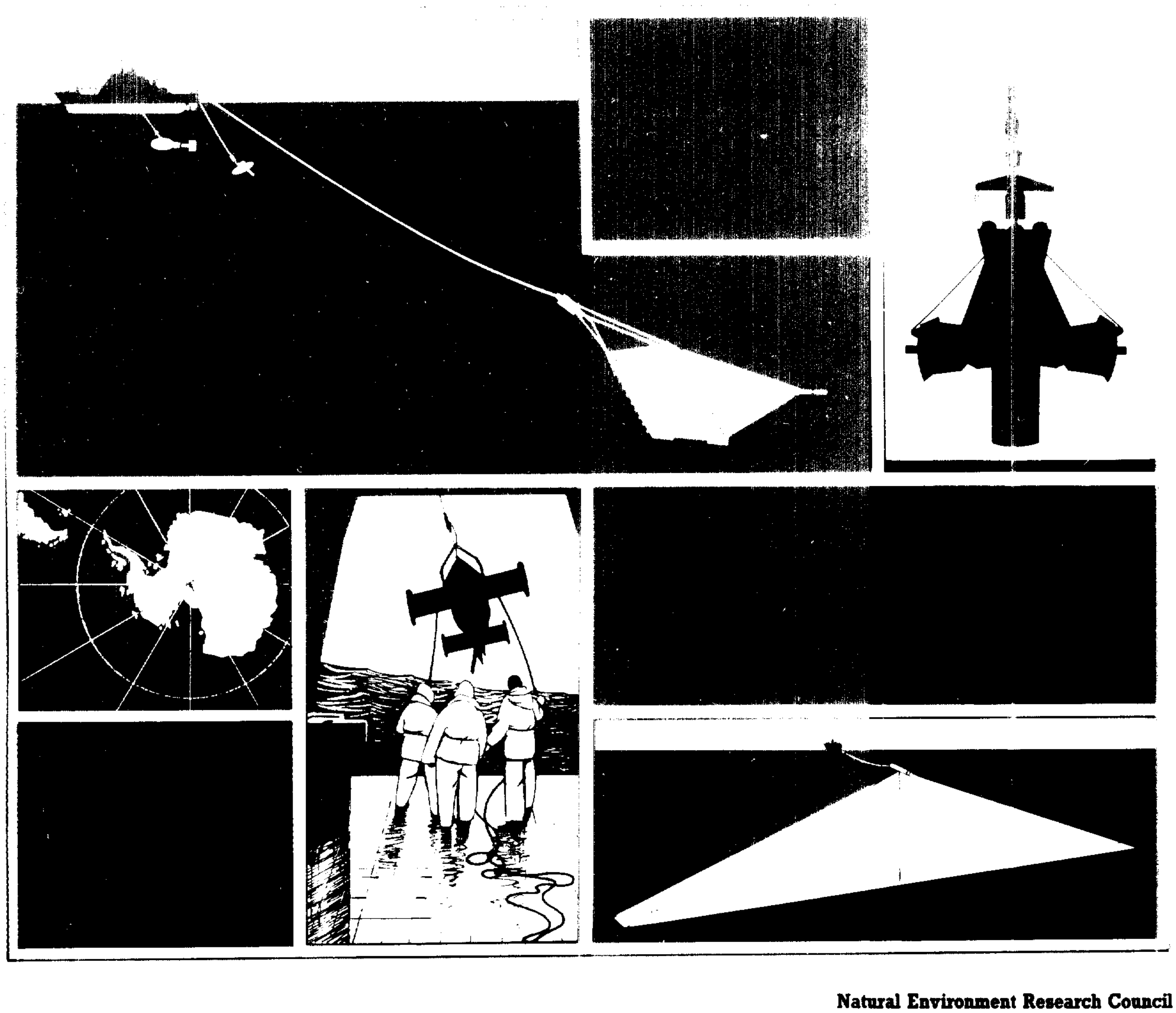
Institute of
Oceanographic Sciences
Deacon Laboratory

Acoustic Doppler Current Profiler data from the western equatorial Pacific Ocean

B A King & M Allison

Report No 290 1991



Natural Environment Research Council

INSTITUTE OF OCEANOGRAPHIC SCIENCES

DEACON LABORATORY

Wormley, Godalming,
Surrey, GU8 5UB, U.K.

Telephone: 0428 79 4141
Telex: 858833 OCEANS G
Telefax: 0428 79 3066

Director: Dr. C.P. Summerhayes

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Acoustic Doppler Current Profiler data from the western equatorial Pacific Ocean, collected on RRS *Charles Darwin* Cruise 34A, September 1988

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AUTHOR

KING, B A & ALLISON, M

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Acoustic Doppler Current Profiler data from the western equatorial Pacific Ocean, collected on RRS *Charles Darwin* Cruise 34A, September 1988.

REFERENCE

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ABSTRACT

During Cruise 34A of RRS Charles Darwin, a number of sections were occupied with SeaSoar and ADCP in the western equatorial Pacific Ocean. The region of study was bounded by 7°N, 3°S, 125°E and 160°E, and included a section across the Mindanao Current at 7°N, and a 1000km section along 142°E from 7°N to the coast of Papua New Guinea. The latter section crossed the North Equatorial Countercurrent, Equatorial Undercurrent, South Equatorial Current and New Guinea Subsurface Coastal Current. This report contains contoured vertical sections of the ADCP data only, which typically describe the upper 300m. The contour plots are of data that have been gridded into bins with 12km horizontal and 8db vertical resolution. Additionally, plan views of the currents at six standard depths are included.

KEYWORDS

ACOUSTIC DOPPLER CURRENT PROFILER(ADCP)
"*CHARLES DARWIN*" - cruise(1988)(34A)
EQUATORIAL UNDERCURRENT
MINDANAO CURRENT
NEW GUINEA SUBSURFACE CURRENT
NORTH EQUATORIAL COUNTERCURRENT
PACIFIC OCEAN (EQUATORIAL WEST)
PACTW
SEASOAR
SOUTH EQUATORIAL CURRENT

ISSUING ORGANISATION

Institute of Oceanographic Sciences
Deacon Laboratory
Wormley, Godalming
Surrey GU8 5UB. UK.

Director: Colin Summerhayes DSc

Telephone Wormley (0428) 684141
Telex 858833 OCEANS G.
Facsimile (0428) 683066

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INTRODUCTION

Cruise 34A of RRS Charles Darwin was in two parts. Leg 1 was principally a passage leg from Auckland, New Zealand to Cairns, Australia, although some SeaSoar trials were carried out en route. Most of the scientific party joined the ship for Leg 2, which departed from Cairns on 24 August 1988 (day 237), and arrived in Suva, Fiji on 30 September (day 274). Further details are given in the Cruise Report (Webb et al. 1989). Figure 1 shows the ship track for Leg 2 of the Cruise.

Shipboard Acoustic Doppler Current Profiler (ADCP) data were collected over most of the cruise track from a hull-mounted RDI 150kHz instrument, and it is these data which form the substance of this report. Profiling CTD data over the upper 250m were also collected over most of the cruise track using the IOSDL SeaSoar system, and are reported elsewhere (King et al., 1991).

DATA COLLECTION

The ADCP was routinely operated throughout the cruise, with a data collection cycle 150 seconds long, and 64 eight metre bins. While towing SeaSoar at 8 knots, this configuration nearly always provided good data to about 300m. The depth extent of acceptable data was estimated by overplotting east and north components of groups of adjacent 150s averages, each profile referenced to the velocity at a common depth. Where the data quality is good, the curves are tightly grouped with each ensemble giving the same shear profile. At depths where data quality is poor, the curves become scattered. This is illustrated in Figure 2, which represents two hours of data collected around 1°N, 142°E. The offset profiles of eastwards velocity component are in groups of four, referenced to the average of bins 20 to 30 (159 to 247 metres). Figure 3 gives the corresponding profiles of percent good pings. For the record displayed, the 90% level is reached at typically 280 metres, 50% at 310 metres.

However, in the second half of the cruise, it was found that data quality deteriorated while steaming at passage speeds (up to 11 knots), with percent good sometimes dropping to zero at all depths. Thus no data are available for the passage legs indicated in Table 1. On the final passage leg, from the southern end of Section 9 into Fiji, ADCP data were of reasonable quality down to about 100 - 150m. These data are not presented as vertical sections, but are included in Figures 4-6.

No satisfactory explanation was found for this dramatic loss of data quality while at passage speeds. The ADCP transducer on the Charles Darwin is mounted in a top-hat shaped recess in the hull. When the instrument first failed to return data at any depth, it was suspected that this recess may have become filled with air from bubbles dragged under the hull. However, the recess was 'bled' of any air bubbles with no resulting improvement. Unfortunately, there was no one on board with any expertise in interpreting the instrument's diagnostic information, so the reason for the instrument's failure to return data remained a mystery. For a while, suspicion fell on the connector between the RDI deck unit and the transducer cable. The matter was not made any clearer by the fact that during Leg 1, and earlier in Leg 2, the ADCP had returned good data even at maximum speed. It was eventually decided, without much conviction, that the difference could be attributed to different sea states.

DATA PROCESSING AND CALIBRATION

Calibration

Early in the cruise, on day 239, a series of manoeuvres was carried out with the purpose of calibrating the ADCP and the ship's EM log.

While GPS coverage was available, a series of right angle turns was made, with steady steaming legs in between; turns commenced at 20 minute intervals. Assuming the current field to be horizontally homogeneous over pairs of adjacent steaming legs, the analysis of Pollard and Read (1989) was used to derive heading and speed corrections (denoted by ϕ and A in their analysis). The speed used for this exercise was eight knots, as used for towing SeaSoar and for the majority of ADCP data collection. The calibrations derived for the ADCP were:

$A = 1.0132 \qquad \phi = -0.3763°$

and for the EM log were

$A = 0.9598 \qquad \phi = 2.33°$.

Part way through the cruise, on day 248, the EM log was struck by passing debris and lost. Although a replacement was fitted, it remained uncalibrated throughout the cruise. A series of manoeuvres undertaken on the following cruise provided calibration data for the replacement EM log, which provided the following calibration:

$A = 1.0292 \qquad \phi = 3.1766°$.

A further correction was applied for the drift of the clock in the IBM PC deck unit; the clock error was noted every four hours, and was found to be drifting by 24 seconds per day.

Processing

Data were captured from the IBM PC to the PDP11 for processing using the suite of PSTAR data processing programs. Data were assembled into two-hourly files of 150-second averages. Although some processing was done on board ship, for the purposes of immediate display and interpretation, the lack of satisfactory navigation while at sea (see below) meant that the whole dataset was reprocessed in the laboratory from the original 150s data.

The reprocessing consisted of assembling all the available data into a single file, checking that corrections for errors in the IBM PC clock had been correctly applied, and correcting the eastward and northward components of water velocity relative to the ship using the calibration given above. The times were corrected so that the time assigned to a profile of data was the time half way through the 150s averaging period. The resulting data were used for all subsequent analyses, including improving the ship navigation file (see below).

Once the Cruise navigation file had been finalised, ship positions and absolute velocities (ship over ground) were merged with the 150s ADCP relative motion data to produce absolute water velocities. It was found that reasonably smooth contour plots of east and north components could be produced if these velocities were then averaged over 12km of distance run. For the purposes of this report, and since the main sections were all run with latitude or longitude constant, the data have been averaged over 0.108 degrees (approximately 12 km) of longitude or latitude as appropriate. In some instances, there were overlapping segments of data arising from manoeuvres to recover or deploy SeaSoar. Such segments were removed before averaging. Small gaps in the data were filled by linear interpolation (in the horizontal) between gridpoints.

Navigation

The loss of the ship's EM log early in the cruise meant that for much of the cruise there was no satisfactory navigation file suitable for combining with ADCP data to deduce absolute water velocities.

On return to IOSDL, a new file of ship-over-water velocities was compiled, using ADCP data, where available, in place of the usual ship's EM log data. Where calibrated ADCP data were available, they were averaged over bins 3-27 (27-219m) to provide relative motion data. If ADCP data were unavailable, then data from either the first or second EM log were used. Although some good ADCP data were collected on the passage to Fiji from the southern end of Section 9, the depth to which data quality was acceptable was uncertain (only 100-150 metres), so EM log data were used in preference.

Next, a file of satellite position fixes was compiled. These positions were a mixture of GPS fixes and transit satellite fixes. First of all, periods of 'good' GPS fixes were compiled. GPS fixes were from either three satellites, or two satellites and a rubidium standard clock. Periods of two satellites plus clock were only used when continuing directly after a period of good three satellite coverage. A three satellite fix was considered to be good if pdop < 7.

Figure 10 is a time series plot showing which method of position fixing was in use during the cruise. Fixes have been assigned a 'status' of 1 for a GPS fix and 2 for a transit fix. Typically, a period of about eight hours good GPS was available each day. However, GPS became unavailable for a period of several days in the central part of the cruise. This was apparently due to a change in the coding used by GPS satellites, the original signals being restored after some days.

The next step in compiling the list of good position fixes was to eliminate poor fixes from the list of transit satellite positions. The list was culled to remove fixes with unsuitable elevations (less than 10 degrees or greater than 70) and numbers of iterations (more than four). The remaining fixes were further culled to remove fixes separated by less than one hour, or fixes within one hour of good GPS fixes.

The resulting position fix file (GPS plus transit) was combined with the relative motion file to produce a master navigation file of positions and absolute ship speeds at one minute intervals throughout the cruise.

This master file was combined with the observed ADCP data to produce absolute water velocities, and was also used to provide position fixing information for processing of all other data from the cruise.

DATA PLOTS

Table 1 defines the way in which the ADCP data have been divided into nine numbered sections.

Figures 4-9 show plan views of the currents at various depths. A standard arrow on each plot, located at 145°E, 7.5°S, represents a speed of 100 cm/s. Many of the major currents in the region may be identified; in particular, the Mindanao Current is clearly visible on Section 1, and the North Equatorial Countercurrent, Equatorial Undercurrent, South Equatorial Current and New Guinea Subsurface Coastal Current may all be identified on Section 6. The Equatorial Undercurrent is displaced northwards and centered on about 2°N on this section.

There are two sets of contoured plots in this report, each divided according to the sections defined in Table 1. The first set of plots (pp. 25-51) are detailed but unshaded contoured sections of north or east component of velocity against pressure. Each panel covers two degrees of latitude or longitude. The contoured quantities are identified on the plots by VE(W-G) and VN(W-G), denoting east and north components of water-over-ground velocity respectively.

The second set of plots (pp. 52-60) have been compressed to fit a complete section on each page, and groups of contours have been shaded to enable the eye to identify features of interest.

The plots for Section 9 (160°E) require some special comment. The section was run from north to south, following a passage leg from 3°N, 150°E. The northernmost part of the section clearly suffers from poor navigation. There are two reasons for this. First, there was a shortage of good position fixes. A transit satellite fix was received at 264/2242, shortly after commencing the section. However, the previous good position fix was a GPS fix nearly four hours earlier (264/1848), and the next good position was not until a GPS fix at 265/1020, when the ship had reached 5.546°N. Secondly, the absence of ADCP data on the passage leg (discussed earlier), meant that the final navigation file for this section was computed using EM log data (rather than ADCP data) for the relative motion north of the first good GPS fix (265/1020).

A second segment of suspect data on Section 9 occurs over four columns of data between 5.032°N and 4.708°N. The first and last of these columns are associated with manoeuvres to recover and redeploy the SeaSoar after a failure. Since available time was very short, the decision was taken to steam south while the SeaSoar was repaired, so that the intermediate two columns of data were collected at about 11 knots rather than the 8 knots of the remainder of the section. The main plots for Section 9 (pp. 48-51 and 60 have had these suspect data removed, and the gap filled by linear interpolation.

Two additional shaded plots are shown for Section 9 (p. 61). These are plots of velocity components relative to the average of bins 3 and 4 (centered on 27 and 35m), in which imperfections of ship navigation are not involved. The four columns of suspect data mentioned in the preceding paragraph are included in these plots.

Contour intervals

The contour interval for the large scale plots is 10 cm/s, with every third contour in bold, starting at zero. For the shaded plots, contours are as indicated on the side bar.

ACKNOWLEDGEMENTS

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Institute of Oceanographic Sciences Deacon Laboratory, Cruise Report, No. 207, 34pp.

Table 1. Definition of Section numbers of data displayed in contour plots (nominal positions).

Section	Start		Stop	
	lat. °N	lon. °E	lat. °N	lon. °E
Section1	7	126.5	7	132
Section2	7	132	3	132
Section3	3	132	3	137
Section4	3	137	7	137
Section5	7	137	7	142
Section6	7	142	-3	142
Section7	-3	142	-3	146
Passage	-3	146	-2.25	150
Section8	-2.25	150	2	150
Passage	2	150	7	160
Section9	7	160	-0.13	160

Table 2. End times of segments of navigation data using ADCP and EM log..

Instrument	Start day/hhmm	Stop day/hhmm
EM log	237/0848	241/1419
ADCP	241/1420	259/0742
EM log	259/0745	260/0720
ADCP	260/0722	261/2322
EM log	261/2326	265/0951
ADCP	265/0952	267/1105
EM log	267/1107	270/1720

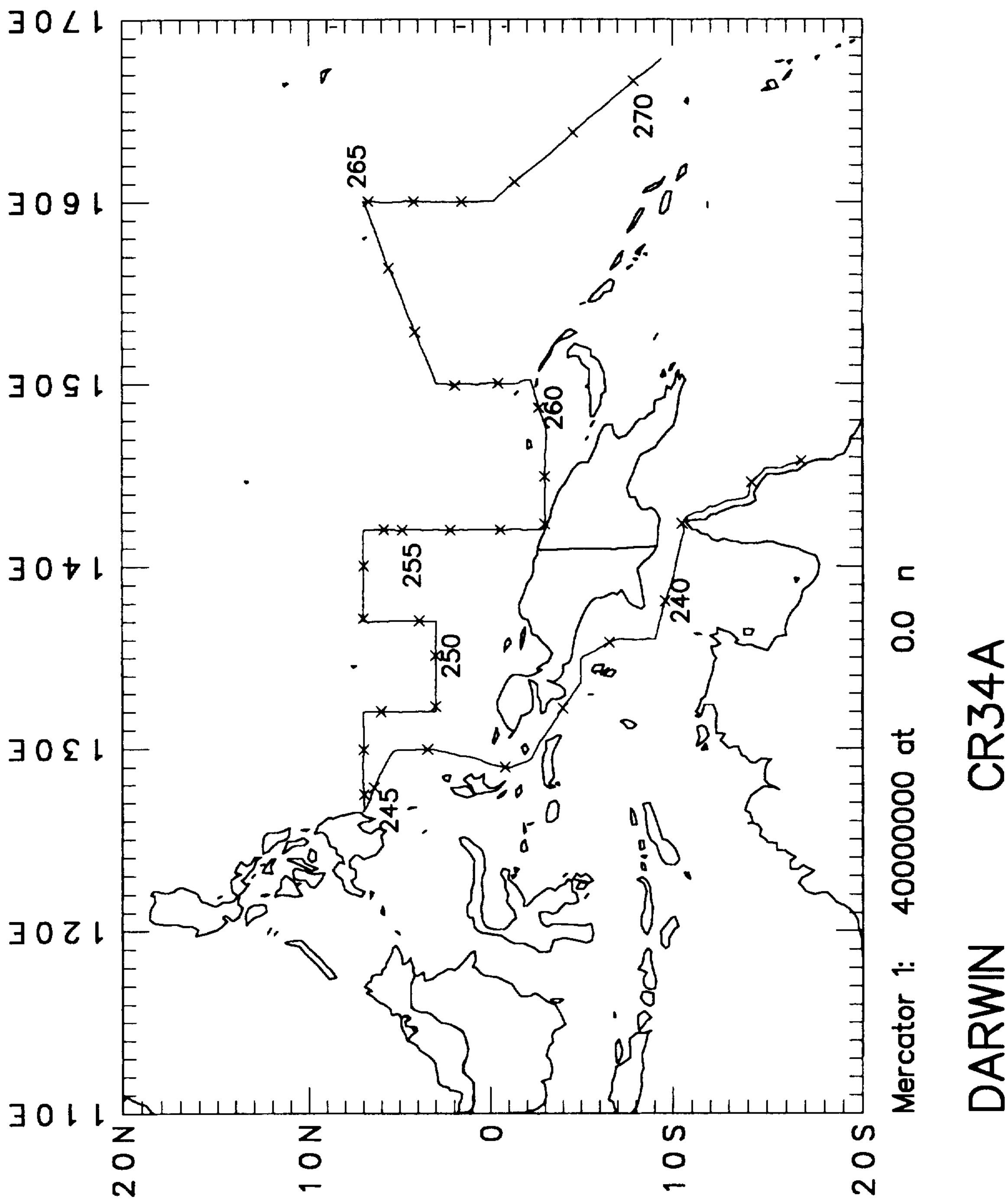

Figure 1. Cruise Track on Leg 2 of Charles Darwin Cruise 34A, 24 August - 30 September 1988. The crosses show the ship's position at 0000Z on the days indicated. Day 237 = 24 August.

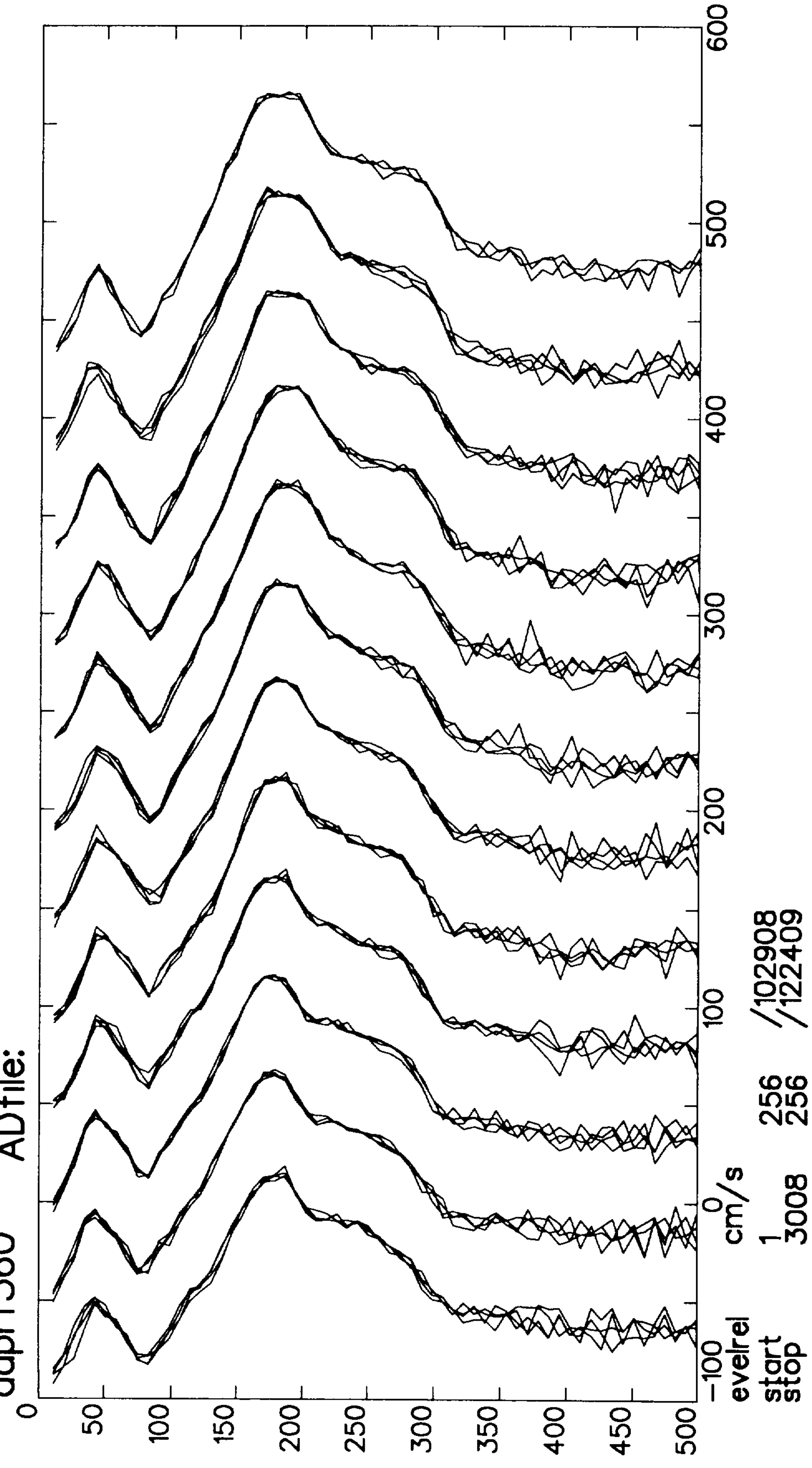

Figure 2. Profile plots (150s ensembles) of eastwards component of current velocity relative to a 159-247m average. Profiles are in groups of four, with successive groups offset by 50cm/s. The data were collected around 1°N on 142°E.

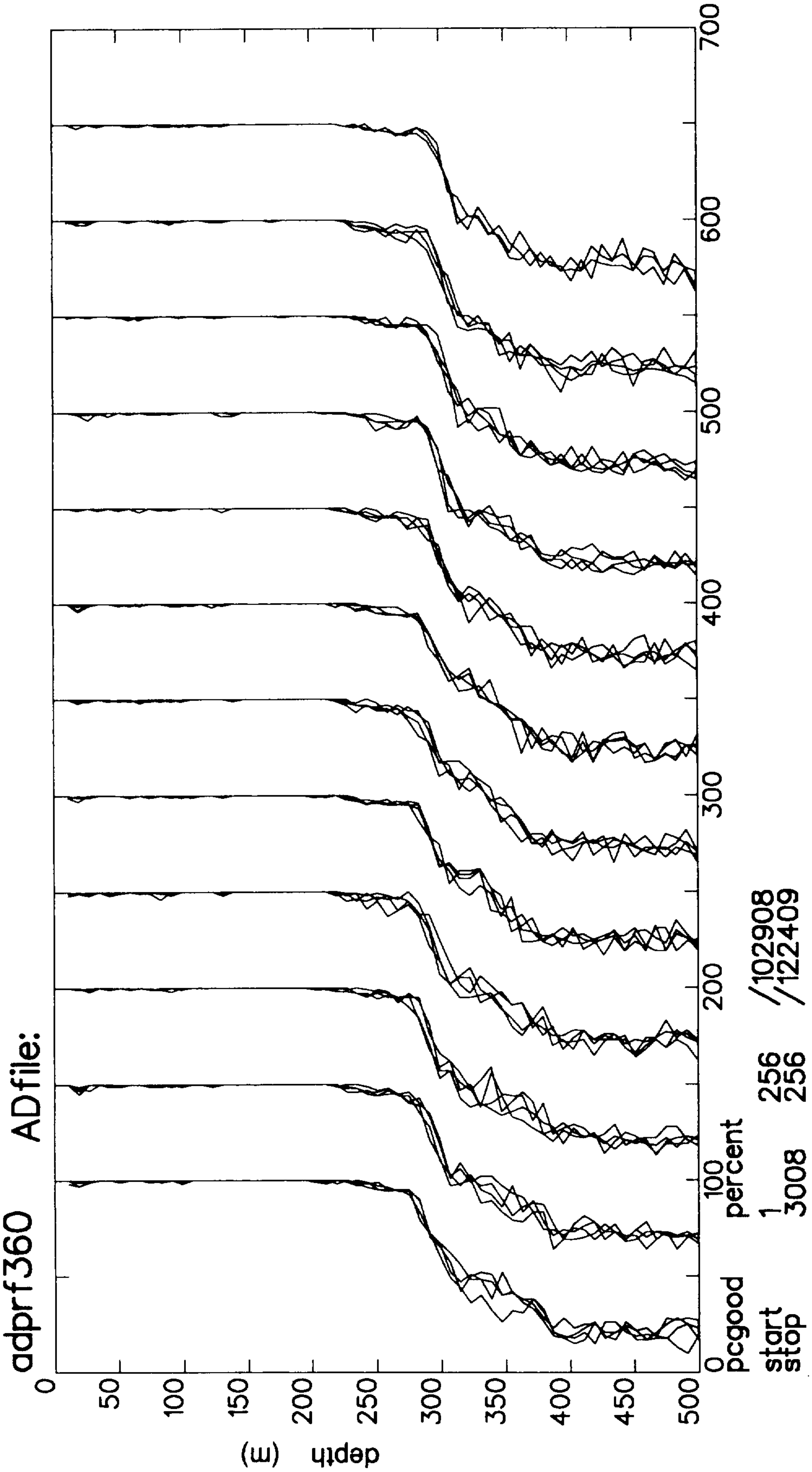

Figure 3. As Figure 2, but profiles of percent good pings (one ping per second for 150 seconds).

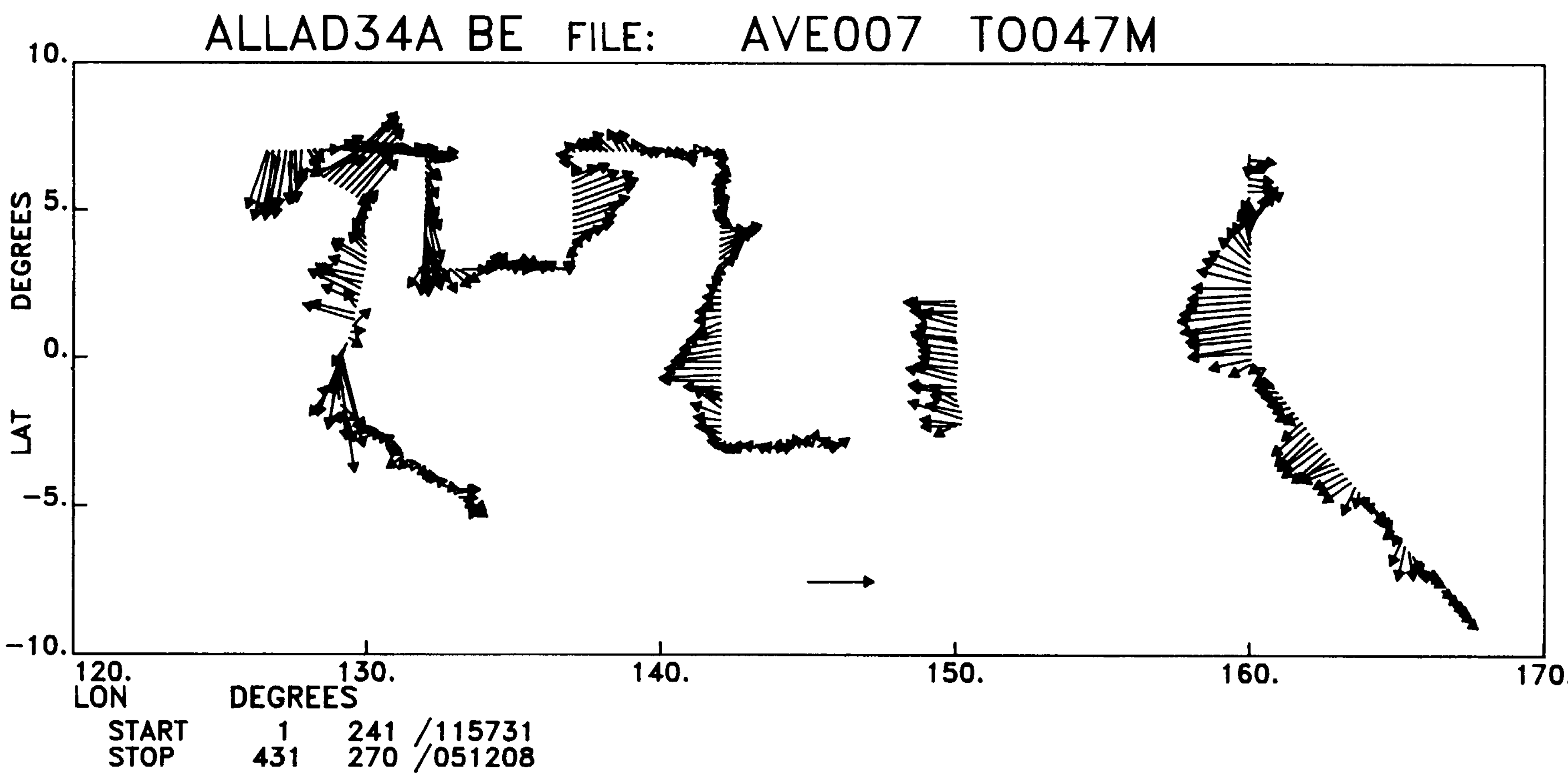

Figure 4. Plan view of absolute current vectors averaged from 7 to 47 m (ADCP bins 1 to 5). Standard arrow in lower part of figure denotes 100 cm/s.

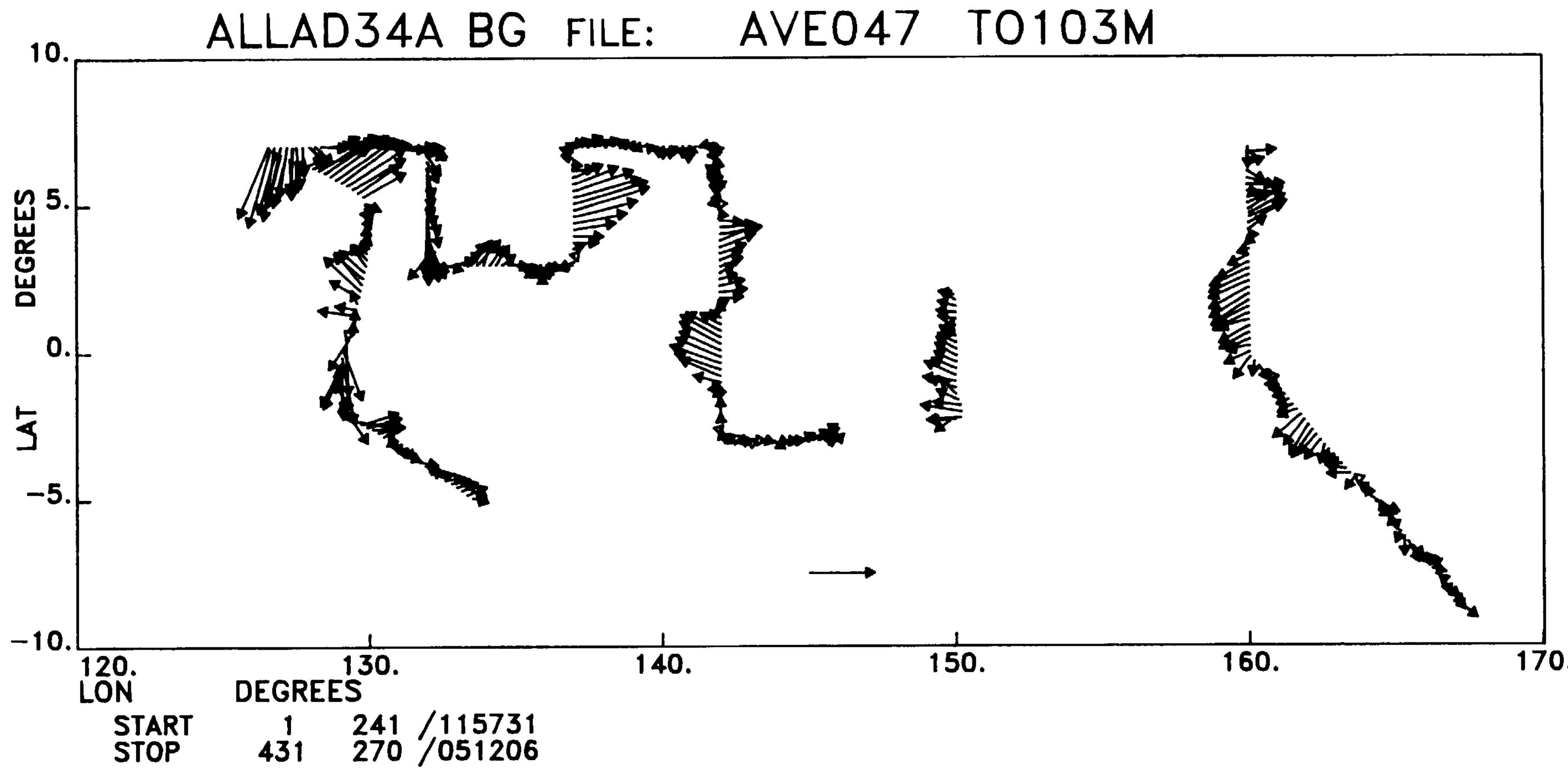

Figure 5. Plan view of absolute current vectors averaged from 47 to 103 m (ADCP bins 6 to 12). Standard arrow in lower part of figure denotes 100 cm/s.

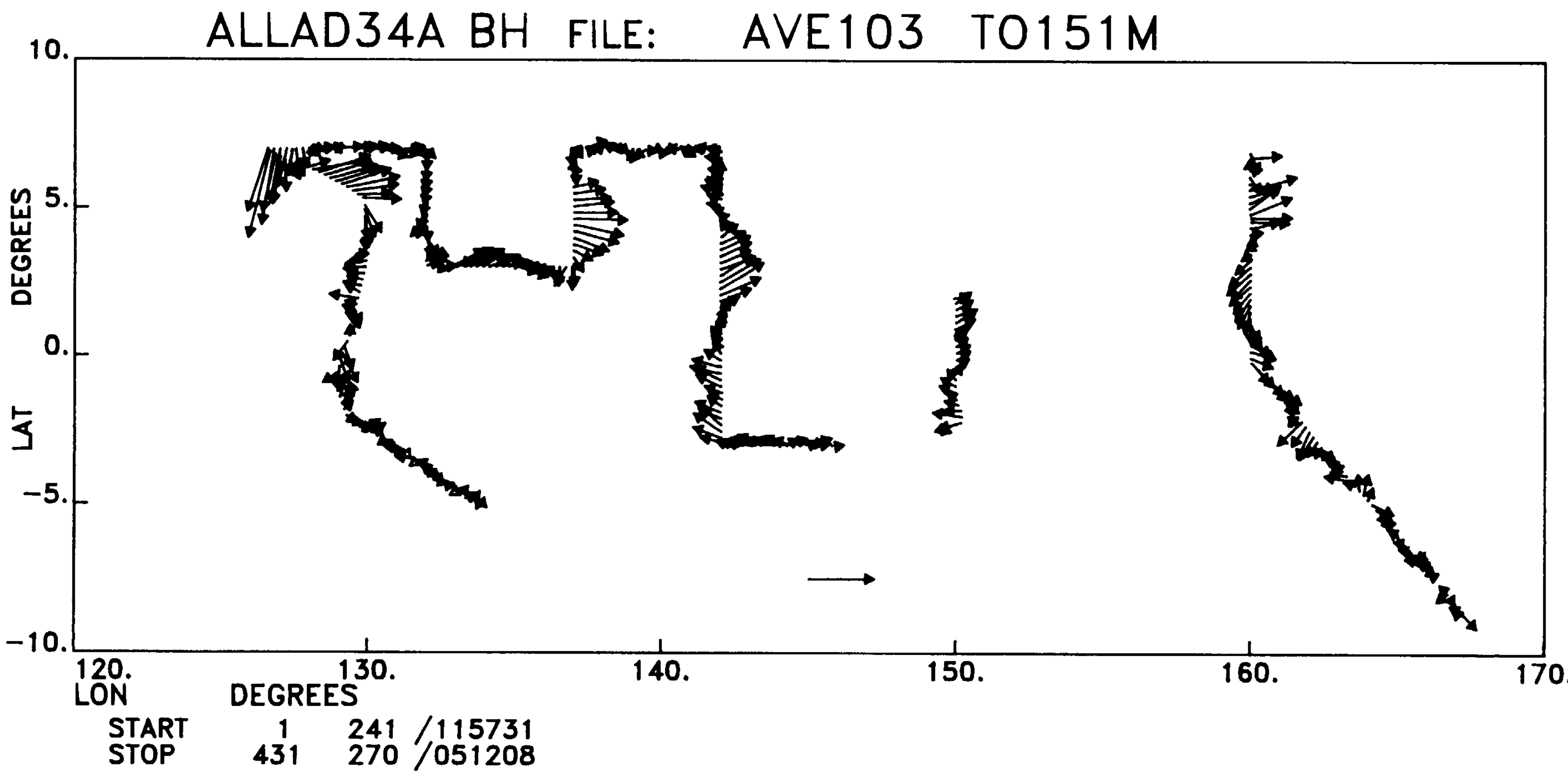

Figure 6. Plan view of absolute current vectors averaged from 103 to 151 m (ADCP bins 13 to 18). Standard arrow in lower part of figure denotes 100 cm/s.

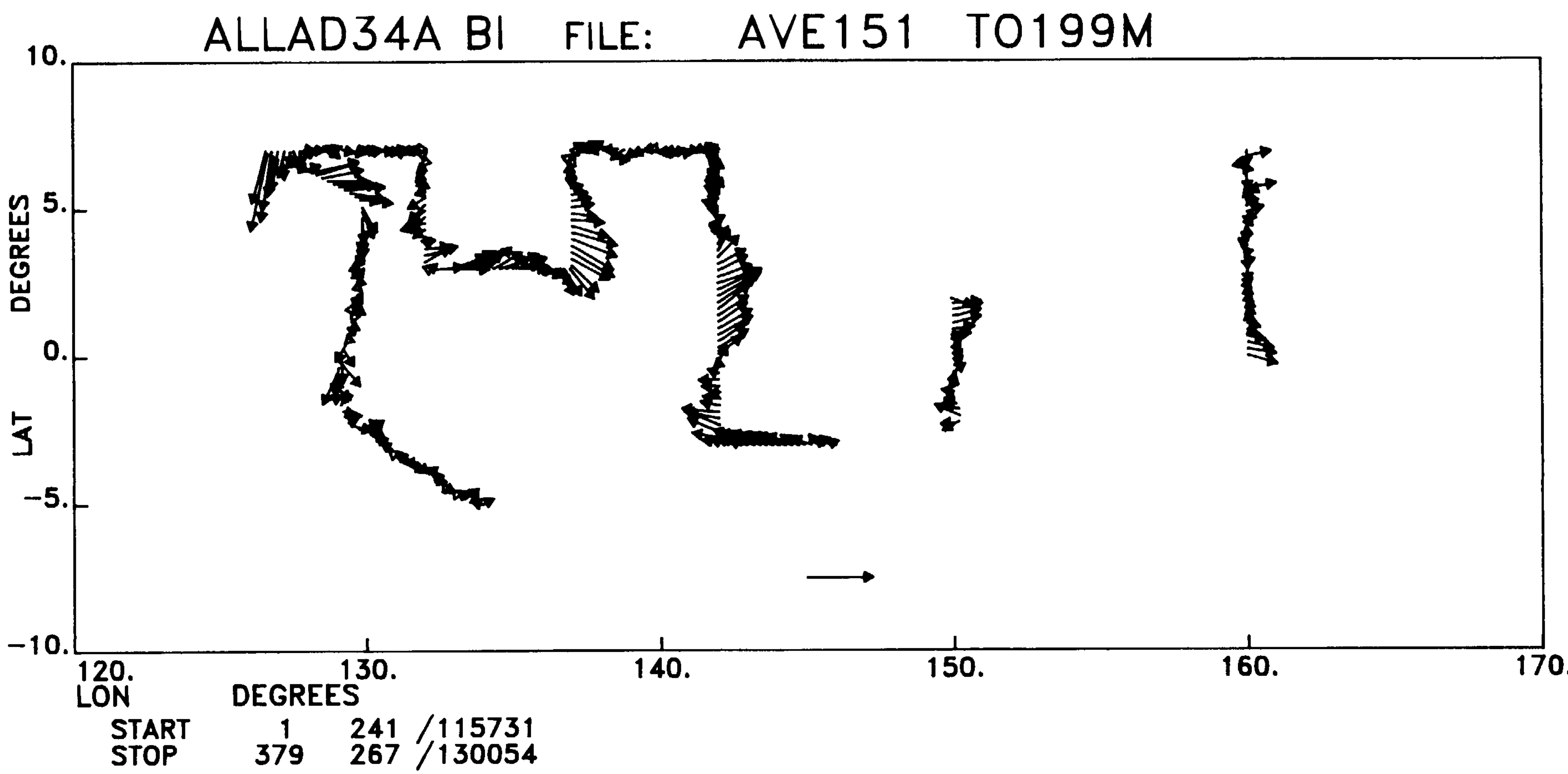

Figure 7. Plan view of absolute current vectors averaged from 151 to 199 m (ADCP bins 19 to 24). Standard arrow in lower part of figure denotes 100 cm/s.

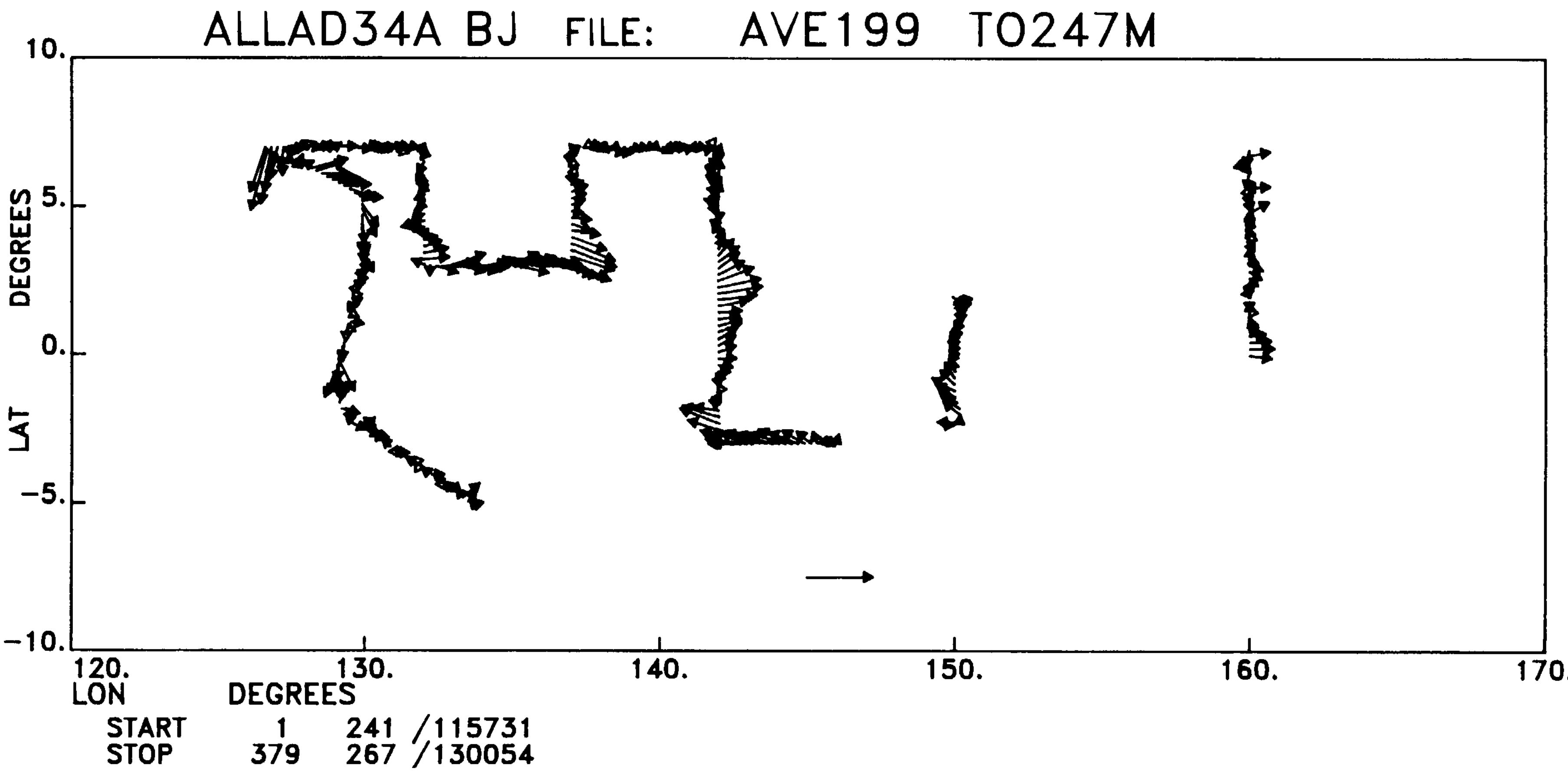

Figure 8. Plan view of absolute current vectors averaged from 199 to 247 m (ADCP bins 25 to 30). Standard arrow in lower part of figure denotes 100 cm/s.

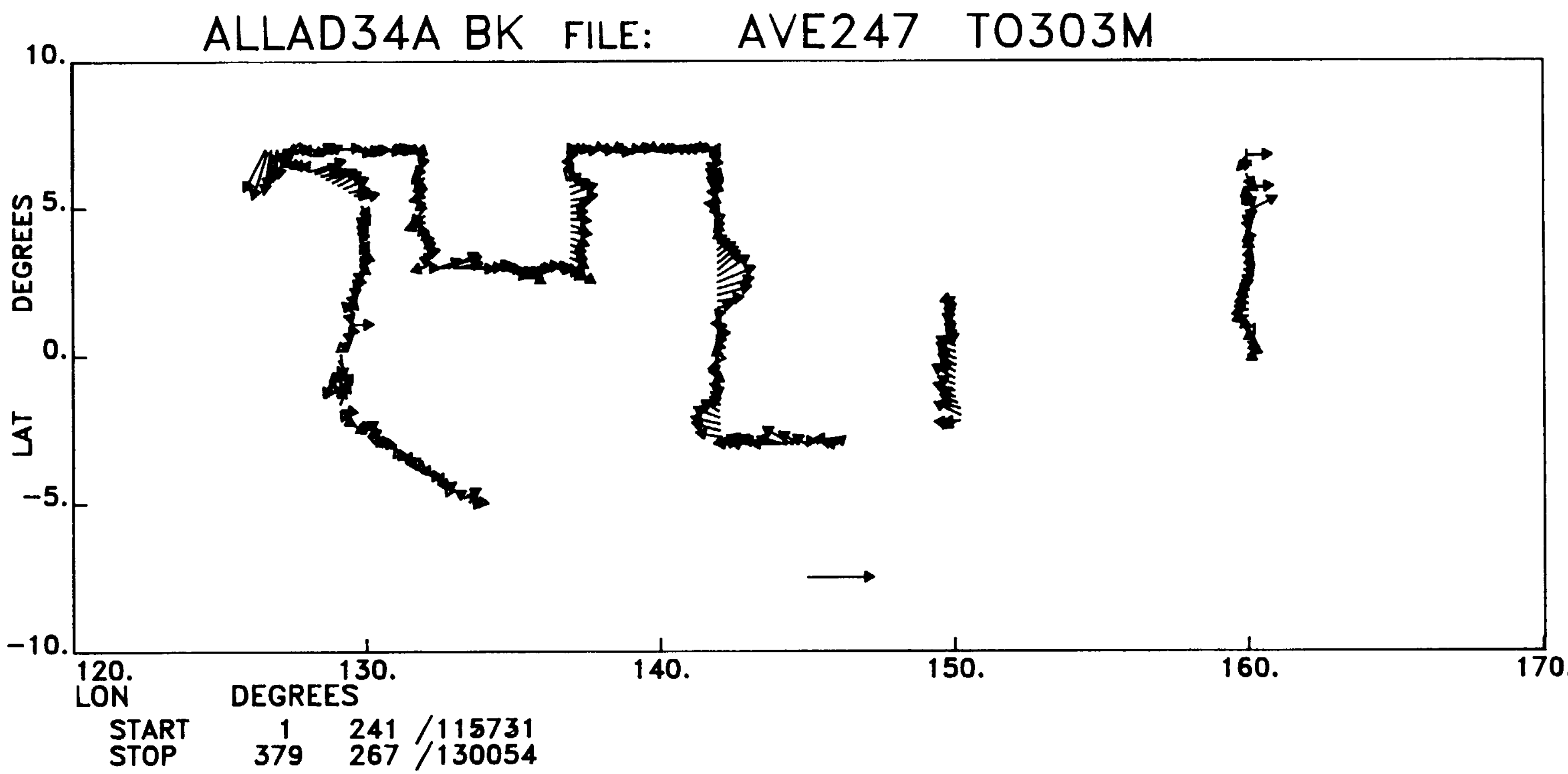

Figure 9. Plan view of absolute current vectors averaged from 247 to 303 m (ADCP bins 31 to 37). Standard arrow in lower part of figure denotes 100 cm/s.

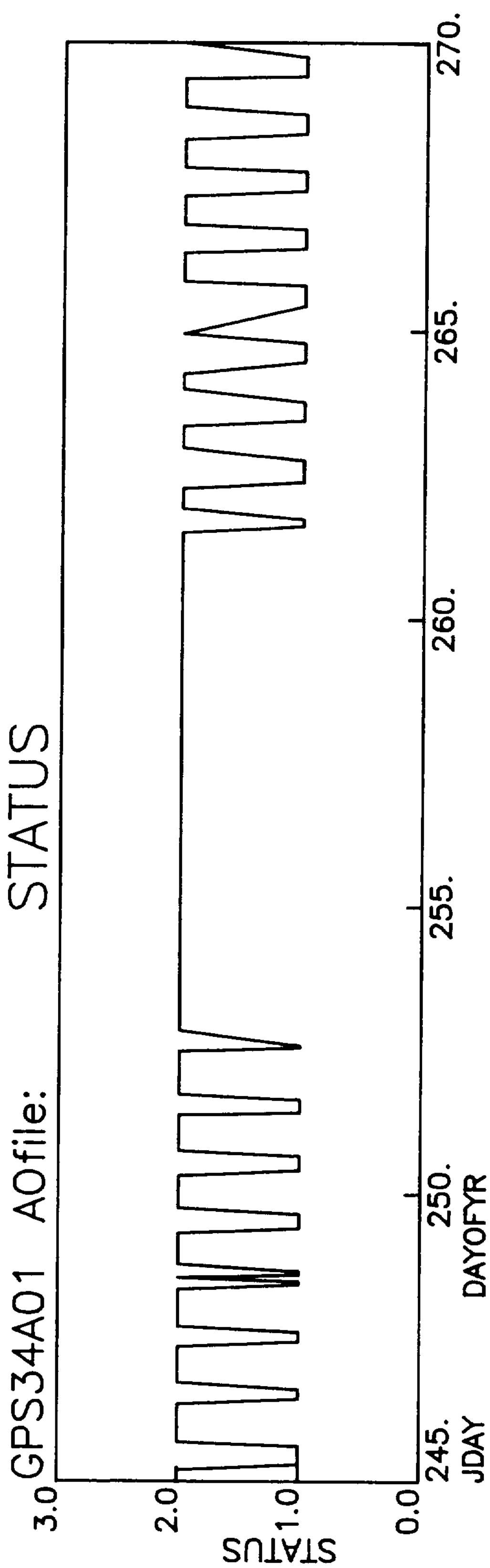

Figure 10. Time series showing whether position fixes for navigation are from GPS (status = 1), or transit satellite (status = 2).

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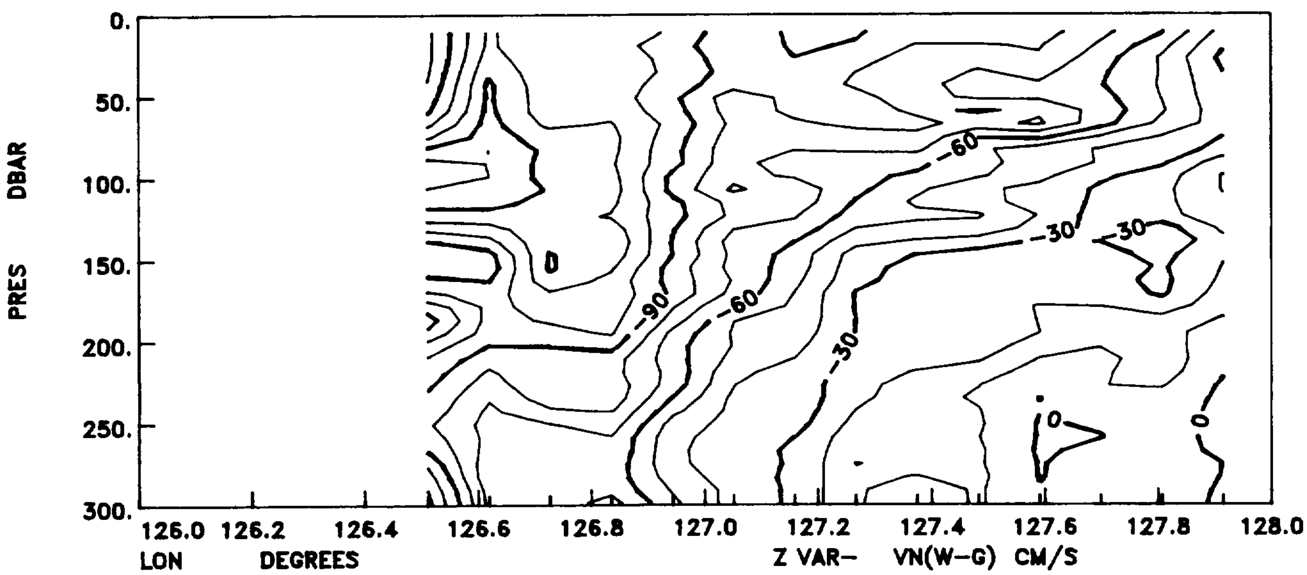
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-30
-30
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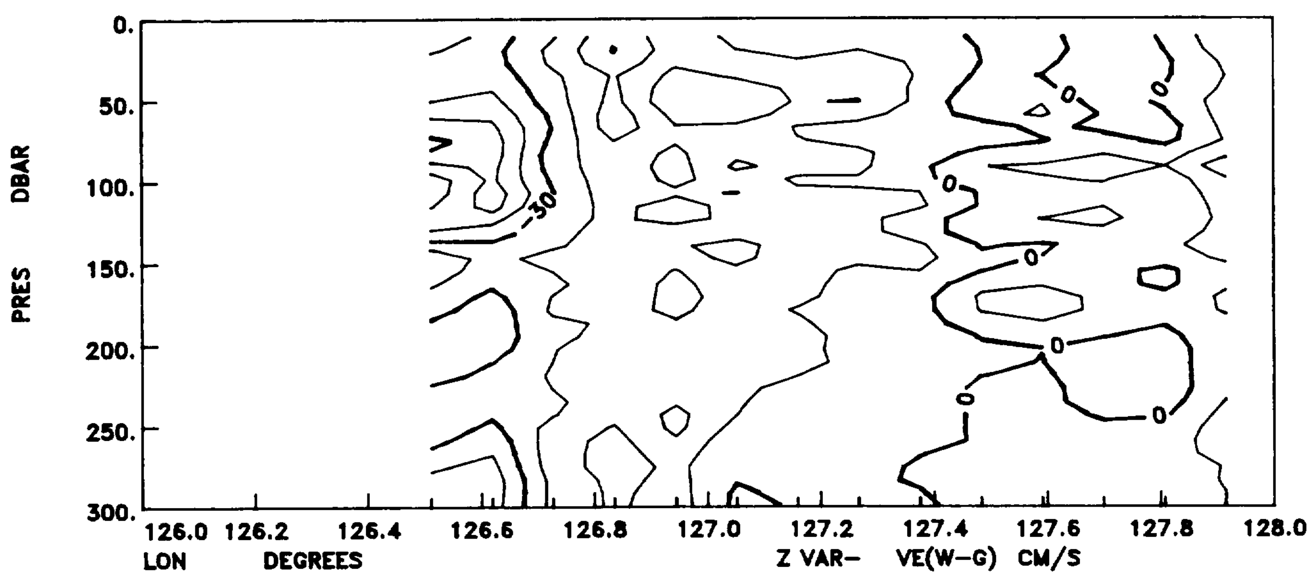
LON DEGREES
Z VAR- VN(W-G) CM/S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LON DEGREES
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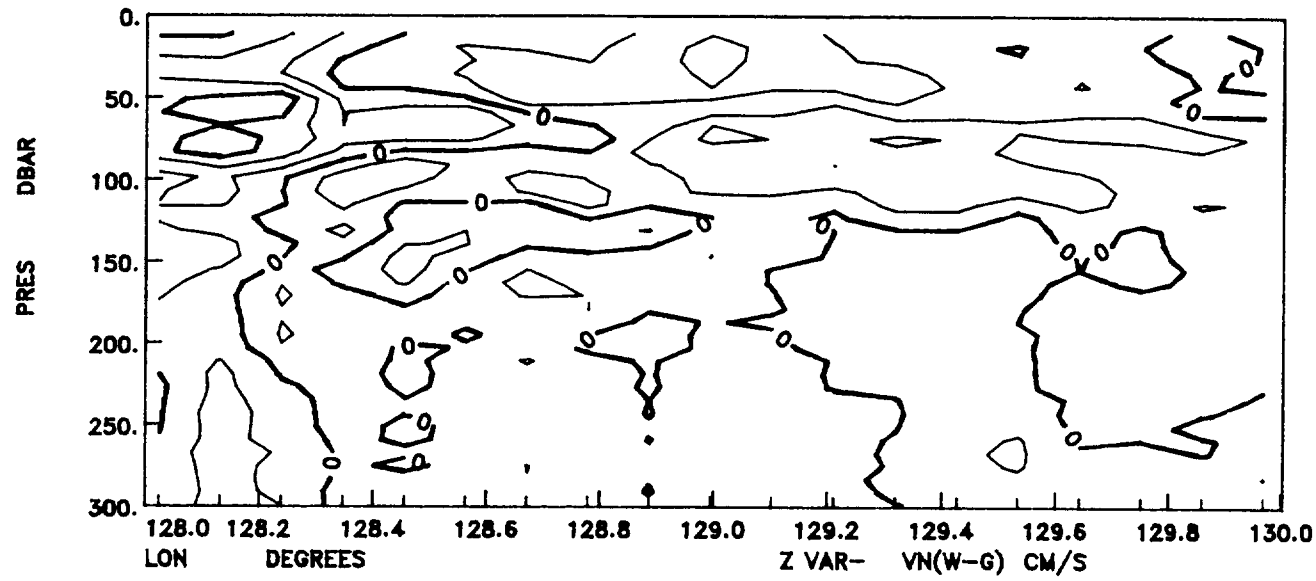
SECTION1-7N



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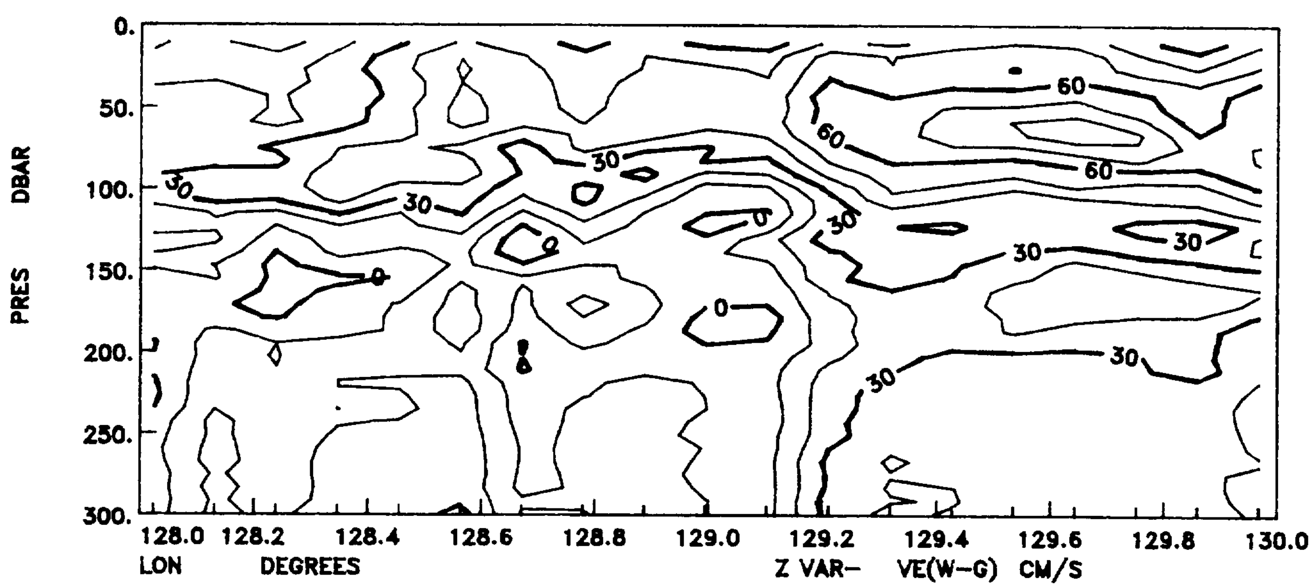

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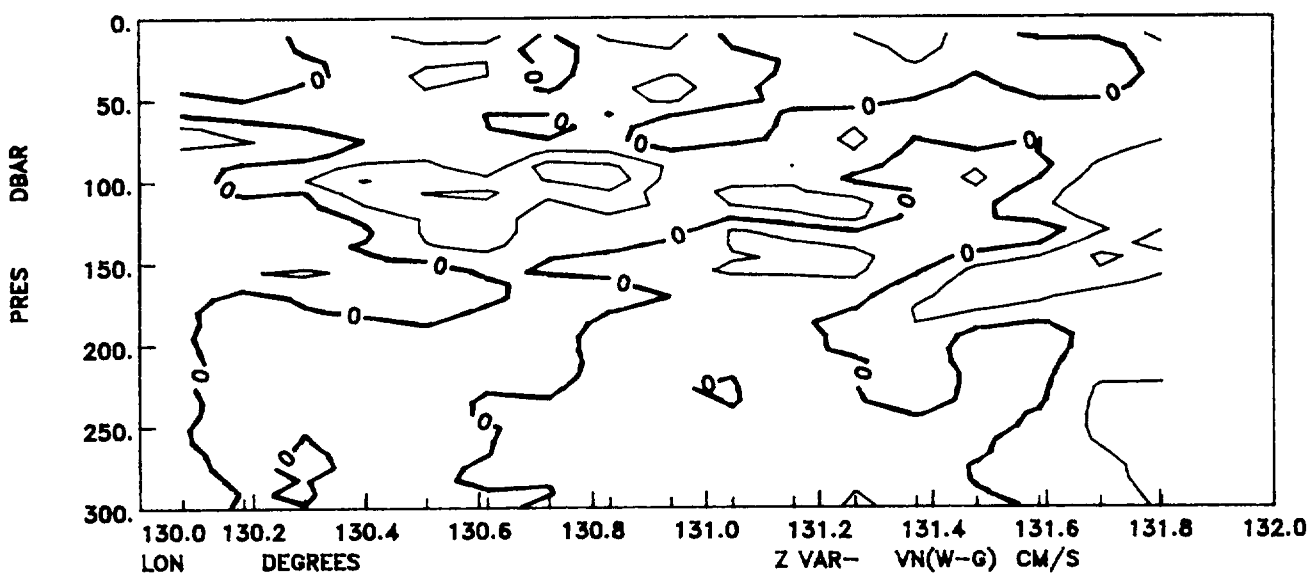

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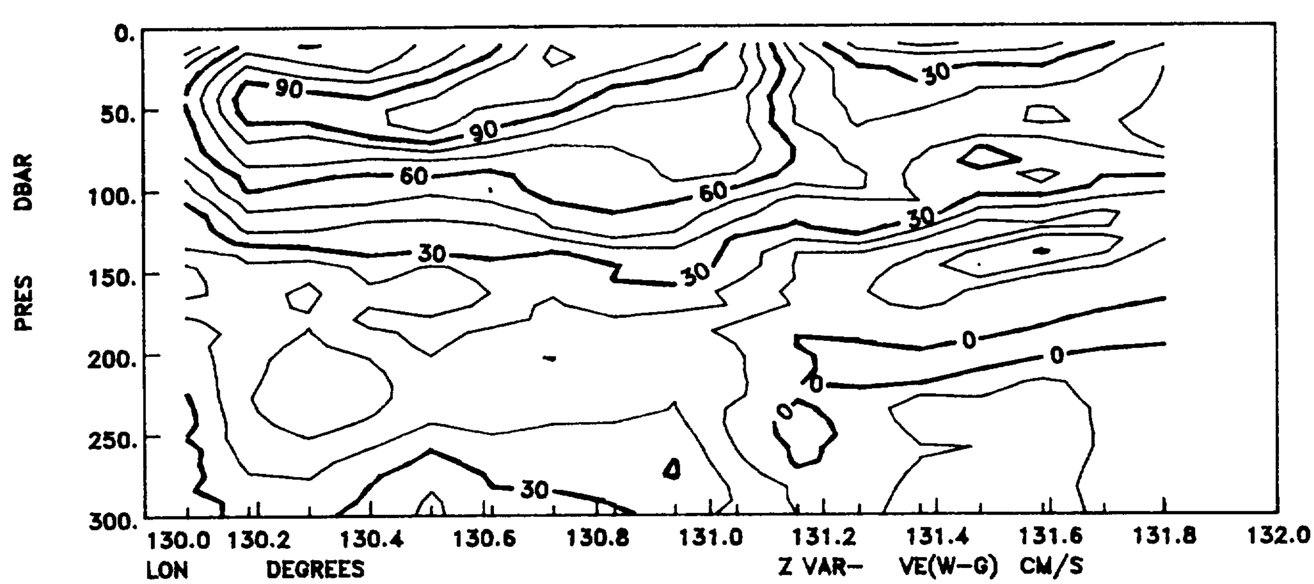

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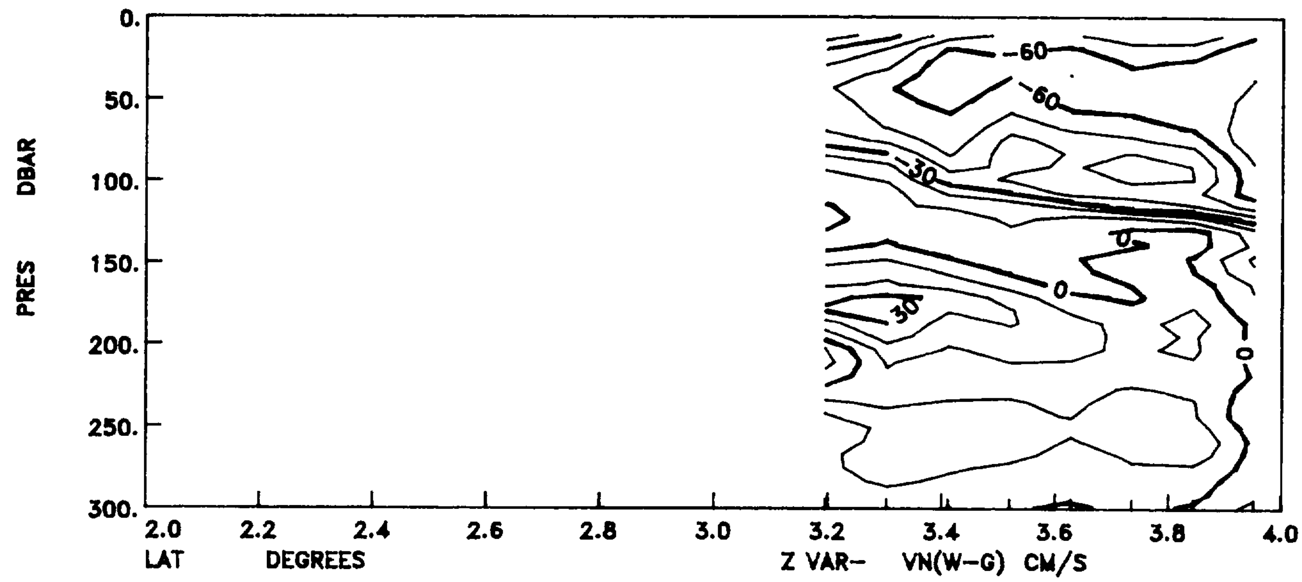

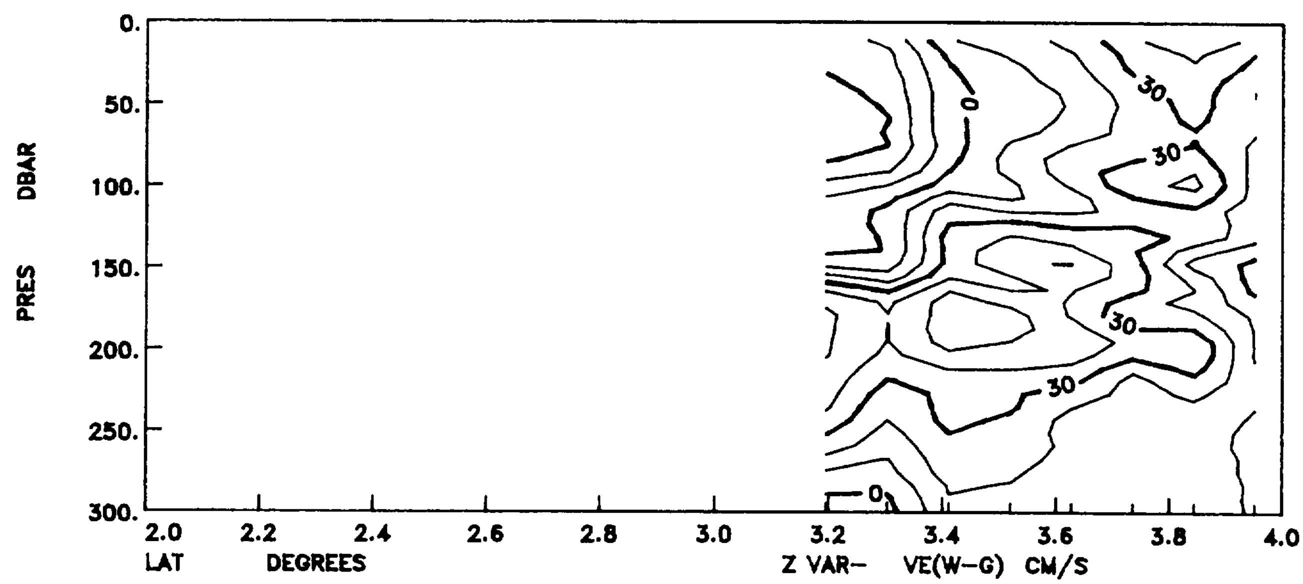

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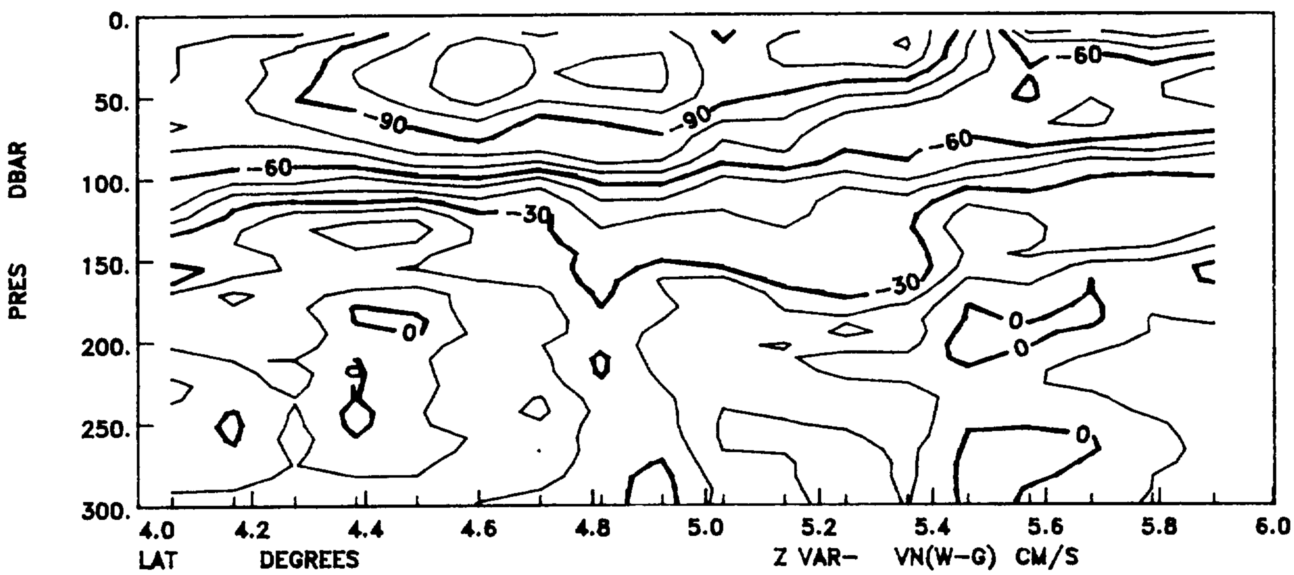

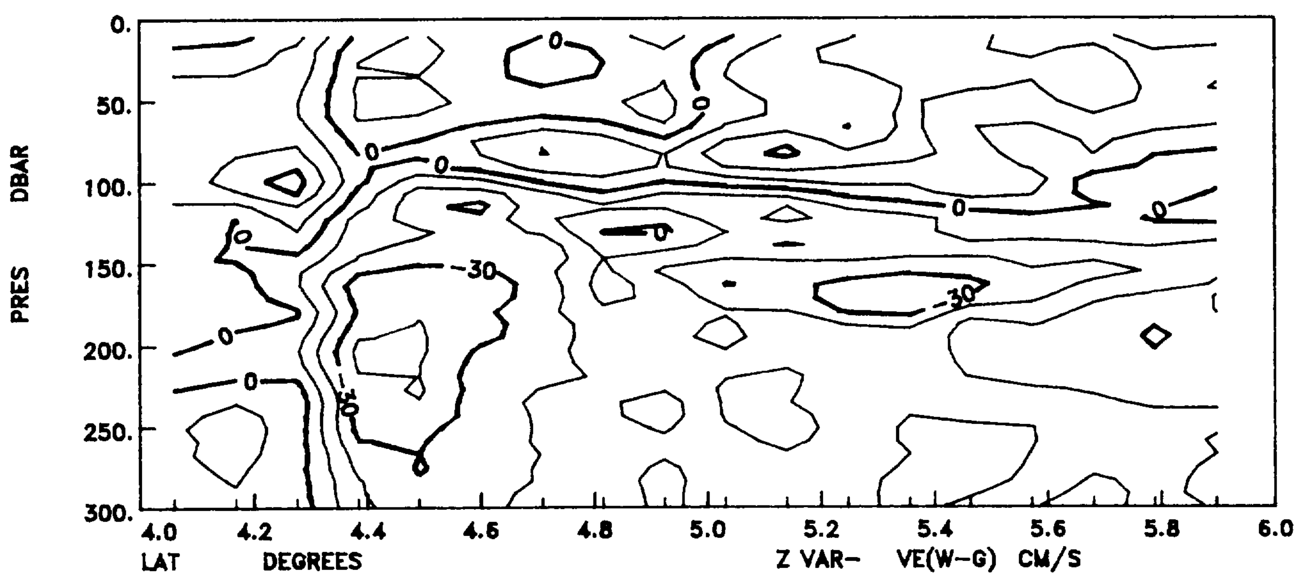

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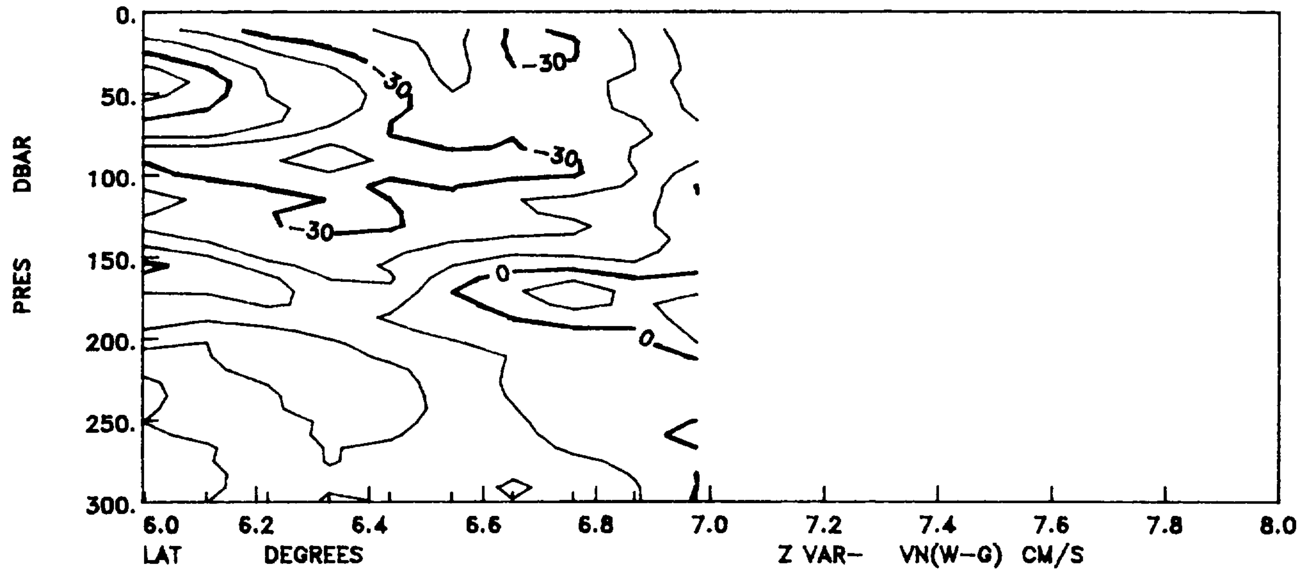

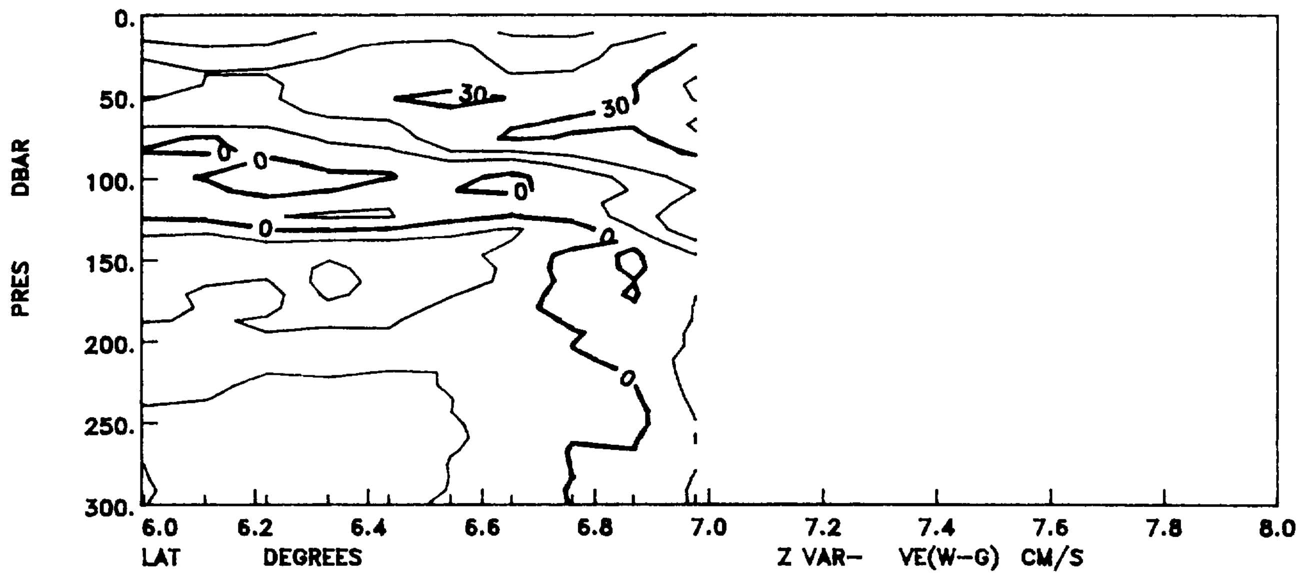

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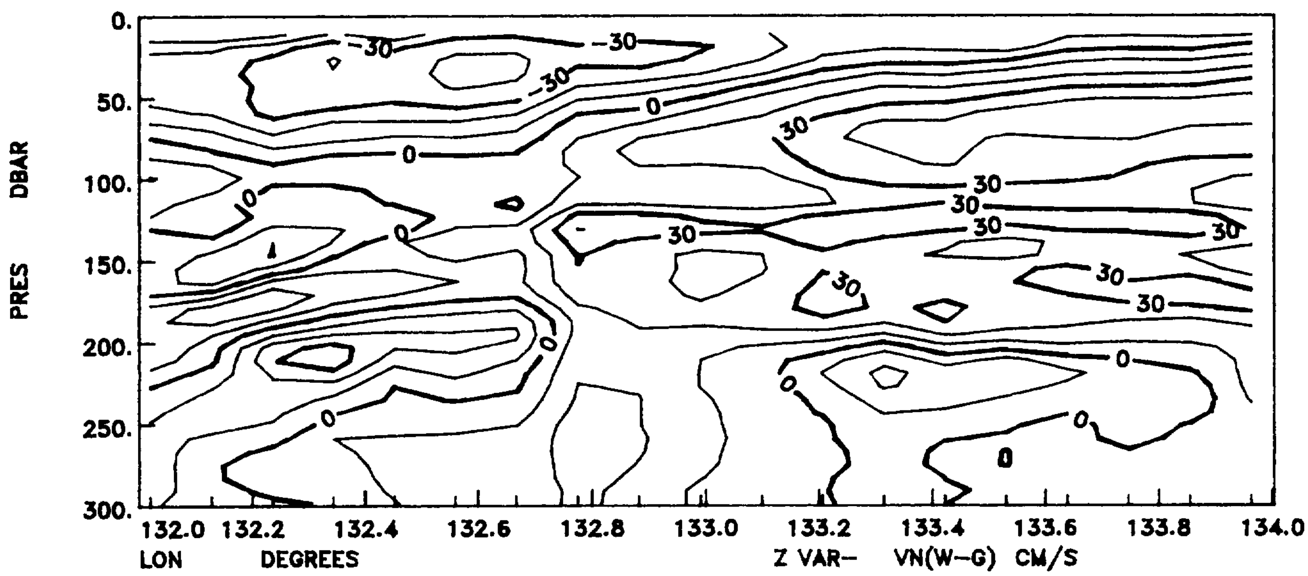
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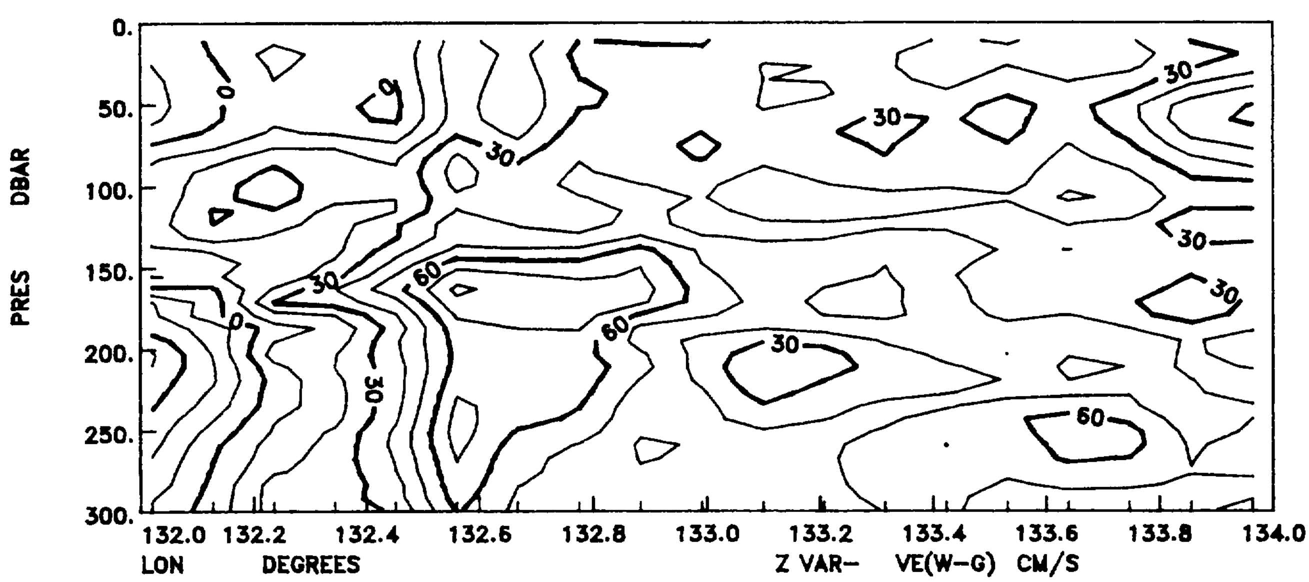
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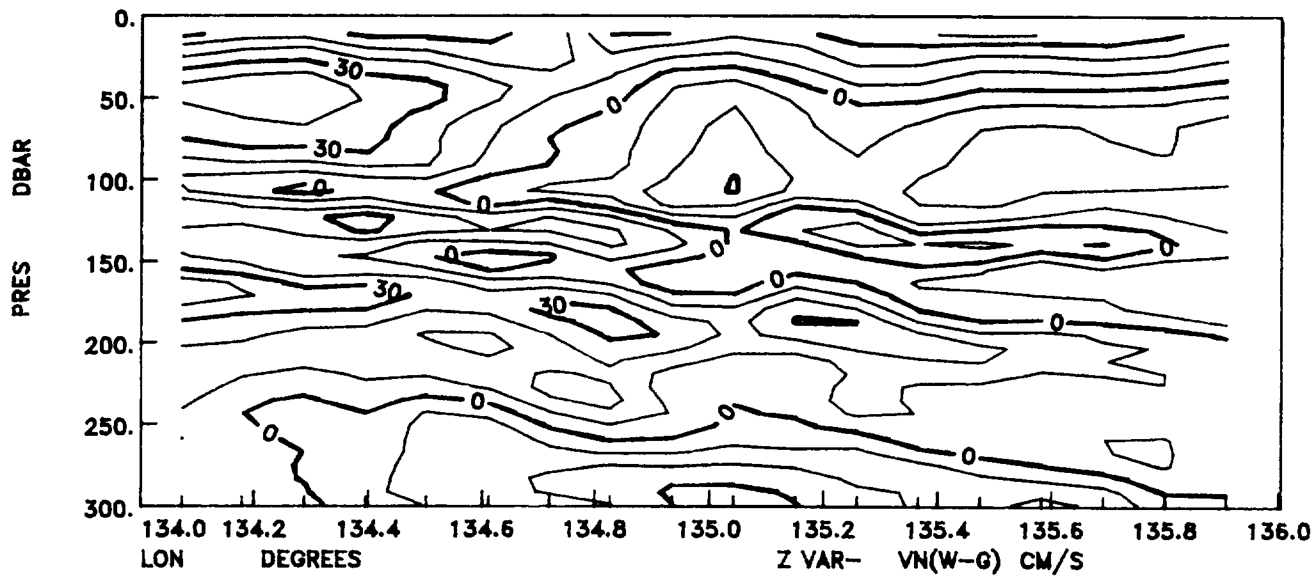
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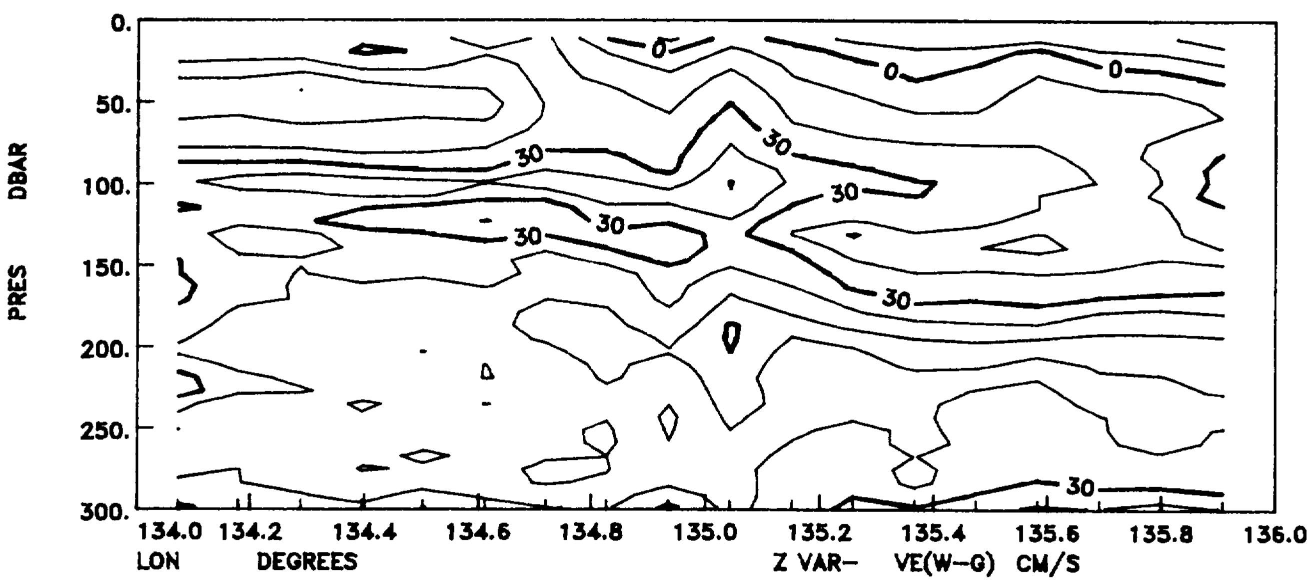
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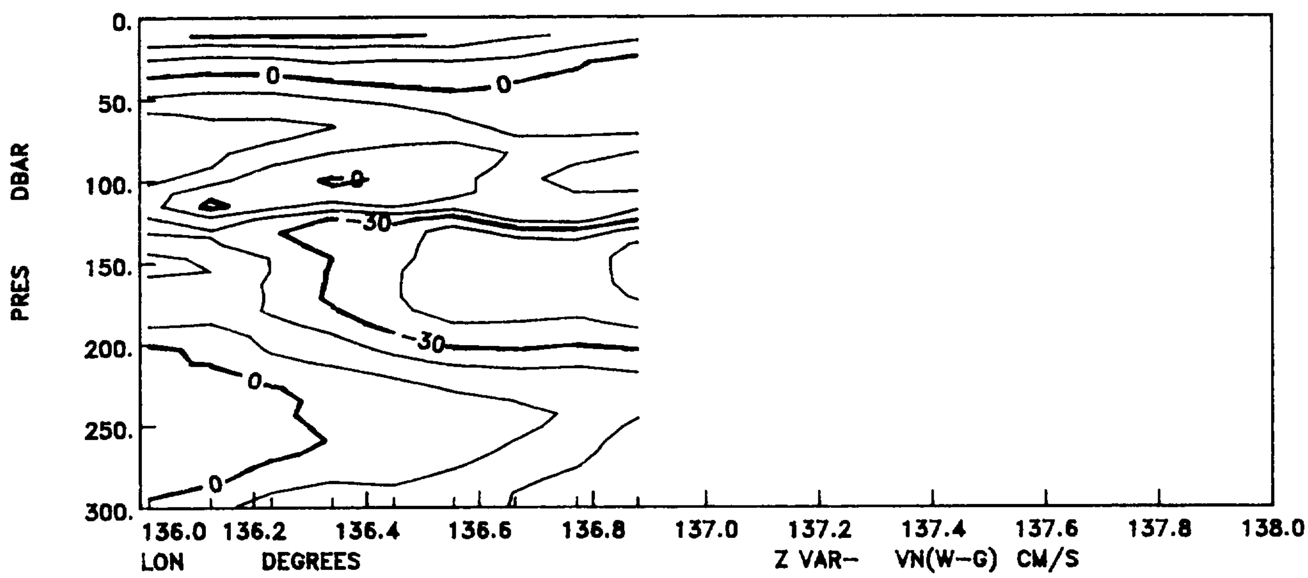
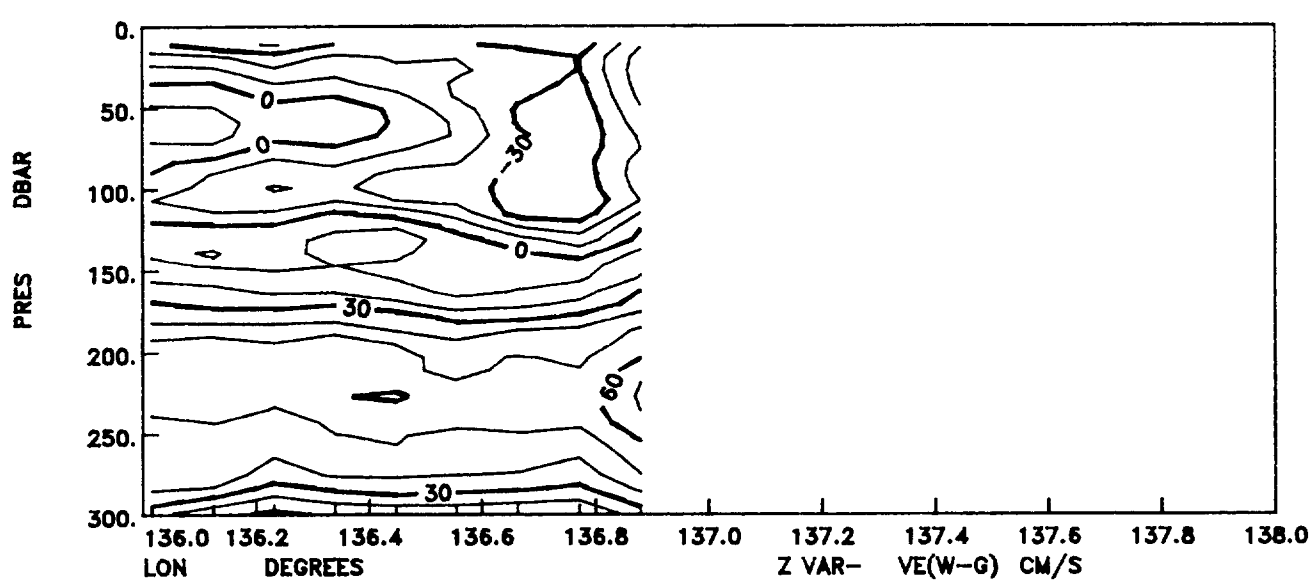
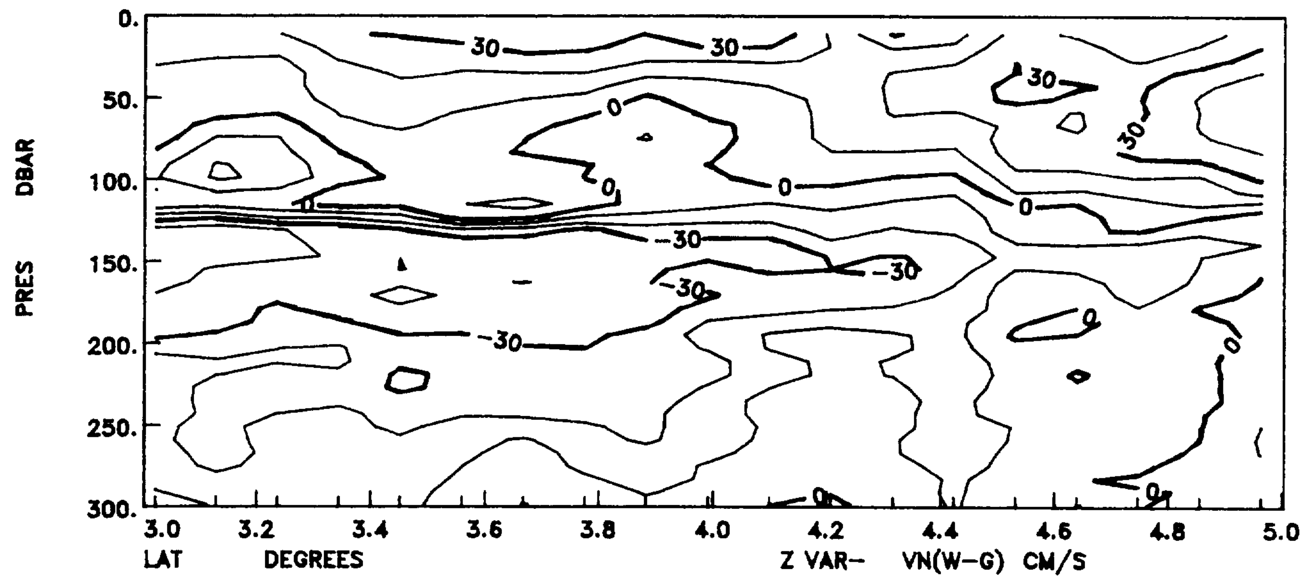
200.
250.
300.
PRES DBAR
134.0 134.2 134.4 134.6 134.8 135.0 135.2 135.4 135.6 135.8 136.0
LON DEGREES
Z VAR- VE(W-G) CM/S
30
0

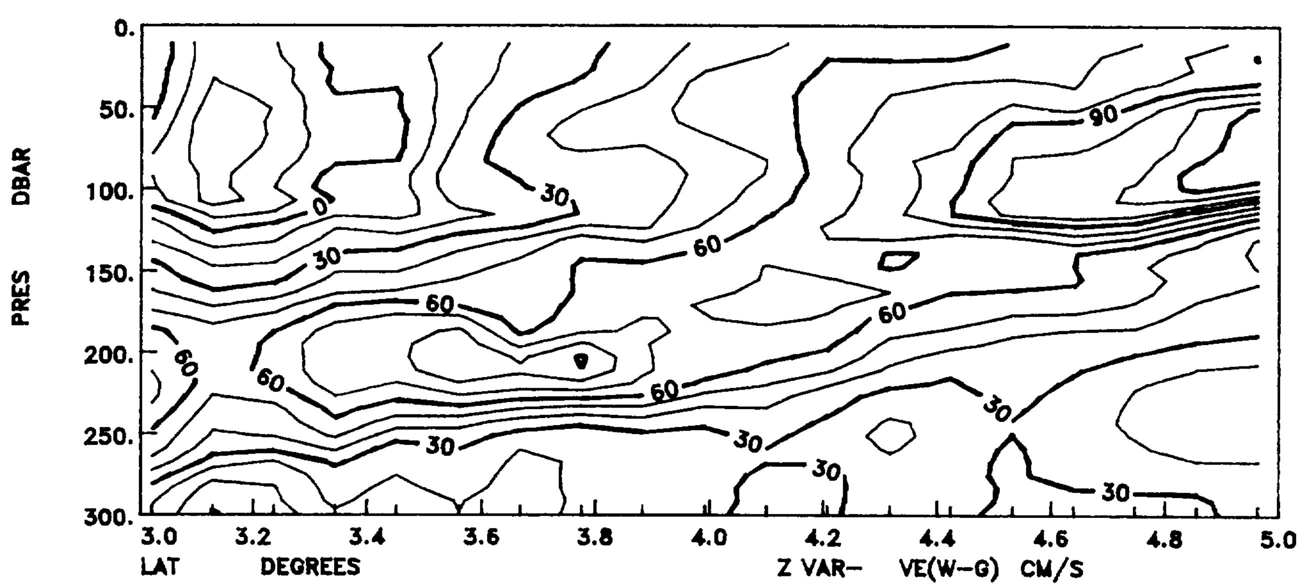
SECTION3-3N


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
-30
136.0 136.2 136.4 136.6 136.8 137.0 137.2 137.4 137.6 137.8 138.0
LON DEGREES
Z VAR- VN(W-G) CM/S

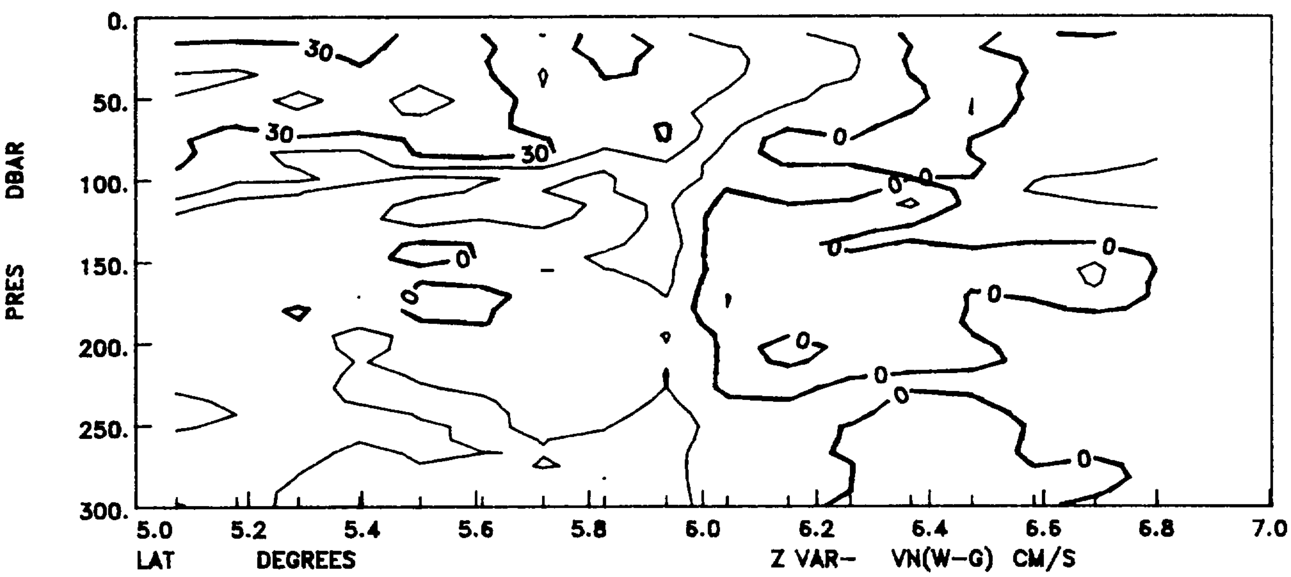

0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
-30
30
60
136.0 136.2 136.4 136.6 136.8 137.0 137.2 137.4 137.6 137.8 138.0
LON DEGREES
Z VAR- VE(W-G) CM/S

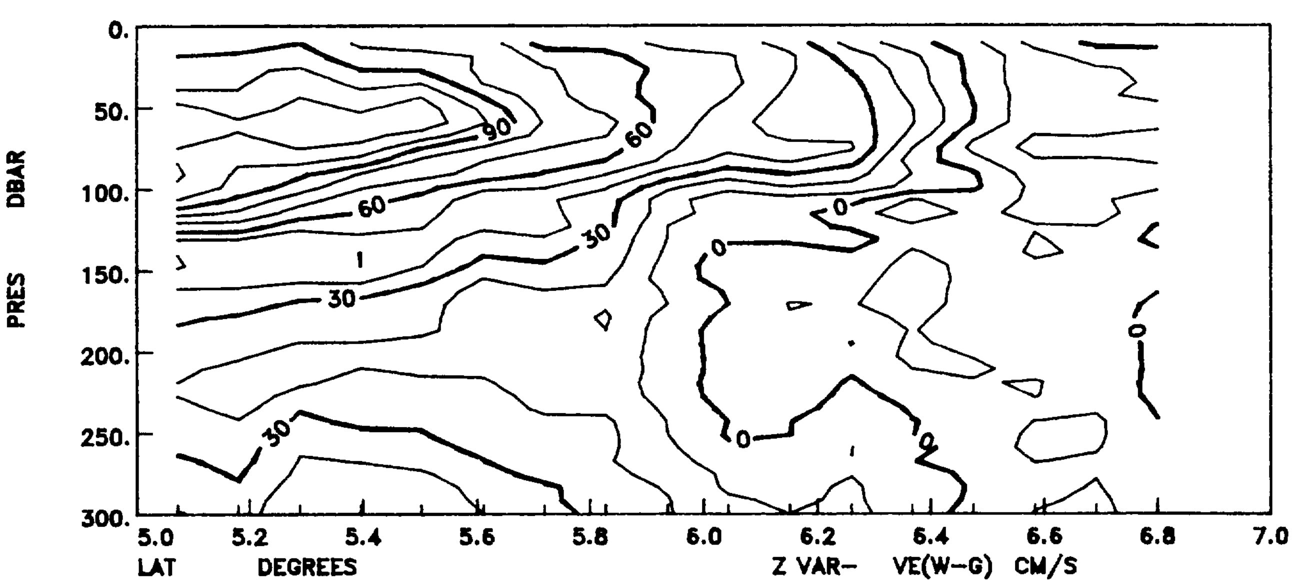
SECTION4–137E



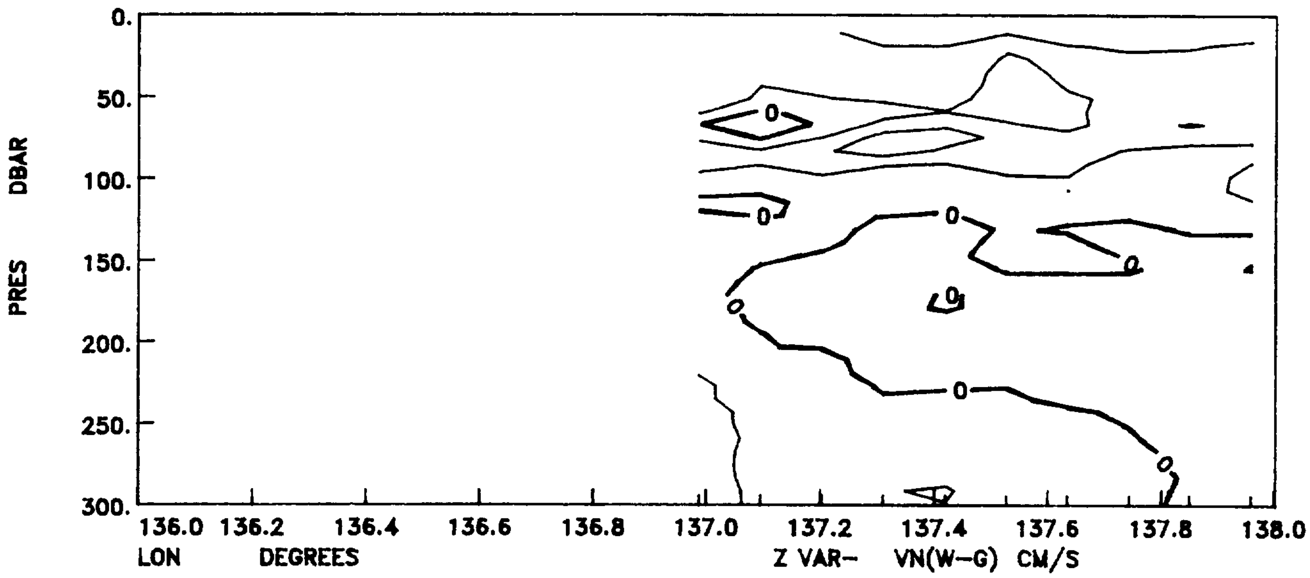


SECTION4-137E

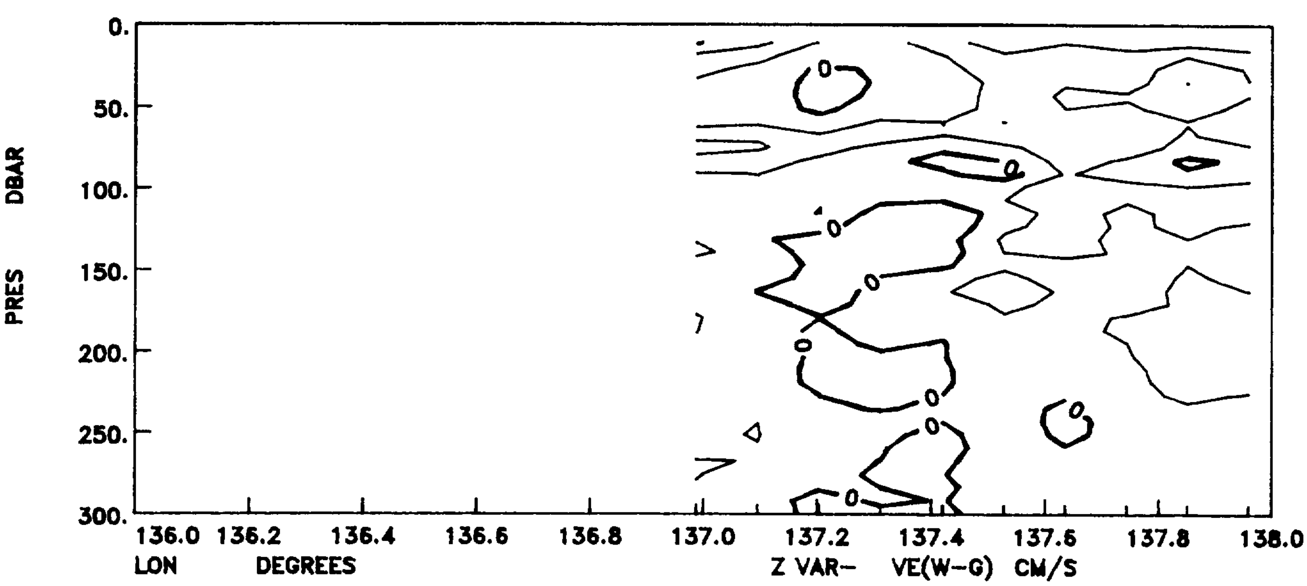




SECTION5–7N

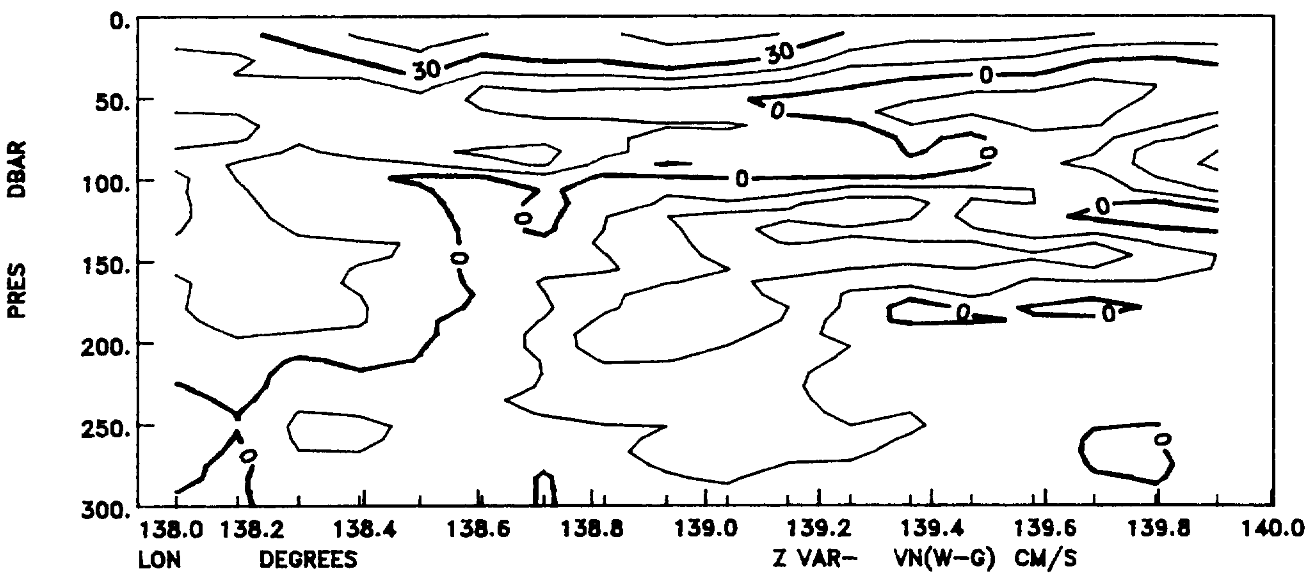


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
136.0 136.2 136.4 136.6 136.8 137.0 137.2 137.4 137.6 137.8 138.0
LON DEGREES
Z VAR– VN(W–G) CM/S

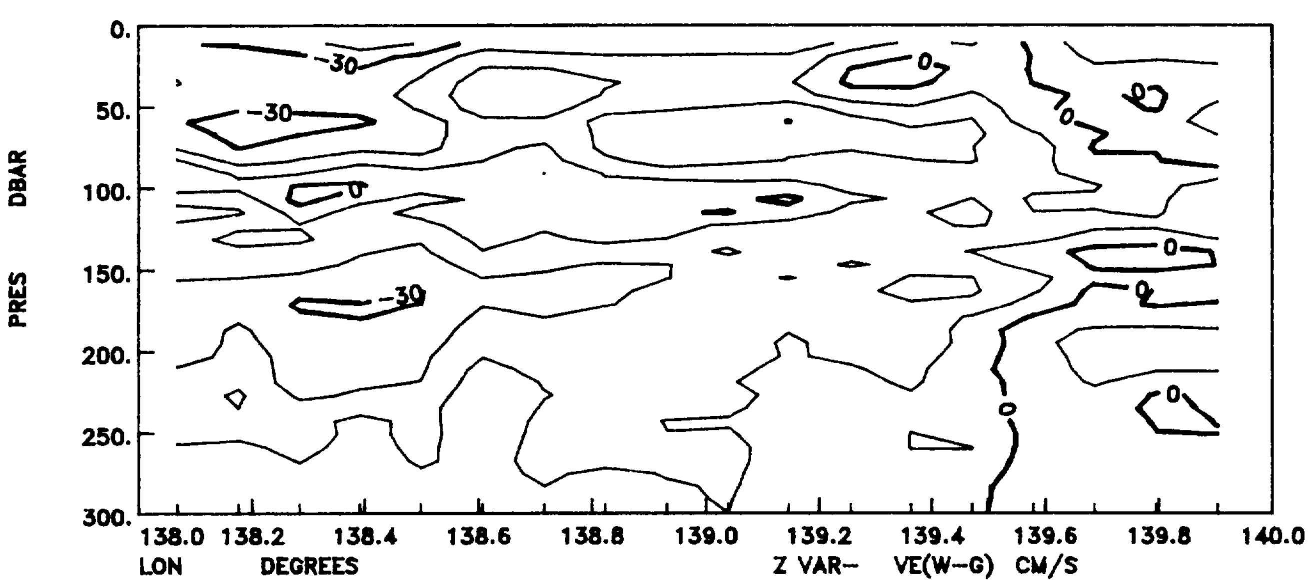


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
136.0 136.2 136.4 136.6 136.8 137.0 137.2 137.4 137.6 137.8 138.0
LON DEGREES
Z VAR– VE(W–G) CM/S

SECTION5−7N

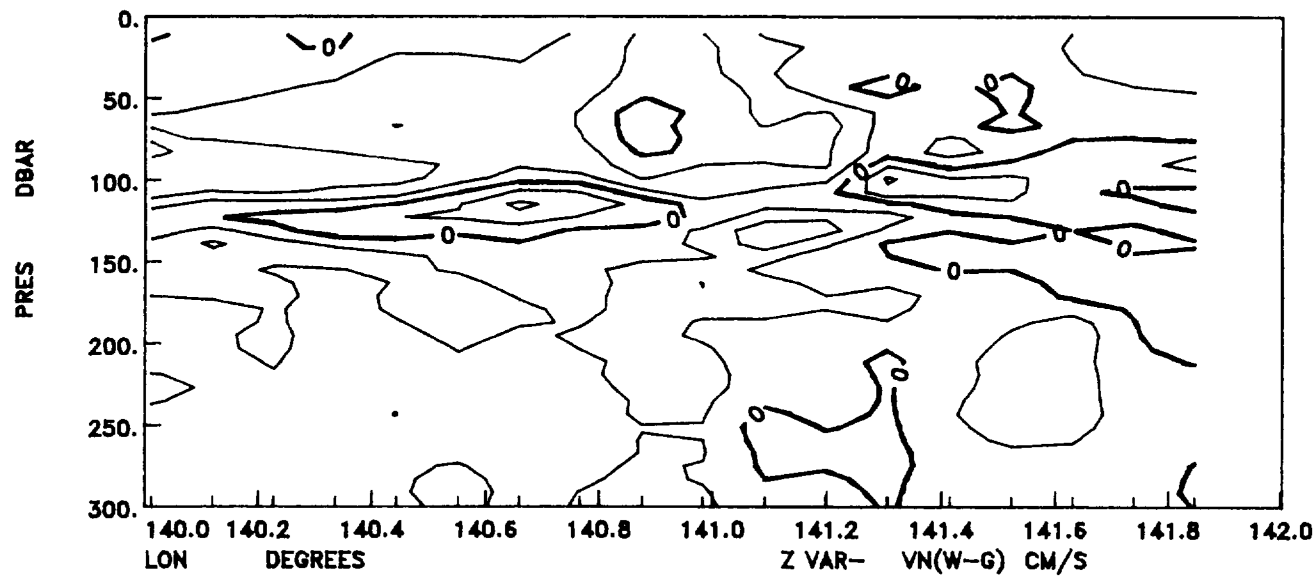


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
30
30
0
0
0
0
0
0
0
0
0
0
138.0 138.2 138.4 138.6 138.8 139.0 139.2 139.4 139.6 139.8 140.0
LON DEGREES
Z VAR− VN(W−G) CM/S

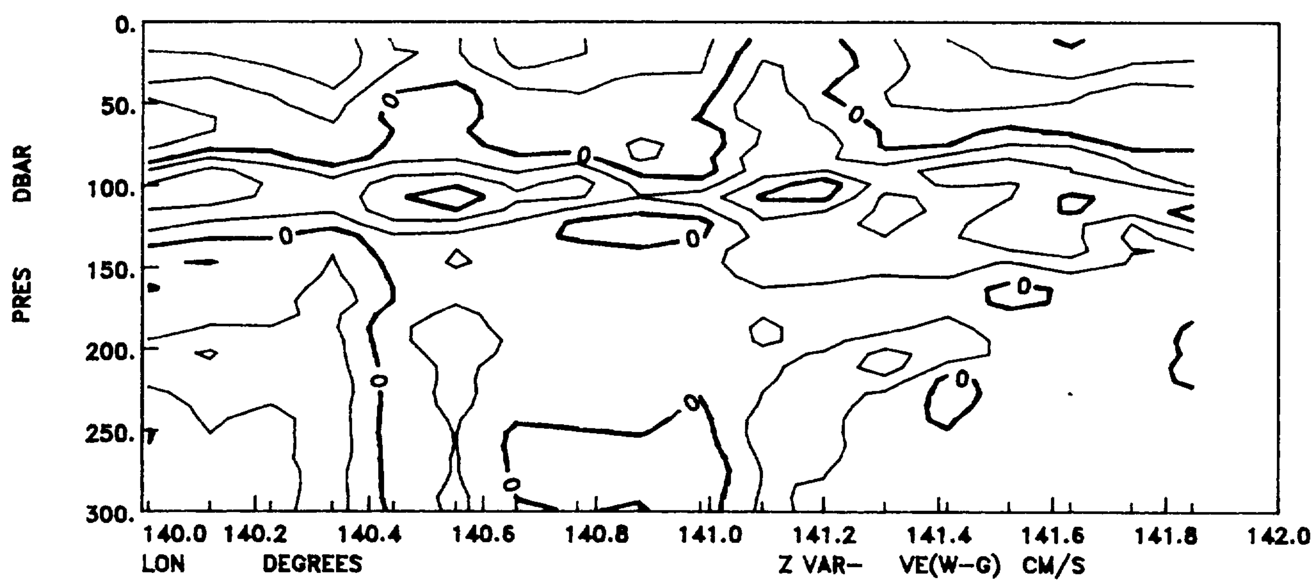


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
−30
−30
−30
0
0
0
0
0
0
0
138.0 138.2 138.4 138.6 138.8 139.0 139.2 139.4 139.6 139.8 140.0
LON DEGREES
Z VAR− VE(W−G) CM/S

SECTION5-7N

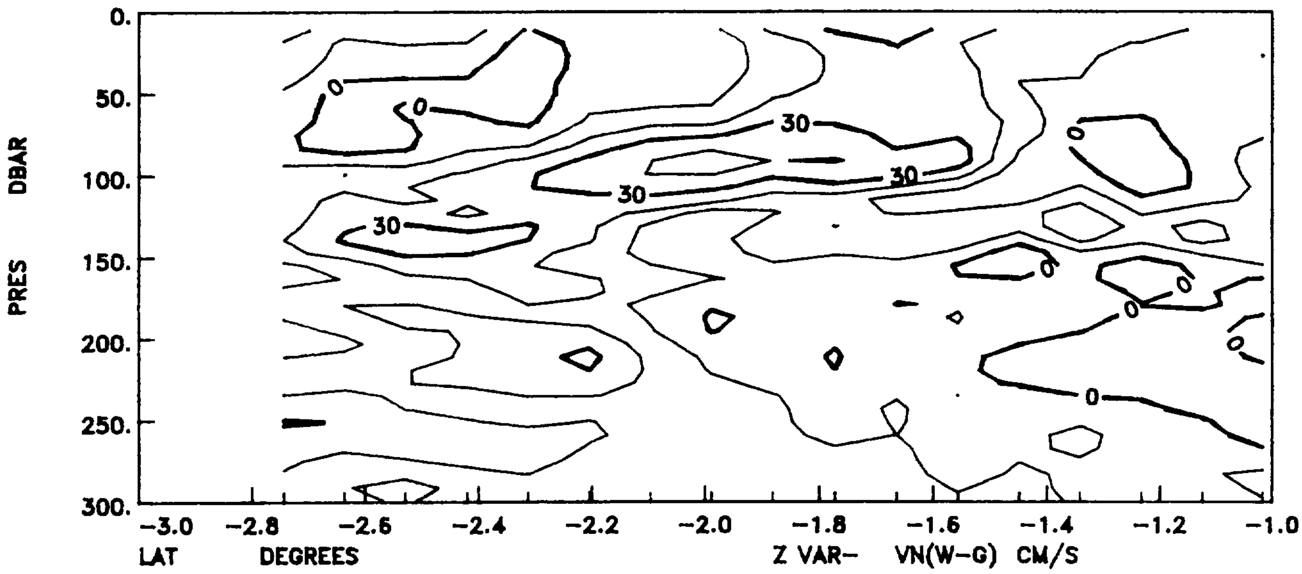


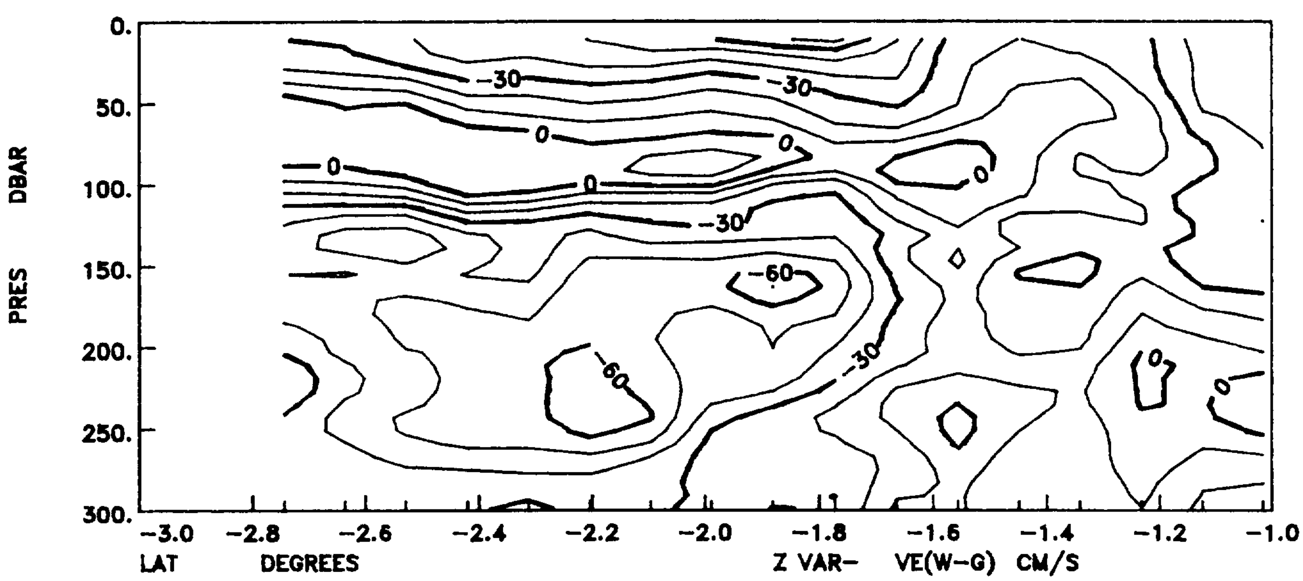
0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
140.0 140.2 140.4 140.6 140.8 141.0 141.2 141.4 141.6 141.8 142.0
LON DEGREES
Z VAR- VN(W-G) CM/S



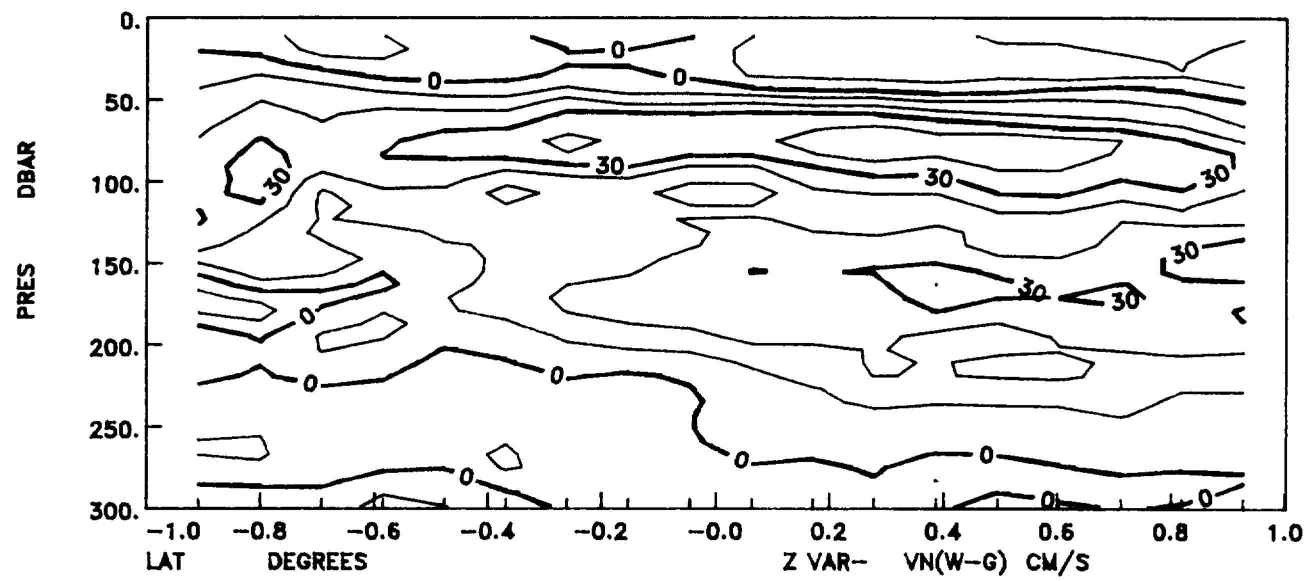
0.
50.
100.
150.
200.
250.
300.
PRES DBAR
0
140.0 140.2 140.4 140.6 140.8 141.0 141.2 141.4 141.6 141.8 142.0
LON DEGREES
Z VAR- VE(W-G) CM/S

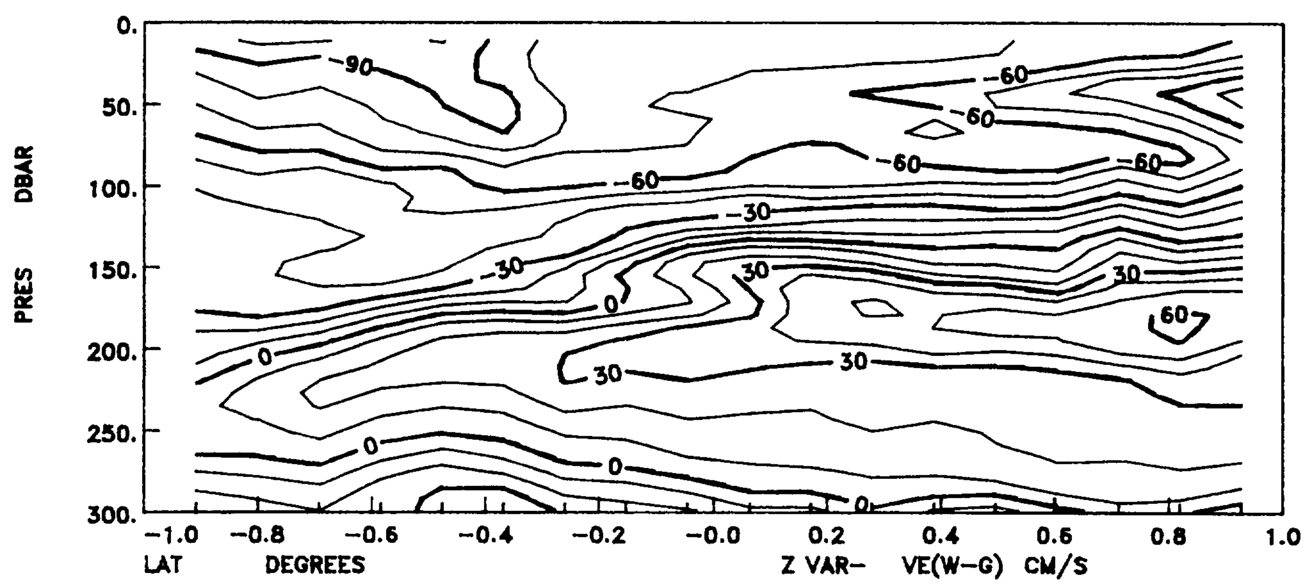
SECTION6-142E



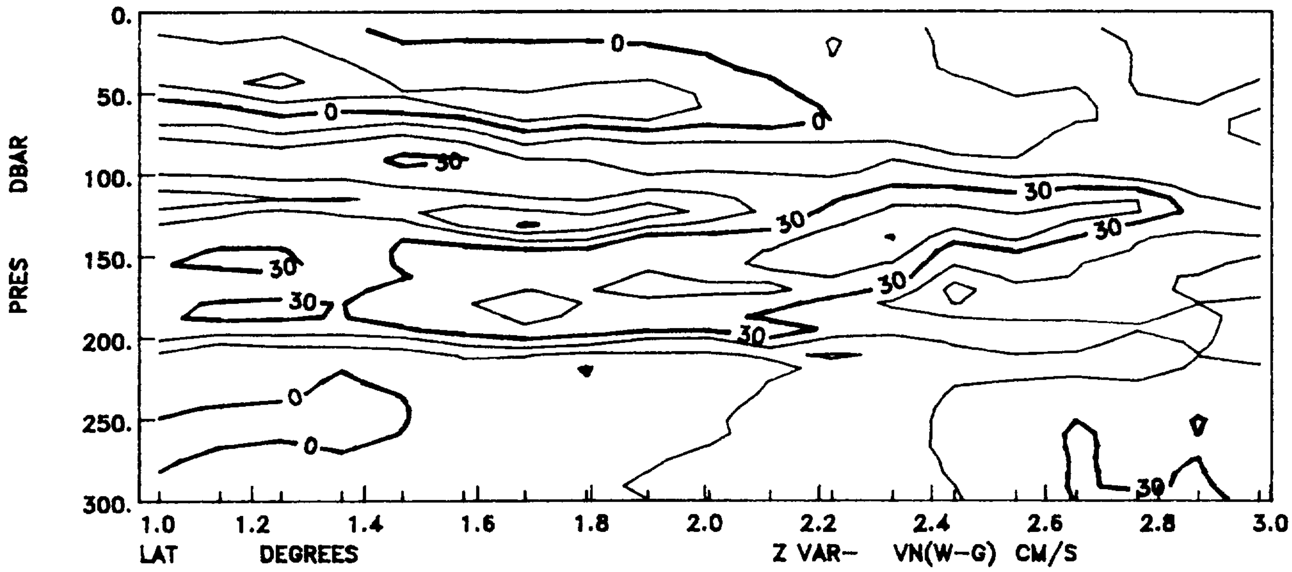


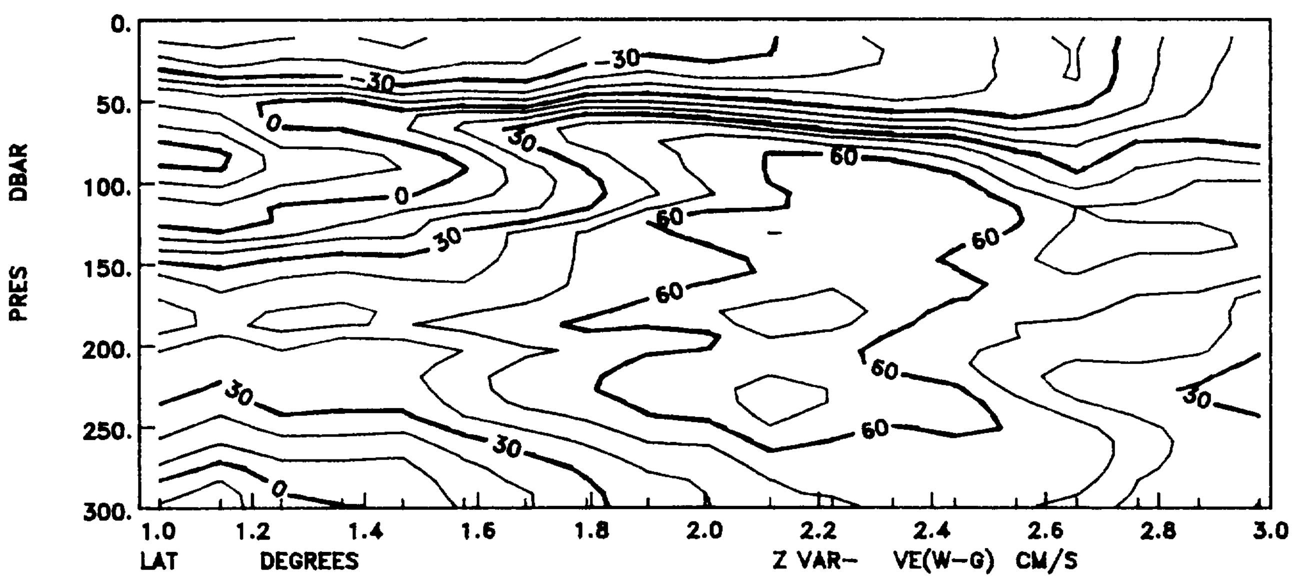
SECTION6-142E



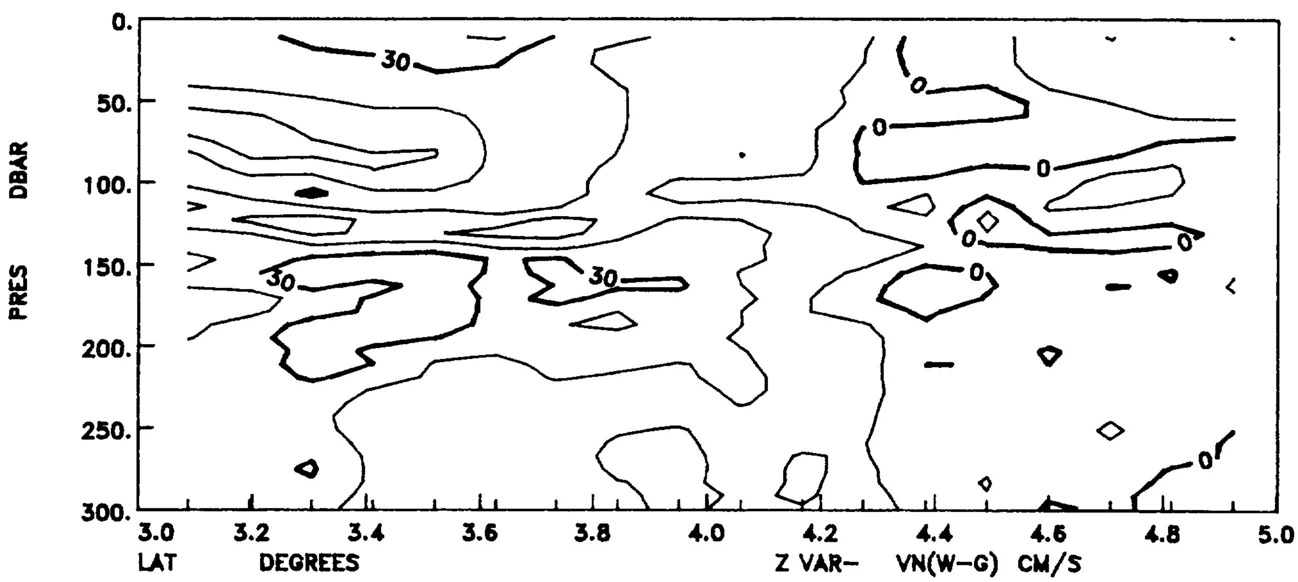


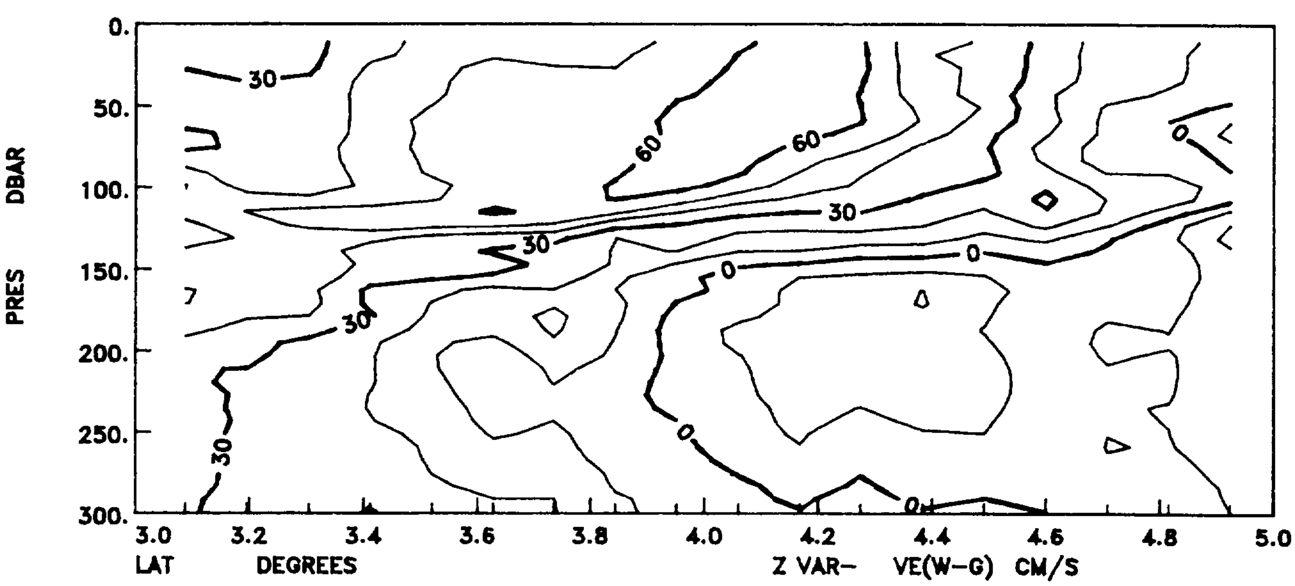
SECTION6-142E



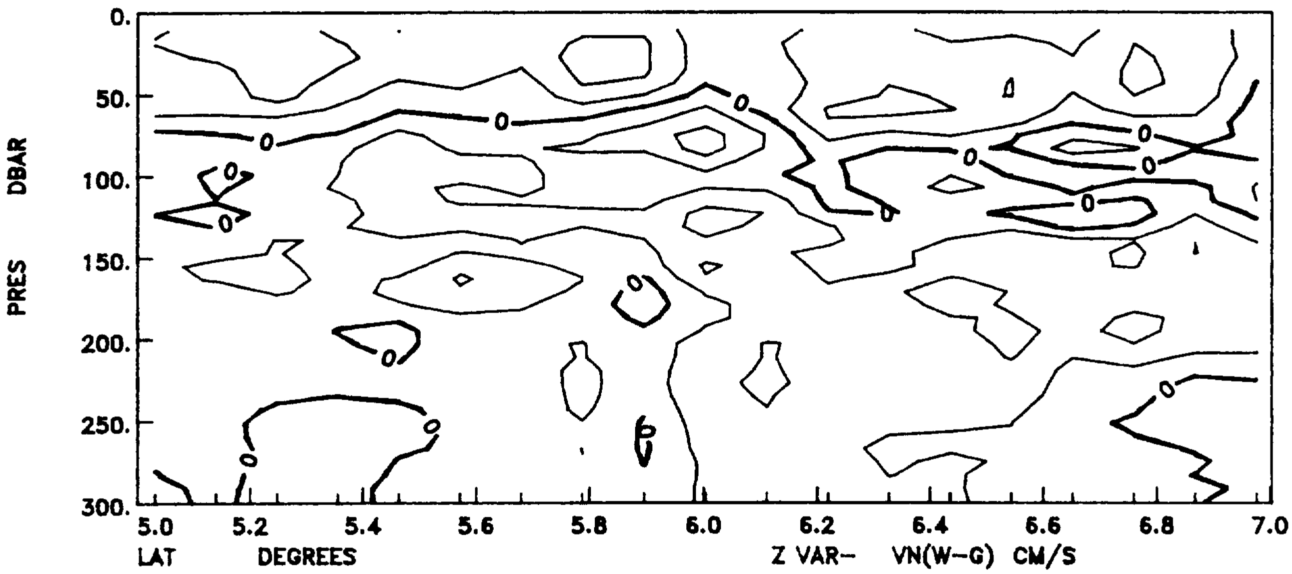


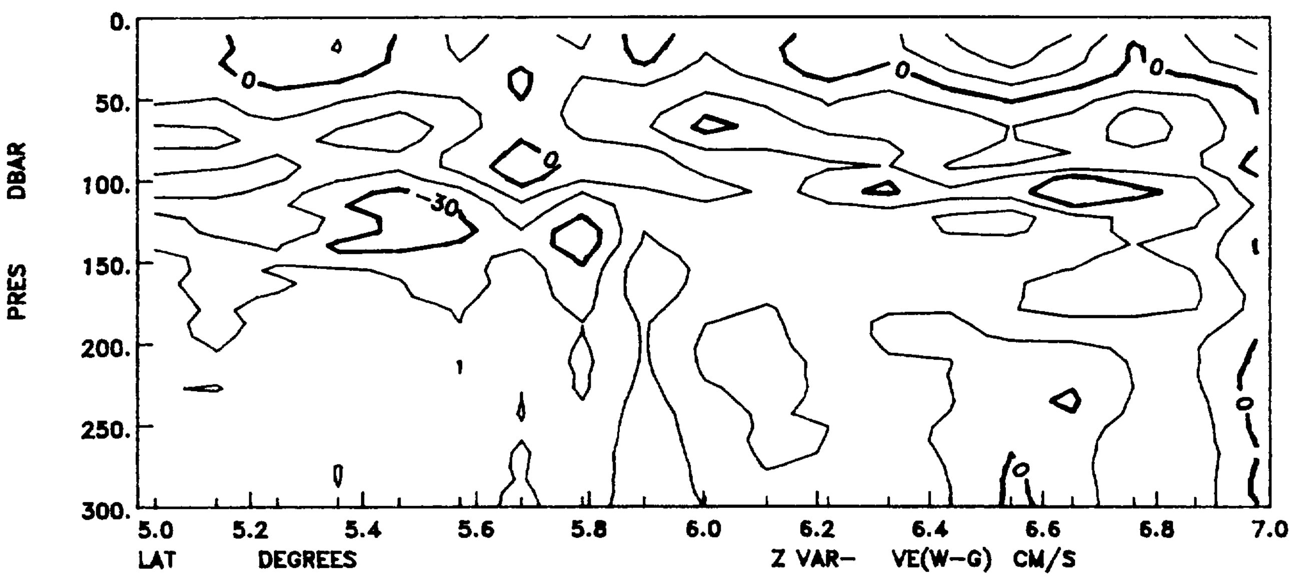
SECTION6-142E



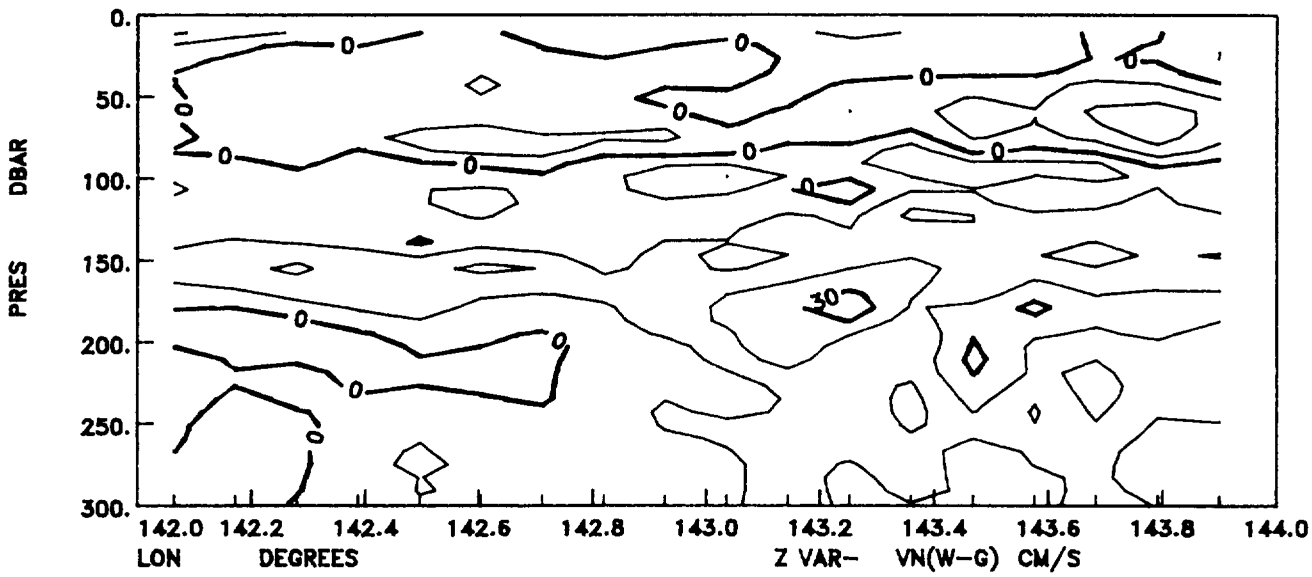


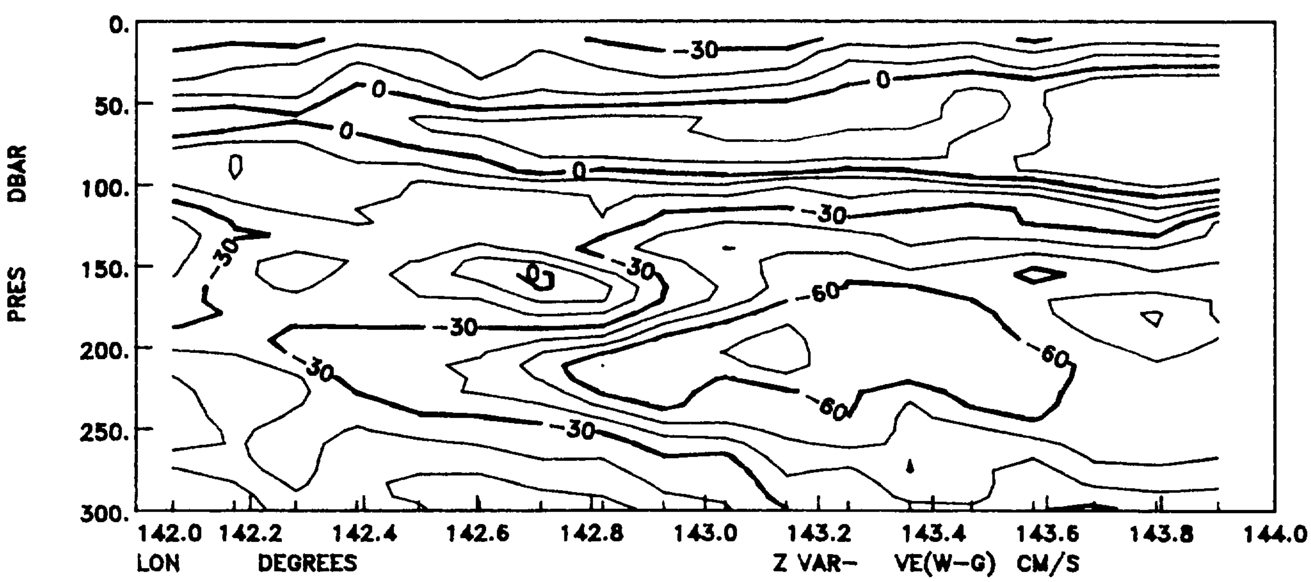
SECTION6-142E



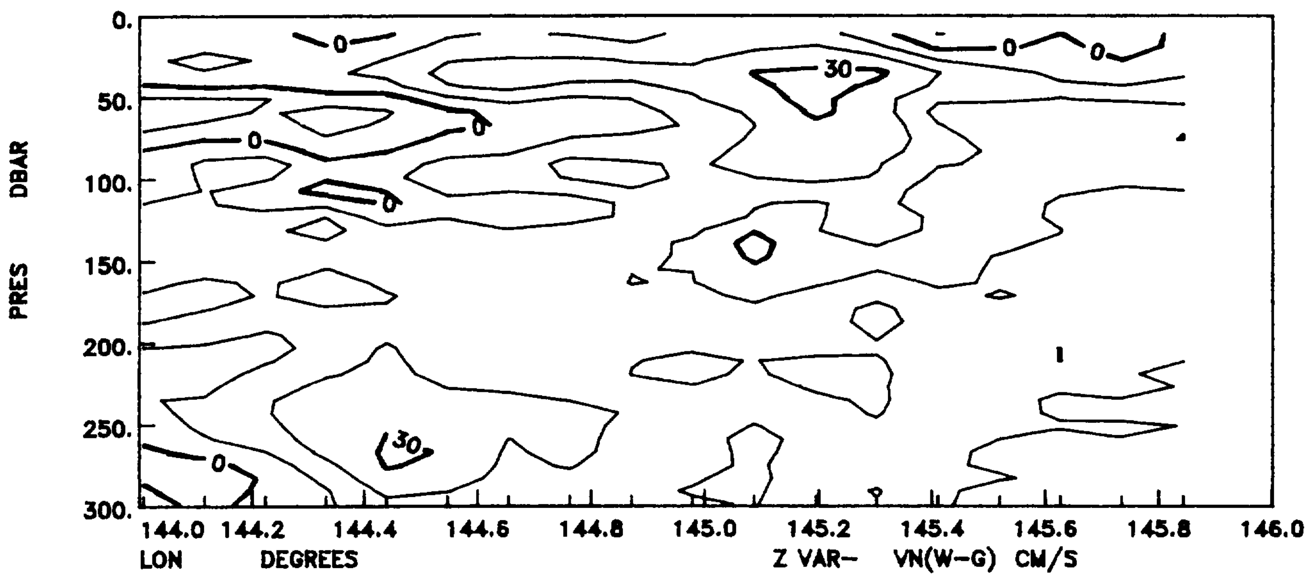


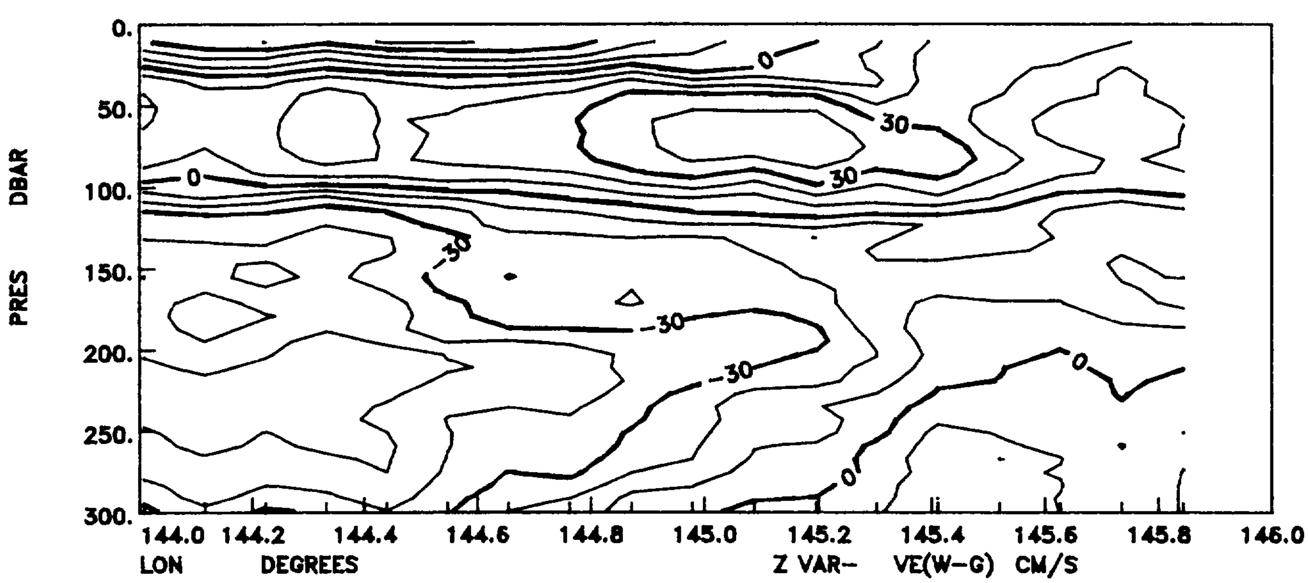
SECTION7-3S


0.
50.
100.
150.
200.
250.
300.
PRES DBAR
142.0 142.2 142.4 142.6 142.8 143.0 143.2 143.4 143.6 143.8 144.0
LON DEGREES
Z VAR- VN(W-G) CM/S

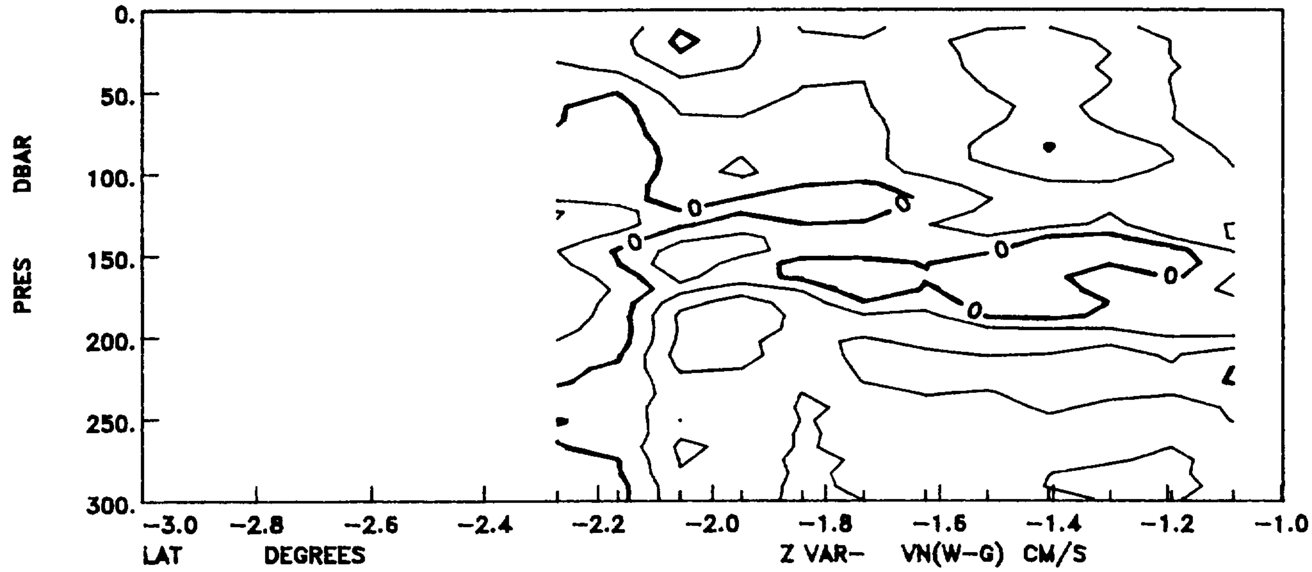

0.
50.
100.
150.
200.
250.
300.
PRES DBAR
142.0 142.2 142.4 142.6 142.8 143.0 143.2 143.4 143.6 143.8 144.0
LON DEGREES
Z VAR- VE(W-G) CM/S

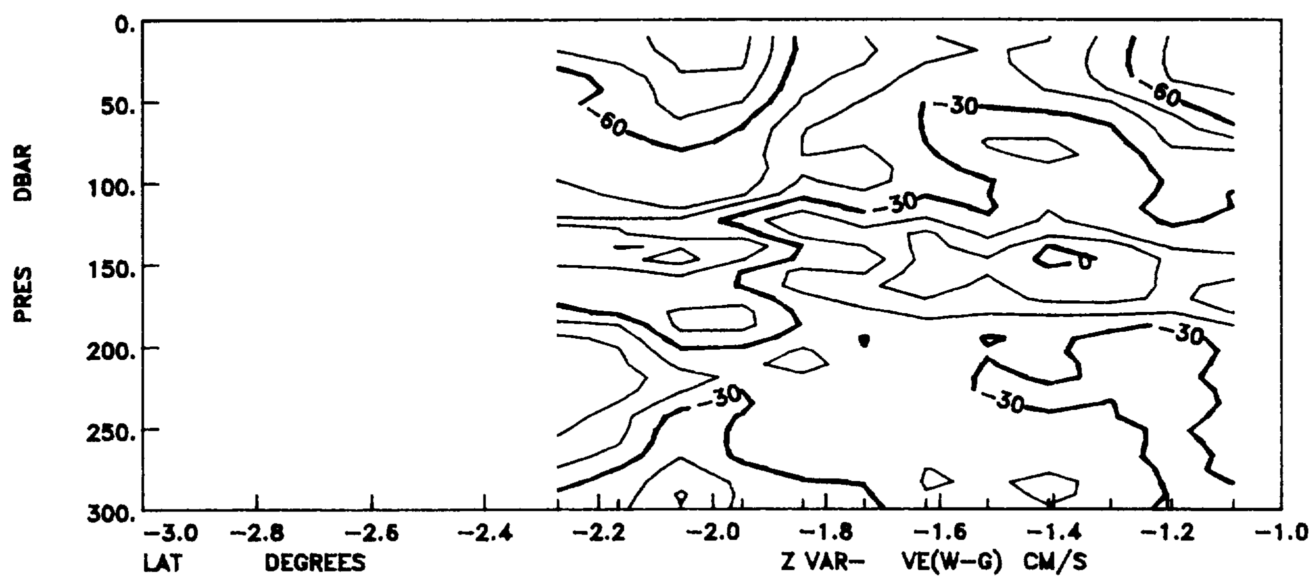
SECTION7-3S


PRES DBAR
0.
50.
100.
150.
200.
250.
300.
144.0 144.2 144.4 144.6 144.8 145.0 145.2 145.4 145.6 145.8 146.0
LON DEGREES
Z VAR- VN(W-G) CM/S

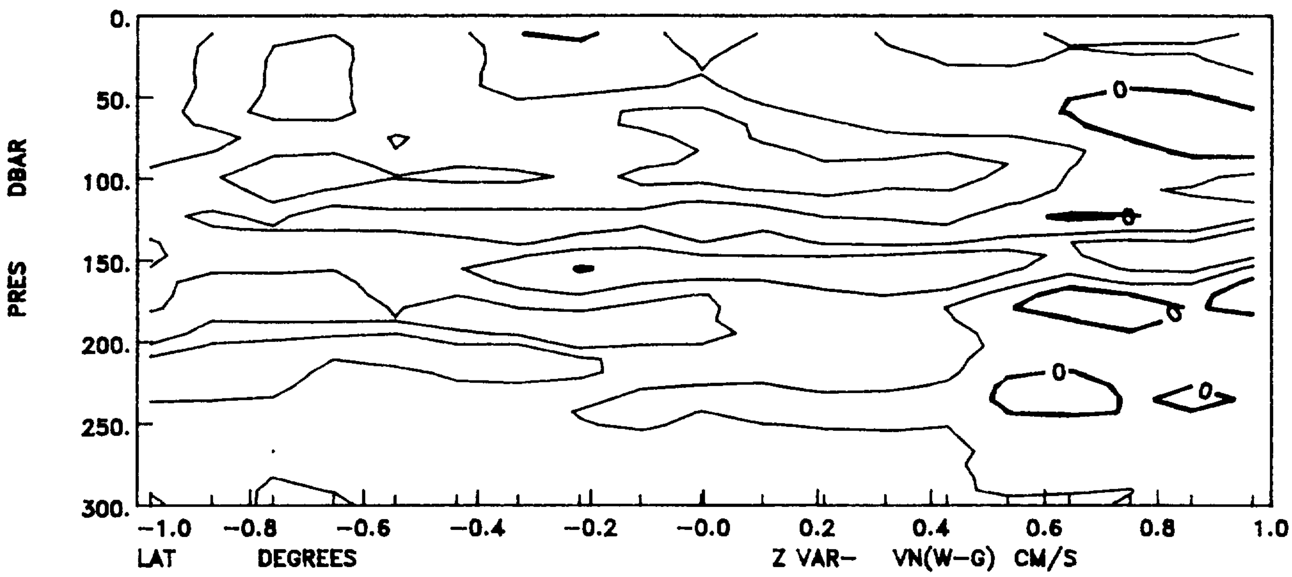

PRES DBAR
0.
50.
100.
150.
200.
250.
300.
144.0 144.2 144.4 144.6 144.8 145.0 145.2 145.4 145.6 145.8 146.0
LON DEGREES
Z VAR- VE(W-G) CM/S

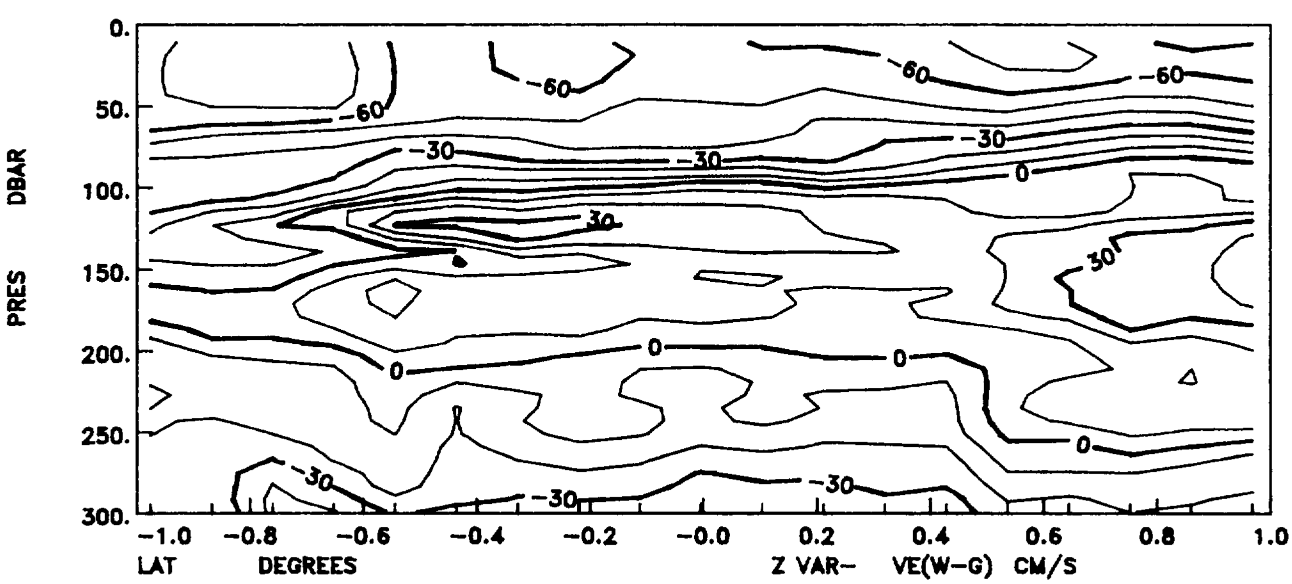
SECTION8-150E



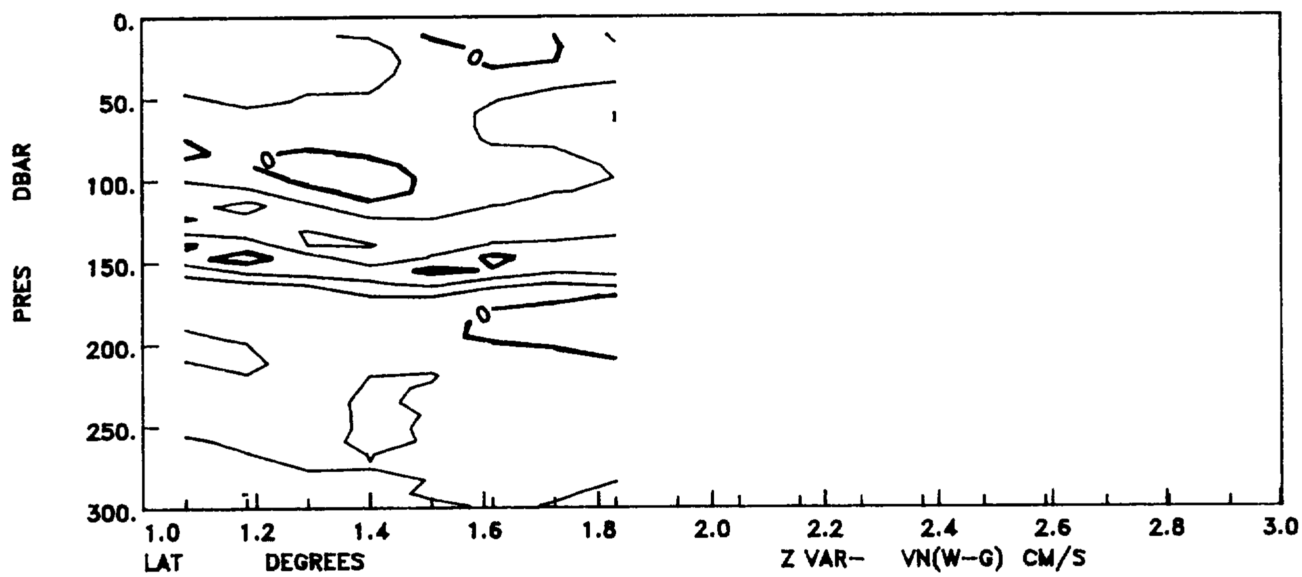


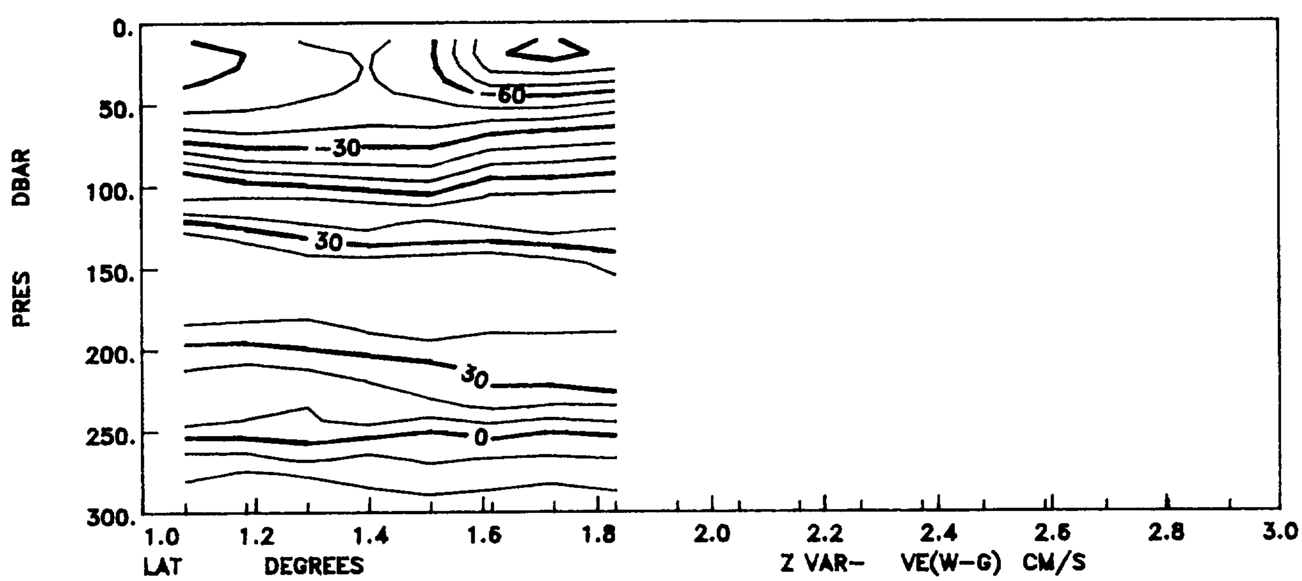
SECTION8-150E



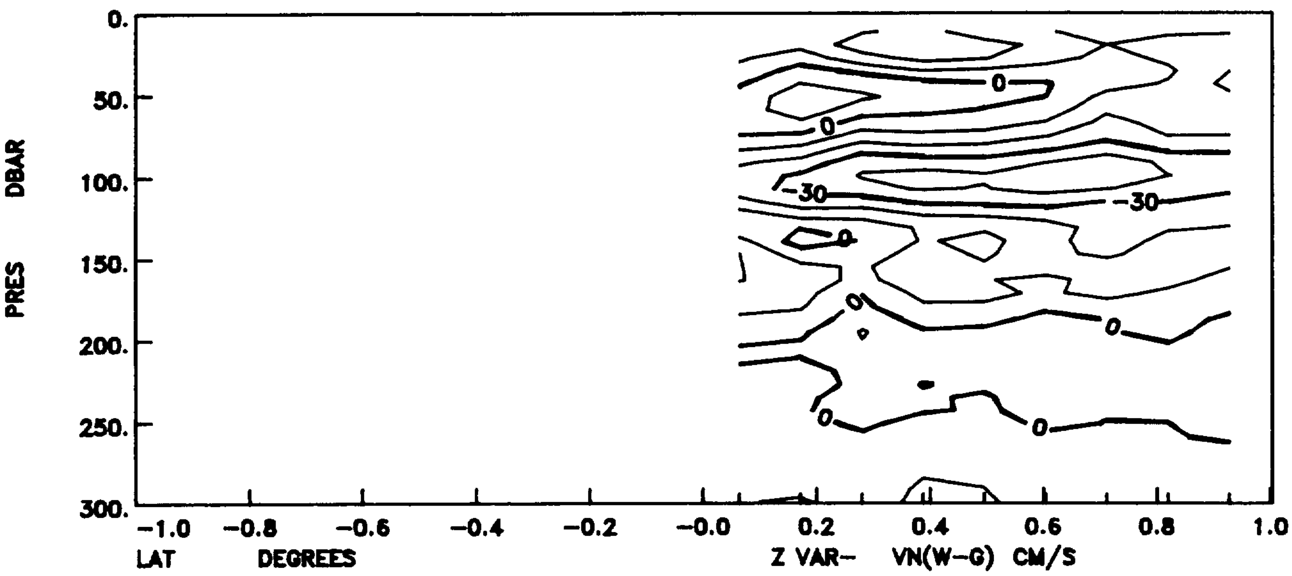


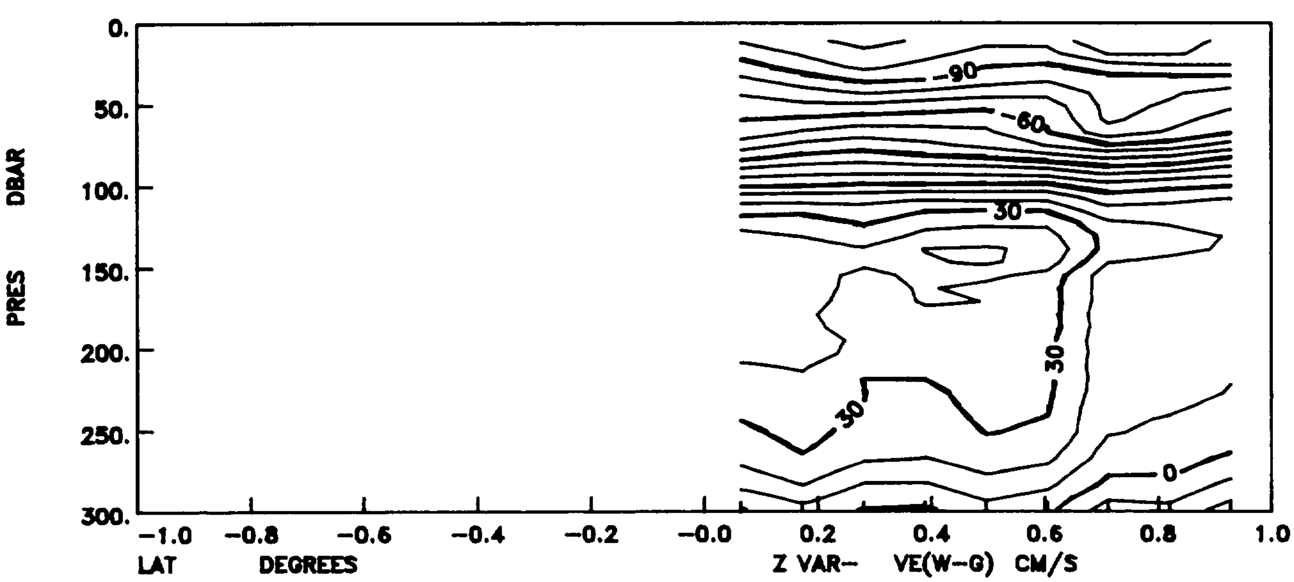
SECTION8–150E



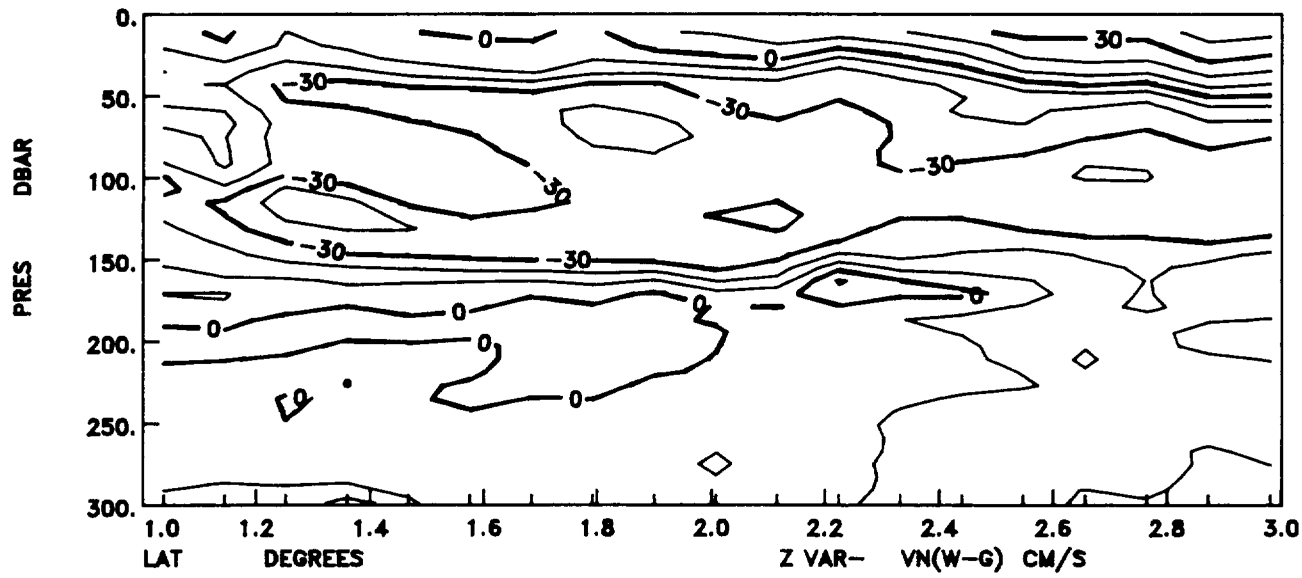


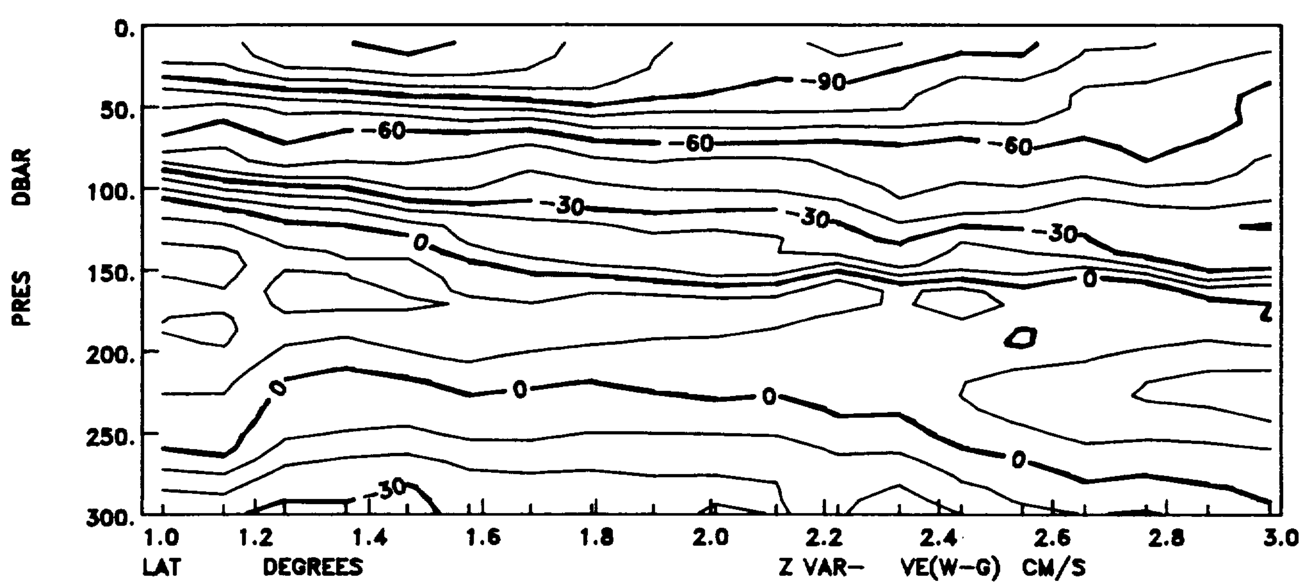
SECTION9−160E



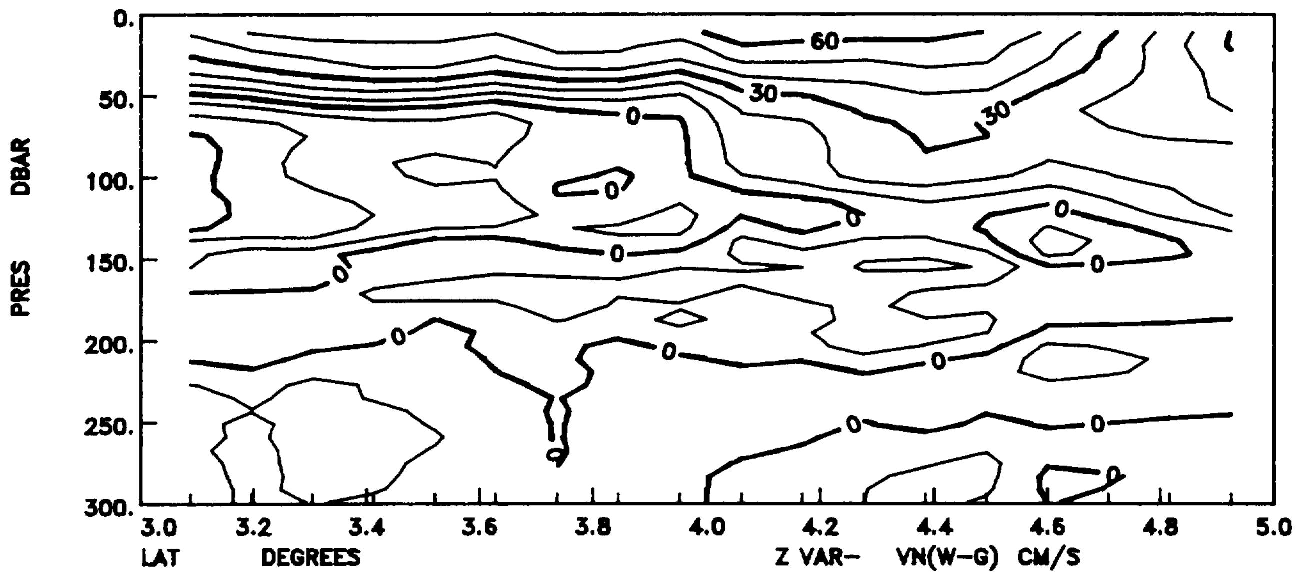


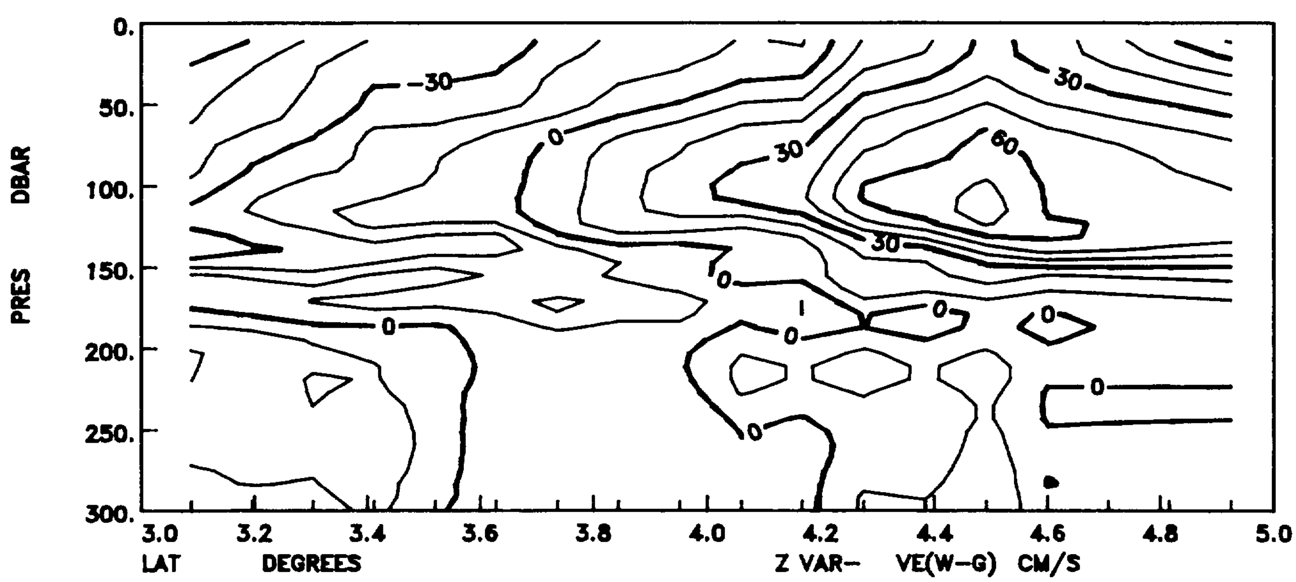
SECTION9-160E



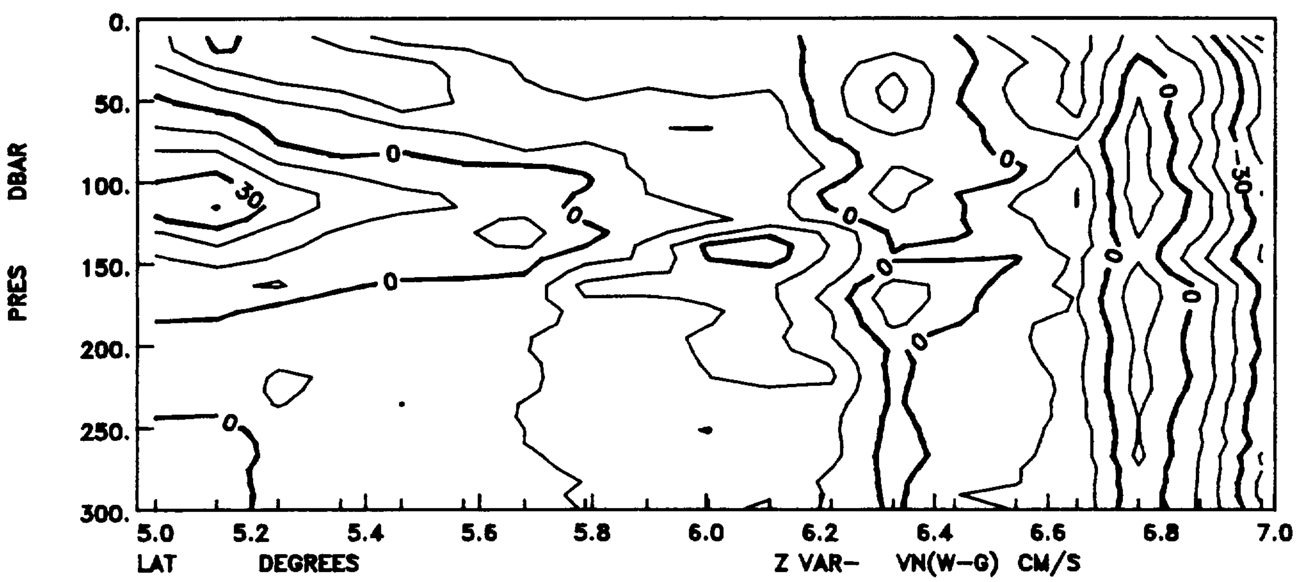


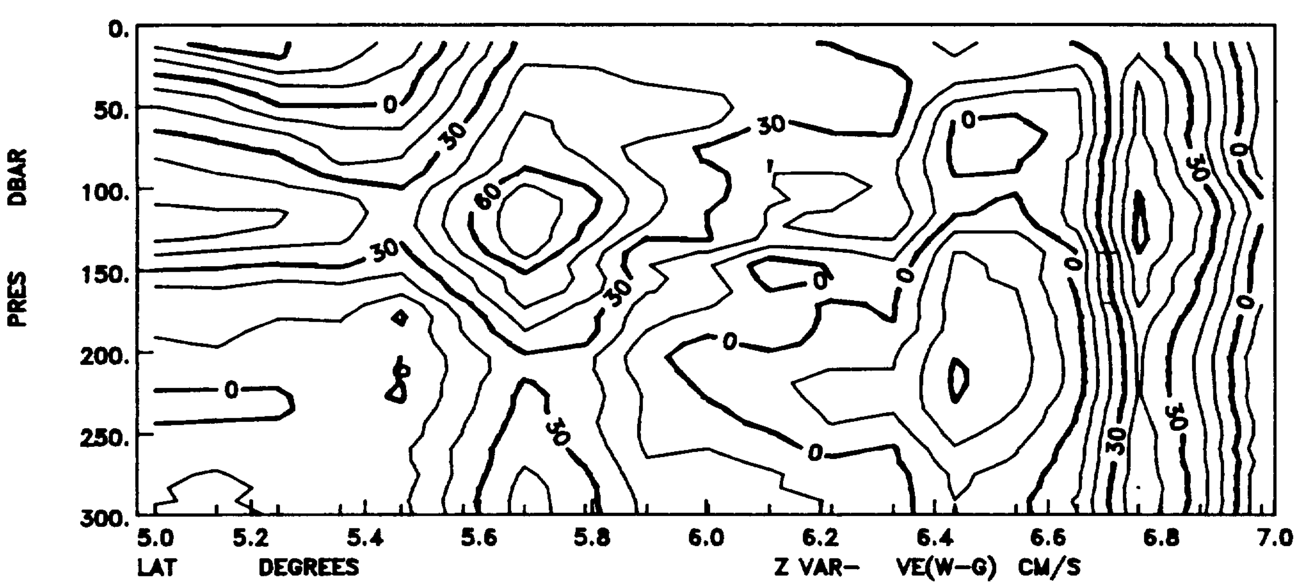
SECTION9-160E

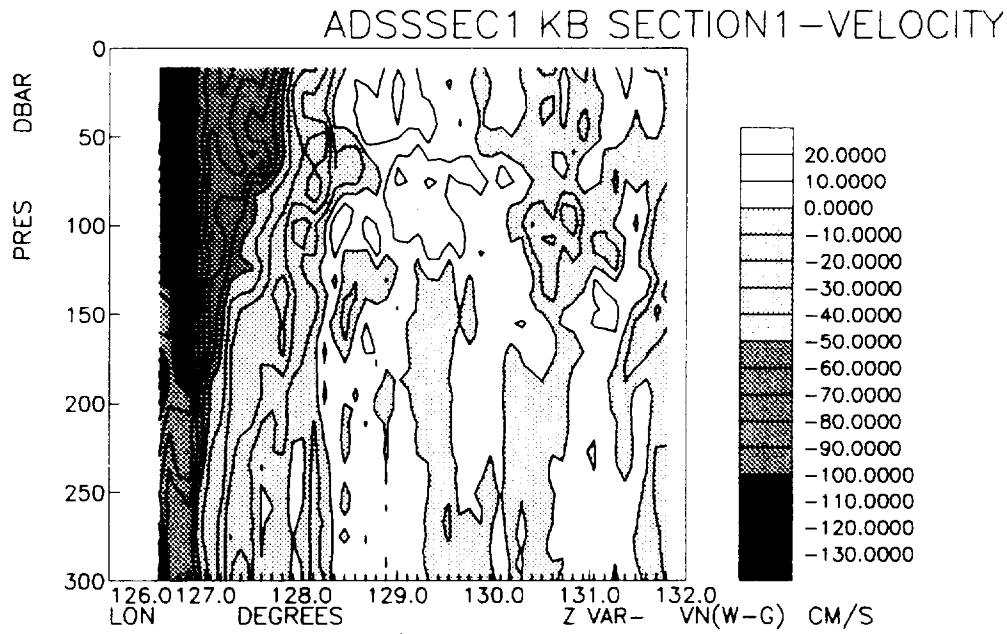


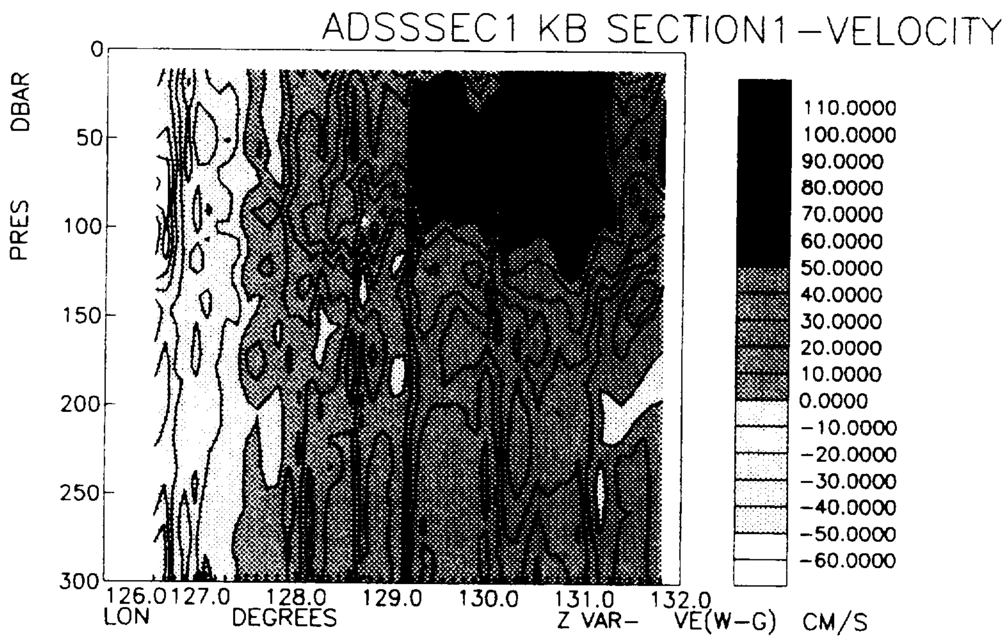


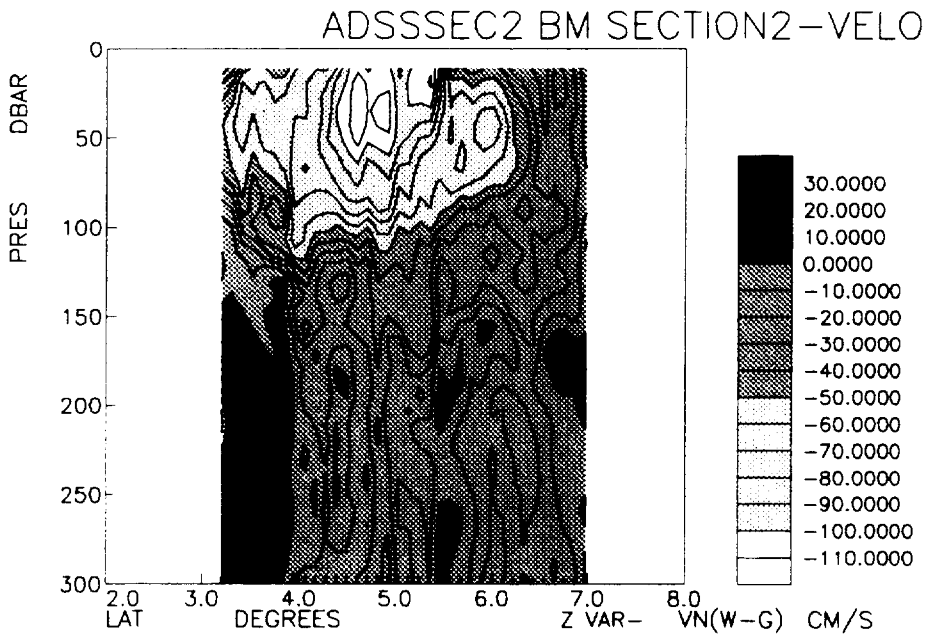
SECTION9-160E

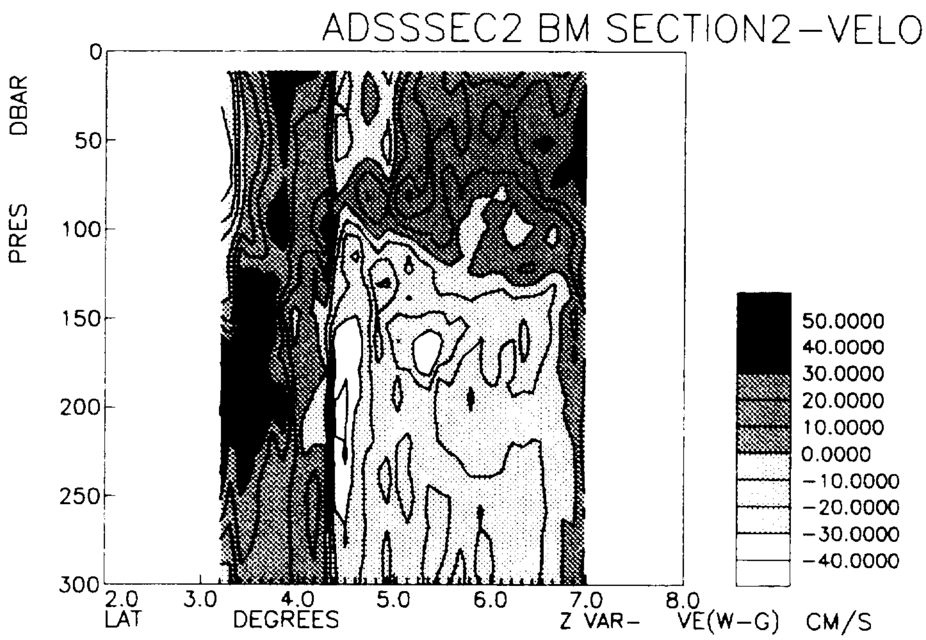


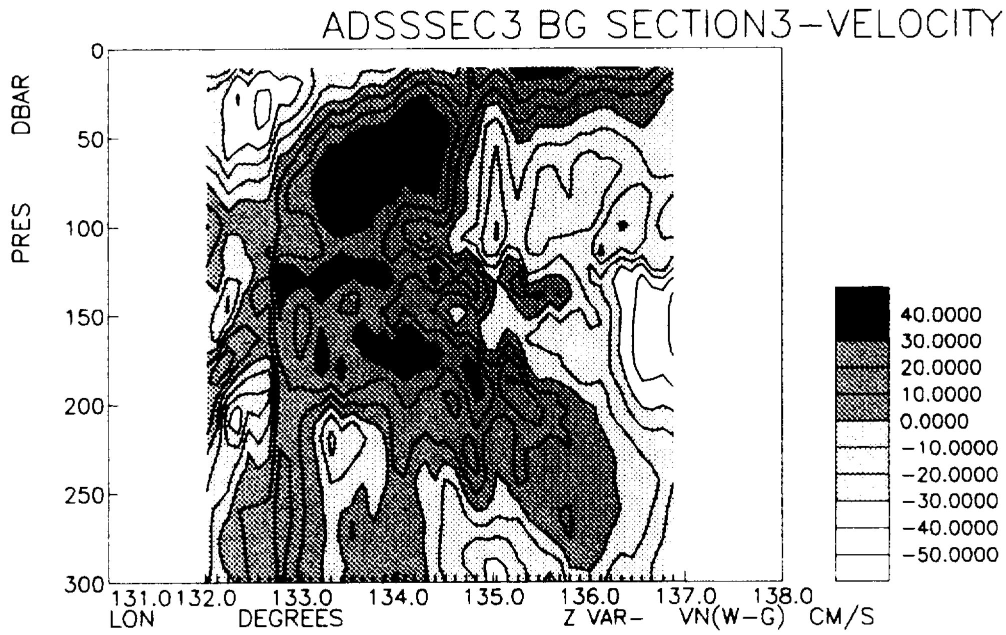


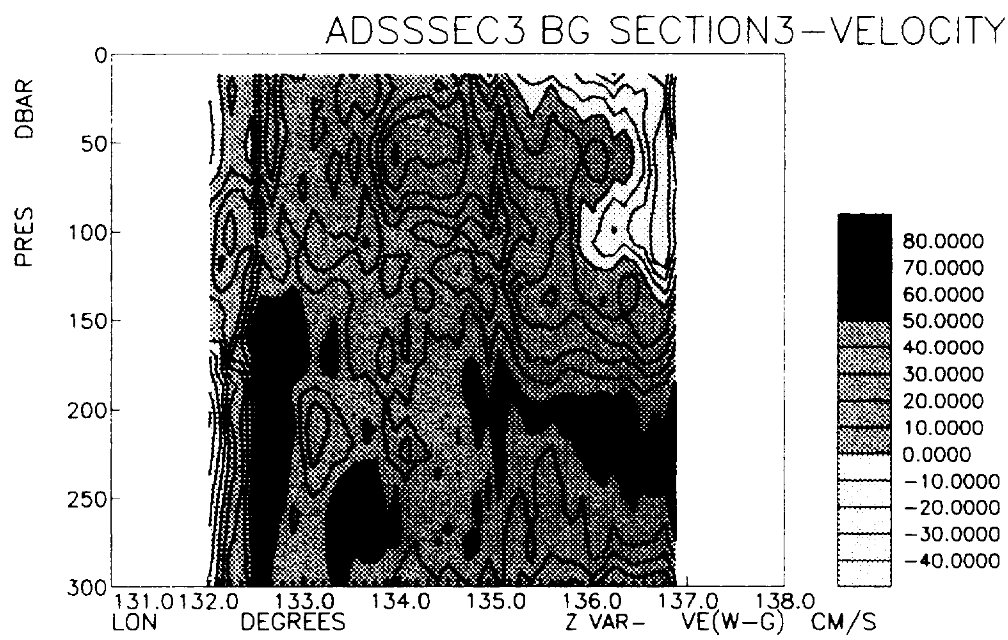

ADSSSEC1 KB SECTION1-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
126.0 127.0 128.0 129.0 130.0 131.0 132.0
LON DEGREES
Z VAR- VN(W-G) CM/S
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000
-70.0000
-80.0000
-90.0000
-100.0000
-110.0000
-120.0000
-130.0000

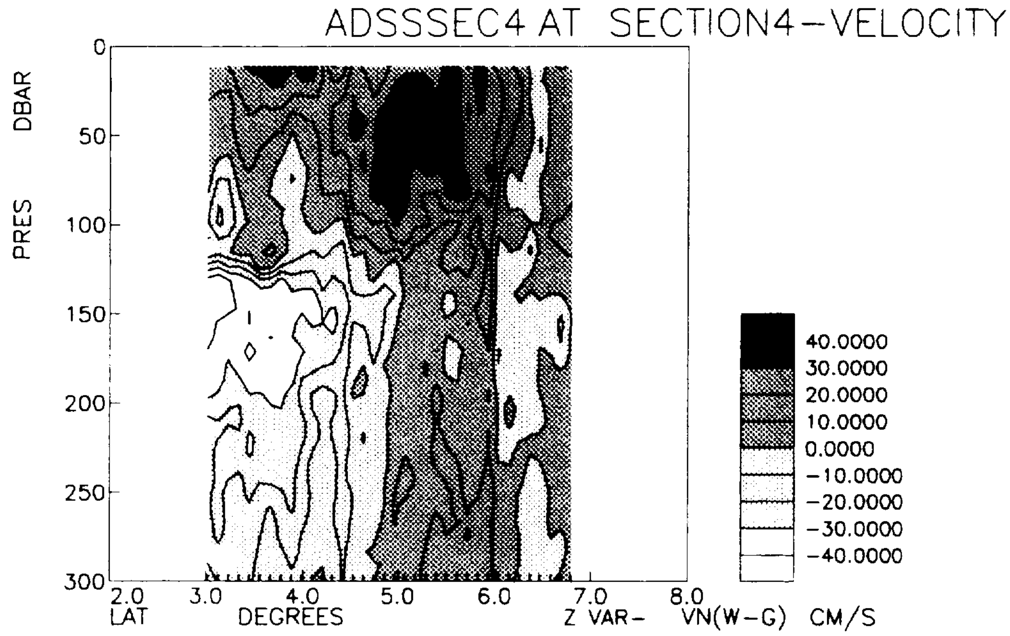

ADSSSEC1 KB SECTION1-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
126.0 127.0 128.0 129.0 130.0 131.0 132.0
LON DEGREES
Z VAR- VE(W-G) CM/S
110.0000
100.0000
90.0000
80.0000
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000

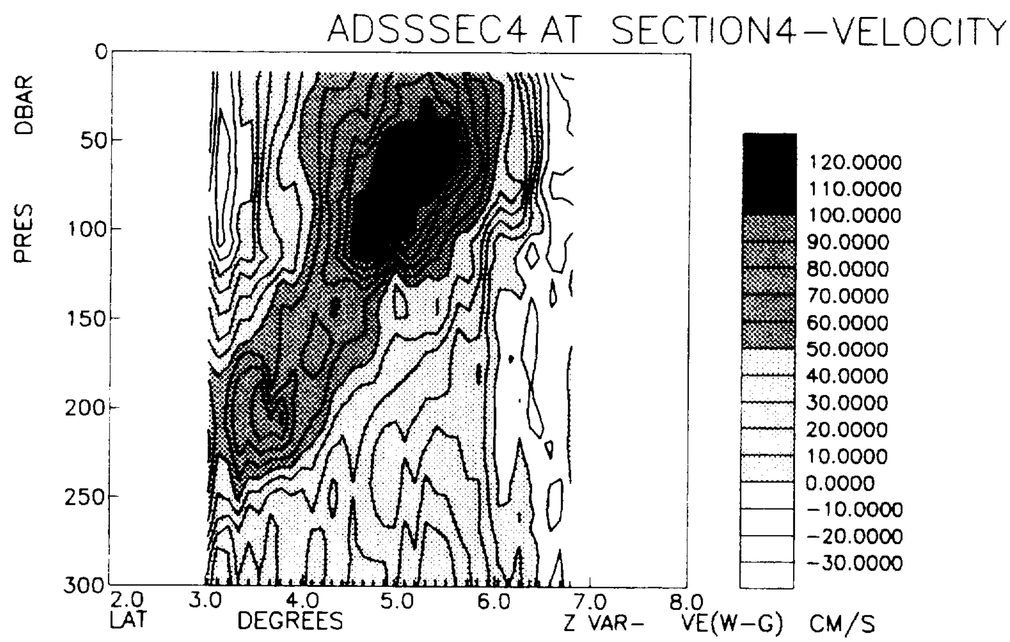

ADSSSEC2 BM SECTION2-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- VN(W-G) CM/S
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000
-70.0000
-80.0000
-90.0000
-100.0000
-110.0000

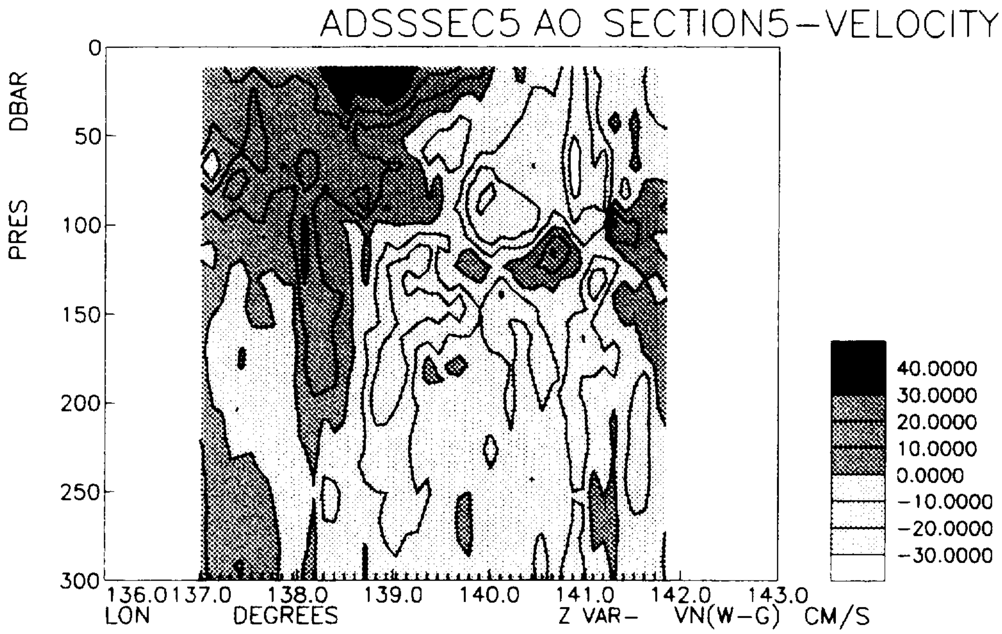

ADSSSEC2 BM SECTION2-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- VE(W-G) CM/S
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000

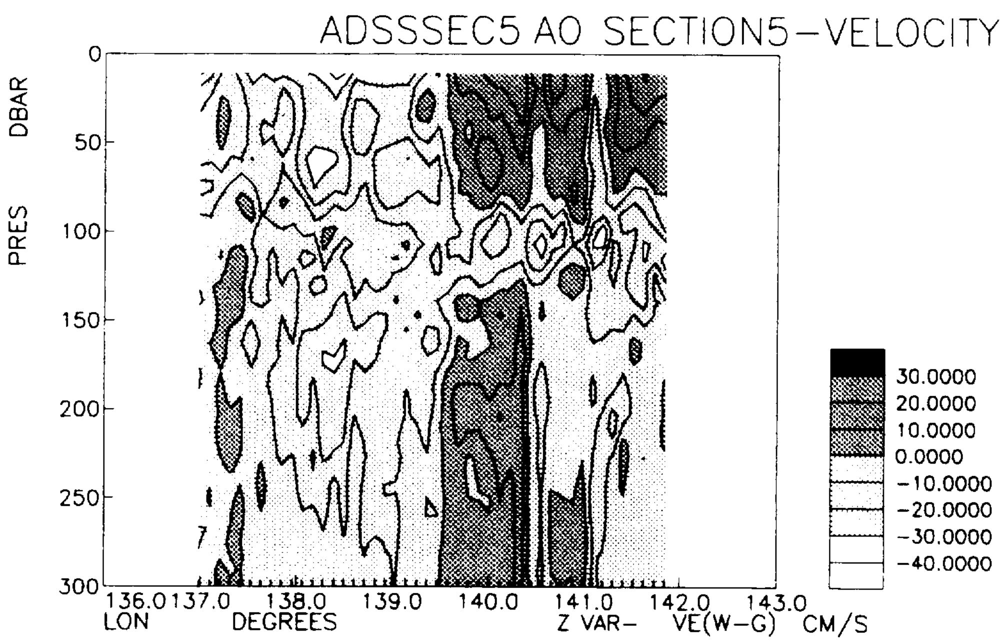

ADSSSEC3 BG SECTION3-VELOCITY
0
50
100
150
200
250
300
PRES DBAR
131.0 132.0 133.0 134.0 135.0 136.0 137.0 138.0
LON DEGREES
Z VAR- VN(W-G) CM/S
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000

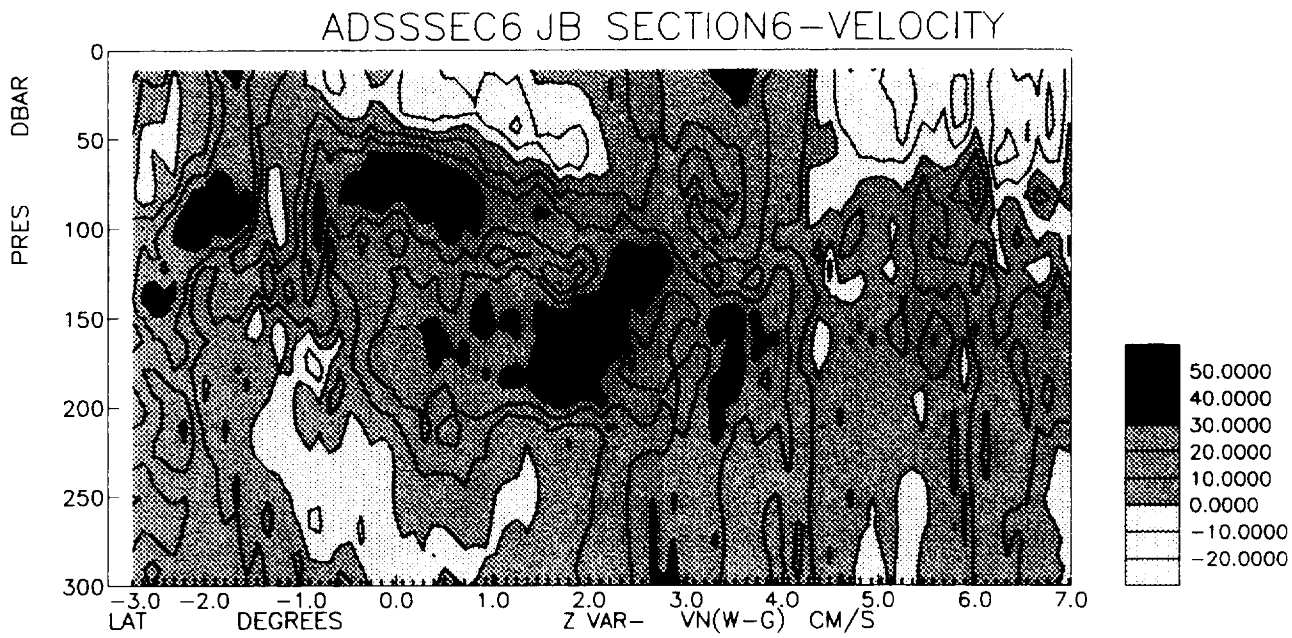

ADSSSEC3 BG SECTION3-VELOCITY
0
50
100
150
200
250
300
PRES DBAR
131.0 132.0 133.0 134.0 135.0 136.0 137.0 138.0
LON DEGREES
Z VAR- VE(W-G) CM/S
80.0000
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000

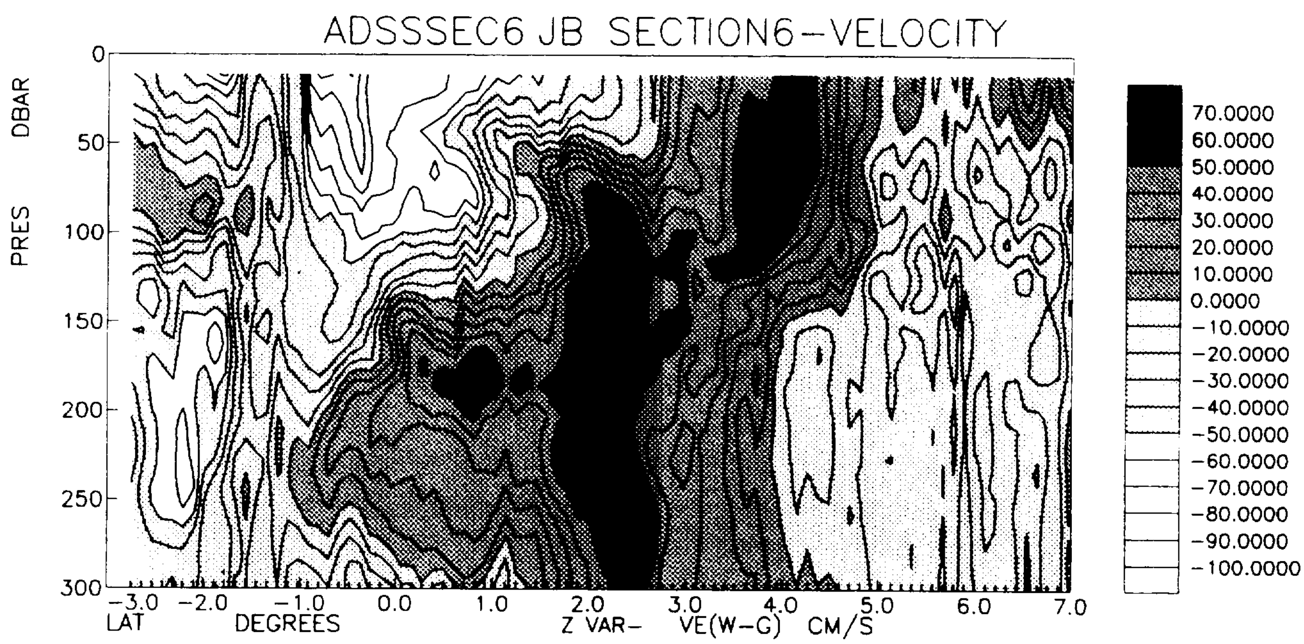

ADSSSEC4 AT SECTION4—VELOCITY
PRES DBAR
0
50
100
150
200
250
300
2.0
3.0
4.0
5.0
6.0
7.0
8.0
LAT
DEGREES
Z VAR— VN(W—G) CM/S
40.0000
30.0000
20.0000
10.0000
0.0000
—10.0000
—20.0000
—30.0000
—40.0000

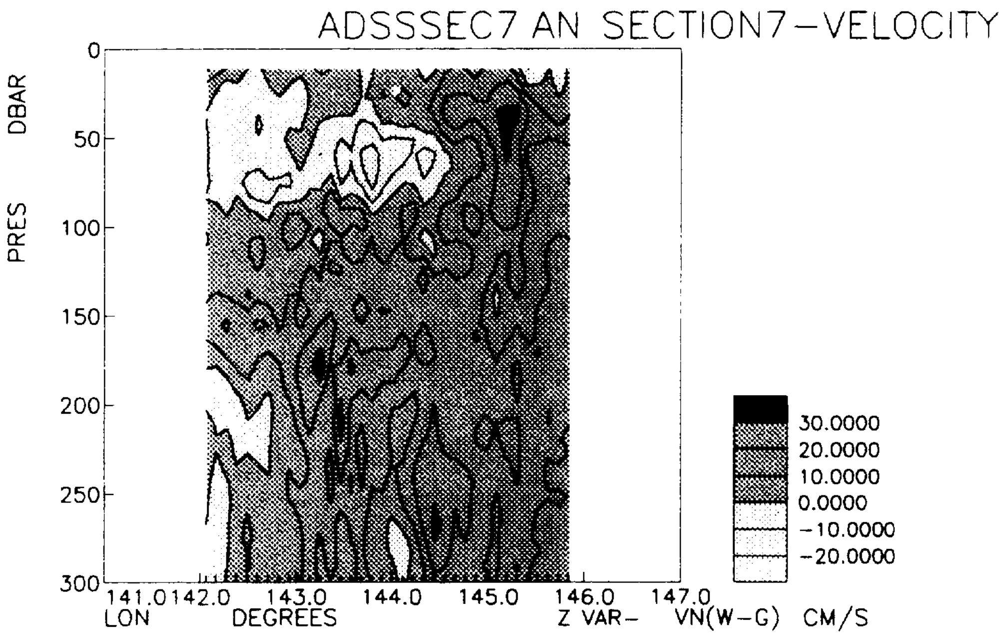

ADSSSEC4 AT SECTION4—VELOCITY
PRES DBAR
0
50
100
150
200
250
300
2.0
3.0
4.0
5.0
6.0
7.0
8.0
LAT
DEGREES
Z VAR— VE(W—G) CM/S
120.0000
110.0000
100.0000
90.0000
80.0000
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
—10.0000
—20.0000
—30.0000

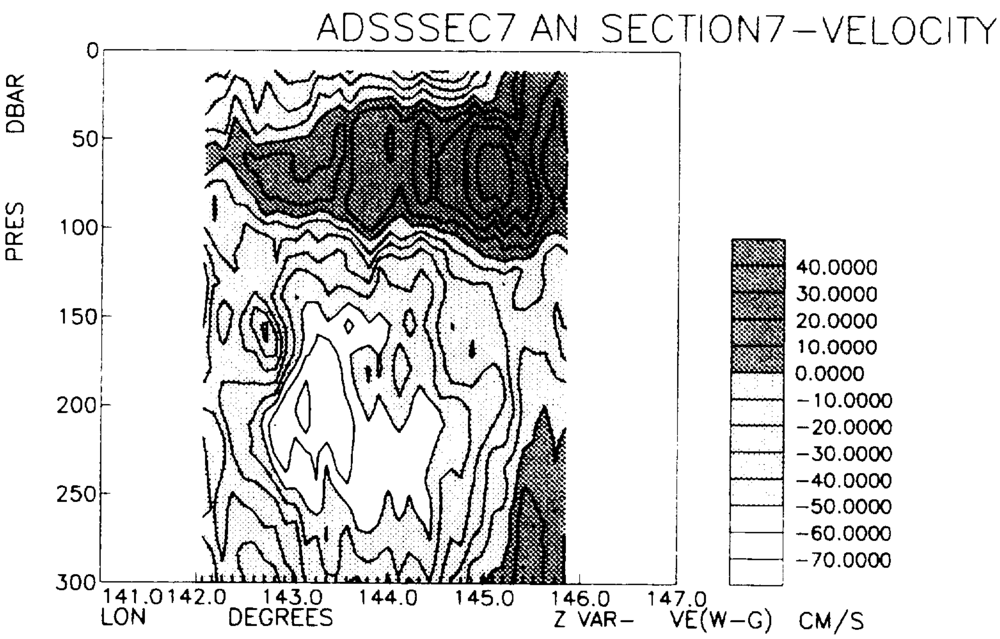

ADSSSEC5 AO SECTION5-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
136.0 137.0 138.0 139.0 140.0 141.0 142.0 143.0
LON DEGREES
Z VAR- VN(W-G) CM/S
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000

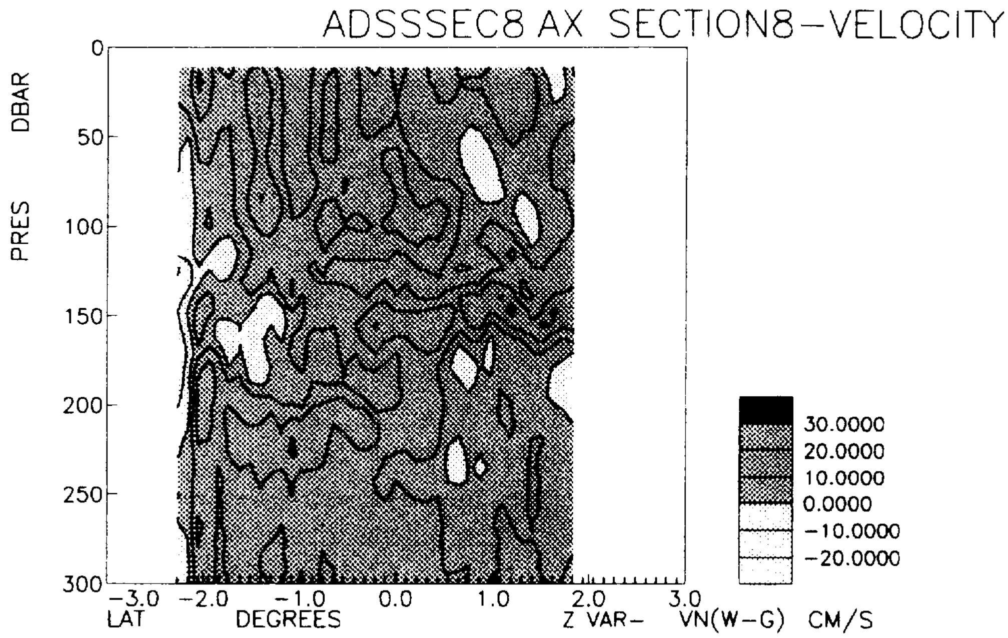

ADSSSEC5 AO SECTION5-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
136.0 137.0 138.0 139.0 140.0 141.0 142.0 143.0
LON DEGREES
Z VAR- VE(W-G) CM/S
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000

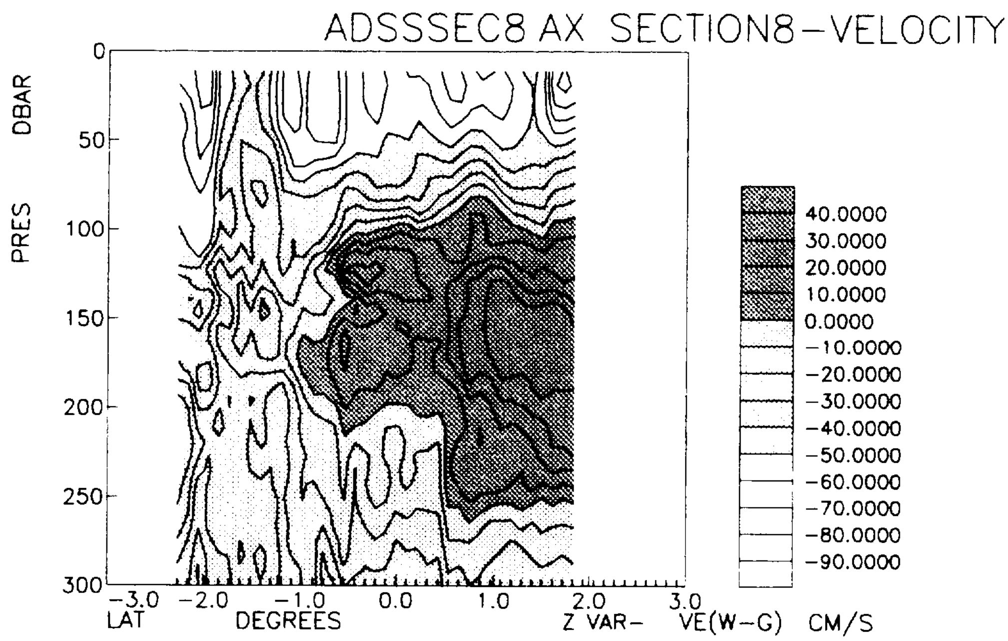

ADSSSEC6 JB SECTION6-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0
LAT DEGREES
Z VAR- VN(W-G) CM/S
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000


ADSSSEC6 JB SECTION6-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0
LAT DEGREES
Z VAR- VE(W-G) CM/S
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000
-70.0000
-80.0000
-90.0000
-100.0000


ADSSSEC7 AN SECTION7–VELOCITY
PRES DBAR
0
50
100
150
200
250
300
141.0142.0 143.0 144.0 145.0 146.0 147.0
LON DEGREES
Z VAR– VN(W–G) CM/S
30.0000
20.0000
10.0000
0.0000
–10.0000
–20.0000


ADSSSEC7 AN SECTION7–VELOCITY
PRES DBAR
0
50
100
150
200
250
300
141.0142.0 143.0 144.0 145.0 146.0 147.0
LON DEGREES
Z VAR– VE(W–G) CM/S
40.0000
30.0000
20.0000
10.0000
0.0000
–10.0000
–20.0000
–30.0000
–40.0000
–50.0000
–60.0000
–70.0000


ADSSSEC8 AX SECTION8-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0
LAT DEGREES
Z VAR- VN(W-G) CM/S
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000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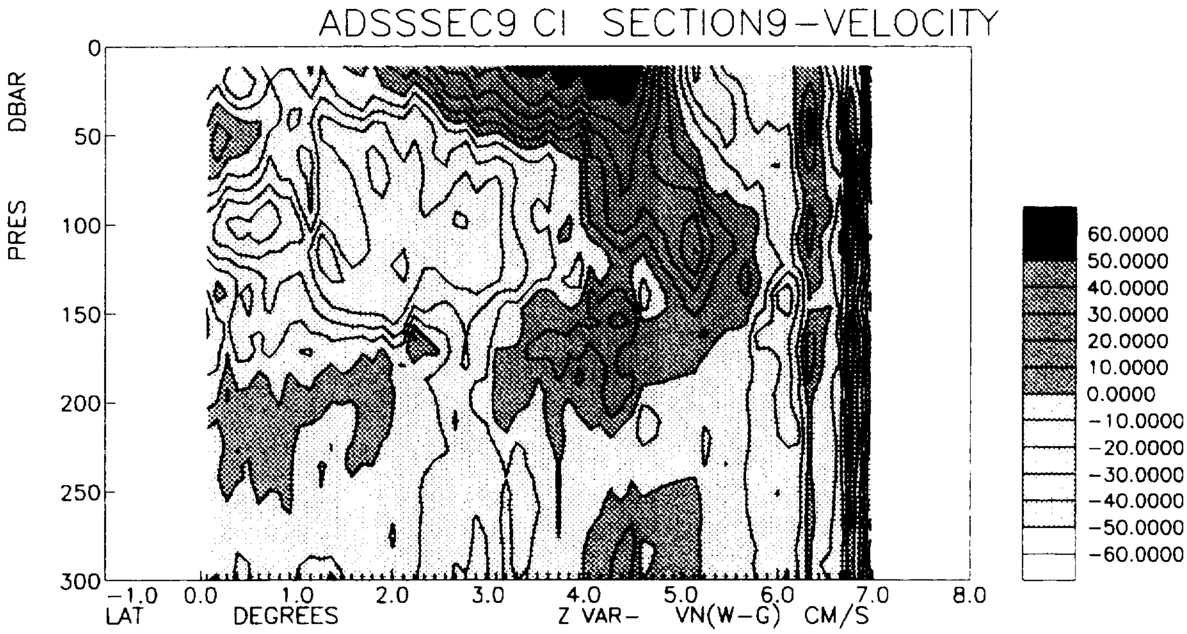
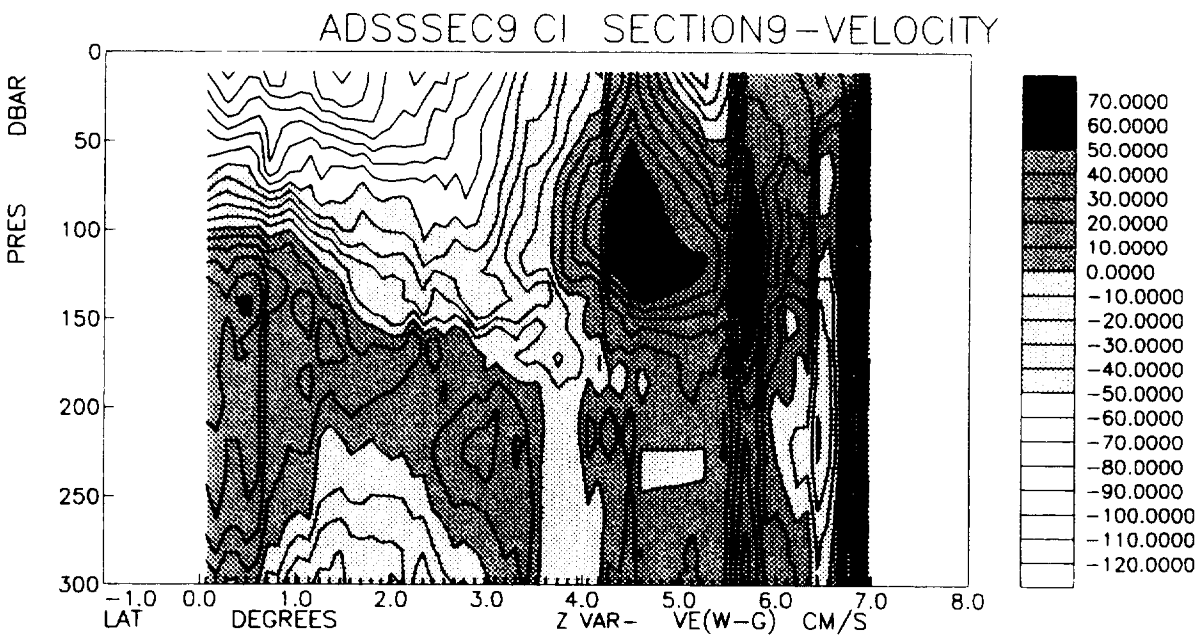
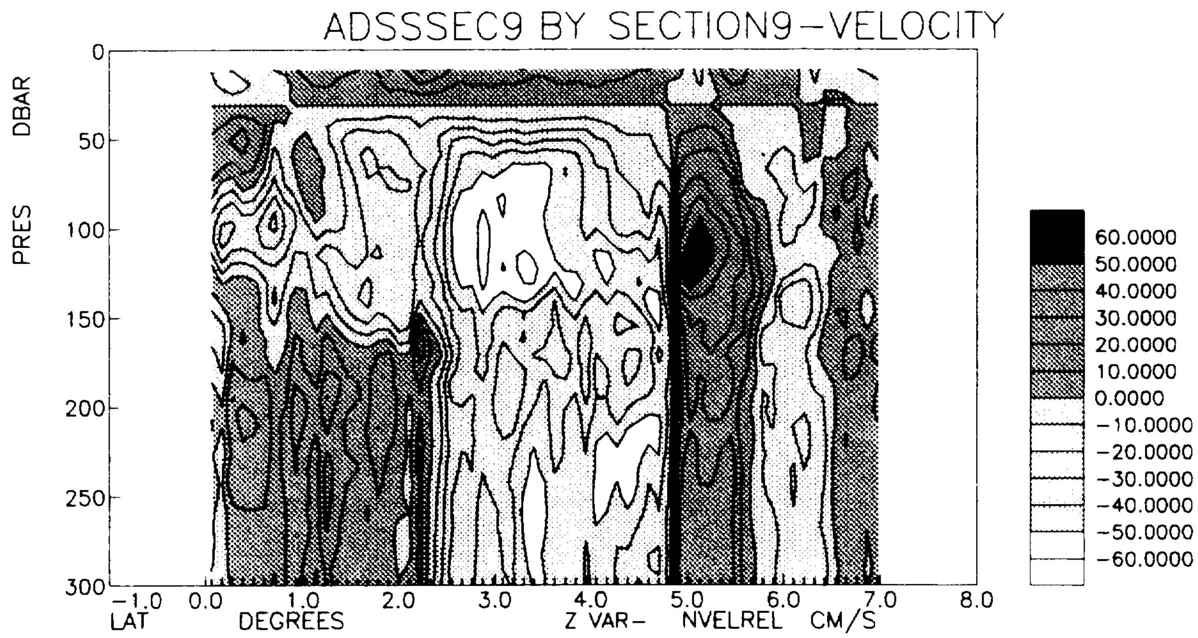
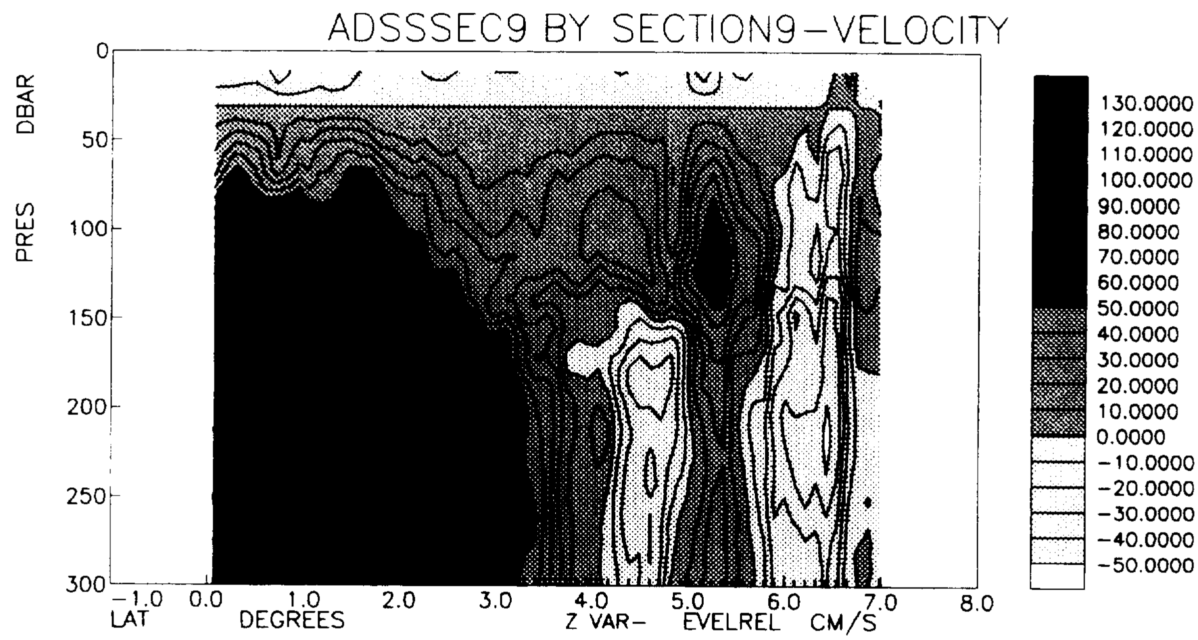
PRES DBAR
0
50
100
150
200
250
300
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0
LAT DEGREES
Z VAR- VE(W-G) CM/S
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000
-70.0000
-80.0000
-90.0000


ADSSSEC9 CI SECTION9-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- VN(W-G) CM/S
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000


ADSSSEC9 CI SECTION9-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- VE(W-G) CM/S
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000
-70.0000
-80.0000
-90.0000
-100.0000
-110.0000
-120.0000


ADSSSEC9 BY SECTION9-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- NVELREL CM/S
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000
-60.0000


ADSSSEC9 BY SECTION9-VELOCITY
PRES DBAR
0
50
100
150
200
250
300
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0
LAT DEGREES
Z VAR- EVELREL CM/S
130.0000
120.0000
110.0000
100.0000
90.0000
80.0000
70.0000
60.0000
50.0000
40.0000
30.0000
20.0000
10.0000
0.0000
-10.0000
-20.0000
-30.0000
-40.0000
-50.0000