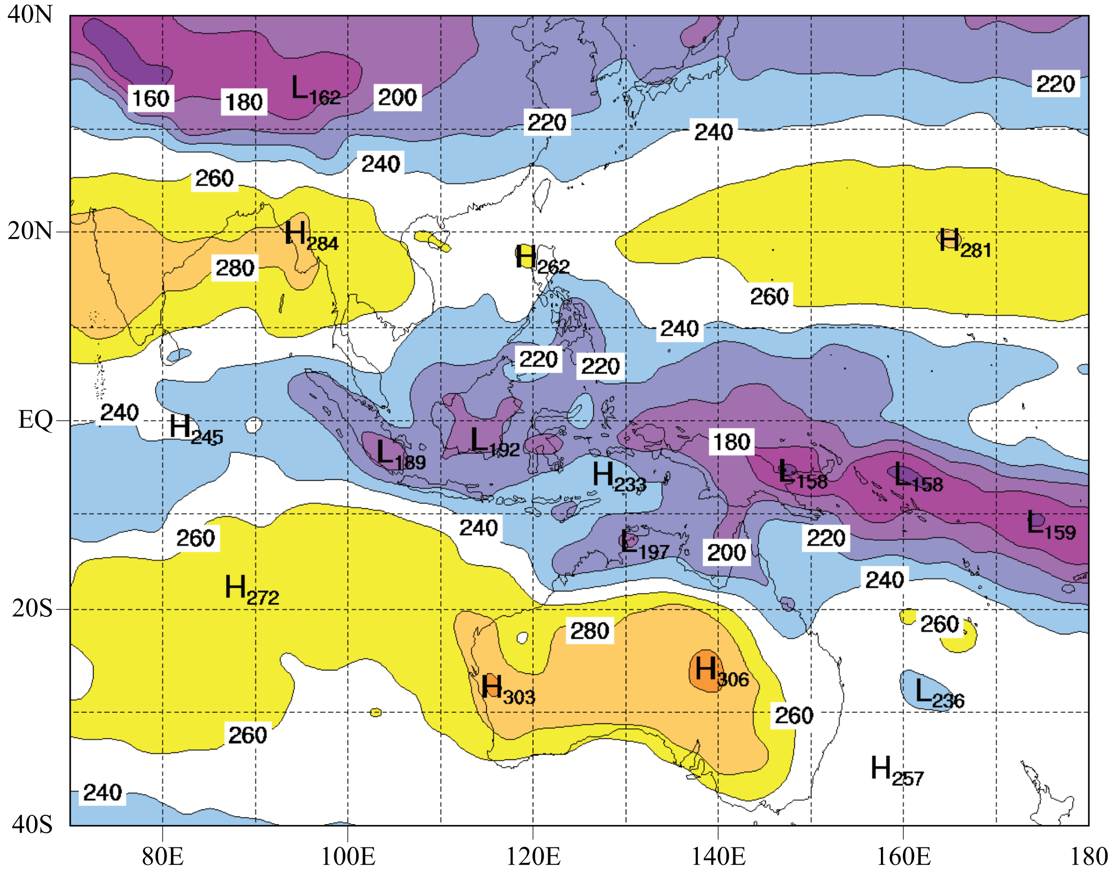

Fig.8(a) OUTGOING LONG WAVE RADIATION, January 2008.
Contour interval 20 watt m^{-2}.

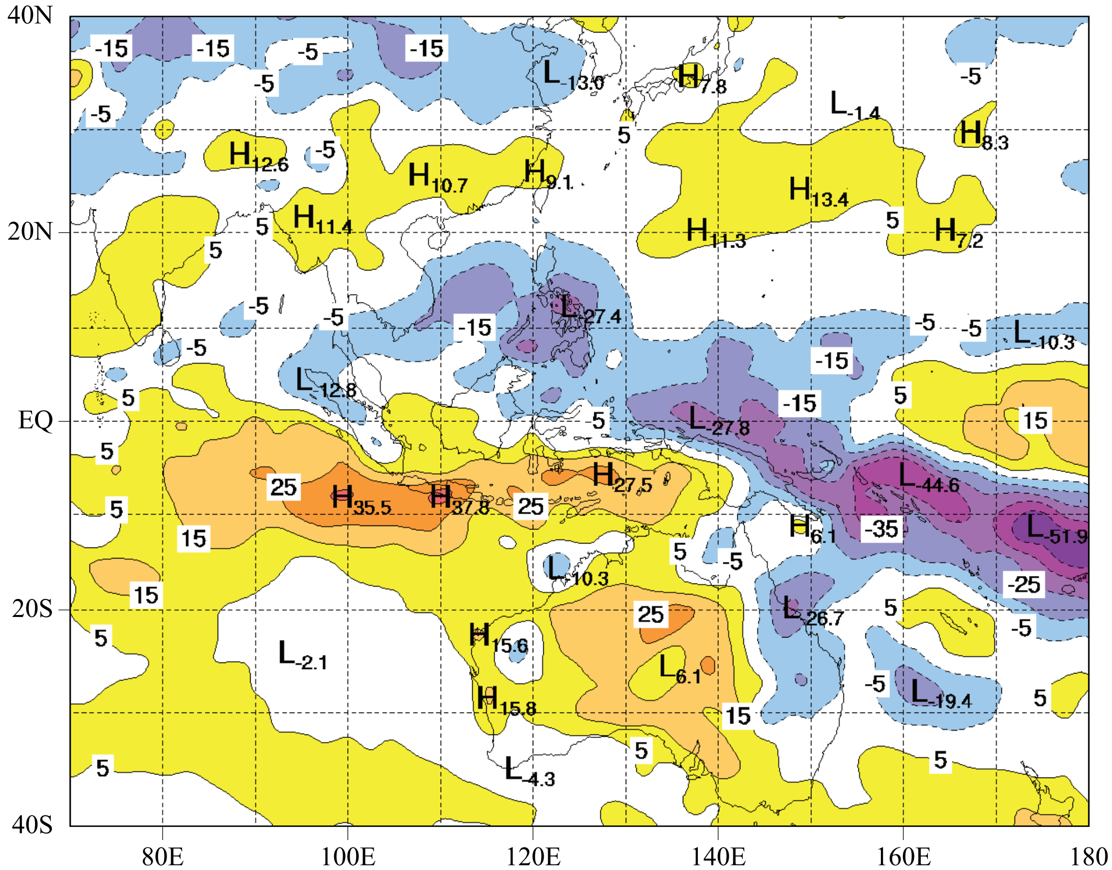

Fig.8(b) OUTGOING LONG WAVE RADIATION ANOMALY, January 2008.
Contour interval 10 watt m^{-2}.

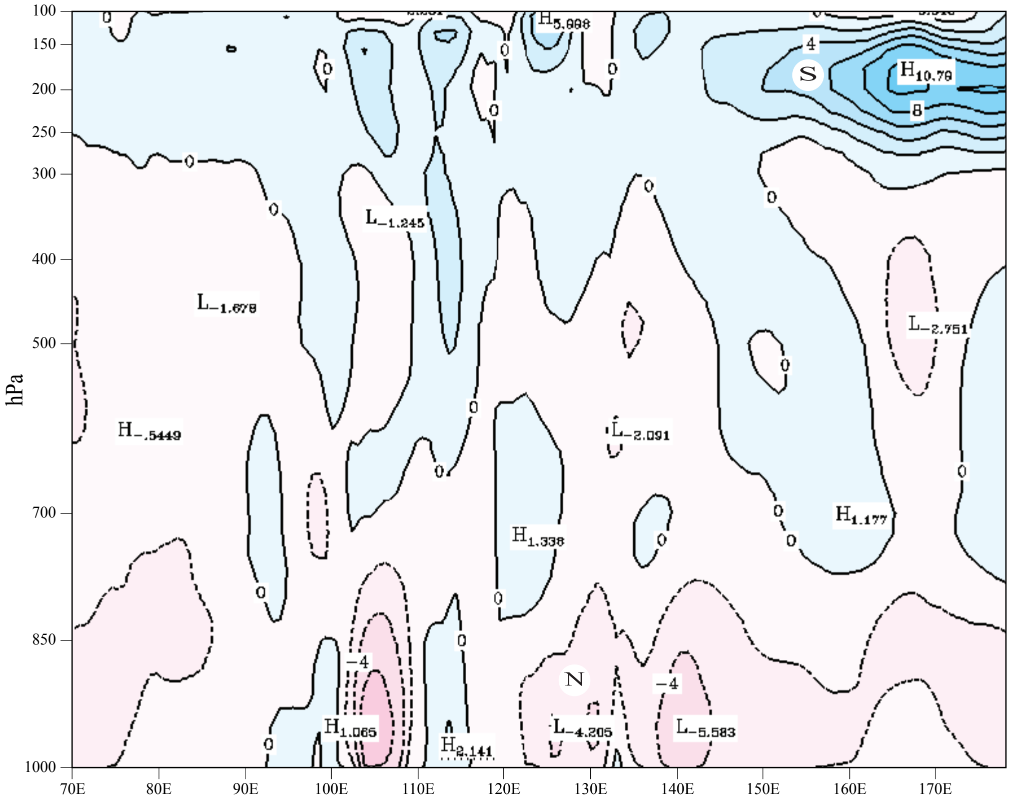

Fig.9 EQUATORIAL CROSS SECTION OF MERIDIONAL WIND, January 2008.
Isotachs at 2ms^{-1} intervals.

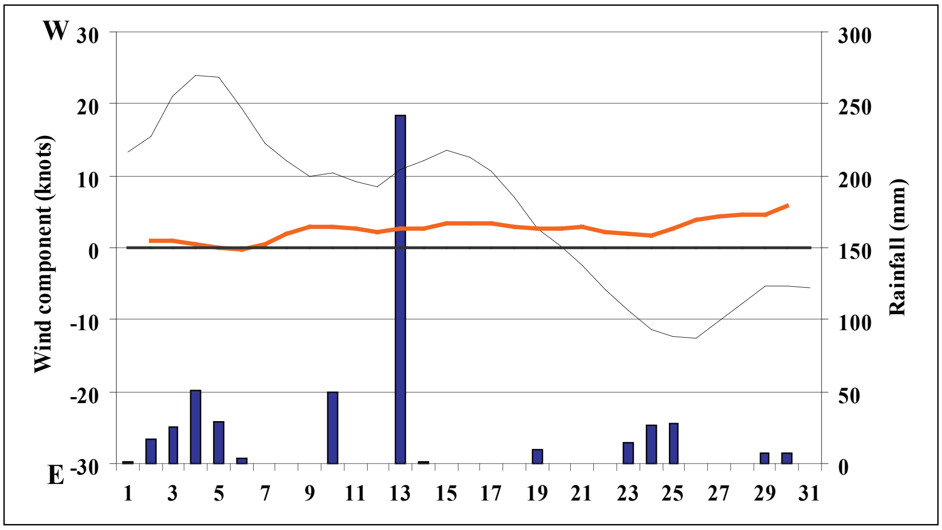

Fig.10(a) DARWIN 850 hPa MEAN ZONAL WIND, January 2008.
Black line represents 3-day running mean. Orange line represents the mean seasonal wind.

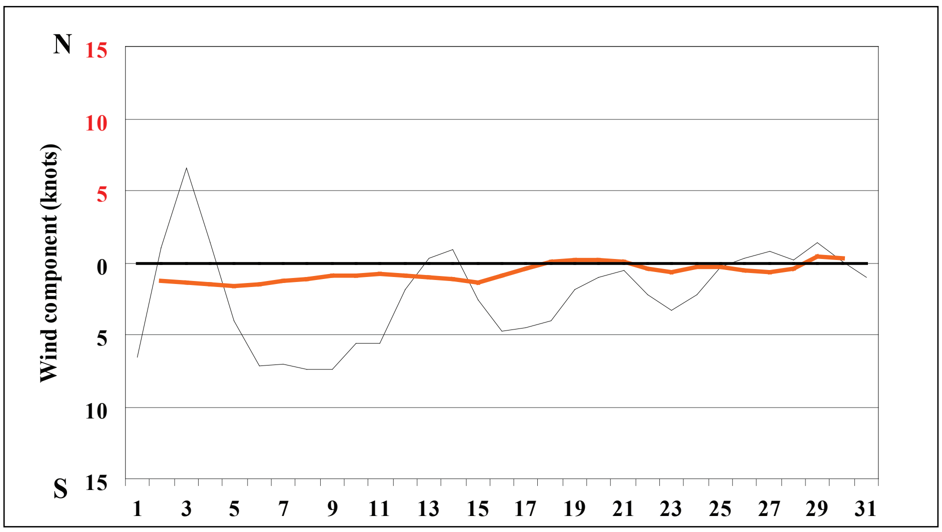

Fig.10(b) DARWIN 850 hPa MEAN MERIDIONAL WIND, January 2008.
Black line represents 3-day running mean. Orange line represents the mean seasonal wind.

Time/longitude cross section, southern series.
5 day running mean, averaged over 15°S to 5°S

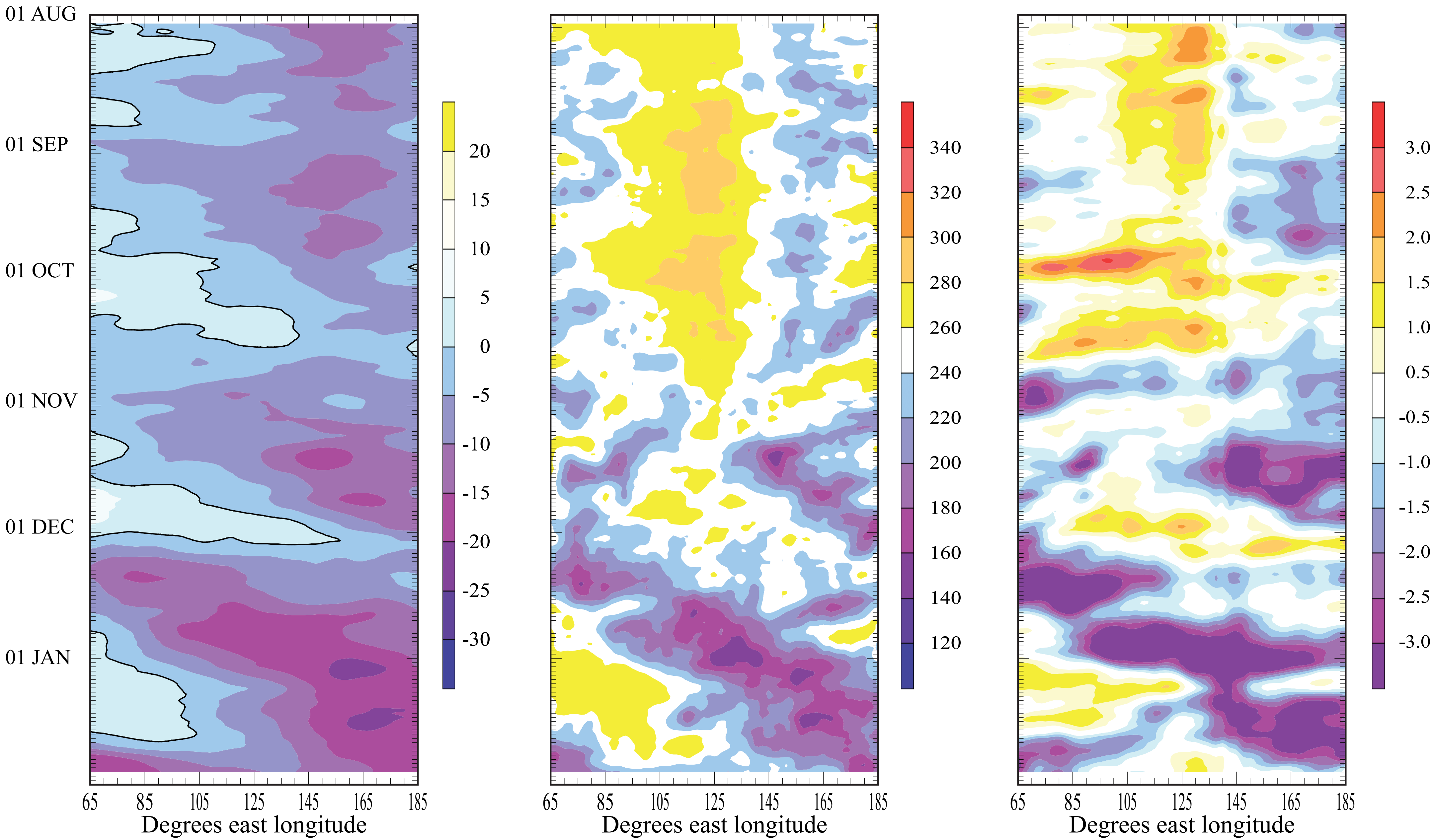

Fig. 11(a) 200hPa velocity potential based on GASP ($10^6 m^2 s^{-1}$)

Fig.11(b) Outgoing long wave radiation (watt m^{-2})

Fig. 11(c) Mean sea-level pressure anomaly (hPa)

Time/longitude cross section, equatorial series.
5 day running mean, averaged over 5°S to 5°N

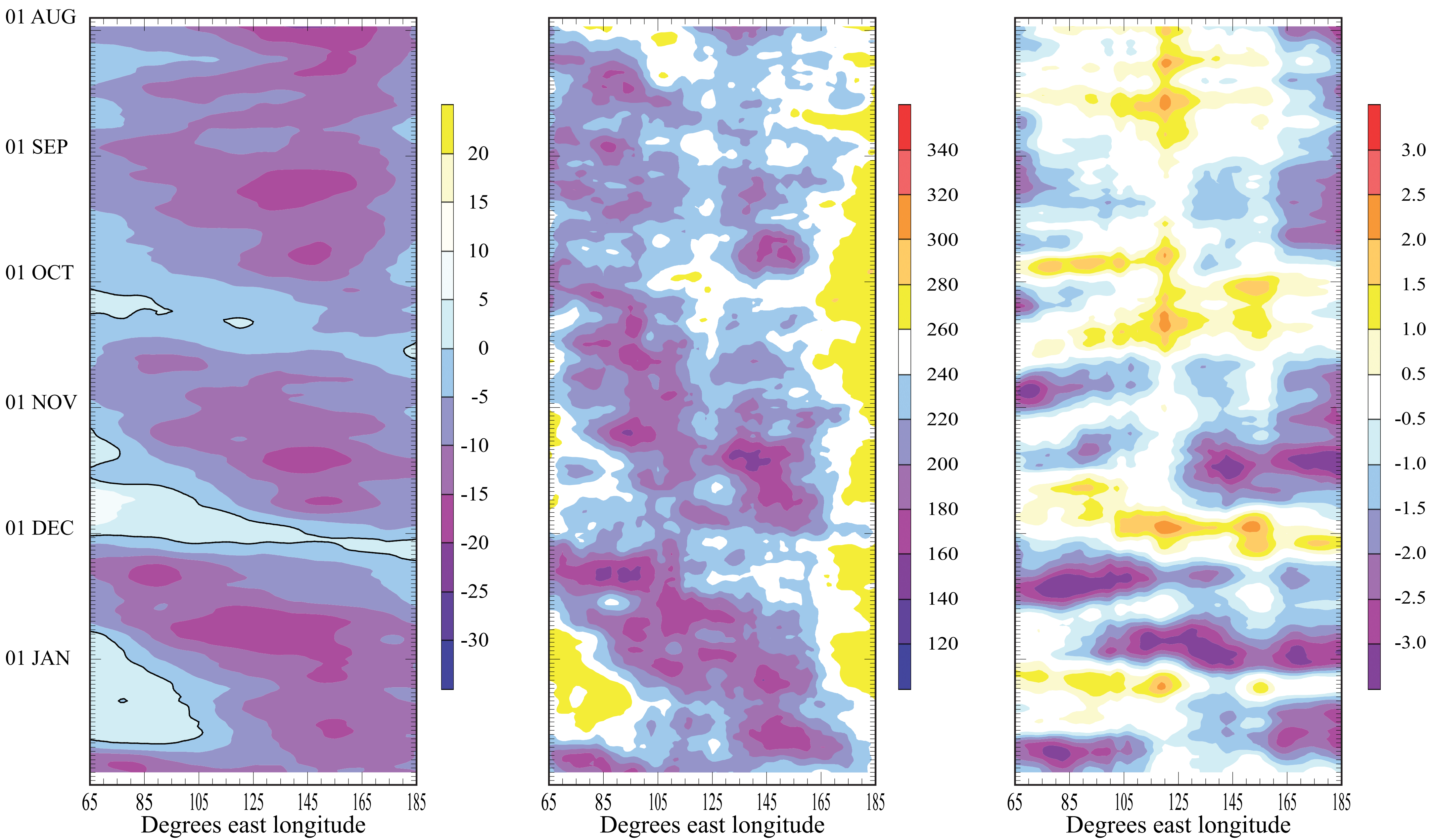

Fig. 12(a) 200hPa velocity potential based on GASP ($10^6 m^2 s^{-1}$)

Fig.12(b) Outgoing long wave radiation (watt m^{-2})

Fig. 12(c) Mean sea-level pressure anomaly (hPa)

Time/longitude cross section, northern series.
5 day running mean, averaged over 5°N to 15°N

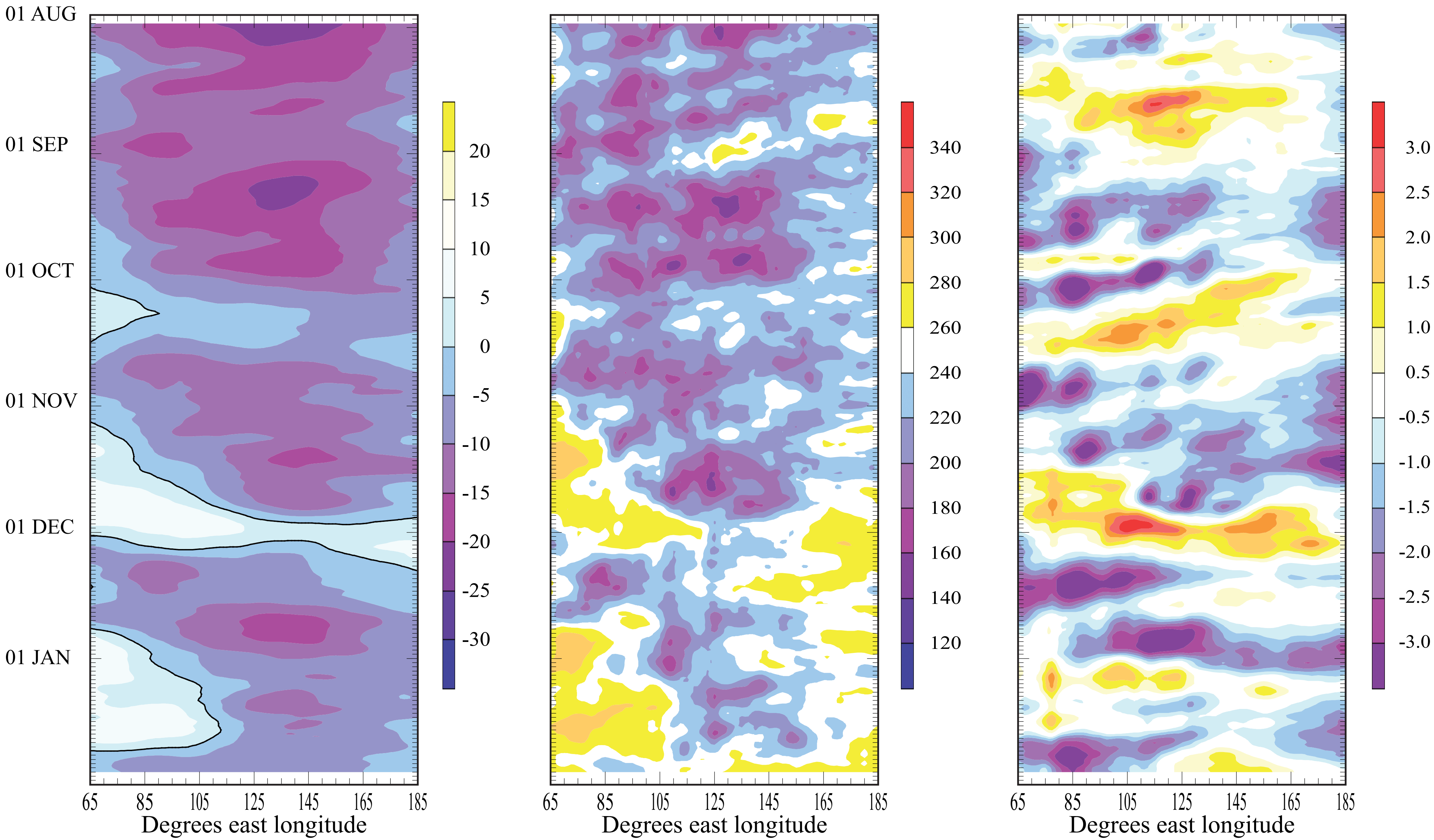

Fig. 13(a) 200hPa velocity potential based on GASP ($10^6 m^2 s^{-1}$)

Fig.13(b) Outgoing long wave radiation (watt m^{-2})

Fig. 13(c) Mean sea-level pressure anomaly (hPa)

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 40ºN-40ºS, 70ºE-180º.

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, 1ºC resolution). The 1ºx 1º 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.
Equatorial cross section of meridional wind field was derived from the Bureau of Meteorology's operational Tropical region Extended Limited Area Prediction System (TXLAPS_PT375n) model. (Refer- *Analysis and Prediction Operations Bulletin No 59*. Bur. Met., Australia.)
A full web version available at: http://www.bom.gov.au/nmoc/bulletins/nmc_bulletin.shtml).

(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**:

CS	- Cyclonic storm
ISO	- Intra-seasonal oscillation
JMA	- Japan Meteorological Agency
JTWC	- Joint Typhoon Warning Center, Pearl Harbour
MJO	- Madden-Julian Oscillation
MSLP	- Mean Sea Level Pressure
MT	- Monsoon trough
NET	- Near-equatorial trough
OLR	- Out-going long-wave radiation
PAGASA	- Philippine Atmospheric, Geophysical and Astronomical Services
PNG	- Papua New Guinea
RSMC	- Darwin Regional Specialised Meteorological Centre (see note 1)
SCS	- South China Sea
SOI	- Southern Oscillation Index
SPCZ	- South Pacific convergence zone
SST	- Sea Surface Temperature
STC	- Severe tropical cyclone
STR	- Subtropical ridge
TC	- Tropical cyclone (see note 3(ii))
TD	- Tropical depression
TXLAPS	- Tropical region Extended Limited Area Prediction Scheme
TS	- Tropical storm (generally used for TC in northern Hemisphere sector)
TUTT	- Tropical upper tropospheric trough
VSCS	- Very severe cyclonic storm

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	24.36 (Rest of the world)	111.16

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