551.501.7:551.515.8

GARP BASIC DATA SET ANALYSIS PROJECT: THE SECOND EXPERIMENT—JUNE 1970

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ABSTRACT

The techniques used for the southern hemisphere portion of the GARP Basic Data Set Analysis Project First Experiment of November 1969 (Phillpot *et al*, 1971) were partly amended for the exercise of June 1970. These changes are described in sections corresponding to those given in the earlier report. As with the November experiment, reservations are held about the quality of the final product.

INTRODUCTION

The Basic Data Set Analysis Project (Thompson, 1971) was designed to obtain multi-level global contour/isotherm analyses for the months of November 1969 and June 1970, and is required to assist planning for the first global experiment of the Global Atmospheric Research Program (GARP). The precise aims, the methods by which they would be achieved, and the detailed responsibilities of the three centres (Washington, Costa Rica and Melbourne) involved in the project, were specified by Phillpot *et al* (1971).

Indicative of the magnitude of the effort expended on this project in Melbourne is the fact that the work occupied the entire resources of the Synoptic Research Branch of the Bureau of Meteorology for two and a half years. It is inevitable that experience gained during the collection, array and analysis of the November 1969 data should lead to the development of changes in processing those of June 1970 and it is the intention of this paper to describe, under the same headings as the November report, the new techniques adopted. No significant changes were made in the adopted techniques *within* either of the two months.

In the *organisation* of the project two major changes were made for the June series.

- Responsibility for the collection and collation of all non-routine ship and aircraft reports in the area 30°N - 90°S was assumed by Costa Rica and copies of all data collected by that Centre in the area 10°S - 90°S were sent to Melbourne

- Computer facilities were used for the selection, sorting and array of both routine and non-routine data. Full details of the procedures adopted are given in the Appendix.

ANALYSIS AIDS

Satellite Data

(a) Cloud Photographs

The Advanced Vidicon Camera System (AVCS) pictures provided (again as rectified hemispherical digital mosaics on a polar stereographic projection of scale 1:30 million) extended no further southwards than 30°S or 40°S, due to the polar night.

Rectified infrared pictures were unavailable, but global unrectified night-time Temperature-Humidity Infrared Radiometer (THIR) 11.5μ channel montaged strips were provided. In spite of the greater difficulty in interpreting these data, it was decided that they would assist materially in the analysis polewards from the limits of the AVCS photographs and, to enable them to be used with the same convenience as a rectified hemispheric presentation, the photographic strips were enlarged and mounted in mosaic form in an approximate 1:30 million polar stereographic projection. Two mosaics centered around each chart time were obtained: one used the portion of each strip between latitudes 20°S and 70°S and matched the projection quite closely between 30°S and 60°S, the other extended from near latitude 65°S to the pole. The latter was particularly useful in delineating the 5-day mean position of the ice edge. Examples of each mosaic are given in Fig 1.

Television Automatic Picture Transmission (APT) pictures were made available by the meteorological services of New Zealand, Australia and Mauritius. Ungridded infrared APT pictures were obtained for some days of the month from the United States Antarctic base at McMurdo, but little use could be made of them.

Once-daily pictures were obtained from both Applications Technology Satellites - ATS I over the Pacific area, and ATS III over the Atlantic.

(b) Derived Wind Data

The only ATS wind estimates supplied were low level vectors at 5 deg × 5 deg grid points over the Pacific Ocean covered by ATS 1. These were derived by an experimental computer technique described by Leese *et al* (1971) and extended southwards only to latitude 35°S. They were used as guidance material for MSL and 1000 mb analyses.

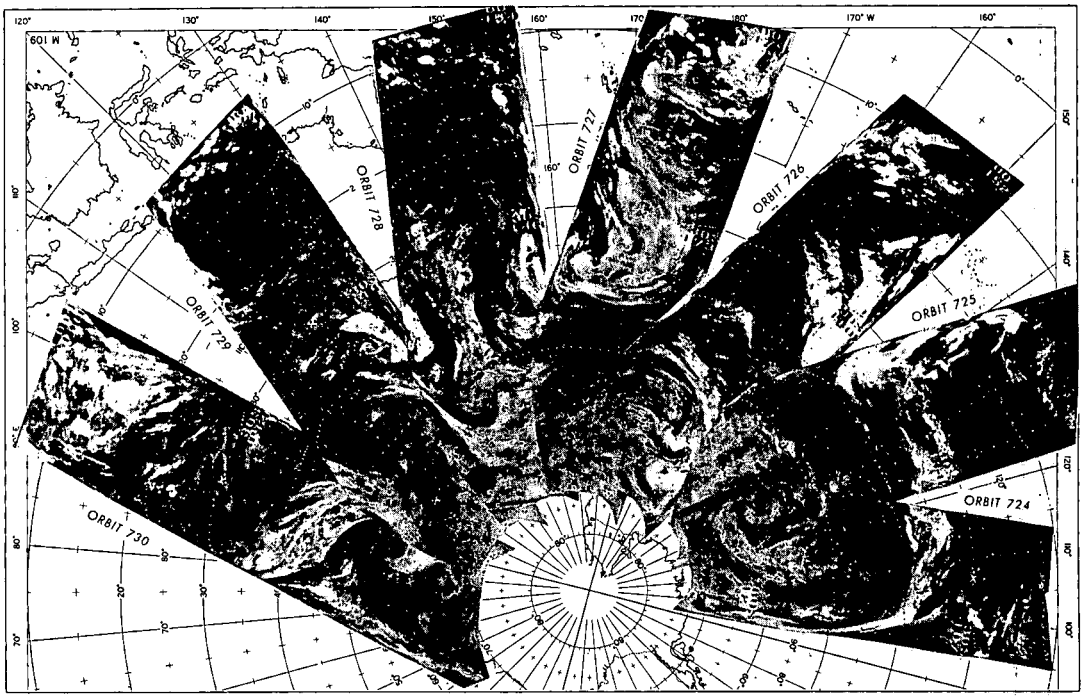
(c) Satellite Infrared Spectrometer (SIRS) Data

NIMBUS 4 (SIRS-B) temperatures and geopotentials were supplied for the same standard pressure levels as in November 1969. A typical coverage of these data is included in Fig 2. Because of the lateral as well as vertical sampling of the atmosphere by the SIRS-B, a more even distribution of data than was available for November 1969 was obtained. However, a greater proportion of measurements were flagged as "less reliable" and in addition there was a disproportionate concentration in polar regions.

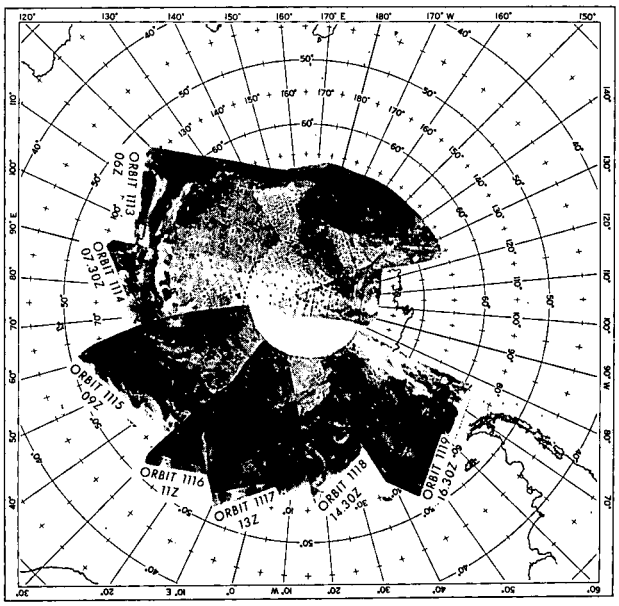
A preliminary estimate of the probable usefulness of these measurements, based on comparison of conventional and SIRS soundings, suggested that the June observations were not as accurate as those for November, but that most weight should continue to be given to "good" 1000-500 mb and 500-200 mb thickness values, and to all 500 and 200 mb temperatures.

Other aids

Surface and upper air time sections and aerological diagrams were computer printed for all stations. In addition, charts showing the tracks of all relevant non-routine SHIPs and corresponding time sections were plotted by computer (Appendix).



(a) using sections 20°S to 70°S



(b) using sections south of 65°S

Fig 1 Typical mounting of THIR strips as approximate 1:30 million polar stereographic projections

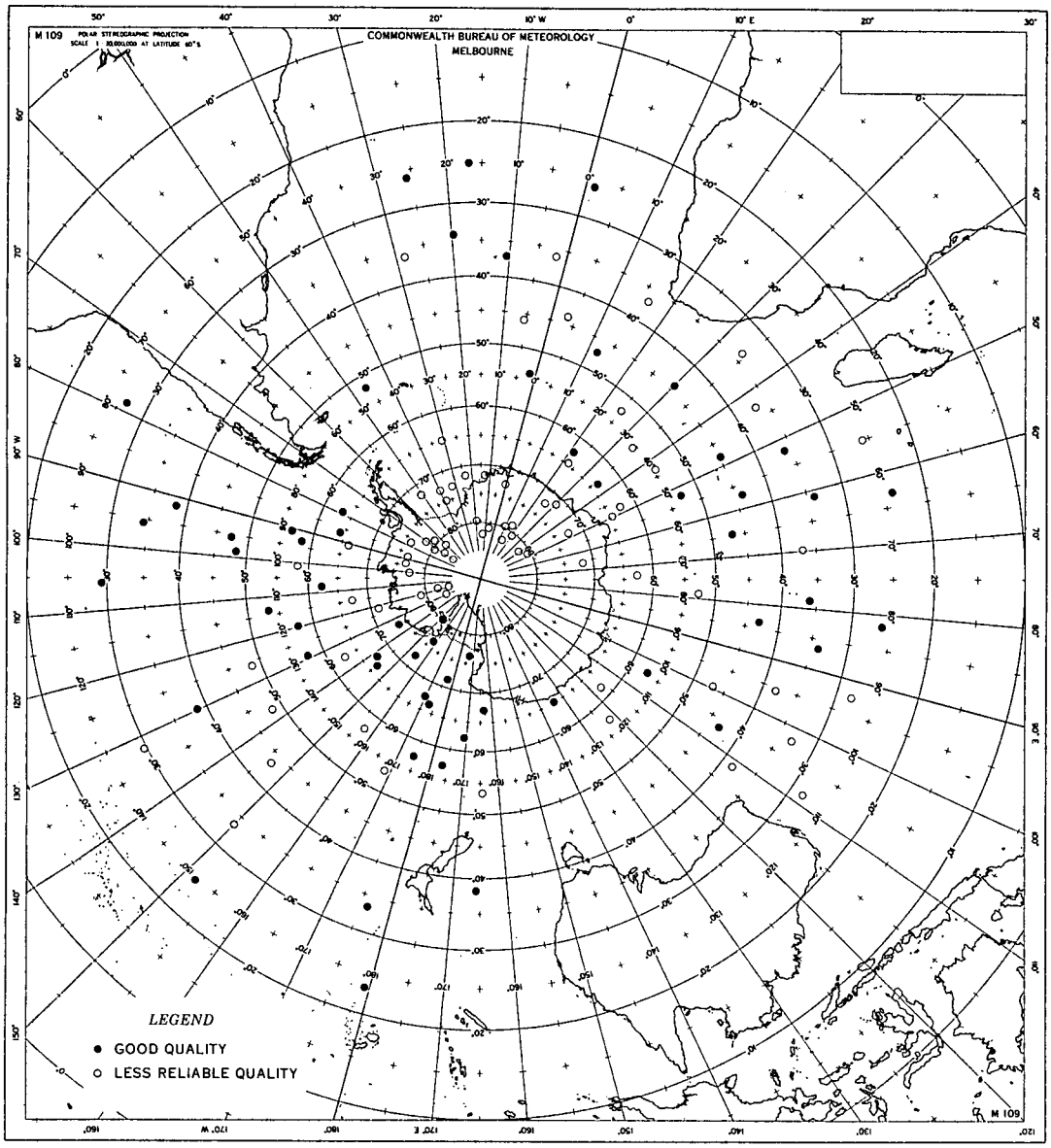


Fig 2 Typical twelve-hour coverage of SIRS-B data in June 1970.

THE ANALYSIS TECHNIQUES

Sea Surface Isotherm Charts

Mean May, June and July sea surface isotherm charts were prepared using all the reference material used by Zillman (1970) in constructing the November normals, together with observations made by the USNS ELTANIN in 1969 and 1970 (unpublished) and observations over Australian waters in June 1970 arrayed by the Bureau of Meteorology. From these, mean charts for each period 1 to 10 June, 11 to 20 June and 21 to 30 June were prepared, which together with variations in the pack ice edge deduced from satellite data, were used as the basis for analysis of the sea surface isotherm field each five days.

MSL Isobaric Charts

The method of Troup and Streten (1972) for obtaining an objective first guess of the pressure and contour field in the vicinity of cyclones was used as an aid in determining the central pressure of cyclones at MSL in sparse data areas. However in the final assessment (as for the November series) greatest weight was given to continuity into and out of data areas.

200 mb Contour Charts

A significant change was made in the analysis technique although the principle of differential analysis was retained to ensure vertical consistency as far as possible. The 500-300 mb and 300-200 mb thickness fields were obtained from the 500 mb and 300 mb temperature fields respectively through an empirically developed relationship. The values used are shown in Tables 1 and 2. Allowance is made for variability of the tropopause height in Table 2.

Table 1 Mean 500-300 mb thickness (dam) in June in relation to 500 mb temperature at different latitudes

500 mb temperature (°C)	20°S	30°S	40°S	50°S	65°S
- 5.0	381	377			
- 7.5	379	374			
-10.0	376	371	374		
-12.5	372	368	371		
-15.0	368	365	366	364	
-17.5		362	363	362	
-20.0		359	359	359	
-22.5		356	354	356	356
-25.0		354	350	351	351
-27.5		352	348	347	347
-30.0		351	347	343	343
-32.5			345*	342*	340
-35.0			344*	341*	337
-37.5				340*	335
-40.0					333
-42.5					331
-45.0					330
-47.5					328

*Add 4 dam if 200 mb temperature is warmer than -45°C

Table 2 Mean 300-200 mb thickness (dam) in June in relation to 200 mb temperature at different latitudes

200 mb temperature (°C)	20°S	30°S	40°S	50°S	65°S
-40.0			276		
-42.5			272		
-45.0	280	270(275)	268	270	
-47.5	277	268(274)	265	266	
-50.0	275	266(273)	263	263	262
-52.5	274	264(271)	261	259	260
-55.0	273	262(270)	259(266)	257(266)	258
-57.5	270	261(269)	257(264)	255(263)	255
-60.0	266	260(267)	256(264)	254(261)	252
-62.5	264	260(264)	256(260)	253(259)	250
-65.0		259(260)	255(259)	252(256)	249
-67.5				251(255)	248
-70.0				251(254)	247(252)

Values in brackets are used when the tropopause pressure is less than 200 mb

CONCLUDING REMARKS

Although extensive use of Automatic Data Processing (ADP) facilities in the processing of *routine* observational data for June 1970 overcame many of the problems experienced with the November 1969 data, in many instances the *non-routine* data available for June were inferior to those available for the first exercise. The lack of high level ATS winds, restriction on the coverage of AVCS photographs by the polar night, the non-availability of rectified infrared data and the apparent lower reliability of SIRS data were particularly severe handicaps.

The authors reaffirm the conclusions drawn from the November exercise and consider that, until accurate, quantitative and (for operational purposes) timely satellite data become available, analyses such as those produced for this project should be regarded as no more than a good first guess. Users of this particular series are again cautioned that the contour and isotherm fields cannot be considered as independent and subsequently cross-checked data.

ACKNOWLEDGMENTS

The authors acknowledge the invaluable guidance of Mr H.R. Phillpot in the execution of this phase of the project. Responsibility for data and array fell to Messrs R. Acaster and I.J. Butterworth whilst the extensive support by the ADP division of the Bureau of Meteorology was supervised by Messrs A. Edvi-Illes and J. Talbot.

The cooperation of many National Meteorological Services in supplying analysed charts and satellite, routine and non-routine data added considerably to the quality of the data sets produced both in November 1969 and June 1970.

APPENDIX

SELECTION, SORTING AND ARRAY OF DATA BY COMPUTER

Experience during the November exercise showed that considerable benefit could be achieved through use of the computer during the data handling phases of the June exercise. In particular, by adopting automatic procedures to search all available data and select the most appropriate version of an observation when two or more versions were available, the inevitable confusion of the manual selection methods used during November could be avoided. Accordingly it was decided to use this approach, and in addition, to use computer facilities to the maximum extent for sorting and array to allow the assisting staff to concentrate fully on chart plotting. Some routines developed may have application in other areas of synoptic analysis.

The procedures adopted were

1 A GARP Southern Hemisphere dictionary of 924 observing stations was compiled with the following information stored for each station:

- Latitude, longitude, elevation
- Time difference from GMT
- Broadcast centre source codes in priority order - up to seven sources were allowed per station
- Controlling country code
- Observation program code

All possible sources for each station were assigned to it, priority being highest for that source considered most likely to contain the least mutilated version of the station observation. A portion of the dictionary is shown as Fig A1.

2 To overcome deficiencies of receipt in Melbourne of data routinely exchanged over WMO telecommunications channels, punch paper tapes used in the broadcasts were obtained from the main Southern Hemisphere broadcasting centres, Mauritius, South Africa, Kenya, Brazil, Argentina, New Zealand, McMurdo (Antarctica) and the Falkland Islands.

All data for these centres, together with those collected in Melbourne and Washington, plus hand-listings and selections from page print material sent by various countries, were transferred to magnetic tape.

3 These data were then searched and the highest priority version of each observation selected and listed. These were then considered to be, and accepted as, the true version of the observations, and were only altered in the light of subsequent analysis checking. In total, almost 130,000 separate routine synoptic messages were selected from an estimated 500,000 messages and included on the final Southern Hemisphere data file.

4 The various observation types were arrayed as follows

- SYNOP/PILOT/TEMP: listed sorted by date/time/station number. The source used, the rank of that source, the principal source and the total number of versions from all sources were indicated with each observation. (Fig A2(a)).

  Only those parts of PILOTs and TEMPs containing data up to 100 mb were listed; the other parts have been retained and will be included as unchecked data on the final file.

- SHIP: listed sorted by date/time/latitude-longitude. The most appropriate version of duplicated observations was selected using a geographic criterion. Each observation was flagged with its source (Fig A2(b)).

- CODAR: listed sorted by date/time. Manual selection of the most appropriate observation was made on the few occasions when duplicate CODARs were received (Fig A2(c)).

- AIREP: this is not yet automatically recognised in the Melbourne WMC operational system. Hence all AIREPs were manually extracted, punched and then presented as listings sorted by date/time (Fig A2(d)).

- MISSING LISTS: were compiled using the programmes scheduled in the dictionary. Each station number was flagged with the controlling country code to facilitate requests for the missed data should they be considered vital (Fig A2(e)).

5 Subsequent processing and array of data included

- Thicknesses (1000-850 mb, 1000-500 mb and 500-200 mb) and shears (1000-850 mb, 1000-500 mb, 600-400 mb, 500-200 mb and 300-150 mb) were computed for all available stations and listed sorted by date/time/station number (Fig A3(a)).

Time Sections: SYNOPs were listed sorted by station number/date/time (Fig A3(b)).

SHIPs by call sign/date/time (Fig A3(c)).

Winds, geopotentials and temperatures at standard pressure levels from the surface to 100 mb plus tropopause and some thickness and shear data were printed as upper air time sections (Fig A4(a)).

- Aerological diagrams: were printed for all available stations to the same scale as the Australian (F160) Skew T-lnp diagram. A transparent overlay was used in conjunction with these print outs (Fig A4(b)).

6 Non-routine SHIP reports: were supplied on tape by Costa Rica. A routine then automatically selected those ships which were located in defined data sparse regions *(ie,* remote from coastlines or established shipping lanes) for part of the month. Tracks and time sections of all observations from these ships were computer plotted (Fig A5(a) and (b)).

STAT NO	LAT	LONG	ALT	TC	LAT S	LONG E	ALT FT		SOURCE CODES	ADR	SYNOP	PP/TT
88958	6746	-6855	25M	0	67.77	291.08	81	10	7 14 15 16 12 0	25	2 2 2 2	2 2 2 2
88961	6810	29258	45	0	68.17	292.97	45	9	7 14 15 16 12 0	24	2 2 2 2	0 0 0 0

Fig A1 Portion of GARP Southern Hemisphere Dictionary.

SYNOP MESSAGES 31/ 5/70 2100GMT PAGE 20

SOURCE	RANK OF SOURCE	PRINCIPAL SOURCE	NO. OF REPORTS	STAT#	MESSAGE BODY	
LIST	0	MELB	4	94996	80622 58616 14019 4742/ 17000	P
MELB	2	MC M	4	94998	82934 58026 94904 854// 02213	P
MELB	1	MELB	4	96996 *	71414 74022 08377 35604 71714	P

(a)

UPPER AIR MESSAGES 31/ 5/70 1800GMT PAGE 1

SOURCE	RANK OF SOURCE	PRINCIPAL SOURCE	NO. OF REPORTS	MSG TYPE	STAT#	MESSAGE BODY
MELB	4	ARG	8	PP	87344	81171 55185 33008
MELB	4	ARG	8	QQ	87623	81181 90012 36005 01007 903// 34008 53185
MELB	4	ARG	8	PP	87623	81181 55185 27519 77999
MELB	4	ARG	8	QQ	87344	81171 900/2 00000 35504 32008 90378 29511 27520 28521 52291

(a)

SHIP MESSAGES 1/ 7/70 1200GMT PAGE 452

LINE	SOURCE	CALL SIGN	MESSAGE BODY
21286	MELB	JQAN	99053 31534 01124 31410 98020 09029 ///// 34205 0//26 12950 30402 14502
21287	NAIR	SPXP	99065 50047 01123 31411 98011 19225 33500 44220 00319 12404 30403 14202
21288	NAIR	PGAP	99070 50168 01123 51611 98151 16525 32430 34015 0//30 12587 30202 14705

(b)

CODAR MESSAGES DAY 81 PAGE 67

1282	CC	81022 99045 3/635 200// 4811/ 04040
1283	CC	81022 99055 30000 200// 4811/ 04040
1284	CC	81041 99010 33700 200// 4111/ 07535
1285	CC	81072 99260 32800 300// 4/11/ 288//

(c)

AIREP MESSAGES DAY 31 PAGE 159

7875	AIREP ZKNZE	3601 16800E 312156 310 -45 285065 SPOT 170E 36205 MOD TURB
7876	AIREP ZKTEB	3652 16300E 312207 220 -23 NIL T510 INC CNS STF
7877	AIREP NZZD	3652 16300 312207 350 -52 275090 SCT CUF SCT STFLINECBSW

(d)

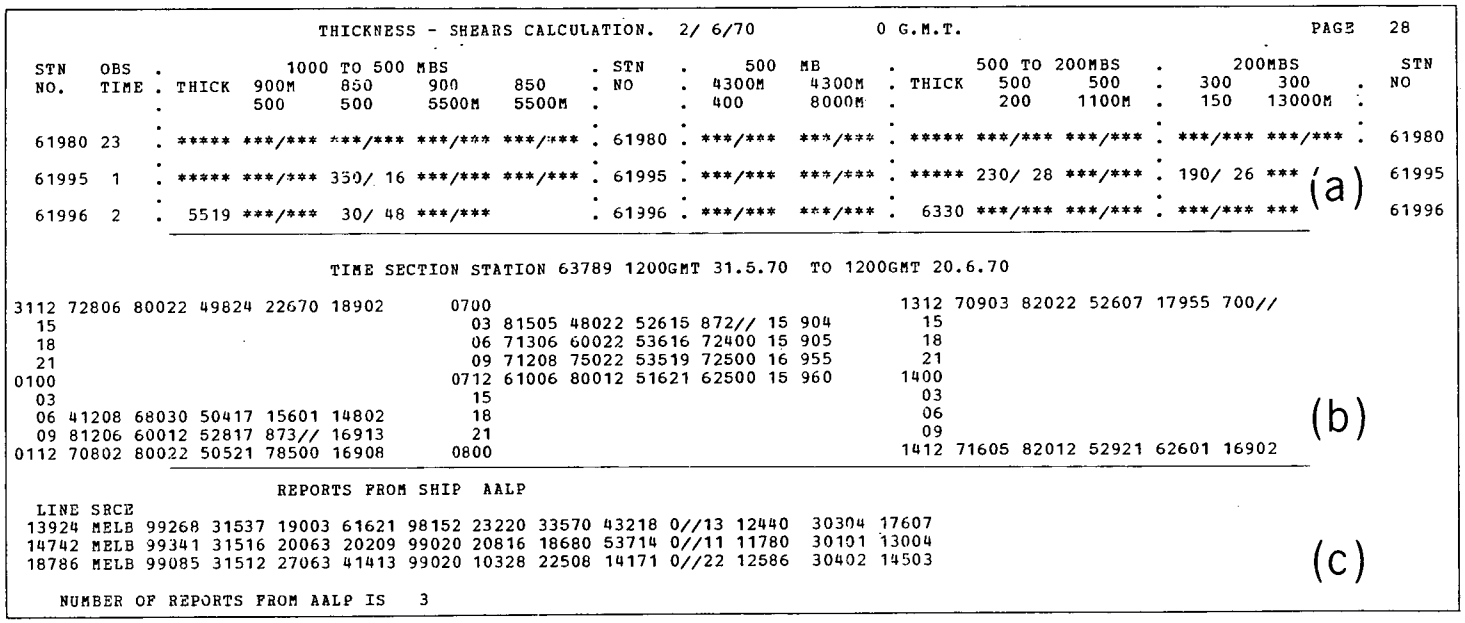
MISSING OBSERVATIONS 1/ 6/70 600HRS PAGE 4

STATIONS FROM COUNTRIES WHICH SENT HAND LISTS

STAT#	SOURCE ADDR	STAT#	SOURCE ADDR	STAT#	SOURCE ADDR	STAT#	SOURCE ADDR	STAT#	SOURCE ADDR	STAT#	SOURCE ADDR
61970 *	4	64504 *	10	64507 *	10	64556 *	10	91570 *	20	91573 *	26
91754 *	26	96009 *	30	96145 *	30	96253 *	30	96509 *	30	96559 *	30
96595 *	30	96645 *	30	96651 *	30	96695 *	30	96853 *	30	97008 *	30

(e)

Fig A2 Typical arrays of selected observations (a) SYNOP and upper air (b) SHIP (c) CODAR (d) AIREP and (e) missing observations.



THICKNESS - SHEARS CALCULATION. 2/ 6/70 0 G.M.T. PAGE 28

STN NO.	OBS TIME	1000 TO 500 MBS THICK	900M 500	850 500	900 5500M	850 5500M	STN NO	500 MB 4300M 400	4300M 8000M	500 TO 200MBS THICK	500 200	500 1100M	200MBS 300 150	300 13000M	STN NO
61980	23	*****	***/***	***/***	***/***	***/***	61980	***/***	***/***	*****	***/***	***/***	***/***	***/***	61980
61995	1	*****	***/***	350/ 16	***/***	***/***	61995	***/***	***/***	*****	230/ 28	***/***	190/ 26	***	61995
61996	2	5519	***/***	30/ 48	***/***		61996	***/***	***/***	6330	***/***	***/***	***/***	***	61996

(a)

TIME SECTION STATION 63789 1200GMT 31.5.70 TO 1200GMT 20.6.70

```
3112 72806 80022 49824 22670 18902      0700                                    1312 70903 82022 52607 17955 700//
  15                                      03 81505 48022 52615 872// 15 904       15
  18                                      06 71306 60022 53616 72400 15 905       18
  21                                      09 71208 75022 53519 72500 16 955       21
0100                                    0712 61006 80012 51621 62500 15 960     1400
  03                                      15                                      03
  06 41208 68030 50417 15601 14802        18                                      06
  09 81206 60012 52817 873// 16913        21                                      09
0112 70802 80022 50521 78500 16908      0800                                    1412 71605 82012 52921 62601 16902
```

(b)

REPORTS FROM SHIP AALP

```
  LINE SRCE
 13924 MELB 99268 31537 19003 61621 98152 23220 33570 43218 0//13 12440  30304 17607
 14742 MELB 99341 31516 20063 20209 99020 20816 18680 53714 0//11 11780  30101 13004
 18786 MELB 99085 31512 27063 41413 99020 10328 22508 14171 0//22 12586  30402 14503

    NUMBER OF REPORTS FROM AALP IS   3
```

(c)

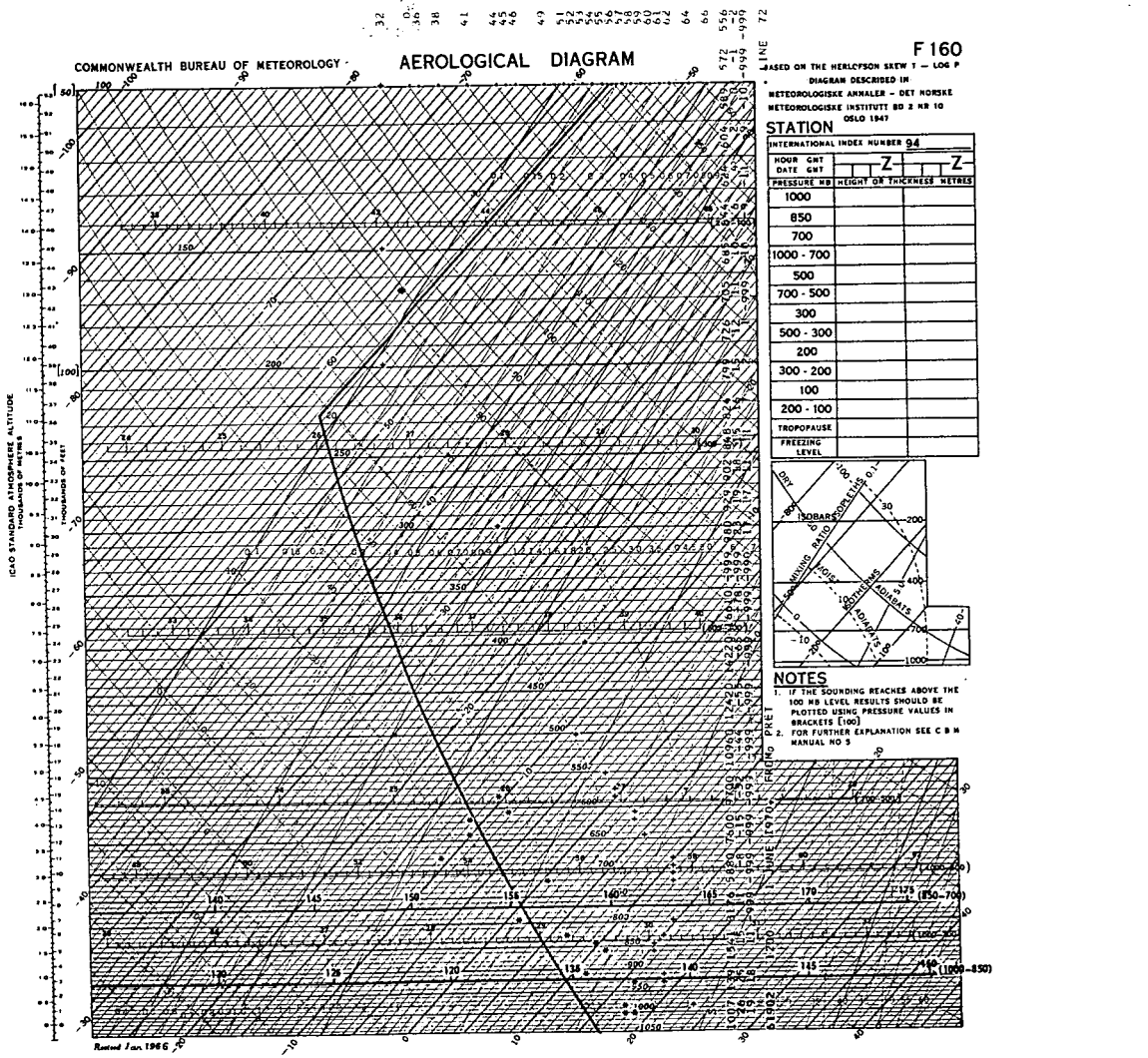
Fig A3 Typical arrays of processed routine data (a) thickness and shears
(b) SYNOP time sections (c) SHIP time sections

TIME SECTION 61967 JUNE LTD 5

TROP	***	***	***	***	***
	*****	*****	*****	*****	*****
150	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	60	***	***	***
	***	58	***	***	***
200	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	60	***	***	***
	***	46	***	***	***
250	***	***	***	***	***
	***	***	***	***	***
300	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	80	***	***	***
	***	29	***	***	***
5-2	*****	*****	*****	*****	*****
	*****	47 70	*****	*****	*****
400	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	30	***	***	***
	***	13	***	***	***
500	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	330	***	***	***
	***	11	***	***	***
600	***	***	***	***	***
	***	***	***	***	***
700	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	110	***	***	***
	***	18	***	***	***
10-5	*****	*****	*****	*****	*****
	*****	27300	*****	*****	*****
850	*****	*****	*****	*****	*****
	****	****	****	****	****
	***	120	***	***	***
	***	19	***	***	***
1000	***	***	***	***	***
	***	***	***	***	***
SFC	****	****	****	****	****
	***	***	***	***	***
90DM	***	100	***	***	***
	***	10	***	***	***

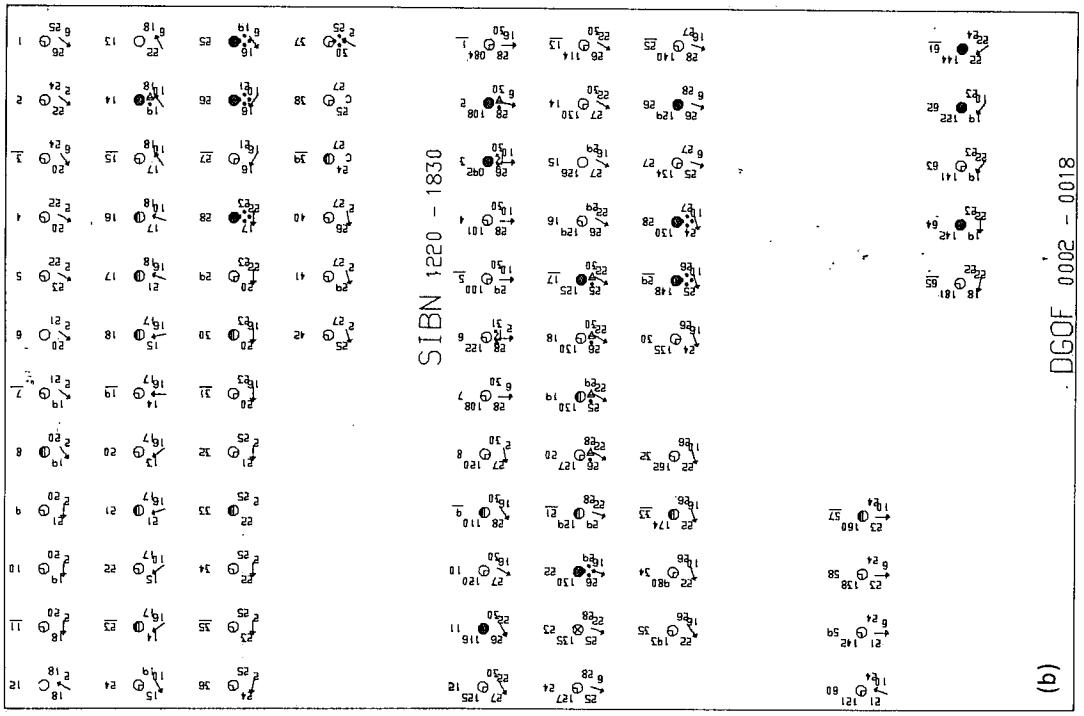
61967 5/18 5/12 5/ 6 5/ 0 4/18 4/12

(a) Upper level time sections.



(b) Aerological diagrams; the overlay used in interpreting the sounding is printed as brown. The numbered row of dots at the top is used in aligning the overlay.

Fig. A4



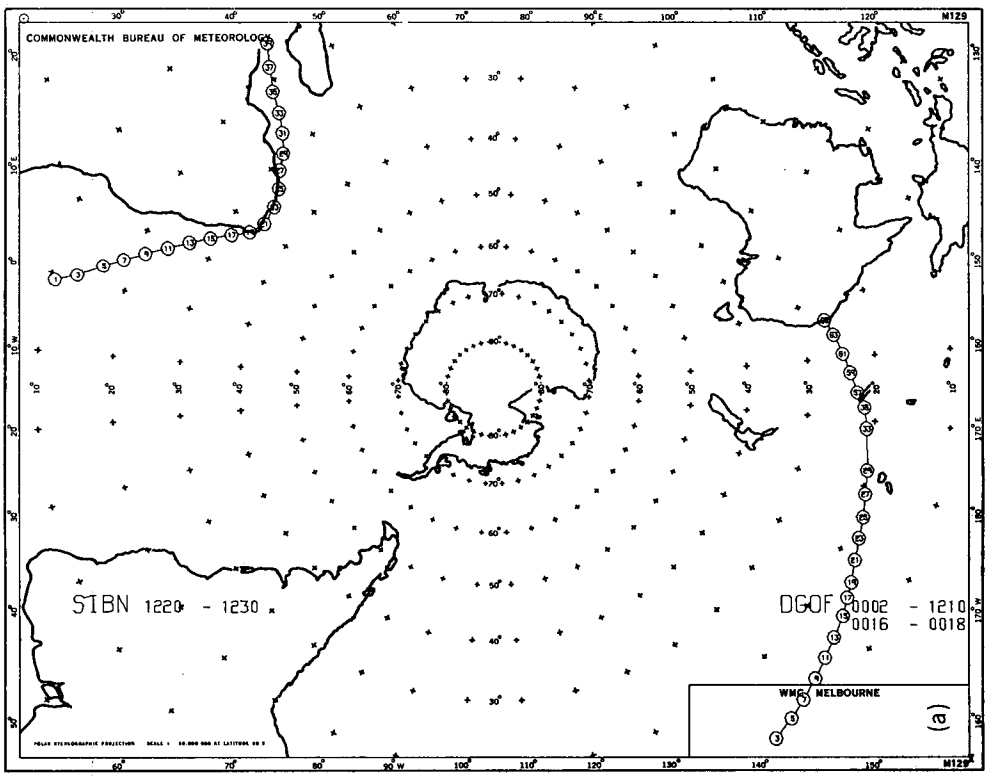


Fig A5 Typical array of processed SHIP data; (a) Tracks (b) Time sections; the number next to each plotted observation corresponds to a position on the track.