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Hydrologic Engineering Center

Generalized Computer Program

WEATHER

User's Manual

January 1986

CPD-52

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14. ABSTRACT
This manual describes the WEATHER program which provides weather input data for WQRRS and HEC-5Q. From a NOAA National Climatic Center weather data file, the program produces a file that is in the proper format for either WQRRS or HEC-5Q. The data file can be hourly or three hourly weather data, and contains air (dry bulb) temperature, wet bulb temperature, dew point temperature, wind speed, barometric pressure, and cloud cover in addition to other weather parameters.

15. SUBJECT TERMS
WEATHER, WQRRS, HEC-5Q, weather data file, National Climatic Center, hourly weather data, air (dry bulb) temperature, wet bulb temperature, dew point temperature, wind speed, barometric pressure, cloud cover, solar radiation

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WEATHER

USERS MANUAL

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WEATHER

1. INTRODUCTION

1.1 Purpose of Program

Program WEATHER was developed to assist the user of the WQRRS and the HEC-5Q models with the preparation of the required input weather data. The program reads a NOAA National Climatic Center weather data file and outputs a file in the proper input format for either the WQRRS or the HEC-5Q program.

1.2 Origin of Program

The WEATHER program was originally written by Mr. Alfred Onodera in 1974 to provide the WQRRS user with input assistance. The program has been modified by Mr. R.G. Willey to provide more flexibility of time scales and output capability for both WQRRS and HEC-5Q.

1.3 Hardware Requirements

This program is written in FORTRAN 77 without machine dependencies. The program has been tested on HARRIS and CDC equipment. There should be little, if any, problem in compilation on other computers.

2. PROGRAM CONCEPTS

The WEATHER program reads a National Climatic Center data file of hourly or three hourly weather data. The file contains air (dry bulb) temperature, wet bulb temperature, dew point temperature, wind speed, barometric pressure, and cloud cover in addition to other weather parameters. Some stations, during some years, only have three hourly data but the general format is considered to be hourly.

The WQRRS model can use hourly weather data or any multiple of hourly that divides evenly into 24 hours. The HEC-5Q model can only use daily average data. The cloud cover, which is used to predict the amount of solar radiation reaching the ground, should be averaged only during day-light hours.

The model needs an initial input record which specifies which program options the user wants to use. Based on the input from this header record, the program provides either hourly (or multiples of hourly) weather data for the WQRRS model, or the averaged daily data for either the WQRRS or the HEC-5Q models. The formats and types of weather parameters used are different for each model.

3. INPUT

The input begins with three title cards having any alpha character in columns 1-80, although it is suggested that the first two columns be used for a card I.D. Following the three titles, the initial header record contains the following:

Columns	Description
1-2	Card identification (e.g. C1).
3-8	Starting year; two digits
9-16	Starting month.
17-24	Starting day.
25-32	Last year of simulation; two digits.
33-40	Last month of simulation.
41-48	Last day of simulation.
49-56	Index which equals 1 for WQRRS output format or 0 for HEC-5Q output format.
57-64	Index which equals 1 for wet bulb input or 0 for dew point input. Only needed for WQRRS interface.

The title records and the header record are read from unit 5. The remaining input is from the National Climatic Center containing weather data in their "CD144" format. This data may need to be unblocked to 80-character (card-image) records before processing. Appendix I defines the type of available data and its format. National Climatic Center data can be ordered from Asheville, North Carolina, for non-Corps offices and from Scott Air Force Base, Illinois for Corps offices. The Corps offices should refer to Army Pamphlet 115-1 "Requests for Climatological Support to Army Activities," dated June 1983. Both offices' addresses and phone numbers are given below:

For Corps Offices

Commander
USFA Environmental Technical
Applications Center
ETAC/DO
Scott AFB, IL 62225
(704) 259-0218

For Non-Corps Offices

National Climatic Center
Federal Building
Ashville, NC 28801
(704) 259-0682

Example inputs are shown in Appendices II and III.

*This phone connects with Air Force Staff located at Asheville, NC. They can answer your questions, although you must order your data from Scott AFB.

4. OUTPUT

The program output is weather data for the input station for the exact period of interest in a format for either the WQRRS or the HEC-5Q (actually HEC-5Q type output is input to a preprocessor called HEATX, which provides output for HEC-5Q input format). The results are written to unit 7. Example outputs for unit 7 are shown in Appendices IV and V.

If your execution is unsuccessful, the following messages (from unit 6) may be helpful for editing your data:

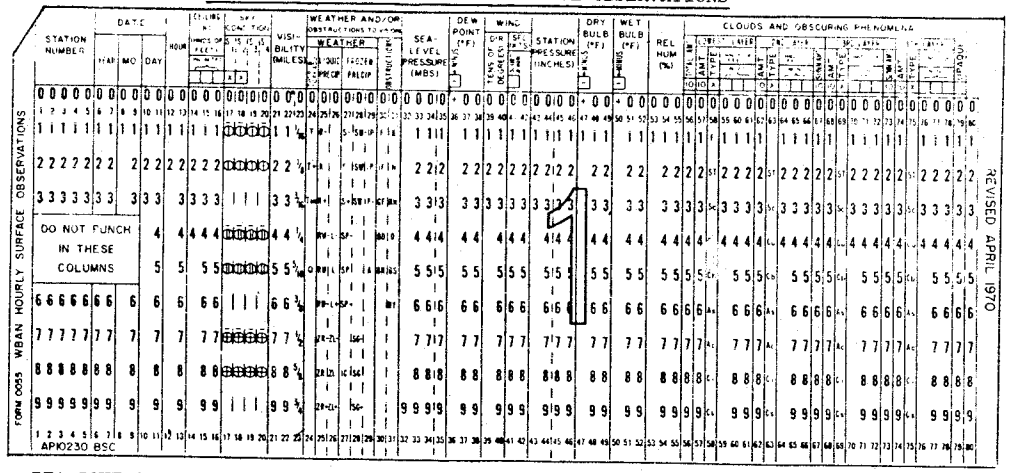
Message	Remarks
STOP 55	Starting hour must be 01 for three hour intervals and 00 for all other intervals.
STOP 200	Program read an end of file.

APPENDIX I

NATIONAL WEATHER SERVICE

CD144 REFERENCE MANUAL

CARD DECK 144 WBAN HOURLY SURFACE OBSERVATIONS



AREA COVERAGE: United States, Caribbean and Pacific Islands and other overseas stations of U. S. Weather Bureau, Air Force and Navy.

PERIOD OF RECORD: Navy Apr 1945- Weather Bureau Jan 1948- Air Force Jan 1949- Note: Some prior periods are included in this deck. A status of the period of record for each station is maintained at the National Climatic Center, Asheville, North Carolina.

OBSERVATION TIME: Local Standard Time (LST). For information relating to changes in time of observation, refer to SUPPLEMENTARY NOTE A, page 9. Beginning 1 Jan 65, the Weather Bureau reduced the number of hourly observations punched from 24 to 8 per day. These 3-hourly observations correspond to record observations at 0000, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 GMT. As a result of special studies, some WB stations may have 24 observations per day punched.

CODES: WBAN and WMO

SOURCE: WBAN Forms 10A, 10B and 10 or similar forms. In addition to WBAN Forms for Weather Bureau, Air Force and Navy, those of FAA and Signal Corps are included. Effective 1 Apr 70, forms redesignated as MF 1-10A, 1-10B and 1-10C. MF indicates Meteorological Form.

MISSING DATA: Blanks in appropriate columns are used to indicate missing data. Identification cards were punched for missing observations at AWS stations unless a whole month's record was missing. Punching of ID cards for AWS stations was phased out from Sep-Dec 1968.

COLUMNS AND ELEMENTS PUNCHED: Columns 1-79 are punched. Elements punched are: (Index on page 14)

Ceiling Height	Rain Showers	Smoke and/or Haze
Sky Condition	Freezing Rain	Dust
Clear	Drizzle	Blowing Snow
Scattered	Freezing Drizzle	Blowing Spray
Broken	Snow	Sea Level Pressure
Overcast	Snow Pellets	Dew Point Temperature
Partial	Ice Crystals	Wind Direction
Obscuration	Snow Showers	Wind Speed
Obscuration	Snow Grains	Station Pressure
Visibility	*Sleet	Dry Bulb Temperature
Weather and/or	Hail	Wet Bulb Temperature
Obstruction to	*Small Hail	Relative Humidity
Vision	Fog	Total Sky Cover
Thunderstorm	Ice Fog	Amount, Type and Height
Tornado	Ground Fog	of Cloud Layers
Squall	Blowing Dust	Opaque Sky Cover
Rain	Blowing Sand	

*Reported as Ice Pellets, effective 1 Apr 70.

ADDITIONAL REMARKS: Card content is generally for recent years. Prior punching or processing procedures are described in "Remarks Column" or in SUPPLEMENTARY NOTES.

Effective 1 Jan 68, the Air Force began the use of the METAR Code at nearly all stations located outside the North American Continent. Observations for these stations are not available on punched cards but on magnetic tape only.

Decks with similar data are listed on page 14.

CORRECTIONS: Any errors detected in this manual should be called to the attention of the Director, National Climatic Center, Environmental Data Service, NOAA; or Chief, Data Processing Division, Environmental Technical Applications Center, USAF. Please give specific instances of error and correct information if available.

CARD CONTENT					
COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
21-79	Missing Data	B	Blank	Unknown	Blank indicates unknown or missing data.
1-5	Station Number WBAN		00001- 99999	WBAN Number	A five digit number formulated to designate the station. A list of stations with their coordinates, elevation and period of record is maintained at the NCC in Asheville, N. C.
6-7	Year		00-99	Last two digits of year	
8-9	Month		01-12	01 Jan to 12 Dec	
10-11	Day		01-31	Day of month	
12-13	Hour		00-23	LST	For information relating to time of observation changes and reduction of punches from 24 to 8 observations per day, reference SUPPLEMENTARY NOTE A, page 9 and OBSERVATION TIME, page 1.
14-16	Ceiling Height	hhh	000- 990	Hundred of feet 0-99,000 feet	Reporting practices are described in SUPPLEMENTARY NOTE B, page 9.
			XXX	Unlimited	
			888	Cirroform ceiling, height unknown	Effective 1 Sep 56. Punching of 888 for Cirroform ceiling, height unknown, was discontinued on 1 Apr 70.
17-20	Sky Condition				Four column field for up to 4 layers. 0 in unused columns.
17 18 19 20	First Sky Cover Layer Second Sky Cover Layer Third Sky Cover Layer Fourth Sky Cover Layer	○	0	Clear Cloud cover <.05 Columns 18-20 punched 000	Thin sky cover is a designation given any layer for which the ratio of transparency to total sky cover at that level is ½ or more. Prior to September 1956 dark scattered, dark broken, and dark overcast were coded 3, 6, and 9, respectively. Reporting practices of sky conditions, etc. are described in more detail in SUPPLEMENTARY NOTE C, pages 9-10.
		−◐	1	Thin scattered	
		◐	2	Scattered Cloud cover .1 thru .5	
		−◑	4	Thin broken	
		◑	5	Broken Cloud cover .6 thru .9	
		−⊕	7	Thin overcast Cloud cover 1.0	
		⊕	8	Overcast Cloud cover 1.0 Columns 18-20 punched 000	
		-X	Blank	Partial Obscuration Columns 18-20 punched 0-8 0.1 or more but not all sky hidden by surface based layer	
		X	X	Obscuration All of sky hidden by a surface based layer. Columns 18-20 punched 000.	

CARD CONTENT					
COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
21-23	Visibility	VVV	000-006 006-020 020-027 027-030 030-150 150-950 990	0 - 3/8 miles 3/8 - 2 miles 2 - 2½ miles 2½ - 3 miles 3 - 15 miles 15 - 95 miles 100 miles or more	1/16 mile increments 1/8 mile increments * 1/4 mile increments 1/2 mile increments 1 mile increments 5 mile increments Refer to Code 3 on page 12. Effective 1 Apr 70, visibilities greater than 7 miles will not be recorded unless a marker is located at a distance greater than 7 miles.
				Visibilities reported other than standard punched for next lower value.	*7/8 was not reported prior to Jul 52; and 1 1/8, 1 3/8, 1 5/8 and 1 7/8 until May 53. 1 1/8, 1 3/8, and 1 5/8 were punched as 1, 1¼, and 1½ until Jan 56. 7/8 and 1 7/8 are punched as 3/4 and 1 3/4.
24-31	Weather and/or Obstruction to Vision				See page 8 for intensity definition Columns 24-31.
24			0	None	
	Thunderstorm	T	1	Thunderstorm	
	Heavy/Severe Thunderstorm	T+	2	Heavy thunderstorm/ Severe thunderstorm	See note, page 8, on thunderstorm intensities. Heavy thunderstorm redefined Severe Thunderstorm 1 Jul 68.
	Tornado Waterspout	Tor	3	Tornado - Land Waterspout - Water	
	Squall	Q	5	Squall	Reported as rain or snow squalls (RQ,SQ) before 1949. Intensity reported prior to 1 Jun 51. Definition is given on page 8.
25	Liquid Precipitation		0	None	
		R-	1	Light rain	
		R	2	Moderate rain	
		R+	3	Heavy rain	
		RW-	4	Light rain showers	
		RW	5	Moderate rain showers	
		RW+	6	Heavy rain showers	
		ZR-	7	Light freezing rain	
		ZR	8	Moderate freezing rain	
		ZR+	9	Heavy freezing rain	
26	Liquid Precipitation		0	None	Codes 1, 2 and 3, light, moderate and heavy rain squalls reported prior to 1949. Drizzle intensity explained in SUPPLEMENTARY NOTE D, page 10.
		L-	4	Light drizzle	
		L	5	Moderate drizzle	
		L+	6	Heavy drizzle	
		ZL-	7	Light freezing drizzle	
		ZL	8	Moderate freezing drizzle	
		ZL+	9	Heavy freezing drizzle	

CARD CONTENT					
COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
27	Frozen Precipitation		0	None	
		S-	1	Light snow	
		S	2	Moderate snow	
		S+	3	Heavy snow	
		SP-	4	Light snow pellets	
		SP	5	Moderate snow pellets	
		SP+	6	Heavy snow pellets	Code 7, IC - and code 9, IC +; intensity reported prior to 1 Apr 63
		IC	8	Ice crystals	
28	Frozen Precipitation		0	None	
		SW-	1	Light snow showers	
		SW	2	Moderate snow showers	
		SW+	3	Heavy snow showers	Codes 4, 5 and 6, light, moderate and heavy snow squalls reported prior to 1949.
		SG-	7	Light snow grains	
		SG	8	Moderate snow grains	
		SG+	9	Heavy snow grains	
29	Frozen Precipitation		0	None	Prior to 1 Apr 70 Ice Pellets were coded as Sleet (E-, E, E+). On this date Sleet and Small Hail were redefined as Ice Pellets. Ice Pellet Showers (IPW) are coded as Ice Pellets; Sleet Showers were coded as Sleet. Hail intensities reported prior to 1 Sep 56: Codes 4, 6, 7, and 9, A-, A+, AP- and AP+.
		IP-	1	Light Ice Pellets	
		IP	2	Moderate Ice Pellets	
		IP+	3	Heavy Ice Pellets	
		A	5	Hail	
		AP	8	Small Hail	Deleted 1 Apr 70; redefined as Ice Pellets.
30	Obstructions to Vision		0	None	SUPPLEMENTARY NOTE E, Page 10 explains the reporting practices of these elements. OBSTRUCTIONS TO VISION are recorded only when the visibility is less than 7 miles.
		F	1	Fog	
		IF	2	Ice fog	
		GF	3	Ground fog	
		BD	4	Blowing dust	
		BN	5	Blowing sand	
31	Obstructions to vision		0	None	
		K	1	Smoke	
		H	2	Haze	
		KH	3	Smoke and haze	
		D	4	Dust	
		BS	5	Blowing snow	
		BY	6	Blowing spray	Effective 1 Jul 52.

CARD CONTENT					
COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
32-35	Sea Level Pressure	PPPP	0000- 9999	Millibars and tenths 0000 = 1000.0 mb 9999 = 999.9 mbs.	Thousands digit not punched. Antarctic stations, see SUPPLEMENTARY NOTE H, page 11. AWS punched 3-hourly only effective 1 Jul 58.
36-38	Dew Point Temperature	$T_dT_dT_d$	000-099 X01-X99	0 to 199 Whole degrees F. -1 to -99 X in Column 36 for negative values.	Before 1949, dew point was computed with respect to ice if temperature was below 32°F. Beginning Jan 49, it was computed with respect to water regardless of temperature.
39-40	Wind Direction	dd	00-36	True direction, in tens of degrees, from which wind is blowing (Code 1, page 12 eff. 1 Jan 64)	Prior to 1964, wind directions were reported according to Code 2, page 12. See SUPPLEMENTARY NOTE H, page 11, for punching procedures at Admundsen-Scott Station, Antarctica.
41-42	Wind Speed	ff	00-99 X/	Knots X overpunch in Column 41 indicates 100 or more knots	Prior to Jan 55 in miles per hour at AF and WB stations; in knots at most Navy stations.
43-46	Station Pressure	PPPP	1000- 3999	10.00 to 39.99 inches to Hundreds H_g.	Station pressure is the pressure at the assigned station elevation. AWS punched 3-hourly only effective 1 Jul 58, 6-hourly effective 1 Jan 64, and 3-hourly eff. on receipt of order dated 1 Jun 65.
47-49	Dry Bulb Temperature	TTT	000-199	Whole degrees F. 0 to 199	
			X01-X99	-1 to -99	Column 47 punched X or X overpunch for values below zero.
			$\frac{X}{100} - \frac{X}{199}$	-100 to -199	
50-52	Wet Bulb Temperature		000-199 X01-X99	Whole degrees F. 0 to 199 -1 to -99	Column 50 punched X for minus. AWS began phasing out punching wet bulb data 1 Jul 58. WB and Navy discontinued punching wet bulb data 1 Jan 65. See SUPPLEMENTARY NOTE F, page 10 for hygrothermometer input. For methods of computation of wet bulb temperature and relative humidity, refer to page 13.
53-55	Relative Humidity	RH	000-100	0 to 100 whole percent	AWS discontinued punching Columns 53-55 1 Jul 58. WB discontinued punching Columns 53-55 1 Jan 65. NWS, effective 1 Apr 70, RH is punched only when entered on Form 1-10B; entry of RH on form is optional. Relative humidity computations respect to ice, etc. reporting practices explained in SUPPLEMENTARY NOTE F, page 10.
56-79	Clouds and Obscuring Phenomena				See SUPPLEMENTARY NOTE G, page 11 for information on cloud layers.
56	Total Sky Cover		0-9 X	Tenths 10 Tenths	

CARD CONTENT					
COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
57	Amount of Lowest Layer		0-9	Tenths	Weather Bureau stations reported detailed cloud observations(Cols. 56-78) only every 3 hours, based upon the time of synoptic observations, until June 1951 and Jan 1965-present. Only Col. 56, Total Sky Cover, was punched for the intermediate observations. Beginning Jun 51, complete cloud observations were reported and punched (Cols.56-79) for every record obs. as was the practice with Air Force and Navy stations. In all cards of FAA(CAA) stations, Cols. 57-78 are not punched. Note: Air Force stations coverage beginning 1 Jul 58, Cols. 57-79 were reduced from hourly to 3-hourly punching. Except for Korean and down range stations, punching of Cols. 58-61 and 63-79 was discontinued on 1 Jan 64 and Cols. 57 and 62 on 1 Jul 65.
			X	10 Tenths	
58	Type of Cloud Lowest Layer		0	None/clear	
		F	1	Fog	
		St	2	Stratus	
		Sc	3	Stratocumulus	
		Cu	4	Cumulus	
		Cb	5	Cumulonimbus	
		As	6	Altostratus	
		Ac	7	Altocumulus	
		Ci	8	Cirrus	
		Cs	9	Cirrostratus	
		Stfra	X/2	Stratus Fractus	Sf was contraction prior to 1 Apr 70. Fs (Fractostratus) prior to 1 May 61.
		Cufra	X/4	Cumulus Fractus	Cf was contraction prior to 1 Apr 70. Fc (Fractocumulus prior to 1 May 61.
		Cbmam	X/5	Cumulonimbus mamma	Cm was contraction prior to 1 Apr 70.
		Ns	X/6	Nimbostratus	
		Accas	X/7	Altocumulus castellanus	Acc was contraction prior to 1 Apr 70.
		Cc	X/9	Cirrocumulus	
			X	Obscuring phenomenon other than fog	
59-61	Height of Lowest Layer		000-990	Hundreds of feet 0 to 99,000 ft.	
			888	Unknown height of a cirroform layer	Effective 1 Sep 56 through 31 Mar 70.
			XXX	Unlimited vertical visibility	Clear, no clouds reported or surface based partial obscuring phenomena (first layer only).
62	Amount of Second Layer		0-9	Tenths	
			X	10 tenths	
63	Type of Second Layer		0-9	See Column 58	
			X/		
64-66	Height of Second Layer			See Columns 59-61	

CARD CONTENT

COLUMN	ITEM OR ELEMENT	SYMBOLIC LETTER	CARD CODE	CARD CODE DEFINITION	REMARKS
67	Summation Amount at Second Layer		0-9 X	Tenths 10 tenths	
68	Amount of Third Layer		0-9 X	Tenths 10 tenths	
69	Type of Third Layer		0-9 X/	See Column 58	
70-72	Height of Third Layer			See Columns 59-61	
73	Summation Amount at Third Layer		0-9 X	Tenths 10 tenths	
74	Amount of Fourth Layer		0-9 X	Tenths 10 tenths	
75	Type of Fourth Layer		0-9 X/	See Column 58	
76-78	Height of Fourth Layer			See Columns 59-61	
79	Total Opaque Sky Cover		0-9 X	Tenths 10 tenths	Effective Jun 51. 1 Jun 62 - Opaque Sky Cover was re-defined: Those portions of cloud layers or obscurations which hide the sky and/or higher clouds. Translucent sky cover which hides the sky but through which the sun and moon (not stars) may be dimly visible will be considered as opaque. 1 Apr 70 - Opaque Sky Cover: The amount (to the nearest tenth) of cloud layers or obscuring phenomena (aloft or surface-based) that completely hides all or a portion of the sky and/or higher clouds that may be present.
80	Not used				

METHODS FOR DETERMINING INTENSITY OF WEATHER

THUNDERSTORM

1945 -

THUNDERSTORM - Characterized by occasional or fairly frequent flashes of lightning; weak to loud peals of thunder; rainfall, if any, light or moderate, and rarely heavy; hail, if any, light or moderate; wind not in excess of 40 miles per hour or 35 knots; and no large temperature drop with passage of the storm.
Note: Wind speed changed to knots on 1 Jan 1955.
1 Jul 68 - Redefined. A thunderstorm is a local storm produced by cumulonimbus cloud, and is always accompanied by lightning and thunder, usually with strong gusts of wind, and sometimes with hail. The intensity of a thunderstorm is based on the following characteristics, observed within the previous 15 minutes: Wind gusts less than 50 knots and hail, if any, less than 3/4 inch in diameter.

HEAVY THUNDERSTORM - Characterized by nearly incessant, sharp lightning; loud peals of almost continuous thunder; heavy rain showers; hail of any intensity; wind in excess of 40 mph (35 knots) as the storm passes overhead; and a rapid drop of temperature, as much as 20°F in 5 minutes with the passage of the storm.
1 Jul 68 - Redefined as SEVERE THUNDERSTORM. The intensity is based on the following characteristics, observed within the previous 15 minutes: Wind gusts of 50 knots or greater or hail, 3/4 inch or greater.

GUSTS OF WIND

1945 - 1951

*RAIN SQUALLS,*SNOW SQUALLS, SQUALLS

Light - Gusts of 24 mph or less (21 knots)
Moderate - Gusts of 25-39 mph (22-34 knots)
Heavy - Gusts of 40 mph or more (35 knots)
*Squalls reported separately after 1948.
Intensity of squalls discontinued 1 Jun 51

GUSTS OF WIND (CONTINUED)

1 Jun 51 - A SQUALL is a strong wind that increases suddenly in speed, maintains a peak speed of 19 mph (16 knots) or more over a period of two or more minutes, and decreases in speed; similar fluctuations will occur at succeeding intervals. (reported if occurred within 15 minutes of time of observation)
1 Apr 70 - A SQUALL is a sudden increase of wind speed by at least 16 knots and rising to 22 kts or more and lasting for at least one minute. (reported if occurred within 10 min. of obs)

RATE OF FALL

1945 -

RAIN, RAIN SHOWERS, FREEZING RAIN

Also DRIZZLE (1945-1946), SNOW, SNOW SHOWERS, SNOW PELLETS, when accompanied by other precipitation or obstructions to vision.

Light - Trace to 0.10 inch per hour; maximum 0.01 inch in six minutes.

Moderate - 0.11 to 0.30 inch per hour; more than 0.01 to 0.03 inch in six min.

Heavy - More than 0.30 inch per hour; more than 0.03 inch in six minutes.

When measurement of rate of fall was impracticable, the intensity was determined visually.

Jan 47-May 51, whether alone or not, and after May 51, when accompanied by other precipitation or obstructions to vision.

DRIZZLE, FREEZING DRIZZLE

Light - Trace to 0.01 inch per hour
Moderate - More than 0.01 to 0.02 inch/hour
Heavy - More than 0.02 inch per hour.

RATE OF FALL AND ACCUMULATION

1946 -

HAIL,*SMALL HAIL,*SLEET,*ICE PELLETS

1 Apr 70 -*Sleet and*Small Hail redefined as *Ice Pellets

Light - Few pellets falling with no appreciable accumulation.
Moderate - Slow accumulation.
Heavy - Rapid accumulation.

VISIBILITY PRECIPITATION

SNOW, SNOW SHOWERS, SNOW PELLETS, DRIZZLE, FREEZING DRIZZLE, SNOW GRAINS
(when occurring alone)

Light - Visibility 5/8 mile or greater
Moderate - Visibility 5/16 - 1/2 mile, inclusive
Heavy - Visibility 1/4 mile or less

1946 - For all forms of snow, when occurring alone, intensity was determined by visibility, as shown above. Intensity of drizzle, when occurring alone, was determined by visibility in 1945-1946 and after May 1951 -

ICE CRYSTALS with an intensity of greater than "very light" will be rarely observed. Above criteria were referred to if needed.
1 Apr 63 - Reporting of intensities of ICE CRYSTALS was discontinued.

HAZE

1945 -

HAZE - Visibility 6 miles or less, but rarely below 3 miles.
DAMP HAZE - Visibility 6 miles or less, but rarely as low as 1 1/4 miles. Not reported after 1948.

NOTE: The intensity "Very light" (less than "Light") was not used before June 1951. It is punched as "Light" for all elements.

SUPPLEMENTARY NOTE A: OBSERVATION TIME Columns 12-13
The time punched is that of the record observations, taken within 10 minutes prior to the hour punched (ex. 1355 punched 14). Prior to Jun 57, obs. were taken within 10 minutes prior to the half hour; minutes are disregarded in punching (ex. 0222 punched 02; 1428, 14. All "War Times" and "Standard Meridian Times" were converted to Local Standard Time before punching. For Air Force stations in the United States, the times were punched in accordance with the established time zones. Time entries for Air Force stations outside the United States were edited prior to punching and where necessary converted to the Local Standard Time of the nearest meridian evenly divisible by 15 degrees.

SUPPLEMENTARY NOTE B: CEILING HEIGHT Columns 14-16
Ceiling was recorded in hundreds of feet above the ground to nearest 100 feet up to 5000 feet, to nearest 500 feet up to 10,000 feet, to nearest 1000 feet above that. Before 1949, Air Force stations recorded ceilings up to and including 20,000 feet, above which point the ceiling was classified as unlimited; Weather Bureau and Navy stations recorded ceiling only up to and including 9,500 feet, above which point the ceiling was considered unlimited. Beginning in 1949, ceiling was re-defined to include the vertical visibility into obscuring phenomena not classified as thin, that, in summation with all lower layers, cover 6/10 or more of the sky. Also at that time all limits to height of ceiling were removed, so that unlimited ceiling became simply less than 6/10 sky cover, not including thin obscuration. Then, beginning 1 Jun 51, ceiling heights were no longer established solely on the basis of coverage. The ascribing of ceilings to thin broken or overcast layers was eliminated. A layer became classified as "thin" if the ratio of transparency to total coverage at that level is ½ or more.

SUPPLEMENTARY NOTE C: SKY CONDITIONS Columns 17-20
Jan 1945-Dec 1948: If there is only one cloud symbol, except for low scattered and obscured, Column 17 was punched with appropriate code, Cols. 18-19 with "X" and Col. 20 was left blank. If clouds were high (above 9,500 ft.) Col. 17 was X overpunched. If clouds were low scattered, "0" was punched in Col.17, height in Cols. 18-19, and code in Col. 20. Cols. 18-19 were left blank if height was missing. When two cloud symbols were reported, the higher cloud was punched in Col.17 and the lower in Col. 20. In 1946, obscured

(continued on next page)

TABLE OF SKY CONDITIONS

The table below shows the punching practices in Columns 17-20 for the periods Jan 45 through Dec 48, and Jan 49 through May 51.

SKY CONDITION	REMARKS	1945-1948 17	18	19	20	1949-5/51 17	18	19	20
Clear ○		0	X	X	0	0	X	X	0
Low Scattered ◑ at 2500 ft		0	2	5	2	0	2	5	2
High Scattered ◑ /(over 9500 ft)		X/2	X	X		0	9	9	2
Hi Sctd Lwr Sctd ◑/95 ◑ at 9500 ft		X/2	9	5	2	2	9	5	2
Broken at 12000 ft 12 ◍		5	X	X		0	X	X	5
High Brkn Lwr Brkn ◍/◍ Ceiling 5000 ft		X/5	X	X	5	5	X	X	5
High Ovc Lwr Sctd at 2500 ft ⊕/◑		X/8	2	5	2	8	2	5	2
High Ovc Lwr Brkn ⊕/◍		X/8	X	X	5	8	X	X	5
Overcast ⊕		8	X	X		0	X	X	8
Ovc Sctd at 3000 ft ⊕ 30 ◑		8	3	0	2	8	3	0	2
Ovc Brkn at 2500 ft ⊕ 25 ◍		8	X	X	5	8	X	X	5
Obscured X		0	X	X	X	0	X	X	X
Thin Obscured -X		0	X	X		0	X	X	

SUPPLEMENTARY NOTE C (Continued)

sky was reported only when heavy obstructions to vision and/or heavy precipitation reduced the ceiling to zero and/or the visibility to less than ¼ mile; and when the visibility was ¼ mile or more, a sky symbol was always reported. Effective 1 Jan 47, the symbol "X", for obscured sky, received the same latitude of usage as all other symbols. "X" then represented sky cover of 6/10 or more, obscured by precipitation or obstructions to vision either alone or in combination with lower clouds, and irrespective of higher clouds and ceiling and/or visibility limits. In August 1947, the use of "-X", for thin obscured, was authorized. In 1946 if a layer of scattered clouds above a layer of broken clouds was clearly observable, it was so reported. In 1947 and 1948, symbols corresponding to higher cloud layers indicated the amount of sky covered not only by their respective layers, but by all layers below them. In all years, the presence of few clouds (less than 1/10) was recorded in Remarks.

Jan 49 through May 51: When only one sky symbol was reported it was punched in Col. 20. The use of an "X" overpunch for high (/) layers was discontinued. (/ indicates over 9500 ft). The height of scattered clouds above 9500 ft was punched in Cols. 18-19 as 99.

Effective 1 Jun 51, the reporting of height of low scattered was discontinued, and provision was made to report any number of sky condition symbols, with the height of each. The ceiling layer was not reported separately as before, but was identified by the entry of a ceiling classification letter immediately preceding the height. Sky condition symbols were reported in ascending order of height, and were punched in that order, unless more than four were reported. In that case, the last (highest) symbol was punched in Column 20, and the first three in Columns 17-19, unless the ceiling symbol was thereby excluded. In the latter case, the first two symbols were punched in Columns 17-18, the ceiling symbol in Column 19, and the highest symbol in Column 20. No symbols were reported in Remarks, as was the practice before June 1951.

Sky condition symbols were also re-defined so that obscuring phenomena aloft and clouds were reported in the same manner (i.e., obscuring phenomena aloft were reported by 0, 0, and 0, rather than X and -X). X and -X were used only to indicate the amount of sky hidden by surface-based phenomena. -X was re-defined as partial obscuration (1/10 to less than 10/10 sky hidden). The symbols X and -X unlike 0, 0, and 0, were defined by the amount of the sky hidden by surface-based phenomena, and -X did not indicate the amount of sky covered. The meaning of "thin" was re-defined. If the total opaque cover created by any layer in combination with lower layers was ½ or less of the summation total cover at that level, the layer was classified as thin. Note that the minus sign, when applied to 0, 0, or 0 means "thin"; when applied to X, means "partial".

SUPPLEMENTARY NOTE D: INTENSITY OF DRIZZLE Column 26

In 1946, intensity determined by visibility (as for smoke) only if drizzle occurred alone. When drizzle was accompanied by other forms of precipitation and/or obstructions to vision, its intensity was determined by rate of fall. In 1947, visibility limitations were dropped, and intensity was determined by rate of fall, even though drizzle occurred alone. In June 1951, previous visibility limits were reinstituted. Intensity of freezing drizzle determined in same manner as for drizzle. See page 8 for limits of intensities.

SUPPLEMENTARY NOTE E: OBSTRUCTIONS TO VISION Columns 30-31

Intensity of light, moderate, or heavy were assigned to obstructions to vision, through 1946. Effective Jan 47, the reporting and punching of all intensities of obstructions to vision were discontinued. Prior to 1 Jan 49, the distinction between F and GF was arbitrary, but beginning with that date an objective distinction was established. If the sky was not hidden above an angle of 33° from horizontal (less than 0.6 hidden), the fog was reported as ground fog (GF). Effective 1 Apr 70, Fog (F)-Ground Fog (GF): This hydrometeor is reported as F when it hides more than half (0.5-1.0) of the sky or extends upward into existing cloud layers. Otherwise it is reported as GF.

SUPPLEMENTARY NOTE F: WET BULB TEMP. & RH Columns 50-55

From Aug 60 - Dec 64 at WB stations with a hygrothermometor, wet-bulb temp. was computed and punched at NCC when instrument was operational above -35°F; when non-operational or -35°F and lower, the wet-bulb temp. was punched at the station from values obtained from standby equipment. At stations not equipped with a hygrothermometer, the wet bulb temperature is considered to be the same as the dry bulb temperature whenever the dry bulb temperature is below -35°F. The same value is entered in parenthesis on the WBAN with dew point being computed in

SUPPLEMENTARY NOTE F (Continued)

respect to water and this value punched into WBAN Card. The relative humidity would then be computed by machine, same as for stations equipped with a hygrothermometer.

Prior to Jan 49, relative humidity computed with respect to ice if the dry bulb temperature was less than 32°F. Beginning Jan 49, computed with respect to water, regardless of temperature. Relative humidity machine calculated from 1 Aug 60. RH was not punched for FAA (CAA) stations except in special cases.

SUPPLEMENTARY NOTE G: CLOUD LAYERS Columns 56-79

Provisions are made for punching as many as four layers of clouds and/or obscuring phenomena existing at one time. If more than four layers existed, the data for levels above the fourth were entered in the Remarks portion of WBAN 10B, and were not punched. Their presence is indicated by the entry for total sky cover. Layers were punched in ascending order of elevation. All fields above a layer which prevented observation were left blank. If two or more types of clouds were observed at the same height, only the predominating type was punched, their amounts being combined. For each layer, the amount, type, and height were punched, and for the second and third layer, the summation amount at the level involved was punched, reflecting the total amount of sky covered by that layer and those below it. The summation total is not necessarily the sum of the individual layers.

In addition to the total sky cover, provision was made in Jun 51 for recording and punching the total amount of opaque sky cover, which is the amount of sky hidden by clouds or obscuring phenomena, as distinguished from the total amount of sky cover.

The height of the layers of clouds or obscuring phenomena aloft was recorded in hundreds of feet, and for fully obscuring phenomena based on the ground, the vertical visibility into it was recorded, with no prescribed limit. All heights were recorded to the nearest 100 feet from the surface to 5,000 feet; to the nearest 500 feet between 5,000 and 10,000 feet; and to the nearest 1,000 feet above 10,000 feet. For obscuring phenomena prescribed as "thin", a condition reportable from Aug 47 through May 51, the height of the base was punched, and in the case of thin fog, was always zero. Before Jan 47, obscuration was not reportable as a cloud type.

SUPPLEMENTARY NOTE G (Cont.) Columns 56-79

Some Weather Bureau and Navy cards in this deck were punched from the old type of reporting form (the WBAN 10 with which deck 142 is aligned) and in which five cloud layers were reported with no summation totals. In these cases, the summation total columns were left blank, and the five layers, if reported, were condensed into four.

SUPPLEMENTARY NOTE H: ANTARCTICA STATION NOTES Columns 32-35, 39-40

I. ADMUNDSEN-SCOTT STATION:

1. Wind Direction on all cards was punched according to the following system:

   A. A wind from 0° longitude was punched as N or 360.
   B. A wind from 90° east longitude was punched as E or 090.
   C. A wind from 180° longitude was punched S or 180.
   D. A wind from 90° west longitude was punched W or 270.

2. In place of sea level pressure (Column 32-35) the height of the 700 mb surface in whole meters was punched. This applies to the period 1 Dec 57 through Jan 66. Station pressure in millibars and tenths punched beginning Feb 66.

II. BYRD STATION, ANTARCTICA

1. In place of sea-level pressure (Columns 32-35) the height of the 850 mb surface was punched in whole meters through Jan 66. Station pressure in millibars and tenths punched beginning Feb 66.

III. PLATEAU STATION, ANTARCTICA 12/65-12/68

1. In place of sea-level pressure (Columns 32-35) the height of the 700 mb surface was punched in whole meters through Jan 66. Station pressure in millibars and tenths punched beginning Feb 66.

CODE TABLES

When coding a meteorological report, symbolic letters are replaced by figures, which specify the value or the state of the corresponding element. In some cases, the specification of the symbolic letter (or group of letters) is sufficient to permit a direct transcription into figures (e.g., GG or PPP). In other cases, these figures are obtained by means of a special code table (or code, in short) for each element.

The codes elaborated to this end, as far as they are in world-wide use, are called international meteorological code tables. These same codes are used inversely for decoding observations and thus making available the information contained in them.

Besides the specifications given by the code tables in world-wide use, other sets of code tables are established by the WMO for regional use. Further arbitrary codes have been made necessary by the use of data in card decks which were never encoded into WMO forms.

Only codes pertinent to this card deck are included in the present manual. They appear in the order in which the elements were introduced in the description of the card content. They are numbered consecutively, and if applicable, the corresponding WMO code numbers are shown.

Code 1

(1949 WMO Code 23)
(1960 WMO Code 0877)

dd - True direction, in tens of degrees, from which wind is blowing (or will blow)

Code figure		Code figure	
00	Calm	19	185° - 194°
01	5° - 14°	20	195° - 204°
02	15° - 24°	21	205° - 214°
03	25° - 34°	22	215° - 224°
04	35° - 44°	23	225° - 234°
05	45° - 54°	24	235° - 244°
06	55° - 64°	25	245° - 254°
07	65° - 74°	26	255° - 264°
08	75° - 84°	27	265° - 274°
09	85° - 94°	28	275° - 284°
10	95° - 104°	29	285° - 294°
11	105° - 114°	30	295° - 304°
12	115° - 124°	31	305° - 314°
13	125° - 134°	32	315° - 324°
14	135° - 144°	33	325° - 334°
15	145° - 154°	34	335° - 344°
16	155° - 164°	35	345° - 354°
17	165° - 174°	36	355° - 4°
18	175° - 184°		

Code 2

dd - Wind Direction

Code Figure	C		
00		Calm	
11	↓↓	North	349° - 11°
12	↓↙	North Northeast	12° - 33°
18	↓↘	North Northwest	327° - 348°
22	↙↙	Northeast	34° - 56°
32	←↙	East Northeast	57° - 78°
33	←←	East	79° - 101°
34	←↖	East Southeast	102° - 123°
44	↖↖	Southeast	124° - 146°
54	↑↖	South Southeast	147° - 168°
55	↑↑	South	169° - 191°
56	↑↗	South Southwest	192° - 213°
66	↗↗	Southwest	214° - 236°
76	→↗	West Southwest	237° - 258°
77	→→	West	259° - 281°
78	→↘	West Northwest	282° - 303°
88	↘↘	Northwest	304° - 326°

Code 3

VVV - Visibility (Statute Miles)

Code	Miles	Code	Miles
000	0	012	1-1/8
001	1/16	014	1-1/4
002	1/8	016	1-3/8
003	3/16	017	1-1/2
004	1/4	018	1-5/8
005	5/16	019	1-3/4
006	3/8	020	2
007	1/2	024	2-1/4
008	5/8	027	2-1/2
009	3/4	030-150	3-15 *1 mile
010	1	150-950	15-95 *5 mile
		990	100 or more

*increments

COMPUTATION OF WET BULB

Dry Bulb zero and above

$TW = T - (.034N - .00072N\,[N - 1])\ (T + Tdp - 2P + 108)$

If temperature is less than 100°

TW Rounded = TW + .9 if col. 48 is 0, 1, 2
TW + [.9 - .01 (T + .9)] if col. 48 is 3, 4
TW + .4 if col. 48 is 5 through 9

If temperature is 100° or greater:

TW Rounded = TW + .9.

for Dry Bulb temperatures less than zero:

$TW = T - (.034N - .006N^2)\ (.6[T + Tdp] - 2P + 108)$

TW Rounded = TW - .01Tdp

T = dry bulb temperature in °F

TW = wet bulb in °F

Tdp = dew point in °F

$N = \frac{T - Tdp}{10}$

P = Station pressure measured in inches of mercury

In all cases TW should be computed to at least two decimal places prior to applying the rounding factor.

COMPUTATION OF RELATIVE HUMIDITY

$$RH \cong \left(\frac{173 - .1T + Tdp}{173 + .9T}\right)^8$$

Where T = Air Temp. in °F
T_{dp} = Dew Point Temp. in °F

Reference to the above formula may be found in "An Approximation Formula to Compute Relative Humidity from Dry Bulb and Dew Point Temperatures" by Julius F. Bosen, Monthly Weather Review, Vol. 86, No. 12, Dec. 1958, page 486.

OTHER CARD DECKS CONTAINING HOURLY OBSERVATIONS

DECK		GENERAL PERIOD
019	London Airport Hourly Surface	1948-1961
021	USAAF in Great Britain Surface	1942-1946
132	Canadian Hourly Surface Obs.	1946-1951
134	Canadian Hourly Surface Obs.	1951-1953
135	Canadian Hourly Surface Obs.	1950-1967
139	Japanese Airway Obs. Hourly Sfc.	1958-1961
141	WBAN Hourly Surface Obs.	1937-1945
142	WBAN Hourly Surface Obs.	1945-1948
156	British Hourly Obs.	1941-1948
157	Turkish Hourly Surface Obs.	1950-1959
158	German Hourly Obs. GZMO	1955-1961
158	German Hourly Obs. GZMO	1962-1964
159	Korean Hourly Obs. ROK	1954-1964
159	Korean Hourly Obs. ROK	1965-1967
160	Azores Hourly Obs.	1951-1955
171	Nanking Hourly Obs.	1928-1937
172	Yungan Hourly Obs.	1938-1942
175	Taichung Hourly Obs.	1952-1956
928	Hourly Marine Sfc OSV's	1965-1970

ELEMENTS (ITEMS) PUNCHED

	Page		Page
CEILING	2	SKY CONDITION	2
CLOUDS (4 layers) Amount, Type, Height	6	STATION NUMBER	2
Amount Total	5	TEMPERATURE	
Amount Total Opaque	7	Dew Point	5
		Dry Bulb	5
DATE		Wet Bulb	5
Yr Mo Day Hour	2		
		VISIBILITY	3
HUMIDITY Relative %	5		
		WEATHER AND/OR OBSTRUCTIONS TO VISION	3-4
PRESSURE			
Sea Level	5		
Station	5	WIND	5

CARD DECK 144 ACRONYMS

AF	Air Force
AWS	Air Weather Service
CAA	Civil Aeronautics Administration (same as FAA)
ESSA	Environmental Science Services Administration (NOAA after 3 Oct 1970)
ETAC	Environmental Technical Applications Center
FAA	Federal Aviation Administration (formerly CAA)
GZMO	German Zonal Meteorological Organization
GMT	Greenwich Mean Time
ID	Identification (cards)
METAR	Meteorological Aviation Routine Weather Report
MF	Meteorological Form
NCC	National Climatic Center (formerly National Weather Records Center (NWRC))
NNWS	NOAA National Weather Service (formerly WB)
NOAA	National Oceanic and Atmospheric Administration (eff. 3 Oct 1970)
NWS	Naval Weather Service
OSV	Ocean Station Vessel
ROK	Republic of Korea
USAF	United States Air Force
WB	Weather Bureau (changed to NNWS 3 Oct 1970)
WBAN	Weather Bureau - Air Force - Navy
WMO	World Meteorological Organization

USCOMM-NOAA-ASHEVILLE

APPENDIX II. Example Input for HEC-5Q Interface

```
TI PROGRAM WEATHER INPUT
TI FOR HEC-5Q OUTPUT OPTION
TI MORGANTOWN WEATHER DATA TEST
C1    85     12      31      86      01      01       0       0
1373685123101---0--00400000000103150057603290601901705 40
1373685123104---0--00300000000103080100000290401601507 70
1373685123107   0--50600000000102950115404289901601508 08
1373685123110---09910600000000102710247604289403803205 72
13736851231131800--51500000000002300277609288404803904 47
13736851231161400--81000000000002170297703287904503805 3-
13736851231191000--80500000000101900253403287104003405 5-
13736851231220700--80600000000101660243406286604003405 2-
13736860101010650--80500100000101220305608285504603905 3-
13736860101040188122030004000010098041550428480420410 96-
13736860101070080--80500040000100980436610284804404409 6-
13736860101100088--50500000000101050427610285004504408 9-
13736860101130120--81200000000001050395610285004504207 9-
13736860101160168--51500000000001220357809285504203907 6-
13736860101190230--80700000000001490327609286203803507 9-
13736860101220180--80900000000001590297708286503403208 2-
```

APPENDIX III. Example Input for WQRRS Interface

```
TI PROGRAM WEATHER INPUT
TI FOR WQRRS OUTPUT OPTION
TI MORGANTOWN WEATHER DATA TEST
C1    85     12      31      86      01      01       1       0
1373685123101---0--00400000000103150057603290601901705 40
1373685123104---0--00300000000103080100000290401601507 70
1373685123107   0--50600000000102950115404289901601508 08
1373685123110---09910600000000102710247604289403803205 72
13736851231131800--51500000000002300277609288404803904 47
13736851231161400--81000000000002170297703287904503805 3-
13736851231191000--80500000000101900253403287104003405 5-
13736851231220700--80600000000101660243406286604003405 2-
13736860101010650--80500100000101220305608285504603905 3-
13736860101040188122030004000010098041550428480420410 96-
13736860101070080--80500040000100980436610284804404409 6-
13736860101100088--50500000000101050427610285004504408 9-
13736860101130120--81200000000001050395610285004504207 9-
13736860101160168--51500000000001220357809285504203907 6-
13736860101190230--80700000000001490327609286203803507 9-
13736860101220180--80900000000001590297708286503403208 2-
```

APPENDIX IV. Example Output for HEC-5Q Interface

```
10 61010 9 2 9 9 5 510 9 9 5 510 8 7 5101010 6 7101010 710101010 3 6
 41010 810 3 9 9 410 110101010 4 5 910 6 4 8 9 2 5 4 8 910 8 9 5 4 9
10 8 5 910 3 5101010 8 5 9 3 0 4 8 4 9 210 710 810 310 1 5 3 5 1 2 8
 0 1 2 6 6 0 2 1 6 7 5 3 410101010 5 310 6 8 6 61010 5 0 710 2 71010
 8 910 8 6 6 3 7 4 910 3 81010 91010 5 3 3 9 4 3 2 3 5 6 7 5 810 6 4
 91010 6 81010 7 0 5 8 710 3 7 8 3 61010 610 9 8 6 5 710 5 2 2 61010
 9 9 8 010 8 810 9 7 5 1 1 910101010 8 3 7 7 810 7 4 1 2 0 0 2 5 5 7
 9 8 8 7 2 41010 5 3 8 2 0 0 6 7 2 1 0 81010 9 7 5 9 8 3 510 7101010
 6101010 5 4 1 8101010 7 2 1 4 0 3 7 9 1 910 8 2 81010 9 7 3 01010 4
 4 8 2 9 3 8 9 6 81010 8 4 7 0 3 3 4 3 910 9 9 7 8 910 9 7 6 9 7 7 1
 710 8 6 81010 5 0 7 7 9 0 71010 510 3 810 910 9 9 4
 5 5 812 6 3 4 811 3 8 8 912 810 9 5 6 81111 410 711 6 910 6 61011 4
 8 5 3 910 61111 8 9 612 8 91114 51211 912 9 8 7 7 9 6 7 9 8131011 7
 7 7 6101210 6 810 6111112 7 4 8 7 614 7 7 7 610 8 5 9 7 7 5 8 7 6 9
 7 5 3 7 5 4 4 4 4 710 6 6 810 8 7 5 4 4 911 8 9 8 8 3 5 5 8 5 4 6 5
 6 7 8101110 4 5 6 4 3 4 6 7 3 8 6 5 7 7 5 4 4 3 4 5 7 5 6 7 6 8 4 4
 6 4 3 4 4 4 7 4 4 5 6 9 9 7 7 4 3 3 6 4 3 51010 6 7 6 7 5 4 2 5 6 4
 7 6 4 2 4 3 6 5 4 5 3 2 3 6 4 6 4 3 3 3 5 5 6 3 3 2 3 4 5 3 3 2 4 4
 3 4 6 8 3 3 3 4 3 6 7 3 2 4 5 9 9 5 3 1 3 5 7 7 4 6 6 6 9 3 2 5 7 4
 3 4 5 4 2 5 4 6 6 5 7 6 3 4 9 811 5 5 4 6 611 9 5 8 7 9 4 6 7 3 9 6
 6 8 7 710 9 9 9 9 4 5 7 6 3 4 61110 5 6 8 9 5 911 8 6 9 8 711 2 6 3
 6 7 9 810 4 8 8 6 6 611 6 710111011 6 9 8 9 911 610
 31 39 35 14 11 23 36 15  4 12 31 26 39 31 27 31 14  7 20 33 25 17
 23 47 40 55 27 22 33 29 30 35  7 22 36 27 22 14 24 24 51 43 39 50
 32 54 58 58 57 46 42 57 41 25 46 57 56 51 54 60 58 64 68 68 63 36
 40 36 31 36 39 48 39 35 42 36 20 33 56 64 51 35 40 54 52 58 60 47
 55 63 55 41 35 47 48 39 48 48 41 36 44 40 33 44 53 64 70 71 75 72
 72 73 62 62 67 62 39 36 43 48 52 50 57 45 45 60 67 52 43 48 58 56
 48 60 70 69 65 60 45 44 60 65 56 54 56 50 49 57 64 62 65 68 65 62
 62 64 63 55 65 69 69 71 72 76 75 76 75 73 69 72 72 61 62 71 72 71
 69 70 70 72 74 69 62 66 66 66 67 66 63 67 68 63 75 68 64 68 76 69
 67 66 70 75 74 75 75 74 68 69 70 75 75 75 70 66 63 66 68 71 72 69
 63 65 68 71 74 74 71 68 68 64 68 70 69 70 70 71 76 78 75 73 72 71
 58 61 66 64 65 69 66 58 63 68 70 58 59 67 68 69 65 63 63 65 63 61
 59 53 62 59 59 65 66 55 54 54 57 59 61 61 66 66 55 52 50 49 51 52
 63 53 63 50 46 40 49 51 44 42 43 52 54 43 35 35 43 45 48 41 43 50
 43 35 42 44 30 39 45 39 36 33 34 36 33 40 44 51 38 36 31 30 27 41
 56 57 40 21 14 27 25 13 31 28 38 36 21 25 45 39 44 27 33 41 38 34
 35 45 45 20 23 29 17 37 31 24 36 21 21 15
 27 28 29  5  3  9 20 11 -2  3 27 18 30 18 11 23  5  0  3 28 19  9
 13 31 33 45 25 13 24 22 25 30 -6 11 23 22 17  7 16 15 26 30 19 40
 15 35 50 44 47 31 27 30 34 13 21 25 32 28 24 30 37 43 50 51 46 17
 17 17 19 25 25 31 30 17 22 22  5 18 35 43 40 15 21 26 38 43 43 27
 31 50 46 32 29 32 37 20 29 27 20 15 20 23 12 18 22 38 49 49 45 45
 46 51 44 41 42 47 24 18 24 27 27 36 37 25 19 31 44 47 31 33 38 49
 33 42 56 60 60 54 42 32 43 48 40 41 42 45 45 45 46 52 57 60 61 58
 49 42 42 48 52 54 55 56 59 62 63 63 65 62 60 62 64 61 60 61 61 63
 64 60 60 62 62 59 54 53 57 57 55 58 60 62 58 57 66 59 51 56 66 64
 54 51 54 60 64 65 66 63 53 53 61 65 65 67 64 56 48 50 53 58 64 65
 57 56 58 59 62 65 61 61 54 52 56 56 51 54 56 59 63 65 65 66 65 55
 43 45 54 58 55 57 55 45 43 54 59 48 43 49 51 54 55 59 58 57 54 57
 49 39 40 48 44 58 61 48 45 50 53 55 54 51 52 54 52 48 45 37 38 38
 47 26 38 32 30 24 25 41 28 20 23 45 49 28 21 21 20 31 42 26 22 31
 20 25 22 23 16 15 30 26 24 21 20 21 19 20 23 25 19 23 19 14 20 28
 35 48 35 13  4 11 17  2 20 19 19 32  9 12 24 31 38 10 11 19 26 21
 18 27 35  6  5 13  0 15 23  8 24  7  6  0
```

APPENDIX V. Example Output for WQRRS Interface

WEATH1	75 1 1 0	1.0	52.	50.	28.57	8.
WEATH1	75 1 1 1	1.0	50.	47.	28.57	6.
WEATH1	75 1 1 2	1.0	48.	46.	28.58	5.
WEATH1	75 1 1 3	1.0	47.	44.	28.60	9.
WEATH1	75 1 1 4	1.0	45.	42.	28.60	8.
WEATH1	75 1 1 5	1.0	43.	40.	28.62	9.
WEATH1	75 1 1 6	1.0	42.	40.	28.64	5.
WEATH1	75 1 1 7	1.0	42.	39.	28.65	11.
WEATH1	75 1 1 8	1.0	40.	37.	28.67	8.
WEATH1	75 1 1 9	1.0	40.	37.	28.67	9.
WEATH1	75 1 110	1.0	39.	38.	28.67	13.
WEATH1	75 1 111	1.0	39.	37.	28.66	14.
WEATH1	75 1 112	1.0	39.	36.	28.61	18.
WEATH1	75 1 113	1.0	39.	34.	28.58	11.
WEATH1	75 1 114	1.0	38.	34.	28.60	17.
WEATH1	75 1 115	1.0	37.	31.	28.60	17.
WEATH1	75 1 116	1.0	34.	31.	28.65	14.
WEATH1	75 1 117	0.9	32.	25.	28.69	18.
WEATH1	75 1 118	0.8	32.	24.	28.72	17.
WEATH1	75 1 119	1.0	31.	21.	28.77	17.
WEATH1	75 1 120	1.0	30.	18.	28.82	17.
WEATH1	75 1 121	1.0	29.	18.	28.84	14.
WEATH1	75 1 122	1.0	28.	18.	28.87	13.
WEATH1	75 1 123	1.0	27.	18.	28.91	11.
WEATH1	75 1 2 0	1.0	27.	18.	28.91	13.
WEATH1	75 1 2 1	1.0	27.	17.	28.95	13.
WEATH1	75 1 2 2	1.0	27.	18.	28.98	8.
WEATH1	75 1 2 3	1.0	26.	17.	29.02	10.
WEATH1	75 1 2 4	1.0	27.	17.	29.03	10.
WEATH1	75 1 2 5	1.0	27.	18.	29.04	9.
WEATH1	75 1 2 6	1.0	26.	19.	29.08	5.
WEATH1	75 1 2 7	1.0	27.	20.	29.10	6.
WEATH1	75 1 2 8	1.0	26.	20.	29.13	6.
WEATH1	75 1 2 9	1.0	28.	20.	29.15	4.
WEATH1	75 1 210	1.0	29.	21.	29.17	9.
WEATH1	75 1 211	0.8	30.	23.	29.17	5.
WEATH1	75 1 212	1.0	30.	22.	29.12	5.
WEATH1	75 1 213	0.4	31.	21.	29.08	4.
WEATH1	75 1 214	0.1	32.	21.	29.07	8.
WEATH1	75 1 215	0.2	34.	21.	29.10	9.
WEATH1	75 1 216	0.0	34.	21.	29.10	5.
WEATH1	75 1 217	0.1	32.	20.	29.09	4.
WEATH1	75 1 218	0.0	31.	20.	29.07	0.
WEATH1	75 1 219	0.0	29.	20.	29.06	0.
WEATH1	75 1 220	0.0	27.	21.	29.04	4.
WEATH1	75 1 221	0.0	27.	21.	28.98	5.
WEATH1	75 1 222	0.3	29.	21.	28.92	6.
WEATH1	75 1 223	0.7	29.	21.	28.89	5.
WEATH1	75 1 3 0	1.0	31.	21.	28.84	0.
WEATH1	75 1 3 1	1.0	34.	16.	28.81	9.
WEATH1	75 1 3 2	0.9	33.	21.	28.82	0.
WEATH1	75 1 3 3	1.0	31.	22.	28.79	0.
WEATH1	75 1 3 4	1.0	35.	16.	28.76	5.
WEATH1	75 1 3 5	1.0	30.	27.	28.75	4.