September 6, 2000

To: Design File
From: Stephen S. Leroy

Subject: Radiosonde Data in HDF-EOS Format PREPQC Files

This documents the contents of the NCEP-quality controlled radiosonde data as translated from the NCEP BUFR PREPQC format into HDF-EOS. Conversion is necessary in order to conform to EOS data format standards and because the BUFR format is a complex—and somewhat subjectively interpreted—data format. Because of the complexities of the BUFR PREPQC format and file organization, it is deemed necessary to truncate the contents of the translated radiosonde data. As part of this document, we provide a list of the data excluded along with the rationale for having excluded it. In Appendix A is a brief overview of the BUFR PREPQC files as published by NCEP. Appendix B contains a list of the truncated variables. Information on how to interpret quality control information is given in Appendix C. Appendix D contains a listing of the BUFR PREPQC radiosonde (ADPUPA) data description.

Here we list the final contents of the HDF-EOS file. Variables are translated from BUFR using their BUFR mnemonic names.

BUFR metadata—one value per subset:

HDF-EOS variable name	*BUFR variable mnemonic*	*data type*
bufr_master_table	n/a	integer
originating_center	n/a	integer
update_sequence_number	n/a	integer
data_category_type	n/a	integer
data_category_subtype	n/a	integer
master_table_version	n/a	integer
local_table_version	n/a	integer
year_of_century	n/a	integer
month	n/a	integer
day	n/a	integer
hour	n/a	integer
minute	n/a	integer
message_number	n/a	integer
subset_of_message	n/a	integer
observation	n/a	logical
compression	n/a	logical

Notes on the BUFR metadata. Note that the cycle time is most useful for the purposes of AIRS. The rest of the data refers to details of the BUFR format used to write the BUFR PREPQC file from which the HDF-EOS was translated. All of this is translated from section 1 of the ADPUPA messages. All data is retained.

- The bufr_master_table indicates the type of BUFR master table used. For WMO FM 94, which is used here, it is 0.
- The originating_center is a code for the center at which the BUFR file was composed. It is 775 for NCEP.
- The update_sequence_number is update number of this file. Mostly 0 to indicate it is the original version of the PREPQC file.
- The data_category_type is an index which describes the data category: It is 240 for ADPUPA (radiosonde, dropwinsonde, pi-balloon, reconnaissance data).
- The data_category_subtype is the data subtype. It is systematically 0 for ADPUPA data.
- The master_table_version is the version number of the BUFR master table used in writing the BUFR file. It is currently 4.
- The local_table_version is version number of the local BUFR look-up tables used. The NCEP look-up tables used here are version 0.
- The year_of_century, month, day, hour, minute refer to the cycle time of the quality-control programs run to generate this file. The year_of_century is actually the number of years elapsed since 1900.
- The message_number is the number of the message from which the particular ADPUPA sounding was extracted. The subset_of_message is the subset number of that message from which this sounding was extracted.
- The observation flag indicates whether this is observational data. Always 1 for ADPUPA data.
- The compression flag indicates whether this is BUFR compressed data. Always 0 for ADPUPA data.

Scalar data variables—one per radiosonde sounding:

Of the variables in the data section (section 4) of each BUFR message, we wish to keep the following:

HDF-EOS variable name	*BUFR variable mnemonic*	*data type*
station_id	SID	integer
longitude	XOB	float (degrees east)
latitude	YOB	float (degrees north)
observation_time_less_cycle_time	DHR	float (hours)
elevation	ELV	float (meters)
report_type	TYP	integer
office_note_29_report_type	T29	integer
report_subtype	TSB	integer
instrument_type	ITP	integer
report_sequence_number	SQN	integer
report_quality_mark	RQM	integer
message_number_of_duplicate	DUP	integer
solar_infrared_correction	SIRC	integer
number_of_levels	n/a	integer

Notes on the scalar data variables.

- The station_id is the WMO number of the radiosonde station. For sounding from non-WMO sites, such as a ship, oil platform, etc., the station_id is set to 0.
- The observation_time_less_cycle_time is time of the radiosonde sounding less the cycle time of the quality-control programs used to generate the BUFR file.
- The report_type, office_note_29_report_type, report_subtype, instrument_type are indexes referred to in Office Note 29 published by NCEP.
- The report_quality_mark indicates the overall quality of the radiosonde report. See Appendix B.
- The message_number_of_duplicate points to where in the BUFR data file this sounding is repeated. Mostly 0 for PREPQC files.

- The solar_infrared_correction indicates whether a correction has been applied to account for solar and infrared radiation effects on the radiosonde instrument package. Sometimes this correction is done at the radiosonde site, sometimes it is done at the NCEP processing center.

- The number_of_levels is the number of altitude/pressure levels in the radiosonde sounding.

Array variables—dimension 255 per subset:

HDF-EOS variable name	*BUFR variable mnemonic*	*data type*
level_type	CAT	integer
pressure	POB	float (millibars)
pressure_quality_marker	PQM	integer
pressure_program_code	PPC	integer
pressure_reason_code	PRC	integer
specific_humidity	QOB	float (mg/kg)
specific_humidity_quality_marker	QQM	integer
specific_humidity_program_code	QPC	integer
specific_humidity_reason_code	QRC	integer
specific_humidity_observation_error	QOE	float (mg/kg)
dewpoint_temperature	TDO	float (°C)
temperature	TOB	float (°C)
temperature_quality_marker	TQM	integer
temperature_program_code	TPC	integer
temperature_reason_code	TRC	integer
temperature_observation_error	TOE	float (°C)
height	ZOB	float (m)
height_quality_marker	ZQM	integer
height_program_code	ZPC	integer
height_reason_code	ZRC	integer
height_observation_error	ZOE	float (m)

Notes on the data array variables.

- Quality markers, program codes, and reason codes are the output of quality control programs run at NCEP. The quality marker is an overall indicator of the quality of the

particular level, the program code refers to the quality-control program from which the last quality indicator was obtained, and the reason code indicates the reason for the quality marker assigned. The description of the quality-control flags is given in Appendix C.

- All data which is forecast model dependent has been excluded. Also, all information related to wind data has been excluded. See Appendix B for a list of those variables.
- Even though the number of levels is stored as a byte, meaning an absolute maximum of 255 levels, a sounding with more than 100 levels is rarely—if ever—encountered.

Appendix A: The Organization of the PREPQC BUFR File

In the process of conversion, most information is retained while some is lost. In order to justify the truncation of the radiosonde data in the BUFR PREPQC file, a short description on the organization of BUFR PREPQC files is given.

PREPQC BUFR files as provided by NCEP contain a record of the quality-controlled input to its FNL run used to compose an atmospheric analysis. Since analyses are composed four times daily, each run called a “cycle”, there are also four PREPQC BUFR files composed per day. The data can be either blocked or unblocked depending on the source. The blocked files are used by ECS because only blocked files can be read by the FORTRAN code provided to ECS in the form of a subroutine library written by Jack Woollen at NCEP. A set of diagnostic routines was written by Stephen Leroy of the AIRS Science Integration Team which operate only on the unblocked data. See Appendix D for the output of one of these diagnostic routines. Translation between blocked and unblocked data is trivial.

It is assumed that the reader is fairly competent with the standard BUFR introductory document by W. Thorpe, “A Guide to the WMO Code Form FM 94 BUFR”. Two of the main strengths of the BUFR format is that it provides an extremely flexible mechanism for storing data from a variety of nonuniform sources and that it provides a data compression scheme which can be customized according to the data type. A problem with the data type is that it is so flexible that it is not necessarily obvious a priori how data will be logically grouped. For instance, one cannot know beforehand whether different variables (temperature, humidity, winds) from a common sounding will be split into apparent multiple soundings.

The NCEP PREPQC BUFR file type is split into several thousand messages, the basic building block of a BUFR file. Each message is organized into 6 “sections”, numbered 0 through 5. Section 0 is trivial in that it contains only the letters “BUFR” followed by the total length of the message in bytes. Section 1 contains important data relevant to the nature of the programs run to generate this particular message. It also contains information on the data type to be encoded in this message. Of note, section 1 contains the cycle time at which it was produced. Section 2 is optional, and indeed is neglected in the PREPQC BUFR format. Section 3, the data description section, describes the data bit-by-bit which is contained in section 4, the data section. Section 3 also gives the number of “subsets” of data in the data section and flags indicating whether it is observed data and whether it is compressed data. For radiosonde data, it is always observed data, it is non-compressed, and each subset contains one radiosonde sounding.

At the beginning of a PREPQC BUFR file there are a few messages (currently 3) which contain the locally-defined BUFR tables. For the PREPQC BUFR files, they are defined by

NCEP. These tables augment the tables pre-supplied as a WMO standard, and are necessary to the interpretation of the data in all of the messages in the PREPQC BUFR files. For example, one element of table B (f=0, x=07, y=192) indicates that it is a pressure observation, mnemonic “POB”, its units are “MB”, and that it is a 14-bit integer after having been previously divided by 10. All subsequent messages in the PREPQC BUFR file contain data.

Section 4 of each message contains the data itself, split into ~10 subsets in the case of radiosonde data. It is bit-packed stream with embedded flags indicating whether vast numbers of variables are present for each subset individually. Appendix A contains an expansion of the section 3 description of the organization of data in section 4 for a radiosonde “ADPUPA” message. Here follows a qualitative outline of the data contents:

1) The first set of variables identify the radiosonde station, its location, the time of the sounding relative to the file cycle time, and the radiosonde instrument type used. All of this data is retained in the HDFEOS translation.

2) Next comes an outer loop of arbitrary (embedded) count. Such embedded counts are called “DRF8BIT” in the data description. This outermost loop corresponds to the altitude levels of the sounding. Inside this loop come several blocks of data. They are

3) Pressure block. A flag indicates whether or not it is present for any level. In truth, it is used as the independent coordinate. The pressure itself is given along with its quality markers in a “history” loop. In an embedded block, with a flag indicating its presence, comes an analysis block containing an analyzed pressure, a forecast pressure, and a description of its climatology. A note on the history loop follows. The units are millibars.

4) Specific humidity block. Like the pressure block, it includes a flag indicating its presence, a history loop containing the observation and associated quality markers, and an analysis block. The units are mg/kg.

5) Temperature block. Just like preceding blocks. Units are °C.

6) Height block. Just like preceding blocks. Units are geopotential meters.

7) Wind block. Just like preceding blocks. Observed winds are given as u and v (eastward and northward) components. Optionally, the raw wind observation may also be present in the form of speed (in knots) and heading (degrees clockwise from northward). The useful u, v observations have units of meters per second.

8) Relative humidity block. Subject to a flag indicating its presence, it contains relative humidity and associated quality control indicators in a history loop. An optional analysis block is included.

9) Precipitable water vapor block. At the top is a history loop containing total precipitable water vapor along with its quality markers. Optional precipitable water vapor analysis and climatology follows. Units are millimeters. Then follow four precipitable water vapor blocks which split up the column.

    a) 1.0-to-0.9 sigma precipitable water vapor. This contains a history loop of precipitable water vapor between the 1.0 and 0.9 sigma levels along with quality markers. Analysis and climatological information follow.

    b) Same for 0.9-to-0.7 sigma precipitable water vapor.

    c) Same for 0.7-to-0.3 sigma precipitable water vapor.

    d) Same for 0.3-to-0.0 sigma precipitable water vapor.

Then comes optional data on whether a solar and infrared radiation correction was applied and by how much the radiosonde drifted in the course of measurement. When present, the drift information is generally constant with level, and hence of no use.

While there is room for an individual subset of data to continue thermodynamic and wind data for a rawinsonde sounding, the thermodynamic and wind data are split into two different subsets. This gives the appearance initially that radiosonde observations are duplicated in a BUFR PREPQC file because two subsets will contain the same station ID. Since handling multiply identified radiosondes complicates the reading and translation of radiosonde data, and since wind data of little interest in the tuning and validation of AIRS data, all wind data has been excluded from the HDF-EOS output, and all subsets which report no temperature or specific humidity data are translated.

Furthermore, no data is ever given for the precipitable water vapor data blocks. By setting one bit in the data stream for each subset to 0, all preipitable water vapor data is declared absent. This always holds true for ADPUPA data, and hence it is not translated into the HDF-EOS file. The same is true of the relative humidity block. In fact, later versions of BUFR PREPQC do not even provide slots for relative humidity variables.

A full listing of the description of the contents of the ADPUPA message type, good on September 13, 1998, is given in Appendix D.

Appendix B: List of Excluded PREPQC BUFR Fields

In this appendix is a list of the BUFR variables left out of the translation from BUFR to HDF-EOS format along with reasons for excluding them. There are five reasons given: "forecast model dependent", "always zero", "mostly absent", "wind data related", and "never present".

- When a variable is dependent on the particular forecast model being used, it is excluded because it is "corrupted" by the numerics of the model. It is "forecast model dependent."
- When a variable is always zero in the BUFR file, it is excluded from the HDF-EOS file. It is "always zero."
- When a variable is almost always absent, and difficult to interpret in the context of the model when it is present, it is excluded. It is "mostly absent."
- All data related to winds is excluded. It is "wind data related."
- All data which was never present to begin with is not translated. It is "never present."

Note: Future editions of the BUFR PREPQC file will add or subtract variables. For instance, since the precipitable water vapor fields are never used, it is anticipated that they will be eliminated from a future version of the BUFR PREPQC format. Likewise, some day fields related to the preparation of the radiosonde data may be added. Unless such fields are explicitly requested in the translation, they will be left off the translation list as well as those that follow.

The table that follows lists the variables which are currently excluded and the reasons for having excluded them.

BUFR variable mnemonic	*Description*	*Reason for exclusion*
PAN	pressure analysis	forecast model dependent
PCL	pressure climatology mean	forecast model dependent
PCS	pressure climatology std. dev.	forecast model dependent
POE	pressure observation error	always zero
PFC	pressure forecast value	forecast model dependent
QAN	specific humidity analysis	forecast model dependent

QCL	specific humidity climatological mean	forecast model dependent
QCS	specific humidity climatological std. dev.	forecast model dependent
QFC	specific humidity forecast value	forecast model dependent
TAN	temperature analysis	forecast model dependent
TCL	temperature climatological mean	forecast model dependent
TCS	temperature climatological std. dev.	forecast model dependent
TFC	temperature forecast	forecast model dependent
TVO	virtual temperature	mostly absent
ZAN	height analysis	forecast model dependent
ZCL	height climatological mean	forecast model dependent
ZCS	height climatological std. dev.	forecast model dependent
ZFC	height forecast	forecast model dependent
UOB	east wind observation	wind data related
WQM	wind quality marker	wind data related
WPC	wind program code	wind data related
WRC	wind reason code	wind data related
VOB	north wind observation	wind data related
UAN	east wind analysis	wind data related
UCL	east wind climatological mean	wind data related
UCS	east wind climatological std. dev.	wind data related
VAN	north wind analysis	wind data related
VCL	north wind climatological mean	wind data related
VCS	north wind climatological std. dev.	wind data related
WOE	wind observation error	wind data related
UFC	east wind forecast	wind data related
VFC	north wind forecast	wind data related
DDO	raw wind direction	wind data related
FFO	raw wind speed	wind data related
DFQ	raw wind quality marker	wind data related
DFR	raw wind reason code	wind data related
DFP	raw wind program code	wind data related
RHO	relative humidity	never present
RHQ	relative humidity quality marker	never present
RHP	relative humidity program code	never present
RHR	relative humidity reason code	never present
RHA	relative humidity analysis	never present
RHE	relative humidity observation error	never present
RHF	relative humidity forecast	never present

PWO	precipitable water observation	never present
PWQ	precipitable water quality marker	never present
PWP	precipitable water program code	never present
PWR	precipitable water reason code	never present
PWA	precipitable water analysis	never present
PWE	precipitable water observation error	never present
PWF	precipitable water forecast	never present
PW1O	1.0-to-0.9 sigma precipitable water observation	never present
PW1Q	1.0-to-0.9 sigma precipitable water quality marker	never present
PW1P	1.0-to-0.9 sigma precipitable water program code	never present
PW1R	1.0-to-0.9 sigma precipitable water reason code	never present
PW1A	1.0-to-0.9 sigma precipitable water analysis	never present
PW1E	1.0-to-0.9 sigma precipitable water observation error	never present
PW1F	1.0-to-0.9 sigma precipitable water forecast	never present
PW2O	0.9-to-0.7 sigma precipitable water observation	never present
PW2Q	0.9-to-0.7 sigma precipitable water quality marker	never present
PW2P	0.9-to-0.7 sigma precipitable water program code	never present
PW2R	0.9-to-0.7 sigma precipitable water reason code	never present
PW2A	0.9-to-0.7 sigma precipitable water analysis	never present
PW2E	0.9-to-0.7 sigma precipitable water observation error	never present
PW2F	0.9-to-0.7 sigma precipitable water forecast	never present
PW3O	0.7-to-0.3 sigma precipitable water observation	never present
PW3Q	0.7-to-0.3 sigma precipitable water quality marker	never present
PW3P	0.7-to-0.3 sigma precipitable water program code	never present
PW3R	0.7-to-0.3 sigma precipitable water reason code	never present
PW3A	0.7-to-0.3 sigma precipitable water analysis	never present
PW3E	0.7-to-0.3 sigma precipitable water observation error	never present
PW3F	0.7-to-0.3 sigma precipitable water forecast	never present
PW4O	0.3-to-0.0 sigma precipitable water observation	never present
PW4Q	0.3-to-0.0 sigma precipitable water quality marker	never present
PW4P	0.3-to-0.0 sigma precipitable water program code	never present
PW4R	0.3-to-0.0 sigma precipitable water reason code	never present
PW4A	0.3-to-0.0 sigma precipitable water analysis	never present
PW4E	0.3-to-0.0 sigma precipitable water observation error	never present
PW4F	0.3-to-0.0 sigma precipitable water forecast	never present

Appendix C: Notes on Quality Control Indicators (NCEP)

Quality markers

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There's a couple ways you can look at the prepda quality marks. From the
data assimilation point of view, any mark <= 3 is accepted and used in the
analysis. The marks can span the range 0-15, with 0-3 representing some
measure of relative good quality, while 4-15 refer to programs (or people)
which decided to reject an observation. See gory details below:

Accepted data:

 0 - keep flag
 1 - checked and found certainly good
 2 - checked and found good
 3 - checked and found good but some lingering doubts remain

Rejected data:

 4 - OIQC rejected keep flag
 5 - OIQC rejected QM 1
 6 - OIQC rejected QM 2
 7 - OIQC rejected QM 3

 8 - surface pressure > 100mb different from model surface or
     report  pressure > 100mb below model surface

 9 - SSI rejected report type

10 - mass report in bogusing area rejected by cyclone bogusing program
11 - not used (as far as I know)
12 - data on reject list
13 - rejected by CQC
14 - rejected by SDM
15 - rejected by PREPRO(data preprocessor) or PREPACQC(aircraft checker)
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Program codes, reason codes

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*  PC #1 -  PREPRO    *
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NOTE 1: FOR ALL DATA TYPES EXCEPT TOVS RETRIEVALS(BUFR) AND GOES-I RETRIEVALS,
        THE ENCODED QUALITY MARKER FOR SPECIFIC HUMIDITY (QQM) IS SET TO THE
        ENCODED QUALITY MARKER FOR TEMPERATURE (TQM).  THEREFORE, ANY EVENTS
        ON TQM FOR THESE DATA TYPES ARE ALSO EVENTS ON QQM.  THE EVENTS ON QQM
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        LISTED HERE ARE SEPARATE FROM THOSE ON TQM.
NOTE 2: FOR ALL DATA TYPES, THE ENCODED QUALITY MARKER FOR WIND U- AND V-
        COMPONENTS (WQM) IS ALSO THE ENCODED QUALITY MARKER FOR WIND SPEED AND
        DIRECTION (DFQ).  IN ADDITION, ALL ENCODED EVENTS FOR THE UOB,VOB,WQM
        SEQUENCE ALSO APPLY TO THE DDO,FFO,DFQ SEQUENCE.
NOTE 3: ONLY SURFACE LAND AND GREAT LAKES MARINE REPORTS CAN ENCODE MEAN SEA-
        LEVEL PRESSURE (PMO, PMQ, PMR) DATA.  ALL REPORT TYPES ENCODE SURFACE
        PRESSURE (POB, PQM, PRC) DATA.

KEY:
     IN REASON CODE COLUMN:
                        G  - OCCURS ONLY IN GLOBAL VERSION OF PREPDATA.
                        R  - OCCURS ONLY IN REGIONAL VERSION OF PREPDATA.
                        B  - OCCURS IN BOTH GLOBAL AND REGIONAL VERSIONS OF
                             PREPDATA.
                        N  - CURRENTLY DOES NOT OCCUR IN EITHER GLOBAL OR
                             REGIONAL VERSION OF PREPDATA.

     IN MNEMONIC COLUMN:
                        ## - QUALITY MARKER IS USUALLY DEFINED AS THE WORSE
                             OF THE TWO SPANNING LEVEL QUALITY MARKERS FOR THE
                             DATA USED TO CREATE THE OBSERVATION (OF THE SAME
                             DATA TYPE).
                        @@ - QUALITY MARKER IS USUALLY DEFINED AS THE WORSE OF
                             THE PAIR OF HEIGHT AND TEMPERATURE QUALITY MARKERS
                             ON THE TWO SPANNING LEVELS FOR THE DATA USED TO
                             CREATE THE OBSERVATION.
                        ** - OBSERVATION OR QUALITY MARKER IS OBTAINED AS
                             DEFINED IN EVENT MEANING.
                        && - QUALITY MARKER IS BASED ON QUALITY OF SOUNDING DATA
                             USED TO CREATE DATA.

     IN MEANING COLUMN:
                        @  - LIMIT IS 150 MB BELOW 700 MB, 200 MB BETWEEN 700
                             AND 601 MB, 100 MB BETWEEN 600 AND 251 MB, AND 50
                             MB AT AND ABOVE 250 MB.  THE REFERENCE PRESSURE
                             HERE IS THAT ON THE BOTTOM SPANNING LEVEL.
                        #  - LIMIT (IN METERS) IS DEFINED AS  30.0 - (PR/50.0) ,
                             WHERE PR IS THE PRESSURE (MB) ON THE NEXT LEVEL
                             ABOVE WITH A VALID REPORTED HEIGHT.
                        $  - D-VALUE IS DEFINED AS THE DIFFERENCE BETWEEN A
                             REPORTED SURFACE (OR MEAN SEA-LEVEL) PRESSURE AND
                             THE U.S. STANDARD ATMOSPHERE PRESSURE AT THE HEIGHT
                             OF THE REPORTED ELEVATION.  THIS RANGE IS -75 TO
                             +50 MB FOR ALL TYPES EXCEPT SPLASH-LEVEL
                             DROPWINDSONDE AND RECONNAISSANCE WITH ESTIMATED
                             MEAN SEA-LEVEL PRESSURE (OI/SSI REPORT TYPE 182)
                             WHERE THE RANGE IS -215 TO +50 MB TO ALLOW FOR
                             HURRICANE PRESSURES.
                        %  - THE BASELINE CHECK IS ACCOMPLISHED BY COMPUTING THE
                             STATION HEIGHT (ELEVATION) BASED ON THE HEIGHTS OF
                             THE TWO MANDATORY PRESSURE LEVELS THAT SPAN THE
                             SURFACE PRESSURE LEVEL (IF THE SURFACE PRESSURE IS
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                          GREATER THAN 1000 MB, THEN USES 1000 MB AND THE
                          NEXT MANDATORY LEVEL ABOVE, EITHER 925 OR 850 MB)
                          AND THE REPORTED SURFACE PRESSURE VALUE FOR A
                          NON-SATELLITE UPPER-AIR REPORT.  ASSUMES A CONSTANT
                          LAPSE RATE OF -6.5 DEG. C/KM.  IF THE DIFFERENCE
                          BETWEEN THIS COMPUTED STATION HEIGHT AND THE
                          REPORTED STATION HEIGHT (ELEVATION) IS GREATER THAN
                          OR EQUAL TO 20 METERS THEN THE REPORT HAS FAILED
                          THE BASELINE CHECK.

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REASON   MEANING                                              MNEMONICS AFFECTED AND
 CODE                                                         NEW VALUE FOR OBS, Q.M.
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100 B  OBSERVATION AND QUALITY MARKER ON REPORT LEVEL
       UNCHANGED FROM ORIGINAL VALUES READ INTO
       PROGRAM PREPDATA.

-------------------------------------------------------------------------------
REASON CODES # 101-129 PERTAIN TO DATA OBSERVATIONS AND QUALITY MARKERS THAT
ARE GENERATED BY PREPDATA.  DATA OBSERVATIONS WERE MISSING PRIOR TO PREPDATA.
-------------------------------------------------------------------------------

101 B  OBSERVATION ON UPPER-AIR CATEGORY 4 (WINDS-BY-  PRC-> POB=  **,PQM=  ##
       HEIGHT) LEVEL CREATED VIA LINEAR AVERAGING OF   ZRC-> ZOB=  **,ZQM=  ##
       REPORTED DATA ON SPANNING LEVELS.               TRC-> TOB=  **,TQM=  ##

102 B  OBSERVATION ON UPPER-AIR REPORT LEVEL CREATED   TRC-> TOB=  **,TQM=  ##
       VIA LINEAR LOG-P INTERPOLATION OF REPORTED      WRC-> UOB,VOB= **,
       DATA ON SPANNING LEVELS.                              WQM=  ##

103 B  OBSERVATION ON UPPER-AIR REPORT LEVEL CREATED   PRC-> POB=  **,PQM=  ##
       VIA HYDROSTATIC INTEGRATION OF REPORTED DATA    ZRC-> ZOB=  **,ZQM=  @@
       ON SPANNING LEVELS.  {PRC AFFECTED ONLY FOR     TRC-> TOB=  **,TQM=  ##
       CATEGORY 4 (WINDS-BY-HEIGHT) LEVELS.}

105 B  NEW REPORT PRESSURE LEVEL CREATED.  PRESSURE    PRC-> POB=  **,PQM=   7
       OBSERVATION CONSIDERED TO BE OF NEUTRAL
       QUALITY. {FOR SSM/I WIND SPEED REPORTS,
       PRESSURE OBSERVATION IS ASSIGNED THE VALUE OF
       1013 MB.  OTHERWISE, PRESSURE OBSERVATION IS
       ASSIGNED TO THE SPECIAL "CATEGORY 7" 25 OR 50
       MB PRESSURE LEVELS ONTO WHICH OBSERVATIONS ARE
       INTERPOLATED FOR UPPER-AIR REPORTS (REGIONAL
       VERSION ONLY).}

116 B  PRESSURE CALCULATED FROM REPORTED ALTITUDE      PRC-> POB=  **,PQM=   7
       VIA U.S. STANDARD ATMOSPHERE. CATEGORY 6
       (SINGLE-LEVEL AIRCRAFT/SATWND/RECCO) LEVEL.
       CALCULATED PRESSURE OBSERVATION IS CONSIDERED
       TO BE OF NEUTRAL QUALITY.
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MISSING - May or may not be original observation. Most PREPDATA "events" are not yet assigned a reason code. (This will change in the future.)

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****
* PC #2 - SYNDATA *
****

Reason code	Description
10	Data rejected for being near hurricane

****
****

****
* PC #3 - CLIMO *
****

No reason codes are stored by this program.

****
****

****
* PC #4 - PREVENT *
****

REASON CODE	MEANING	MNEMONIC CHANGED	NEW VALUE
01	PRESSURE OBSERVATION ON ANY LEVEL IS MORE THAN 100 MB BELOW MODEL (GUESS) SURFACE PRESSURE. ALL DATA ON LEVEL REJECTED.	PQM	8
		TQM	8
		QQM	8
		WQM	8
02	PRESSURE OBSERVATION ON ANY LEVEL IS ZERO OR NEGATIVE. ALL DATA ON LEVEL REJECTED.	PQM	8
		TQM	8
		QQM	8
		WQM	8
02	SURFACE PRESSURE OBSERVATION IS ABOVE 450 MB OR BELOW 1100 MB. ALL DATA ON SURFACE LEVEL REJECTED.	PQM	8
		TQM	8
		QQM	8
		WQM	8
02	TEMPERATURE ON ANY LEVEL IS MISSING OR	QQM	9

	LESS THAN -150 DEG. CELSIUS. SPECIFIC HUMIDITY ON LEVEL REJECTED.		
02	SPECIFIC HUMIDITY OBSERVATION IS ZERO OR NEGATIVE. SPECIFIC HUMIDITY ON LEVEL REJECTED.	QQM	9
03	SURFACE PRESSURE OBSERVATION ERROR VALUE IS MISSING. ALL DATA ON SURFACE LEVEL REJECTED.	PQM TQM QQM WQM	9 9 9 9
03	TEMPERATURE OBSERVATION ERROR VALUE ON ANY LEVEL IS MISSING. TEMPERATURE AND SPECIFIC HUMIDITY ON LEVEL REJECTED.	TQM QQM	9 9
03	SPECIFIC HUMIDITY OBSERVATION ERROR VALUE ON ANY LEVEL IS MISSING. SPECIFIC HUMIDITY ON LEVEL REJECTED.	QQM	9
03	WIND OBSERVATION ERROR VALUE ON ANY LEVEL IS MISSING. U- AND V-COMP WIND ON LEVEL REJECTED.	WQM	9
03	TOTAL COLUMN PRECIPITABLE WATER OBSERVATION ERROR IS MISSING. TOTAL COLUMN PRECIPITABLE WATER REJECTED.	PWQ	9
04	SURFACE PRESSURE IS MORE THAN 100 MB ABOVE OR BELOW MODEL (GUESS) SURFACE PRESSURE. ALL DATA ON SURFACE LEVEL REJECTED.	PQM TQM QQM WQM	9 9 9 9
05	PRESSURE ON ANY LEVEL IS ABOVE 300 MB. SPECIFIC HUMIDITY ON LEVEL REJECTED.	QQM	9

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* PC #5 - CQCHT *
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Reason Code	Description
	Communication and Computation Errors
	Errors at a Single Interior Mandatory Level
1 -	Single height
2 -	Single temperature
3 -	Height and temperature at the same level, or

```
      Height and temperature at the same level with residual compensation
-------------------------------------------------------------------------------
      Errors at the Top Mandatory Level
5  -  Height, temperature, or both
-------------------------------------------------------------------------------
      Computation Error in Height at Mandatory Levels
6  -  Height computation error between any two mandatory levels
-------------------------------------------------------------------------------
      Errors at Adjacent Mandatory Levels
7  -  Height at two adjacent levels
8  -  Temperature at two adjacent levels
9  -  Height at the lower, and temperature at the upper of two adjacent levels
10 -  Temperature at the lower, and height at the upper of two adjacent levels
-------------------------------------------------------------------------------
15 -  (No error) Auxiliary level height in Regional recalculated by CQCHT
-------------------------------------------------------------------------------
      Errors at Significant Levels
20 -  Significant level temperature corrected
21-25 Non-correctable significant level temperature errors
-------------------------------------------------------------------------------
      Surface Errors
100 - Surface pressure communication error
102 - Surface temperature error
105 - Likely surface temperature error, too small to correct
      Undetermined error(s), possibly in surface pressure
106 - Surface pressure observation error
-------------------------------------------------------------------------------
            Observation Errors
            ------------------
30,35 Temperature observation errors; reject or use with reduced weight
36,37 Height observation errors; reject or use with reduced weight
-------------------------------------------------------------------------------


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                          *  PC #6 -  RADCOR    *
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All ZRC and TRC values are set to 1.


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                          *  PC #7 -  PREPACQC  *
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REASON  MEANING                                    MNEMONIC    NEW
 CODE                                              CHANGED    VALUE
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01	CARSWELL/TINKER CONVERTED PIREP REPORT. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
02	REPORT BETWEEN ALTITUDE 2000 TO 5000 FEET WITH TEMPERATURE THAT DIFFERS FROM FIRST GUESS TEMPERATURE BY MORE THAN 25 DEGREES CELSIUS. [PROBABLY ACTUALLY AT ALTITUDE 20,000 TO 50,000 FEET, BUT REPORTED WITH A "0" DIGIT DROPPED(?)]. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
03	REPORT WITH NON-MISSING TEMPERATURE GREATER THAN 12 DEGREES CELSIUS. TEMPERATURE DATA CONSIDERED BAD.	TQM	13
04	REPORT WITH CALM WIND FROM A DIRECTION OTHER THAN 360 DEGREES. WIND DATA CONSIDERED BAD.	WQM	13
05	PIREP REPORT WITH VECTOR WIND INCREMENT GREATER THAN 20 KNOTS, OR WITH UNKNOWN VECTOR WIND INCREMENT. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
06	REPORT WITH A CALM WIND IN A STACK OF LESS THAN SEVEN CO-LOCATED REPORTS WITH LESS THAN FOUR REPORTS HAVING A CALM WIND. WIND DATA CONSIDERED BAD.	WQM	13
07	MID- OR HIGH-LEVEL ASDAR/AMDAR REPORT IN A TRACK WITH AN UNREASONABLE GROUND SPEED AND A VECTOR WIND INCREMENT GREATER THAN 70 KNOTS. WIND DATA CONSIDERED BAD.	WQM	13
08	THIS ONE OF A PAIR OF AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO BE A TYPE 2A DUPLICATE. WIND DATA CONSIDERED BAD.	WQM	13
09	THIS ONE OF A PAIR OF AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO HAVE A TYPE 3 ERROR. WIND DATA CONSIDERED BAD.	WQM	13
10	THIS ONE OF SEVERAL (> 2) AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO HAVE A HAVE A TYPE 3 ERROR. WIND DATA CONSIDERED BAD.	WQM	13
11	THIS ONE OF SEVERAL (> 2) AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO BE A TYPE 2B DUPLICATE. WIND DATA CONSIDERED BAD.	WQM	13

12	THIS ONE OF SEVERAL (> 2) AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO BE A TYPE 2A DUPLICATE. WIND DATA CONSIDERED BAD.	WQM	13
13	THIS LAST OF SEVERAL (> 2) AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO IN ERROR. WIND DATA CONSIDERED BAD.	WQM	13
14	THIS ONE OF SEVERAL (> 2) AIREP/PIREP REPORTS IN A TRACK IS DETERMINED TO BE A TYPE 3 DUPLICATE. WIND DATA CONSIDERED BAD.	WQM	13
15	REPORT IS USED TO GENERATE A SUPEROB REPORT. TEMPERATURE AND WIND DATA ARE FLAGGED FOR NON-USE BY ANALYSIS.	TQM WQM	10 10
16	ISOLATED AIREP/PIREP REPORT WITH VECTOR WIND INCREMENT GREATER THAN 50 KNOTS. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
17	ISOLATED AIREP/PIREP REPORT WITH VECTOR WIND INCREMENT LESS THAN 21 KNOTS. TEMPERATURE AND WIND DATA CONSIDERED GOOD.	TQM WQM	1 1
18	ISOLATED AIREP/PIREP REPORT WITH VECTOR WIND INCREMENT GREATER THAN 20 KNOTS BUT LESS THAN 51 KNOTS. TEMPERATURE AND WIND DATA CONSIDERED SUSPECT.	TQM WQM	3 3
19	REPORT (ISOLATED OR STACKED) WITH WIND DATA THAT HAS FAILED ONE OR MORE CHECKS AND IS CONSIDERED BAD. TEMPERATURE DATA CONSIDERED BAD.	TQM	13
20	REPORT IN A STACK OF CO-LOCATED REPORTS WITH TEMPERATURE AND WIND DATA THAT HAS PASSED ALL CHECKS. TEMPERATURE AND WIND DATA CONSIDERED GOOD.	TQM WQM	1 1
21	REPORT IN A STACK OF CO-LOCATED REPORTS WITH WIND DATA THAT HAS FAILED THE WIND SHEAR CHECK. WIND DATA CONSIDERED BAD.	WQM	13
22	REPORT IN A STACK OF CO-LOCATED REPORTS WITH TEMPERATURE DATA THAT HAS FAILED THE LAPSE CHECK. TEMPERATURE DATA CONSIDERED BAD.	TQM	13
23	REPORT IN A STACK OF CO-LOCATED REPORTS WITH WIND DATA THAT HAS FAILED ONE OR MORE CHECKS. THE REPORT IS NOT USED TO	TQM WQM	13 13

	GENERATE A SUPEROB. TEMPERATURE AND WIND DATA CONSIDERED BAD.		
24	THIS ONE OF A PAIR OF CO-LOCATED REPORTS HAS A VECTOR WIND INCREMENT GREATER THAN 50 KNOTS AND CONTAINS A SUSPECTED TRACK CHECK ERROR. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
25	AIREP/PIREP OR SUPEROB REPORT OVER THE CONTINENTAL U.S. OR SURROUNDING ENVIRONS. TEMPERATURE AND WIND DATA ARE FLAGGED FOR NON-USE BY THE ANALYSIS.	TQM WQM	15 15
26	SUPEROB REPORT. TEMPERATURE AND WIND DATA CONSIDERED GOOD.	TQM WQM	1 1
27	IN A TRACK CONTAINING AT LEAST 15 ASDAR/ AMDAR REPORTS, THERE ARE AT LEAST 10 REPORTS WITH A VECTOR WIND INCREMENT GREATER THAN 50 KNOTS. WIND DATA CONSIDERED BAD.	WQM	13
28	ISOLATED ASDAR/AMDAR REPORT WITH TEMPERATURE AND WIND DATA THAT HAVE PASSED ALL CHECKS. TEMPERATURE AND WIND DATA CONSIDERED GOOD.	TQM WQM	1 1
29	AIREP/PIREP REPORT IN A STACK OF ONLY TWO CO-LOCATED REPORTS WITH VECTOR WIND INCREMENT GREATER THAN 50 KNOTS. TEMPERATURE AND WIND DATA CONSIDERED BAD.	TQM WQM	13 13
30	ISOLATED ASDAR/AMDAR REPORT WITH A MISSING PHASE OF FLIGHT INDICATOR (PROBABLY BANKING). TEMPERATURE AND WIND DATA CONSIDERED SUSPECT.	TQM WQM	3 3

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* PC #8 - VIRTMP *
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REASON CODE	MEANING	MNEMONIC CHANGED	NEW VALUE
00	SPECIFIC HUMIDITY OBSERVATION IS REGENERATED FROM REPORTED DEWPOINT TEMPERATURE AND PRESSURE. (DEWPOINT	QOB	----

	TEMPERATURE HAS UNDERGONE POSSIBLE CQC AND RADIATION CORRECTIONS). THIS IS VALID ONLY FOR SURFACE LAND OR MARINE DATA TYPES.		
00	TEMPERATURE OBSERVATION IS CONVERTED TO VIRTUAL TEMPERATURE, CALCULATED FROM THE REGENERATED SPECIFIC HUMIDITY (SEE ABOVE) AND FROM A SENSIBLE TEMPERATURE OBSERVATION THAT HAS UNDERGONE POSSIBLE COMPLEX QUALITY CONTROL AND RADIATION CORRECTIONS. THIS IS VALID ONLY FOR SURFACE LAND OR MARINE DATA TYPES.	TOB	----
01	SPECIFIC HUMIDITY OBSERVATION IS REGENERATED FROM REPORTED DEWPOINT TEMPERATURE AND PRESSURE. (DEWPOINT TEMPERATURE HAS UNDERGONE POSSIBLE CQC AND RADIATION CORRECTIONS). THIS IS VALID ONLY FOR RADIOSONDE, DROPWINSONDE, AND MULTI-LEVEL RECONNAISSANCE DATA TYPES.	QOB	----
01	TEMPERATURE OBSERVATION IS CONVERTED TO VIRTUAL TEMPERATURE, CALCULATED FROM THE REGENERATED SPECIFIC HUMIDITY (SEE ABOVE) AND FROM A SENSIBLE TEMPERATURE OBSERVATION THAT HAS UNDERGONE POSSIBLE COMPLEX QUALITY CONTROL AND RADIATION CORRECTIONS. THIS IS VALID ONLY FOR RADIOSONDE, DROPWINSONDE, AND MULTI-LEVEL RECONNAISSANCE DATA TYPES.	TOB	----

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* PC #9 - CQCPROF *
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Reason code	Description
3	Data are of questionable quality
13	Data are bad

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* PC #10 - OIQC *
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REASON CODE	MEANING	MNEMONIC CHANGED	NEW VALUE
04	Observation with keep flag was rejected because it was more than 20 times the expected difference from the interpolated Nearby independent information.	Pqm Tqm Wqm	4 4 4
05	Observation with original qm 1 is rejected by the OIQC checking algorythm.	Pqm Tqm Wqm	5 5 5
06	Observation with original qm 2 is rejected by the OIQC checking algorythm.	Pqm Tqm Wqm	6 6 6
07	Observation with original qm 3 is rejected by the OIQC checking algorythm.	Pqm Tqm Wqm	7 7 7

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* PC #11 - SSI *
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No reason codes are stored by this program.

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Appendix D: Example Data Description of BUFR PREPQC ADPUPA Message

On the following pages is a listing of the data description of an ADPUPA message as extracted from a BUFR PREPQC file for the 00-hr cycle of 13 September 1998. This listing was generated by “bufr_table”, a utility written at the Jet Propulsion Laboratory by Stephen Leroy.

```
Message #4: bufr_master_table: 0, originating_center: 775, update_sequence_number: 0, data_category_type: 240, data_category_subtype:
0, master_table_version: 4, local_table_version: 0.
year: 98, month: 9, day: 13, hour: 0, minute: 0
data_subsets: 12, observation/compression: 80
fxy=063000 a=0 b=0 w=16  BYTCNT (BYTES)
fxy=360240 a=0 b=0 w=0   ()
  fxy=361001 a=0 b=0 w=0   ()
    fxy=001192 a=0 b=0 w=64  SID      TABLE B ENTRY - STATION IDENTIFICATION (CCITT IA5)
    fxy=006002 a=2 b=-18000 w=16  XOB      TABLE B ENTRY - LONGITUDE (DEG E)
    fxy=005002 a=2 b=-9000 w=15  YOB      TABLE B ENTRY - LATITUDE (DEG N)
    fxy=004192 a=3 b=-24000 w=16  DHR      TABLE B ENTRY - OBSERVATION TIME MINUS CYCLE TIME (HOURS)
    fxy=010194 a=0 b=-1000 w=17  ELV      TABLE B ENTRY - STATION ELEVATION (METER)
    fxy=001193 a=0 b=0 w=9  TYP      TABLE B ENTRY - OI/SSI REPORT TYPE (CODE TABLE)
    fxy=055006 a=0 b=0 w=10  T29      TABLE B ENTRY - NMC OFFICE NOTE 29 REPORT TYPE (CODE TABLE)
    fxy=055192 a=0 b=0 w=2  TSB      TABLE B ENTRY - REPORT SUB-TYPE (CODE TABLE)
    fxy=002001 a=0 b=0 w=8  ITP      TABLE B ENTRY - INSTRUMENT TYPE (CODE TABLE)
    fxy=050001 a=0 b=0 w=17  SQN      TABLE B ENTRY - REPORT SEQUENCE NUMBER (CODE TABLE)
    fxy=001195 a=0 b=0 w=5  RQM      TABLE B ENTRY - REPORT QUALITY MARK (CODE TABLE)
    fxy=001196 a=0 b=0 w=14  DUP      TABLE B ENTRY - MESSAGE NUMBER OF DUPLICATE (CODE TABLE)
    fxy=001197 a=0 b=0 w=64  PRG      TABLE B ENTRY - TRANSLATOR PROGRAM NAME (CCITT IA5)
    fxy=001198 a=0 b=0 w=64  SRC      TABLE B ENTRY - FILE NAME OF DATA SOURCE (CCITT IA5)
    fxy=001199 a=0 b=0 w=64  RUD      TABLE B ENTRY - RUN DATE OF TRANSLATE PROGRAM (CCITT IA5)
  fxy=360002 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=361002 a=0 b=0 w=0   ()
    fxy=001194 a=0 b=0 w=6  CAT      TABLE B ENTRY - NMC OFFICE NOTE 29 CATEGORY (CODE TABLE)
    fxy=360004 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
    fxy=362001 a=0 b=0 w=0   ()
      fxy=360003 a=0 b=0 w=0   ()
        fxy=101000
        fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
      fxy=362101 a=0 b=0 w=0   ()
        fxy=007192 a=1 b=0 w=14  POB      TABLE B ENTRY - PRESSURE OBSERVATION (MB)
        fxy=007193 a=0 b=0 w=5  PQM      TABLE B ENTRY - PRESSURE (QUALITY) MARKER (CODE TABLE)
        fxy=007194 a=0 b=0 w=4  PPC      TABLE B ENTRY - PRESSURE PROGRAM CODE (CODE TABLE)
        fxy=007195 a=0 b=0 w=10  PRC      TABLE B ENTRY - PRESSURE REASON CODE (CODE TABLE)
      fxy=360004 a=0 b=0 w=0   ()
        fxy=101000
        fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
      fxy=362201 a=0 b=0 w=0   ()
        fxy=007198 a=1 b=0 w=14  PAN      TABLE B ENTRY - PRESSURE ANALYSED VALUE (MB)
        fxy=007199 a=1 b=0 w=14  PCL      TABLE B ENTRY - PRESSURE CLIMATOLOGY (MB)
        fxy=007200 a=1 b=0 w=14  PCS      TABLE B ENTRY - PRESSURE CLIMATOLOGY SD (MB)
```

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    fxy=007197 a=1 b=0 w=14  POE      TABLE B ENTRY - PRESSURE OBSERVATION ERROR (MB)
    fxy=007196 a=1 b=0 w=14  PFC      TABLE B ENTRY - PRESSURE FORECAST VALUE (MB)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362002 a=0 b=0 w=0   ()
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362102 a=0 b=0 w=0   ()
    fxy=013192 a=0 b=0 w=16  QOB      TABLE B ENTRY - SPECIFIC HUMIDITY OBSERVATION (MG/KG)
    fxy=013193 a=0 b=0 w=5  QQM      TABLE B ENTRY - SPECIFIC HUMIDITY (QUALITY) MARKER (CODE TABLE)
    fxy=013194 a=0 b=0 w=4  QPC      TABLE B ENTRY - SPECIFIC HUMIDITY PROGRAM CODE (CODE TABLE)
    fxy=013195 a=0 b=0 w=10  QRC      TABLE B ENTRY - SPECIFIC HUMIDITY REASON CODE (CODE TABLE)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362202 a=0 b=0 w=0   ()
    fxy=013197 a=0 b=0 w=16  QAN      TABLE B ENTRY - SPECIFIC HUMIDITY ANALYSED VALUE (MG/KG)
    fxy=013199 a=0 b=0 w=16  QCL      TABLE B ENTRY - SPECIFIC HUMIDITY CLIMATOLOGY (MG/KG)
    fxy=013200 a=0 b=0 w=16  QCS      TABLE B ENTRY - SPECIFIC HUMIDITY CLIMATOLOGY SD (MG/KG)
  fxy=013198 a=0 b=0 w=16  QOE      TABLE B ENTRY - SPECIFIC HUMIDITY OBSERVATION ERROR (MG/KG)
  fxy=013196 a=0 b=0 w=16  QFC      TABLE B ENTRY - SPECIFIC HUMIDITY FORECAST VALUE (MG/KG)
  fxy=012194 a=1 b=-2732 w=14  TDO      TABLE B ENTRY - DEWPOINT TEMPERATURE OBSERVATION (DEG C)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362003 a=0 b=0 w=0   ()
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362103 a=0 b=0 w=0   ()
    fxy=012192 a=1 b=-2732 w=14  TOB      TABLE B ENTRY - REPORTED TEMPERATURE OBSERVATION LATER (DEG C)
    fxy=012195 a=0 b=0 w=5  TQM      TABLE B ENTRY - REPORTED TEMPERATURE (QUALITY) MARKER (CODE TABLE)
    fxy=012196 a=0 b=0 w=4  TPC      TABLE B ENTRY - REPORTED TEMPERATURE PROGRAM CODE (CODE TABLE)
    fxy=012197 a=0 b=0 w=10  TRC      TABLE B ENTRY - REPORTED TEMPERATURE REASON CODE (CODE TABLE)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362203 a=0 b=0 w=0   ()
    fxy=012199 a=1 b=-2732 w=14  TAN      TABLE B ENTRY - REPORTED TEMPERATURE ANALYSED VALUE (DEG C)
    fxy=012201 a=1 b=-2732 w=14  TCL      TABLE B ENTRY - REPORTED TEMPERATURE CLIMATOLOGY (DEG C)
    fxy=012202 a=1 b=0 w=10  TCS      TABLE B ENTRY - REPORTED TEMPERATURE CLIMATOLOGY SD (DEG C)
  fxy=012200 a=1 b=0 w=10  TOE      TABLE B ENTRY - REPORTED TEMPERATURE OBSERVATION ERROR (DEG C)
  fxy=012198 a=1 b=-2732 w=14  TFC      TABLE B ENTRY - REPORTED TEMPERATURE FORECAST VALUE (DEG C)
  fxy=012193 a=1 b=-2732 w=14  TVO      TABLE B ENTRY - NON-QC'D VIRTUAL TEMPERATURE OBS. (DEG C)
```

```
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362004 a=0 b=0 w=0   ()
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362104 a=0 b=0 w=0   ()
    fxy=010195 a=0 b=-1000 w=17  ZOB      TABLE B ENTRY - HEIGHT OBSERVATION (METER)
    fxy=010196 a=0 b=0 w=5  ZQM      TABLE B ENTRY - HEIGHT (QUALITY) MARKER (CODE TABLE)
    fxy=010197 a=0 b=0 w=4  ZPC      TABLE B ENTRY - HEIGHT PROGRAM CODE (CODE TABLE)
    fxy=010198 a=0 b=0 w=10  ZRC      TABLE B ENTRY - HEIGHT REASON CODE (CODE TABLE)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362204 a=0 b=0 w=0   ()
    fxy=010200 a=0 b=-1000 w=17  ZAN      TABLE B ENTRY - HEIGHT ANALYSED VALUE (METER)
    fxy=010202 a=0 b=-1000 w=17  ZCL      TABLE B ENTRY - HEIGHT CLIMATOLOGY (METER)
    fxy=010203 a=0 b=0 w=10  ZCS      TABLE B ENTRY - HEIGHT CLIMATOLOGY SD (METER)
  fxy=010201 a=0 b=0 w=10  ZOE      TABLE B ENTRY - HEIGHT OBSERVATION ERROR (METER)
  fxy=010199 a=0 b=-1000 w=17  ZFC      TABLE B ENTRY - HEIGHT FORECAST VALUE (METER)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362005 a=0 b=0 w=0   ()
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362105 a=0 b=0 w=0   ()
    fxy=011003 a=1 b=-4096 w=13  UOB      TABLE B ENTRY - U-COMPONENT WIND OBSERVATION (M/S)
    fxy=011192 a=0 b=0 w=5  WQM      TABLE B ENTRY - WIND (QUALITY) MARKER (CODE TABLE)
    fxy=011193 a=0 b=0 w=4  WPC      TABLE B ENTRY - WIND PROGRAM CODE (CODE TABLE)
    fxy=011194 a=0 b=0 w=10  WRC      TABLE B ENTRY - WIND REASON CODE (CODE TABLE)
    fxy=011004 a=1 b=-4096 w=13  VOB      TABLE B ENTRY - V-COMPONENT WIND OBSERVATION (M/S)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362205 a=0 b=0 w=0   ()
    fxy=011197 a=1 b=-4096 w=13  UAN      TABLE B ENTRY - U-COMPONENT ANALYSED VALUE (M/S)
    fxy=011200 a=1 b=-4096 w=13  UCL      TABLE B ENTRY - U-COMPONENT CLIMATOLOGY (M/S)
    fxy=011202 a=1 b=0 w=10  UCS      TABLE B ENTRY - U-COMPONENT CLIMATOLOGY SD (M/S)
    fxy=011198 a=1 b=-4096 w=13  VAN      TABLE B ENTRY - V-COMPONENT ANALYSED VALUE (M/S)
    fxy=011201 a=1 b=-4096 w=13  VCL      TABLE B ENTRY - V-COMPONENT CLIMATOLOGY (M/S)
    fxy=011203 a=1 b=0 w=10  VCS      TABLE B ENTRY - V-COMPONENT CLIMATOLOGY SD (M/S)
  fxy=011199 a=1 b=0 w=10  WOE      TABLE B ENTRY - WIND OBSERVATION ERROR (M/S)
  fxy=011195 a=1 b=-4096 w=13  UFC      TABLE B ENTRY - U-COMPONENT FORECAST VALUE (M/S)
```

```
  fxy=011196 a=1 b=-4096 w=13  VFC      TABLE B ENTRY - V-COMPONENT FORECAST VALUE (M/S)
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362106 a=0 b=0 w=0   ()
    fxy=011001 a=0 b=0 w=9  DDO      TABLE B ENTRY - WIND DIRECTION OBSERVATION (DEGREES)
    fxy=011191 a=0 b=0 w=9  FFO      TABLE B ENTRY - WIND SPEED OBSERVATION (KNOTS)
    fxy=011204 a=0 b=0 w=5  DFQ      TABLE B ENTRY - WIND (DIR/SPD) (QUALITY) MARKER (CODE TABLE)
    fxy=011205 a=0 b=0 w=10  DFR      TABLE B ENTRY - WIND (DIR/SPD) PROGRAM CODE (CODE TABLE)
    fxy=011206 a=0 b=0 w=4  DFP      TABLE B ENTRY - WIND (DIR/SPD) REASON CODE (CODE TABLE)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362013 a=0 b=0 w=0   ()
  fxy=360003 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
  fxy=362112 a=0 b=0 w=0   ()
    fxy=013201 a=1 b=0 w=10  RHO      TABLE B ENTRY - RELATIVE HUMIDITY OBSERVATION (PER CENT)
    fxy=013202 a=0 b=0 w=5  RHQ      TABLE B ENTRY - RELATIVE HUMIDITY (QUALITY) MARKER (CODE TABLE)
    fxy=013203 a=0 b=0 w=4  RHP      TABLE B ENTRY - RELATIVE HUMIDITY PROGRAM CODE (CODE TABLE)
    fxy=013204 a=0 b=0 w=10  RHR      TABLE B ENTRY - RELATIVE HUMIDITY REASON CODE (CODE TABLE)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362211 a=0 b=0 w=0   ()
    fxy=013206 a=1 b=0 w=10  RHA      TABLE B ENTRY - RELATIVE HUMIDITY ANALYSED VALUE (PER CENT)
  fxy=013207 a=1 b=0 w=10  RHE      TABLE B ENTRY - RELATIVE HUMIDITY OBSERVATION ERROR (PER CENT)
  fxy=013205 a=1 b=0 w=10  RHF      TABLE B ENTRY - RELATIVE HUMIDITY FORECAST VALUE (PER CENT)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362006 a=0 b=0 w=0   ()
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362007 a=0 b=0 w=0   ()
    fxy=360003 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
    fxy=362107 a=0 b=0 w=0   ()
      fxy=013208 a=1 b=0 w=10  PWO      TABLE B ENTRY - TOTAL PRECIPITABLE WATER OBSERVATION (MM)
      fxy=013209 a=0 b=0 w=5  PWQ      TABLE B ENTRY - TOTAL PRECIP. WATER (QUALITY) MARKER (CODE TABLE)
      fxy=013210 a=0 b=0 w=4  PWP      TABLE B ENTRY - TOTAL PRECIPITABLE WATER PROGRAM CODE (CODE TABLE)
      fxy=013211 a=0 b=0 w=10  PWR      TABLE B ENTRY - TOTAL PRECIPITABLE WATER REASON CODE (CODE TABLE)
    fxy=360004 a=0 b=0 w=0   ()
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    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362206 a=0 b=0 w=0   ()
    fxy=013213 a=1 b=0 w=10  PWA      TABLE B ENTRY - TOTAL PRECIPITABLE WATER ANALYSED VALUE (MM)
  fxy=013214 a=1 b=0 w=10  PWE      TABLE B ENTRY - TOTAL PRECIP. WATER OBSERVATION ERROR (MM)
  fxy=013212 a=1 b=0 w=10  PWF      TABLE B ENTRY - TOTAL PRECIPITABLE WATER FORECAST VALUE (MM)
fxy=360004 a=0 b=0 w=0   ()
  fxy=101000
  fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
fxy=362008 a=0 b=0 w=0   ()
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362009 a=0 b=0 w=0   ()
    fxy=360003 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
    fxy=362108 a=0 b=0 w=0   ()
      fxy=013215 a=1 b=0 w=10  PW1O     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER OBS. (MM)
      fxy=013216 a=0 b=0 w=5  PW1Q     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER MARKER (CODE TABLE)
      fxy=013217 a=0 b=0 w=4  PW1P     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER P. CODE (CODE TABLE)
      fxy=013218 a=0 b=0 w=10  PW1R     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER R. CODE (CODE TABLE)
    fxy=360004 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
    fxy=362207 a=0 b=0 w=0   ()
      fxy=013220 a=1 b=0 w=10  PW1A     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER ANAL (MM)
    fxy=013221 a=1 b=0 w=10  PW1E     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER OBS ERR (MM)
    fxy=013219 a=1 b=0 w=10  PW1F     TABLE B ENTRY - 1.0 TO 0.9 SIGMA LAYER P. WATER FCST (MM)
  fxy=360004 a=0 b=0 w=0   ()
    fxy=101000
    fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
  fxy=362010 a=0 b=0 w=0   ()
    fxy=360003 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
    fxy=362109 a=0 b=0 w=0   ()
      fxy=013222 a=1 b=0 w=10  PW2O     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER OBS. (MM)
      fxy=013223 a=0 b=0 w=5  PW2Q     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER MARKER (CODE TABLE)
      fxy=013224 a=0 b=0 w=4  PW2P     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER P. CODE (CODE TABLE)
      fxy=013225 a=0 b=0 w=10  PW2R     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER R. CODE (CODE TABLE)
    fxy=360004 a=0 b=0 w=0   ()
      fxy=101000
      fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
    fxy=362208 a=0 b=0 w=0   ()
      fxy=013227 a=1 b=0 w=10  PW2A     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER ANAL (MM)
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          fxy=013228 a=1 b=0 w=10  PW2E     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER OBS ERR (MM)
          fxy=013226 a=1 b=0 w=10  PW2F     TABLE B ENTRY - 0.9 TO 0.7 SIGMA LAYER P. WATER FCST (MM)
        fxy=360004 a=0 b=0 w=0   ()
          fxy=101000
          fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
        fxy=362011 a=0 b=0 w=0   ()
          fxy=360003 a=0 b=0 w=0   ()
            fxy=101000
            fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
          fxy=362110 a=0 b=0 w=0   ()
            fxy=013229 a=1 b=0 w=10  PW3O     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER OBS. (MM)
            fxy=013230 a=0 b=0 w=5  PW3Q     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER MARKER (CODE TABLE)
            fxy=013231 a=0 b=0 w=4  PW3P     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER P. CODE (CODE TABLE)
            fxy=013232 a=0 b=0 w=10  PW3R     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER R. CODE (CODE TABLE)
          fxy=360004 a=0 b=0 w=0   ()
            fxy=101000
            fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
          fxy=362209 a=0 b=0 w=0   ()
            fxy=013234 a=1 b=0 w=10  PW3A     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER ANAL (MM)
          fxy=013235 a=1 b=0 w=10  PW3E     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER OBS ERR (MM)
          fxy=013233 a=1 b=0 w=10  PW3F     TABLE B ENTRY - 0.7 TO 0.3 SIGMA LAYER P. WATER FCST (MM)
        fxy=360004 a=0 b=0 w=0   ()
          fxy=101000
          fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
        fxy=362012 a=0 b=0 w=0   ()
          fxy=360003 a=0 b=0 w=0   ()
            fxy=101000
            fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
          fxy=362111 a=0 b=0 w=0   ()
            fxy=013236 a=1 b=0 w=10  PW4O     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER OBS. (MM)
            fxy=013237 a=0 b=0 w=5  PW4Q     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER MARKER (CODE TABLE)
            fxy=013238 a=0 b=0 w=4  PW4P     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER P. CODE (CODE TABLE)
            fxy=013239 a=0 b=0 w=10  PW4R     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER R. CODE (CODE TABLE)
          fxy=360004 a=0 b=0 w=0   ()
            fxy=101000
            fxy=031000 a=0 b=0 w=1  DRF1BIT (NUMERIC)
          fxy=362210 a=0 b=0 w=0   ()
            fxy=013241 a=1 b=0 w=10  PW4A     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER ANAL (MM)
          fxy=013242 a=1 b=0 w=10  PW4E     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER OBS ERR (MM)
          fxy=013240 a=1 b=0 w=10  PW4F     TABLE B ENTRY - 0.3 TO 0.0 SIGMA LAYER P. WATER FCST (MM)
fxy=102000
fxy=031001 a=0 b=0 w=8  DRF8BIT (NUMERIC)
fxy=206001
fxy=063255 a=0 b=0 w=1  BITPAD (NONE)
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