0. Introduction

CMR.4 has been superseded by CMR.5 (described in supp. D). The material herein has been retained only for reference and includes details on translation from LMR (supp. F). The only omission from CMR.5 is the recorded wind speed. Because of rounding in the calculation of *coded* U and V, it can be only approximated by $(U^2 + V^2)^{1/2}$.

Table E0-1 gives the internal structure of each CMR.4 report. Except for the differences given there and in sec. 1, CMR.4 is identical to CMR.5.

Table E0-1
CMR.4

#	Field	Description	True value	Units*	Base	Coded	Bits
		Location					
1	BOX10	10 ° box	1≤ 648**	1***	0	same	10
2	MONTH		1≤ 12	1	0	same	4
3	BOX2	2 ° box	1≤ 16202	1	0	same	14
4	YEAR		1800≤ 2054	1	1799	1≤ 255	8
5	DAY		1≤ 31	1	0	same	5
6	HOUR		0≤ 23	1	-1	1≤ 24	5
7	X	lon (from BOX2	0≤ 2.0	0.1 °	-1	1≤ 21	5
8	Y	lat SW corner)	0≤ 2.0	0.1 °	-1	1≤ 21	5
						sub-total	56
		Temperature					
9	S	sea surface temperature	-5.0≤ 40.0	0.1 ° C	-51	1≤ 451	9
10	BI	bucket indicator	0≤ 2	1	-1	1≤ 3	2
11	A	air temperature	-88.0≤ 58.0	0.1 ° C	-881	1≤ 1461	11
12	DP	dew point depression	0≤ 70.0	0.1 ° C	-1	1≤ 701	10
13	TI	temperature indicator	0≤ 5	1	-1	1≤ 6	3
						sub-total	35
		Wind					
14	W	wind speed	0≤ 102.2	0.1 m s^{-1}	-1	1≤ 1023	10
15	WI	wind speed indicator	0≤ 1	1	-1	1≤ 2	2
16	U	eastward component	-102.2≤ 102.2	0.1 m s^{-1}	-1023	1≤ 2045	11
17	V	northward component	-102.2≤ 102.2	0.1 m s^{-1}	-1023	1≤ 2045	11
18	DI	direction indicator	0≤ 5	1	-1	1≤ 6	3
						sub-total	37
		Pressure and clouds					
19	P	sea level pressure	870.0≤ 1074.6	0.1 mb	8699	1≤ 2047	11
20	C	total cloud amount	0≤ 9	1	-1	1≤ 10	4
21	NH	lower cloud amount	0≤ 9	1	-1	1≤ 10	4
22	CL	low cloud type	0≤ 10	1	-1	1≤ 11	4
23	H	cloud height	0≤ 10	1	-1	1≤ 11	4
24	HI	cloud height indicator	0≤ 1	1	-1	1≤ 2	2
25	CM	middle cloud type	0≤ 10	1	-1	1≤ 11	4
26	CH	high cloud type	0≤ 10	1	-1	1≤ 11	4
						sub-total	37
		Misc.					
27	ST	ship type	0≤ 7	1	-1	1≤ 8	4
28	PW	present weather	0≤ 99	1	-1	1≤ 100	7
29	CD	card deck	0≤ 999	1	-1	1≤ 1000	10
						sub-total	21
30	CK	checksum	n/a	n/a	n/a	n/a	6
						total	192

* "Units" gives the smallest increment of the data that has been encoded. Thus a change of one unit in the integer ***coded*** value represents a change in the ***true value*** of one of the units shown.
** m≤ n denotes "from m through n inclusive."
*** Units of 1 are explained in the text.

1. Fields

All fields in CMR.4 are identical in content with the corresponding fields in CMR.5, except for the following:

14) W wind speed

Wind speed is stored in tenths of a meter per second.

30) CK checksum

A checksum was computed and stored with each report as a measure of reliability during storage and transmission. The checksum is computed by

1) Summing *coded* values of all other fields in the report besides the checksum.

2) Obtaining the modulo $(2^6 - 1)$ of the sum.

Repeating this calculation for every unpacked report, and then verifying that the checksum so obtained agrees with the *coded* checksum stored in the report, is strongly encouraged. For example, supposing that the *coded* values of the preceding 29 fields are available in an array FIELD, the checksum CK is computed and verified against the stored checksum CKS in FORTRAN as follows:

```
      INTEGER CK,J,FIELD(29),CKS
      CK = 0
      DO 500 J = 1,29
  500 CK =  CK + FIELD(J)
      CK = MOD(CK, 63)
      IF (CK .NE. CKS) THEN
        PRINT *,'ERROR. CK = ',CK,' .NE. CKS = ',CKS
        STOP
      ENDIF
```

Note that using modulus 2^6-1 takes into account every bit of CK, versus chopping at the sixth bit using modulus 2^6.

2. Translation of LMR.5 into CMR.4

Two separate translations of LMR.5 into CMR.4 were actually performed, resulting in two slightly different versions of the data, both stored as CMR.4. The first version was used to compute the untrimmed monthly and decadal summaries. Subsequently, a few errors in LMR (or in translation from LMR) were fixed in a second version of the data prior to its use in generating the trimmed summaries. Given here are rules for the first translation, followed by comments and differences in the second translation.

2.1 First Translation

The CMR set contains only reports with a dup status less than three; i.e., all possible dups have been deleted. Refer to supp. K for more information on dup status, and supp. J for a definition of the following quality control flags.

Because of the format similarities, very little action was required in translating individual fields from LMR into CMR. Fields whose CMR writeup number follows required one of three different types of action in translation. First, some fields do not exist in LMR and were computed. Second, some field bit-lengths are shorter in CMR; those values that do not map into the reduced bit-length are termed "outliers." Third, since no room is available in CMR for

quality control flags, a selection of flags was used to eliminate erroneous data.

Out of the first eight fields, only DAY and HOUR may be missing; otherwise the report was discarded altogether. Other missing fields were transferred without change; this implicitly discarded a present weather, pressure, air, dew point, or sea surface temperature with Flag M (data so garbled that they would not fit into the regular section of LMR). Otherwise, extant data were included subject to the following conditions:

3) BOX2 2 ° box number

Computed. Because of the 30 ° offset and the polar conventions, BOX10-1 and -648 contain 26 BOX2, e.g., BOX10-1 contains BOX2 numbers 1, 17, 18,....

7) X longitude

8) Y latitude

Position measured from BOX2 lower-left (SW) corner.

9) S sea surface temperature

Flag Q or outlier discarded.

10) BI bucket indicator

There were no outliers defined.

11) A air temperature

Flag Q, N, or outlier discarded.

12) DP dew point depression

Flags Q and N (of dew point temperature), missing or discarded A, or outlier after computation of DP discarded.

13) TI temperature indicator

There were no outliers defined.

14) W wind speed

15) WI wind speed indicator

16) U vector wind eastward component

17) V vector wind northward component

For WI, no distinction was made between meters per second and knots. Thus 2 in LMR translated into 0 in CMR and 3 translated into 1. Table E2-1 gives the wind flag values possible at different W and wind direction D, with the action taken for each flag in translation.

Table E2-1
Flag Values Possible and Translation Action*

Wind speed	Wind direction				
	$1° \leqslant D \leqslant 360°$	361(calm)	362(variable)	Missing	Illegal
$W=0$ m s^{-1}	(D=361) A,J, or M (U,V)=0	R or J (U,V)=0	(D=361) A or J (U,V)=0	(D=361) A or J (U,V)=0	M (W)
$0.1 \leqslant W \leqslant 3.1$	R or J (U,V)	(D=362) A or J (W)	R or J (W)	(D=362) A or J (W)	M (W)
$3.2 \leqslant W \leqslant 102.2$	R or J (U,V)	(D=360°) A or J (U,V)	J (W)	M (W)	M (W)
Missing	M	(W=0 m s^{-1}) A or J (U,V)=0	M	S	M
Illegal	M	M	M	M	M

* The change made so that the direction D and speed W would be consistent is given above some flags; Flag A is always one of these. Beneath each flag is the resulting (U,V), W if only it results, or blank if all are missing. The Flag M in the upper-left corner is an exception because for it all of (U,V) and W become missing, whereas for Flag A or J the rules are as stated. Besides this exception, any $0 \leqslant W \leqslant 102.2$ m s^{-1} is accepted; this is more restrictive than the Flag Q, and accepts four other Flags M.

19) P sea level pressure

Flag Q discarded.

After the aforementioned field discards had been made these further restrictions were applied: indicators referring to discarded data were discarded, and any report with no extant data besides the location, ship type, and card deck was discarded altogether.

2.2 Second Translation

Only differences from the first translation, or comments on the impact of changes to LMR are presented. Otherwise the translation process was the same.

11) A air temperature

Under certain conditions, some (source Exchange) HSST air temperatures had been inadvertently overwritten by barometric tendency during QC. This was fixed before the second translation, but the untrimmed summaries of air temperature were contaminated to an unknown extent. In addition, this error had unknown side-effects on the computation of dew point depression.

12) DP dew point depression

GTS data carry dew point temperature DPT rounded to 1 °C and air temperature A to 0.1 °C. At or near saturation a rounded DPT might exceed A, causing A and DP to be discarded in the first translation because A and DPT were flagged N. Other small computational problems, such as roundoff errors in Australian (deck 900) and (source Exchange) HSST negative DPT, had a similar effect. These problems all biased the untrimmed summaries, particularly against saturation DP, to an unknown extent. To fix them, QC was changed to give 0.5 °C tolerance on all N tests among the temperatures, and the computation of DP was changed to yield zero for $-0.5 \leqslant A - DPT < 0$.